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On the economic impact of FDI and trade liberalization in the Asia-Pacific region: A structural quantitative analysis

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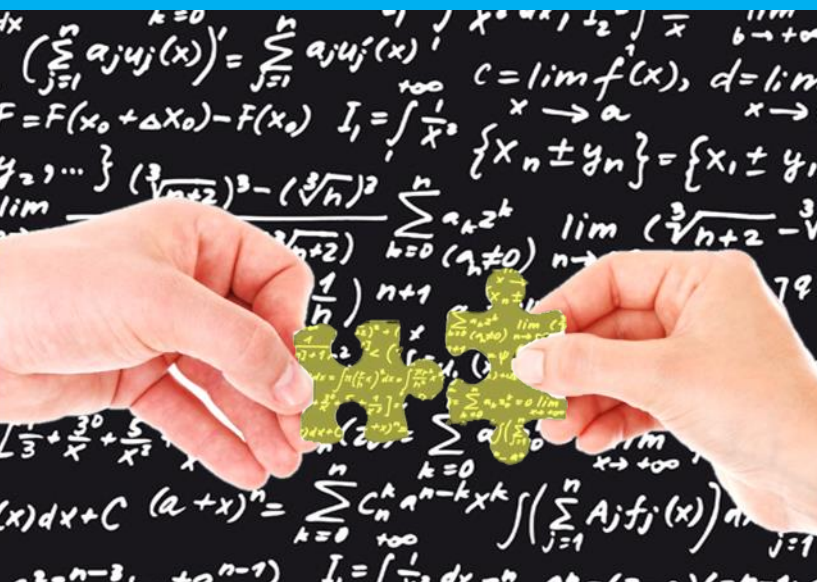
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A structural quantitative
analysis



Mario Larch
Yoto V. Yotov

ASIA-PACIFIC RESEARCH AND TRAINING NETWORK ON TRADE

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ASIA-PACIFIC RESEARCH AND TRAINING NETWORK ON TRADE

WORKING PAPER

On the economic impact of FDI and trade liberalization in the Asia-Pacific region: A structural quantitative analysis[†]

Mario Larch* and Yoto V. Yotov**

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Abstract

We employ the structural model of trade and investment from Anderson, Larch and Yotov (2017) in order to quantify the impact of Foreign Direct Investment (FDI) and trade liberalization on exports and real GDP per capita in the Asia-Pacific region. Using a dataset of 89 countries for 2011, which covers more than 97 percent of the trade and investment activity in the ESCAP member countries from the Asia-Pacific region, we find that FDI has had a strong but heterogeneous impact on the economic performance of the countries in this region. On average, our estimates reveal that FDI is responsible for 7% of exports, for 3% of physical capital accumulation, and for 7% of real GDP per capita in the Asia-Pacific region. We also find that a uniform 10% decrease of bilateral trade costs for all ESCAP members in our sample would have led to strong and positive, but quite heterogeneous, impact on exports and real GDP per capita in the Asia-Pacific region.

Key words: FDI, trade liberalization, international trade

JEL codes: F21, F13

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1. Introduction: Motivation and goals

Over the past quarter century, the world witnessed an unprecedented wave of globalization efforts that often took the form of regional trade agreements and deeper integration agreements, including numerous bilateral investment treaties. The Asia-Pacific region has played a central role in these integration efforts both in relation to trade and with respect to foreign direct investment. While the impact of trade liberalization has been studied extensively in the academic and in the policy literature, the effect of foreign direct investment (in part due to lack of data and in part due to the need for theoretical foundations that reflect the changing nature of FDI) is less studied and, therefore, less understood.

Furthermore, notwithstanding obvious and intuitive links between trade liberalization and FDI, the relationship between FDI and trade has attracted little attention in the academic literature as well as in the policy circles. Thus, despite the significant investments in trade liberalization and promoting FDI in the Asia-Pacific region, and despite the great expectations for positive economic outcomes as result of the integration efforts in this area and around the globe,¹ there is little theoretically-founded quantitative evidence for the economic impact of FDI in the Asia-Pacific region and, specifically, for the relationship

¹ For example, the role of foreign investment and the expectations for a positive impact of FDI featured prominently during the negotiations of the Comprehensive Trade and Economic Agreement (CETA) between Canada and the European Union, where one of the main goals was the removal and/or alleviation of barriers to foreign investment among members. Specifically, the agreement assures that all European investors in Canada and all Canadian investors in Europe would be treated equally and fairly. (See <http://ec.europa.eu/trade/policy/in-focus/ceta/>.) As pointed by Anderson, Larch and Yotov (2017), EU analysts shared similar expectations about the impact of FDI during the negotiations of TTIP, which would “liberalize trade and investment between the EU and the US and will result in more jobs and growth and assist Europe in its long-term recovery from the economic crisis.” (Press release, Brussels, 28 January 2014).

between FDI, international trade, domestic investment in physical capital and real GDP in this region.

The primary objective of this project is to provide a quantitative evaluation the impact of FDI on trade, domestic investment in physical capital and real GDP per capita in the Asia-Pacific region. In addition, motivated by significant multilateral trade liberalization efforts and success among the ESCAP members in the Asia-Pacific region, we aim to quantify the economic impact of trade liberalization in this area. In order to achieve these goals, we will employ the structural computable general equilibrium (CGE) model of Anderson, Larch and Yotov (2017, ALY henceforth), which quantifies and decomposes the relationships between trade, domestic investment (via physical capital accumulation), and foreign direct investment (in the form of non-rival technology capital)² within a comprehensive and unified framework.

To that end, ALY combine components from three main strands of the literature including:³ (i) the structural general equilibrium (GE) trade literature, e.g. Eaton and Kortum (2002), Anderson and van Wincoop (2003), and Costinot and Rodríguez-Clare (2014); (ii) the literature on trade and domestic investment via capital accumulation, e.g. Lucas and Prescott (1971), Hercowitz and Sampson (1991), Olivero and Yotov (2012), Anderson,

² ALY's modeling choice of FDI as non-rival technology capital is motivated by the fact that "[t]oday, FDI is [...] about technology and know-how, [...] International patterns of production are leading to new forms of cross-border investment, in which foreign investors share their intangible assets such as know-how or brands in conjunction with local capital or tangible assets of domestic investors." (World Bank, 2015). We view this modeling choice as particularly appropriate for the Asia-Pacific region because, while the technological gap between many of the investing developed countries and many of the host Asia-Pacific economies is sufficiently wide, the level of skill, infrastructure and education in the Asia-Pacific region is sufficiently high in order to complement the incoming knowledge capital. This is consistent with the findings and arguments from OECD (2002), Hall (2011) and OECD (2011) surveys on the motivations for knowledge-based FDI.

³ We offer a detailed literature review in the next section.

Larch, and Yotov (2015a), and Eaton, Kortum, Neiman, and Romalis (2016); and (iii) the literature that models FDI as non-rival technology capital, e.g. McGrattan and Prescott (2009, 2010) and McGrattan and Prescott (2017).

The main contribution of ALY's framework is that trade, domestic and foreign investment are determined simultaneously and are mutually interdependent. This makes ALY's model particularly appropriate for analysis of the Asia-Pacific region, where trade and foreign direct investment have both played key roles in a period of intense integration and globalization. In ALY's model, trade affects investment in technology capital (and therefore FDI) by changing producer prices, the prices of consumer goods and the prices of investment goods. Trade liberalization leads to an increase in producer prices, which in turn stimulates investment in technology capital and leads to more FDI. At the same time, trade liberalization lowers the prices of consumer and investment goods, which also makes investment more attractive due to lower direct and opportunity costs.

FDI and FDI liberalization affect trade via two channels. First, more FDI leads to increased nominal output and, therefore, to more trade with all partners, since larger countries trade more, all else equal. In addition, through its impact on the countries' multilateral resistances (MRs), changes in FDI affect trade indirectly. Finally, since the MRs are general equilibrium indexes, i.e. they capture the effects of trade liberalization between any two countries on consumer and on producer prices in every country in the model, their changes will transmit throughout the world. Given the significant effort to increase FDI in and from the Asia-Pacific region, we expect to identify and document large economic impact of FDI in this region.

To test the model, we employ a dataset of trade, investment and production for 89 countries in 2011. Importantly, our data cover representative countries from all five major ESCAP sub-areas in the Asia-Pacific region including: (i) countries from East and North-East Asia, (ii) countries from South-East Asia, (iii) countries from South and South-West Asia, (iv) countries from North and Central Asia, and (v) countries from the Pacific region. In addition, in terms of economic activity, according to official data from the ESCAP Statistics Division, the countries in our sample account for more than 98% of *Gross Domestic Product (GDP)*, for more than 98% of the *Gross Capital Formation*, and for more than 97% of both total *Exports of Goods and Services* and total *Imports of Goods and Services* among all ESCAP member states.

Several main results stand out from an experiment that quantifies the economic impact of FDI. First, we find that the contributions of FDI to exports, domestic investment in physical capital, and real GDP per capita in the Asia-Pacific region in 2011 are large. Specifically, we obtain average estimates of the impact of FDI on exports of 7.0%, on physical capital accumulation of 3.1%, and on real GDP per capita of 7.1%, respectively. Second, our estimates reveal that the impact of FDI in the ESCAP member countries from the Asia-Pacific region has been quite heterogeneous. In particular, we find that the biggest winners from FDI are Hong Kong (China) (with 151% increase in exports, 90% increase in physical capital, and 132% increase in real GDP per capita due to FDI) and Singapore (with 80% increase in exports, 64% increase in physical capital, and 93% increase in real GDP per capita due to FDI). On the other side of the spectrum, we find the economies of Bangladesh (with 5% decrease in exports, 0.1% decrease in physical capital, and 0.2% increase in real GDP per capita due to FDI) and Uzbekistan (with 0.5% increase in exports, 0.1% increase

in physical capital, and 0.3% increase in real GDP per capita due to FDI) to be the countries in the Asia-Pacific region that have experienced the least positive impact of FDI on real GDP per capita.

The intuitive explanation for the wide variation in our estimates is that the biggest winners from FDI have been the ones with the most BITs and the largest FDI share, while the countries that have won the least from FDI have been outsiders to the globalization process over the past quarter century. We also investigate other possible explanations for these results. Finally, we note that while our estimates suggest that the exports of some ESCAP members in the Asia-Pacific region have actually decreased as a result of FDI (i.e. FDI and exports in these countries are substitutes), the impact of FDI on real GDP per capita in the Asia-Pacific region has been positive for all ESCAP members.

In order to evaluate the impact of trade liberalization in the Asia-Pacific region, we quantify the effects of a uniform 10% reduction in bilateral trade costs for all ESCAP members in the Asia-Pacific region.⁴ Our results reveal that the impact of trade liberalization on exports from Asia-Pacific region is large and positive, but quite heterogeneous among the ESCAP members. Hong Kong (China) and Turkey are the two economies that have enjoyed the largest gains from trade liberalization, as measured by the increase in their exports, while Iran and Malaysia are the two countries that have enjoyed the smallest increase in exports. We also obtain strong and positive impact of trade liberalization on real GDP per capita in

⁴ The 10% trade reduction scenario is consistent with the findings from recent ESCAP analysis, which suggest a 9.45% average trade cost reduction from a full WTO TF implementation in Asia and the Pacific. Furthermore, our counterfactual trade liberalization is also consistent with findings from the WTO's World Trade Report 2015, which focuses on trade costs and suggests that most developing countries do not expect to be able to cut trade costs by more than 10% through implementation of the WTO TFA.

the Asia-Pacific region. In addition, as before, we document that the effects on real GDP per capita in the region are quite heterogeneous. The Philippines and Singapore enjoy the largest gains of 19% and 18%, respectively, while Russia (2.1%) and Australia (3.3%) gain the least.

The remainder of this study is organized as follows. Section 2 offers a review of the related literature. Section 3 presents and reviews the theoretical model of ALY and offers a discussion of the structural links and relationships in their framework of trade and investment. Section 4 describes the data and presents the calibration parameters. Section 5 presents and discusses our main findings about the impact of FDI and trade liberalization in the ESCAP countries from the Asia-Pacific region. Section 6 concludes with a summary of our analysis and a discussion of possible caveats and directions for future work.

2. Relation to literature

Our analysis and ALY's framework are related to the following prominent strands of the literature: (i) The empirical and theoretical literatures that develop and use CGE models in order to study the impact of trade liberalization on national welfare; (ii) The empirical and theoretical literatures that study the links between trade and domestic capital accumulation; (iii) The empirical and theoretical literatures concerned with the determinants and the impact of FDI. Below, we discuss and compare our approach and analysis in relation to each of these literatures.

First, the CGE framework of ALY, which will be employed to perform the main analysis, belongs to the class of new small-scale quantitative general equilibrium trade models that are developed in the spirit of the traditional CGE literature and offer solid theoretical foundations and tight connection to the data.⁵ Arkolakis et al. (2012) and Costinot and Rodríguez-Clare (2014) demonstrate that a wide class of so-called *structural gravity models* converge to a unified structural representation that is now accepted, tested, and well-established as the workhorse in the trade literature.⁶ ALY's framework is representative of this family of models. However, in addition to the standard channels (i.e. impact on producer and on consumer prices) through which trade liberalization impacts welfare and real GDP per capita in our setting, two important features of the model are that it also allows for trade to impact domestic physical capital accumulation as well as FDI with feedback links from capital accumulation and FDI back to trade, welfare, and real GDP per capita.

The second strand of the literature to which our analysis is related to is the literature that studies the links between trade and growth via domestic asset accumulation. The links between growth and trade have been of interest to academics and policy makers since

⁵ Yotov et al. (2016) point to the following studies representative of the evolution of the CGE literature: Jones (1965), Dervis, de Melo and Robinson (1982), Shoven and Whalley (1984), Deardorff and Stern (1986), Shoven and Whalley (1992), Amman, Kendrick and Rust (1996), Dixon and Parmenter (1996), Hertel (1997), Francois and Reinert (1998), Ginsburgh and Keyzer (2002), and Gilbert and Tower (2012).

⁶ Anderson (1979) is the first to offer a theoretical economic foundation for the gravity model. Other early gravity models include those of Krugman (1980) and Bergstrand (1985). Leamer and Levinsohn (1995) and Deardorff (1998) review the early gravity literature. The most influential structural gravity models are those of Eaton and Kortum (2002) and Anderson and van Wincoop (2003). More recently, the gravity model has been derived from the perspective of the new firm-heterogeneity literature, e.g. Chaney (2008) and Helpman, Melitz and Rubinstein (2008). Empowered by the solid theoretical foundations of the structural gravity model and stimulated by its remarkable empirical success, a series of recent papers have used the gravity model to perform counterfactual analysis of the impact of trade policy on various economic outcomes. Some examples include Anderson and Yotov (2010), Egger et al. (2011), Egger and Larch (2011), Ossa (2011), Fielser (2011), Costinot, Donaldson and Komunjer (2012), Behrens et al. (2014), Eaton, Kortum and Sotelo (2013), Arkolakis et al. (2013), Allen, Arkolakis and Takahashi (2014), Felbermayr et al. (2015), Caliendo and Parro (2015), and Heid and Larch (2016).

Adam Smith (1776) and Alfred Marshall (1890). Frankel and Romer (1999), who offer reduced-form evidence for the significant impact of trade on growth, is one of the most prominent empirical studies in this literature. Anderson, Larch and Yotov (2015a) offer theoretical foundations for the reduced-form econometric model of Frankel and Romer (1999) and confirm their findings.

In support of ALY's modeling approach for the links between growth and trade, physical capital accumulation has been identified as a key driver of growth in a series of empirical studies including Wacziarg (2001), Baldwin and Seghezza (2008), and Wacziarg and Welch (2008). Cuñat and Maffezzoli (2007) demonstrate that factor accumulation is responsible for the large increase in trade in response to moderate trade cost reductions.⁷ These studies motivate the use of capital accumulation as a key channel through which trade liberalization affects growth in ALY's model.

The links between trade and growth have also attracted significant interest from a theoretical perspective. Prominent examples on this front include Eaton and Kortum (2001, 2002, 2005), who study the impact of trade on growth via technological spillovers.⁸ Motivated by the empirical literature that shows that capital accumulation is a key driver of growth, ALY's theoretical model is developed in the spirit of the dynamic general equilibrium models of Lucas and Prescott (1971) and Hercowitz and Sampson (1991). The most closely related recent paper is Eaton, Kortum, Neiman, and Romalis (2016), who, in addition to allowing

⁷ Anderson, Larch and Yotov (2015a) offer more details on the related literature.

⁸ For a thorough review of the early theoretical literature on trade and (endogenous) technology up to the 1990s, we refer the reader to Grossman and Helpman (1995). Acemoglu and Zilibotti (2001), Acemoglu and Ventura (2002), Alvarez and Lucas, Jr. (2007), and Sampson (2014) are more recent examples in the related literature.

for domestic investment in physical capital model financial markets and incorporate sectors. The links between domestic investment and trade in our analysis operate in both directions. Trade affects growth through changes in consumer prices and changes in producer prices, which in turn stimulate or impede physical capital accumulation. At the same time, domestic investment affects trade directly, through changes in country size, and indirectly, through altering the incidence of trade costs on the consumers and on the producers.

Third, and most important, our analysis expands on the previously described CGE models of trade and growth-and-trade via asset capital accumulation by also modeling FDI. This is the key innovation of ALY and the key focus of our empirical analysis in this paper. Thus, our work is related to the literature that studies the determinants and implications of foreign direct investment. In the spirit of McGrattan and Prescott (2009, 2010) and McGrattan and Waddle (2017), FDI takes the form of technology capital, which is non-rival, i.e. a country can use its technology capital not only at home but at the same time in all other countries in the world. The interpretation of technology capital is akin to the notion of knowledge capital from Markusen (1997, 2002) and Markusen and Maskus (2002), and one can think about the technology capital in ALY's setting as patents, blue-prints, management skills/practices, etc. As discussed in Footnote 2, ALY's decision to model FDI as technology capital is consistent with empirical evidence and we view it as particularly appropriate for the Asia-Pacific region.

ALY's choice of modeling FDI is complementary to existing early and more recent FDI theories. For example, the model is consistent with the eclectic FDI paradigm of Dunning (1980, 1981), which expands on the original work of Hymer (1976) and combines market-

seeking, resource-seeking, and efficiency-seeking motives for FDI. It is also consistent with Markusen et al. (1996) who argue that vertical FDI is more prominent among countries with different relative factor endowments. ALY's framework is also consistent with the setup from Head and Ries (2008). The reason for FDI in their framework is value-added by the headquarters, while the reason for FDI in our setup is technology transfer. Bergstrand and Egger (2007, 2010) also allow for two types of capital, physical capital and knowledge capital. However, their framework is static, does not provide accumulation functions for the capital stocks, and does not lead to analytical gravity equation specifications. Finally, we note that the aggregate nature of ALY's framework and lack of sectoral FDI data will prevent us from analyzing the impact of FDI on wages, productivity and structural change at the sectoral and at the firm level. We refer the reader to Antras and Yeaple (2014) for an excellent survey of the literature on the decisions of multinational firms.

The non-rivalry and dynamic features of FDI in ALY's framework lead to new insights for the effects of trade liberalization on trade, investment, and real GDP per capita, which we expect to be very pronounced and important for the Asia-Pacific region. Our expectations are based on and consistent with a series of studies, e.g. Borensztein et al (1998), De Mello (1999), and Li and Liu (2005), and survey articles, e.g. OECD (2002) and Moura and Forte (2010), that document a positive impact of FDI on various economic outcomes. We will complement these studies by quantifying the impact of FDI in the Asia-Pacific region within a structural model and using data that essentially cover the whole world economy and, therefore, would enable us to identify the impact not only of the direct but also of the indirect, general equilibrium links among all of the economies in our model.

3. Theoretical foundations

This section reviews ALY's theory and offers a detailed discussion of the structural links between trade, domestic investment and FDI within the model with a focus on Singapore as a representative country from the Asia-Pacific region, which has been involved in significant liberalization efforts both on the trade and on the FDI side.

3.1. A structural model of trade and investment

The model of ALY provides theoretical micro-foundations for the relationships between trade, domestic investment in physical capital and FDI within a tractable structural framework. In order to achieve these goals, ALY nest a standard N -country Armington (1969) model of trade within a dynamic model of investment, where representative households maximize the present discounted value of their lifetime utility and choose how much to invest in domestic physical capital as well as in non-rival technology capital, which can be used at home, but also in any other country in the world, thus constituting FDI. By solving the consumer's optimization problem ALY derive the following system, which captures the interactions between trade, domestic investment and foreign direct investment in the steady state of their model:

$$X_{ij} = \frac{Y_i E_j}{Y} \left(\frac{t_{ij}}{\Pi_i P_j} \right)^{1-\sigma} \quad \text{for all } i \text{ and } j \quad (1)$$

$$P_j^{1-\sigma} = \sum_{i=1}^N \left(\frac{t_{ij}}{\Pi_i} \right)^{1-\sigma} \frac{Y_i}{Y} \quad \text{for all } j, \quad (2)$$

$$\Pi_i^{1-\sigma} = \sum_{j=1}^N \left(\frac{t_{ij}}{P_j} \right)^{1-\sigma} \frac{E_j}{Y} \quad \text{for all } i, \quad (3)$$

$$p_j = \frac{\left(Y_j / \sum_{j=1}^N Y_j \right)^{\frac{1}{1-\sigma}}}{\gamma_j \Pi_j} \quad \text{for all } j, \quad (4)$$

$$Y_j = p_j A_j (L_j^{1-\alpha} K_j^\alpha)^{1-\phi} \left(\prod_{i=1}^N (\max\{1, FDI_{ij}\})^{\eta_i} \right)^\phi \quad \text{for all } j, \quad (5)$$

$$E_j = Y_j + \phi \eta_j \sum_{i \in N} Y_i - \phi Y_j \sum_{i \in N} \eta_i \quad \text{for all } j, \quad (6)$$

$$K_j = \frac{\alpha \beta (1-\phi) (1-\phi \sum_{i \in N} \eta_i) Y_j}{1-\beta + \beta \delta_K P_j} \quad \text{for all } j, \quad (7)$$

$$FDI_{ji}^{value} = \frac{\beta \phi \eta_j}{1-\beta + \beta \delta_M} \omega_{ij} \frac{E_j}{P_j} \phi \eta_j \frac{Y_i}{M_j} \quad \text{for all } j. \quad (8)$$

The structural relationships among the variables in system (1) - (8) are intuitive.

- Equation (1) is the familiar structural gravity equation from the trade literature. Equation (1) implies that the value of exports (X_{ij}) from exporter i to importer j should be proportional to the sizes of the two countries, as measured by the values of the exporter's output (Y_i) and the value of the importer's expenditure (E_j), respectively, and inversely proportional to the trade frictions between the two trading partners, which are captured by a composite trade cost term. In addition to bilateral trade costs (t_{ij}), trade between two nations is also influenced by general equilibrium trade costs, which are captured by the multilateral resistance (MR) indexes of Anderson and van Wincoop (2003), which we discuss next.

- Equations (2) and (3) define the inward multilateral resistances (P_i) and the outward multilateral resistance (Π_i) as general equilibrium trade cost indexes that consistently aggregate all bilateral trade costs for each importer and for each exporter to the country level, and simultaneously decompose their incidence on the consumers and the producers in each country. The multilateral resistances are the key vehicles that transmit the impact of bilateral policies and shocks to trade costs throughout the trade-and-investment system (1) - (8). We refer the reader to Yotov et al. (2016) for a detailed discussion of the MR terms and their properties and importance in relation to GE modeling.
- Equation (4) is a restatement of the market-clearing condition, according to which, at delivered prices, the total value of production in each country j should be equal to the total shipments of this country to each other country in the world, including j itself. As currently written, Equation (4) enables us to clearly capture the fact that when the producers in country j face lower outward resistance (Π_j) to shipping their goods, they will internalize part of this by enjoying higher factory-gate prices (p_j).
- Equation (5) defines the value of production in a Cobb-Douglas functional form, where, as defined before, p_j is the factory-gate price, and production combines technology (A_j), labor (L_j), physical capital (K_j), and, importantly, foreign direct investment (FDI_{ij}). Here, α is the Cobb-Douglas capital share, (η_j) is the share of bilateral FDI from country i to country j , and (ϕ) is the production share of FDI. In order to be able to capture the empirically relevant case of zero bilateral FDI, ALY employ a *max*-functional form to model FDI.

- Equation (6) defines expenditure (E_j) as a function of nominal national income (Y_j), and the revenues from outward FDI and the payments to inward FDI, respectively. This equation captures the fact that the FDI payments drive a wedge between the value of domestic production and value of domestic expenditure. This also implies that the impact of FDI on national expenditure will depend on the net FDI position of the country.
- Equation (7) defines physical capital (K_j) as a function of model parameters, the value of national income (Y_j) and the inward multilateral resistance (P_j). The intuition for the inverse relationship between capital accumulation and P_j is that, from a theoretical perspective, the latter is also the price of investment and consumer goods and, therefore, it reflects the direct and the opportunity costs of investment, respectively.
- Finally, Equation (8) describes bilateral (FDI_{ij}). Several features of (8) resemble the structural gravity equation of trade. Specifically, (8) implies that bilateral FDI should be proportional to the sizes of the two countries, as measured by the values of output (Y_i) in the destination country and value of expenditure in the source country (E_j). In addition, bilateral FDI should be inversely proportional to the bilateral FDI barriers (ω_{ij}) between them, where, in ALY's model, larger ω_{ij} is associated with smaller FDI barriers. Finally, (8) implies that FDI is inversely related to the amount of technology capital (M_j). The intuition for this result is that FDI in ALY's framework takes the form of international movements of non-rival technology capital. Therefore, the inverse

relationship between FDI and M_j is a simple reflection of the law of diminishing returns to investments into technology capital.

Our eight-equation system can be used to perform a series of counterfactual experiments. For example, we could investigate the impact of trade liberalization or a trade costs shock by changing t_{ij} . Alternatively, we could investigate the impact of FDI liberalization by changing ω_{ij} . We also can study the impact of any other of the exogenous variables and parameters in the model. We will demonstrate the usefulness and effectiveness of our theory in Section 5, where we i) counterfactually shut of all inward and outward FDI to and from the Asian-Pacific ESCAP member states in our data set, and ii) reduce trade costs by 10% for the exports and for the imports of all ESCAP member countries. Before that, in the next subsection, we will describe the mechanics of the theoretical system (1) - (8) by considering a hypothetical trade and investment liberalization shock.

3.2. Trade and investment liberalization in a global world: A discussion

In order to offer further intuition for the links between trade, domestic investment and FDI in system (1) - (8), in this section we present an analysis of the transmission mechanisms that are triggered by a hypothetical scenario of simultaneous trade and FDI liberalization. To add realism, we specifically consider trade and investment liberalization between Singapore and the United States.¹⁰ For expositional clarity, we discuss the effects of trade liberalization and investment liberalization sequentially.

¹⁰ We chose Singapore because this country has been heavily involved both in trade liberalization as well as

3.2.1. On the economic impact of trade liberalization

We start with a discussion of the effects of trade liberalization, which in our model are represented by a reduction in the bilateral trade costs (t_{ij}) between Singapore and the United States. Trade liberalization will affect trade and investment through several channels. The first, direct effect of the reduction of trade costs between Singapore and US will see an immediate increase in bilateral trade flows between the two countries without any implications for the rest of the world. This effect is captured by Equation (1), which directly translates changes in bilateral trade costs (t_{ij}) into changes in bilateral trade flows, all else equal.

The reduction in trade costs between Singapore and US also has additional, indirect effects, which are channeled through the multilateral resistance terms, as given in Equations (2) and (3). The intuition for these general equilibrium effects is that while Singapore and US are becoming more integrated with each other, the two countries will become more ‘isolated’ from the rest of the world. As a result, the fall in trade costs between Singapore and the US will result in lower multilateral resistances for the consumers and the producers in member countries, i.e. in Singapore and US, and higher multilateral resistances faced by the consumers and the producers in all other countries in the world, all else equal.

in the removal of FDI barriers. In addition, and as a result, Singapore is one of the Asian-Pacific countries with the highest production share of FDI and with the most BITs in this region. We chose the United States as Singapore’s partner because of its size and because the US has also been heavily involved in trade and investment liberalization with Asian countries.

The changes in the multilateral resistances will lead to additional changes in trade, income, domestic capital accumulation and foreign investment. The additional effects on trade are captured by Equation (1). The fall in the MRs for Singapore and US will mitigate the direct positive effect on nominal bilateral trade between these countries. In addition, it will lead to lower trade flows between Singapore and US on one side and all other countries in the world on the other side. The intuition is that the decrease in the MRs for member countries will outweigh the increase in the MRs for non-members. Finally, the GE effects that are channeled via the multilateral resistances will lead to increased trade among non-members. The intuition is that once these countries find themselves more isolated from Singapore and US, they will trade more with each other and sell more internally.

Trade liberalization will also affect nominal income in Singapore, the US, and in the rest of the world. These effects are indirect and will, once again, be channeled through the multilateral resistances in Equations (4) and (5). For example, according to Equation (4), a lower outward multilateral resistance faced by the producers in Singapore will translate into a higher factory-gate-price for these producers. Through Equation (5), the increase in the factory-gate price, will result in higher nominal output/income in Singapore. The same will happen in US, while the opposite will be true for all other countries.

It should also be noted that the additional effects on nominal output that we just described would lead to additional effects on trade via the gravity Equation (1). For example, when Singapore will become 'richer' it will sell more not only to the US but also to all other countries in the world. Furthermore, since nominal income is directly related to

expenditure (see Equation (6)), Singapore will also buy more from all other countries in the world. In principle, it is possible that such size effects that lead to trade creation may dominate and outweigh the trade diversion effects on non-members that we described earlier.¹¹ Finally, we note that the changes in nominal income and expenditure will lead to further changes in the MRs, which will affect trade via the channels that we discussed above.

Next, we discuss the effects of trade liberalization on capital accumulation. These effects are captured by Equation (7). Besides parameters, the steady-state physical capital stock is a function of nominal income and the IMR. The relationship between the value of production and capital accumulation is direct. The intuition is that trade liberalization will increase the value of marginal product of capital and, therefore, will make investment more attractive. Specifically, trade liberalization between Singapore and US will decrease the OMR for producers in Singapore, which will increase their factory-gate prices and the value of marginal product of capital in Singapore and, therefore, increase investment in domestic physical capital. The relationship between capital accumulation and the IMR is an inverse one. The reason is that, from a theoretical perspective, the inward resistance in ALY's setting is also the aggregate price of capital and consumer goods. Thus, a lower IMR means lower direct cost of investment and a lower opportunity cost of investment. In both cases, a decrease in the inward multilateral resistance would lead to more capital accumulation. Finally, we note that, as captured by Equation (5), capital accumulation will lead to additional changes in nominal output. This will lead to further changes in trade via

¹¹ Anderson, Larch, Yotov (2015a) and Anderson Larch, and Yotov (2015b) offer empirical support for this theoretical possibility in the case of NAFTA and TTIP, respectively.

the channels that we discussed earlier, e.g. via Equation (1). In sum, trade liberalization will make domestic investment in Singapore more attractive, which in turn will lead to more output, more expenditure, and more trade.

Finally, we discuss the effects of trade liberalization on FDI. These effects are due to the fact that trade liberalization will also alter the investment patterns for technology capital. These relationships are captured by Equation (8). Some of the impact of trade liberalization on FDI is similar to the impact of trade liberalization on accumulation of domestic physical capital. However, ALY's model also unveils some additional channels through which trade liberalization will affect FDI. Similar to the equation for physical capital, Equation (8) links FDI to trade through expenditures and through the IMR. Specifically, outward FDI from Singapore to any other country would be directly related to expenditure and inversely related to the IMR in Singapore. As before, the intuition for this result is that expenditure in Singapore is proportional to the value of marginal product of technology capital in this country, while the IMR captures the direct and the opportunity costs of investing in technology capital in Singapore. Thus, since trade liberalization between US and Singapore would lead to increased expenditure and lower IMRs in the two liberalizing countries, we expect that this will promote outward FDI in each of these countries.

In addition to establishing that expenditure and the prices of consumption and investment goods are key structural determinants of investment in technology capital, Equation (8) points to two additional factors that will affect FDI. Specifically, (8) reveals that outward FDI originating from Singapore will be inversely related to the stock of technology capital

(M_j) in this country. As noted earlier, this relationship is a reflection of the law of diminishing marginal productivity of technology capital. Finally, Equation (8) implies that trade will affect inward FDI in Singapore through the country's value of output (Y_j). The intuition for this result is that larger nominal income in Singapore means larger value of marginal product of incoming FDI. Thus, by making the country richer, trade liberalization between Singapore and the US will attract more FDI in each of the two liberalizing countries. Lastly, we note that the increase in FDI and technology capital in Singapore will lead to additional changes in nominal output and expenditure, which will trigger further, even though secondary in nature, changes in bilateral trade and in the multilateral resistances. Thus, also affecting (at least in theory) all other countries in the world.

3.2.2. On the economic impact of FDI liberalization

An important feature of ALYs framework, especially in relation to our analysis of the impact of FDI in the Asia-Pacific region, is that the model can capture the effects on trade, investment, and real GDP per capita of FDI liberalization, which nowadays takes a central stage in the negotiations of contemporary economic integration agreements.¹² The effects of liberalizing investment in ALY's framework are captured by an increase of (ω_{ij}) in Equation (8) and, similar to the effects of trade liberalization, removing or decreasing the barriers to FDI will have a direct and an indirect economic impact. According to Equation (8), the direct effect of a bilateral removal of the barriers to FDI between Singapore and US would be an immediate increase in FDI between the two liberalizing

¹² See discussion in Footnote 1.

partners in each direction, i.e. this will lead to more outward and to more inward FDI in Singapore.

The indirect effects of FDI liberalization are channeled through Equations (5) and (6). According to Equation (5), the increase in inward FDI will lead to an increase in nominal output/income. According to Equation (6), the increase in FDI will also alter expenditure through three channels: (i) increased nominal output will lead to more expenditure; (ii) increased payments to incoming FDI would lower expenditure; and (iii) increase payments to outward FDI would once again increase expenditure. Whether expenditure increases or decreases for specific countries is an empirical question, to which we will come back in our counterfactual analysis.

The changes in income and expenditure due to FDI will also affect the trade flows of both the liberalizing countries and of all other countries in the world through Equation (1). In addition, the changes in country size will lead to changes in the multilateral resistances, which in turn will lead to more general equilibrium effects. A subtle, but potentially important, channel through which FDI liberalization will have an additional (indirect) effect on FDI is through accumulation of technology capital. Specifically, by altering expenditure and the inward multilateral resistances, FDI liberalization will further stimulate technology capital accumulation in the liberalizing countries, which in turn will lead to more FDI not only among them but also increase outward FDI to all other countries in the world with further implications for income and expenditure in the liberalizing partners.

In sum, the analysis in this section demonstrated how the structural system of ALY captures and decomposes a series of direct and indirect channels through which trade

and investment liberalization may affect trade, investment, income and real GDP in the liberalizing countries as well as in all other countries. We capitalize on these structural properties of system (1) - (8) in Section 5, where we quantify the impact of FDI and trade liberalization in the Asia-Pacific region on the countries in this area as well as on the countries in the rest of the world. Before that, we present the data for the analysis.

4. Data: Description and sources

In order to quantify the impact of FDI and trade liberalization in the Asia-Pacific region, we rely on ALY's dataset, which covers 89 countries in 2011 and includes data on foreign direct investment, trade flows, gross domestic product (GDP), employment, and physical capital.¹³ Without going into details, we note that the original data on GDP, employment, and capital stocks are from the Penn World Tables 8.0.¹⁴ The trade data come from the United Nations Statistical Division (UNSD) COMTRADE database. Finally, the bilateral

¹³ 2011 was determined based on availability of capital stock data. The list of countries and their respective labels in parentheses includes Angola (AGO), Argentina (ARG), Australia (AUS), Austria (AUT), Bangladesh (BGD), Belarus (BLR), Belgium (BEL), Brazil (BRA), Bulgaria (BGR), Canada (CAN), Chile (CHL), China (CHN), Colombia (COL), Croatia (HRV), Czech Republic (CZE), Cyprus (CYP), Denmark (DNK), Ecuador (ECU), Egypt (EGY), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Ghana (GHA), Greece (GRC), Hong Kong, China (HKG), Hungary (HUN), India (IND), Indonesia (IDN), Iran (IRN), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Kazakhstan (KAZ), Kenya (KEN), Republic of Korea (KOR), Kuwait (KWT), Lebanon (LBN), Lithuania (LTU), Latvia (LVA), Luxembourg (LUX), Macedonia (MKD), Malaysia (MYS), Malta (MLT), Mexico (MEX), Morocco (MAR), Netherlands (NLD), New Zealand (NZL), Nigeria (NGA), Norway (NOR), Pakistan (PAK), Peru (PER), Philippines (PHL), Poland (POL), Portugal (PRT), Qatar (QAT), Romania (ROU), Russia (RUS), Saudi Arabia (SAU), Singapore (SGP), Slovak Republic (SVK), Slovenia (SVN), South Africa (ZAF), Spain (ESP), Sweden (SWE), Switzerland (CHE), Syria (SYR), Thailand (THA), Turkey (TUR), Ukraine (UKR), United Kingdom (GBR), United States (USA), Uzbekistan (UZB), Venezuela (VEN), and Viet Nam (VNM).

¹⁴ The Penn World Tables are now hosted and maintained by the Groningen Growth and Development Centre and reside at <http://www.rug.nl/research/ggdc/data/pwt/>, and we refer the reader to Feenstra, Inklaar and Timmer (2013) for further details on the dataset.

data on stock values of FDI are from the United Nations Conference on Trade and Development (UNCTAD), supplemented with data from Organization for Economic Cooperation and Development (OECD).¹⁵ In addition to actual data, in order to perform the counterfactual analysis, we rely on a series of calibrated parameters that were constructed and collected by ALY. All variables and parameters are summarized in Table 1, and we refer the reader to ALY for a more detailed description of the data and the calibrated parameters.

Importantly for the purpose of the current analysis, while data availability did not allow us to cover all of the ESCAP member states, our data includes all major economic players in the Asia-Pacific region including the following ESCAP countries (ISO country codes in parenthesis): Australia (AUS), Bangladesh (BGD), China (CHN), Hong Kong (China) (HKG), India (IND), Indonesia (IDN), Iran (IRN), Japan (JPN), Kazakhstan (KAZ), Republic of Korea (KOR), Malaysia (MYS), New Zealand (NZL), Pakistan (PAK), Philippines (PHL), Russian Federation (RUS), Singapore (SGP), Thailand (THA), Turkey (TUR), Uzbekistan (UZB), and Viet Nam (VNM).

In terms of geographic coverage, our data cover countries from all five major ESCAP regions including (i) East and North-East Asia (e.g. China and Japan), (ii) South-East Asia (e.g. Indonesia and Malaysia), (iii) South and South-West Asia (e.g. Bangladesh and India), (iv) North and Central Asia (e.g. Kazakhstan and the Russian Federation), and (v) the Pacific region (e.g. Australia and New Zealand). In terms of economic activity,

¹⁵ UNCTAD's Bilateral FDI Statistics database can be found and accessed from UNCTAD's web site at <http://unctad.org/en/Pages/DIAE/FDI%20Statistics/FDI-Statistics-Bilateral.aspx>.

according to official data from the ESCAP Statistics Division, the countries in our sample account for more than 98% of Gross Domestic Product, more than 98% of the Gross Capital Formation, and more than 97% of both total exports of goods and services and total imports of goods and services among all ESCAP states in 2011, which is the baseline year of our investigation.

Table 1: Summary of the model's endogenous variables, exogenous variables, and parameters

Variables/Parameters	Value	Description	Data/Calibration
Endogenous Variables			
X_{ij}	Matrix	Trade flows	UNIDO, COMTRADE Penn World Tables 8.0
K_j	Vector	Physical capital	Calibrated
M_j	Vector	Technology capital	UNIDO, COMTRADE
Y_j	Vector	Income	Calibrated
P_j	Vector	Inward MRT	Calibrated
Π_j	Vector	Outward MRT	Calibrated
E_j	Vector	Expenditure	Calibrated
Exogenous Variables			
L_j	Vector	Labor Endowment	Penn World Tables 8.0
A_j/γ_j	Vector	Technology Parameter	Calibrated
Parameters			
N	89	Number of countries	Given by data set
t_{ij}	Matrix	Trade cost matrix	Calibrated
ω_{ij}	Matrix	FDI friction matrix	Calibrated
σ	6	Elasticity of substitution	Head and Mayer (2014)
β	0.98	Discount factor	Yao et al. (2012)
α_j	Vector	Capital share in production	Penn World Tables 8.0
δ_j	Vector	Adjustment costs for physical and technology capital	Penn World Tables 8.0
η_j	Vector	Share of technology capital of a country to all destinations as a share from total world technology capital	Calibrated
ϕ_j	Vector	FDI share in production	Calibrated

Source: Authors.

5. On the impact of FDI and trade in the Asia-Pacific region

This section offers a quantitative evaluation of the impact of FDI and trade liberalization in the Asia-Pacific region. In order to perform the analysis, we use the structural system of trade-and-investment (1) - (8) along with the data and calibration parameters that we presented in Section 4.

5.1. On the impact of FDI in the Asia-Pacific region

First, we present and discuss the results from a hypothetical scenario that eliminates FDI for the Asia-Pacific countries in the sample in 2011, while preserving FDI for all other countries in the sample. In order to perform the analysis, we calibrate our eight-equation system (1) - (8) to fit the observed levels of trade and foreign direct investment perfectly, and then we use it to perform the counterfactual experiment of shutting off all inward and outward FDI for the ESCAP member states from the Asian-Pacific region in our sample.

We focus on the impact of FDI on four key economic outcomes that have been of significant interest to academics and policy makers alike. Specifically, first, we construct and report the percentage changes in real total exports for each country i , i.e. $\sum_j X_{ij}/P_i$. Note that the changes are calculated as a change from the world without FDI to a world with FDI, i.e. a positive index should be interpreted as increase in trade due to FDI.

Then, in order to shed more light on the relationship between FDI and trade, we study the impact of FDI on trade costs. To do so, we capitalize on the structural gravity theory and, in particular, on the fact that Equation (1) decomposes the determinants of bilateral trade

into two components; a size term, $\left(\frac{Y_i E_j}{Y}\right)$, and a total trade cost term, $\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}$, which combines the impact of bilateral trade costs (t_{ij}) and of general equilibrium trade costs ($\Pi_i P_j$). Agnosteva, Anderson and Yotov (2014) define the trade cost term as Constructed Trade Bias (CTB) and discuss a series of attractive features of CTB. In terms of reporting and interpretation: (i) We follow Agnosteva, Anderson and Yotov (2014) to report aggregated weighted averages of CTB_{ij} for each exporter using expenditure shares as weights, i.e., $\left(CTB_i = \sum_{j \neq i} \left(\frac{E_j}{\sum_{k \neq i} E_k} CTB_{ij}\right)\right)$; (ii) We note that, by definition, CTB_{ij} takes a value of one for frictionless trade between countries and zero for prohibitive trade costs. Thus, an increase in CTB_{ij} should be interpreted as a fall in the total bilateral trade cost bill between two partners, which, all else equal, should be associated with more trade; (iii) Finally, since in our model FDI does not have any impact on bilateral trade frictions (t_{ij}), all changes in CTB that we obtain and report are triggered exclusively by the impact of FDI on the multilateral resistances through changes in country size.

Third, we report indexes that capture the impact of FDI on real GDP per capita (RGDPpC). Once again, a positive RGDPpC index should be interpreted as increase in real GDP per capita due to FDI.

Finally, we construct and report the percentage change in physical capital in response to FDI. Once again, the indexes for physical capital are calculated as a change from the world without FDI to a world with FDI, i.e. a positive index should be interpreted as increase in physical capital due to FDI.

The results from our counterfactual experiment are presented in Table 2. In order to ease exposition, we only report explicitly the indexes for the Asia-Pacific countries in our sample. All other countries are aggregated in a rest-of-world (ROW) region. Country names appear in column (1) of Table 2. Columns (2) to (5) of Table 2 offer the country-specific values of our calibrated parameters, as well as the average values for the ROW region. Columns (6), (7), (8) and (9) report the changes in total exports, total trade costs (CTB_i), real GDP per capita, and physical capital accumulation, respectively, that we obtain as a result of eliminating all inward and outward FDI flows to and from the Asia-Pacific ESCAP countries in our sample.

Table 2: On the economic impact of FDI and trade liberalization in the Asia-Pacific region

	Model Parameters				FDI Effects				Trade Liberalization Effects		
	α	φ	η	δ	Exports	CTB	Real GDP	Capital	Exports	CTB	Real GDP
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
AUS	0.44	0.05	0.01	0.04	27.40	11.17	14.83	9.23	53.40	48.58	3.26
BGD	0.47	0.00	0.00	0.04	-4.58	-4.76	0.19	-0.11	60.82	54.73	3.94
CHN	0.46	0.01	0.18	0.05	-10.93	-11.55	1.81	1.13	45.22	38.86	4.83
HKG	0.48	0.23	0.01	0.04	151.14	8.65	131.82	89.58	97.76	85.11	6.82
IDN	0.54	0.02	0.01	0.04	4.03	-0.39	4.50	3.05	47.76	38.27	6.90
IND	0.50	0.01	0.04	0.06	-12.00	-13.72	2.22	1.59	70.08	62.18	4.86
IRN	0.74	0.00	0.01	0.06	-3.64	-3.92	0.32	0.26	31.16	26.17	4.01
JPN	0.39	0.00	0.07	0.05	-9.28	-10.05	1.30	0.93	52.19	45.86	4.39
KAZ	0.58	0.06	0.00	0.04	30.90	13.73	15.13	8.49	43.12	38.23	3.56
KOR	0.50	0.01	0.02	0.05	-1.07	-3.04	2.16	0.97	51.72	41.98	6.95
MYS	0.47	0.03	0.01	0.06	8.70	0.98	7.70	4.71	38.48	25.69	10.23
NZL	0.43	0.08	0.00	0.04	35.33	18.93	13.80	6.03	57.10	51.64	3.60
PAK	0.47	0.01	0.00	0.06	-14.41	-16.13	2.07	1.58	67.22	60.22	4.37
PHL	0.64	0.01	0.00	0.05	2.29	-2.74	5.20	4.19	46.68	23.76	18.55
RUS	0.26	0.01	0.03	0.04	-6.18	-6.73	0.64	-0.33	43.42	40.57	2.06
SGP	0.56	0.18	0.00	0.05	80.44	-6.25	92.87	63.52	49.00	26.43	17.91
THA	0.61	0.04	0.01	0.07	6.27	-3.71	10.45	7.11	49.59	31.61	13.74
TUR	0.56	0.04	0.01	0.06	3.24	-3.31	6.80	3.31	75.13	61.96	8.15
UZB	0.47	0.00	0.00	0.03	0.51	0.25	0.26	0.07	72.79	64.96	4.75
VNM	0.47	0.01	0.01	0.05	0.87	0.33	0.53	-0.25	55.83	50.39	3.62
ROW	0.49	0.06	0.01	0.05	-1.92	0.89	-0.95	-2.87	22.93	13.08	1.71

Notes: Column (1) of this table lists the country abbreviations. Columns (2) to (5) present the model parameters including: capital shares α , in Column (2), production shares of FDI φ , in Column (3), country shares of technology capital η , in column (4), and depreciation rates δ , in Column (5). Column (6) to (9) report the results of our counterfactual analysis of the effects of FDI for the Asia-Pacific countries and for a rest-of-the-world (ROW) aggregate region. Column (6) reports the percentage change in total exports. Column (7) reports the percentage change in the physical capital stock, column (8) reports the percentage change in real GDP per capita, and column (9) reports the percentage change in the constructed-trade-bias (CTB). Finally, columns (10) to (12) report the results from a uniform 10% reduction in trade costs for the ESCAP members. Column (10) reports percentage change in exports, column (11) reports the percentage change in the constructed-trade-bias (CTB), and column (12) reports the percentage change in real GDP per capita. See text for further details. *Source:* Authors.

Several findings stand out from our estimates of the impact of FDI on exports in the Asia-Pacific region. First, the estimates in column (6) of Table 2 reveal that the impact of FDI on trade in the Asia-Pacific region has been very significant. Specifically, our estimates show that, on average, FDI has led to an increase in the exports of the ESCAP member states from the Asia-Pacific region by 7.0%. Thus, our results suggest that, on average, FDI has stimulated/complemented exports from the Asia-Pacific region. Second, we find that the average effect of FDI to and from the Asia-Pacific region on the total exports of the countries in the rest of the world is negative but relatively small, on average about -1.9%. This impact on ROW is channeled through the general equilibrium forces that we described in Sections 3.2.1 and 3.2.2.

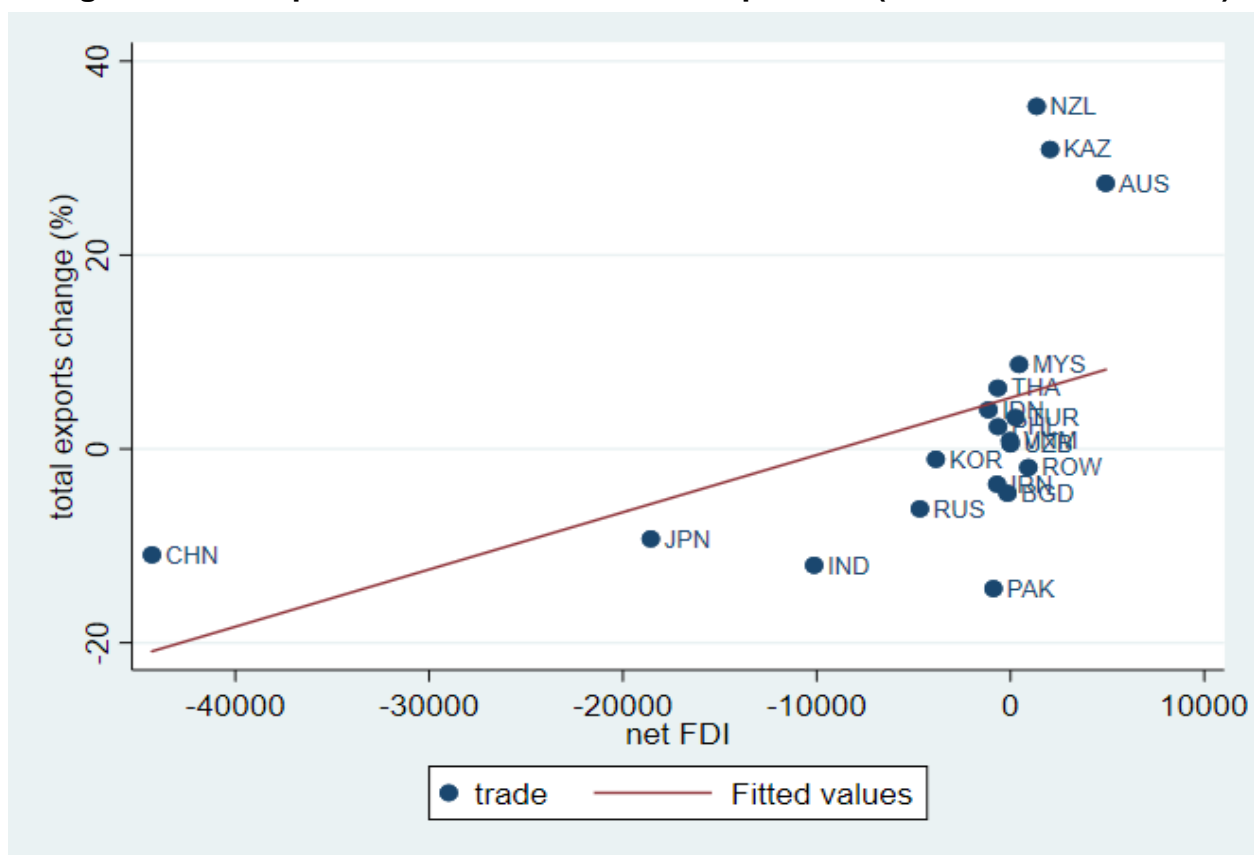
Third, we also find that the impact of FDI on the exports of the Asia-Pacific countries has been quite uneven, ranging from 151% to -14%. Some countries, such as Hong Kong (China), Singapore, New Zealand, and Kazakhstan, see substantial increases in their total exports due to FDI, suggesting that for this group of countries FDI and trade are complements: i.e. allowing for FDI will also stimulate trade.¹⁶ Other countries, such as Pakistan, India and China actually see a fall in their total exports. Hence, our estimates suggest that for these countries FDI and trade are substitutes.

The variation in the net FDI position of the countries in our sample offers a possible explanation for the heterogeneous (and even opposing) results regarding the relationship

¹⁶ Unlike many of the former Soviet Republics that have struggled to attract FDI, Kazakhstan has been quite successful in this area. “Kazakhstan has adopted a series of reforms to liberalize its economy and facilitate foreign investment. The decade of 1999-2009 witnessed FDI multiplying ten-fold, which enabled to boost oil and gas production. Between 2005 and 2015, the country attracted USD 215 billion worth of FDI. In 2016 FDI amounted to USD 9 billion, an increase of 126% compared to 2015.” (<https://en.portal.santandertrade.com/establish-overseas/kazakhstan/investing>).

between FDI and trade in the Asia-Pacific region. In support of this argument, Figure 1 plots the change in total exports against the net (inward minus outward) FDI position of countries. For countries in which trade has increased following FDI liberalization, such as Hong Kong (China), Singapore, New Zealand and Kazakhstan, the total value of inward FDI is larger than the total value of outward FDI, i.e. these countries are net FDI recipients. In countries whose trade has fallen in response to FDI, such as Pakistan, India and China, the total value of inward FDI is smaller than the total value of outward FDI, i.e., their net FDI position is negative. Those countries substitute exports against FDI if FDI restrictions are lifted, i.e. trade and FDI are substitutes in these cases. Hence, even when accounting for all general equilibrium forces, we still see a clear positive relationship between the net FDI position and the change in total exports following FDI liberalization.

Figure 1: FDI impact on trade and the net FDI position (without HKG and SGP)



Source: Authors.

In order to gain further intuition about the relationship between FDI and trade in the Asia-Pacific region, we proceed with a discussion of the impact of FDI on trade costs, which, as discussed earlier, we are going to measure as changes in properly aggregated CTB indexes. Before we present our findings, we remind the reader that changes in FDI have no direct effect on bilateral trade costs in our framework. However, changes in FDI would affect general equilibrium trade costs and, therefore, total bilateral trade costs via the multilateral resistances.

CTB percentage changes are reported in column (7) of Table 2. Our estimates reveal that FDI has had a sizable positive impact on trade flows by decreasing the total trade cost

bill (increase of CTB) for eight of the Asia-Pacific ESCAP members including New Zealand, Kazakhstan, Australia, and Hong Kong (China). The explanation for this result is that the significant impact of FDI on the size of these economies have resulted in more prominent roles for them in the world trade system, which is captured technically by larger weights in the multilateral resistance system. We also obtain positive but small effects of FDI on trade costs for Malaysia, Viet Nam and Uzbekistan. However, the impact of FDI on trade costs for most of the ESCAP members has been negative, i.e., higher trade costs, suggesting that FDI has led to larger multilateral trade resistance for these countries. Concentration of economic activity in the few 'winners' from FDI and diversion from the rest may explain this result.

Next, we turn to the relationship between FDI and real GDP per capita. The estimates from column (8) of Table 2 reveal that the impact of FDI on real GDP per capita in the Asia-Pacific region has been significant as well. Our estimates reveal that the average effect of FDI on real GDP per capita in the ESCAP member countries is about 7.1%.¹⁷ In addition, we find that, without any exception and despite the negative impact of FDI on total exports that we documented earlier in this section, the FDI effects on real GDP per capita are positive for all Asia-Pacific countries in our sample. The real GDP per capita gains range from 132% for Hong Kong (China) to 0.2% for Bangladesh.¹⁸ We view the variation in the impact of FDI on real GDP per capita as mostly intuitive and below we

¹⁷ This index is obtained as output-weighted average across the Asia-Pacific countries in our sample.

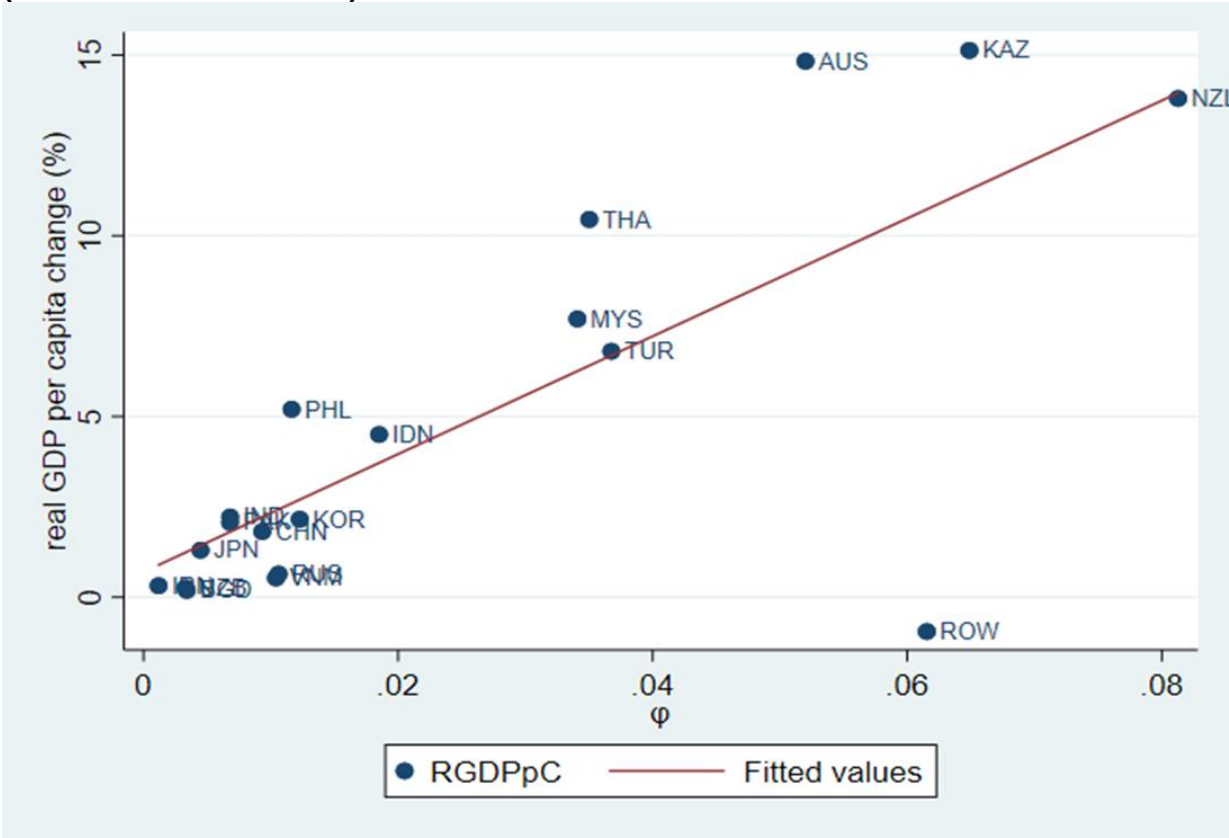
¹⁸ We remind the reader that the increase in real GDP per capita in our framework does not translate directly into increased consumption/welfare. The two reasons for this are that: (i) only part of consumer's income is used for consumption (the other part is used for investment); and (ii) the stream of consumption should be properly discounted to take into account the dynamic nature of our framework. We refer the reader to ALY for welfare analysis.

point to some possible explanations for it. Finally, we find that, on average, the effects of FDI to and from the Asia-Pacific region on real GDP per capita in the rest of the world is negative (-1%). These effects are due to direct and to indirect (GE) forces that are triggered by FDI, which, as discussed earlier, ultimately decrease exports from the ROW but also lead to higher prices in this aggregate region.

To understand the mechanisms that translate the removal of FDI into real GDP per capita effects, we plot the obtained real GDP per capita changes against a series of parameters.¹⁹ First, in Figure 2, we plot the real GDP per capita changes against the country-specific production shares of FDI (ϕ). As can be seen from Figure 2, a larger production share implies larger gains from FDI opening. Intuitively, when counterfactually shutting of FDI, the negative consequences on real GDP per capita will be larger if the importance of FDI in production is bigger for a country.

¹⁹ We caution the reader that the figures that we produce and discuss are only suggestive of the underlying links in our framework, where, as discussed in Sections 3.2.1 and 3.2.2, there is a series of GE channels that may influence our real GDP per capita estimates. Furthermore, one may worry that outliers, such as Hong Kong (China) and Singapore, drive some of the correlations that we present. We therefore present all figures excluding Hong Kong (China) and Singapore (see Figures 1a-6a). These outliers do not drive the relationships. Overall, we find the results in Figures 1-6 informative.

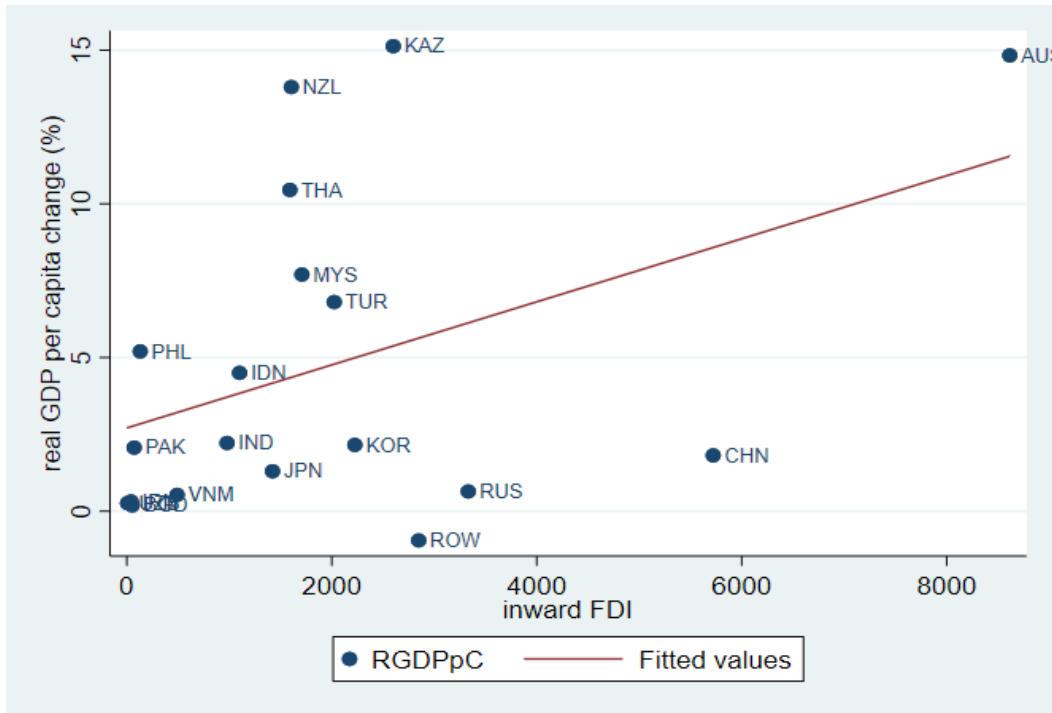
Figure 2: FDI impact on real GDP per capita and the production shares of FDI (φ) (without HKG and SGP)



Source: Authors.

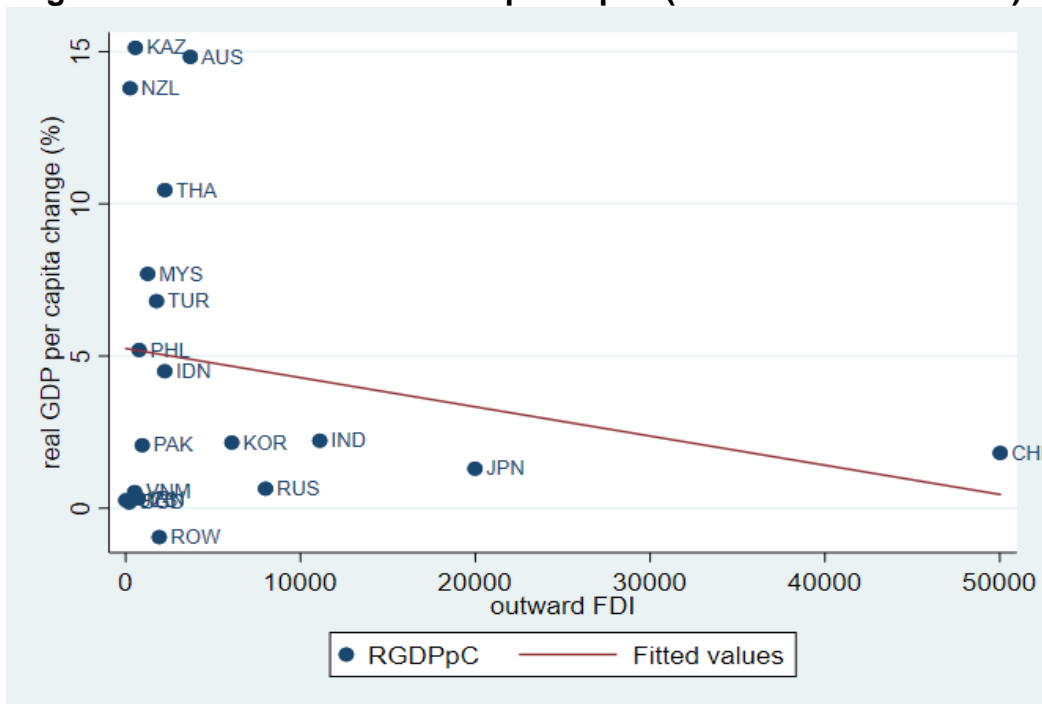
Next, in Figures 3 to 5 we investigate the relationship between the real GDP per capita effects and inward, outward and net (inward-outward) FDI, respectively. We find that the real GDP per capita changes and inward and net FDI are positively linked, while real GDP per capita changes and outward FDI are negatively linked: higher inward, lower outward and higher net FDI positions drive larger positive real GDP per capita effects from FDI liberalization. Economically, the implication is that a country with a positive net FDI position (i.e., more inward than outward FDI), has profited more from FDI liberalization, as it took the opportunity to use the additional possibilities of employing (relatively cheap) foreign technology capital for production at home.

Figure 3: Inward FDI and GDP per capita (without HKG and SGP)



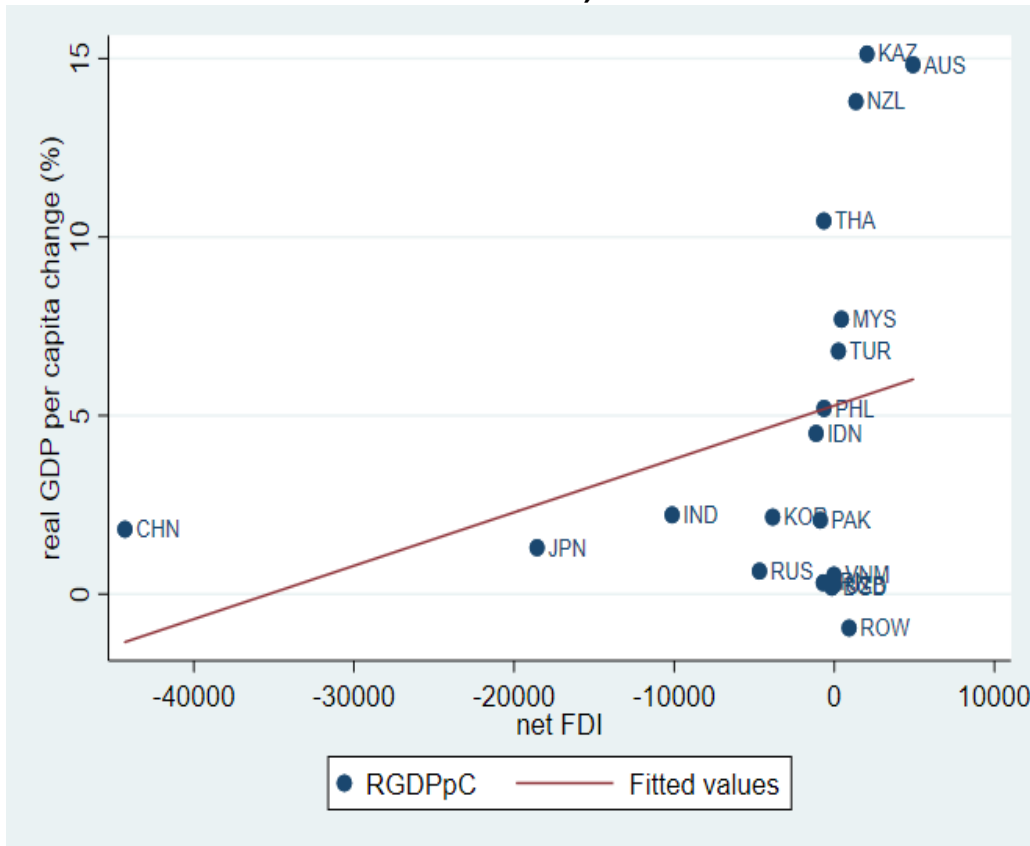
Source: Authors.

Figure 4: Outward FDI and GDP per capita (without HKG and SGP)



Source: Authors.

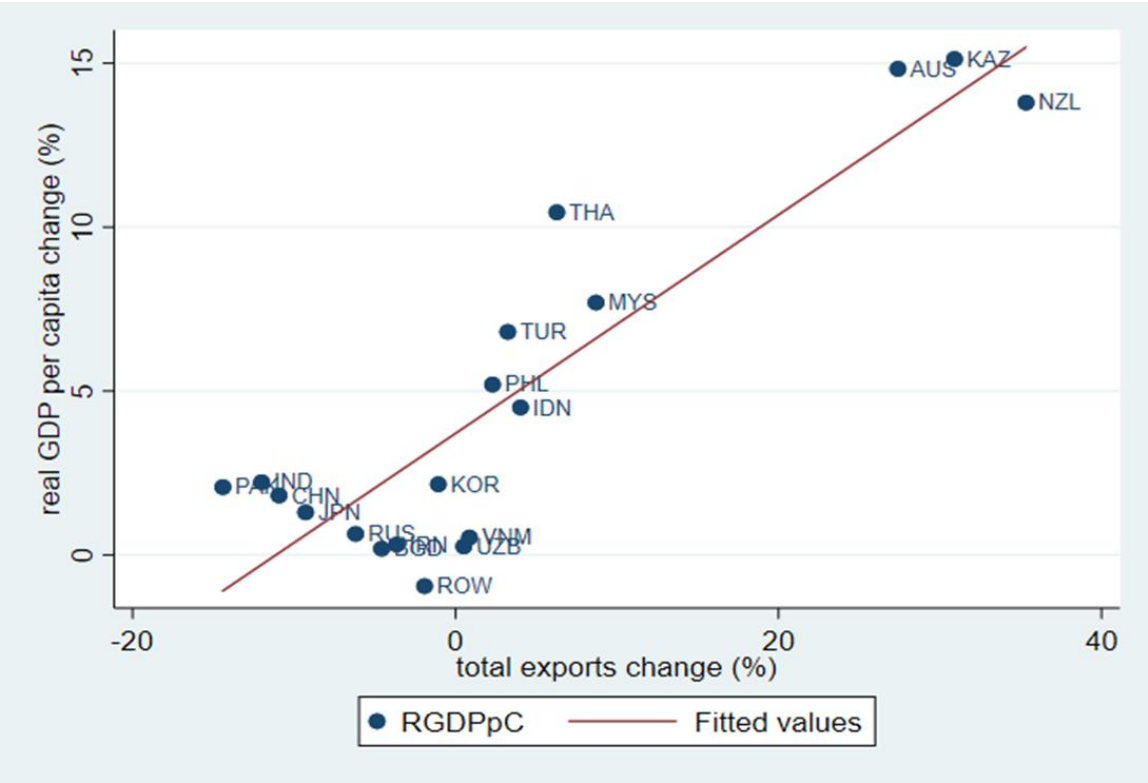
Figure 5: FDI impact on real GDP per capita and net FDI position (without HKG and SGP)



Source: Authors.

Finally, to investigate the effects between real GDP per capita and trade, we also plot in Figure 6 the relationship between the real GDP per capita change and the change in total exports induced by FDI liberalization. The figure suggests a positive relationship, i.e., larger trade changes induced by opening up to FDI also lead to larger real GDP per capita gains. It seems from the figure that this relationship is driven mainly for the countries with large positive trade and real GDP per capita gains, while for the countries with negative trade effects (mainly explained by their initial net FDI position) the relationship is less pronounced.

Figure 6: FDI impact on real GDP per capita and the change in total exports (without HKG and SGP)



Source: Authors.

It is interesting to see whether FDI in the Asia-Pacific region has stimulated or impeded investment in domestic physical capital. To shed some light on this relationship, in column (9) of Table 2 we report percentage changes in physical capital for each of the ESCAP countries in our sample as well as for the rest of the world. Before we present our findings, we remind the reader that our experiment evaluates the impact of *both inward and outward FDI in all ESCAP members in the Asia-Pacific region in a general equilibrium setting, and our estimates should be interpreted accordingly.*²⁰ Our estimates suggest

²⁰ Our framework allows for alternative scenarios that study the impact of only inward or only outward FDI. It can also be used to evaluate the effects of FDI between specific pairs of countries.

that FDI in the Asia-Pacific region has had a significant positive influence on domestic investment in physical capital in Hong Kong (China), Singapore, Australia and Kazakhstan. All of these economies have been engaged in intensive FDI activities. We also observe that the impact of FDI on physical capital accumulation has been positive but relatively small for many other ESCAP members from the Asia-Pacific region. According to our estimates, on average, FDI has led to an increase in the physical capital of the ESCAP member states from the Asia-Pacific region by 3%. This suggests that, on average, FDI has been a complement to domestic investment in physical capital accumulation in this region.²¹ Finally, we also obtain some negative (but small) changes in physical capital in response to FDI for three countries including Russia, Viet Nam, and Bangladesh. These negative estimates are a result of the general equilibrium forces and interactions that are captured in our framework, as described in Sections 3.2.1 and 3.2.2.

5.2. On the impact of trade liberalization in the Asia-Pacific region

This section complements the FDI analysis from the previous section by presenting and discussing results from an experiment that quantifies the impact of trade liberalization in the Asia-Pacific region. Specifically, we reduce trade costs by 10% for the exports and for the imports of all ESCAP member countries with their trading partners in the sample in 2011, i.e., we simulate a scenario that reduces bilateral trade costs (t_{ij}) by 10%

²¹ We remind the reader that the indexes that we report capture the direct and the indirect impact of FDI on domestic physical capital accumulation in a general equilibrium setting. An attractive feature of the theoretical framework of ALY is that it delivers analytical expressions that can be translated into econometric models that allow for a test of the direct causal relationship between FDI and physical capital accumulation. While clearly important, such analysis is beyond the scope of this study.

$(0.9 \times t_{ij})$ if the exporter i or importer j is an ESCAP member from the Asia-Pacific region.²²

Before we present our findings, we note that, according to the structural gravity Equation (1), the direct/partial equilibrium effect of a 10% uniform reduction in bilateral trade costs for the ESCAP countries would be a uniform increase of 70% in the bilateral trade flows for all of the effected trade relationships, i.e. for bilateral trade between any ESCAP country and each of its trading partners.²³

Estimation results of the impact of trade liberalization of the described scenario on exports, total trade costs, and real GDP per capita are presented in columns (10) to (12), respectively, of Table 2. Similar to the presentation of the results from the FDI scenario from the previous section, we only report results for the ESCAP members from the Asia-Pacific region and for the rest-of-the-world aggregate region.

The estimates from column (10) reveal that the initial uniform trade-cost decrease of 10% for all Asia-Pacific countries has had large and positive, but quite heterogeneous impact on the exports of the ESCAP members. Exports have increased the most for Hong Kong (China) and Turkey while the countries that have enjoyed the smallest increase in exports are Iran and Malaysia. Given that the initial decrease in bilateral trade costs is identical for all ESCAP members, the heterogeneous response that we obtain is due to the general

²² As mentioned earlier, the choice for reducing trade costs by 10% is motivated by recent findings from ESCAP analysis of trade costs in the Asia-Pacific region.

²³ The partial effect of 70% is obtained as $(0.9^{1-\sigma} - 1) \times 100\% = (0.9^{-5} - 1) \times 100\% = 70\%$, with our preferred calibrated value of $\sigma=6$.

equilibrium forces in our framework. Specifically, size effects drive part of this response and part of it should be attributed to the changes in total trade costs.

To substantiate this argument, in column (11) of Table 2 we report percentage changes in CTBs as comprehensive trade cost indexes that correspond to the initial 10% reduction in bilateral trade costs for the ESCAP members. The CTB estimates from column (11) offer two insights. First, we see that the initial uniform reduction in bilateral trade costs has generated quite heterogeneous response in total trade costs among the ESCAP members.²⁴ The variation in the CTB indexes is due to the GE forces that operate through the multilateral resistances. Second, we see that the reduction in total trade costs is not sufficient to explain the increase in exports from column (10). Consistent with theory, the differences between the two columns are due to the changes in country size, which are triggered by the initial trade liberalization shock.

We gain further intuition about the impact of trade liberalization on the sizes of the countries in the Asia-Pacific region from column (12) of Table 2, where we report changes in real GDP per capita. Trade liberalization affects real GDP via two channels. Specifically, focusing on the liberalizing ESCAP members, trade liberalization would result in higher factory-gate prices, through lowering the OMRs for the liberalizing countries, as captured by Equation (4) of our theory. In addition, trade liberalization would further increase real GDP in the liberalizing countries by lowering the prices of consumption and investment goods through lower IMRs.

²⁴ We remind the reader that CTB are constructed as power transforms and, therefore, the CTB changes that we report in column (11) of Table 2 should be compared to the corresponding 70% power transformation of the 10% decrease in bilateral trade costs.

Consistent with this intuition, the estimates from column (12) reveal that trade liberalization leads to increases in real GDP per capita in all ESCAP members. Furthermore, we find that the effect of trade liberalization through this channel is quite heterogeneous. The impact on real GDP per capita is the strongest for the Philippines and Singapore, while Russia and Australia would enjoy the smallest increase in real GDP per capita. We also obtain a small positive impact on real GDP per capita in the rest-of-the-world region. The explanation for this result is that, while we do liberalize trade between the Asia-Pacific countries and the rest of the world (which explains the positive impact), the ROW region is significantly larger as compared to the ESCAP countries (which explains the small impact for ROW).

6. Concluding remarks, caveats and future work

We utilized the methods of Anderson, Larch and Yotov (2017) in order to quantify the economic impact of foreign direct investment and trade (liberalization) in the Asia-Pacific region. Our estimates reveal that both FDI and trade have been significant drivers of economic activity in the Asia-Pacific region. At the same time, we document significant heterogeneity in the impact of FDI and trade among the ESCAP member countries. FDI has led to more exports in most countries from the Asia-Pacific region, however, we also find that the exports of some ESCAP members have fallen as a result of FDI. We also find that the FDI impact on real GDP per capita has been positive across all ESCAP members in the Asia-Pacific region. Similarly, we simulate a hypothetical scenario of a uniform 10% decrease in all bilateral trade costs for the ESCAP countries to find that the

impact of trade liberalization in the Asia-Pacific region has been strong but also quite heterogeneous among the ESCAP members.

While our focus has been limited to structural analysis of the impact of FDI and trade liberalization on several key economic outcomes (e.g. export, domestic investment, and real GDP per capita), the large indexes that we obtain in terms of those economic indicators and the wide variation across geographic regions point to possible strong impact of FDI and trade in other areas including employment, economic growth, the environment, etc. In combination with the relatively small share of FDI in gross national outcome and the significant scope for further trade liberalization in the Asia-Pacific region, our results suggest significant potential gains from further FDI and trade liberalization.

We finish our study with a brief discussion of several extensions of ALY's framework, which we believe have the potential to generate important additional policy insights beyond the current analysis.

- An interesting and important extension of our ALY's aggregate framework would be to introduce a sectoral dimension. Costinot et al. (2012) and Anderson and van Wincoop (2004) demonstrate the importance of allowing for sectoral differences within the structural gravity model of trade. In combination with the dynamic investment channels in ALY's framework, a sectoral model of trade, physical capital accumulation and FDI would enable researchers and policy makers to study the impact of trade, investment and their interactions on structural changes in the Asia-Pacific economies.

- On a related note, and parallel to the analysis of Caliendo and Parro (2015) who extend the structural gravity model of trade to allow for intermediates, we expect that introducing intermediate goods into the current dynamic trade-and-investment framework would have significant quantitative implications for the impact of trade and FDI on all key economic outcomes that may be of interest to policy makers. While we believe that extending ALY's theory to introduce sectors and intermediate goods are natural and feasible directions for future work, we also note that such developments should be accompanied by the construction of corresponding databases of sectoral FDI.

- Third, in order to develop the quantitative analysis in this study, we calibrated all bilateral trade costs as well as all bilateral FDI frictions. The main advantage of the calibration approach is that it enabled us to measure trade and FDI frictions comprehensively to match the actual data. However, an important disadvantage of the calibration method is that it does not allow for a decomposition of the different channels through which trade and FDI liberalization actually affect the corresponding trade and FDI flows. The structural gravity model of trade has been used to identify and study the determinants in hundreds of applications. However, as discussed in the literature review, the empirical FDI literature is lagging behind. A nice feature of ALY's framework is that it delivers a structural FDI gravity system, which can be used along with the latest econometric techniques from the trade gravity literature in order to identify the causal links between FDI and its determinants as well as to decompose the impact of the latter.

- On a related note, ALY's framework delivers analytical expressions for the relationships between FDI and income (see equation (5)) as well as between FDI and domestic investment in physical capital accumulation (see equation (7)). We believe that translating Equations (5) and (7) into econometric specifications and estimating those models are promising directions for future work for at least two reasons. First, such econometric analysis would enable researchers to study the causal impact of FDI on income as well as to establish whether FDI stimulates or crowds out domestic investment. Second, in combination with the underlying theory, the estimates that are obtained from such econometric analysis could deliver the key (country-specific) structural parameters.

- Finally, we believe that, due to its ability to consistently aggregate the impact of bilateral FDI into country-specific indexes and also to decompose their impact on the consumers and on the producers in each country, ALY's framework can be nested successfully into a series of general equilibrium superstructures, including models that speak to sustainable development. For example, in combination with appropriate labor and environmental models, the impact of FDI on producer prices and on consumer prices can be translated into effects on inequality and jobs or into environmental outcomes. In addition, the accumulation of non-rival technology capital that is generated by our framework can be used to study the impact of FDI on technology transfer, which has been identified as one of the key drivers of sustainable development.

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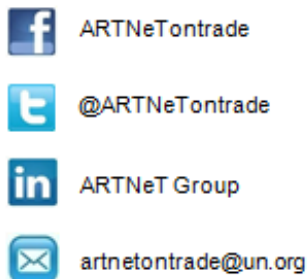
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