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# Estimating Outward FDI Flows under the Heterogeneous Firm Model: A Case Study of Selected Asian Economies

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## Abstract

The problem with FDI flows is that zero or negative flows are being ignored or handled differently. This paper modifies the heterogeneous firm model proposed by Helpman et al. (2008) and examines the determinants of the bilateral outward foreign direct investment (FDI) flows. Given the significance of developing Asian economies as outward investors in the early 2000s, we use a unique dataset on bilateral outward FDI flows of selected Asian economies between 2001 and 2012 to find the determinants of outward FDI with different econometric models. The findings indicate that the determinants of the home economy are quite context-specific, and the determinants of outward FDI from the South are different from the traditional Ownership, Location, and Internationalization (OLI) theory. We find that in the whole sample, the determinants of the outward FDI are consistent with the vertical FDI, where the overseas investment is to relocate and integrate the production process in the GVC, while the determinants of the South align with the horizontal FDI, where overseas investment is to overcome the disadvantages such as trade barriers. In addition, we find that the familiarity with the host economies holds greater significance for the South. We also find that the performance of the heterogeneous firm model is superior to the conventional augmented gravity model. In addition to the selection bias, the productivity threshold or "firm heterogeneity" should be included in estimation to control for further bias when the zero flows are ignored.

**Keywords:** Bilateral Outward FDI, Heckman Two-Step Estimation, Firm Heterogeneity Models
**JEL Classifications**: F12, F21, C20

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# 1. Introduction

Foreign direct investment (FDI)[1] has traditionally originated from the developed or advanced economies, the so-called "North." The relationship between FDI and developing economies, the so-called "South," used to be one-way traffic from North to South, i.e., rich countries invested in poor developing countries. However, since the beginning of the 2000s and after the global financial crisis in 2009, there has been a gradual shift in the global FDI landscape, where developing economies became more prominent as both the source of and destination for FDI. Even though the outward side of FDI is very sticky, it surely increases their role as a source of global capital. However, many country-pairs do not have outward FDI flows between them, especially between developing economies. So, the numbers are not reported and treated as zero or missing. This pattern of missing bilateral outward FDI is quite common and prevalent in studies.

The aim of this paper is to get a better understanding of the aggregate patterns of outward FDI flows and their drivers from developing economies. Our empirical focus is on the developing economies in Asia since they had become primary investors during the period of our study. As there are many missing and zero flows in outward FDI, it is important to consider how to examine such flows. In this paper, we extend the Helpman et al. (2008) model, where the model uses the firm productivity differences, or "firm heterogeneity," to explain the missing flows in bilateral trade without assuming symmetry between trading countries, and the Garrett (2016) model, where the Helpman et al. (2008) heterogeneous firm model is applied to FDI flows. We also compare the results with various econometric techniques, including Poisson pseudo maximum likelihood (PPML), which has become conventional in the literature.

Our findings make two contributions to literature: (1) by examining the bilateral FDI flows, our results may help differentiate the behaviors of investors from developed and developing economies. Additionally, our study may also reveal the specific actions that Asian developing economies need to take in their home to encourage outward FDI to further improve their country's competitiveness and development. And (2) we show that Helpman et al. (2008) heterogeneous firm model is applicable to the outward FDI, and its performance is superior to other techniques considered. However, it requires complicated computation.

The content of this paper is organized as follows. Section 2 provides literature reviews on the determinants of the outward FDI from the developing economies ("South") and our analytical framework used in this paper. Section 3 provides an overview of trends and patterns of outward FDI during the period of study. The data used in this study is explained in Section 4. Section 5 discusses the econometric techniques and model specifications used to deal with zero flows. Section 6 presents our results and discussion. Finally, Section 7 gives a conclusion.

[1] In this paper, we use the general definition of foreign direct investment (FDI) based on OECD, World Bank, and UNCTAD, where it is a category of cross-border investment involving a long-term relationship or establishing a lasting interest in and holding a significant degree of influence over management (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor.

# 2. Literature Review and Analytical Framework

First, we examine the literature on the determinants of the outward FDI and how much they can explain the patterns of the outward FDI in developed and developing economies. We then outline our frameworks of analysis.

Dunning's eclectic paradigm, often known as the OLI theory (1980, 1993), outlines four distinct incentives for foreign investment: resource seeking, market seeking, efficiency seeking, and strategic asset seeking. Based on the OLI theory, companies will utilize their ownership advantages, such as patents, knowledge, technology, and skills, along with the locational advantages of recipient nations, such as resources, reduced labor costs, tariff privileges, and market sizes, to invest overseas. In addition, companies also possess internationalization incentives to invest in foreign markets. The motives encompass the objectives of minimizing trade expenses, regulating excessive production and management, and safeguarding against the unauthorized replication of products or technology throughout the transition from international trade to outbound investment. However, Dunning (1993) placed greater emphasis on pull factors.

According to UNCTAD (2006), the "push factors" that influence an economy's decision to invest abroad are primarily domestic factors. These factors include market conditions, such as small domestic markets or market saturation, trade costs resulting from trade barriers like export quotas, production costs, local business conditions like intense competition in the domestic market, and government policies that encourage outward investment.

Obstfeld & Rogoff (2000) found that distance has a significant impact on FDI. According to Brainard (1997), FDI from the home economy may increase with distance since high transportation costs make it expensive to export to the host economy. The literature on the gravity equation of FDI emphasizes the distinction between horizontal and vertical FDI. Lim (2001) pointed out that horizontal FDI replaces export, so the distance has a positive impact on this type of FDI, while vertical FDI decreases with distance due to the need to ship intermediate goods or parts and components. Also, according to a transaction cost model of MNCs, when the transaction costs are bigger, the greater the spatial distribution and the scale of transactions undertaken to shorten the geographical distance of the factor of production and combine them in each production. As a result, when the transaction costs are higher than internalizing those operations, the MNCs appear. Portes & Rey (2005) found that distance has a significantly negative impact on the gravity equation of equity investment, suggesting that transaction costs must be partly behind the role of distance on FDI flows. Several studies highlight a distinction in the factors driving outward FDI for developed (or "North") and developing (or "South") economies. Goldstein (2009) highlighted the significance of market knowledge in the decision of South MNEs to make investments in foreign economies. Azemar et al. (2012) proposed three mechanisms that South MNEs utilize when making investment decisions, particularly when entering the South. These mechanisms include the evolution stage hypothesis, the resilience advantage hypothesis, and the moderating influence of bilateral ties.

During the evolutionary phase, South MNEs will allocate investments to economies with which they possess a certain level of familiarity, such as geographical proximity, shared language, and robust bilateral relationships. Various studies, including Cuervo-Cazurra (2006), propose that South MNEs are less affected by weak institutions and governance in the host economies compared to North MNEs. This is because South MNEs have already dealt with a less favourable business environment in their own

countries. Similar to Azemar et al. (2012), which found that South-South FDI places significant emphasis on market familiarity, including factors such as physical proximity and shared language. However, it tends to overlook the macroeconomic and governance circumstances that are essential for North-South FDI. Both bilateral ties and international institutions have an impact on North-South FDI as well as South-South FDI. However, regional trade agreements play a crucial role in promoting intra-regional investment for South-South FDI, while North-South FDI benefits from extra-regional investment. A more recent study by Gomez et al. (2022) provides similar findings. They find efficiency-enhancing factors, such as technological readiness, higher education, labor market catalysts, or financial market catalysts, are important determinants that attract FDI, while the traditional factors, such as societal institutions, infrastructure, macroeconomics, and health, are less important in the South-South FDI.

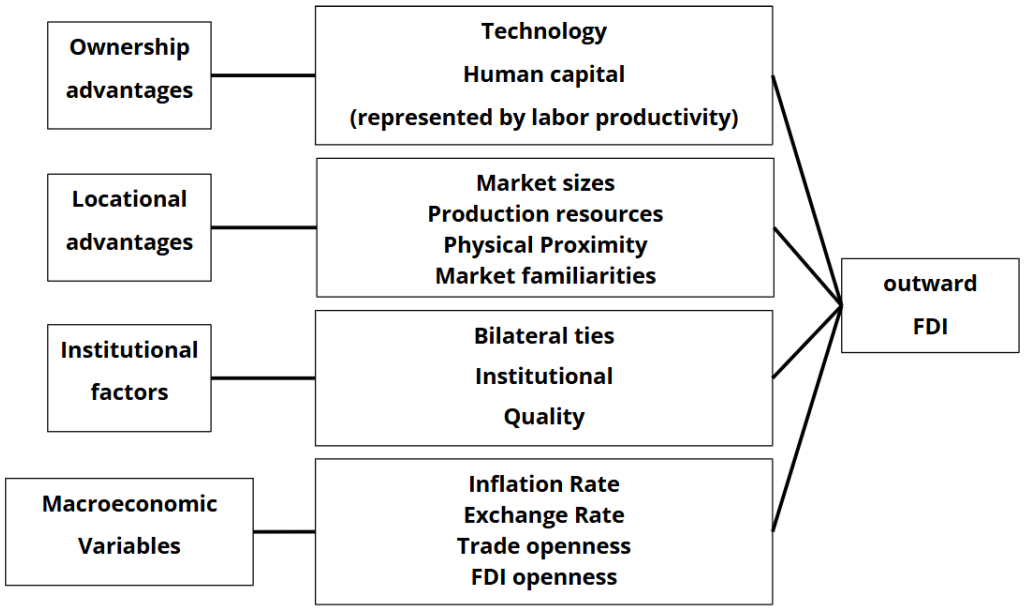
Banga (2005) demonstrated that the South-South and South-North FDI flows are not influenced by the home economy's efforts to promote outward FDI. Trade agreements, particularly those driven by trade, have a significant role in promoting outward FDI in developing economies. This is because increasing market integration and the establishment of production networks make FDI and trade mutually supportive. Furthermore, FDI spillovers also enhance the ownership advantages of developing economies. Additionally, developing economies are compelled to invest abroad due to local limitations such as inadequate infrastructure, a shortage of skilled workers, inflexible labor regulations, and elevated tax rates. These characteristics align with more recent research, such as Das (2013), Cieślik & Tran (2019), and Correa de Cunha et al. (2022), which indicate that the primary drivers of outward FDI from home economies are economic conditions, infrastructure, political risks, and science and technology. This literature found that the traditional FDI theories can explain FDI flows from the South economies. This is consistent with Behera et al. (2021) that found the Asian emerging economies invest in other South for its resources and better institutions but invest in North for their market and assets.

In summary, many research papers find that the drivers of outward FDI from the South exhibit significant differences compared to the North, with variations observed in both the factors influencing the host and home economies. The South's decision to invest overseas is influenced by their market familiarity, bilateral ties, and pull factors from their home economies. On the other hand, the macroeconomic conditions and excellent governance of host countries, which are crucial for the North, do not have a significant impact on the South's investment decisions. The South's decision to invest overseas may be influenced by unfavourable economic conditions, inadequate infrastructure, and political dangers. However, few studies also find that traditional FDI drivers such as market size, resource abundance, trade cost, and distance also play an important role in FDI flows from South economies.

The significant increase of outward FDI from developing economies over the last few decades has led to a growing body of research explaining the drivers of this phenomenon. As developing economies have different institutional contexts compared to developed economies, this strand of literature asks whether mainstream theory is able to explain outward FDI flows from emerging economies (Rugman & Nguyen, 2014), whether these theories require extension (Buckley et al., 2007; Child & Rodrigues, 2005; Cuervo-Cazurra, 2012; Ramasamy et al., 2012), or whether new theories are needed (Kalotay & Sulstarova, 2010; Mathews, 2006). As a result, it is important to understand drivers of outward FDI from developing economies.

From the strand of literature regarding drivers of outward FDI, we can summarize our analytical framework by including both traditional FDI drivers and additional drivers of FDI flows from the South as follows:

Figure 1: Analytical Framework



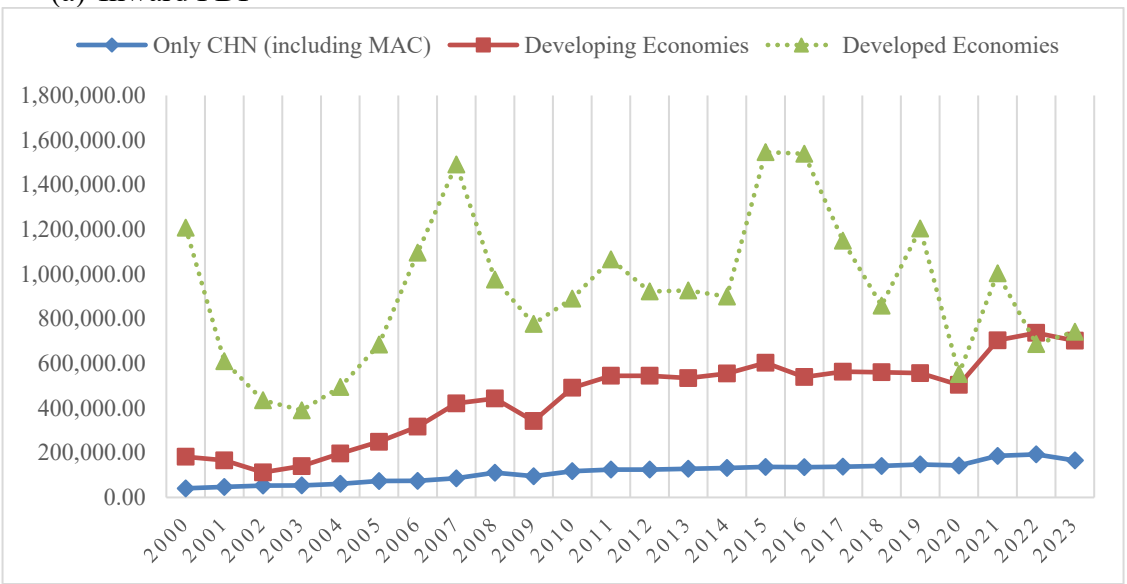

Source: Authors' compilation

## 3. Trends and Patterns of Outward FDI from Asian and Emerging Economies

Developed economies have significantly contributed to global FDI for many years. Most of the FDI flows in the 1990s are dominated by the flows between the developed economies, or "North-North" investment. This can be seen from Figure 2, which shows the patterns of both inward FDI and outward FDI from 2000 to 2023. The declines in both inward FDI and outward FDI from developed economies in 2007 and again in 2016/2017 indicate a decrease in the dominance of developed economies.

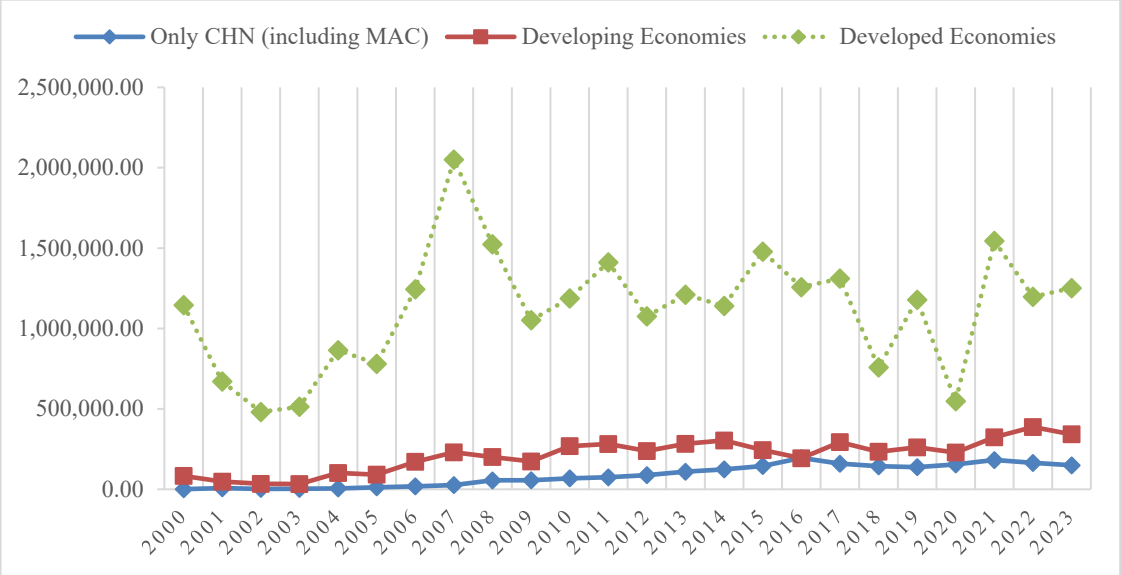
Figure 2: FDI Flows by Group of Economies[2] from 2000 to 2023 (Unit: Mil. US$)

(a) Inward FDI




[2] We consider Hong Kong, Republic of Korea, Taiwan and Singapore as developed economies.

Figure 2: FDI Flows by Group of Economies[3] from 2000 to 2023 (Unit: Mil. US$)
(b) Outward FDI



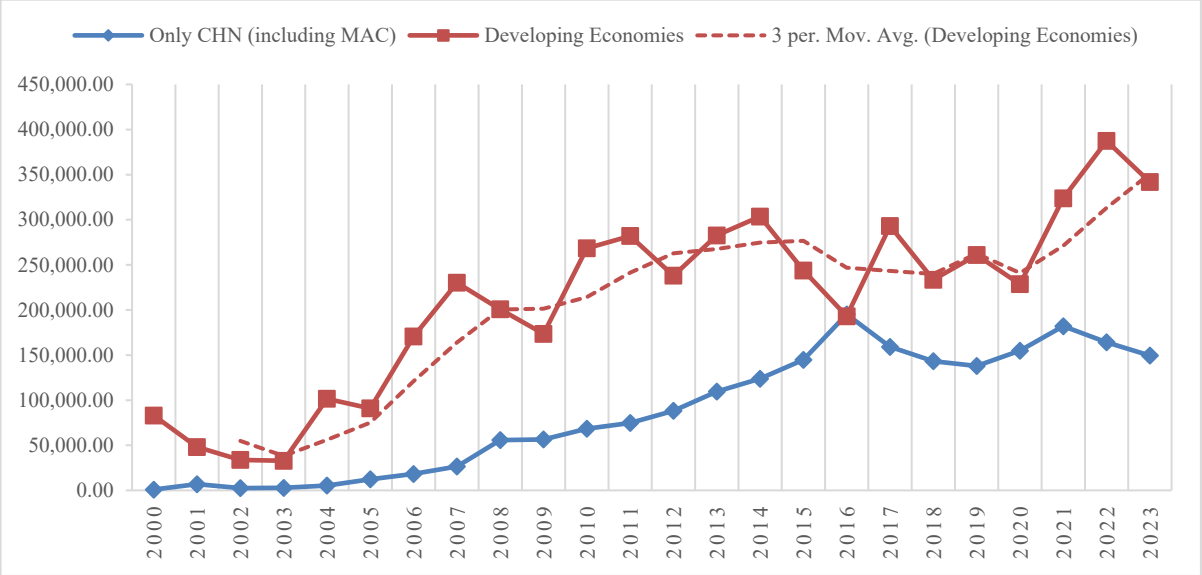

Source: Computed by authors based on UNCTAD Statistics (https://unctadstat.unctad.org/datacentre/)

Global investment patterns have undergone a transformation since the beginning of the 2000s. Developing economies, especially those in Asia, have a significant impact as both beneficiaries and home economies. The rapid growth in the global value chain (GVC) and international production network (IPN)-related investments within the immediate geographic regions are contributing factors to such changes (Cuervo-Cazurra & Pananond, 2023). These investments have replaced investment from the developed economies. Put simply, investment flows between South and South and between South and North have grown significantly and tend to occur more within each economy's immediate geographic region (UNCTAD, 2015; Jungbluth, 2019; Irwin-Hunt, 2020, 2024; UNESCAP, 2020). Upon a closer observation at the outward FDI from the developing economies (excluding China), shown in Figure 3, we can see a clear rising trend in the outward FDI from the South that started in 2003 and died down in 2013. The trend became stable after 2013.[4]

Starting in the 2000s, a new phenomenon had emerged in the way that the world had experienced the reverse outward FDI flows from the developing economies to other developing and developed economies instead. Figure 4 shows that, in 2000, outward FDI from developing economies constituted just 1.41% of global FDI flows, while in 2014 this share significantly increased twelve-fold to 17.27%. Chinese outward FDI constituted half of total developing economies' flows, and if China was excluded, the outward FDI patterns of developing economies peaked at 9.73% (a five-fold increase) in 2013 and stayed relatively stable at about 8.8% afterward. Hence, by studying the period from 2001 to 2012, we might be able to understand the early rise of the outward FDI from the developing economies.

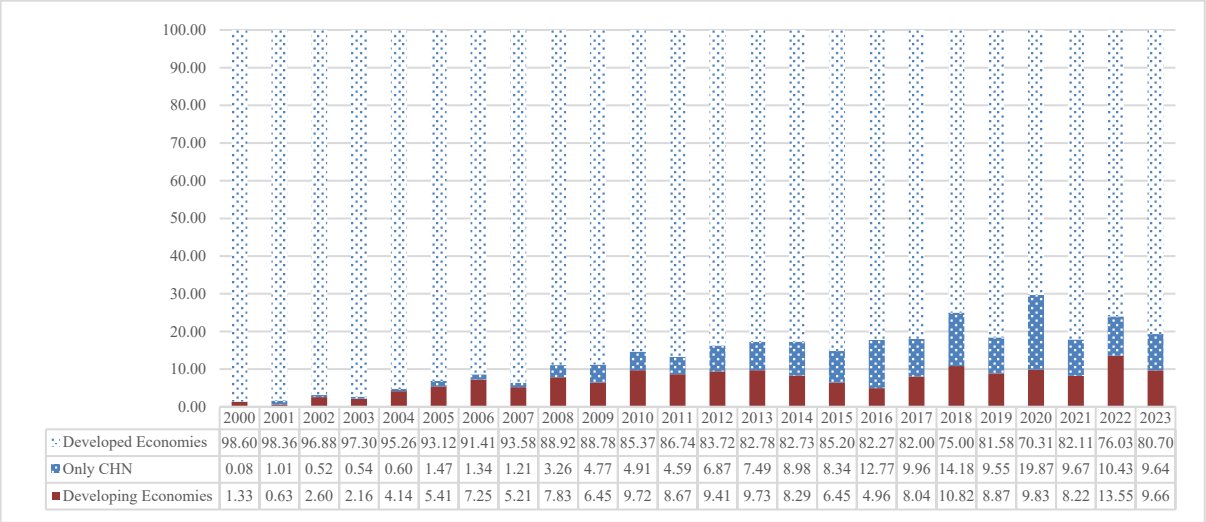
[3] We consider Hong Kong, Republic of Korea, Taiwan and Singapore as developed economies.
[4] We use the 3-period moving average trend to smooth out the overall trend line and show that the trend was stable after 2013.

Figure 3: Outward FDI Flows from the Developing Economies from 2000 to 2023
(Unit: Mil US$)




Source: Computed by authors based on UNCTAD Statistics
(https://unctadstat.unctad.org/datacentre/)

Figure 4: Share of Outward FDI Flows from Developing Economies from 2000 to 2023
(% of the World FDI)




| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Developed Economies | 98.60 | 98.36 | 96.88 | 97.30 | 95.26 | 93.12 | 91.41 | 93.58 | 88.92 | 88.78 | 85.37 | 86.74 | 83.72 | 82.78 | 82.73 | 85.20 | 82.27 | 82.00 | 75.00 | 81.58 | 70.31 | 82.11 | 76.03 | 80.70 |
| Only CHN | 0.08 | 1.01 | 0.52 | 0.54 | 0.60 | 1.47 | 1.34 | 1.21 | 3.26 | 4.77 | 4.91 | 4.59 | 6.87 | 7.49 | 8.98 | 8.34 | 12.77 | 9.96 | 14.18 | 9.55 | 19.87 | 9.67 | 10.43 | 9.64 |
| Developing Economies | 1.33 | 0.63 | 2.60 | 2.16 | 4.14 | 5.41 | 7.25 | 5.21 | 7.83 | 6.45 | 9.72 | 8.67 | 9.41 | 9.73 | 8.29 | 6.45 | 4.96 | 8.04 | 10.82 | 8.87 | 9.83 | 8.22 | 13.55 | 9.66 |

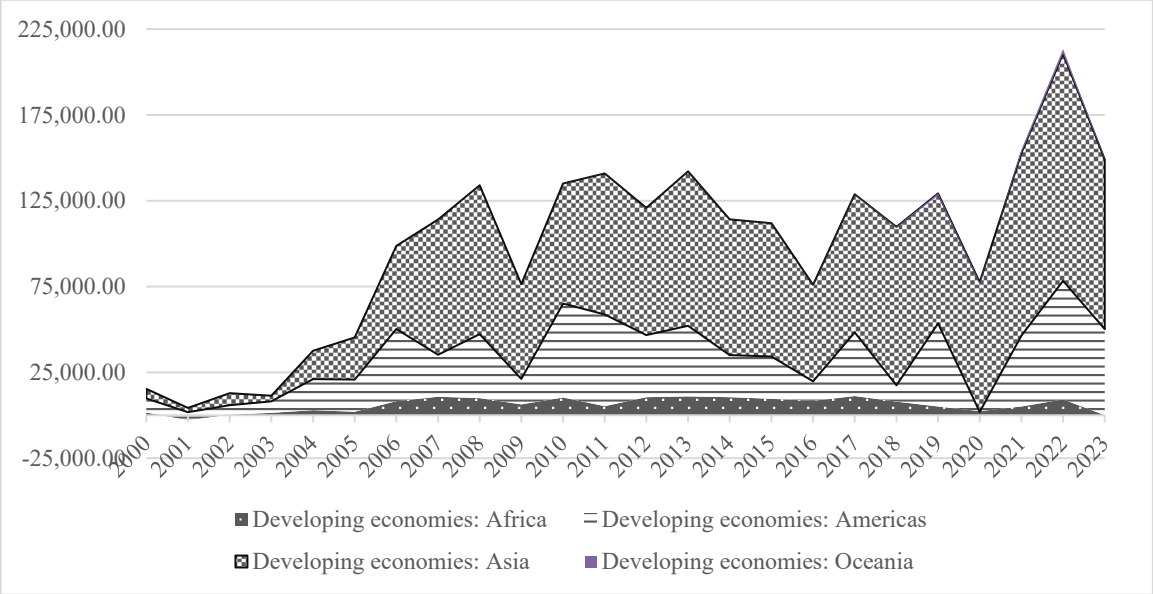
Source: Computed by authors based on UNCTAD Statistics
(https://unctadstat.unctad.org/datacentre/)

Figure 5 shows that MNEs from developing Asia increased their investment abroad and became the largest investment group. The growing outward FDI in Asia is a result of the expanding GVC- and IPN-related investments between economies in the region, started in 2003. Since then, developing Asian economies (excluding China) have emerged as the primary location for investment among the developing economies.

Asian economies' outward FDI can be categorized into three distinct time periods. The initial period marks the onset of the first wave, during which MNEs made the

strategic decision to transfer their production facilities and establish "networked FDI"[5] in various developing countries in Asia (see Thorbecke & Salike, 2013; JBIC, 2010; Baldwin & Okubo, 2012). Dunning et al. (1997) observed that the second wave of outward FDI from the Asian NIEs (Singapore, Taiwan, and the Republic of Korea) differs from the patterns seen in developed economies, where the surge aligns with the investment development path (IDP) outlined by Dunning & Narula (1994, 1996). The primary factors driving outward FDI from Asian NIEs were ownership benefits, locational advantages, and internalization (see Dunning et al., 1997; Yoshitomi, 2003; Lee et al., 2012 for the case of Taiwan and Korea).

Figure 5: Outward FDI from Developing Economies by Region from 2000 to 2023 (Unit: Mil US$)




Source: Computed by authors based on UNCTAD Statistics (https://unctadstat.unctad.org/datacentre/)

The third wave consists of FDI originating from other developing economies in Southeast Asia, especially Thailand, Malaysia, and Indonesia. Three notable examples of outward FDI from developed countries are Bangna (2005), Cieślik & Tran (2019), and Mishra & Jena (2019). They demonstrate that South–South FDI and South–North FDI are becoming increasingly significant in East, South, and Southeast Asian regions. These studies highlight disparities in the investment strategies of South MNEs and North MNEs when expanding internationally. Additionally, it observes that FDI flows between countries within the same area (South–South) and between countries in different regions (South–North) tend to be more prevalent.

In summary, whereas the initial two waves of outward FDI from Asian economies shared many features and motivations, the most recent outward FDI flows from developing economies have distinct drivers and deserve further investigation.

[5] Networked FDI refers to the situation when subsidiaries of a company function as interconnected nodes within regional production networks. In this context, these subsidiaries import a significant portion of intermediate goods and export a significant portion of finished products.

# 4. Data

Bilateral FDI data is an important source of information for quantitative analysis of FDI and can capture detailed investment trends and patterns between economies. With the rise of GVCs and IPN, intraregional investment in developing economies has replaced investment from the developed economies. Hence, the importance of intraregional FDI is more evident when outflows are considered. This study uses a unique dataset of bilateral outward FDI flows[6] compiled by the United Nations Conference on Trade and Development (UNCTAD).[7] We focus our analysis on bilateral outward FDI between 18 economies in East, South, and Southeast Asia from 2001 to 2012.[8]

Given the characteristics of the outward investment flows, it is not imperative for every economy to engage in foreign investments. Hence, it is possible for country A to invest in country B, but not vice versa. Hence, there exists an asymmetrical pattern in the investment flows. This holds especially true for developing economies. This leads to a challenge on how to deal with zero and negative flows of outward FDI, which can provide valuable insight into understanding the investment patterns.

Based on the IMF's criteria for categorizing a country's development level, we divide our sample into two groups: advanced economies and less advanced economies. Our sample consists of three advanced economies[9]: Japan, the Republic of Korea, and Taiwan. The remaining economies are considered less advanced economies. Figure 6 displays the magnitude of outward FDI flows for both advanced and less advanced economies within our sample. Apart from China, most nations in the less advanced economies category have minimal or non-existent outward FDI flows.

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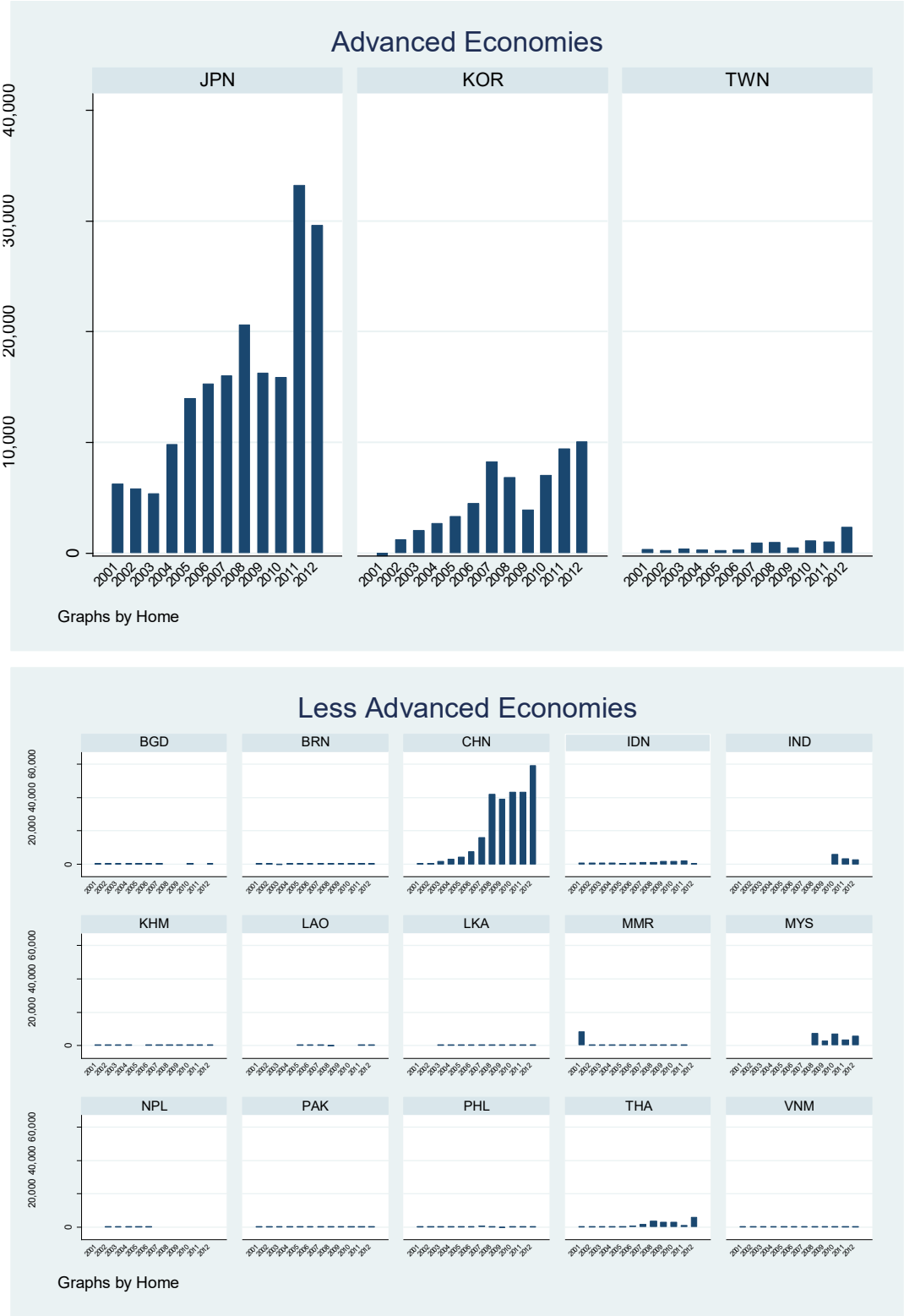
[6] This dataset is based on the "directional principle," which distinguishes the inward and the outward investments that flow between two economies. The key difference between inward and outward FDI is the nationality of the ultimate beneficial owner. Based on UNCTAD, if that company (or ultimate beneficial owner) is located in the home country, the flow and the outstanding (of the provision of short-term and long-term loans between companies maintaining a direct investment relationship) are recorded as outward FDI. But if the ultimate parent company is resident abroad, then the loans constitute inward FDI. This makes it more appropriate to examine the investment patterns and formulate policies because it reflects the direction of the influence by the foreign direct investor underlying the direct investment.

[7] The data on bilateral outward FDI compiled by UNCTAD was discontinued in 2014 and is no longer available on the UNCTAD website. For those who are interested, the dataset can be provided upon request.

[8] The 18 economies are Bangladesh (BGD), Brunei (BRN), Cambodia (KHM), China (CHN), India (IND), Indonesia (IDN), Japan (JPN), Korea (KOR), Lao PDR (LAO), Malaysia (MYS), Myanmar (MMR), Nepal (NPL), Pakistan (PAK), the Philippines (PHL), Sri Lanka (LKA), Taiwan (TWN), Thailand (THA), and Vietnam (VNM).

[9] We would like to thank the referee for the suggestion on how to classify the advanced economies and point out the problem with the UNCTAD definition of developing countries.

Figure 6: Average Size of Outward FDI from Each Country to the Other 18 Economies Over Time (Mil US$)




Source: Computed and tabulated by authors based on UNCTAD Statistics (https://unctadstat.unctad.org/datacentre/)

In Table 1, we can see that in our sample of 3,553 bilateral outward FDI flows, about 74 percent are either negative or zero. The proportion of zero flows in this study is significantly greater than that reported in Zuccato (2013), Martin (2020), and Martin &

Pham (2008, 2020), where it is approximately 25%. Hence, it is rational to address these negative and zero outward FDI flows.

Table 1: Number and Percentage of Negative and Zero Outward FDI Flows

| **Value of OFDI** | **No.** | **%** |
|---|---|---|
| Less than 0 | 100 | 2.81 |
| 0 | 2,539 | 71.46 |
| Greater than 0 | 914 | 24.26 |

*Note: We follow Helpman et al. (2008) and treat missing values as zeros.*
Source: Computed and tabulated by authors based on UNCTAD Statistics (https://unctadstat.unctad.org/datacentre/)

The additional variables employed in this study are derived from the conventional and augmented gravity models, which are economics, trade costs, and regulation and institutional factors. The economic statistics are from UNCTAD, BIS, APO, and CEIC databases. Most trade cost statistics are from the CEPII databases, specifically the Gravity, GeoDist, and Language databases. Finally, the regulation and institutional elements are derived from the World Bank's World Governance Indicator. Table 2 contains comprehensive definitions and sources of the key variable data used in this paper.

Figure 7 displays the outward FDI flows based on our data set categorized by level of development. The outward FDI flows from South to North and South to South start to increase since 2004, and the changes are significantly visible in 2007/2008. Hence these two cases deserve further investigation.[10]

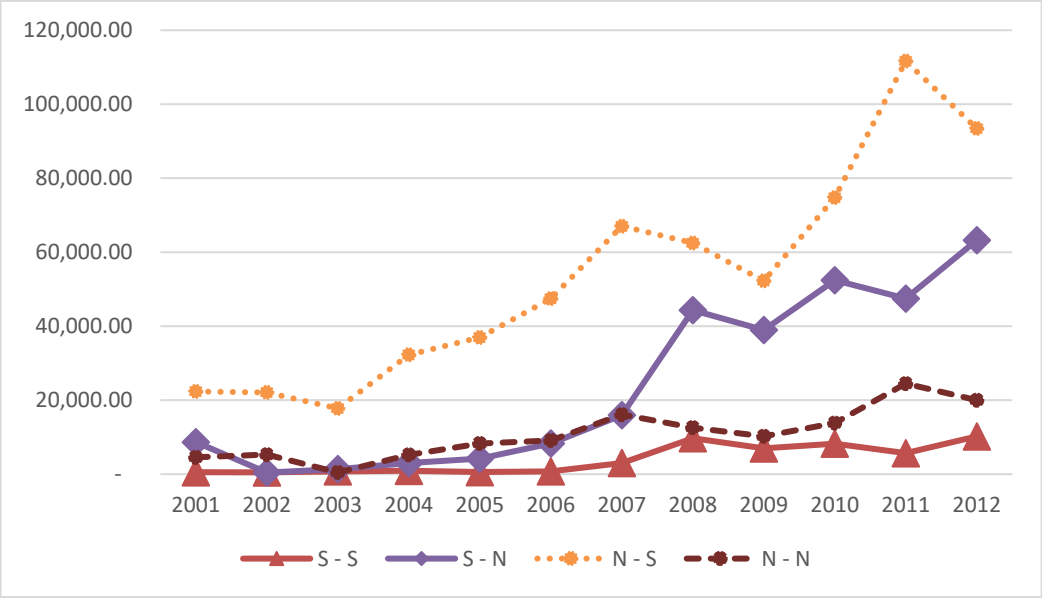
# 5. Methodology and Model Specifications

### *5.1 How to deal with missing, zero and negative flows*

The presence of zero and negative flows poses a significant problem in examining bilateral trade, investment, and immigration flows. Existing literature commonly considers zero or negative flows as missing data, resulting in the removal of these missing pairs from the dataset. Yeyati et al. (2007) and Zuccato (2013) utilize the double-logarithmic form, where the variable is approximated by $\ln(1+x) \cong \ln(x)$or use the semi-log transformation, where the variable is expressed as $\text{sign}(x) \cdot \ln(1+|x|) \cong \ln(x)$, to address the issue of zero flows. These studies suggest that utilizing semi-log transformation is beneficial for explaining variations between positive and negative FDI flows, rather than analysing the overall FDI patterns. However, Cavallari and D'Addona (2013) argue that using the semi-log transformation could diminish the model's explanatory capacity.

[10] However, due to the small number of North in our sample and the estimation not converging, we do not show our analysis for the South-North. But we believe that this case is worth exploring.

Figure 7: Outward FDI Flows by Flow Direction (Mil US$)




Source: Computed by authors based on UNCTAD Statistics (https://unctadstat.unctad.org/datacentre/)

The Tobit model is an alternative method for estimating the gravity model when there are no flows present. Eichengreen & Irwin (1998) asserted that the Tobit model is better suited for estimating the gravity model that includes zero flows. Abdellah et al. (2012) utilized the Tobit model to analyse FDI flows by applying left-censoring to the dependent variable. Guerin & Manzocchi (2009) argued that negative FDI flows can emerge when specific components of FDI, such as reinvested earnings, are negative. These negative components can offset any new inflows of FDI. In addition to a significant proportion of zero FDI inflows, Zuccato (2013) discovered that a substantial proportion of negative FDI inflows from OECD nations during the period from 2006 to 2011 also impacts the accuracy of the estimation. Instead of utilizing the left-censored dependent variable, multinomial logit estimation is more appropriate.

Razin et al. (2005) presented the concept of fixed costs, or "lumpy setup costs," associated with new investments. In the model presented by Razin et al. (2005), a prospective FDI investor determines how much to invest, also known as the "flow" or gravity equation. Subsequently, the individual must decide whether to implement the new investment, contingent upon its fixed costs ("selection" equation). The Heckman selection method is employed to simultaneously estimate the maximum likelihood of both the flow equation and the selection equation. In this study, any missing or negative data is treated as zero.

The Poisson Pseudo Maximum Likelihood (PPML) is an alternative method for estimating the gravity model, introduced by Silva & Tenreyro (2006). This technique is specifically designed to handle zero flows with heteroskedasticity. Martinez-Zarzoso (2013) demonstrated that the PPML is effective in addressing heteroskedasticity issues, although it requires a substantial sample size. Nevertheless, Gómez-Herrera (2013) and Tran et al. (2013) demonstrated that the Heckman selection model is better suited for handling zero trade flows compared to the PPML. According to Martin & Pham (2008, 2020), when there are many zero flows, the performance of PPML is worse compared to truncation estimation. Martin (2020) argued that the problem of selection bias becomes more significant when dealing with foreign investment, and it is important to take into account Helpman et al. (2008) heterogenous firm model.

The primary contribution regarding the management of zero flows is provided by Helpman et al. (2008). This paper constructs a theoretical framework for global trade that takes into account the presence of firm heterogeneity. Helpman et al. (2008) propose an estimation method that incorporates the Heckman two-step estimating strategy. They employ a selection equation to measure the access to the marketplaces of trading partners in the initial stage and thereafter establish a trade flow equation. The estimation incorporates the inverse Mills ratio (IMR) to account for a potential sample selection bias and a productivity threshold to account for an unobserved firm heterogeneity bias in the trade flow equation. Helpman et al. (2008) discovered that traditional estimations are mostly biased, not because of the selection process but rather because of the exclusion of the firm's heterogeneity. Garrett (2016) utilizes the framework put forward by Helpman et al. (2008) to analyse FDI movements in both OECD and Asian countries. The study concludes that considering the selection and heterogeneous firm biases is crucial for understanding the factors that influence FDI flows and the absence of investment flows.

As far as we know, none of the prior studies have used the model suggested by Helpman et al. (2008) to analyse outward FDI flows. Our study will extend this model to investigate the factors that influence outward FDI and try to find determinants of the existing outward FDI flows.

### *5.2 Model Specifications*

To make it comparable to other gravity studies, we utilize a conventional augmented gravity model as a benchmark. Given that PPML has become a standard method of estimation in the gravity model with zero flows, we use it as a reference for comparison with other studies. Subsequently, we also use the sample selection or "Heckman" two-step selection model to address the potential selection bias resulting from excluding the zero flows. Our study utilizes the heterogeneous firm model developed by Helpman et al. (2008) and expanded upon by Garrett (2016). This model allows us to account for both the selection bias and the unobserved firm heterogeneity bias resulting from the asymmetric outward FDI flows and the impact of investment friction, specifically the variation in productivity among different economies.

#### **5.2.1 Benchmark model**

Within FDI literature, many studies utilize the augmented gravity model to identify the factors that influence outward FDI. In this approach, zero or negative flows are considered as missing or incomplete. For instance, Ledyaeva & Linden (2006), Gao (2005), Buckley et al. (2007), Zhang & Daly (2011), and Bhasin & Jain (2013) use the OLI theory and incorporate the subsequent push and pull factors as supplementary determinants of outward FDI: (i) Market-related factors encompass the use of gross domestic product (GDP) as a measure of market size, and GDP per capita as an indicator of market demand.[11] (ii) Economic-related factors include the inflation rate, the labor force participation rate, the real exchange rate, and the labor productivity index. (iii) the policies of host countries regarding trade and investment openness, governance, political risks, and corruption also play a significant role. (iv) production-related factors involve capital, technology, and human capital.

We follow the approach of Banga (2005) and Azemar et al. (2012) and incorporate the attributes of both the home and host economies as the factors that determine the outward FDI. We utilize three metrics to assess institutional environment:

[11] Our model assumptions, we considered incorporating both real GDP and real GDP per capita. However, we chose to only report real GDP because there is a strong possibility of high collinearity between real GDP and real GDP per capita.

regulatory quality, rule of law, and control of corruption. In addition, we incorporate the home economy's productivity as factors that influence capability. The model also incorporates additional variables such as distance, standard gravity model dummies (e.g., sharing a common border, being landlocked, or being an island), a dummy variable to account for market familiarity (e.g., a common official language or being from the same colony), and a regional trade and investment agreement dummy variable to measure bilateral ties.

The following Eq. (1) is our benchmark model:

Eq. (1)

$$\begin{aligned}\log(OFDI_{ijt}) = {} & \beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \beta_3 \log(dist_{ij}) \\ & + \beta_4 Inflation_{it} + \beta_5 Inflation_{jt} + \beta_6 LFPR_{it} + \beta_7 LFPR_{jt} \\ & + \beta_8 \log(REER_{it}) + \beta_9 \log(REER_{jt}) + \beta_{10} TradeOpen_{it} \\ & + \beta_{11} TradeOpen_{jt} + \beta_{12} FDIOpen_{it} + \beta_{13} FDIOpen_{jt} + \beta_{14} \log(LP_{it}) \\ & + \beta_{15} \log(LP_{jt}) + \beta_{16} RegQual_{it} + \beta_{17} RegQual_{jt} + \beta_{18} RuleLaw_{it} \\ & + \beta_{19} RuleLaw_{jt} + \beta_{20} ContCorrupt_{it} + \beta_{21} ContCorrupt_{jt} \\ & + \beta_{22} Border_{ij} + \beta_{23} Island_{ij} + \beta_{24} Landlock_{ij} + \beta_{25} ComLangOff_{ij} \\ & + \beta_{26} ComCol_{ij} + \beta_{27} TRIMS_{ijt} + \beta_{28} I_i + \beta_{29} I_j + \beta_{30} I_{ij} + \beta_{31} Year_t \\ & + \varepsilon_{ijt}\end{aligned}$$

where subscript $ijt$ represents the flow from home economy$i$ to host economy $j$ at time $t$. The variables $I_i$, $I_j$and $I_{ij}$are indicator variables that capture the home, host economy-specific and pair-effects. Due to the short period of the dataset, we do not consider the time-varying economy-specific effect. The $\varepsilon_{ijt}$ is the idiosyncratic error term.

The estimate of the benchmark model relies on the fixed-effect panel regression model. To ensure accurate results, we need to exclude any zero or negative flows from the estimation process, as the logarithm of such values is undefined. An obvious drawback of this strategy is that the estimators exhibit bias because of the loss of information.

**5.2.2 Poisson pseudo-maximum likelihood (PPML)**

The Poisson pseudo-maximum likelihood estimator, introduced by Silva & Tenreyro (2006, 2011), has gained popularity in the field of gravity literature. The model utilizes the multiplicative form of the gravity model, which allows for more effective handling of zero flows and heteroscedasticity resulting from the log-linearized transformation in standard gravity model estimation. By including zero observations, the results are no longer affected by sample selection bias. The model we utilized is Eq. (2):

Eq. (2)

$$\begin{aligned}OFDI_{ijt} = \exp\big( & \beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \beta_3 \log(dist_{ij}) \\ & + \beta_4 Inflation_{it} + \beta_5 Inflation_{jt} + \beta_6 LFPR_{it} + \beta_7 LFPR_{jt} \\ & + \beta_8 \log(REER_{it}) + \beta_9 \log(REER_{jt}) + \beta_{10} TradeOpen_{it} \\ & + \beta_{11} TradeOpen_{jt} + \beta_{12} FDIOpen_{it} + \beta_{13} FDIOpen_{jt} + \beta_{14} \log(LP_{it}) \\ & + \beta_{15} \log(LP_{jt}) + \beta_{16} RegQual_{it} + \beta_{17} RegQual_{jt} + \beta_{18} RuleLaw_{it} \\ & + \beta_{19} RuleLaw_{jt} + \beta_{20} ContCorrupt_{it} + \beta_{21} ContCorrupt_{jt} \\ & + \beta_{22} Border_{ij} + \beta_{23} Island_{ij} + \beta_{24} Landlock_{ij} + \beta_{25} ComLangOff_{ij} \\ & + \beta_{26} ComCol_{ij} + \beta_{27} TRIMS_{ijt} + \beta_{28} I_i + \beta_{29} I_j + \beta_{30} I_{ij} + \beta_{31} Year_t \big) \\ & \times \eta_{ijt}\end{aligned}$$

where $\eta_{ijt}$ is the log normal random variable with mean one and variance $\sigma_i^2$. Traditionally $\eta_{ijt} = 1 + \frac{\varepsilon_{ijt}}{\exp(X_{ijt}\beta)}$ with $E(\eta_{ijt}|X) = 1$.

### 5.2.3 Sample selection or "Heckman" two-step selection model

An effective strategy to address the zero FDI outflow is to employ the sample selection, or the "Heckman" two-step selection model. This methodology consists of two sequential steps. Initially, we employ the probit model to estimate the selection model, which allows us to determine the relationship between the likelihood of participating in outward investment (measured by observed positive flows) and a group of independent variables. The second step involves the computation of the Inverse Mills Ratio (IMR) derived from the initial step and includes it in the typical augmented gravity model. By doing so, we consider the potential effect of the home economy's decision not to invest abroad. This approach has been applied by Bikker & De Vos (1992), Linders & DeGroot (2006), and Martin & Pham (2008, 2020) to analyse trade flows, while Razin et al. (2005) have applied it to FDI flows.

To ensure the viability of this method, it is imperative to establish exclusion limitations that solely impact the decision-making process without impeding the investment flow. Initially, we employ probit estimation using Eq. (3) to assess the home economy's decision to invest overseas.

Eq. (3)

$$\begin{aligned}P(OFDI_{ijt} = 1) &= \Phi[\beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \beta_3 \log(dist_{ij}) \\ &+ \beta_4 Inflation_{it} + \beta_5 Inflation_{jt} + \beta_6 LFPR_{it} + \beta_7 LFPR_{jt} \\ &+ \beta_8 \log(REER_{it}) + \beta_9 \log(REER_{jt}) + \beta_{10} TradeOpen_{it} \\ &+ \beta_{11} TradeOpen_{jt} + \beta_{12} FDIOpen_{it} + \beta_{13} FDIOpen_{jt} + \beta_{14} \log(LP_{it}) \\ &+ \beta_{15} \log(LP_{jt}) + \beta_{16} RegQual_{it} + \beta_{17} RegQual_{jt} + \beta_{18} RuleLaw_{it} \\ &+ \beta_{19} RuleLaw_{jt} + \beta_{20} ContCorrupt_{it} + \beta_{21} ContCorrupt_{jt} \\ &+ \beta_{22} Border_{ij} + \beta_{23} Island_{ij} + \beta_{24} Landlock_{ij} + \beta_{25} ComLangOff_{ij} \\ &+ \beta_{26} ComCol_{ij} + \beta_{27} TRIMS_{ijt} + \beta_{28} I_i + \beta_{29} I_j + \beta_{30} I_{ij} + \beta_{31} Year_t \\ &+ \varepsilon_{ijt}]\end{aligned}$$

where Φ is the cumulative density function (CDF) of the normal distribution. The second step involves adding the IMR$= \phi(X\hat{\beta})/\Phi(X\hat{\beta})$, where $\phi$ is the probability density function (PDF) of the normal distribution, to the standard augmented gravity model to control for the selection bias. Hence, the model in the second step is Eq. (4), which can be written as follows:

Eq. (4)

$$\begin{aligned}\log(OFDI_{ijt}) &= \beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \beta_3 \log(dist_{ij}) \\ &+ \beta_4 Inflation_{it} + \beta_5 Inflation_{jt} + \beta_6 LFPR_{it} + \beta_7 LFPR_{jt} \\ &+ \beta_8 \log(REER_{it}) + \beta_9 \log(REER_{jt}) + \beta_{10} TradeOpen_{it} \\ &+ \beta_{11} TradeOpen_{jt} + \beta_{12} FDIOpen_{it} + \beta_{13} FDIOpen_{jt} + \beta_{14} \log(LP_{it}) \\ &+ \beta_{15} \log(LP_{jt}) + \beta_{16} ComLangOff_{ij} + \beta_{17} ComCol_{ij} + \beta_{18} IMR \\ &+ \beta_{19} I_i + \beta_{20} I_j + \beta_{21} I_{ij} + \beta_{22} Year_t + \varepsilon_{ijt}\end{aligned}$$

We assume that the regulatory quality, rule of law, and control of corruption within an economy are associated with the costs incurred by a firm when investing abroad, as well as the fixed costs resulting from the geographic location of the host economy (such as sharing a border, being an island, or being landlocked) and trade-related investment measures (TRIMS) between the home and host economies as additional exclusion restrictions in the second step[12].

**5.2.4 Heterogeneous firm model**

The main contribution of our study is that we adopt the approach of Helpman et al. (2008), or "HMR," and effectively address two issues: the selection bias resulting from excluding investment outflows that are zero or negative and the bias arising from unobserved differences in firms' heterogeneity (or economy's productivity). To be sure that the productivity threshold comes from the unobserved firm heterogeneity, we carefully control the observed labor productivity. The technique is the same as the "Heckman" two-stage selection model, with the addition of incorporating the productivity threshold suggested by Helpman et al. (2008) in the second step. In the second stage, instead of using Eq. (4), we consider the following Eq. (5).

Eq. (5)

$$\begin{aligned}\log(OFDI_{ijt}) = {} & \beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \beta_3 \log(dist_{ij}) \\ & + \beta_4 Inflation_{it} + \beta_5 Inflation_{jt} + \beta_6 LFPR_{it} + \beta_7 LFPR_{jt} \\ & + \beta_8 \log(REER_{it}) + \beta_9 \log(REER_{jt}) + \beta_{10} TradeOpen_{it} \\ & + \beta_{11} TradeOpen_{jt} + \beta_{12} FDIOpen_{it} + \beta_{13} FDIOpen_{jt} + \beta_{14} \log(LP_{it}) \\ & + \beta_{15} \log(LP_{jt}) + \beta_{16} ComLangOff_{ij} + \beta_{17} ComCol_{ij} + \beta_{18} IMR \\ & + ProdThres + \beta_{19} I_i + \beta_{20} I_j + \beta_{21} I_{ij} + \beta_{22} Year_t + \varepsilon_{ijt}\end{aligned}$$

where the term $ProdThres = \ln\left(exp\left(\delta\left(IMR + X\hat{\beta}\right)\right) - 1\right)$. The additional parameter of interest is $\delta$. Since the model is non-linear in this parameter, it needs to be estimated by a maximum likelihood estimation.

To prevent the occurrence of simultaneous causation between trade and investment variables, we use lagged independent variables ( $x_{it-1}$ or $x_{jt-1}$ where applicable) in every case examined. Table 2 presents a concise overview of the expected signs for the primary parameters in each of the scenarios.

# 6. Results

In this section, we present our results from different estimation techniques and compare their predictive performance using data validation. Finally, we examine and discuss our findings.

### *6.1 Estimation results*

In this study, we consider estimation results in two cases, namely, the whole sample and the South-South.[13] Based on the sample of eighteen economies, we find

[12] We also consider Bilateral Investment Treaties, Regional Trade Agreement, or other WTO measures as alternative exclusions. The results are similar and are not reported. However, they can be given upon request.

[13] The estimations of N-S and S-N investments are excluded due to insufficient data, and estimations do not converge.

distance conforms with gravity literature with the significant negative signs, i.e., with high fixed costs of investment (measured by distance), the home economy invests less in the host economy (see Table 3). Our findings suggest that outward FDI among sample economies is vertical FDI, as the vertical FDI decreases with distance due to the need to ship intermediate goods or parts and components. The signs across different estimations are identical with comparable magnitude. However, they are insignificant. In terms of magnitude, some of the estimates from PPML are quite different from others. The common significant driving factor of outward FDI in this case is the home economy's labor productivity, i.e., 100 basis point increases in the labor productivity index, outward FDI increases by 5-7%. On the other hand, we find no conclusive significant host economy factors. Based on the cross-validation in Section 5.2, we will focus our analysis on the gravity and HMR models.

Table 2: Definitions, Sources, and Expected Signs of Key Variables

| Variables | Definition of Original Variable | Source | All 18 | S-S |
|---|---|---|---|---|
| $log(OFDI_{ijt})$ | Outward FDI flows (Mil US$) | UNCTAD | | |
| $\log(GDP_{it-1})$ | Real Gross Domestic Product (Mil US$) | UNCTAD | +/- | - |
| $\log(GDP_{jt-1})$ | | | + | + |
| $\log(GDPPC_{it-1})$ | Real Gross Domestic Product per Capita (US$) | UNCTAD | + | + |
| $\log(GDPPC_{jt-1})$ | | | + | + |
| $\log(dist_{ij})$ | Simple distance between two populated cities (Kilometer) | CEPII | - | - |
| $Inflation_{it-1}$ | Inflation rate (%, base year = 2000) | UNCTAD | + | - |
| $Inflation_{jt-1}$ | | | 0/- | 0 |
| $LFPR_{it-1}$ | Labor Force Participation Rate, measured by the percentage of labor force in the total adult population (%) | UNCTAD | 0/- | 0 |
| $LFPR_{jt-1}$ | | | +/0 | + |
| $\log(REER_{it-1})$ | Real Effective Exchange Rate (Index, base = 2000) | UNCTAD | + | + |
| $\log(REER_{jt-1})$ | | | 0/- | 0 |
| $TradeOpen_{it-1}$ | Degree of country's openness to trade, measured by the percentage of total trade to GDP (%) | Authors (based on UNCTAD) | + | + |
| $TradeOpen_{jt-1}$ | | | +/0 | 0 |
| $FDIOpen_{it-1}$ | Degree of country's openness to foreign investment, measured by the percentage of stock of inward FDI to GDP (%) | Authors (based on UNCTAD) | + | + |
| $FDIOpen_{jt-1}$ | | | +/0 | 0 |
| $\log(LP_{it-1})$ | Labor Productivity (Index) | APO | 0/- | 0/- |
| $\log(LP_{jt-1})$ | | | + | + |

| Variables | Definition of Original Variable | Source | All 18 | S-S |
|---|---|---|---|---|
| $ComLangOff_{ij}$ | = 1 if the country-pair uses the same common official language; 0 otherwise | CEPII | + | + |
| $ComCol_{ij}$ | = 1 if the country-pair had been colonized by the same country; 0 otherwise | CEPII | + | + |

Source: Authors' compilation and perspective

Given the exclusion of zero and negative flows, it is reasonable to anticipate a loss of information and the introduction of bias. The selection model shows that the pull and push components are the same as the benchmark, but their magnitudes are smaller. Our analysis reveals a positive correlation between the size of a home country's real GDP, labor productivity, and outward FDI. Additionally, we see that an increase in the host economy's level of investment openness is associated with a stronger flow of outward investment. However, the rise in macroeconomic uncertainty in the host economy leads to a decrease in foreign investment outflows. The higher level of worker productivity can be attributed to an increase in wages in the home economy or advancements in technology. This prompts the home economy to invest in other countries due to the higher local production costs.

Conversely, when considering the factors that pull investment into the host economy, we observe that a larger host economy's GDP, or those with greater investment openness, tends to experience higher levels of outward investment. Conversely, an increase in macroeconomic volatility, as measured by a rise in the inflation rate, tends to decrease the amount of outward investment flowing into the host economy. Nevertheless, the presence of a common official language and colonial ties as indicators of market familiarity indicates a reduction in investment flow, contrary to our initial expectations. However, we find no selection bias in the selection models. There is a possibility that certain undisclosed variables could be the cause of this issue.

After accounting for both the selection bias and the unobserved firm heterogeneity bias (referred to as the "productivity threshold"), we see that the model is still affected by the firm heterogeneity bias. While the signs of most coefficients remain unchanged, the size of the coefficients does vary. As an illustration, the impact of the host economy's GDP on outward FDI declines from -4.173% to -4.376%. Likewise, these findings show the influence of pull factors in the host economy. For instance, a greater inflation rate in the host economy reduces the outflow of investment from -0.182% to -0.177%. These imply that the augmented gravity and selection models overestimate the results. We have also observed that some factors change from being insignificant to being significant. For instance, the rise in the labor force participation rate in the home economy and the growth in labor productivity in the host economy unexpectedly led to a higher outflow of investment, contrary to what we anticipated.

The HMR model yields substantial disparities in the factors influencing outward FDI when compared to the gravity and Heckman two-step selection techniques. The labor force participation rate and labor productivity of a home country, as well as the degree of investment openness, have significant impacts on the level of outward FDI. Specifically, higher labor force participation rates and labor productivity in host economies tend to lead to increased outward FDI. On the other hand, a higher degree of investment openness of the home economy is associated with a decrease in the level of outward FDI. Additionally, we observe that PPML yields comparable outcomes when compared to the selection model, except for more prominent factors such as the positive impact of the

home economy's real effective exchange rate and the negative influence of trade openness in the host economy. The primary disparities in estimating among each estimation method are outlined in Table 3.

Table 3 also shows the results for the outward FDI between developing economies, or South–South. It is evident that the GDP of both home and host economies, the labor force participation, the inflation rate, the trade openness of the home economy, the presence of common languages, and the history of common colonialization are significant factors influencing outward FDI flows for South–South economies.

Our research supports the findings of Azemar et al. (2012) that market familiarities play a crucial role in motivating developing economies to invest in other developing peers. This is particularly true for market familiarities related to cultural proximities. Similar to the studies by Banga (2005) and Azemar et al. (2012), we discover that developing economies are less affected by unfavorable institutional conditions in the host economies compared to developed economies.

Table 3: Estimation Results Across Different Estimations - (i = Home, j = Host)

| | Whole Sample | | | | S-S | | | |
|---|---|---|---|---|---|---|---|---|
| $\log(OFDI_{ijt})$ | **Gravity** | **PPML** | **Selection** | **HMR** | **Gravity** | **PPML** | **Selection** | **HMR** |
| $\log(GDP_{it-1})$ | -1.902 | -2.736 | -3.850 | -3.711 | -1.819 | 12.63 | -7.519 | -8.042** |
| $\log(GDP_{jt-1})$ | 0.819 | -0.382 | 1.103 | 0.992 | 0.836 | -0.968 | 1.772 | 2.385** |
| $\log(dist_{ij})$ | -1.806*** | -4.214* | -1.505** | -1.740*** | 2.664 | -35.57 | 4.710 | 3.755*** |
| $LFPR_{it-1}$ | -0.00121 | 0.0738 | 0.00505 | 0.128 | -0.121 | -0.0615 | 0.0574 | 0.0260 |
| $LFPR_{jt-1}$ | -0.0981 | -0.106 | -0.0807 | -0.175*** | 0.0136 | -0.0181 | -0.0127 | 0.0367 |
| $Inflation_{it-1}$ | -0.0164 | 0.0121 | -0.00847 | -0.0371*** | 0.0021 | -0.0137 | -0.00478 | -0.0482*** |
| $Inflation_{jt-1}$ | -0.0051 | 0.0042 | -0.00938 | -0.0129 | -0.0141 | -0.0125 | -0.0135 | -0.0129 |
| $\log(REER_{it-1})$ | 1.061 | 0.448 | 1.358 | 1.550* | -1.668 | -4.601** | -0.593 | 1.842 |
| $\log(REER_{jt-1})$ | 0.900 | 0.779 | 0.772 | 0.451 | 0.335 | 0.550 | 0.494 | -0.0008 |
| $TradeOpen_{it-1}$ | 0.0153 | -0.0062 | 0.0152 | 0.0166* | 0.0289*** | 0.0343*** | 0.0236 | 0.0288*** |
| $TradeOpen_{jt-1}$ | -0.0002 | -0.0014 | -0.00105 | 0.00336 | 0.0006 | -0.00124 | 0.00235 | -0.0066 |
| $FDIOpen_{it-1}$ | 0.0051 | 0.0236 | 0.00841 | 0.00897 | 0.00500 | 0.0439 | 0.000425 | -0.0021 |
| $FDIOpen_{jt-1}$ | 0.0056 | 0.0166* | 0.00385 | 0.00138 | 0.00821 | 0.0266*** | 0.00958 | 0.0042 |
| $\log(LP_{it-1})$ | 5.551** | 6.153** | 6.917*** | 5.877** | 6.232** | -3.496 | 9.972** | 8.902*** |
| $\log(LP_{jt-1})$ | -0.526 | -2.097* | -0.973 | -0.0744 | 0.134 | 0.913 | -0.651 | 0.209 |
| $ComLangOff_{ij}$ | -1.654 | 3.584*** | -0.0912 | 0.221 | -7.030 | 2.393 | -1.262 | 2.084*** |
| $ComCol_{ij}$ | 0.538 | 0.601 | -0.138 | -4.428*** | -3.599 | 14.65** | -10.19 | 2.807*** |
| $IMR$ | | | 0.0788 | 0.227 | | | 0.161 | 0.271 |
| $ProdThres$ | | | | 0.0004*** | | | | 0.0005*** |
| Observations | 813 | 1,300 | 813 | 813 | 394 | 690 | 394 | 394 |

*Note: (1) Country-pair and time-fixed effects are included in all specification;*
*(2) *, **, *** = significant at 10%, 5% and 1 %, respectively*

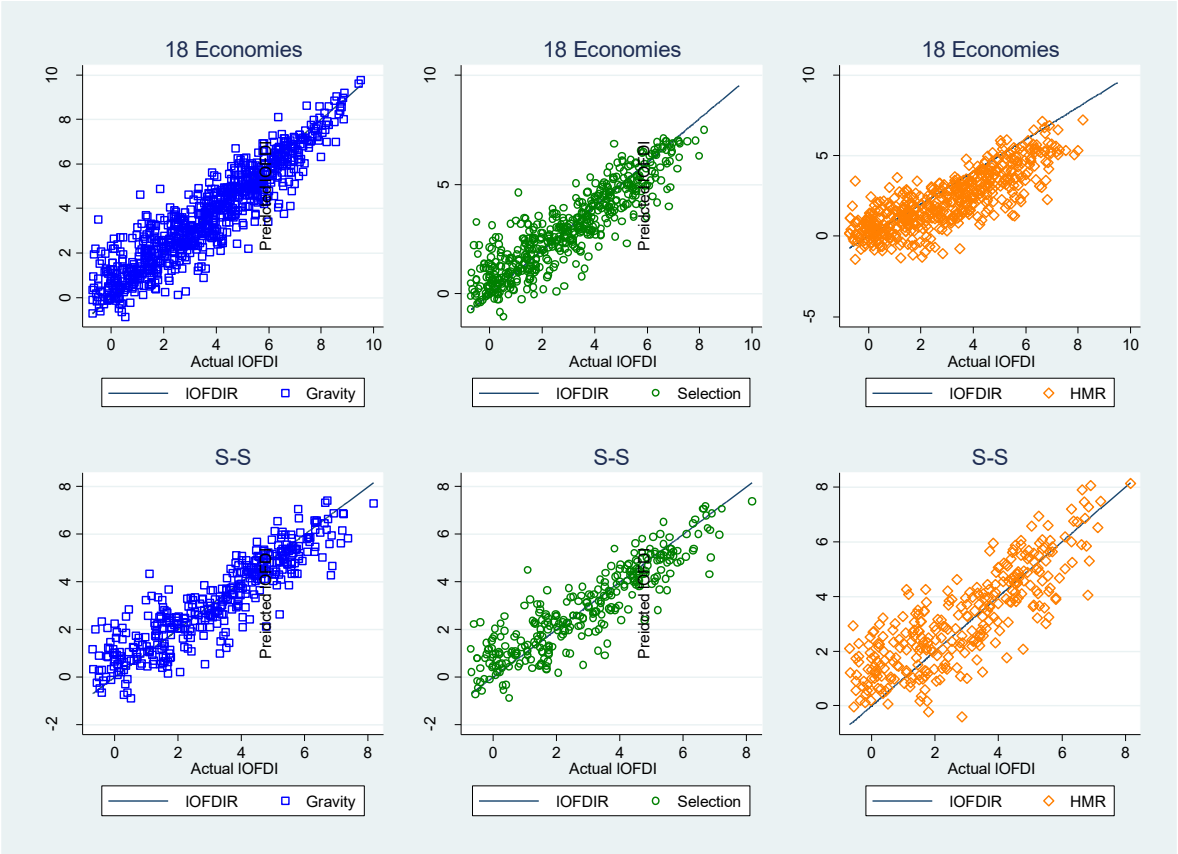
Source: Authors' calculations

### *6.2 Comparing the model's performance*

To assess the performance of each estimation, we follow the methodology outlined by Gomez (2013). We compare the simple in-sample predicted values with the actual values to determine the most suitable model and subsequently calculate the root mean squared error (RMSE). Figure 8 displays the predicted values alongside the 45-degree lines, where the empty blue square symbolizes the traditional gravity model, the empty green circle symbolizes the "Heckman" two-step selection model, and the empty orange diamond symbolizes the HMR model. The results from Figure 6 suggest that the estimation in the whole sample (18 economies) is "equally accurate," while the

heterogeneous firm model (HMR) performs poorer than the other two in the South-South case.

Figure 8: In-sample Prediction for Gravity, Selection and HMR




Source: Authors' calculations

In Figure 9, it is observed that the predicted values for PPML are highly precise when the actual value of outward FDI is extremely low. But the performance deteriorates with larger values of outward FDI.[14]

To make the cross-estimation results comparable, we further compute the in-sample RMSE as an extra criterion. Surprisingly, Table 4 reveals that conventional gravity yields the lowest RMSE compared to alternative estimations. The selection and HMR rank second and third, exhibiting marginally greater RMSE. The PPML yields the poorest outcomes, which might result from using the actual FDI value, comparing the log transformation in other estimations.

Table 4: RMSE Based on In-Sample Data Across Different Estimations

| **RMSE** | **Gravity** | **PPML** | **Selection** | **HMR** |
|---|---|---|---|---|
| **Whole Sample** | .91697671 | 272.79846 | .97396629 | 1.4706514 |
| **S-S** | .92084795 | 122.82508 | .95120833 | 1.2659252 |

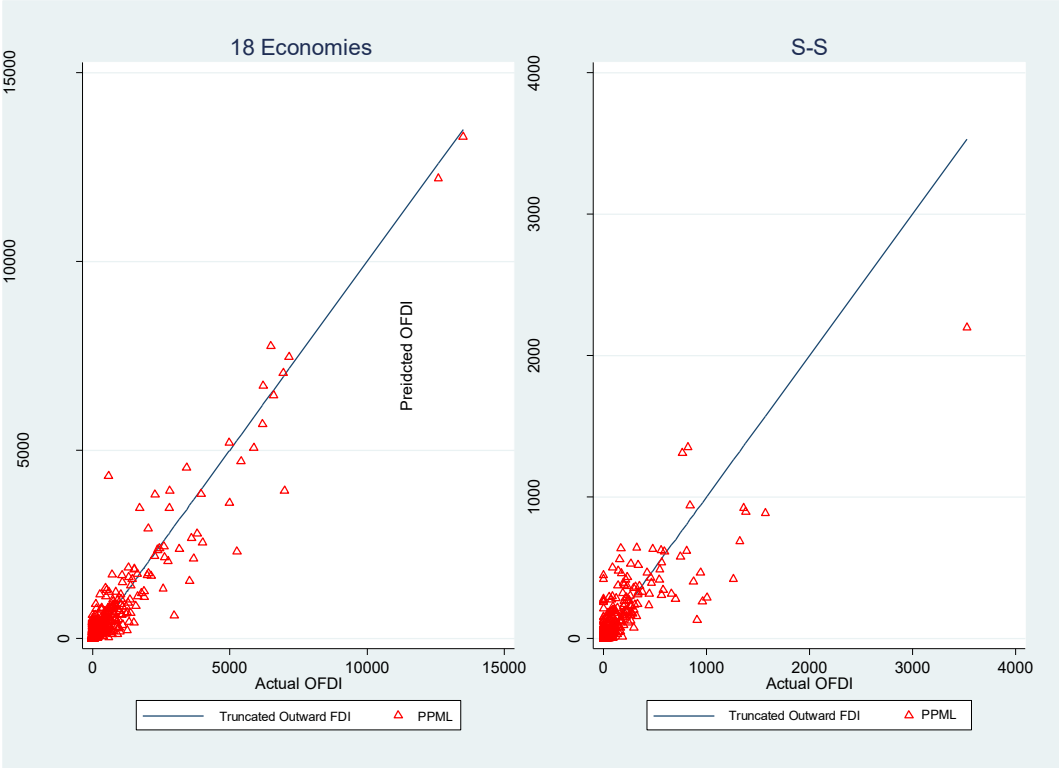
Source: Authors' calculations

Considering these characteristics, the most suitable estimating methods in all cases appear to be conventional gravity and Heckman two-step selection models.

[14] Please note that in PPML, the outward FDI is in its original value, and the predicted values are harder to compare to other estimations.

Nevertheless, the in-sample prediction is subject to some constraints, including overfitting, which occurs when too many variables are included and the degree of freedom increases. To address these constraints, we also consider the out-of-sample RMSE.

Figure 9: In-sample Prediction for PPML




Source: Authors' calculations

To perform out-of-sample prediction, we divide the sample into two time periods, the first half from 2001 to 2006, while the subsequent second half covers 2007 to 2012. In the first half of the out-of-sample, we use data from 2001 to 2006 to predict and compare the actual data from 2007 to 2012. Conversely, in the second half of the out-of-sample, we reverse this process. Table 5 shows the RMSE computed using the out-of-sample prediction.

Table 5: RMSE Based on Out-of-Sample Data Across Different Estimations

| | **Whole Sample** | | **S-S** | |
|---|---|---|---|---|
| | Predicting 2007-2012 | Predicting 2001-2006 | Predicting 2007-2012 | Predicting 2001-2006 |
| Gravity | 4.5590992 | 15.84125 | 23.835963 | 57.281928 |
| PPML | 3.114e+09 | 3.559e+36 | 9.153e+32 | 5.112e+36 |
| Selection | 12.288333 | 9.5862517 | 17.846095 | 23.926137 |
| HMR | 6.5183385 | 10.298758 | 8.6160773 | 16.573895 |

Source: Authors' calculations

The cross-validations in Table 5 show that the HMR performs well in South-South, where there are many zeros in the sample. Surprisingly, the gravity and selection models have superior predictive performance in one of the predictions when compared to the other models. The estimation derived from the PPML is the poorest compared to

the other three estimation methods. Hence, we focus our analysis and discussion on the results from gravity and HMR models.

### *6.3 Discussion*

When we analyse the factors that drive outward FDI in East and Southeast Asian economies, we observe that the expansion of outward FDI is influenced by geographical proximity between economies, trade openness policies, and market familiarities. Additionally, a limited labor force, high inflation, and high labor productivity, together with trade openness policies in the home economy, also play a role in determining the extent of outward FDI. The results align with the OLI paradigm in the way that insufficient production resources, superior productivity, and unfavorable macroeconomic stability are push factors from the home economy's perspective. Surprisingly, market sizes do not play a significant role in outward FDI of East and Southeast Asian economies. This might come from the fact that outward FDI in this region is vertical FDI, as supported by a negative relationship between outward FDI and distance. The results can be succinctly presented in Table 6.

Table 6: Summary of Key Drivers

| **18 Economies** | **S-S** |
|---|---|
| **Home** | **Home** |
| Labor force (-) | GDP (-) |
| Inflation (-) | Inflation (-) |
| Trade openness (+) | Trade Openness (+) |
| Labor productivity (+) | Labor Productivity (+) |
| **Host** | **Host** |
| None | GDP (+) |
| **Market Familiarities** | **Market Familiarities** |
| Common colonizer (-) | Common official language (+) |
| | Common colonizer (+) |
| **Distance (-)** | **Distance (+)** |
| Selection bias: No | Selection bias: No |
| Productivity threshold: Yes | Productivity threshold: Yes |

Source: Authors' categorization based on estimation results

Table 6 also illustrates the differences in various factors that drive the expansion of outward FDI patterns of South–South investment. Our analysis reveals that developing economies are more likely to invest overseas when they desire to enter new and larger markets and when there is cultural similarity between the two economies. The results also show that a small domestic market is an important push factor. As for ownership advantages, high labor productivity and trade openness policies of the home economy are important drivers for South-South investment. Finally, the positive relationship between distance and outward FDI indicates that the South-South investment is horizontal FDI, as the FDI replaces exports. This result confirms market-seeking motives for the South-South investment in this region.

### *6.4 Limitations*

Despite the limitations of this dataset due to the common challenges in the definition and collection of FDI across different economies, discrepancies may exist in the measurements of outward FDI between home and host economies. Discrepancies in bilateral outward FDI flows are crucial because they can impact economic analyses. These discrepancies are natural but often arise due to differences in data collection

methods, reporting standards, and timing of data collection. For example, if one country reports higher FDI outflows than the recipient country reports as inflows, it could suggest inefficiencies or inaccuracies in data collection. This can affect our estimates, and we should interpret our results cautiously. Nonetheless, we believe that if we use the data and interpret the results cautiously, it can shed light on the early rise of the outward FDI from the developing economies. Also, there is a growing trend of individual investors investing in collective investment institutions (CIIs) and acquiring sufficient ownership to be qualified as direct investment, and such investments are included in FDI statistics. This occurrence requires more observation, as the motives of CIIs differ from those of MNEs.[15]

We use this dataset because it is relatively difficult (costly) to estimate outward FDI flows using well-established and well-defined accounting and reporting procedures.

# 7. Conclusions

Asian countries are becoming increasingly significant in global investment flows, serving as both investing and recipient economies. One notable fact is that foreign direct investment (FDI) outflows account for a larger proportion of total outflows compared to developed economies in Asia. Our primary interests are the factors that drive foreign investment from the Asian region and the factors that influence FDI flows between countries within the region.

To address the potential sample selection bias caused by a significant proportion of zero and negative flows, we utilize the heterogeneous firm model suggested by Helpman et al. (2008). In comparison to the conventional augmented gravity model and the widely used PPML, we demonstrate that the effectiveness of Helpman et al. (2008) is superior when applied to outward investment. We find that the conventional gravity estimation is subject to bias. In the absence of a selection bias, it is still subject to an unobserved firm heterogeneity bias, which greatly impacts the results.

Additionally, our analysis reveals that outward FDI flows in the region are vertical FDI, and investing abroad has a motive to seek scarce labor forces of home economies. Considering South-South investment, we found that developing economies are more inclined towards more familiar host economies. Compared with outward FDI in the whole sample, South-South investment is horizontal FDI and has a motive to seek for larger markets.

In order to promote outward FDI, we found that high labor productivity is the key ownership advantage for investing abroad. As a result, improvements in technology and human capital to promote labor productivity will benefit home economies that desire to invest abroad. By further removing or reducing the barriers to international trade of the home economy, we can help promote outward FDI and increase investment within the region.

[15] Even though the Bilateral FDI dataset compiled by the UNCTAD is available only from 2001 to 2012, there is another updated dataset compiled by Steenbergen et al. (2022), the World Bank's harmonized Bilateral FDI database and Sectoral FDI database (WBG-HBFDI). This database aims to fill the gap of missing bilateral FDI dataset from UNCTAD. By harmonizing bilateral FDI data from several sources, including the UNCTAD bilateral FDI dataset, the IMF CDIS dataset, the OCED bilateral FDI statistics, and China's inward and outward FDI statistics, it is the most updated database available that covers 2000 to 2019 and 251 economies. The database is available upon request from the authors, and it should be useful for future studies of bilateral FDI flows.

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