GTAP-FDI Model Extension and Application on the Investment Facilitation for Development

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Overview

The presentation is part of a multi-year project to develop a CGE model to carry out policy analysis related to multinational production and foreign direct investment.

Step ①: Updating the global Foreign Direct Investment (FDI) and Foreign Affiliate Sales database (FAS) that are compatible with GTAP Database Version 11 (Bekkers et al., 2021a,b)

Step ②: Extending the analytical structure of the standard GTAP Model Version 7 to incorporate FDI and FAS

Step ③: As an application example, in Bekkers and So (2021), we looked at the WTO's Investment Facilitation for Development and estimate the relevant ad valorem equivalent (AVE) changes using the Investment Facilitation Index developed by Berger et al. (2023)

Step ④: Conduct simulation and further analyses

FDI & FAS Datasets

Early efforts to introduce multinational firms and FDI into CGE modelling come from Petri (1997) and Hanslow (2000), but their analysis is limited by a lack of data

Gouel et al. (2012) and Fukui and Lakatos (2012) constructed fully balanced FDI and FAS datasets for GTAP Database Version 7.

- The two datasets are adapted to later versions of the GTAP Database through scaling with GDP

In Bekkers et al. (2021a,b), we updated the datasets to be fully compatible with GTAP Database Version 11 with 160 regions, 65 sectors, and the reference year of 2017.

Datasets can be accessed from `https://www.wto.org/english/res_e/reser_e/invest_related_db_e.htm`

FDI & FAS Datasets (Cont.)

Overview of the construction process:

- Reported FDI/FAS data across different dimensions are collected from various sources (e.g. UNCTAD, OECD, national database)
- Missing data at the most disaggregated level (i.e. host, home, sector) are extrapolated from gravity estimations
- Optimisation procedures to reconcile differences across different data dimensions
- Additional adjustments to build linkages between the FDI and FAS datasets, to correct for phantom FDI, and to address compatibility issues with the GTAP database

Overview of Model Extensions

We extend the standard GTAP model to incorporate FDI and multinational production in the following areas:

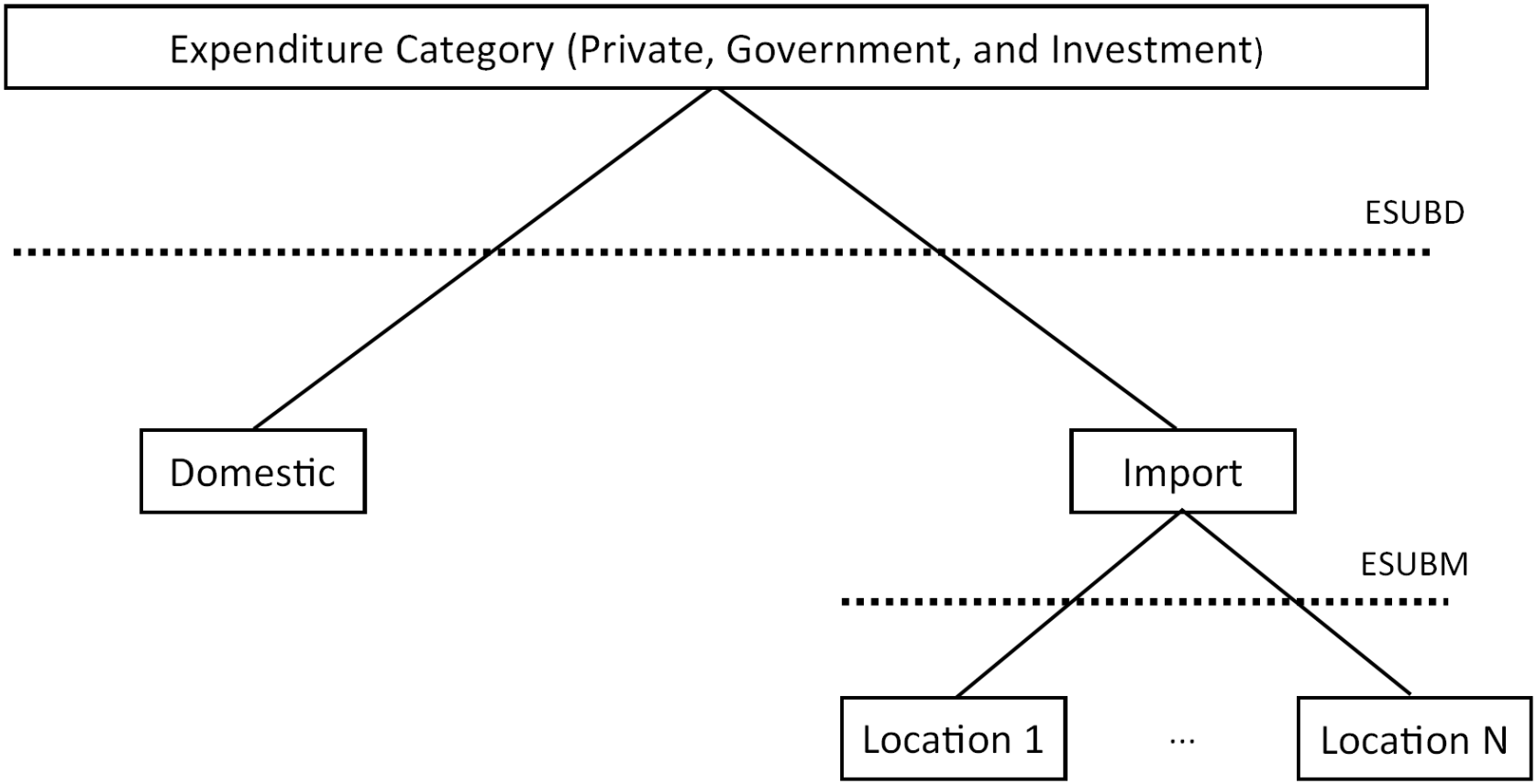
- In the **final demand structure**, commodities are distinguished by the underlying ownership of the producing firms
- In the **production structure**, FDI is separated from capital stock in value-added as an additional factor of production
- In the **allocation of savings**, they are separated into the conventional channel of the 'global bank' and direct investment to other regions (i.e. FDI flow)

Final Demand Structure

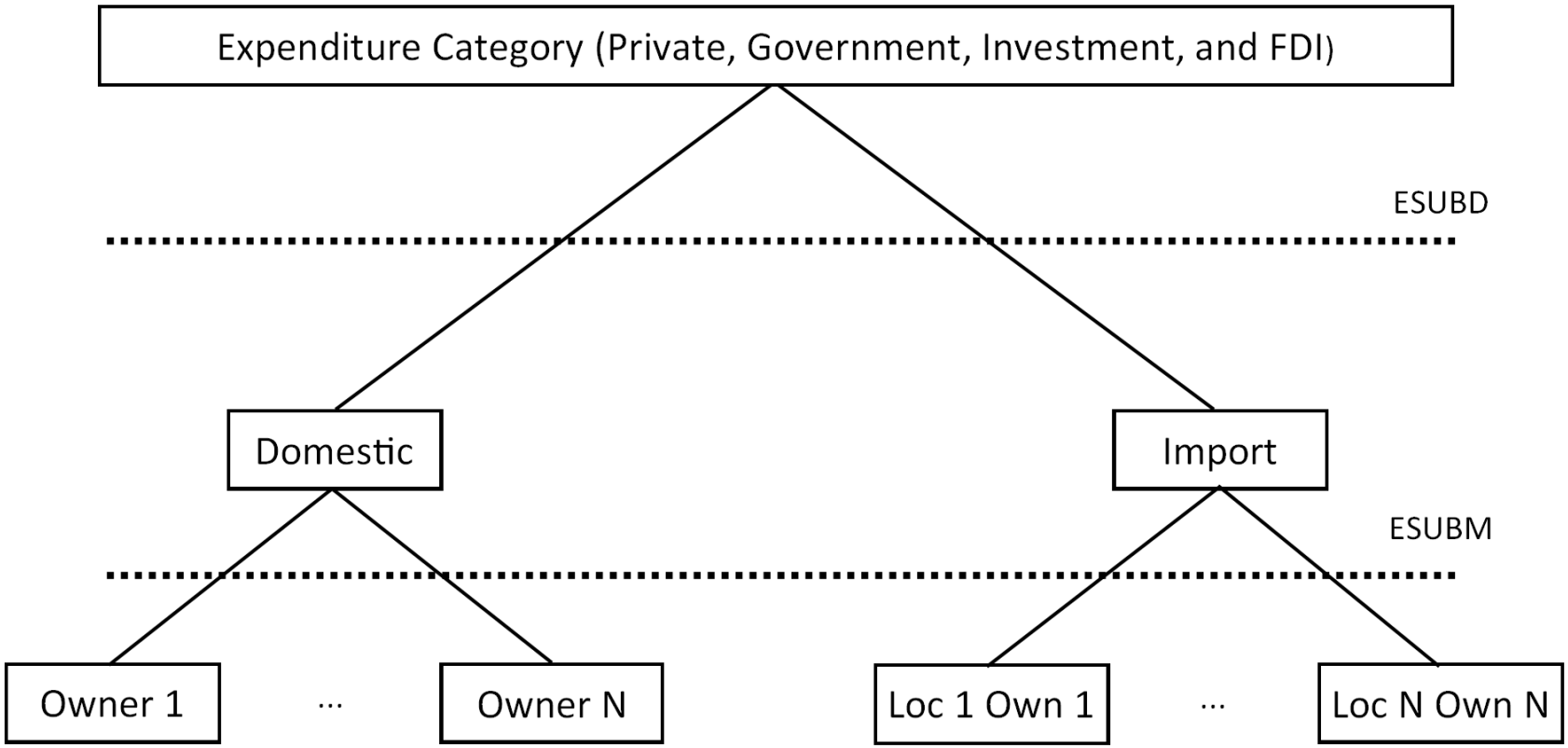
Aside from the **location** of production (domestic vs import), commodities are further distinguished by the **ownership** of the producing firms:

- Expenditures in each category are first allocated to domestic or imported goods with ESUBD
- Expenditures on domestically produced goods are allocated to firms of different ownership with ESUBM.
- Similarly, expenditures on imported goods are distinguished by both firm ownership and location and they are allocated with ESUBM
- This differs from earlier approaches that set up two separate CES nests for imported goods, one distinguishing location and the other for ownership with varying substitution elasticities.

Standard Demand Structure



GTAP-FDI Demand Structure



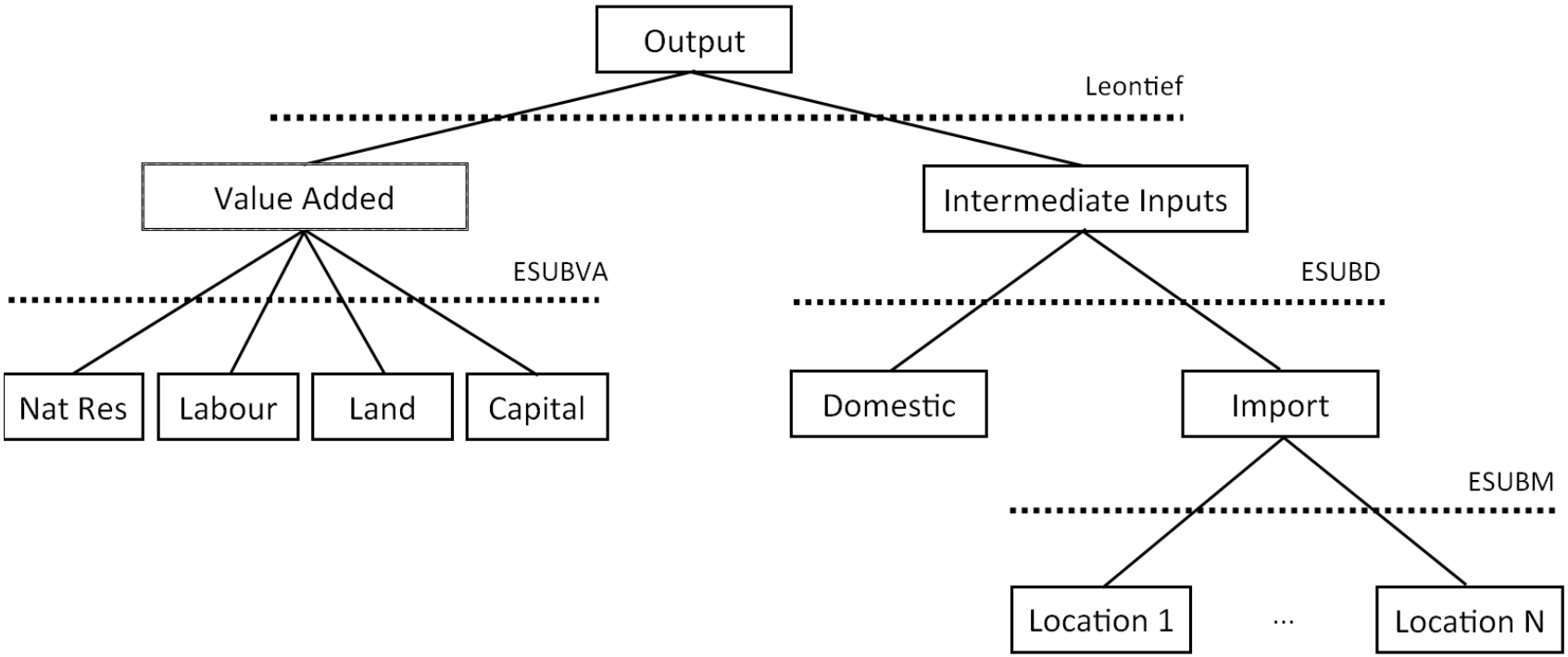
Production Structure

At the top nest, output is produced by combining the intermediate input and value-added bundles. The sourcing of the intermediate inputs from firms follows the same final demand structure as discussed.

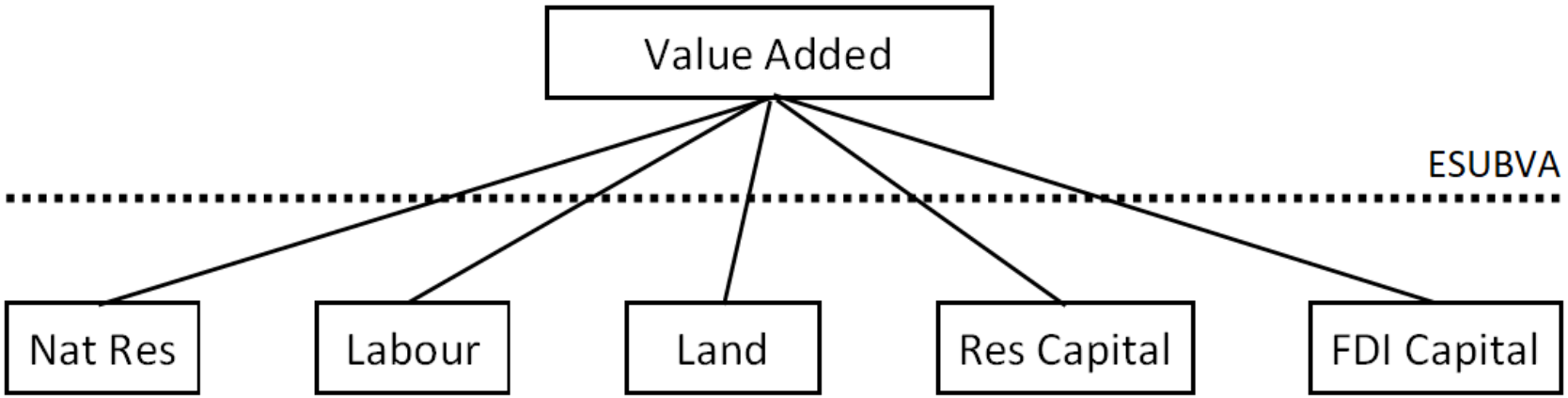
Regarding value-added, the capital stock in the standard GTAP model is split into activity- and ownership-specific **FDI stock** and the **residual capital stock**.

- The FDI stock constitutes an additional factor of production
- The FDI stock is modelled as an immobile factor across both ownership and activity, this reflects the fixed/sunk cost nature of many FDI projects
- The FDI stock can only be utilised in production by foreign affiliates under the same activity and ownership

Standard Production Structure

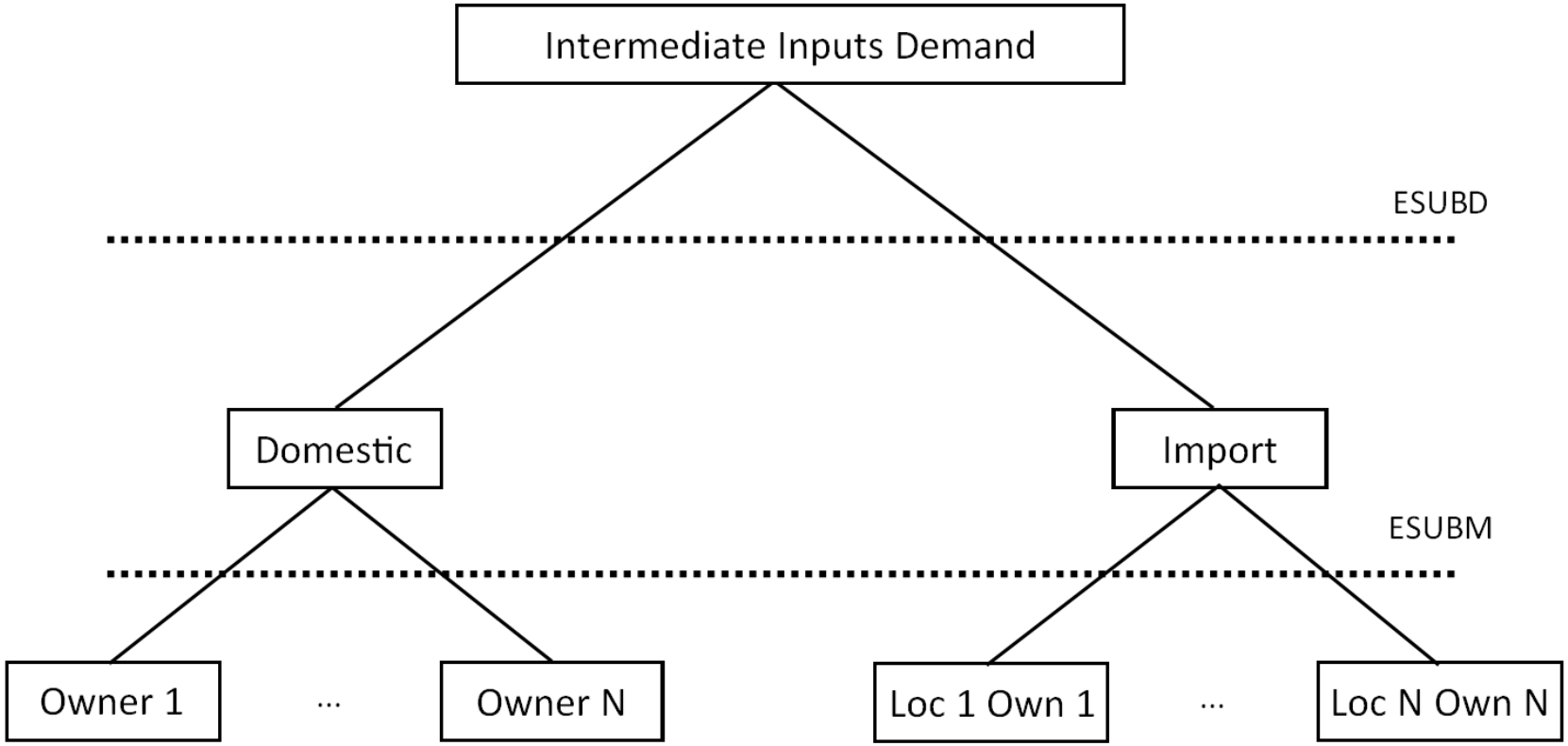


GTAP-FDI Production Structure (Value-added)



- FDI capital is similar to natural resources in that it is **activity-specific**. But additionally, FDI capital is also **owner-specific**
- Since there is no substitutability between FDI stock of different activities and ownership, we do not introduce additional nesting structure as opposed to earlier approaches

GTAP-FDI Production Structure (Intermediate Inputs)



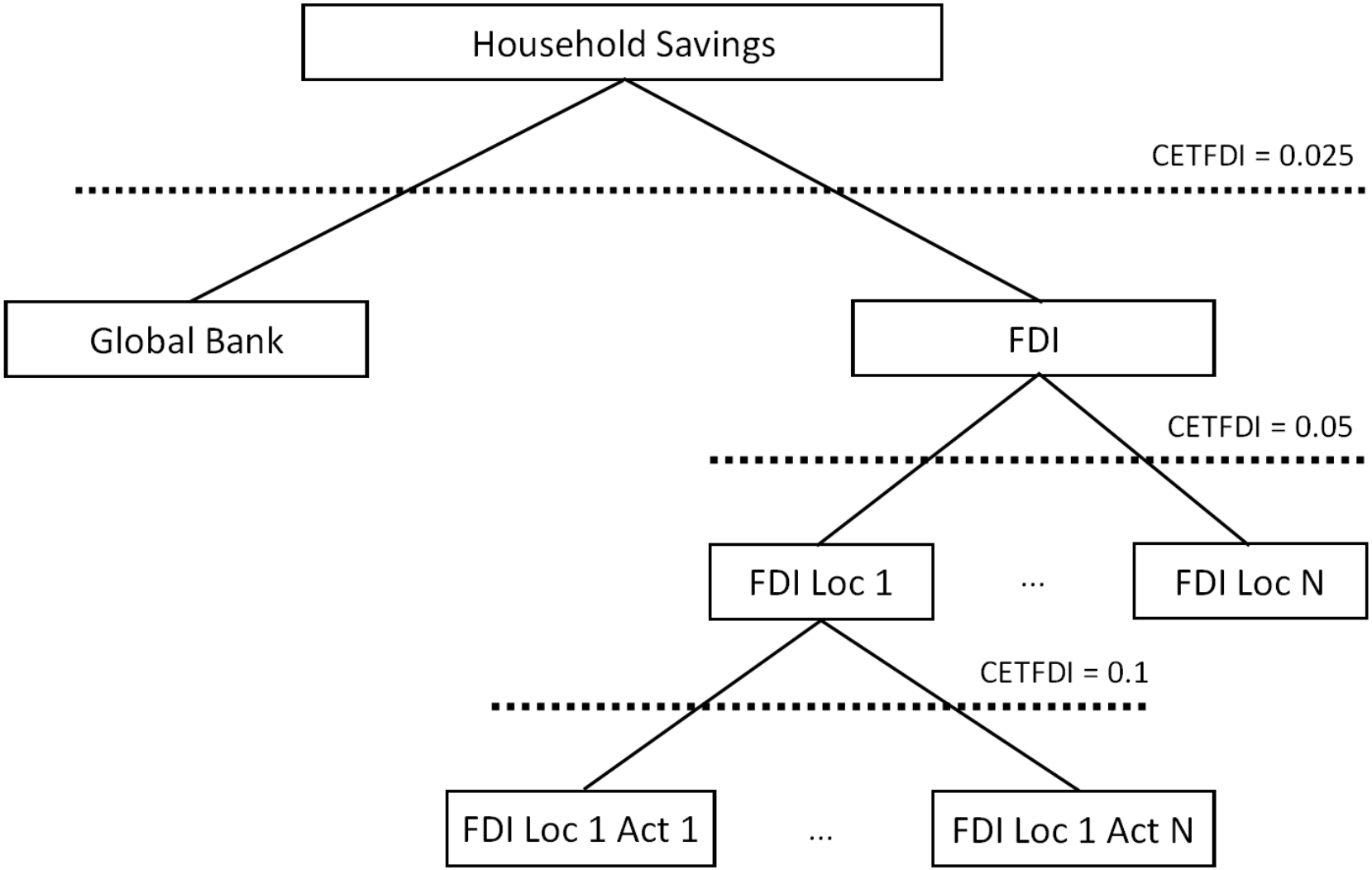
- The demand structure for intermediate inputs is the same as those for final demands

Allocation of Savings

Mirroring the accumulation equation of residual capital stock, the end-of-period FDI stock is net of depreciation and new FDI investment (i.e. FDI flow)

- Unlike the standard model, savings from the regional household are now allocated to both the global bank and FDI which are host- and activity-specific
- We define a CET nesting structure where the households first allocate between the global bank and FDI flow with `CETFDI = 0.025`
- Since FDI stock is location- and activity-specific. At the second nest, households allocate FDI flow to different host countries (location) with `CETFDI = 0.05`
- Finally, within a host country, households allocate FDI flow to different sectors (activity) with `CETFDI = 0.1`

Allocation of Savings (Cont.)



Linkages Between FDI & FAS

The CET nesting structure for the allocation of savings which is driven by the rate of return establishes direct linkages between FDI and FAS

- A positive policy shock to a specific location and activity would lead to an increase in FAS as well as raise the rate of return of the corresponding FDI capital
- It in turn attracts FDI flow from other sectors (activity) and host countries (location)

Potential Adjustments and Further Extensions

- Both the sales structure and production technology of multinational firms can be further refined to differ from domestically-owned firms.
- Distinguishing intra-regional FDI and FAS in aggregated regions
- MRIO structure of intermediate import demand with linkages between intermediates bought by owner o and the location of sourcing s

Investment Facilitation for Development

As an application example, we use our estimates of AVEs for the WTO's **Investment Facilitation for Development** (Bekkers and So, 2021)

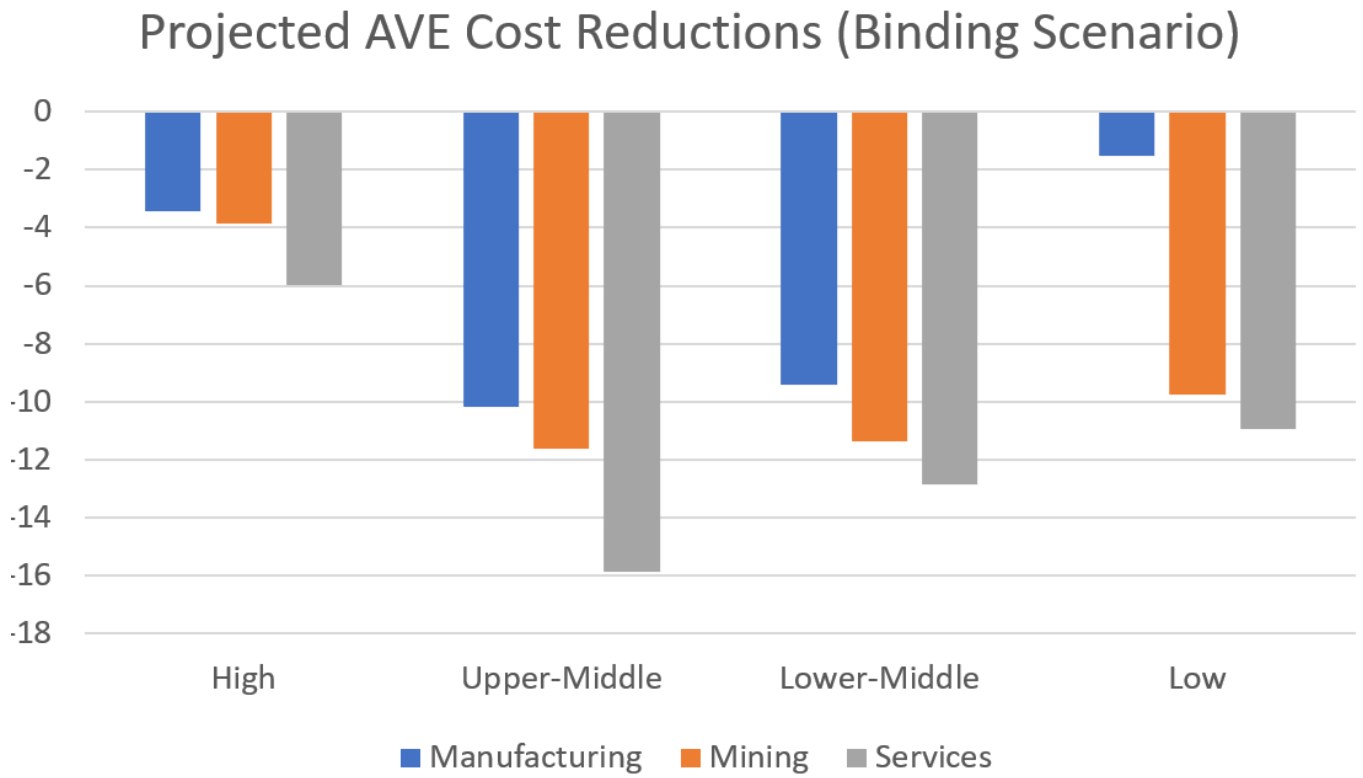
- A plurilateral agreement for over 125 WTO Members
- The final text focuses on improving the transparency and streamlining administrative procedures (e.g. single window) of investment-related measures
- Investment facilitation provisions are non-discriminatory by design, so the policy shocks apply to all foreign affiliates of the host country

We conduct a structural gravity estimation with the Investment Facilitation Index (IFI) developed by Berger et al. (2023)

- Sector-by-sector estimation for agriculture, mining, five manufacturing sectors and nine service sectors
- The identification relies on the interaction with a border dummy

AVE Calculation and Policy Shocks

With the coefficients from the gravity estimation and the changes in IFI scores based on 50% of the **'binding scenario'** (Balistreri and Olekseyuk, 2024), the AVE cost reductions are as follows and they are implemented as ams shocks:



Note: the AVEs are calculated as the weighted average of all High/Upper-Middle/ Lower-Middle/Low Income countries

Aggregate Results

We aggregate the model and shocks into 4 sectors (agriculture, mining, manufacturing and services) and 12 aggregate regions

	Real GDP (Host)	**Real FDI (Home)**	**Real Exports (Host)**	**Real FAS (Host Domestic plus Exports)**
High	1.2	2.6	4.9	16.8
Upper-Middle	2.5	4.4	-10.6	67.0
Lower-Middle	2.1	5.9	0.9	45.9
Low	0.7	1.9	5.4	16.8
Global	1.6	3.3	1.0	31.4

- Decrease in real export in upper-middle income despite increases in FAS $\Rightarrow$ Horizontal FDI and resource constraint
- Large increase in FAS relative to other macro indicators $\Rightarrow$ FAS are a small share of output in many countries

Thank you!

Reference I

Balistreri, E. J. and Olekseyuk, Z. (2024). Investment Facilitation for Development Agreement: Potential Gains. *Working Paper*.

Bekkers, E., Corong, E., Lakatos, C., Macskasi, I., Metivier, J., Yuan, W. J., and Wettstein, S. (2021a). Foreign Affiliate Sales Data. *GTAP Conference papers*, No. 6358.

Bekkers, E., Lakatos, C., So, Y. R., Yuan, W. J., and Traverso, F. (2021b). A Global Foreign Direct Investment Stocks Database. *Conference papers*, No. 6377.

Bekkers, E. and So, Y. R. (2021). Estimating cost reductions of multinational activity of a potential Investment Facilitation Agreement. *GTAP Conference Paper*, No. 6361.

Berger, A., Dadkhah, A., Gitt, F., and Olekseyuk, Z. (2023). The Updated Investment Facilitation Index (IFI). *the German Institute of Development and Sustainability*.

Fukui, T. and Lakatos, C. (2012). A Global Database of Foreign Affiliate Sales. *USITC Working Paper*, No. 2012-08A.

Reference II

Gouel, C., Guimbard, H., and Laborde, D. (2012). A Foreign Direct Investment database for Global CGE models. *CEPII Working Paper*, No. 2012-08.

Hanslow, K. (2000). The structure of the ftap model. Conference Paper: 3rd Annual Conference on Global Economic Analysis.

Petri, P. A. (1997). Foreign Direct Investment in a Computable General Equilibrium Framework. Conference Paper: Making APEC Work Economic Challenges and Policy Alternatives.