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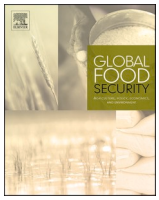

How do non-reciprocal trade preferences affect the food exports and food availability per capita of Global South countries?

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ABSTRACT

We investigate the historical effects of non-reciprocal preferential trade agreements (NRPTAs) on food exports and food availability per capita in 112 countries in the Global South to address concerns about their potential non-trade effects. Our empirical analyses use FAO Food Balance Sheet data for the years 1961–2013, covering 14 food categories and 91 product groups. We assess the link between NRPTA intensity - measured at the country level as the annaul sum of NRPTAs a country has in place - and the two outcomes using fixed effects dummy variable regressions. Our findings show that NRPTA intensity has a positive effect on food export performance and on food availability per capita, with heterogeneities across least developed, transition, and developing country groups, and its export effects do not jeopardize food insecurity.

1. Introduction

Embeddedness in world trade is considered a cornerstone for transitioning to a developed country (UNCTAD, 2022). Therefore, since 1971, developed countries have granted trade preferences to Global South countries through the Generalized System of Preferences (GSP) on a non-reciprocal and voluntary basis to improve economic development and alleviate poverty (UNCTAD, 2020). In contrast to reciprocal trade preferences, beneficiaries of non-reciprocal trade preferences do not have to liberalize their markets in return (European Commission, 2023).[1] The agro-food sector plays a vital role in the economic performance of Global South countries (Lin, 2018). Accordingly, non-reciprocal preferential trade agreements (NRPTAs) always cover agro-food products (Hoekman et al., 2005). However, the voluntary nature of NRPTAs makes them somewhat unpredictable. Products and countries can be excluded from NRPTAs, such as the GSP, by the donor country at any time (Kishore, 2017). In addition, the US GSP expires periodically and has always been renewed eventually, so an end is always likely (Hakobyan, 2020; Busch, 2021). In a sense, this uncertainty makes the schemes a tool for unregulated protectionism (Edjigu et al., 2023). In addition, trade wars and protectionism (World Bank, 2023), on the one hand, and the increasing number of reciprocal preferences in the form of Regional Trade Agreements (WTO, 2023a) and European Union (EU) Economic Partnership Agreements (European Commission, n.d.), on the other, potentially undermine the effectiveness of NRPTAs. Nevertheless, a recent study by Ridley and Shirin (2024) highlights the importance of NRTPAs for agricultural trade. In particular, the preference margin (i.e., the difference between the most-favored-nation tariff and the NRPTA tariff) provides an incentive for importers from the preference granting country to source agricultural products from countries in the Global South.

Global food security has improved steadily since the 1960s. This is reflected, for example, in the increase in calories available per capita per day or the decrease in the prevalence of undernourishment as a percentage of the total population (Hoddinott, 2021). Nevertheless, the 2007/2008 price shocks for agricultural commodities (Tangermann, 2016) or droughts due to global warming (Ahmed, 2020) show how vulnerable countries in the Global South are in terms of food security. The reduction or elimination of protection and subsidies in developed countries is considered to have a positive impact on food security in Global South countries (Díaz-Bonilla and Ron, 2010; Martin 2017). However, according to the academic literature, improved access to

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[1] However, aid payments from industrialized countries can lead to a tariff overhang, in which case the more aid developing countries receive as compensation, the more they reduce the applied tariff below the bound tariff rate (Lorz and Thede, 2024). Note that we do not consider this issue in this study due to a lack of historical data availability.

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developed country markets can have a "twin" role. On the one hand, if developing countries export more food as a result of NRPTAs, this could make food scarcer in these countries and increase the prevalence of undernourishment (Mary, 2019). On the other hand, revenues from food exports could generate income and investment capital to increase agricultural and industrial productivity, which could increase the employment rate of the domestic population (Smith and Glauber, 2020). In particular, increased agricultural productivity could have a positive impact on food security. Accordingly, the aim of this study is twofold: First, we assess whether NRPTAs are effective in fostering the food export performance of beneficiary countries. Second, we evaluate the impact of NRPTAs on the food security of beneficiary countries. We measure export performance as the share of food exports in relation to the total food supply of a country. Using this approach, we reveal how much of the available domestic supply is used for exports. In addition, we proxy food security as the food availability per capita (i.e., food available for human consumption) of a country—one of the four dimensions of food security[2] (FAO, 2008).

Our empirical analysis takes a historical approach spanning the years 1961–2013. We calculate measures of export performance and food availability per capita at the country and food category levels using the Food Balance Sheets provided by the United Nations' (UN) Food and Agriculture Organization (FAO, 2023). The NRPTA intensity at the country level is measured as the annual sum of NRPTAs based on an economic integration agreements database maintained by Baier and Bergstrand (2021). We further control for the intensity of other trade arrangements (i.e., reciprocal preferential and free trade agreement, customs union, common market, and economic union), for membership in the World Trade Organization (WTO), for labor and capital productivity in agriculture (USDA, 2022), and for gross domestic product (GDP) and population (Bolt and van Zanden, 2020). To investigate the link between NRPTA intensity and the two selected outcome variables, we apply fixed effects dummy variable regression.

Although many studies have investigated the relationship between NRPTAs and trade creation, indicating rather mixed effects (Seyoum, 2006; Herz and Wagner, 2011; Ritzel and Kohler, 2017; Ornelas and Ritel, 2020; Fernandes et al., 2023), less is known about their impact on the food security of beneficiary countries. The counterfactual (ex-ante) simulations of Aghajanzadeh-Darzi et al. (2015) consider the period from 2015 to 2025. The results of an applied general equilibrium model show that the removal of EU trade preferences will have a negative impact on beneficiaries' exports and macroeconomic performance. As the contribution of export gains and higher incomes is rather indirect, the observed impacts on food and nutrition security indicators are limited. Kersten (2018) analyzes the impact of reciprocal preferential trade agreements (i.e., regional and bilateral trade agreements) on food security in 93 low- and middle-income countries for the period 1990–2014. The results show heterogeneous impacts: While bilateral trade agreements have a negative impact on food security, regional trade agreements have a positive impact. To the best of our knowledge, a global and historical ex-post evaluation of the impact of NRPTAs on export performance and food security is lacking in the academic literature. Accordingly, our contribution to the literature investigating the impact of trade integration on export performance and on the food security of countries in the Global South is threefold. First, this is the first ex-post study to consider both dimensions (i.e., export performance and food security). Second, the data used, covering the years 1961–2013, allow us to provide evidence of the historical effect of NRPTA intensity on the two selected outcome variables. Third, our data basis enables us to capture the effect of all NRPTAs in force, thereby allowing us to provide general policy recommendations regarding the effectiveness of NRPTAs.

The remainder of this article is organized as follows: In Section 2, we present the databases, data and measurement issues, and the methods used. In Section 3, the results for export performance and food availability per capita are provided, and in Section 4, we discuss them. In Section 5, we conclude the paper and provide policy implications.

2. Databases, data and measurement issues, and methods

2.1. Databases

Our empirical analyses focus on countries in the Global South, which are considered underdeveloped or economically disadvantaged countries. During the five decades that comprise our databases and empirical analyses, the economic situation of a country can improve, and its status can therefore change, for example, from a transition to a developed country. Accordingly, we do not select countries that were classified as a developed economy in the last year of our analysis period (i.e., 2013). Following the UN (2013), we exclude the following countries or country groups: developed economies, including the USA, Canada, Japan, Australia, and New Zealand, the member states of the EU-15, the new member states of the EU, and other developed countries from the European continent (i.e., Iceland, Norway, and Switzerland). We also exclude Czechoslovakia, Yugoslavia, and North Korea, owing to long-term trade sanctions. The complete list of countries can be found in Table A1 in the Appendix. Our dataset consists of 15 transition, 64 developing, and 33 least developed countries.

To construct our variables that measure export performance and food availability per capita, we use data from the Food Balance Sheets for the years 1961–2013. From 2014 on, the Food Balance Sheet methodology has changed. Among others, the key difference between the new and old food balances methodologies is the absence of a balancer variable (FAO, n.d.). To avoid inconsistencies, we do not include the years from 2014 onward in our analyses. We select volumes of domestic production, imports, and exports (each measured in 1000 tons). The data cover 18 food categories, with each food category consisting of individual or multiple product groups. However, we exclude alcoholic beverages because they are not relevant for food security. Infant food was also excluded because production volumes are missing for many countries. In some cases, we combined food categories that are topically related or that consist of a single product group (i.e., 'sugar crops, sugar, and sweeteners,' 'pulses and tree nuts,' 'meat and edible offal,' 'milk and eggs,' and 'fish and aquatic products'). Thus, we obtain 14 food categories for a total of 91 product groups, as presented in Table A2 in the Appendix.

The *export performance* of country c and product group p in year t is calculated as shown in Equation (1).

$$Export\ performance_{cpt} = \frac{Exports_{cpt} \times 100}{\left(Domestic\ production_{cpt} + Imports_{cpt}\right)} \quad (1)$$

where $Exports_{cpt}$ is the export volume of product p from country c in year t, $Imports_{cpt}$ is the import volume of p from c in year t, and $Domestic\ production_{cpt}$ is the volume of p produced in c in year t. The values of $Export\ performance_{cpt}$ range between 0 and 100%.

The *food availability* per capita (in kg) of country c and product group p in year t is computed as in Equation (2).

[2] The other three dimensions are 'economic and physical access to food,' 'food utilization,' and 'stability of the other three dimensions over time' (FAO, 2008).

$$Food\ availability\ per\ capita_{cpt} = \frac{\left(Domestic\ production_{cpt} + Imports_{cpt} - Exports_{cpt}\right)}{Total\ population_{ct}} \quad (2)$$

where $Total\ population_{ct}$ is the population of country c in year t. All other variables remain as defined in Equation (1).

For data on NRPTAs, we used the dataset constructed by Baier and Bergstrand (2021). The dataset also covers the period 1961–2013, 195 country pairs, and contains six economic integration agreements—defined following Frankel (1997)—which are coded as follows: 1 = non-reciprocal (one-way) preferential trade agreement, 2 = reciprocal (two-way) preferential trade agreements, 3 = free trade agreements, 4 = customs unions, 5 = common markets, and 6 = economic unions. The overall dataset thus includes a sample of 2,572,440 observations.[3] A detailed overview of NRPTAs, such as the GSP, the GSP+, the Everything But Arms regime, and the African Growth and Opportunity Act, can be found in a database hosted by the World Trade Organization (WTO, 2023b).

Our main variable of interest is the NRPTA intensity, which we calculated as the sum of NRPTAs per (beneficiary) country c in year t:

$$NRPTA\ intensity_{ct} = \sum NRPTA_{ct} \quad (3)$$

To calculate $NRPTA\ intensity_{ct}$, we use dummies of country pairs indicating "1 = non-reciprocal (one-way) preferential trade agreement." We summed up the NRPTA dummies for country c (i.e., an exporting country benefiting from non-reciprocal trade preferences) at year t. The economic integration agreements dataset provides no indication for NRPTAs offering market access to multiple countries. For instance, in 2013, the EU's GSP offered market access to its 27 member states. This implies that the NRPTA intensity for a certain beneficiary country exclusively exporting via EU NRPTAs takes the value of 27 in 2013.

We generate another variable that captures the intensity of other trade arrangements (i.e., $OTA\ intensity_{ct}$). It is constructed according to Equation (3) using economic integration arrangements coded as 2, 3, 4, 5, and 6. The WTO membership dummy variable is derived from the Centre d'Etudes Prospectives et d'Informations Internationales gravity database (Conte et al., 2022).

Data on gross domestic product (GDP) and total population are derived from Maddison's historical statistics (Bolt and van Zanden, 2020). The database contains data on GDP (in 2011 US$) and total population for 169 countries dating back to the eighth century. Based on data from the US Department of Agriculture (USDA, 2022), we compute two partial productivity measures (Federal Statistical Office, n.d.). First, agricultural labor productivity captures the efficiency with which human resources are used in the agricultural production process. The agricultural labor productivity of country c in year t is calculated by dividing the quantity of total agricultural output (in US$) by the quantity of total labor in agriculture (per 1000 persons economically active in agriculture) of country c in year t. Second, capital productivity measures the efficiency with which capital is used in the agricultural production process. The agricultural capital productivity of country c in year t is computed by dividing the quantity of total agricultural output (in US$) by the quantity of total agricultural capital stock (in US$) of country c in year t.

After excluding export performance values greater than 100 (2469 observations) and merging NRPTA and OTA intensity as well as further control variables, the dataset relies on 298,585 observations. The summary statistics for the variables used for the econometric analyses are presented in Table 1.

2.2. Data sources and measurement issues

We use data from the FAO Food Balance Sheets, which have two major advantages. First, trade and food security issues can be addressed using data from the same source. Second, data covering the years 1961–2013 allow for historical assessments of trade policy effects on trade and food security. As a limitation, the historical dimension may, in some cases, come with impreciseness. In this context, most imputation modules for missing data rely on measurements made in the past, so errors are likely (GSARS, 2017). This might explain why for the outcome 'export performance,' we had to drop 2469 observations greater than 100%. For cash crops, such as sugar, we observe very high values for food availability per capita up to 9700 kg. In such cases, conducting robustness checks by excluding or including food categories is unequivocally necessary.

2.3. Methods

To estimate the effect of NRPTA intensity on export performance and food availability per capita, we use a fixed effects dummy variable estimator. The major challenge hereby is to identify an unbiased effect of our variable of interest on the two outcomes. The omitted variable (and selection) bias is the major source of endogeneity facing studies estimating the effects of (reciprocal) free trade agreements on trade flows. Trade partners select themselves into free trade agreements, implying that unobserved factors determine the selection into free trade agreements. Thus, unobserved factors also affect trade flows; thus, studies estimating the effect of free trade agreements on trade flows usually yield biased estimates (Baier and Bergstrand, 2007). By contrast, NRPTAs are given exogenously to beneficiary countries by donor countries (Ito and Aoyagi, 2019; Ritzel and Kohler, 2017; Ritzel et al., 2018; Panda, 2020). This implies that NRPTA donor countries can decide upon country and product coverage, as well as on the period in which NRPTAs are granted. In this context, it is highly unlikely that countries in the Global South would withhold economic development just to benefit from NRPTAs. Consequently, NRPTAs can be considered an exogenously given treatment, enabling us to estimate the unbiased effect of NRPTA intensity on relevant outcomes.

We estimate a fixed effects dummy variable regression model (Wooldridge, 2012) using the Poisson pseudo-maximum likelihood (PPML) estimator. The PPML estimator provides consistent estimates in the presence of heteroskedasticity and is a natural way to deal with zero values of the dependent variable (Santos Silva and Tenryro, 2006). The regression equation takes the functional form shown in Equation (4):

$$Y_{cpt} = \exp\left[\beta_0 + \beta_1 NRPTA\ intensity_{ct} + \delta X_{ct} + \gamma_c + \theta_p + \lambda_t\right] + \varepsilon_{cpt} \quad (4)$$

where Y represents the dependent variable (i.e., export performance and food availability per capita). Equation (1) is separately estimated for (i) export performance and (ii) food availability per capita. β_0 depicts the intercept, and β_1 captures the effect of the variable $NRPTA\ intensity_{ct}$. X represents a vector of further control variables affecting export performance and food availability per capita. In particular, we control for the intensity of other trade arrangements (OTAs) aside NRPTAs, WTO membership, GDP, and population, as well as for labor and capital

[3] There are some cases (coded as 7 = no country) defined as a country-pair/year cell in which at least one of the two countries in a pair either does not exist or does not have independence. We drop these observations, which make up about 21% of the dataset.

Table 1
Summary statistics for variables used for the econometric analyzes for all countries in the Global South.

Variable	Mean	Std. Dev.	Min.	Max.	N
NRPTA intensity (continuous)	17.3	12.3	0.0	43.0	298,585
OTA intensity (continuous)	8.8	10.7	0.0	66.0	298,585
WTO member (binary)	0.6	0.5	0.0	1.0	298,585
GDP (in billion 2011 US$)	268.2	856.3	0.1	15,304.4	298,585
Population (in million)	52.3	165.3	0.1	1351.0	298,585
Labor productivity	4,753,054.0	8,134,463.0	244,154.0	116,516,805.0	298,585
Capital productivity	1.7	1.9	0.1	22.8	298,585

productivity in agriculture. GDP and population are used as measures of economic size (Head and Mayer, 2014). GDP also captures the political stability of a nation, as both variables are positively correlated (Cervantes and Villaseñor, 2015). Labor and capital productivity are directly related to the production component of our two outcomes (Fuglie, 2018). Additionally, we include country fixed effects γ to account for time-invariant country characteristics (e.g., island or landlocked country), food category fixed effects θ to control for, for example, differences in prices and quantities across food categories and year fixed effects λ capturing, for example, shocks such as the 2007 and 2008 food crisis affecting all of the considered countries. ε_{cpt} denotes the error term. Due to the exogeneity of NRTPAs, we assume that β_1 and ε_{cpt} are not correlated, enabling us to estimate the unbiased effect. For NRPTA and OTA intensity, as well as for the WTO membership dummy variable, we compute average marginal effects. The remaining control variables are expressed in natural logarithms.

Equation (4) is estimated for the aggregate of all food categories and country groups. To exploit country group heterogeneity, we separately estimate Equation (4) on sub-samples for the least developed countries, transition countries, and developing countries. This means that for the independent variables considered in Equation (4), we obtain an average effect of the estimators at the country group level. Additionally, to exploit food category heterogeneity, we separately estimate Equation (4) for the 14 individual food categories.

3. Results

In Section 3.1, we present descriptive results on the development of export performance and food availability per capita at the country level. In Section 3.2, we present the results of the PPML regression for all country groups (Section 3.2.1), for individual country groups (Section 3.2.2.), and for individual food categories (Section 3.2.3). As we are mainly interested in the effect of NRPTA intensity, we do not interpret and discuss the results of the control variables (i.e., results for OTA intensity, WTO membership, GDP, population, labor, and capital productivity). However, in many cases, the variables have the expected signs and meaningful magnitudes. The complete results tables can be found in the Appendix.

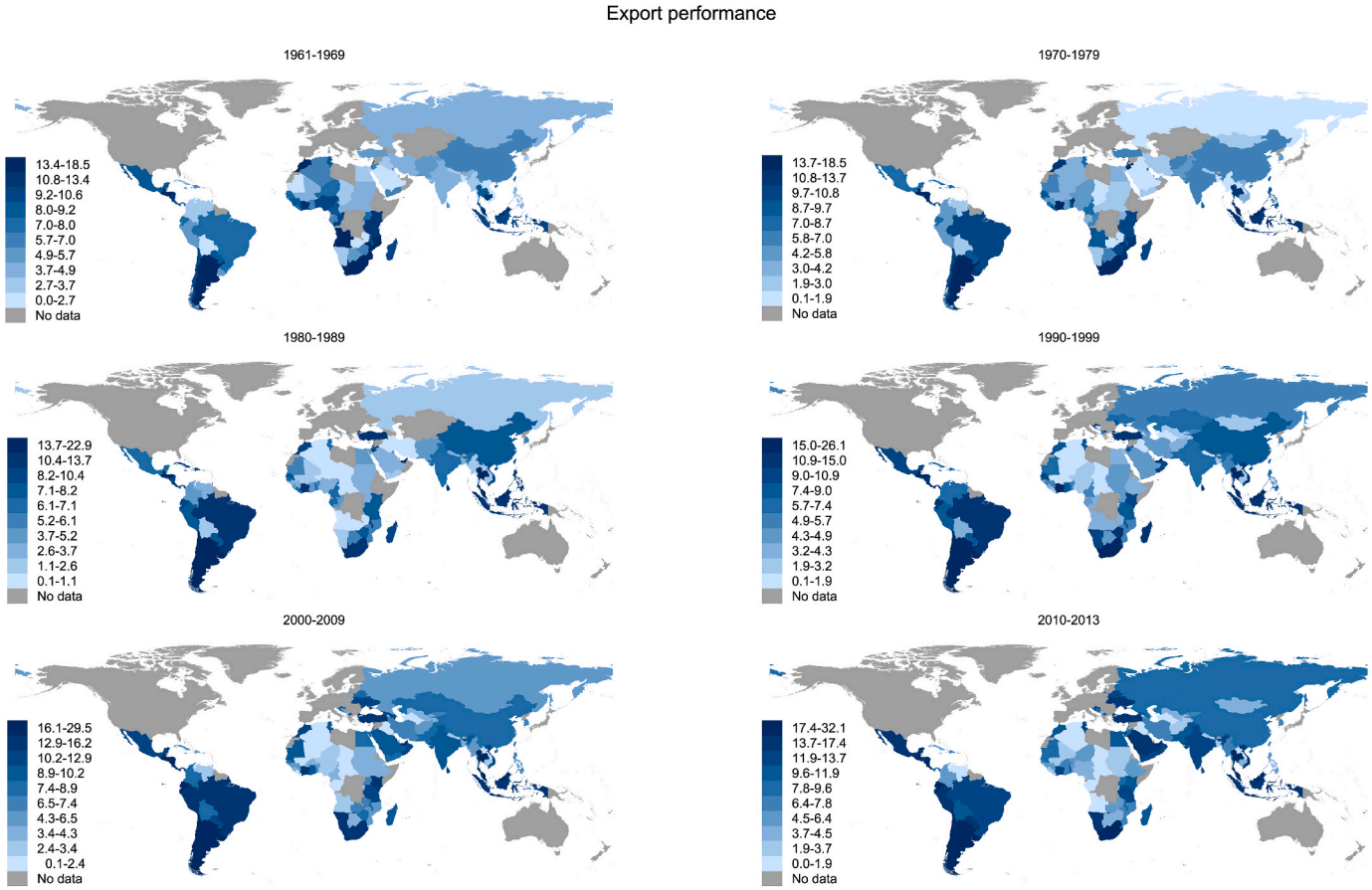

Fig. 1. Average export performance across all food categories for each of the selected countries between 1961 and 2013.

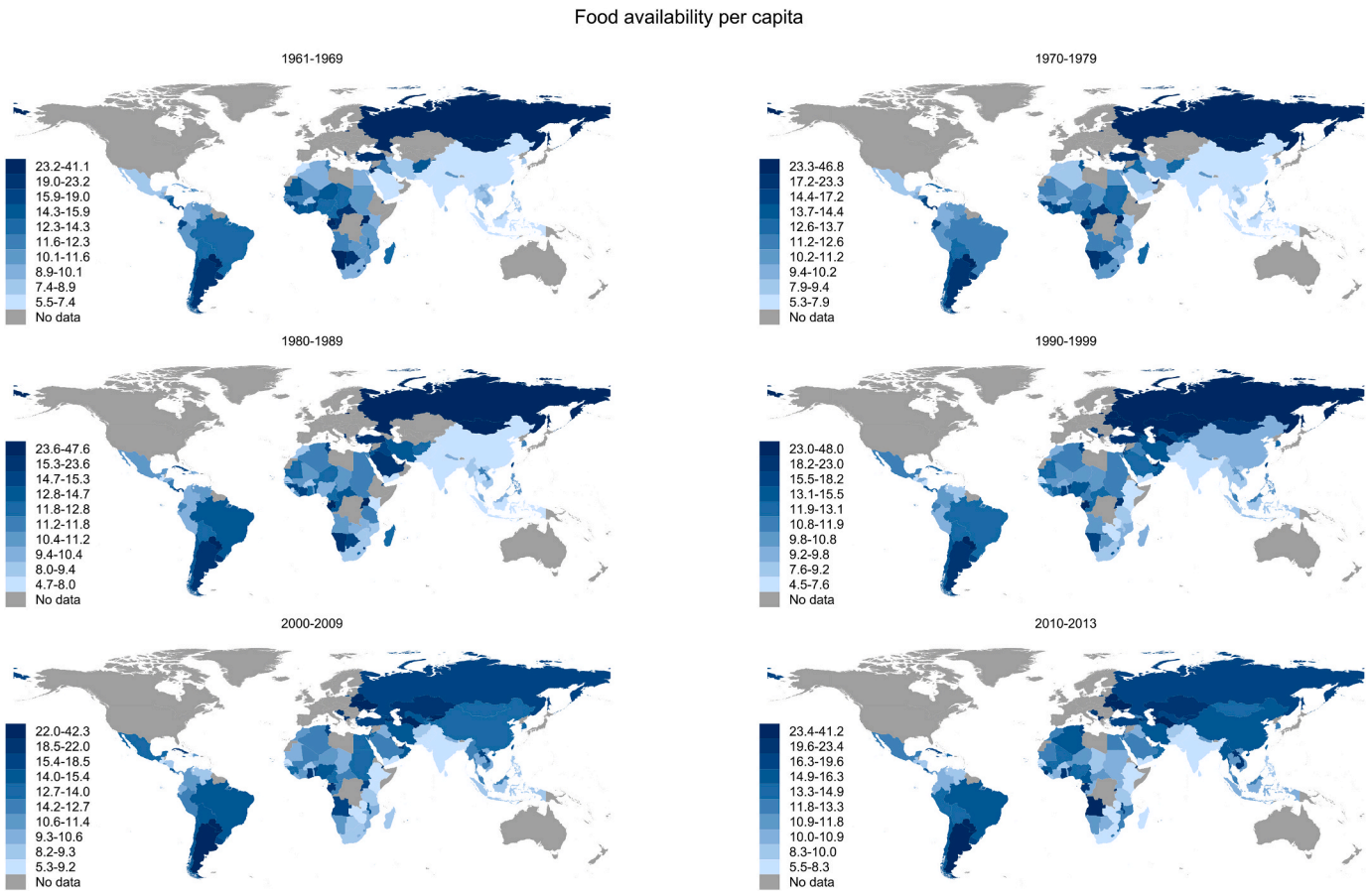

Fig. 2. Average food availability per capita across all food categories for each of the selected countries between 1961 and 2013.

3.1. Descriptive results

In Fig. 1, we visualize the average export performance across all food categories for each country of the Global South over the decades that fall within 1961–2013. The value ranges of the average export performance are presented in decile rankings and colored from light blue (low values) to dark blue (high values). Countries that are not considered are colored gray.

During the 1960s and 1970s, the maximum average export performance was 18.5%. With the start of global trade liberalization in the 1980s (Clapp, 2017), the average maximum export performance constantly increased up to 32.1% for the period 2010–2013. Morocco was the top exporting country in the 1960s (average export performance = 18.5%), whereas Argentina was the top exporting country since the 1970s. From the 1980s onward, Latin and Central American countries, such as Uruguay, Chile, Costa Rica, Guatemala, and Nicaragua, as well as Southeast Asian countries, such as Thailand and Malaysia, increased their export performance. Accordingly, these countries constantly belonged to the upper decile. With the end of the Cold War in the beginning of the 1990s, Russia and satellite states, such as Belarus and Ukraine, increased their export performance.

Fig. 2 visualizes the average per capita food availability across all food categories (in kg) on the world map for each of the selected countries. For sugar, sugar crops, and sweeteners, we observe huge values for the measure of food availability per capita up to 9700 kg. Accordingly, we do not consider the sugar crops, sugar, and sweeteners category in the visualization of the development of food availability per capita presented in Fig. 2.

In contrast to the variable food export performance, we do not observe a constant increase in the maximum value for the average food availability per capita between 1961 and 2013. The maximum levels were reached in the 1970s (46.8 kg), 1980s (47.6 kg), and 1990s (48.0 kg). Afterward, the maximum value for the average food availability per capita decreased. From the 1990s on, we can observe a deterioration in food availability per capita for countries located in East and Southeast Africa, such as Ethiopia, Kenya, Tanzania, Zimbabwe, and South Africa. By contrast, the situation in China improved with the end of the Cold War in the beginning of the 1990s.

In the next section, we empirically test the role that NRPTAs play in the patterns we observe in Figs. 1 and 2.

3.2. Regression results

3.2.1. All country groups

Table 2 shows the PPML regression results for all country groups and food categories. Due to high food availability per capita values, we excluded the food category ‘sugar, sugar crops, and sweeteners’. However, this choice does not affect our findings. If we include sugar products, our findings remain the same in direction and statistical significance and only differ slightly in magnitude (see Table A3 in the Appendix).

For both models, we identify a statistically significant positive effect of the variable NRPTA intensity. An increase in NRPTA intensity by one unit boosts the export performance of a beneficiary country by, on average, 5.5 percentage points. An increase in NRPTA intensity by one unit is associated with a rise in food availability per capita by, on average, 0.04 kg per food category. As we show in the next section, the results obtained for the variable NRPTA intensity are driven by country group heterogeneity.

3.2.2. Individual country groups

Fig. 3 visualizes the average marginal effects of the variable NRPTA

intensity on export performance and their 90% confidence intervals for different country groups. The results of the control variables can be found in Table A4 in the Appendix.

For the least-developed countries, our estimates reveal a statistically significant negative effect of NRPTA intensity on export performance. Here, a one-unit increase in NRPTA intensity is associated with a decrease in export performance by, on average, 6.8 percentage points. By contrast, for transition and developing countries, the effect of NRPTA intensity is positive and statistically significant.

Fig. 4 shows the average marginal effects of the variable NRPTA intensity and their 90% confidence intervals on food availability per capita (the results of the control variables can be found in Table A5 in the Appendix). Due to the high food availability per capita values for sugar, sugar crops, and sweeteners, we exclude this food category. However, this choice does not affect our findings. If we include sugar products, our findings remain the same in direction and statistical significance and only differ slightly in magnitude (see Fig. A1 and Table A6 in the Appendix).

For all individual country groups, the effect of NRPTA intensity on food availability per capita is statistically significant and positive. The largest effect of the variable NRPTA intensity can be observed for transition countries, where a one-unit increase in NRPTA intensity is associated with an increase in food availability per capita by, on average, 0.36 kg per food category. By contrast, the lowest effect can be identified for developing countries. Here, a one-unit increase in NRPTA intensity leads to an increase by, on average, 0.03 kg per food category.

3.2.3. *Individual food categories*

Fig. 5 shows the average marginal effects of the variable NRPTA intensity for individual food categories and their 90% confidence intervals for the model variant with the dependent variable export performance. For brevity, we do not present estimates separated by country groups. The regression results for the control variables can be found in Table A7 in the Appendix.

For most of the individual food categories, we identify a positive sign of our variable of interest, that is, NRPTA intensity. Only for oil crops is the effect of NRPTA intensity on export performance statistically significantly negative. Within plant-based food categories, the strongest effect of NRPTA intensity on export performance can be observed for pulses and tree nuts, for which a one-unit increase in NRPTA intensity leads to an increase in the export performance of beneficiary countries by, on average, 14.1 percentage points. The smallest magnitude of the NRPTA intensity estimator is observed for the food category cereals, for which a one-unit increase in NRPTA intensity only leads to an increase in export performance by 2.8 percentage points. Within the animal-based food categories, NRPTAs cause the strongest boost in export performance for fish and aquatic products. Here, a one-unit increase in NRPTA intensity causes the export performance of fish and aquatic products to increase by 10.8 percentage points. By contrast, the effect of NRPTA intensity on the export performance of animal fats is positive but statistically non-significant.

In Fig. 6, we present the average marginal effects of the variable NRPTA intensity for individual food categories and their 90% confidence intervals for the model variant with food availability per capita as the dependent variable. The regression results for the control variables can be found in Table A8 in the Appendix.

For most of the individual food categories, our variable of interest shows a statistically significant positive effect on food availability per capita. In the case of cereals, a unit increase in NRPTA intensity is associated with an increase in food availability per capita by, on average, 0.16 kg. Only for stimulants and spices do we observe a statistically significant negative effect of NRPTA intensity.

Table 2
PPML regression results pooled for all country groups and food categories.

Independent variable	Export performance – All country groups	Food availability per capita – All country groups
NRPTA intensity	0.055*** (0.007)	0.042*** (0.012)
OTA intensity	0.015*** (0.006)	−0.034*** (0.010)
WTO member	0.164 (0.124)	0.443** (0.217)
Log GDP	0.218*** (0.019)	0.052*** (0.019)
Log Population	−0.078** (0.033)	−0.028 (0.034)
Log Labor productivity	0.184*** (0.020)	0.368*** (0.019)
Log Capital productivity	0.121*** (0.016)	0.095*** (0.018)
Intercept	−4.482*** (0.606)	−2.732*** (0.583)
Country FE	Yes	Yes
Time FE	Yes	Yes
Product FE	Yes	Yes
N	298,585	280,693
Pseudo R^2	0.262	0.551

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.

4. Discussion

Our work sheds light on the role of NRPTAs in direct trade and their non-trade effects. This is necessary because many policies have second-order effects that are often overlooked when considering their first-order effects. We extend existing works by going beyond export performance to also consider food security.

Our main finding is that NRPTAs enhance the export performance and food security of beneficiaries. On export performance, our findings confirm theoretical predictions of the trade-promoting effect of trade agreements (Grossman and Sykes, 2005; Persson, 2015) and are also in line with empirical findings for the aggregate economy (Cirera et al., 2016; Gil-Pareja et al., 2017; Ornelas and Ritel, 2020) and agriculture (Afesorgbor et al., 2023; Agostino et al., 2010; Cardamone, 2011; Cipollina and Salvatici, 2010; Ridley and Shirin, 2024; Ritzel and Kohler, 2017; Scoppola et al., 2018). Our findings differ in the choice of trade performance measure. Existing estimates are based on observed trade values. We, however, measure export performance as observed trade values in relation to domestic food supply (i.e., domestic production plus imports). Using this approach, we reveal how much of the available domestic supply is used for exports.

On food security, we observe, on average, a positive effect of NRPTA intensity on food availability per capita. This implies that gains from embeddedness in world trade through NRPTAs are invested in improved agricultural inputs and production processes. Investments in, for example, water management practices and stress-tolerant varieties, in turn, have a positive impact on food security (Dar et al., 2013). Furthermore, by providing preferential access to specific markets, beneficiaries may see it prudent to expand their range of agricultural production to take advantage of new markets (Scoppola et al., 2018). This diversification can reduce dependence on a few staple crops and enhance food security. Therefore, opening up the economy for trade can help reduce the structural food supply inadequacy prevalent in many developing countries. Nevertheless, the reverse is also true if the preferences target only specific products (Persson and Wilhelmsson, 2016). Our findings are consistent with existing works that test the effect of trade openness on food security. In their global study, Dithmer and Abdulai (2017) find that a one standard deviation increase in trade openness increases dietary energy consumption by 93 kcal.

Beyond these average effects, we also observe heterogeneities across country groups and products. Although NRPTAs enhance the export performance of transition and developing countries, they reduce the export performance of least developed countries. This is indeed a surprising finding, given that LDCs are the target of many NRPTAs; however, it also confirms that the preferences alone may not be sufficient to enhance exports if the corresponding domestic trade infrastructure is weak. Yet, weak domestic institutions and trade facilitation measures coupled with the inability to meet standards in developed countries

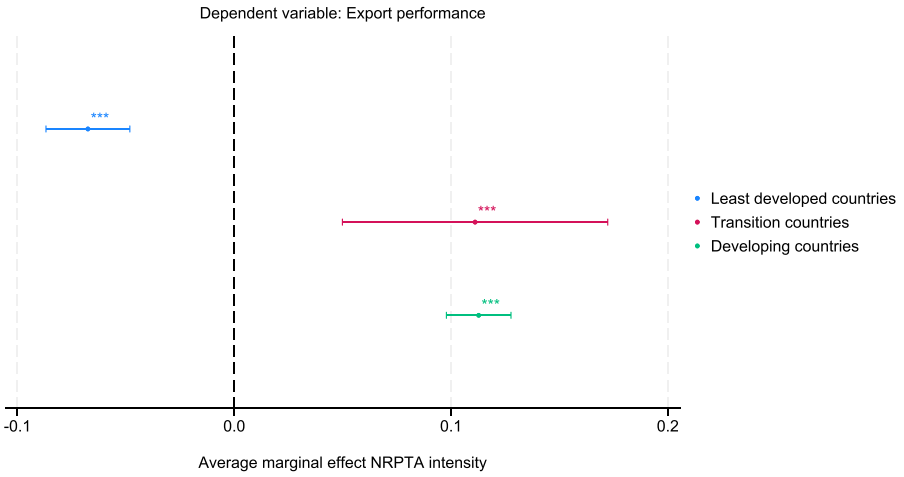

Fig. 3. Average marginal effects of NRPTA intensity on export performance.

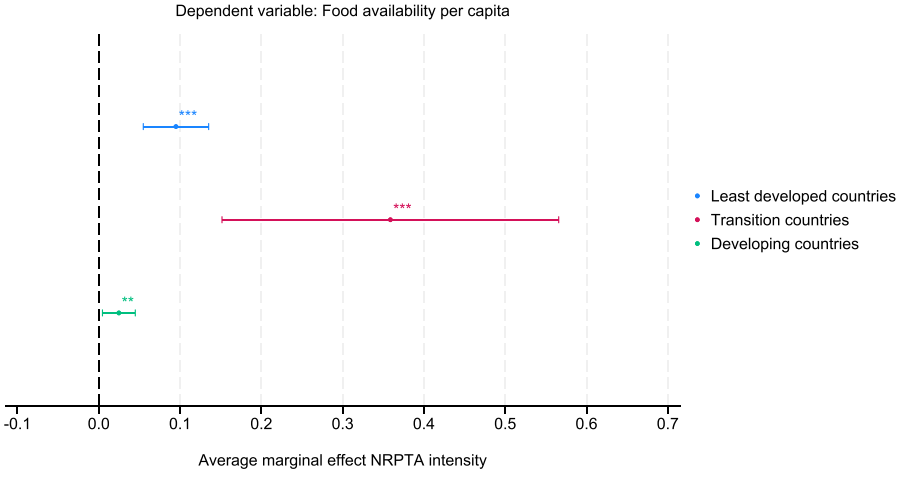

Fig. 4. Average marginal effects of NRPTA intensity on food availability per capita.

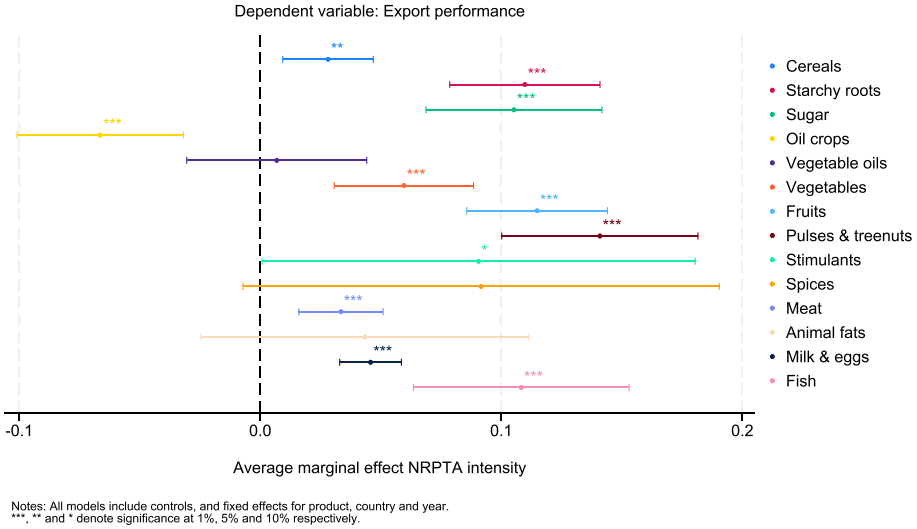

Fig. 5. Average marginal effects of the variable NRPTA intensity for individual food categories for the model variant with the dependent variable export performance.

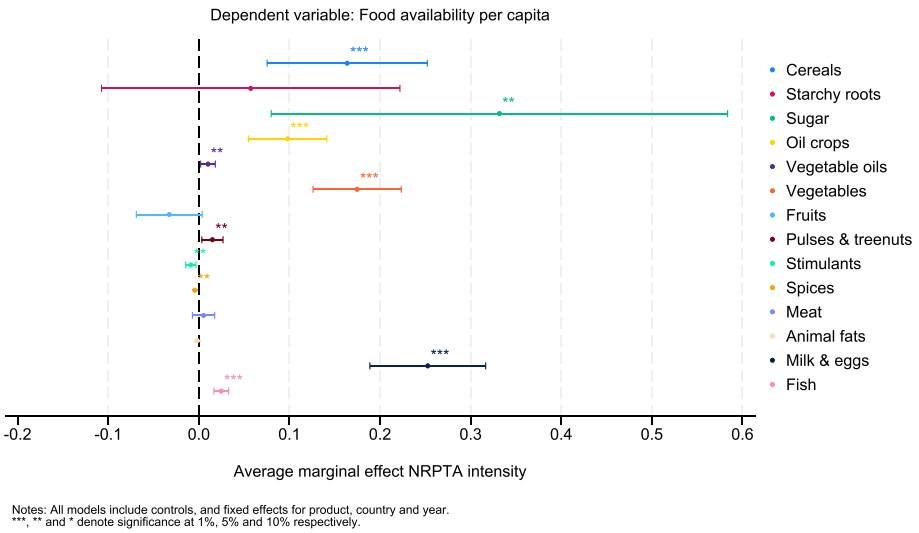

Fig. 6. Average marginal effects of the variable NRPTA intensity for individual food for the model variant with food availability per capita as the dependent variable.

characterize many LDCs (Kareem et al., 2023), and these factors may dampen the effectiveness of NRPTAs. Although this introduces further nuance into our main finding, it highlights the importance of going beyond aggregate findings and assessing effects at lower levels. The negative effect is also supported by a literature stream that finds that NRPTAs have marginal, null, or even negative effects on export performance (e.g., Cardamone, 2011; Fernandes et al., 2023; Gradeva and Martínez-Zarzoso, 2016). Our findings confirm the positive effect of NRPTAs on food availability per capita for all country groups.

Overall, while the magnitude of the positive effect of existing NRPTAs is heterogeneous across country and product groups, our positive average effects support the consensus view that the observed export performance of beneficiaries may have been worse off without preferences (Grossman and Sykes, 2005). Regarding concerns about whether NRPTAs influence food insecurity, our findings show that, at least in our setting, this is not the case. Although food security has been challenged in recent times by major global events, including COVID-19 and the war in Ukraine, we affirm the role of trade preferences in enhancing food security.[4] Our macro-level evidence is also confirmed by micro-level findings from Senegal (Van den Broeck et al., 2018) and multiple developing countries (Van den Broeck and Maertens, 2016) that horticultural exports do not jeopardize the availability of food.

5. Conclusions and policy implications

Integrating developing countries into the global trading system is high on the development agenda. Many uni- and multi-lateral efforts acknowledge the role of trade and globalization in economic development. One way developed countries attempt to achieve this policy objective is to offer NRPTAs to their developing country partners. Such NRPTAs often grant developing countries substantial free market access to developed countries' markets. How these trade preferences affect exports has been the subject of empirical scrutiny. However, increasing export potential may come at the expense of food availability per capita in the preference-receiving country. In this paper, we tackle this "twin" role of NRPTAs using historical data. We ask a simple yet policy-relevant question: How do NRPTAs affect export performance and food security (proxied as food availability per capita)?

Our empirical analysis combines data on imports, exports, food production—to compute our outcome variables, export performance and food availability per capita—and NRPTAs for 112 transition, developing, and least developed countries from 1961 to 2013. We then estimate a linear fixed effects model in which we regress our outcome variables on a count of country-specific NRPTAs in separate equations. Due to the exogeneity of NRPTAs—as recipients cannot self-select into being granted beneficiary status—we are able to estimate the unbiased effect of preferences on export performance and food availability.

Our main finding can be summarized as follows: On average, NRPTAs increase export performance and food availability per capita for beneficiaries. That is, beneficiaries of NRPTAs trade more and have better food security outcomes. Specifically, a unit increase in the count of NRPTAs a country enjoys increases its export performance by 5.5 percentage points and food availability per capita by 0.04 kg. However, these average effects are heterogeneous across countries and products.

Our findings are policy-relevant. First, regarding export performance, we show that the role of trade preferences cannot be denied. Over our long study period, they are instrumental in increasing the export performance of the recipient countries. Therefore, it is important that they continue to be used as tools for economic development. This requires relevant measures to ensure that the preferences are stable. Regarding food security, we find that some of the increased production triggered by the new export possibilities also enhances domestic food availabilty. However, we also see that for cash crops, such as spices and stimulants, the effect of NRTPAs on domestic availability is negative. Although these are not necessary to feed the population—and thus, negative effects are not directly detrimental for food security reasons—they could yield more export revenue for beneficiary countries when exported in their processed form. However, limited processing and value-addition potentials exist for these products in recipient countries, partly because higher tariffs are often charged on the processed form of these products. In the future, the policy focus should also target how these preferences can induce domestic value addition, not just the export of raw commodities.

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[4] While our work shows that NRPTAs enhance food security, we cannot reach conclusions about the quality and diversity of available foods. This will nevertheless be an interesting point of departure for future studies in assessing how NRPTAs affect nutritional outcomes. For instance, Geyik et al. (2021) find that trade (more generally and not NRPTAs specifically) does not substantively improve the nutrient adequacy of most low/lower-middle income countries.

CRediT authorship contribution statement

Christian Ritzel: Writing – original draft, Visualization, Validation, Software, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Dela-Dem Doe Fiankor:** Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no conflicts of interest.

Data availability

All data used in this paper are open-source and will be made available on request.

Appendix

Table A1
Complete list of countries selected for the empirical analyses.

ISO 3 code	Country	Country status in 2013
AFG	Afghanistan	Least developed country
AGO	Angola	Least developed country
BGD	Bangladesh	Least developed country
CAF	Central African Republic	Least developed country
COG	Congo	Least developed country
DJI	Djibouti	Least developed country
ETH	Ethiopia	Least developed country
GIN	Guinea	Least developed country
GMB	Gambia	Least developed country
GNB	Guinea-Bissau	Least developed country
HTI	Haiti	Least developed country
KHM	Cambodia	Least developed country
LAO	Lao People's Democratic Republic	Least developed country
LBR	Liberia	Least developed country
LSO	Lesotho	Least developed country
MDG	Madagascar	Least developed country
MLI	Mali	Least developed country
MMR	Myanmar	Least developed country
MOZ	Mozambique	Least developed country
MRT	Mauritania	Least developed country
MWI	Malawi	Least developed country
NGA	Nigeria	Least developed country
NPL	Nepal	Least developed country
RWA	Rwanda	Least developed country
SDN	Sudan	Least developed country
SEN	Senegal	Least developed country
SLE	Sierra Leone	Least developed country
STP	Sao Tome and Principe	Least developed country
TCD	Chad	Least developed country
TGO	Togo	Least developed country
TZA	Tanzania	Least developed country
UGA	Uganda	Least developed country
YEM	Yemen	Least developed country
ZMB	Zambia	Least developed country
ALB	Albania	Transition country
ARM	Armenia	Transition country
AZR	Azerbaijan	Transition country
BIH	Bosnia and Herzegovina	Transition country
BLR	Belarus	Transition country
GEO	Georgia	Transition country
HRV	Croatia	Transition country
KGZ	Kyrgyzstan	Transition country
MLD	Republic of Moldova	Transition country
RUS	Russian Federation	Transition country
TJK	Tajikistan	Transition country
TKM	Turkmenistan	Transition country
UKR	Ukraine	Transition country
UZB	Uzbekistan	Transition country
ARE	United Arab Emirates	Developing country
ARG	Argentina	Developing country
BEN	Benin	Developing country
BFA	Burkina Faso	Developing country
BOL	Bolivia	Developing country
BRA	Brazil	Developing country
BWA	Botswana	Developing country
CHL	Chile	Developing country
CHN	China	Developing country

(*continued on next page*)

Table A1 (*continued*)

ISO 3 code	Country	Country status in 2013
CIV	Cote d'Ivoire	Developing country
CMR	Cameroon	Developing country
COL	Colombia	Developing country
CPV	Cape Verde	Developing country
CRI	Costa Rica	Developing country
CUB	Cuba	Developing country
DOM	Dominican Republic	Developing country
DZA	Algeria	Developing country
ECU	Ecuador	Developing country
EGY	Egypt	Developing country
GAB	Gabon	Developing country
GHA	Ghana	Developing country
GTM	Guatemala	Developing country
HND	Honduras	Developing country
IDN	Indonesia	Developing country
IND	India	Developing country
IRN	Iran	Developing country
IRQ	Iraq	Developing country
ISR	Israel	Developing country
JAM	Jamaica	Developing country
JOR	Jordan	Developing country
KEN	Kenya	Developing country
KOR	Republic of Korea	Developing country
KWT	Kuwait	Developing country
LBN	Lebanon	Developing country
LKA	Sri Lanka	Developing country
MAR	Morocco	Developing country
MEX	Mexico	Developing country
MKD	Macedonia	Developing country
MNG	Mongolia	Developing country
MUS	Mauritius	Developing country
MYS	Malaysia	Developing country
NAM	Namibia	Developing country
NER	Niger	Developing country
NIC	Nicaragua	Developing country
OMN	Oman	Developing country
PAK	Pakistan	Developing country
PAN	Panama	Developing country
PER	Peru	Developing country
PHL	Philippines	Developing country
PRY	Paraguay	Developing country
SAU	Saudi Arabia	Developing country
SLV	El Salvador	Developing country
SWZ	Swaziland	Developing country
THA	Thailand	Developing country
TTO	Trinidad and Tobago	Developing country
TUN	Tunisia	Developing country
TUR	Turkey	Developing country
TWN	Taiwan	Developing country
URY	Uruguay	Developing country
VEN	Venezuela	Developing country
VNM	Vietnam	Developing country
ZAF	South Africa	Developing country
ZWE	Zimbabwe	Developing country

Table A2
14 food categories with in total 91 product groups.

Food category	Product groups
(1) Cereals	Barley and products, other cereals, maize and products, millet and products, oats, rice (milled equivalent), rye and products, sorghum and products, wheat and products
(2) Starchy roots	Cassava and products, potatoes and products, other roots, sweet potatoes, yams
(3) Sugar crops, sugar, and sweeteners	Honey, sugar (raw equivalent), sugar beet, sugar cane, sugar non-centrifugal, other sweeteners
(4) Oil crops	Coconuts incl. Copra, cottonseed, groundnuts (shelled equivalent), other oil crops, olives, including preserved, palm kernels, rape and mustard seed, sesame seed, soybeans, sunflower seed
(5) Vegetable oils	Coconut oil, cottonseed oil, groundnut oil, maize germ oil, other oil crops oil, olive oil, palm oil, palm kernel oil, rape and mustard oil, rice bran oil, sesame seed oil, soybean oil, sunflower seed oil
(6) Vegetables	Onions, tomatoes and products, other vegetables
(7) Fruits	Apples and products, bananas, other citrus, dates, other fruits, grapefruit and products, grapes and products excl. wine, lemons, limes and products, oranges and mandarins, pineapples and products, plantains
(8) Pulses and tree nuts	Beans, nuts and products, peas, pulses and products

(*continued on next page*)

Table A2 (*continued*)

Food category	Product groups
(9) Stimulants	Cocoa beans and products, coffee and products, tea incl. mate
(10) Spices	Cloves, pepper, pimento, other spices
(11) Meat and edible offal	Bovine meat, other meat, mutton and goat meat, edible offal, pig meat, poultry meat
(12) Animal fats	Butter, cream, raw animal fats, fish body oil, fish liver oil
(13) Milk and eggs	Milk (excl. butter), eggs
(14) Fish and aquatic products	Other aquatic animals, aquatic plants, cephalopods, crustaceans, demersal fish, freshwater fish, other marine fish, other mollusks, pelagic fish

Table A3
PPML regression results of the effect of NRTPAs on food availability per capita.

Independent variable	Food availability per capita all country groups
NRPTA intensity	0.106*** (0.030)
OTA intensity	−0.017 (0.023)
WTO member	1.529*** (0.528)
Log GDP	0.100*** (0.026)
Log Population	0.228*** (0.052)
Log Labor productivity	0.463*** (0.031)
Log Capital productivity	0.198*** (0.025)
Intercept	−8.654*** (0.977)
Country FE	Yes
Time FE	Yes
Product FE	Yes
N	298,580
Pseudo R^2	0.701

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.
Note: The food category 'sugar, sugar crops and sweeteners' is included in this model.

Table A4
PPML regression results of the effect of NRTPAs on export performance.

Independent variable	Export performance least developed countries	Export performance transition countries	Export performance developing countries
NRPTA intensity	−0.068*** (0.012)	0.111*** (0.037)	0.113*** (0.009)
OTA intensity	0.005 (0.009)	0.040 (0.034)	0.047*** (0.008)
WTO member	−0.225 (0.225)	−0.692* (0.407)	0.128 (0.163)
Log GDP	0.065 (0.040)	−1.041*** (0.167)	0.192*** (0.022)
Log Population	0.829*** (0.144)	0.238 (0.449)	−0.015 (0.036)
Log Labor productivity	0.438*** (0.060)	−0.132 (0.115)	0.063*** (0.023)
Log Capital productivity	−0.009 (0.040)	−0.288** (0.126)	0.133*** (0.017)
Intercept	−18.819*** (2.335)	25.801*** (6.964)	−3.132*** (0.669)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Product FE	Yes	Yes	Yes
N	80,358	19,341	198,453
Pseudo R^2	0.441	0.270	0.270

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.

Table A5
PPML regression results of the effect of NRTPAs on food availability per capita.

Independent variable	Food availability per capita – Least developed countries	Food availability per capita – Transition countries	Food availability per capita – Developing countries
NRPTA intensity	0.095*** (0.024)	0.359*** (0.126)	0.025** (0.012)
OTA intensity	0.049*** (0.019)	0.016 (0.140)	−0.001 (0.010)
WTO member	1.381*** (0.460)	5.597*** (1.229)	−0.040 (0.231)
Log GDP	0.052 (0.039)	0.416*** (0.083)	0.043** (0.019)
Log Population	−0.328*** (0.115)	0.415* (0.222)	−0.260*** (0.033)
Log Labor productivity	0.536*** (0.057)	0.532*** (0.077)	0.290*** (0.020)
Log Capital productivity	0.059 (0.046)	0.285*** (0.084)	0.088*** (0.017)
Intercept	−0.284*** (1.767)	−21.320*** (7.742)	2.110*** (0.579)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Product FE	Yes	Yes	Yes
N	75,849	18,330	186,513
Pseudo R^2	0.570	0.841	0.565

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.
Note: The food category 'sugar, sugar crops and sweeteners' is excluded from the models.

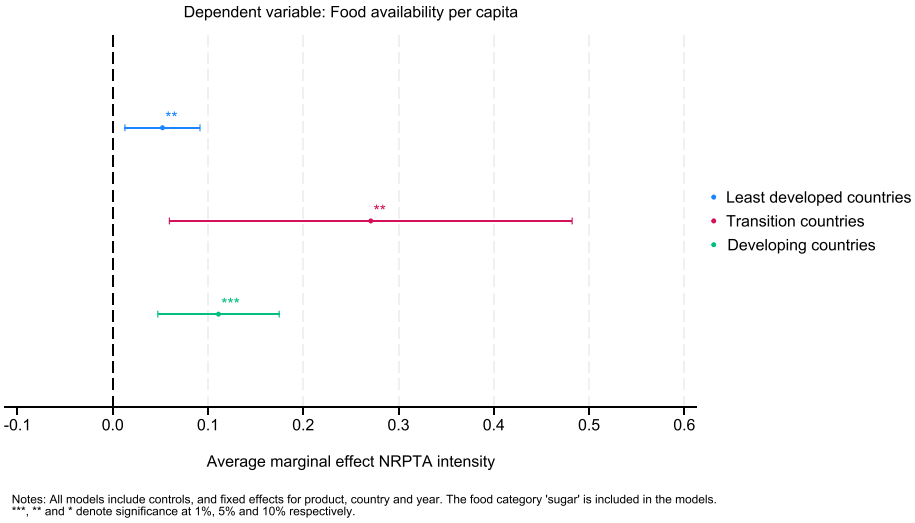

Fig. A1. Average marginal effects of NRPTA intensity on export performance.

Table A6
PPML regression results of the effect of NRPTAs on food availability per capita (including sugar, sugar crops, and sweeteners).

Independent variable	Food availability per capita – Least-developed countries	Food availability per capita – Transition countries	Food availability per capita – Developing countries
NRPTA intensity	0.052** (0.024)	0.271** (0.129)	0.111*** (0.039)
OTA intensity	0.056*** (0.019)	−0.031 (0.139)	−0.004 (0.031)
WTO member	1.749*** (0.479)	5.624*** (1.261)	1.626** (0.668)
Log GDP	0.043 (0.037)	0.396*** (0.084)	0.147*** (0.031)
Log population	−0.073 (0.109)	0.481** (0.217)	0.037 (0.059)
Log labor productivity	0.603*** (0.054)	0.574*** (0.075)	0.458*** (0.036)
Log capital productivity	0.029 (0.044)	0.261*** (0.081)	0.228*** (0.026)
Intercept	−4.883*** (1.731)	−22.515*** (3.698)	−6.419*** (1.158)
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Product FE	Yes	Yes	Yes
N	80,827	19,504	198,448
Pseudo R^2	0.577	0.837	0.762

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.
Note: The food category 'sugar, sugar crops and sweeteners' is included in the models.

Table A7
PPML regression results for individual food categories for the model variant with the dependent variable export performance. ***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.

Export performance							
Independent variable	Cereals	Starchy roots	Sugar	Oil crops	Vegetable oils	Vegetables	Fruits
NRPTA intensity	0.028** (0.011)	0.110*** (0.019)	0.105*** (0.022)	−0.066*** (0.021)	0.007 (0.023)	0.060*** (0.018)	0.115*** (0.018)
OTA intensity	−0.008 (0.010)	−0.001 (0.016)	0.021 (0.022)	−0.092*** (0.018)	0.044** (0.020)	0.000 (0.014)	0.023 (0.015)
WTO member	0.435** (0.207)	0.496 (0.325)	1.314*** (0.460)	−0.507 (0.417)	3.218*** (0.400)	−0.811*** (0.263)	−1.159*** (0.328)
Log GDP	−0.012 (0.065)	−0.280** (0.124)	0.328*** (0.063)	0.316*** (0.058)	0.588*** (0.059)	−0.010 (0.079)	0.335*** (0.042)
Log Population	0.232** (0.111)	0.685*** (0.259)	0.189* (0.110)	−0.936*** (0.120)	−0.136 (0.106)	0.212 (0.137)	0.062 (0.073)
Log labor productivity	0.122* (0.072)	−0.028 (0.130)	0.384*** (0.062)	0.565*** (0.062)	0.465*** (0.072)	−0.492*** (0.087)	−0.161*** (0.045)
Log capital productivity	−0.193*** (0.064)	−0.163 (0.112)	0.079 (0.053)	−0.022 (0.058)	0.143** (0.061)	0.230*** (0.076)	0.203*** (0.041)
Intercept	−3.460** (1.979)	−2.279 (4.691)	−14.231*** (1.875)	1.942*** (2.240)	−17.364*** (2.042)	6.621*** (2.259)	−4.243*** (1.356)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

(*continued on next page*)

Table A7 (*continued*)

Export performance							
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	33,351	14,230	17,106	27,811	31,394	13,275	34,750
Pseudo R^2	0.377	0.475	0.520	0.248	0.297	0.465	0.341
Export performance							
Independent variable	Pulses & tree nuts	Stimulants	Spices	Meat	Animal fats	Milk & eggs	Fish
NRPTA intensity	0.141*** (0.025)	0.091* (0.055)	0.092 (0.060)	0.034*** (0.011)	0.043 (0.041)	0.046*** (0.008)	0.108*** (0.027)
OTA intensity	−0.013 (0.022)	0.423*** (0.049)	−0.188*** (0.054)	0.045*** (0.010)	−0.008 (0.035)	−0.028*** (0.008)	0.026 (0.023)
WTO member	−0.901* (0.482)	0.493 (1.030)	2.465** (1.117)	−0.876*** (0.228)	−1.170 (0.808)	−0.173 (0.157)	0.356 (0.497)
Log GDP	−0.139** (0.063)	0.268*** (0.046)	0.087 (0.081)	0.150* (0.077)	−0.268*** (0.103)	0.524*** (0.126)	0.159*** (0.043)
Log Population	0.525*** (0.130)	−0.030 (0.092)	0.197 (0.151)	0.114 (0.133)	0.885*** (0.190)	0.374** (0.175)	−0.130 (0.084)
Log labor productivity	0.200** (0.078)	0.184*** (0.051)	−0.082 (0.082)	0.332*** (0.078)	0.805*** (0.103)	−0.552*** (0.109)	−0.091* (0.047)
Log capital productivity	−0.052 (0.055)	0.175*** (0.040)	0.527*** (0.071)	0.030 (0.067)	−0.008 (0.085)	0.273*** (0.100)	0.082*** (0.029)
Intercept	−5.675** (2.533)	−5.140*** (1.638)	−1.199 (2.848)	−8.494*** (2.255)	−17.303*** (3.345)	−8.916*** (2.706)	2.486* (1.506)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	14,498	10,204	6696	24,700	10,998	9395	31,164
Pseudo R^2	0.378	0.455	0.299	0.501	0.354	0.552	0.314

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.

Table A8

PPML regression for individual food categories for the model variant with the dependent variable food availability per capita. ***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.

Food availability per capita							
Independent variable	Cereals	Starchy roots	Sugar	Oil crops	Vegetable oils	Vegetables	Fruits
NRPTA intensity	0.164*** (0.054)	0.057 (0.100)	0.332** (0.153)	0.098*** (0.026)	0.010* (0.005)	0.175*** (0.030)	−0.033 (0.022)
OTA intensity	−0.076* (0.043)	−0.155** (0.077)	−0.803*** (0.160)	−0.055*** (0.020)	−0.008** (0.003)	−0.029 (0.025)	−0.055*** (0.021)
WTO member	1.202 (0.998)	2.900 (1.959)	15.970*** (2.786)	0.753* (0.430)	0.065 (0.072)	0.730 (0.558)	−0.390 (0.407)
Log GDP	0.060* (0.031)	−0.085* (0.049)	0.060 (0.039)	−0.023 (0.066)	0.175*** (0.037)	0.156*** (0.020)	0.073** (0.035)
Log Population	0.228*** (0.061)	0.770*** (0.135)	0.772*** (0.081)	−0.409*** (0.145)	−0.179** (0.092)	−0.467*** (0.057)	−0.418*** (0.059)
Log labor productivity	0.335*** (0.031)	0.273*** (0.056)	0.678*** (0.044)	0.773*** (0.075)	0.230*** (0.042)	0.287*** (0.026)	0.374*** (0.039)
Log capital productivity	−0.004 (0.030)	0.470*** (0.046)	0.339*** (0.026)	0.047 (0.054)	−0.250*** (0.073)	0.133*** (0.022)	0.124*** (0.037)
Intercept	−6.258*** (1.010)	−10.060*** (2.312)	−25.003*** (1.413)	−1.998*** (2.698)	−3.808*** (1.548)	−3.070*** (1.097)	−2.503** (1.130)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	34,576	16,696	17,887	28,227	32,799	14,392	36,544
Pseudo R^2	0.398	0.573	0.951	0.457	0.304	0.739	0.480
Food availability per capita							
Independent variable	Pulses & tree nuts	Stimulants	Spices	Meat	Animal fats	Milk & eggs	Fish
NRPTA intensity	0.015** (0.007)	−0.009** (0.004)	−0.005*** (0.002)	0.005 (0.007)	−0.002 (0.002)	0.253*** (0.039)	0.025*** (0.005)
OTA intensity	−0.000 (0.006)	0.001 (0.003)	−0.005*** (0.001)	0.009 (0.006)	−0.000 (0.002)	−0.042 (0.035)	0.005 (0.005)
WTO member	−0.226* (0.126)	−0.050 (0.059)	0.065* (0.035)	0.263* (0.137)	0.225*** (0.042)	4.404*** (0.769)	0.060 (0.101)
Log GDP	−0.098*** (0.033)	0.116** (0.047)	−0.121* (0.064)	0.029 (0.030)	0.228*** (0.035)	0.220*** (0.019)	0.288*** (0.038)
Log Population	0.183** (0.089)	−0.531*** (0.083)	−0.200** (0.085)	−0.034 (0.054)	−0.109 (0.122)	−0.046 (0.044)	−0.547*** (0.070)

(*continued on next page*)

Table A8 (*continued*)

Food availability per capita							
Log Labor productivity	0.375*** (0.039)	0.450*** (0.056)	0.110* (0.061)	0.566*** (0.030)	0.405*** (0.037)	0.329*** (0.020)	0.285*** (0.048)
Log capital productivity	0.042 (0.041)	−0.010 (0.057)	0.246*** (0.053)	−0.067*** (0.025)	−0.033 (0.034)	−0.045** (0.020)	−0.129*** (0.032)
Intercept	−4.324*** (1.533)	−0.608 (1.575)	4.738** (1.871)	−6.748*** (0.952)	−9.239*** (2.041)	−5263*** (0.813)	−1.059*** (1.252)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Product FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	15,315	10,745	7578	29,020	12,952	9395	31,297
Pseudo R^2	0.371	0.267	0.309	0.419	0.430	0.899	0.492

***, ** and * denote significance at 1%, 5% and 10% respectively. Robust standard errors are in parentheses.

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