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Mapping trade to household budget survey

A CONVERSION FRAMEWORK FOR ASSESSING THE DISTRIBUTIONAL IMPACT OF TRADE POLICIES

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Mapping trade to household budget survey: A conversion framework for assessing the distributional impact of trade policies

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Whether gains from trade are equally distributed within countries is the subject of a lively debate. This paper presents a novel framework to analyse the distributional effects of trade policy by linking the OECD's CGE trade model, METRO, with consumption expenditure data from household budget surveys. Specifically, this paper describes a methodology to produce a concordance and transition matrix linking GTAP sectors to household survey classifications based on the Classification of Individual Consumption According to Purpose (COICOP). A mapping methodology is an important pre-requisite for investigating research questions concerning the influence of household behaviour changes on trade, as well as trade developments and policy on household welfare. The paper provides an illustration of the mapping of trade policy induced price changes onto household expenditures by conducting stylized tariff simulations with METRO and translating those into household expenditures by income decile for selected EU countries.

Keywords: Inequality, household expenditure microdata, trade policy, modelling

JEL Codes: C68, D12, E21, F13, F14

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Executive Summary

The question of whether the gains from trade are equally distributed within countries is the subject of a lively debate. In order to analyse the distributional effects of trade policy, this paper develops a novel framework to link the OECD's CGE trade model, METRO (OECD, 2020[1]), with consumption expenditure data from household budget surveys. This allows for examining the effect of a wide range of trade policy scenarios on different household consumption baskets, and for estimating the exposure of different socio-economic groups, such as income groups, to trade-driven changes in the relative prices of consumption items.

The objective of this paper is to describe a methodology to produce a concordance and transition matrix linking GTAP sectors to household survey classifications (COICOP specifically). The methodology is two-fold. First, a cross-walk to establish a [0,1] concordance table between COICOP and GTAP classifications is produced. This is achieved by linking multiple correspondence tables between COICOP and a number of different product classifications. Second, a transition matrix to convert changes in the prices of GTAP categories to COICOP categories is built. Because there is not always a one-to-one mapping between GTAP and COICOP classifications, the matrix is necessary. The transition matrix gives the extent to which the prices of COICOP items (for example, Meat as opposed to Animal drawn vehicles) change following a given price change of its associated GTAP sector (i.e. cmt-bovine meat).

A mapping methodology is an important pre-requisite for investigating research questions concerning the influence of household behaviour changes on trade, as well as trade developments and policy on household welfare. The paper illustrates the mapping of trade policy induced price changes onto household expenditures by conducting stylized tariff simulations with METRO and translating those into household expenditures by income decile for selected EU countries.

1. Introduction

The distributional effects of trade are the subject of a lively debate. A vast body of research has examined this question through the channel of income and earnings. This research has found that in advanced economies, trade integration has contributed, along with technological change, to regionally-concentrated declines in manufacturing employment and in the wage share of middle-skilled workers, therefore to some of the increase in wage inequality (OECD, 2018[1]; IMF, 2017[2]; Autor, Dorn and Hanson, 2016[3]; Autor et al., 2014[4]).

The distributional effects of trade also materialise through consumption expenditures, although existing research is more limited in this area (Borusyak and Jaravel, 2017[5]; Furman, Russ and Shambaugh, 2017[6]; Hottman and Monarch, 2018[7]; Fajgelbaum and Khandelwal, 2016[8]; USITC, 2017[9]). This channel refers to the effects of trade on the relative prices of goods that are consumed at different intensities by rich and poor households. Trade-driven changes in relative prices may reduce inequality if price declines are concentrated in the basket of goods consumed by lower-income households. An equalising effect of trade through the consumption channel could thus mitigate a dis-equalising effect through the earnings channel. Filling this knowledge gap may shed new light on the distributional effects of trade and help answer the following policy questions:

- What is the exposure of households in different socio-economic groups such as income groups to trade-driven changes in consumer prices?
- How do distributional effects vary across different policy changes?
- What are the policy implications of the distributional effects of trade liberalisation on consumers?

Answering these questions raises analytical challenges associated with mapping trade commodity and household expenditure data, models and metrics. The purpose of this paper is to address those challenges and thus propose an analytical framework for analysing the distributional effects of trade from an expenditure perspective. As explained below, this framework is general enough to be applied to a number of additional areas of research linking trade and consumption. The idea is to link the OECD Computable General Equilibrium (CGE) trade model METRO (ModEling Trade at the OECD) with household budget surveys (e.g. HBS for European countries). This allows for simulations of the effects of a range of trade policy scenarios, such as changes in import tariff and non-tariff measures in given sectors and from specific trading partners, on the prices of goods and services consumed by households.

The challenge arises from the fact that trade models, including METRO, and expenditure survey data use different classifications of consumption items that thus have to be matched. The METRO model is based on the Global Trade Analysis Project (GTAP) sector classification (GSEC) while that used in households expenditure surveys is the Classification Of Individual Consumption by Purpose (COICOP). COICOP and GTAP are two overlapping complete partitions of the space of consumption goods and services. A given GTAP category may partially encompass multiple COICOP categories, and vice versa. This paper introduces a conversion framework that translates price shocks assessed by a trade model for each GTAP category into a price shock vector expressed in terms of COICOP categories that can thus be matched to household budget surveys. The conversion framework starts by building a “concordance table” that assigns each category from the GTAP classification to one or multiple consumption categories of the COICOP classification. Second, a “transition matrix” converts changes in the relative prices of GTAP categories into price changes expressed in terms of COICOP categories.

The conversion framework may have many applications. To start with, the conceptual pillars underlying the GTAP-COICOP conversion framework can be adapted to map other trade and consumption classifications with each other. While the focus of this paper is on mapping trade-policy induced price changes to consumption, the analysis can also start at the other end: for example, the framework can be used to examine how a change in consumption patterns due to ageing influences international trade patterns. Or, more topical in the current context of the global COVID-19 crisis, the mapping can be useful to infer the wider economic consequences of changing consumption patterns.

The rest of this paper is organised as follows. Section 2 presents the approach in the context of the analysis of the distributional implications of trade from an expenditure perspective. Section 3 provides an overview of the micro data on household expenditure and Section 4 an overview of the OECD METRO model.

Section 5 is the core of the paper as it presents the mapping of the consumption classification from the household budget surveys, i.e. COICOP, with the classification from the METRO model, i.e. GTAP. Section 5 delivers an example of the proposed analysis to assess the distributional effects of trade from an expenditure perspective, based on a stylised trade scenario applied to France and Spain.

2. A conversion framework for analysing the distributional consequences of trade policies on consumers

The approach develops a novel framework linking consumption expenditure data based on household budget surveys with the OECD METRO model. This allows for examination of the impact of a wide range of trade policy scenarios on household consumption. The exposure of different income groups to trade-driven changes in the relative prices of consumption items is analysed in the following four steps:

Analysing household budget surveys to assess the structure of consumption expenditure across the distribution of household income, i.e. the share of consumption expenditure allocated to detailed categories of goods and services, by income groups (e.g. quintiles, deciles). This requires working on country-specific household budget survey data and addressing the issue of cross-country differences in the classification of consumption items (see below).

Mapping the classification of individual consumption by purpose from the household budget surveys (COICOP in the case of EU countries) with the GTAP classification of commodities used in the METRO trade model. The mapping requires building a concordance and a transition matrix.

Simulating a range of trade policy scenarios using the METRO model, e.g. changes in import tariff and non-tariff measures in given sectors and trading partners on the relative prices of goods and services consumed by households, taking into account the different inter-linkages that connect economic activity within and across countries, e.g. input-output linkages and global value chains (GVC).

Based on the mapping between the classification of commodities from the trade model and that from household expenditure data), assessing the exposure of different income groups to trade-driven changes in relative prices, depending on their consumption structure.

This approach does not take into account that households may adjust their consumption bundle in response to price and income changes. It thus focuses on household exposure, and does not capture final welfare effects.

3. Survey data on household expenditure

The analysis draws on the European Household Budget Surveys (HBS). HBS are national surveys focusing on household consumption expenditure on goods and services. The data are provided by Eurostat and harmonised across European countries. The expenditure categories in HBS are classified according to the COICOP (United Nations, 2018[10]). This classification divides consumption goods and services into categories, with a hierarchical structure. The structure has twelve main categories at the most aggregate level (Level 1), which are then subdivided into fifty categories (Level 2) and further to more disaggregated classifications (Levels 3 to 5). The COICOP classification is the standard international classification and is the benchmark for the mapping exercise. Table 1 describes the main COICOP categories and subcategories.

The rationale behind the conversion framework can directly be applied to non-European countries such as the US consumer expenditure survey (CEX), which uses a different classification of goods and services[1].In other cases like Chile and South Africa, countries' classifications are directly compatible with COICOP, which makes it easier to apply the framework developed here. The interpretation of the insights on the

[1] There are two options to address this issue: i) reclassify the data according to COICOP; or ii) map directly CEX categories with GTAP, hence having a specific US mapping.

distribution of consumption from household budget surveys needs in principle to factor in the distinction between actual consumption and consumption expenditure. Surveys measure expenditure, which is a subset of actual consumption as the provision of free or subsidised services by government as well as the consumption of an owned house (see OECD (2019[11]), Chapter 4, for a discussion) is not included. In practice, this issue is less of a concern here since the focus is on tradable goods and services.

4. The METRO model

The METRO model is a computable general equilibrium model (CGE) and is described in detail in OECD (2020[12]). In its basic version, model simulations represent medium-term shocks where production factors are mobile across different sectors of the economy, but there is no capital accumulation.

CGE models rely on a comprehensive specification of all economic activity within and between countries (and therefore the different inter-linkages that tie these together) and are suitable for examining the impact of a wide range of different trade shocks. The METRO model builds on the GLOBE model developed by McDonald and Thierfelder (2013[13]). The novelty and strength of the METRO model lies in the detailed trade structure and the differentiation of commodities by end use. Specifically, commodities and thus trade flows, are distinguished by end-use category, as those designed for intermediate use, for use by households, for government consumption, and as investment commodities. As a result, for the purpose of this project, the model will be used to simulate the effect of trade policy shocks on the prices of final commodities consumed by households.

The underlying framework of METRO consists of a series of individually specified economies interlinked through trade relationships. Like all CGE models, the price system in the model is linearly homogeneous, with a focus on relative, not absolute, price changes.

The database of the model relies on the GTAP database version 10 (Aguiar et al., 2019[14]) in combination with OECD Trade in Value Added data. Policy information combines tariff and tax information from GTAP with OECD estimates of non-tariff measures on goods (Cadot, Gourdon and van Tongeren, 2018[15]), services (Ferencz, 2019[16]), trade facilitation (OECD, 2018[17]) and export restricting measures[2]. The dataset contains 65 countries and regional aggregates, 65 commodities and 8 factors of production.

The model is rooted in microeconomic theory, with firms maximising profits and creating output from primary inputs (i.e. land, natural resources, labour and capital), which are combined using constant elasticity of substitution (CES) technology, and intermediate inputs in fixed shares (Leontief technology). Households are assumed to maximise a Stone-Geary utility function, which allows for the inclusion of a subsistence level of consumption. All commodity and activity taxes are expressed as ad valorem tax rates, and taxes are the only income source for the government.

For the purposes of this analysis, METRO has the advantage that it produces a considerable degree of detail on estimates of price changes at the commodity level in response to trade policy changes. An example of this detail can be seen from the equation defining the supply price of a commodity:

$$PQS_{c,u,r} = \frac{PD_{c,u,r} * QD_{c,u,r} + PM_{c,u,r} * QM_{c,u,r}}{QQ_{c,u,r}} \quad (1)$$

$PQS_{c,u,r}$ is the supply price of commodity c, in use category u, in region r. This is a volume weighted function of the domestic supply price PD, and the price of imports PM, of that commodity. The price of imports is itself a weighted average of import prices from different sources. For example, a tariff change would change the price of imports and thus the domestic supply price. For households, one of the use categories, this supply price plus taxes is the consumer price of household consumption of commodity c in region r. The price change can be traced back as being of domestic or imported origin and from which partner region.

[2] There are two useful OECD sources on export restricting measures: a database of export measures on raw materials, https://www.oecd.org/trade/topics/trade-in-raw-materials/; and a database on trade and domestic measures related to the four AMIS crops (wheat, maize, rice, and soybeans) as well as biofuels, http://statistics.amis-outlook.org/policy/index.html.

As a result of the breakdown by use categories, it can also be seen whether the price change is from a direct impact on the households or indirectly through a change in the price of intermediates.

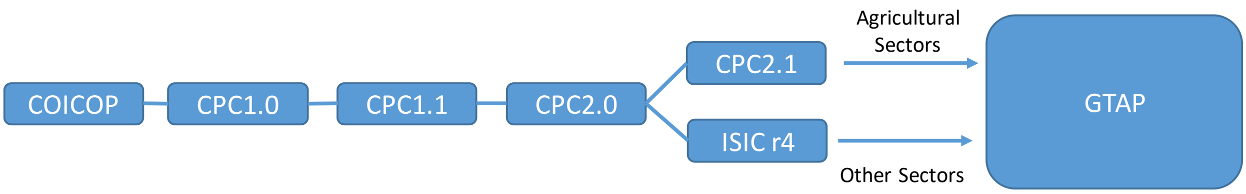
5. Mapping trade shocks to household budget data: The conversion framework

The objective of the conversion framework is to infer price changes expressed at the COICOP category level from price changes at the GTAP category level. The mapping between GTAP and COICOP refers to final goods and services that overlaps each pair of GTAP and COICOP categories. Thus, it is not an input-output nor a causal relationship. The METRO model and its simulations already take into account input-output linkages and deliver policy-driven changes in relative prices of items directly used by households. This is a major difference and value added of this paper relative to the recent literature, which has measured the expenditure channel by mapping final consumption goods to their import content.

The mapping framework proceeds in two steps (Figure 1). The first step is a cross-walk to establish a [0,1] concordance table between COICOP and GTAP classifications. The second step is a transition matrix to convert changes in the prices of GTAP categories to COICOP categories. The coefficients of this matrix measure the degree of overlap between any pairs of COICOP-GTAP items (Figure 1, Panel B). The rest of this section delivers a detailed description of these two steps.

Figure 1. Mapping consumption and trade data: A snapshot

Panel A: The crosswalk from COICOP to GTAP



Panel B: From the concordance to the transition matrix

GTAP CATEGORY	COICOP CATEGORY: Meat	Oils and fats	Household textile	Animal drawn vehicles
Cmt-Bovine meat prods	1	0	0	1
Oap- Animal products n.e.c.	1	0	1	1
Omt- Meat products n.e.c.	1	0	0	0

GTAP CATEGORY	COICOP CATEGORY: Meat	Oils and fats	Household textile	Animal drawn vehicles
Cmt-Bovine meat prods	a_{11}	0	0	a_{14}
Oap- Animal products n.e.c.	a_{21}	0	a_{23}	a_{24}
Omt- Meat products n.e.c.	a_{31}	0	0	0

Note: The Classification of Individual Consumption by Purpose (COICOP), the 1.0, 1.1, and 2.1 versions of the Central Product Classification (CPC 1.0, CPC 1.1, CPC 2.0 and CPC2.1), and the fourth revision of International Standard Industrial Classification of All Economic Activities (ISICr4) are provided by the United Nation Statistics Division. The third revision of Global Trade Analysis Project sector classification (GSCE3) which is the classification used in the GTAP database version 10 is published by the Centre of Global Trade Analysis in Purdue University's Department of Agricultural Economics.

5.1. The crosswalk from COICOP to GTAP

Concordance tables between the different versions of the CPC classifications and between COICOP as well as ISIC revision 4 make it possible to link the COIPCOP and the GTAP (Panel A of Figure 1). GTAP sectors under the GSCE3 classifications are defined using two sets of nomenclature: CPC version 2.1 for the agriculture sectors; and ISIC revision 4 for the remaining sectors (Aguiar et al., 2019[14]). Once a new cross-walk between COICOP and these two nomenclatures is created, the sector definitions can be used to classify the COICOP product codes into GTAP sectors.[3]

The first step is to match each four-digit product code in COICOP to at least one product code in the CPC 2.1 and ISIC revision 4 classifications using the appropriate concordance tables. The COICOP-CPC 1.0 concordance table is used as the starting point. This concordance table, along with the concordance tables between CPC 1.0 and CPC 1.1, can be linked together to create a new concordance table between COICOP and CPC 1.1 (Figure 2). The resulting cross-walk along with the concordance table between CPC 1.1 and CPC 2.0 can be linked together to create a concordance table between COICOP and CPC 2.0. The linking process is repeated with subsequent concordance tables until product codes in COICOP are linked to codes in the CPC 2.1 and ISIC revision 4 nomenclatures.

When linking two concordance tables together, product codes in each table are linked to the next concordance table using a full join with the common classification nomenclature as the matching variable. A full join is a many-to-many match, which maintains all products codes from each classification. As such, no products codes are lost when linking different classification systems or versions of the same system. For example, when creating a cross-walk between COCOIP and CPC 1.1, COICOP codes that could not be linked to CPC 1.1 are maintained. Similarly, CPC 1.1 codes that do not correspond to a COICOP code are also kept (Figure 2).

Figure 2. Creating a new concordance table

Concordance table
COICOP-CPC 1.0

COICOP	CPC1.1
01.1.1	23420
01.1.1	23430
01.1.1	23710
01.1.1	23720
01.1.1	23999
01.1.1	24320
01.1.2	02111
01.1.2	02112
01.2.4	99999

Concordance table
CPC 1.0 – CPC 1.1

CPC1.1	CPC2.0
23420	23420
23430	23430
23710	23710
23720	23721
23999	01930
24320	24320
02111	02111
02112	02122
02113	02130

New concordance table
COICOP – CPC 1.1

COICOP	CPC2.0
01.1.1	23420
01.1.1	23430
01.1.1	23710
01.1.1	23721
01.1.1	01930
01.1.1	24320
01.1.2	02111
01.1.2	02122
NA	02130
01.2.4	NA

Note: Illustrative example.

Once there is a cross-walk between COICOP and the nomenclatures used in the GTAP sector definition, the next step is to use the definitions found in Aguiar et al. (2019[14]) to classify the COICOP codes into the 65 GTAP sectors. Two different nomenclatures are used to define a sector. The Center for Global Trade Analysis, which coordinates GTAP, provides a concordance table between the CPC version 2.1 and GSCE3, which is used to classify the CPC 2.1 product codes into the 21 different food and agriculture sectors. Similarly, GTAP provides a concordance table between ISIC revision 4 and GSCE3, which is used to classify the ISIC revision 4 codes into the remaining manufacturing and services sectors.

[3] In the METRO model, a sector produces only one commodity.

Ultimately, the COICOP-GTAP link is of interest. As an intermediate step, the correspondence table is reduced to three columns: 1) COICOP product codes; 2) GTAP sectors defined by CPC 2.1 and 3) GTAP sectors defined by ISIC revision 2.1. Furthermore, the rows in the table are reduced so that table contains only unique combinations of the three columns.

In most cases, the definitions are mutually exclusive. The COICOP product code has either a sector classification based on the CPC 2.1 definition or one based on the ISIC revision 4 definition. In cases where a COICOP can be mapped to a sector using both definitions, the definition based on the CPC nomenclature is used since the CPC codes cover products while ISIC codes cover activity. There are only five unique COICOP codes where using CPC 2.1 and ISIC revision 4 definitions mapped to different GTAP sectors.

The final cross-walk table contains two columns: the COICOP four digit product codes and the GTAP sectors. The mapping between COICOP and GTAP is fairly complete. There are 117 unique COICOP codes at the four-digit level in the COICOP-CPC 1.0 concordance table and all are mapped to at least one GTAP sector. Fifty-nine of the 65 GTAP sectors can be mapped to at least one COICOP Code.

GTAP sectors that are not mapped to a COICOP category include: pfb (Fiber crops); wol (Raw animal materials used in textiles); oil (Extraction of crude petroleum); gas (Extraction of natural gas); i_s (Manufacture of basic iron and steel); dwe (Dwellings). Dwellings was not expected to be included in the final COICOP-GTAP cross-walk, since it does not have a CPC 2.1 or ISIC revision 4 definition in GTAP. The other sectors, pfb, wol, oil, gas and i_s, are matched to a CPC1.1 product code, however, the CPC code is not in the COICOP-CPC 1.0 concordance table. This is expected since only household consumption goods are included in the concordance table. With the exception of dwellings, the sectors without a COICOP match seem to be raw materials for intermediate inputs rather than household consumption.

Creating a cross walk between the four-digit COICOP product code to a GTAP sector involves mapping two nomenclatures at a fairly high level of aggregation. It is not surprising that many COICOP codes map too many GTAP sectors and vice versa. Sixty-eight per cent of the COICOP code is mapped to two or more GTAP sectors, and most GTAP sectors (79.7%) are mapped to more than one COICOP product. Because of the many-to-many mapping between COICOP and GTAP, a transition matrix is need to translate the sectoral price effects from the METRO to effects on commodities found in the household survey.

5.2. From the concordance to the transition matrix

This section introduces the transition matrix, which allocates price changes of GTAP sectors across COICOP categories. This allows inferring price changes of COICOP categories from policy-induced price changes of GTAP categories.

As illustrated in Panel B of Figure 1, the transition matrix has the same dimension as the concordance table. The values in the cells of this matrix range between 0 and 1. A value of 0 refers to no mapping between a given pair of GTAP-COICOP items, while 1 refers to a one-to-one or many-to-one mapping. Hence, the former implies that changes in the price of a GTAP item will have no impact on COICOP items, while the latter implies that changes in the price of a GTAP item will be translated into changes in the price of a COICOP item.

Price change translation is made difficult by the many-to-many (m:n) nature of the concordance. To understand why, it is useful to recall that both the GTAP and COICOP classifications refer to final consumption items. Put differently, in the final goods space Ω, each good ω_i belongs to both a GTAP category and a COICOP category. The METRO model provides information on the average price change in goods $\omega_1, \omega_2, \dots, \omega_n$ in some GTAP category: $\frac{1}{n}\sum_i P(\omega_i)$, where $P(.)$ indicates the price of a consumption item. However, the METRO model does not allow to infer the price changes of each ω_i. As a result, it is not possible to infer with certainty the exact price change in terms of COICOP categories. Assumptions will be made in order to break down the price changes of the GTAP category and obtain estimates for the price change in the relevant COICOP category.

A snapshot of the m:n concordance is displayed in Table 1. It shows that the two GTAP sectors, Bovine meat products and Animal products, are both mapped to two COICOP categories, i.e. Meat and Animal drawn vehicles.

Table 1. Concordance table snapshot: The m:n relationship

GTAP	COICOP	
	Meat	Animal-drawn vehicles
Bovine meat products	1	1
Animal products	1	1
Meat products	1	0

The extent to which the price of Animal drawn vehicles responds to a change in Bovine meat price is a priori unknown. As Bovine meat and Animal products are both mapped to Animal drawn (AD) vehicles, the relationship among the three elements can be expressed as follows:

$$dP(A.D\ vehicles) = \alpha\ dP(Bovine\ meat \cap A.D.vehicles) + (1-\alpha)dP(Animal\ prods \cap A.D.vehicles) \quad (2)$$

where α captures the importance of Bovine meat relative to Animal products in the consumption of A.D. vehicles; $dP(Bovine\ meat\ \cap A.D.vehicles)$ refers to the average price change of goods that belong to both the "Bovine meat" GTAP category and the "A.D. vehicles" COICOP category. Price changes of bovine meat products, i.e. $dP(Bovine\ meat)$, and animal prods goods, $dP(Animal\ prods)$, are outputs of METRO model simulations. However, price changes of corresponding COICOP categories, i.e. $dP(Bovine\ meat \cap A.D.vehicles)$ and $dP(Animal\ prods \cap A.D\ vehicles)$, are undetermined. Solving this conceptual problem requires posing some assumptions.

Assumption 1: Homogeneity

Price changes in GTAP categories are homogeneous: the price change of any good ω_i within a GTAP category is equal to the price change of goods in this category, i.e.

$$dP(\omega_i) = dP(GTAP_i)$$

The homogeneity assumption allows to derive the price change of goods at the intersection of a GTAP and a COICOP category from the price change of goods in a GTAP category:

$$dP(GTAP_i \cap COICOP_j) = dP(GTAP_i) \quad (3)$$

Assumption 2: Proportionality

The *relative* share of a GTAP category within an overlapping COICOP category is proportional to the share of this GTAP in total consumption. It follows that

$$d\,P\left(COICOP_j\right) = \frac{consumption(GTAP_i)}{\sum_k consumption\ (GTAP_k)} d\,P\left(GTAP_i \cap COICOP_j\right) = \alpha_i d\,P(GTAP_i \cap COICOP_j)$$

where α_i is the relative weight associated with the GTAP item i; $consumption(GTAP_i)$ refers to the household consumption in term of GTAP item i; and $\sum_k consumption\ (GTAP_k)$ refers to the total demand of all GTAP items *that overlap the same* $COICOP_j$ *category*.

Under assumption 1, the price change of a GTAP category is translated into the intersection of that GTAP category with a COICOP category. Assumption 2 allows to map the price change of the intersection of the GTAP and COICOP categories to the price change of the COICOP category:

$$d\,P(COICOP_j) = \frac{consumption(GTAP_i)}{\sum_k consumption\,(GTAP_k)} d\,P(GTAP_i) = \alpha_i d\,P(GTAP_i) \quad (4)$$

below illustrates an example of the transition matrix. Data on total household expenditure on commodities, classified in terms of GTAP items, is obtained from the GTAP database. The coefficients in the table can be interpreted as follows: α_{12} implies that a change in the price of GTAP category Bovine meat products by 1% will translate into a change in the price of COICOP category Animal drawn vehicles by α_{12}%. Meanwhile, a 1% change in the price of Animal products will drive the price of the same COICOP category, Animal drawn vehicles, by $(1 - \alpha_{12})$%. By construction, each column of this matrix sums up to 1.

In short, the mapping framework allows for the evaluation of the direct impacts of trade policy-driven changes on household welfare through prices of consumer goods and services. It is a two-step process, involving first a correspondence table between COICOP and GTAP classifications, and then a transition matrix that translates the price changes expressed in GTAP items to price changes of COICOP categories. In the construction of the transition matrix, two assumptions have been made: (1) the homogeneity in the prices of GTAP items and (2) the proportionality in price of a GTAP item within a COICOP category. Based on these assumptions, the average price change in each COICOP category can be estimated. While these assumptions are essential, their limitations and caveats are recognized and discussed in the following section.

Table 2. Transition matrix snapshot: The m:n relationship

GTAP	COICOP	
	Meat	Animal-drawn vehicles
Bovine meat products	α_{11}	α_{12}
Animal products	α_{21}	$1 - \alpha_{12}$
Meat products	$1 - (\alpha_{11} + \alpha_{21})$	0

Source: OECD and GTAP.

5.3. Limitations and caveats of the mapping exercise

Assumptions 1 and 2 may introduce possible sources of bias. For example, price shocks may not be homogeneous within GTAP categories (assumption 1) and the conversion may over- or under-estimate the impact on the price COICOP categories. These assumptions are the weakest possible assumptions to address in a context where the number of unknowns is larger than the number of equations. The conversion framework thus provides an educated guess to a problem that is undetermined in nature.

Another limitation is that the quality of goods is not taken into account. Bias can also arise from quality heterogeneity. It might be true that the bovine meat that is used for food has a different quality in comparison with the one used for Animal drawn vehicles. Therefore, their prices will likely depend on their quality. Addressing this issue would require data at a much higher level of granularity. Barcode level data or the brand level for cars have been used in recent studies (Hottman and Monarch, 2018[7]; Borusyak and Jaravel, 2017[18]; Levell, O'Connell and Smith, 2017[19]), but for selected items and on a single country scale. Although these data enables linking expenditure microdata to a much finer level of trade products, it cannot be applicable for the cross-country comparative analysis due to data availability.

6. Applying the mapping framework to the analysis of the distributional implications of trade from an expenditure perspective: An illustrative example

The mapping framework is applied to investigate the distributional implications of trade from an expenditure perspective. This section outlines the approach and delivers some illustrative results based on stylised scenarios of trade policy-driven changes in consumer prices.

6.1. Assessing the exposure of different socioeconomic groups to trade-driven changes in consumer prices

Household exposure to trade-driven changes in consumer prices is expressed in terms of change in purchasing power based on the compensating variation approach (Deaton and Muellbauer, 1980[20]). The compensating variation (CV) measures how much expenses need to be increased (decreased) when consumer prices rise (fall) so that the utility level remains the same before the price increase (decrease). For household i, the CV is measured relative to total household expenditure (C_i) or to total income (Y_i), under the expenditure and income-based approach, respectively. This is a measure of the change in household purchasing power resulting from trade-driven changes in consumer prices. It decomposes the change in the price into the price change due to trade ($\frac{dp_k}{p_k}$) weighted by the share of expenditure or income that is spent on those items (sc_k^i or sy_k^i):

$$\text{Expenditure approach: } \frac{CV_i}{C_i} = \frac{\sum_k q_k^i p_k * dp_k/p_k}{C_i} = \sum_k sc_k^i * \frac{dp_k}{p_k} \tag{5}$$

$$\text{Income approach: } \frac{CV_i}{Y_i} = \frac{\sum_k q_k^i p_k * dp_k/p_k}{Y_i} = \sum_k sy_k^i * \frac{dp_k}{p_k} \tag{6}$$

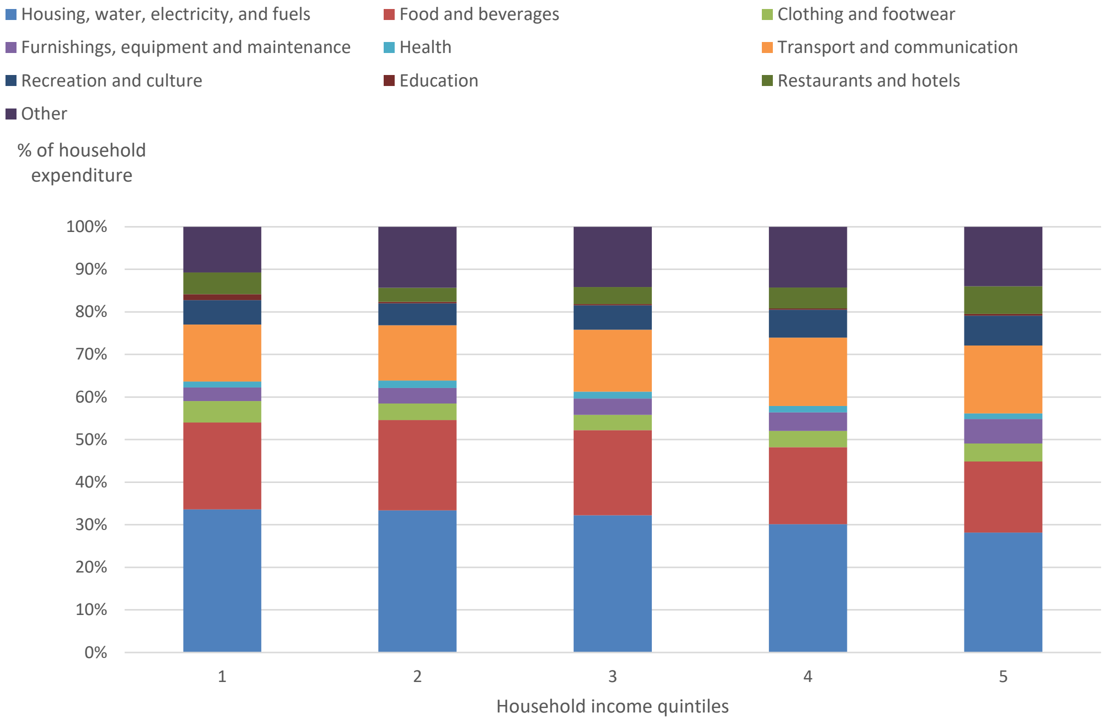
The change in purchasing power resulting from trade-driven changes in consumer prices can be computed for the average household and by income quintile or decile to assess the distributional effect of trade policy shocks. This framework has been used in a number of papers on the distributional effects of trade from an expenditure perspective and recently in the OECD country reviews of Argentina (OECD, 2019[21]) and India (OECD, 2019[22]). The distributional analysis can be applied to other socioeconomic groups defined, for example, by demographic characteristics (e.g. age, size of household), education and urbanisation of the area of residence, depending on availability in household surveys.

Income and expenditure-based approaches can be considered as complementary. The income-based approach may be of interest in analysing the immediate distributional effects of trade-driven changes in consumer prices, while the expenditure-based approach may provide a measure of the long-term or lifetime distributional effects. They have for instance been used jointly to assess the distributional effects of consumption taxes (OECD/KIPF, 2014[23]).

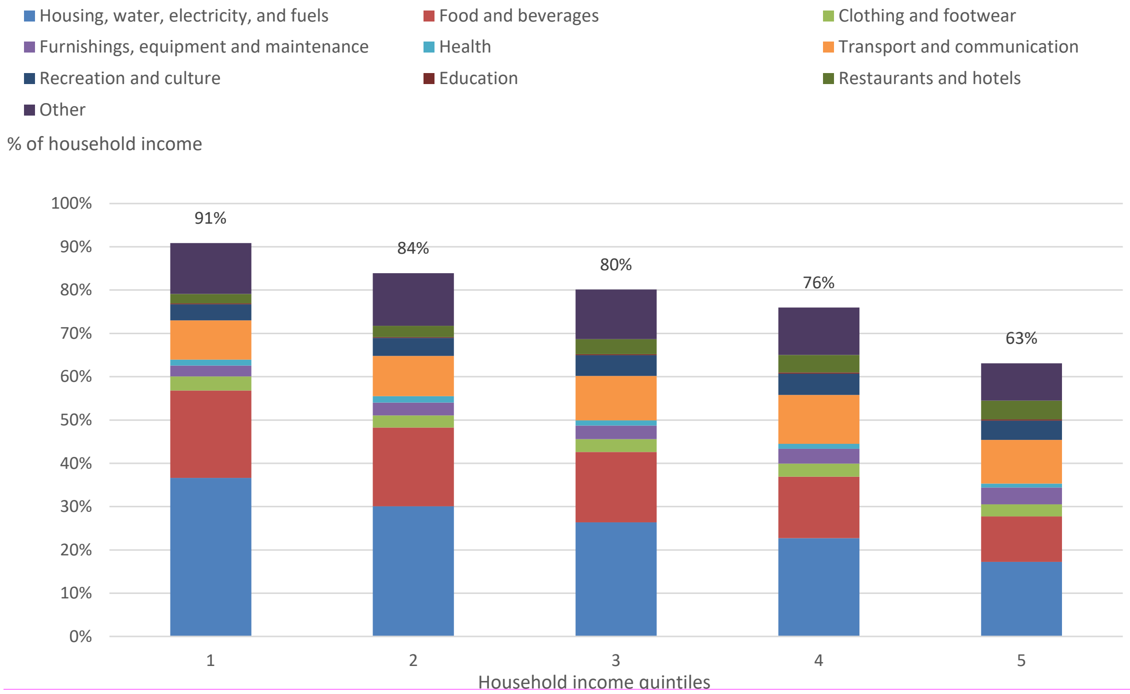
Expenditure shares by COICOP category are derived from the household expenditure microdata. As an illustration, Figure 3 and Figure 4 report expenditure shares by income quintiles for France and Spain. The differences in the structure of expenditure across income groups are small. For most households, a large part of household expenditure is allocated to non-tradable items, in particular housing, which represents in around a third of total expenditure on average, reaching almost 40% at the bottom of the distribution in Spain (Figure 4, Panel A). Distributional differences are significant when expenditure is expressed relative to income, due to the increasing propensity to save with income. In France, households in the bottom quintile spend around 91% of their income, while households in the top quintile spend around 63% of their income (Figure 3 Panel B). A similar spending pattern is also present, though less pronounced, in Spain (Figure 4 Panel B). Given the role of household savings for expenditure patterns, income and expenditure-based approaches are likely to deliver different distributional effects of changes in consumer prices.

Figure 3. Expenditure shares by income quintiles: France

Panel A. Expenditure per category as a share of total expenditure, by equivalised household income quintiles



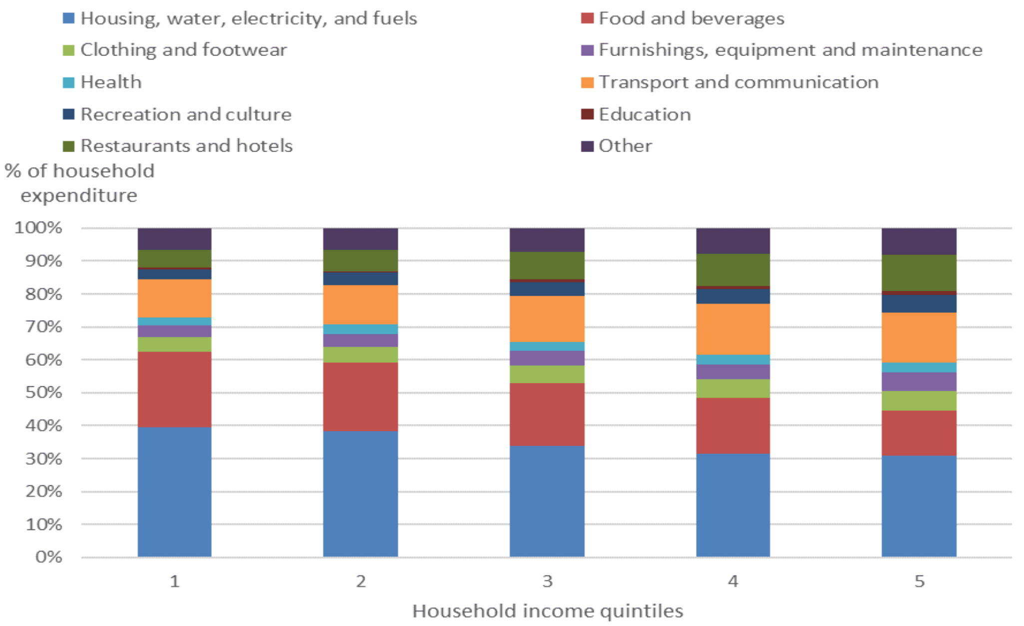
Panel B. Expenditure per category as a share of total income, by equivalised household income quintiles



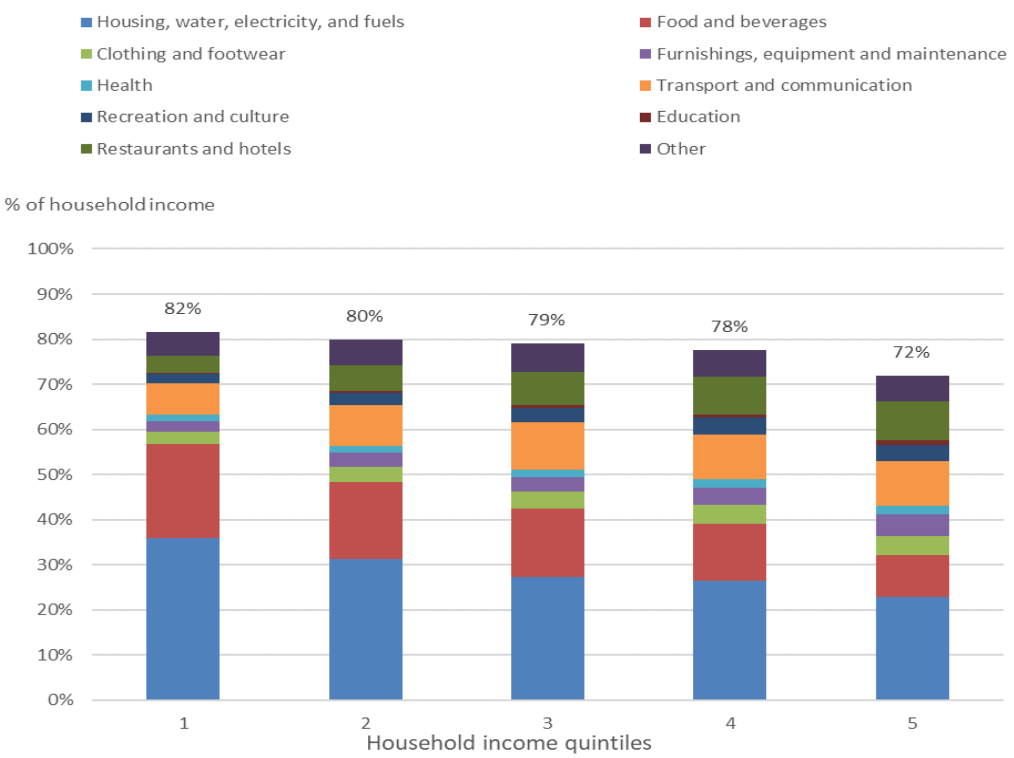
Note: OECD calculations based on HBS data.
Source: HBS data for France, 2010.

Figure 4. Expenditure shares by income quintiles: Spain

Panel A. Expenditure per category as a share of total expenditure, by equivalised household income quintiles



Panel B. Expenditure per category as a share of total income, by equivalised household income quintiles



Note: OECD calculations based on HBS data.
Source: HBS data for Spain, 2010.

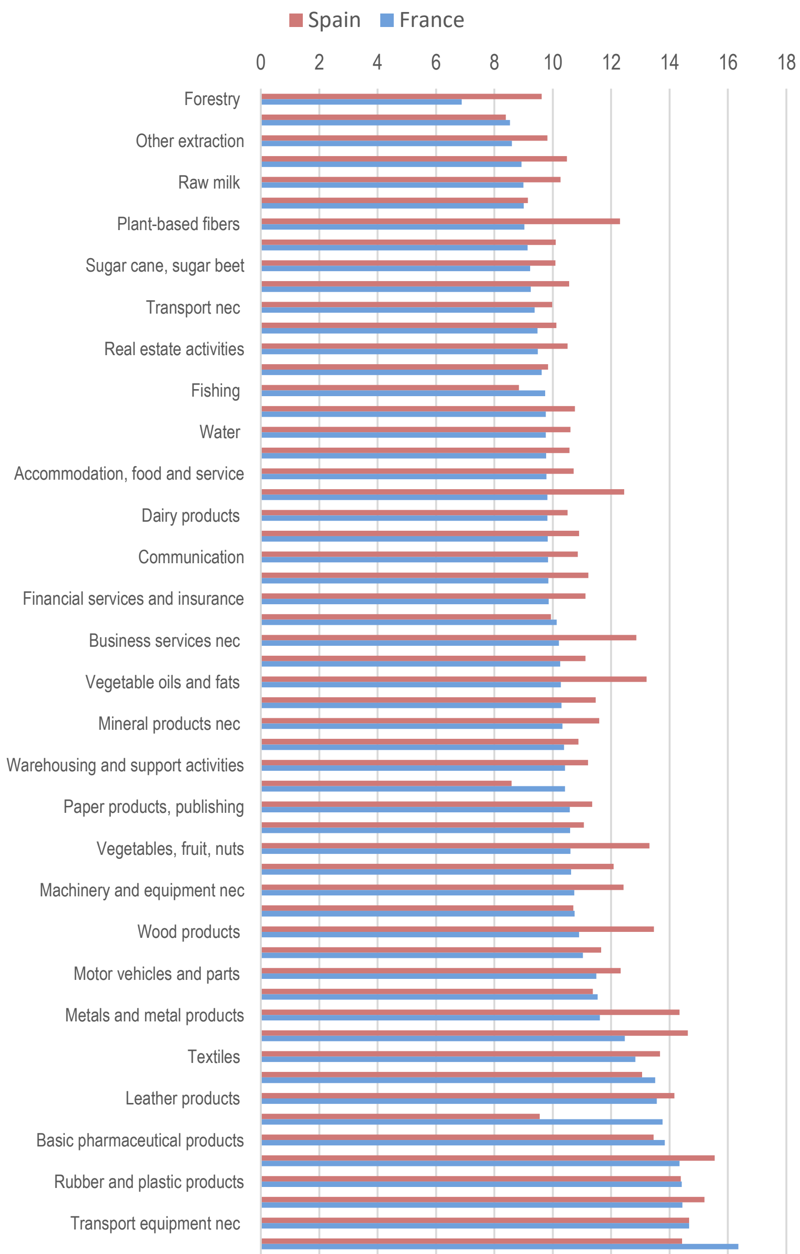
6.2. A stylised trade scenario applied to French and Spanish consumers

The trade simulation scenario is run with the OECD METRO model. In this stylised setting, world trade is aggregated into five economies: The People's Republic of China, the EU27 (the European Union as of September 2019, minus France or minus Spain), France (Spain), the United States and the rest of the world. The effects of the EU imposing a 25% tariff on all imports except oil and gas from non-EU sources is then simulated and the effects on French (Spanish) consumer prices are extracted. In this scenario, France (Spain) can partially substitute non-EU imports with imports from the European Union and local production. Nevertheless, this shock results in marked changes in consumer prices across sectors. Price increases over 11% are experienced in 30 sectors in France and in 15 sectors in Spain (Figure 5).

The change in household purchasing power following the imposition of the tariff is computed both on an expenditure and on an income-based approach. The results of this exercise are presented in Figure 6 for France and Figure 7 for Spain. They can be summarised as follows:

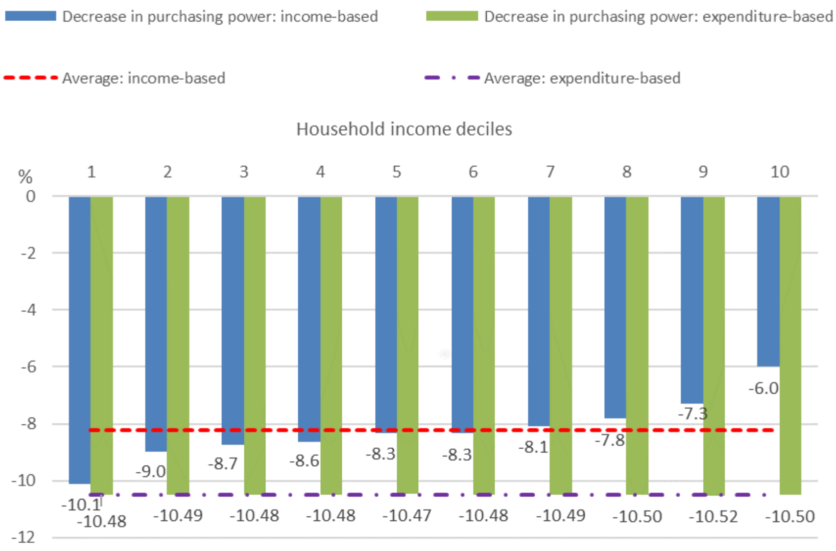
- Imposing a 25% tariff on all imports except oil and gas from non-EU sources would, on average, generate a loss of 10.5% (11.4%) in household purchasing power on an expenditure basis and of 8.2% (8.8%) on an income basis in France (Spain).
- These purchasing power effects are distributionally neutral on an expenditure basis, as all income groups experience the same loss. By contrast, they are regressive when measured on the basis of income. Low income households tend to experience larger losses when prices rise because they have a higher propensity to consume out of income – or, in other words, they save less of their income than rich households. For instance, in France, the loss is 10% in the first income decile and around 6% in the last income decile, so about 1.7 times higher for low-income households. In Spain, households in the bottom income decile suffer a loss of 9.2%, which is around 1.2 times higher than that of households in the top income decile (7.8%).
- The reason behind the distributional neutral result in the case of the expenditure-based approach is that the structure of household expenditure is similar across income groups (Figure 5 and Figure 6 Panel A) for the available degree of disaggregation and the range of consumer products affected by trade shocks. The finding of regressive effects in the case of the income-based approach is due to the fact that lower-income households have a higher propensity to consume out of their income (Figure 5 and Figure 6 Panel B) and limited consumption smoothing possibilities make them more exposed to price changes. This is consistent with recent OECD work on the distributional effects of changes in consumption taxes, which also found neutral effects on an expenditure basis and regressive effects on an income basis (OECD/KIPF, 2014[23]).

Figure 5. Change in consumer prices in France and Spain after imposing a 25% tariff on all imports except oil and gas from non-EU sources (%)



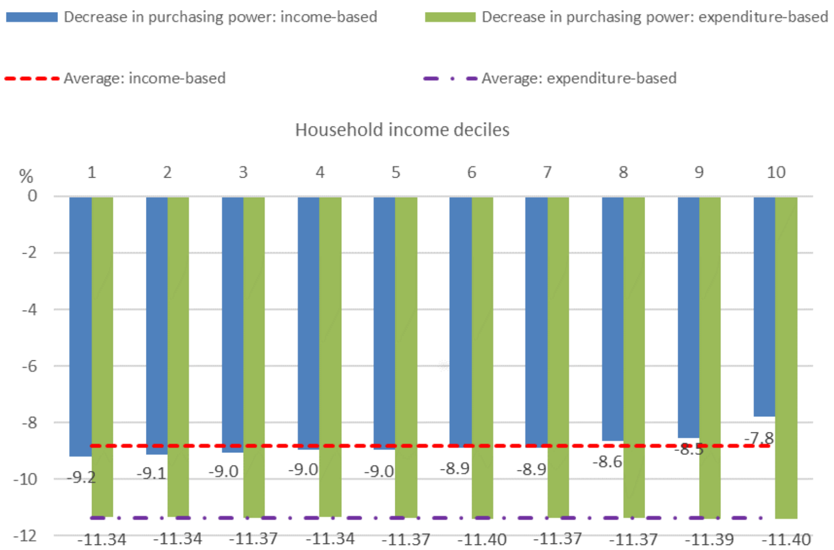
Note: This figure shows the per cent change in consumer prices in France and Spain associated with an increase in tariffs on all imports except oil and gas to 25% by the EU on non-EU sources. The relative price changes produced by the METRO model have been converted to absolute price using the exchange rate appreciation. As with most CGE models, METRO produces price changes relative to each country's numeraire, the consumer price index (CPI). With CPI fixed and normalized to one in each region, the exchange rate in the model captures the price adjustment needed in domestic relative prices to balance the external accounts. The conversion preserves the price ratios of the domestic system and maps it into international purchasing power.
Source: OECD METRO model.

Figure 6. Change in household purchasing power in France after imposing a 25% tariff on all imports except oil and gas from non-EU sources



Note: This figure shows the change in French households' purchasing power, both expenditure and income-based (according to equation (1) and (2) presented in Section 3.6) after imposing a 25% tariff on all imports except oil and gas from non-EU sources. The change in purchasing power is computed for each household and on average per equivalised household disposable income decile. The simulations are run with the OECD METRO model and applied to household expenditure microdata.
Source: OECD METRO model and 2010 HBS data for France.

Figure 7. Change in household purchasing power in Spain after imposing a 25% tariff on all imports except oil and gas from non-EU sources



Note: This figure shows the change in Spanish households' purchasing power, both expenditure and income-based (according to equation (1) and (2) presented in section 3.6) after imposing a 25% tariff on all imports except oil and gas from non-EU sources. The change in purchasing power is computed for each household and on average per equivalised household disposable income decile. The simulations are run with the OECD METRO model and applied to household expenditure microdata.
Source: OECD METRO model and 2010 HBS data for Spain.

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