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Impact assessment of the Investment Facilitation for Development (IFD) Agreement

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World Trade OrganizationEconomic Research and Statistics Division

**IMPACT ASSESSMENT OF THE INVESTMENT FACILITATION FOR
DEVELOPMENT (IFD) AGREEMENT***Eddy Bekkers¹, Erwin Corong², Donal Smith¹, Roger So Yu¹, and Danchen Zhao¹¹World Trade Organization (WTO)²Purdue University, Center for Global Trade Analysis*Manuscript date: March 23, 2026***Abstract**

This paper presents quantitative projections on the expected economic impact of the Investment Facilitation for Development (IFD) Agreement, which proceeds in three steps. First, we estimate the empirical impact of the host-economy investment facilitation environment on foreign affiliate sales. Second, we map the agreement's mandatory and soft obligations (including best-endeavour) into ad-valorem equivalent reductions in the costs of multinational production. Third, the economic effects of these policy shocks are projected with a multi-region, multi-sector economic model that explicitly incorporates affiliate sales, foreign direct investment (FDI) and input-output linkages. Our benchmark simulations project that implementation of the IFD Agreement's mandatory obligations would increase global real GDP by 0.8 per cent over the next ten years, driven by a substantial expansion in global FDI flows and foreign affiliate sales. The simulations indicate that developing and low-income economies are expected to see the largest increases in GDP, since they are expected to see the largest improvement in the investment facilitation environment.

Keywords: Foreign Direct Investment, Foreign Affiliate Sales, Computable General Equilibrium**JEL Codes:** C68, F21, F23**Disclaimer:** The opinions expressed in this paper are those of the authors. They do not represent the positions or opinions of the WTO or its Members and are without prejudice to Members' rights and obligations under the WTO. Any errors are attributable to the authors.

* The opinions expressed in this paper are those of the authors. They do not represent the positions or opinions of the WTO or its Members and are without prejudice to Members' rights and obligations under the WTO. We are grateful to our discussants, Marc Bacchetta and Juan Marchetti, for their detailed and insightful feedback. We also thank Roberta Piermartini, Claudia Locatelli, Raul Torres, Pamela Apaza Lanyi, Johanna Hill, and Tomasz Koziel for their valuable comments. Any errors are attributable to the authors. Correspondence: eddy.bekkers@wto.org

Non-Technical Summary

The recently concluded Investment Facilitation for Development (IFD) Agreement at the World Trade Organization aims to make it easier, more transparent, and more predictable for businesses to invest across borders. Rather than altering market access or investment protection rules, the agreement focuses on cutting red tape, streamlining administrative procedures, and improving regulatory transparency. To measure the real-world economic impact of these new rules, we use data to see how strongly an economy's current investment climate affects the sales of foreign businesses operating within its borders. We then estimate how much the IFD Agreement would improve that climate, translating these improvements into equivalent reductions in business costs, and feed these into an economic simulation of the global economy that tracks how trade, investment, and production interact.

Our results show that the IFD Agreement is poised to act as a major catalyst for the global economy. The effect of implementing the mandatory obligations within the agreement reduces the cost of operating foreign affiliates by an average of 3.9 per cent, and global GDP would increase by 0.8 per cent over ten years compared to a world without the IFD Agreement. However, full impact of the agreement – including all hard- and soft-type obligations as well as “best-endeavour” provisions – could nearly triple the cost reductions to 10.8 per cent. This full impact scenario supercharges the benefits, making the global economy 2.4 per cent larger overall (adding another 1.6 per cent on top of the mandatory provisions). Crucially, low- and middle-income economies stand to gain the most, as they currently face the highest regulatory hurdles and will see the largest relative improvements in their investment climates.

The benefits of foreign investment also go beyond just the money coming in. When foreign companies set up shop, local businesses that supply them often learn new technologies and better management practices. When we factor these productivity spillovers into our simulation, the economic gains become significantly larger. Under the full impact scenario, these indirect benefits help push the projected global GDP gains to an impressive 4.2 per cent, with developing nations capturing a massive share of this growth.

These findings align with the initial assessment of the IFD Agreement by [Balistreri and Olekseyuk \(2025\)](#). While they use an ad-hoc assumption to link the investment climate to affiliate sales, our policy shocks are data-driven. Furthermore, we use a perfect competition model tracking foreign direct investment, whereas they assume monopolistic competition. Despite these methodological differences, both studies project similar increases in global real income, highlighting the robustness of the IFD Agreement's anticipated economic benefits.

1 Introduction

Following the successful conclusion of the Trade Facilitation Agreement at the 2013 Bali Ministerial Conference, policy attention gradually expanded to the promotion of similar regulatory transparency and facilitative measures in international investment. Early discussions on investment facilitation emerged through a series of expert- and scholar-led dialogues supported by multilateral institutions such as UNCTAD, the OECD, and the World Bank. A notable milestone occurred at the 2016 Shanghai G20 Summit, where G20 Trade Ministers endorsed the "G20 Guiding Principles for Global Investment Policymaking," a set of nine non-binding principles aimed at strengthening cooperation in global investment governance.

At the World Trade Organization (WTO), the discussion has eventually led to the launching of a new joint initiative on investment facilitation by the "Friends of Investment Facilitation for Development" - a group of 14 WTO Members composed of developing countries and least-developed countries. Momentum accelerated in December 2017, when 70 WTO Members issued the Joint Ministerial Statement on Investment Facilitation for Development at the 11th Ministerial Conference, calling for structured discussions on developing a multilateral framework on investment facilitation. This was followed by a second Joint Ministerial Statement in November 2019, supported by 98 WTO Members, which further clarified the potential scope of the agreement and emphasised the need to promote the participation of developing and least-developed Members in global investment flows. Formal negotiations on what became known as the Investment Facilitation for Development (IFD) Agreement were launched in September 2020. After several years of negotiations, the agreement was finalised in February 2024 at the 13th Ministerial Conference with the participation of 123 WTO Members. At the time of writing (March 2026), 128 Members are parties to the Agreement, including 91 developing economies of which 27 are least-developed countries. In the lead-up to the upcoming 14th Ministerial Conference, Members are working towards the incorporation of the plurilateral IFD Agreement into Annex 4 of the Marrakesh Agreement to enable its full implementation.

The newly concluded IFD Agreement primarily comprises measures aimed at enhancing regulatory transparency and streamlining administrative procedures related to the approval and establishment of foreign investments. Investment facilitation is intertwined with both trade in goods and trade in services. In the context of trade in goods, the establishment and operation of foreign affiliates often stimulate cross-border trade through imports of intermediate inputs and exports of goods along the global value chains. The relationship is even more direct in the case of trade in services, where the domestic sales of services by foreign affiliates constitute a form of service trade itself (Mode 3 of service supply).

In this paper, we conduct an *ex-ante* assessment of the potential economic impacts of the Agreement in three steps. First, we empirically investigate the relationship between an economy's investment climate, captured by the Investment Facilitation Index (IFI) developed by [Berger et al. \(2026\)](#), and multinational activity, as captured by foreign affiliate sales (FAS).¹ Because

¹Foreign affiliate sales consist of sales by foreign owned firms, both to the domestic market and to the exporting market. For services the former is also defined as Mode 3 trade.

the IFI is an economy-specific variable that would be absorbed in a standard structural gravity framework with fixed effects, we follow the methodology of [Heid et al. \(2021\)](#), adapted to affiliate sales, by incorporating both sales by domestic owned firms (the equivalent of intra-national sales) and sales by foreign owned firms (foreign affiliate sales; the equivalent of international sales) and distinguishing them with a border (or ownership) dummy. Subsequently, this approach enables the identification of the effects of non-discriminatory policies, such as the IFI, through their interaction with the border dummy. This framework also implies that, as our main dependent variable, we use foreign affiliate sales (FAS) to measure multinational activity, rather than more commonly used indicators such as Foreign Direct Investment (FDI) flows or stocks. This choice reflects two considerations: foreign affiliate sales are more accurate and less prone to distortions from transit or phantom investments, and our empirical strategy requires both intra- and inter-national flows, which are not available for capital-based measures such as FDI. Using a Poisson pseudo maximum likelihood (PPML) estimator, our baseline results demonstrate a robust, positive impact. We find that the magnitude of the estimated coefficient can be sensitive to alternative regression specifications and sample selection. The benchmark estimate used to calibrate the shocks within our model is relatively conservative. However, in some specifications checking the sensitivity of the estimation results to the sample of countries included, the impact of the IFI on affiliate sales loses significance. The presented results are the best possible in light of the limited number of economies reporting affiliate sales at a bilateral level.

Building on these empirical estimates, the second stage of our analysis translates these policy metrics into quantifiable economic shocks to project the impacts of the IFD Agreement. We construct counterfactual IFI scores under two scenarios: a “Mandatory Requirements” scenario focusing on the effects of the Agreement’s hard obligations, and a “Full Impact” scenario that additionally covers the soft and “best-endeavour” obligations. By mapping these IFI improvements into Ad-Valorem Equivalent (AVE) efficiency shocks, we project a global reduction in foreign affiliate costs of 3.9 per cent under the Mandatory Requirements scenario commitments, and up to 10.8 per cent under the Full Impact scenario.

The last stage of our analysis is to feed the constructed shocks into a quantitative model. In this paper, we employ a multi-region, multi-sector quantitative general equilibrium model that incorporates both foreign direct investment and foreign affiliate sales to capture the role of multinational production in the global economy. The model features input–output linkages, Armington differentiation by origin and ownership (domestic and foreign firms), and a recursive dynamic structure in which physical capital and foreign direct investment accumulate over time through investment. Production combines intermediate inputs and multiple production factors, including labour, regular capital, and FDI capital used by foreign-owned firms, while international trade and production allocation are jointly determined through nested demand structures. The framework captures interactions between trade, investment, and production decisions across regions and sectors, allowing for quantitative counterfactual analysis of policy and structural shocks.

In our simulations, we assume that efficiency gains from the IFD materialise over a ten-year period beginning in 2026. Baseline simulation results indicate that the IFD Agreement yields positive

macroeconomic effects, driven by a substantial expansion in global foreign affiliate sales and a corresponding increase in global FDI flows. By reducing the frictions associated with operating foreign affiliates, the agreement stimulates multinational production. Quantitative estimates suggest that the implementation of mandatory IFD requirements increases global real GDP by approximately 0.8 per cent over a ten-year horizon. Furthermore, the aggregate economic impact of these investments extends beyond direct capital accumulation. The introduction of positive productivity spillovers into the model, specifically, the mechanism through which the presence of upstream foreign-owned firms increases the productivity of domestically owned suppliers significantly amplifies these general equilibrium effects: the GDP gains from mandatory requirements rise to 1.5 per cent. We also find that the comprehensive implementation of the soft obligations has the strongest potential to strengthen economic responses, with significantly larger increases in foreign affiliate sales, foreign direct investment, and economic activity.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature on multinational production, foreign direct investment, and their representation in quantitative trade models. Section 3 presents the empirical gravity estimation linking a host economy's regulatory environment to foreign affiliate sales. Section 4 details the methodology for translating counterfactual policy improvements into Ad-Valorem equivalent (AVE) efficiency shocks. 5 outlines the multi-region, multi-sector computable general equilibrium framework employed for the counterfactual analysis. Section 6 presents the quantitative findings and macroeconomic implications of the IFD Agreement under various effects scenarios. Finally, Section 7 concludes.

2 Literature Review

This paper follows the initial assessment of the IFD Agreement from [Balistreri and Olekseyuk \(2025\)](#), who construct AVE cost reductions based on the IFI and implement them in a CGE framework with FDI under monopolistic competition. They assume that a one per cent increase in the IFI score reduces the costs (increases the efficiency) of foreign affiliates by 0.05 per cent. In this paper, instead of assuming a link between changes in IFI scores and costs of foreign affiliates, our approach derives AVE cost reductions from estimates of the impact of the IFI on FAS under a structural gravity model, which we argue is more robust empirically. Also, our simulations are conducted with a different model. Whereas they employ a model with monopolistic competition without FDI, we employ a model with perfect competition which incorporates FDI flows and FDI capital accumulation, a feedback mechanism between foreign affiliate sales and the rate of return on FDI, and productivity spillovers from foreign affiliates' presence to domestic firms as an extension.

The shocks introduced in [Balistreri and Olekseyuk \(2025\)](#) are roughly one order of magnitude smaller than ours, yet their model generates comparable GDP effects. They project that mandatory requirements would increase world GDP by 0.36 per cent (nearly half of our 0.8 per cent projection), indicating their model produces larger GDP effects for a given efficiency shock. In terms of real income their framework generates projections close to ours, since their real income effects tend to be about twice as large as their GDP effects. The difference can be explained

by two main factors. First, [Balistreri and Olekseyuk \(2025\)](#) use a model with monopolistic competition that generates additional welfare gains through increased access to product variety. This mechanism lowers the price index and raises real income but does not directly increase real GDP. In contrast, in our model the projected effects on GDP and real income are very similar and differ only because they are measured using different deflators. Second, [Balistreri and Olekseyuk \(2025\)](#) compute bilateral shares of foreign affiliate sales for their model using the data from [Fukui and Lakatos \(2012\)](#). These data imply higher foreign affiliate sales shares for most countries and regions than the dataset used in this paper. As a result, shocks to the efficiency of foreign affiliate firms have larger effects in their framework.

More broadly, our research relates to the wider literature evaluating the impact of facilitation policies. In particular, similar *ex-ante* simulations were conducted for the Trade Facilitation Agreement concluded in 2013. Most studies in this area rely either on CGE simulations ([Decreux and Fontagne, 2009](#), [Mevel et al., 2015](#)) or on partial equilibrium gravity-based analyses ([Hoekman and Nicita, 2011](#), [Hufbauer and Schott, 2013](#)). In this respect, our approach is closest to [Zaki \(2014\)](#), who estimates AVEs of time to export and import using a gravity framework and subsequently incorporate them into a CGE model by assuming a 50 per cent reduction in existing trade facilitation barriers.

Beyond the immediate confines of CGE modeling of trade and investment facilitation policies, this paper contributes to several strands of literature. First, it advances the quantitative evaluation of foreign affiliate sales and foreign direct investment in a multi-region setting ([Anderson et al., 2019](#), [Arkolakis et al., 2018](#), [Balistreri and Olekseyuk, 2025](#), [Hanslow, 2000](#), [Irrazabal et al., 2013](#), [Lakatos and Fukui, 2014](#), [Ramondo and Rodríguez-Clare, 2013](#), [Tintelnot, 2017](#)).² [Lakatos and Fukui \(2014\)](#) examines the effects of retail services liberalisation in India, while [Ramondo and Rodríguez-Clare \(2013\)](#) study the gains from openness when multinational firms are introduced into the model. Compared with this literature, our main contribution is to explicitly model the link between foreign affiliate sales and foreign direct investment. This allows us to study the overall effects of policies and shocks in greater detail, as illustrated in our quantitative analysis. In addition, the model features FDI capital accumulation and a feedback from FDI to production. In many quantitative trade models, FDI is either absent or does not affect production through a distinct capital accumulation channel. By incorporating this mechanism, the framework captures the dynamic interaction between investment decisions and production outcomes.³

The empirical literature applies gravity frameworks to foreign affiliate sales and foreign direct investment to show that multinational activity increases with market size and declines with bilateral frictions such as distance and policy barriers, with early work testing predictions from multinational firm theory using bilateral affiliate sales data ([Blonigen et al., 2003](#), [Carr et al., 2001](#)). Recent work shows that foreign affiliate sales better capture real production activity than FDI financial flows ([Ramondo et al., 2015](#)). This motivates our choice of dependent variables.

²[Ramondo and Rodríguez-Clare \(2013\)](#) and [Arkolakis et al. \(2018\)](#) introduce production differentiation à la [Eaton and Kortum \(2002\)](#), which generates a structural gravity equation similar to that implied by the Armington assumption as shown in [Arkolakis et al. \(2012\)](#).

³Similarly, [Anderson et al. \(2019\)](#) also allows international capital flows but assumes that FDI is a type of “technology stock”

This paper is also related to the literature on the positive spillover effects of foreign direct investment (Bitzer et al., 2008, Blalock and Gertler, 2008, Iršová and Havránek, 2013, Ivarsson and Alvstam, 2009, Javorcik, 2004). This literature studies how the presence of foreign direct investment generates positive spillovers to domestically owned firms through channels such as technology transfer, increased demand, and improvements in management practices and production efficiency. Empirical studies document both horizontal and vertical spillovers, with stronger evidence for productivity gains among upstream domestic suppliers linked to foreign firms. In this paper, we incorporate such a mechanism into a quantitative model, which allows us to examine the general equilibrium effects of these spillovers. By embedding FDI spillovers in a multi-region framework with input-output linkages, our approach captures both direct productivity effects and indirect effects transmitted through production networks, providing a structural assessment of their aggregate and distributional impacts.

3 Gravity Estimation

The first step of our analysis examines the relationship between an economy’s regulatory environment and the volume of foreign affiliate sales within its borders. The estimation relies on the Investment Facilitation Index (IFI) as the key variable of interest. As a policy index developed by the German Institute of Development and Sustainability (IDOS) and later expanded in collaboration with the WTO (Berger et al., 2023, 2026), the IFI quantifies the investment-facilitative environment of an economy across different dimensions. The latest version of the index encompasses six policy areas with a total of 101 individual measures.⁴ Each measure is scored zero for no implementation, one for partial or planned implementation, and two for full implementation. Through an expert survey, the scores are further weighted according to the significance of the respective policy areas and compiled into an aggregate index score for each economy that similarly ranges from zero to two.

Unlike bilateral variables such as distance, which have distinct values for each economy pair, the IFI is an economy-specific variable that remains constant across all source countries. This poses an identification challenge in our estimation, as economy-specific variables like the IFI are fully absorbed by the host and source fixed effects required to account for multilateral resistance terms (Anderson and van Wincoop, 2003). To address this, we follow the method proposed by Heid et al. (2021) that incorporates both international and intra-national flows in the dataset and distinguishes between them with a border dummy. This border dummy is constructed to take the value one for international flows and zero for intra-national flows. Next, by interacting the IFI with the constructed border dummy, the variable is effectively bilateralised, thereby enabling its identification.⁵

We adopt the reported bilateral-sector FAS data, first collected for the construction of the FAS dataset as input to the GTAP-FDI model extension (see Appendix B.2), as the dependent

⁴These are (1) Regulatory Transparency & Predictability, (2) Electronic Governance, (3) Focal Point & Review, (4) Application Process, (5) Cooperation, and (6) Responsible Business Conduct & Anti-Corruption

⁵Within this framework, interaction with the border dummy means that the economy-specific variable takes the value of zero for all intra-national economy pairs (i.e., whenever host = source)

variable. While we retain observations obtained through the mirroring technique, we exclude other imputed values such as those derived from the imposition of zeros based on FDI data, as well as those generated through extrapolation following the gravity estimation. However, these data only account for the international component of the dependent variable. To implement the interaction with the border dummy following [Heid et al. \(2021\)](#), information on intra-national flows is also required. In the context of foreign affiliate sales where the emphasis is on firm ownership rather than cross-border trade, the intra-national component corresponds to the value of sales made by domestically owned firms which we impute as the residual of sectoral gross output after subtracting total foreign affiliate sales:

$$\text{Domestic-Owned Sales}_{itk} = \text{Gross Output}_{itk} - \text{Total Foreign Affiliate Sales}_{itk} \quad (1)$$

In total, the FAS dataset covers 77 host countries and 55 source countries. Domestic-owned sales—defined as sales by domestically owned firms—are imputed for 54 host countries. Along the sectoral dimension, we aggregate the 24 ISIC two-digit manufacturing divisions into five broader manufacturing sub-sectors, and additionally include agriculture, mining, and eight ISIC one-digit service sectors. Further details on the data construction process are provided in [Section Appendix C](#).

As more than 60 per cent of our FAS observations are zero, we employ the Poisson pseudo-maximum likelihood (PPML) estimator, as recommended by [Silva and Tenreyro \(2006\)](#), which accommodates zero flows and is robust to heteroskedasticity that would otherwise bias log-linear estimations. Given that the IFI is only available for the year of 2021, this necessarily restricts our estimation to a cross-sectional analysis. To maximize coverage while limiting short-term volatility, we average the FAS data over the period 2016–2018. In our baseline specification, we estimate a pooled PPML model across all sectors to identify the overall effect of the IFI on multinational activity. This yields the following gravity equation where k , i , j denote sector, host economy, and source economy, respectively:

$$\begin{aligned} \text{Sales}_{ijk} = \exp(\beta_1 + \beta_2 \text{Border}_{ij} + \beta_3 \text{IFI}_i \times \text{Border}_{ij} + \delta \mathbf{X}_{ik} \times \text{Border}_{ij} \\ + \gamma \mathbf{Z}_{ij} + \eta_{ik} + \mu_{jk}) \times \epsilon_{ijk} \end{aligned} \quad (2)$$

As discussed above, the IFI is identified by interacting with the border dummy which equals 1 if $i \neq j$; \mathbf{X} refers to a vector of economy-specific control variables that are similarly identified through interaction with the border dummy; \mathbf{Z} is a vector of bilateral control variables; finally, $\eta_{i,k}$ and $\mu_{j,k}$ represent the host-sector and source-sector fixed effects which are included to account for the multilateral resistance terms.

We include a comprehensive set of control variables grouped into two broad categories: macroeconomic fundamentals and institutional/regulatory quality. The first captures market size and development through log GDP, log GDP per capita, and accounts for market access restrictions through the OECD FDI Restrictiveness Index ([Kalinova et al., 2010](#)) (scaled zero to 1), and institutional quality through the Worldwide Governance Indicators (WGI) ([Kaufmann et al., 2011](#)) (scaled -2.5 to 2.5). Similar to the IFI, we identify the impact of these controls

by incorporating their interaction terms into the gravity specification. For robustness, we further augment our baseline specification with additional policy determinants, including the Regulatory Governance Indicators (RGI) (Mathieu et al., 2017), the IMF Financial Efficiency and Development indices (Svirydzenka, 2016), and the World Bank Doing Business Score (World Bank, 2020).

The second group of control variables comprises bilateral variables that can be identified directly. We adopt a standard set of indicators from the CEPII database (Conte et al., 2022) to control for various geographic, cultural, and historical bilateral relationships. These include the log of bilateral distance, the religious proximity index and three other binary variables taking the value of one if an economy pair (1) has shared a colonial relationship, (2) shares a common legal origin (post-transition), or (3) has a common language as measured on an ethnographic basis. Finally, we have constructed an FTA dummy from the Design of Trade Agreements (DESTA) Database⁶ as well as a European Economic Area (EEA) dummy which takes the value of one when both the host and source economy are EEA Members to reflect the uniquely deep integration within the Single Market.

The main results are reported in Table 1. Column (1) presents the baseline pooled specification. Overall, the estimation outputs are largely in line with our expectations. The coefficient on our main variable of interest, the IFI, is positive and statistically significant. This supports the hypothesis that a more facilitative regulatory environment is associated with higher foreign affiliate sales in the host economy, and by extension, greater multinational activity. Columns (2)–(4) demonstrate that this effect remains stable across multiple specifications: the IFI coefficient retains its magnitude and statistical significance when alternative policy indices are included as controls.

Turning to the bilateral controls, the coefficients on the border dummy and the logarithm of distance are both negative and statistically significant at the one per cent level. The remaining historical and cultural variables drawn from the CEPII database also largely display the expected signs. By contrast, the coefficient on the FTA dummy is negative and statistically significant. A plausible explanation from the horizontal FDI literature is that multinational production and international trade can act as substitutes in serving foreign markets. As FTAs reduce trade costs through tariff elimination and the removal of non-tariff barriers, exporting becomes relatively more attractive, thereby reducing the incentive to establish foreign affiliates for the purpose of circumventing trade barriers (Helpman et al., 2004).

We conduct a range of robustness checks and report the results in Appendix D. First, we examine the responsiveness of foreign affiliate sales to IFI across broad sectors, with the results reported in Table D.1. The mining and agriculture sectors appear to be the most responsive, followed by services and then manufacturing. We further assess robustness by excluding selected control variables. As shown in Table D.2, removing these controls generally increases the magnitude of the estimated coefficients. To evaluate the sensitivity of the results to sample selection, we also perform a jackknife exercise in which host countries are sequentially excluded. This

⁶At the time of writing, the FTA dummy in the CEPII database is only updated to 2015, meanwhile the DESTA database from Dür et al. (2014) is updated to 2019 and covers all treaties that were notified to the WTO

Table 1: Gravity Estimation Results

	(1)	(2)	(3)	(4)
Investment Facilitation Index \times Border	2.415** (1.104)	5.057*** (0.820)	4.709*** (0.911)	4.399*** (0.913)
GDP \times Border	0.584*** (0.100)	0.514*** (0.065)	0.431*** (0.066)	0.589*** (0.076)
GDP per capita \times Border	1.071*** (0.380)	1.801*** (0.278)	1.814*** (0.336)	1.945*** (0.307)
FDI Restrictiveness Index \times Border	-3.596*** (0.524)	-3.253*** (0.511)	-3.599*** (0.549)	-3.452*** (0.527)
Worldwide Governance Index \times Border	0.909** (0.357)			
Doing Business Score \times Border		-0.059*** (0.015)		
Regulatory Governance Index \times Border			-0.372*** (0.133)	
Financail Development Index \times Border				-2.979*** (0.917)
Border Dummy	-36.457*** (3.500)	-40.599*** (3.333)	-40.302*** (3.722)	-45.234*** (3.640)
Log of Distance	-0.498*** (0.070)	-0.534*** (0.070)	-0.565*** (0.067)	-0.513*** (0.065)
Colonial Relationships	-0.023 (0.153)	-0.062 (0.142)	-0.085 (0.138)	-0.034 (0.133)
Common Language	0.576*** (0.139)	0.594*** (0.139)	0.514*** (0.141)	0.548*** (0.136)
Religious Proximity Index	1.041*** (0.181)	0.874*** (0.179)	0.923*** (0.176)	0.909*** (0.169)
Common Legal Origin	0.290*** (0.064)	0.295*** (0.063)	0.307*** (0.064)	0.311*** (0.062)
Free Trade Agreement	-0.983*** (0.208)	-1.100*** (0.209)	-1.032*** (0.190)	-0.845*** (0.181)
European Economic Area	0.161 (0.195)	0.078 (0.177)	-0.028 (0.173)	0.066 (0.166)
Constant	16.746*** (0.451)	16.981*** (0.452)	17.180*** (0.433)	16.840*** (0.415)
Observations	21320	21317	21320	21320

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Standard errors in parentheses. All specifications include host-sector and source-sector fixed effects

procedure reduces the magnitude of the coefficients and increases the standard errors of the IFI term, leading to statistically insignificant estimates. However, across all specifications, the IFI coefficient remains positive. As a result, in favour of a relatively conservative estimate, we select Column (1) of Table 1 as our baseline for the imputation of policy shocks.

4 Construction of Ad-Valorem Equivalent Shocks

In the second stage, we map the estimated IFI coefficient from the gravity model into Ad-Valorem equivalent (AVE) cost reductions. Since the observed IFI scores reflect countries’ current regulatory practices, constructing the AVE requires imputing counterfactual IFI values that capture different post-implementation scenarios of the IFD Agreement.

Similar to certain other WTO agreements and many FTAs, the IFD Agreement comprises obligations with different degrees of stringency – some imposing hard or mandatory requirements, others worded more softly. We follow Berger et al. (2026) who classified provisions of the IFD Agreement based on their legal wording as follows:

- **Binding provisions** (which should be understood as mandatory or hard obligations): these are identified by the use of term “**shall**”, which confers a legally binding obligation on Members. In the IFD Agreement, binding provisions cover core transparency and governance disciplines, including the establishment of inquiry points, the publication and accessibility of investment-related information, and anti-corruption measures.
- **Best-endeavour provisions** (which should be understood to also cover a separate category of soft obligations): these are identified by the use of the terms such as “**should**”, “**endeavour to**” and “**may**”, which signal hortatory or aspirational commitments. The implementation of these obligations may depend on each Member’s administrative and technical capacity, and it is therefore likely to be more gradual and heterogeneous across Members.

In line with the categorisation above, we construct two sets of counterfactual IFI scores and compute the differences between the current and counterfactual values, denoted as ΔIFI_j^{IFD} . These score changes correspond to the two policy scenarios implemented in the subsequent CGE analysis: **Mandatory Requirements** and **Full Impact**. Under the first scenario, all hard-type provisions are implemented. Under the Full Impact scenario, all provisions (including both mandatory and soft obligations) are fully put into effect.⁷ Figure 1 presents the current IFI scores alongside gains arising from the two policy scenarios. Overall, low- and middle-income economies tend to exhibit larger increases in IFI scores, reflecting their relatively limited implementation of the relevant facilitation measures under the IFD Agreement.

⁷In comparison with Berger et al. (2026), our Mandatory Requirements scenario corresponds to their “IFD binding” scenario, while our Full Impact scenario corresponds to their “IFD All” scenario. Note that Berger et al. (2026) additionally introduces two intermediary scenarios, the “IFD conditional” and “IFD binding and conditional” scenario. In both, conditional provisions are defined as lying between binding and best-endeavour provisions with wordings such as “shall, to the extent practicable” and “shall encourage”. We omit the two intermediate scenarios to avoid presenting too many results.

Next, we map these score changes and estimated gravity effects into FAS efficiency shocks within the GTAP–FDI model. Let γ_{ijs} represent the iceberg-type efficiency cost for a firm from home economy i operating in sector s within host economy j . Assuming γ_{ijs} is a function of the host economy’s IFI score, the AVE change induced by the IFD is:

$$AVE_{ijs}^{\text{IFD}} = \exp \left[\frac{\beta}{1 - \sigma_k} \Delta IFI_j^{\text{IFD}} \right] - 1, \quad (3)$$

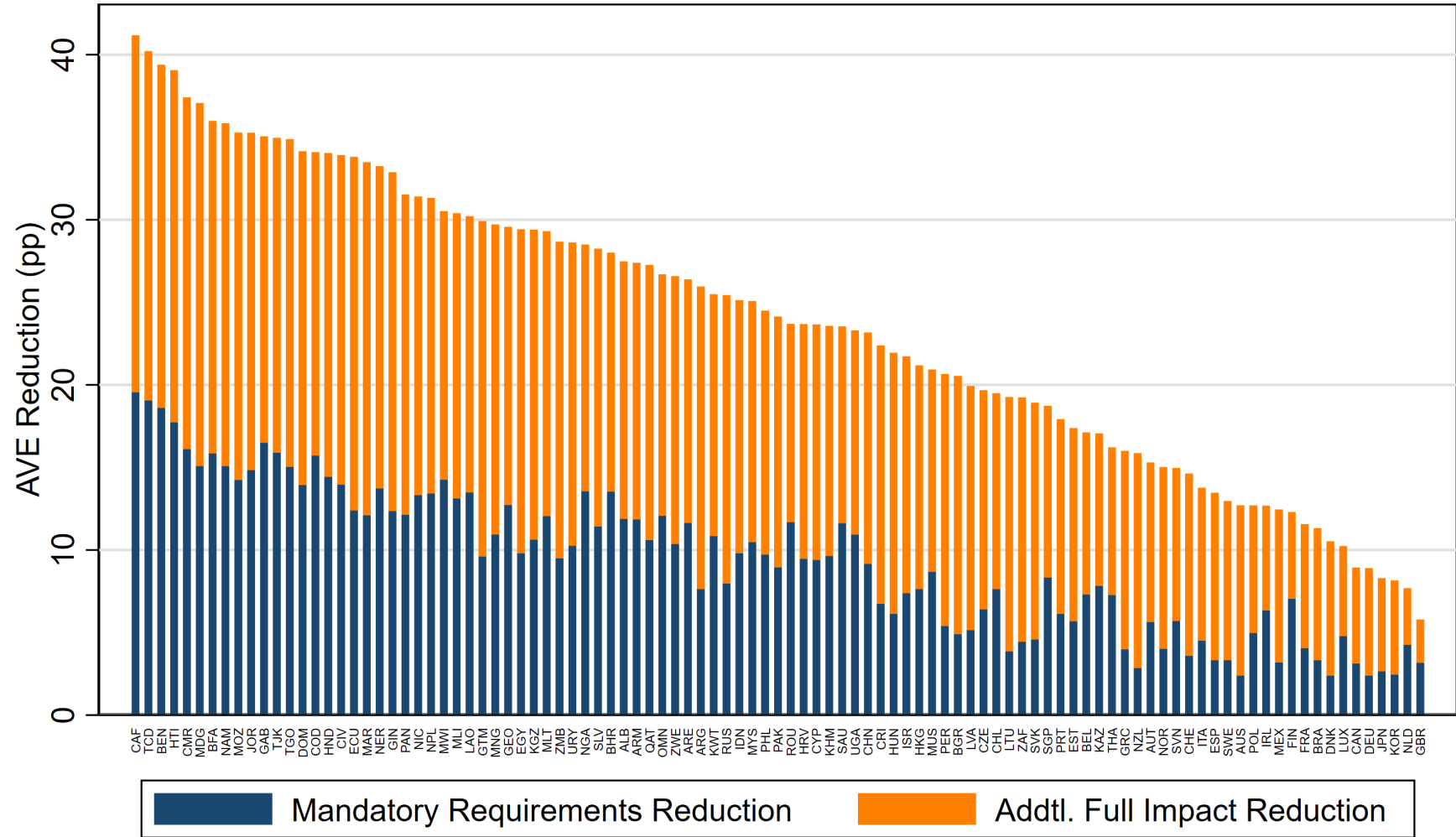
where σ_k is the elasticity of substitution among goods from different home countries. We report the AVE changes in Figure 2.⁸ On a global scale, foreign affiliate costs are projected to decrease by approximately 3.9 per cent under current mandatory requirements (weighted by the economy’s total affiliate sales). If countries also implement the provisions containing soft obligations, this reduction nearly triples, lowering costs by an average of 10.8 per cent. Low-income economies stand to benefit the most from the IFD as they achieve the highest average cost reductions of 13.09 per cent under the Mandatory Requirements scenario commitments and nearly 30 per cent under the Full Impact scenario. Upper-middle-income countries also see substantial gains (19.85 per cent), notably outperforming Lower Middle Income nations (10.44 per cent). High-income economies experience the smallest relative reductions, starting at roughly 3.2 per cent under the Mandatory Requirements scenario and reaching 8.9 per cent under the Full Impact scenario, as shown in Figure 3. In general, we find that the implementation of soft obligations more than doubled the cost reduction associated with the IFD Agreement. We then aggregate these to the model regions using FAS-weighted averages from the GTAP-FAS dataset, which is discussed in Appendix B. We assume an implementation period of 10 years for the IFD Agreement and that the AVE cost reductions are phased in gradually. Moreover, assuming an equal proportional adjustment every year, the annual AVE shock is computed as:

$$AVE_{ijst}^{\text{IFD,annual}} = \left[\left(1 + \frac{AVE_{ijs}^{\text{IFD}}}{100} \right)^{\frac{1}{10}} - 1 \right]. \quad (4)$$

⁸We set the AVE cost reduction within the European Economic Area (EEA) to zero, reflecting the free movement of capital within the Single Market. Because no licensing requirements apply within the EEA, many investment facilitation measures, particularly measures aimed at streamlining the application process for potential foreign affiliates, do not significantly improve the regulatory environment among EEA member states.

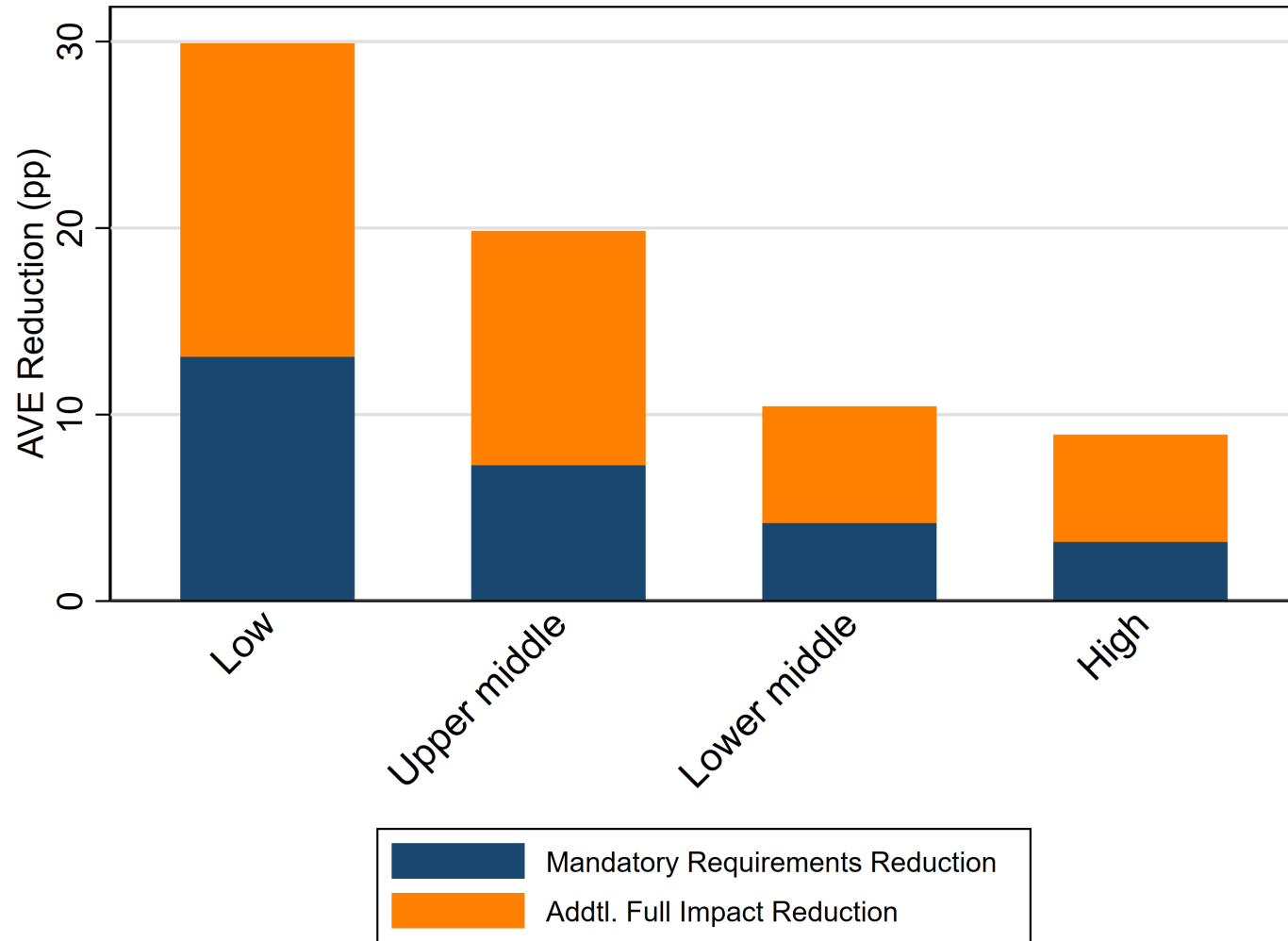
Figure 2: AVE Cost Reduction

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Note: See appendix Table A.3 for a full list of economy codes. This figure presents the magnitude of economy-level AVE reductions (percentage points), calculated as FAS-weighted averages across all sectors. Navy segments show guaranteed reductions from mandatory requirements; orange segments show supplemental reductions from full impact. Countries are sorted by total reduction magnitude.

Figure 3: Average AVE Cost Reduction by Income Group



Note: This figure presents weighted average AVE reductions (percentage points) aggregated by income classifications. Group averages are FAS-weighted. Navy segments indicate reductions from mandatory requirements; orange segments denote additional potential reductions from full impacts.

5 Economic Model

The counterfactual experiments are conducted with a quantitative trade model extended with both FDI and affiliate sales. The general equilibrium model features multiple sectors, multiple regions, input-output linkages, and goods differentiated according to Armington preferences both by location and by ownership (domestic-owned and foreign-owned firms). The model is recursive dynamic with the capital stock changing over time as a function of investment.

In each region a representative agent allocates his or her income to three categories of expenditures: private household expenditures, government expenditures, and savings. Income of the representative household consists of the sum of factor income and tax revenues. Perfectly competitive firms use intermediate inputs and production factors in production. There are six factors of production: natural resources, land, high-skilled and low-skilled labour, regular capital (accumulated through portfolio investment) and FDI capital (accumulated through foreign direct investment). There is no scope for substitution between the different intermediates and value added (Leontief production function), whereas value added is characterized by a constant elasticity of substitution (CES) production function. Capital and labour are mobile, which means that arbitrage equalizes the cost of labour across all sectors. Land is imperfectly mobile between sectors, natural resources and FDI capital are sector-specific production factors, whereas regular capital and labour are perfectly mobile between sectors. FDI capital is only used by foreign-owned firms in each region.

International trade is modelled with an Armington structure featuring love of variety between goods from different economies of origin. The Armington structure is also employed to model the demand for goods (intermediates and final goods) produced by different owners. The Armington structure is nested with agents first choosing between imported and domestic goods, subsequently between imports produced in different regions and finally within each producing economy between goods by different owners.

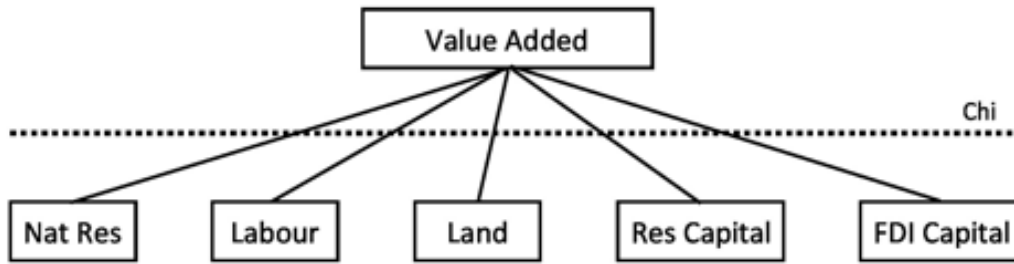
The import price is equal to the export price plus the export tax, the CIF-FOB margin, and the import tariff. The CIF-FOB margin is used to pay for services provided by the global transportation sector, which hires transport services from different economies. There are three sets of equilibrium equations, goods market equilibrium, factor market equilibrium, and global savings equal to global investment. We describe the key elements of the model setup in this section and present the remaining details in [Appendix E](#).

5.1 Firms' Production

There are two types of firms operating within each region and economic sector: those owned domestically and those owned by foreign entities.⁹ Both types of firms operate under perfect competition. They combine value-added components and intermediate inputs from each sector

⁹The model calibration relies on foreign affiliate sales data. Therefore, consistent with standard definitions in foreign affiliate statistics, firms are classified as foreign-owned if they are directly or indirectly controlled by a foreign parent that holds a significant ownership stake, typically defined as at least 50 per cent of the voting power.

Figure 4: Value Added Structure



using a Leontief structure. This implies there is no scope for substituting raw materials for value-added.

Firms have the flexibility to substitute among six distinct production factors based on relative costs and applicable taxes. These factors are land, natural resources, regular capital, Foreign Direct Investment (FDI) capital, skilled labour, and unskilled labour. A key distinction in the model is that purely domestic-owned firms do not utilize FDI capital.

5.2 International Trade and Foreign Affiliate Sales

Commodity demand within this economy is driven by five distinct end-user groups: private households, the government, general capital investors, FDI investors, and firms purchasing intermediate inputs. Every purchaser makes allocation decisions using a nested Armington preference structure, meaning they differentiate products based on their origin rather than treating them as perfect substitutes.

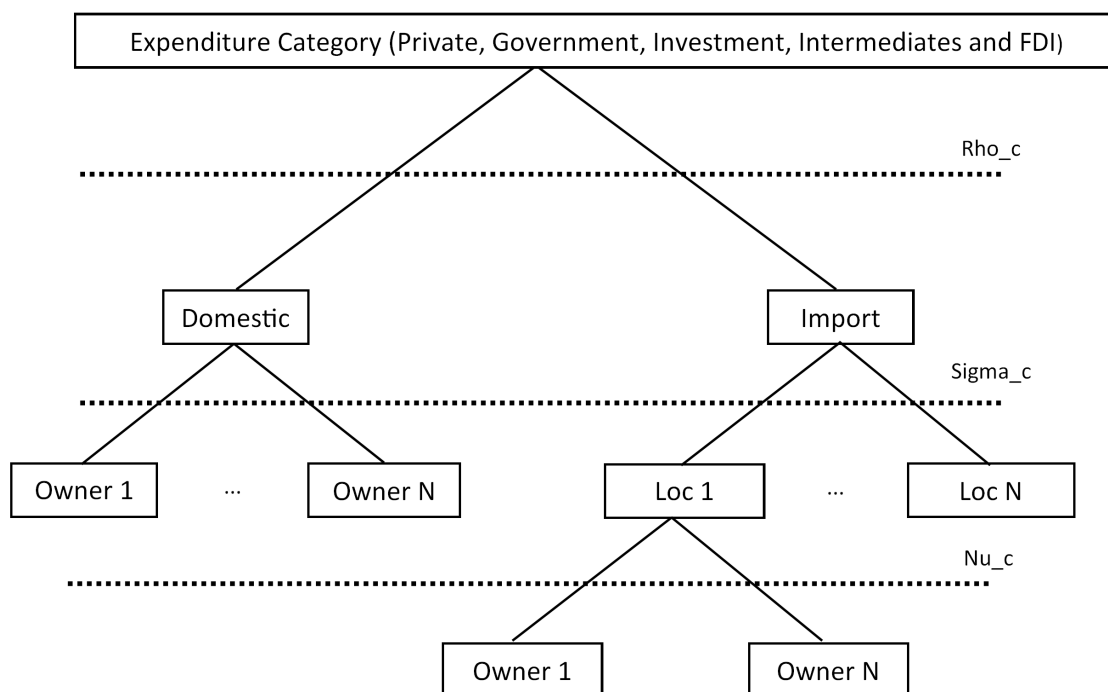
Initially, buyers decide how to split their total demand between domestically produced goods and imported goods based on relative prices. When purchasing domestic goods, buyers make a secondary choice between goods produced by domestically-owned firms and those produced by foreign-owned affiliates. When buyers choose to import, they first select the origin economy of the import, and then choose between domestic-owned and foreign-owned firms operating within that specific source economy.

5.3 Allocation of Global Saving, FDI, and Trade Balance

A representative household in any given region owns all the firms originating from this economy. It splits its savings between portfolio investments, which are managed by a global bank, and direct outward FDI. This initial split is determined by a Constant-Elasticity-of-Transformation (CET) function that reacts dynamically to the expected global rates of return for both investment types.

The global bank aggregates all portfolio savings and distributes them across different regions,

Figure 5: Demand Structure



actively directing capital toward the markets offering the highest rental rates on capital. However, this flow of funds does not equalize global interest rates instantaneously.

Similarly, the capital invested for outward FDI is distributed through a nested CET process. Investors first evaluate global markets to allocate funds to the destination regions offering the most attractive overall rates of return. Once FDI is allocated to a destination region, it is further allocated among specific economic sectors based on which sectors are currently delivering the highest net rates of return on FDI.

6 Quantitative Findings

This section reports the quantitative findings from the model simulations.

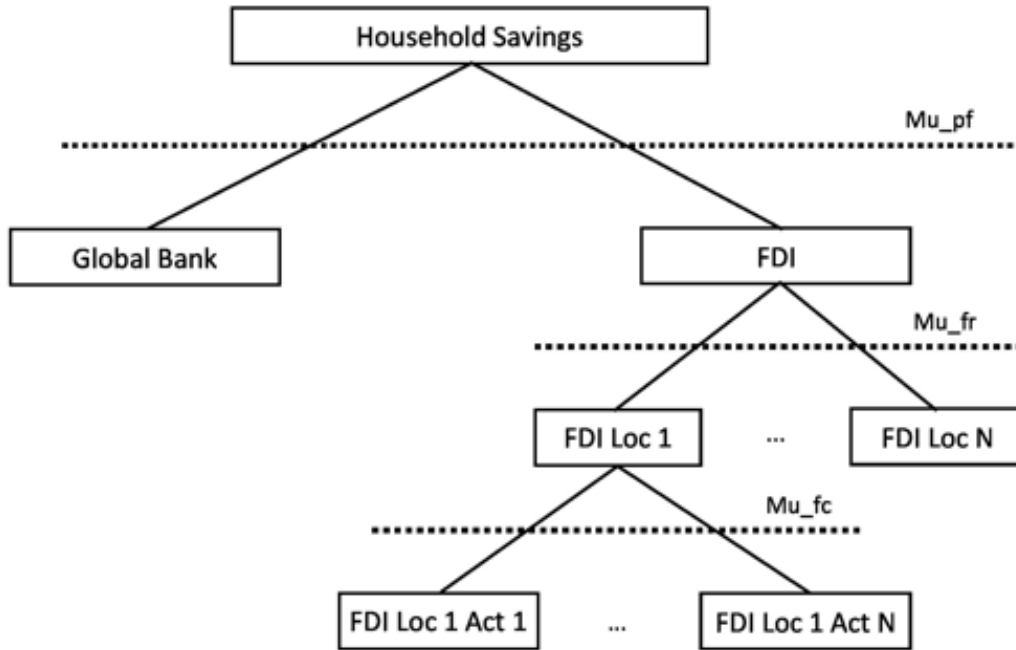
6.1 Foreign Affiliate Sales and Foreign Direct Investment Flows

This subsection examines how the implementation of the Investment Facilitation for Development (IFD) provisions are projected to impact global patterns of foreign direct investment (FDI) and foreign affiliate sales (FAS) in the model.

Figure 7 shows the regional distribution of changes in foreign affiliate sales. The result suggests a substantial expansion in multinational production across host economies.¹⁰ With the exception

¹⁰The simulations also contains a region "Rest of the World", but results for this region are not reported, since it functions as a residual region used to maintain the trade balance of the other regions in the model which complicates interpretation of the model results for this region.

Figure 6: Saving Structure



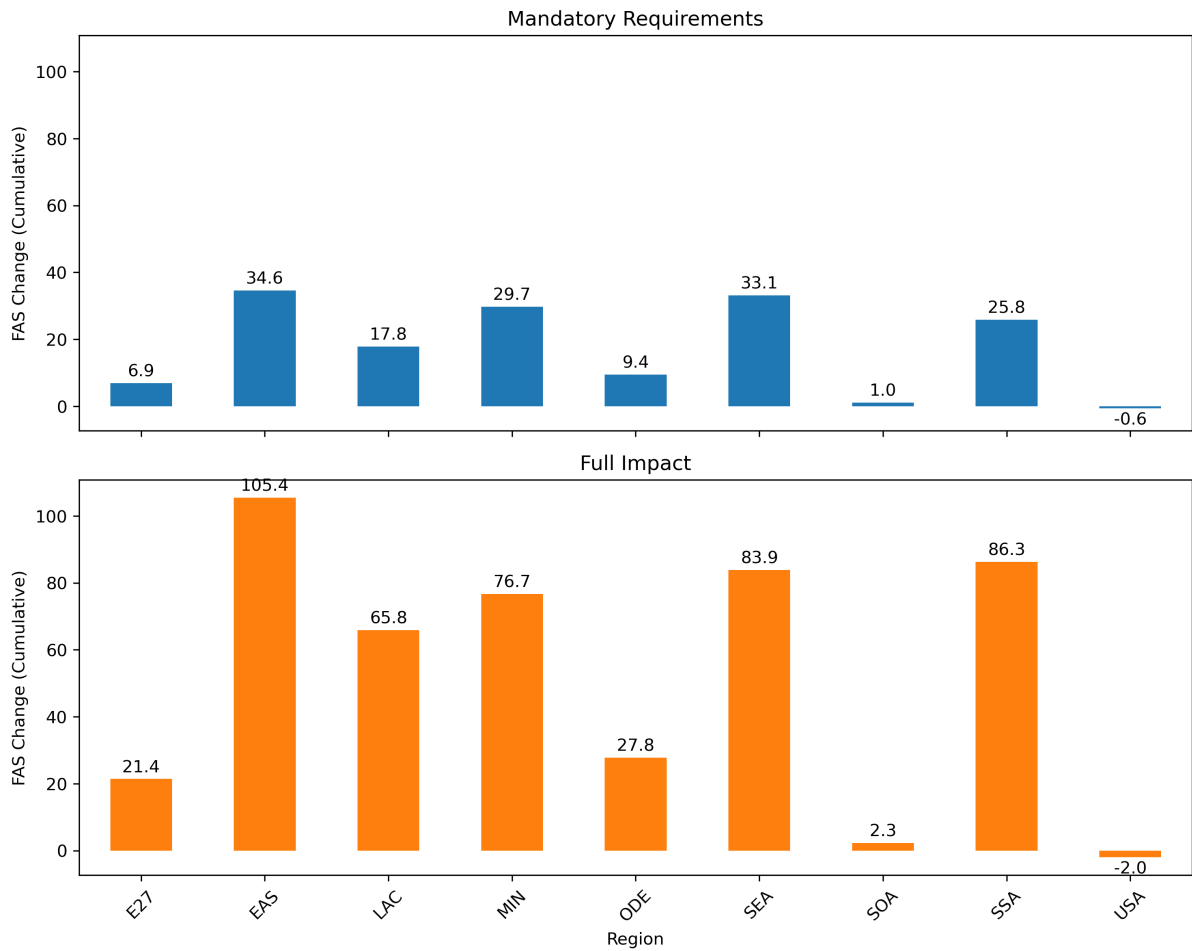
of the United States, which does not participate in the IFD Agreement and already has a high IFI score, and South Asia, mostly containing economies not participating in the IFD Agreement, foreign affiliate sales increase in all regions. East Asia records the largest increase, followed by Southeast Asia with foreign affiliate sales increasing by over 30 per cent under the Mandatory Requirements scenario.¹¹ On top of the effects of the mandatory requirements, provisions containing softer disciplines, including best-endeavour requirements, more than double the impact of the IFD Agreement across all regions. This pattern is consistent with the larger AVE shocks observed under the Full Impact scenario.

Figure 8 further decomposes the increases in foreign affiliate sales by broad economic sectors. In general, the expansion in foreign affiliate sales largely reflects the existing distribution of affiliate activity across sectors as we assume the shocks are uniform across sectors. For example, manufacturing accounts for the majority of the increase in East Asia, while services contribute more prominently to the gains in the European Union and other developed economies. The contributions of the mining and agriculture sectors are limited, as affiliate sales in these sectors are typically small.

We next examine the response of FDI inflows, as shown in Figure 9. The increase in FAS is accompanied by a strong rise in global FDI. In the model, IFD requirements considered as mandatory increase worldwide FDI flows by about 9.1 per cent, while the inclusion of soft obligations generates an additional increase of about 24.4 per cent relative to the baseline. At the regional level, the largest relative increases in FDI inflows occur in East Asia and Sub-Saharan

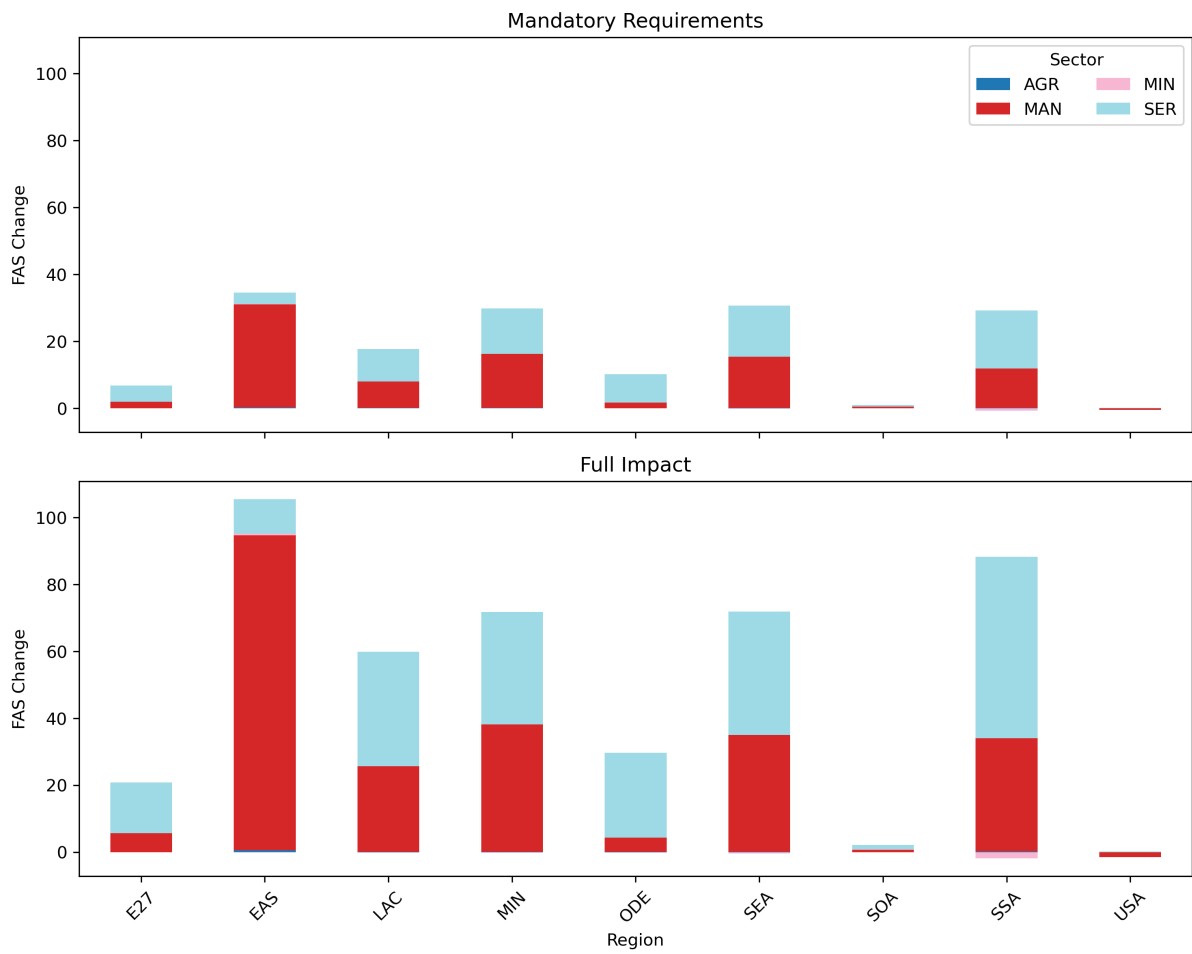
¹¹China is projected to be one of the main beneficiaries in East Asia.

Figure 7: Cumulative FAS changes



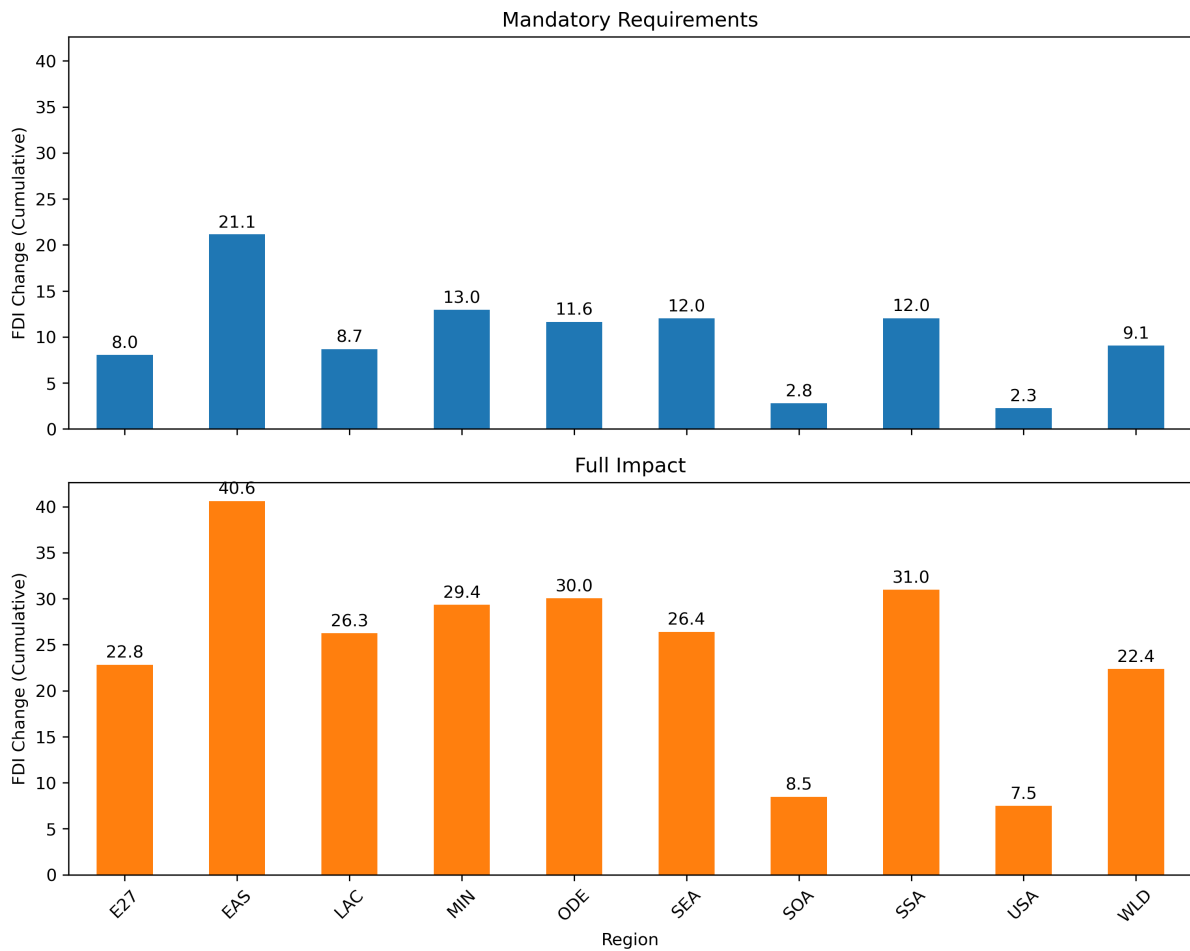
Note: This figure shows the cumulative per cent changes in foreign affiliate sales across regions at the end of simulation period . The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

Figure 8: Cumulative changes in foreign affiliate sales by sector



Note: This figure reports the cumulative per cent changes in foreign affiliate sales across regions at the end of simulation period, decomposed by broad economic sectors.

Figure 9: Cumulative FDI inflow changes

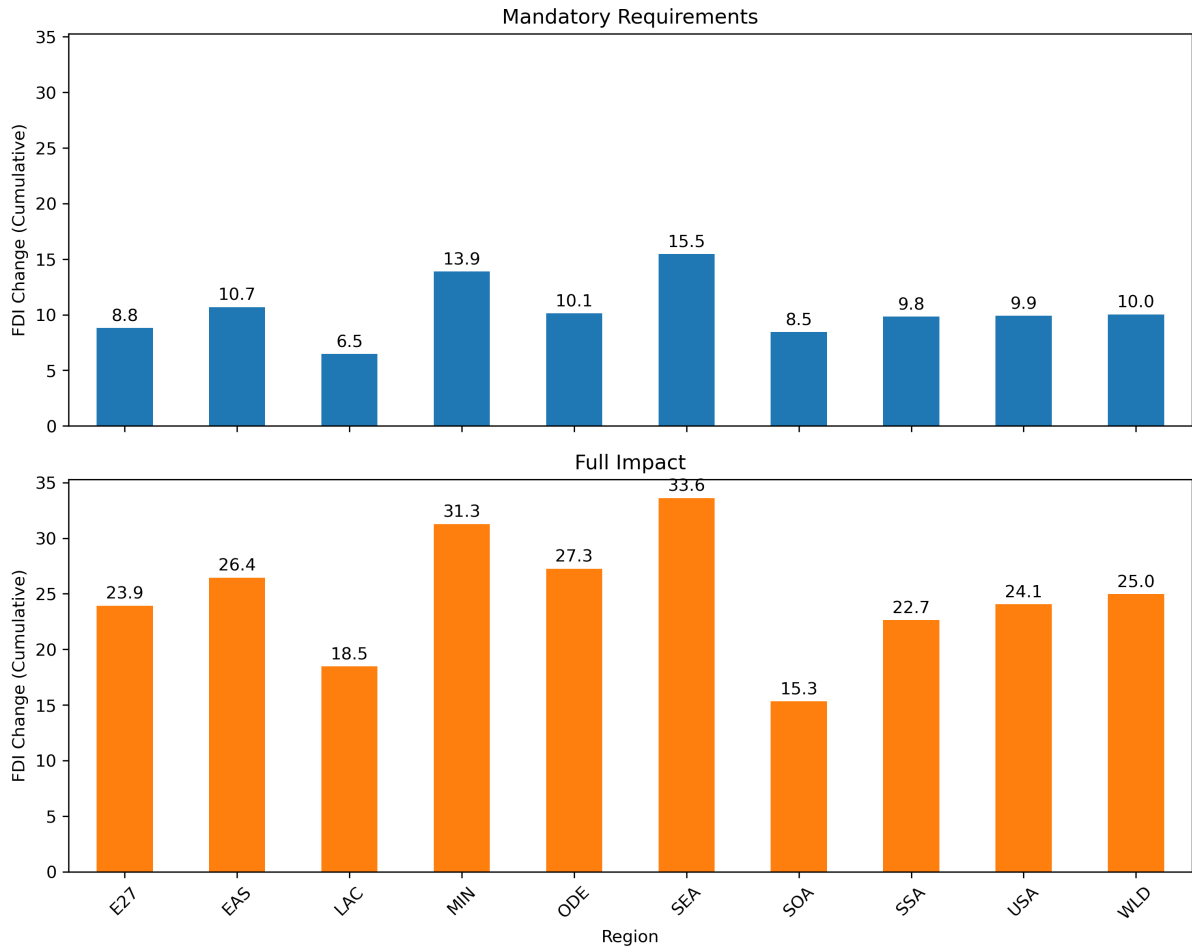


Note: This figure shows the cumulative per cent changes in net foreign direct investment inflows across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

Africa.

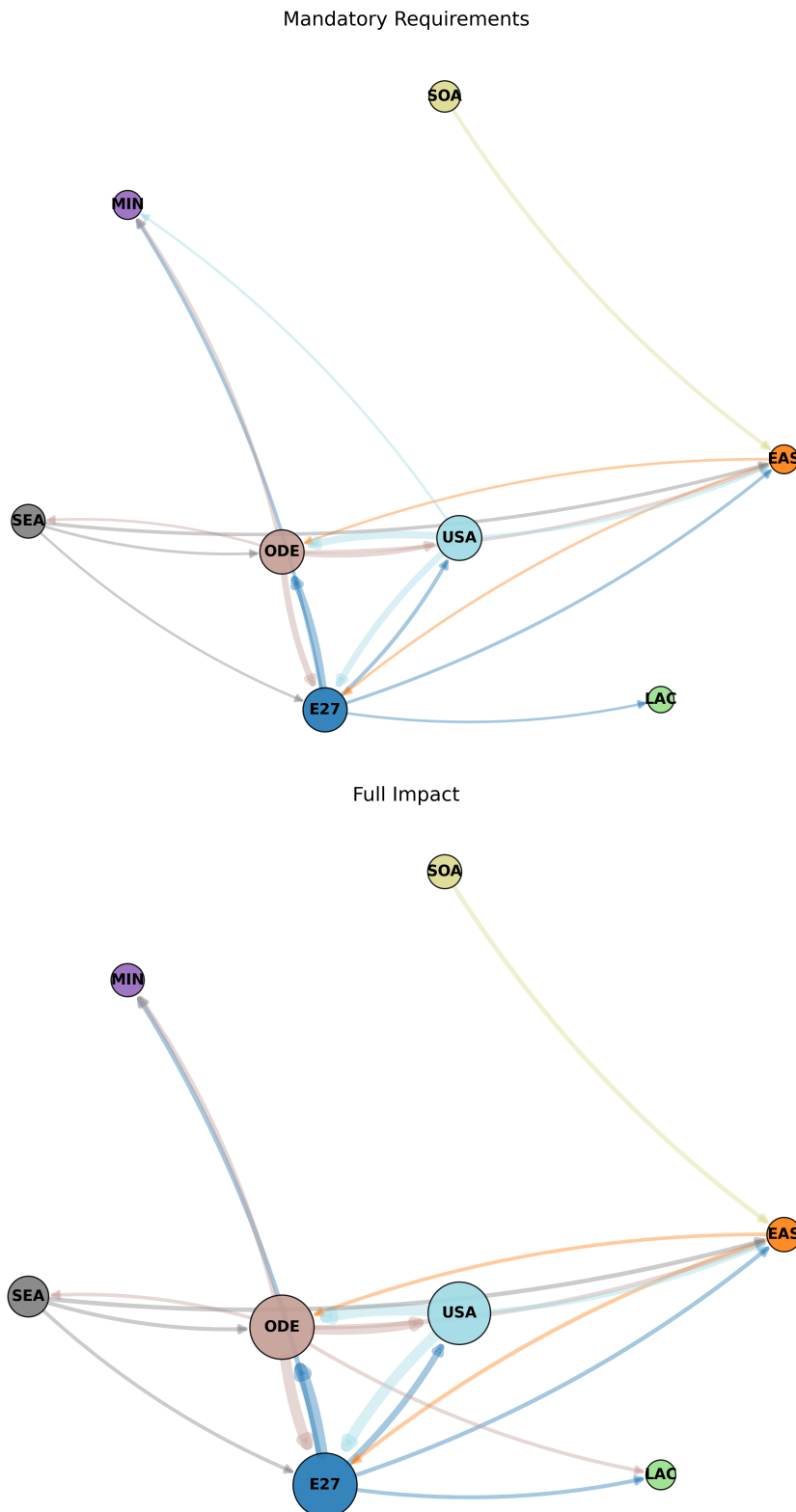
We then examine FDI outflows as shown in Figure 10. In the model, East Asia, and Southeast Asia experience the largest increases in FDI outflows in relative terms, even though Other Developed Economies, the European Union, and the United States are the top sources for additional FDI flows under the IFD in absolute terms. In general, changes in bilateral flows under the IFD Agreement largely reflect existing investment relationships and are relatively consistent under the two scenarios, as shown in Figure 11. For example, FDI outflows from the United States are primarily directed toward Other Developed Economies and the European Union, while Southeast Asia and the European Union experience the largest increases in capital outflows to Other Developed Economies. We also observe that regions that do not participate in the IFD Agreement still experience substantial positive increases in FDI outflows, benefiting from the improvement in the FDI business environment in FDI partners. Furthermore, it reflects that improved global economic conditions raise the demand for FAS and FDI more broadly.

Figure 10: Cumulative FDI outflow changes



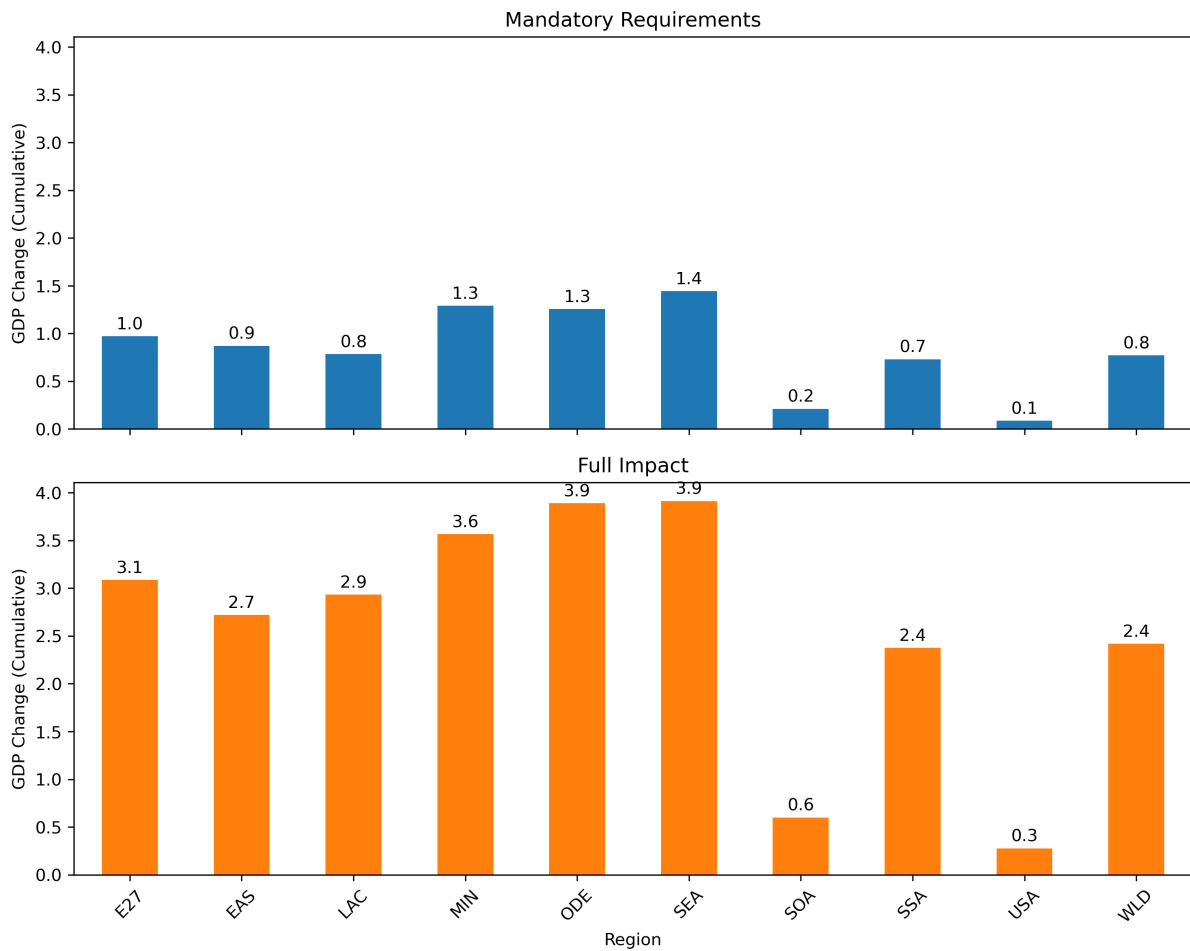
Note: This figure shows the cumulative per cent changes in net foreign direct investment outflows across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

Figure 11: Cumulative FDI flow changes



Note: This figure shows the cumulative per cent changes in net foreign direct investment flows across regions at the end of the simulation period. The top panel shows the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The bottom panel shows the gains under the Full Impact scenario. Only the major investment channels (the top 30 per cent of flows by volume) are displayed. Node sizes are proportional to the total changes in outgoing investment (total outward FDI) originating from each region. Edge thicknesses represent the magnitude of specific bilateral flow changes. Arrow colours correspond to the source (investing) region.

Figure 12: Cumulative GDP changes

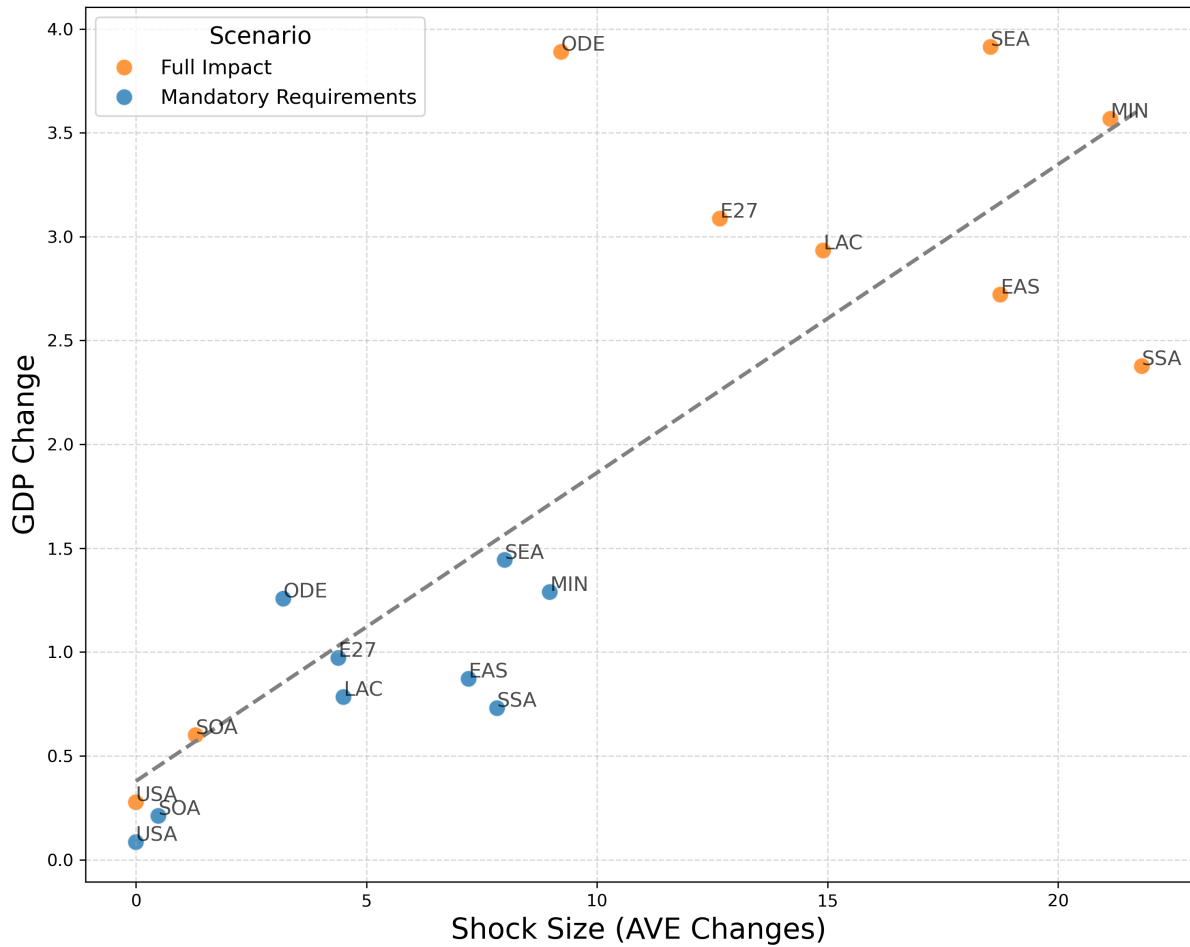


Note: This figure shows the cumulative per cent changes in GDP across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

6.2 GDP Impacts

This subsection examines the projected effects of the Investment Facilitation for Development (IFD) Agreement on GDP. Figure 12 reports the regional distribution of GDP changes relative to the baseline. At the global level, the implementation of the mandatory requirements of the IFD is projected to lead to a cumulative increase of about 0.8 per cent in world GDP over the next decade. The inclusion of soft obligations further raises global GDP by an additional 1.6 per cent. The gains are uneven across regions. Southeast Asia and Other Developed Economies experience the largest increases in GDP, each exceeding one per cent over the next ten years. The relatively large GDP gains in developing economies partly reflect the larger improvements in their Investment Facilitation Index (IFI) scores following the implementation of the IFD, which generate stronger efficiency gains in foreign affiliate sales. Figure 13 illustrates this mechanism by plotting regional changes in FDI inflows against changes in IFI scores, revealing a positive relationship between improvements in investment facilitation and foreign investment. As shown in Section 3, the magnitude of IFI improvements, and therefore the associated Ad-Valorem

Figure 13: Relationship between IFD shocks and GDP changes



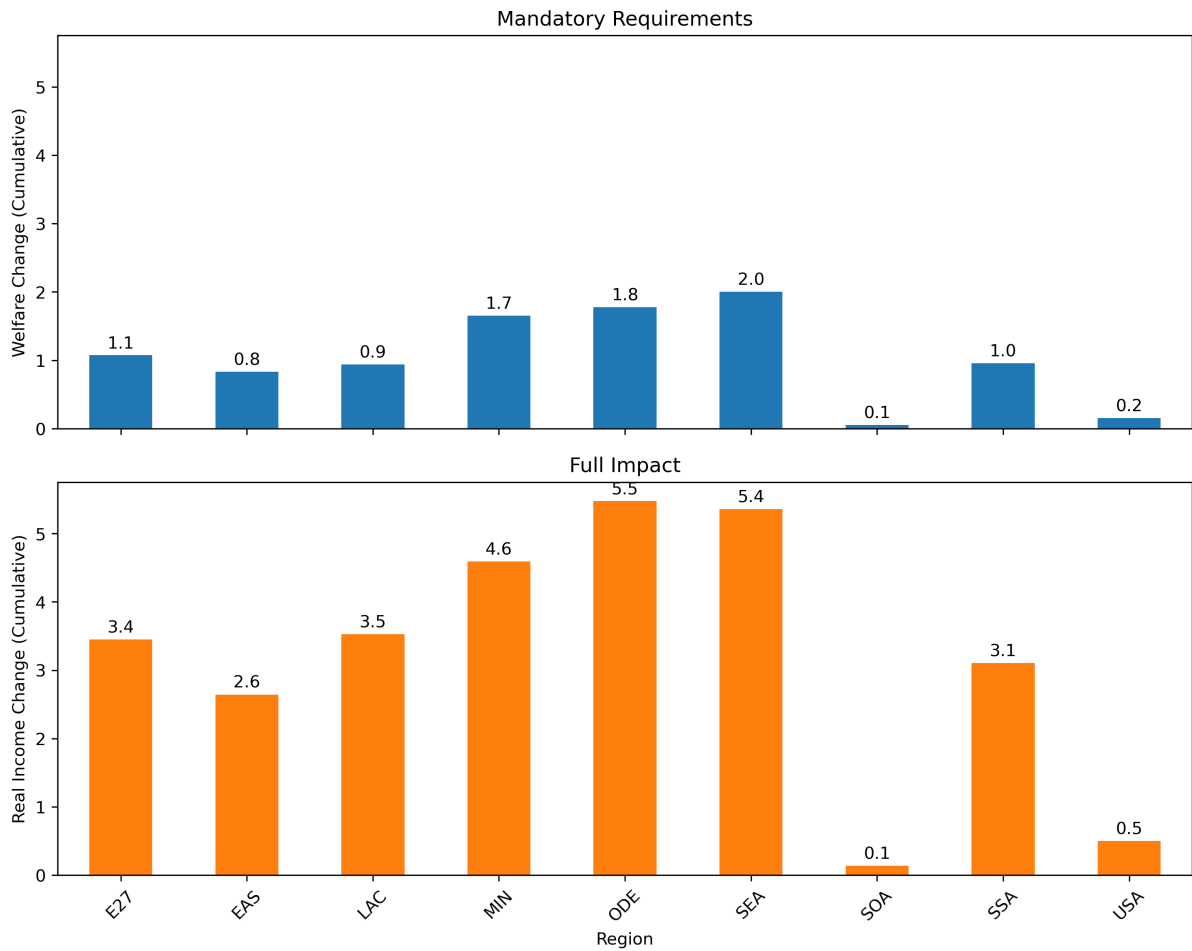
Note: This figure shows the cumulative per cent changes in real GDP across regions at the end of the simulation period and the corresponding Ad-Valorem equivalent (AVE) changes.

equivalent (AVE) shocks, is generally larger in developing economies participating in the IFD. These results suggest that developing economies may have greater potential to benefit from participation in the agreement. Nevertheless, all regions experience positive GDP effects following the implementation of the IFD. As a matter of fact, also economies not participating in the agreement such as the United States are also projected to see their GDP increase because of positive economic spillovers from the rise of GDP in other regions with whom the US has trade and FDI linkages. Stronger demand from trading partners stimulates production, while cost reductions in U.S.-owned foreign affiliates raise income.

Finally, the introduction of FDI income in our model creates a distinction between real GDP and real income (welfare), defined as nominal income deflated by the price index. This difference arises because FDI income is included in real income but not in real GDP. We therefore report the corresponding welfare changes in Figure 14. The results indicate that welfare changes are broadly consistent with the patterns observed for real GDP.¹²

¹²Interestingly, the projected increase in real income is substantially larger for the United States which is partially related to the increase in FDI capital income earned in FDI partner economies.

Figure 14: Cumulative real income changes



Note: This figure shows the cumulative per cent changes in real income across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

6.3 Impact of FDI Productivity Spillover Mechanism

This subsection examines the additional GDP effects of the IFD across regions after incorporating the positive FDI spillover mechanism: it is well documented that domestically owned firms can benefit from productivity gains through interactions with foreign direct investment (FDI) enterprises (Blalock and Gertler, 2008, Ivarsson and Alvstam, 2009). We extend our baseline model by incorporating positive FDI spillovers, focusing on upstream linkages from foreign-owned firms to domestically owned suppliers. Specifically, following the spirit of the reduced-form specification of Bitzer et al. (2008), we assume that a greater presence of foreign-owned firms in downstream sectors induces productivity gains for upstream domestic suppliers.

Introducing positive FDI spillovers further amplifies the GDP gains from the IFD, as shown in Figure 15. Under the implementation of mandatory requirements, the spillover mechanism generates an increase in global GDP of about 1.5 per cent. When soft obligations are also implemented, the GDP gains rise to 4.2 per cent on average, compared with 0.8 and 2.4 per cent when spillover effects are not taken into account.

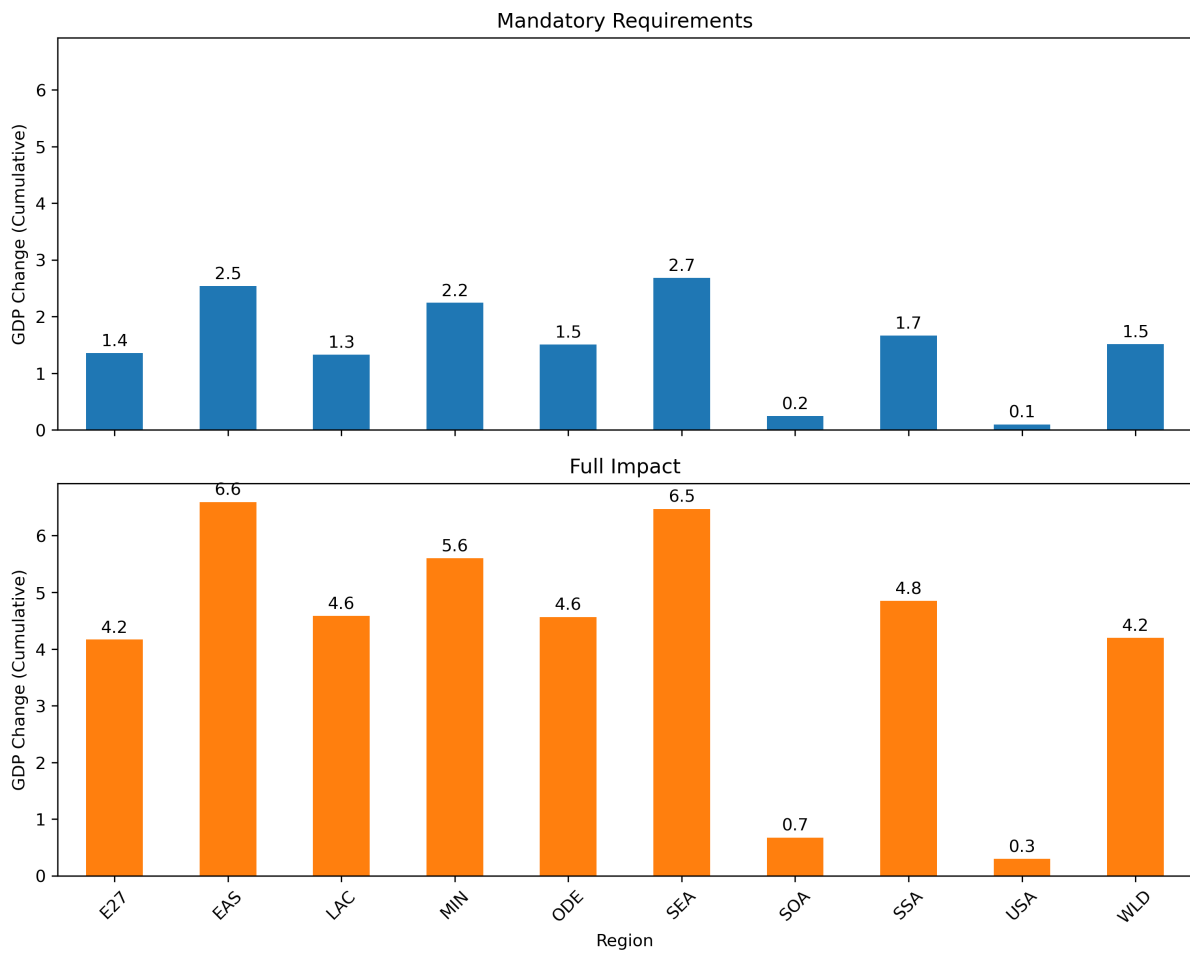
Overall, the additional GDP gains associated with positive spillovers are more pronounced in developing economies. GDP gains in East Asia, Southeast Asia and Sub-Saharan Africa nearly double once spillover effects are incorporated under the Full Impact scenario. By contrast, the incremental gains in developed regions, such as the European Union, are smaller. This pattern reflects the greater scope for productivity improvements in developing economies, which benefit more from learning and technology diffusion from foreign-owned firms in our framework. We report more results under the spillover in Appendix F.2.

7 Conclusion

This paper provides a comprehensive quantitative assessment of the economic impacts of the newly concluded Investment Facilitation for Development (IFD) Agreement. By transforming the agreement's regulatory transparency and administrative streamlining measures into ad-valorem equivalent reductions in trade costs for foreign affiliate sales, we project significant macroeconomic benefits. Our baseline simulations demonstrate that the IFD Agreement has the potential to act as a major catalyst for global economic growth. Even under a baseline scenario where members only implement the strictly mandatory requirements, the global economy is projected to expand by approximately 0.8 per cent over a ten-year horizon, driven by a 9.1 per cent increase in global FDI flows and a substantial expansion in multinational production.

Moreover, our analysis highlights that the more profound economic gains lie within the widespread adoption of the soft obligations within the IFD Agreement. We project that the Full Impact scenario would more than double the reduction in foreign affiliate costs, dropping them by an average of 10.8 per cent globally compared to 3.9 per cent under the mandatory-requirement scenario. Consequently, the incorporation of soft obligations generates an additional 13.3 per cent increase in global FDI inflows and a 1.6 per cent increase to the global GDP compared to the baseline in which IFD is not implemented. For developing and low-income economies,

Figure 15: Cumulative GDP changes when positive spillover is introduced



Note: This figure shows the cumulative per cent changes in GDP across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

these comprehensive facilitative measures represent a vital opportunity. In these regions, the Full Impact scenario slashes affiliate costs by nearly 30 per cent, unlocking unprecedented levels of inward investment and accelerating economic convergence.

The magnitude of these full-impact gains is further underscored when accounting for productivity spillovers from foreign direct investment. Our extended model, which captures the technology transfer and efficiency gains from foreign-owned firms to upstream domestic suppliers, reveals that the indirect benefits of the IFD Agreement are also crucial. Under the Full Impact scenario, these spillover effects magnify the projected global GDP gains to a striking 4.2 per cent on average. This underscores that the additional implementation of soft obligations within the IFD Agreement do not merely attract foreign capital; they improve the productivity and competitiveness of domestic supply chains, particularly in developing economies where the scope for technological catch-up is greatest.

While our framework provides robust *ex-ante* estimates of the IFD Agreement's potential, several directions remain for future research. First, the structural gravity framework employed in this paper could be extended to incorporate variables capturing bilateral investment treaties (BITs) ([Adlung and Molinuevo, 2008](#)), as well as Members' schedule commitments under the General Agreement on Trade in Services (GATS) ([Lamprecht and Miroudot, 2018](#)). Doing so would not only improve the precision of the estimated impacts of the IFI, but also provide broader insights into the relationship between the IFD Agreement and the wider landscape of international investment treaties. Second, the model could be extended to allow foreign-owned firms to exhibit different import sourcing and export destination patterns from domestic firms. In the current framework, the model predicts weak substitutability between foreign direct investment and exports but does not fully capture the nuanced role of FDI in global value chains, where foreign affiliates often import and export more intensively. In addition, while the current baseline calibration includes 10 regions, a more disaggregated regional structure could be implemented. Third, future iterations could incorporate forward-looking FDI capital accumulation, allowing investment decisions to respond dynamically to expectations about future policies and economic conditions. A related structural extension would be to explicitly model the fixed costs of FDI, rather than relying on the current iceberg cost formulation. Finally, future work could further examine the role of the pervasive issue of phantom FDI and its complex implications for the precise measurement and interpretation of global foreign investment and affiliate activity.

References

- Adlung, R. and Molinuevo, M. (2008). Bilateralism in Services Trade: Is There Fire Behind the (Bit-)Smoke? *Journal of International Economic Law*, 11(2):365–409.
- Anderson, J. E., Larch, M., and Yotov, Y. V. (2019). Trade and investment in the global economy: A multi-country dynamic analysis. *European Economic Review*, 120:103311.
- Anderson, J. E. and van Wincoop, E. (2003). Gravity with Gravitas: A Solution to the Border Puzzle. *American Economic Review*, 93(1):170–192.
- Arkolakis, C., Costinot, A., and Rodríguez-Clare, A. (2012). New Trade Models, Same Old Gains? *American Economic Review*, 102(1):94–130. ACR12.
- Arkolakis, C., Ramondo, N., Rodríguez-Clare, A., and Yeaple, S. (2018). Innovation and Production in the Global Economy. *American Economic Review*, 108(8):2128–2173.
- Balistreri, E. J. and Olekseyuk, Z. (2025). Investment Facilitation for Development Agreement: Potential Gains. *The World Economy*, 48(7):1496–1519.
- Berger, A., Dadkhah, A., Gitt, F., and Olekseyuk, Z. (2023). The Updated Investment Facilitation Index.
- Berger, A., Dadkhah, A., Gitt, F., Olekseyuk, Z., and Schwab, J. (2026). The Investment Facilitation Index (IFI): Quantifying Domestic Investment Facilitation Frameworks. *World Trade Review*, pages 1–16.
- Bitzer, J., Geishecker, I., and Görg, H. (2008). Productivity spillovers through vertical linkages: Evidence from 17 OECD countries. *Economics Letters*, 99(2):328–331.
- Blalock, G. and Gertler, P. J. (2008). Welfare gains from Foreign Direct Investment through technology transfer to local suppliers. *Journal of International Economics*, 74(2):402–421.
- Blonigen, B. A., Davies, R. B., and Head, K. (2003). Estimating the Knowledge-Capital Model of the Multinational Enterprise: Comment. *American Economic Review*, 93(3):980–994.
- Carr, D. L., Markusen, J. R., and Maskus, K. E. (2001). Estimating The Knowledge-Capital Model of the Multinational Enterprise. *American Economic Review*, 91(3):693–708.
- Conte, M., Cotterlaz, P., and Mayer, T. (2022). The CEPII Gravity Database. *CEPII Working Paper*, No 2022-05.
- Decreux, Y. and Fontagne, L. (2009). Economic Impact of Potential Outcome of the DDA. *CEPII Working Paper*, No 2009 – 01.
- Dür, A., Baccini, L., and Elsig, M. (2014). The design of international trade agreements: Introducing a new dataset. *The Review of International Organizations*, 9(3):353–375.
- Eaton, J. and Kortum, S. (2002). Technology, Geography, and Trade. *Econometrica*, 70(5):1741–1779. EK02.

- Fukui, T. and Lakatos, C. (2012). A Global Database of Foreign Affiliate Sales. *USITC Working Paper*, No. 2012-08A. Series: GTAP Research Memoranda Series.
- Hanslow, K. (2000). The Structure of the FTAP Model. zotero-item-3395.
- Heid, B., Larch, M., and Yotov, Y. V. (2021). Estimating the effects of non-discriminatory trade policies within structural gravity models. *Canadian Journal of Economics/Revue canadienne d'économique*, 54(1):376–409.
- Helpman, E., Melitz, M. J., and Yeaple, S. R. (2004). Export Versus FDI with Heterogeneous Firms. *American Economic Review*, 94(1):300–316.
- Hoekman, B. and Nicita, A. (2011). Trade Policy, Trade Costs, and Developing Country Trade. *World Development*, 39(12):2069–2079.
- Hufbauer, G. and Schott, J. (2013). Payoff from the World trade agenda 2013. *ICC Research Foundation Report*.
- Irrarrazabal, A., Moxnes, A., and Opromolla, L. D. (2013). The Margins of Multinational Production and the Role of Intrafirm Trade. *Journal of Political Economy*, 121(1):74–126.
- Iršová, Z. and Havránek, T. (2013). Determinants of Horizontal Spillovers from FDI: Evidence from a Large Meta-Analysis. *World Development*, 42:1–15.
- Ivarsson, I. and Alvstam, C. G. (2009). The Effect of Spatial Proximity on Technology Transfer from TNCs to Local Suppliers in Developing Countries: The Case of AB Volvo in Asia and Latin America. *Economic Geography*, 81(1):83–111.
- Javorcik, B. S. (2004). Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers Through Backward Linkages. *American Economic Review*, 94(3):605–627.
- Kalinova, B., Palerm, A., and Thomsen, S. (2010). OECD's FDI Restrictiveness Index: 2010 Update. OECD Working Papers on International Investment 2010/03. Series: OECD Working Papers on International Investment Volume: 2010/03.
- Kaufmann, D., Kraay, A., and Mastruzzi, M. (2011). The Worldwide Governance Indicators: Methodology and Analytical Issues. *Hague Journal on the Rule of Law*, 3(02):220–246.
- Lakatos, C. and Fukui, T. (2014). The Liberalization of Retail Services in India. *World Development*, 59:327–340.
- Lamprecht, P. and Miroudot, S. (2018). The value of market access and national treatment commitments in services trade agreements. *OECD Trade Policy Papers*, No. 213. Series: OECD Trade Policy Papers Volume: 213.
- Mathieu, E., Verhoest, K., and Matthys, J. (2017). Measuring multi-level regulatory governance: Organizational proliferation, coordination, and concentration of influence. *Regulation & Governance*, 11(3):252–268.

- Mevel, S., de Alba, J. M., and Oulmane, N. (2015). Regional trade integration and trade facilitation as a pro-industrialization policy tool The case of North African countries. *Inclusive and Sustainable Industrial Development Working Paper*, WP 01 | 2015.
- Ramondo, N. and Rodríguez-Clare, A. (2013). Trade, Multinational Production, and the Gains from Openness. *Journal of Political Economy*, 121(2):273–322.
- Ramondo, N., Rodríguez-Clare, A., and Tintelnot, F. (2015). Multinational Production: Data and Stylized Facts. *American Economic Review*, 105(5):530–536.
- Silva, J. M. C. S. and Tenreyro, S. (2006). The Log of Gravity. *The Review of Economics and Statistics*, 88(4):641–658.
- Svirydzenka, K. (2016). Introducing a New Broad-based Index of Financial Development. *IMF Working Papers*, 16(05):1.
- Tintelnot, F. (2017). Global Production with Export Platforms*. *The Quarterly Journal of Economics*, 132(1):157–209.
- World Bank (2020). *Doing Business 2020: Comparing Business Regulation in 190 Economies*. Washington, DC: World Bank.
- Zaki, C. (2014). An empirical assessment of the trade facilitation initiative: econometric evidence and global economic effects. *World Trade Review*, 13(1):103–130.

Appendix A Sectoral and regional aggregations

Table A.1: Aggregated regions, their descriptions, and corresponding economies

Agg Region	Region Name	Economies and Regions
ODE	Other Developed Economies	Australia, New Zealand, Canada, United Kingdom, Switzerland, Norway, Rest of European Free Trade Association; Rest of Oceania
EAS	East Asia	Chinese Taipei; Korea, Republic of; Mongolia; Rest of East Asia; Japan; China
SEA	Southeast Asia	Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic, Malaysia, Philippines, Singapore, Thailand, Viet Nam, Rest of Southeast Asia; Hong Kong, China
SOA	South Asia	Afghanistan, Bangladesh, India, Nepal, Pakistan, Sri Lanka, Rest of South Asia
USA	United States	United States
LAC	Latin America and the Caribbean	Argentina, Bolivia, Plurinational State of; Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, Venezuela, Bolivarian Republic of; Costa Rica, Guatemala, Honduras, Nicaragua, Panama, El Salvador, Dominican Republic, Haiti, Jamaica, Trinidad and Tobago, Rest of South America, Rest of Central America, Rest of Caribbean
E27	Europe Union Members	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden
MIN	Middle East and North Africa	Bahrain, Kingdom of; Iran; Iraq, Israel, Jordan, Kuwait, the State of; Lebanese Republic, Oman, Qatar, Saudi Arabia, Kingdom of; Syrian Arab Republic, Türkiye, United Arab Emirates, Algeria, Egypt, Morocco, Tunisia, Rest of Western Asia, Rest of Middle East and North Africa
SSA	Sub-Saharan Africa	Benin, Burkina Faso, Cameroon, Côte d'Ivoire, Ghana, Guinea, Mali, Niger, Nigeria, Senegal, Togo, Central African Republic, Chad, Congo, Democratic Republic of the Congo, Equatorial Guinea, Gabon, Comoros, Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Sudan, Tanzania, Uganda, Zambia, Zimbabwe, Botswana, Eswatini, Namibia, South Africa, Rest of Western Africa, Rest of South and Central Africa, Rest of Eastern Africa, Rest of South African Customs Union
ROW	Rest of the World	Republic of Belarus, Kazakhstan, Ukraine, Albania, Serbia, Russian Federation, Rest of Eastern Europe, Rest of Europe, Kyrgyz Republic, Tajikistan, Uzbekistan, Rest of Former Soviet Union, Armenia, Azerbaijan, Georgia, Rest of the World aggregate

Table A.2: Allocation of Sectors to Broad Categories

Broad Sector		Sector Codes & Descriptions	
Agriculture			
pdr: Rice (seed, paddy)		wht: Wheat (seed, other)	
rmk: Raw milk		pfb: Fibre crops	
osd: Oil seeds and oleaginous fruit		c_b: Sugar cane & sugar beet	
frs: Forestry, logging and related services		fsb: Fishing, hunting, trapping, aquaculture	
ctl: Cattle and other live ruminants/equines		oap: Other animal products (swine, poultry, eggs, etc.)	
gro: Other grains (maize, sorghum, barley, rye, oats, millets, etc.)		v_f: Vegetables & fruit; roots/tubers; pulses	
ocr: Other crops (stimulant/spice/aromatic/forage, etc.)		wol: Wool, silk, other raw animal textile materials	
Mining			
coa: Coal, lignite, peat extraction		oxt: Metal ores; other mining and quarrying	
oil: Crude petroleum extraction and related services		gas: Natural gas extraction and related services	
Manufacturing			
cmt: Cattle meat		omt: Other meat	
vol: Vegetable oils and fats		mil: Dairy products	
pcr: Processed rice		sgr: Sugar and molasses	
tex: Textiles		wap: Wearing apparel	
lea: Leather products		lum: Wood/cork products	
chm: Chemicals		bph: Pharmaceuticals	
rpp: Rubber and plastics		nmm: Non-metallic mineral products	
i_s: Iron and steel		nfm: Non-ferrous metals	
fmp: Fabricated metal products		eeq: Electrical equipment	
mvh: Motor vehicles and trailers		otn: Other transport equipment	
omf: Other manufacturing (incl. furniture)		ofd: Other food products	
b_t: Beverages and tobacco		ome: Machinery and equipment n.e.c.	
ppp: Paper products; printing/recorded media		p_c: Coke and refined petroleum products	
ele: Computer/electronic/optical products			
Services			
cns: Construction		trd: Wholesale/retail trade; vehicle repair	
wtp: Water transport		atp: Air transport	
whs: Warehousing and support		ins: Insurance and pension funding	
rsa: Real estate activities		ros: Recreation and other services	
osg: Government services		edu: Education	
hht: Health and social work		dwe: Dwellings (imputed rents)	
gdt: Gas manufacture and distribution		wtr: Water supply; waste management	
afs: Accommodation and food services		otp: Land transport; pipelines	
cmn: Information and communication		ofi: Financial intermediation (incl. auxiliary)	
ely: Electricity; steam; air conditioning supply		obs: Other business services n.e.c.	

Table A.3: Economy Abbreviations (used in Tables with projected IFI changes)

Code	Economy	Code	Economy	Code	Economy
AFG	Afghanistan	GHA	Ghana	NAM	Namibia
AGO	Angola	GIN	Guinea	NER	Niger
ALB	Albania	GRC	Greece	NGA	Nigeria
ARG	Argentina	GTM	Guatemala	NIC	Nicaragua
ARM	Armenia	GUY	Guyana	NLD	Netherlands
AUS	Australia	HKG	Hong Kong, China	NOR	Norway
AUT	Austria	HND	Honduras	NPL	Nepal
AZE	Azerbaijan	HRV	Croatia	NZL	New Zealand
BDI	Burundi	HTI	Haiti	OMN	Oman
BEL	Belgium	HUN	Hungary	PAK	Pakistan
BEN	Benin	IDN	Indonesia	PAN	Panama
BFA	Burkina Faso	IND	India	PER	Peru
BGD	Bangladesh	IRL	Ireland	PHL	Philippines
BGR	Bulgaria	IRN	Iran	PNG	Papua New Guinea
BHR	Bahrain, Kingdom of	ISR	Israel	POL	Poland
BOL	Bolivia (Plur. State of)	JAM	Jamaica	PRT	Portugal
BRA	Brazil	JOR	Jordan	PRY	Paraguay
CAF	Central African Republic	JPN	Japan	QAT	Qatar
CHE	Switzerland	KAZ	Kazakhstan	ROU	Romania
CHL	Chile	KEN	Kenya	RUS	Russian Federation
CHN	China	KGZ	Kyrgyz Republic	RWA	Rwanda
CIV	Côte d'Ivoire	KHM	Cambodia	SAU	Saudi Arabia, Kingdom of
CMR	Cameroon	KOR	Korea, Republic of	SEN	Senegal
COD	Dem. Rep. of the Congo	KWT	Kuwait, the State of	SGP	Singapore
COG	Congo	LAO	Lao People's Dem. Rep.	SLV	El Salvador
COL	Colombia	LBN	Lebanese Republic	SRB	Serbia
CRI	Costa Rica	LKA	Sri Lanka	SVN	Slovenia
CYP	Cyprus	LTU	Lithuania	SWE	Sweden
CZE	Czech Republic	LUX	Luxembourg	SYR	Syrian Arab Republic
DEU	Germany	LVA	Latvia	TCD	Chad
DNK	Denmark	MAR	Morocco	TGO	Togo
DOM	Dominican Republic	MDG	Madagascar	THA	Thailand
DZA	Algeria	MDV	Maldives	TTO	Trinidad and Tobago
ECU	Ecuador	MEX	Mexico	TUN	Tunisia
EGY	Egypt	MKD	North Macedonia	TZA	Tanzania
ESP	Spain	MLI	Mali	UGA	Uganda
EST	Estonia	MMR	Myanmar	URY	Uruguay
ETH	Ethiopia	MNG	Mongolia	VNM	Viet Nam
FIN	Finland	MOZ	Mozambique	ZAF	South Africa
FRA	France	MRT	Mauritania	ZMB	Zambia
GAB	Gabon	MUS	Mauritius	ZWE	Zimbabwe
GBR	United Kingdom	MWI	Malawi		
GEO	Georgia	MYS	Malaysia		

Note: Codes follow ISO 3166-1 alpha-3 conventions.

Appendix B Data Development

As we incorporate the FDI and FAS model extension into the standard GTAP model framework, analogous extensions are required on the data side prior to conducting counterfactual analysis. To this end, we construct two complementary datasets on FDI stock and FAS. Both datasets are three-dimensional (bilateral by sector) and are fully compatible with version 11 of the GTAP Database, which covers 160 regions and 65 sectors with the reference year of 2017. The complete methodological descriptions are provided in [Bekkers et al. \(2021a,b\)](#). In this section, we present an overview of the data construction process.

Appendix B.1 Construction of the FDI Stock Dataset

The construction of the FDI stock dataset builds on the work by [Gouel et al. \(2012\)](#) and [Lakatos and Walmsley \(2011\)](#), which were originally developed for earlier releases of the GTAP Database. Broadly speaking, the data construction process consists of four main steps. First, reported data are collected from a range of national and multilateral sources, including the UNCTAD FDI Statistics from its annual World Investment Report, the IMF Coordinated Direct Investment Survey, the OECD FDI Statistics, the Eurostat FDI Statistics, and the ITC Investment Map project. As shown in Panel A of Table [B.1](#), the coverage of the aforementioned data sources differs in terms of dimensional detail, ranging from one-dimensional aggregates from UNCTAD to fully three-dimensional breakdowns from Eurostat. We compile these reported FDI stock data into six separate intermediary datasets according to their dimensionality, with adjustments to address overlapping observations, currency conversions, the subtraction of FDI made by special purpose entities (SPEs), and the treatment of negative values.¹³ To further expand data coverage, we apply a mirroring technique to the two-dimensional bilateral and three-dimensional datasets. Specifically, outward FDI stock reported by home countries is treated as inward FDI stock of the corresponding host countries, which is then used to fill gaps in reported inward positions.

In the second step, we estimate a gravity model on the reported three-dimensional data. Given the focus on predictive power, we largely follow [Gouel et al. \(2012\)](#) and adopt parsimonious gravity specification with PPML estimator and year fixed effects, along with a set of commonly used predictors in the literature:

$$\begin{aligned}
 FDI_{ijt,k} = & \exp(\beta_1 + \beta_2 \ln(GDP_{ti}) + \beta_3 \ln(GDP_{tj}) + \beta_4 \ln(GDPpc_{ti}) + \beta_5 \ln(GDPpc_{tj}) \\
 & + \beta_6 \ln(DIST_{ij}) + \beta_7 COMLG_{ij} + \beta_8 COL_{ij} + \beta_9 DEV_i + \beta_{10} DEV_j \\
 & + \beta_{11} LUX_{ij} + \beta_{12} NLD_{ij} + \beta_{13} HKG_{ij} + \eta_t) \times \epsilon_{ijt,k}
 \end{aligned} \tag{B.1}$$

where k, t, i, j index sector, time, host economy, and source economy, respectively. GDP , $GDPpc$, and DEV denote nominal GDP, GDP per capita, and developing-economy status. These variables enter the specification separately for both source and host countries. η_t denotes

¹³The six intermediary datasets are: one-dimensional inward, one-dimensional outward, two-dimensional bilateral (inward with mirrored data), two-dimensional inward-sector, two-dimensional outward-sector, and three-dimensional bilateral-sector (inward with mirrored data).

Table B.1: Dimensional Coverage Across FDI Stock and FAS Data Sources

Database	One-Dimensional	Two-Dimensional		Three-Dimensional
		Bilateral	Sectoral	
Panel A: FDI Stock Data Sources				
UNCTAD	✓			
IMF	✓	✓		
OECD	✓	✓	✓	
Eurostat	✓	✓	✓	✓
ITC (National Sources)*	✓	✓	✓	✓
Panel B: FAS Data Sources				
OECD	✓	✓	✓	
Eurostat	✓	✓	✓	✓
National Sources*	✓	✓	✓	✓

*The dimensional coverage of the national sources varies depending on the reporting country

year fixed effects. *DIST*, *COMLG* and *COL* are bilateral variables capturing geographical distance, a common official language, and a past colonial relationship between the source–host economy pair, respectively. Finally, compared to the specification in [Gouel et al. \(2012\)](#), the only modification we introduce is the inclusion of three economy-specific binary variables, each equal to one when either the source or host economy is Luxembourg (*LUX*), the Netherlands (*NLD*), or Hong Kong, China (*HKG*). They are included to account for the significant distortions in FDI statistics associated with these financial hub jurisdictions. We estimate the above specification separately for each sector. The sector definitions, along with their concordance to the GTAP classification and the 4th Revision of the International Standard Industrial Classification (ISIC Rev.4), are reported in [Table B.2](#) in the Appendix. The regression results are reported from [Table B.3](#) to [B.6](#) in the Appendix.

In the third step, we first apply the estimated coefficients to extrapolate for all missing bilateral–sector entries at the three-dimensional level. We then apply a quadratic optimisation procedure to reconcile the completed three-dimensional dataset with the aggregate totals reported in the previously compiled one- and two-dimensional intermediary datasets. These aggregate totals serve as targets (or constraints), and the optimisation routine minimises the quadratic deviations between the extrapolated values and the corresponding aggregates (the specific minimisation equation is presented in [Equation B.3](#) in the Appendix). Note that given the relatively broad economy coverage and higher reliability of the two-dimensional bilateral dataset, we impose the reported bilateral totals as binding constraints in the optimisation procedure.¹⁴

Finally, as most FDI statistics are attributed to the immediate investor economy, phantom

¹⁴An undesirable feature of the quadratic optimisation procedure is that it penalises large absolute deviations disproportionately. This is particularly problematic in the context of FDI stocks, given their cumulative nature and the substantial differences across economies. As a result, except for economy pairs whose bilateral totals are imposed as binding constraints, the optimisation procedure tends to allocate overly larger FDI values to large economies at the two-dimensional bilateral level. A similar size-related bias also arises at the three-dimensional bilateral–sector level, where larger sectors are systematically favoured in the optimisation process. To address this issue, we implement additional correction steps, see [Bekkers et al. \(2021b\)](#) for further discussion.

FDI arises when investment flows are routed through special purpose entities (SPEs) located in intermediary jurisdictions. These investments do not correspond to real economic activity and therefore artificially inflate FDI positions in these intermediary locations. We have attempted to mitigate these distortions at several stages of the data construction process, including the inclusion of economy-specific dummy variables for Luxembourg, the Netherlands, and Hong Kong, China, in the gravity specification, as well as the exclusion of FDI stocks undertaken by SPEs in the reported data where available. We further adjust the reconciled and balanced dataset using the probabilistic approach proposed in [Casella \(2019\)](#) to account for the remaining presence of Phantom FDI.

In short, the correction is based on an absorbing Markov chain that reattributes FDI from immediate investors to ultimate investors. Within this framework, each economy is assigned an exogenous conduit probability ranging from zero, indicating it is the ultimate destination for all hosted FDI stock, to one, indicating it is a fully transient jurisdiction in which all hosted FDI stock is phantom FDI and will be redirected to other jurisdictions.¹⁵ In each iteration, any phantom FDI identified in countries with a non-zero conduit probability is further redistributed, and the Markov chain process is repeated until it converges. The final output reduces the value of FDI stock in proportion to the magnitude of the conduit probability, thereby correcting distortions in the reported data. For example, in jurisdictions identified as tax havens with a conduit probability of one, the adjusted FDI stock is effectively reduced to zero.

Appendix B.2 Construction of the FAS Dataset

The data construction process of the FAS dataset largely mirrors that of the FDI stock dataset and prior work from [Fukui and Lakatos \(2012\)](#), which comprises data collection, extrapolation with gravity estimates, and final reconciliation and balancing. However, the procedure is adapted to reflect key differences between FAS and FDI stock statistics. In particular, FAS data are attributed to the ultimate investing economy rather than the immediate investing economy. In addition, classification as a foreign affiliate in the FAS statistics requires meeting an ownership threshold of 50 per cent, which is substantially higher than the 10 per cent threshold applied in FDI statistics. These features make FAS data more accurate and significantly more robust to the influence of SPEs in intermediary jurisdictions.

However, the more stringent reporting standards of FAS statistics entail a trade-off in terms of data coverage. As shown in Panel B of Table [B.1](#), FAS data are drawn primarily from Eurostat, a regional database, and the OECD, whose membership largely consists of developed economies and substantially overlaps with the Eurostat database. Given the significant under-representation of developing countries in the FAS statistics, we implement several additional steps to expand the dataset's coverage prior to conducting the gravity estimation. In addition to applying a mirroring technique similar to that used for the FDI stock data, we employ interpolation, as well as backcasting and forecasting based on three-year moving averages, to fill gaps in the time series.

¹⁵The exogenous conduit probabilities are assigned based on OECD tax haven classifications, reported SPE shares from FDI statistics, or regression-based estimates using GDP and outward FDI data. See [Casella \(2019\)](#) and [Bekkers et al. \(2021b\)](#) for further discussions.

Furthermore, we impose a direct link with the reported FDI stock data: if FDI stock is zero for a given bilateral–sectoral pair, the corresponding FAS value is also set to zero. Note that the last step accounts for a sizeable share of the observations, as zeros imputed from FDI account for more than 50 per cent of the three-dimensional FAS dataset. A detailed breakdown of the data by methodology flag is provided in Table B.7 in the Appendix.

The gravity specification applied to the three-dimensional FAS dataset is as follows:

$$\begin{aligned}
FAS_{ijt,k} = & \exp(\alpha_1 + \beta_1 \ln(Dist_{ij}) + \beta_2 Colony_{ij} + \beta_3 Contig_{ij} + \beta_4 Comlang_{ij} + \beta_5 \ln(VA_{it,k}) \\
& \beta_6 \ln(VA_{jt,k}) + \beta_7 \ln(GDPpc_{it}) + \beta_8 \ln(GDPpc_{jt}) + \beta_9 DevStatus_i \\
& + \beta_{10} DevStatus_j + \beta_{11} FTA_{ijt} + \beta_{13} WGI_{it} + \beta_{14} EU_{ijt} + \eta_t) \times \epsilon_{ijt,k}
\end{aligned} \tag{B.2}$$

Compared to the specification for FDI stock in Equation (B.1), the estimation for FAS incorporates several additional explanatory variables, including sector-specific value added, the World Bank’s Worldwide Governance Indicators, and an EU dummy. At the same time, it omits the three economy dummy variables, as FAS data are less susceptible to distortions arising from special purpose entities (SPEs). The sector-by-sector estimation results are presented from Table B.8 to Table B.11 of the Appendix, the estimated coefficients are subsequently used to extrapolate the remaining missing entries to complete the dataset at the three-dimensional level.

In the final step of reconciliation, due to the similar lack of data at the more aggregate datasets as targets, instead of a quadratic optimisation procedure, we adopt an RAS balancing procedure to reconcile FAS data across different dimensions. Specifically, the procedure is anchored on two targets/constraints: the total affiliate sales in a host economy with sector breakdown (two-dimensional sector) and the total affiliate sales originating from different home countries (two-dimensional bilateral). These two datasets correspond to the RAS row and column control totals, respectively for each host economy. The RAS is then implemented via an iterative procedure that scales the initial matrix using row and column multipliers until the row and column totals are satisfied. Note that we do not apply Casella (2019)’s probabilistic approach at the end, as discussed, FAS data are less affected by SPEs-related distortions.

Appendix B.3 Incorporating FDI stock & FAS into the GTAP Database

The reconciled FDI stock and FAS dataset covers more than 200 economies and 34 sectors, with its dimensionality largely determined the data structure of the OECD and Eurostat database. To ensure consistency with Version 11 of the GTAP database, which comprises 160 regions and 65 sectors, the economy dimension is first aggregated accordingly. However, aligning the sectoral dimension requires additional assumptions, as the 34 sectors must be mapped into the 65 more disaggregated sectors in GTAP.

For the FDI stock data, we follow Lakatos and Walmsley (2011) whereby FDI stock in each host economy is distributed across the 65 GTAP sectors using its sector capital stock shares from the GTAP database. In addition, because the model extension disaggregates the capital stock in the standard GTAP framework into FDI stock and a residual portfolio investment component,

the total FDI stock in each host economy is capped so that it does not exceed the total capital stock in the GTAP database. For FAS data, the sectoral disaggregation is based on each host economy's sectoral output structure inferred from the GTAP output matrix. Similarly, total FAS in each host economy is capped so that it does not exceed total sectoral sales in the GTAP database.

Finally, although we impose direct linkages between FDI stock and FAS in the data construction process by setting FAS to zero whenever FDI stock is zero, due to the many differences in reporting standards, gravity specification, and reconciliation procedure, there are inevitably cases where large foreign affiliate sales are associated with relatively low FDI stocks, and vice versa. These discrepancies are not problematic from a data perspective, as the FAS-to-FDI stock ratio naturally varies across industries, host countries, and even firms. From a modelling perspective, however, an excessively large FDI stock relative to FAS may generate negative FDI flows through the depreciation mechanism, which is undesirable. To address this issue, we impose a lower depreciation rate for FDI and introduce a minimum ratio between FDI stock and FAS.

Appendix B.4 Additional Results from Construction of FDI Stock and FAS Datasets

Table B.2: Sector List with Concordance to GTAP Database and ISIC Revision 4

Sector Description	Eurostat/OECD Code	ISIC Rev. 4	GTAP 11
Agriculture, forestry and fishing	A	01-03	1-14 (ag)
Mining and quarrying	B	05-09	15-18 (coailgas)
Manufacturing			
<i>Manufacture of food products; beverages and tobacco products</i>	C10_12	10-12	19-26 (foodbt)
<i>Manufacture of textiles and wearing apparel</i>	C13_14	13-14	27-28 (texwap)
<i>Manufacture of wood, paper, printing and reproduction</i>	C16_18	16-18	30-31 (lumppp)
<i>Manufacture of coke and refined petroleum products</i>	C19	19	32 (p_c)
<i>Manufacture of chemicals and chemical products</i>	C20	20	33 (chm)
<i>Manufacture of basic pharmaceutical products and pharmaceutical preparations</i>	C21	21	34 (bph)
<i>Manufacture of rubber and plastics products</i>	C22	22	35 (rpp)
<i>Manufacture of basic metals and fabricated metal products, except machinery and equipment</i>	C24_25	24-25	37-39 (metals)
<i>Manufacture of computer, electronic and optical products</i>	C26	26	40 (ele)
<i>Manufacture of machinery and equipment n.e.c.</i>	C28	28	42 (ome)
<i>Manufacture of motor vehicles, trailers and semi-trailers</i>	C29	29	43 (mvh)
<i>Manufacture of other transport equipment</i>	C30	30	44 (otn)
<i>Other manufacturing</i>	C_OTH	15, 23, 27, 31, 32, 33	29,36,41,45 (otherman)
Electricity, gas, steam and air conditioning supply	D35	35	46-47 (elygas)
Water supply; sewerage, waste management and remediation activities	E	36-39	48 (wtr)
Construction	F	41-43	49 (cns)
Wholesale and retail trade; repair of motor vehicles and motorcycles	G	45-47	50 (trd)
Accommodation and food service activities	I	55-56	51 (afs)
Transportation and storage			
<i>Land transport and transport via pipelines</i>	H49	49	52 (otp)
<i>Water transport</i>	H50	50	53 (wtp)
<i>Air transport</i>	H51	51	54 (atp)
<i>Warehousing and support activities for transportation</i>	H52	52	55 (whs)
<i>Postal and courier activities</i>	H53	53	56 (cmn)
Information and communication	J	58-63	56 (cmn)
Financial and insurance activities			
<i>Financial service activities, except insurance and pension funding</i>	K64	64	57 (ofi)
<i>Insurance, reinsurance and pension funding, except compulsory social security</i>	K65	65	58 (ins)
Real estate activities	L	68	59 (rsa)
Professional, scientific and technical activities	M	69-75	60 (obs)
Administrative and support service activities	N	77-82	60 (obs)
Arts, entertainment and recreation	R	90-93	61 (ros)
Other service activities	S	94-96	61 (ros)
Public administration; activities of households and of extraterritorial organisations	O_T_U	84, 97-99	62 (osg)
Education	P85	85	63 (edu)
Human health and social work activities	Q	86-88	64 (hht)
Private real estate activities	PRV_RE	n.a.	65 (dwe)

n.a. - not available

Table B.3: FDI Sector-by-Sector Gravity Estimation

VARIABLES	(1) ag (1-14)	(2) coaoilgas (15-18)	(3) foodbt (19-26)	(4) texwap (27-28)	(5) lumppp (30-31)	(6) p_c (32)	(7) chm (33)	(8) bph (34)	(9) rpp (35)
ln_DIST	-0.266* (0.142)	-0.0718 (0.0718)	-0.339*** (0.0894)	-0.543*** (0.127)	-0.381*** (0.0676)	-0.741*** (0.148)	-0.259*** (0.0759)	-0.166 (0.120)	-0.950*** (0.0770)
ln_GDP_host	0.271** (0.138)	0.593*** (0.0626)	0.689*** (0.0534)	1.091*** (0.0781)	0.478*** (0.0494)	0.832*** (0.125)	0.926*** (0.0572)	0.518*** (0.103)	0.767*** (0.0412)
ln_GDP_source	0.911*** (0.0600)	0.760*** (0.0492)	0.703*** (0.0581)	0.807*** (0.0540)	0.285*** (0.0427)	0.609*** (0.0688)	0.674*** (0.0457)	0.597*** (0.0591)	0.871*** (0.0497)
ln_GDPpc_host	1.862*** (0.406)	1.033*** (0.223)	1.297*** (0.249)	-0.461*** (0.136)	1.670*** (0.412)	1.954*** (0.465)	2.836*** (0.450)	1.760*** (0.402)	0.124 (0.251)
ln_GDPpc_source	0.397** (0.166)	1.086*** (0.160)	0.760*** (0.177)	-0.210 (0.145)	1.550*** (0.142)	1.594*** (0.459)	1.367*** (0.223)	1.727*** (0.273)	0.660*** (0.158)
Developing Country_host	4.421*** (0.659)	2.613*** (0.334)	2.191*** (0.370)	-0.261 (0.322)	2.921*** (0.569)	3.299*** (0.729)	3.871*** (0.695)	1.509*** (0.434)	1.271*** (0.405)
Developing Country_source	0.138 (0.414)	1.783*** (0.282)	-0.476 (0.324)	-1.736*** (0.315)	-0.426* (0.235)	1.010 (0.652)	-0.703** (0.351)	-1.700*** (0.359)	0.190 (0.350)
Common Language	0.692** (0.294)	1.414*** (0.181)	0.283 (0.175)	0.730** (0.291)	0.525** (0.229)	1.620*** (0.316)	0.445** (0.210)	-0.208 (0.316)	0.659** (0.284)
Colonial Relationship	-0.639*** (0.224)	1.039*** (0.170)	1.159*** (0.137)	0.284 (0.420)	0.671** (0.318)	0.0168 (0.284)	0.137 (0.164)	1.901*** (0.239)	0.447** (0.203)
LUX Dummy	0.184 (0.811)	1.111*** (0.394)	1.229*** (0.303)	3.522*** (0.330)	-0.330 (0.512)	1.053** (0.468)	1.765*** (0.480)	1.115** (0.513)	2.080*** (0.330)
NLD Dummy	0.399* (0.222)	1.804*** (0.226)	2.775*** (0.127)	1.262*** (0.344)	1.885*** (0.179)	3.373*** (0.251)	3.175*** (0.121)	2.654*** (0.423)	0.380** (0.167)
HKG Dummy	1.706*** (0.353)	2.317*** (0.308)	0.758** (0.369)	2.728*** (0.391)	-0.710 (0.563)	-3.111*** (0.444)	0.946** (0.372)	-2.294*** (0.479)	2.242*** (0.615)
Observations	7,060	12,693	7,907	7,936	7,447	8,100	7,917	7,006	7,192
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.386	0.389	0.531	0.446	0.458	0.529	0.565	0.566	0.508

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.4: FDI Sector-by-Sector Gravity Estimation (Continued)

VARIABLES	(1) metals (37-39)	(2) ele (40)	(3) ome (42)	(4) mvh (43)	(5) otn (44)	(6) otherman (29/36/41/45)	(7) elygas (46-47)	(8) wtr (48)	(9) cns (49)
ln_DIST	-0.440*** (0.0548)	-0.130** (0.0637)	-0.404*** (0.0456)	-0.251*** (0.0851)	-0.973*** (0.109)	-0.239*** (0.0690)	-1.028*** (0.0895)	-1.155*** (0.0854)	-0.795*** (0.0586)
ln_GDP_host	0.667*** (0.0294)	1.052*** (0.0709)	0.748*** (0.0366)	0.874*** (0.0506)	1.296*** (0.0860)	0.884*** (0.0708)	0.669*** (0.0592)	0.734*** (0.0701)	0.663*** (0.0352)
ln_GDP_source	0.617*** (0.0362)	0.667*** (0.0532)	0.619*** (0.0413)	0.876*** (0.0472)	1.039*** (0.0621)	0.700*** (0.0449)	0.897*** (0.0505)	0.915*** (0.0556)	0.608*** (0.0467)
ln_GDPpc_host	-0.182* (0.103)	0.773*** (0.210)	0.529* (0.286)	-0.403*** (0.131)	-0.497** (0.237)	0.805*** (0.282)	-0.275** (0.134)	-0.408*** (0.142)	-0.169** (0.0770)
ln_GDPpc_source	0.778*** (0.137)	0.958*** (0.214)	1.320*** (0.166)	0.280* (0.155)	-0.479 (0.333)	0.167 (0.187)	-0.434*** (0.158)	0.125 (0.167)	0.313* (0.180)
Developing Country_host	0.310 (0.253)	0.902*** (0.327)	1.119*** (0.424)	-0.161 (0.381)	-0.530 (0.481)	1.255*** (0.457)	0.108 (0.301)	0.0881 (0.282)	0.712*** (0.162)
Developing Country_source	-0.336 (0.400)	-0.558 (0.441)	-1.066*** (0.280)	-2.085*** (0.365)	-3.441*** (0.772)	-1.473*** (0.399)	-2.258*** (0.376)	-3.338*** (0.392)	-0.490* (0.297)
Common Language	0.183 (0.157)	-0.348 (0.266)	-0.288** (0.122)	-0.255 (0.342)	0.483** (0.211)	-0.0341 (0.180)	1.096*** (0.207)	0.321* (0.190)	0.809*** (0.168)
Colonial Relationship	0.172 (0.171)	0.564** (0.241)	0.822*** (0.121)	-0.824*** (0.228)	0.776*** (0.225)	0.806*** (0.214)	0.438 (0.273)	0.829*** (0.215)	0.436** (0.191)
LUX Dummy	2.608*** (0.277)	1.683*** (0.444)	1.320*** (0.362)	3.054*** (0.367)	5.372*** (0.362)	3.284*** (0.318)	2.546*** (0.292)	2.288*** (0.321)	1.612*** (0.297)
NLD Dummy	0.949*** (0.126)	2.141*** (0.199)	1.909*** (0.109)	1.507*** (0.182)	-0.654** (0.295)	1.726*** (0.202)	0.886*** (0.231)	0.527*** (0.192)	0.654*** (0.167)
HKG Dummy	-0.823*** (0.229)	1.192*** (0.282)	0.198 (0.202)	0.324 (0.378)	-2.108*** (0.587)	0.0321 (0.258)	1.705*** (0.312)	3.447*** (0.516)	1.602*** (0.361)
Observations	7,425	11,903	7,809	7,508	7,547	7,392	12,733	12,461	12,547
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.539	0.675	0.676	0.562	0.710	0.677	0.540	0.521	0.466

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.5: FDI Sector-by-Sector Gravity Estimation (Continued)

VARIABLES	(1) trd (50)	(2) afs (51)	(3) otp (52)	(4) wtp (53)	(5) atp (54)	(6) whs (55)	(7) cmn (56)	(8) ofi (57)	(9) ins (58)	(10) rsa (59)
ln_DIST	-0.404*** (0.0562)	-0.649*** (0.0643)	-1.032*** (0.116)	-0.593*** (0.0890)	-0.937*** (0.150)	-0.492*** (0.0612)	-0.446*** (0.0711)	-0.237*** (0.0629)	-0.442*** (0.0687)	-0.971*** (0.0656)
ln_GDP_host	0.647*** (0.0537)	0.804*** (0.0552)	0.752*** (0.0799)	0.0899 (0.189)	0.777*** (0.138)	0.696*** (0.0353)	0.974*** (0.0687)	0.508*** (0.0467)	0.845*** (0.0475)	0.804*** (0.0388)
ln_GDP_source	0.822*** (0.0390)	0.759*** (0.0447)	0.725*** (0.0677)	0.569*** (0.0939)	1.090*** (0.164)	0.648*** (0.0407)	0.678*** (0.0736)	0.784*** (0.0544)	0.790*** (0.0402)	0.789*** (0.0403)
ln_GDPpc_host	0.510*** (0.0961)	-0.00858 (0.103)	-0.0106 (0.244)	0.439* (0.233)	-0.408 (0.378)	-0.571*** (0.134)	0.403 (0.464)	0.445*** (0.113)	0.587*** (0.205)	-0.393*** (0.0719)
ln_GDPpc_source	0.864*** (0.125)	0.330** (0.155)	0.885*** (0.213)	1.521*** (0.214)	-0.387 (0.620)	0.619*** (0.130)	1.227*** (0.412)	1.814*** (0.179)	0.481*** (0.139)	0.556*** (0.0859)
Developing Country_host	0.598*** (0.138)	0.452** (0.215)	1.989** (0.803)	-1.790*** (0.363)	-0.644 (0.966)	-1.376*** (0.376)	1.446** (0.662)	-0.108 (0.236)	-0.0667 (0.337)	-0.00641 (0.170)
Developing Country_source	0.553** (0.280)	-0.381 (0.314)	-0.252 (0.491)	-2.382*** (0.585)	-3.243** (1.298)	-1.687*** (0.340)	1.021* (0.611)	1.729*** (0.306)	-3.430*** (0.317)	0.255 (0.194)
Common Language	0.915*** (0.138)	0.959*** (0.188)	-0.782** (0.356)	-1.891*** (0.572)	0.197 (0.408)	0.478*** (0.145)	0.532 (0.427)	0.656*** (0.116)	0.459*** (0.165)	0.626*** (0.158)
Colonial Relationship	-0.327* (0.183)	1.342*** (0.169)	-2.031*** (0.544)	-1.210*** (0.378)	1.808** (0.735)	-0.0588 (0.198)	-0.506 (0.331)	0.193 (0.146)	0.918*** (0.192)	-0.127 (0.125)
LUX Dummy	2.054*** (0.203)	2.377*** (0.321)	2.051*** (0.444)	-0.614 (0.436)	0.831 (1.007)	2.993*** (0.221)	3.660*** (0.295)	2.149*** (0.189)	0.805** (0.367)	2.235*** (0.146)
NLD Dummy	1.444*** (0.0938)	-0.154 (0.186)	2.588*** (0.546)	0.688** (0.323)	1.892*** (0.512)	1.681*** (0.173)	-0.0498 (0.406)	2.836*** (0.115)	1.475*** (0.165)	0.549*** (0.126)
HKG Dummy	2.460*** (0.190)	1.898*** (0.225)	0.983* (0.531)	0.526 (0.425)	-4.384*** (0.906)	1.470*** (0.376)	3.501*** (0.251)	0.945*** (0.356)	0.313 (0.337)	2.392*** (0.196)
Observations	12,167	12,723	7,698	7,627	7,701	7,026	13,008	7,396	7,533	8,314
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.655	0.566	0.553	0.315	0.471	0.614	0.622	0.760	0.699	0.620

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table B.6: FDI Sector-by-Sector Gravity Estimation (Continued)

VARIABLES	(1) obs (60)	(2) ros (61)	(3) osg (62)	(4) edu (63)	(5) hht (64)	(6) dwe (65)
ln_DIST	-0.677*** (0.105)	-0.308** (0.142)	-1.033*** (0.284)	-0.960*** (0.125)	-0.474** (0.184)	-1.269*** (0.109)
ln_GDP_host	0.610*** (0.0885)	0.480*** (0.136)	0.602*** (0.211)	1.374*** (0.150)	0.762*** (0.0838)	1.232*** (0.0641)
ln_GDP_source	0.900*** (0.0608)	0.653*** (0.0741)	0.105 (0.122)	1.030*** (0.128)	0.669*** (0.0878)	1.340*** (0.0738)
ln_GDPpc_host	2.449*** (0.483)	0.210 (0.372)	-0.658 (0.663)	-1.216*** (0.383)	-0.0534 (0.210)	-1.201*** (0.256)
ln_GDPpc_source	2.371*** (0.407)	0.000298 (0.0936)	1.302** (0.513)	1.213*** (0.409)	0.992*** (0.174)	0.200 (0.174)
Developing Country_host	3.608*** (0.765)	2.189*** (0.598)	-1.926 (1.415)	-2.190* (1.316)	0.880 (0.628)	-3.827*** (0.619)
Developing Country_source	3.860*** (0.623)	1.527*** (0.179)	-0.951 (0.661)	0.538 (0.599)	-0.0293 (0.610)	-1.385*** (0.374)
Common Language	0.364 (0.368)	-0.240 (0.381)	3.345*** (0.601)	0.538 (0.796)	1.641*** (0.320)	0.602*** (0.183)
Colonial Relationship	-1.000*** (0.380)	-0.203 (0.427)	-0.0682 (0.937)	0.179 (0.406)	0.564* (0.304)	-0.894* (0.459)
LUX Dummy	2.649*** (0.321)	2.348*** (0.655)	-3.320** (1.413)	3.909*** (0.694)	2.404*** (0.386)	2.979*** (0.247)
NLD Dummy	0.285 (0.403)	0.308 (0.342)	-2.050 (1.248)	1.059* (0.578)	1.282*** (0.496)	-0.456** (0.199)
HKG Dummy	4.205*** (0.255)	2.996*** (0.314)	-0.946 (0.983)	1.045* (0.595)	-5.459*** (0.675)	1.968*** (0.351)
Observations	12,658	13,266	6,286	7,929	7,978	7,728
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.595	0.302	0.605	0.577	0.506	0.698

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Quadratic Optimisation Procedure

For a given sector k , host economy i and source economy j , the quadratic optimisation is formulated as follows, where w denotes the reliability weights assigned to the different intermediary datasets:

Minimise:

$$\sum_{ijk} w_{ijk} (FDI_{ijk}^1 - FDI_{ijk}^0)^2 + \sum_{ik} w_{ik} (FDI_{ik}^1 - FDI_{ik}^0)^2 + \sum_i w_i (FDI_i^1 - FDI_i^0)^2 + w (FDI^1 - FDI^0)^2 \quad (\text{B.3})$$

Subject to:

$$\left. \begin{array}{ll} \sum_k FDI_{ijk}^1 = FDI_{ij} & (\text{Bilateral}) \\ \sum_j FDI_{ijk}^1 = FDI_{ik} & (\text{Sector-Inward}) \\ \sum_i FDI_{ijk}^1 = FDI_{jk} & (\text{Sector-Outward}) \\ \sum_{jk} FDI_{ijk}^1 = FDI_i & (\text{Total-Outward}) \\ \sum_{ik} FDI_{ijk}^1 = FDI_j & (\text{Total-Inward}) \\ \sum_{ijk} FDI_{ijk}^1 = FDI & (\text{Total World}) \end{array} \right\} \text{Adding-up Constraints}$$

$$\sum_k FDI_{ijk}^1 = FDI_{ij}^0 \quad (\text{Fixed Bilateral})$$

where FDI_{ijk}^0 denotes the extrapolated three-dimensional dataset while FDI_{ij}^0 , FDI_{ik}^0 , and FDI_i^0 denote the two-dimensional bilateral, sector-inward, and one-dimensional inward intermediary dataset, respectively. FDI^1 denotes the final optimised values obtained from the quadratic optimisation procedure.

Table B.7: Three-dimensional FATS Data, Breakdown by Methodology Flag

Methodology	Inward		Outward	
	#	Share	#	Share
Reported				
agr	41,273	1.05	1,841	0.10
agr2	1,518	0.04	2,315	0.13
R_EUR	244,361	6.20	234,263	13.14
R_NAT	1,122	0.03	2,794	0.16
R_OECD	5,423	0.14	1,362	0.08
Simple derivation				
E0	7,462	0.19	974,594	54.66
World derivation				
E0.1	56,716	1.44	308,244	17.29
Mirroring				
M_E0	862,524	21.90	6,507	0.36
M_E0.1	277,134	7.04	55,675	3.12
M_EUR	234,383	5.95	154,777	8.68
M_NAT	2,423	0.06	1,004	0.06
M_OECD	1,353	0.03	3,980	0.22
Mirroring (Shaar method)				
Mb_E0	3	0.00	NA	NA
Mb_E0.1	4	0.00	NA	NA
Mb_EUR	505	0.01	333	0.02
Mb_NAT	7	0.00	2	0.00
FDI				
E0.21	57,631	1.46	12,275	0.69
E0.22	1,610	0.04	541	0.03
E0.23	2,135,639	54.22	NA	NA
Number of enterprises				
E0.3	7,291	0.19	16,861	0.95
Correction negative				
E6	1	0.00	NA	NA
Adjustements				
E7	363	0.01	3,671	0.21
E7.1	330	0.01	2,105	0.12

Table B.8: FAS Sector-by-Sector Gravity Estimation

VARIABLES	(1) A	(2) B	(3) C10-C12	(4) C13-C14	(5) C16-C18	(6) C19	(7) C20	(8) C21	(9) C22
$\ln(Dist_{ij})$	0.070 (0.140)	-0.388*** (0.013)	-0.448*** (0.009)	-0.495*** (0.023)	-0.407*** (0.008)	-0.765*** (0.035)	-0.549*** (0.013)	-0.290*** (0.010)	-0.256*** (0.008)
$Contig_{ij}$	0.266 (0.407)	-0.696*** (0.044)	0.557*** (0.022)	0.383*** (0.047)	0.246*** (0.017)	-1.603*** (0.109)	0.152*** (0.032)	-0.534*** (0.028)	0.543*** (0.016)
$CommLang_{ij}$	2.788*** (0.250)	0.991*** (0.024)	0.271*** (0.019)	-0.012 (0.042)	0.383*** (0.015)	1.462*** (0.080)	-0.009 (0.027)	1.140*** (0.017)	-0.247*** (0.015)
$Colony_{ij}$	-1.813*** (0.441)	1.390*** (0.030)	0.588*** (0.019)	1.088*** (0.040)	1.000*** (0.016)	-0.183* (0.094)	0.279*** (0.027)	-0.013 (0.018)	0.739*** (0.015)
$\ln(VA_{ist})$	0.894*** (0.067)	0.930*** (0.007)	0.750*** (0.004)	0.804*** (0.009)	0.817*** (0.004)	1.168*** (0.020)	1.047*** (0.007)	0.958*** (0.005)	0.860*** (0.003)
$\ln(VA_{jst})$	1.021*** (0.068)	0.631*** (0.006)	0.902*** (0.004)	0.908*** (0.011)	0.751*** (0.004)	1.062*** (0.019)	1.133*** (0.007)	1.224*** (0.005)	0.963*** (0.004)
$\ln(GDPpc_{it})$	0.554** (0.231)	-0.098*** (0.017)	0.617*** (0.017)	0.051 (0.036)	0.009 (0.017)	0.546*** (0.102)	0.213*** (0.028)	1.304*** (0.022)	0.350*** (0.015)
$\ln(GDPpc_{jt})$	1.175*** (0.187)	0.995*** (0.019)	2.533*** (0.020)	1.500*** (0.040)	1.975*** (0.016)	2.261*** (0.059)	1.816*** (0.027)	2.535*** (0.023)	1.438*** (0.015)
$DevStatus_i$	0.858** (0.361)	-0.275*** (0.030)	0.959*** (0.017)	-0.073* (0.043)	0.206*** (0.015)	0.757*** (0.078)	-0.171*** (0.030)	-0.467*** (0.022)	0.132*** (0.016)
$DevStatus_j$	0.034 (0.386)	-0.727*** (0.029)	0.761*** (0.023)	-0.003 (0.051)	-0.119*** (0.020)	2.209*** (0.074)	-0.460*** (0.037)	0.297*** (0.024)	-0.469*** (0.022)
WGI_{ij}	0.491 (0.316)	0.414*** (0.020)	-0.212*** (0.018)	-0.360*** (0.040)	0.350*** (0.019)	0.653*** (0.104)	-0.039 (0.028)	-0.832*** (0.019)	-0.168*** (0.015)
EU_{ijt}	0.786** (0.346)	0.788*** (0.047)	0.043** (0.019)	0.525*** (0.045)	1.172*** (0.017)	-0.322*** (0.084)	0.170*** (0.028)	0.297*** (0.022)	0.937*** (0.016)
Constant	-36.748*** (3.204)	-17.267*** (0.306)	-44.024*** (0.321)	-29.825*** (0.625)	-33.079*** (0.272)	-46.648*** (1.369)	-37.696*** (0.461)	-58.689*** (0.401)	-34.040*** (0.237)
R2 adj	0.61	0.504	0.48	0.308	0.329	0.369	0.563	0.441	0.404
Observations	177,632	193,867	184,668	186,164	185,636	198,934	186,923	189,093	187,132

Robust standard errors are clustered by country pair, all estimations include year dummies

***p < 0.01; **p < 0.05; *p < 0.1

Table B.9: FAS Sector-by-Sector Gravity Estimation (continued)

VARIABLES	(1) C24-C25	(2) C26	(3) C28	(4) C29	(5) C30	(6) C(OTH)	(7) D35	(8) E	(9) F
$\ln(Dist_{ij})$	-0.567*** (0.011)	-0.434*** (0.012)	-0.301*** (0.006)	-0.190*** (0.010)	-0.738*** (0.027)	-0.349*** (0.006)	-0.953*** (0.012)	-0.093*** (0.020)	-0.272*** (0.008)
$Contig_{ij}$	0.271*** (0.027)	-1.006*** (0.037)	0.414*** (0.015)	0.137*** (0.023)	0.280*** (0.059)	0.708*** (0.013)	-0.263*** (0.021)	0.815*** (0.039)	0.731*** (0.019)
$CommLang_{ij}$	-0.052** (0.023)	0.898*** (0.017)	-0.299*** (0.011)	-0.016 (0.020)	-0.353*** (0.058)	-0.137*** (0.011)	-0.072*** (0.022)	-0.129*** (0.035)	0.504*** (0.016)
$Colony_{ij}$	0.905*** (0.024)	-0.929*** (0.031)	0.352*** (0.013)	0.020 (0.021)	1.602*** (0.049)	1.121*** (0.010)	1.174*** (0.023)	1.372*** (0.035)	0.874*** (0.017)
$\ln(VA_{ist})$	0.907*** (0.005)	0.877*** (0.005)	0.897*** (0.003)	1.061*** (0.004)	1.293*** (0.018)	0.884*** (0.002)	1.001*** (0.006)	0.721*** (0.010)	0.693*** (0.004)
$\ln(VA_{jst})$	0.610*** (0.005)	1.252*** (0.007)	1.030*** (0.003)	1.503*** (0.006)	0.933*** (0.016)	0.892*** (0.002)	0.968*** (0.006)	0.810*** (0.009)	0.695*** (0.004)
$\ln(GDPpc_{it})$	-0.046** (0.020)	-0.622*** (0.017)	0.308*** (0.011)	-0.091*** (0.017)	0.652*** (0.079)	0.044*** (0.009)	0.304*** (0.024)	-0.141*** (0.041)	0.234*** (0.019)
$\ln(GDPpc_{jt})$	1.645*** (0.019)	0.767*** (0.026)	2.003*** (0.013)	0.270*** (0.022)	1.798*** (0.055)	1.643*** (0.011)	0.987*** (0.024)	1.058*** (0.037)	0.903*** (0.015)
$DevStatus_i$	-0.133*** (0.026)	0.592*** (0.022)	0.231*** (0.012)	0.192*** (0.018)	0.658*** (0.058)	-0.110*** (0.011)	0.002 (0.020)	0.429*** (0.033)	0.392*** (0.016)
$DevStatus_j$	0.368*** (0.025)	-1.884*** (0.062)	-0.090*** (0.017)	-2.340*** (0.046)	0.498*** (0.056)	-0.608*** (0.015)	-2.176*** (0.045)	-1.379*** (0.056)	-0.755*** (0.023)
WGI_{ij}	-0.014 (0.024)	1.452*** (0.023)	0.166*** (0.012)	0.144*** (0.018)	0.038 (0.076)	-0.064*** (0.010)	-0.469*** (0.024)	0.768*** (0.045)	0.467*** (0.020)
EU_{ijt}	0.239*** (0.024)	-0.527*** (0.032)	0.415*** (0.013)	1.221*** (0.025)	0.819*** (0.063)	0.633*** (0.011)	1.567*** (0.025)	0.745*** (0.042)	1.046*** (0.018)
Constant	-25.069*** (0.323)	-20.140*** (0.335)	-40.061*** (0.201)	-26.163*** (0.296)	-43.868*** (1.098)	-30.790*** (0.167)	-20.547*** (0.376)	-20.503*** (0.614)	-21.306*** (0.267)
R2 adj	0.375	0.296	0.598	0.458	0.309	0.618	0.217	0.125	0.352
Observations	186,120	192,170	188,199	189,937	192,093	183,040	194,373	194,563	192,577

Robust standard errors are clustered by country pair, all estimations include year dummies

***p < 0.01; **p < 0.05; *p < 0.1

Table B.10: FAS Sector-by-Sector Gravity Estimation (continued)

VARIABLES	(1) G	(2) H49	(3) H50	(4) H51	(5) H52	(6) H53	(7) I	(8) J	(9) K64
<i>ln(Dist_{ij})</i>	-0.300*** (0.006)	-0.671*** (0.009)	-0.540*** (0.024)	-0.758*** (0.023)	-0.700*** (0.009)	-0.911*** (0.301)	-0.419*** (0.010)	-0.273*** (0.009)	-0.570*** (0.016)
<i>Contig_{ij}</i>	0.175*** (0.016)	0.423*** (0.016)	-0.454*** (0.069)	-0.950*** (0.052)	0.127*** (0.020)	0.964 (0.618)	0.448*** (0.023)	-0.265*** (0.023)	0.285*** (0.034)
<i>CommLang_{ij}</i>	0.281*** (0.012)	-0.238*** (0.016)	-0.039 (0.058)	0.623*** (0.052)	0.094*** (0.018)	-0.334 (0.494)	-0.263*** (0.020)	0.760*** (0.017)	-0.072** (0.029)
<i>Colony_{ij}</i>	-0.017 (0.015)	0.936*** (0.018)	0.429*** (0.063)	-0.364*** (0.085)	-0.007 (0.023)	0.043 (0.648)	0.998*** (0.018)	-0.011 (0.018)	0.813*** (0.028)
<i>ln(VA_{ist})</i>	0.826*** (0.003)	0.735*** (0.005)	0.799*** (0.012)	0.777*** (0.013)	0.860*** (0.005)	1.095*** (0.212)	0.969*** (0.005)	0.730*** (0.004)	1.049*** (0.008)
<i>ln(VA_{jst})</i>	1.019*** (0.003)	1.019*** (0.005)	0.989*** (0.013)	1.158*** (0.014)	0.967*** (0.005)	1.943*** (0.210)	0.978*** (0.005)	1.013*** (0.004)	1.008*** (0.007)
<i>ln(GDPpc_{it})</i>	0.557*** (0.014)	0.227*** (0.017)	1.487*** (0.049)	1.273*** (0.063)	0.103*** (0.017)	-0.335 (0.780)	-0.090*** (0.024)	0.854*** (0.019)	0.651*** (0.034)
<i>ln(GDPpc_{jt})</i>	1.170*** (0.013)	1.580*** (0.019)	1.432*** (0.049)	-0.148*** (0.038)	1.487*** (0.018)	4.066*** (1.053)	1.928*** (0.021)	1.351*** (0.019)	0.405*** (0.022)
<i>DevStatus_i</i>	0.108*** (0.014)	0.774*** (0.015)	0.601*** (0.046)	1.141*** (0.038)	0.161*** (0.018)	1.784*** (0.539)	0.383*** (0.018)	0.525*** (0.016)	-0.674*** (0.029)
<i>DevStatus_j</i>	-0.344*** (0.017)	-0.625*** (0.022)	-1.205*** (0.081)	-1.300*** (0.061)	-0.683*** (0.025)	-1.534 (1.574)	0.518*** (0.024)	0.178*** (0.018)	-0.692*** (0.032)
<i>WGI_{ij}</i>	0.228*** (0.013)	0.110*** (0.018)	-0.819*** (0.042)	0.406*** (0.060)	0.411*** (0.019)	2.046** (0.969)	0.542*** (0.025)	-0.474*** (0.018)	-0.949*** (0.034)
<i>EU_{ijt}</i>	0.790*** (0.014)	1.580*** (0.019)	-0.404*** (0.053)	1.929*** (0.056)	0.170*** (0.018)	1.853** (0.799)	0.656*** (0.023)	0.921*** (0.020)	0.677*** (0.034)
Constant	-31.095*** (0.226)	-30.593*** (0.303)	-41.715*** (0.851)	-25.528*** (0.858)	-26.763*** (0.305)	-69.329*** (16.300)	-33.123*** (0.353)	-33.813*** (0.310)	-22.481*** (0.473)
R2 adj	0.634	0.471	0.242	0	0.522	0.723	0.511	0.544	0.355
Observations	189,596	189,112	193,405	192,770	188,881	192,740	192,555	189,662	189,662

Robust standard errors are clustered by country pair, all estimations include year dummies

***p < 0.01; **p < 0.05; *p < 0.1

Table B.11: FAS Sector-by-Sector Gravity Estimation (continued)

VARIABLES	(1) K65	(2) K66	(3) L	(4) M	(5) N	(6) P85	(7) Q	(8) R	(9) S
<i>ln(Dist_{ij})</i>	-0.402*** (0.010)	-0.593*** (0.041)	-0.455*** (0.011)	-0.218*** (0.007)	-0.371*** (0.008)	0.892*** (0.038)	-0.329*** (0.014)	-0.365*** (0.022)	-0.087*** (0.017)
<i>Contig_{ij}</i>	0.689*** (0.022)	0.809*** (0.093)	0.786*** (0.025)	-0.037* (0.020)	0.202*** (0.018)	1.083*** (0.090)	1.368*** (0.030)	0.163*** (0.044)	0.631*** (0.043)
<i>CommLang_{ij}</i>	0.160*** (0.017)	-0.290*** (0.070)	-0.027 (0.023)	0.564*** (0.014)	0.130*** (0.016)	0.913*** (0.074)	0.294*** (0.027)	0.564*** (0.044)	0.500*** (0.042)
<i>Colony_{ij}</i>	0.544*** (0.018)	0.947*** (0.066)	0.595*** (0.025)	0.445*** (0.015)	0.618*** (0.017)	0.736*** (0.073)	0.739*** (0.031)	1.798*** (0.043)	0.195*** (0.044)
<i>ln(VA_{ist})</i>	1.143*** (0.005)	0.996*** (0.020)	0.782*** (0.005)	0.818*** (0.004)	0.719*** (0.004)	0.666*** (0.016)	0.745*** (0.006)	0.600*** (0.008)	0.714*** (0.006)
<i>ln(VA_{jst})</i>	1.091*** (0.005)	1.167*** (0.019)	0.618*** (0.005)	0.840*** (0.003)	0.843*** (0.004)	1.119*** (0.023)	1.189*** (0.008)	0.772*** (0.011)	0.941*** (0.010)
<i>ln(GDPpc_{it})</i>	0.608*** (0.023)	-0.663*** (0.080)	-0.035 (0.026)	0.179*** (0.019)	0.533*** (0.020)	0.771*** (0.062)	1.020*** (0.031)	0.488*** (0.039)	0.949*** (0.027)
<i>ln(GDPpc_{jt})</i>	0.513*** (0.016)	1.243*** (0.065)	1.969*** (0.022)	1.488*** (0.016)	1.985*** (0.019)	3.068*** (0.099)	1.863*** (0.037)	1.557*** (0.038)	2.665*** (0.043)
<i>DevStatus_i</i>	-0.993*** (0.022)	-2.072*** (0.112)	-0.171*** (0.025)	0.220*** (0.015)	0.405*** (0.015)	0.622*** (0.082)	1.215*** (0.030)	-0.013 (0.051)	0.765*** (0.035)
<i>DevStatus_j</i>	-0.750*** (0.022)	0.231*** (0.075)	0.467*** (0.024)	0.143*** (0.016)	0.285*** (0.017)	3.506*** (0.059)	1.778*** (0.025)	1.282*** (0.033)	2.444*** (0.028)
<i>WGI_{ij}</i>	-0.697*** (0.024)	0.256*** (0.087)	0.272*** (0.026)	0.341*** (0.018)	0.044** (0.019)	0.073 (0.055)	-0.448*** (0.027)	-0.579*** (0.038)	-0.604*** (0.026)
<i>EU_{ijt}</i>	1.390*** (0.021)	0.135 (0.090)	0.547*** (0.024)	0.620*** (0.017)	0.597*** (0.018)	3.457*** (0.095)	1.393*** (0.030)	1.445*** (0.048)	1.786*** (0.041)
Constant	-27.044*** (0.333)	-22.337*** (1.219)	-30.020*** (0.389)	-29.354*** (0.277)	-35.222*** (0.329)	-69.903*** (1.351)	-48.538*** (0.588)	-29.714*** (0.628)	-53.721*** (0.639)
R2 adj	0.322	0.338	0.511	0.63	0.683	0.575	0.363	0.315	0.391
Observations	190,457	190,916	191,136	189,464	189,002	191,420	189,107	191,623	189,660

Robust standard errors are clustered by country pair, all estimations include year dummies

***p < 0.01; **p < 0.05; *p < 0.1

Appendix C The Construction of the Sales Data

This appendix discusses how the sales data used in the gravity estimation is constructed.

Appendix C.1 Foreign Affiliate Sales (FAS)

When measuring the activities of multinational firms, many studies rely on FDI stock or flow data from multilateral databases. However, the reliability of FDI statistics has been increasingly questioned in recent literature. A key limitation is that most countries report inward FDI based on the immediate investor rather than the ultimate investor, thereby failing to capture the complex financing structures used by multinational firms. As a result, the presence of special purpose entities (SPEs)¹⁶ in tax havens and offshore financial centres would lead to geographical distortions and double counting in the FDI statistics¹⁷. Although recent efforts have aimed to distinguish between SPE and non-SPE investments and to report FDI by ultimate investor, such improvements in FDI reporting remain limited to a small number of developed countries, mainly within OECD and Eurostat datasets. Moreover, by definition, FDI statistics capture only the cross-border capital movements between affiliates and their parent companies. As a result, in host countries with well-developed financial markets, domestic sourcing of capital by multinationals would lead to an underestimation of affiliates' economic activities.

Consequently, we follow recent academic practice and adopt FAS as an alternative to FDI statistics. Unlike FDI, which relies on investment relationships as proxies, FAS comprise survey-level data that directly record operational details of foreign affiliates, thus providing a more accurate reflection of multinational corporations' activities. Moreover, FAS cover only entities that are majority foreign-controlled (over 50 per cent of voting rights, compared with the 10 per cent threshold used for FDI) and assign ownership according to their ultimate investors and destinations, thereby mitigating distortions from SPEs and tax haven jurisdictions.

We use bilateral inward and outward FAS data with further sector disaggregation, internally compiled at the WTO drawing from the Eurostat Foreign Affiliates Statistics Database, the OECD Foreign Affiliates Statistics Database, and various national sources such as the US Bureau of Economic Analysis (Wettstein et al., 2019). FAS statistics provide operational data across a range of firm-level indicators, including turnover, output, operating surplus, and number of employees. Although output data would be the most appropriate in representing the activities of foreign affiliates, turnover data are more widely available across surveys, allowing for broader data availability from the aforementioned databases. Conceptually, turnover and output are closely related in most sectors, as reflected in our data.¹⁸ Accordingly, we primarily use the turnover values, except in two service sectors, wholesale and finance, where output data are employed instead. In the remainder of this study, the terms output and turnover are used interchangeably.

¹⁶SPEs generally refer to entities with few employees or limited operational activity, and primarily serving as financial conduits for transmitting pass-through FDI

¹⁷For more discussions on the shortcomings of the FDI data, refer to Beugelsdijk et al. (2010)

¹⁸The main difference concerns changes in stocks of finished goods and work in progress; see the System of National Account 2008 for more details

To maximise coverage, we supplement the reported FAS data with mirrored values which treat outward FAS from the source economy as equivalent to inward FAS in the destination (host) economy. This procedure, however, can create overlapping observations where both mirrored and reported inward values exist, often with substantial discrepancies. For reconciliation, we give priority to reported inward values and only using mirror values to fill in the gaps. We assume that host countries should have stronger incentives to accurately measure inward FAS for taxation and regulatory objectives. Furthermore, mirrored values are only adopted when there is no inward data for the entire time period within a given economy-pair. This additional condition on data collection minimises potential volatility caused by mixing inward and mirrored values within time series. After integrating mirrored values, our dataset encompasses data from 77 host countries and 55 source countries. The limited economy coverage reflects the lack of a comprehensive global FAS database as our primary source of sectoral bilateral FAS data comes from the Eurostat, a regional database that is mainly comprised of information on European countries.

Appendix C.2 Construction of Domestic-Owned Sales

In [Heid et al. \(2021\)](#), the distinction between intra- and international trade flows is based on the location of the recipients, so any output not exported is classified as intra-national trade. In contrast, in the context of FAS statistics, the distinction depends on the ownership of the producing firms: the international component corresponds to sales by foreign affiliates, while the intra-national component corresponds to sales by domestically owned firms. In other words, we do not consider the final destinations of sales. For any given foreign affiliate, we make no distinction between output sold domestically in the host economy and output exported back to the source country or a third country.¹⁹

Since gross output in national account statistics is typically defined as the aggregate value of goods and services produced by all entities located in a given economy, output from domestically owned firms (i.e. domestic-owned sales) in each sector can be calculated as follows:

$$\text{Domestic-Owned Sales}_{itk} = \text{Gross Output}_{itk} - \text{Total Foreign Affiliate Sales}_{itk} \quad (\text{C.1})$$

The data on sectoral gross output at basic prices are collected from two sources. First, output data at the International Standard Industrial Classification (ISIC) one-digit section are collected from the United Nations Statistics Division (UNSD). To ensure consistency at the sectoral level, we only adopt output data under the 4th Revision of the ISIC. In addition, some countries only report output data under the 1993 System of National Account (SNA) conceptual framework while most other countries report under the 2008 version or both. We give preference to the 2008 framework when data under both versions are available. However, we also incorporate reporting under the 1993 framework to maximise the economy coverage.

¹⁹For further intuition, this contrasts with Mode three of service supply (commercial presence), which is restricted to output sold by foreign affiliates to consumers or firms within the host economy.

While data at the broadest ISIC one-digit level is sufficient to capture the primary (i.e. A – agriculture, forestry and fishing and B – mining and quarrying) and all service sectors, for the secondary (manufacturing) sector, we have collected more detailed ISIC two-digit divisional data from the OECD. In total, there are 24 ISIC two-digit divisions under the manufacturing sector and we have aggregated them into five groups, thus effectively splitting the overall manufacturing sector into five sub-sectors. Note that the data from the OECD adhere to the SNA 2008 framework²⁰ and they are reported in local currencies which we have converted into USD using annual average exchange rates from the World Bank.

Regarding the compilation of total foreign affiliate sales across sectors, while the direct aggregation of sectoral bilateral FAS data across all source countries might seem straightforward, we opt for officially reported aggregated FAS as it should account for missing values at the more disaggregated level due to confidentiality reasons. It is only in instances where aggregate FAS data are not available that we resort to manually aggregating the sectoral bilateral dataset to derive total FAS figures.

Finally, note that following Equation (C.1), the calculation of domestic-owned sales is contingent upon the availability of both gross output and total foreign affiliate sales. In the end, we acquired domestic-owned sales data for 54 out of the 77 countries where FAS data are available. These domestic-owned sales entries are subsequently appended to the sector bilateral FAS dataset and marked by setting $i = j$. Furthermore, the border dummy variable is also constructed at this stage and entries for domestic-owned sales are assigned a value of zero.

²⁰For a few European countries, their output data are compiled according to the European System of Accounts 2010 which is based on and is broadly consistent with the 2008 SNA

Appendix D Additional Results for the Gravity

Table D.1: Cross-sector Gravity Estimation

	(1)	(2)	(3)
	Agri & Mining	Manufacturing	Services
Investment Facilitation Index * Border	6.085*** (2.241)	0.890 (1.427)	3.141** (1.369)
GDP * Border	0.327* (0.179)	0.915*** (0.134)	0.523*** (0.128)
GDP per capita * Border	1.509*** (0.496)	0.517 (0.473)	0.460 (0.714)
FDI Restrictiveness Index * Border	7.790 (8.176)	-8.680 (8.390)	-0.270 (0.417)
Worldwide Governance Index * Border	-0.138 (0.544)	1.714*** (0.428)	1.180*** (0.433)
Border Dummy	-37.448*** (6.956)	-38.248*** (4.340)	-30.448*** (6.572)
Log of Distance	-1.266*** (0.130)	-0.691*** (0.111)	-0.505*** (0.088)
Colonial Relationships	0.468*** (0.175)	0.009 (0.171)	0.161 (0.195)
Common Language	0.013 (0.236)	0.548*** (0.201)	0.446** (0.199)
Religious Proximity Index	1.218*** (0.307)	1.008*** (0.324)	0.972*** (0.249)
Common Legal Origin	0.254* (0.140)	0.287*** (0.091)	0.369*** (0.085)
Free Trade Agreement	-1.387*** (0.505)	-1.301*** (0.371)	-1.133*** (0.274)
European Economic Area	-0.382 (0.327)	0.078 (0.290)	0.453** (0.213)
Constant	22.007*** (0.850)	18.274*** (0.732)	16.124*** (0.570)
Observations	1327	5132	11234

Standard errors in parentheses

Notes: Standard errors in parentheses. Regressions are estimated using the baseline WGI specification across three distinct broad sectors. All specifications absorb host-sector and source-sector fixed effects.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D.2: Additional Robustness Tests Gravity Estimation

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	- FDIR	- WGI	- log GDP per capita	- log GDP	Jackknife
Investment Facilitation Index * Border	2.415** (1.104)	2.120** (1.075)	3.784*** (0.821)	7.570*** (0.606)	9.440*** (0.552)	1.193 (2.722)
GDP * Border	0.584*** (0.100)	0.671*** (0.101)	0.528*** (0.069)	0.398*** (0.073)		0.579*** (0.213)
GDP per capita * Border	1.071*** (0.380)	1.023*** (0.379)	1.669*** (0.312)			0.505 (0.929)
FDI Restrictiveness Index * Border	-3.596*** (0.524)					-3.230*** (1.097)
Worldwide Governance Index * Border	0.909** (0.357)	0.975*** (0.364)				1.369* (0.780)
Border Dummy	-36.457*** (3.500)	-38.422*** (3.433)	-42.258*** (3.560)	-26.740*** (1.988)	-17.539*** (0.891)	-29.510*** (10.338)
Log of Distance	-0.498*** (0.070)	-0.435*** (0.064)	-0.463*** (0.062)	-0.468*** (0.066)	-0.672*** (0.062)	-0.353* (0.190)
Colonial Relationships	-0.023 (0.153)	0.059 (0.155)	-0.025 (0.143)	-0.135 (0.151)	-0.198 (0.147)	0.026 (0.313)
Common Language	0.576*** (0.139)	0.538*** (0.139)	0.534*** (0.139)	0.855*** (0.135)	0.784*** (0.136)	0.789*** (0.264)
Religious Proximity Index	1.041*** (0.181)	1.168*** (0.185)	1.018*** (0.178)	1.598*** (0.187)	1.396*** (0.185)	1.199*** (0.423)
Common Legal Origin	0.290*** (0.064)	0.301*** (0.065)	0.306*** (0.065)	0.120* (0.063)	0.140** (0.061)	0.100 (0.171)
Free Trade Agreement	-0.983*** (0.208)	-0.894*** (0.208)	-0.925*** (0.189)	-1.005*** (0.192)	-1.374*** (0.201)	-1.303** (0.522)
European Economic Area	0.161 (0.195)	0.445** (0.188)	0.343** (0.167)	0.101 (0.174)	-0.534*** (0.137)	0.480 (0.485)
Constant	16.746*** (0.451)	16.300*** (0.410)	16.489*** (0.396)	16.476*** (0.423)	17.794*** (0.397)	16.746*** (0.451)
Observations	21320	25572	25572	25572	25572	21320

Standard errors in parentheses

Notes: Column 1 is the baseline specification. Columns 2–5 test sensitivity by removing potentially endogenous controls.

Column 6 reports Jackknife standard errors (leave-one-country-out).

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix E Model Description

Appendix E.1 Firms' Production

There are two types of firms in each region r and sector c : domestic-owned firms, denoted with a superscript do , and foreign-owned firms, denoted with a superscript fo . Gross output of a firm in sector c in region r with ownership o and ownership type $to = do, fo$ is defined as y_{orc}^{to} . Domestic-owned firms are characterized by the fact that $o = do$, implying $y_{orc}^{do} = 0$ if $o \neq do$.

Both types of perfectly competitive firms produce by combining value added and intermediate inputs without scope for substitution between the inputs. Hence, the quantity of composite output, y_{orc}^{to} , is a Leontief function of the quantity of value added, v_{orc}^{to} , and intermediate from sector d , z_{ordc}^{to} with productivity defined as b_{orc}^{to} :

$$y_{orc}^{to} = b_{orc}^{to} \min \left\{ \varpi_{orc}^{to,va} v_{orc}^{to}, \varpi_{or1c}^{to,ii} z_{or1c}^{to}, \dots, \varpi_{orCc}^{to,ii} z_{orCc}^{to} \right\} \quad (\text{E.1})$$

where ϖ represents the Leontief technical coefficient.

Demand for the quantities of value added in purchasing sector c and intermediates purchased by sector c from sector d are thus given by:

$$v_{orc}^{to} = \varpi_{orc}^{to,va} y_{orc}^{to} \quad (\text{E.2})$$

$$z_{ordc}^{to} = \varpi_{ordc}^{to,ii} y_{orc}^{to} \quad (\text{E.3})$$

The price index of gross output, $p_{orc}^{to,y}$, is a function of the prices of intermediates, $p_{rdc}^{to,ii}$, and the price of value added $p_{rd}^{to,va}$. Because of the Leontief assumption the equation is additive:

$$p_{orc}^{to,y} = \varpi_{orc}^{to,va} p_{rd}^{to,va} + \sum_{d=1}^C \varpi_{ordc}^{to,ii} p_{rdc}^{to,ii} \quad (\text{E.4})$$

Demand for intermediates is split between domestic and imported in the next subsection based on Armington preferences, separately for each owner (domestic and foreign-owned), in the next subsection.

There are six production factors in the model as demonstrated in Figure 4: land, natural resources, regular capital and FDI capital, and labour, skilled and unskilled.

Demand for the different production factors is CES, implying the following expressions for the price of value added, $p_{orc}^{to,va}$, and demand for factor inputs, $q_{orce}^{to,end}$:

$$p_{orc}^{to,va} = \left[\sum_{e=1}^E (\iota_{orce})^{\chi_c} \left(\iota_{orce}^{to,end} \omega_{orce}^{to} \right)^{1-\chi_c} \right]^{\frac{1}{1-\chi_c}} \quad (\text{E.5})$$

$$q_{orce}^{to,end} = \left(\iota_{orce} \frac{p_{orc}^{to,va}}{\iota_{orce}^{to,end} \omega_{orce}^{to}} \right)^{\chi_c} v_{orc}^{to} \quad (\text{E.6})$$

where t_{orce}^{to} is the CES distribution parameter. ω_{orce}^{to} and $t_{orce}^{to,end}$ are respectively the price of production factor e and the tax on it. The substitution elasticity between production factors is denoted by χ_c .²¹ All taxes are expressed in power terms, so as 1 plus the ad-valorem tax rate. FDI capital is not used by domestic-owned firms, $q_{orc,FDI}^{do,end} = 0$.

For the allocation of production factors across sectors we make a distinction between mobile production factors (regular capital and labour), immobile production factors (land) and sector-specific production factors (natural resources and FDI capital). For mobile production factors, the factor price w_{rce} (also the nominal rental rate on capital) is equal among sectors, implying that total factor supply, q_{rce}^{end} , is equal to the sum of sectoral supplies, q_{re}^{end} :

$$\omega_{orce}^{to} = w_{re} \text{ if } e \text{ is mobile} \quad (\text{E.7})$$

$$q_{re}^{end} = \sum_{c=1}^C q_{rce}^{do,end} + \sum_{c=1}^C \sum_{o=1}^R q_{orce}^{fo,end} \text{ if } e \text{ is mobile} \quad (\text{E.8})$$

For immobile production factors a constant elasticity of supply (CET) function is employed. Hence, the supply of the immobile production factor e in sector c rises if the factor reward of the production factor in sector c , ω_{rce} , increases relative to the average factor reward, w_{re} , with the responsiveness governed by the elasticity of transformation, μ_e :

$$q_{orce}^{to,end} = \left(\frac{\omega_{orce}^{to,end}}{\vartheta_{orce}^{to,end} w_{re}} \right)^{\mu_e} q_{re}^{end} \text{ if } e \text{ is immobile} \quad (\text{E.9})$$

$$w_{re} = \left(\sum_{c=1}^C \left(\vartheta_{rce}^{do,end} \right)^{-\mu_e} \left(t_{rce}^{do,end} \omega_{rce}^{do,end} \right)^{\mu_e+1} + \sum_{c=1}^C \sum_{o=1}^R \left(\vartheta_{orce}^{fo,end} \right)^{-\mu_e} \left(t_{orce}^{fo,end} \omega_{orce}^{fo,end} \right)^{\mu_e+1} \right)^{\frac{1}{\mu_e+1}} \quad (\text{E.10})$$

if e is immobile

where ϑ_{orce}^{end} is a CES shifter.

For sector-specific production factors the price and quantity are sector specific, implying $\omega_{orce}^{to,end} = w_{orce}^{to,end}$.

The supply of land, natural resources and labour is governed by an isoelastic supply function with ξ_e the elasticity of supply of production factor e :

$$q_{re}^{end} = w_{re}^{\frac{1}{\xi_e}} \quad (\text{E.11})$$

The supply of capital in period t , $q_{r,cap}^{end,t}$, is equal to the supply of capital in period $t - 1$ minus depreciation plus the quantity of aggregate investment, $q_{in,r}^{in,t}$:

$$q_{r,cap}^{end,t+1} = (1 - \delta_{r,cap}) q_{r,cap}^{end,t} + q_{in,r}^{in,t} \quad (\text{E.12})$$

²¹ χ_c is sector-specific to reflect that in some sectors there are sector-specific production factors which drive down the substitution elasticity.

Investment goods are, like intermediates, a Leontief composite of goods used for investment from different sectors, $q_{in,r}^t$:

$$q_r^{in} = \min \{ \varpi_{r1}^{in} q_{r1}^{in}, \dots, \varpi_{rC}^{in} q_{rC}^{in} \} \quad (\text{E.13})$$

Hence, investment demand in different sectors, q_{rc}^{in} , is proportional to aggregate investment demand:

$$q_{rc}^{in} = \varpi_{rc}^{in} q_r^{in} \quad (\text{E.14})$$

$$p_r^{in} = \sum_{c=1}^C \varpi_{rc}^{in} p_{rc}^{in} \quad (\text{E.15})$$

The supply of FDI capital, $q_{orc,fc}^{end}$, is determined like the supply of regular capital, as a function of the previous period capital (adjusted for depreciation) and FDI:

$$q_{orc,fc}^{end,t+1} = (1 - \delta_{orc,fc}) q_{orc,fc}^{end,t} + q_{fdi,orc}^t \quad (\text{E.16})$$

And the demand for FDI in different sectors is proportional to aggregate FDI:

$$q_{orcd}^{fdi} = \varpi_{orcd}^{fdi} q_{orc}^{fdi} \quad (\text{E.17})$$

$$p_{orc}^{fdi} = \sum_{d=1}^C \varpi_{orcd}^{fdi} p_{orcd}^{fdi} \quad (\text{E.18})$$

Appendix E.2 International Trade and Foreign Affiliate Sales

There are five types of end users or agents ag demanding commodities: private households (pr), the government (go), capital investments (in), FDI (fdi), and firms (in absorbing sector d and of ownership $to = do, fo$) purchasing intermediate inputs (ii_d^{to}). Each agent allocates total demand $q_{ag,rc}$ between domestically produced and imported goods, $q_{ag,r}^{so,c}$ with $so \in \{dom, imp\}$, according to a CES aggregator reflecting Armington preferences:

$$q_{ag,rc}^{so} = \left(\frac{ta_{ag,rc}^{so} p_{ag,rc}^{so}}{p_{ag,rc}} \right)^{-\rho_c} q_{ag,rc}; so = dom, imp; ag = pr, go, in, fdi, ii_d^{to} \quad (\text{E.19})$$

$$p_{ag,rc} = \left[\left(ta_{ag,rc}^{dom} p_{ag,rc}^{dom} \right)^{1-\rho_c} + \left(ta_{ag,rc}^{imp} p_{rc}^{imp} \right)^{1-\rho_c} \right]^{\frac{1}{1-\rho_c}}; ag = pr, go, in, fdi, ii_d^{to} \quad (\text{E.20})$$

where ρ_c is the substitution elasticity; $ta_{ag,rc}^{so}$ is a group-specific and source-specific tax; $p_{ag,rc}$ and $p_{ag,rc}^{so}$ are respectively the prices corresponding with $q_{ag,rc}$ and $q_{ag,rc}^{so}$.

Aggregating across agents and owners yields total demand for domestic and imported goods:

$$q_{rc}^{so} = \sum_{ag \in \{pr, go, in, fdi, ii_e^{to}\}} q_{ag,rc}^{so}; so = dom, imp \quad (\text{E.21})$$

Domestic goods in region r , q_{rc}^{dom} , are in turn further allocated to domestic goods provided by domestic-owned firms, $q_{rc}^{do,dom}$, and domestic goods provided by foreign-owned firms from different origin countries o , $q_{orc}^{fo,dom}$, according to CES (Armington) preferences with substitution elasticity ν_c :

$$q_{rc}^{do,dom} = \left(\frac{p_{rc}^{do,dom}}{p_{rc}^{dom}} \right)^{-\nu_c} q_{rc}^{dom} \quad (\text{E.22})$$

$$q_{orc}^{fo,dom} = \left(\frac{p_{orc}^{fo,dom}}{p_{rc}^{dom}} \right)^{-\nu_c} q_{rc}^{dom}; o = 1, \dots, R \quad (\text{E.23})$$

$$p_{rc}^{dom} = \left[\left(p_{rc}^{do,dom} \right)^{1-\nu_c} + \sum_{o=1}^R \left(p_{orc}^{fo,dom} \right)^{1-\nu_c} \right]^{\frac{1}{1-\nu_c}}. \quad (\text{E.24})$$

The price of domestically produced output is equal to the price of the input bundle, $p_{orc}^{to,ib}$ (defined in equation (E.4)), times the production tax, tp_{orc}^{to} , and iceberg costs of affiliate sales activity, $t_{orc}^{to,dom}$, and divided by the firm's productivity, b_{orc}^{to} :

$$p_{rc}^{to,dom} = \frac{tp_{orc}^{to} t_{orc}^{to,dom} p_{orc}^{to,ib}}{b_{orc}^{to}}; to = do, fo \quad (\text{E.25})$$

Import demand by all end users is allocated based on a nested Armington structure with agents first choosing between goods imported from different locations of production and subsequently between goods provided by domestic-owned firms and foreign-owned firms from different origin countries. Import demand for goods produced in region s (by importing region r) is defined as follows with associated price index:

$$q_{src}^{imp} = \left(\frac{p_{src}^{imp}}{p_{rc}^{imp}} \right)^{-\sigma_c} q_{rc}^{imp} \quad (\text{E.26})$$

$$p_{rc}^{imp} = \left[\sum_{s=1}^S \left(p_{src}^{imp} \right)^{1-\sigma_c} \right]^{\frac{1}{1-\sigma_c}} \quad (\text{E.27})$$

where σ_c is the substitution elasticity between goods produced in different locations.

Import demand from source s in turn is allocated to goods produced by domestic-owned firms in source s and foreign-owned firms from different origins o :

$$q_{src}^{do,imp} = \left(\frac{p_{src}^{do,imp}}{p_{src}^{imp}} \right)^{-\nu_c} q_{src}^{imp} \quad (\text{E.28})$$

$$q_{osrc}^{fo,imp} = \left(\frac{p_{osrc}^{fo,imp}}{p_{src}^{imp}} \right)^{-\nu_c} q_{src}^{imp}; o = 1, \dots, R \quad (\text{E.29})$$

$$p_{src}^{imp} = \left[\left(p_{src}^{do,imp} \right)^{1-\nu_c} + \sum_{o=1}^R \left(p_{osrc}^{fo,imp} \right)^{1-\nu_c} \right]^{\frac{1}{1-\nu_c}}. \quad (\text{E.30})$$

The bilateral trade price of goods produced by domestic-owned and foreign-owned firms, respectively $p_{src}^{do,imp}$ and $p_{osrc}^{fo,imp}$, are defined as follows:

$$p_{src}^{do,imp} = ta_{src}^{do} t_{src}^{do} p_{src}^{do,cif} = ta_{src}^{do} t_{src}^{do} \left(p_{src}^{do,FOB} + \frac{p_{src}^{do,ts}}{a_{src}^{do,ts}} \right) \quad (E.31)$$

$$= ta_{src}^{do} t_{src}^{do} \left(\frac{t_{src}^{do} te_{src}^{do} tp_{sc}^{do} p_{sc}^{do,ib}}{b_{sc}^{do}} + \frac{p_{src}^{do,ts}}{a_{src}^{do,ts}} \right) \quad (E.32)$$

$$p_{osrc}^{fo,imp} = ta_{osrc}^{fo} t_{osrc}^{fo} p_{osrc}^{fo,cif} = ta_{osrc}^{fo} t_{osrc}^{fo} \left(p_{osrc}^{fo,FOB} + \frac{p_{osrc}^{fo,ts}}{a_{osrc}^{fo,ts}} \right) \quad (E.33)$$

$$= ta_{osrc}^{fo} t_{osrc}^{fo} \left(\frac{t_{osrc}^{fo} te_{osrc}^{fo} tp_{osc}^{fo} p_{osc}^{fo,ib}}{b_{osc}^{fo}} + \frac{p_{osrc}^{fo,ts}}{a_{osrc}^{fo,ts}} \right) \quad (E.34)$$

t_{src}^{do} and t_{osrc}^{fo} denote iceberg trade costs from s to r for respectively domestic-owned firms and foreign-owned firms (from region o). ta_{src}^{do} and ta_{osrc}^{fo} bilateral tariffs, te_{osrc}^{fo} and te_{orc}^{do} export taxes. Payments for transport services, $\frac{p_{src}^{do,ts}}{a_{src}^{do,ts}}$, are proportional to trade volumes, as discussed in Section [Appendix E.8](#). Note that the FOB prices, $p_{src}^{do,FOB}$ and $p_{osrc}^{fo,FOB}$, depend on the production costs, $p_{sc}^{do,ib}$ and $p_{osc}^{fo,ib}$, and production taxes, tp_{sc}^{do} and tp_{osc}^{fo} , in source region s .

Appendix E.3 Allocation of Global Saving, FDI, and Trade Balance

The representative household in region o allocates its savings, $q_{sa,o}$, to a global bank as portfolio investments, $q_{por,o}$, and to outward FDI, $q_{fdi,o}$. This allocation follows a constant elasticity of transformation (CET) function, based on the global expected rate of return on portfolio investments, r_{por} , and the rate of return on outward FDI, $r_{fdi,o}$, with the elasticity between portfolio investments and FDI investments given by μ_{pf} .

$$q_{fdi,o} = \left(\frac{r_{fdi,o}}{\vartheta_{fdi,o} r_o} \right)^{\mu_{pf}} q_{sa,o} \quad (E.35)$$

$$q_{por,o} = \left(\frac{r_{por,o}}{\vartheta_{por,o} r_o} \right)^{\mu_{pf}} q_{sa,o} \quad (E.36)$$

The composite return on savings in region o is given by

$$r_o = \left(\vartheta_{fdi,o}^{-\mu_{pf}} (r_{fdi,o})^{\mu_{pf}+1} + \vartheta_{por,o}^{-\mu_{pf}} (r_{por,o})^{\mu_{pf}+1} \right)^{\frac{1}{\mu_{sa}+1}}. \quad (E.37)$$

where $\vartheta_{fdi,o}$ and $\vartheta_{por,o}$ denote the distribution parameter of the CET function.

All portfolio investments are channeled to the global bank, which invests the savings funds across different regions. The current real rate of return on capital, r_o , is equal to the rental rate on capital, $w_{o,cap}$, divided by the price of investment goods, p_o^{in} , minus the rate of depreciation,

$\delta_{o,cap}$:

$$r_{o,cap} = \frac{w_{o,cap}}{p_{in,o}} - \delta_{o,cap}. \quad (\text{E.38})$$

Investment across regions is now determined by imposing that rates of return tend to equalize, with the ratio of the end-of-period to beginning-of-period capital stock preventing the ratios from equalizing, reflecting the presence of capital adjustment costs.²²

$$r = r_o \left(\frac{q_{o,cap}^{end,t+1}}{q_{o,cap}^{end,t}} \right)^{-flex} \quad (\text{E.39})$$

$flex$ is a parameter determining the importance of capital adjustment costs.²³ Total investment, q_{in} , is thus determined by equations (E.12), (E.38), and (E.39). A shock raising demand for capital would increase the nominal rental rate $w_{o,cap}$. This in turn leads to an increase in the end-of-period capital stock, $q_{o,cap}^{end,t+1}$, according to equations (E.38)-(E.39). The rise in $q_{o,cap}^{end,t+1}$ in turn generates an increase in investment demand q_i^{in} .²⁴

Outward FDI of owner o is in turn allocated across destination regions r according to their respective rates of return, following again a CET function with elasticity μ_{fr} :

$$q_{fdi,or} = \left(\frac{r_{fdi,or}}{\vartheta_{fdi,or} r_{fdi,o}} \right)^{\mu_{fr}} q_{fdi,o} \quad (\text{E.40})$$

This implies that the aggregate return on outward FDI for owner o is

$$q_{fdi,o} = \left(\sum_{r \in R} \vartheta_{fdi,or}^{-\mu_{fr}} (r_{fdi,or})^{\mu_{fr}+1} \right)^{\frac{1}{\mu_{fr}+1}}. \quad (\text{E.41})$$

FDI investment from owner o to destination region r is further allocated across sectors c based on sectoral returns, again using a CET function with elasticity μ_{fc} :

$$q_{fdi,orc} = \left(\frac{r_{fdi,orc}}{\vartheta_{fdi,orc} r_{fdi,or}} \right)^{\mu_{fc}} q_{fdi,or}. \quad (\text{E.42})$$

The corresponding composite return on FDI invested by owner o in region r is therefore

$$r_{fdi,or} = \left(\sum_{c \in C} \vartheta_{fdi,orc}^{-\mu_{fc}} (r_{fdi,orc})^{\mu_{fc}+1} \right)^{\frac{1}{\mu_{fc}+1}}. \quad (\text{E.43})$$

The current net rate of return on FDI is given by:

²² r^e is determined because one of the prices in the model is set as numeraire.

²³A large value of $flex$ means that additions to the capital stock, corresponding with $q_{o,cap}^{end,t+1} > q_{o,cap}^{end,t}$, are costly and thus have a strong negative impact on the expected rate of return. As a result only relatively small flows of capital already lead to equalization of the expected rate of return. With small values of $flex$ instead large changes in the capital stock are required to equalize rates of return.

²⁴The degree to which an increasing rate of return on capital, r_o , leads to additional investment and thus capital inflows into an economy is determined by $flex$. A small value of $flex$ generates a larger response in ke_i and thus a larger investment response.

$$r_{fdi,orc} = \frac{\omega_{fdi,orc}}{p_{fdi,orc}} - \delta_{fdi,orc}. \quad (\text{E.44})$$

$q_{fdi,orc}$ determined in equation (E.42) serves as FDI used in the FDI capital accumulation equation (E.16).

Appendix E.4 Demand

There are $r = 1, \dots, R$ economies, $c = 1, \dots, C$ commodities (sectors), and $e = 1, \dots, E$ factors of production. Utility of a representative agent in region r is determined by private household consumption, $q_{pr,r}$, government consumption, $q_{go,r}$, and savings, $q_{sa,r}$, according to a Cobb-Douglas utility function:

$$u_r = (q_{pr,r})^{\kappa_r^{pr}} (q_{go,r})^{\kappa_r^{go}} (q_{sa,r})^{\kappa_r^{sa}} \quad (\text{E.45})$$

Preferences for private household consumption across different sectors are non-homothetic implying that it is not possible to define a price index for private household consumption. Therefore, we cannot maximise utility in equation (E.45) subject to a conventional budget constraint with prices. Instead, based on McDougall (2003) an implicit budget constraint is defined, with income x_r equal to expenditures on category ca goods, $e_{ca,r}$, which are a function of the quantity of private consumption, $q_{ca,r}$:

$$\sum_{ca \in \{pr, go, sa\}} e_{ca,r}(q_{ca,r}) = x_r \quad (\text{E.46})$$

This leads to the following expression for expenditures on category $ca = pr, go, sa$, $x_{ca,r}$:

$$x_{ca,r} = \kappa^{ca} \left(\frac{\Psi_{ca,r}}{\Psi_r} \right) x_r; ca = pr, go, sa \quad (\text{E.47})$$

The difference with a standard Cobb-Douglas expression is the presence of the ratio of $\Psi_{ca,r}$ and Ψ_r . $\Psi_{ca,r}$ is defined as the elasticity of quantity, $q_{ca,r}$, with respect to expenditure, $x_{ca,r}$, whereas Ψ_r is the elasticity of utility, u_r , with respect to expenditure, x_r . For goods with homothetic preferences across different sectors or no further allocation across sectors, respectively government consumption and savings, the elasticity is 1 ($\Psi_{go,r} = \Psi_{sa,r} = 1$).

Given non-homothetic preferences for private household consumption across sectors, the share of spending on private goods is larger than the Cobb-Douglas parameter κ^{pr} if the elasticity of private quantity, $q_{pr,r}$, with respect to private expenditure, $x_{pr,r}$, is larger than 1.

$\Psi_{pr,r}$ follows from differentiating the indirect utility function for private goods defined below in equation (E.50) below with respect to quantity and expenditure, implying the following

expression with $s_{pr,rc}$ the share of private consumption allocated to good c :

$$\Psi_{pr,r} = \frac{1}{\sum_{c=1}^C s_{pr,rc} \eta_{rc}} \quad (\text{E.48})$$

Ψ_r follows from utility maximization in equation (E.45):²⁵

$$\Psi_r = \Psi_{pr,r} \kappa_r^{pr} + \kappa_r^{go} + \kappa_r^{sa}. \quad (\text{E.49})$$

Non-homothetic preferences for private household consumption across sectors are characterized by the constant distance elasticity (CDE) utility function.²⁶ CDE preferences are formally described by the following implicit expenditure function:

$$\sum_{c=1}^C \alpha_{rc} (q_{pr,r})^{\gamma_{rc} \eta_{rc}} \left(\frac{p_{pr,rc}}{x_{pr,r}} \right)^{\gamma_{rc}} = 1 \quad (\text{E.50})$$

$q_{pr,rc}$ and $p_{pr,rc}$ are respectively the quantity and price of private household consumption; $x_{pr,r}$ private household expenditure, while α_{rc} , γ_{rc} and η_{rc} are respectively the distribution, substitution and expansion parameters of the CDE utility function. Applying Shephard's lemma, $q_{pr,rc}$ can be derived by differentiating equation (E.50) with respect to $p_{pr,rc}$ and $x_{pr,r}$:

$$q_{pr,rc} = \frac{\alpha_{rc} (q_{pr,r})^{\gamma_{rc} \eta_{rc}} \left(\frac{p_{pr,rc}}{x_{pr,r}} \right)^{\gamma_{rc}-1} \gamma_{rc}}{\sum_{d=1}^C \alpha_{rd} (q_{pr,r})^{\gamma_{rd} \eta_{rd}} \left(\frac{p_{pr,rd}}{x_{pr,r}} \right)^{\gamma_{rd}} \gamma_{rd}}. \quad (\text{E.51})$$

Preferences across the different sectors for government consumption are described by a Cobb-Douglas utility function with the quantity of sectoral demand, $q_{go,rc}$, and the price index, $p_{go,r}$, for government consumption defined as:

$$q_{go,rc} = \frac{\beta_{rc}^{go}}{p_{go,r}} p_{go,r} q_{go,r} \quad (\text{E.52})$$

$$p_{go,r} = \prod_{c=1}^C \left(\frac{p_{go,rc}}{\beta_{rc}^{go}} \right)^{\beta_{rc}^{go}} \quad (\text{E.53})$$

where β_{rc}^{go} is the value share of commodity c in government consumption.

²⁵The formal derivation is available in [Appendix E.9](#).

²⁶Under this non-homothetic utility function income elasticities differ from one and do not converge to one as for the more basic linear expenditure system. At the same time the model stays tractable, since a limited number of parameters can be calibrated from income and own-price elasticities of demand unlike utility functions such as AIDADS which requires a larger number of parameters.

Appendix E.5 Goods Market Equilibrium, Household Income, Numeraire and Walras law

There are two sets of goods market clearing conditions, for domestic firms and for foreign-owned firms. Goods market clearing for domestic firms requires that gross output, y_{sc}^{do} , in sector c in region s is equal to the domestic quantity and export quantity demanded:

$$y_{sc}^{do} = q_{sc}^{do,dom} + \sum_{r=1} t_{src} q_{src}^{do,imp} + t s_{oc}^{do} \quad (\text{E.54})$$

Goods market clearing for foreign-owned firms requires that gross output of region o owned firms producing in region s , y_{osc}^{fo} , is equal to the domestic quantity and export quantity demanded:

$$y_{osc}^{fo} = q_{osc}^{fo,dom} + \sum_{r=1} t_{osrc} q_{osrc}^{fo,imp} + t s_{osc}^{fo} \quad (\text{E.55})$$

Household income x_r is equal to the sum of gross factor income of the different factors of production minus the value of depreciation of capital, $\delta w_{re}^{end} q_{re}^{end}$, plus the sum of all indirect tax incomes, tr_r^{ind} , defined in [Appendix E.7](#):

$$x_r = \sum_{e=1}^E \left(w_{re} q_{re}^{end} - \delta_r^e w_{re}^{end} q_{re}^{end} \right) + tr_r^{ind} \quad (\text{E.56})$$

Appendix E.6 Modelling Productivity Spillovers of FDI

It is well documented that domestically owned firms can adopt more advanced technologies through interactions with foreign direct investment (FDI) enterprises ([Blalock and Gertler, 2008](#), [Ivarsson and Alvstam, 2009](#)). We extend our baseline model by incorporating positive FDI spillovers, focusing on upstream linkages from foreign-owned firms to domestically owned suppliers. Empirical evidence suggests that upstream FDI linkages generate substantial spillovers to domestic firms, whereas the effects of horizontal FDI remain ambiguous ([Iršová and Havránek, 2013](#), [Ivarsson and Alvstam, 2009](#)). Specifically, following the spirit of the reduced-form specification of [Bitzer et al. \(2008\)](#), we assume that a greater presence of foreign-owned firms in downstream sectors induces productivity gains for upstream domestic suppliers.

We measure upstream foreign firm presence, FP_{rc}^{UP} , as total sales to foreign-owned firms, weighted by productivity differences between the host region and the owner region Z_{orkc} :

$$FP_{rc}^{UP} = \sum_{k=1}^C \sum_{o=1}^R (\text{PREMIUM}_{orc} \cdot Z_{orkc}). \quad (\text{E.57})$$

Here, PREMIUM_{orc} denotes the productivity gap between the owner (home) region and the host region and is bounded below by zero:

$$\text{PREMIUM}_{orc} = \max \left\{ b_{oc}^{do} - b_{rc}^{do}, 0 \right\}. \quad (\text{E.58})$$

Table E.1: Overview taxes in the model

Power of tax	Tax revenue	Description
tn_{rce}	tnr_{rce}	Tax on use of endowment e in sector c
td_{re}	tdr_{re}	Direct income tax on endowment e
tp_{orc}	tpr_{orc}	Tax on production in sector s by owner o
$ta_{orc}^{so,ag}$	$tar_{orc}^{so,ag}$	Tax on purchases by group $ag = pr, go, iv, fdi, fi$ in sector s by owner o from source $so = imp, dom$
ta_{sorc}	tar_{sorc}	Tax on imports (tariff) from s to r in sector c by owner o
te_{osrc}	ter_{osrc}	Tax on exports from s to j in sector c by owner o

The productivity gain for domestically owned firms in sector c and region r is defined as

$$\widehat{b}_{do,rc} \equiv \log \left(\frac{b_{do,rc}}{b_{do,rc}^{baseline}} \right), \quad (\text{E.59})$$

and is assumed to depend on upstream foreign firm presence:

$$\widehat{b}_{do,rc} = \phi \log (FP_{rc}^{UP}), \quad (\text{E.60})$$

where ϕ denotes the elasticity of domestic firm productivity with respect to upstream foreign firm presence. This specification implies that domestic firms supplying to foreign-owned firms located in the same region r and in downstream sectors experience positive productivity spillovers, with larger effects when the foreign firm originates from a more productive sector in its home economy.

Appendix E.7 Tax Revenues and Price of Savings

Table E.1 gives an overview of the six type of taxes in the model. Tax rates are in power terms (as one plus the ad-valorem rate).

It is straightforward to calculate the tax revenues for the first three domestic tax rates, since tax bases are unambiguously defined:

$$tr_{rce}^{do,end} = (t_{rce}^{do,end} - 1) \omega_{rce}^{do} q_{rce}^{do,end} \quad (\text{E.61})$$

$$tr_{orce}^{fo,end} = (t_{orce}^{fo,end} - 1) \omega_{orce}^{fo} q_{orce}^{fo,end} \quad (\text{E.62})$$

$$tdr_{re} = (td_{re} - 1) w_{ie} q_{re}^{end} \quad (\text{E.63})$$

$$tpr_{rc}^{do} = (tp_{rc}^{do} - 1) p_{rc}^{y,do} y_{rc}^{do} \quad (\text{E.64})$$

$$tpr_{orc}^{fo} = (tp_{orc}^{fo} - 1) p_{orc}^{y,fo} y_{orc}^{fo} \quad (\text{E.65})$$

Source-specific import tax revenues, $ta_{ag,rc}^{so}$, can also be easily determined according to the following equation with $q_{ag,rc}^{so}$ defined in (E.19):

$$tar_{ag,rc}^{so} = (ta_{ag,rc}^{so} - 1) p_{ag,rc}^{so} q_{ag,rc}^{so}; so = dom, imp; ag = pr, go, in, fdi, iv_c^{to} \quad (\text{E.66})$$

Import tariff revenues and export tax revenues can also be expressed in a straightforward way as follows:

$$tar_{src}^{do} = \frac{(ta_{src}^{do} - 1) p_{src}^{cif,do} q_{src}^{do,imp}}{ta_{src}^{do}} \quad (\text{E.67})$$

$$tar_{osrc}^{fo} = \frac{(ta_{osrc}^{fo} - 1) p_{osrc}^{cif,fo} q_{osrc}^{fo,imp}}{ta_{osrc}^{fo}} \quad (\text{E.68})$$

$$ter_{src}^{do} = (te_{src}^{do} - 1) p_{sc}^{y,do} tp_{sc}^{do,y_{sc}^{do}} \quad (\text{E.69})$$

$$ter_{osrc}^{do} = (te_{osrc}^{do} - 1) p_{osc}^{y,do} tp_{osc}^{fo,y_{osc}^{do}} \quad (\text{E.70})$$

Because the bilateral price $p_r^{s,c}$ is defined as tariff inclusive, in equation (E.67) we divide by the power of the tariff to calculate tariff revenues. This is not the case for source-specific import and domestic tax revenues and export taxes instead, as for these taxes the tax base is defined based on prices, exclusive of the power of the tax. The different indirect tax revenues can be added up to generate total tax revenues on indirect taxes.

Finally, the price of savings in a specific economy is a weighted average of the price of investment goods across the world acquired by the global bank and the price of domestic investment goods. With this specification more weight is given to the domestic price of investment flows. The price of savings is determined by the domestic price of investment and a weighted average of the global price of investment goods:

$$p_{sa,r} = p_{in,r} \sum_{s=1}^R (p_{in,s})^{\psi_s} \quad (\text{E.71})$$

ψ_s is the value of net investment minus the value of savings in economy s divided by the value of global net investment:

$$\psi_s = \frac{p_{sa,s} (q_{sa,s} - \delta_s q_{cap,s}^{end}) - p_{sa,s} q_{sa,s}}{\sum_{u=1}^K p_{sa,u} (q_{sa,u} - \delta q_{cap,u}^{end})} \quad (\text{E.72})$$

Appendix E.8 Transport Services

Transportation services ts_{crs} are proportional to the quantity traded:²⁷

$$ts_{src}^{do} = \frac{q_{src}^{do,imp}}{a_{src}^{do,ts}} \quad (\text{E.73})$$

$$ts_{osrc}^{fo} = \frac{q_{osrc}^{fo,imp}}{a_{osrc}^{fo,ts}} \quad (\text{E.74})$$

Hence, there is no scope for substitution between transport services and FOB quantities, implying that the CIF price is additive in the FOB price and the price of transport services in equations (E.32)-(E.34).

Since transport services are a homogeneous good globally, there is only one price of transport

²⁷We assume that there is only one type of transport sector, but this could easily be generalized.

services, p^{ts} :

$$p_{src}^{do,ts} = p_{osrc}^{fo,ts} = p^{ts} \quad (\text{E.75})$$

The demand for transport services on all routes is equal to the supply of global transport services, ts , provided by a global transport sector:

$$\sum_s \sum_r \sum_c \left(ts_{src}^{do} + \sum_o ts_{osrc}^{do} \right) = ts \quad (\text{E.76})$$

The global transport sector demands transport services in turn from different regions supplying these services (both domestic-owned firms and foreign-owned firms), according to a Cobb-Douglas function:²⁸

$$p^{ts} = \prod_s \left(p_{s,ts}^{do,y} \right)^{\nu_s^{do}} \prod_o \left(p_{os,ts}^{fo,y} \right)^{\nu_{os}^{fo}} \quad (\text{E.77})$$

By a slight abuse of notation the transport services sector has sector index ts . This sector also produces services sold domestically and to its trading partners. The corresponding demands for transport services from economy s , ts_s^{do} and ts_{os}^{fo} , are given by:

$$ts_s^{do} = \nu_s^{do} \frac{p^{ts} ts}{p_{s,ts}^{ib}} \quad (\text{E.78})$$

$$ts_{os}^{fo} = \nu_{os}^{fo} \frac{p^{ts} ts}{p_{os,ts}^{ib}} \quad (\text{E.79})$$

Appendix E.9 Derivations Demand

Log differentiating the expenditure function in equation (E.50) with respect to utility $q_{pr,r}$, prices $p_{pr,rc}$, and expenditure $x_{pr,r}$ and solving for $\widehat{x_{pr,r}}$ leads to:

$$\widehat{x_{pr,r}} = \frac{\sum_{c=1}^C \frac{\alpha_c (q_{pr,r})^{\gamma_c \eta_c} \left(\frac{p_{pr,rc}}{x_{pr,r}} \right)^{\gamma_c} \gamma_c}{\sum_{u=1}^C \alpha_u (q_{pr,r})^{\gamma_u \eta_u} \left(\frac{p_{pr,ru}}{x_{pr,r}} \right)^{\gamma_u} \gamma_u}}{\left(\widehat{p_{pr,rc}} + \eta_c \widehat{q_{pr,r}} \right)} = \sum_{c=1}^C s_{pr,rc} \widehat{p_{pr,rc}} + \sum_{c=1}^C s_{pr,rc} \eta_c \widehat{q_{pr,r}} \quad (\text{E.80})$$

Variables with a hat indicate relative changes, i.e. $\widehat{x} = \frac{dx}{x}$. Equation (E.80) can be used to derive two equations in the main text, the expression for sectoral private demand, $q_{pr,rc}$, in equation (E.51) and the expression for the elasticity of quantity, $q_{pr,r}$, with respect to expenditure, $x_{pr,r}$, in equation (E.48).

$s_{pr,rc}$, the coefficient on $\widehat{p_{pr,rc}}$, is the expenditure share on good c by Shephard's lemma, i.e. $s_{pr,rc} = \frac{dx_{pr,r}}{dp_{pr,rc}} \frac{p_{pr,rc}}{x_{pr,r}} = \frac{q_{pr,rc} p_{pr,rc}}{x_{pr,r}}$. Recall that Shephard's lemma shows that the partial derivative of the expenditure function, $x_{pr,r}$, with respect to the price of the good from sector c , $p_{pr,rc}$, gives Hicksian demand, which can be converted into Marshallian demand by writing utility as a function of expenditure. From equation (E.80) we can thus find the expression for demand $q_{pr,rc}$

²⁸Because more detailed data on transport services are lacking, the supply of transport services first goes into a global transport sector, which in turn distributes these services without a link between the supplying economy and the demanding trade partners

in equation (E.51) using the expression for $s_{pr,rc}$ and the fact that $q_{pr,rc} = s_{pr,rc} \frac{x_{pr,rc}}{p_{pr,rc}}$:

$$q_{pr,rc} = s_{pr,rc} \frac{x_{pr,rc}}{p_{pr,rc}} = \frac{\alpha_c (q_{pr,r})^{\gamma_c \eta_c} \left(\frac{p_{pr,rc}}{x_{pr,r}} \right)^{\gamma_c - 1} \gamma_c}{\sum_{u=1}^C \alpha_u (q_{pr,r})^{\gamma_u \eta_u} \left(\frac{p_{pr,ru}}{x_{pr,r}} \right)^{\gamma_u} \gamma_u} \quad (\text{E.81})$$

The coefficient on $\widehat{q_{pr,r}}$, $\sum_{c=1}^C s_{pr,rc} \eta_c$, is the inverse of the elasticity of utility with respect to expenditure, $\Psi_{pr,r}$ in equation (E.48).

To derive equations (E.47) and (E.49) we maximise utility in equation (E.45) subject to the implicit budget constraint in equation (E.46). The first order conditions (FOCs) are given by:

$$\kappa_r^{ca} \frac{u_r}{q_{ca,r}} = \lambda \frac{\partial e_{ca,r}}{\partial q_{ca,r}} \quad (\text{E.82})$$

λ is the Lagrange multiplier of the maximisation problem. Combining the FOCs, defining $\Psi_{ca,r}$ as the elasticity of quantity with respect to expenditure, $\Psi_{ca,j} = \frac{\partial q_{ca,j}}{\partial e_{ca,j}} \frac{x_{ca,j}}{q_{ca,j}}$, and substituting the result into the budget constraint leads to the following expression for $x_{ca,r}$:

$$x_{ca,r} = \frac{\kappa_r^{ca} \Psi_{ca,r}}{\sum_{d \in \{pr,go,sa\}} \kappa_r^d \Psi_{d,r}} x_r \quad (\text{E.83})$$

We get then to equation (E.47) using the expression for Ψ_r in equation (E.49). To derive equation (E.49) we log differentiate the utility function in (E.45). Applying the definition of $\Psi_{ca,r}$ gives:

$$\widehat{u}_r = \sum_{ca \in \{pr,go,sa\}} \kappa_r^{ca} \widehat{q_{ca,r}} = \sum_{ca \in \{pr,go,sa\}} \kappa_r^{ca} \Psi_{ca,r} \widehat{x_{ca,r}} \quad (\text{E.84})$$

Log differentiating the budget constraint and substituting equation (E.47) generates:

$$\sum_{ca \in \{pr,go,sa\}} \kappa_r^{ca} \frac{\Psi_{ca,r}}{\sum_{d \in \{pr,go,sa\}} \kappa_r^d \Psi_{d,r}} \widehat{x_{ca,r}} = \widehat{x}_r \quad (\text{E.85})$$

Substituting equation (E.84) into equation (E.85) we get:

$$\frac{1}{\sum_{ca \in \{pr,go,sa\}} \kappa_r^d \Psi_{d,r}} \widehat{u}_r = \widehat{x}_r \quad (\text{E.86})$$

Hence, equation (E.86) shows that the elasticity of utility u_r with respect to expenditure x_r is given by the expression in equation (E.49).

Appendix E.10 Model Calibration

For the quantitative exercise in the next section, we aggregate the 65 sectors into four broad sectors (agriculture, mining, manufacturing, and services) and 141 economies into 10 regions, as

shown in Table A.1. We construct baseline values until 2026 by conducting a baseline simulation with the recursive dynamic model targeting GDP, population, and labour force growth rates and changes in savings rates. GDP per capita growth is based on actual IMF data until 2022 and IMF World Economic Outlook (April 2023) until 2027. From 2028 onwards, we use the OECD Shared Socioeconomic Pathways (SSP2) projections of GDP per capita (Dellink et al., 2017). Population and labour force growth come from the UN population projections, medium variant for 2015 (United Nations, 2015). Changes in the number of skilled and unskilled workers are inferred from projections on education levels by IIASA (Kc and Lutz, 2017). In particular, we use changes in the share of tertiary educated as a proxy for changes in the share of skilled workers. Counterfactual experiments, in which AVE shocks resulting from the IFD Agreement are fed into the model, are introduced at the end of simulation period and results are reported for 2037.

Table E.2: Model Parameterization

Panel A: Sector-Specific Parameters				
Sector	χ_c	σ_c	ρ_c	ν_c
agr	0.2540	4.6459	3	6
min	0.2000	13.0434	3	6
man	1.2382	7.0903	3	6
ser	1.3697	3.8270	3	6
Panel B: CET Transformation Elasticities				
Factor	μ_e			
Land	-1			
UnSkLab	-5			
SkLab	-5			
Capital	0			
NatRes	-0.001			
FdiCap	-1			

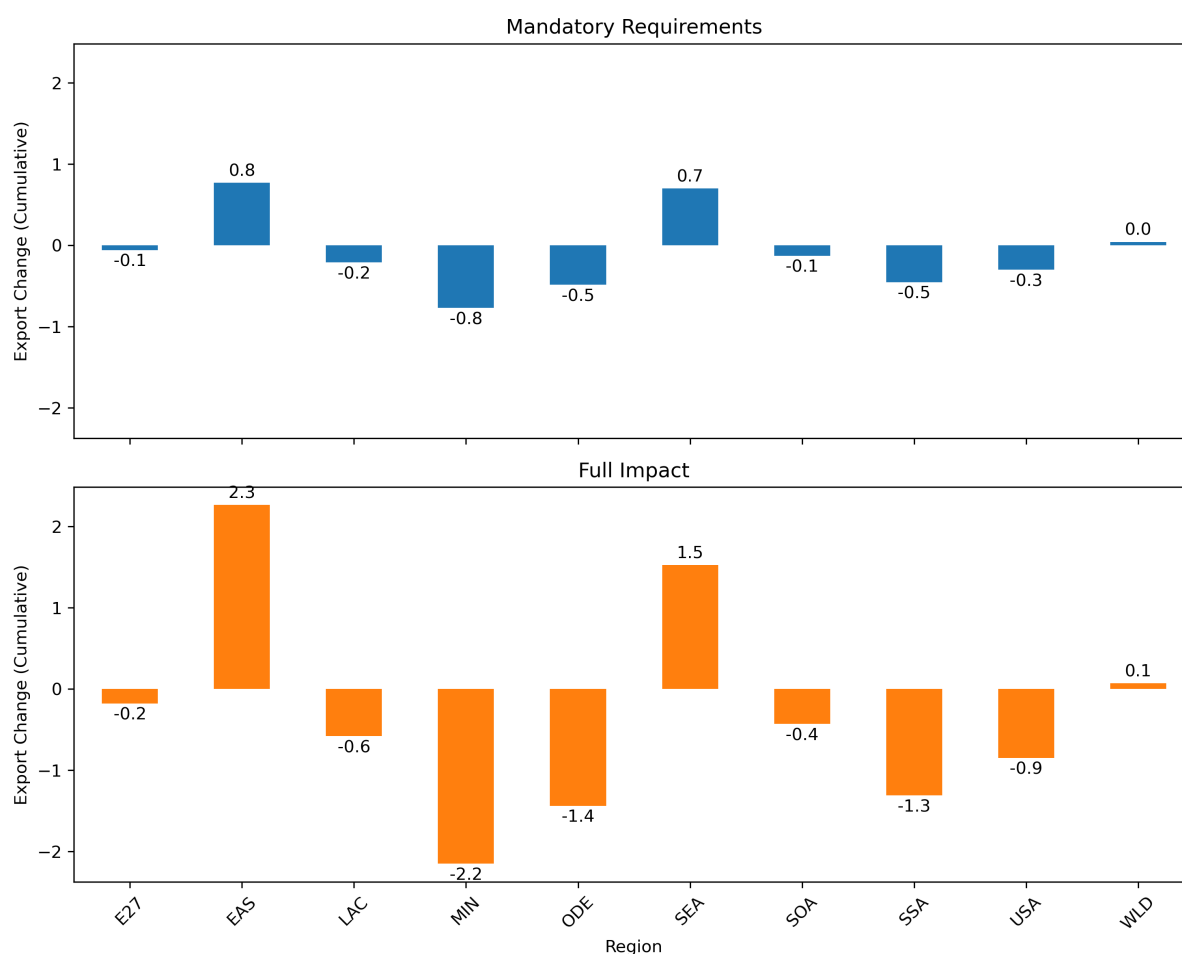
Table E.2 reports some of the behavioral parameters used in our quantitative exercise and their sources. Several behavioral parameters, including the CDE expansion parameters $\Psi_{ca,r}$, substitution parameters $u_{ca,r}$, the elasticity of substitution between production factors χ_c , the CET transformation elasticities for immobile factors μ_e , and the supply elasticities of production factors ϵ_e , are taken from (Aguiar et al., 2019). Similarly, the depreciation rate of physical capital is calibrated to match depreciation data from the GTAP database (Aguiar et al., 2019). We also set the depreciation rate of FDI capital to 0.02.

We set the elasticity of substitution between imported and domestically produced goods, ρ_c , to three for all sectors. The elasticity of substitution among imports from different source countries follows the estimates of Hertel et al. (2007). The elasticity of substitution across different owners, ν_c , is set to 6. Finally, we set the CET transformation elasticity between portfolio and FDI investment, μ_{pf} , the elasticity across FDI destinations, μ_{fr} , and the elasticity across sectors, μ_{fc} , to 0.1, respectively.

In the simulations in which the spillover mechanism is introduced, we set the elasticity of domestically owned firms' productivity with respect to upstream FDI presence to 0.3, following

[Bitzer et al. \(2008\)](#). We then impute the sector–owner–location productivity premium based on differences in value added per worker using World Bank data ([World Bank, 2019](#)). To be more specific, we assume that the productivity of foreign affiliate firms is proxied by value added per worker in the home economy multiplied by 1.2. This adjustment reflects the empirical observation that foreign affiliate firms tend to be more productive than the average firm. In contrast, the productivity of domestically owned firms is proxied by value added per worker without adjustment. The productivity premium is therefore defined as the difference between the productivity of foreign affiliate firms and that of domestically owned firms.

Figure F.1: Cumulative trade volume changes



Note: This figure shows the cumulative per cent changes in export volumes across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

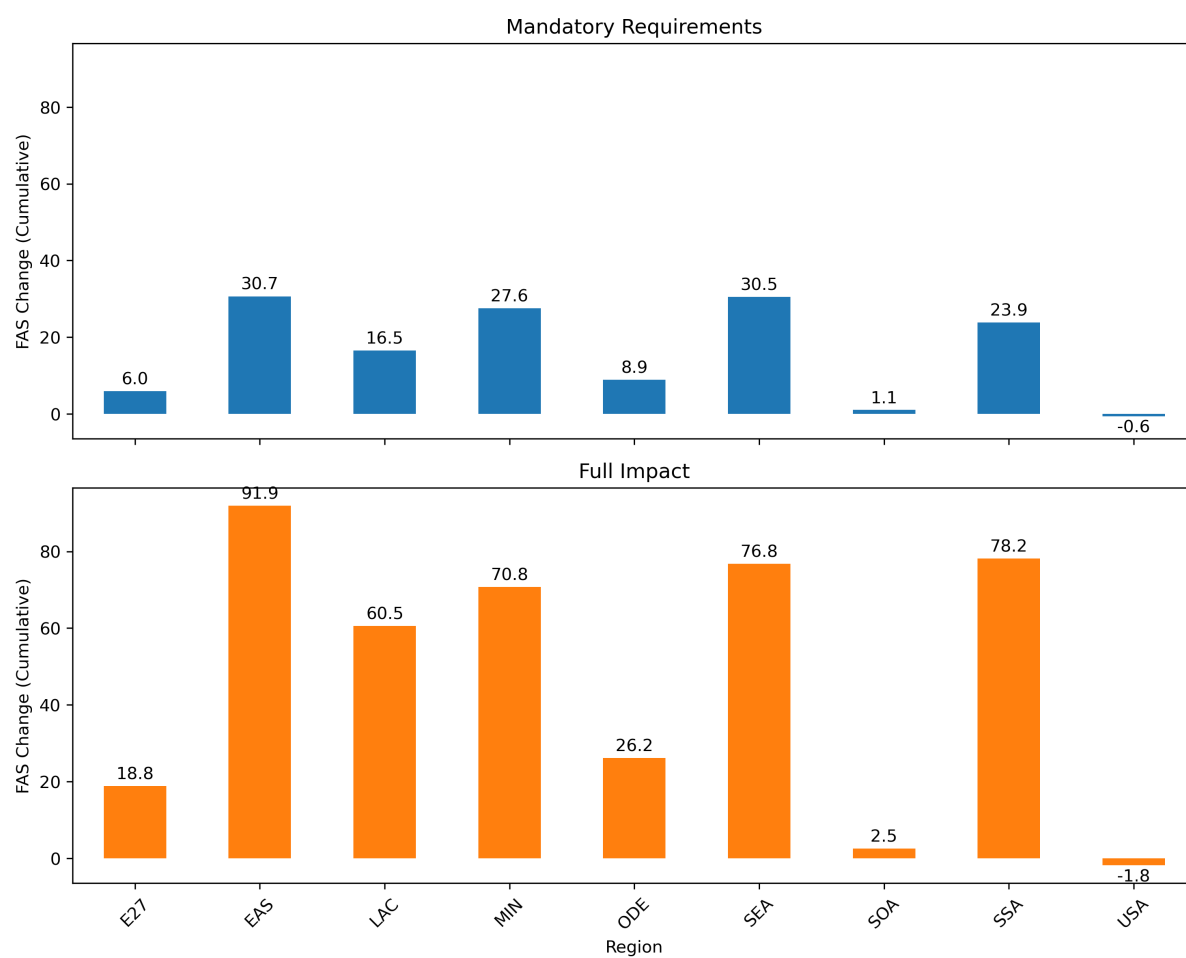
Appendix F Additional Quantitative Results

Appendix F.1 Trade

This subsection examines the effects of the IFD Agreement on global trade volumes, as shown in Figure F.1. Overall, the IFD Agreement leads to only modest changes in aggregate world trade. In our simulations, both Mandatory Requirements and Full Impact scenario has trivial impacts on the global export volume. Export responses vary across economies, though. Chinese export volumes increase by more than three per cent compared to the baseline under the Full Impact scenario, whereas exports decline in several other economies, with the largest decreases observed in Other Developed Economies and the Middle East and North Africa.

These relatively small changes reflect several offsetting effects. On the one hand, the expansion of horizontal FDI and foreign affiliate sales partly substitutes for cross-border exports. On the other hand, higher GDP increases import demand across regions. As a result, the net effect of the IFD Agreement on global trade volumes is limited.

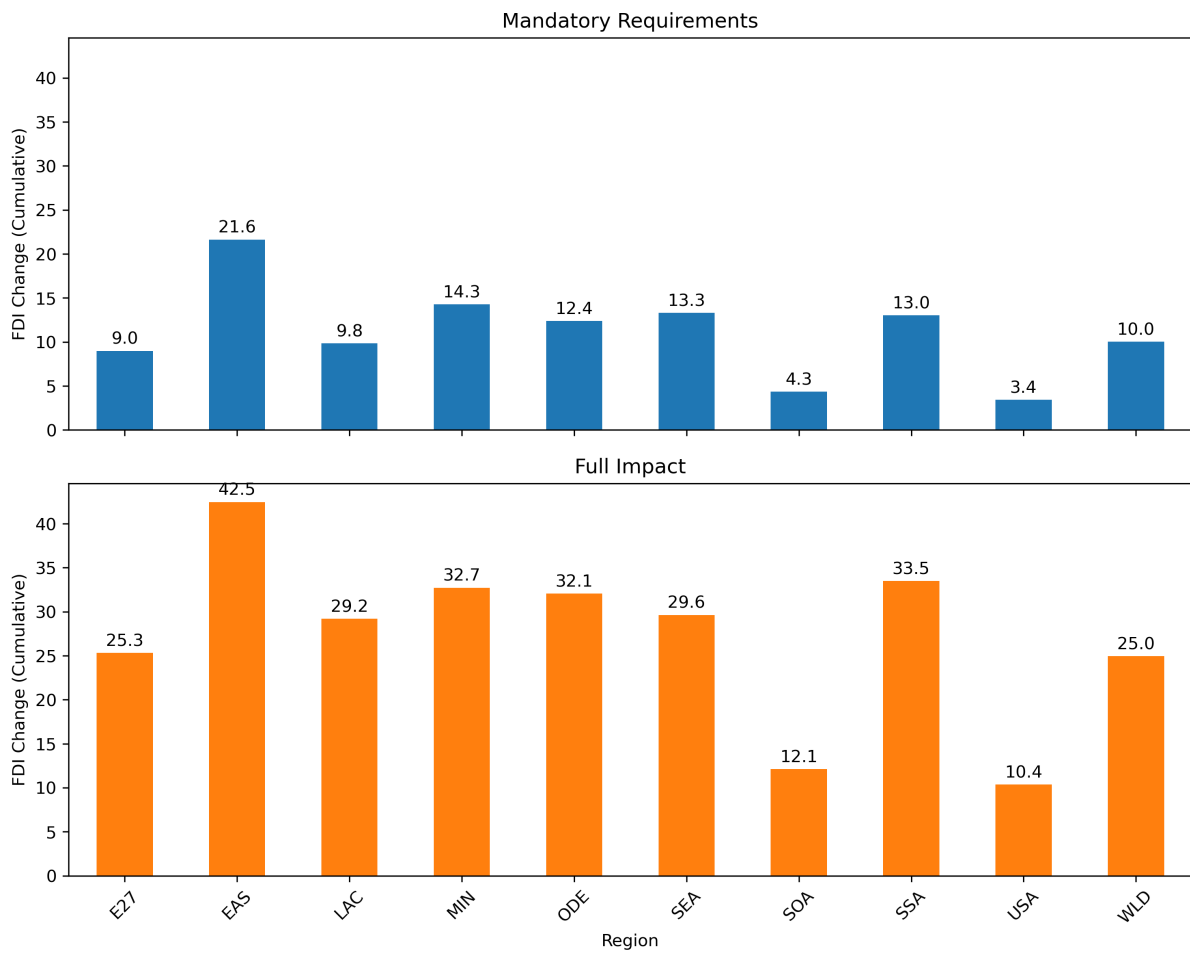
Figure F.2: Cumulative FAS changes under spillover



Note: This figure shows the cumulative per cent changes in foreign affiliate sales across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

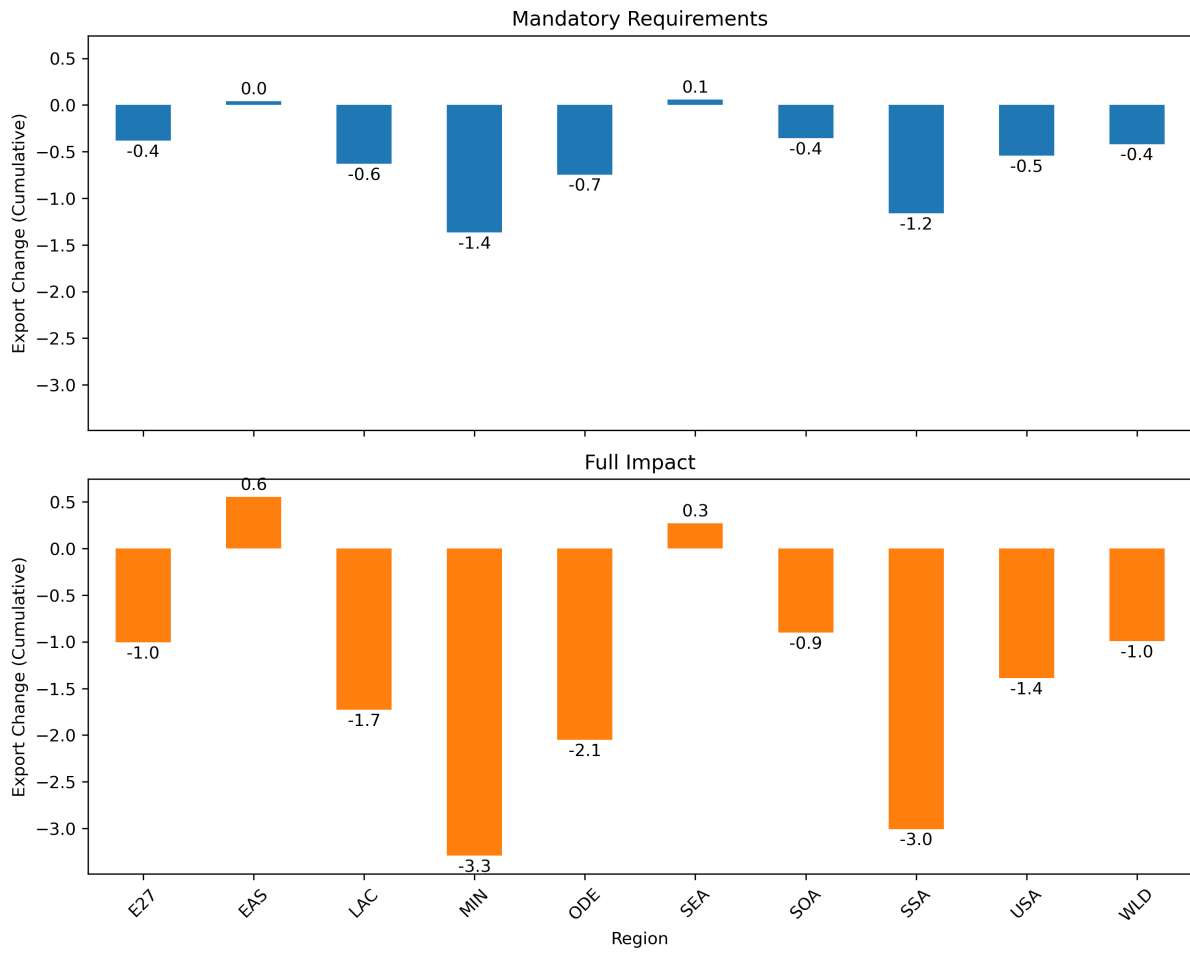
Appendix F.2 Additional Results Under Spillover

Figure F.3: Cumulative FDI inflow changes under spillover



Note: This figure shows the cumulative per cent changes in FDI inflows across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

Figure F.4: Cumulative export volume changes under spillover



Note: This figure shows the cumulative per cent changes in export volumes across regions at the end of the simulation period. The blue bars show the effects under the Mandatory Requirement scenario, in which all mandatory requirements within the IFD Agreements are implemented. The orange bars show the gains under the Full Impact scenario, where all soft obligations are implemented on top of the mandatory requirements.

References

- Aguiar, A., Chepeliev, M., Corong, E. L., McDougall, R., and Van Der Mensbrugge, D. (2019). The GTAP Data Base: Version 10. *Journal of Global Economic Analysis*, 4(1):1–27.
- Bekkers, E., Corong, E., Lakatos, C., Macskasi, I., Metivier, J., Yuan, W. J., and Wettstein, S. (2021a). Foreign Affiliate Sales Data. *GTAP 2021 Conference Paper*, 6358.
- Bekkers, E., Lakatos, C., So, Y. R., and Traverso, F. (2021b). A Global Foreign Direct Investment Stocks Database. *GTAP 2021 Conference Paper*, 6377.
- Beugelsdijk, S., Hennart, J.-F., Slangen, A., and Smeets, R. (2010). Why and how FDI stocks are a biased measure of MNE affiliate activity. *Journal of International Business Studies*, 41(9):1444–1459.
- Bitzer, J., Geishecker, I., and Görg, H. (2008). Productivity spillovers through vertical linkages: Evidence from 17 OECD countries. *Economics Letters*, 99(2):328–331.
- Blalock, G. and Gertler, P. J. (2008). Welfare gains from Foreign Direct Investment through technology transfer to local suppliers. *Journal of International Economics*, 74(2):402–421.
- Casella, B. (2019). Looking through conduit FDI in search of ultimate investors – a probabilistic approach. *Transnational Corporations*, 26(1):109–149.
- Dellink, R., Chateau, J., Lanzi, E., and Magné, B. (2017). Long-term economic growth projections in the Shared Socioeconomic Pathways. *Global Environmental Change*, 42:200–214.
- Fukui, T. and Lakatos, C. (2012). A Global Database of Foreign Affiliate Sales. *USITC Working Paper*, No. 2012-08A. Series: GTAP Research Memoranda Series.
- Gouel, C., Guimbard, H., and Laborde, D. (2012). A Foreign Direct Investment database for Global CGE models. *CEPII Working Paper*, No 2012-08.
- Heid, B., Larch, M., and Yotov, Y. V. (2021). Estimating the effects of non-discriminatory trade policies within structural gravity models. *Canadian Journal of Economics/Revue canadienne d'économique*, 54(1):376–409.
- Hertel, T., Hummels, D., Ivanic, M., and Keeney, R. (2007). How confident can we be of CGE-based assessments of Free Trade Agreements? *Economic Modelling*, 24(4):611–635.
- Iršová, Z. and Havránek, T. (2013). Determinants of Horizontal Spillovers from FDI: Evidence from a Large Meta-Analysis. *World Development*, 42:1–15.
- Ivarsson, I. and Alvstam, C. G. (2009). The Effect of Spatial Proximity on Technology Transfer from TNCs to Local Suppliers in Developing Countries: The Case of AB Volvo in Asia and Latin America. *Economic Geography*, 81(1):83–111.
- Kc, S. and Lutz, W. (2017). The human core of the shared socioeconomic pathways: Population scenarios by age, sex and level of education for all countries to 2100. *Global Environmental Change*, 42:181–192.

- Lakatos, C. and Walmsley, T. (2011). A Global Multi-sector Multi-region Foreign Direct Investment Database for GTAP. *GTAP Research Memorandum*, No. 18.
- McDougall, R. (2003). A New Regional Household Demand System for GTAP. *GTAP Technical Papers*, Paper 20.
- United Nations (2015). The 2015 Revision of the UN's World Population Projections. *Population and Development Review*, 41(3):557–561.
- Wettstein, S., Liberatore, A., Magdeleine, J., and Maurer, A. (2019). A GLOBAL TRADE IN SERVICES DATA SET BY SECTOR AND BY MODE OF SUPPLY (TISMOS).
- World Bank (2019). World Development Indicators (WDI) (February 2019 Edition).