Methodology

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Introduction

The most recent strand of literature dedicated to the study of comparative capitalist systems differentiates national political economies based on the long-term drivers of their aggregate demand. By that account, the authors in general distinguish between export-led and private consumption (debt) driven growth models(Baccaro and Pontusson 2016; Baccaro, Blyth, and Pontusson 2022). From the methodological standpoint, many author rely on a very simple desaggregation of the gross domestic product (GDP) into its components in order to analyze the respective contributions of (net) exports and consumption to the GDP growth rates (e.g., Baccaro and Pontusson 2016, 2021; Hein, Meloni, and Tridico 2021; Mertens et al. 2022).

Standard decomposition exercise stems from the simple GDP (Y) accounting identity:

$$Y = C + I + G + (EX - IM) \tag{1}$$

Using the expenditure-based Y, we can calculate the growth contribution of each demand component (K) in Y [C, I, G, EX] as:

$$growthK = \frac{\Delta K}{K_{t-1}} \frac{K_{t-1}}{Y_{t-1}} = \frac{\Delta K}{Y_{t-1}} \tag{2}$$

This approach has, however, few shortcomings. In particular, as the imports are only subtracted from exports, it tends to underestimate the export contributions and overestimate the domestic demand contributions. In reality, some imports are also used for private and public consumption purposes as well as gross capital formation. In the end, only a fraction of imports is absorbed by the exports. Thus, the expenditure-based GDP formula should be expressed as a sum of import-adjusted components of the growth contributions which should reflect their respective importance for a particular growth model more precisely (e.g., Baccaro and Höpner 2022; Baccaro and Neimanns 2022; Bondy and Maggor 2023). For this, the imports (IM) need to be decomposed into the imported expenditures of each demand component individually:

$$IM = IM_C + IM_I + IM_G + IM_{EX} \tag{3}$$

so the expenditure-based formula for import-adjusted GDP can be derived as follows:

$$Y = (C - IM_C) + (I - IM_I) + (G - IM_G) + (EX - IM_{EX}) \tag{4}$$

Import-Adjusted Growth Contributions

Standard decomposition exercise relies on national accounts data. The national accounts data, however, do not contain information about import content of the respective demand components. To be able to break the imports down by demand component, we need to make use of the Input-Output tables (IOT). A standard IOT representation based on the OECD is in the following form:

Figure 1 Structure of OECD IOT

		Intermediate				Final demand				
		Ind. 1	*Ind. 2*	…	*Ind. n*	*C*	*I*	*G*	*EX*	*Total*
Domestic	*Ind. 1* *Ind. 2* … *Ind. n*	Z^d (n x n)				F^d (n x n)				
Import	*Ind. 1* *Ind. 2* … *Ind. n*	Z^m (n x n)				F^m (n x n)				
Value Added										
Total										

The IOT envisages the economy as a matrix being composed on n sectors. The domestic matrix Z^d (the cell z_{ij}^d) describes the flows of domestically produced intermediate inputs from each industry i (rows) purchased by industry j (columns) for domestic production processes. Naturally, not all inputs are domestically produced. Therefore, the import matrix Z^m (the cell z_{ij}^m) contains information about the value of imported intermediate inputs from i industry (rows) purchased by domestic industry j (columns) for domestic production.

The right side of the IOT contains the final demand components. The matrix F^d (the cell F_{ij}^d) reports the flows of domestically produced goods and services from industry i needed by one of the four final expenditure components (k) - C, I, G and EX. Conversely, the matrix F^m (the cell F_{ij}^m) reports the absorption of direct imports of goods and services from industry i (rows) by one of the four final demand component k. The direct imports from each sector i for each final demand component k alone are not sufficient though. It is also necessary to estimate the indirect import content of domestic final demand components k - the value of imports "induced by spending on goods and services produced domestically" (Baccaro and Hadziabdic 2022, 9). The indirect imports cover imports of intermediate goods and services from foreign industries j or imports that are used in intermediate inputs of domestic suppliers.

The value of direct imports absorbed by each expenditure component M^{dir} can be directly retrieved from the IOT:

$$M^{dir} = F^m \tag{5}$$

To estimate the indirect imports, we follow the methodology outlined by Bussière et al. (2013), Auboin and Borino (2018) and Baccaro and Hadziabdic (2022). We first divide each cell in matrices Z^d and Z^m by the sector's outputs in each column (total output of each sector j) to compute input coefficients:

$$a_{i,j}^d = \frac{z_{i,j}^d}{x_j} \tag{6}$$

and

$$a_{i,j}^m = \frac{z_{i,j}^m}{x_j} \tag{7}$$

Then, the cells in A^d matrix (a^d_{ij}) represent the amount of domestically produced intermediate inputs from industry i required for one unit of domestic output in industry j, and analogously, the cells in A^m matrix (a^m_{ij}) the amount of imported intermediate inputs from foreign industry i necessary to produce one unit of domestic output per industry j.

Subsequently, we calculate the domestic output of industry i satisfying the final expenditure demand component k as:

$$x_{i,k} = \sum_{j=1}^{n} a^d_{i,j} * x_{j,k} + f^d_{i,k} \tag{8}$$

or in matrix form:

$$X = A^d X + F^d \tag{9}$$

where X is the matrix of domestic output induced by each spending component k. The matrix of domestic output can then be adjusted as:

$$\begin{aligned} X - A^d X &= F^d \\ (I - A^d)X &= F^d \end{aligned} \tag{10}$$

$$X = (I - A^d)^{-1} F^d$$

where

$$X = (I - A^d)^{-1} \tag{11}$$

and represents the *Leontief inverse matrix*. In order for this system of equations to have an unambiguous solution, certain conditions need to be met (Miller and Blair 2009). In context of the structural models of this type, these conditions are always met (e.g., Tiruneh, Dujava, and Lábaj 2011, 20; Lábaj 2014, 104).

Subsequently, the imports of intermediate inputs from industry i induced by one of the four expenditure components k can be expressed as follows:

$$m^{ind}_{i,k} = \sum_{j=1}^{n} a^m_{i,j} * x_{j,k} \tag{12}$$

or in matrix form:

$$M^{ind} = A^m (I - A^d)^{-1} F^d = A^m * X \tag{13}$$

Given the direct imports can be directly derived from F^m as $M^{dir} = F^m$, total imports M^{tot} can be expressed as:

$$M^{tot} = M^{ind} + M^{dir} = A^m (I - A^d)^{-1} F^d + F^m \tag{14}$$

Prior to adjustments, the total final demand F^{tot} stemming from each demand component equals the sum of final expenditure on domestic goods and services (F^d) and expenditure on directly imported goods and services F^m. To calculate the import-adjusted final demand components in line with Baccaro and Hadziabdic (2022), we proceed as follows:

$$F^{imp.adj} = F^{tot} - (M^{ind} + F^m) = F^d - M^{ind} \tag{15}$$

As a result, the import-adjusted demand components are calculated when we subtract the direct as well as indirect imports induced by domestically produced goods and services from the expenditures on domestic production. Subsequently, the import-adjusted expenditures are plugged into the equation 2 and import-adjusted contributions of consumption, investment, government expenditures and exports are expressed based on the following formula:

$$growthK^{imp.adj} = \frac{\Delta K^{imp.adj}}{Y_0} \tag{16}$$

Data Used

To calculate the import-adjusted components of the GDP, we make use of the latest release of the OECD national Input-Output Tables database, which covers 66 countries for years ranging from 1995 to 2018. The OECD IOT have numerous advantages. Firstly, the latest release of the OECD IOT is based on ISIC Rev 4 industrial classification, covering 45 sectors, which creates a space for potential analysis of (import-adjusted) sectoral contributions to the GDP growth. Secondly, the OECD IOT seem to have a higher quality of data, especially with regards to direct re-exports as other IOT tend to overvalue import-adjusted exports contributions of selected countries (Baccaro and Hadziabdic 2022).

The raw OECD IOT are available at the OECD.stat website, where they can be accessed in csv form. For every country for each year, the raw data comes in form as visualized in Figure 2.

Figure 2 Structure of Raw OECD IOT, 2021 release

		Intermediate				Final demand		
		Ind. 1	*Ind. 2*	…	*Ind. 45*	*Household Consumption*	…	*Total*
Domestic	*Ind. 1* *Ind. 2* … *Ind. 45*	Z^d (45 x 45)				F^d (45 x 10)		
Import	*Ind. 1* *Ind. 2* … *Ind. 45*	Z^m (45 x 45)				F^m (45 x 10)		
Total	*Taxes less subsidies* … *Output*	Total (5 x 55)						

To remind, matrix Z^d describes the flows of domestically produced intermediate inputs between domestic sectors, matrix Z^m represents the flows of imported intermediate inputs from foreign industries needed for domestic production, F^d reports the expenditure on goods and services produced in the domestic economy and F^m gives the direct imports of goods and services from foreign industries needed by one of the final demand component. Given the ISIC Rev 4 industrial classification covers 45 sectors, the size of the matrices Z^d and Z^m is 45 x 45 sectors. That is 45 rows of domestic industries for Z^d and 45 rows of foreign industries for Z^m, by 45 columns of domestic industries acquiring the inputs from 45 domestic and foreign sectors. F^d and F^m matrices each consist of the same 45 industries (rows) but their columns represent 10 different final demand components including the output and imports, which are not used in our final analysis. The remaining eight columns were then subsequently summed into four final demand components as follows:

Private Consumption (C) = Final consumption expenditure of households + Final consumption expenditure of non-profit institutions serving households

Investment (I) = Gross Fixed Capital Formation + Changes in inventories

Government Spending (G) = Final consumption expenditure of general government

Exports (EX) = Exports (cross border) + Direct purchases by non-residents (exports) + Direct purchases abroad by residents (imports)

This simple computations allow us to reduce the F^d and F^m into two 45x4 matrices. Finally, the bottom five rows in matrix Tot contain summary indicators for each column, such as taxes less subsidies on intermediate and final products (paid in foreign countries); taxes less subsidies on intermediate and final products (paid in domestic territory); total intermediate consumption at purchasers' prices; value added at basic prices and output at basic prices. After the reduction in the F^d and F^m columns, the Tot matrix's size is 5x49. The final IOT after reduction and adjustments has then following structure:

Figure 3 Reduced Structure of OECD IOT

<table>
<tr><td colspan="2" rowspan="2"></td><td colspan="4">Intermediate</td><td colspan="4">Final demand</td></tr>
<tr><td>Ind. 1</td><td>Ind. 2</td><td>…</td><td>Ind. 45</td><td>C</td><td>I</td><td>G</td><td>EX</td></tr>
<tr><td>Domestic</td><td>Ind. 1
Ind. 2
…
Ind. 45</td><td colspan="4">Z^d (45 x 45)</td><td colspan="4">F^d (45 x 4)</td></tr>
<tr><td>Import</td><td>Ind. 1
Ind. 2
…
Ind. 45</td><td colspan="4">Z^m (45 x 45)</td><td colspan="4">F^m (45 x 4)</td></tr>
<tr><td>Total</td><td>Taxes less subsidies
…
Output</td><td colspan="8">Total (5 x 49)</td></tr>
</table>

Since all data in OECD IOT are provided at basic prices in current US dollars, we convert them in line with Baccaro and Hadziabdic (2022) into local currencies using the country-year specific exchange rates made available alongside the 2021 release of the OECD Inter-Country IOT (available HERE). Subsequently, we deflate the converted values making use of the OECD Economic Outlook GDP deflators (available HERE). The GDP deflators at market prices are employed with national reference year (see also Baccaro and Hadziabdic 2022). Using the modified (reduced, converted and deflated) OECD IOT, we proceed with calculations as described in previous section (Bussière et al. 2013; Auboin and Borino 2018; Baccaro and Hadziabdic 2022). Data management, calculations and result visualizations are all conducted in R. The R codes and data used are all available on Github.

References

Auboin, Marc, and Floriana Borino. 2018. "The Falling Elasticity of Global Trade to Economic Activity: Testing the Demand Channel." *CESifo Working Paper*. Munich Society for the Promotion of Economic Research. https://www.cesifo.org/en/publications/2018/working-paper/falling-elasticity-global-trade-economic-activity-testing-demand.

Baccaro, Lucio, Mark Blyth, and Jonas Pontusson. 2022. *Diminishing Returns the New Politics of Growth and Stagnation*. Oxford University Press.

Baccaro, Lucio, and Sinisa Hadziabdic. 2022. "Operationalizing Growth Models." *MPIfG Discussion Paper 22/6*. Max Planck Institute for the Study of Societies, Cologne. https://pure.mpg.de/rest/items/item_3456441/component/file_3456736/content.

Baccaro, Lucio, and Martin Höpner. 2022. "The Political- Economic Foundations of Export- Led Growth: An Analysis of the German Case." In *Diminishing returns the new politics of growth and stagnation*. Oxford University Press.

Baccaro, Lucio, and Erik Neimanns. 2022. "Who Wants Wage Moderation? Trade Exposure, Export-Led Growth, and the Irrelevance of Bargaining Structure." *West European Politics* 45 (6): 1257–82. https://doi.org/10.1080/01402382.2021.2024010.

Baccaro, Lucio, and Jonas Pontusson. 2016. "Rethinking Comparative Political Economy: The Growth Model Perspective." *Politics & Society* 44 (2): 175–207. https://doi.org/10.1177/0032329216638053.

———. 2021. "European Growth Models Before and After the Great Recession." In *Growth and Welfare in Advanced Capitalist Economies: How Have Growth Regimes Evolved?* Oxford University Press. https://doi.org/10.1093/oso/9780198866176.003.0003.

Bondy, Assaf S., and Erez Maggor. 2023. "Balancing the Scales: Labour Incorporation and the Politics of Growth Model Transformation." *New Political Economy* 0 (0): 1–20. https://doi.org/10.1080/13563467.2023.2217770.

Bussière, Matthieu, Giovanni Callegari, Fabio Ghironi, Giulia Sestieri, and Norihiko Yamano. 2013. "Estimating Trade Elasticities: Demand Composition and the Trade Collapse of 2008-2009." *American Economic Journal: Macroeconomics* 5 (3): 118–51. https://doi.org/10.1257/mac.5.3.118.

Hein, Eckhard, Walter Paternesi Meloni, and Pasquale Tridico. 2021. "Welfare Models and Demand-Led Growth Regimes Before and After the Financial and Economic Crisis." *Review of International Political Economy* 28 (5): 1196–1223. https://doi.org/10.1080/09692290.2020.1744178.

Lábaj, Martin. 2014. *Štrukturálne Aspekty Ekonomického Rozvoja: Slovenská Ekonomika v Globálnych Súvislostiach*. EKONÓM.

Mertens, Daniel, Andreas Nölke, Christian May, Michael Schedelik, Tobias ten Brink, and Alexandre Gomes. 2022. "Moving the Center: Adapting the Toolbox of Growth Model Research to Emerging Capitalist Economies." *Working Paper, No. 188/2022*. Institute for International Political Economy Berlin. https://www.ipe-berlin.org/fileadmin/institut-ipe/Dokumente/Working_Papers/IPE-working_paper_188.pdf.

Miller, Ronald E., and Peter D. Blair. 2009. "Foundations of Input–Output Analysis." In *Input-Output Analysis: Foundations and Extensions*, 2nd ed., 10–68. Cambridge University Press. https://doi.org/10.1017/CBO9780511626982.003.

Tiruneh, Menbere Workie, Daniel Dujava, and Martin Lábaj. 2011. *Štrukturálne Aspekty Ekonomického Rozvoja: Slovenská Ekonomika v Globálnych Súvislostiach.* IRIS.