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THE MULTIPLIER EFFECTS OF MANUFACTURING CONSUMPTION

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The multiplier effects of manufacturing consumption

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Abstract

We use three different input-output (IO) databases to calculate type-I and type-II value added multipliers of manufacturing consumption. Our main findings show that (i) the size of domestic household consumption multipliers has decreased since 1990; (ii) multiplier effects between manufacturing industries differ to a large extent; (iii) there is a weak negative relationship between import share and type-II multipliers and a positive relationship between wage share and type-II multipliers, and (iv) the strength of type-I and type-II multipliers of most industries depends on the respective economy's level of industrial development.

1 Introduction

Input-output (IO) multipliers are valuable for evaluating the income creation potential of economic policies that focus on specific industries of an economy. Multipliers measure changes in economic activity across all industries of an economy due to change(s) in final demand for specific industry(ies).

Different types of multipliers have been discussed in the literature.[1] Type-I (output) multipliers are the most commonly used multipliers in IO analysis. They are based on the open IO model which accounts for direct and indirect effects. That is, type-I multipliers measure changes in the gross output of an economy as a result of a change in final demand for the goods of a specific industry.[2] Such changes in gross output as a result of changes in final demand are also referred to in the literature as (domestic) backward linkages (Reis and Rua, 2006).

An increase in gross output also, of course, increases the income of individuals with the potential of inducing a positive feedback effect: increases in income may lead to additional demand for commodities and further increases in gross output. This effect may then trigger another increase in income and household consumption demand. However, type-I multipliers do not account for this additional income effect and can therefore be classified as a conservative measure for the increase in gross output as a result of a demand stimulus.[3]

Building on the idea of backward linkages, type-II output multipliers account for changes in income and the possibility of any additional demand effects that arise from them. It endogenizes household demand and household income, proxied by wages, to create a closed IO model which captures income effects as well. The model consequently accounts for feedback effects from increased factor incomes (induced effects) in addition to the direct and indirect effects derived from the open IO model (Ernst and Sarabia, 2015). By accounting for induced effects in addition to direct and indirect effects, type-II multipliers are larger than type-I multipliers.

While output multipliers are commonly used to calculate the additional gross output resulting from a change in final demand, we are interested in additional income here. We will therefore not focus on output multipliers, but on value added (VA) multipliers. Thus, the results presented

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[1] For a summary, see Miller and Blair (2009), for example.

[2] To increase readability, we implicitly assume that we are dealing with industry × industry tables here. In case of commodity × commodity tables, we would analyse a change in demand for a specific commodity and how it induces demand for other commodities.

[3] Although type-I multipliers can be considered a conservative estimate of an industry's backward linkages, one has to keep in mind that they still maintain some restrictive assumptions that are common to all IO models. These are the assumptions of constant returns to scale, fixed proportion technology and unlimited production capacity in response to demand changes. The reader may refer to Miller and Blair (2009) and Lúcia and Sargento (2009) for assumptions and limitations of IO analysis.

in the following sections capture increases in VA—and hence income—attributable to an increase in final demand. From a technical point of view, this implies multiplying the output multiplier with the share of VA in output as discussed below in more detail.

The rest of the paper is structured as follows: the next section discusses how the multipliers are computed, while Section 3 summarizes the data compilation process. We use different sources to compute the multiplier effects. At the country level, we use the OECD IO database[4] and the national EORA IO tables[5]. We thereby focus on 10 countries from the OECD database representing different income levels, and on 4 countries from the EORA database. The countries covered—as well as their income levels—are summarized in Table 5 in Section 3. In addition, we also use the EORA26 database which, however, is not as precise as the standard EORA data, but facilitates immediate comparison between countries due to a homogeneous industry classification system. This database contains more than 180 countries over a period of 24 years. However, only a subset of the countries was used in the analysis. The countries used, as well as the outliers, are listed in the appendix. Descriptive statistics based on the EORA26 database are reported in Section 4. Section 5 uses the same data source as Section 4 and explores the relationship between the multipliers and a number of key economic variables including, for example, GDP per capita and the wage share. Section 6 applies the OECD and national EORA data, which allows us to take a closer look at the countries described in Table 5. Section 6.1 reports the results using the OECD database, and in Section 6.2, we use the EORA database to analyse the type-II-multipliers of China, Cambodia, India and South Africa. Finally, Section 7 summarizes the main findings.

[4] http://www.oecd.org/trade/input-outputtables.htm
[5] http://worldmrio.com/

2 Calculating the multipliers

In this section, we summarize how type-I and type-II multipliers are calculated. We assume that a symmetric IO-table is given and we use data from 2011 for Germany from the OECD database for numerical examples.

2.1 Step 1: Transaction matrix

We use the domestic transaction matrix $\mathbf{Z}$ for a given country and the domestic household consumption of domestic products is added as an additional column, while wages are added in an additional row in the matrix. Adding consumption and wages to the transaction matrix allows us to calculate the *induced* output effects—in addition to the direct and indirect output effects—resulting in additional household spending as a result of increased factor income. As wages and household consumption become industries of their own, wages also "sell" to household consumption. This element is set to 0 in the extended transaction matrix $\mathbf{Z}^*$. The design of $\mathbf{Z}^*$ is shown in Table 1, which depicts a portion of the transaction matrix for Germany in 2011.[6] Table 1 only contains five industries, while the original table contains 35 industries (34 OECD industries[7] and the additional household consumption industry).

Table 1 Depiction of the transaction matrix for Germany in 2011

	Food	Textiles	Wood	Paper	Household
Food	24,381	127	36	94	131,139
Textiles	106	1,613	12	36	13,287
Wood	306	48	6,042	622	3,784
Paper	4074	699	172	21,996	28,192
Wages	36,786	8,479	7,120	25,585	0

While matrix $\mathbf{Z}^*$ will be used to calculate type-II multipliers, matrix $\mathbf{Z}$ is utilized in the evaluation of type-I multipliers.

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[6] The OECD country IO database does not provide data on household consumption. Instead, consumption data consists of household consumption, consumption of non-profit organizations serving private households and government consumption. However, the multi-regional OECD database distinguishes between the three categories and is therefore used to calculate household consumption based on total consumption as described in Section 3.
[7] See Cection 3 and the appendix for more details.

2.2 Step 2: Output

Gross output (at basic prices) for all industries of an economy can be calculated as the sum of *sales of intermediate inputs* plus *sales to final demand* (row sum approach) or as the sum of *purchases of intermediate inputs* plus *taxes less subsidies on intermediate and final products* plus *value added* (column sum approach). These two approaches should yield the same result, taking statistical discrepancies into account. The OECD database provides output based on the second (column sum) approach and we therefore follow the same approach for the EORA database.

Finally, as household consumption enters the $\mathbf{Z}^*$ matrix as a separate column (and wages as a new row), "output" of household consumption/wages must be computed as well to facilitate the computation of type-II multipliers. Here we use total consumption expenditure of private households for every industry (domestic and imported) and add it up to calculate the "output" level.

2.3 Step 3: Technology and the Leontief Matrix

After obtaining the $\mathbf{Z}$ and $\mathbf{Z}^*$ matrices and outputs, the technology matrices, $\mathbf{A}$ and $\mathbf{A}^*$, are calculated. While the technology matrix for type-I multipliers is calculated as $\mathbf{A} = \mathbf{Z} \times \hat{\mathbf{X}}^{\mathbf{-1}}$, the corresponding matrix for type-II multipliers is given by $\mathbf{A}^* = \mathbf{Z}^* \times \hat{\mathbf{X}}^{*\mathbf{-1}}$. Here, $\hat{\mathbf{X}}^{\mathbf{-1}}$ and $\hat{\mathbf{X}}^{*\mathbf{-1}}$ represent diagonal matrices with the inverse of output on the diagonal and all other elements set equal to 0.[8] The Leontief matrices are then computed as $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ and $\mathbf{L}^* = (\mathbf{I}^* - \mathbf{A}^*)^{-1}$, with $\mathbf{I}$ and $\mathbf{I}^*$ being the conformable identity matrices for the two cases.

[8] The technology matrix is constructed by solving the equation $\mathbf{Z} = \mathbf{A} \times \hat{\mathbf{X}}$. By inverting $\hat{\mathbf{X}}$, we obtain a matrix with the inverse of the output vector on the diagonal, which allows us to solve for $\mathbf{A}$.

An example for $\mathbf{L}^*$ is given in Table 2. Once again, only five industries are shown here.

Table 2 Depiction of the Leontief matrix for Germany in 2011

Food	Textiles	Wood	Paper	Household
1.182000	0.065040	0.069350	0.060700	0.140100
0.005928	1.052000	0.006454	0.005812	0.012600
0.006386	0.006408	1.226000	0.011300	0.007486
0.051130	0.052230	0.037050	1.228000	0.048340
0.584900	0.623100	0.661500	0.613300	1.471000

2.4 Step 3a: Value added multiplier

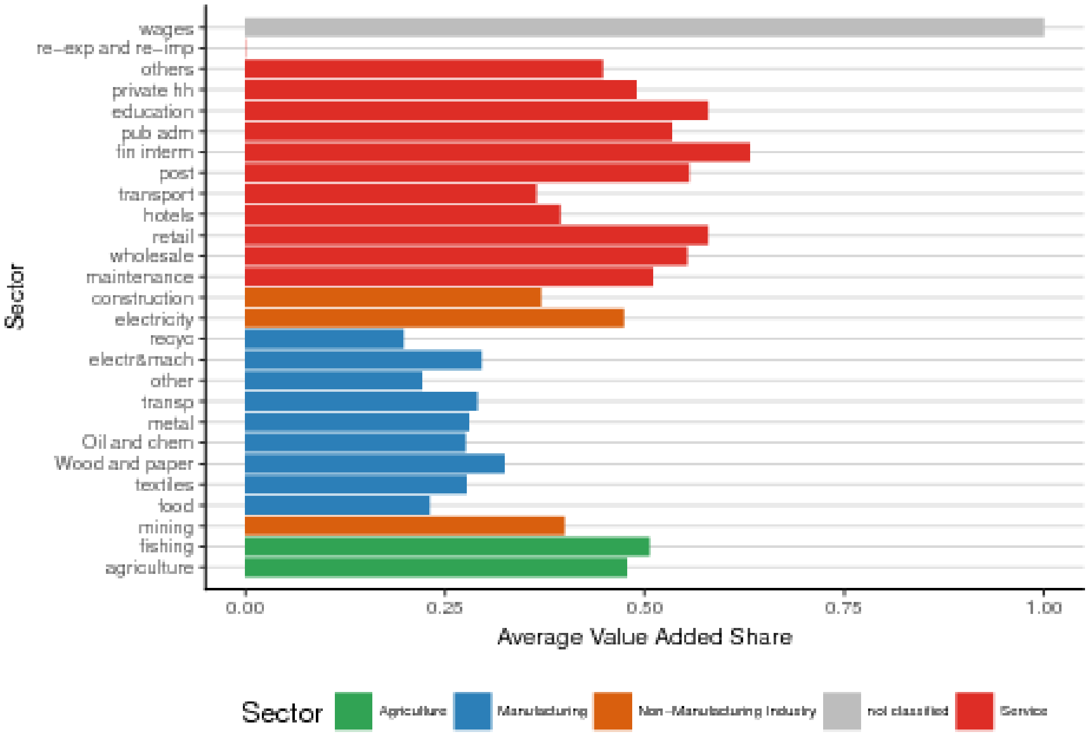
The Leontief matrices obtained in the last subsection show the additional (gross) output attributable to an increase in demand. However, we are interested in "additional value added" instead of output. The increase in value added is obtained by pre-multiplying the Leontief matrix with the *value added coefficient matrix*. A depiction of the matrix is given in Table 3. As the table illustrates, the matrix is a diagonal-matrix where the diagonal elements contain the ratio of value added to output of the industry (i.e. $\mathbf{VA\_M}_{ii} = \frac{VA_i}{Y_i}$ and $\mathbf{VA\_M}^*{}_{ii} = \frac{VA_i^*}{Y_i^*}$). Lastly, the wage ratio of value added to output is set to unity for type-II multipliers.

Table 3 Depiction of the Leontief matrix for Germany in 2011

Food	Textiles	Wood	Paper	Renting of machinery
0.2262	0	0	0	0
0	0.3177	0	0	0
0	0	0.2959	0	0
0	0	0	0.357	0
0	0	0	0	0.7751

Figure 1 reports the average VA shares of all 27 industries of the EORA database for 2011, where outliers were deleted before calculating the average. As can be seen from the figure, the manufacturing industries exhibit small value added ratios compared with other industries as a result of higher intermediate input requirements (this pattern also holds for the OECD database). Thus, differences between value added multipliers and output multipliers will be larger for manufacturing compared with other industries.

Figure 1 **Average VA share for EORA countries in 2011. Bars are coloured according to broad sector classification**



We focus on VA multipliers here because we are interested in additional income generated in the economy as a result of an increase in final household demand. Thus, increases in intermediate consumption are subtracted to avoid double counting of output. Instead, VA multipliers will represent the increase in GDP attributable to an increase in final demand as GDP represents net increases in output as well (Bess and Ambargis, 2011).

2.5 Step 4: Final demand vectors and multipliers

The final demand vectors are computed as weighted vectors here. For example, if an increase in demand for manufactured products is simulated, then the household's final demand vector for manufactured goods is summed up and each manufacturing component is divided by this sum. This results in a vector that adds up to unity. An example is shown in Table 4, where an increase in final demand for manufactured products is simulated. Note that wages also enter as final demand, but they are set equal to 0, like all other non-manufacturing industries. This, of course, only applies for type-II multipliers. The wage row is omitted for type-I multipliers.

Finally, the *value added multipliers* are computed as $\mathbf{M_{VA}} = \mathbf{VA\_M} \times \mathbf{L} \times \mathbf{d}$ and $\mathbf{M^{*}_{VA}} = \mathbf{VA\_M}^{*} \times \mathbf{L}^{*} \times \mathbf{d}^{*}$, where $\mathbf{d}$ and $\mathbf{d}^{*}$ are the final demand vectors. The *total value added multipliers* are then computed by building the column sums of the *value added multipliers*.

To summarize, VA type-I multipliers for, say, manufacturing, will show the income generated by a unit of final demand in manufacturing goods. They will tell us how much of the value added needed to produce that manufacturing good is generated in the domestic economy. On the other hand, VA type-II multipliers extend the type-I multipliers by incorporating the so-called induced effects: part of the VA created in the first round of effects (direct and indirect effects as captured in type-I multipliers) will be re-spent as additional consumption for manufacturing and other goods. This, in turn, will create additional income that will also be re-spent. A positive feedback loop thus emerges. VA type-II multipliers will differ across industries and countries depending not only on the size of direct and indirect leakages, but also on the way incomes generated directly and indirectly are distributed. If they tend to be more evenly distributed across a larger number of households, they will foster consumption growth. As a consequence, multiplier effects will be larger. If, instead, they create income for a few only, then the induced multiplier effect is assumed to be low.

Table 4 **Household final demand vector for Germany in 2011**

	Sector	Household final demand
1	Agriculture	0
2	Mining	0
3	Food	0.326
4	Textiles	0.033
5	Wood	0.009
6	Paper	0.07
7	Petroleum	0.084
8	Chemicals	0.085
9	Plastic	0.022
10	Non-metallic	0.014
11	Basic metals	0.005
12	Metal prod	0.026
13	Machinery	0.028
14	Electronics	0.03
15	Elec mach	0.038
16	Vehicles	0.184
17	Oth transp	0.006
18	Other and recyc	0.039
19	Electricity	0
20	...	...
35	wages	0
37	TOTAL	1

3 Data compilation

As already mentioned in the introduction, we use three different sources in this study, namely the OECD IO database, the EORA26 database and the national tables of the full EORA database.

3.1 EORA26

The EORA26 database is a multi-regional database with 26 standardized industries for each country. The industry classification can be found in the appendix. We furthermore introduce a broad sector classification system, where we distinguish between four sectors: agriculture, non-manufacturing industry, manufacturing and services. They consist of the individual industries of the databases summarized in the appendix.

We do not analyse all available years in the database, but instead focus in our analysis on three years, namely 1990, 2000 and 2013. Furthermore, countries that show extreme outliers in their private consumption share in domestic absorption (aggregate level) or in their share of manufacturing exports in total exports are excluded. The reference sources for this comparison were the UNSD NAMADA database for domestic consumption and COMTRADE for manufacturing exports in total exports of goods. Very small countries have also been deleted. The deleted countries are listed in the appendix, as are the included countries.

After deleting these outliers, the database is used as provided by EORA. The results based on the EORA26 are presented in the following two sections.

3.2 OECD database

We use the national tables of the OECD IO database as provided. The appendix shows the industries included in the database and the broad sector classification used in the analysis in the following sections. As discussed earlier, we distinguish between agriculture, non-manufacturing industry, manufacturing and services in the broad sector classification. Thus, we follow the same procedure as for the EORA26 database.

Our analysis focuses on the year 2011 and the countries listed in Table 5. The individual country tables of the OECD database do not report household consumption separately. Instead, all consumption categories are aggregated into total consumption. We therefore use the MRIO version of the OECD database, which distinguishes between household consumption, government consumption and the consumption of non-profit organizations serving private households in order to proxy private household demand for the national tables. By summing up these three categories for each country, we can compute the share of household consumption in total consumption from the MRIO table for domestic and imported demand. These shares are then used to compute household consumption for the country-specific tables.

Table 5 List of countries included in the analysis

Country Code	Country Name	Income Group	Region	EORA
BRA	Brazil	Upper middle-income	Latin America and Caribbean	
KHM	Cambodia	Lower middle-income	East Asia and Pacific	x
CHN	China	Upper middle-income	East Asia and Pacific	x
DEU	Germany	High-income	Europe and Central Asia	
IND	India	Lower middle-income	South Asia	x
JPN	Japan	High-income	East Asia and Pacific	
MEX	Mexico	Upper middle-income	Latin America and Caribbean	
ZAF	South Africa	Upper middle-income	Sub-Saharan Africa	
USA	United States	High-income	North America	
VNM	Viet Nam	Lower middle-income	East Asia and Pacific	x

Note: Country information on region and income group are based on the World Bank country classification (December, 2016). Column EORA denotes whether a country is analysed in more depth by deploying the EORA database.

3.3 National EORA tables

While the OECD and the EORA26 databases are built on a common industry classification across countries, the national EORA tables do not follow a standard industry classification. This makes comparisons between countries more difficult. The advantage of the national EORA tables, however, lies in their detailed industrial structure. Hence, to gain an even more in-depth industry perspective, consumption multipliers are estimated from this source for four countries at different stages of development: China, India, South Africa and Viet Nam.

China and Viet Nam are represented by commodity × commodity tables with 123 commodities in the case of China and 113 commodities for Viet Nam.[9] The Indian and South African tables, on the other hand, are given by supply and use tables and have been converted into symmetric

[9] The OECD and EORA26 database are industry × industry tables.

industry × industry tables based on the *fixed product sales structure assumption* which builds on the idea that each product has its own specific sales structure independent of which industry produced it (see Eurostat, 2008, especially Chapter 11, for more details). By transforming the tables into industry × industry tables, the problem of negative entries in the transaction matrix is avoided, which would not be the case if commodity × commodity tables were created using the product technology assumption.

In the case of India, the mapping between the commodity side and the industry side of the tables is one-to-one, as the tables consist of 116 commodities and 116 corresponding industries. In the case of South Africa, a SUT table with 96 commodities and 95 industries is provided by EORA. Here, the commodities "Insurance services" and "FSIM" (Financial Intermediation Services Indirectly Measured) are mapped into the industry "Insurance services". For the other industries, a one-to-one mapping—as for the case of India—was feasible again.

Finally, after converting the tables, final demand for imported goods had to be computed to facilitate the construction of type-II multipliers. As the national EORA tables only provide data on consumption of domestically produced goods, the full MRIO EORA tables were used to compute total final demand (domestic and imported) for all four countries. By subtracting the final demand for domestically produced goods from total final demand, we are able to compute an aggregate measure of final demand spent on imported goods which is sufficient for calculating type-II multipliers.

4 Manufacturing consumption multipliers: global perspective

4.1 Aggregate consumption for manufactured products

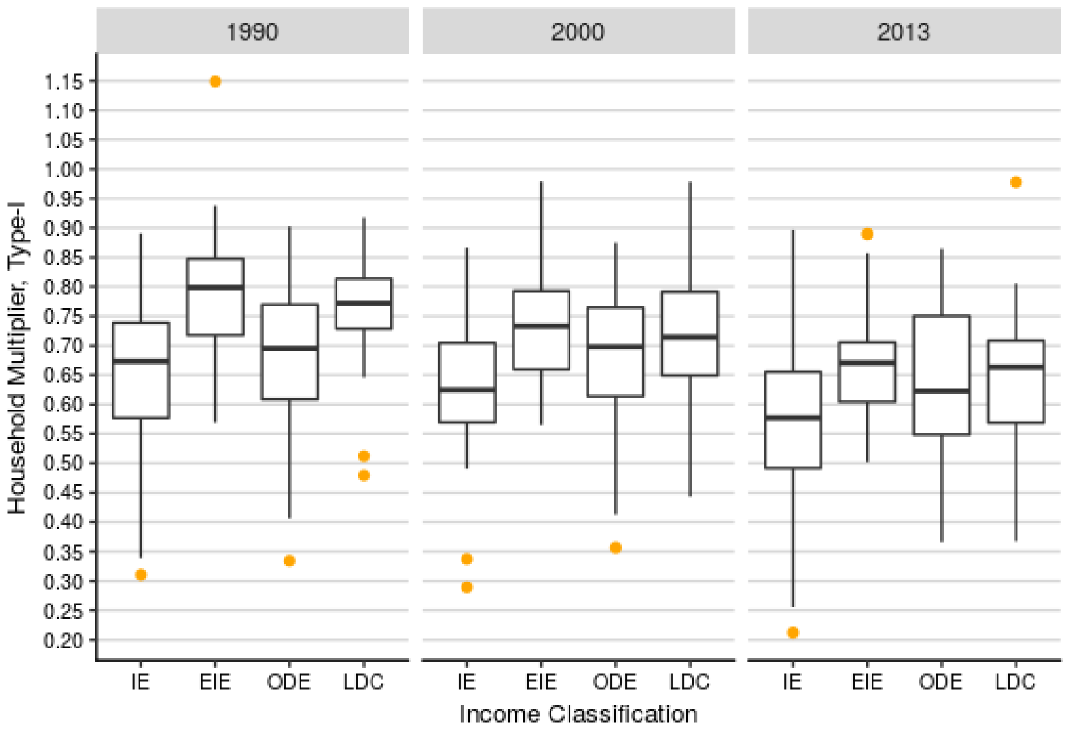
In this section, we present descriptive statistics based on the EORA26 database. We analysed type-I and type-II household consumption multipliers for all countries and classified countries according to the UNIDO classification by stage of industrial development (Upadhyaya, 2013). However, some countries showed consumption patterns that were not in line with other databases and/or involved a limited population size such that their patterns were not deemed to be representative. These countries were deleted before conducting the analysis as already discussed previously.

Figure 2 summarizes value added type-I household consumption multipliers for the years 1990, 2000 and 2013. As can be seen from the figure, the size of the (domestic) household consumption multiplier decreased from 1990 to 2013 for each country group with respect to the median value. In general, we observe a secular trend of decreasing domestic VA multipliers in Figure 2. This observation is in line with an increase in the foreign sourcing of inputs over the last three decades.

Furthermore, the number of outliers for each country group is rather limited. The length of the whiskers in Figures 2 and 3 are determined by the 25/75 percentile and the interquartile range (IQR). The lower end of the whisker is the smallest value larger than the 25 percentile of the distribution minus $1.5 \times IQR$, while the upper end of the whisker is equal to the largest value smaller than the 75 percentile of the distribution plus $1.5 \times IQR$. As can be seen, there are only a few negative outliers in Figure 2 for the first two periods, and only one negative outlier for 2013. The number of positive outliers is even lower.

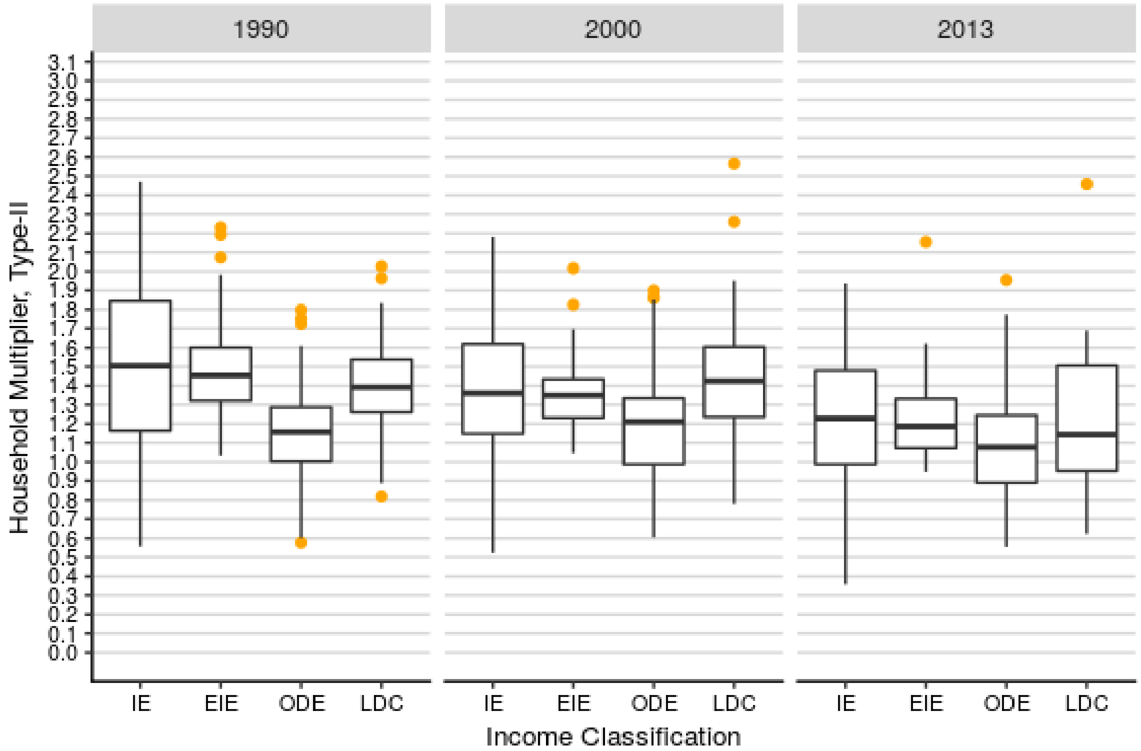
Finally, emerging industrial economies (EIE) and least developed economies (LDC) exhibit larger VA type-I multipliers than industrialized economies (IE) and other developing economies (ODE).

Figure 2 VA type-I household multiplier for 4 UNIDO country groups



Similar to Figure 2, Figure 3 shows VA household consumption multipliers for the four selected regions, although induced effects are taken into account here such that Figure 3 depicts the type-II multiplier.

Figure 3 **VA type-II household multipliers for 4 UNIDO country groups**



Comparing Figures 3 and 2, we see that the type-II multiplier is larger due to the positive feedback effect from an increase in household income. Furthermore, while previously, the multiplier effect was largest for EIE and LDC, the type-II multiplier is largest—when taking a look at the median and upper end of the whisker—for IE in 1990. Thus, feedback effects due to an increase in household income are stronger in highly developed countries than in the other three country groups.

The differences between country groups of the VA type-II multipliers are smaller than of the VA type-I multipliers, and the differences decreased over the years, as Figure 3 illustrates. Finally, as before, the extent of multiplier decreases over the years with respect to the median and to most other measures and the number of outliers (positive and negative) is larger than before. We thus conclude that the feedback effects from increased wages leads to a wider distribution of multiplier effects, although the number of outliers is still limited.

4.2 Consumption by industries

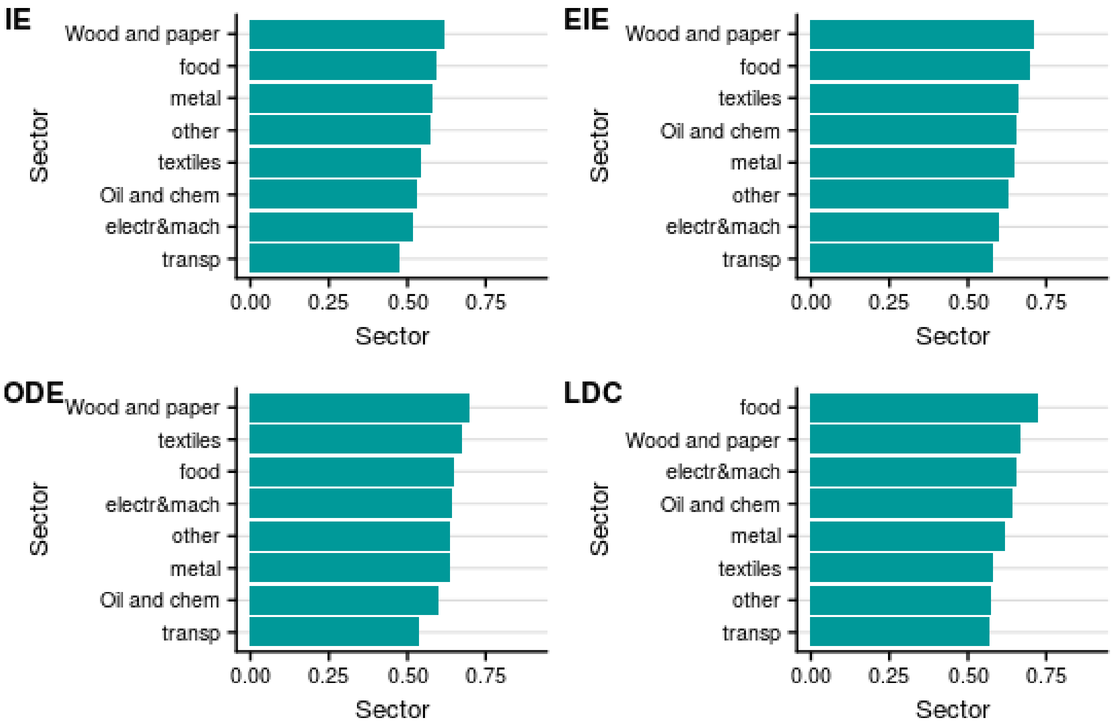
We analyse the VA type-I multiplier (Figure 4) and the VA type-II multiplier (Figure 5) of the individual manufacturing industries in the EORA26 database. The focus lies on the year 2013, which is the latest available year in the database.

Once again, country outliers as defined above were deleted and country groups were formed. The barplots show the average multiplier values of the eight manufacturing industries and are categorized from largest to smallest for each country group. Some similarities between the country groups emerge in Figure 4: while *wood and paper* (sector 20t22: Wood and Paper) and *food* (sector 15t16: Food & Beverages) exhibit large multiplier effects for all groups, those of *transp* (sector 34t35: Transport Equipment) are rather small for all four groups.

In general, we observe that the absolute values of the multiplier do not differ noticeably between country groups: the smallest multipliers are centred around a value of 0.5, while the largest multiplier reaches a level of nearly 0.75. Figure 4 also shows that multiplier values are generally slightly smaller for country group IE compared with the other groups, while the LDC group exhibits relatively large multiplier values. This pattern was observed above as well.

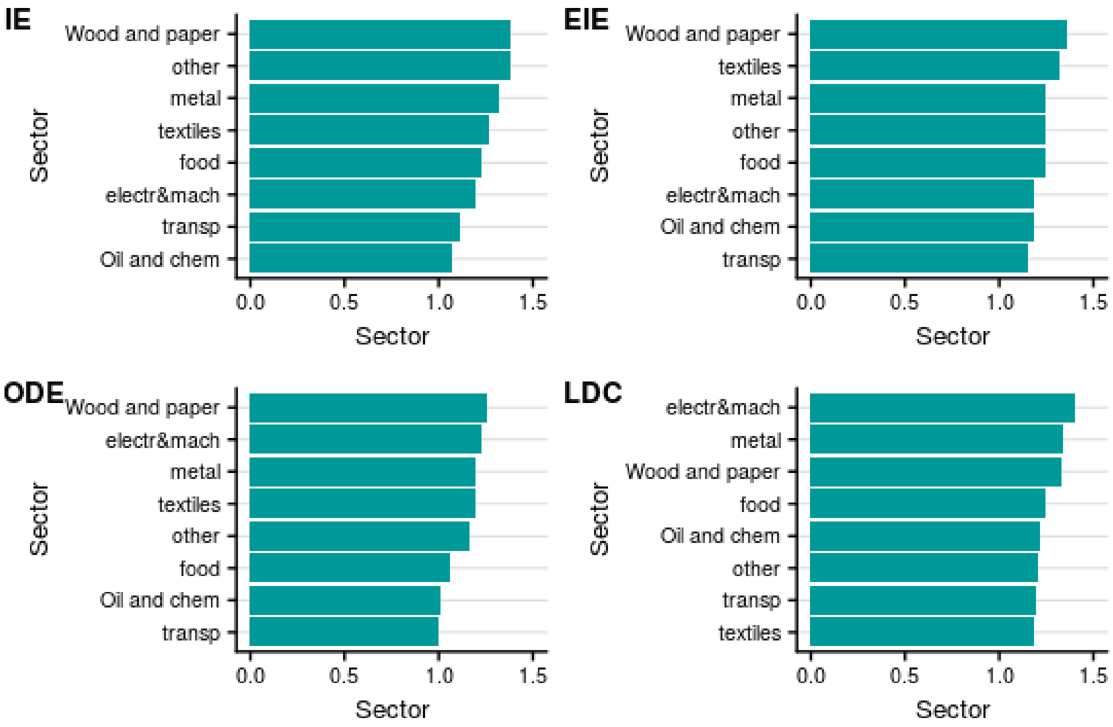
The patterns observed in Figure 4 also to a large extent hold for VA type-II multipliers. *Wood and paper* is a very important industry in terms of additional income generation, while *transp* exhibits a small multiplier effect. However, *food*, which assumed a very important role above, is of medium significance for type-II multipliers. In terms of absolute multiplier size, we see that it is very similar for type-II multipliers across country groups. Differences are slightly larger for type-I multipliers, but still not very large. This pattern was already observed in the previous section.

Figure 4 VA type-I household multiplier for 4 UNIDO country groups



In addition, Figure 5 suggests that group IE is "catching up" when it comes to type-II multipliers compared with type-I multipliers: while type-I multipliers for IE were smaller, on average, compared with, for example, ODE, type-II multipliers are now larger by a small margin. This suggests that the feedback effects from an increase in income are stronger for IE compared with other country groups. One possible explanation could be that the share of income allocated wage earners is higher and additional income is distributed more evenly in highly developed countries, thereby allowing for a stronger induced effect. This effect was already observed above as well.

Figure 5 VA type-II household multiplier for 4 UNIDO country groups



5 Analysis of determinants

In this section, we analyse the relationship between household multipliers and potential explanatory factors with respect to multiplier size. Building on the VA type-II multiplier we are investigating, *gdp per capita (in PPP)*, *import share*, *share of high-tech industry*, *wage share*, *size of the middle class* and *gini (net)* are correlated with the household multiplier in the following subsections. Once again outliers are deleted before conducting the analysis. The additional data was obtained from the World Bank for GDP per capita, the PEW research centre for the size of the middle class measurement and from Solt (2016) for the Gini coefficient.

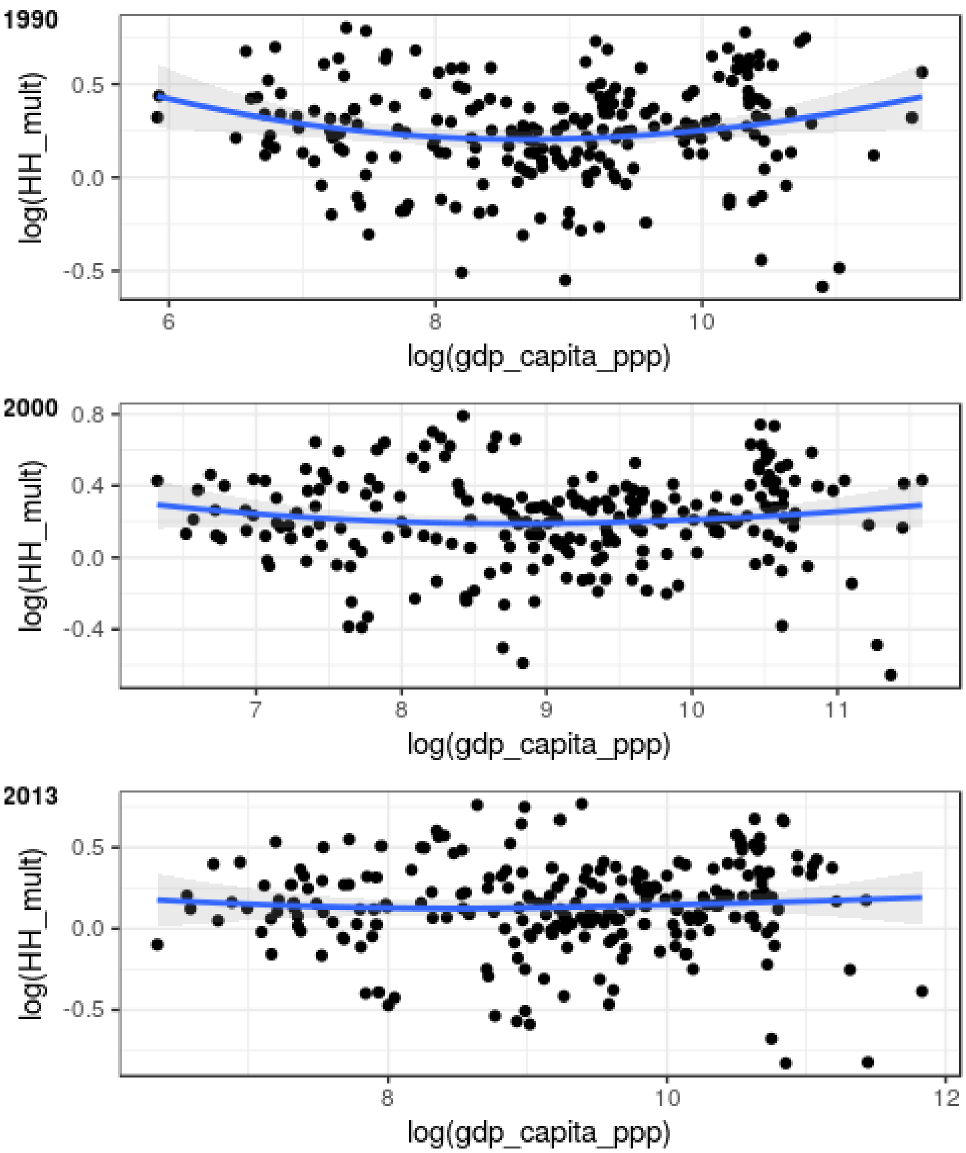
5.1 Household demand multipliers and GDP per capita

Figure 6 captures the relationship between the *household demand multiplier* and *gdp per capita (in PPP)* for our data. Three cross-sections of the data are shown. The first cross-section contains data for the year 1990. To increase the number of observations, we also added data for the year 1995 in the cross-sectional analysis for 1990. This procedure is repeated for the other two cross-sections as well, which are given by the years 2000/2005 and 2008/2013.

The relationship between the two variables is analysed after taking the natural logarithm of both variables. As can be seen from the three plots, local regression (loess) curves are fitted with GDP per capita as the independent variable and the multiplier as the dependent variable. In addition, 95 per cent confidence intervals are also shown in grey.

The relationship between the two variables is not very strong. Figure 6 is almost flat for all three periods. Moreover, while the relationship was weakly u-shaped for the first period, the pattern faded during the years.

Figure 6 **Relationship between GDP per capita and HH multiplier**

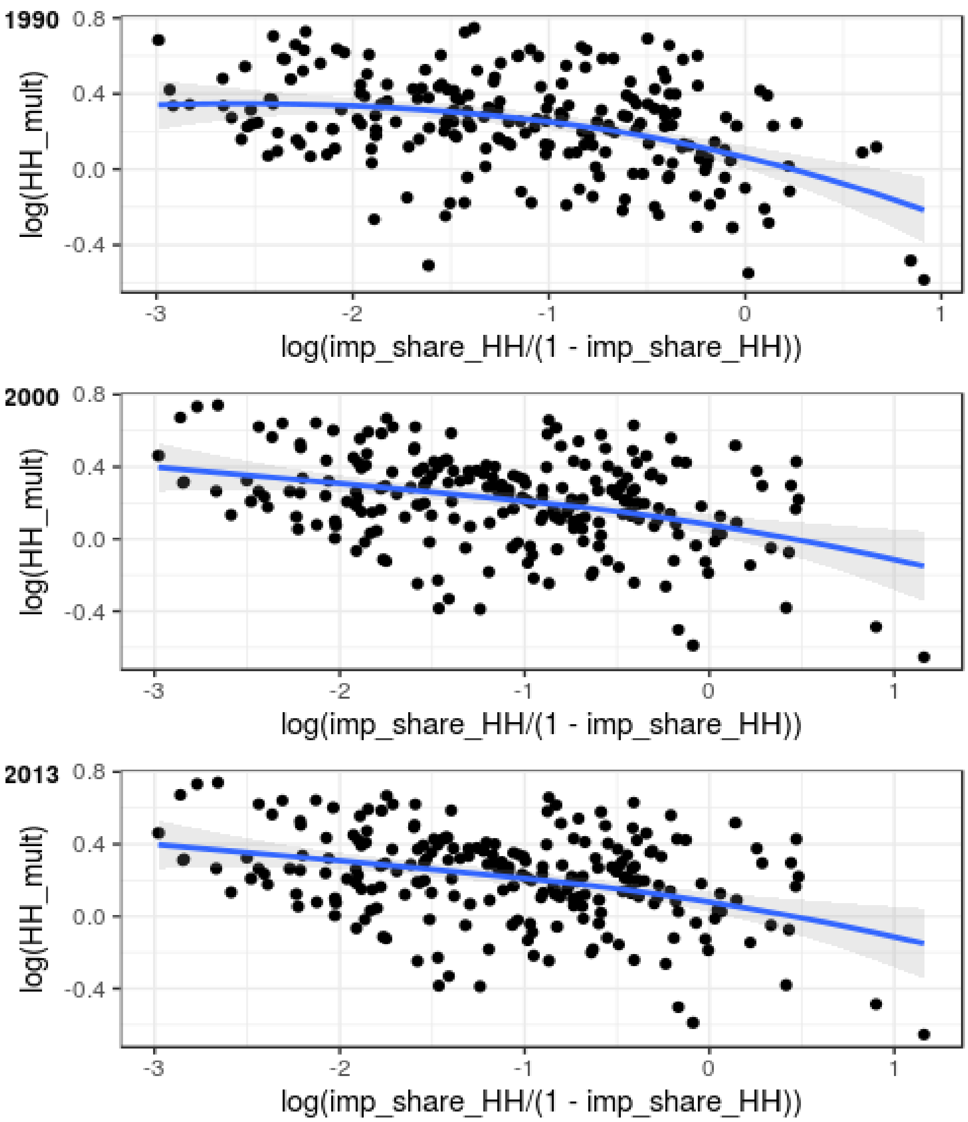


5.2 Household demand multipliers and share of imported goods

Our independent variable is *import share*, while the household multiplier remains the dependent variable. As the *import share* lies between 0 and 1, a logit transformation of the variable is undertaken. A weakly negative relationship is given for all three periods: as the share of imports increases, the household consumption multiplier decreases.

Thereby the pattern barely changes throughout the years, although it has become more linear in recent years. The result clearly suggests that countries with strong domestic linkages have a bigger potential of increasing income levels by stimulating their manufacturing industries. This also suggests that larger countries are at an advantage here, as their potential to source from domestic industries is stronger than for smaller countries.

Figure 7 Relationship between import share and HH multiplier

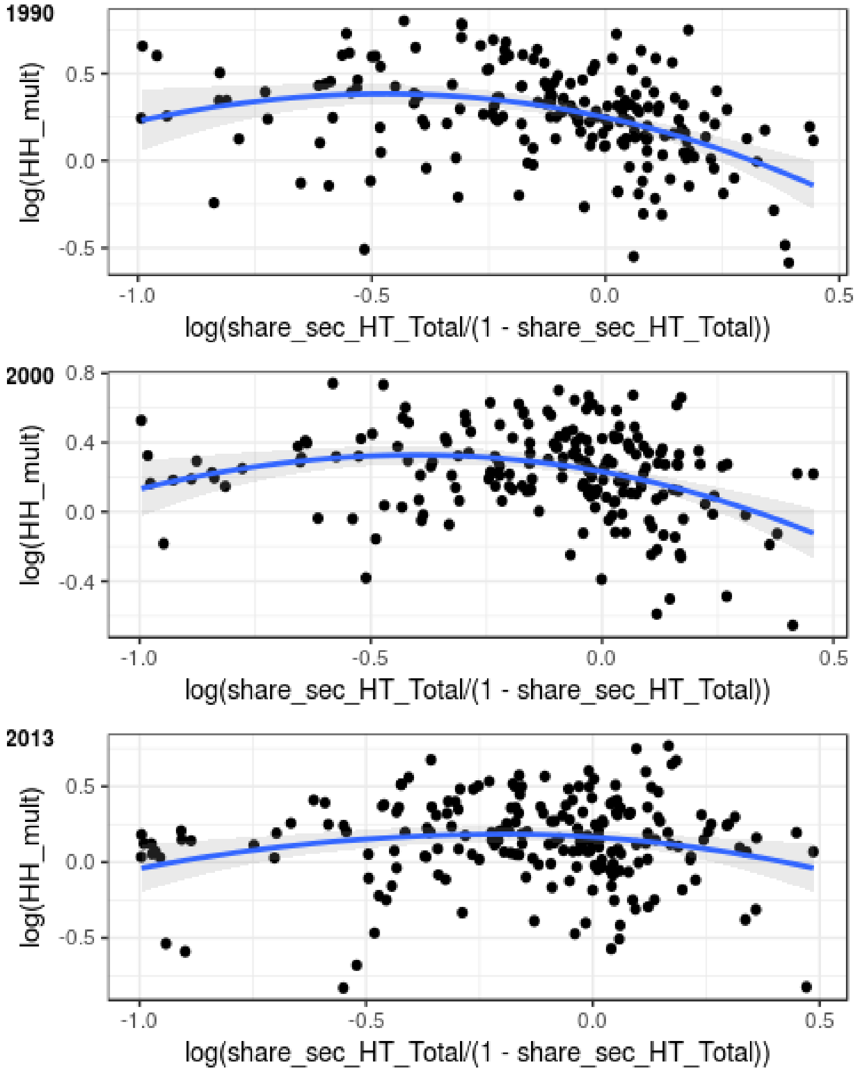


5.3 Household demand multipliers and share of high-tech industries

The relationship between the share of high-tech industries in total final demand (*share of high-tech industry*) and the household multiplier is depicted in Figure 8. We define the industries *Electrical and Machinery* and *Transport Equipment* as high-tech industries within manufacturing. Here it is important to note that the independent variable focuses on total final demand for products produced at home and abroad, i.e. we do not distinguish between final demand categories.

The pattern follows an inverted u-pattern and flattens out over the years, although the general pattern persists. This suggests that the household multiplier increases with a larger share of high-tech final demand in the beginning, but eventually starts decreasing again. The maximum value for the year 2013 is given by an import share of approximately 0.44. This suggests that the multiplier increases until a value of approximately 0.44 is reached before it starts declining again. Figure 8 also suggests that the optimal level has increased (shifted to the right) over the years. While the optimal level suggested by the loess curve was around 0.38 in 1990, it has shifted towards a value of 0.44 over the last two decades.

Figure 8 **Relationship between share of high-tech industry in final demand and HH multiplier**

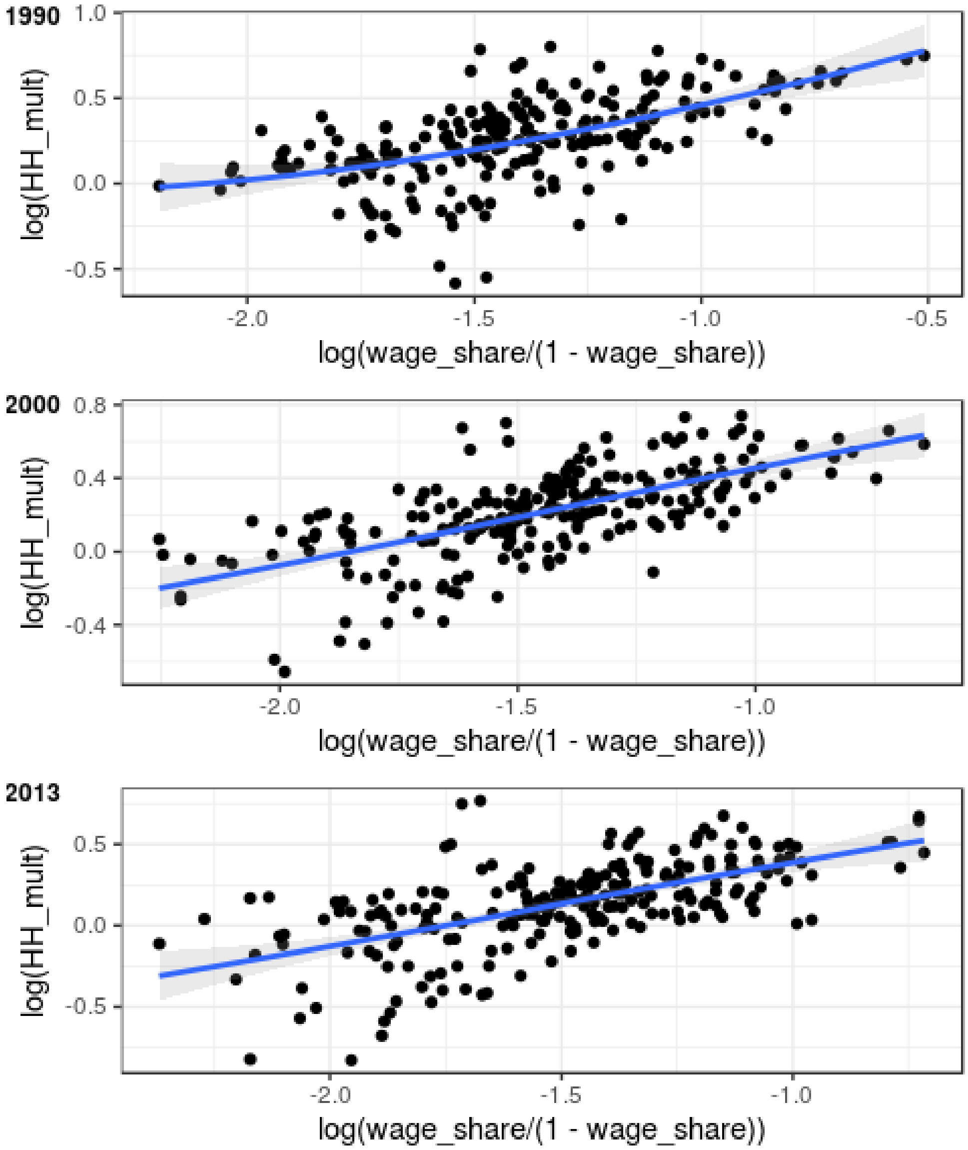


5.4 Household demand multipliers and wage share

Next, the wage share is analysed. A logit transformation has been used for the wage share. It should be mentioned that the implied wage share of the EORA database seems problematic insofar that the values are rather low for some countries.

However, the observed pattern follows the expected one: a higher wage share increases the multiplier size. A positive relationship is observed across all periods, but decreases between 1990 and 2013. The declining relationship between wages and multiplier size is again in line with an increase in foreign sourcing such that the induced effect decreases over the years.

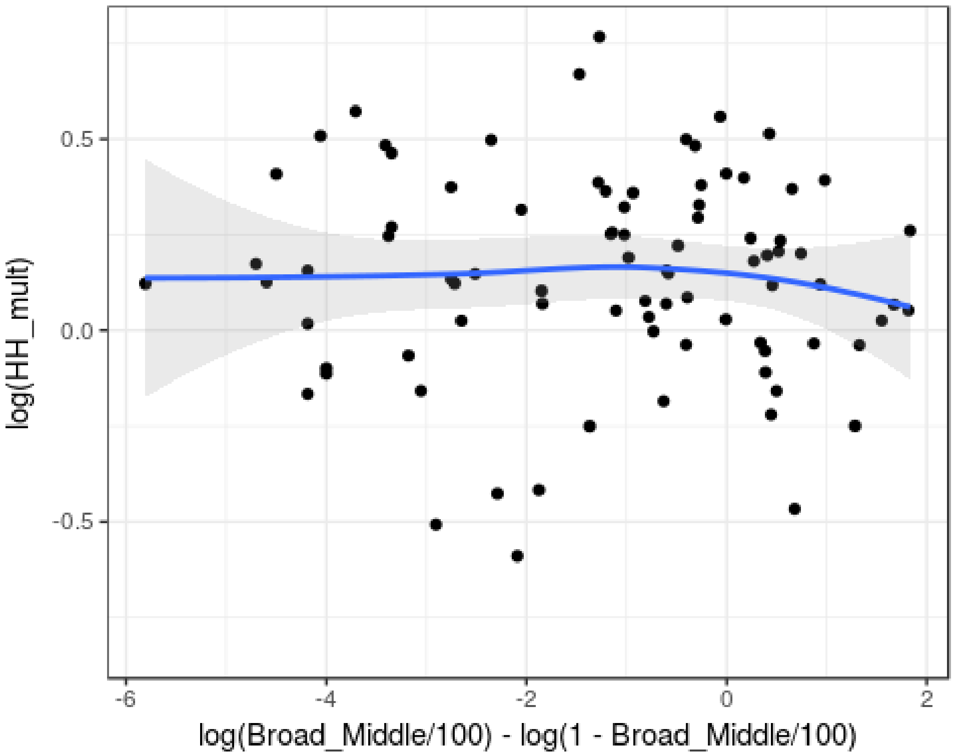
Figure 9 **Relationship between wage share and HH multiplier**



5.5 Household demand multiplier and size of the middle class

In this section, we use the PEW database and its measurement of the size of the middle class. We use the data from 2011 and merge it with multipliers from 2013 to study the relationship of these two variables. The result is presented in Figure 10. A logit transformation was undertaken again. However, the result does not show a clear pattern. This can also be seen from the loess curve which is almost constant.

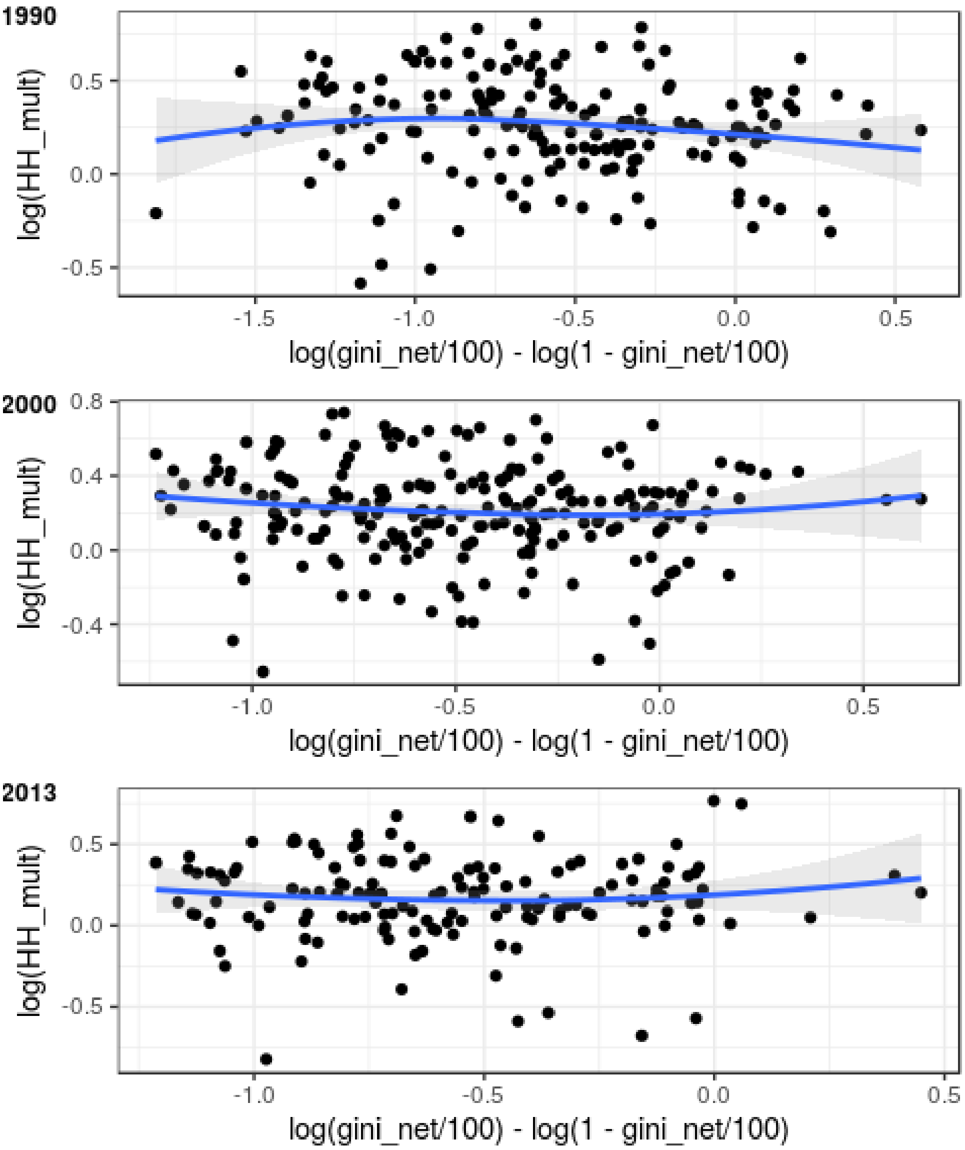
Figure 10 **Relationship between net GINI coefficient and HH multiplier**



5.6 Household demand multipliers and Gini coefficient

Lastly, in this section we focus on the net GINI coefficient (post-transfer, post-tax) and how it is related with the multiplier. The GINI coefficient has been log-transformed, and like the multiplier and the effects is presented in Figure 11. Once again, a clear pattern does not emerge here.

Figure 11 **Relationship between size of middle class and HH multiplier**



6 Manufacturing consumption multipliers: country cases

6.1 An in-depth view of 10 countries

Here we use the OECD database and take a look at the 16 manufacturing industries in the database to analyse the industries' type-I and type-II VA household multipliers. Instead of absolute values, we present a ranking of the industries for the 10 countries mentioned above, where a smaller value signals a larger multiplier effect. The results for the type-I multipliers are shown in Table 6, while Table 7 depicts the results for type-II multipliers. The same information is also summarized in heatmaps in Figures 12 and 13.

As can be seen from Table 6 and Figure 12, *food* (sector 15T16: Food products, beverages and tobacco) is very significant in terms of type-I multipliers for all countries. The only exception is Germany where food production is only ranked ninth out of sixteen. However, the pattern changes when taking a look at type-II multipliers: here we see that *food* loses its position in the advanced countries within the sample (Japan, the United States and Germany). Food products no longer exhibit strong type-II multipliers. The significance of *food* also diminishes in the other seven countries of the sample (Table 7). Still, *food* remains significant outside highly developed countries.

Textiles (sector 17T19: Textiles, textile products, leather and footwear) is significant for type-I multipliers in Brazil, China, India and Viet Nam. It is of medium significance for Mexico, the United States and South Africa, but rather insignificant for Germany, Japan and Cambodia as shown in the table and heatmap of the type-I multiplier. However, the textiles industry gains in position in most countries of the sample when it comes to type-II multipliers. It even becomes the most important industry for Brazil and the United States.

Wood (sector 20: Wood and products of wood and cork) is important for all countries, with the exception of Japan, for type-I and type-II multipliers as can be seen from the tables and heatmaps. With respect to type-I multipliers, we also observe the significance of the industries *paper* (sector 21T22: Pulp, paper, paper products, printing and publishing), and *non-metallic* (sector 26: Other non-metallic mineral products). *Metal prod* (sector 28: Fabricated metal products) is an important multiplier for Germany and Japan, but not for the third high-income country in the sample, the United States. The type-I multiplier effect is only average or low for the other countries in the sample. A fairly unimportant industry for all countries—with the exception of Mexico—is *basic metal* (sector 27: Basic metals). Furthermore, *pertoleum* (sector 23: Coke, refined petroleum products and nuclear fuel) also exhibits a fairly small type-I multiplier.

With respect to type-II multipliers, we observe that the industries *pertoleum* and *basic metal* (with the exception of Cambodia) exhibit a fairly small multiplier effect. The pattern does not change much for a number of industries when comparing type-I and type-II multipliers. For example, *wood* is an important industry for all countries for type-I and type-II multipliers, with the exception of Japan. *Paper* also exhibits a large multiplier effect for most countries for both multiplier categories. *Machinery* (sector 29: Machinery and equipment, nec) is more important for type-I than for type-II multipliers. *Electronics* (sector 30T33X: Computer, Electronic and optical equipment) is a fairly important industry for the high-income countries in the sample, while it is rather unimportant for the other countries in the sample.

Table 6 **Ordering of type-I VA household multipliers (manufacturing industry only)**

Sector	BRA	CHN	DEU	IND	JPN	KHM	MEX	USA	VNM	ZAF
food	4	1	9	1	2	1	3	4	1	1
textiles	3	4	12	3	15	13	7	8	2	10
wood	2	3	5	2	12	2	2	5	6	2
paper	5	7	1	5	1	4	5	1	5	3
petroleum	15	14	16	16	16	16	8	16	9	13
chemicals	8	11	11	7	14	12	6	7	12	7
plastic	12	8	10	6	10	15	10	9	11	5
non-metallic	6	5	2	4	3	5	1	3	4	6
basic metal	11	16	15	15	13	10	4	14	14	16
metal prod	7	12	3	10	4	14	9	10	8	8
machinery	10	6	8	11	6	7	13	13	16	9
electronics	16	15	4	9	9	8	16	2	15	14
elec mach	9	13	6	13	8	6	14	12	13	12
vehicles	14	9	13	12	5	11	15	15	7	11
oth transp	13	10	14	8	7	9	12	11	10	15
Other and recyc	1	2	7	14	11	3	11	6	3	4

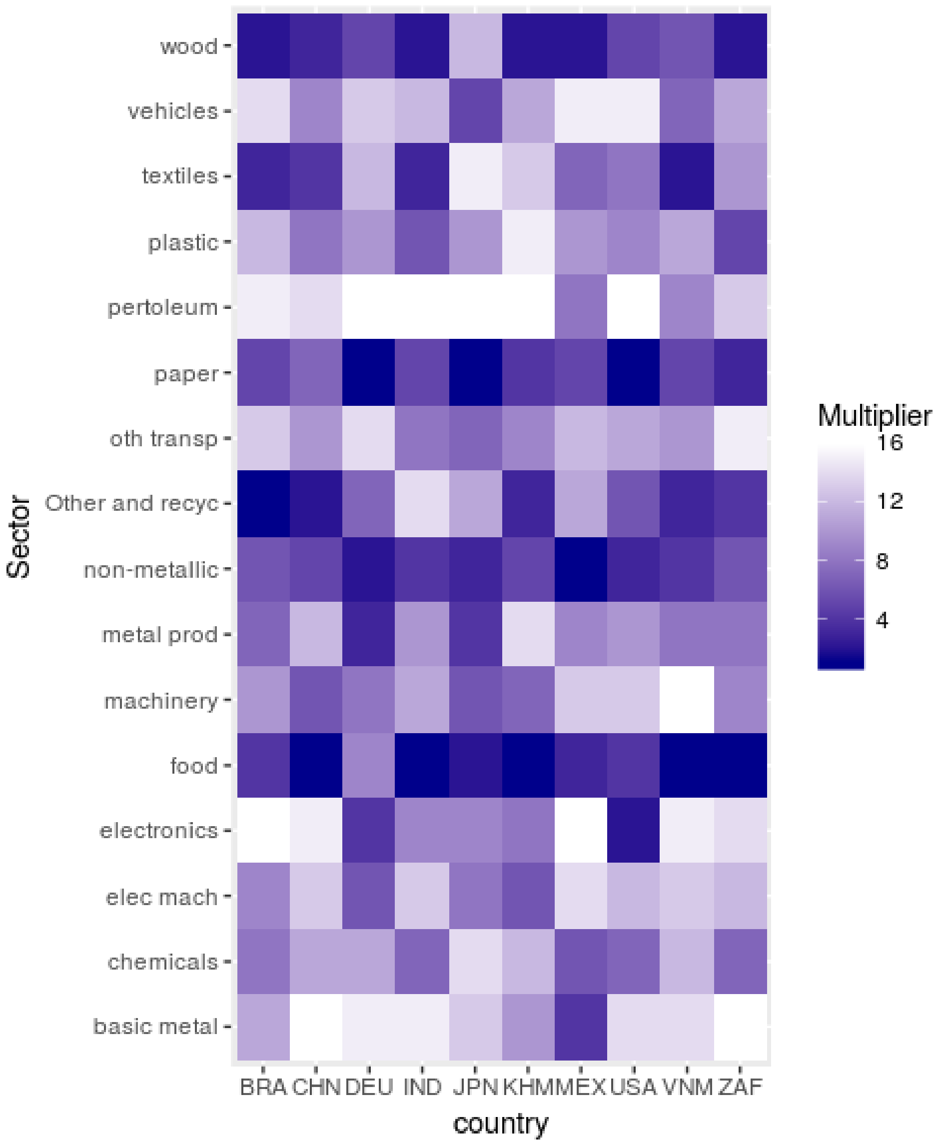
Note: The industries are ranked in descending order with a value of 1 signalling the largest multiplier effect for a given country

Table 7 **Ordering of type-II VA household multipliers (manufacturing industry only)**

Sector	BRA	CHN	DEU	IND	JPN	KHM	MEX	USA	VNM	ZAF
food	5	1	12	1	13	1	5	12	1	6
textiles	1	3	10	2	4	13	3	1	2	7
wood	3	2	4	3	12	2	1	2	4	2
paper	4	5	6	5	7	3	2	5	3	3
petroleum	16	14	16	16	16	16	13	16	12	15
chemicals	13	11	14	9	14	10	9	13	11	8
plastic	10	9	13	6	9	15	8	10	8	1
non-metallic	6	8	9	4	10	9	4	4	6	12
basic metal	15	16	15	15	15	4	10	15	16	16
metal prod	12	12	2	14	2	12	7	7	7	4
machinery	8	7	3	8	5	7	11	11	14	5
electronics	14	15	1	7	6	6	16	6	15	13
elec mach	11	13	8	10	1	8	14	9	13	9
vehicles	2	10	7	13	3	14	15	14	10	10
oth transp	9	6	11	12	11	11	12	8	9	14
Other and recyc	7	4	5	11	8	5	6	3	5	11

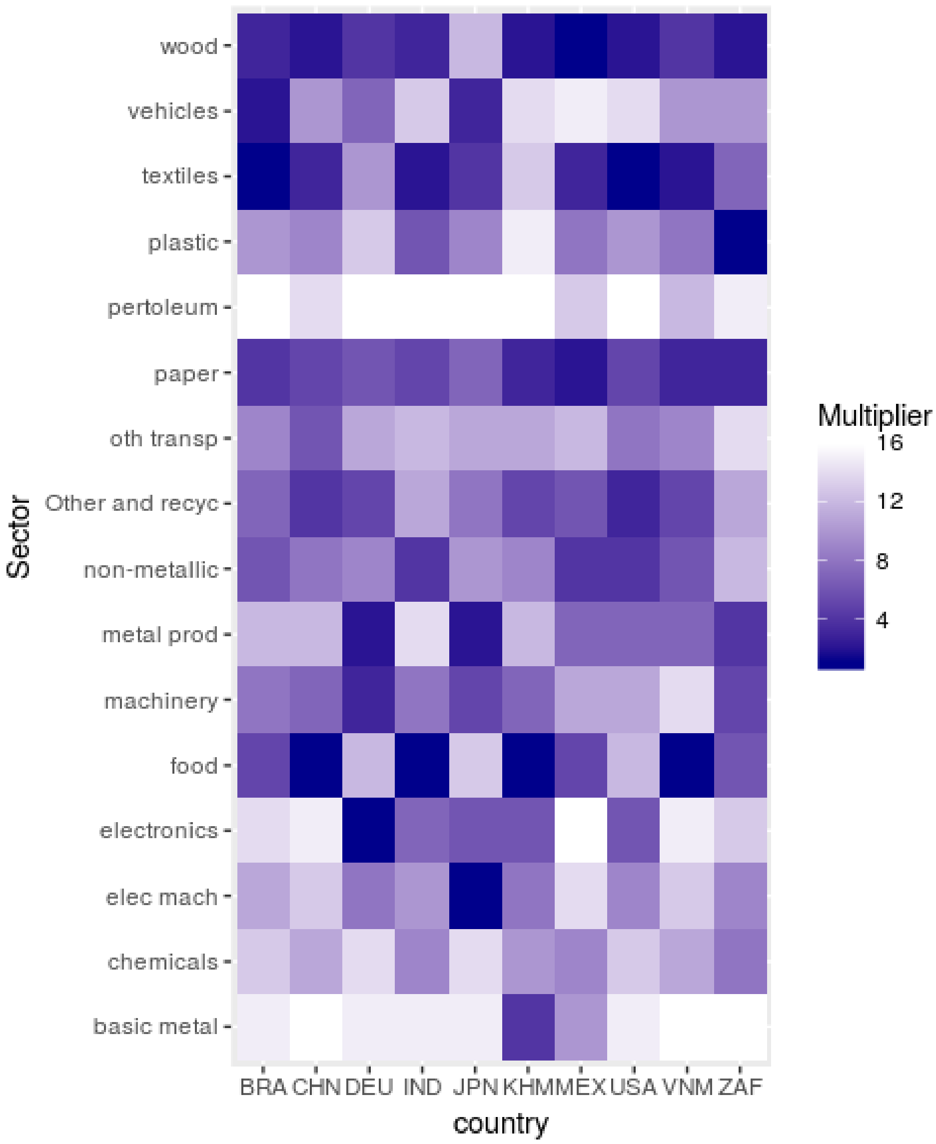
Note: The industries are ranked in descending order with a value of 1 signalling the largest multiplier effect for a given country

Figure 12 **Heatmap of manufacturing multipliers (type-I)**



Note: The value of dark blue tiles signals a large multiplier for a given country. White tiles reflect small multiplier effects.

Figure 13 **Heatmap of manufacturing multipliers (type-II)**



Note: The value of dark blue tiles signals a large multiplier for a given country. White tiles reflect small multiplier effects.

6.2 An even more in-depth view of four countries

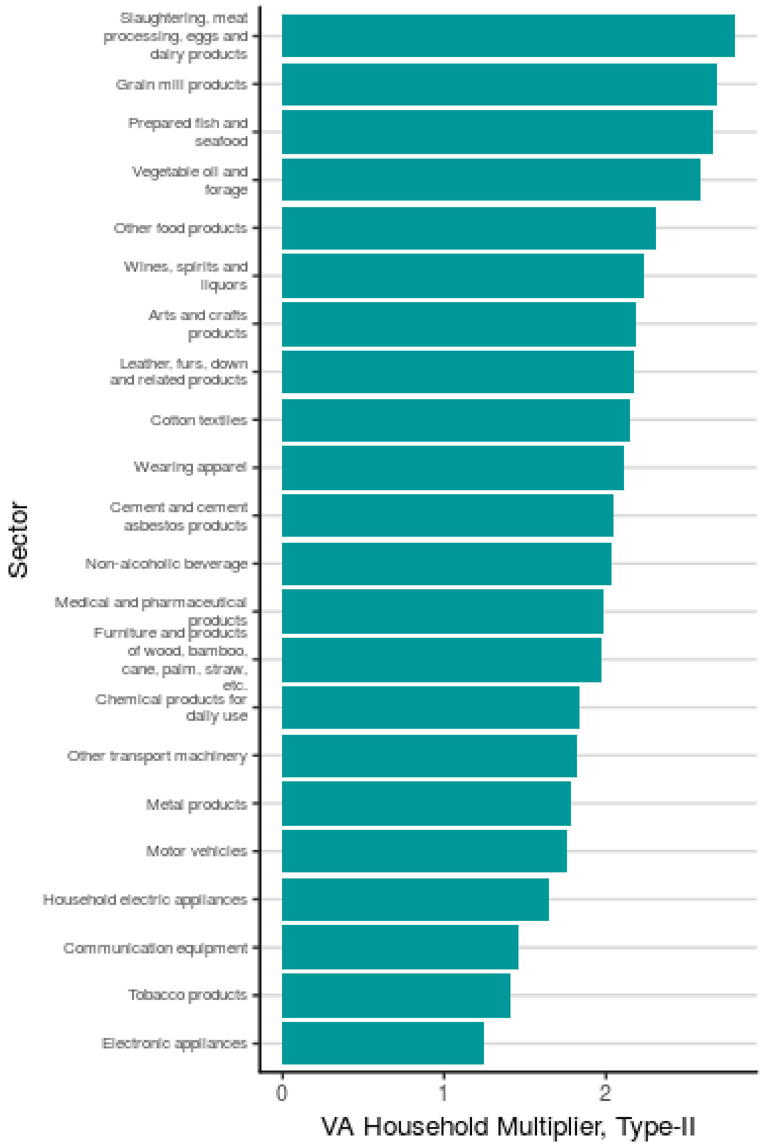
In this section, we focus on the large EORA tables and type-II multipliers for individual manufacturing industries. The national EORA tables are very detailed and we therefore only focus on a selection of industries. More specifically, we only report manufacturing industries with a household final consumption share of at least 0.5 per cent.

Figure 14 presents China's most important manufacturing commodities with respect to the creation of income (value added).[10] The EORA national tables report 72 distinct manufacturing commodities, but we only show commodities with a household final demand share of 0.5 per cent or larger. The commodities are ordered by size of the VA multiplier.

As can be seen from the figure, basic *food processing commodities* have the largest multiplier effect for China. *Textiles* and *clothing commodities* exhibit large effects. High-tech commodities like *medical and pharmaceutical products* and *electronic appliances* do not exhibit strong multiplier effects. Still, their effect is significantly larger than 1.

[10] As already discussed above, the tables for China and Viet Nam are based on commodities and not on industries.

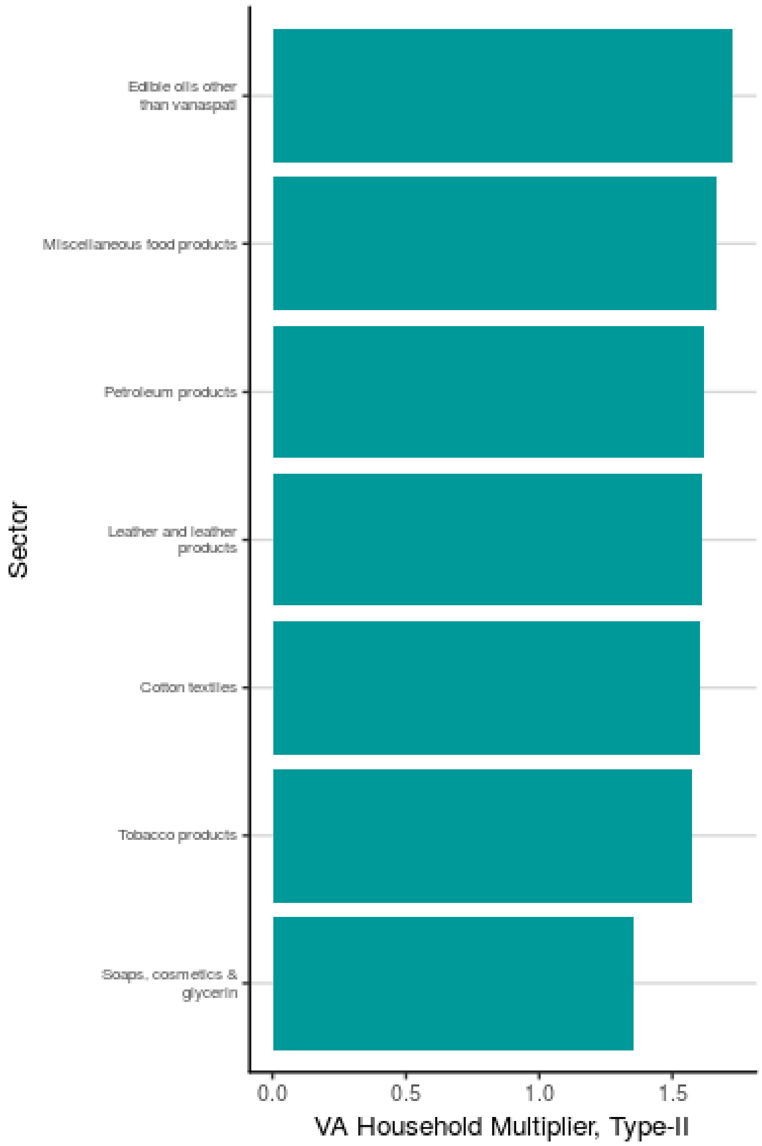
Figure 14 **VA type-II household multiplier for China based on full EORA database**



Note: Only industries with a household consumption share larger than 0.5 % are plotted.

Figure 15 presents the results for India. As discussed above, this table has been transformed from a SUT table to an industry × industry table. As can be seen from the barplot, only 7 manufacturing industries exhibit a consumption share larger than 0.5 per cent. Fairly basic manufacturing industries like *edible oils* or *miscellaneous food products* dominate. However, *petroleum products* exhibit a larger type-II multiplier effect as well.

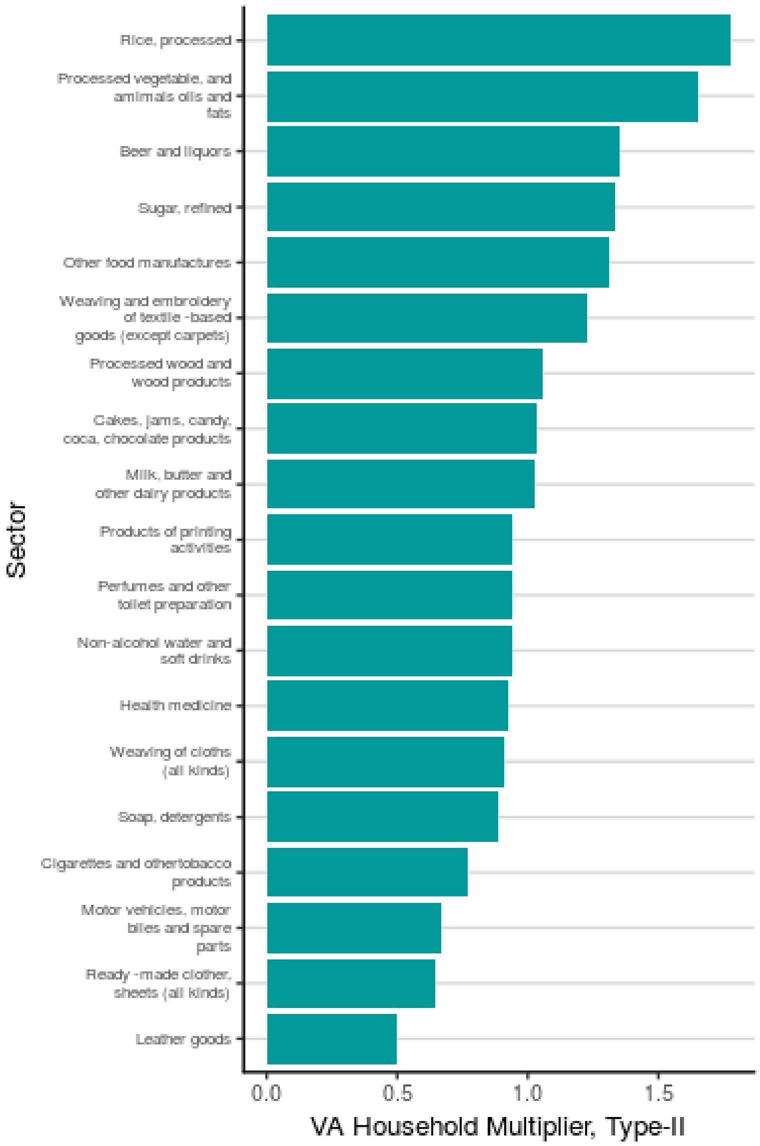
Figure 15 **VA type-II household multiplier for India based on full EORA database**



Note: Only industries with a household consumption share larger than 0.5 % are plotted

Figure 16 shows the size of the most important manufacturing industries for Viet Nam. Here, *processed food* items dominate again. Especially *rice* and *processed vegetables* and *animal oils and fats* exhibit large multiplier effects.

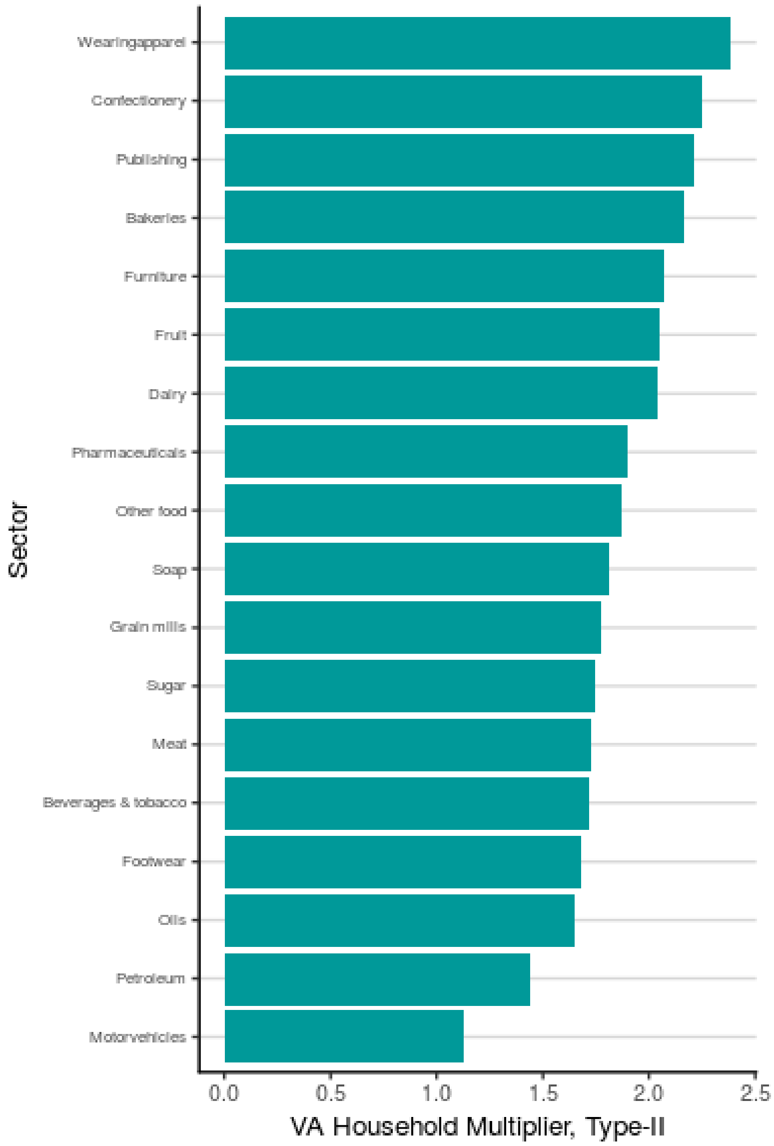
Figure 16 **VA type-II household multiplier for Viet Nam based on full EORA database**



Note: Only industries with a household consumption share larger than 0.5 % are plotted

For South Africa, we once again observe that basic manufacturing industries exhibit strong multiplier effects. In addition, *pharmaceuticals* is also once again the advanced manufacturing industry with the largest multiplier effect. This effect was already observed for China and Viet Nam as well.

Figure 17 VA type-II household multiplier for South Africa based on full EORA database.



Note: Only industries with a household consumption share larger than 0.5 % are plotted

Finally, comparing the size of multipliers between countries, the last four figures indicate that the largest multipliers are larger in China and South Africa than in India and Viet Nam. This suggests that local sourcing plays a bigger role in the former two countries where VA type-II multipliers larger than 2 are obtained for certain industries.

7. Concluding remarks

In this paper, we analysed the income generation capabilities of an increase in manufacturing demand. This was achieved by applying a multiplier analysis based on three different IO databases. We built on VA type-I and type-II multipliers to capture *direct* and *indirect* income effects (type-I multipliers) and, in addition, *induced* effects (type-II multipliers). The results were based on the standardized EORA26 database (with 155 countries), the more detailed OECD IO-tables (10 countries), and, lastly, the regular EORA tables as the most detailed data source (4 countries). We observe that the size of the induced effects should not be neglected as they differ significantly between manufacturing industries and country groups. This result suggests that promoting social inclusiveness—by helping disadvantaged groups participate in industrial development—is beneficial in generating economic and social progress.

To be precise, our results in Section 4 demonstrate that domestic manufacturing multipliers have been decreasing since 1990. This result holds for type-I and type-II VA multipliers. In addition, Section 4 also shows that emerging industrial economies and least developed economies exhibit, on average, larger VA type-I multipliers than industrialized economies and other developing economies. However, this pattern does not hold for type-II multipliers, where industrialized economies show the largest multipliers due to stronger feedback effects of increased factor income and consumption expenditure.

Our results also show that multiplier effects differ between manufacturing industries. Section 4.2 suggests that basic industries such as *food and beverages* and *wood and paper* exhibit large type-I multipliers. The results change when we analysed type-II multipliers where *food and beverages* loses in significance, while *wood and paper* remains an industry with large backward linkages.

In Section 5, we analysed the relationship between some key economic indicators and our VA type-II multipliers. The results suggest that the relationship between GDP per capita (in PPP) and the multipliers is rather weak. This also holds true for the link between the size of the middle class and our multipliers, and the relationship between the Gini coefficient and the multipliers. On the other hand, we obtain the expected results for the relationship between import share and VA type-II multipliers and the wage share and our multipliers; an increasing import share reduces type-II multipliers, while a positive correlation between wage share and our multipliers was observed. Finally, the relationship between the share of high-tech industries within manufacturing and multiplier size follows an inverted u-pattern.

Section 6.1 used the OECD IO-database to analyse VA type-I and VA type-II multipliers for 10 selected countries at different income stages. Here a similar pattern as in Section 4 emerges. *Food products, beverages and tobacco* is an important industry with respect to type-I multipliers for all countries with the exception of Germany, while the industry loses its significance in the most advanced economies when taking a look at induced effects in addition to the direct and indirect effects. Section 6.1 shows that *wood and products of wood and cork* is important for all countries, with the exception of Japan, for type-I multipliers. This result is also in line with the results from Section 4. For the other industries, no uniform pattern emerges. For example, *textiles, textile products, leather and footwear* exhibits large VA type-I multipliers for Brazil, China, India and Viet Nam. The industry is also important for Mexico, the United States and South Africa. However, multipliers are rather small in Germany, Japan and Cambodia.

With respect to type-II multipliers, we observe that the ranking of industries is similar to the ranking of type-I multipliers. *Wood and paper* is an important industry for all countries for type-I and type-II multipliers. On the other hand, *machinery and equipment, nec* falls back in the ranking when taking a look at type-II multipliers, while *computers, electronics and optical equipment* is only important for high-income countries when taking induced effects into account as well.

Finally, Section 6.2 summarizes the results based on the regular EORA tables for China, India, South Africa and Viet Nam. Here we only analysed VA type-II multipliers and found that *food processing commodities* exhibit the largest multiplier of all commodities in China. In general, fairly basic manufacturing industries show very large multiplier effects in China and India, South Africa and Viet Nam. In addition, we also saw that multiplier effects are, on average, larger in China and South Africa than in India and Viet Nam.

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9 Appendix

9.1 EORA26 sector classification

Table 8 EORA26 sector classification

Sector Description	Broad Sector Classification
Agriculture	Agriculture
Fishing	Agriculture
Mining and Quarrying	Non-Manufacturing Industry
Food and Beverages	Manufacturing
Textiles and Wearing Apparel	Manufacturing
Wood and Paper	Manufacturing
Petroleum, Chemical and Non-Metallic Mineral Products	Manufacturing
Metal Products	Manufacturing
Electrical and Machinery	Manufacturing
Transport Equipment	Manufacturing
Other Manufacturing	Manufacturing
Recycling	Manufacturing
Electricity, Gas and Water	Non-Manufacturing Industry
Construction	Non-Manufacturing Industry
Maintenance and Repair	Service
Wholesale Trade	Service
Retail Trade	Service
Hotels and Restaurants	Service
Transport	Service
Post and Telecommunications	Service
Financial Intermediation and Business Activities	Service
Public Administration	Service
Education, Health and Other Services	Service
Private Households	Service
Others	Service
Re-export and Re-import	Service

9.2 Outliers EORA26

The following countries were excluded from the EORA26 database (as discussed above):

Belarus, Brunei Darussalam, Kazakhstan, Latvia, Mauritius, Serbia, Aruba, Bermuda, Greenland, Iceland, Liechtenstein, Malta, New Caledonia, French Polynesia, Qatar, British Virgin Islands, Democratic Rep of the Congo, Eritrea, Ethiopia, Guinea, Liberia, Mali, Mauritania, Niger, South Sudan, Sao Tome and Principe, Sudan, Chad, United Republic of Tanzania, Vanuatu, Samoa, Zambia, Andorra, Netherlands Antilles, Cayman Islands, Monaco, Gaza Strip, San Marino, Former Soviet Union, Angola, Armenia, Antigua and Barbuda, Azerbaijan, Bahamas, Belize, Barbados, Congo, Cuba, Ghana, Guyana, Honduras, Libya, Republic of Moldova, Maldives, Nigeria, Panama, Papua New Guinea, Democratic People's Rep of Korea, Seychelles, Turkmenistan, Trinidad and Tobago, Zimbabwe

The following countries remain in the database:

Argentina, Bulgaria, Brazil, Chile, China, Colombia, Costa Rica, Cyprus, Greece, Croatia, Indonesia, India, Mexico, The f. Yugosl. Rep of Macedonia, Oman, Poland, Romania, Saudi Arabia, Suriname, Thailand, Tunisia, Turkey, Ukraine, Uruguay, Venezuela (Bolivarian Republic of), South Africa, United Arab Emirates, Australia, Austria, Belgium, Bahrain, Canada, Switzerland, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, China, Hong Kong SAR, Hungary, Ireland, Israel, Italy, Japan, Republic of Korea, Kuwait, Lithuania, Luxembourg, China, Macao SAR, Malaysia, Netherlands, Norway, New Zealand, Portugal, Russian Federation, Singapore, Slovakia, Slovenia, Sweden, China, Taiwan Province, United States of America, Afghanistan, Burundi, Benin, Burkina Faso, Bangladesh, Bhutan, Central African Republic, Djibouti, Gambia, Haiti, Cambodia, Lao People's Dem Rep, Lesotho, Madagascar, Myanmar, Mozambique, Malawi, Nepal, Rwanda, Senegal, Sierra Leone, Somalia, Togo, Uganda, Yemen, Morocco, Albania, Bosnia and Herzegovina, Bolivia (Plurinational State of), Botswana, Côte d'Ivoire, Cameroon, Cabo Verde, Dominican Republic, Algeria, Ecuador, Egypt, Fiji, Gabon, Georgia, Guatemala, Iran (Islamic Republic of), Iraq, Jamaica, Jordan, Kenya, Kyrgyzstan, Lebanon, Sri Lanka, Montenegro, Mongolia, Namibia, Nicaragua, Pakistan, Peru, Philippines, Paraguay, El Salvador, Swaziland, Syrian Arab Republic, Tajikistan, Uzbekistan, Viet Nam

9.3 OECD sector classification

Table 9 OECD sector classification

Sector Code	Sector Description	Broad Sector Classification
C01T05	Agriculture, hunting, forestry and fishing	Agriculture
C10T14	Mining and quarrying	Non-manufacturing industry
C15T16	Food products, beverages and tobacco	Manufacturing
C17T19	Textiles, textile products, leather and footwear	Manufacturing
C20	Wood and products of wood and cork	Manufacturing
C21T22	Pulp, paper, paper products, printing and publishing	Manufacturing
C23	Coke, refined petroleum products and nuclear fuel	Manufacturing
C24	Chemicals and chemical products	Manufacturing
C25	Rubber and plastics products	Manufacturing
C26	Other non-metallic mineral products	Manufacturing
C27	Basic metals	Manufacturing
C28	Fabricated metal products	Manufacturing
C29	Machinery and equipment, nec	Manufacturing
C30T33X	Computer, electronic and optical equipment	Manufacturing
C31	Electrical machinery and apparatus, nec	Manufacturing
C34	Motor vehicles, trailers and semi-trailers	Manufacturing
C35	Other transport equipment	Manufacturing
C36T37	Manufacturing nec; recycling	Manufacturing
C40T41	Electricity, gas and water supply	Non-manufacturing industries
C45	Construction	Non-manufacturing industries
C50T52	Wholesale and retail trade; repairs	Service
C55	Hotels and restaurants	Service
C60T63	Transport and storage	Service

C64	Post and telecommunications	Service
C65T67	Financial intermediation	Service
C70	Real estate activities	Service
C71	Renting of machinery and equipment	Service
C72	Computer and related activities	Service
C73T74	R&D and other business activities	Service
C75	Public administration and defence; compulsory social security	Service
C80	Education	Service
C85	Health and social work	Service
C90T93	Other community, social and personal services	Service
C95	Private households with employed persons	Service

9.4 Manufacturing consumption shares

The following table summarizes the share of consumption of domestically produced manufacturing goods in total domestic consumption for the OECD and EORA26 tables. As previously, we deleted sector 37 (recycling) from the EORA26 database.

Table 10 Consumption shares of EORA26 and OECD database

Region	EORA	OECD
World	0.1992	0.2823
EIE	0.25	0.3192
IE	0.1835	0.2103
LDC	0.1543	0.2077
ODE	0.2096	0.3887

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