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Trade and dietary diversity in Eastern Europe and Central Asia

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ABSTRACT

In public and academic debates, the linkages between agricultural markets and nutrition across the world are vividly discussed. This paper contributes to the ongoing debate by analyzing the relationship between greater openness to trade and dietary diversity. It focuses on the post-communist countries of Eastern Europe and Central Asia where trade reforms as part of the economic and political transition provide a natural experiment for studying the effects of trade openness on agricultural markets and consumer behaviour. Reduction in trade barriers, for instance in the context of the accession to the WTO and the EU, and the gradual integration with world markets after 1991 had implications for diets through changes in production, prices and incomes. We utilize country-level panel data for 26 post-communist countries in the period 1996–2013 to assess the effects of trade costs, openness to trade and incomes on dietary diversity measured by the Shannon entropy index. The results arising from fixed effects and instrumental variables estimation are consistent with previous findings that income growth affects dietary diversity positively and provide novel evidence that trade barriers reduce variety of products available in domestic markets, in particular fruits and vegetables.

KEYWORDS Trade, nutrition transition, dietary diversity, post-communist countries, Eastern Europe

JEL CLASSIFICATIONS D12, F13, F68, Q11, Q18

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1 \ Introduction

While the share of undernourished population has declined in most parts of the world, the transition towards diets high in calories and poor in nutrients has contributed to overweight, obesity and diet-related non-communicable diseases. These dietary shifts are characterized by higher intakes of livestock products, vegetable oils, sugar, as well as higher reliance on processed foods (Drewnowski and Popkin, 1997; Popkin et al., 2012). While differences in the composition of diets among countries persist, there appears to be a global convergence towards so-called "western diets". The key drivers of this transition include economic growth, urbanization and globalization (FAO, 2017; Traill et al., 2014). Among policy variables, liberalization of trade and investments has been cited as one of the determinants of dietary change (Traill et al., 2014).

Trade affects diets through incomes, food prices, food availability and food preferences (Shankar, 2017; Traill et al., 2014). For all these channels, different directions of effects are conceivable. For example, trade has facilitated access to cheaper foods and ingredients that are nutritionally inferior (such as oils and sugars). At the same time, its contribution to more varied diets, which is a determinant of healthy nutrition, is equally important (IFPRI, 2018; Remans et al., 2014). Very few countries can provide the necessary diversity of food products through domestic production alone. In countries where the agro-ecological conditions make it impossible to produce a wide variety of fruits and vegetables (or where such production has high economic or environmental costs), trade plays a particularly important role in making healthier options available to consumers at affordable prices.

The collapse of the Soviet Union and the transition in the post-communist countries towards market economies provide an interesting natural experiment for studying the consequences of trade liberalization for consumer behavior and diets. The reduction in trade barriers – most notably in the context of the accession to the WTO and the EU – as well as the gradual integration with the world economy after 1991 inevitably had implications for incomes as well as prices, quantity, quality and diversity of food available in domestic markets.

This paper contributes to the limited but growing body of empirical literature on trade and nutrition by focusing on the effects of trade liberalization on dietary diversity in the post-communist countries. It assesses the effects of greater openness to trade and income growth in these countries on their dietary diversity as measured by the Shannon entropy index. To this end, we use panel data for 26 post-communist countries in the period 1996–2013 for conducting fixed effects and instrumental variables estimations with different explanatory variables that capture trade policy. The paper is structured as follows: Section 2 discusses the role of trade in changing diets at the global level, focusing on the dietary variety. Section 3 gives an overview of trade-related reforms in the post-communist countries and discusses the implications for agricultural trade. Section 4 contains a descriptive analysis of the shifts in diets. Methodology and data are presented in section 5, while section 6 outlines the results. Interpretation and concluding remarks are provided in section 7.

2 \ The role of trade in changing diets

Drivers of the nutrition transition towards more energy-dense and processed products include relative price changes, income growth, urbanization, investments and technological shifts in food production, processing, transport and retailing, labor market and lifestyles changes, public and private food standards and regulation, advertising, agricultural support policies and trade liberalization (Drewnowski and Popkin, 1997; Popkin, 2014, 2006b; Traill et al., 2014). Among these factors, the growth in Foreign Direct Investment (FDI) in the food processing sector, the transformation of the retail sector with dominance of supermarkets and greater reliance on imports are widely seen as major contributors to the nutrition transition (FAO, 2017; Hawkes, 2005; Shankar, 2017). As argued by Popkin (2014), the structure of the retail sector is a major influence factor for diets in middle-income countries.

Trade also plays an important role in determining nutritional outcomes. At the broadest level, it is acknowledged that trade can improve the availability and affordability of different foods, add to a wider choice for consumers, and help smooth food supply and reduce price instability by buffering domestic production shocks (FAO, 2015; Pinstrup-Andersen, 2007). Importantly, trade can also improve the economic access to various food products via positive impact on income levels (FAO, 2015; Hawkes, 2015; Shankar, 2017). Higher incomes in low and middle-income countries have been associated with higher fruit and/or vegetable consumption, diet quality, and diversity, but are also related to higher energy, cholesterol, and saturated fat intakes (Mayen et al., 2014). Therefore both positive and negative health effects are conceivable. Trade also influences consumer choices by affecting marketing practices and the relative prices of healthy and unhealthy foods, which may result in the excess consumption of nutritionally inferior products that may gain a greater share in overall calorie intake (Shankar, 2017).

Empirical evidence on how trade and trade policies have changed the patterns of consumption and nutritional outcomes is still rather limited. Several descriptive studies point towards a general association between trade openness and unhealthy diets. Burggraf et al. (2015) quantify the ongoing nutrition transition in two transition economies, Russia and China, following market liberalizations. Miljkovic et al. (2018) find that an increase in trade openness leads to an increase in overweight and obesity ratios in Brazil. At the global level, the Body Mass Index (BMI) has been shown to be positively associated with the index of economic globalization (de Vogli et al., 2014). Other studies like Oberlander et al. (2017) find no effects of trade openness on dietary outcomes or health. In the same vein, Hallam et al. (2016) do not find evidence for the effects of agricultural trade costs as a measure of restrictiveness of trade policy on the shares of different products in national food availability.

The assessment of the relative importance of these various drivers, especially through quantitative analysis, is hampered by difficulties in separating their effects and determining causality (FAO, 2017; Traill et al., 2014). Generally, studies try to differentiate between import effects and FDI effects. For instance Hawkes (2006) discusses how trade liberalization in India in the 1990s was conducive to an expansion in imports of palm and soybean oils, displacing traditional oils such as peanut and rapeseed oil. Thow et al. (2015) show that imports of processed foods and soft drinks rose dramatically in Southern African Development Community (SADC) in parallel with trade and investment liberalization. Trade and agricultural policy changes in Fiji and Samoa have also been linked to increased availability of refined cereals, meats, fats and oils as well as processed and packaged foods (Thow et al., 2011). In other instances, agricultural imports from the US to Mexico are held responsible for growing obesity rates in Mexico following the NAFTA agreement (Hawkes et al., 2012). Baker et al. (2016) find an increased availability and variety of unhealthy soft-drinks in Peru and Bolivia following free trade agreements. Giuntella et al. (2017) classify Mexican food imports from the U.S. into healthy and unhealthy items and find that exposure to imports of unhealthy foods significantly contributes to the rise of obesity in Mexico. With few exceptions however, these studies do not make a causal link between trade growth and diets.

Other studies investigate the impact of trade and globalization via the retailing structure. Dries et al. (2004) find that massive FDIs and domestic investments after the collapse of the Soviet Union led to a fast growth of modern retail stores in Central and Eastern Europe. Zhang et al. (2012) find a significant impact of the retailing environment on growing obesity in transition economics like China. The same argument is used by Hawkes et al. (2012), who connect increasing obesity rates in Mexico after the NAFTA agreement with increased US investment into the food and retail sector.

An important channel through which trade can affect nutrition is improving access to a diversified food basket. Imports supplement domestic production, in particular in countries with limited diversity of own production (Hawkes, 2015; IFPRI, 2018; Remans et al., 2014). Dependence on locally produced food alone greatly limits dietary choices, especially during the months when fresh produce such as fruits and vegetables are not available in particular agro-climatic zones.

Dietary variety is considered an important dimension of diet quality. Other dimensions commonly used in diet quality indices are adequate nutrient intake, moderate (i.e. limited) intake of unhealthy foods and nutrients as well as balance of macro- and micronutrients (e.g. Burggraf et al., 2018; Kim et al., 2003; Stookey et al., 2000). Firstly, diet diversity has been shown to improve micronutrient adequacy (Foote et al., 2004; Moursi et al., 2008; Royo-Bordonada et al., 2003; Steyn et al., 2006) and reduce childhood undernutrition (Remans et al., 2014). While diet diversity is certainly no equivalent for healthy diet, it is a good predictor of nutrient adequacy (Torheim et al., 2004). Secondly, the risk of excess intake of contaminated food can be reduced by stronger dietary diversity (Krebs-Smith and Kantor, 2001).

Few empirical studies link trade and food variety. Microeconomic theory suggests that consumers value variety and prefer to consume a diversified bundle of goods rather than one type of good (the assumption of convex preferences). In the special case of constant elasticity of substitution (CES) utility function, Dixit and Stiglitz (1977) show in their seminal work on optimal product diversity in a context of monopolistic competition that utility is increasing in the number of products consumed at the same level of expenditure. In other words, consumers love variety for variety's sake (Baldwin et al., 2003).

Jackson (1984) suggests a framework for modelling consumer demand for variety. The paper develops and tests a hierarchic demand system which allows for a subset of commodities to be in a purchased set, demonstrating the importance of corner solutions in consumer demand theory. The paper shows that the number of commodities purchased expands with income using US expenditure data. Several others provide empirical evidence for the positive relationship between income and diversity in consumption using household data, for example Jekanowski and Binkley (2000) in the case of the US or Thiele and Weiss (2003) using data for Germany or Rizov et al. (2014) in the case of Slovakia.

Linking dietary diversity to national incomes and trade, Remans et al. (2014) show that supply diversity becomes higher than production diversity as a country transitions from low-income to high middle-income category, pointing out the important role that trade plays in supplementing domestic production and contributing to nutritional variety. It is also possible, however, that changing tastes and other drivers of consumer demand are affecting trade flows. For example Regmi et al. (2004) argue that rising incomes in the US increased the demand for the Mediterranean diet, leading to an increase in imports of products that form part of this diet, such as fruits and vegetables.

Overall, the literature review reveals that empirical evidence for the effect of trade on food intake diversity is still rather limited. This paper is intended to contribute to closing this gap by assessing the implications of trade policy for dietary diversity in Eastern Europe and Central Asia.

3 \ Trade reforms and developments in agricultural trade

3.1. | Transition to market economies and trade reforms

The global trends of income growth and greater participation in international trade are accentuated in the case of transition economies, where political and economic shifts were profound and happened rapidly with both short and long-term effects on food consumption. These shifts provide an interesting case for estimating the effects of trade openness on diets. The political and economic transformation in the post-communist countries included far-reaching changes in macro-economic policies, institutions, property rights, economic relations and productive structures, leading to an overall greater openness of economies and greater integration with world markets. Trade and prices were liberalized quickly in most countries, while the institutional reforms in key areas such as governance, privatization, competition policy and labor markets took substantially longer, facing widespread opposition (IMF, 2014).

In agriculture, the system of state and collective farms and government-managed supply was replaced by new market-based relations, deeply affecting production, distribution and sales of food. Land reforms and farm restructuring played a particularly important role in this transition. Farm support (mostly in the form of price distortions introduced by the planned economy rather than tariffs) was reduced, leading to a severe contraction in agricultural production at the onset of the reforms (see for instance Csaki, 2000; Swinnen and Gow, 1999). At the same time, countries like Russia and Ukraine started realizing their comparative advantages in products such as grains and sunflower seeds, and exports of these products grew rapidly, especially after 2000.

Trade liberalization was one of the key components of the reform package undertaken as part of the economic transition. After decades of closed borders, creating an enabling environment to facilitate free flow of goods and services was one of the main instruments of closer integration with the world (IMF, 2014). State-managed imports and exports were replaced by trade relations driven by the private sector. Removing foreign exchange controls and inviting foreign investment further facilitated trade. The removal of price distortions provided additional incentives for reallocation of productive resources towards more competitive sectors and stimulating trade (e.g. Anderson and Swinnen, 2008).

Under planned economies, imports and exports had been tightly controlled, with food products imported from a limited number of trading partners mostly among Comecon[1] members and limited exchange with the rest of the world. Reducing trade barriers led to diversification of trading partners and facilitated access to domestic markets for a wider variety of product. Most symbolic, banana, which is the most traded fruit globally, was largely unavailable to consumers in the Soviet Union due to restricted trade with other countries. Following the transition to market economy and opening up for trade, Russia became one of the key banana importers in the world and per capita consumption soared (Arias, 2003).

Apart from the initial macroeconomic and trade reforms, joining the WTO and closer integration with the EU provided a major boost to imports and exports by reducing barriers to trade while also supporting the development of regulatory frameworks and building institutions that helped making trade more predictable and transparent. Bringing the national trade-related norms and regulation in line with international practices and standards helped solidify the efforts made by the initial market reforms.

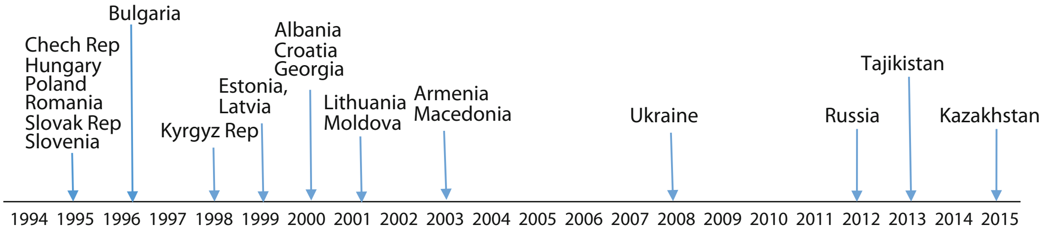

Figure 1 **WTO accession chronology**

Source: World Trade Organization www.wto.org

1 Comecon consisted of the countries of the Eastern Bloc and a number of other communist states: Bulgaria, Czechoslovakia, Cuba, East Germany, Hungary, Mongolia, Poland, Romania, Soviet Union and Vietnam.

A number of countries outside of the former Soviet Union joined the WTO as early as 1995, which led them to lowering tariff and non-tariff barriers and aligning their trade-related regulation with the WTO rules. By 2000 almost all of the non-CIS countries had joined the organization. In contrast, among the CIS countries the process of negotiating WTO membership has proceeded at very different speeds (Roberts and Wehrheim, 2001). Kyrgyzstan joined as the first country in the group in 1998, and Georgia, Moldova and Armenia followed, becoming members in 2000, 2001 and 2003, respectively. The accession negotiations of Russia and Ukraine lasted over a decade, and Ukraine joined the WTO in 2008, while Russia acceded in 2013. The latest members in the region – Tajikistan and Kazakhstan – joined in 2013 and 2015, respectively[2].

To foster greater integration with the EU, already by 1995 several countries in Central and Eastern Europe had signed the so-called "Europe agreements", which formed the legal framework for the accession process of these countries to the EU. The Europe agreements introduced bilateral free trade areas covering almost all industrial products, but with limited liberalization in agriculture. The signatory countries eventually applied for EU membership and were admitted in 2004[3] or 2007[4]. Other countries (among the former Soviet republics) also sought to deepen their economic ties with the EU, accelerating integration in recent years. In 2016, preferential trade regimes were established between the EU and three countries – Georgia, Moldova and Ukraine – as part of the Deep and Comprehensive Free Trade Areas (DCFTAs)[5].

Overall, the extent and speed of economic reforms, including those of direct relevance for trade and agriculture, varied substantially among the transition countries. Among the former Soviet republics, for example, the Baltic States and Kyrgyzstan opened their economies quickly, while others, such as Belarus and Uzbekistan, retained some of the old structure with substantial government control of the key economic sectors, trade barriers and foreign exchange restrictions until the present day.

3.2. | **Evolution in trade and trade costs**

As GDP contracted in all countries during the initial years of transition, so did the value added in agriculture, forestry and fishery. As Figure 2 illustrates, the value added of the sector declined by 29.4% in real terms between 1990 and 1995. The value of agricultural imports and exports, in current US$, grew slightly in the early 1990s, contracted following the 1997 financial crisis, and increased rapidly after 2000. Since agricultural value added declined during the 1990s while trade continued to evolve, the share of agricultural imports and exports in the sector's value added increased substantially from 20.9% in 1990 to 61.3% in 1995. By 2007, the share was over 100%

2 The countries that are not yet WTO members are Azerbaijan, Belarus, Bosnia and Herzegovina, Serbia, Turkmenistan and Uzbekistan.

3 Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovak Republic and Slovenia.

4 Bulgaria and Romania. Croatia joined in 2013.

5 For Ukraine, the DCFTA provisions applied provisionally since 1 January 2016 and the agreement entered fully into force in October 2017.

and continued to grow strongly subsequently. While over most of the period aggregate imports consistently exceeded exports, exports continued to grow at a pace similar to those of imports, and some countries, most notably Ukraine, emerged as net agricultural exporters.

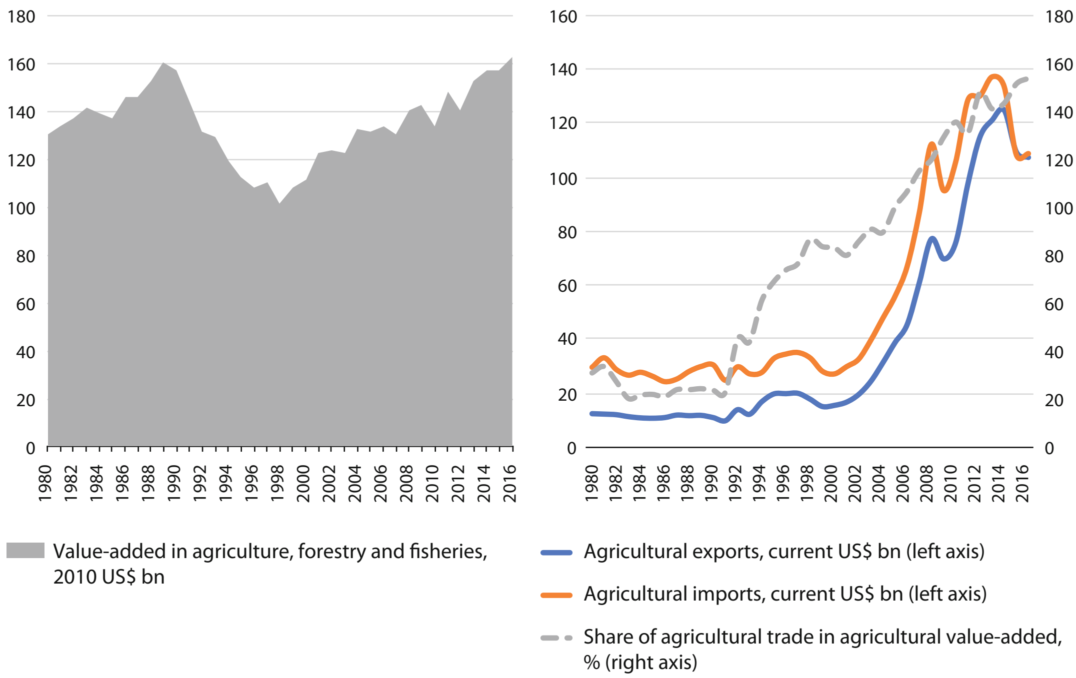

Figure 2 **Value added in agriculture, forestry, fisheries, and trade in agricultural products, Eastern Europe and Central Asia, 1980–2016**

Source: FAOSTAT

The changes in agricultural and trade policies and investments in crucial trade infrastructure during the transition led to a decline in agricultural trade costs, providing a boost to the countries' participation in global agricultural markets. These costs measure the trade-depressing effect of separation between countries, capturing a wide range of factors that affect trade, including distance, tariffs, non-tariff barriers, transportation costs and logistics performance and a measured as percent ad valorem equivalent (Arvis et al., 2016). In many countries, trade costs are higher for agricultural products than for manufacturing and remain high as protection in other sectors declines. Non-tariff barriers and other non-traditional forms of trade policy are particularly important determinants of trade costs, often having a greater impact than tariffs in determining trade performance.

Between 1997 (the first year for which trade costs are available for almost all countries) and 2015, all countries in the region except Uzbekistan reduced their agricultural trade costs (Figure 3). Most countries also increased agricultural trade openness as measured by the percentage share of agri-cultural trade (imports plus exports) in the agriculture value-added.

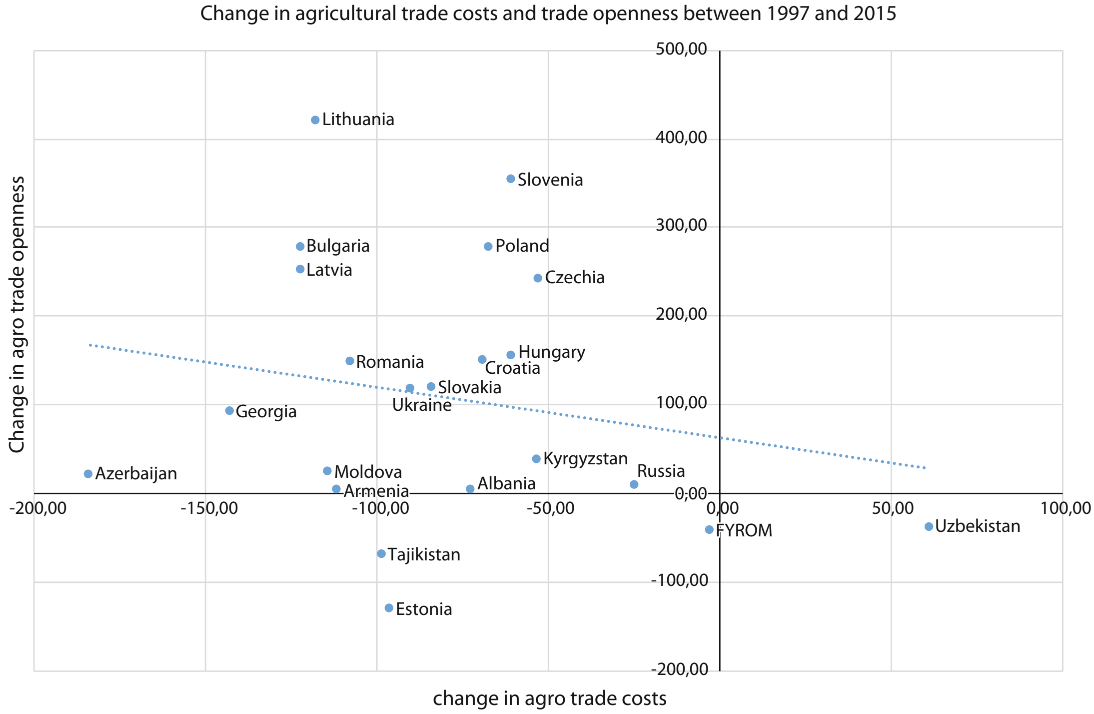

Figure 3 **Change in agricultural trade costs and trade openness 6 in 1997 and 2015, by country**

Note: Changes show the difference in variables in percentage points.

Source: Own calculations based on FAOSTAT and the ESCAP World Bank International Trade Costs database

To understand how agricultural trade costs differ by WTO members and non-members, we perform a simple T-test for differences in mean between the two groups. The results indicate that WTO members have a significantly higher degree of agricultural trade openness and lower agricultural costs (**Annex 1**). The same holds for EU members versus non-members, with differences in means even larger than in the case of WTO membership. Clearly, conclusions cannot be drawn regarding any causal relationship between acceding to these organizations and the outcomes in terms of trade liberalization, although they do suggest a certain association, which is consistent with expectations: Countries join the multilateral trading system to boost trade, and the EU is first and foremost a common market for goods and services, including agricultural products.

6 The sum of agricultural imports and exports divided by agricultural value added.

4 \ Shifts in diets – calories and composition

Over the two decades following the collapse of planned economies, all countries increased their overall calorie availability measured by the dietary energy supply (see Appendices). At the same time, the composition of diets (approximated by food availability) also changed. Figure 4 plots the composition of the total average calorie availability in 1993–95 and 2011–13 for the seven largest post-communist countries (by population). Cereals, roots and tubers account for a large share of the total calorie availability in all countries, but the share has declined during the transition period. While countries like Russia, Kazakhstan and Ukraine relied for roughly half of their calories on these products in 1993–95 (primarily wheat and potatoes and their derivatives), by 2011–13 the share in the overall availability declined to 35–40%. The drop was most pronounced in Kazakhstan (from 60% of total calories to 34%). In many countries of the former Soviet Union and Eastern Europe (but not all), the shares of dairy, meat, oils/fats and fruits/vegetables increased, while the proportion of sugar remained largely unchanged across the board. The increase in the share of oils/fats has been particularly strong in some countries; for example in Belarus it grew from 6% to 16%. Hungary had the largest share of oils and fats) among all countries (23% in 2011–13), while in other countries, such as Azerbaijan, Estonia and Kyrgyzstan, it remained low (in the range of 3–6%).

These developments are consistent with a shift from Stage 3 to Stage 4 in Popkin's nutrition transition schematic (Table 1), which is characterized by increased intake of fat, sugar, processed foods and decreased intake of fiber in the wake of income growth and further mechanization of agricultural production (Popkin, 2006a).

Table 1 **Nutrition profiles of nutrition transition steps**

Stage 1: ***Collecting food***	**Stage 2:** ***Famine***	**Stage 3:** ***Receding famine***	**Stage 4:** ***Degenerative disease***	**Stage 5:** ***Behavioral change***
Plants, low-fat wild animals, varied diet	Cereals predominant, diet less varied	Fewer starchy staples; more fruit, vegetables, animal protein; low variety continues	More fat (especially from animal products), sugar, processed foods; less fiber	Higher-quality fats, reduced refined carbohydrates, more whole grains, fruit, vegetables

Source: Popkin, 2006a

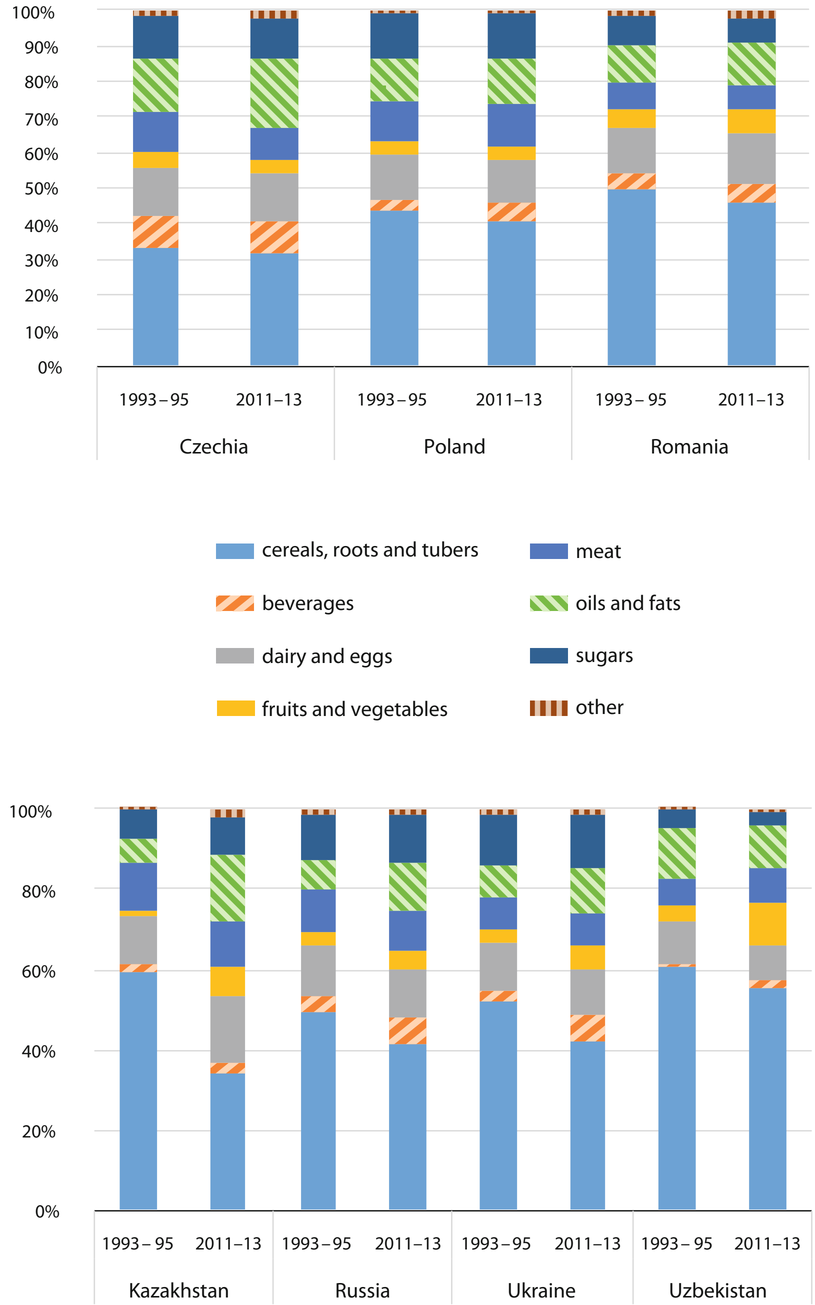

Figure 4 **Composition of the average calorie availability by main category of products, selected countries**

Source: FAOSTAT

5 \ Methodology and data

The effects of trade openness on diet diversity are assessed by regressing measures of dietary diversity on several independent variables. For this study, we are using panel data that consists of annual observations at country level for 26 post-communist countries[7] in the period 1996–2013.

For estimating the effect of trade liberalization on diet diversity, we chose a fixed-effects panel data estimation, which controls for time-invariant regional political, socioeconomic or geographic factors that are not captured by our explanatory variables. The basic model is

$$D_{it} = \beta_1 \ln(X_{it}) + \beta_2 T_{it} + \alpha_i + \varepsilon_{it} \quad (1)$$

where D_{it} is a measure of dietary diversity in country i at time t. The vector of explanatory variables X_{it} includes GDP per capita in constant 2011 US$ at purchasing power parity (PPP) and the share of urban population, while T_{it} is a vector of variables that capture the degree of trade openness. The estimated models differ in terms of how trade measures are captured. α_i and ε_{it} denote the unobserved time-invariant country effect and the error term, respectively.

Measuring dietary diversity is an important methodological question in nutrition-related research. International organizations (e.g. FAO, 2013; WFP, 2008) have developed guidelines to assist national governments with tracking the changes in dietary diversity as a key dimension of diet quality. The most common indicators include the modified Household Dietary Diversity Score (HDDS) (USAID, 2006), the Food Consumption Score (FCS) (FAO, 2013; Jones et al., 2014), the Dietary Diversity Score (DDS) and the Dietary Variety Score (DVS) (Drewnowski et al., 1996). These scores are calculated by summing the number of different food groups or products consumed in the household or by the individual respondent over the 24-hour recall period. Focusing on specific foods, the Minimum Diet Diversity for Women of reproductive age (MDD-W), a similar indicator, measures whether at least five of ten specific food groups were consumed in the previous 24 hours (Masters et al., 2017).

While providing a useful snapshot of the variety in daily diets, these indicators do not capture contribution of individual products to the overall diet. This information is important, however, since dietary recommendations are usually expressed in quantitative terms, either at the level of nutrients or specific food groups. For example, in many countries a minimum of 400 grams of the fruits and vegetables per day is recommended (FAO, 2018). A more nuanced approach would need to consider the amounts consumed or calorie shares of each product or group of products. Moreover, the HDDS and similar indicators are suited for measuring dietary diversity of individuals and are not adequate for aggregate country level food availability data.

7 Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Kazakhstan, Kyrgyz Republic, Latvia, Lithuania, Macedonia (FYR), Moldova, Poland, Romania, Russian Federation, Slovak Republic, Slovenia, Tajikistan, Turkmenistan, Ukraine and Uzbekistan.

In this paper we therefore measure dietary diversity using calorie shares of different food products in the total food supply. The indicator that is increasingly used in nutrition research (INDDEX project, 2018) is the Shannon entropy index expressed as:

$$S = -\sum_{i=1}^{n} s_i \ln s_i \qquad (2)$$

where s_i is the share of product i in the total calories available through n different food items. This index is commonly used in ecology literature to measure species diversity and is based on the weighted geometric mean of the proportional abundances of the types of species. Applied to the analysis of dietary composition, the Shannon Index equals zero in the extreme case of only one item being consumed while a higher value of the index reflects a greater variety of diet.

Another common measure that can be used for diversity analysis is the Herfindahl index, which is the sum of quadratic shares of all available food products in the total calorie availability of a country. The index is thus a measure of concentration, which is commonly used in the analysis of firm market power. It ranges from 0 to 1, with the value of 1 denoting the extreme situation when only one firm supplies the market or, when applied to diets, one product is consumed.

Both Herfindahl and Shannon index (as well as other entropy-based indices) find application in the measurement of food diversity (e.g. Lee and Brown, 1989; Remans et al., 2014; Thiele and Weiss, 2003). For our estimations, we focus exclusively on the Shannon index. While being a relatively novel measure of dietary diversity (e.g. INDDEX project, 2018; Remans et al., 2014 INDDEX project, 2018; Remans et al., 2014), it allows comparing dietary diversity across time and countries since it puts variety in relation to a common factor, the total number of food items available in the world market. With this property, it has been suggested as one important indicator for food nutrient adequacy (Gustafson et al., 2016). Calorie shares are calculated using food supply data expressed in kcal/person/day from FAO's Supply Utilization Accounts (SUA)[8]. SUAs contain supply and utilization data at detailed product level as defined by the FAOSTAT Commodity List (FCL), with 447 products available, although not all products are covered for all countries, depending on their production and consumption patterns. Overall, up to 390 products are reported in the sample countries.

Figure 5 shows the evolution of the Shannon index of dietary diversity for selected countries from 1993 to 2013. All countries have increased their dietary diversity during the transition period, es-pecially after 2000 when incomes grew strongly. In general, countries that already had diverse di-ets in 1993 (these are predominantly Eastern European countries) did not increase the variety very much. Other countries, such as Armenia and Kyrgyzstan, started with low levels of food variety and increased dietary diversity substantially. Finally, there are some exceptions, such as Uzbekistan, which remained at the relatively low level of dietary diversity throughout the period.

8 SUA data are not available for Serbia and Montenegro.

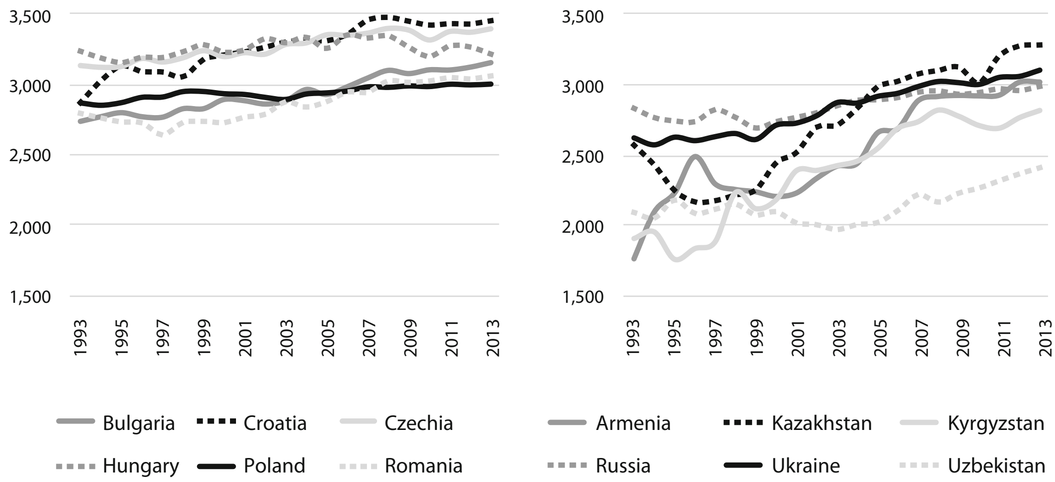

Figure 5 **Dietary diversity measured by the Shannon entropy index based on calorie shares of available foods, selected countries, 1993–2013**

Source: Own calculations based on FAO Supply Utilization Accounts

Since we treat diversity without an explicit reference to the nutrient content of the products available, we control for the healthiness aspect of diets by estimating equation (1) also for the variety of fruits and vegetables as the dependent variable. Moreover, we also use the proportion of total calories from staple foods as an additional measure of dietary diversity as well as the share of oils and fats in the overall diet to assess to what extent trade has contributed to nutrition transition in the countries analyzed. Among poor households, a large share of calories stems from consumption of cheap staples with a high share of carbohydrates but a limited content of other macronutrients and valuable micronutrients. Therefore, an increase in the ratio of other products in total consumption is an indication of a more varied diet. In this study, we define staples as all products derived from cereals, roots and tubers. The most commonly consumed products in this category across the region are bread, wheat flour and potatoes. In Moldova, maize flour also forms an important part of the national diet and falls into this category.

In order to ease the interpretation of the results, we rescale the Shannon index to fit a scale from 0 to 100. The minimum value of the index is 0, an equivalent of only one product available for consumption in a country. The maximum possible value of the index is determined by the number of products that hypothetically could be consumed, with equal shares of calories derived from each product. The maximum of the index is therefore

$$S^{max} = -\sum_{i=1}^{n} \frac{1}{n} \ln\left(\frac{1}{n}\right) = \ln n \qquad (3)$$

Where n is the maximum number of products that could potentially be present in the market. We take this number to be the number of products with a positive value for at least one country in the sample in at least one year, which brings the total number of products that were available to 390 products. Similarly, we use the maximum possible number of fruits and vegetables (105) to rescale the Shannon index for this subset of products (a similar normalizations is for instance suggested by Gustafson et al., 2016).

The rescaled value becomes:

$$S' = {}^{S * 100}/_{S_{max}} \tag{4}$$

This allows us to interpret the estimated coefficients as the percentage by which the Shannon index would increase when the exogenous variable increased by one unit.

To capture the degree of trade liberalization, three types of variables are used: Agricultural trade costs; membership in WTO and EU; and the share of agricultural imports and exports in agricultural value added (agricultural trade openness). Agricultural trade costs were obtained from a global dataset of bilateral trade costs published jointly by the World Bank and the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). The dataset captures a wide array of trade barriers and market imperfections as described in Section 3.2. Since the data are bilateral for each country and in order to avoid the potentially misleading composition effects (Arvis et al., 2016), the same partner country is used for each of the countries in the sample. Germany is chosen as the representative partner country to capture the trade cost because it is one of the major agricultural exporters to Europe and Central Asia and is available as a partner for most years in the trade costs database. WTO and EU membership are included because joining both organizations has expansion of trade through reduction in trade barriers as a key objective. These are represented by dummy variables with one denoting being a member. Imports and exports of agricultural products as well as agricultural value added used in the calculation of agricultural trade openness are obtained from FAOSTAT. The agricultural trade openness indicator is an adapted version of the commonly used measure of trade openness which is the share of imports and exports in GDP. This measure is commonly used for estimating the effects of trade liberalization on poverty, among other variables (e.g. Dollar and Kraay, 2004).

While the general premise is that trade openness affects dietary diversity by influencing the variety of products available to consumers, the demand for food is also likely to affect trade. Consumers who demand higher variety could be driving an increase in food imports which in turn would be reflected in a higher share of trade in agricultural value added. To resolve the potential endogeneity problem associated with including agricultural trade openness as an explanatory variable, we apply an instrumental variable approach using agricultural trade costs as an instrument for trade openness. Agricultural trade costs are not likely to depend on dietary variety, but they affect agricultural imports and exports, which in turn are expected to influence the availability of foods in domestic markets and consumer choice.

To control for shifts in economic development and population flows between urban and rural areas over the observed time period, which are both acknowledged to influence nutrition transition and diet composition (Popkin, 2002, 1998), we include two additional explanatory variables, namely GDP and the level of urbanization. GDP per capita (in constant 2011 PPP US$) and the share of urban population in total (%) are taken from World Development Indicators of the World Bank.

Table 2 contains means and standard deviation for the variables used in the regressions. Two points in time are used to show the change in annual means: 1996 (the first year for which agricultural trade costs data are available for most countries) and 2013 (the last year for which SUA data are available). On average, all countries increased the overall dietary diversity and the diversity of available fruits and vegetables. At the same time, the share of cereals roots and tubers declined, while the share of oils and fats increased. The mean GDP per capita in constant 2011 US$ at PPP doubled over the time period; agricultural trade openness also increased by almost 100 percentage points, while the average agricultural trade costs declined. The share of urban population remained largely unchanged. Roughly one third of the countries were EU members in 2013 (from zero in 1996) and 69% were members of the WTO (up from 19% in 1993).

Table 2 **Descriptive statistics (averages across countries), 1996 and 2013**

Variable	1996		2013	
	Mean	Std. Dev.	Mean	Std. Dev.
Shannon Index of overall diversity of available foods	2.70	0.47	3.11	0.40
Shannon Index of diversity of available fruits and vegetables	2.80	0.31	3.15	0.36
Share of cereals, roots and tubers in total available calories, %	50.78	11.30	43.26	9.07
Share of oils and fats in total available calories, %	9.59	4.21	12.57	5.01
GDP per capita in constant 2011 US$-PPP[1]	8,159.51	483.09	6,372.74	8,415.08
Share of urban population in total, %	56.11	12.76	57.02	13.11
Trade costs in agriculture, % ad valorem[2]	203.29	67.60	154.03	72.67
Share of WTO members, %	19.23	40.19	69.23	47.07
Share of EU members, %	-	-	34.62	48.52
Agricultural trade openness[3], %	104.88	83.27	206.99	168.65

Notes: [1]purchasing power parity, [2]with Germany as trading partner, [3](exports+imports)/agricultural value-added

6 \ Results

Tables 3 through 5 present the regression results for the effects of trade variables on different measures of dietary diversity. Columns (1) through (3) in each table report the outcomes of least square regressions with country fixed effects using different sets of regressors that capture trade policy: Agricultural trade costs; Agricultural trade costs as well as membership in the WTO and EU; and agricultural trade openness. Column (4) shows the results of the instrumental variables (IV) estimation with agricultural costs used as an instrument for agricultural trade openness. Statistics related to the IV specification are provided below the tables.

The results confirm that incomes play a major role in determining dietary diversity. In all four specifications in Table 3 and Table 4, the coefficient on GDP per capita is positive and significant. The effects are stronger for the variety of fruits and vegetables than for the overall diversity. Moreover, the share of staples in the overall calories intake declines with income (Table 5), also in line with the literature on nutrition transition. The estimated coefficients are also consistent with previous findings in the literature that economic growth induces diversification of diets. On the other hand, the share of urban population does not seem to play an important role in determining dietary diversity, indicating that both rural and urban population follow similar patterns when it comes to changes in dietary diversity. The estimates provide novel results concerning the role of trade: Agricultural trade costs affect the overall dietary diversity when WTO and EU memberships are included (Table 3 column 2), with higher costs leading to lower variety at an elasticity equal to 1.5. The effect also holds for the variety of fruits and vegetables (Table 4), where the coefficient is even higher: A one percent decline in agricultural trade costs leads to a 4.5 percent increase in the diversity of available fruits and vegetables. This is consistent with the expectation that trade liberalization in Eastern Europe and Central Asia led to greater variety of these products by supplementing diets with crops that may not be cultivated domestically or are not available all year around.

Table 3 **Estimation results for overall diet diversity as the dependent variable**

	Dependent variable – Shannon Index of overall diversity of available foods			
	Fixed effects			IV (w FE)
	[1]	[2]	[3]	[4]
ln(GDP per capita)	4.136 ***	2.703 ***	3.934 ***	7.241 ***
	(0.723)	(0.681)	(0.658)	(0.399)
Urban population (%)	0.054	0.045)	-0.006	0.053
	(0.062)	(0.057)	(0.060)	(0.065)
ln(avg agro trade costs)	-0.225	-1.509 ***		
	(0.599)	(0.586)		
WTO member		1.429 ***		
		(0.287)		
EU member		-2.367 ***		
		(0.327)		
Agro trade openness			-0.522 ***	1.007 ***
			(0.152)	(0.217)
Year dummy	Yes	Yes	Yes	Yes*
Number of observations	453	453	494	453
Adj R2	0.949	0.957	0.949	0.937

Note: Standard errors are shown in parenthesis. * denotes that the coefficient is significant at 10%; ** at 5% and *** at 1%

Test of endogeneity		
Ho: agro trade openness is exogenous		
Durbin (score) chi2	46.60	(p=0.000)
Wu-Hausman F	48.50	(p=0.000)
* Year dummies are included as instruments only		
Ho: All year coefficients in the second stage are jointly equal to zero		
chi2(18) = 23.85 Prob > chi2 = 0.160		

While WTO membership has a positive and significant effect on the overall dietary diversity, it does not affect the variety of fruits and vegetables. Joining the EU, on the other hand, leads to a slightly lower overall diversity, but a marginally more varied basket of fruits and vegetables. Interestingly, EU membership is associated with a higher share of cereal, roots and tubers in diets, although the effect is very small. Overall, while the average share of these products in the EU members in the sample is 37.6%, the share among non-members is 49.2%. However, most of this difference is explained by other variables, such as income levels (which are higher in EU members) and not by EU membership itself.

Table 4 **Estimation results for fruits and vegetables diversity as the dependent variable**

	Dependent variable – Shannon Index of diversity of available fruits and vegetables			
	Fixed effects			IV (w FE)
	[1]	[2]	[3]	[4]
ln(GDP per capita)	5.292 ***	6.256 ***	8.355 ***	9.524 ***
	(1.024)	(1.048)	(0.852)	(1.070)
Urban population (%)	-0.077	-0.071	-0.045	-0.035
	(0.088)	(0.087)	(0.077)	(0.082)
ln(avg agro trade costs)	-5.594 ***	-4.499 ***		
	(0.849)	(0.901)		
WTO member		-0.074		
		(0.441)		
EU member		1.751 ***		
		(0.502)		
Agro trade openness			2.150 ***	3.268 ***
			(0.197)	(0.458)
Year dummy	Yes	Yes	Yes	Yes*
Number of observations	453	453	494	453
Adj R2	0.872	0.875	0.907	0.878

Note: Standard errors are shown in parenthesis. * denotes that the coefficient is significant at 10%; ** at 5% and *** at 1%

Test of endogeneity		
Ho: agro trade openness is exogenous		
Durbin (score) chi2	9.00	(p=0.003)
Wu-Hausman F	8.21	(p=0.004)
* Year dummies are included as instruments and in the second stage		
Ho: All year coefficients in the second stage are jointly equal to zero		
chi2(18) = 38.39 Prob > chi2 = 0.003		

The endogeneity tests (Durbin and Wu-Hausman) show that agricultural trade openness is in fact endogenous to the dietary diversity (both overall and for fruits and vegetables) and the share of cereals, roots and tubers. Therefore, an OLS estimator is inconsistent when trade openness is included as an exogenous variable. The instrumental variable specification used to correct for the bias lends support to the hypothesis that agricultural trade openness can affect dietary diversity positively.

Results reported in column (4) in Tables 4 and 5 show that both the overall dietary diversity and the variety of fruits and vegetables increase in agricultural trade openness. A one percent increase in agricultural trade openness leads to 3.3 percent higher variety of fruits and vegetables. There is no evidence of a similar effect on the share of cereals, roots and tubers in diets.

Overall, the results provide further evidence to the findings in Remans et al. (2014) that trade is an important determinant of dietary variety, in particular for middle and high income countries. Trade barriers in agriculture, as approximated by agricultural trade costs, seem to affect diets both directly and through their impact on agricultural trade openness.

Table 5 **Estimation results for shares of cereals, roots and tubers in total calorie availability**

	Dependent variable – Share of cereals, roots and tubers in total available calories			
	Fixed effects			IV (w FE)
	[1]	[2]	[3]	[4]
ln(GDP per capita)	-0.098 ***	-0.073 ***	-0.090 ***	-0.102 ***
	(0.012)	(0.010)	(0.011)	(0.006)
Urban population (%)	0.001	0.001	0.003 **	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ln(avg agro trade costs)	0.007	0.027 ***		
	(0.010)	(0.009)		
WTO member		-0.036 ***		
		(0.004)		
EU member		0.039 ***		
		(0.005)		
Agro trade openness			0.010 ***	-0.003
			(0.002)	(0.003)
Year dummy	Yes	Yes	Yes	Yes*
Number of observations	453	453	494	453
Adj R2	0.935	0.952	0.933	0.934

Note: Standard errors are shown in parenthesis. * denotes that the coefficient is significant at 10%; ** at 5% and *** at 1%

Test of endogeneity		
Ho: agro trade openness is exogenous		
Durbin (score) chi2	21.58	(p=0.000)
Wu-Hausman F	21.15	(p=0.000)
* Year dummies are included as instruments only		
Ho: All year coefficients in the second stage are jointly equal to zero		
chi2(18) = 6.82	Prob > chi2 = 0.992	

To assess to what extent trade openness and income growth the countries in Europe and Central Asia have facilitated the transition to Stage 4 explained in Table 1, we also include estimates for the share of oils and fats in the overall calories as dependent variable. The regression outputs are shown in Table 6. As for the effects of income growth, the results are inconclusive – only in the specification with instrumental variable, the coefficient is positive and significant, albeit low. Trade openness does seem to increase the share of oils and fats in diets, but at a very low rate – a one percent point increase in trade openness translates to a 0.01 percent point higher proportion of oils and fats. Lowering trade costs and WTO membership also marginally increase the share, while joining the EU lowers it.

Table 6 **Estimation results for shares of oils and fats in total calorie availability**

	Dependent variable - Share of oils and fats in total available calories			
	Fixed effects			IV (w FE)
	[1]	[2]	[3]	[4]
ln(GDP per capita)	-0.002	-0.012 *	0.006	0.026 ***
	(0.007)	(0.007)	(0.006)	(0.004)
Urban population (%)	-0.001	-0.001 *	-0.001 **	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
ln(avg agro trade costs)	-0.010 *	-0.019 ***		
	(0.006)	(0.006)		
WTO member		0.008 **		
		(0.003)		
EU member		-0.017 ***		
		(0.003)		
Agro trade openness			0.000	0.010 ***
			(0.001)	(0.002)
Year dummy	Yes	Yes	Yes	Yes*
Number of observations	453	453	494	453
Adj R2	0.891	0.900	0.879	0.879

Note: Standard errors are shown in parenthesis. * denotes that the coefficient is significant at 10%; ** at 5% and *** at 1%

Test of endogeneity		
Ho: agro trade openness is exogenous		
Durbin (score) chi2	33.05	(p=0.000)
Wu-Hausman F	33.29	(p=0.000)

* Year dummies are included as instruments and in the second stage
Ho: All year coefficients in the second stage are jointly equal to zero
chi2(18) = 19.71 Prob > chi2 = 0.349

7 \ Conclusions

The countries in Eastern Europe and Central Asia have undergone a transformation from planned and relatively closed economies to market economies characterized by more open trade, leading to fundamental changes in their food systems. These structural changes, together with growing incomes, led to a shift in food consumption patterns with higher average calorie intake and more diverse diets.

This paper quantifies the contribution of trade openness and GDP growth to dietary diversity. The results are consistent with the evidence in previous research that shows that income growth plays an important role in ensuring varied consumption (e.g. Mayen et al., 2014) and that trade contributes to this variety (Remans et al., 2014). Reducing the overall agricultural trade costs and membership in WTO stimulate agricultural trade and increase the diversity of available foods, which in other studies has been shown to have beneficial effects for nutritional quality. Joining the EU, on the other hand, reduces the overall variety of diets, which could perhaps be a result of conversion in cultural norms and adoption of more uniform eating habits across member countries, facilitated by movement of people across borders. Further research is needed to explain these linkages. EU membership does, however, increase the variety of available fruits and vegetables, which could be a reflection of greater accessibility to crops produced in different climates.

Clearly, the question of whether the improved diversity stems from greater variety of healthy foods, such as fruits and vegetables, or nutritionally inferior products, for example processed foods with high content of oil and sugar requires further analysis. The initial results show that trade openness is indeed associated with higher share of oils and fats in consumption, which is consistent with nutrition transition, but the effect is very small. On the other hand, the paper also establishes a robust link between reducing agricultural trade costs and the increased variety of fruit and vegetable available to consumers. Therefore, reducing tariff or non-tariff barriers for healthier products, especially in countries where the variety of domestically grown crops is limited, should play a part in any strategy targeting better nutrition. This could include stronger efforts to facilitate trade, giving priority to reducing the time and costs of crossing borders for fresh fruits and vegetables, which tend to be perishable. These products are also usually subject to stringent sanitary and phytosanitary controls and efforts are needed to prevent that these become de facto trade barriers. On the demand side, increasing incomes of poor households combined with targeted nutrition measures (such as information campaigns, labelling, regulation and possibly targeted taxes on unhealthy foods) can be effective in improving nutrition.

An important limitation of this study is that it does not account for additional factors that could be driving nutritional changes, such as the relative food prices, FDI in food processing and retail, or tastes, traditions and cultural norms, highlighting only the key drivers cited in nutrition literature, such as incomes, urbanization and trade openness. Another limitation is that we define diversity at a highly aggregate level by looking at country level food availability, essentially making the results only valid for an average person and thus ignoring the large differences in food consumption and incomes across individuals. These differences and the resulting inequality in dietary diversity and quality can be substantial, warranting targeted nutrition interventions. A more nuanced approach would require utilizing micro-level consumption data which are not widely available in many countries. The results of this study could be extended to look closer at the quality of diets – for example by dividing all products available in domestic markets into more or less healthy or converting the total quantities of available products to nutrients – in order to determine whether the overall diet is becoming more or less healthy.

More sophisticated measurement of agricultural trade policy could also help to improve the reliability of results since agricultural trade costs include everything that separates one country from another, for example distance and logistics. To focus on border measures alone, it would be useful to construct an indicator that would capture tariffs and non-tariff measures (NTMs) for different products. However, annual tariff data by product are scarce and there is no reliable estimation of NTMs for this group of countries, which makes improvements in data collection a priority.

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APPENDICES

Table A1 **Results of two-sample t-tests for differences in means of agricultural trade costs and agricultural trade openness among members and non-members of WTO and EU**

	Agricultural trade costs			Agricultural trade openness		
	Obs	Mean	Std. Err.	Obs	Mean	Std. Err.
non-WTO member	227	215.207	5.36	354	0.920	0.039
WTO member	276	157.001	4.06	294	1.931	0.083
combined	503	183.269	3.53	648	1.379	0.047
diff		58.206	6.61		-1.011	0.087
	Ho: diff = 0	Ha: diff > 0		Ho: diff = 0	Ha: diff < 0	
	t = 8.806	Pr(T > t) = 0.000		t = -11.667	Pr(T > t) = 0.000	

	Agricultural trade costs			Agricultural trade openness		
	Obs	Mean	Std. Err.	Obs	Mean	Std. Err.
non-EU member	406	202.594	3.717	541	0.996	0.031
EU member	97	102.382	3.120	107	3.310	0.127
combined	503	183.269	3.531	648	1.379	0.047
diff		100.212	7.760		-2.314	0.090
	Ho: diff = 0	Ha: diff > 0		Ho: diff = 0	Ha: diff < 0	
	t = 12.914	Pr(T > t) = 0.000		t = -25.804	Pr(T > t) = 0.000	

Table A2 **Dietary energy supply (kcal/person/day)[9] by country**

former Soviet Union	1993–95	2014–16	Change (%)
Armenia	2183	2929	34.2
Azerbaijan	2173	3150	44.9
Belarus	3171	3223	1.6
Estonia	2731	3290	20.5
Georgia	2086	2944	41.1
Kazakhstan	2921	3235	10.8
Kyrgyzstan	2403	2802	16.6
Latvia	3171	3244	2.3
Lithuania	2807	3488	24.3
Republic of Moldova	2472	2663	7.7
Russian Federation	2928	3363	14.9
Tajikistan	2024	2211	9.3
Turkmenistan	2554	2823	10.5
Ukraine	3034	3061	0.9
Uzbekistan	2686	2765	2.9

Other	1993–95	2014–16	Change (%)
Albania	2796	3252	16.3
Bosnia and Herzegovina	2578	3155	22.4
Bulgaria	2909	2910	0.0
Croatia	2385	3184	33.5
Czechia	3075	3270	6.4
Hungary	3027	3063	1.2
Macedonia, FYR	2528	2948	16.6
Poland	3348	3467	3.5
Romania	2986	3377	13.1
Slovakia	2868	3009	4.9
Slovenia	2843	3171	11.6

Source: FAOSTAT

9 Dietary energy supply (DES) is defined as food available for human consumption, expressed in kilocalories per person per day (kcal/person/day). At country level, it is calculated as the food remaining for human use after deduction of all non-food utilizations (i.e. food = production + imports + stock withdrawals – exports – industrial use – animal feed – seed – wastage – additions to stock). Wastage includes loss of usable products occurring along distribution chains from farm gate (or port of import) up to retail level. (FAO, IFAD, UNICEF, WFP and WHO. 2017)

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