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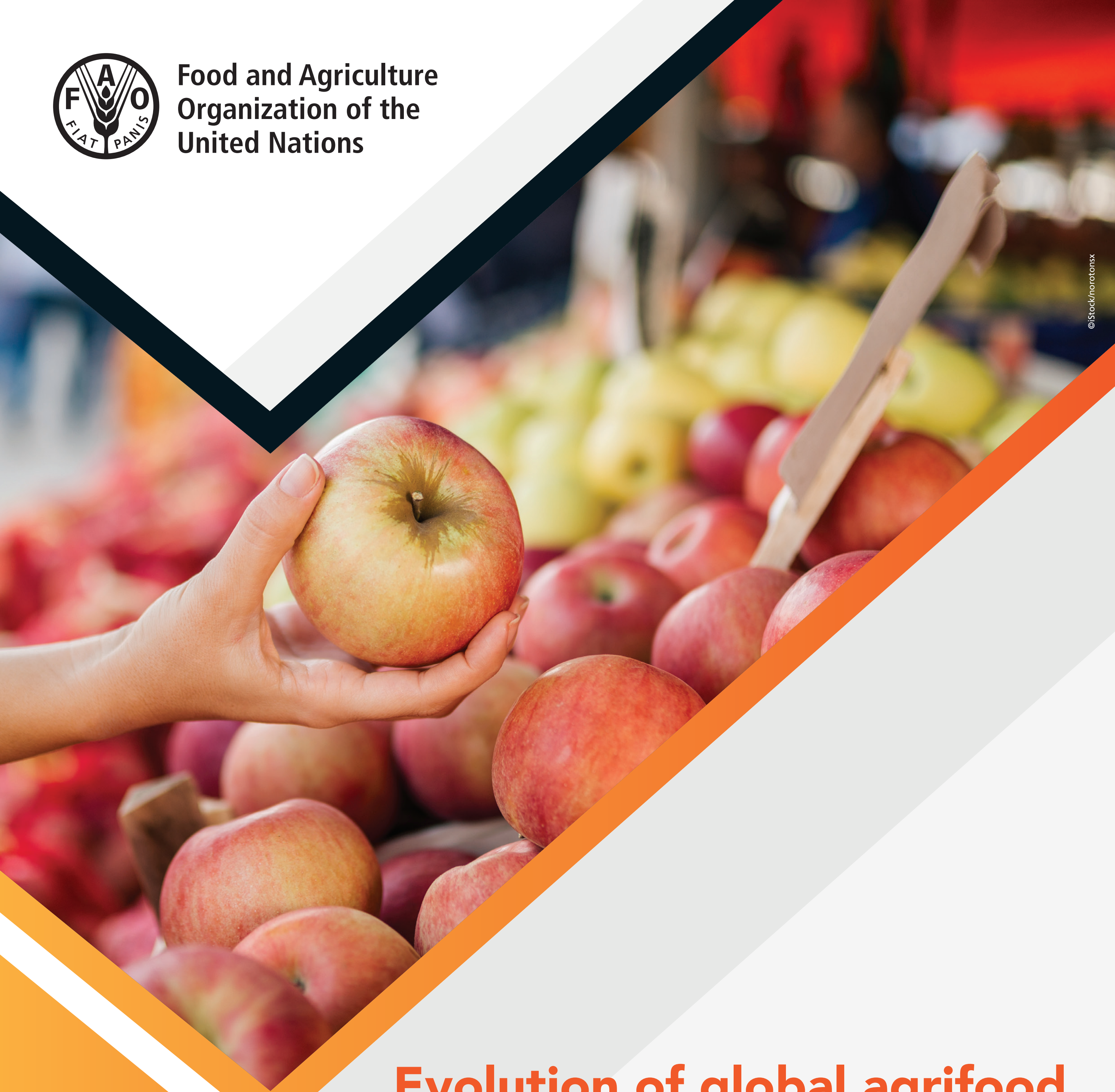

Evolution of global agrifood trade and trade policy and implications for nutrition

Evolution of global agrifood trade and trade policy and implications for nutrition

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Food and Agriculture Organization of the United Nations
Rome, 2025

Required citation:

Abay, K., Rauschendorfer, J. & Solórzano López, J. D. 2025. *Evolution of global agrifood trade and trade policy and implications for nutrition.* Rome, FAO. https://doi.org/10.4060/cd4217en

ISBN 978-92-5-139598-1

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Acknowledgements

This study was prepared by Kibrom Abay, Senior Research Fellow in the International Food Policy Research Institute (IFPRI), Jakob Rauschendorfer, PhD candidate at the Institut d'études politiques de Paris (Sciences Po), and José David Solórzano López, Economist, PhD candidate at Roma Tre University. The report was prepared with inputs and guidance from George Rapsomanikis, Senior Economist, EST, FAO.

The authors are grateful to Iryna Kobuta, Economist, EST, and Andrea Zimmerman, Economist, EST, for their comprehensive review and comments. The authors are also thankful to Derek Headey, Senior Research Fellow, IFPRI, for sharing data used in this report.

The authors thank the Federal Office for Agriculture of Switzerland (FOAG) for contributing financially to the production of this report. The authors also thank Dominique Burgeon, Director of the FAO Liaison Office in Geneva, Pinar Karakaya, Economist of the FAO Liaison Office in Geneva for coordinating with the donor, as well as Ekaterina Krivonos, Chief of the FAO Latin America and the Caribbean Service (CFIF), for overall support and guidance in the initial stage of the study.

The authors are also grateful to Jonathan Hallo and Ettore Vecchione for the design of the report, to Araceli Cardenas for production support, and to Evelyne van Heck for publishing coordination support.

Finally, the authors thank Boubaker Ben-Belhassen, Director of EST, FAO, for his overall guidance and support.

Abbreviations

ADER	average dietary energy requirement
AGOA	African Growth and Opportunity Act
AVE	ad valorem equivalent
BACI	Database for International Trade Analysis at the product-level
CEPII	Centre for Prospective Studies and International Information
CPC	UN's Central Product Classification
EBA	Everything But Arms
FAO	Food and Agriculture Organization of the United Nations
FAOAG	Swiss Federal Office for Agriculture of Switzerland
FBS	food balance sheets
GSP	generalised scheme of preferences
HHI	Herfindahl-Hirschman Index
HS	harmonized system
ICP	International Comparison Programme
IDR	import dependency ratio
IFAD	International Fund for Agricultural Development
HIS	Inverse hyperbolic sine transformation
MFN	most favoured nation
NENA	Near East and North Africa
NTM	non-tariff measures
OECD	Organisation for Economic Co-operation and Development
RCP	relative caloric prices
SDG	Sustainable Development Goal
SuA	supply utilization accounts
SWAC	Sahel and West Africa Club
TRAINS	Trade Analysis Information System
UNCTAD	United Nations Conference on Trade and Development
UN COMTRADE	United Nations Commodity Trade Statistics Database
UNICEF	United Nations Children's Fund
WFP	World Food Programme
WHO	World Health Organization
WITS	World Bank's World Integrated Trade Solution
WTO	World Trade Organization

Executive summary

Malnutrition and global agrifood trade: parallel developments. Following decades of decreasing hunger and food insecurity, since 2017 the global prevalence of undernourishment has again been on the rise. In 2021, almost one in ten people worldwide were suffering from hunger. Recent estimates suggest that over 3 billion people cannot afford a healthy diet, and micro-nutrient deficiencies remain an important health concern in many countries.

At the same time, the global prevalence of obesity has now reached epidemic dimensions. Around 2 billion people were obese or overweight in 2016, with obesity causing an estimated 3.7 million deaths in 2021. Additionally, instances of excessive weight and obesity are now widespread in countries with lower income levels, with around 70 percent of those affected living in low- or middle-income countries. Overall, and with only seven years remaining to achieve Sustainable Development Goal (SDG) 2 to end hunger, food insecurity and all forms of malnutrition, the global community is lagging behind in achieving this target. Simultaneously, global agrifood trade has expanded rapidly over the past decades, increasing around threefold between 1995 and 2020 and with more low- and middle-income countries participating in global agrifood trade and value chains. Motivated by the enormous human and economic cost of malnutrition in countries all over the globe, these parallel developments have fuelled public policy discourse and interest in understanding the role of trade in food security and nutrition, as well as potential policy options to leverage trade for improved nutrition. This report contributes to this critical debate by addressing the following important questions.

How does trade matter for nutrition? The first part of this report examines the evolution of global agrifood trade over the past two decades from a nutritional angle. Employing a newly developed dataset, this section considers developments at the global level and specific to the countries comprising the Near East and North Africa (NENA), a region characterized by high food import dependence, considerable food insecurity and hunger, and high rates of overweight and obesity. The first section shows that agrifood trade is a critical source of caloric and nutrient supply for many countries and that a small number of suppliers account for the bulk of globally traded calories, macro-nutrients, and vitamins and minerals. Combined, these findings show that calorie and nutrient availabilities across countries are shaped considerably by international trade and the documented concentration patterns reinforce calls to diversify global food markets and trade.

Subsequently shifting to a temporal perspective, the analysis then goes on to show that over the past two decades, many countries increased the diversity of their domestic food supply, with trade likely having played a significant role in this transition. While dietary diversity is generally desirable from a nutritional perspective, the analysis also shows that many countries have increased their imports of foods high in sugar, salt, or fats/oils over the last 20 years. Fewer countries expanded the domestic availability of nutritious foods like fruits, vegetables, or pulses through imports. The analysis also highlights important differences between changes in food supply and imports at the global level *vis-à-vis* the NENA region. While the latter experienced large increases in the role that wheat, sugar and fats/oils play in aggregate food supply and imports over the last 20 years, these patterns are less pronounced at a global level where the analysis also suggests a diminishing role of wheat. Finally, the analysis also shows that smaller countries (especially island states) import a larger share of their food imports in the form of items high in sugar, salt or fats/oils. This is likely explained by limited production and processing capacities and/or a lack of the agricultural endowments that are necessary to produce a range of food items, thereby stimulating import demand for more durable and hence more processed items.

How does trade policy affect consumer incentives for foods with different nutritional content and characteristics? The second part of the report considers what role (if any) trade policy could play in shaping nutritional outcomes across countries. Specifically, the analysis explores how import tariffs – as one trade policy instrument employed by virtually all countries around the world – affect the relative prices of different food groups and hence consumer price incentives for items with different nutritional content (e.g. nutritious fruits and vegetables versus foods high in sugar, salt and fats/oils).

The most important result from this statistical analysis is that import tariffs only have a relatively modest effect on the relative retail prices of different foods. To illustrate, doubling import tariffs on a specific food group (i.e. a 100 percent increase) would at most result in an increase of the relative price of the targeted food group by four to five percent, on average. This analysis also highlights that demand for different food groups reacts differently to tariff increases. For example, the results show that a 100 percent increase in import tariffs on animal foods would have negligible implications for the (relative) prices of these foods. If applied to fruit and vegetable foods, the same change would increase the relative retail price of these items by around seven percent.

Policy considerations and opportunities for further research. Taken together, the findings presented in this report suggest that while international trade itself is critically relevant for food security, nutrition and diet-related outcomes, import tariffs should be taken as one policy instrument with limited or modest potential to shift consumer behaviour towards more nutritious foods or to disincentivize the consumption of foods high in sugar, salt or fats/oil. This is not surprising against the background that many countries have several alternative domestic policies that can weaken or distort the effect of import tariffs (including food and agricultural input subsidies). Overall, the modest impacts established in the second part of this study suggest that opting for other or additional domestic and trade policy instruments would be necessary to improve nutritional outcomes. Policy options that should be subject to increased scrutiny by researchers and practitioners in the future include non-tariff trade policy (e.g. non-tariff measures or agricultural trade costs) as well as domestic policies such as food subsidies and food taxes that encourage or disincentivize the consumption of any given food, regardless of its origin.

Introduction

Following decades of progress, since 2017 the global prevalence of undernourishment has again been on the rise, affecting an estimated affecting an estimated 9.1 percent of the global population in 2023 (FAO, IFAD, UNICEF, WFP and WHO, 2024). While overall in decline, micro-nutrient deficiencies remain an important health concern in many countries.[1] At the same time, the global prevalence of obesity has now reached epidemic dimensions. According to WHO (2024), 2.5 billion adults (aged 18 years and above) were obese or overweight., with overweight among individuals aged 20 years and older causing an estimated 3.7 million deaths in 2021 (Zhou *et al.*, 2024). Altogether, the world is not on track to reach most of the SDG2 nutrition targets by 2030, including ending hunger. In parallel to these developments, global agrifood trade has expanded rapidly – the value of global trade in food and agricultural products increased more than three-fold between 1995 and 2020, with increased participation of low- and middle-income countries (FAO, 2022a). Given these developments and the enormous human cost of malnutrition, an area of key interest to policymakers around the world is how nutrition and trade are linked and what role trade policy could play in enabling healthy diets for better nutritional and health outcomes. This report contributes to this debate in two steps.

First, Chapter 1 adopts a global view on two decades of agrifood trade to present a description of the evolution of agrifood trade and how trade is linked to food security and nutrition across countries. Chapter 2 offers new econometric evidence on how trade policy matters for nutrition. Specifically, this part explores how import tariffs – as one trade policy used by virtually all countries – shape price incentives for consumers to buy foods with different nutritional values (e.g. fruit versus sugar-rich snacks).

To explore these issues, the analysis relies on a newly constructed database that combines several datasets in different domains. In Chapter 1, newly generated conversion factors on the edible portion, as well as the caloric and nutrient content of different foods, were applied to FAOSTAT data on trade, production and food supply for more than 400 food items, in 190 countries and for two decades (2000–2020). By expressing information on trade and production in energy and nutrient terms, these data allow a study of global trade through a nutritional lens.[2] In Chapter 2, the analysis of the links between import tariffs and consumer prices, relies on data on retail prices for more than 600 food items in more than 170 economies. These are combined with data from Chapter 1, as well as data on countries' item-level import tariffs. A comprehensive description

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1 For example, a meta-analysis of 28 studies estimated the global pooled prevalence of anaemia and iron deficiency among children below the age of five as in excess of 16 percent (Gedfie, Getawa and Melku, 2022).

2 Specifically, expressing trade and production data in caloric terms allows for seamless cross-country and cross-item comparison. For example, one kilogram of "potato" and one kilogram of "wheat" have very different nutritional characteristics. A few critical limitations of the global data on agrifood trade and production used in this report are as follows. First, the data do not capture country-specific heterogeneity regarding the nutritional characteristics of items. For example, "yoghurt, with additives" may differ considerably across countries regarding its fat content but in the data these content factors are provided as globally representative. Second, for results relying on grouping individual items into broader food categories it is important to highlight that such classifications are not definite. For example, there are no clear guidelines on whether groups like "fruits" or "vegetables", should also include items which have been preserved in various ways. Finally, mapping data on retail prices to data on trade, tariffs and production poses some statistical and conceptual challenges which are discussed in Annex I.

of the dataset and how it was constructed is provided in Annex I. Throughout the report, findings are often presented with reference to the NENA region, a set of countries that are not only dependent on food imports but also have high prevalence of overweight and obesity.

To reiterate the key results, findings from Chapter 1 suggest that trade is not only an important source of calories across countries but also matters for the supply of various nutrients and different food groups. There are additional key messages around the evolution of agrifood trade. A critical insight from Chapter 2 is that while import tariffs do have an effect on the relative prices of different foods (and may particularly matter for nutritious foods), estimated effects are modest. On average, doubling the import tariff on a food group is found to be associated with a mere five to six percent increase in its retail price, relative to a comparison group of staple foods that account for the majority of energy intake worldwide (e.g. wheat, rice, cassava, potatoes and yams). Combined, the findings in this report suggest that while trade itself is critical for the achievement of multiple nutrition objectives, tariff policy may not be sufficient to shape consumer incentives in favour of more nutritious foods.

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Chapter 1.

How does trade matter for food security and nutrition? Evolution of agrifood trade and production

While a detailed review and theoretical discussion of the various interlinkages between trade, trade policy and food security, nutrition and diets are beyond the scope of this report, it is generally accepted that global agrifood trade can affect nutrition in both positive and negative ways.

Firstly, focusing on the most obvious pathway, that of making food available domestically, trade can foster both the availability and affordability of various foods and increase the number of individual items that are available to domestic consumers, ultimately stimulating dietary diversity. Imported foods can also offset seasonal scarcities of domestically produced fresh foods (FAO, 2018). At the same time, global trade can also lead to increased availability of foods that are high in fats, sugars and/or salt or that are highly processed and thus may contribute to malnutrition in the form of overweight and obesity. Beyond shaping the availability and variety of foods available domestically, trade may also influence nutrition through additional channels. To illustrate, trade may foster economic growth and lead to rising household incomes that can shape nutrition both positively (e.g. by enabling consumers to afford a healthy diet) and negatively (e.g. by allowing consumers to purchase pre-prepared foods that are more convenient or more palatable but possibly also high in fats, sugars and/or salt). Additionally, increased openness to global markets may reduce domestic food prices for consumers but can also expose farmers and other players in the domestic agrifood value chain to increased import competition that may undermine livelihoods and ultimately affect their ability to purchase nutritious foods (FAO, 2018).

Focusing predominantly on trade as a source of supply for domestic availability, in this part of the report a novel dataset spanning two decades of global agrifood trade and production is employed to explore how trade may matter for food security, the adequate supply of different nutrients, and the availability of a variety of foods with different nutritional characteristics. These data allow for a conversion of all food items that were produced, traded and supplied as food for human consumption over the past two decades into caloric equivalents and to also assess the amount of macro-nutrients, vitamins and minerals included in them.[3]

1.1 Imports as source of energy supply

Does trade matter in making food available across different countries, and to what extent? To answer this question, Figure 1 shows import dependency ratios, which express the share of domestically available calories that are sourced through imports.[4] Positive values indicate that a country is a net importer of calories, while

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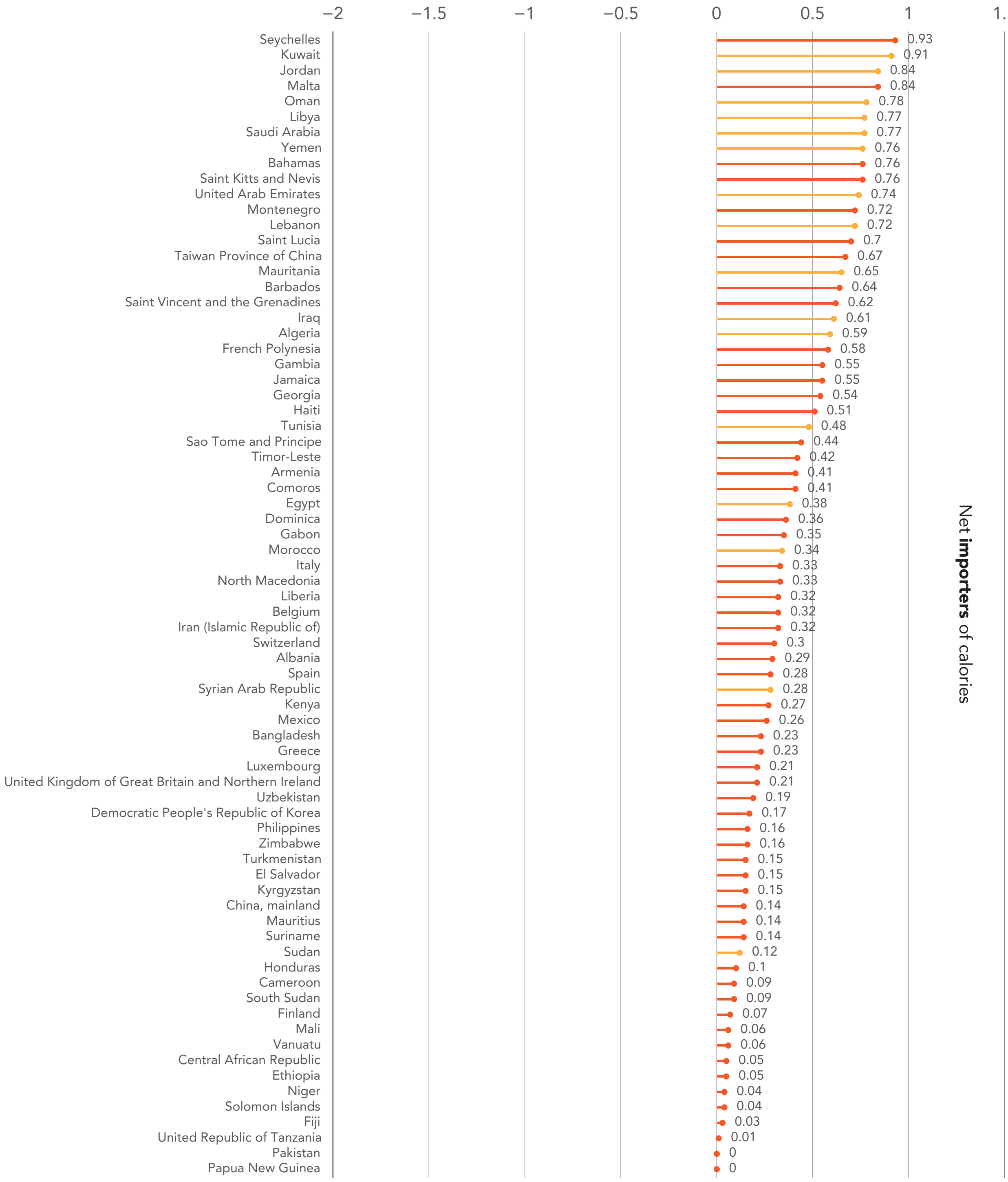
[3] A detailed description of this dataset is provided in Annex I of this report.

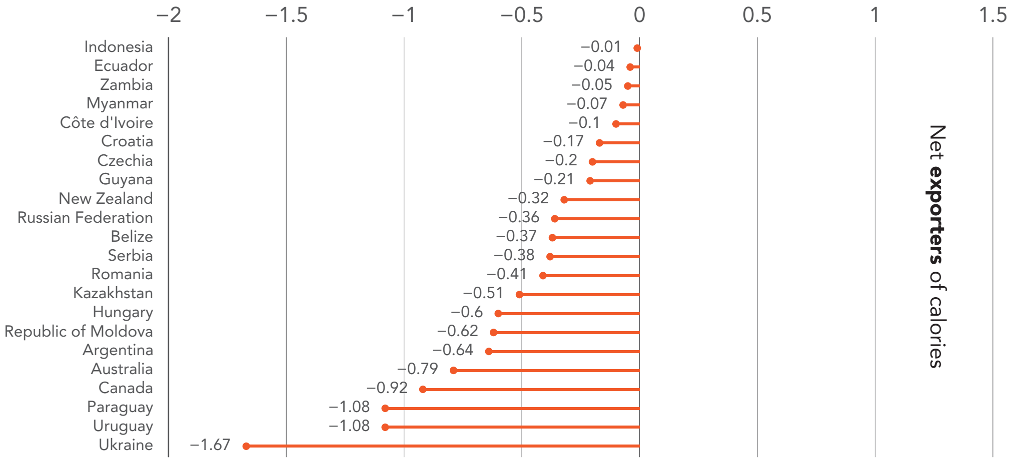
[4] Import dependency ratios reflect the extent to which a country's supply of food comes from trade. A high value implies high dependency on imports. It is important to note that not all available calories will end up as "food" for humans (e.g. commodities may first be used as feed for animals, undergo further processing or simply be lost as waste). To compute import dependency ratios, as a first step, all traded or domestically produced food commodities were converted into calories. Second, for each country, calories provided across all food commodities were totalled for each of the three statistical domains: production, imports and exports. The import dependency ratio (in kilocalories) was then computed as: (imports - exports)/(production + imports - exports). An important methodological note is that for the case of domestic production, derivatives of primary commodities were excluded to avoid double counting. For example, a country's data may show zero wheat imports but a domestic production of one tonne of wheat grain, 0.75 tonne of wheat flour, 0.4 tonne of bread 0.1 tonne of pastries. In terms of domestic calorie production, this country produces wheat grain – the primary commodity – which is then processed into various derivatives. Hence, items that are a direct derivative of a primary commodity were excluded from the production statistics throughout this exercise. Nevertheless, this approach remains imperfect as it is difficult to accurately identify "derivative" products (e.g. "marmalade" may be made up of fruit as well as sugar).

negative values mean that a country is a net exporter of calories. As Figure 1 shows, countries in the NENA region[5] (highlighted with bright bars) are sizable net importers of food – especially in the case of the Gulf countries). Globally, around a quarter of all countries show an import dependency ratio of 0.5 or higher while roughly the same number of countries are net exporters of calories. For example, Ukraine, the Russian Federation, Canada or Australia are globally important suppliers of grains and vegetable oils and thus reveal negative import dependency ratios (see also 1.3 below).

Figure 1. Food import dependency around the world (2017–2019 averages)



[5] The NENA region consists of the countries of Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libya, Yemen, Mauritania, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syrian Arab Republic, Tunisia and United Arab Emirates.



Notes: Import dependency ratio = (imports - exports)/(production + imports - exports), in kilocalorie terms. A positive import dependency ratio indicates that a country is a net importer of calories, while a negative ratio indicates net exporter status. All values are 2017–2019 averages. Sixteen countries in the NENA region and 84 randomly selected countries are presented.

Source: Authors' own elaboration.

1.2 Imports for the adequate supply of essential nutrients

While Figure 1 offers a global view of the contribution of imports to domestic availability of food in terms of calories, it is important to note that such an approach does not directly allow for an assessment of how critical trade is in facilitating meeting dietary requirements. This is because the share of total domestic availability of calories that is sourced through imports does not reveal anything about the absolute levels of food supply.[6] Additionally, the indicator cannot account for the fact that imported food commodities may also be used for non-food purposes (e.g. palm oil is often used for biofuel, maize as animal feed).

To illustrate these points and facilitate a more nuanced understanding of the role of trade in supporting a recommended dietary intake of 2 330 kilocalories per capita per day, Figure 2 combines import dependency ratios (black dots) with the total domestic supply of calories per capita per day, broken down into food (orange bar) and non-food (yellow bar).[7,8] The data suggest that both the United Arab Emirates and Yemen have similar import dependency ratios. However, in the United Arab Emirates both the total domestic supply of calories, as well as

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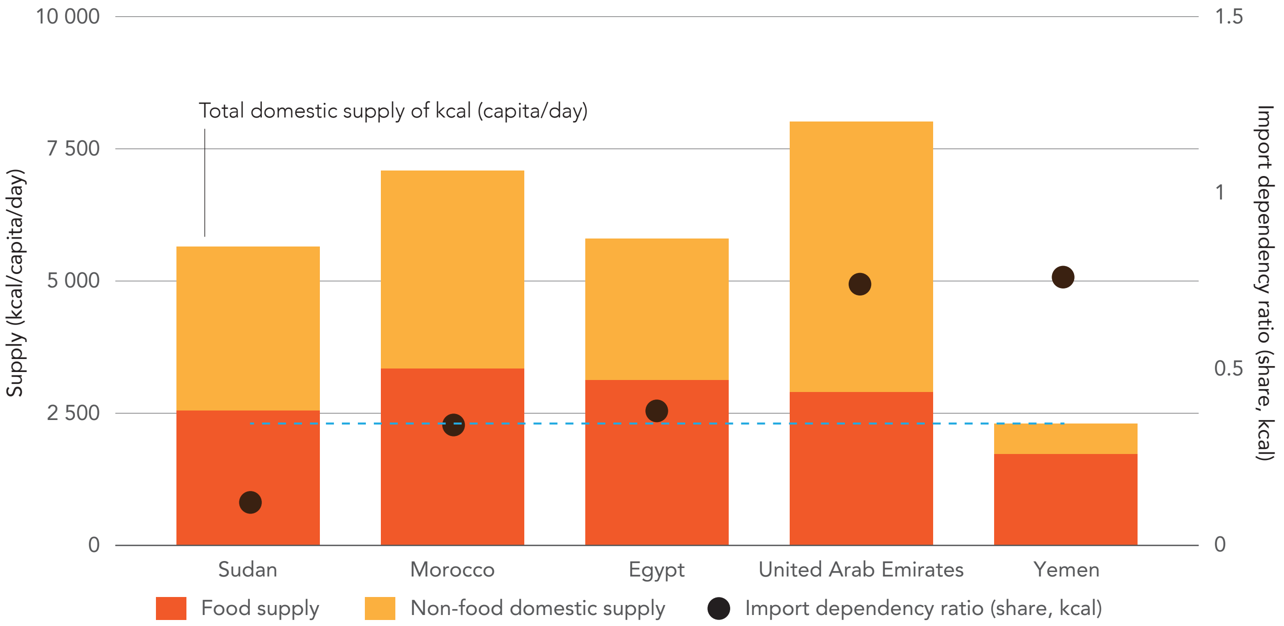
[6] For example, two countries may source the same percentage of their food supply through trade but the overall supply in terms of calories could be lower in one of the two. See Figure 2 and main body of the text for an elaboration referring to the cases of the United Arab Emirates and Yemen, two countries with very similar import dependency ratios but different levels of food supply.

[7] The chosen value of 2 330 kcals per capita per day is similar to the energy needs across all sex-age-year groups and was therefore chosen as a normative reference point for dietary intake (see Herforth *et al.*, 2022). It should be noted that for the case of dietary energy intake, other benchmarks also exist. For example, FAO's average dietary energy requirement (ADER) is a "proper normative reference for adequate nutrition in the population" and is computed for each country taking into consideration relevant parameters sex ratio (FAO, 2023a). For example, for Egypt, the ADER was estimated as 2 322 kilocalories per person per day in 2021 (FAO, 2023a).

[8] Total domestic supply = production + imports - exports.

the number of calories supplied as food for humans are considerably higher.[9] Additionally, across all countries included in the graph, a sizable share of the calories that are available domestically is not supplied as food for human consumption (yellow bars). Therefore, while it is possible to assess the contribution of imports to the total domestic supply of calories, or that of micro- and macro-nutrients, such information has to be accompanied with data on volumes made available as food for human consumption. These, in turn, will be shaped by factors specific to the domestic food system that – at least in the short run – may be independent of a country's participation in trade.[10]

Figure 2. Import dependency, total supply and food supply (in kilocalories)



Notes: Black dots (right y-axis) correspond to import dependency ratios in calories. Orange bars depict a country's domestic supply of food calories per capita per day, while yellow bars show the approximated domestic supply of non-food calories per capita per day. The orange and yellow bars combined correspond to total domestic availability of calories per capita per day. The dotted blue line depicts the recommended dietary energy intake and corresponds to 2 330 kilocalories per capita per day – the dietary energy needs of an active, healthy adult woman. 2017–2019 averages are shown throughout.

Source: Authors' own elaboration.

Being mindful of these analytical limitations, Figure 3 uses the three indicators introduced above to explore the role of imports for the domestic supply of five different nutrients: iron, zinc, calcium, vitamin A and vitamin B1 (thiamin). Vitamins and minerals in foods are necessary for the body to grow, develop and function properly, and are essential for people's health and well-being (FAO, IFAD, UNICEF, WFP and WHO, 2024). Figure 3 shows the import dependency ratios (black dots), the total domestic supply per capita per day for each of the five nutrients, broken down in food (orange bar) and non-food (yellow bar) supply for 14 countries in the NENA region, as well as a selection of other countries from different regions to facilitate comparisons. Horizontal lines indicate dietary reference intakes, with values being the average requirements of a non-pregnant woman between the age of 19–50 (Institute of Medicine, 2011).[11]

[9] In Yemen average food supply is below the benchmark, in line with the undernourishment and food insecurity in the country.

[10] Nonetheless, calories that are utilized for non-food purposes may of course be used for human consumption in the case of emergencies (e.g. maize is used as feed in some countries but as food in others).

[11] The authors thank the FAO Food and Nutrition Division for their support with these dietary intake reference values.

Key insights are as follows. First, and mirroring widespread import dependency for foodstuffs, many countries in the NENA region are net importers of essential nutrients. For example, across all five nutrients, the United Arab Emirates sources more than three quarters of its total domestic availability through imports. Generally, high import dependency for one nutrient (or for calories) is also a good predictor for import dependency in other nutrient categories. At the other end of the spectrum, Paraguay (on the left side of Figure 3) is a net exporter across all nutrients included in this exercise and also a net exporter of calories as shown in Figure 1 above.

Second, and taking into account that not all food items will be supplied as food for human consumption, for some countries, imports are critical to ensure sufficient availability and supply of nutrients for food for human consumption. For example, in Jordan, daily supply of vitamin B1 (thiamin) for human consumption stands at around 1.16 milligrams per capita, against a recommended daily intake of around 0.9 milligrams (for an adult woman). Total domestic supply including food and non-food use amounts to 3.35 milligrams, with imports accounting for around 85 percent. These figures suggest that, at least in the short term, Jordan's own domestic production would be insufficient to meet the recommended intake of these nutrients. Additionally, substantial reductions in the country's imports could reduce average nutrient supplies to levels close to or below the recommended benchmark value and prevent sufficient intake by at least some of the country's population.[12] In several other countries, such as Yemen, Jordan, Libya or Egypt, average supply for human consumption in at least some nutrient categories is close to or below the recommended daily intake. In these cases, shocks affecting imports could be detrimental to nutrition-related outcomes beyond merely affecting the availability of calories if no other sources of supplies can be mobilized.

1.3 Top countries exporting nutrients

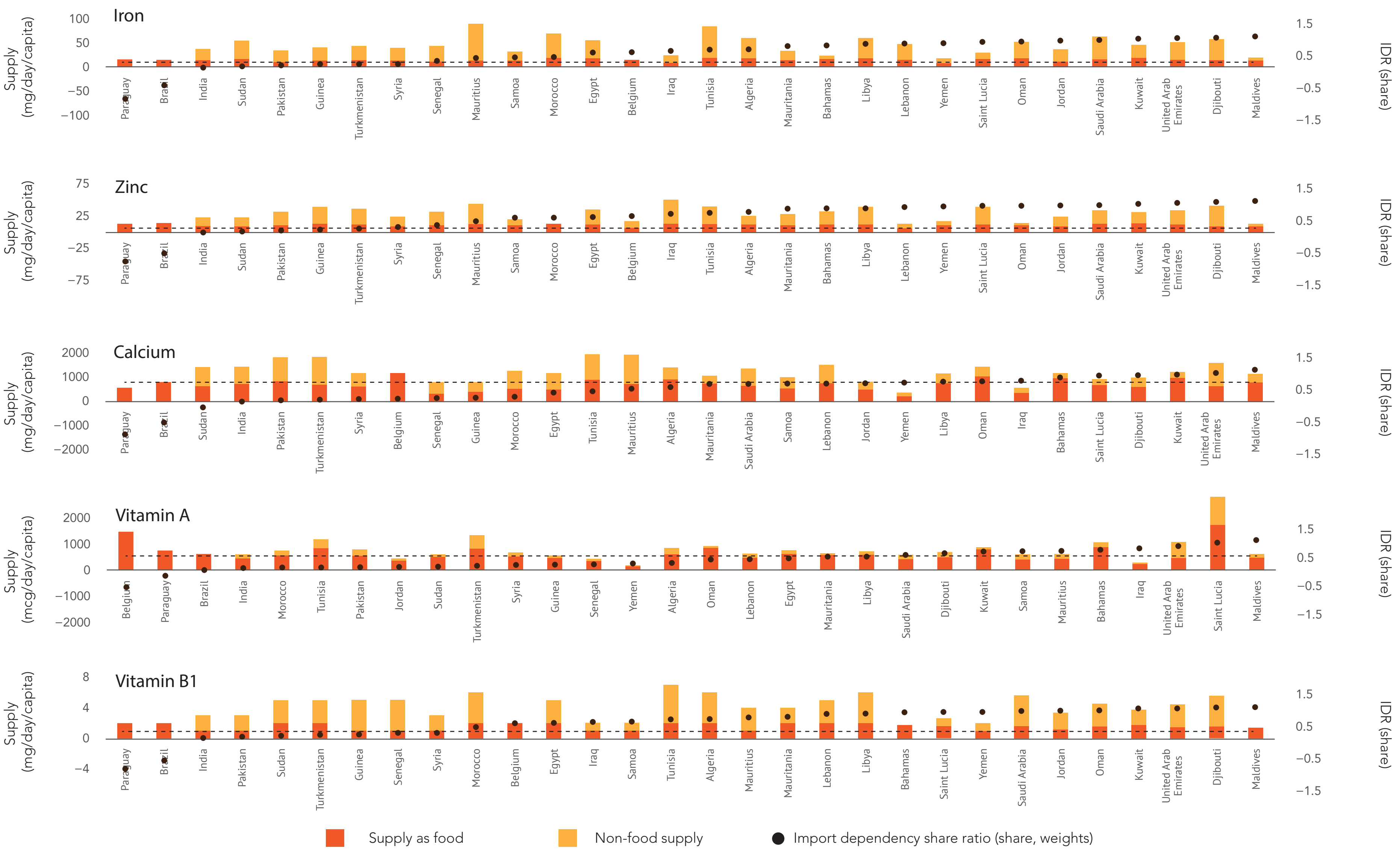
Globally, a relatively small number of countries account for a large share of food exports and therefore for the macro-nutrients, vitamins and minerals carried in these exports. Figure 4 presents the shares of cumulative global exports of calories and various nutrients, for the top five exporting countries in each category over a three-year period (2017–2019). Across the considered nutrients, a distinct pattern of concentration emerges, albeit with some notable differences. For example, while the role of the United States of America is significant for calories and presented nutrients, for globally traded vitamin C this country accounts for around 5.6 percent of global exports (compared to 14 percent for calories).[13] Finally, and while shocks to key global suppliers will also affect world food prices, it is worth noting that not all import dependent countries rely on these global suppliers. For example, Eswatini and Botswana are net importers of calories and many nutrients, but mostly import from South Africa.

Overall, these concentration patterns reinforce recent calls to diversify the world's food markets and countries'

[12] The magnitude of implications from such trade shocks for nutrition will also depend on the contribution of imports to food for human consumption, a statistic that is not readily available.

[13] Additionally, it is worthwhile mentioning that a high degree of concentration is found for many socio-economic statistics. For example, in 2021 Lebanon imported around 75 percent of its wheat from only two origin countries (Ukraine and the Russian Federation). Similarly, Fernandes, Freund and Pierola (2016) report that in Brazil, Bulgaria and Botswana, the top five percent of all domestic exporter firms accounted for 82, 83 and 99 percent of these countries' total export values.

Figure 3. Import dependency, total supply and food supply: iron, zinc, calcium, vitamin A and vitamin B1 (from top to bottom)

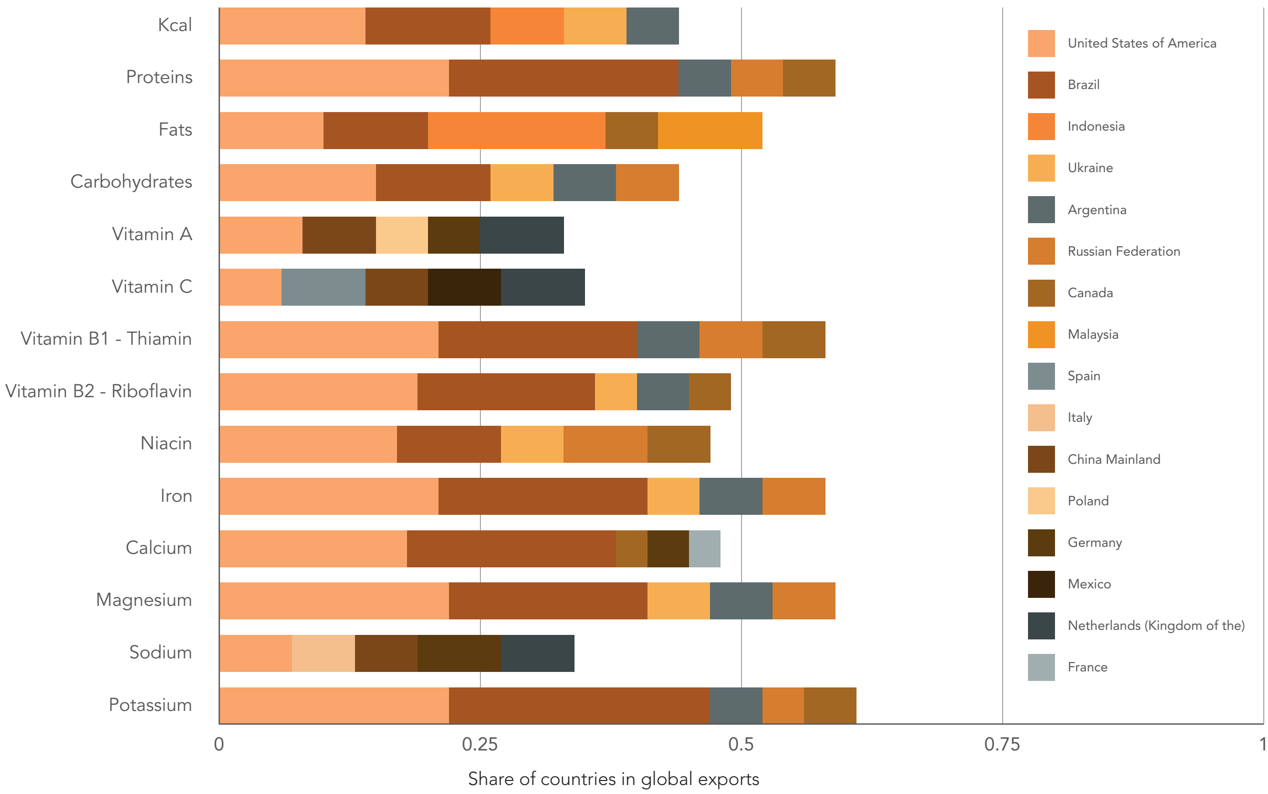


Notes: For each of the five nutrients, black dots depict import dependency ratios based on weights (mcg for Vitamin A, mg for all other nutrients). Orange bars show average daily per capita supply of the nutrient as "food available for human consumption", while yellow bars indicate domestic availability of the nutrient that is not supplied as food for humans. Orange plus yellow bars thus correspond to total domestic availability (production + imports - exports). For each nutrient, horizontal lines indicate recommended daily intake for an adult woman as a benchmark (taken from Institute of Medicine, 2011). All values are 2017–19 averages to smooth out year-specific shocks (e.g. droughts leading to higher than usual imports). For some countries, domestic availability was dropped throughout so as to foster legibility (Belgium, Brazil, Paraguay).

Source: Authors' own elaboration.

import patterns in order to foster resilience in agrifood systems (e.g. Abay *et al*., 2023; Rauschendorfer and Krivonos, 2022). Most recently, an FAO flagship examining the geography of global agrifood trade attains that while over the past 15 years the global trade network has become less centralized, agrifood imports of most countries remain concentrated on a limited number of products and partners, concluding that *"strengthen their resilience and ensure food security and healthy diets, countries should aim to diversify the products they import and to increase the number of their trading partners"* (FAO, 2022a, p. xii). While previous analyses were confined to food items in terms of calories (as well as fats and proteins) or key commodities like wheat, the results presented here confirm the need for increased diversification also from the perspective of essential vitamins and minerals.

Figure 4. A small number of countries account for the bulk of globally exported nutrients



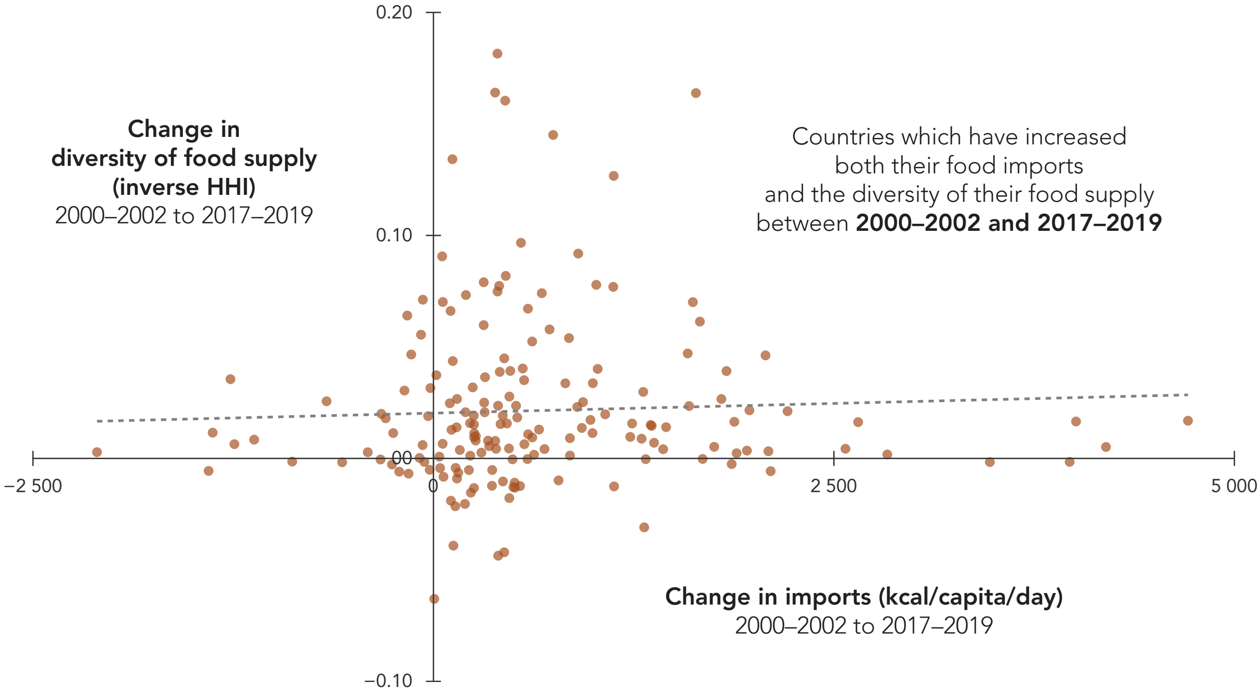
Notes: The share that countries held in cumulative exports of calories and various nutrients over the years 2017–2019 is presented.

Source: Authors' own elaboration.

1.4 Dietary diversity and food imports

Dietary diversity is important for better nutrition and empirically the diversity of foods consumed has been validated to predict nutritional outcomes (e.g. Ruel, 2003; Arimond and Ruel, 2004; Kennedy *et al.,* 2007). At the country level the diversity of foods supplied can provide the basis for dietary diversity at household and individual level. Figure 5 shows the relationship between changes in the diversity of foods supplied in countries and changes in the volumes of their food imports over the past two decades and across countries.[14] Countries located at the top right quadrant of Figure 5 are those where increased food imports have been accompanied by a rise in the diversity of foods supplied over the last two decades. As a key result, the majority of countries that have increased their aggregate food imports (111 countries out of 174) have also experienced an increase in the diversity of foods supplied.[15]

Figure 5. Changes in dietary diversity and food imports over the last two decades



Notes: Each dot represents a country. Higher values on the y-axis indicate an increase in the diversity of food supply between the two periods 2000–2002 and 2017–2019, while higher values on the x-axis indicate an increase in imports of calories between the two periods. It is important to recognize that not all imported food commodities that are included in this illustration will end up directly or exclusively as "food" for human consumption. Many food commodities may also be used as animal feed, may be lost as food waste, or losses or may be used for non-food purposes (e.g. palm oil is widely used as food, but also as biofuel or for the production of cosmetic products).

Source: Authors' own elaboration.

[14] To measure the diversity of domestic food supply, an inverse of the Herfindahl-Hirschman Index (HHI) was computed. The HHI is a measure for the concentration in a statistical distribution, and in this case was calculated as the sum of the squares of each individual food item's share in a country's total supply of calories in a given year. Formally, $HHI_j = \sum_{j=1}^{n}(s_j^2)$, where s_j is a food item's share in the total food supply of a country j, and n is the total number of items supplied as "food". Since in the HHI higher values indicate less diversity, the inverse of this measure was calculated (i.e. 1- HHI_j) so as to allow for a more intuitive interpretation of results. A total of 434 food items was included.

[15] It should be noted, however, that there is no strong statistical association between the two indicators – some countries have increased their dietary diversity without increasing their food imports while others have experienced large increases in imports without any change to dietary diversity.

With respect to countries in the NENA region, the data suggest that many of these countries have increased both food imports and the diversity of foods supplied. For each of the NENA countries, Figure 6 (left panel) shows 2000–2002 and 2017–2019 averages of both the same measure of food supply diversity used in Figure 5 and the volume of food imports (measured by kilocalories per capita per day). With some notable exceptions (namely Egypt, Lebanon and Yemen), the countries in the NENA region have experienced an increase in the diversity of foods supplied, which in many cases was also accompanied by an increase in energy supply. The right panel of Figure 6 further explores whether food imports have contributed to increased diversity of foods in the NENA region by tracking the number of individual items that were imported by these countries in the 2000–2002 and 2017–2019 periods.[16] Across all NENA countries, the number of individual food items that were imported exhibited a significant increase, suggesting an important role of trade in supporting dietary diversity. It is noteworthy to mention that this result is not unique to the region - the number of unique imported food items decreased in only few countries between 2000–2002 and 2017– 2019.[17]

For net importing countries, fostering dietary diversity is important for meeting dietary requirements but can also serve to increase the resilience of import-dependent countries from shocks affecting individual global exporters. For example, wheat has a global production and export pattern that is different from the global export pattern for pulses, implying that importing countries that source calories from both commodities may not be as exposed to shocks as those importers that predominantly rely on either of the two.[18]

A final comment concerns the nutritional quality of products that countries imported in the later periods in addition to (or in place of) those imported two decades ago. Looking for example at data for the United Arab Emirates, the additional products imported in 2017–2019 include both nutritious foods (e.g. pumpkins, peas or papayas) and a number of foods that are usually high in fats, sugar and/or salt (e.g. peanut butter, pig meat preparations, sausages and similar products). Thus, increased dietary diversity due to higher imports may not be strictly positive for nutrition, if, for example, a number of these energy-dense imported foods high in fats, sugars and/or salt replace the nutritious options (see also 1.5 below).

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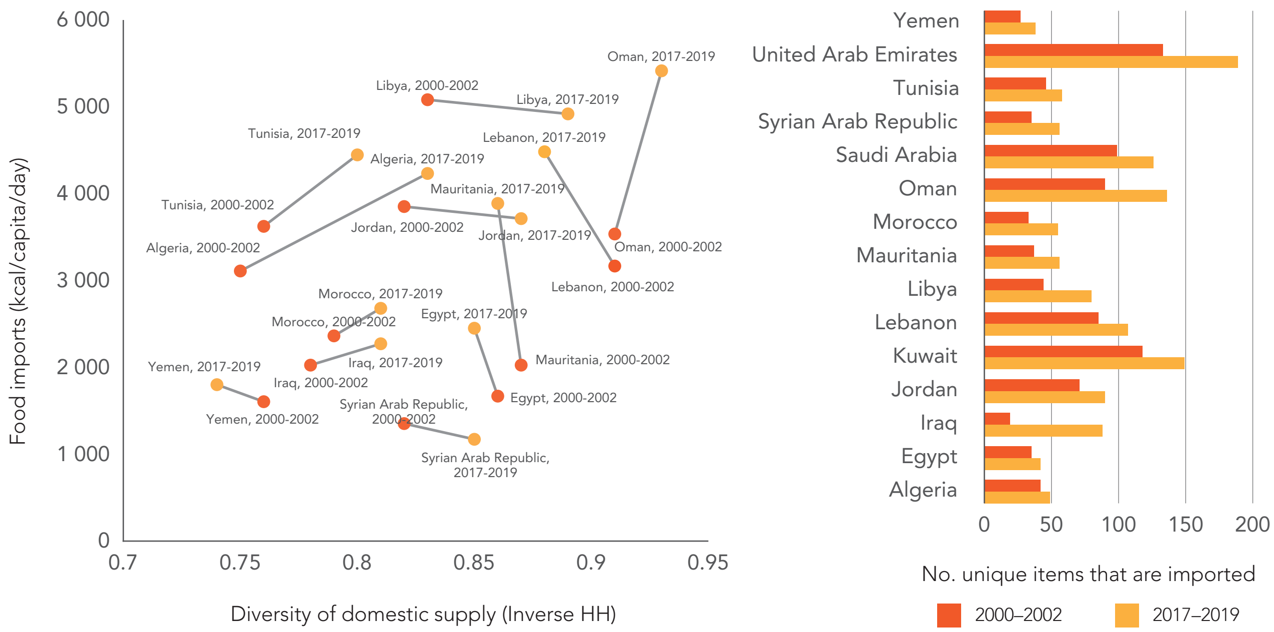
[16] Only items with a minimum import volume of one kilocalorie per capita per day were kept, so as to ensure that results are not biased by the importation of items that may only be consumed by sub-groups of a population (e.g. luxury food items consumed predominantly by a country's upper income classes).

[17] Additionally, and by large, the pattern of a rise in the number of individual items that countries import also holds when considering 2010–2012 averages instead of 2000–2002 values. This test was done to ensure that the pattern is not simply driven by countries becoming better at reporting statistics on imports in more recent periods. While most countries did increase the number of individual items they imported between these two periods, some changes are minimal and there are also cases in the NENA region where the number of individual imported items decreased marginally by two to five varieties (in Algeria, Egypt, Jordan and Yemen).

[18] For example, Myanmar is a large exporter of pulses but the country is not a significant contributor to global wheat trade.

Figure 6. Changes in food imports and dietary diversity across NENA countries



Notes: Left panel: orange dots = 2000–2002 averages and yellow dots = 2017–2019 averages. Kuwait, Saudi Arabia and the United Arab Emirates were dropped for legibility. Three-year averages are used to amend the potential impact of year-specific shocks.

Source: Authors' own elaboration.

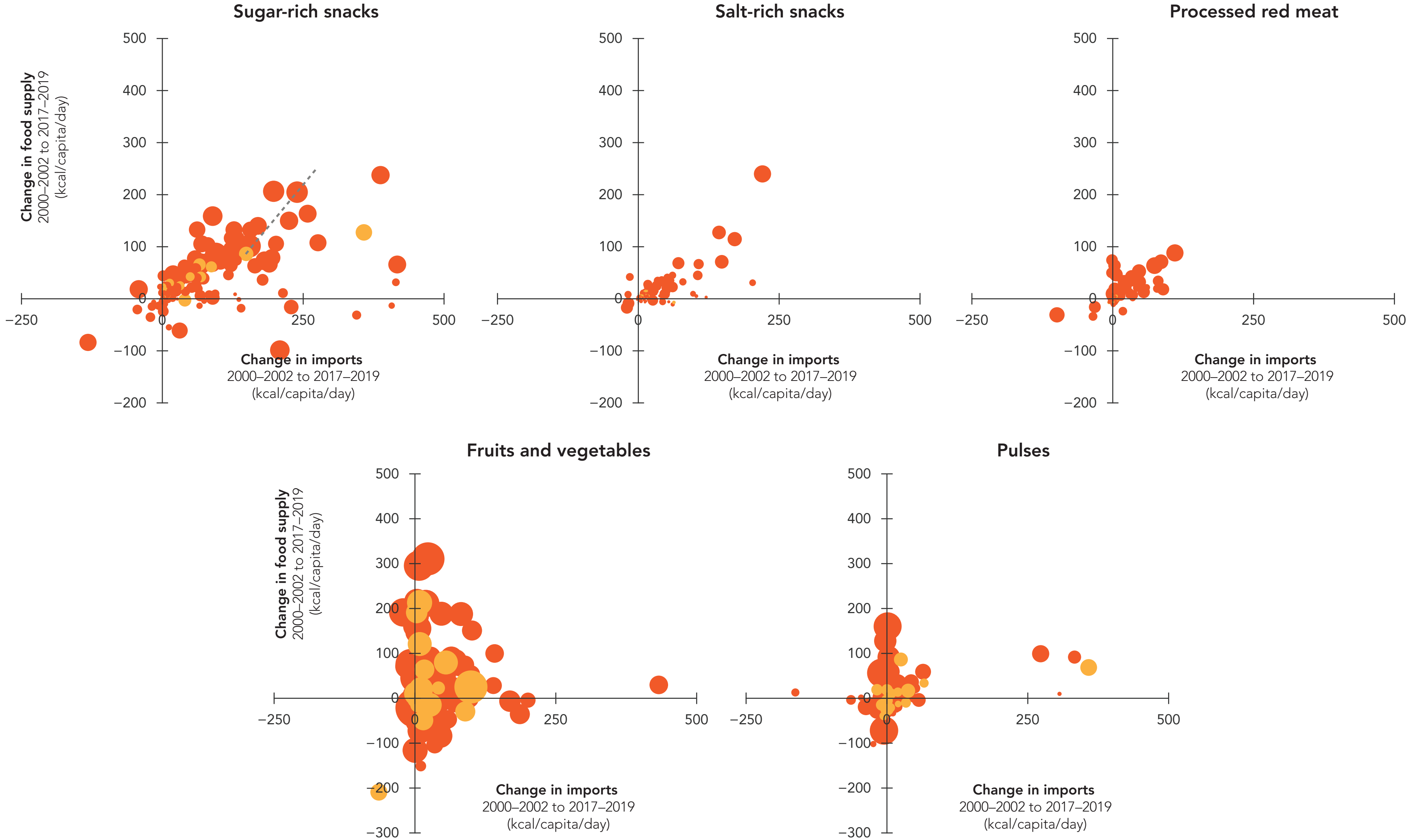
1.5 Contribution of imports to domestic supply of different food groups

Figure 7 explores how countries' import patterns for five broad food groups with different nutritional characteristics have changed over the last two decades (sugar-rich snacks, salt-rich snacks, processed red meat, fruits and vegetables, and pulses). Each of the five graphs shows the relationship between the change in imports per capita of a food group between 2000–2002 and 2017–2019 and the corresponding change in the number of calories per person per day that are supplied as food for human consumption from this group.[19] The size of each circle corresponds to the share of a food group in a country's total food supply in the 2017–2019 period. For example, in Oman, imports of sugar-rich snacks per person per day increased by 149 kilocalories between the two periods. This was accompanied by an increase of around 86 kilocalories per capita per day in food supply from these items (from roughly 52 kilocalories per person per day in 2000–2002 to around 138 kilocalories in 2017–2019).[20] In 2017–2019 sugar-rich snacks contributed around 4.4 percent to total energy supply in the country.

[19] Three-year averages are employed to smooth out year-specific effects (e.g. droughts that result in high imports in a specific year).

[20] For additional comparison, in 2010 the food supply from sugar-rich items stood at 71 kilocalories per person per day.

Figure 7. Many countries have expanded their imports of foods high in sugar or salt, as well as processed red meat



Notes: The x-axis shows the change in imports per capita of a food group between 2000–2002 and 2017–2019, in terms of calories per person per day. The y-axis shows the change between these two periods in the number of calories per person per day that are supplied as food for human consumption from this group. To allow for cross item comparison, all trade and domestic supply variables were converted into caloric terms employing data on energy content and edible portion. To additionally facilitate cross-country comparison, all data were expressed in per capita terms. The size of a circle is proportional to the contribution of a food group to domestic food supply and yellow circles are countries in the NENA region. Food items included under each food group are available upon request.
Source: Authors' own elaboration.

Focusing on the sugar-rich snacks, salt-rich snacks, processed red meat food groups (top half of Figure 7), the data suggest that trade has contributed to increased food supply from these food groups that include items high in sugar, salt, oil, or fats and that are often highly processed.[21] More specifically, the data show a strong, positive association between changes in imports and changes in food supply for each food group. In terms of their contribution to food supply, it should be noted that for at least some countries, the contribution of these three food groups to aggregate food supply is non-negligible. For example, in Oman, sugar-rich and salt-rich snacks and processed red meat combined accounted for just above 5 percent of total food supply in 2017–2019.[22] From a global perspective, however, it is also important to consider that those countries that significantly increased their food supply from these foods are relatively small in terms of population (see also 1.7 below).

On the contrary, over the last two decades relatively fewer countries have increased their per capita imports of fruit, vegetables and pulses, foods that are essential components of healthy diets and a good source of vitamins, minerals or fibre (lower half of Figure 7). Changes in the contribution of these food groups to domestic food supply appear not to be correlated with changes in the participation in global trade. For countries in the NENA region, the relationship appears to be similar to that observed globally. A possible exception would be the case of pulses. Here, many NENA countries show both an increase in imports of pulses, together with an increase in food supply over the past two decades, suggesting that trade may have played a role in the increased consumption of these nutritious foods across the region.

Such heterogenous findings on imports and the contribution to aggregate food supply across food groups that include nutritious foods and foods high in sugar, salt, or oil/fats, may be due to the fact that fruits and vegetables are perishable and thus usually more costly to store and transport. Additionally, these foods often have unit values below those of items like sugar-rich snacks like confectionary, potentially affecting incentives of producers to exploit available trading opportunities.[23] Finally, food import baskets are likely to be shaped by a country's own production and processing capacities that may tilt imports towards more or less nutritious options (see 1.7).

1.6 Growth of trade and supply for different food groups

Figure 8 identifies those food groups which have increased their prominence in food supply at a global level (top panel) and for the NENA region (bottom panel) over the past two decades. It also explores whether any such increases may have been accompanied by trade expansion. To this end, individual food items were

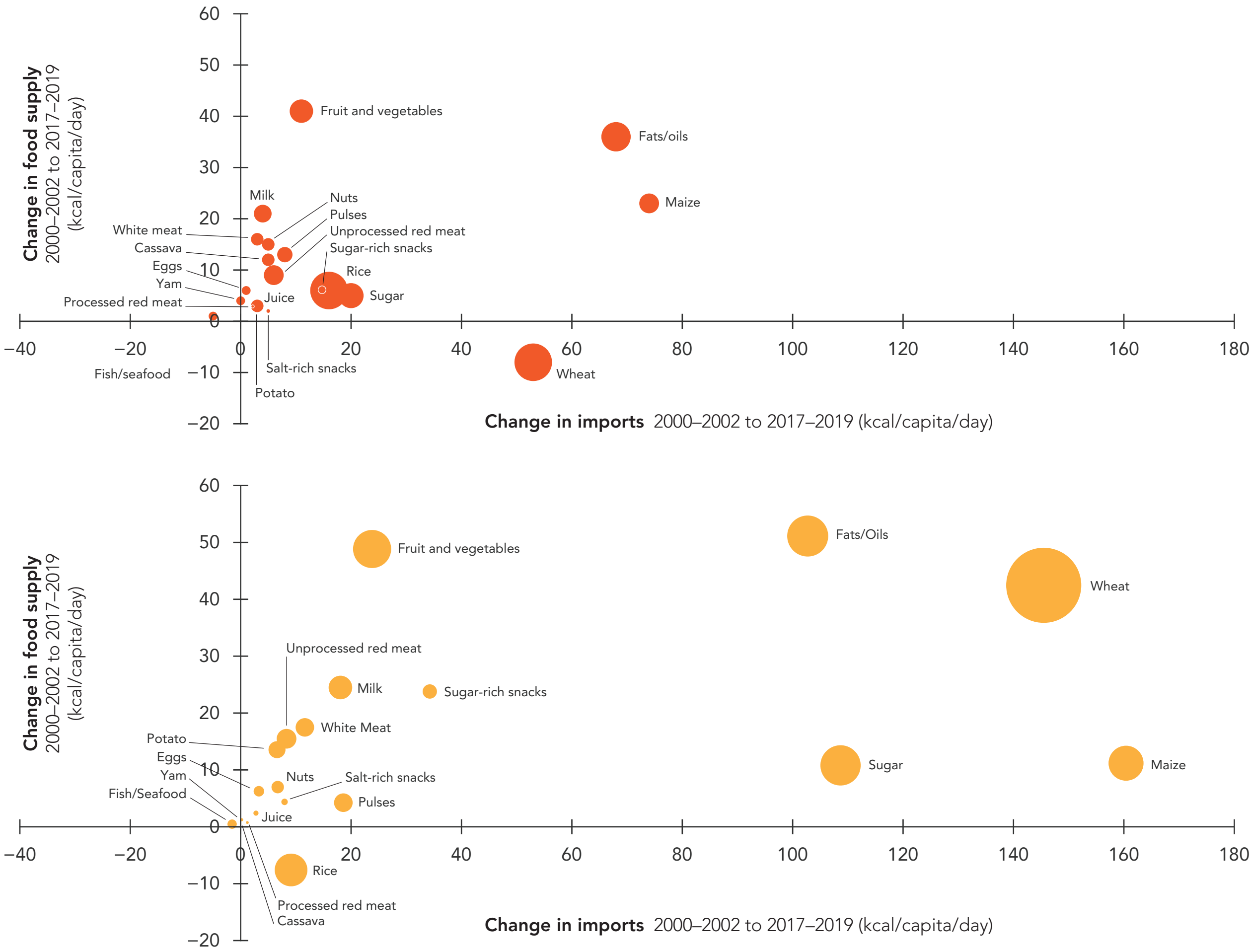
[21] For example, "sugar rich snacks" includes items like sugar confectionary, sugar preserved fruits and nuts, ice cream or honey, while "processed red meat" includes food items like sausages, bacon, ham or salted/dried/smoked bovine meat.

[22] A potential empirical concern with this finding is that low or zero imports in the earlier period may simply be due to missing observations at the item level (e.g. a lesser developed country may have always reported on wheat imports but only recently added more processed sugary snacks to the list of monitored items). To consider this possibility, Annex II replicates the graph on "sugar-rich snacks" from Figure 6, but replaces values from 2000–2002 with values from 2010–2012. The same qualitative results are found. Similarly, considering changes in food supply from a food group in terms of their share in total domestic supply (rather than levels of supplies in kilocalories per capita per day terms) produces similar results (Annex II).

[23] To illustrate, constructing export unit values for the United States of America in 2021 suggests an average export price of USD 1.23 per kilogram of apples (HS 0808) versus USD 3.75 per kilogram of sugar confectionary (HS 1704) (UNComtrade, 2023).

grouped into aggregated food groups, such as fats and oils, white meat or fish and seafood and presented along with key food items, such as rice and maize. To explore global patterns, production and trade data were converted into calories and expressed in per capita terms.

Figure 8. Shifts in imports and food supply per food group and single food items: Global (top) and NENA-specific results (bottom)



Notes: The top panel shows changes in global food supply (y-axis) and global imports (x-axis) over the last two decades, while the bottom panel shows the same variables for the NENA countries. All variables are expressed in per capita terms. Some food groups were excluded for better legibility (e.g. "other cereals" or "other dairy"). Circle size is proportional to contribution of a food group to domestic supply in 2017–2019.

Source: Authors' own elaboration.

Key results include the following. First, both at the global level and for the NENA region, food supply and imports of the fats and oils group have increased considerably over the last 20 years. Globally, between the 2000–2002 and 2017–2019 periods, imports of this food group have increased by almost 70 kilocalories per day (corresponding roughly to a 67 percent increase). In the NENA region, the increase is even larger. Over the last two decades, imports of fats and oils having increased by more than 100 kilocalories per NENA citizen per day. In both cases, higher imports were accompanied by an increase in the share of these foods in total domestic supply. While fats and oils are also important for human health, overconsumption can lead to obesity and thus have negative consequences for public health (Thow and Hawkes, 2009; Thow *et al.*, 2011).[24] NENA countries have also substantially increased their wheat imports over the past two decades, with this commodity now accounting for a staggering 34 percent of total food supply in the region. This stands in contrast to global patterns, where the importance of wheat has been marginally declining over the last two decades, accounting for around 18 percent of global food supply in 2017–2019. Globally and in the NENA region, imports from other cereals and sugar, as well as aggregate food supply, have also increased (Figure 7). Finally, regarding those food groups that were previously identified as high in sugar, salt, and fats/oils (sugar-rich snacks, salt-rich snacks and processed red meat) it is worth noting that once global figures that account for the population size of individual countries are considered, results are less. Specifically – and notable increases in the calories provided from these foods notwithstanding – the aggregate contribution of these foods to overall food supply remains relatively small overall. For example, at the global level the share of high calories from sugar-rich snacks in 2017–2019 stood at just around 0.2 percent, while it was around 1.3 percent in the NENA region. These figures suggest considerable heterogeneity at the country level, with smaller countries relying more on these foods for caloric supply (see also 1.7).

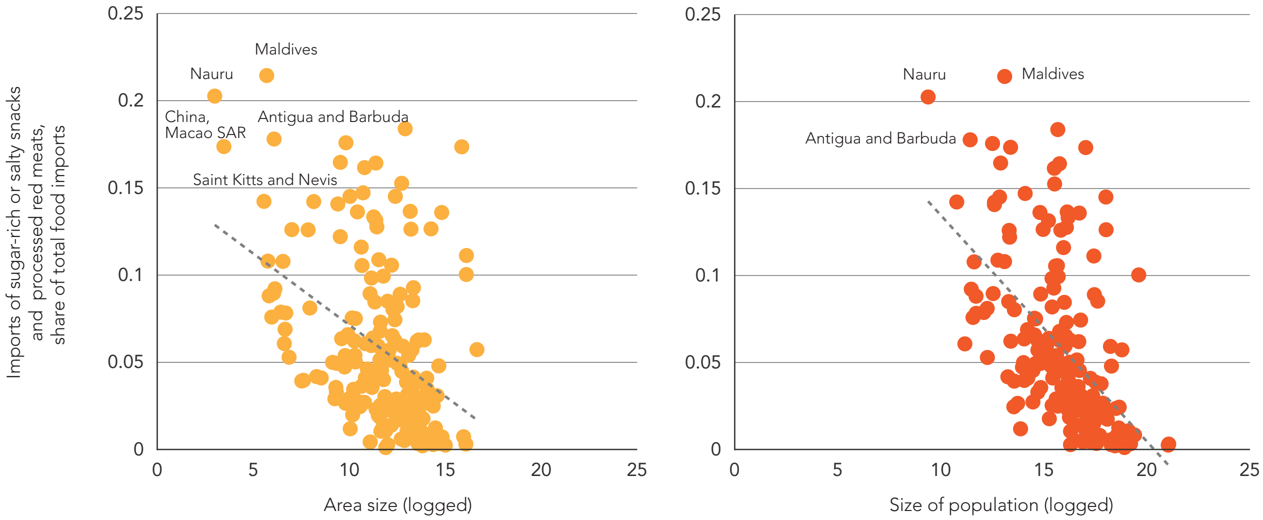
1.7 Country size and imports of foods that are high in salt, sugar, or fats/oils

What country characteristics are predictive of large imports of foods high in salt, sugar, or fats/oils? Looking at aggregate imports per capita per day of food items that were classified as "sugar-rich snacks", "salt-rich snacks" or "processed red meat" and expressing these as shares of total food imports, suggests that "small" countries generally import a larger proportion of their total food imports in the form of these items (Figure 9, top panel). Considering instead the share that these items make up in the total food supply of a country, the same pattern emerges (Figure 9, bottom panel). Combined, this suggests that smaller countries source a larger share of their total food supply from processed foods that are high in sugar, salts or fats/oils and that imports are a key source for their supply.[25] This result is corroborated by previous work. For example, Thow et al. (2017) discuss the case of imported turkey tails (a fatty meat) in Samoa and the efforts of the government to ban imports of this food to combat high rates of non-communicable diseases.

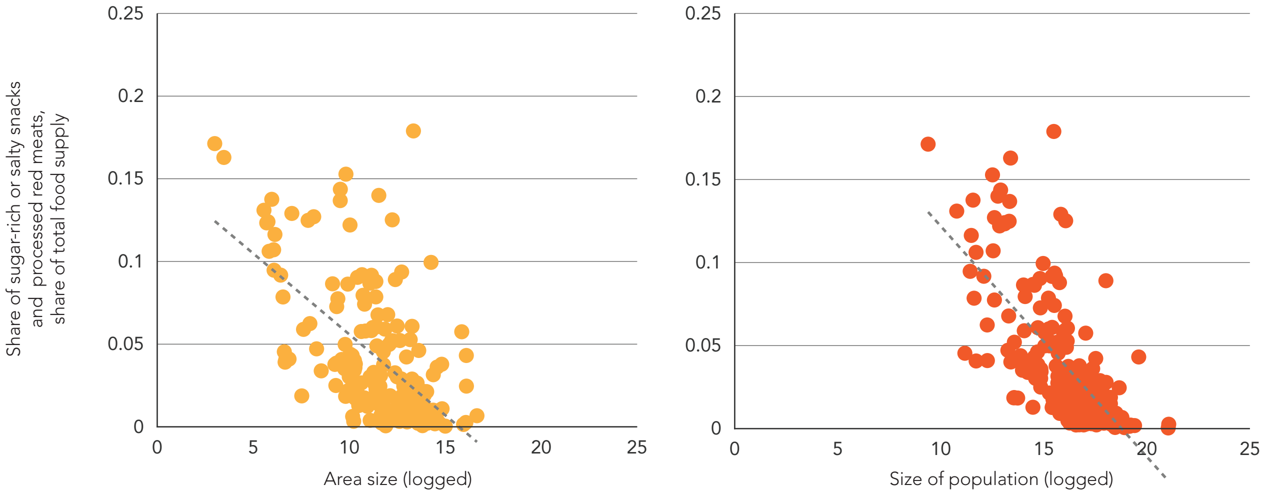
[24] For example, Herforth *et al.* (2022) suggest that daily intake of oils and fats as part of a healthy diet should be around 300 kilocalories. In a number of NENA countries, the daily food supply from this food group is considerably higher, e.g. 381, 449, or 527 kilocalories per person per day in Morocco, Jordan or the United Arab Emirates, respectively.

[25] No significant relationship was found between incomes and the share of the included items in a country's total food imports.

Figure 9. Food imports of smaller countries contain a high share of sugar-rich or salty snacks as well as processed meats



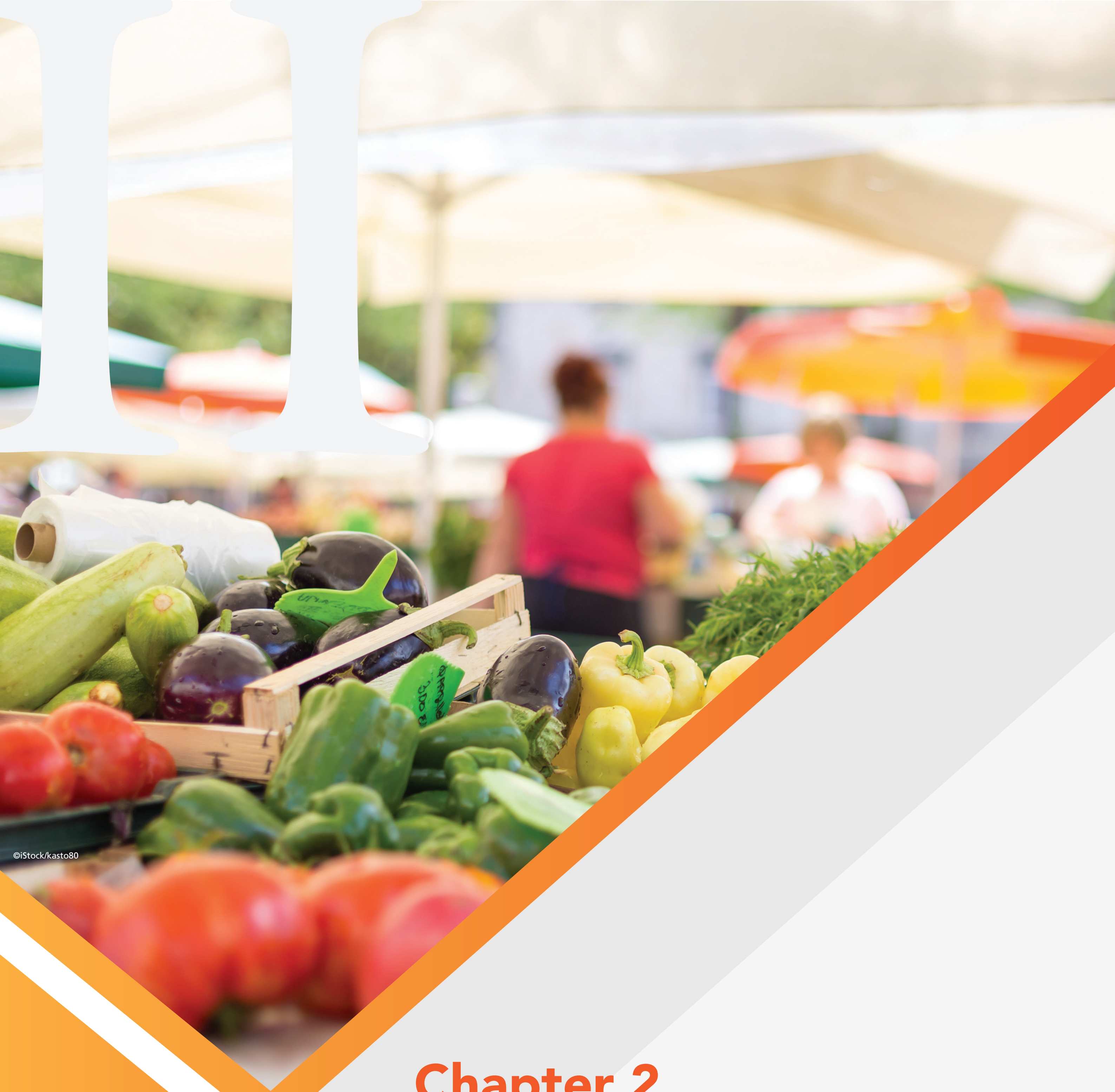
… and these countries also source a higher share of their food supplies from these items



Notes: The y-axis shows the share of food items that were classified as sugar-rich snacks, salty snacks and processed red meat in the food imports of a country (top panel) and in the food supply of a country (bottom panel). All data are 2017–2019 averages.

Source: Authors' own elaboration.

A mechanism that potentially explains this strong pattern is that "smaller" countries, such as island states, do not themselves have the processing capacities and/or endowments to produce a range of food items themselves. This may lead to higher demand for imports of processed foods with long shelf-life that substitute for a lack of nutritious options that may not be possible to be produced domestically (e.g. processed meat preparations rather than freshly slaughtered poultry).



Chapter 2.

How does trade policy affect relative prices and consumer incentives for different foods?

Imports matter considerably as a source of food supply for some countries and across a range of different food groups. The existing literature suggests that trade and trade policy may be relevant factors in shaping nutrition and diet-related health outcomes. Barlow *et al*. (2017) as well as Unar-Munguía, Flores and Colchero (2019) find that the conclusion of the North American Free Trade Agreement led to higher consumption of sugar and sweeteners in Canada and Mexico, respectively. Similarly, Abay, Ibrahim and Breisinger (2022) combine macro-data on tariffs with micro-data on individual body weight outcomes from several low- and middle-income countries and find that tariff rates on processed energy-dense foods high in fats, sugars and/or salt are negatively associated with body weight. Nevertheless, recent studies suggest that trade policy, on its own, may be a relatively unimportant driver of improving nutrition. For example, Masters *et al*. (2023) find that globally, a complete elimination of import tariffs would only decrease the cost of a healthy diet by around 0.58 percent, on average. The second part of this report contributes to the vibrant debate on the role of trade policy in shaping nutrition-related outcomes by focussing on if and to what extent import tariffs levied by countries on food imports shape relative consumer prices for foods with different nutritional characteristics.

To nest this exercise into a wider context, it is important to note that (relative) food prices are only one factor that will shape a consumers' demand and enable access to affordable healthy diets. Factors like the taste and smell of foods, culinary habits and culture, the cost of meal preparation and marketing all influence consumer preferences and purchase decisions (cf. Masters *et al*., 2023). Additionally, when considering the various drivers of food prices, import tariffs and other border measures may be factors, but other drivers will influence food prices as well and often more substantially so. Other drivers include domestic factors – such as the cost of labour and infrastructure required to transport, store, and distribute foods to final consumer – as well as trade policy-independent global factors, for example the global cost of food and non-food commodities (fertilizers, energy). Furthermore, domestic policies, including subsidies and domestic taxes may also distort prices.

From the vantage point of policy, it is also necessary to stress that import tariffs are only one trade policy tool that can affect the relative price of foods and shape consumer price incentives. While import tariffs typically vary by product and trading partner and are used by virtually all countries worldwide, the magnitude of agricultural tariff protection has decreased considerably since the Uruguay round of trade negotiations. Contrary to this, non-tariff measures (NTMs) are widespread.[26] For example, as reported in a recent flagship publication by FAO, the International Fund for Agricultural Development, the United Nations Children's Fund, the World Food Programme, and the World Health Organization (2022), around 80 percent of the total import value of 100 countries is subject to NTMs and agrifood products are usually disproportionally affected by these measures. Beyond this, the economic effects of NTMs when converted into tariff equivalents are often found to be higher than ordinary import tariffs. For example, using a global dataset, Gourdon, Stone and van Tongeren (2020) estimate that tariff equivalents for technical barriers to trade and sanitary and phytosanitary measures combined are equivalent to an eight percent tariff for vegetable

[26] NTMs have been broadly defined as "(...) policy measures, other than ordinary customs tariffs, that can potentially have an economic effect on international trade in goods, changing quantities traded, or prices or both" (UNCTAD, 2010, p. xvi). In the context of agrifood trade, NTMs include, for example, sanitary and phytosanitary requirements or requirements with respect to labelling and packaging. It is important to note that NTMs in agrifood trade generally fulfil important functions, with sanitary and phytosanitary measures for example being in place for the protection of human, animal, or plant life or health. Food safety measures, for instance, are put in place to ensure that imported food commodities are safe for human consumption (FAO, IFAD, UNICEF, WFP and WHO, 2022).

products and close to 14 percent tariff for processed foods. Recent evidence also suggests that in light of widespread import tariff reductions, some countries have increased their use of NTMs for protectionist measures (Baylis *et al*., 2022). Other trade policy tools include, for example, export restrictions, which are often imposed by countries on staple foods and in the pursuit of food security objectives. To illustrate, in the context of the war in Ukraine, Egypt imposed a short-lived ban on exports of various foodstuffs citing food security concerns (FAO, 2022b). Finally, it is important to stress that the aggregate costs of trading agrifood products internationally is shaped by both policy factors (such as tariffs, NTMs or certain regulations) but also by non-policy factors such as geography and distance to trading partners that affect transport costs, or the quality of infrastructure (FAO, 2022a).

While the introduction or increase of tariffs can affect food availability and prices it is important to note that countries generally implement tariffs for the pursuit of policy objectives other than nutrition. These include issuing protection to domestic industries from import competition, the collection of tax revenues, or the reduction of a trade deficit. For instance, following a long episode of trade liberalization, in 2016 Egypt substantially raised import tariffs for more than 300 products with the intention of reducing the country's trade deficit (Giovannetti, Marvasi and Vivoli, 2021).

In brief, the analysis in this part explores how import tariffs – as one trade policy instrument employed by virtually all countries around the world – affect the relative price of various food groups and hence consumer price incentives for foods with different nutritional characteristics. Generally, tariffs will increase domestic consumer prices for the targeted imported product and its domestic substitutes (e.g. imported apples and locally grown varieties). As such, an important policy question is whether countries' import tariff regimes shape the relative prices faced by consumers to purchase more or less nutritious foods and whether tariff policy could be used for nutrition-related goals.

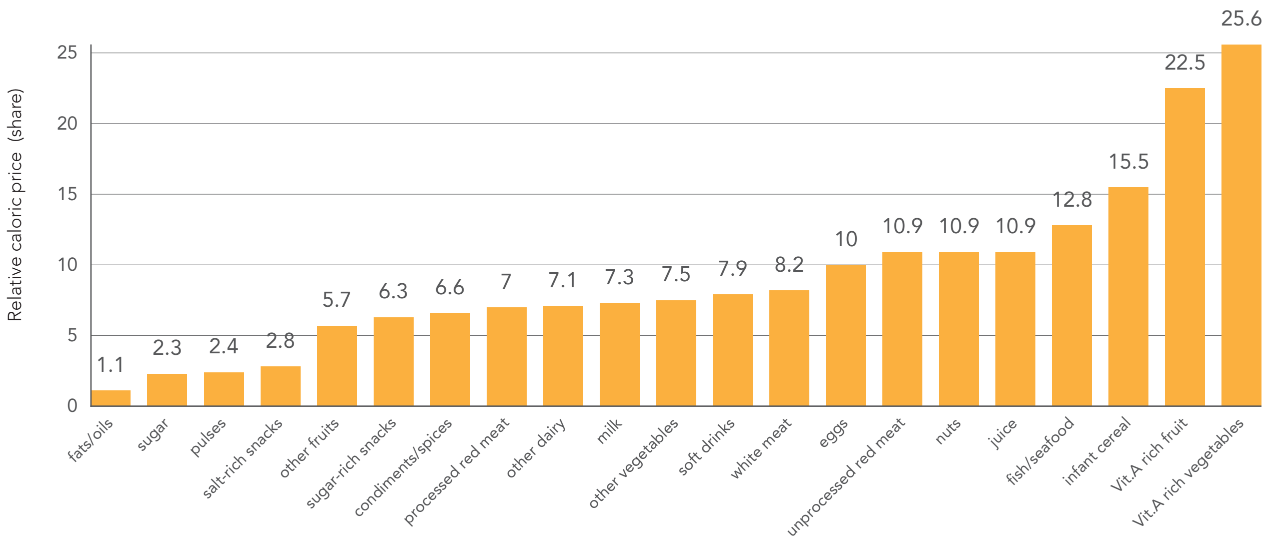
2.1 The concept of relative caloric prices

To empirically explore the implications of trade policy on the relative price of different foods, relative caloric prices (RCPs) were employed, a concept originally introduced by Headey and Alderman (2019).[27] RCPs express how expensive it would be for a country's consumers to purchase one calorie from a food group of interest (e.g. "sugar-rich snacks") relative to the cost of purchasing one calorie from a benchmark basket of staple foods in proportions that reflect the respective contribution of different foods included in this basket (wheat, rice, yams, potato, cassava, etc.). For example, an RCP of six for the food group "sugar-rich snacks" would mean that it is six times as expensive for a consumer to purchase one calorie coming from "sugar-rich snacks" than it is to buy one calorie from the benchmark basket of staple foods. Consequently, RCPs reflect the extent to which relative prices can provide an incentive to diversify their food purchases away from staple foods and towards different nutritious options.[28] **Figure 10** shows computed RCPs for the case of Saudi Arabia.

[27] For an overview of this data collection initiative see: **World Bank.** 2024. International Comparison Program (ICP). In: *World Bank*. [Cited 20 March 2024]. https://www.worldbank.org/en/programs/icp. For the analysis in this paper, ICP retail price data were kindly provided by Derek Headey, IFPRI.

[28] Annex I provides a comprehensive explanation of RCPs as well as their practical computation.

Figure 10. Relative caloric prices in Saudi Arabia (2017 data)



Notes: RCPs for different food groups for Saudi Arabia for 2017 are presented. In the version presented here, RCPs were computed using the average of the three cheapest retail prices in both the staple foods benchmark basket and the included food groups of interest. For legibility the food group "dark green leafy vegetables" was dropped (RCP = 69.7). Among the staple foods, Saudi Arabia has no price data for food groups that are less likely in this country but relevant in others, namely millet, oats, sorghum, cassava and yams.

Source: Authors' own elaboration.

As suggested by large and positive values, for Saudi Arabian consumers it is considerably more expensive to purchase one calorie from food groups like pulses, eggs, or fruits and vegetables than it is to purchase one calorie from the staple foods basket.[29] In comparison to nutritious foods, sugar, fats/oils as well as salt-rich snacks have comparatively low RCPs. With an RCP of 1.1, it is nearly equally as expensive to buy one calorie from the fats/oils group as it is to buy one calorie from the staple foods basket.

2.2 Data and descriptive statistics

To explore how trade policy shapes relative prices as captured by RCPs, the analysis combines data on RCPs for 22 different food groups across 173 countries and for 2011 and 2017 with data on import tariffs at the food group level.[30] Annex I provides a comprehensive description and summary of the data composition. Table 1 provides some essential summary statistics for 2017 as the latest available year. There is considerable variation across food groups for both RCPs as well as import tariffs. For example, for various fruits and vegetables, RCPs are high on average across countries, while for fats/oils as well as sugar and sugar-rich snacks RCPs are comparatively low.

[29] As for other NENA countries, wheat products account for a large share of food supply in Saudi Arabia (about 27 percent of total food supply or close to 60 percent of calories from the staple foods basket).

[30] For this report, data on "effectively applied" tariffs were used. Effectively applied tariffs are those tariffs that a country imposes on any product/origin country combination after taking into account that trade between two countries may be subject to preferential treatment. This may, for example, be due to trade agreements or unilateral preference schemes such as the European Union's Everything But Arms (EBA) agreement. Given that each food group covers several items, we applied averaged tariff rates across these food items. Annex I provides additional details.

Table 1. Relative caloric prices and import tariffs (2017 values)

Food group		Relative caloric prices*		Import tariffs**	
		Mean	SD	Mean	SD
Animal-source foods	milk	3.4	*2.4*	13.1	*26.2*
	unprocessed red meat	3.9	*1.9*	10.0	*13.6*
	white meat	4.2	*2.6*	12.5	*18.7*
	other dairy	4.4	*2.8*	11.4	*19.7*
	eggs	4.7	*3.1*	6.1	*12.3*
	fish/seafood	5.5	*2.7*	5.8	*6.4*
	processed red meat	7.3	*4.7*	11.9	*17.8*
Sugar-rich, salt-rich and fat-rich foods	fats/oils	0.5	*0.3*	6.6	*7.0*
	sugar	0.6	*0.4*	10.2	*23.2*
	sugar-rich snacks	1.8	*1.0*	10.1	*9.9*
	salt-rich snacks	2.6	*1.6*	8.1	*7.8*
	soft drinks	4.7	*3.3*	9.9	*12.2*
	juice	5.3	*3.7*	9.0	*10.5*
	condiments/spices	7.4	*13.2*	18.1	*59.8*
Fruit and vegetables	nuts	2.4	*1.6*	5.6	*8.6*
	other fruits	3.3	*1.7*	7.5	*8.4*
	pulses	3.3	*4.3*	6.9	*23.5*
	other vegetables	4.7	*2.2*	8.6	*9.8*
	infant cereal	5.3	*3.3*	6.1	*10.5*
	vitamin-A rich fruits	7.2	*3.6*	6.8	*9.1*
	vitamin-A rich vegetables	12.8	*8.2*	7.1	*10.3*
	dark green leafy vegetables	22.8	*15.4*	6.2	*8.8*

Notes: Food group classifications following Headey and Alderman (2019). *RCPs with variable shares in the staple foods basket (see Annex I for notes). **Import tariffs are average, effectively applied import tariffs across all HS6 varieties included under a food group (not import-value weighted). All data are 2017 values and 172 countries are included. Food groups included in the staple basket category are excluded since RCPs for this category have a different interpretation.

Source: Authors' own elaboration.

From a global perspective, not only are calories from sugar and fats/oils cheaper on average than calories from the staple foods basket, but the corresponding standard deviation for these two food groups is low, indicating that this is the case for most countries included in the sample. Regarding tariffs, an important result is that standard deviations are large across all food groups, indicating substantial variation across countries.[31]

[31] An important methodological point is that the tariff data presented in Table 1 are not import-value weighted. This means that for each importer, tariffs across all origin countries of a food group are treated equally regardless of the importance of an origin country in the importer's imports of the food group under consideration. Values remain unweighted in this empirical work since trade flows may be an outcome of tariff policy and endogenously respond to change in tariff rates. To highlight the significance of this point with an example, according to the data, Egypt had an unweighted average effectively applied tariff on the food group "wheat" of 8.9 percent in 2017. Once weighting Egypt's bilateral tariffs on wheat imports by the respective contribution of different trading partners this value drops to close to zero (0.015 percent ad valorem).

2.3 Empirical estimation approach

How do import tariffs affect the relative prices of different foods? Empirically, quantifying this relationship can be confounded by several observable and unobservable factors. For instance, countries with different income levels may systematically apply different trade policies. Food price levels may also differ due to some unobservable time-varying and time-invariant attributes. Temporal shocks, such as drought or economic downturns, may also affect trade policies and domestic price of foods at the same time. Trade policies, such as import tariffs, could also be endogenous to changes in domestic food prices and food availability. For example, increases in import tariffs on foods considered "unhealthy" may be explicitly introduced as a policy response to public health concerns. In addition, some foods are globally traded while others are mostly produced and consumed domestically, implying heterogeneities in the response of food prices to changes in trade policies. In view of these considerations, an empirical approach that accounts for potential temporal and spatial variations in import tariffs across countries and food groups is necessary.

To quantify the relationship between RCPs and import tariffs, a two-way fixed effects model is employed – an empirical approach that exploits temporal variations in tariff rates and RCPs across countries and across food groups. Fixed effects effectively capture unobservable time-invariant differences across countries, as well across food groups. The fixed effects model specification is as follows:

Equation (1): $$RCP_{fct} = \alpha_f + \alpha_c + \beta_1 T_{fct} + \beta_2 X_{fct} + \alpha_t + \varepsilon_{fct}$$

Where RCP_{fct} stands for relative calorie price (RCP) of a food group f in a country c in year t, i.e. either 2011 or 2017. α_f is a vector of food group fixed effects (22 food groups). α_c represents a vector of country fixed effects, which can control for any unobservable time-invariant differences across countries, including cultural, geographic and climate-related factors that remain broadly constant over time. T_{fct} denotes the average import tariff rate for food group *f*, implemented by country *c* in year *t*.[32] X_{fct} is a vector including variables related to countries and food groups, including the share of imports in the total domestic availability of a food group, gross domestic product per capita, and the share of the population that is living in urban areas. αt is a year dummy variable to capture changes in the evolution of food systems or nutrition transitions between 2011 and 2017. Finally, ε_{fct} is an error term capturing unobservable factors that could have an influence on RCP_{fct}. Of primary interest in the context of the debate around trade policy and nutrition is the estimate for β_1 – the effect of import tariffs on the relative caloric price of a food group.

As prices for a specific food group are likely to respond not only to their "own" import tariffs but also to changes in import tariffs on other foods, equation (1) is also estimated with relative tariff rates instead of average ones.[33] These relative tariff rates are constructed in the same manner as the RCPs with tariffs rates of

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[32] Non-linear terms (higher-order polynomial terms) associated with tariff rates are also included and retained whenever they appear statistically significant.

[33] For example, high tariffs on rice may induce higher demand for other cereals thereby increasing their prices.

a food group being expressed relative to the tariff rates of the benchmark category of staple foods.[34] Finally, from an empirical perspective it is important to note that temporal changes in RCPs, between 2011 and 2017, may arise for two reasons. First, due to actual differences in the relative prices of different food groups, and second, due to changes in the composition of the food groups included in the benchmark basket of staple foods. For example, the relative importance of individual staple foods included in the benchmark basket could change across time within the same country due to nutrition transition or other factors.[35] Thus, two variants of RCPs are considered in the estimations: one with changing shares of staple foods in the benchmark basket and one with fixed shares as observed in 2011.

The empirical model specified in equation (1) exploits temporal variations in RCPs and tariff rates across countries, as well as across food groups within the same country. Fixed effects for country and food group control for any unobservable time-invariant cross-country differences and cross-food group heterogeneities. However, equation (1) may suffer from endogeneity problems, arising from possible bi-directional causality between RCPs and tariff rates. For example, policymakers may adjust tariff rates to respond to domestic food availability and prices, a scenario in which prices determine tariff rates rather than the other way around. Furthermore, the impact of changes in tariff rates may not be immediately felt in domestic food systems if such changes had to dissipate through the domestic economy. To address these concerns, in addition to quantifying a contemporaneous relationship, lagged import tariff rates are employed, and the following empirical specification is estimated:

Equation (2):

$$RCP_{fct} = \alpha_f + \alpha_c + \beta_1 T_{fct-1} + \beta_2 X_{fct} + \alpha_t + \varepsilon_{fct}$$

Where all terms, except T_{Fct-1}, are defined as in equation (1). T_{Fct-1} stands for lagged tariff rate or simply the import tariff rate in the previous year. Equations (1) and (2) are estimated for all food groups combined, as well as by categorizing the food groups across three broad categories: (i) animal-source foods, (ii) sugar-rich, salt-rich, and fat-rich foods, and (iii) fruit and vegetables (also see Table 1 above).[36]

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[34] This is done by dividing a country's average import tariff in year (t) on food group (f) by the tariff rate associated with staple foods in the same year.

[35] To illustrate with an example, between 2011 and 2017, the importance of wheat products in India's national food supply derived from all staple foods included in the benchmark basket (wheat, rice, maize, oats, millet, sorghum, cassava, potatoes) increased from 34 percent to 38.9 percent (FAO, 2023a).

[36] Further technical comments on the estimation approach are as follows: first, the average tariff rates in the assembled data are sufficiently continuous with a small share of zero values, for which reason inverse hyperbolic sine (IHS) transformations are taken. Results produced from estimating Equation (1) and (2) therefore represent semi-elasticities (level-log) in these cases, with slight adjustments when the IHS transformations are applied to small values (Bellemare and Wichman, 2020). Second, unobserved factors associated with each country may generate correlation in the error terms in both equations. To capture this, standard errors are clustered at the country level.

2.4 Results and discussion: how are import tariffs associated with relative caloric prices?

Table 2 presents the estimation results for equations 1 and 2, while also controlling for the average import tariff implemented on staple foods.[37]

The estimates suggest that increasing the import tariff rate on a non-staple food group by 100 percent is associated with an increase of the RCP of that food group by around 0.19 on average.[38] This result is statistically significant at the one percent level (column 1). Expressing this estimate as a percentage of the average RCP in the sample (5.2) implies that a 100 percent increase in the tariff rate is associated with a 4 percent increase in the relative caloric price of the food group targeted by the increase (0.19/5.2). With lagged tariffs (Column 3), the mean effect strengthens. A 100 percent tariff increase can result in a 5 percent increase in the RCP. This is intuitive, because the impact of tariff rates may not be immediately passed-through to the domestic market and across various food groups. This implies that tariff impacts may be larger after some time. A second result is that tariffs implemented on staple foods also affect RCPs for other foods. Specifically, a 100 percent increase in the average tariff rate implemented on staple foods is associated with a reduction in the relative price of non-staple foods by around 10 percent, if the obtained point estimate is applied again to the mean RCP in the data.[39] Finally, the results remain qualitatively unchanged when considering a different approach to computing RCPs, namely by keeping staple foods shares fixed across 2011 and 2017 (see columns 2 and 4).

[37] The tariff indicator used in these regressions corresponds to the average, effectively applied import tariff applied by an importing country across all individual HS6<>trading partner combinations that belong to an RCP food group.

[38] To recap, the RCP as the dependent variable in these estimations is a ratio: price of a calorie from a food group of interest / price of a calorie from staple foods. To allow for a more seamless interpretation of results, for the remainder of the text the obtained point estimates are expressed as percent of the mean observation in the data.

[39] However, this result is not statistically significant at conventional levels across all estimated specifications. See Table 4 for further results on the importance of tariffs on the benchmark category.

Table 2. Import tariffs and relative caloric prices

	(1) RCP	(2) RCP with fixed share	(3) RCP	(4) RCP with fixed share
IHS (average tariff)	0.193***	0.191***		
	(0.072)	(0.072)		
IHS (average tariff rate for staple foods)	-0.436**	-0.329		
	(0.206)	(0.214)		
IHS (average tariff)-lagged			0.280***	0.282***
			(0.081)	(0.081)
IHS (average tariff rate for staple foods) -lagged			-0.523*	-0.474*
			(0.265)	(0.266)
Year/ICP round dummy (2011 or 2017)	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Food group fixed effects	Yes	Yes	Yes	Yes
Time-varying characteristics of countries and food groups	Yes	Yes	Yes	Yes
R-squared	0.611	0.610	0.614	0.613
Mean RCP	5.212	5.231	5.212	5.231

Notes: IHS stands for inverse hyperbolic sine transformation of values. The time-varying controls include the share of import in the domestic availability for a food group; gross domestic product per capita, share of urban population and oil revenue. Standard errors, clustered at the country level, are given in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Authors' own elaboration.

The results presented above relate to the estimated effects of import tariff changes on relative caloric prices on average across all food groups. This masks some important heterogeneities between various food groups that may arise due to the fact that relative prices of different foods can react differently to tariff changes, depending on characteristics such as the exposure of food groups to global markets and other prevailing factors in domestic and international markets. In order to address such heterogeneities, the data is organized into three categories, namely animal-sourced foods; foods high in fats, sugars and/or salt and fruit and vegetables. Table 3 presents the estimation results, which suggest that relative prices of foods in different categories respond differently to changes in tariff rates. For example, relative caloric prices of animal-source foods do not, on average, respond to changes in the corresponding import tariffs as the estimated coefficient is statistically insignificant (Panel A). Nevertheless, the relative price of animal-sourced foods does respond to tariff rates on staple foods, as reflected by the statistically significant coefficient associated with lagged tariffs on staple foods. In contrast, Panel B shows that relative caloric prices of foods high in fats, sugars and/or salt do react to changes in tariffs targeting products in this group, but such effects take time to be realized and appear to be statistically significant only with a lag. In sum, in the case of both animal-source foods and foods high in fats, sugars and/or salt point estimates for the effects of tariffs on relative prices are relatively small in almost all specifications.

These findings stand in contrast to the results found for fruit and vegetables (Panel C), which are of particular importance to healthy diets. Across all specifications, increases in import tariffs targeting these foods are found to have relevant and statistically significant effects both in specifications that include contemporaneous effects, as well as those that consider lagged values. For example, the point estimate for the effect of import tariffs implemented on fruit and vegetable foods imply that raising the tariff rate by 100 percent is associated with an increase in the relative caloric price of foods in the fruit and vegetable foods category by 6 percent, if the obtained point estimate is applied to the mean observation in the sample.[40] This effect further increases with a time lag. A 100 percent increase in the tariff rate implemented in the previous year is associated with approximately a 7 percent increase in the relative calorie price for fruit and vegetable foods.

Table 3. Import tariffs and relative caloric prices: results disaggregated by broad food category

	(1) RCP	(2) RCP with fixed share	(3) RCP	(4) RCP with fixed share
Panel A: animal-sourced foods				
IHS (average tariff)	-0.064	-0.065		
	(0.076)	(0.077)		
IHS (average tariff rate for staple foods)	-0.192	-0.072		
	(0.306)	(0.321)		
IHS (average tariff)-lagged			-0.001	-0.009
			(0.077)	(0.079)
IHS (average tariff rate for staple foods) -lagged			-0.662**	-0.612*
			(0.314)	(0.326)
R-squared	0.610	0.606	0.586	0.583
Mean RCP	5.181	5.196	5.305	5.317
No. observations	1 632	1 632	1 746	1 746
Panel B: foods high in fats, sugars and/or salt				
IHS (average tariff)	0.126	0.125		
	(0.127)	(0.127)		
IHS (average tariff rate for staple foods)	0.018	0.106		
	(0.190)	(0.217)		
IHS (average tariff)-lagged			0.204**	0.208**

[40] That is: 0.419/7.058 ~ 0.059.

	(1) RCP	(2) RCP with fixed share	(3) RCP	(4) RCP with fixed share
			(0.093)	(0.093)
IHS (average tariff rate for staple foods) -lagged			-0.301	-0.267
			(0.194)	(0.218)
R-squared	0.578	0.575	0.574	0.570
Mean RCP	3.262	3.271	3.375	3.380
No. observations	1 710	1 710	1 839	1 839
Panel C: Fruit and vegetable foods				
IHS (average tariff)	0.419**	0.413**		
	(0.173)	(0.172)		
IHS (average tariff rate for staple foods)	-0.933*	-0.775		
	(0.483)	(0.470)		
IHS (average tariff)-lagged			0.507***	0.516***
			(0.184)	(0.185)
IHS (average tariff rate for staple foods) -lagged			-0.699	-0.618
			(0.516)	(0.499)
R-squared	0.606	0.606	0.617	0.616
Mean RCP	7.058	7.088	7.095	7.124
No. observations	1 821	1 821	1 945	1 945
Controls in all estimations				
Year/ICP round dummy (2011 or 2017)	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Food group fixed effects	Yes	Yes	Yes	Yes
Time-varying characteristics of countries and food groups	Yes	Yes	Yes	Yes

Notes: IHS stands for inverse Hyperbolic Sine Transformation of values. The time-varying controls include the share of import in the domestic availability for a food group; gross domestic product per capita, share of urban population, and oil revenue. Standard errors, clustered at country level, are given in parentheses.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Authors' own elaboration.

Table 4 further considers whether the size of tariffs on a food group relative to tariff protection issued on staple foods affects relative caloric prices. In this specification, the average import tariff on a food group is replaced with the ratio of tariffs on that food group to tariffs on staple foods. This approach takes into account that several food groups can be substitutable and hence an increase in the relative price of a specific food can lead to an increase in demand for a substitutable food. However, staple foods may substitute some food groups but not others, implying that responses in relative calorie prices may vary across different groups depending on the degree of substitutability between food groups. In the context of achieving the global nutrition targets and global dietary patterns, understanding the relationship between the tariffs levied on different food groups relative to those on starchy stapples is also important in light of the phenomenon commonly referred to as the "nutrition transition", which describes the shift of a population away from traditional diets with a high share of caloric supply from staples and towards an increasing role of foods that are energy-dense and more processed (Shekar and Popkin, 2020).

Table 4. Relative import tariffs and relative caloric prices: results disaggregated by broad food category

	(1) RCP	(2) RCP with fixed share	(3) RCP	(4) RCP with fixed share
	Panel A: animal-source foods			
Relative tariff	-0.099*	-0.100*		
	(0.053)	(0.053)		
Relative tariff-square	0.002*	0.002*		
	(0.001)	(0.001)		
Relative tariff-lagged			0.011	0.004
			(0.062)	(0.062)
Relative tariff-lagged-square			-0.002	-0.002
			(0.002)	(0.002)
R-squared	0.697	0.694	0.663	0.661
Mean RCP	5.085	5.101	5.266	5.277
No. observations	1 273	1 273	1 359	1 359
	Panel B: foods high in fats, sugars and/or salt			
Relative tariff	0.473***	0.475***		
	(0.129)	(0.130)		
Relative tariff-square	-0.045***	-0.045***		
	(0.011)	(0.011)		
Relative tariff-lagged			0.256***	0.253***
			(0.096)	(0.097)

	(1) RCP	(2) RCP with fixed share	(3) RCP	(4) RCP with fixed share
Relative tariff-lagged-square			-0.012**	-0.011**
			(0.005)	(0.005)
R-squared	0.559	0.556	0.557	0.553
Mean RCP	2.972	2.981	3.108	3.113
No. observations	1 343	1 343	1 448	1 448
Panel C: Fruit and vegetable foods				
Relative tariff	0.944**	0.951**		
	(0.409)	(0.407)		
Relative tariff-square	-0.175**	-0.177**		
	(0.080)	(0.080)		
Relative tariff-lagged			0.876**	0.907**
			(0.389)	(0.393)
Relative tariff-lagged-square			-0.138***	-0.140***
			(0.039)	(0.039)
R-squared	0.621	0.621	0.627	0.626
Mean RCP	7.002	7.031	7.055	7.082
No. observations	1 660	1 660	1 772	1 772
Controls in all estimations				
Year/ICP round dummy (2011 or 2017)	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes
Food group fixed effects	Yes	Yes	Yes	Yes
Time-varying characteristics of countries and food groups	Yes	Yes	Yes	Yes

Notes: Relative tariff stands for the ratio of food group-specific average tariff rate over the average tariff rate for staple foods. The time-varying controls include the share of import in domestic availability for each food group; gross domestic product per capita, share of urban population, and oil revenue. Standard errors, clustered at the country level, are given in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Authors' own elaboration.

In general, the estimates suggest that relative caloric prices also respond to changes in relative tariffs across commodities. This means that changes in the tariffs applied on staple foods will matter for the relative prices of foods that do not belong to this category. Additionally, such effects differ according to the food group under consideration. As shown in Table 4, the estimated coefficients for animal-source foods are small and barely statistically significant (and negative) in most specifications. By contrast, relatively sizable effects are found for foods high in fats, sugars and/or salt and fruit and vegetable foods, with point estimates for the latter group being more than twice as large than for the former, a result that is in line with the previous findings. This is not surprising given that staple foods are likely to be substitutes for some of the sugar and fat-rich foods. The impact of changes in relative tariff rates appears to be stronger for fruit and vegetable foods. Applying the estimate in Panel C, Column 1 to the average RCP in the fruit and vegetable category, an increase in the ratio of the tariff levied on fruit and vegetables to staple foods by one is associated with an increase in the RCP of a fruit and vegetable foods by around 13.5 percent.[41] Finally, across all specifications, the effect of relative tariffs diminishes as ratios between the tariff on the targeted food group and tariffs on staple foods become larger, as reflected by the negative and statistically significant squared term.

What can this analysis say for the potential of import tariff policy to shape consumer price incentives for foods with different nutritional characteristics? First and foremost, it is critical to note that throughout, the estimated effects associated with changes in tariff rates on specific foods are relatively modest. For example, increasing tariffs on a food group by 100 percent would at most result in an increase of the relative caloric price of the targeted food group by 4 to 5 percent. This means that in order to have a meaningful impact on prices, tariff changes would have to be very substantial. Secondly, it is important to note that relative tariffs matter: The tariffs that a country implements on staple foods – foods that account for the bulk of caloric intake worldwide – will also shape the relative cost of alternative sources of calories. Finally, the results on the disaggregated broader food group categories imply that different food groups respond differently to tariff changes. For example, a 100 percent increase in the tariff rate on animal-source foods has negligible impact, while a corresponding increase in the tariff on fruit and vegetable foods can bring about 7 percent increase in the relative caloric price of foods that fall into this category.

That relative caloric prices for fruit and vegetable foods are more sensitive to tariff changes is also relatively consistent across different specifications, with several possible explanations for this finding. First, these foods are relatively more expensive, especially in many low- and middle-income countries (Headey and Alderman, 2019). Hence increases in tariff rates may make them unaffordable. Second, many households in low- and middle-income countries may not be able to afford a "healthy diet" (FAO, IFAD, UNICEF, WFP and WHO, 2024), implying that the demand for energy-dense foods is likely to be inelastic, while that for fruit and vegetables, can be more elastic. Finally, most countries have domestic policies that support and subsidize production and consumption of staple foods, yet there are not many countries that subsidize production and consumption of fruit and vegetable foods. The significant heterogeneity in impacts of tariff changes across different food categories could, in theory, offer some opportunities for nutrition-sensitive tariff interventions targeted to improve the relative attractiveness of nutritious food items for consumers. However, it is again important to stress that the potential of such policy changes appears to be relatively modest. Additionally, raising import tariffs will imply trade-offs and other policy instruments may hold greater promise in providing incentives to promote a higher consumption of nutritious foods.

[41] That is: 0.944/7.002 ~ 0.135.

Concluding remarks

Policy considerations and opportunities for further research

Taken together, the findings presented in this report support several key policy messages.

Policy message 1: International trade is key in promoting food security, and contributes towards enabling healthy diets, critical for the achievement of multiple nutrition and health objectives including through increasing the variety of foods supplied that, in turn, provides the basis for dietary diversity. Many countries source a sizable share of their overall domestic supply of calories and different nutrients through imports.

Policy message 2: Overall, import tariffs are not effective in shifting consumer price incentives towards increasing the consumption of nutritious foods or discouraging the consumption of foods high in sugar, salt or fats/oils. Overall, the modest impacts established in Chapter 2 of this report suggest that opting for other policy instruments that act directly on the relevant margin would be necessary to improve nutritional outcomes.

Policy message 3: Instead of import tariffs, consumer subsidies or taxes could provide incentives for the consumption of nutritious foods or disincentives for foods high in sugar, salt or fats/oils. These domestic policy instruments may be more suitable since they equally encourage or discourage the consumption of a food regardless of its origin (imported or domestically produced). For example, in Latvia, a reduction in the value-added tax on fruit and vegetables was found to have led to a reduction in their retail prices (FAO, IFAD, UNICEF, WFP and WHO, 2022). A literature review on ex-post evidence regarding the effectiveness of different policies targeted at promoting healthier diets considered the security and nutrition on soft drinks high in sugar (soda taxes) and foods high in fats (fat taxes). Across five developed economies, the review concluded that "(…), the body of evidence is not conclusive, but is (strongly) suggestive of effectiveness in terms of reducing consumption (…)" (Mazzocchi, 2017, p. 5). Similar results are reported in a review of studies on the effects of sugar-sweetened beverages taxation in six middle-income countries (Nakhimovsky *et al.*, 2016). In the context of trade and nutrition, these findings are particularly relevant since in many countries, foods like sugar-sweetened beverages are not imported in large quantities but instead produced domestically.

Beyond these considerations, it is also important to highlight that raising tariffs and other barriers to international trade may negatively affect food security and nutrition as well as other development objectives. Policymakers should therefore carefully consider potential trade-offs. For example, import tariffs (or domestic taxes) on any food product would likely affect overall food supply. Implementing such fiscal measures could undermine sufficient intake of calories in some cases if not accompanied by measures that offer support for consumers to access nutritious foods. With regards to other development objectives that a country may have, raising import tariffs on a product that is considered harmful from a public health perspective (e.g.

sugar) could lead to retaliation by trading partners that matter for the country's own export performance.[42] Additionally, there is also some evidence that in the long run trade liberalization can be important to raise overall productivity in the agricultural sector (for example by raising incentives to innovate and leading to the exit of the least productive producers due to import competition). For example, in Chile an analysis of 70 000 farms found that farm yields are positively correlated with exposure to international trade (see FAO, 2022a).

Overall, integrated approaches that are conscious of country-specific contexts and that combine different policy instruments appear to be needed to enable better nutritional outcomes. This could, for example, include using revenues generated from soda/fat taxes to finance targeted initiatives to reduce undernutrition (FAO, IFAD, UNICEF, WFP and WHO, 2022).

Building upon the results of this report and the above considerations, opportunities for future policy research on the nexus between nutrition, trade and trade policy are as follows:

1. Import tariffs are only one trade policy instrument that may contribute to shaping consumer prices for different foods. Other aspects of trade policy that could be considered in future research on trade and nutrition include food-group specific trade costs or NTMs such as sanitary and phytosanitary measures or technical barriers to trade, which may disproportionately affect fresh products. This is particularly important in the context where changes in tariff rates may interact and induce changes in NTMs (Baylis *et al*., 2022). As shown in this report, fruit and vegetable foods are relatively more sensitive to import tariffs, providing motivation to explore the potential heterogenous effects of other trade policies as well.

2. The effects of trade and investment liberalization events on nutrition-related outcomes are likely to be highly country- and context-specific. To illustrate this with some examples, Masters *et al*. (2023) suggest that intra-African trade liberalization would only have a marginal effect on the cost of a healthy diets in countries that partake in the African Continental Free Trade Agreement (AfCFTA), while studies like Barlow *et al*. (2017) and Unar-Munguía, Flores and Colchero (2019) find that the conclusion of the North American Free Trade Area Agreement led to substantially higher supply and consumption of sugar and sweeteners in Canada and Mexico, respectively. Such findings suggest that more research should be conducted on the effects of specific trade and/or investment agreements, with a view to identifying aspects that render them harmful (or beneficial) to nutrition-related outcomes.[43]

3. Beyond trade policy, results in this report suggest that the size of a country is strongly correlated with the share of foods high in sugar, salt and/or fats and oils in total imports. More research on which characteristics drive this pattern could be relevant, such as features of domestic agricultural production, diversity of processing industries, tax structure, etc.

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[42] For a prominent example, as discussed in Fajgelbaum *et al*. (2020), in 2018 the United States of America raised import tariffs on a range of products, with critical trading partners like China, Canada or Mexico retaliating promptly. Critically, if and to what extent a trading partner may retaliate to tariff increases will be highly dependent on the specific context. For example, if a targeted product is not relevant as an export product for the implementing country's main export partners, retaliation seems less likely.

[43] For example, in the NENA region, Bahrain concluded a trade agreement with the United States of America in 2006, the effects of which on nutritional outcomes in the country have not yet been studied.

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Annex I.

Comprehensive documentation on data assembly

This annex describes the composition of a dataset for a report with two goals. First, to characterize global agrifood trade from a nutritional perspective (Chapter 1). Second, to assess if and how trade policy shapes consumer price incentives for buying foods with different nutritional characteristics (Chapter 2). These issues are explored in a cross-country setting, bringing to bear a range of different datasets in the areas of trade and domestic production, nutrition, retail prices and trade policy. In the following sections the different data sources used for the project are described, along with information on their limitations.

I. Data on trade, production, utilization as well as nutritional content factors

The data described in this section are the main statistical basis to characterize global agrifood trade from a nutritional perspective (Chapter 1 of this report).

1. FAO supply utilization accounts (2000–2020)

Data on countries' imports, exports, production and food supply from different agrifood items are taken from FAO's supply utilization accounts (SuAs). The SuAs hold data at an annual level for 193 countries and for 457 individual agrifood items. Items are systematically classified using the UN's Central Product Classification (CPC) nomenclature (V. 2.1, expanded for agriculture and rural statistics), with each item being assigned a unique item code (e.g. "Raisins": CPC-Code 21411). In terms of data collection and assembly, data are compiled by the FAO Statistics Division from a range of sources, including government responses to FAO's annual production/utilization questionnaire, national statistical offices, customs offices, "unofficial" expert sources (e.g. International Coffee Organization) and academic work. For missing data, these sources are further complemented by employing different statistical methods such as using "mirrored" trade data for missing reports of a country's imports or exports or imputations using time series models, for missing data on domestic production (FAO, 2020). Finally, data are further cleaned and validated by detecting outliers and through an extensive exchange with countries. Combining the currently available SuA database (2010–2020) with an older series made available by the FAO Statistics Division for the purposes of this report, annual SuAs are available for a total of 193 countries over the period 2000–2020.[44]

[44] In 2010, the SuA methodology was updated with the main new feature being the absence of a so called "balancer variable". Specifically, in previous editions of the SuAs, one statistical domain (often stocks, feed or industrial used) would absorb any "unbalanced" quantities at the country<>year<>item level. In the new methodology, such imbalances are distributed across all statistical domains (for more details see FAO [2023]). While no trend breaks were evident between the "old" and the "new" series in key statistical domains such as imports or production, for Part 2 of the report, SuA data used are for 2011 and 2017 and therefore consistently taken from the series using the new methodology (except for the lagged 2011 values).

Since the SuAs do not hold data on "fish" or "seafood", items which are of nutritional importance in many countries, the data are appended by using annual country-level information from FAO's more aggregate food balance sheets (FBS).[45] Specifically, data on domestic production as well as imports and exports in quantity terms are taken from this data source for eight different items that are grouped together into a collector group of "fish and seafood".

2. Data on an item's edible portion and content of micro-, macro-nutrients and calories

The SuA data described in section 1 above are only available in quantity terms. In order to make cross-product and cross-country comparisons from a nutritional perspective it is therefore necessary to factor in information on an item's edible portion (e.g. "almonds, in shell" versus "bread") as well as nutritional content factors.

This information is taken from a new dataset developed by the FAO Statistics Division in collaboration with the FAO Food and Nutrition Division that provides data on the edible portion of 434 different CPC items, as well as caloric content and content of various micro- and macro-nutrients per portion of edible matter.[46] To compile these data, the FAO statistics team, in collaboration with nutrition experts from FAO, considered 29 different food composition tables with different coverage regarding nutrients and items. Out of these, 13 were selected to be of high enough quality using a set of screening questions, and served as a statistical basis to compile nutritional content factors at the CPC level.[47]

With respect to limitations, it should be noted that these data do not vary at the country or at the year level, i.e. 100 grams of wheat has the same edible portion as well as macro- and micro-nutrient content regardless of where and when they were produced. Also, these data do not include data on "fish" and "seafood". Therefore, caloric, fat and protein content of fish and seafood items was computed from information provided in FAO's FBS. Specifically, available information of the quantities supplied as "food" from eight different fish items were combined with information on calorie/fat/protein amounts supplied as food from the same items. This allowed for the computation of item-specific calorie/fat/protein content factors for the eight available fish and seafood items.[48] Conversion factors for micro-nutrients such as vitamins or minerals are not available for these items.

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[45] In brief, FBS are a more aggregated version of SuA, where items in individual food items are combined into one food category. For example, the SuA may hold data on wheat flour, bread, pastries etc., which would appear in the FBS data as the food group "wheat and products".

[46] The following nutrients are available in the dataset in addition to caloric contents. ***Macro-nutrients:*** protein, fat, carbohydrate, water, dietary fibre, alcohol, and ash. ***Minerals:*** calcium, iron, magnesium, phosphorus, potassium, sodium, and zinc. ***Vitamins:*** vitamin A (retinol equivalent), vitamin A (retinol activity equivalent), thiamine, riboflavin, niacin, and vitamin C.

[47] For more information see FAO. 2023b. Generation of new nutrients dataset from agricultural and food trade data 2000–2021 Notes on the process, procedures, and datasets structure for nutrients. Rome. Mimeo.

[48] It should be mentioned that the same method was employed for the FAO Flagship Report "The State of Food and Agriculture 2021". Conversion factors were computed by combining data from the variables "food supply (kilocalorie per capita per day)"and "food supply (gram per capita per day)", protein supply quantity (gram per capita per day), fat supply quantity (gram per capita per day).

Combining the data described under **sections 1 and 2** above yields a country-year-item panel dataset spanning the period 2000–2020, covering a total of 193 countries and information on quantities as well as edible portion and nutritional contents for 434 different agrifood items across a range of different statistical domains (imports, exports, domestic production, food supply, feed, further processing, etc.).[49]

Regarding the coverage and quality of these data, the following points should be noted. First, due to missing data on nutritional content, a total of 23 items for which data are available in the FAO SuAs are dropped from the sample. These 23 items mostly concern items that are usually used as feed (e.g. "gluten feed and meal"), non-food items (e.g. "industrial monocarboxylic fat", "wool grease and lanolin") or residues of commodities (e.g. "bran of pulses"). However, some of the 23 items for which data on nutritional content is missing are "proper" food items, such as "oil of castor beans" or "asparagus". Second, missing data are frequent in the SuAs, for example, due to non-reporting of countries in some years and/or lack of relevant information to impute missing data points. Further to this, it is not systematically the case that missing values are also indicated in the data as such. Instead, often a given year<>country<>item<>statistical domain (e.g. production/exports/imports, etc.) combination is missing from the data. To avoid computational issues of working with an incomplete dataset, the data were rectangularized at the level of year<>country<>item<>statistical domain with unreported combinations being included in the data as "properly" missing.

In the context of this report, from a conceptual angle an important advantage of complementing data on exports and imports with data on production or food supply of an item is that the impact of trade policy may differ significantly dependent on how relevant imports are to domestic supplies. For example, changes to import tariffs applicable to an item could have less of an impact on nutritionally relevant outcomes if a country produces a sizable share of domestic supplies itself.

II. Data on domestic retail prices and construction of relative caloric prices

In Chapter 2 of this report, the relationship between trade policy (import tariffs) and relative caloric prices (RCP) is explored. RCPs are a statistical concept introduced in a relatively recent but already influential study (Headey and Alderman, 2019). RCPs are computed on the basis of retail prices and express how expensive it would be on average for a country's consumers to buy one calorie from a food group of interest (e.g. "dark leafy green vegetables" or "sugar-rich snacks"), relative to the cost of buying a calorie from a benchmark basket of staple foods. RCPs are expressed in the form of ratios. For example, an RCP of "two" for the food group "nuts" would imply that on average it is twice as expensive for a consumer to purchase a calorie from the food group "nuts" than it would be to buy a calorie from staple foods. RCPs can therefore be interpreted as price-related consumer incentives to buy items from food groups that differ with respect to their nutritional characteristics and benefits (e.g. "confectionary" versus "vitamin A-rich fruits").

[49] To illustrate the character of these data with an example, in 2015 Italy produced 95 911 tonnes of the item "butter of cow milk". In the same year, Italy imported 37 339 tonnes of the same item and exported 7 628 tonnes. In this year, 125 623 tonnes of cow milk butter were supplied as food for human consumption, with the average food supply from "butter of cow milk" standing at 41 kilocalories per day per capita. In terms of nutritional contents, the share of "butter of cow" that is edible is "one", with 100 grams having 742 kilocalories, 81 grams of fat, and (among others) 15 milligrams of calcium, 359 milligrams of sodium and 808 milligrams of vitamin A (retinol activity equivalent).

For this report, a 2011 dataset consisting of RCPs for the cross-section of countries in Headey and Alderman (2019) is expanded by an additional year. Specifically, Headey and Alderman (2019) leverage 2011 data from the World Bank's International Comparison Programme (ICP) that holds data on domestic retail prices for 743 food items across 176 countries. They then combine these data with information on edible fraction and caloric content from the United States Department of Agriculture Food Composition database. Making use of the availability of a 2017 release of the ICP, which contains retail price data for 665 food items across 175 countries, for this report RCPs for 36 food groups were computed for both 2011 and 2017 as described next.[50] Throughout, the procedure described in Headey and Alderman (2019) was followed closely and these authors also provided data for the project that already expresses ICP retail prices in 2017 in terms of "kilocalories per edible portion" of an item.

First, to append the 2011 and 2017 waves of the ICP survey, each food item from 2017 was manually assigned to one of the 36 food groups created by Headey and Alderman (2019). Comparing the food items in 2017 to the previous 2011 data, around two thirds of all 2017 items have an identical match in 2011 (i.e. the name of the product is the same). The remaining one third includes new products, however most are variants of the same food product that can unambiguously be assigned to a specific food group (e.g. "risotto rice" is a new product only included in the ICP 2017 data but clearly belongs to the food group "rice"). After the group assignment, the 2017 dataset was appended to the 2011 dataset. This results in a panel data structure identified at the level of the country<>year<>ICP item. The panel is not balanced since the food items in each country differ across 2011 and 2017.

After having the necessary data for both years assembled at the level of individual food groups, the first step to constructing the RCPs themselves was to calculate the cost of a staple foods basket, which was used as the denominator in the final RCP ratio (cost of the benchmark basket of staple foods). In line with Headey and Alderman (2019), the selected nine staples were cassava, maize, millet, oat, potato, rice, sorghum, wheat, and yam. The share of each staple in the total staple foods basket was computed from data on food supply (kilocalorie per capita per day) as provided in the FAO food balance sheets. For each of the two years for which ICP data are available, a three-year average was taken (for 2011 the period 2010–2012 and for 2017 the period 2016–2019). Any missing data on shares at the country level was imputed using sub-regional averages as provided in the FBS.

Next, for the cost of the staple foods basket (the denominator in the final RCP ratio), four different variants were calculated:

- Two variants correspond to the use of minimum and median prices of the specific food retail items considered for each of the nine staple food groups, using year-specific shares for each of the two years as calculated above (2011 and 2017).

- The other two variants also use the minimum and median prices of specific retail items, however, this time the shares that individual food groups make up in the staple foods basket were kept constant at

[50] Following cleaning, a small number of food groups outside of the nine staple foods groups were dropped from the data. See below for details, along with a list of the final 31 food groups, of which 22 food groups are non-staple foods of interest.

their 2011 values. This was done to account for the fact that a food group-specific RCP (e.g. for "eggs) can change over the years either due to an actual change in final retail prices or because the share of any food group included in the staple foods basket can change, thus affecting the denominator of the RCP, independent of changes in retail prices (e.g. in the case of India, the share of wheat products in overall food supply derived from the nine staple food groups increased from 34 percent in 2011 to 38.9 percent in 2017 according to FAO-FBS data).

ICP retail prices were all expressed in international dollars, using the World Bank's data on purchasing power parity exchange rates. Due to this conversion, it was possible to impute missing retail price data at the level of country<>year for flours made from wheat and maize, which Headey and Alderman (2019) use as the default cheapest retail item in their computation of the cost of a staple foods basket.[51] It is relevant to note that only items for which ICP price data were available were included in the calculation of the staple baskets (e.g. in the case of Germany, no price data for "cassava" was available and hence this item does not enter the basket for this country).

Finally, RCPs by groups are constructed by averaging the three cheapest items in each of the 36 food groups constructed from the ICP retail price data and dividing them by the cost of the basket of staple foods. Since there are four variants of the cost of the staple foods basket as the denominator in the RCP ratio, this results in four different RCPs constructed for each of the food groups.

III. Mapping relative caloric prices to data on domestic production and trade

To explore how trade and trade policy are linked to the relative prices of different food groups, it is necessary to assign data on trade and trade policy for individual commodities to these food groups.

A key conceptual and data-related issue in this regard is around assigning agrifood items and commodities that are traded internationally to food groups that are built from data on final retail prices. Several issues of relevance emerge. First, given their purpose of facilitating cross-country comparison, the ICP data on final retail prices were limited to a set of items that is internationally comparable. Many items for which trade, production and trade policy data are available were not included, however developments in these items may well affect RCPs. For example, in some countries, "pigeons" are used as food and may contribute to the food group "white meat" or serve as a substitute for poultry meat. However, the ICP data does not hold prices for pigeon meat. Second, many domestically produced, imported or exported items are raw commodities (or "inputs") that are usually not retail options for final consumers. Third, it is often the case that one individual raw commodity may be used as an input into several different retail items, each of which may fall into a different RCP group with varying nutritional characteristics. To illustrate the second and third issue with an example, "soybeans", a widely traded commodity can be used for a range of purposes, such as:

[51] In Headey and Alderman (2019), for wheat and maize the lowest prices are always based on only "flour" products.

a.) feed for animals (contribution to meat food groups)

b.) production of soybean oil (contribution to the food group “fats/oils”)

c.) creation of “healthy” protein and fibre rich consumer items (e.g. tofu or as an ingredient in curries)

Which purpose imported or domestically produced raw commodities are used for and in what form they contribute to final retail item depends on characteristics of the domestic environment, such as consumer demands for different items or capacities of the domestic food industry.

To reflect such issues, when linking data on production and trade to data on domestic retail prices at the level of the different food groups for which RCPs were computed, two mappings were produced employing the list of 457 CPC items used by FAO to classify production and international trade data as a basis.

The first mapping identifies those final retail items included in the World Bank’s International Comparison Programme data used to compute RCPs that have a direct match in the CPC nomenclature used to classify data on trade and production in the SuAs. The second mapping expands on the first one, by adding trade and production items to individual food groups that reasonably belong to them, based on the text description of items. Table A1 provides an illustration for the food group “white meat”. In this instance, five CPC items that are included in the World Bank’s ICP data on retail prices could be linked directly to CPC items (e.g. “chicken breast without skin” could be linked to “meat of chickens, fresh or chilled”). Five additional CPC items did not have a direct match with ICP items but nonetheless belong to the food group “white meat” and were therefore added when producing the second mapping. For example, the ICP does not hold data on geese and pigeon meat which nonetheless all classify as “white meat”. Trade and trade policy for these items could theoretically affect RPCs for “white meat” and were therefore added to this food group.

Table A1. Identifying food groups in data on trade and production as well as retail prices ("white meat")

Food Group	CPC Item	Item description	Direct match in WB ICP price data	HS6-digit codes (HS07 nomenclature)	HS6 codes (HS12 nomenclature)	CPC item included in mapping 1: ICP items	CPC item included in mapping 2: expanded
White meat	21121	Meat of chickens, fresh or chilled	YES	**020711**, 020712, 020713, 020714, 020732, 020733, 020735, 020736	020711, 020712, 020713, 020714, 020760		
White meat	21160.01	Edible offals and liver of chickens and guinea fowl, fresh, chilled or frozen	YES	020713, 020714, 020732, 020733, 020735, 020736	020713, 020714, 020760		
White meat	F1061	Poultry meat preparations	YES	160231, 160232, 160239	160231, 160232, 160239		
White meat	21122	Meat of ducks, fresh or chilled	YES	020732, 020733, 020735, 020736	020741, 020742, 020744, 020745		
White meat	21123	Meat of geese, fresh or chilled	NO	020732, 020733, 020735, 020736	020751, 020752, 020754, 020755		
White meat	21160.02	Edible offals and liver of geese, fresh, chilled or frozen	NO	020734, 020735, 020736	020753, 020754, 020755		
White meat	21160.03	Edible offals and liver of ducks, fresh, chilled or frozen	NO	020734, 020735, 020736	020743, 020744, 020745		
White meat	21124	Meat of turkeys, fresh or chilled	YES	020724, 020725, 020726, 020727	020724, 020725, 020726, 020727		
White meat	21160.04	Edible offals and liver of turkey, fresh, chilled or frozen	NO	020726, 020727	020726, 020727		
White meat	21170.01	Meat of pigeons and other birds n.e.c., fresh, chilled or frozen	NO	020890	020890		

Notes: CPC = Central Product Classification code; WB ICP = World Bank International Comparison Programme; HS = Harmonized system. HS6 is the most disaggregated level of the harmonized system that can be used for international comparison purposes (e.g. **0207.11** as highlighted in the table is the HS6 code corresponding to the item "meat and edible oval; of fowls of the species Gallus Domesticus, not cut in pieces, fresh or chilled"). The HS nomenclature is updated by the World Customs Organization every five years for amendments and to accommodate new internationally traded items.

Source: Authors' own elaboration.

IV. Data on trade policy: effectively applied import tariffs

An advantage of constructing the mappings for food groups on the basis of CPC codes used by FAO to classify trade and production data is that this approach automatically provides a list of Harmonized System six-digit codes for each individual food group for which RCPs are computed. Specifically, an existing one-to-many mapping by FAO between CPC codes and HS6 codes of the harmonized system was exploited, with the resulting food group-specific list being used to compute trade policy indicators at the country<>year<>food group level.[52] Making use of the example provided in Table A1, this list would consist of HS6 classified items highlighted in light blue (for the first mapping described above) or of those highlighted in light blue plus those highlighted in light grey (for the second mapping described above). Notably, six digits is the most granular disaggregation for cross-country comparison of tariff and other trade policy data.[53]

Applying the food group specific lists of HS6 codes for the two different mappings/groupings, indicators for tariff protection at the country<>year<>food group level were computed, using so-called "effectively applied tariff rates". The effectively applied tariff on a product is the tariff that a country imposes on imports of a HS6 item from a specific trading partner after accounting for the (potential) existence of preferential trade arrangements such as trade agreements (e.g. free trade agreements or bilateral agreements) or unilateral preference schemes –e.g. EBA, African Growth and Opportunity Act (AGOA) or the generalised scheme of preferences (GSP). Effectively applied tariffs are virtually always lower than those tariffs a country imposes on other World Trade Organization (WTO) members in the form of most favoured nation (MFN) rates (or simply "tariffs" if the country is not a WTO member).[54] Additionally, but only for one of five constructed indicators, to reflect that some trading partners matter more than others for the sourcing of any individual HS6 product, additional data on the value of imports per specific trading partner and HS6 item were used to weigh individual trading relationships more than others in the computation of some indicators of tariff protection.[55] As detailed further below, however, this was only done for one of the indicators to facilitate more options for future analysis.

In terms of practical implementation, data on import flows (in values) by trading partner were taken from the Database for International Trade Analysis at the product-level (BACI) from the Centre for Prospective Studies and International Information (CEPII), at the HS6 level. Additionally, data on effectively applied tariffs in ad valorem equivalent (AVE) were taken from the global TRAINS database using the World

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52 It should be noted that some HS6 codes also have multiple corresponding CPC codes, usually within the same food group. For example, as seen in Table 1, HS6 0207.13 is matched to both CPC 21121 and CPC 21160.01, both of which are uniquely assigned to the food group "white meat".

53 Some countries expand their own classifications beyond six digits for more granular product identification for the purposes of setting trade policy. For example, the European Union uses ten digits in its common external tariff, while the countries comprising the East African Community use an eight-digit system.

54 For example, in 2017 Burundi imposed an MFN tariff of "75 percent or USD 345 per tonne, whichever is higher" on rice imports. However, imports from members of the East African Community Customs Union, which Burundi is a part of, entered the country duty free at a tariff of zero.

55 To illustrate by expanding on the example of Burundi, the "75 percent or USD 345 per tonne, whichever is higher" tariff rate on rice imports in Burundi's tariff book would also be implemented for countries from which Burundi does not or not significantly import rice (e.g. Germany or Samoa). Simply averaging effectively applied tariff rates across tariff partners without taking into consideration their respective relevance could therefore lead to biases.

Bank's World Integrated Trade Solution (WITS) tool.[56] Using both data sources, five different import tariff measures were calculated that represent external tariff protection at the level of the importer <> year <> RCP food group:

- The first corresponds to the simple average of effectively applied tariffs across all HS6 products <> trading partner combination within a given RCP food group.

- The second is computed on the same basis as the first measure, but instead of the average the median effectively applied tariff was identified.

- The third measure is the import value weighted average of effectively applied tariffs. This measure was calculated as the sum of the duties collected (tariffs rates times import value) by each HS code and trading partner, divided by the total value of imports across all HS6 varieties included in an RCP food group.

- The fourth indicator corresponds to an "average of averages". Specifically, in a first step per each HS6 code the average of effectively applied tariffs was computed across all trading partners. In a second step, the average of the resulting values was computed across all HS6 varieties included in an RCP food group.

- Finally, the fifth measure replicates the approach taken for the fourth measure, but instead of working in averages, median values were used for both steps.

It is worth highlighting the UNCTAD-TRAINS database on tariffs considers European Union countries as a single unit given their common external tariff and does also not explicitly list zero tariffs on trade flows within the European Union. These zero values are essential for the calculation of the measures introduced above and hence a tariff of zero was imputed for intra-European Union import flows. Leaving this information out would lead to significant upward biases in the tariff measures for European Union countries, since large volumes of imports that an European Union member imports from other European Union countries would be left unconsidered.

Beyond indicators for tariff protection at the RCP food group level, an additional food group was constructed that subsumes all HS codes that belong to the RCP benchmark basket of "staple foods". The tariff measures for this group were used to construct tariff ratios between the tariff on each RCP group and this benchmark group. This was done in light of work that suggests that the relative size of taxes instead of nominal taxes may be important in shaping consumer behaviour (Boysen *et al*., 2019). Finally, since no data on fish and seafood are available in the SuA, which provides a list of HS6 codes for all other food groups, the tariff measures for the RCP group "fish and seafood" were computed from a list of official HS6 codes comprising all fish and seafood items.[57] Similarly, for the group "soft drinks" four HS6 codes were used (2201.10, 2201.90, as well as

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[56] The term ad valorem equivalent (AVE) means that "specific tariffs" in the form of monetary amounts per imported quantity (as in Burundi's USD 345 per tonne of rice) are converted to be expressed in terms of percent of the value or imports.

[57] The list is available here: FAO. 2024. HS codes for fish and fish products. In *FAO*. [Cited 7 November 2024]. https://openknowledge.fao.org/handle/20.500.14283/cb3813en

2202.10 and 2202.90). The resulting tariff database contains information for 186 countries (or "territories"). These data were then merged with the RCP dataset.

V. Notes on the resulting dataset

Merging data on production, trade, trade policy and RCPs at the country<>year<>food group level results in a two-period panel that forms the main statistical basis for the analysis in Chapter 2 of this report. Relevant comments on these data are as follows:

Food groups

- From the original 36 food groups included in the Headey and Alderman (2019) data, a total of three food groups for which RCPs can be computed were dropped. These were: "other beverages", "infant formula", and "infant fruits". These three groups are also not included in the final Headey and Alderman (2019) article, suggesting that they were only considered in earlier stages of their project ("infant cereals" is included).

- For the food group "soft drinks", no data at the CPC level is available in FAO's SuAs. Nonetheless, this group is kept in the final dataset as data on import tariffs is available.

- Exploiting an existing distinction in the data provided by Headey and Alderman (2019), the food group "vitamin A-rich fruit and vegetables" is split into two separate groups (fruits as well as vegetables).

- Given the vast conceptual difficulties of cleanly assigning "oilseeds" to any individual food group (see notes above), these were assigned to an "other" category and excluded from the analysis in Chapter 2.

- Overall, the final data contain RCPs, trade, production and import tariff data for a total of 31 food groups, of which nine are staple foods. This corresponds to the 29 food groups in the Headey and Alderman (2019) paper, plus one extra food group "spices and condiments" and an additional one resulting from the split of "vitamin A-rich fruit and vegetables" into two groups. As for Headey and Alderman (2019), different food groups were further assigned to four more aggregated food categories: *staple foods; vegetable foods, animal-sourced foods; and sugar-rich, salt-rich, and fat-rich foods*.

Table A2. List of different food groups and broader food categories

Food group	Food group category
Rice	Staple foods
Sorghum	
Yam	
Oats	
Cassava	
Maize	
Wheat	
Millet	
Potato	
Dark green leafy vegetables	Fruit and vegetables
Nuts	
Pulses	
Other vegetables	
Vit-A rich fruits	
Vit-A rich vegetables	
Infant cereals	
Other fruits	
Fish and seafood	Animal foods
Eggs	
Unprocessed red meat	
Milk	
Processed red meat	
Other dairy	
White meat	
Soft drinks / sugar sweetened beverages	Foods high in sugar, salts or fats/oils
Confectionary	
Fats and oils	
Sugar	
Condiments and spices	
Juice	
Salt-rich snacks	

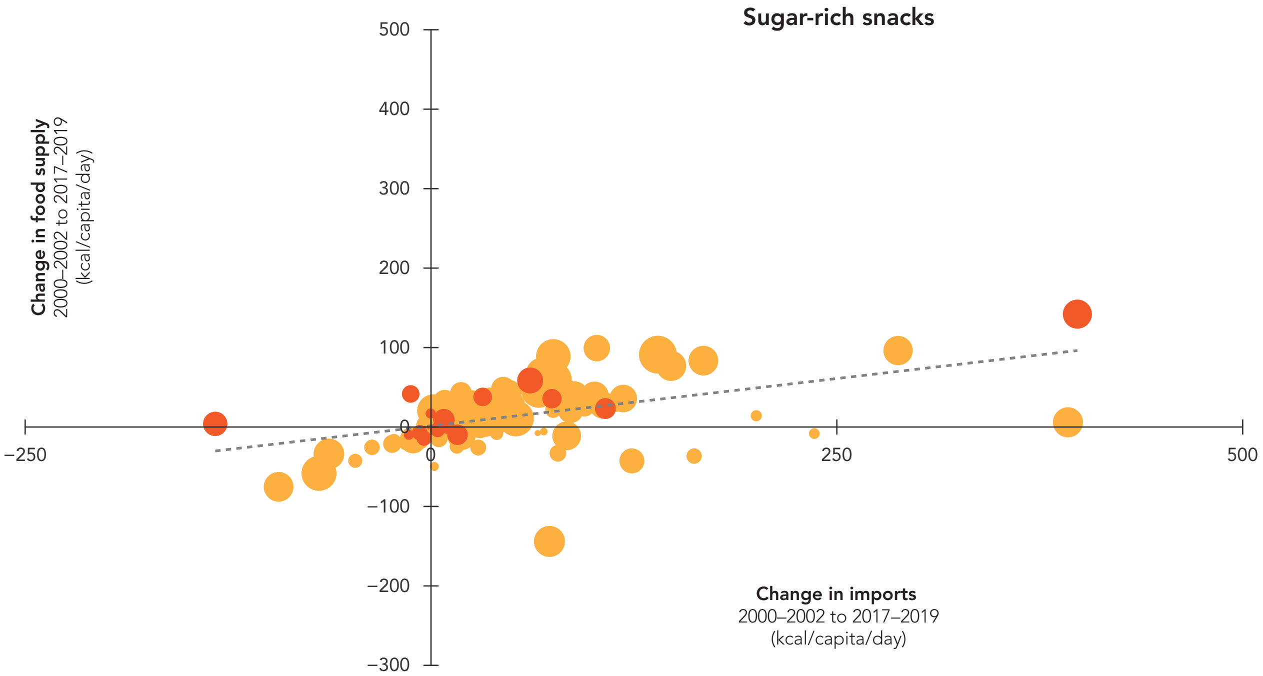
Notes on the quality of the merge across different datasets and coverage

- No. countries with RCP/retail price data: 173 (*171 in 2011, 172 in 2017*).
- No. countries with SuA data (for imports/production): 176 (*175 in 2011, 176 in 2017*)
- No. countries with tariff data: 167 (*166 in 2011, 167 in 2017*); data available in either "t" or any of the three lags for a period under consideration.
- Country<>year<>food group combinations with non-missing RCP data: 9 266.
- For these, co-variates are not available for all observations but for most (e.g. for >90 percent of these observations tariff data, either at "t" or as lag is available).

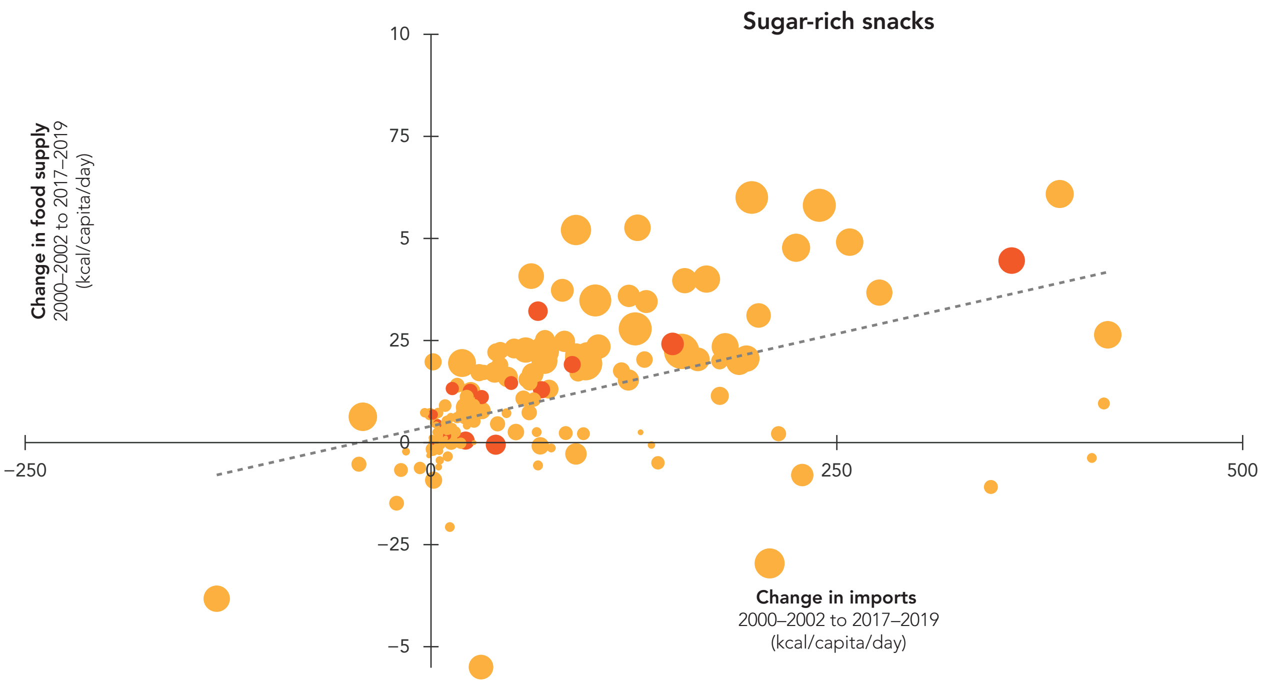
Annex II.

Robustness checks for Figure 7 (sugar-rich snacks only)

a. Replicating Figure 7 with a later cross section



b. Replicating Figure 7, using changes in the share of food supply instead of kilocalorie per capita per day



Source: Authors' own elaboration.

Markets and Trade Division – Economic and Social Development
www.fao.org/markets-and-trade

Food and Agriculture Organization of the United Nations
Rome, Italy

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Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Department of Economic Affairs,
Education and Research EAER
Federal Office for Agriculture FOAG

ISBN 978-92-5-139598-1

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CD4217EN/1/02.25