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Food sovereignty, food security, and international trade: evidence from Chile

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Introduction: There is an ongoing debate regarding the role of international trade on food security and food sovereignty. While food security is a concept with a recognized definition and methodologies to assess it, food sovereignty has multiple definitions, and it is not clear how to measure it. Our purpose is to analyze the evolution of cherry and avocado domestic purchases as an illustrative example of the role of international trade on food security and food sovereignty.

Method: Using a descriptive analysis, we analyse export data at country level and household data representative of urban centers.

Results: We found that cherry and avocado exports have increased over the last decades. We found that domestic cherry and avocado purchases have been stable, while the overall fruit and vegetable purchases have been decreasing. Besides, the cherry seasons are showing some signs of expansion. In terms of disparities, households from quintiles 1 and 2, the two lowest income quintiles, increased cherry purchases. Moreover, households from quintiles 4 and 5, the two highest income quintiles, decreased cherry purchases.

Discussion: International trade can also help to increase domestic purchases and decrease purchases disparities, which can be linked to food access and food security. However, the increased of off-season imports of avocado can be linked to a decreased food sovereignty. We expect to contribute to illustrate how international trade, food security and food sovereignty are linked, while the concept of food sovereignty keeps developing.

KEYWORDS

food sovereignty, food security, self-sufficiency, international trade, fruits and vegetables, cherry, avocado, Chile

1 Introduction

The definition of food security has been presented in many articles, and is widely accepted in academic and public policy areas (Gordillo and Mendez, 2013). On the other hand, food sovereignty, in one of its approaches, would be the right of each nation to maintain and develop its own capacity to produce its basic foods, respecting cultural and productive diversity (Patel, 2009). Moving from a macro to a micro scale, according to La via campesina (2009) food sovereignty is "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems." Although food sovereignty is not a new concept, its definition is not yet consolidated, with multiple approaches (Bustos et al., 2022).

According to FAO (1996), "food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life." This definition has

been presented in many articles, and is widely accepted in academic and public policy areas (Gordillo and Mendez, 2013). On the other hand, food sovereignty, in one of its approaches, would be the right of each nation to maintain and develop its own capacity to produce its basic foods, respecting cultural and productive diversity (Patel, 2009). Moving from a macro to a micro scale, according to La via campesina (2009) food sovereignty is "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems." Although food sovereignty is not a new concept, its definition is not yet consolidated, with multiple approaches (Bustos et al., 2022).

Food sovereignty includes a social pillar of sustainability and sustainable food production (Keske, 2021). For instance, indiginizing food sovereignty enhances the cultural responsibilities and relationships indigenous peoples have with their environment (Coté, 2016). Colson-Fearon and Versey (2022), in the urban context, highlights the importance of community initiatives as a means to achieve food autonomy and address food inequalities. Food sovereignty is associated to local production consumption, which has low environmental costs, while imports make local food production economically infeasible (Keske, 2021). Moreover, out-of-season fruit consumption leads to high environmental costs. Xiong et al. (2023) showed that, in China, cherries from Chile that arrive by plane in October are associated to the highest greenhouse gas emissions, while domestic production in season is associated to the lowest greenhouse gas emissions.

The literature identifies three main differences between the concepts of food security and food sovereignty, understanding in any case the different conceptualizations existing on the latter. First, food security favors a market-oriented global trading system (FAO, 1996), while food sovereignty is frequently associated with positions of food protectionism, and is often anti-free trade (Akter, 2022). While food sovereignty is not explicitly against international trade, there is a strong preference for local markets (Burnett and Murphy, 2017). Food sovereignty implies to shift away from global trade, while make emphasis on smallholder producers and reliance on local communities for food sourcing (Jones et al., 2015). Second, food security is mainly promoted by intergovernmental organizations and is neutral in terms of power relations, while food sovereignty is promoted by non-governmental organizations and civil society actors and points to the asymmetry of power in food markets. Thirdly, food security does not take a single position with respect to different types of food production, while food sovereignty, in general, privileges small-scale agriculture, preferably organic, and mainly using the concept of agroecology (Gordillo and Mendez, 2013). However, Burnett and Murphy (2017) argue that, even for the small farmers, trade is relevant for their regular activities and food security. There is, therefore, no clear role and valuation in the main approaches to food sovereignty with regard to international trade (Bustos et al., 2022).

At the same time the evolving interplay between food security and food sovereignty is increasingly recognized in academic discourse, emphasizing diverse and context-specific aspects. While traditional definitions of food security focus on the accessibility and nutritional adequacy of food (FAO, 1996), contemporary perspectives are broadening to incorporate environmental, socio-cultural, and agency dimensions (Calistri et al., 2013; Lerner and Berg, 2015; Chappell, 2018; del Valle M et al., 2022). This shift aligns with the concept of food sovereignty, which emphasizes social inclusion and participatory governance in food systems, resonating with cultural values and acceptance around food production and consumption (Chappell, 2018). In this context, Young et al. (2023) highlight the importance of involving alternative visions from local food system actors to achieve a sustainable and fair agricultural transformation, arguing that understanding and valuing the diversity of perspectives is crucial for designing effective interventions that respond to the needs and rights of everyone involved in the food system. As an empiric example of local food governance, Kerr et al. (2019) show that participatory agroecological research on climate change adaptation significantly enhances household food security and dietary diversity in Malawi, showcasing the effectiveness of integrating local knowledge and agroecological practices in bolstering resilience against climate challenges. These approaches necessitate a transformation of food systems, advocating for local levers in civil society engagement and recognizing the complexity and diversity of food systems (van Bers et al., 2019; Dupouy and Gurinovic, 2020).

In this context, the purpose of this study is to revisit the role of international trade on local purchases. In particular, we analyze the changes in the domestic market of cherries and avocados in Chile, which, to some extent, can be associated with exports of these fruits. The dataset does not allow us to argue a causal relation between exports and domestic market changes. However, we want to analyze the available data and let the reader judge. We have conducted descriptive analysis regarding the changes in domestic purchases and wholesaler and consumer prices. We analyze domestic purchases in terms of *per capita* purchase by income quintile to show potential purchase inequalities, coverage or the percentage of the population that purchases such products and how long the period, or season of trade lasts.

Therefore, the role of international trade on food security and food sovereignty is unclear. Utilizing data from avocado and cherry, in both cases international trade is relevant. Our study pursues to provide illustrative examples on the role of international fruit trade on food security and food sovereignty. In the coming section, we revise previous evidence on the role of international trade on food security and how sovereignty can be measured. Then, we analyze two waves of household level data. Finally, we discuss our results and identify some areas for future research.

2 Literature review

In this article, our focus is on the association between food exports and domestic food purchases; therefore, we reviewed the evidence on the effect of international trade, particularly food exports, at the consumer level. International trade could play a key role in food security, which is directly linked to Sustainable Development Goal 2 (zero hunger), by allowing production to take place in the most suitable regions and allowing food to flow from countries with abundant food supplies to those with less (Dithmer and Abdulai, 2017). For instance, Miller et al. (2020), classified countries into three trade freedom groups, lowest, middle, and highest, and found that countries with more trade freedom have

scored higher in *per capita* national income, political stability and food security. However, the literature is still scarce, and analyzing the causal links between trade, trade policies, and food security can be challenging due to the multiple dimensions of food security, such as availability, access and utilization (Barros and Martínez-Zarzoso, 2022).

Previous export effect research has focused on the effect of export restrictions on local production. Some of the most cited examples in the literature are the effects of export restrictions on international markets during the global food price crises of 2007–08 and 2010–2011. Then, there is also some evidence about the COVID-19 pandemic, the Russian invasion of Ukraine, as well as some harvest failures (Akter, 2022), but these studies remain descriptive rather than analytical. In these cases, in general, after supply disruptions, exporter countries restricted international trade to mitigate their domestic price increases.

For example, India cut rice exports to Bangladesh in mid-2007 to protect its own domestic market from potential price increases. As a result in changes in the net supply, Bangladesh experienced an increase of 9.0% in the real price of rice, according to Dorosh and Rashid (2013). On the other hand, Fellmann et al. (2014) showed that the effect of grain export restrictions from Russia, Ukraine, and Kazakhstan benefited producers in the rest of the world. In 2010, the latter increased their profits in the short term, as they increased their production in response to higher prices.

Akter (2022) reviewed 13 empirical studies on the impact of export restrictions on local economies. The authors found mixed evidence in the literature on the effectiveness of food export restrictions as an instrument of short-term food price stabilization in local economies among food-exporting countries. When export restrictions lower domestic food prices, they benefit net food buyers at the expense of net food sellers by redistributing the potential economic surplus of high food prices from producers to consumers. However, the net welfare effect generated by such redistribution is very small and disproportionately benefits urban consumers over many small net food sellers.

Baylis et al. (2019) and Giuntella et al. (2020) indicate that trade liberalization increases food security (e.g., China and Mexico) as food products become relatively less expensive after trade liberalization. In addition, Law (2019), examining the Indian case, found that trade liberalization led to a shift in dietary patterns from a grain-based diet to one increasingly based on animal products. Dithmer and Abdulai (2017), studied the impact of trade openness on food security in 151 countries, measured by food energy consumption obtaining positive and significant impacts, as well as improvements in dietary diversity and diet quality. In contrast, Mary (2019) found that a 10.0% increase in food trade openness would increase the prevalence of undernourishment by about 6.0%, using a sample of 52 developing countries and a fixed-effect model with instrumental variables.

There is also evidence of an increase in rural poverty rates with local decreases in food prices, as it causes income losses and decreases agricultural work for most rural households that depend on agriculture for their livelihoods (Ivanic and Martin, 2008; Koo et al., 2021). For example, Diao and Kennedy (2016) reported that maize export bans in Tanzania are expected to lead to a relevant amount of rural households below the poverty line in maize-surplus regions. In this regard, Akter (2022) concluded that food export restrictions, while bringing short-term food security by lowering food prices and thus protecting buyers from inflation, invoke price uncertainty and market instability that restrict long-term food production and agricultural growth.

Despite the mixed results of the literature on the impacts of trade on food security, evidence shows that food prices are the main transmission channels through which increased trade could improve food security if more open trade policies lead to lower food prices at the consumer level. Djuric and Götz (2016) studied the effects of wheat export restrictions on final consumer prices in Serbia during the food crises of 2007/08 and 2011. This is of strategic importance because wheat provides a base for the milling and feed production industries in the country. They suggest that consumers in Serbia experienced welfare losses because the milling and bakery industries transmitted significant changes in wheat prices to end consumers. The study concluded that the effectiveness of implementing an export restriction to dampen domestic food inflation depends on the price behavior of actors along the food supply chain.

Regarding the effects that food export restrictions have on domestic producers, the evidence reveals unintended negative consequences for food producers in most cases (Akter, 2022). Export restrictions prevent domestic producers from taking advantage of high international prices. Also, export restrictions lead to high economic costs in terms of lost income of producers, lost agricultural investments, high implementation costs and high fiscal costs to acquire and maintain larger than normal food reserves (Akter, 2022).

For example, Götz et al. (2013) analyzed the impact on the domestic market of wheat export controls in Russia and Ukraine during the 2007-08 global food crisis. They found that export restrictions caused market instability and pushed producer prices below their long-term equilibrium level. This also discouraged private investors and thus prevented Russia and Ukraine from maximizing their grain potential. Houssa and Verpoorten (2015) studied the impact of Benin's shrimp export ban, triggered by non-compliance with EU food safety rules. The ban had significant improvements in compliance with EU safety standards. In particular, the government updated safety standards provided training on health issues to small-scale actors, strengthened the Competent Authority, and improved laboratories. However, the improvements made were insufficient to allow the country to maintain exports, due to the lack of national capacity building (financial, human, and institutional capacity) with rapidly evolving EU food safety standards.

Previous research used gravity models to analyze the effect on international trade. Adding a perception index of rigor that comprises different dimensions of business requirements, Melo et al. (2014) analyzed the effect that stricter regulations and standards using a stringency index, as perceived by exporters, had on Chile's fresh fruit exports. The stringency index used quantified the impact of multidimensional regulations and standards in a trade gravity model using exporters' perceptions of their rigidity. The selected fruits were grapes, apples, kiwis and cherries in the period from 2002 to 2010. The authors found that a 1.0% increase in the stringency index reduces exports by 0.5%, on average, and also

suggested that the effect is greater if a developed country imposes the standard. Also, Ehrich and Mangelsdorf (2018), analyzed food processing companies from 87 countries, between 2008 and 2013, that are certified with the International Featured Standard (IFS) to study how food standards affect exports. Seven different sectors were considered: egg products, meat, fruits and vegetables, bakery products, dairy products and beverages. Using IFS's 1-year delay as well as IFS certification in neighboring countries as an instrument, the results show that a 1.0% increase in IFS certification increases countries' exports by 0.3% on average. However, the effect remains robust only for high- and middle-income countries and disappears for low-income countries.

More recently, the COVID-19 pandemic led to uncertainty about the availability of food supplies, and despite requests to avoid imposing trade restrictions, more than 20 countries implemented export bans on agri-food products to ensure domestic availability (Koppenberg et al., 2021). For example, countries such as Vietnam, Cambodia and Myanmar declared bans on rice exports, suspended the registration of new export contracts, defined export quotas and temporarily suspended the issuance of rice export licenses (FAO, 2020). As a result, in the Thai market the price of rice increased by around US$100 per ton (more than 20 percent) putting pressure on the budgets of low-income households and making it difficult to pay for nutritious food. The restrictions can cause panic, price increases in international markets and a collapse of food supply chains. Using data from 144 countries, Gilbert et al. (2023) found that 55% of retail items had some active imports supplementing domestic production. Moreover, 83% of the retail price corresponds to value-added at the country of destination. Therefore, international trade helps to provide a more diverse food supply, while consumer prices would depend on the cost levels, infrastructure and institutions underlying each product's entire value chain.

Flexor et al. (2023) argue that food security cannot be solved by the market mechanisms. In Brazil, Flexor et al. (2023) enhance an active role of local governments regarding food security, beyond food production and access to food, while including food diversity and food quality. In this sense, Clapp (2017), away from more extreme positions, argues that food self-sufficiency pursuits of policies to increase domestic food production may make sense both politically and economically.

As presented in the Introduction, there is not an agreement regarding food sovereignty. Therefore, there is not a consensus on the way the need to be measured. Butti Al Shamsi et al. (2018) point out that food sovereignty can be measured through indicators that assess a community's ability to maintain sustainable food systems, the accessibility and availability of nutritious foods, and the autonomy of local producers in decision-making. Sowerwine et al. (2019) suggest that measuring food sovereignty should include community participation in food systems, equitable access to food resources, and the sustainability of agricultural practices, highlighting the importance of qualitative and participatory methods to capture the concept's complexity. Colson-Fearon and Versey (2022) propose that, in urban contexts, food sovereignty can be measured by assessing the impact of urban agriculture initiatives on local food security, social inclusion, and community resilience to food crises.

In summary, most of the studies carried out have focused on how restrictions on food exports by exporting countries affect their own domestic producers, first, and then their consumers and how they affect the domestic market of third countries, mainly through prices. Second, previous research has also focused on the relationship between international trade and food security, and finally, on the effect of higher quality and safety standards driven by developed country markets on exports from third countries. In this context, export restrictions can be linked with a specific period, and then, it is possible to argue a before vs. after effect. To the best of our knowledge, no previous research has provided figures regarding how changes in international trade can be linked to food sovereignty indicators. In this context, our research pursues to provide some figures to the academic debate regarding the role of international trade on food sovereignty and food security.

3 Methodology

The analyzes presented are descriptive in nature. These descriptive analyzes are presented as a combination of descriptive statistical tables and figures that include values as references. Therefore, these analyzes cannot argue causality; however, they can show changes in purchases over time. The choice of cherries and avocados for the study is to show the changes in purchases associated with relevant changes in production. The selection of descriptive analysis in this study is justified by its relevance for exploratory research. This method is recognized for its effectiveness in clearly and accessibly presenting data trends (Babbie, 2020), initial understanding of a subject (Kothari, 2004), and for its value in food security research, particularly in identifying baseline consumption patterns as demonstrated by Headey and Ecker (2013).

3.1 Data

This study works with two databases. First, the *Encuesta de Presupuestos Familiares* (EPF, Family Budget Survey) of *Instituto Nacional de Estadísticas* (National Institute of Statistics of Chile, INE). Every five years, the EPF collects spending information of a representative sample of households, 10-15 thousand households, in the main urban centers of Chile. The data collected are organized according to international classification standards similar to the Consumer Expenditure Survey in the United States and Living Cost and Food Survey in the United Kingdom. For food, the EPF reports expenditure and quantity by type of fruit and vegetable, FV, and its format (e.g., fresh and frozen). In particular, this study works with data on fresh cherries and avocados collected in the wave 7 of the *Encuesta de Presupuestos Familiares*, EPFVII, between November 2011 and October 2012 and in the wave 8 of *Encuesta de Presupuestos Familiares*, EPFVIII, collected between July 2016 and June 2017. Additionally, the EPF data include sociodemographic variables that allow cross-referencing data, for example, in terms of purchases per household income quintile.

Secondly, *Oficina de Estudios y Políticas Agrarias* (the Office of Agricultural Studies and Policies, ODEPA), from the Ministry of Agriculture, publishes a series of databases regarding the marketing of fruits and vegetables at the level of international trade, wholesale markets and prices at the consumer level. Databases vary in

data frequency (calendar year, season, monthly, and daily) and with respect to the start of the data series. However, most of the data can be consolidated on an annual basis since 1994. Wholesale market sales correspond to a sample of markets, and direct sales are not marketed through wholesale markets; therefore, aggregate production marketed in wholesale markets should not be considered an estimate of domestic purchases. In summary, the EPF and ODEPA data provide data on purchases, not consumption, of fruits and vegetables. The EPF databases allow us to cross reference with sociodemographic variables; however, the ODEPA databases allow us to have time series data, in some cases since 1994, regarding prices by quality (first and second) and point in the marketing chain.

We have selected data on avocados and cherries from Chile as illustrative examples since they have experienced relevant changes over the last decades. Moreover, avocados and cherries have been associated to healthy attributes. Avocados have been named a superfood due to their numerous health benefits (Bhuyan et al., 2019). Cherries also have essential vitamins, minerals, carotenoids, dietary fiber, and bioactive food components associated with health benefits (Faienza et al., 2020). Overall, Chile's fresh fruit exports have increased significantly since 1990. Adjusting the export values in 1990 reported by Parodi (2019), US$ 1.4 billion were exported in fresh fruits, while in 2018 exports of these products reached US$ 7.6 billion. Avocados and cherries are two emblematic fruits of this process, with relevant growth in their exports at different times during these three decades. Despite their robust export dynamics, these fruits present some important differences, which makes them interesting to be analyzed: (i) avocado is consumed all year round, while cherries have a seasonal domestic consumption; and (ii) cherry production is destined for export, mainly to China, and given its little relevance, there is no estimate of the production left in the domestic market (iQonsulting, 2023). Additionally, Chile does not import cherries. With this, the domestic cherry market is supplied exclusively by the country's production. On the other hand, avocados face market conditions that make the domestic market attractive (iQonsulting, 2022). Thus, in the 2021/22 season, Chile exported 126.5 thousand tons (iQonsulting, 2022). In 2021, imports reached 71.5 thousand tons, with a domestic market close to 110 thousand tons (iQonsulting, 2022). Avocado imports have been increasing over the years. To illustrate, in 2013 imports were around 3.8 thousand tons, and in 2021 imports, mainly from Peru (March to September), rose to almost 71.6 thousand tons (iQonsulting, 2022).

4 Results

4.1 International trade statistics

Figure 1 shows cherry and avocado exports from Chile and unit values, proxy of price, in US$ per kilogram. In the last decade (2010–2020), cherry exports have grown exponentially. In contrast, avocado exports have increased robustly in the previous decade (2000–10), with significant annual variations in the last decade. In terms of unit values, dollars per kilogram, these have increased steadily in the case of cherries until 2020. In the case of avocados, their prices do not show a clear trend in the period analyzed. According to Guevara et al. (2021), after analyzing the period 2008–2017 for export from Chile using the Balassa index, the avocado price in dollars, has not experienced a relevant increase; in contrast, to other exporting countries that is a sign of a loss of competitiveness. In this regard, it is important to bear in mind that fruit prices in international markets depend mainly on variety, quality, destination markets and timing.

According to data from the *Oficina de Estudios y Políticas Agrarias* (the Office of Agricultural Studies and Policies, ODEPA), from the Ministry of Agriculture, comparing 2000 and 2020, the productive area with cherry trees increased more than ten times (from 3.7 to 39.7 thousand hectares), while the productive area with avocado trees increased two times (from 14.6 to 30.4 thousand hectares). It is expected that the change in production land would lead to an increase in production; however, it may have some lag. Orchards take some time to reach the commercial production level.

4.2 Domestic market statistics

The World Health Organization recommends a minimum consumption of five servings of FV per day per person, which is equivalent to 400 g per day per person. In order to make comparisons easier, the purchase data of cherries and avocados are converted to their equivalent of portions. However, purchased portions overestimate actual consumption because part of the purchases may be wasted (overripening), or fruits and vegetables have portions that are not edible (for example, avocado pit). The overall FV *per capita* purchases have not changed significantly, being close to four portions per person. Therefore, in the period under study, the overall FV purchases at home have remained relatively stable.

In our analyzes, we show the evolution of the cherry and avocado markets in terms of quantity purchased, market coverage, and inequalities in purchases associated with household income. Purchases of cherries, which are equivalent to 0.05 servings per day/person, are marketed mainly in December and January, and do show a significant change in quantity purchased between the EPFVII (2011–12) and the EPFVIII (2016–17). On the other hand, avocado is marketed year round. Its purchases are equivalent to 0.20 servings per day/person, and do not show a significant variation in purchases between the EPFVII (2011–12) and the EPFVIII (2016–17). Also, when comparing the 2011/12 and 2016/17 seasons, exports in tons experienced an increase of 160.7 and 47.2% of cherries and avocados, respectively.

However, a non-relevant variation in the average quantity of cherries and avocados purchased is not an indicator that the distribution of purchases remain the same. Even keeping the average unchanged, it is possible that a greater percentage of the population, coverage, purchase cherries and avocados, or that there is a change in the potential inequalities in purchases associated with income. The EPF data are representative of the urban center spending at the aggregate level (considering the 12 months of data collection). Therefore, the results at the monthly level should be considered as references. As presented in Table 1, in the EPFVIII (2016–17), 12.9 and 46.3% of the population purchased cherries and avocados, representing a decrease of 1.9 and 1.1%, respectively

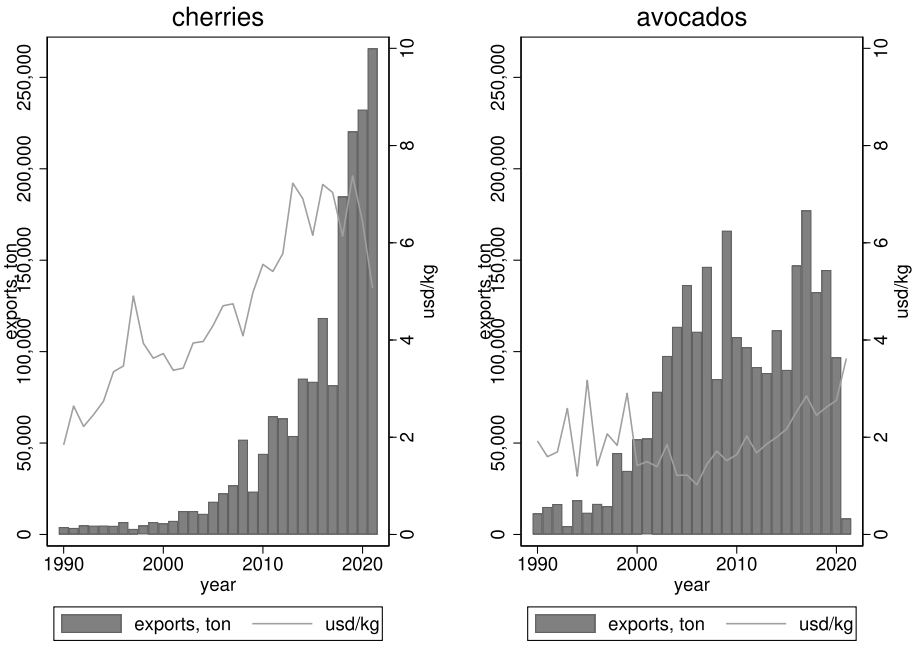

FIGURE 1
Fresh fruit exports.

compared to the EPFVII (2011–12). In the case of cherries, in the EPFVIII (2016–17), purchases in November and January were lower and the maximum coverage was 20.1% in December, which represents a decrease of 5.1% points compared to the EPFVII (2011–12). In the case of avocados, in the EPFVIII (2016–17), coverage varied between 40.2 and 50.0%, while in EPFVII (2011–12), coverage fluctuated between 41.7 and 55.9%.

Figure 2 shows how the different income segments have varied their purchases, in this case of cherries and avocados. The EPF, by including sociodemographic variables, allows data cross-referencing. The graphs above show changes in purchases by household income quintile. Cherry and avocado behave differently. In the case of cherry, households in quintiles 1 and 2 (lower-income households) increased their purchases between 2011–12 and 2016–17 and on the other hand, higher-income households decreased their purchases. In the case of avocado, quintile 4 increased its purchases, while all other quintiles decreased.

With regard to the quantity purchased of these fruits per quintile, EPF VIII shows us that in both cases—cherries and avocados—quintile 5 purchased more than quintile 1. Indeed, while quintile 5 buys 103 g of cherries per household per month and 1,905 g of avocados per household per month, quintile 1 buys 75 g of cherries per household per month and 864 g of avocados per household per month. In summary, comparing income quintiles, the difference in the purchased quantity is 37 and 120% for cherries and avocados, respectively. Comparing 2011–12 and 2016–17, there was a decrease in purchase disparities for cherries, and an increase for avocados.

Now, we analyze domestic prices by qualities. Cherry and avocado fruits are classified into first and second quality. Second quality includes any fruit marketed that is not of first quality. The information used corresponds mainly to ODEPA data for the Lo Valledor Wholesale Market, the main trade market for fresh fruit in Chile located in Santiago.

In Figure 3, the solid line is the first quality and the segmented line the second quality in Lo Valledor. Prices were deflated by inflation as of December 2022. In this way, nominal prices became real prices in December 2022. The results show that cherry prices have remained relatively stable, while avocado prices are on the rise. Also, cherry and avocado prices have cyclical price patterns, beyond the price fluctuations of the season. Finally, the first and second qualities register different prices, and maintain their relatively stable difference for avocado and increase for cherry.

Using real deflated prices as of December 2022 of first quality fruit, in 1994 (base year), the prices of cherries and avocados were Ch$ 2,108.6 and Ch$ 1,335.8 per kilo. In 2002, compared to 1994, prices decreased by 48.9 and 21.7%, respectively. In 2012, compared to 1994 (base year), the price of cherries decreased by 25.9% and that of avocado by 4.7%. In 2022, compared to 1994, the price of cherry decreased by 58.8% and the price of avocado increased by 100.3%. In short, in almost three decades, the price of cherry first quality and avocado have evolved differently. The price of cherries maintains a significant decrease compared to mid-1990. However, the price of avocado shows a relevant increase over the years. In some extent, the price increases of avocado, classified as "superfood," can be a response of the increasing demand in the United States and Europe (Magrach and Sanz, 2020). With regard to the prices of second-quality fruit, the evolution is similar comparing the years 1994 and 2022: cherries price fell by 60.1% and avocados increased by 155%.

For the period 1994–2022, the difference between the price of the first and second quality cherry was Ch$ 419.0 per kilo. In 1994, the difference was $ 881.0, in 2002 Ch$ 245.5, in 2012 Ch$ 386.3 and in 2022 Ch$ 387.8. Thus, although it is true that the price difference

TABLE 1 Descriptive statistics by survey wave.

	EPFVII (2011–12)		EPFVIII (2016–17)		
	Mean	SD	Mean	SD	Difference
Portions FV/day/person	4.08	(4.17)	3.88	(4.01)	0.20
Household size, number of people	3.50	(1.72)	3.29	(1.66)	−0.20**
hline Household income, thousand Ch$	1,295.01	(1,423.898)	1,288.68	(1,336.48)	−6.33
Cherry purchases, population share					
All quintiles	14.73%	(35.44%)	12.86%	(33.49%)	1.87
Quintile 1	11.11%	(31.46%)	10.72%	(30.96%)	0.30
Quintile 5	17.14%	(37.72%)	15.52%	(36.24%)	1.62
Avocado purchases, population share					
All quintiles	47.47%	(49.94%)	46.29%	(49.86%)	1.19**
Quintile 1	38.96%	(48.78%)	35.20%	(47.77%)	3.76**
Quintile 5	56.97%	(49.52%)	50.93%	(50.00%)	6.04**
Observations	10,488		15,184		

A fruit and vegetable portion corresponds to 80 g. Both survey waves are representative for the main urban areas in Chile. The percent corresponds to the proportion of the population share that purchases the fruit under study. The overall purchases statistics are presented in Silva et al. (2021). Standard deviation in parentheses, (**) 5% significance level.

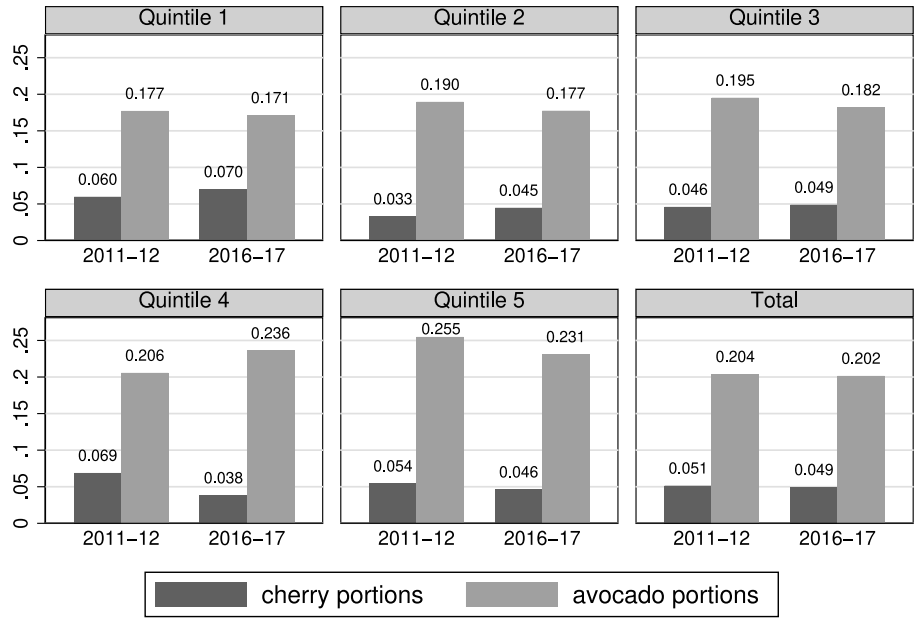

FIGURE 2
Portions of cherry and avocado domestic purchases.

between qualities of the cherries have increased in recent years, this difference is still less than the differences of the mid-90's. In the case of avocado, also in the period 1994–2022, the difference between the price of first and second quality avocado was Ch$ 523.2 per kilo. In 1994, the difference was Ch$ 440.7, in 2002 Ch$ 417.2, in 2012 Ch$ 462.8 and in 2022 Ch$ 746.5. In both, the price difference between qualities in avocado has increased during the studied period.

Using ODEPA data, in the case of cherries, comparing real prices deflated as of December 2022, between 2012 and 2022 of first quality at the wholesale level, the price decreased by 44.5%. On the other hand, at the retail level, the price increased by 176.2%. In the case of avocado, comparing between 2012 and 2022 of first quality at the wholesale level, the price increased by 110.3%. At the retail level, price increased by 151.5%. In summary, in a decade (2012–22), at the first quality (no information is available for the second quality), the price at the consumer level increased more at the wholesale level.

Comparing the difference between first and second quality fruit, in the case of avocado, at the wholesale level the difference was Ch$

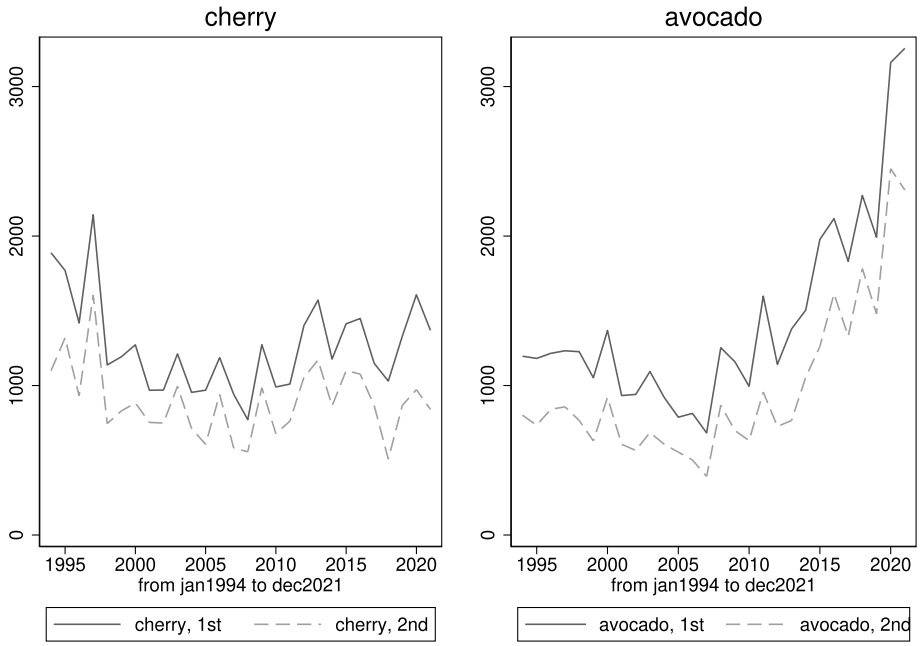

FIGURE 3
Wholesaler price in Santiago.

462.8 in 2012 and Ch$ 746.5 in 2022, which represents an increase of 61.3%. At the retail level, the difference was Ch$ 345.4 in 2012, and Ch$ 520.7 in 2022, which represents an increase of 50.8%. In summary, there is no data to make claims from the evaluation of price margins with respect to qualities for the case of cherry. On the other hand, in the case of avocado, the data show that wholesale prices have decreased, while prices at the consumer level have increased. That is, the price decrease at the wholesale level is not being passed on to the consumer.

Finally, according to ODEPA data from wholesalers, from 1975 to 1991, cherries were marketed only 3 months in the domestic market: from November to January. Starting in 1992, the season starts in October and since 2010, the season ends in February. In summary, in just over three decades, the season expanded from 3 to 5 months a year, although most of the production is still marketed mainly between November and January, which are the months of greatest production for export.

5 Discussion

Previous research has focused on the effect of international trade on food safety standards (Otsuki et al., 2001; Jongwanich, 2009) and the effect of trade restrictions on food exports (Dorosh and Rashid, 2013; Fellmann et al., 2014), and more recently, the effect of imports on domestic food supply (Gilbert et al., 2023). In the best of our knowledge, aligned with the research by Gilbert et al. (2023), our article is one of the few efforts to disentangle the relation between international trade and domestic purchases. We are aware that, based on the available data, is not possible to argue that fresh fruit exports cause a change in domestic purchases. Since exports are a global phenomenon is not possible to have a counterfactual. However, the results show an increase of cherries purchase from households in quintiles 1 and 2, the two lowest quintiles. This seems to indicate that an expansion of cherry production in Chile increased the availability and lower the prices of cherries making them more affordable to lower income households. In the case of avocados, the impact is not as clear because production rose and prices went up over the last ten years, which seems to have impacted lower income households. In this context, we expect that this article can help provide some data to inform the public debate of the role of food export on domestic purchases.

Our article pursues to provide data regarding the role of international trade on food sovereignty and food security. Firstly, as we presented in the literature review section, there is no agreement on how to measure food sovereignty. If we are willing to accept the share of total purchases that is satisfied with domestic production as proxy of food sovereignty, a country that can completely satisfy domestic demand with local production and does not depend on other countries for food supply would have food sovereignty. In our case, Chile used to consume avocado only when they were in season. International trade has opened the possibility to consume them year around; therefore, the domestic market has expanded. In Chile, close to 60% of the avocado production is consumed domestically and the remaining quantity is imported. In a few words, in the case of avocados, Chile has been losing food sovereignty as the population start consuming avocados out of season. In the case of cherries, Chile does not import any cherries and the domestic purchases have increased substantially during the last decade. For cherries, Chile has food sovereignty since all the cherries that are purchased in Chile are produced domestically. Therefore, food sovereignty is linked with eating in season produce;

however, in some cases, people prefer purchasing some products year around. If we are willing to accept that the share of total purchases is a meaningful proxy of food sovereignty, in the last three decades, Chile has been losing food sovereignty in the case of avocado and gaining sovereignty for cherries.

Regarding food security, previous research has linked food security to food access. The FIES questionnaire is an internationally validated instrument to measure food security. In some cases, food *per capita*, also known as apparent consumption, is used as proxy of food security. Food *per capita* is calculated as domestic production minus net exports (imports minus exports). Overall, export development has had some limited effects on the domestic purchases for avocados and cherries during the period under review. The percentage of the population that purchases avocados and cherries in terms of average purchased quantity has remained relatively stable. However, the overall fruit and vegetable purchases are decreasing near to 5.2%. Therefore, cherries and avocados are moving away from the average purchase trend. For the staple cereals in Africa, Grote et al. (2021) state that food security research has focused largely on the availability and stability dimensions, while not relevant attention has been paid to the access and utilization dimensions. In this same way, more research needs to be done in terms of fruit and vegetable access and utilization beyond food availability.

Avocado and cherry production in Chile has been export driven, which takes advantage to sell these products in off-season markets. However, Keske (2021) argue that imports make economically infeasible to local production. The lower prices that would face producers would disincentive domestic production, while it would facilitate economic access to consumers. Therefore, the social pillar of sustainability and sustainable food production of food sovereignty, presented by Keske (2021), may lead to higher prices of off-season products. However, as presented by Lee (2013), trade-oriented food security is relatively unconcerned with sustainability aspects.

Butti Al Shamsi et al. (2018) discuss that the main challenges for food sovereignty include the globalization of food systems, which undermines local autonomy, and the economic and political obstacles faced by small producers. Sowerwine et al. (2019) identify climate change and environmental degradation as significant challenges threatening the sustainability of local food systems, in addition to structural barriers that limit access to resources by marginalized communities. Colson-Fearon and Versey (2022) highlight that, in urban areas, one of the greatest challenges is the limited availability of land for urban agriculture, along with gentrification and the rising cost of living, which can exclude low-income communities from participating in food sovereignty initiatives.

Sowerwine et al. (2019) point out a lack of research on how food sovereignty practices can adapt and withstand climate change and other environmental challenges, as well as the need to study the structural barriers that prevent equitable access to food resources. Colson-Fearon and Versey (2022) identify a gap in research on the role of food sovereignty in promoting social inclusion and equity in urban contexts, particularly on how urban agriculture initiatives can contribute to community resilience.

Our research is built upon previous research by Clapp (2017), in the sense, that food sovereignty and international trade do not need to be treated as opposite concepts. As presented by Silva et al. (2023), in an open-market economy, the production decision of companies and the consumption decision of households are taken separately. In Latin America, most of the fruits that cannot be sold in external markets due to cosmetic imperfections (Balsevich et al., 2003) are eaten in the domestic market. Therefore, trade restrictions may increase domestic fruit supply in the short run, while it would disincentivize investments, and then, would contract fruit production in the long run.

6 Conclusions

Chile's trade opening, for four decades now, has been intensely exploited by the country's agriculture, especially fruit production. Two species of the latter, such as avocados and cherries, are examples of this and have been analyzed in this article. Both fruits have had different dynamics of growth of their exports in the period analyzed, especially in the last decade, and both exhibit different relevance of their domestic markets. In the case of avocado, the domestic market is relevant, but in the case of cherries it is not. Overall cherry prices, for the analyzed period of time, have dropped. This complements the finding that low-income households are purchasing more cherries. On the other hand, avocado prices had no significant trend from 1994 to 2012 and then started mostly and upward trend through 2022. This also coincides with higher avocado purchases from higher income households such as the one in quintile 4. Finally, we found that cherries are expanding the trade season from 3 to 5 months per year, while the trade still focuses in December and January. In the future, based on store innovations and development of new varieties, it is possible that we could see additional expansions of the trade seasons.

In terms of income disparity purchases, households from quintiles 1 and 2, the two lowest income quintiles, increased cherry purchases, while quintiles 4 and 5 decreased cherry purchases. Since food-away-from-home (FAFH) data is unavailable, we do not know whether high income households are purchasing cherries in different formats. However, we do have evidence to support that low-income households are purchasing more cherries than before. In this sense, further research may consider food-away-from-home data to have a more complete measure of total purchases. Finally, in our article, we use the share of total purchases that is satisfied with domestic production as a proxy of food sovereignty. However, previous research has not reached an agreement regarding the most appropriate index to measure food sovereignty. More research is needed to provide indexes that can be followed over time.

This study's descriptive approach has its limitations. While it reveals trends and correlations, it cannot establish causality. The analysis may not capture all influencing factors, potentially leading to an incomplete understanding of the broader context. The focus on cherries and avocados in a specific region also means the findings might not be universally applicable to other fruits or regions in Chile.

Furthermore, this approach does not delve into deeper mechanisms behind the observed trends. Therefore, caution is advised when extrapolating these results to different contexts or agricultural products.

In general, an export boom causes an increase in production that is marketed internally. This could develop consumption habits that are expressed in a demand for the product over longer periods. This increased domestic demand could be met through imports, which has happened with avocado via imports from Peru and more recently from Colombia. Domestic trade periods could also be extended due to the increase in the months in which products are exported, with the consequent availability also on the domestic market. This issue seems to be happening with cherries and that will probably happen more in the future due to the expansion of cultivation to the south of Chile and the incorporation of later maturing varieties that respond to markets other than China.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: www.odepa.gob.cl/estadisticas-del-sector/comercio-exterior and www.ine.gob.cl/estadisticas/sociales/ingresos-y-gastos/encuesta-de-presupuestos-familiares.

Author contributions

AS: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Writing - original draft, Writing - review & editing. AB: Formal analysis, Investigation, Writing - original draft. LR: Investigation, Validation, Writing - review & editing. MV: Investigation, Writing - review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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