The Linder Hypothesis for Foreign Direct Investment Revisited*

Dongin Kim Sandro Steinbach

Abstract

This paper examines the Linder hypothesis for foreign direct investment using a newly constructed and comprehensive dataset of greenfield and brownfield investment activities across various industries from 2003 to 2018. The canonical three-way gravity framework is used to examine the Linder hypothesis, which suggests that firms are more likely to invest in countries with similar income levels as their home country. The main findings indicate that the Linder hypothesis holds regardless of the foreign direct investment type. The Linder effect varies according to the economic sector, being more relevant for the utility, construction, and manufacturing sectors compared to finance and business support. Furthermore, the Linder effect is larger in downstream segments of global value chains. Our results underscore the importance of industry, quality, and value chain differences in the Linder effect.

Keywords: Foreign direct investment, sectoral Linder hypothesis, product quality, proximity-concentration tradeoff, three-way gravity model

JEL Codes: F12; F23

* Dongin Kim, Department of Agricultural and Resource Economics, University of Connecticut, email: dong.i.kim@uconn.edu; and Sandro Steinbach, Corresponding Author, Department of Agribusiness and Applied Economics and Sheila and Robert Challey Institute for Global Innovation and Growth, North Dakota State University, email: sandro.steinbach@ndsu.edu. This work is supported by the National Institute of Food and Agriculture through the Agriculture and Food Research Initiative Award 2020-67024-30964. Any opinions, findings, conclusions, or recommendations expressed in this paper are those of the authors and do not necessarily reflect the views of the United States Department of Agriculture.

1. Introduction

The Linder hypothesis, proposed by Linder (1961), has gained significant attention in the field of international economics. It is primarily recognized for its ability to explain the phenomenon of home bias in international trade (McCallum 1995, Caron, Fally and Markusen 2014). Linder argued that countries specialize in producing goods for which they face robust local demand, a concept known as the "home-market effect." This implies that countries more likely to trade intensively with those trading partners that have similar consumer demand structures in their domestic market (Krugman 1980). Importantly, this demand-side perspective of international trade gained prominence as it correlates consumer preferences with per capita income levels, explaining why trade between high-income countries is often more substantial (Hunter 1991, Markusen 2013).

In recent years, the Linder hypothesis has been extended to examine its implications for foreign direct investment (FDI) patterns, an area less explored. Fajgelbaum, Grossman and Helpman (2015) built upon Linder's original framework, combining it with a proximity-versus-concentration trade-off model to understand how multinational firms decide to serve foreign markets through FDI. While the Linder hypothesis in trade focuses on explaining patterns of international trade, the Linder hypothesis in FDI delves into the relationship between non-homothetic preferences and home-market effects on FDI decisions (Fajgelbaum, Grossman and Helpman 2015). This distinction highlights the need to investigate how these hypotheses manifest differently in trade and FDI, considering factors like industry characteristics and asymmetry in the effects. Our paper seeks to address this gap in the literature by quantifying the Linder effects for FDI at the sector level using a newly constructed and comprehensive dataset on brownfield and greenfield FDI, providing valuable insights into this understudied aspect of international economics.

The theoretical model of Linder hypothesis in FDI combines a product-quality view with a proximity-versus-concentration tradeoff on how firms decide to serve foreign markets. Building on their previous work in Fajgelbaum, Grossman and Helpman (2011), Fajgelbaum, Grossman and Helpman (2015) expand it to the FDI model, allowing multinational corporations to sell their varieties through foreign affiliates and subsidiaries. Consumers in this model make discrete choices for horizontally and vertically differentiated products, while each consumer has a distinctive evaluation of the available varieties. This feature implies that a fraction of consumers at any income level purchase each available variety. Consumer preferences are such that the fraction of consumers that decide on one of the higher quality varieties rises with the income level. In equally-sized countries with different income distributions, the model implies that the aggregate demand for the set of higher-quality varieties is more significant in the market with a greater fraction of higher income consumers. By introducing trade/investment costs, the model gives rise to a home-market effect that governs the patterns of specialization, which implies that rich countries tend to specialize in goods with large domestic markets in the presence of economies of scale. Firms in this model can serve foreign markets via exports or subsidiary sales. They face a constant per-unit cost of exporting and a fixed cost of setting up a foreign affiliate. This model feature implies that the choice to serve a given market depends on the proximity-concentration tradeoff. The view suggests that firms are more likely to serve foreign consumers via foreign affiliates when the destination market is larger. Jointly, the home-market and proximity-concentration tradeoff suggests that firms serve destinations with a similar demand composition to their home market via FDI and consumers in countries with a different demand composition via export sales. Since the demand composition correlates with the level and distribution of income, FDI flows are arguably more intense among countries with a similar development stage.

This demand-side view of international trade gained considerable traction through the empirical work of Schott (2004), Hummels and Klenow (2005) and Hallak (2006), which show that richer countries export products with higher unit value and direct them to other high-income markets. Because unit value and product quality are positively correlated (Bils and Klenow 2001), high-income countries that demand product quality also specialize in producing such goods. Hallak (2010) offers a sectoral perspective and provides robust empirical evidence for a positive association between income similarity and international trade. Recently, Dingel (2016) has expanded on this work by providing empirical evidence consistent with the previous mechanism using information about shipment prices from different U.S. cities and the income composition of neighboring towns. The growing empirical evidence on the relationship between income similarity and international trade provides considerable traction for the Linder hypothesis (Markusen 2013, Costinot et al. 2019, Matsuyama 2019).

Empirical studies of the Linder hypothesis in FDI have gained relatively little attention. Although Fajgelbaum, Grossman and Helpman (2015) offer a solid theoretical foundation, the empirical study is inconclusive and strained by data and identification issues. The review by Blonigen and Piger (2014) indicates that most earlier FDI studies rely on aggregated data and cannot capture the Linder effect. A growing recent literature relies on industry-level investment data to explain FDI patterns (see, for example, Alfaro, Kalemli-Ozcan and Sayek 2009, Ramondo, Rappoport and Ruhl 2011, Kox and Rojas-Romagosa 2020, Kruse 2020, Wang 2021). Fajgelbaum, Grossman and Helpman (2015) use a cross-section of establishment-level data from the Dun & Bradstreet WorldBase to identify multinational relationships between parent firms and affiliate establishments that operate in the same narrowly defined industry. They find consistent patterns of negative coefficients on the Linder term for employment as the dependent variable. Taking into account the length of the industry quality ladders (Khandelwal 2010), their results indicate that the Linder effect is more pronounced for industries with higher quality differentiation and weaker for industries that produce goods with homogenous quality. Notably, this effect does not hold up for the extensive margin, likely due to estimation bias induced by the cross-sectional nature of their analysis. Three issues arise from relying on cross-sectional investment data. The primary issue relates to the empirical model, which predicts that non-homothetic preferences and home-market effects should affect FDI flows instead of stocks due to the sluggish nature of FDI stock adjustments (Feld and Heckemeyer 2011). By relying on a cross-section, their empirical approach cannot distinguish between FDI flows and stocks, inducing a potential bias in the sector-level estimates. An additional challenge relates to the dependent variable choice, which is defined as the number of employees in the same narrowly-defined industry (Anwar and Sun 2022). Although the empirical model accounts for fixed technology differences with industry fixed effects, the measure cannot appropriately capture capital costs associated with foreign investment activities. Lastly, the model choice could lead to estimation bias by not controlling for time-invariant investment costs, which correlate with the Linder term through unobserved dyadic fixed costs. Research by Egger and Staub (2016), Anderson, Larch and Yotov (2019), and Kox and Rojas-Romagosa (2020) showed that dyadic fixed effects are needed to accurately control for time-variant trade/investment costs in a gravity-type regression framework. Accordingly, the insights drawn by Fajgelbaum, Grossman and Helpman (2015) are limited by these identification challenges.

Our paper addresses the empirical limitations in earlier work on the Linder hypothesis for FDI relying on a novel dataset constructed from project-level FDI data, which includes detailed brownfield and greenfield investment information. The dataset covers 2003 to 2018 and allows us to control for time-variant investment costs in the three-way gravity regression framework. We identify the relationship between the Linder term and FDI using the Poisson Pseudo Maximum-Likelihood (PML) estimator. This empirical strategy allows us to address zero observation and high-dimensional fixed effects consistently. Our industry-level estimates provide strong evidence for a negative and statistically significant association between the Linder term and FDI. This effect is present in the extensive and intensive investment margins. We show that by excluding time-invariant dyadic control variables, earlier studies suffer from substantial estimation bias. We also find evidence for considerable heterogeneity in the Linder effect according to industry characteristics. The Linder effect is more pronounced for agriculture, forestry, fishing, and hunting than for manufacturing and retail trade. By interacting the Linder term with the value chain position, we find significant evidence for differences between industries. The Linder effect is also more considerable for downstream sectors in the global value chains. Notably, the estimation results indicate asymmetries in the Linder effect. We find that the Linder term is larger for horizontal FDI from high-income to low-income than the other way around. Although the theoretical model by Fajgelbaum, Grossman and Helpman (2015) suggests that the Linder hypothesis holds only for horizontal FDI, our empirical results contradict this hypothesis by revealing a statistically significant relationship at the extensive margin for horizontal and vertical FDI. These insights constitute the need for new theoretical models that explain this empirical pattern.

Our paper provides three distinct contributions to the growing literature on the Linder effect and FDI. First, we construct a novel project-level dataset to provide consistent and new insights regarding the relationship at the industry level. Earlier work relied on inaccurate measures unable to control for time-invariant investment costs (see, for example, Alfaro, Kalemli-Ozcan and Sayek 2009, Ramondo, Rappoport and Ruhl 2011, Fajgelbaum, Grossman and Helpman 2015). Second, we expand on earlier work by providing empirical evidence for a statistically significant and economically meaningful Linder effect for the extensive and intensive FDI margins that earlier work failed to identify because of data limitations. Although Fajgelbaum, Grossman and Helpman (2015) find some evidence of the Linder effect for the intensive margin, their estimates for the extensive margin are largely inconsistent with the product-quality view of the Linder hypothesis. Our work addresses this discrepancy by providing empirical evidence for a negative and statistically significant Linder effect for both investment margins. Third, we show that the Linder effect varies according to industry characteristics and provide empirical evidence for asymmetry in the Linder effect. By interacting the Linder term with the length of the industry quality ladder (Khandelwal 2010), we find that the Linder effect is more pronounced for industries that operate downstream of global supply chains. These novel insights are supported by considerable evidence for differences in the Linder effect according to industry characteristics and the economic development stage of the host and source countries. Our results provide a nuanced understanding of the Linder hypothesis for FDI. Notably, potential endogeneity issues in earlier studies are likely to explain some of the differences observable (Fajgelbaum, Grossman and Helpman 2015, Osnago, Rocha and Ruta 2017, Anderson, Larch and Yotov 2019, Chang and Chen 2021). While Fajgelbaum, Grossman and Helpman (2015) suggest that the Linder hypothesis holds for horizontal FDI only, we provide evidence for a statistically significant relationship at the extensive margin for horizontal and vertical FDI. Our findings imply that demand-side FDI models fail to comprehensively explain the empirically observed FDI patterns, constituting the need to integrate supply-side factors into the prevailing theoretical frameworks.

2. Empirical Strategy and Data

We rely on a sectoral gravity-type regression model to test the Linder hypothesis for FDI flows (Fajgelbaum, Grossman and Helpman 2015). This model specification bears similarities to the sectoral gravity framework for international trade by Hallak (2010), Costinot, Donaldson and Komunjer (2012), and Anderson and Yotov (2016). Our baseline regression model accounts for time-variant industry-country characteristics for source and host countries in the following panel regression framework:

$$X^s_{ij,t} = \exp(e^s_{i,t} - \theta \log \tau^s_{ij,t} + m^s_{j,t})\eta_{ij,t}\,, \tag{1}$$

where $X^s_{ij,t}$ stands for bilateral FDI flows from source country i to host country j in industry s and for year t. We control for source and host country characteristics at the industry level with time-variant fixed effects $e^s_{i,t}$ and $m^s_{j,t}$. These coefficients mimic multilateral resistance terms commonly used in gravity-type regression frameworks (Anderson and van Wincoop 2003, Baier and Bergstrand 2007). The investment cost function $\tau^s_{ij,t}$ is symmetric and of the iceberg form (Bergstrand and Egger 2007). We compare a specification that includes covariates for contiguity, common language, same colonizer, and the log of physical distance with one that controls for time-invariant investment cost between source and host countries with source-host fixed effects at the industry level. From an empirical perspective, the specification with dyadic fixed effects is superior, as it accounts for potential correlations of the Linder term with time-invariant and unobserved investment costs (Costinot et al. 2019). We estimate both specifications as a reference to Fajgelbaum, Grossman and Helpman (2015). We also include time-variant bilateral covariates, namely, the economic mass, measured by the log of the sum of gross domestic products, and dummies for international investment, tax, and non-investment trade agreements. The decision to include these covariates is informed by the literature review conducted by (Blonigen and Piger 2014). The variable of interest, the Linder term, is defined according to Hallak (2010) and Fajgelbaum, Grossman and Helpman (2015) as the absolute value of the log income level in the host country minus that of the source country (*$|\log(Income_i)) - \log(Income_j)|$). We hypothesize this coefficient to have a negative sign and vary according to industry characteristics according to the prevailing FDI literature.

We obtained brownfield and greenfield investment data at the project-level from Refinitiv (2023) and fDi Intelligence (2023). These comprehensive data sources record every multinational activity publicly announced between 2003 and 2020.[1] We complement this dataset with GDP and income per capita information from the Penn World Tables (Feenstra, Inklaar and Timmer 2023). Potential data gaps are closed with information from the World Development Indicator database (World Bank 2023), allowing us to construct consistent time series of national income measured in current USD. The international investment agreements variable comes from United Nations Conference on Trade and Development (2023), while we derive the tax treaty variable from Tax Notes (2023). We include all enforced agreements and treaties as indicator variables in our estimation. The bilateral economic integration variable is from the Economic Integration Agreement Dataset (Kellog Institute 2023) and updated with recent information from World Trade Organization (2023). This dataset indexes

[1] We limited the data sample to 2003 to 2018 because of data availability issues for the other data sources.

the amount of trade openness on a scale from 0 to 6, where 0 stands for no economic integration and 6 for an economic union. The remaining control variables come from the CEPII Gravity Database by Centre d'Etudes Prospectives et d'Informations Internationales (2023). We extracted information on geographical distance, same colonizer, shared border, and common language from this database. The complete dataset covers 194 countries and 27 industries from 2003 to 2018.

To assess the Linder hypothesis for the extensive margin, we sum the number of horizontal FDI projects implemented between source country i and host country j for each industry s in year t. We measure the Linder effect for the intensive margin by calculating the sum of the value of all FDI flows for the same industry within source-host country pairs at the industry level. We combine brownfield and greenfield FDI flows to construct these measures. Although we could transform the outcome variable and then estimate the relationship using a linear regression model, this approach is inappropriate for the data because the outcome variable is a count. A linear regression model cannot identify the relationship of primary interest because it does not ensure the positivity of the predicted values for the count outcome (Wooldridge 1999). The discrete nature of the count outcome makes it difficult to find a transformation with a conditional mean that is linear in parameters. This issue is further exaggerated by heteroskedasticity as the transformed errors could be correlated with the covariates. Such correlation can result in an inconsistent identification of the Linder effect. Even if one transforms the conditional mean correctly, it would be impossible to obtain an unbiased inference of the relationship. To address this concern, we model the relationship between the outcome and the investment costs variables directly. We ensure the positivity of the covariates by employing a non-linear regression model, which relies on an exponential form equation.

We use the Poisson PML estimator to identify the relationship between the Linder term and FDI (Gong and Samaniego 1981, Gourieroux, Monfort and Trognon 1984, Silva and Tenreyro 2006).[2] The estimator is unbiased and consistent in the presence of heteroskedasticity. Even if the conditional mean is not proportional to the conditional variance, the estimator is still consistent

[2] Although we could also rely on the standard Poisson regression model to estimate the relationship, this estimator has two properties that could complicate the identification of the exchange rate volatility treatment effect. First, this regression is known to suffer from convergence problems which can result in spurious estimation results. Second, it is sensitive to numerical difficulties, a particular issue for regressions with high-dimensional fixed effects and highly disaggregated data (Silva and Tenreyro 2010). Therefore, we use the PML estimator as it allows me to circumvent these cavities of the standard Poisson regression.

(Wooldridge 1999, Cameron and Trivedi 2013). Note that because the estimator does not make any specific assumption on the dispersion of the fitted values, we do not have to test for this aspect of the data. A further advantage of the Poisson PML estimator is that the scale of the dependent variable has no effect on the parameter estimates, which is a particular concern for the Negative Binomial PML estimator. As long as the conditional mean is correctly specified, the Poisson PML estimator yields parameter estimates that have a similar magnitude to the estimates of both the Gaussian and Negative Binomial PML estimators. We also provide the ordinary least squares (OLS) estimates of the baseline model for comparison. These estimates are likely biased as they ignore zero investment activities (Silva and Tenreyro 2006). We account for high-dimensional fixed effects using the approach outlined in Correia, Guimaraes and Zylkin (2020, 2021). Lastly, since we suspect the presence of residual correlation at the industry-source-host level, we address this potential source of heteroskedasticity in the error term using a robust variance estimator that accounts for clustering at this level (Cameron and Miller 2015).

3. Results and Discussion

3.1 Main Results

Table 1 shows the Linder effect for FDI. This baseline analysis underscores the significance of incorporating sectoral heterogeneity when estimating the Linder effect. We compare the estimation results of the aggregated and the sector-level models, which measure the Linder effect for the extensive (count) and intensive (value) FDI margins. We use standard gravity control variables for the reference, while the preferred model specification includes source-host country fixed effects to account for any unobserved dyadic factors. According to Fajgelbaum, Grossman and Helpman (2015), the Linder hypothesis holds as firms in countries with similar income per capita invest more and larger projects among each other.

In columns (1) to (4), we estimate the Linder effect at the aggregated level. The results indicate that income similarity increases the number and value of FDI projects between countries. With the traditional approach using gravity control variables, presented in (1) and (3), we find that the Linder term has a negative effect on both the extensive and intensive FDI margins, with an effect size of 0.19 for the count and 0.25 for the value. In other words, a 1% increase in the Linder term (that is, a 1% decrease in the income similarity) leads to 0.19% fewer projects and a 0.25% lower value of FDI. However, from the three-way fixed effects models in columns (2) and (4), we observe that the Linder term negatively affects FDIs but is only statistically significant on intensive FDI margins, with an effect size of 0.36 for the value.

Because the quality of products produced by each industry varies while being a critical factor for FDI in the sectoral gravity model (Fajgelbaum, Grossman and Helpman 2015), we analyze the relationship between FDI and the Linder term at the sector level in columns (5) to (8). Using 2-digit NAICS codes, we classified FDI projects into 24 sectors. Unlike the aggregated model, we find statistically significant Linder effects on both the extensive and intensive margin of FDIs. Focusing on the three-way gravity model results, presented in columns (6) and (8), we observe that the Linder term negatively impacts both the extensive and intensive FDI margins, with an effect size of 0.12 and 0.38, respectively. The estimates are larger in magnitude than those at the aggregated level, and they are statistically significant at the 5% and 1% levels for both margins. These results suggest that using the aggregated model may induce estimation biases in the association between the Linder term and FDI. Therefore, the aggregated FDI specification will likely underestimate the Linder effect and suffers from inefficiencies compared to the sectoral specification (Kruse 2020).

3.2 Horizontal and Vertical FDI

The theoretical framework of the Linder hypothesis developed by Fajgelbaum, Grossman and Helpman (2015) focuses solely on horizontal FDI, relying on the demand-driven view of the FDI mechanism. Horizontal FDI provides a distinct explanation of the Linder term, while vertical FDI tends to be more driven by supply factors (Markusen and Venables 2000). However, our baseline empirical results do not distinguish the FDI types, leading to a question of which type derived the Linder effects. We re-estimate Equation 1 under the alternative assumption that the Linder effect varies for horizontal and vertical FDI. We classify FDI types based on the business information of parent and subsidiary companies. Precisely, we categorize FDI as horizontal if the investor operates a business in the same sector for the headquarters and the foreign affiliate and as vertical otherwise. The existing literature encountered challenges matching industry information (Ramondo, Rodríguez-Clare and Tintelnot 2015). First, due to the limitations of publicly available data, industry information is often either missing or overly broad in classification, leading to the erroneous characterization of most FDI as horizontal. Second, because the parent company operates in multiple sectors, an exact match results in very few matches. The advantage of our dataset lies in its comprehensive list of all primary industries, identified by 4-digit SIC codes, operated by the companies. This unique feature allows us to make more precise distinctions in FDI types. We define FDI as horizontal when the parent company's primary industries contain all the foreign affiliate's primary industries in 4-digit SIC.

Table 2 shows the estimation results of the differential Linder effect by FDI type. We considered sectoral heterogeneity in all models. We find supporting evidence of the Linder effect on horizontal FDI, consistent with the theoretical findings of Fajgelbaum, Grossman and Helpman (2015). In all models, the Linder term decreases horizontal FDI significantly, while it has the inverse or statistically insignificant impact on vertical FDI. Focusing on the more strict model specification with three-way fixed effects in (2) and (4), a 1% increase in Linder term decreases horizontal FDI by 0.68% and 0.92% for extensive and intensive margins. Notably, we find that a 1% increase in Linder term increases vertical FDI by 0.11% for extensive margin. Because we measure the Linder effects by per capita income similarity between the countries, it is unsurprising that we got the opposite results for the vertical FDI. Vertical FDI involves multinationals investing in offshoring their production line, in which the demand-driven framework of Fajgelbaum, Grossman and Helpman (2015) cannot explain the relationship between the Linder term and vertical FDI. Given that the cost of value-added activities in the host country is fixed, the proximity-concentration trade-off will influence multinationals' decisions to export or establish operations in downstream sectors. Of course, this cannot explain the multinationals' offshoring investments, driven by their desire for greater cost savings through investing in countries with larger income disparities. This may partially offset the Linder effect in the intensive margin in (4), though not statistically significant, suggesting the need to integrate supply-side measures into existing theoretical frameworks to explain the observed FDI patterns.

3.3 Sectoral Differences and Value Chain Position

Our baseline regression has unveiled substantial heterogeneity effects across sectors. We delve further into sector-specific analyses in this section. Utilizing the interaction term of the sector variable and the Linder term, we aim to illuminate how the Linder effect varies across different sectors. We classified all FDI projects into 24 sectors using 2-digit NAICS codes, further grouped into seven broader sectors: *agriculture and resources, utility and construction, manufacturing, wholesale and retail trade, financial services, business support services*, and *other uncategorized services*. Figure 1 shows the Linder effect at the sector-level. The sectoral variation of the Linder effect is evident, wherein service sectors show a notable Linder effect, while manufacturing sectors exhibit an inverse relationship.

The panel (a) of Figure 1 illustrates the estimated results on the extensive margin. A 1% increase in the Linder term is associated with less than a 1% decrease in FDI in agriculture, resources, utility, construction, retail trade, wholesale trade, and finance services. However, in manufacturing, we observe an increase in FDI with the widening per capita income gap. Given that manufacturing often operates in the intermediate segment of global value chains (Antrás and Chor 2013), catering less directly to host market consumers, our findings support the notion that income similarity more strongly promotes FDI in downstream segments.[3] In other service sectors, we observe a more pronounced Linder effect. Compared to goods, services tend to embody economies of scale and product differentiation. Following Krugman (1980), countries with higher sales of some products in the home market will tend to have higher sales of those same products abroad. This elucidates why similar demand patterns, resulting from comparable factor endowments, generate patterns of intra-industry investment in services (Fu, Chen and Zhang 2020). In panel (b) of Figure 1, we present the estimated results on the intensive margin. The observed patterns mirror those identified in the extensive margin, with the Linder hypothesis holding more consistently in downstream sectors. Notably, this trend prevails across sectors except for the agricultural sector, which, despite its position upstream, demonstrates a noteworthy adherence to the Linder effect. This could be attributed to the unique characteristics of the agricultural industry, particularly its association with

[3] We focus on horizontal FDI in Figure A.1, neglecting vertical FDI, yet the patterns observed are similar.

food safety standards (Disdier, Fontagné and Mimouni 2008). Given the stringent requirements, such as Sanitary and Phytosanitary (SPS) measures, when crossing borders, the agricultural sector places a heightened emphasis on quality (Santeramo and Lamonaca 2022).

Drawing on Fajgelbaum, Grossman and Helpman (2015)'s theory, which centers on consumer final demand, we further evaluate how the position in the value chain shapes the impact of the Linder term on FDI. We capture the nuanced effects by utilizing an interaction term between the value chain position and the Linder term. We quantify downstreamness by calculating the ratio of direct to total product usage, with a higher ratio indicating a more direct connection to the end consumer in the downstream process.[4] We use a more detailed classification of 367 industries based on the 4-digit NAICS, categorizing them into ten percentiles based on their level of downstreamness. Figure 2 illustrates the varying impact of the Linder term on FDI by the degree of downstreamness. The model captures the nuanced effect that the Linder effect is more pronounced for FDI in downstream sectors; however, industries in the 20 to 30 percentiles exhibit a significant Linder effect. With this model specification, the relationship between the Linder theory in FDI and the value position yields inconclusive.

To broaden the discussion concerning the value chain position and Linder effects, we incorporate a project-level analysis that measures the Linder effects in the intensive FDI margin. We classified all projects into four quantiles based on the value chain position and then interacted with the Linder term. Due to the limited occurrence of firms making multiple investments in the same country, we solely focus on measuring the intensive margin.[5] Table 3 shows the estimation results, where the first two columns measure the average impact directly comparable to our findings from Table 1, and the following columns report the diverged effects across quantiles. We observe that the project-level approach reveals Linder effects, albeit to a lesser extent compared to the baseline results. In columns (1) and (2), the Linder term is associated with approximately a 14 % decrease in FDI. Subsequent columns introduce two downstream measures: the direct-to-total use ratio and

[4] We employ another downstream measure based on the weighted distance from the final consumption to each industry (Antràs and Chor 2013). As shown in Figure A.2, the results were also mixed, similar to what we found in this section.

[5] Similarly, we do not include firm-level fixed effects in this analysis due to the limited variation in the data because there are few observations of multiple investments from one company.

Antrás and Chor (2013)'s weighted distance. Overall, compelling evidence supports the notion that the Linder hypothesis holds more significantly in downstream sectors. Notably, in column (4), only projects in the 2nd quantile or above demonstrate a significant Linder effect, while projects in the first quantile show no impact. Furthermore, FDI in the downstreammost sector is most affected compared to others. These results are consistent with the other downstreamness measure in column (6), indicating that the Linder term decreases FDI only in sectors classified in the 3rd and 4th quantiles. These results show that the Linder effect is more potent in downstream sectors, serving the consumer directly.

3.4 Quality Differentiation

According to the Linder hypothesis for FDI proposed by Fajgelbaum, Grossman and Helpman (2015), sectors characterized by greater product differentiation attract more FDI as a result of non-homothetic preferences and quality differentiation across destinations. We utilize two measures for the degree of quality differentiation: the *Rauch's product classification system* developed by Rauch (1999) and the *quality ladder* measure devised by Khandelwal (2010). First, Rauch's classification categorizes products into homogeneous, differentiated, and intermediate types. Figure 3 shows that the quality differentiation view on the Linder hypothesis for FDI does not hold. In both conservative and liberal Rauch measures, we find that the Linder effects are statistically insignificant for industries that produce differentiated products. In contrast, they are pronounced for those that produce intermediate and homogeneous products. One drawback of these results is that the Rauch classification may not be representative since roughly 75% of industries are categorized into differentiated goods, so it may not capture the heterogeneity within the group.

We use the more comprehensive quality ladder measure by Khandelwal (2010) to further assess the role of product differentiation. We classify industries into ten groups based on the decile distribution of the quality ladder. The quality ladder represents a hierarchy of goods or products based on their quality or sophistication.[6] Figure 4 examines the Linder effect on FDI based on

[6] The estimated qualities reveal substantial heterogeneity in product markets' scope for quality differentiation (quality ladders). Khandelwal (2010) explores how firms and countries can move up this quality ladder by producing higher-quality goods or by entering more advanced and technologically sophisticated markets. The idea behind the quality ladder is closely tied to comparative advantage and international trade and investment dynamics.

the length of the quality ladder. Our findings suggest that the length of the ladder matters on the magnitude of the Linder effect for the extensive FDI margin. As the ladder lengthens, the size of the Linder effect increases, indicating that higher-quality products are more differentiated, which fosters FDI in those industries (Khandelwal 2010, Kruse 2020). However, we find less evidence of the relationship between the quality ladder and the Linder term for the value of FDI.

3.5 Comparative Advantage and Production Specialization

An important feature of the Ricardian trade theory is that high-income countries have a comparative advantage in producing high-quality goods (Hallak 2006). The Linder hypothesis extends on this notion, arguing that this comparative advantage comes from the demand for quality goods differently distributed across countries (Hallak 2010, Sun 2020). In contrast, the Heckscher-Ohlin model suggests that capital-intensive goods tend to be produced by capital-abundant countries that enjoy a comparative advantage over less developed countries (Alviarez 2019). These differences raise a question of whether the Linder effect exists and is consistent across different income levels.

Table 4 compares the Linder effect on FDI across host countries with different income levels. In columns (1) to (4), encompassing all types of FDI, the results reveal a stronger Linder effect in lower-income than high-income countries. For instance, the three-way gravity model presented in (2) show a 1 % increase in the Linder term is negatively associated with the extensive FDI margins in mid-income countries by 0.7 % and low-income countries by 0.3 %. In contrast, nearly zero estimates are observed for high-income countries. The results remain consistent for the intensive margin in column (4). We re-estimate the same models but accounting only for the horizontal type in columns (5) to (8). We find similar patterns that the Linder effects are more significant in low- and mid-income countries but show nearly zero impact on FDI hosted in high-income countries. The diversified consumer preferences in high-income countries may explain the estimation results, given that demand structures are typically more intricate in these regions.

3.6 Alternative Mechanisms

As a supplementary analysis, we include an additional variable to our model that signifies the dissimilarity in within-country income inequality levels. This measure can serve as a proxy for diversified demand preferences, with similar levels indicating comparable degrees of within-country consumer preference diversification between two countries (Fu, Chen and Zhang 2020). Data on income inequality is obtained from the standardized world income inequality database (SWIID), which incorporates comparable Gini indices for 198 countries for as many years as possible from 1960 to the present (Solt 2020). We use Ginis of market income in our analyses. Like the Linder term, we define Gini dissimilarity, taking the absolute value of the log income inequality level difference in the host and source countries (*$|\log(Gini_i))-\log(Gini_j)|$). Table 5 reports the estimation results. In column (1), we show that a 1 % increase in Gini dissimilarity decreases extensive margin of FDI by 0.5 %. The Linder effect, represented in the first row, replicates the results from our baseline analyses in Table 1. This suggests that consumer patterns, as proxied by Gini indices, shed light on bilateral FDI flows beyond the Linder effect. This constitutes a noteworthy addition to the prevailing theoretical framework outlined in (Fajgelbaum, Grossman and Helpman 2015), which assumes a preference for homogeneous products among all consumers in a country. We find no significant Gini dissimilarity effect on the intensive margin of FDI. In columns (3) and (4), we incorporate differential effects based on income levels. We show that consumer patterns significantly influence FDI flows between lower-income countries, extending beyond income similarity. When combined with the Linder effect, our findings lead to the conclusion that demand similarity and home market effects do not significantly influence FDI flows between high-income countries.

An alternative explanation for the presence of a Linder effect relates to the buying power of consumers, which plays a vital role in explaining the association between income similarity and multinational activities in the demand-driven model (Hallak 2010, Fajgelbaum, Grossman and Helpman 2015, Matsuyama 2019, Kruse 2020). To better understand the association between the buying power of consumers and FDI, we use an alternative measure of income similarity based on differences in annual salaries between countries. We used annual salary data in current USD for 102 countries and calculated a wage similarity index (United Nations Industrial Development

Organization 2022). Table 6 illustrates an inverse relationship between wage dissimilarity and FDI—countries with similar buying power tend to host more FDI in terms of extensive and intensive margins. This alternative approach underscores a significant challenge in the Linder hypothesis literature. Demand-side and supply-side similarity measures are highly correlated, posing difficulty in conclusively attributing the influence to one driver over the other (Kruse 2020).

4. Conclusion

This paper evaluates the Linder hypothesis for FDI at the sector level using a theory-consistent gravity framework and a newly developed FDI dataset based on project-level brownfield and greenfield investment data. Building upon earlier theoretical modeling work by Fajgelbaum, Grossman and Helpman (2015), we demonstrate that non-homothetic preferences are crucial in explaining FDI. By accounting for differences in the Linder effect across economic sectors, we provide evidence for a negative and statistically significant Linder effect for the extensive and intensive investment margins. These empirical findings supplement previous cross-sectional studies that found mixed evidence for the Linder hypothesis (Ramondo, Rappoport and Ruhl 2011, Fajgelbaum, Grossman and Helpman 2015, Osnago, Rocha and Ruta 2017, Anderson, Larch and Yotov 2019, Kox and Rojas-Romagosa 2020). Notably, the sector-level analysis shows significant heterogeneity among industries, explaining the inability of previous studies to provide consistent evidence for a Linder effect due to neglecting the impact of aggregation bias (Kruse 2020).

Moreover, we expand this earlier work by examining the sources of industry differences according to the value chain position. Our results suggest that the downstreamness of an industry affects the Linder effect on FDI. The more downstream the industry, the more income similarity fosters FDI. However, we also find evidence of a significant Linder effect for some upstream sectors. Furthermore, we contribute to the literature on the Linder hypothesis by examining the role of product quality in moderating the Linder effect (Fajgelbaum, Grossman and Helpman 2015). By interacting the Linder term with various quality differentiation measures, namely the Rauch classification and the length of the quality ladder, (Rauch 1999, Khandelwal 2010), we reveal differences in the Linder effect according to the degree of quality differentiation of each industry. Although the empirical results are mixed, we find evidence that the Linder effect correlates positively with the length of degree product quality differentiation.

An important feature of previous work related to the Linder hypothesis is its focus on horizontal FDI (Fajgelbaum, Grossman and Helpman 2015). Based on the demand-driven view of the FDI mechanism, horizontal FDI provides a distinct explanation for a negative Linder effect. In contrast, the Linder effect should have a positive sign for vertical FDI since supply-side factors drive it (Bergstrand and Egger 2007, Ramondo and Rodríguez-Clare 2013, Antrás and Chor 2013, Alviarez 2019). However, our findings suggest that the Linder hypothesis holds for horizontal and vertical FDI. Specifically, we find no evidence for treatment heterogeneity between horizontal and vertical FDI according to the extensive investment margin. These empirical results support the need for further research that integrates supply- and demand-oriented economic theory to understand better the role of income similarity and the Linder effect in the sectoral FDI model.

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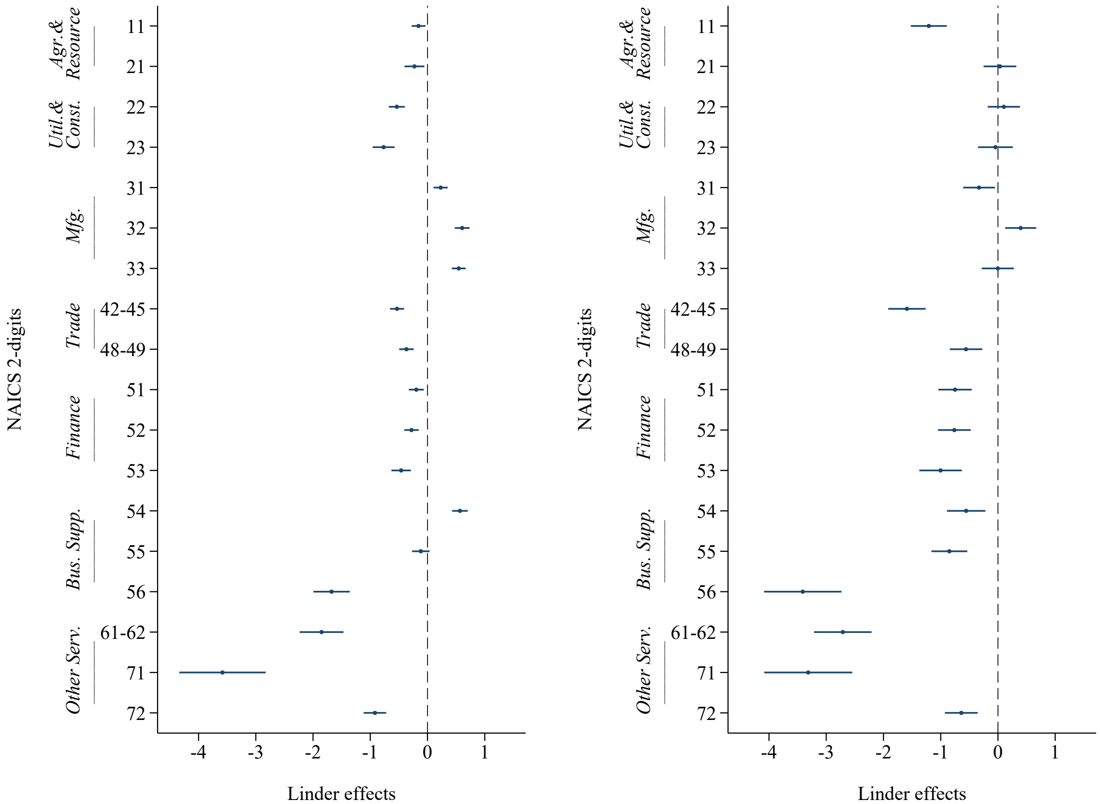
Figures and Tables

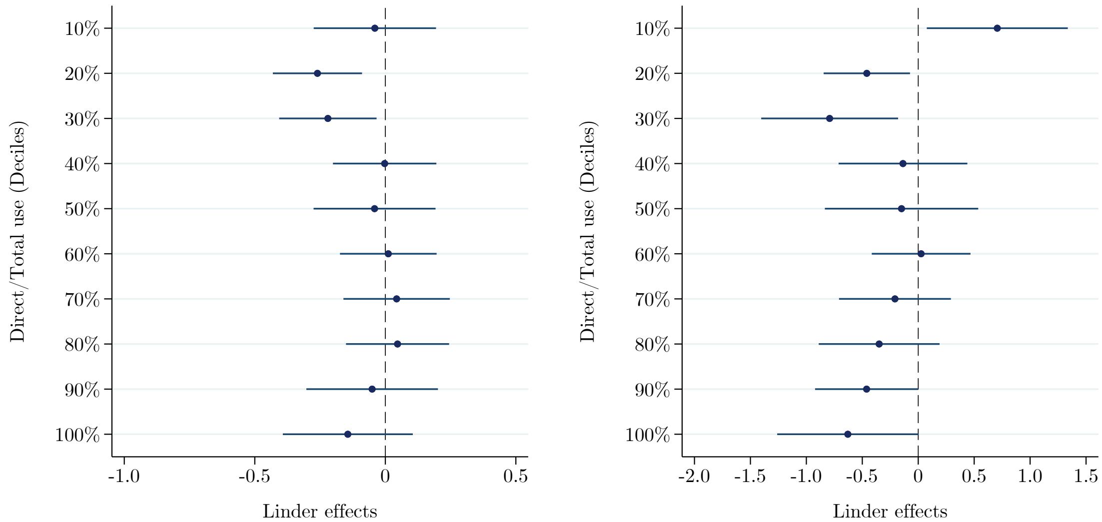


(a) Count

(b) Value

Figure 1: Industry-level differences in the Linder effect.

Note. The figure shows industry-level differences in the Linder effect for the extensive and intensive FDI margins. We interacted the Linder term with the two-digit NAICS code to assess sectoral differences. The estimates are based on the three-way gravity framework, which includes time-variant industry-source-year, industry-host-year, and industry-source-host fixed effects. Points indicate point estimates, while the bars show the corresponding 95% confidence intervals. The standard errors are clustered at the source-host level.

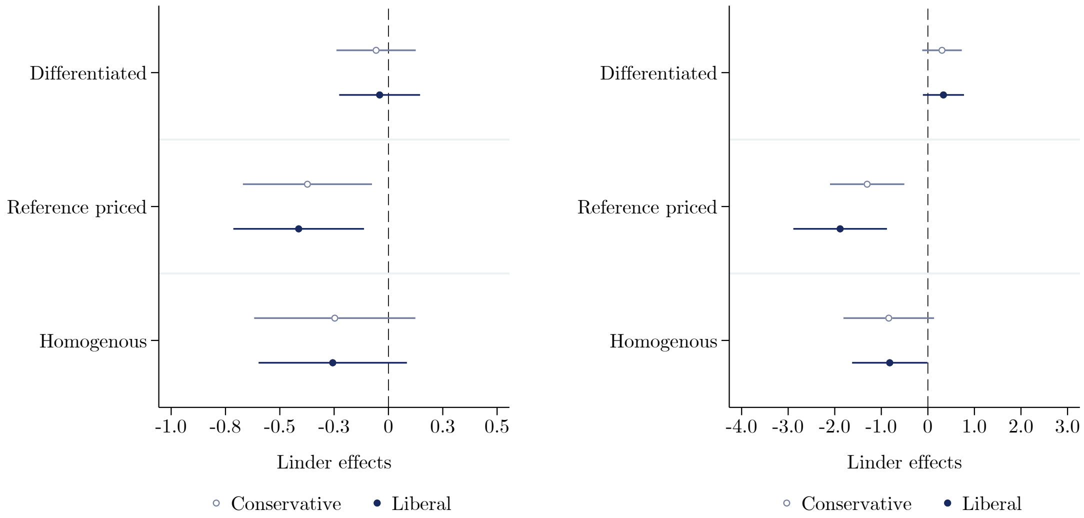


(a) Count

(b) Value

Figure 2: Linder effect and the value chain position.

Note. The figure shows differences in the Linder effect according to the position of industries in global value chains. A larger decile is associated with a sector downstream in the global value chain. Points indicate point estimates, while the bars show the corresponding 95% confidence intervals. The standard errors are clustered at the source-host level.

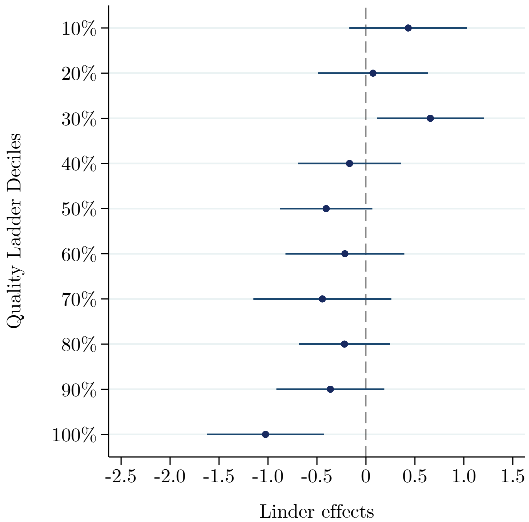


(a) Count

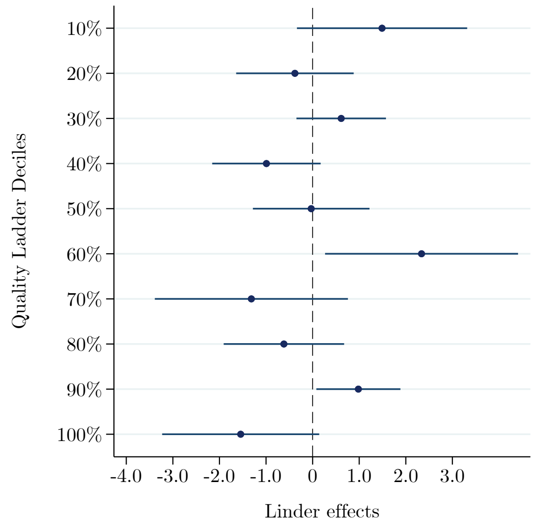
(b) Value

Figure 3: Linder effect and the Rauch industry classification.

Note. The figure examines differences in the Linder effect according to the Rauch classification (Rauch 1999). The classification groups industries into producing homogenous, reference-priced, and differentiated products. We compare estimates of the Linder effect for the liberal and conservative classifications. Points indicate point estimates, while the bars show the corresponding 95% confidence intervals. The standard errors are clustered at the source-host level.



(a) Count



(b) Value

Figure 4: Linder effect and the quality ladder length.

Note. The figure compares the magnitude and significance of the Linder effect according to the quality ladder length by Khandelwal (2010). We classified industries into ten groups based on deciles of the FDI distribution according to the quality ladder length. A higher decile implies that those industries produce more differentiated goods. Points indicate point estimates, while the bars show the corresponding 95% confidence intervals. The standard errors are clustered at the source-host level.

Table 1: Aggregated and sector-level estimates of the Linder effect.

	Aggregated				Sector-level			
	(1) Count	(2) Count	(3) Value	(4) Value	(5) Count	(6) Count	(7) Value	(8) Value
Linder term	-0.193***	-0.062	-0.247***	-0.364***	-0.176***	-0.120**	-0.214***	-0.381***
	(0.041)	(0.055)	(0.044)	(0.135)	(0.040)	(0.056)	(0.042)	(0.117)
Investment treaty	-0.179***	0.045*	-0.137**	0.071	-0.147***	0.027	-0.094**	0.025
	(0.045)	(0.027)	(0.055)	(0.069)	(0.043)	(0.024)	(0.047)	(0.055)
EIA	0.010	0.019	0.048**	0.017	0.012	0.021*	0.053***	0.005
	(0.016)	(0.012)	(0.020)	(0.029)	(0.015)	(0.011)	(0.017)	(0.020)
Income tax treaty	0.114***	-0.001	0.159***	-0.010	0.123***	-0.014	0.170***	-0.028
	(0.038)	(0.018)	(0.050)	(0.041)	(0.036)	(0.017)	(0.042)	(0.038)
Contiguity	0.027		-0.046		0.061		-0.013	
	(0.092)		(0.106)		(0.087)		(0.096)	
Common language	0.935***		0.869***		0.897***		0.826***	
	(0.062)		(0.071)		(0.060)		(0.060)	
Same colonizer	0.780***		0.607***		0.818***		0.703***	
	(0.162)		(0.206)		(0.157)		(0.193)	
Distance	-0.568***		-0.481***		-0.568***		-0.511***	
	(0.035)		(0.041)		(0.034)		(0.036)	
Source-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Host-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Source-host FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	262,939	88,750	262,484	88,591	1,281,049	370,951	1,133,713	327,783
Pseudo R-squared	0.857	0.875	0.784	0.834	0.655	0.624	0.666	0.757

Note. The table shows the aggregated and sector-level estimates of the Linder effect for the extensive and intensive FDI margins. In sector-level analyses, we include fixed effects that interact with sector-specific dummies to account for variations across different industries. Asterisks denote statistical significant at < 0.10 (*), < 0.05 (**), or < 0.01 (***). Heteroskedasticity-robust standard errors clustered at the source-host level are reported in parenthesis.

Table 2: Linder effect for horizontal and vertical FDI.

	(1) Count	(2) Count	(3) Value	(4) Value
Linder term				
× Vertical	0.055	0.114**	0.010	-0.158
	(0.039)	(0.057)	(0.042)	(0.117)
× Horizontal	-0.731***	-0.677***	-0.747***	-0.918***
	(0.055)	(0.065)	(0.050)	(0.119)
Investment treaty	-0.147***	0.030	-0.095**	0.028
	(0.043)	(0.025)	(0.047)	(0.055)
EIA	0.009	0.020*	0.051***	0.004
	(0.015)	(0.011)	(0.017)	(0.021)
Income tax treaty	0.126***	-0.014	0.174***	-0.030
	(0.036)	(0.016)	(0.042)	(0.039)
Contiguity	0.069		-0.003	
	(0.086)		(0.096)	
Common language	0.893***		0.820***	
	(0.060)		(0.060)	
Same colonizer	0.831***		0.716***	
	(0.156)		(0.192)	
Distance	-0.569***		-0.511***	
	(0.034)		(0.036)	
Industry-source-year FE	Yes	Yes	Yes	Yes
Industry-host-year FE	Yes	Yes	Yes	Yes
Industry-source-host FE	No	Yes	No	Yes
Observations	2,562,100	748,442	2,267,434	663,018
Pseudo R-squared	0.597	0.545	0.603	0.656

Note. The table shows the estimation results of the Linder effect for horizontal and vertical FDI. We classify FDI types by matching the primary business operation industry of the foreign affiliate with that of the parent company. We rely on the 4-digit NAICS codes for matching. Asterisks denote statistical significant at < 0.10 (*), < 0.05 (**), or < 0.01 (***). Heteroskedasticity-robust standard errors clustered at the source-host level are reported in parenthesis.

Table 3: Linder effect on value chain position (*project-level).

	Average		Direct/total use		Antra's classification	
	(1)	(2)	(3)	(4)	(5)	(6)
Linder term	-0.148***	-0.144**				
	(0.024)	(0.063)				
× 1st quantile			-0.024	-0.023	-0.083***	-0.075
			-0.03	-0.066	-0.026	-0.065
× 2nd quantile			-0.162***	-0.152**	0.058**	0.059
			-0.025	-0.065	-0.028	-0.066
× 3rd quantile			-0.152***	-0.139**	-0.235***	-0.222***
			-0.028	-0.065	-0.028	-0.065
× 4th quantile			-0.215***	-0.206***	-0.310***	-0.296***
			-0.027	-0.064	-0.027	-0.064
Investment treaty	-0.032	-0.022	-0.023	-0.016	-0.026	-0.018
	-0.024	-0.032	-0.024	-0.033	-0.024	-0.033
EIA	0.024***	-0.018	0.025***	-0.016	0.025***	-0.015
	-0.007	-0.013	-0.007	-0.013	-0.007	-0.013
Income tax treaty	0.004	0.033	0.005	0.034	0.004	0.036*
	-0.021	-0.02	-0.021	-0.022	-0.021	-0.021
Contiguity	-0.011		-0.019		-0.015	
	-0.035		-0.036		-0.036	
Common language	-0.076***		-0.063**		-0.062**	
	-0.024		-0.025		-0.024	
Same colonizer	-0.052		-0.051		-0.082	
	-0.086		-0.09		-0.085	
Distance	0.036**		0.043***		0.046***	
	-0.015		-0.016		-0.016	
Source-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Host-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Source-host FE	No	Yes	No	Yes	No	Yes
Observations	272,795	270,784	256,728	254,748	256,728	254,748
Adj. R-squared	0.094	0.113	0.096	0.115	0.101	0.119

Note. The table summarizes the estimation results of the Linder effect at the project level. We compare interaction effects with the downstreamness measures developed by Antrás and Chor (2013). Downstreamness represents the degree to which an industry is located in the final stage of the value chain. Direct/total use is a simple fraction of direct final use over total use of the products, including intermediate demands. Asterisks denote statistical significant at < 0.10 (*), < 0.05 (**), or < 0.01 (***). Heteroskedasticity-robust standard errors clustered at the source-host level are reported in parenthesis.

Table 4: Linder effect and economic development stage.

	All type				Horizontal type			
	(1) Count	(2) Count	(3) Value	(4) Value	(5) Count	(6) Count	(7) Value	(8) Value
Linder term								
× High-income	-0.012	0.024	-0.180**	-0.240*	0.012	-0.079	-0.071	-0.160
	(0.066)	(0.065)	(0.081)	(0.143)	(0.076)	(0.107)	(0.086)	(0.286)
× Mid-income	-0.454***	-0.269***	-0.287***	-0.270	-0.504***	-0.438***	-0.370***	-1.083***
	(0.093)	(0.083)	(0.095)	(0.168)	(0.096)	(0.131)	(0.117)	(0.310)
× Low-income	-0.331***	-0.318***	-0.236***	-0.575***	-0.306***	-0.202	-0.292***	-0.723**
	(0.078)	(0.070)	(0.079)	(0.158)	(0.088)	(0.125)	(0.094)	(0.294)
Investment treaty	-0.148***	0.022	-0.095**	0.024	-0.188***	-0.008	-0.037	0.051
	(0.043)	(0.024)	(0.047)	(0.055)	(0.047)	(0.041)	(0.057)	(0.117)
EIA	0.016	0.022**	0.054***	0.004	0.032*	0.042**	0.064***	-0.009
	(0.015)	(0.011)	(0.017)	(0.020)	(0.017)	(0.017)	(0.020)	(0.048)
Income tax treaty	0.123***	-0.014	0.170***	-0.019	0.123***	-0.039	0.185***	-0.096
	(0.036)	(0.017)	(0.043)	(0.037)	(0.040)	(0.026)	(0.054)	(0.064)
Contiguity	0.067		-0.011		0.103		-0.015	
	(0.086)		(0.097)		(0.096)		(0.109)	
Common language	0.880***		0.822***		0.954***		0.887***	
	(0.059)		(0.060)		(0.065)		(0.072)	
Same colonizer	0.812***		0.702***		0.760***		0.623**	
	(0.156)		(0.193)		(0.172)		(0.242)	
Distance	-0.566***		-0.511***		-0.611***		-0.618***	
	(0.034)		(0.037)		(0.039)		(0.041)	
Industry-source-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-host-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-source-host FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1,281,049	370,951	1,133,713	327,783	485,326	137,332	355,951	98,795
Pseudo R-squared	0.655	0.624	0.666	0.757	0.546	0.505	0.633	0.771

Note. This table presents the estimation results of the differential Linder effects by the economic development stage of the host countries. Asterisks denote statistical significant at < 0.10 (*), < 0.05 (**), or < 0.01 (***). Heteroskedasticity-robust standard errors clustered at the source-host level are reported in parenthesis.

Table 5: Linder effect and consumer patterns.

	(1) Count	(2) Value	(3) Count	(4) Value
Linder term	-0.155**	-0.424***		
	(0.065)	(0.131)		
× High-income			0.012	-0.232
			(0.075)	(0.165)
× Mid-income			-0.314***	-0.231
			(0.091)	(0.174)
× Low-income			-0.387***	-0.654***
			(0.078)	(0.164)
Gini dissimilarity	-0.511***	0.094		
	(0.192)	(0.386)		
× High-income			-0.271	0.161
			(0.233)	(0.500)
× Mid-income			-0.528*	-0.329
			(0.280)	(0.501)
× Low-income			-0.964**	0.708
			(0.386)	(0.599)
Investment treaty	0.032	0.024	0.032	0.016
	(0.025)	(0.054)	(0.025)	(0.054)
EIA	0.023**	0.028	0.024**	0.024
	(0.012)	(0.021)	(0.011)	(0.021)
Income tax treaty	-0.010	-0.021	-0.009	-0.008
	(0.017)	(0.038)	(0.017)	(0.037)
Industry-source-year FE	Yes	Yes	Yes	Yes
Industry-host-year FE	Yes	Yes	Yes	Yes
Industry-source-host FE	Yes	Yes	Yes	Yes
Observations	331,922	292,504	331,922	292,504
Pseudo R-squared	0.630	.759	0.630	0.759

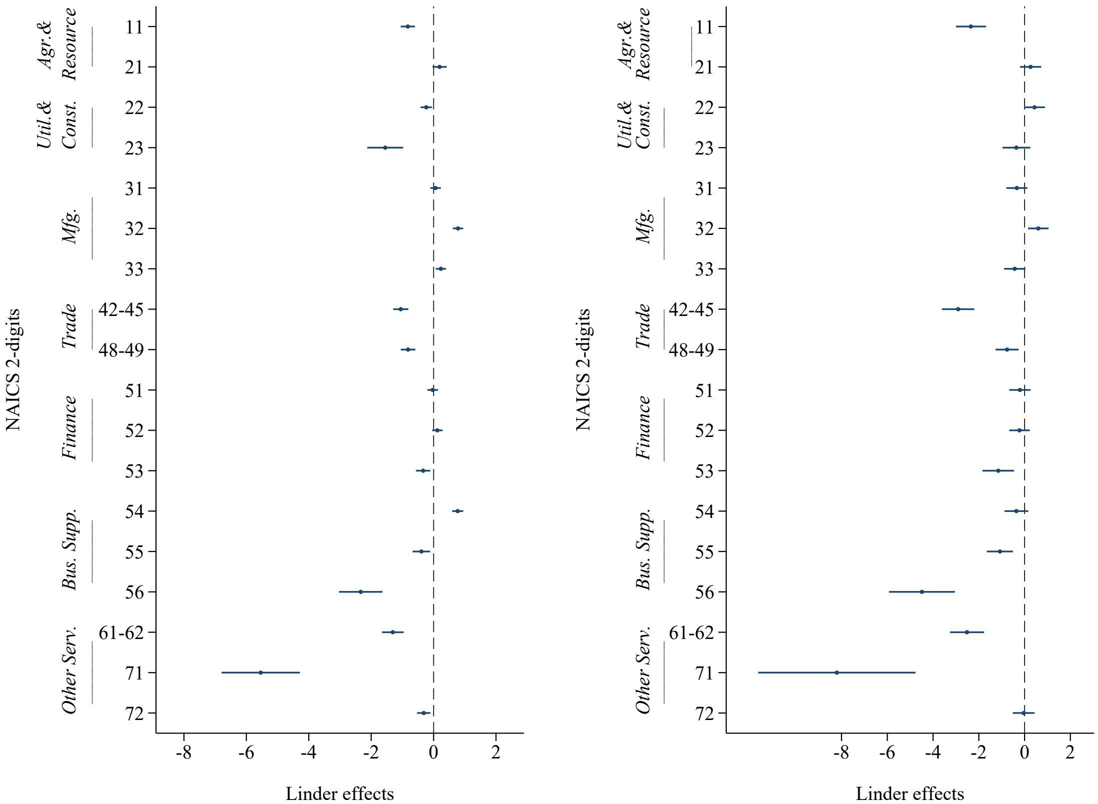
Note. This table presents the estimation results of the Linder effect and the consumer pattern similarity effect on FDI. Asterisks denote statistical significant at < 0.10 (*), < 0.05 (**), or < 0.01 (***). Heteroskedasticity-robust standard errors clustered at the source-host level are reported in parenthesis.

Table 6: Wage similarity and the Linder effect.

	(1) Count	(2) Count	(3) Value	(4) Value
Wage dissimilarity	-0.085***	-0.082**	-0.161***	-0.242***
	(0.029)	(0.036)	(0.027)	(0.087)
Investment treaty	0.162***	0.020	0.059	0.058
	(0.042)	(0.022)	(0.055)	(0.059)
EIA	0.020	0.023**	0.051***	-0.011
	(0.014)	(0.011)	(0.015)	(0.024)
Income tax treaty	0.105***	-0.016	0.109**	0.005
	(0.034)	(0.016)	(0.044)	(0.043)
Contiguity	0.091		-0.023	
	(0.084)		(0.102)	
Common language	0.807***		0.814***	
	(0.061)		(0.072)	
Same colonizer	0.722***		0.237	
	(0.152)		(0.193)	
Distance	-0.510***		-0.652***	
	(0.032)		(0.032)	
Industry-source-year FE	Yes	Yes	Yes	Yes
Industry-host-year FE	Yes	Yes	Yes	Yes
Industry-source-host FE	No	Yes	No	Yes
Observations	1,080,063	384,652	846,451	281,183
Pseudo R-squared	0.667	0.651	0.638	0.767

Note. The table shows the estimation results of the wage similarity effect on FDI. Asterisks denote statistical significant at < 0.10 (*), < 0.05 (**), or < 0.01 (***). Heteroskedasticity-robust standard errors clustered at the source-host level are reported in parenthesis.

Appendix

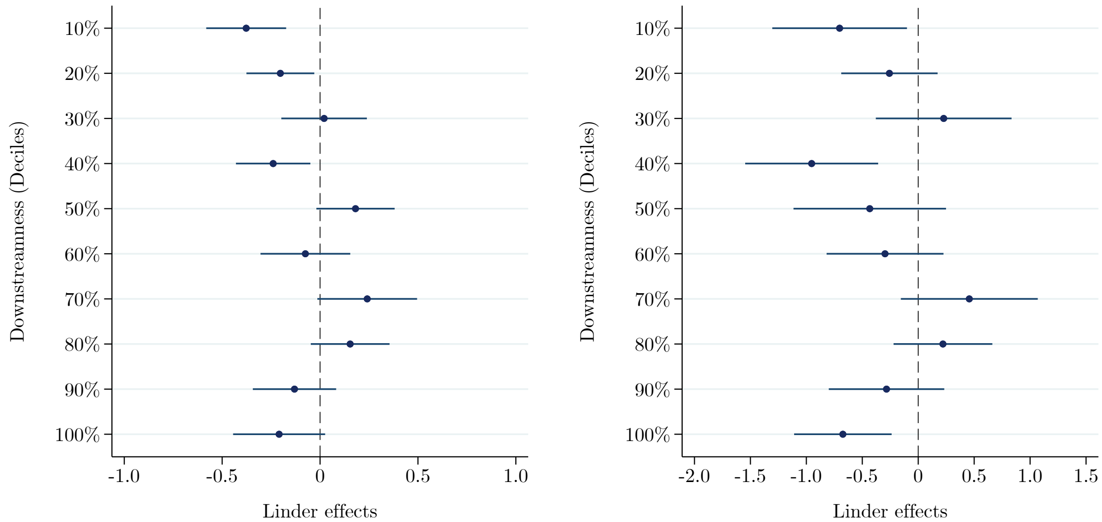


(a) Count

(b) Value

Figure A.1: Industry-level differences in the Linder effect (horizontal type).

Note. The figure shows industry-level differences in the Linder effect for the horizontal FDI. We interacted the Linder term with the two-digit NAICS code to assess sectoral differences. The estimates are based on the three-way gravity framework, which includes time-variant industry-source-year, industry-host-year, and industry-source-host fixed effects. Points indicate point estimates, while the bars show the corresponding 95% confidence intervals. The standard errors are clustered at the source-host level.



(a) Count

(b) Value

Figure A.2: Linder effect and the value chain position.

Note. The figure shows differences in the Linder effect according to the position of industries in global value chains. To measure the industry position, we use the downstreamness measures proposed by Antrás and Chor (2013). A larger decile is associated with a sector downstream in the global value chain. Points indicate point estimates, while the bars show the corresponding 95% confidence intervals. The standard errors are clustered at the source-host level.