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# An Import-Adjusted Approach to Quantify the Contributions to Real GDP Growth in Slovenia

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**Abstract**

In general, there are two broadly utilized approaches for decomposing real GDP growth rates. The standard approach treats imports of goods and services as an aggregate and deducts their total contribution to economic activity from the contribution of exports of goods and services, resulting in an underestimated contribution of net exports to real GDP growth. On the other hand, an alternative approach deals with the shortcomings of the previously mentioned approach by distributing the amount of imports of goods and services between domestic demand expenditure components and exports of goods and services in line with their respective import intensities. In this article an alternative approach, based on the nominal and real import intensities of final demand expenditure components calculated from the SORS's symmetric input-output tables, is applied to Slovenian national accounts macroeconomic data. The results of the analysis suggest a significant re-evaluation of the importance of the net exports contribution to real GDP growth vis-à-vis the standard approach. The key finding suggests that the Slovenian real GDP growth between 2014 and 2021 was, contrary to the results based on the standard approach, mainly driven by net export developments. This supports the hypothesis that the maintenance of external competitiveness via the advancement in integration and participation in global value chains is of key importance for supporting growth of the Slovenian economy.

**JEL Classification Numbers:** C67, D57, E32, F43, O47

**Keywords:** contributions to real GDP growth, net export developments, symmetric input-output tables, nominal and real import intensities

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# Povzetek

Razčlenitev realne rasti BDP se običajno analizira z uporabo enega od dveh splošno uporabljenih pristopov. Standardni pristop obravnava uvoz blaga in storitev kot agregat in njegov skupni prispevek h gospodarski dejavnosti odšteje od prispevka izvoza blaga in storitev, kar se največkrat odrazi v podcenjenosti prispevka neto izvoza k realni rasti BDP. Alternativni pristop po drugi strani odpravlja pomanjkljivosti prej omenjenega pristopa tako, da znesek uvoza blaga in storitev razporedi med komponente izdatkov domačega povpraševanja ter izvozom blaga in storitev v skladu z njihovimi uvoznimi intenzivnostmi. V tem članku se z uporabo slovenskih makroekonomskih podatkov iz nacionalnih računov uporabi alternativni pristop, ki temelji na nominalnih in realnih uvoznih intenzivnostih komponent izdatkov končnega povpraševanja, izračunanih na podlagi SURS-ovih simetričnih input-output tabel. Rezultati analize kažejo na bistveno razliko v ovrednotenju pomena prispevka neto izvoza k realni rasti BDP v primerjavi s standardnim pristopom. Ključna ugotovitev kaže, da je slovensko realno rast BDP med letoma 2014 in 2021 v nasprotju z rezultati, ki temeljijo na standardnem pristopu, spodbujalo predvsem gibanje neto izvoza. To potrjuje hipotezo, da je ohranjanje zunanje konkurenčnosti z napredkom v povezovanju in sodelovanju v globalnih vrednostnih verigah ključnega pomena pri podpiranju rasti slovenskega gospodarstva.

# 1 Introduction

The analysis of macroeconomic developments in particular country usually entails a decomposition of real gross domestic product (GDP) growth to the contributions made by the standard expenditure components (i.e. private consumption, government consumption, investments incl. change in inventories, exports of goods and services and imports of goods and services). This break down serves as an information for policy makers about the factors that are prevailing in the structure of the growth of economic activity. In general, there exist two broadly utilized approaches to decomposing real GDP growth.

The standard approach (Robjohns, 2007 and Lequiller & Blades, 2014), used in the analyses of the European Central Bank (ECB), the European Commission (EC), the International Monetary Fund (IMF) and the Organization for Economic Cooperation and Development (OECD), treats imports of goods and services as an aggregate and deducts their total contribution to economic activity from the contribution of exports of goods and services, resulting in a net exports contribution (i.e. the difference between exports and imports of goods and services' contributions), while the contributions coming from the domestic demand expenditure components (i.e. contributions of private consumption, government consumption and investments incl. change in inventories) are not adjusted for the associated imports of goods and services (i.e. zero import intensities are assumed for all domestic demand expenditure components). There are certain advantages and disadvantages to this approach. On the positive side, the standard approach is simple and easily applicable. In addition, it provides clear distinction between the domestic factors and factors related to foreign trade. On the other hand, the main weakness of the standard approach can be found in the calculation of net exports contribution mentioned above, as it does not recognize that part of the imports of goods and services is also used by expenditure components other than exports of goods and services. In this way, the standard approach underestimates the contribution of net exports of goods and services, and overestimates the importance of domestic demand expenditure components in real GDP growth.

In a world of rapid international trade developments, the integration of a small open economy in the global value chains plays a vital role (Amador et al., 2015; Grodzicki & Geodecki, 2016 and Damjanović & Banerjee, 2018). Thereby, the deepening of the Slovenian trade relations has an important implications on the dynamics of expenditure components, especially exports and imports of goods and services. In order to correctly take into account the importance of exports of goods and services in designing more complex sets of small open economy's policy measures for economic growth and external stability, an alternative approach to decomposing real GDP growth is needed. Following the ideas initially proposed by Kranendonk and Verbruggen (2008a,

2008b) and Bussière et al. (2013), an alternative approach seeks to determine the import intensities (i.e. import contents) of the corresponding expenditure components by utilizing the symmetric input-output tables (as defined in Leontief, 1986; Ten Raa, 2005 and Miller & Blair, 2009). By properly allocating the amount of imports of goods and services across domestic demand expenditure components and exports of goods and services, it takes into account the heterogeneity in the penetration of imports of goods and services across all considered expenditure components.

Such allocation provides the foundation for the research conducted in this paper as it aims to assess the role of imports of goods and services in different expenditure components of Slovenian economy by utilizing Statistical Office of the Republic of Slovenia's (SORS's) symmetric input-output tables (Kalin, 2022), and to revisit the standard approach to decomposing real GDP growth. Additionally, by following Cardoso et al. (2013) and Cardoso and Rua (2019, 2021), the goal of the study is to quantify both nominal (i.e. calculated at current prices) and real (i.e. calculated at constant prices) import intensities of the corresponding expenditure components. Such a distinction is important in order to properly capture the volume and price effects of the changes in nominal import intensities of the aforementioned expenditure components in the observed period. To address certain lack in data availability in the symmetric input-output tables, the analysis also considers several data extrapolation methods in order to obtain values of nominal and real import intensities of corresponding expenditure components for the years for which symmetric input-output tables are not available. To the best of our knowledge, current research is one of the first applications of SORS's symmetric input-output tables in such calculations[1].

The rest of the paper is organized as follows. Section 2 discusses the prevailing methodological frameworks behind the quantification of contributions to real GDP growth (i.e. standard and alternative approaches discussed above) and lays out the standard matrix representation of the symmetric input-output tables. Section 3 presents the specific composition of SORS's symmetric input-output tables and addresses the explicit treatment of the utilized data set. Section 4 discusses the major results of the analysis, while Section 5 concludes.

[1] A previous analysis by Banka Slovenije (2019) can be considered a closest related research. It utilizes both OECD's and SORS's symmetric input-output tables to compare nominal import intensities calculated based on the data of both institutions, and compares the contributions to real GDP growth by standard and alternative approaches. The current research opts out from using the OECD's symmetric input-output tables due to the unavailability of supply and use tables at constant prices, which are crucial in obtaining deflators for calculating the real import intensities of expenditure components.

# 2 Methodology

The standard approach to the real GDP growth decomposition utilizes the break down of GDP to the basic expenditure components from the national accounts statistics, shown by the following formula:

$$Y_t = \underbrace{C_t + G_t + I_t}_{DD_t} + \underbrace{(E_t - M_t)}_{NE_t} \tag{1}$$

In the Equation 1, $Y_t$ denotes GDP, $C_t$ is private consumption, $G_t$ is government consumption, $I_t$ are investments incl. change in inventories (i.e. gross capital formation), $E_t$ are exports of goods and services, and $M_t$ imports of goods and services. Furthermore, $DD_t$ refers to domestic demand, while $NE_t$ denotes net exports (i.e. foreign trade balance).

The contributions by the expenditure components to real GDP growth can be calculated and summed together in order to obtain real GDP growth decomposition in the following way (Robjohns, 2007 and Lequiller & Blades, 2014):

$$\Delta y_t = \underbrace{\frac{C_{t-1}}{Y_{t-1}}\Delta c_t + \frac{G_{t-1}}{Y_{t-1}}\Delta g_t + \frac{I_{t-1}}{Y_{t-1}}\Delta i_t}_{\frac{DD_{t-1}}{Y_{t-1}}\Delta dd_t} + \underbrace{\left(\frac{E_{t-1}}{Y_{t-1}}\Delta e_t - \frac{M_{t-1}}{Y_{t-1}}\Delta m_t\right)}_{\frac{NE_{t-1}}{Y_{t-1}}\Delta ne_t} \tag{2}$$

In the Equation 2, the upper case letters denote the values of expenditure components in nominal terms, while the lower case letters correspond to the values of expenditure components in real terms. Furthermore, $\Delta$ stands for the growth rate operator. The application of the standard approach follows the idea of deducting imports of goods and services from one expenditure component only, which is the exports of goods and services. This further implies that the negative contribution of imports of goods and services is allocated exclusively to the contribution of exports of goods and services (suggesting that import intensities of expenditure components are not embedded in the interpretation). The main advantages of this approach are its simplicity and the fast applicability (as only nominal and real values of expenditure components from the national accounts statistics are used), with the net exports contribution to real GDP growth being clearly defined. However, one key drawback of the standard approach lies in the biased allocation of the contribution of imports of goods and services, disproportionate to their actual shares of usage in expenditure components of domestic demand. In that sense, the standard approach underestimates the contribution of exports of goods and services, and overestimates the importance of real domestic demand expenditure components in real GDP growth.

The alternative approach to decomposing real GDP growth (initially proposed by Kranendonk & Verbruggen, 2008a, 2008b and Bussière et al., 2013)

addresses the shortcomings of the standard approach by distributing the amount of imports of goods and services across domestic demand expenditure components and exports of goods and services in line with their respective import intensities. The alternative approach therefore recognizes that part of the imports of goods and services is used for domestic expenditures as well. In this case, the usage of imports of goods and services is not attributed only to the imports of final goods and services, but also to the imports of intermediary goods and services to sectors that operate domestically. Taking all this into consideration, the GDP is, according to the alternative approach, broken down to somewhat modified expenditure components in the following way:

$$Y_t = \underbrace{C_t - \underbrace{\Omega_{C,t}C_t}_{MC_t} + G_t - \underbrace{\Omega_{G,t}G_t}_{MG_t} + I_t - \underbrace{\Omega_{I,t}I_t}_{MI_t}}_{MDD_t} + \underbrace{\left(E_t - \underbrace{\Omega_{E,t}E_t}_{ME_t}\right)}_{MNE_t} \tag{3}$$

In the Equation 3, $\Omega_{C,t}$, $\Omega_{G,t}$, $\Omega_{I,t}$ and $\Omega_{E,t}$ represent import intensities for the corresponding expenditure component defined at the end of this Section, while $MC_t$, $MI_t$, $MG_t$ and $ME_t$ refer to the final and intermediate imports of goods and services for the examined expenditure component. $MDD_t$ and $MNE_t$ denote altered domestic demand and net exports, respectively. In such manner, contributions of import-adjusted expenditure components to real GDP growth can be calculated and summed together in order to obtain an alternative real GDP growth decomposition (Kranendonk & Verbruggen, 2008a, 2008b), where the application of upper and lower case letters is directly related to the notation exploited in Equation 2:

$$\begin{aligned}\Delta y_t = &\underbrace{\frac{C_{t-1}}{Y_{t-1}}\Delta c_t - \frac{MC_{t-1}}{Y_{t-1}}\Delta mc_t + \frac{G_{t-1}}{Y_{t-1}}\Delta g_t - \frac{MG_{t-1}}{Y_{t-1}}\Delta mg_t +}\\ &\underbrace{+\frac{I_{t-1}}{Y_{t-1}}\Delta i_t - \frac{MI_{t-1}}{Y_{t-1}}\Delta mi_t}_{\frac{MDD_{t-1}}{Y_{t-1}}\Delta mdd_t} + \underbrace{\left(\frac{E_{t-1}}{Y_{t-1}}\Delta e_t - \frac{ME_{t-1}}{Y_{t-1}}\Delta me_t\right)}_{\frac{MNE_{t-1}}{Y_{t-1}}\Delta mne_t}\end{aligned} \tag{4}$$

As evident from Equation 4, the alternative approach offers somewhat different insight into the decomposition of real GDP growth, as it, based on corresponding import intensities, re-evaluates the relative importance of domestic demand expenditure components and exports of goods and services.

Despite its clear representation, the alternative approach introduces a non-trivial extension of the analysis. It requires the utilization and detailed investigation of symmetric input-output tables (as defined in Leontief, 1986; Ten Raa, 2005 and Miller & Blair, 2009) in order to construct the import intensities

of the corresponding expenditure components mentioned above. For this purpose, a standard representation of such tables has to be laid out (this mainly follows Cardoso & Rua, 2019). We consider that there exists $N$ products and $K$ final demand expenditure components (i.e. private consumption, government consumption, investments incl. change in inventories, and exports of goods and services) in the Slovenian economy. Furthermore, the domestic output of each product is used as an intermediate input (i.e. intermediate consumption) in the production of other products or to satisfy final demand. The domestic output of product $i$ is then given by:

$$x_i = \sum_{i=1}^{N} a_{ij}^{d} x_j + \sum_{k=1}^{K} z_{ik}^{d} \tag{5}$$

In the Equation 5, $x_i$ refers to the domestic output of product $i$, $a_{ij}^{d} = \frac{r_{ij}^{d}}{x_j}$ corresponds to domestic input coefficient that relates the domestic output of product $i$ used as an intermediate input by sector $j$ and domestic output of sector $j$, $x_j$ denotes domestic output of sector $j$ and $z_{ik}^{d}$ is the domestic output of product $i$ used to satisfy the $k$-th final demand expenditure component. Using the matrix form, Equation 5 translates to:

$$X = A^{d}X + Z^{d}J \tag{6}$$

$X$ in the Equation 6 denotes the $N \times 1$ vector of domestic output, $A^{d}$ is the $N \times N$ matrix of domestic input coefficients, $Z^{d}$ corresponds to $N \times K$ matrix of final demands for domestic goods and services, and $J$ is the $K \times 1$ vector of ones. Solving Equation 6 for $X$ gives us:

$$X = \underbrace{\left(I - A^{d}\right)^{-1}}_{L^{inv}} Z^{d}J \tag{7}$$

$I$ in the Equation 7 is an $N \times N$ identity matrix, and $\left(I - A^{d}\right)^{-1}$ is commonly known as $N \times N$ Leontief inverse matrix ($L^{inv}$).

Following the demonstrated steps, similar reasoning can be applied to the use of imports of goods and services. The imports of each product are used as an intermediate input in the production of other products or to satisfy directly final demand. Imports of product $i$ are therefore determined by:

$$m_i = \sum_{j=1}^{N} a_{ij}^{m} x_j + \sum_{k=1}^{K} z_{ik}^{m} \tag{8}$$

In the Equation 8, $m_i$ refers to the imports of product $i$, $a_{ij}^{m} = \frac{r_{ij}^{m}}{x_j}$ corresponds to imported input coefficient that relates the imports of product $i$ used as an intermediate input by sector $j$ and the domestic output of sector $j$, and

$z_{ik}^m$ are the imports of product $i$ used to satisfy directly the $k$-th final demand expenditure component. Using again the matrix form, Equation 8 becomes:

$$M = A^m X + Z^m J \tag{9}$$

$M$ in the Equation 9 denotes an $N \times 1$ vector of imports of goods and services, $A^m$ is the $N \times N$ matrix of imported input coefficients, $Z^m$ corresponds to $N \times K$ matrix of final demands for imported goods and services, and $J$ is again the $K \times 1$ vector of ones. From Equations 7 and 9 follows:

$$M = \underbrace{A^m L^{inv} Z^d}_{M^{ind}} J + \underbrace{Z^m}_{M^{dir}} J \tag{10}$$

Equation 10 shows that total imports of goods and services are decomposed into the indirect ($M^{ind}$) and direct ($M^{dir}$) part, from which we can further derive the equations for indirect and direct import intensities of the $k$-th final demand expenditure component:

$$\Omega_k^{ind} = \frac{\sum_{i=1}^{N} m_{ik}^{ind}}{\sum_{i=1}^{N} z_{ik}} \tag{11}$$

$$\Omega_k^{dir} = \frac{\sum_{i=1}^{N} m_{ik}^{dir}}{\sum_{i=1}^{N} z_{ik}} \tag{12}$$

In Equations 11 and 12, $m_{ik}^{ind}$ and $m_{ik}^{dir}$ correspond to the $ik$ element of $M^{ind}$ and $M^{dir}$ $N \times K$ matrices, respectively, while $z_{ik} = z_{ik}^d + z_{ik}^m$. According to the above equations, the indirect import intensity reflects the imported intermediate input used in the domestic production in order to satisfy the $k$-th final demand expenditure component, while the direct import intensity reflects the imports of goods and services used to directly satisfy the $k$-th final demand expenditure component. The total import intensity of the $k$-th final demand expenditure component is thus represented as the sum of the indirect and the direct import intensities (i.e. the amount of imports of goods and services, both indirect and direct, needed to satisfy the $k$-th final demand expenditure component):

$$\Omega_k = \Omega_k^{ind} + \Omega_k^{dir} \tag{13}$$

# 3 Data

The calculation of import intensities for expenditure components defined in Section 2 is based on the information available in the symmetric input-output

tables which are published by SORS[2]. They are provided solely in nominal terms and are currently available for the years 2010, 2014 and 2015[3]. The information included in them complements the composition of the supply and use tables of annual national accounts statistics, but are available less frequently. Our analysis utilizes two kinds of such tables, namely symmetric input-output table for domestic output, and a symmetric use of imports table, which finally compose the overall symmetric input-output table. In the former, domestic output of each product is used either as an intermediate input in the production of other products or to satisfy final demand, while in the latter, imports of each product are used either as an intermediate input in the production of other products or to satisfy directly final demand. Tables 1 and 2 further provide the illustrative break down of both aforementioned tables, with the notation directly referring to Section 2.

Table 1: Illustrative symmetric input-output table for domestic output

| | Intermediate consumption<br>Sector 1 $\cdots$ Sector 64 | Final demand<br>$C$ $G$ $I$ $E$ | Total output |
|---|---|---|---|
| Product 1<br>$\vdots$<br>Product 64 | $r_{ij}^d$ | $z_{ik}^d$ | $x_j$ |
| $\vdots$<br>Total value-added | | | |
| Total output | $x_j$ | | |

***Source**: SORS, own representation.*

Table 2: Illustrative symmetric use of imports table

| | Intermediate consumption<br>Sector 1 $\cdots$ Sector 64 | Final demand<br>$C$ $G$ $I$ $E$ |
|---|---|---|
| Product 1<br>$\vdots$<br>Product 64 | $r_{ij}^m$ | $z_{ik}^m$ |

***Source**: SORS, own representation.*

As evident from both illustrative tables, the level of aggregation considered by SORS results in 64 products/sectors, which are listed in the Appendix A

[2]Symmetric input-output tables are expressed in millions of EUR and valued at different price categories. For example, total intermediate consumption/final consumption is valued at purchasers prices, while total output is calculated at basic prices. Total value-added is equal to the difference between the two and is expressed at basic prices. For all other methodological details please refer to Kalin (2022).

[3]Symmetric input-output tables for the respective years are all in accordance with the 2010 version of the European System of Accounts (ESA).

of the paper (Table A.1). Since the initial division of sectors has not changed throughout the observed period and no changes were made in the production nomenclature of the national accounts statistics, the results for the examined years are directly comparable over time. Given such detailed information, it is possible to compute the import intensities in nominal terms (defined by Equations 11 to 13) for all corresponding final demand expenditure components.

For the sake of consistent application of Equation 4, we need to retrieve the import intensities also in real terms, which can only be calculated from the symmetric input-output tables at constant prices. Unfortunately, no such data are officially published by SORS. To carry-out the calculations of the import intensities in real terms, it is therefore necessary to compute deflators, at an aggregation level of 64 products/sectors, for the two symmetric input-output tables discussed above. In acquiring such detailed deflators we follow the methodology of Cardoso et al. (2013), Cardoso and Rua (2019, 2021) and Kalin (2022), however, the given availability of the data necessitates the introduction of certain assumptions in the process of calculation. All deflators have been obtained from the supply and use tables published by SORS[4], taking into account for each year the data at current prices and previous year prices. For the sake of conformity with the publicly available data for GDP and the expenditure components from the national accounts statistics, the initially computed deflators are further re-calculated to have 2015 as a base year. For domestic intermediate consumption, total output at basic prices, imported intermediate consumption, and the vectors of directly imported final demand (i.e. $r^d_{ij}$, $x_j$, $r^m_{ij}$ and $z^m_{ik}$ in Tables 1 and 2), deflators have been obtained from supply tables for each analysed year. In the case of domestic intermediate consumption (i.e. $r^d_{ij}$ in Table 1), the available data in the supply tables allow us to calculate the domestic price variation of each product in each sector, while in the case of imported intermediate consumption and vectors of directly imported final demand (i.e. $r^m_{ij}$ and $z^m_{ik}$ in Table 2), only information on import price variation of each product are available. Hence, an assumption is made that the import price evolution of particular product in each sector as well as for each directly imported final demand expenditure component is identical. For the calculation of deflators of total output at basic prices (i.e. $x_j$ in Table 1) no particular issues have been encountered, as only information on domestic price variation of each product are needed. Regarding the information on domestic price variation of each vector of final demand for domestic goods and services (i.e. $z^d_{ik}$ in Table 1), use tables are utilized in order to obtain needed deflators.

Lastly, due to the given data availability of the symmetric input-output tables, values of nominal and real import intensities of final demand expenditure

[4]Supply and use tables at constant and previous year prices are available on an annual basis from 2010 to 2019.

components for the missing years (between 2010 and 2021) have to be imputed. For the purpose of the analysis, two general alternatives are considered:

- For the entire analysed period, the nominal and real import intensities of final demand expenditure components for the last available year (2015) are considered (Const.).
- All available information from the symmetric input-output tables is used in order to obtain nominal and real import intensities of final demand expenditure components for years 2010, 2014, and 2015. For the period 2010-2014, the missing values are imputed using the linear interpolation, in a similar manner as in Bussière et al. (2013) and Cardoso and Rua (2021). Along the rest of the considered sample (i.e. up to year 2021), various nominal and real import intensities' extrapolation methods are explored. Listed below is a brief overview of their application in the current analysis:
  - Linear trend (LT) extrapolation ⇒ a trend in nominal and real import intensities of final demand expenditure components is assumed to be well approximated by a simple deterministic function of time (as done by Cardoso & Rua, 2021).
  - Simple exponential smoothing (ES) extrapolation ⇒ average nominal and real import intensities of final demand expenditure components, based on the double smoothing method (Brown, 1963) and the Holt-Winters method excluding seasonal component (Holt, 1957 and Winters, 1960), are considered.
  - Error-trend-season (ETS) exponential smoothing extrapolation ⇒ ETS method (Hyndman et al., 2002, 2008), applied in the current analysis, utilizes multiplicative error and trend components, while the specification of seasonal component is not incorporated due to the annual frequency of nominal and real import intensities of final demand expenditure components.
  - Extrapolation based on ordinary least squares (OLS) equations ⇒ each OLS equation for the considered nominal (real) import intensity includes nominal (real) value of the expenditure component, corresponding to the nominal (real) import intensity which has to be extrapolated, and nominal (real) value of imports of goods and services as explanatory variables.

Results presented in the following Section resort to the data extrapolation method based on OLS equations, which was found to produce the lowest discrepancy (according to the applied goodness-of-fit (GoF) measures to the data extrapolation methods mentioned above) between the sum of the final demand expenditure components' contributions and the real GDP growth.

# 4 Results of the analysis

Using the methodology presented in Section 2 and the available data from SORS, thoroughly discussed in Section 3, Section 4 demonstrates results of the analysis.

Table 3: Nominal and real import intensities of final demand expenditure components (in percent)

| | | | | | Current prices | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2010 | | | | 2014 | | | | 2015 | | | |
| | $C$ | $G$ | $I$ | $E$ | $C$ | $G$ | $I$ | $E$ | $C$ | $G$ | $I$ | $E$ |
| Indirect | 13.74 | 10.94 | 14.81 | 36.45 | 14.43 | 12.41 | 13.22 | 32.74 | 14.18 | 12.43 | 12.37 | 33.20 |
| Direct | 22.77 | 1.81 | 42.80 | 11.43 | 21.40 | 2.18 | 43.48 | 19.37 | 21.38 | 2.24 | 42.82 | 19.01 |
| Total | 36.51 | 12.75 | 57.61 | 47.88 | 35.82 | 14.59 | 56.70 | 52.11 | 35.56 | 14.67 | 55.19 | 52.21 |
| | | | | | Constant prices (base year = 2015) | | | | | | | |
| | 2010 | | | | 2014 | | | | 2015 | | | |
| | $C$ | $G$ | $I$ | $E$ | $C$ | $G$ | $I$ | $E$ | $C$ | $G$ | $I$ | $E$ |
| Indirect | 14.34 | 11.15 | 14.02 | 36.71 | 14.24 | 12.13 | 13.02 | 32.74 | 14.18 | 12.43 | 12.37 | 33.20 |
| Direct | 23.17 | 1.71 | 41.19 | 10.80 | 20.37 | 2.19 | 43.07 | 18.61 | 21.38 | 2.24 | 42.82 | 19.01 |
| Total | 37.51 | 12.85 | 55.21 | 47.51 | 34.61 | 14.32 | 56.09 | 51.35 | 35.56 | 14.67 | 55.19 | 52.21 |

***Source**: SORS, own calculations.*

Table 3 reports import intensities of final demand expenditure components at current prices and constant prices of 2015, defined by Equation 13. It further provides the corresponding decomposition in their direct and indirect parts, calculated from Equations 11 and 12. As evident from the results, the two expenditure components with the highest nominal import penetration are investments incl. change in inventories and exports of goods and services. The high nominal import penetration of these two components can be explained by their high level of external dependence given the increasing integration of Slovenian economy in the global production chains. On the other hand, government consumption displays the lowest values, which reflects the prevalence of non-tradeable goods and services as part of this final demand expenditure component. Regarding the dynamics of total import intensities in nominal terms, private consumption and investment incl. change in inventories experienced a decline in their respective import intensity values from 36.51% (57.61%) in 2010 to 35.56% (55.19%) in 2015, while government consumption and exports of goods and services displayed an increase in their corresponding import intensities from 12.75% (47.88%) in 2010 to 14.67% (52.21%) in 2015. In the case of private consumption, the observed decline can be attributed to the change of direct import intensity component from 2010 to 2014 (-1.37 p.p.), while for investments incl. change in inventories indirect import intensity component deteriorated significantly in both examined periods, namely from 2010 to 2014 (-1.59 p.p.) as well as from 2014 to 2015 (-0.85 p.p.). On the other hand, the increase in the government consumption's total nominal

import intensity was largely driven by the change of indirect imports intensity component from 2010 to 2014 (1.47 p.p.), while for exports of goods and services the increase largely originated from the change in direct import intensity component (7.93 p.p.) during the first examined period.

Table 4: Decomposition of the change in the nominal import intensities of final demand expenditure components (in percentage points)

| | 2010-2014 | | | | 2014-2015 | | | |
|---|---|---|---|---|---|---|---|---|
| | $C$ | $G$ | $I$ | $E$ | $C$ | $G$ | $I$ | $E$ |
| Volume effect | -2.90 | 1.47 | 0.88 | 3.84 | 0.95 | 0.35 | -0.89 | 0.86 |
| Price effect | 2.22 | 0.38 | -1.78 | 0.39 | -1.21 | -0.27 | -0.61 | -0.76 |
| Total change | -0.68 | 1.84 | -0.91 | 4.23 | -0.26 | 0.08 | -1.50 | -0.10 |

***Source**: SORS, own calculations.*

By taking into account also the developments in the real import intensities, available in Table 3, Table 4 provides the decomposition of the change in the total nominal import intensities of the final demand expenditure components, which is decomposed in a volume effect (i.e. a change in the import intensities at constant prices) and a price effect (i.e. a difference between the change in the import intensities at current prices and the change in the import intensities at constant prices) (Cardoso & Rua, 2019). Taking into consideration all final demand expenditure components, positive volume effects are evident in both observed periods (with the exception of private consumption from 2010 to 2014 and investment incl. change in inventories from 2014 to 2015), while price effects are positive from 2010 to 2014 (with the exception of investment incl. change in inventories) and negative from 2014 to 2015. It should be noted that the variation in the price effect does not reflect merely the difference in composition between imports and domestic expenditures related to particular final demand expenditure component, but it also indicates a difference between the change of import prices and the change in corresponding final demand expenditure's deflator over the examined period.

Table 5: Goodness-of-fit measures for the applied data extrapolation methods

| | 2011-2021 | | | | |
|---|---|---|---|---|---|
| | Const. | LT | ES | ETS | OLS |
| MAE | 0.92 | 0.67 | 0.64 | 0.66 | **0.47** |
| RMSE | 1.15 | 0.86 | 0.90 | 0.85 | **0.55** |
| SRMSE | 0.32 | 0.24 | 0.25 | 0.24 | **0.15** |

***Note**: MAE - mean absolute error, RMSE - root mean squared error, SRMSE - standardized root mean squared error. Numbers in bold indicate the lowest value for particular GoF measure across all considered data extrapolation methods. Missing values for nominal and real import intensities are handled as explained in detail in Section 3.*
***Source**: SORS, own calculations.*

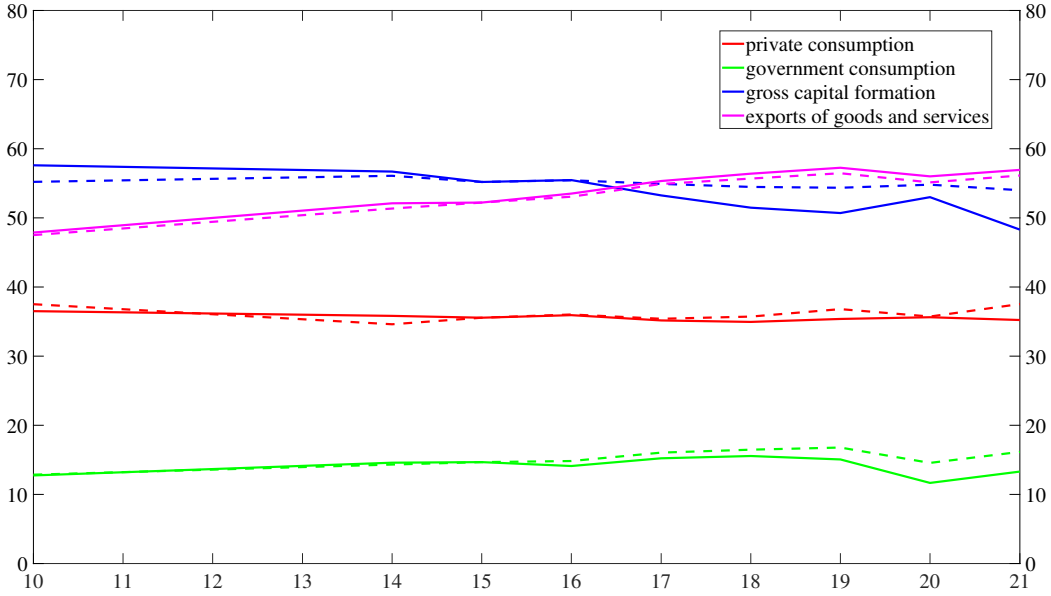
Figure 1: Sum of the final demand expenditure components' contributions using the data extrapolation method based on OLS equations and the real GDP growth (in percent)


***Source**: SORS, own calculations.*

As the nominal and real import intensities of final demand expenditure components from Table 3 are calculated based on the symmetric input-output tables, available only for years 2010, 2014, and 2015, application of data extrapolation methods, proposed at the end of Section 3, is required in order to obtain their time series. Table 5 displays the standard GoF measures for the applied data extrapolation methods. A lower value of a particular GoF measure indicates that the underlying method produces better fit to the real GDP growth. Results from the comparison of the methods reveal that the

discrepancies between the sum of the contributions of the final demand expenditure components and the real GDP growth tend to be the least pronounced when applying data extrapolation method based on OLS equations. The superiority of this method is observed not only in the context of smaller mean absolute errors but also in the inferior root mean squared errors[5]. For the sake of consistency, Figure 1 additionally displays the best performing data extrapolation method together with the real GDP growth. As a non-trivial caveat, it has to be pointed out that part of the prevailing discrepancies can also be attributed to the lack of revision of input-output tables compared to the standard national accounts statistics that tend to get regularly revised through time.

Figure 2: Nominal and real import intensities of final demand expenditure components using the data extrapolation method based on OLS equations (in percent)




***Note**: Solid lines correspond to nominal import intensities, while dashed lines refer to real import intensities.*
***Source**: SORS, own calculations.*

Figure 2 further shows the nominal and real import intensities of corresponding expenditure components based on the preferred data extrapolation method for the years between 2010 and 2021. In accordance with the high degree of openness of Slovenian economy, the resulting time series (in terms of the importance of imports of goods and services in particular final demand

[5]This takes into account the concentration of the errors of a particular data extrapolation method around the real GDP growth (i.e. how spread out the errors are in the case of a particular data extrapolation method).

expenditure component and their respective absolute values) are broadly comparable to other small open economies studied by Mikulić and Lovrinčević (2018), Cardoso et al. (2013), Cardoso and Rua (2019, 2021), Grech and Rapa (2019), and OeNB Forecasts (2019), for example. In the case of larger economies, Kranendonk and Verbruggen (2008a, 2008b), Bravo and Álvarez (2012), and Bussière et al. (2013) show somewhat lower import intensity values across all final demand expenditure components with a similar ranking of the importance of imports of goods and services in particular final demand expenditure component as in Slovenia.

Table 6: Real GDP growth decomposition by standard and alternative approaches (in percentage points)

| | Standard approach | | | | Alternative approach | | | |
|---|---|---|---|---|---|---|---|---|
| | $C$ | $G$ | $I$ | $E-M$ | $MC$ | $MG$ | $MI$ | $ME$ |
| 2011 | 0.4 | 0.0 | -0.6 | 1.1 | 0.4 | -0.2 | -0.7 | 1.3 |
| 2012 | -1.2 | -0.5 | -3.7 | 2.8 | -0.3 | -0.5 | -1.4 | -0.4 |
| 2013 | -2.3 | -0.4 | 0.9 | 0.8 | -1.1 | -0.4 | 0.2 | 0.3 |
| 2014 | 0.9 | 0.0 | 0.3 | 1.6 | 1.1 | -0.1 | 0.2 | 1.5 |
| 2015 | 1.1 | 0.4 | 0.0 | 0.6 | 0.3 | 0.4 | 0.3 | 1.2 |
| 2016 | 2.4 | 0.5 | -0.1 | 0.4 | 1.3 | 0.4 | -0.1 | 1.6 |
| 2017 | 1.0 | 0.1 | 2.5 | 1.2 | 1.0 | -0.1 | 1.3 | 2.6 |
| 2018 | 1.9 | 0.5 | 2.1 | -0.1 | 1.1 | 0.4 | 1.2 | 1.7 |
| 2019 | 2.5 | 0.4 | 0.1 | 0.3 | 1.3 | 0.3 | 0.3 | 1.3 |
| 2020 | -3.4 | 0.8 | -1.5 | -0.1 | -1.9 | 0.9 | -1.0 | -2.3 |
| 2021 | 5.8 | 0.8 | 3.1 | -1.6 | 2.7 | 0.4 | 1.5 | 3.5 |

***Note**: In the case of the alternative approach, the remaining discrepancy has been eliminated by proportionally distributing the imports of goods and services differential over the final demand expenditure components.*
***Source**: SORS, own calculations.*

Finally, Table 6 illustrates the contributions made by domestic expenditure components and net exports to real GDP growth by considering both, standard and the alternative approach, where the latter also exploits information on nominal and real import intensities of final demand expenditure components from Figure 1 in the process of contributions' calculations. Results suggest somewhat different insights into the decomposition of real GDP growth according to both approaches. By solely considering standard approach, the contribution of net exports of goods and services to real GDP growth is significantly underestimated, which is especially evident in the period from 2014 to 2021. This is associated with the usage of imports of goods and services not only in exports of goods and services, but also their importance in other affected expenditure components, especially investment incl. inventories and private consumption. On average of the 2014-2019 period, the net exports contribution under the standard approach has thus been equal to 0.7 p.p., while the figures retrieved from the alternative approach reveal significantly higher

net exports contribution at 1.7 p.p. In addition, the decomposition of real GDP growth for 2020 and 2021, the period characterized by the outburst of the COVID-19 pandemic, implies that it was the developments in net exports, rather than in domestic demand that played a key role in driving the slump as well as the consequent rebound of economic activity in Slovenia (similar findings are obtained by Cardoso & Rua, 2021 in the case of Portugal and by Andersson et al., 2021 for the euro area aggregate).

# 5 Conclusion

This paper reassesses the importance of net export developments in Slovenian real GDP growth dynamics by employing standard and the alternative approach to decomposing real GDP growth. Seeking to address the shortcomings of the standard approach in providing a more intuitive decomposition of the sources of real GDP growth, the current analysis uses the information available in SORS's symmetric input-output tables for computing the nominal and, based on the deflators obtained from supply and use tables, also the real import intensities of the final demand expenditure components. Results based on the data available for years 2010, 2014, 2015 suggest several inferences. First, the two expenditure components with the highest nominal import penetration are investment incl. change in inventories and exports of goods and services, which can be related to their high level of external dependence given increasing integration of Slovenian economy in the international environment. Second, concerning the dynamics of total import intensities in nominal terms, private consumption and investment incl. change in inventories have experienced a decline in their respective import intensity values, while government consumption and exports of goods and services display an increase. By taking into account also the developments in the real import intensities, a third major result shows broadly positive volume effects in both observed periods (i.e. from 2010 to 2014 and form 2014 to 2015), while price effects are mainly positive from 2010 to 2014 and negative from 2014 to 2015. The results take into consideration the developments across all the final demand expenditure components.

Given that the nominal and real import intensities of final demand expenditure components are calculated based on symmetric input-output tables, available only for years 2010, 2014, and 2015, application of some data extrapolation methods is required in order to obtain their time series. An analysis of various data extrapolation methods indicates that the discrepancies between the sum of the contributions of the final demand expenditure components and the real GDP growth are least pronounced when applying data extrapolation method based on OLS equations. The superiority of this method is observed not only in the context of smaller mean absolute errors but also in the inferior root mean squared errors. Reflecting further on the nominal and real import

intensities of corresponding expenditure components based on the preferred extrapolation method for the 2010-2021 period, the results show (in terms of the importance of imports of goods and services in particular final demand expenditure component and their respective absolute values) that these are broadly comparable to other small open economies, while, in the case of larger economies, somewhat lower import intensity values across all final demand expenditure components with a similar ranking of the importance of imports of goods and services in particular final demand expenditure component as in Slovenia are observed.

Lastly, the comparison of the contributions made by domestic demand expenditure components and net exports to real GDP growth by considering both standard and the alternative approach, suggests a somewhat different insight into the decomposition of real GDP growth, as the alternative approach, based on the nominal and real import intensities of final demand expenditure components, re-evaluates the relative importance of domestic demand expenditure components and exports of goods and services. The findings that Slovenian real GDP growth from 2014 to 2021 has been, contrary to results based on standard approach, mainly driven by net export developments has an important implication for the process of designing more complex sets of small open economy's policy measures to ensure economic growth and external stability. To maintain external competitiveness via the advancement of integration and participation in global value chains should therefore be one of the key issues in supporting growth of Slovenian economy.

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# Appendices

## A List of 64 products/sectors defined by SORS

Table A.1: List of 64 products/sectors defined by SORS

| |
|---|
| 01 Products of agriculture, hunting and related services |
| 02 Products of forestry, logging and related services |
| 03 Fish and other fishing products; aquaculture products; support services to fishing |
| 05-09 Mining and quarrying |
| 10-12 Food products, beverages and tobacco products |
| 13-15 Textiles; wearing apparel; leather and related products |
| 16 Wood and of products of wood and cork, except furniture; articles of straw and plaiting materials |
| 17 Paper and paper products |
| 18 Printing and recording services |
| 19 Coke and refined petroleum products |
| 20 Chemicals and chemical products |
| 21 Basic pharmaceutical products and pharmaceutical preparations |
| 22 Rubber and plastics products |
| 23 Other non-metallic mineral products |
| 24 Basic metals |
| 25 Fabricated metal products, except machinery and equipment |
| 26 Computer, electronic and optical products |
| 27 Electrical equipment |
| 28 Machinery and equipment n.e.c. |
| 29 Motor vehicles, trailers and semi-trailers |
| 30 Other transport equipment |
| 31-32 Furniture; other manufactured goods |
| 33 Repair and installation services of machinery and equipment |
| 35 Electricity, gas, steam and air conditioning |
| 36 Natural water; water treatment and supply services |
| 37-39 Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services |
| 41-43 Constructions and construction works |
| 45 Wholesale and retail trade and repair services of motor vehicles and motorcycles |
| 46 Wholesale trade services, except of motor vehicles and motorcycles |
| 47 Retail trade services, except of motor vehicles and motorcycles |
| 49 Land transport services and transport services via pipelines |
| 50 Water transport services |
| 51 Air transport services |
| 52 Warehousing and support services for transportation |
| 53 Postal and courier services |
| 55-56 Accommodation and food services |
| 58 Publishing services |
| 59-60 Motion picture, video and television programme production services, sound recording and music publishing; programming and broadcasting services |
| 61 Telecommunications services |
| 62-63 Computer programming, consultancy and related services; information services |
| 64 Financial services, except insurance and pension funding |
| 65 Insurance, reinsurance and pension funding services, except compulsory social security |
| 66 Services auxiliary to financial services and insurance services |
| 68 Real estate services |
| 69-70 Legal and accounting services; services of head offices; management consulting services |
| 71 Architecture and engineering services; technical testing and analysis services |
| 72 Scientific research and development services |
| 73 Advertising and market research services |
| 74-75 Other professional, scientific and technical services; veterinary services |
| 77 Rental and leasing services |
| 78 Employment services |
| 79 Travel agency, tour operator and other reservation services and related services |
| 80-82 Security and investigation services; services to buildings and landscape; |
| office administrative, office support and other business support services |
| 84 Public administration and defence services; compulsory social security services |
| 85 Education services |
| 86 Human health services |
| 87-88 Social work services |
| 90-92 Creative, arts and entertainment services; library, archive, museum and other cultural services; gambling and betting services |
| 93 Sporting services and amusement and recreation services |
| 94 Services furnished by membership organisations |
| 95 Repair services of computers and personal and household goods |
| 96 Other personal services |
| 97-98 Services of households as employers of domestic personnel and undifferentiated goods and services produced by private households for own use |
| 99 Services provided by extra-territorial organisations and bodies |

***Source**: SORS.*