**Trends and Evolution of Global Value Chains in Food and Agriculture: Implications for Food Security and Nutrition**

**Abstract**

Value chains in the food and agricultural sectors are crucial for food systems transformation and economic development. As countries are increasingly participating in global agrifood value chains (GAVC), their significance becomes even more pronounced. We highlight stylized facts, evolution, trends, and key players of GAVCs integration between 1990 and 2020 using data from the rich EORA multi-region input-output tables. Following this, we examine the relationship between GAVCs and food and nutrition security relying on a constructed panel of countries in low and middle income countries in 2000 – 2020. Employing the Bartik shift share instrumental variable approach and several other identification strategies, we show a positive (negative) association between countries’ participation in GAVCs and energy intake (prevalence of undernourishment). We underscore substantial heterogeneity by income groups. Generally, results for the upper-middle-income groups, are consistent with those of the global sample. However, GAVC participation of the low-income group is associated with reduced stunting only, and mixed results are found for lower-middle-income countries These findings suggest that integration in global value chains could be conducive to food security and nutrition on a global level average and for the majority of the country income groups. However, policies strengthening global value chain integration alone may not be sufficient in the context of low- and lower-middle-income countries but should be coupled with other measures that positively affect food security and nutrition. At the same time national policies should be designed on a country-by-country basis, with context-specific policies tailored to the challenges faced by each country targeting all vulnerable groups in mind.

**Keywords:** Agri-food; Global value chains; food and nutrition security; diets; trade

JEL Codes : C33, C55, Q17, Q18, Q27

1. **Introduction**

The triple burden of malnutrition – the coexistence of undernutrition (stunting and wasting), overnutrition (overweight and obesity) and micronutrient deficiencies - continues to be a major global issue faced by many countries, especially developing countries. This has been exacerbated by COVID-19 which has been greatly associated with food insecurity (FAO et al., 2023; Tabe-Ojong et al. 2023). Concurrently, global agrifood value chains (GAVCs) continue to evolve, making production and consumption of various agricultural and food products available to many people and contributing to economic growth by realizing gains from specialization and fragmentation of the production process in line with comparative advantages. GAVCs also link countries and firms horizontally and vertically with each other as well as to consumers (Swinnen and Maertens 2007; Sexton 2013; Balié et al. 2019) and can create employment opportunities and increase household income. Nonetheless, integration into global value chains may bring competition to the local/regional global value chain, having welfare and distributional implications that may not favor all households, and may also signal negative global shocks to the domestic economy. Consequently, integration into global value chains may have both positive and negative aspects with implications on the status of food security and nutrition globally and across countries. Despite these implications and the importance of GAVCs integration in food system transformation, only few studies have analyzed the food security and nutrition impacts of GAVCs (Barrett et al. 2022; Nenci et al. 2022).

We map and document the evolution of GAVCs between 1990 and 2020, highlighting trends and key country players. We then investigate the relationship between GAVCs and different aspects of food security and nutrition such as the average per capita energy intake of the population as well as children’s nutritional outcomes such as overweight, undernourishment, and stunting. Using the EORA multi-region input-output (EORA-MRIO) tables, we measure the sectorial agrifood value chains integration and employ the Bartik-shift share Instrumental Variable (IV) approach and several other identification strategies including the Lewbel’s IV method and the Arrelano-Bond estimator as well as the Kinky Least Squares regression to alleviate concerns associated with the simultaneity between food security and nutrition status of countries and their integration to global agrifood value chains. We focus on GAVCs in both the agricultural the food and beverages sector. This paper primarily focuses on agri-food value chains to analyze their impact on food and nutrition security, while also recognizing the significance of spillover effects from non-agrifood global value chains.[[1]](#footnote-2) Agrifood value chains play a critical role by directly influencing food availability, affordability, nutritional content, and intricate supply chain dynamics. We also perform the analysis globally across different countries classified by income group to address the associated heterogeneities.

About a third of all agrifood exports are taking place through GAVCs (FAO, 2020). Our analysis reveals a global uptrend in participation in GAVCs, yet significant potential remains for greater involvement, particularly among developing nations that often lack robust integration into global markets. Notably, countries in higher income groups exhibit greater levels of integration into GAVCs. Using GVC network graphs, we further show that all continents (Africa, Asia, Europe, Americas) seem to be well integrated in GAVCs and the intensity of GAVC participation is increasing over time with more established links between countries. Countries are also integrated in GAVCs with some more positioned in the upstream agriculture sector and others in the downstream food and beverages sector. GAVC participation in both the upstream agriculture sector and the downstream food and beverages sector follows a similar trend although with some nuanced heterogeneity.

We show a positive (negative) association between countries’ participation in GAVCs and energy intake (prevalence of undernourishment) and no association with obesity and stunting at the global level. Disentangling the results by income groups following the World Bank classification (World Bank, 2023), we underscore significant heterogeneity on several fronts. In general, we find consistent results for higher income groups compared to the global sample. GAVC participation for low-income groups is associated solely with reduced stunting, while lower middle-income groups exhibit mixed outcomes, including reduced stunting alongside increased undernourishment and overweight. These insights are robust to different estimators, suggesting the reliability of the findings.

We offer three main contributions to the growing literature on the evolution of GAVCs and their implications on food and nutrition security. First, we map and document the evolution of GAVCs showing the participation of different countries in both the agriculture sector as well as the food and beverages sector, building on and extending the work of Nenci et al. (2022) that analyzed GAVCs evolution for the period between 1995 and 2015. The second contribution is in establishing the food and nutrition security implications of agrifood value chains, specifically GAVCs. Here, we find a positive association between GAVCs and dietary energy consumption and a negative association between GAVCs and undernourishment. Agrifood value chains and their economic and social implications have mainly been studied from the perspective of local value chains and based on limited case studies (Salvatici and Nenci 2017; Barrett et al. 2022). Recent studies provide global assessments making use of data from the EORA-MRIO tables. These papers have broadly looked at interlinkages between GAVCs and economic and social upgrading. While economic upgrading is generally assumed to translate into social upgrading, this may not necessarily be the case (Nenci et al. 2022). Previous studies have also established a positive association between GAVCs and structural transformation (Lim 2021), job creation effects with an increase in agricultural employment (Lim and Kim 2022), and changes in agriculture value per worker (Montalbano and Nenci 2022). Additionally, GAVCs are shown to be negatively associated with food prices but positively associated with price volatility (Dalheimer et al. 2023). We add to this group of studies by focusing on the food security and nutritional implications of GAVCs. The final contribution is in uncovering substantial heterogeneity in food and nutrition security implications of GAVCs across countries. While undertaking a global analysis of the nutrition and health implications of GAVCs, we also assess effects disaggregated by income levels.

The remainder of the article is structured as follows. Section two presents a brief conceptual framework highlighting the linkages between GAVCs and food and nutrition security. In section 3, we present the data used in the analysis and the definition of the outcome variables. Here, we also discuss the computation of the GAVCs. In section 4, we present the empirical strategy. Section 5 delves into the results and discussions, first highlighting stylized facts and trends based on the EORA-MRIO data followed by the empirical results on the relationship between GAVC participation and food and nutrition security. Finally, we summarize and offer some policy thoughts in section 6.

1. **Global Agrifood Value Chains and Food and Nutrition Security**

Agrifood trade can be related to nutrition outcomes in various ways. Trade is interlinked with economic growth, which in turn affects food security and nutrition. Both food security and nutrition improve at higher per capita incomes due to higher purchasing power. Agrifood trade also directly affects the four dimensions of food security – food availability, access, utilization, and stability. Food availability in a country increases as agrifood imports increase. If more food is available, food prices decline and access to food improves. Agrifood trade allows more diversified food imports, which can translate into more diversified diets and improved utilization (Krivonos and Kuhn, 2019; Remans et al., 2014). Agrifood trade also allows for buffering short-term fluctuations in domestic production, caused either by production shocks or seasonal growing patterns (Dithmer and Abdulai, 2017).

This paper looks at a specific aspect of agrifood trade – agrifood trade that occurs through global value chains. Globally, around one-third of agrifood exports are traded within global value chains (Nenci et al., 2022). While interlinkages between agrifood trade and food security and nutrition has attracted some attention in the literature, specific characteristics of GVCs and food security and nutrition have received limited recognition. We identify three main channels in which agrifood GVCs can impact food security and nutrition. (1) GVCs in the agrifood sector have been shown to be positively related to agriculture value added per worker on average, but the exact effect is subject to geographical heterogeneity (Montalbano and Nenci, 2022). Higher productivity is correlated with economic growth and higher per capita incomes, which may translate into better access to food and enhanced food security and nutrition. Higher agricultural productivity could also increase food availability, food prices and production diversity, all of which could in turn raise the level of food security and nutrition. (2) Greater participation in agrifood GVCs can be associated with the development process (Montalbano and Nenci, 2022) and better employment opportunities (Lim and Kim, 2022), which again would affect per capita incomes and food security and nutrition. (3) A more direct way of how participation in agrifood GVCs can affect food security and nutrition is when it is combined with higher rates of downstreamness. Global and local value chain development and evolving agrifood industries may translate into higher rates of downstreamness, especially in the food and beverages sector. Downstream value chain activities, especially in food and beverages, can indicate domestic food processing capacity, which could directly impact dietary patterns and nutrition. The development of global and local value chains may also contribute to the proliferation of both global and local agrifood industries. Some agrifood industries even offer additional services to farmers such as providing access to healthy and nutritious foods. An example is food price support, where mobile vendors are leveraged to reach marginalized and geographically isolated groups in far regions and countries (Nordhagen and Demmler 2023).

The impacts of GVCs in the agrifood sector on food security and nutrition may differ across nations depending on the capacity of countries in the value-added generation and employment opportunities associated with the agriculture and food sector (Jared, 2018). As countries do not have the same comparative advantages, countries may integrate into different segments of the global value chain and face different benefits and challenges (Jared, 2018), depending on the competition between the (sub)national value chains and the global value chains. Additionally, depending on how the benefits are distributed across value chain actors within a country, the impacts on food and nutrition security within a nation may vary. The impacts are more desirable when the vulnerable groups benefit more from the integration.

The influence of global value chains in agriculture may also vary among households. Households may face different income increases from the global value chain depending on the primary source of their income, and their ability to seize employment opportunities. For households reliant on agriculture for income, the productivity and income channel (the first channel) hold greater significance. The impact through the second channel differs based on factors such as education levels and gender composition within households, affecting their ability to take employment opportunities. Furthermore, the third channel's impact is diverse across households, with income effects predominantly affecting those housholds primarily employed in the related sector. The impact of a rise in income on spending on nutrient-rich products may differ across households, and therefore a one-dollar increase in income across different households may have different nutrition implications. However, this depends on the initial level of household income, which affects their relation to further income increase and price changes, as well as other households’ characteristics affecting dietary patterns. The latter may be determined by several factors such as the education of the household’s head, cultural background, household size, access to food outlets, and importantly the role that gender plays in the economics of the households.

The impact on employment opportunities may also have different nutrition implications as global value-added may change the relative compositions of gender in labor market participation. There is a common association between women's labor market participation with improved maternal and child nutrition outcomes, albeit women's labor participation may account for a small share of the variance in nutrition outcomes (Quisumbing, 2021). The relationship between women's participation in the labor market and nutritional outcomes can be explained through three major pathways (Quisumbing, 2021). First, greater participation of women in the workforce can enhance women’s social status and empowerment through increased access to and control over resources, that may enable families to afford diverse and nutritious food options and apply healthier dietary practices. Second, women's time allocation in agriculture presents a dual aspect, potentially affecting their and their children's nutrition either positively or negatively. For instance, women's participation in oil palm production has been associated with lower dietary diversity for women as the cultivation of this cash crop displaces food crop production (Tabe-Ojong, 2023). Third, there's the pathway of women's health and nutrition directly linked to women's engagement in agriculture, with impacts varying based on exposure to occupational hazards and the balance between energy intake and expenditure.

1. **Data and variable measurement**
   1. **Data**

The data for this analysis come from multiple sources. First, we construct the global agrifood data from the EORA multi-region input-output (EORA-MRIO) databases that provide comprehensive dat on world input-output (IO) tables. Second, we extract nutrition and food security data from the Food and Agriculture Organization statistics database (FAOSTAT). Third, we obtain most of the control variables, including agriculture, economics, and demographic variables from the World Development Indicators (WDI) database hosted by the World Bank. Finally, we obtain trade policy variables from Mario Larch’s Regional Trade Agreements Database which includes bilateral and multilateral regional trade agreements (Egger and Larch, 2008), We provide more details about these outcome variables, control variables as well as the GAVC participation variables below. While we use the data from the EORA-MRIO database to characterize agrifood value chains in the descriptive insights, we only use the sub-sample for low, lower-middle as well as upper-middle-income group classification for the empirical analysis.

* 1. **Measurement of variables of interest**
     1. **Measuring GAVCs**

There have been several attempts to accurately measure GVC participation (Koopman et al. 2014; Wang et al. 2017; Los and Timmer 2018; Belotti et al. 2021). For our analysis, we employ the EORA-MRIO database to measure GAVC participation, following the framework proposed by Borin and Mancini (2019).[[2]](#footnote-3) The framework captures all the sources of value-added activities for more than two countries, which are often missing in other measures of GAVCs, and has recently been used by several empirical papers (Borin et al. 2021; Lim and Kim 2022).

Following this extensive literature on GAVCs, we decompose gross agrifood exports into broad value-added activities, allowing us to estimate GAVC participation. Gross agrifood exports are decomposed into several components including domestic agrifood value-added exports (), and foreign agrifood value added (). refers to the value of domestic agrifood products exported and used by third countries as intermediate goods for their exports and re-exported. refers to the value of agrifood products exports that originates from imported inputs. Follow Borin and Mancini (2019) GAVC participation is measured as follows:

|  |  |
| --- | --- |
|  | (1) |

Where and represents respectively forward GAVC participation in country *I* at period *t and* backward GAVC participation in country *i* at period *t*. Total agriculture (*Total agri*) refers to both agriculture and food and beverage. Thus equation (1) can be expressed as follows:

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|  | (2) |

Calculating subsector level of GAVC participation follows the same process. Thus, to calculate GAVC participation, we use the agriculture subsector classification to measure agricultural GVCs (GaVC) and the food and beverage subsector classifications to measure food GVCs (GfVC), respectively as follow:

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| --- | --- |
|  | (3) |

|  |  |
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|  | (4) |

* + 1. **Measuring nutrition**

We have four food and nutrition security measures: dietary energy consumption, prevalence of undernourishment, prevalence of overweight and prevalence of stunting. The prevalence of overweight and prevalence of stunting variables refer to children under 5 years of age as obtained from the FAOSTAT database. Dietary energy consumption is the amount of food expressed in kilocalories per day (kcal) available for individuals in the population (Dithmer and Abdulai 2017). It has a wide representation and is generally available for many countries over different years. Given the way it is constructed, it also captures some aspects of food consumption and is closely related to the above-mentioned nutritional indicators (Smith and Haddad 2001). We use data from 2000 to 2020. Moreover, since we are concerned about nutrition, we limit the sample here to low, lower-middle as well as upper-middle-income groups as per the 2023 World Bank classification (World Bank, 2023).

1. **Empirical and identification strategy**

We are interested in understanding the association between GAVCs and food and nutrition security. Given that we have a panel data, we specify a regression equation of the form:

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|  | (5) |

Where refers to the four food and nutrition security outcomes of country *i* and time *t*: dietary energy consumption, prevalence of undernourishment, overweight and stunting. refers to participation in GAVCs. Its parameter estimate, is indicative of the relationship between GAVCs and the nutrition indicators. is a vector of *h* control variables added to the model to increase the precision of the estimates and reduce pathways through which GAVCs and food and nutrition security may be correlated. We include control variables representing agricultural attributes, socio-economic and trade policy characteristics as well as demographic characteristics. Some of these variables are foreign direct investment, fertilizer consumption, employment in agriculture, percentage of land area occupied by agricultural land, unemployment as a percentage of the total labour force, labour force participation rate, population, arable land, population density, free trade agreement, regional trade agreement, currency union, tree cover, food production, average rainfall and temperature change. In all models, we include country fixed effects ( to control for time invariant factors that may be associated with food and nutrition security. We also include time fixed effects (to control for possible shocks that may be affecting countries over time. refers to the stochastic error term.

Assuming endogeneity is not an issue in this analysis, equation (5) can be estimated using the OLS estimator with just country and time fixed effects. The addition of many controls can help reduce some aspects of endogeneity and other pathways through which GAVCs and food and nutrition security may be correlated but may also risk overspecification of the model. Endogeneity could arise from unobserved heterogeneity, reverse causality, and measurement error. While unobserved heterogeneity can be addressed through exploring the panel data by controlling for time and country fixed effects, reverse causality may be more difficult to tackle in the analysis. That notwithstanding, we explain how we navigated this issue that may potentially bias the estimates. Reverse causality or simultaneity may arise due to the prevalence of food and nutrition security responding to participation in GAVCs and/or the desire of countries to address and possibly reduce food and nutrition security through increased participation in global production networks. Ignoring this possibility could lead to biased estimates of the true relationship between GAVCs and food and nutrition security. We thus employ the two-stage least squares regressing using instrumental variables. For measurement error, we do not think this is much of an issue in the analysis as care was taken in the data generation process to make sure that all our regression variables are measured right and capture what they indeed measure. We relied on databases that cleanly measure these variables, but it is hard to refute the existence of measurement error especially as we estimated fixed effects regressions. The measurement error in this case is classical implying the presence attenuation bias. Thus, one may treat the estimated coefficients as a lower bound of the true estimated coefficients (see Lim 2021 for a discussion about the different sources of endogeneity in these kinds of estimations). That said, it has been previously established that IV techniques can purge out measurement error from an endogenous regressor especially in a standard linear setting (Aldrich, 1993; Pancost and Schaller, 2021).

* 1. **Bartik shift share instrumental variable**

Given all these, we estimate two-stage least-squares regression (2SLS) that uses an instrumental variable (IV) to reduce some of these potential biases. One of the main challenges is the identification of strong instruments that satisfy the three IV conditions of relevance, exogeneity and exclusion restriction. Given the sectorial GAVC data for which shares can be computed, we deploy the Bartik-shift share IV approach (Bartik 1991). This IV approach can isolate exogenous variation in GAVC participation and has recently been used to understand the implications of agri-food GVC participation (Lim and Kim 2022; Dalheimer et al. 2023). The IV is constructed as shown in equation (6):

|  |  |
| --- | --- |
|  | (6) |

where weights the instrument using the gross exports from country *i* at year *t.* refers to the sector specific share (initial agriculture or food and beverage sector) which represents the exposure of the sector in country *i* to a previous global shock (*t*-1). The share is computed as the ratio of sector specific GAVC for any country in a previous time to the sum of the GAVCs through all countries i.e., . Thus, the share simply represents the sectorial contribution by country within the GAVC. The shift is then represented by which is defined as the sum of all a countries’ sectorial participation in the agrifood sector. For a full and better understanding of this IV strategy alongside its strengths and limitations, confer Goldsmith-Pinkham et al. (2020). Like every other IV, we comment on aspects of relevance, exogeneity and exclusion restriction although the conditions here are somewhat nuanced. Relevance in this case is obtained by looking at the relationship between the initial exposure of the agri-food sub-sector to a global shock in the representative country and the real change in GAVC participation in that country. This is a testable assumption that we test in our empirical setting. Assessing the exogenous and exclusion restriction conditions follows pretty much the same scenario where the initial shares of the sectorial distribution should be independent from our food and nutrition security outcomes and other unobserved factors. We do not think there is a possibility of this scenario given that the initial distribution of both the agriculture and food and beverage sub sectors are most likely driven by natural endowments, geographical suitability, resource availability, climatic and arable land factors that are possibly exogenous to food and nutrition security. We test some of these assumptions and estimate different models such as the limited information maximum likelihood (LIML) (Anderson and Rubin, 1949) and a modification of bias-corrected two-stage least squares (MBLS) (see Kolesár et al., 2015) and verify our inference using both Ecker-Huber-White standard errors which is heteroskedasticity robust and the information matrix-based standard errors (IM-SE).

* 1. **Robustness checks for identification**

To support the use of the Bartik shift share IV and improve on the identification strategy, we employ three additional checks on the identification strategy; (1) the Lewbel IV approach; (2) Arrelano Bond estimator; and (3) Kinky least squares regression; The Lewbel’s IV approach is a heteroskedasticity based method that exploits heteroskedastic covariance to construct internal IVs (Lewbel, 2012). It identifies structural parameters in models with regressors that are endogenous or mismeasured in the presence of weak instruments or no valid instruments. In our case, we use this method to supplement the shift share IV to improve the efficiency of the IV estimator. Identification here is achieved when regressors are uncorrelated with heteroskedastic errors. This strategy in addition to supporting the efficiency of the IV estimator also provides some tests on the validity of the instrumental variable including the Sargan-Hansen test of orthogonality conditions, Anderson canon. corr. LM statistic for under-identification, Cragg-Donald Wald F statistic, Stock-Yogo weak identification test.

The second robustness check we undertake is the Arrelano-Bond estimator, also known as the Generalized method of moments (GMM) estimator. The GMM estimator was originally developed by Holtz-Eakin et al (1988) and advanced by Arellano and Bond (1991). Unlike the IV approach, it uses internal instruments to address potential endogeneity challenges. The model is specified as follows:

|  |  |
| --- | --- |
|  | (7) |

Where represent nutrition indicators, is GAVC (agriculture sub-sector and food and/or beverage sub-sector) and represent the set of control variables mentioned above for countries over time , and is the number of control variables where . are time and country fixed effects.

The Arrelano-Bond estimator uses lagged values of endogenous variables as instruments. The number of instruments can easily explode as the time-series dimension of the dataset becomes longer weakening the test for over-identifying restrictions due to overidentification (Roodman 2009). According to Windmeijer (2005), GMM becomes more efficient when the lag length is controlled to use fewer instruments in the estimation. The Sargan or Hansen tests are diagnostic tests designed to establish whether additional instruments associated with the system GMM estimator are valid. Additionally, second-order autocorrelation of the residuals (serially correlated residuals) may undermine insights from the GMM estimator by rendering the IVs inconsistent. The Arellano–Bond test for first order (AR1) and second order (AR2) serial correlation are used to detect this problem. To limit instruments proliferation and serial correlation serial correlation, we restricted the study period to 5 periods, each period representing four consecutive years and each variable for a given period represents the mean over four consecutive years.

The final identification check is using the Kinky Least Square (KLS) regression which is an instrument-free inference for models with endogenous regressors (Kiviet, 2013; Kripfganz and Kiviet, 2021). It is an identification strategy that imposes assumptions on the regressor endogeneity which is normally left unrestricted in many IV models. It exploits non orthogonality conditions using bounds on different degrees of endogeneity. It also estimates confidence intervals that can be more informative than confidence intervals from the traditional IV estimations in the presence of weak IV. It enables a sensitivity analysis for IV inference as it allows for assessing the validity of the exclusion restrictions. It does not entail the addition of any IV but rather corrects the bias from the OLS estimator throughout of endogeneity correlations. Given this, it is very informative and avoids the usually difficult search for valid IVs. It is akin to other approaches such as the coefficient stability and omitted variable check that also creates bounds on causal effect (Oster, 2019).

1. **Results and discussion**
   1. **Descriptive insights**

Here, we present descriptive insights from the global agrifood participation data where we consider all the available data constructed from the EORA-MRIO database (1990 -2020) to understand the evolution and trends of agrifood value chains as well as some stylized facts and where countries lie in the agrifood GVC. Important to mention here that these descriptives are for the period 1990 to 2020 and we use a reduced sample size[[3]](#footnote-4) for the empirical analysis linking GAVC and nutrition (2000-2020). We also present trends in the nutrition indicators, disaggregated by income groups.

* + 1. **Evolution of GAVCs**

We begin by documenting the evolution of GAVCs using the EORA-MRIO tables. We highlight the participation of countries over time in GAVCs using GAVC network figures. Since we have a 30-year period data (1990-2020), we look at 4 production network graphs over a 10-year period as shown in Figure 1. We look at the years 1990, 2000, 2010 and 2020 and show which countries are most integrated in GAVCs. To ease understanding and visibility, we use different colours for the different continents which enables us to also see the continental engagements in the GAVCs. In 1990, all continents (Africa, America, Asia, and Europe) excluding the Pacific countries were involved in GAVCs. At this point in time, Asian countries seem to be most integrated in GAVCs with Europe and America countries also integrating well. For Africa, we can observe the integration of countries such as the Democratic Republic of Congo, Botswana, and Lesotho. The most integrated countries at that period were Suriname, Singapore, Bermuda, Hongkong and Botswana. Between 1990 and 2000, we can observe that many more countries are involved in GAVCs with 6 countries representing Africa, 6 representing Asia, and 8 representing Europe. The number of American countries also dropped from 4 to 3 but Suriname was still the most integrated country in the agri-food chain. We also see the rise of countries such as Malaysia, Belgium, Estonia, Eritrea, and Gambia. Due to their size and limited domestic production/processing capacity, small countries tend to be strongly integrated in global and regional markets and exhibit high GVC participation rates.

**Figure 1** Agriculture Global value chains (Percentage) and value-added exported network

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| --- | --- |
| Network 2020 | Network 2010 |
| Une image contenant cercle, capture d’écran, dessin, dessin humoristique  Description générée automatiquement | Une image contenant cercle, capture d’écran, dessin, Caractère coloré  Description générée automatiquement |
| Network 2000 | Network 1990 |
| Une image contenant capture d’écran, dessin, cercle, Caractère coloré  Description générée automatiquement | Une image contenant cercle, dessin, capture d’écran, diagramme  Description générée automatiquement |

**Source:** Authors’ calculations based on EORA MRIO input output tables 1990 - 2020.

**Note:** These four graphs are directed networks. The size of each node (country) represents the Agriculture Global Value Chain integration in percentage of Gross Exports. For network 2020, 2010, 2000 and 1990, node sizes represent GAVC participation in percentage of gross exports and edge widths represent bilateral value-added exports (Value added exports / $US 100 million). For network 2020, 2010, 2000 and 1990 on node sizes that are higher than 30 percent, 23 percent, 20 percent, and 19 percent respectively are included in the network for visibility and clear representation. Nodes are colored by continent.

After another 10-year period, that is by 2010, more countries had integrated into GAVCs. While 5 countries are competitively integrated into the chain from Africa, we see that the Americas return to the 4-country representation. The number of European countries as well as Asian countries also reduce by one. That said, it is important to mention that these are not the only countries involved in the chain but more likely the most integrated countries as the network graphs only pick up the most integrated countries. In 2020, we observe that fewer countries seem integrated, but the size of the nodes are bigger implying that they are more intensively integrated in the chain. In 2020, we observe that the most integrated countries are Antigua and Barbuda, Bermuda, Cape Verde, and Seychelles.

* + 1. **Mapping GAVCs**

After understanding the evolution of countries with regard to their participation in GAVCs, we also map their current participation. As we earlier highlighted, most countries are integrated in GAVCs at different levels and participate either in the upstream agriculture sector or the downstream food and beverages sector. Figure 2 shows a global mapping of the participation of countries in GAVCs highlighting differences in the two sectors. While the agriculture sector considers mainly agricultural commodities that are produced and exported as raw materials, often as inputs to produce value-added finished products, the food and beverage sector covers mainly value-added products. Our measure of GAVC participation measures the share of exports in GAVC in total exports of the country. Actual participation levels are given in the supplementary materials. We observe a varying participation of countries in both the agriculture and food and beverage sectors. The levels of integration differ, but most countries seem to be participating in GAVCs. Actual participation levels reveal that most African and some Asian and American countries are more integrated in the agriculture sector, which is relatively more upstream than the food and beverage sector. However, many of these countries are strengthening their integration into the food and beverage sector, indicating the rise of food processing capacity and increasing purchasing power in these countries.

**Figure 2** Agrifood GVC participation (percentage) across countries (average 1990-2020)

**(a) Agriculture sector**

Map

Description automatically generated

**(b) Food & beverages sector**

Map

Description automatically generated

**Notes:** GVC participation (% gross exports) (average 1990-2020). Panels (a) and (b) display GVC participation rate across countries in agriculture sector and food and beverages sector, respectively. Data from EORA MRIO.

* + 1. **Trends of GAVCs**

We also present the trends of the GAVC over time using simple line plots. As shown in Figure 3, GAVC participation levels have, with few exceptions, been steadily increasing. Both forward and backward GAVC participation levels follow a similar trend. Figure 4 disaggregates total GAVC participation levels into both agriculture and food and beverages subsectors, exhibiting similar trends as in the case of the combined GAVC participation. Prior to 2016, participation in the agricultural sector was higher than participation in the food and beverage subsector. Participation levels in food and beverage GVCs rose sharply between 2015 and 2016.[[4]](#footnote-5)

**Figure 3** Trends of GAVC participation

**Source:** Authors’ calculation based on EORA-MRIO data

**Figure 4:** Disaggregated trend of GAVCs

**Source:** Authors’ calculation based on EORA-MRIO data

Given our interest in heterogeneity and in understanding how GAVCs vary by income groups in various countries, we follow the 2023 World Bank income classification and show the trends of GAVC participation by these income classifications: high-income countries (HICs), upper-middle-income countries (UMICs), lower-middle-income countries (LMICs), low-income countries (LICs). As expected, we observe significant heterogeneity in the different income groups especially in the trend relationship between the agriculture and food and beverage subsectors (Figure 5).

**Figure 5** Trends of Agriculture and Food & Beverage sectorial participation by income group.

**Source:** Authors’ calculation based on EORA-MRIO data

For the LICs, both GVCs in agriculture and in the food and beverages sector developed in parallel between 1990 and 2015, with a sudden upsurge in GVC participation rates in the food and beverage subsector between 2015 and 2016. Between 2016 and 2020, GVC participation in food and beverages remained relatively stable at a high level. Similar trends are observed for both UMICs and LMICs. In the group of HICs, both GVC participation in agriculture and in food and beverages surged in 2016.

Table 1 shows summary statistics of key GAVC indicators and nutrition outcome variables from 2000-2020. On average across years and countries, GAVC participation is about 34% of total agriculture exports - about a third of all agri-food exports are taking place through GVCs. We also find that participation in the agriculture subsector is generally higher than participation in the food and beverage subsector. In all, 22% of our sample are stunted children while 7% are overweight. We also observe that 14 percent of children under the age of 5 are undernourished.

**Table 1: Summary statistics of GAVCs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Obs.** | **Mean** | **SD.** | **Min** | **Max** |
| *GAVC participation (%)* | 3507 | 34.38 | 11.73 | 0.86 | 81.09 |
| Upstream segment (%) | 3507 | 17.68 | 8.68 | 0.74 | 53.65 |
| Downstream segment (%) | 3507 | 16.71 | 11.94 | 0.037 | 69.11 |
| *Agriculture sectorial participation (%)* | 3507 | 35.35 | 12.14 | 0.80 | 82.86 |
| Upstream segment (%) | 3507 | 23.68 | 9.22 | 0.68 | 67.81 |
| Downstream segment (%) | 3507 | 11.67 | 9.90 | 0.021 | 78.76 |
| *Food and Beverage participation (%)* | 3507 | 34.84 | 12.75 | 0.89 | 88.26 |
| Upstream segment (%) | 3507 | 13.24 | 7.36 | 0.76 | 48.70 |
| Downstream segment (%) | 3507 | 21.60 | 12.54 | 0.10 | 81.04 |
| Overweight children (%) | 2709 | 7.18 | 4.73 | 0.70 | 29.30 |
| Stunted children (%) | 2709 | 22.24 | 14.76 | 1.20 | 62.30 |
| Undernourishment (%) | 1984 | 14.13 | 11.35 | 2.50 | 67.50 |
| Dietary energy supply (%) | 2800 | 120.39 | 14.91 | 74 | 160 |

* + 1. **Trend in Nutrition measures**

We also document the evolution of the four nutrition measures over time and by income groups. Figure 6 shows the evolution of dietary energy consumption, prevalence of undernourishment, prevalence of overweight and prevalence of stunting over the period 2000- 2020. The prevalence of stunting slightly decreased over the past 20 years. The prevalence of stunting only decreased by nine (9) percentage points in 20 years, from 27 percent in 2000 to 18 percent in 2020. The prevalence of undernourishment also follows the same trend with two different phases. It decreased by four (4) percentage points over the period from 17 percent in 2000 to 13 percent in 2020. However, it decreased to 12 percent in 2011 before increasing to 13 percent in 2020, possibly because of the persistence of the global financial crisis and export restrictions implemented by several countries. The prevalence of overweight children follows the shape of a cubic function. It increased slightly from 6.7 percent to 7.4 percent in 2006 before dropping to 7 percent in 2017, where it reached its turning point (started increasing). Finally, dietary energy consumption shows a positive evolution over the period highlighting a potential evolution in food system transformation.

**Figure 6** Trend of Nutrition Variables

|  |  |
| --- | --- |
|  |  |
|  |  |

**Source:** Authors’ visualization based on FAOSTAT database.

We further present the evolution of the four nutrition indicators by income groups. As shown in Figure 7, there is a clear association between the different income groups and the nutrition indicators. For instance, HICs have the highest dietary energy consumption which decreases down to low-income countries. This is also the case for stunting and prevalence of undernourishment which increases as we move down the income group spectrum. The lone exception is overweight where we observe that upper- and middle-income countries have a higher rate than high income countries. In addition to all these descriptive insights, we also look at some scatter plots to visually examine the relationship between GAVCs and the nutrition indicators. These plots are shown in Figure A1 in the supplementary material.

**Figure 7** Trends of Nutrition variables by income group.

|  |  |
| --- | --- |
|  |  |
|  |  |

**Source:** Authors’ visualizations based on FAOSTAT database. **Note:** HICs represent high income countries; UMICs is upper middle-income countries; LMICs represents lower middle-income countries and LIUCs represents low-income countries.

* 1. **Empirical insights**

In this section, we discuss the empirical results from the use of the Bartik shift share instrument for the entire sample, and for the individual groups of countries classified by their income level, and apply robustness check using alternative identification strategies.

* + 1. **GAVC and nutrition**

We present the empirical results on the association between GAVC and food security and nutritional outcomes (dietary energy consumption, prevalence of undernourishment, overweight and stunting). The results build on the Bartik shift share IV to which selected controls have been added. Broadly speaking, these controls relate to agriculture, socio-economic, demography and trade policy controls. We also check the validity of the Bartik shift-share instrument where we establish its relevance based on the large F statistics. For the exclusion restriction, we follow Goldsmith-Pinkham et al., (2020) using individual industry shares as separate IVs to assess the exogeneity of industry shares. For the most parts as shown in Table A4 in the supplementary material, we find large p- values, confirming the exogeneity of our share-driven instruments. For the other alternative estimators, we again find similar estimates and standard errors as in our core results, suggesting little room for model misspecification. Given these, our instrument may be valid, nonetheless, we perform several robustness checks on these to support the identification strategy. Table 2 shows the estimates of the association between GAVC and nutrition. We obtain a positive association between GAVC participation and dietary energy consumption, that is in response to increase in agrifood value chain participation, dietary energy consumption increases. The magnitudes are somewhat high, implying that a percent increase in GAVC is associated with an accompanying 63 percentage increase in dietary energy consumption. This result corroborates earlier findings from Dithmer and Abdulai (2017) who established a positive association between trade openness and dietary energy consumption. It also partly supports evidence from Eastern Europe and Central Asia where trade openness has been shown to increase dietary diversity but also a higher share of fats and oils in consumed calories (Krivonos and Kuhn, 2019).

**Table 2 GAVC participation and food security and nutrition**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **(1)** | **(2)** | **(3)** | **(4)** |
|  | **Energy** | **PoU** | **Overweight** | **Stunting** |
|  |  |  |  |  |
| GAVC (%) | 0.628\*\*\* | -0.426\*\*\* | -0.036 | 0.048 |
|  | (0.195) | (0.160) | (0.050) | (0.105) |
| Constant | 30.194\*\*\* | 100.145\*\*\* | 10.985\*\*\* | 33.893\*\*\* |
|  | (14.922) | (12.649 | (3.559) | (7.440) |
|  |  |  |  |  |
| *Controls* |  |  |  |  |
| Agriculture controls | Yes | Yes | Yes | Yes |
| Economic controls | Yes | Yes | Yes | Yes |
| Demography controls  Trade Policy controls | Yes  Yes | Yes  Yes | Yes  Yes | Yes  Yes |
| *Fixed Effects*  Year | Yes | Yes | Yes | Yes |
| Country | Yes | Yes | Yes | Yes |
| *Fit statistics*  F test  Wald chi2  Observations  Number of countries | 73.38\*\*\*  766288.2\*\*\*  1620  83 | 62.65\*\*\*  15282.48\*\*\*  1487  82 | 184.42\*\*\*  42440.58\*\*\*  1732  90 | 144.42\*\*\*  127892.5\*\*\*  1732  90 |

Notes: PoU is prevalence of undernourishment and Energy is dietary energy consumption. Agriculture, economic, demographic and trade policy controls include foreign direct investment, fertilizer consumption, employment in agriculture, percentage of land area occupied by agricultural land, unemployment as a percentage of the total labour force, labour force participation rate, population, arable land, population density, free trade agreement, regional trade agreement, currency union, tree cover, food production, average rainfall, and temperature change. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Full results are presented in the supplementary material.

We also show that globally higher GAVC participation rates are associated with lower prevalence of undernourishment. We do not find any statistically significant relationship between GAVC and overweight as well as nutrition. The results on undernousrishment are in line with earlier work from Smith and Haddad (2001) who established a positive association between food supply (availability) and nutritional outcomes for children. Using evidence from low-and middle-income countries, assistance to tradable agriculture has been shown to increase both nutritional status among children (Adjaye-Gbewonyo et al., 2019). As highlighted above, this increase in nutritional status could arise from three different mechanisms: (1) increased productivity and price effects; (2) income and employment changes and (3) increased downstreamness. For instance, beyond the direct effect on the production mix, GAVC participation may lead to income and employment changes (Lim and Kim, 2022; Montalbano and Nenci, 2022) and affect food prices and food price volatility with possible implications for food and nutrition security. For the later, GAVCs have been shown to be positively associated with food prices and negatively with price volatility (Dalheimer et al., 2023).

From another perspective, GAVCs can lead to an increase in agricultural investment and consumption and thus also foster the development of local value chains (Feyaerts et al., 2020). An increase in economic activity through both GAVCs and local value chains could increase household incomes and thus improve food and nutrition security. For example, the export of horticultural crops from Senegal has been found to increase smallholder incomes and reduce poverty (Maertens and Swinnen 2009; van den Broeck et al. 2017). More specifically, van den Broeck et al. (2018) found a positive association between horticultural exports and different aspects of food security (access, availability, utilization and stability). Horticultural exports have macroeconomic advantages such as enabling greater food imports through export earnings, thus increasing food security. Looking at tobacco production (for export) in post reform Zimbabwe, Scoones et al. (2018) analyze possible reinvestment portfolios of farmers. Farmers invest in fixed term equipment such as farm machinery as well as short-term farm inputs. Beyond this, farmers also diversify into livestock, probably increasing their consumption of animal source foods and improving their nutritional status. In addition to this, the cultivation of large export crops is often complemented with staples and food crops production, further enhancing the nutritional status of households (Tabe-Ojong and Abay 2023)

* + 1. **Heterogeneity by income groups**

Beyond the pooled global insights, we perform some heterogeneity analysis by considering the various income groups following the 2023 World Bank income group classification. We exclude the high-income group category[[5]](#footnote-6) and separately look at three country income groups: low-income countries (LICs), lower- middle-income countries (LMICs) and upper- middle-income countries (UMICs). Table 3 reveals significant heterogeneity across the various income groups. For instance, we obtain a positive association between GAVCs and increased dietary energy consumption for UMICs. For prevalence of undernutrition, we obtain a positive association between GAVC and PoU for LMICs and a negative association in UMICs, supporting previous baseline estimates. We also find new additional results about GAVC and overweight and stunting. Agrifood participation is positively associated with overweight in LMICs and negatively associated with stunting in both LICs and LMICs. That is, in response to agrifood value chain participation, stunting reduces in low and lower- and middle-income countries. In these countries, participation in agrifood value chains may play an important role in reducing stunting.

**Table 3** **Income heterogeneity of GAVC participation and food security and nutrition**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **(1)** | **(2)** | **(3)** | **(4)** |
|  | **Diets** | **PoU** | **Overweight** | **Stunting** |
| *LICs* |  |  |  |  |
| Agriculture GVC (%) | -2.649 | 1.892 | -0.016 | -1.064\*\*\* |
|  | (2.079) | (1.624) | (0.033) | (0.219) |
| *LMICs*  Agriculture GVC (%)  *UMICs*  Agriculture GVC (%) | 0.024  (0.176)  0.517\*\*\*  (0.162) | |  | | --- | | 0.643\*\*\* | | (0.209) |   -0.344\*\*\*  (0.104) | |  | | --- | | 0.326\* | | (0.168) |   -0.018  (0.040) | |  | | --- | | -1.495\*\*\* | | (0.514) |   0.111  (0.075) |
| *Controls* |  |  |  |  |
| Agriculture controls | Yes | Yes | Yes | Yes |
| Economic controls | Yes | Yes | Yes | Yes |
| Demography controls | Yes | Yes | Yes | Yes |
| Trade Policy controls | Yes | Yes | Yes | Yes |
|  |  |  |  |  |
| *Fixed Effects* |  |  |  |  |
| Year FE | Yes | Yes | Yes | Yes |
| Country FE | Yes | Yes | Yes | Yes |
|  |  |  |  |  |

Notes: PoU is prevalence of undernourishment and Energy is dietary energy consumption. Agriculture, economic, demographic and trade policy controls include foreign direct investment, fertilizer consumption, employment in agriculture, percentage of land area occupied by agricultural land, unemployment as a percentage of the total labour force, labour force participation rate, population, arable land, population density, free trade agreement, regional trade agreement, currency union, tree cover, food production, average rainfall, and temperature change. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Full results are presented in the supplementary material.

Overall, the disaggregated regressions underscore significant heterogeneity between GAVCs and the food and nutrition security indicators. Aggregated estimations may significantly mask important relationships in the lack of disaggregated estimations. While part of the relationship between GAVC participation and dietary energy consumption as well as the prevalence of undernourishment could be explained by UMICs, the relationship between GAVCs and the prevalence of stunting appears to be mostly driven by LICs and LMICs. That is, GAVC participation is associated with a lower prevalence of stunting in LICs and LMICs. For overweight, we establish a positive association for LMICs. This increase in overweight could be due to heavy participation in backward linkages and the effect of downstreamness. Countries such as Cote d’Ivoire, Kenya, Mauritania, Namibia, Senegal, and Swaziland are making great strides in the food sector (Balie et al., 2019). Increase in overweight could also result from the heavy consumption of energy dense foods such as sugary foods and saturated fats. Recent evidence has been shown in this regard, especially considering the supermarket revolution in many LMICs (Qaim, 2016). For the case of undernutrition in LMICs, this could result from competition of GAVCs with local value chains for agricultural inputs such as land, labour, water, and soil nutrients which could negatively affect nutrition. In many LMICs, GAVCs can foster the production of cash crops with potentially adverse effects on the environment and nutrition security given the food security trade-off between food crops and cash crop production. For instance, the expansion of oil palm production in Cameroon has been shown to be associated with lower dietary diversity for women as well as dietary quality (Tabe-Ojong 2023).

* 1. **Robustness checks**

To support the main findings about the association between agrifood value chains and nutrition, we performed some robustness checks. These checks are mainly to support the identification strategy involving the Bartik shift share IV and as earlier presented are the Lewbel’s (2012) IV approach and the Kinky least squares regression. As shown in Table 4, we obtain estimates that are in support of the positive association between agrifood value chains and dietary energy consumption and the negative association with prevalence of undernutrition. Besides these estimates that confirm and bolster our initial findings, we obtain some important statistics that additionally speaks to the strength and validity of our shift share IV. First, based on the Anderson canon. correlation LM statistic, we reject the null hypothesis that the model is under-identified, suggesting that the IV is well identified. Second, we obtain a Cragg-Donald Wald F statistic of above 10 in all models, implying that the IV is not weak. This is also the case with the Stock-Yogo weak identification test which also has a value above 10, indicating the IV is not weak. Finally, the Sargan-Hansen J statistic also supports the view that the models are exactly identified, and the instrument is valid.

**Table 4 Lewbel’s IV regression estimates**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **(1)** | **(2)** | **(3)** | **(4)** |
|  | **Diets** | **PoU** | **Overweight** | **Stunting** |
|  |  |  |  |  |
| GAVC (%) | 0.761\*\*\* | -0.605\*\*\* | -0.059 | 0.189 |
|  | (0.261) | (0.227) | (0.067) | (0.141) |
|  |  |  |  |  |
| Observations | 2,432 | 1,652 | 2,139 | 2,119 |
| Agriculture controls | Yes | Yes | Yes | Yes |
| Economic controls | Yes | Yes | Yes | Yes |
| Demography controls  Trade Policy controls | Yes  Yes | Yes  Yes | Yes  Yes | Yes  Yes |
| *Fixed Effects*  Year | Yes | Yes | Yes | Yes |
| Country | Yes | Yes | Yes | Yes |
| *Fit statistics*  F test  Anderson canon. corr. LM Cragg-Donald Wald F  Stock-Yogo weak ID test  Sargan statistic  Observations | 73.39\*\*\*  24.45\*\*\*  24.53  16.38  0.00  1,620 | 41.69\*\*\*  17.45\*\*\*  24.53  16.38  0.00  1,487 | 9.58\*\*\*  42440.58\*\*\*  17.45  17.32  0.00  1,732 | 146.86\*\*\*  127892.5\*\*\*  17.32  16.38  0.00  1,732 |

Notes: Agriculture, economic, demographic and trade policy controls include foreign direct investment, fertilizer consumption, employment in agriculture, percentage of land area occupied by agricultural land, unemployment as a percentage of the total labour force, labour force participation rate, population, arable land, population density, free trade agreement, regional trade agreement, currency union, tree cover, food production, average rainfall and temperature change. Standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

As a second robustness check, we also used the Arrelano-Bond estimator. Table 5 presents the results of the association between agrifood value chains and nutrition using the GMM approach. The credibility of the results of the GMM estimator usually depends on the outcomes of diagnostic tests for overidentification and serial correlation. In each specification, the number of instruments is lower than the number of countries. In our case, the Hansen test, which diagnoses the problem of overidentification, shows that the additional instruments associated with the system GMM estimator are valid. The two tests for serial correlation show evidence of first order autocorrelation and no second order autocorrelation. Therefore, most of the results of the diagnostic tests indicate that the GMM model is valid. The GMM results suggest the robustness of the IV estimation. The result of the GMM approach confirms the positive and significant relationship between of global agrifood value chains on dietary energy consumption (column 1) and the negative association with the prevalence of undernourishment. We additionally find a negative and statistically significant association between agrifood value chains and overweight suggesting that the IV estimator is conservative. The advantage of the GMM estimator is its ability to not only estimate short term estimates but also long-term estimates. The long-term estimates are similar for dietary energy consumption and PoU but turns positive for overweight as was the case with LMICs.

**Table 5 GMM regression estimates**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | (1) | (2) | (3) | (4) |
|  | **Diets** | **PoU** | **Overweight** | **Stunting** |
|  |  |  |  |  |
| Long Term GAVC (%) | 0.1795\* | -0.356\*\*\* | 0.497\*\*\* | 0.7343 |
|  | (0.0997) | (0.08499) | (0. .0841) | (0.3378) |
| Short term GAVC (%) | 0.0582\* | -0.176\*\*\* | -0.117\*\*\* | 0.0596 |
|  | (0.0326) | (0.0418) | (0.00838) | (0.0154) |
|  | 0.676\*\*\* |  |  |  |
|  | (0.0275) |  |  |  |
|  |  | 0.505\*\*\* |  |  |
|  |  | (0.0427) |  |  |
|  |  |  | 1.235\*\*\* |  |
|  |  |  | (0.0324) |  |
|  |  |  |  | 0.919\*\*\* |
|  |  |  |  | (0.0248) |
| Agriculture controls | Yes | Yes | Yes | Yes |
| Economic controls | Yes | Yes | Yes | Yes |
| Demography controls | Yes | Yes | Yes | Yes |
| Trade Policy controls | Yes | Yes | Yes | Yes |
|  |  |  |  |  |
| Observations | 326 | 299 | 349 | 349 |
| Country FE | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes |
| Number of Inst | 81 | 65 | 81 | 81 |
| F stat | 97861 | 261.7 | 1261 | 11094 |
| F stat p-value | 0.000 | 0.000 | 0.000 | 0.000 |
| Hansen J stat | 64.77 | 38.20 | 56.84 | 63.91 |
| Hansen J p-value | 0.282 | 0.679 | 0.556 | 0.308 |
| AR1 p-value | 0.0346 | 0.228 | 0.0253 | 0.00554 |
| AR2 p-value | 0.216 | 0.104 | 0.00228 | 0.358 |

Note: This regression is performed using a system generalized method-of-moments estimators. The period goes from 2000 to 2020, and we constructed 5 periods, each variable for a given period representing the average on four consecutive years. **Variables -** is the lag of dietary energy consumption; is the lag of the prevalence of undernourishment; is the lag of the prevalence of overweight; and is the lag of the prevalence of stunting. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The second order lagged dependent variables are used as an instrument for the lagged dependent variable and the lag of regressors are used as instruments.

The final robustness check we perform is the KLS and compare the results with that of 2SLS approach where we used the shift share IV. Figure 8 presents this comparison for all the four nutrition outcomes. The first check here is to observe the confidence intervals of the 2SLS approach. Here, we see that the confidence intervals are narrow, indicating that the shift share IV is not weak. The second check is about positive endogeneity correlations where we check for possible overlap between KLS and 2SLS. We show large overlap in the confidence intervals for KLS and 2SLS with the point estimates overlapping as they cross at some point of the range. These additionally strengthen our identification strategy and the validity of the shift share IV.

**Figure 8 KLS and 2SLS coefficient estimates and confidence intervals.**



1. **Conclusion and policy implications**

We document trends and some stylized facts in the evolution of agrifood GVCs, using a 30-year period dataset obtained from the EORA MRIO tables. Following this, we examine the relationship between GAVCs and various food and nutrition security indicators including dietary energy consumption, prevalence of undernourishment, prevalence of overweight children and prevalence of stunted children. With respect to the trends and evolution of GAVCs, we show that participation in GAVCs is growing worldwide. However, significant room exists to induce more participation in GAVCs, especially of developing countries that are often not well-integrated in global markets. Countries in higher income groups show a higher level of integration to the GAVC. Generally, there has been a tendency to increase participation in the global value chain of processed food products more relative to increased participation in the global value chain of primary agricultural products. While participation in agricultural value chain occurs mainly through forward linkages and in the food processing value chain through backward linkages, this implies that the two sectoral value chain has also further interconnected and countries have shown tendency to enhance their food processing capacity.

Considering the relationship between GVCs integration and food and nutrition security, we apply a Bartik shift share IV regression approach robustified with other estimators, such as the Lewbel’s IV approach, the Arrelano-Bond estimator and Kinky Least Squares regression, we report three main results: (1) On global average, GAVC participation is positively associated with dietary energy consumption; (2) GAVC participation is negatively associated with the prevalence of undernourishment and (3) there exist significant differences by country income groups with respect to the relationship between GAVC participation and the nutrition outcomes. Our results show that GAVCs are positively associated with dietary energy intake but this positive association is mainly to the upper middle income countries without significant impact in other income groups. There could be at least two alternative reasons for this. Firstly, in lower-income countries, the participation in global value chains may not have substantially bolstered consumers' purchasing power. Alternatively, participation may have predominantly augmented the purchasing power of the wealthier demographic, whose food expenditure is less sensitive to income fluctuations.

Our results further suggest that the agri-food global value chain has resulted in improved nutrition aspects in low-income countries and upper high-income countries but mixed results are found in lower middle-income countries. In lower-income countries, the major benefit is associated with reduced stunting, and in upper high-income countries with reduced undernourishment. In low-middle-income countries, stunting decreases but overweight and prevalence of undernourishment increase. These heterogeneous results may suggest that the global value chain has indeed resulted in changes in the dietary nutrition consumption and nutrient diversity of the households and health practices but the distributional impact across countries and households is different.

In view of this, it would be important to strengthen participation in GAVCs as they offer some opportunities to improve food security and some aspects of nutrition. In this respect, policies that strengthen participation in global value chains may be coupled with a strengthening of measures conducive to the positive impact channels of GVCs on nutrition. This may include standards to ensure food safety, labor rights, and gender equality; measures that enhance the competitiveness of local value chain actors, such as facilitating or mandating technology and knowledge transfer to local value chain players; and measures that stimulate the integration of local firms into global value chains. Moreover, given the substantial heterogeneity in the findings from different income group regressions, and the diverse impacts on three aspects of malnutrition—overweight, prevalence of undernourishment, and prevalence of stunting—across various income groups, appropriate complementary policies are required. These policies should be context-specific and tailored to the challenges faced by each country. Policies that bolster local/regional value chains' competitiveness for prodcuts with comparative advantges alongside integration into global value chains may offer promising avenues for supporting households’ income, food security and nutrition. At the same time, policies can also facilitate smooth transition of the players in local value chain with low potential to alternative activities. Moreover, the heterogenous impact across nutrition indicators and income groups suggests that the positive effects of global value chains on dietary and nutrition status have not reached all and households in lower-income countries may remain vulnerable. Dedicated policies may be needed to prioritize the inclusion of vulnerable households. Policies could specifically target the increased competition of individual product value chains that are more closely linked to the food security and nutritional status of vulnerable groups. National policies may also ensure access to nutritious foods for vulnerable groups depending on where the vulnerable groups are located. For example, in a country with a high prevalence of malnutrition among rural communities, policies might focus on improving the productivity and market access of smallholder farmers growing staple crops. In urban areas where access to nutritious foods is limited, national policies might prioritize initiatives to increase the availability and affordability of healthy food options.

Two limitations of our study may be addressed in future research endeavors. First, although we conceptually identify and discuss some of the pathways that could link GAVCs and food and nutrition security, we did not empirically test for any of these. More structured approaches could add valid information on the exact relationships. Second, we have used rich longitudinal data to model the relationship between GAVCs and food and nutrition security, but we refer to these estimates as correlates rather than as causal effects. We used the Bartik shift share instrument and several alternative identification strategies to reduce endogeneity concerns, but the strength of these approaches depends on some assumptions on the IV. Thus, future work in this line should consider weaker assumptions regarding identification as a way of moving towards causal effects.

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1. Involvement in non-agrifood global value chains can indirectly impact food security and nutrition through income generation, technology transfer, and market integration. [↑](#footnote-ref-2)
2. For similar analytical frameworks that have been developed to measure supply and demand contributions of countries and sectors in GVCs, see Koopman et al. 2014, Wang et al. 2017, and Los and Timmer 2018. [↑](#footnote-ref-3)
3. This is due to the lack of nutrition data beyond these years. [↑](#footnote-ref-4)
4. Despite significant efforts, so far, no reasonable explanation for the upsurge has been found. To our knowledge, conditions in global markets did not change drastically in this period rendering a jump from a relatively stable GAVC participation rate of 30 percent to 40 percent within one year rather unlikely. Nonetheless, the pattern appears to be consistent across countries, suggesting a relatively fundamental change, perhaps related to changes in data processing/methodology. [↑](#footnote-ref-5)
5. Since we are concerned about food and nutrition security, we excluded the high income countries to focus on countries where food and nutrition security continue to be of urgent concern. [↑](#footnote-ref-6)