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The Import Effects of the Entry Price System

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The European fruit and vegetable (F&V) trade regime is regulated by the Entry Price System (EPS), a nontariff measure on imported goods. We investigate the trade effects of the EPS by estimating a structural gravity model for the major European suppliers of apples, lemons, oranges, peaches, pears, table grapes, and tomatoes. We assess how imports react to EPS overshoots, and price dynamics. The EPS limits imports, but marked differences exist across products. The efficacy of the EPS is valid for all products; its effectiveness is found only for less perishable F&Vs.

Key words: EU agriculture, fruits and vegetables, nontariff measure, price dynamics, trade dynamics.

Introduction

The reduction of tariffs witnessed in the agri-food sector since the mid-1990s has been balanced by the proliferation of nontariff measures (Martin, 2018), particularly in policy-sensitive sectors such as fruits and vegetables (F&Vs). The complexity of the trade policy environment is particularly evident in the European F&V market: To avoid the global market turbulences that lead to food inflation in domestic markets, domestic production and trade are heavily regulated, (Kornher, Balezentis, and Santeramo, 2023). Countries of the European Union (EU) are both major producers and top importers of F&Vs: In 2021, the European Union accounted for 6% of world production and 35% of world imports. EU imports of F&Vs are regulated by a complex system of interventions (e.g., Fiankor, Martínez-Zarzoso, and Brümmer, 2019), among which the Entry Price System (EPS)—the efficacy of which has been called into question—deserves attention. This border-protection mechanism sets a minimum price threshold for imported F&Vs, below which an extra duty is applied.

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The EPS is comparable to the import regime for the Japanese pork market, which is protected by domestic support, several border measures, and a Gate Price System (GPS). According to Bergen and Kawaguchi (2004), the GPS is the major obstacle to Japanese imports of pork. The EPS and the GPS are analogous in that both systems apply a charge determined by comparing the import values with a threshold price.[1] However, the limited coverage of the GPS (applied only to pork imports) and the constant level of the price threshold in the GPS makes it possible to predict its effectiveness. The EPS, on the other hand, is more complex: It is applied to numerous products and combines quotas and seasonally varying entry prices. While the main function of the EPS is to act as a price stabilizer, by preventing imports of low-priced F&Vs, the EPS may contribute to shaping trade flows.

A specific strand of literature has examined the relevance and efficacy of the EPS in terms of price stabilization and trade effects. The relevance of the EPS seems to vary across products, suppliers, and periods (e.g., Goetz and Grethe, 2009; Emlinger, Chevassus-Lozza, and Jacquet, 2010; Santeramo and Lamonaca, 2023). Additionally, the ability of the EPS as price stabilizer is rather limited (e.g., Cioffi, Santeramo, and Vitale, 2011; Santeramo and Cioffi, 2012); conversely, the impacts of the EPS on trade are still not well established, in part due to a lack of transparency of this mechanism of protection (e.g., Cioffi and dell'Aquila, 2004). The trade effects have often been evaluated jointly with other trade policy phenomena—such as tariff protection (e.g., Emlinger, Jacquet, and Chevassus-Lozza, 2008), nontariff measures (e.g., Kareem, Brümmer, and Martínez-Zarzoso, 2017), and preferential agreements (Cardamone, 2011)—with conflicting conclusions. The existing evidence is highly dependent on the products and countries under study and on the proxies used to capture the functioning of the EPS. In addition, previous studies have neglected the issue of endogeneity between the EPS and trade, which tends to lead to biased results: Low standard import values (SIVs) activate the mechanism of protection and reduce imports, which in turn influences the process of determining the SIVs.[2]

Our focus is primarily on quantifying the role of the EPS in shaping imports of F&Vs. We use monthly data on EU imports of seven products under the EPS (i.e., apples, lemons, oranges, peaches, pears, table grapes, and tomatoes, selected according to their relevance for the EPS as established by Goetz and Grethe, 2009), originating from 12 non-EU trading countries. We collected daily SIVs for these products to proxy their respective prices at the EU border. We adopt novel indicators capable of capturing the functioning of the EPS and the dynamics of SIVs. More precisely, the indicators provide information on how long SIVs stay below the entry price (EP) threshold, how distant the EP and SIVs are, and the level and variability of the SIVs. The first two indexes proxy cases in which the extra duty may have been applied to imports and allow us to quantify the trade effects of the EPS when it works effectively. The position of the distribution of the SIVs (i.e., the level of SIVs, which is the monthly average SIV) and its dispersion (i.e., the variability of SIVs, which is the relative difference between the monthly mean and median SIV) is informative on the likelihood of observing SIVs below the EP and allow us to quantify, in terms of trade values, the impact of potential strategic behavior among suppliers that may temporarily reduce imports to circumvent tariffs imposed by the EPS. The empirical specification, a gravity-based model, controls for the functioning of the EPS as well as for omitted variables bias, the endogeneity of the mechanism of protection, and heteroskedasticity.

Our contribution is twofold: First, we quantify and compare the impacts of the EPS for a large set of countries and products to complement the existing strand of literature based on product- and country-specific studies. Second, we emphasize how the statistics of the SIVs may provide information on the effects of the EPS. Our research allows us to draw conclusions regarding the trade effects of applying extra duties and the potential strategic behavior among suppliers attempting

[1] A detailed comparison between the EPS and the GPS is provided in the online supplement (Table S1), available at www.jareonline.org.

[2] The SIV is a synthetic import price calculated by the European Commission for each product and origin as the weighted average of prices collected in representative markets, reduced by a marketing margin and costs of transport and insurance within the customs territory. Details on the calculation of the SIV are specified in Commission Regulation (EC) No 3223/94.

to circumvent higher tariffs (e.g., Cioffi and dell'Aquila, 2004; Santeramo and Cioffi, 2012). In addition, our findings open a path for building a synthetic and simple price index to infer the efficacy/effectiveness of restrictive trade regimes.

Existing Evidence on the Entry Price System

Early studies on the EPS have analyzed its functioning (e.g., Swinbank and Ritson, 1995; Grethe and Tangermann, 1999) and highlighted its flexibility and lesser degree of protectiveness compared to its predecessor, the Reference Price System.[3]

Goetz and Grethe (2009) examine the impact of the EPS on the 15 products under the EPS, concluding that the mechanism of protection has the greatest influence on artichokes, zucchini, cucumbers, lemons, plums, and tomatoes, and on the origin countries closest to the European Union. Similar assessments of the EPS have been carried out by Cioffi and dell'Aquila (2004), focusing on apples, oranges, and tomatoes from countries of the Southern Hemisphere and by Goetz and Grethe (2010) on pears and apples from China. To sum up, the influence of the EPS varies on a case-by-case basis and, as recently demonstrated (e.g., Romdhani and Thabet, 2017), its effects are concentrated in specific periods.

As for the role of the EPS in price stabilization (i.e., the main function of the mechanism of protection), a report by Agrosynergie (2008) concludes that the EPS acts as a stabilizer in certain cases (i.e., tomatoes from Morocco, apples from China, and lemons from Turkey). Similarly, Cioffi, Santeramo, and Vitale (2011) and Santeramo and Cioffi (2012) conclude that the EPS has limited price stabilization effects. It contributes to make F&V markets more efficient than the neighboring markets of F&Vs subject to, for instance, seasonal tariff rate quotas (e.g., Hillen, 2019; Loginova, Portmann, and Huber, 2021).

The role of the EPS in trade flows, a side effect of the EPS, has been analyzed as well. García-Álvarez-Coque, Martinez-Gomez, and Villanueva (2010) assess the trade effects of phasing out the supplementary tariff related to the entry price (EP) for tomatoes, cucumbers, clementines, and table grapes and conclude that the EPS has an effect only in specific periods and for few products: Eliminating the EPS would increase exports of clementines (in December) and Moroccan exports of cucumbers (in March and November) and tomatoes (from November to May). Similarly, Agrosynergie's (2008) analysis of tomatoes, cucumbers, table grapes, and clementines reveals that the trade effects are limited to a few months and products (e.g., November for tomatoes).

Emlinger, Jacquet, and Chevassus-Lozza (2008) use a gravity-based approach to evaluate the sensitivity to the EU tariffs of F&V exports from Mediterranean countries. They find that for products under the EPS, the tariffs hinder exports from Mediterranean countries, with heterogeneous impacts across exporters and periods of the year: Israel is more sensitive than Morocco to tariffs, Turkey is not sensitive to tariffs, and Egypt is sensitive to tariffs only between March and October. A limitation of the study is that it does not disentangle the effects of the EPS from those of the tariffs. Cardamone (2011) assesses the effect of different preferential trade agreements granted by the European Union on imports of fresh grapes, pears, apples, oranges, and mandarins, showing that the preferential EP has a positive effect on imports of oranges, but is not relevant for the other products. Kareem, Brümmer, and Martínez-Zarzoso (2017) investigate the impact of pesticide standards and of the EPS on African exports of tomatoes, oranges, limes, and lemons and show that the EPS reduces the extensive margin of trade for tomatoes but has no effect on trade of oranges, limes, or lemons. Appendix Table A1 summarizes the main findings of previous studies on the relevance of the EPS and its effects on price stabilization and trade flows.

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[3] Introduced in the first Common Market Organization (CMO) of F&Vs in 1972, the Reference Price System worked as minimum import prices: Imports from specific non-EU countries were subject to the payment of an extra duty if the import price of their products fell below the reference prices (Cioffi and dell'Aquila, 2004). When countervailing charges began to be applied on a product from a country, they increased as long as import flows tended to disappear, to the detriment of extra-EU exporters (Swinbank and Ritson, 1995).

To sum up, while the existing literature agrees on the heterogeneous relevance of the EPS across products and exporters and on the limited ability of the EPS to act as price stabilizer, current knowledge on the trade impacts of the EPS seems limited to a few product- and country-specific cases, with contrasting evidence. For instance, Cardamone (2011) suggests that the EPS relevant for the trade of oranges, while Kareem, Brümmer, and Martínez-Zarzoso (2017) find no effects for the same product. It is plausible that the inference regarding the trade effects may be influenced by the type (and pros and cons) of the proxies used for the EPS. For instance, a dummy variable can capture the existence of preferential EP (e.g., Cardamone, 2011) but does not provide information about cases in which the mechanism of protection effectively works. The gap between SIVs and the EP (e.g., Kareem, Brümmer, and Martínez-Zarzoso, 2017) captures the accumulation of SIVs slightly below the EP but cannot explain the dynamics of prices over time. The tariffication of the EPS (e.g., Emlinger, Jacquet, and Chevassus-Lozza, 2008) does not capture the pricing behavior of exporters.[4]

A further limitation of the literature on trade effects of the EPS is that it does not account for the issue of endogeneity between SIVs and imports. Trefler (1993) argues that treating a mechanism of protection as exogenous tends to bias the estimated impacts on imports. In the EPS, low SIVs activate the mechanism of protection and reduce imports, which in turn influences the price determination process of the SIVs: As a result, imports and SIVs are likely to be endogenous, a characteristic that we recognize and model in our empirical analysis.

Estimating the Trade Effects of the Entry Price System

Theoretical Framework

Evaluations of trade policy measures frequently rely on gravity models, which explain how bilateral trade reacts to changes in income, country-specific characteristics of importers and exporters, and country–pair-specific determinants of trade (Mayer, Vicard, and Zignago, 2019). In line with Peterson et al. (2013), who assess the impact of phytosanitary measures on imports of F&Vs, we use a product-level gravity model to evaluate how the EPS affects F&V imports to EU countries (i) from non-EU countries (j).[5] We assume that all varieties of each kth F&V are differentiated by their destination and source (i and j) and are imperfect substitutes. Accordingly, consumer preferences in i are weakly separable and can be represented by a constant elasticity of substitution (CES) function,

$$\sum_{jk}\left\{\alpha_{jk}^{\frac{1-\sigma_k}{\sigma_k}}\, c_{ijk}^{\frac{\sigma_k-1}{\sigma_k}}\right\}^{\frac{\sigma_k}{\sigma_k-1}},$$

where $\alpha_{jk} > 0$ is the exogenous CES preference parameter, $\sigma_k > 1$ is the elasticity of substitution between all varieties of each k, and c_{ijk} is the consumption of varieties from j in i. We also assume perfect competition among all varieties in i and j (i.e., prices are marginal cost of production). The total expenditure in i is equal to the total spending on varieties from all countries $E_{ik} = \sum_j p_{ijk}c_{ijk}$, where $p_{ijk} = p_{jk}\theta_{ijk}$ are delivered prices depending on prices in the country of origin (p_{jk}) and bilateral

[4] Tariffication is the conversion of all existing nontariff barriers to trade into bound tariffs.

[5] The motivation for treating trade as a country decision, which aggregates the economic decisions of heterogeneous firms in that country, has a theoretical foundation in the model of international trade in differentiated products in which firms face fixed and variable trade costs. Helpman, Melitz, and Rubinstein (2008) argues that—since only the more productive firms find it profitable to export—trade flows from a country aggregate exports over heterogeneous firms. Accordingly, trade flows aggregated at the country level predict the selection of heterogeneous firms into export markets and their associated aggregate trade flows.

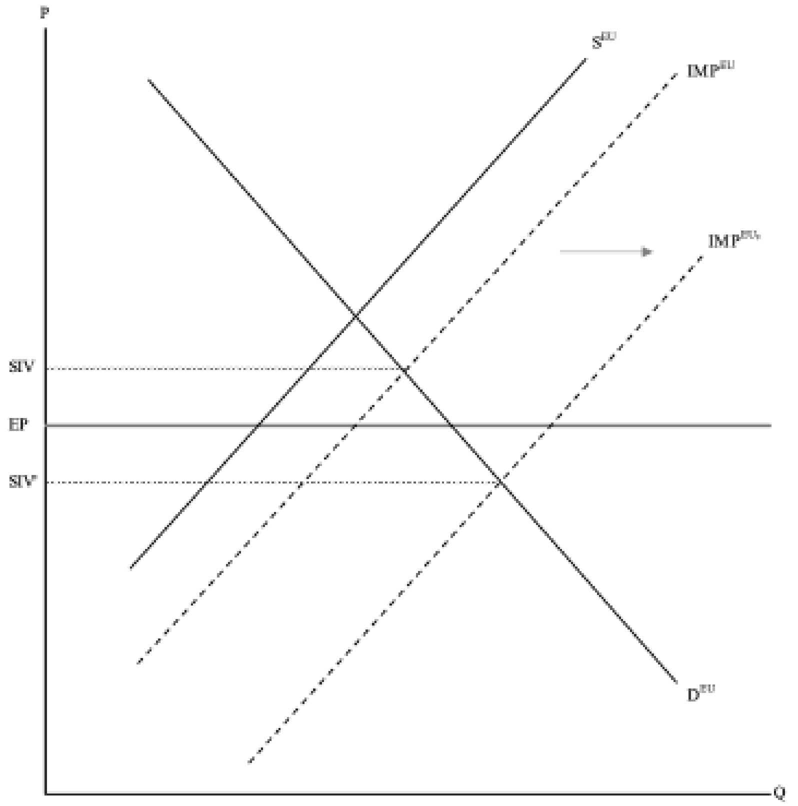

Figure 1. The Daily Import Price Determination Process for a Generic Product under the Entry Price System

Notes: Acronyms are domestic demand (D^{EU}), domestic supply (S^{EU}), imported supply (IMP^{EU}), entry price (EP), standard import value (SIV).

trade costs ($\theta_{ijk} > 1$). The structural form of the gravity model is as follows:[6]

$$X_{ijk} = \frac{E_{ik}}{\Phi_{ik}^{1-\sigma_k}} \frac{Y_{jk}/Y}{\Omega_{jk}^{1-\sigma_k}} \theta_{ijk}^{1-\sigma_k}, \tag{1}$$

where the ith imports of k from j (X_{ijk}) depend on the ith total expenditure on k (E_{ik}, defined as above), the jth value of production of k (i.e., the total expenditure on j's outputs of product k in all countries in the world, including j itself, $Y_{jk} = \sum_I X_{ijk} \; \forall \, i$) divided by the total value of output (Y), the relative price indices in i ($\Phi_{ik}^{1-\sigma_k}$) and j ($\Omega_{jk}^{1-\sigma_k}$), and bilateral trade costs ($\theta_{ijk}^{1-\sigma_k}$). The terms $\Phi_{ik}^{1-\sigma_k}$ and $\Omega_{jk}^{1-\sigma_k}$ are based on market-clearing conditions for each k and proxy multilateral resistances (Anderson and van Wincoop, 2003). The term $\theta_{ijk}^{1-\sigma_k}$ captures time-invariant (e.g., distance, common language, contiguity) and time-varying (e.g., product-specific trade policy measures, such as the EPS) country-pair determinants of trade.

The relationship between protection and imports may be endogenously determined (Trefler, 1993; Santeramo and Lamonaca, 2022a,b): Low SIVs for a certain product activate the mechanism of protection and reduce imports of that product, which in turn influences the price determination process of the SIVs for that product. Let us assume that the EU countries are price setters while non-EU countries are price takers, and the daily process of price determination in the EU market for a certain product under the EPS occurs as shown in Figure 1. The EU daily domestic supply

[6] Time period (t) subscript is initially suppressed for ease of notation.

for that product (S^{EU}) is complemented by the import supply of the same product (IMP^{EU}). The European Union sets a threshold entry price (EP) for that product that serves as a benchmark to establish the duty to levy on the imports of the product according to their price, the SIV. The EP, set by the European Union, is a minimum import price, varying according to seasonality, product, and origin. Product- and origin-specific SIVs, a proxy of import prices, are computed daily by the European Commission (EC). The SIV is an index built as a weighted average of representative prices, collected from EU import markets. For the specific product, when SIVs are above the EP, the European Union applies an *ad valorem* duty (i.e., the specific duty provided in the European Union's list of concessions to the World Trade Organization). When SIVs are lower than the EP, the European Union applies an extra duty, which is the difference between the EP and the SIV: For instance, if the SIV is 2%, 4%, 6%, or 8% lower than the EP, the specific customs quota duty shall be equal to 2%, 4%, 6%, or 8% of the EP, respectively. When SIVs fall below 92% of the EP, the extra duty is augmented to the maximum tariff equivalent (MTE) (i.e., the specific customs duty bound within the World Trade Organization shall apply).

The mechanism of protection is activated by the dynamics of SIVs, which are determined by the level of imports. However, the level of imports depends on the dynamics of SIVs, whose position with respect to the EP may trigger the mechanism of protection.

Indexes Capturing the Functioning of the Entry Price System

The existing literature has proposed several approaches to investigate the functioning of the EPS.[7] Emlinger, Jacquet, and Chevassus-Lozza (2008); Emlinger, Chevassus-Lozza, and Jacquet (2010); and Kareem, Brümmer, and Martínez-Zarzoso (2017) consider specific duties of the EPS and compute a global measure of tariff protection without focusing on exporters' pricing strategies. Agrosynergie (2008) and Cardamone (2011) use dummy variables to model the EPS, focusing on the relevance of the system rather than on its effectiveness and efficacy. Goetz and Grethe (2009, 2010) and García-Álvarez-Coque, Martinez-Gomez, and Villanueva (2010) compute the shares of negative gaps, defined as the difference between the SIV and the EP, and draw conclusions regarding the relevance of the EPS and the accumulation of SIVs (closely) above the EP. Kareem, Brümmer, and Martínez-Zarzoso (2017) also focus on gaps to examine exporters' pricing strategies. We complement the existing literature, proposing four indicators based on the empirical distribution of SIVs, to draw conclusions about the functioning of the EPS (Figure 2). Following the standard approach of assuming prices to be log-normally distributed with positive skewness, the first and the second moment of the distribution are enough to characterize the entire distribution of the SIVs (Goodwin and Ker, 2002). As a result, the four (importer–product-specific) indicators computed are (i) the overshoot index (i.e., the sum of days in a month in which the SIVs are below the EP), (ii) the distance index (i.e., the distance between the EP and SIVs when SIVs are below or equal to the EP),[8] (iii) the position index (i.e., the mean of the empirical distribution of the SIVs, which is the monthly average SIV), and (iv) the dispersion index (i.e., the standard deviation of the empirical distribution of the SIVs, which is the relative difference between the monthly mean and median SIV).

Firms in non-EU countries export their F&Vs subject to quotas and duties. The extra duty (or MTE) is applied when SIVs of the traded F&Vs fall below the EP (or 92% of the EP). The four indicators mimic the precise functioning of the EPS. The overshoot index represents a proxy of the number of days in which the extra duty may have been applied to imports of the product. The distance between the EP and SIVs if SIVs are below or equal to the EP further captures the effect of the mechanism of protection when it works: It is referred to as the potential deterrence mechanism of the EPS. We hypothesize that imports tend to be limited when the extra duty (or MTE) is applied; thus, frequent overshoots and larger distance between the EP and SIVs should lower the imports. The

[7] The indicators that have been adopted in recent empirical studies are summarised in Appendix Table B1.

[8] This indicator measures the deviation between the monthly EP and the monthly average SIV, when SIVs are below or equal to the EP at least once in a month.

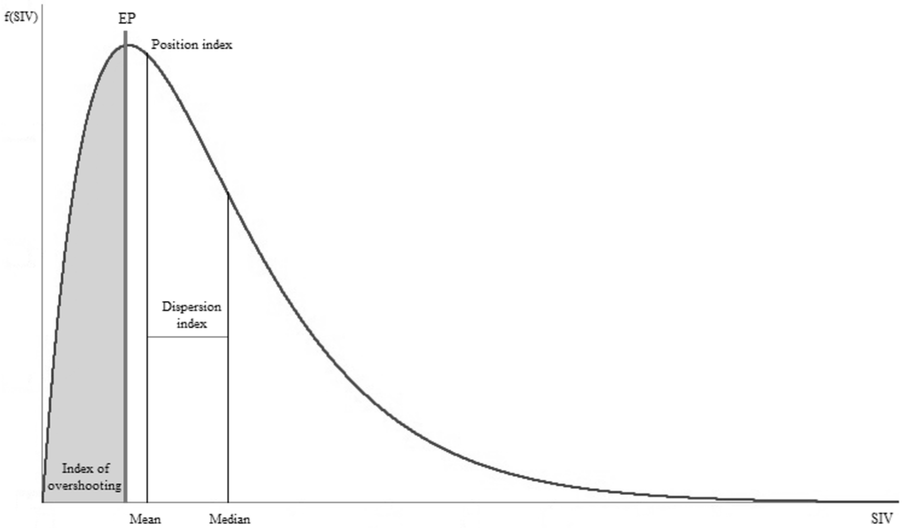

Figure 2. Three Indexes to Capture the Functioning of the Entry Price System

Notes: Acronyms are standard import value (SIV) and entry price (EP).

position and dispersion of SIVs are referred to as the general behavior of SIVs. The position index provides information on the likelihood of observing SIVs below the EP for a certain product: Our approach extends that adopted by Cioffi and dell'Aquila (2004), who describe the daily distribution of SIVs compared with the EP. The higher the level of SIVs, the higher the likelihood that SIVs are above the EP and the extra duty is avoided to the benefit of imports. The dispersion index provides information on the variability of the product-specific distribution of SIVs: The higher the variability, *ceteris paribus*, the higher the likelihood of observing SIVs below the EP and the extra duty applied to the detriment of imports.

Empirical Setting

Model (1) is estimated in its log-linearized form:

$$X_{ijk,t} = e^{\{\overbrace{\boldsymbol{\beta}_{ikt}}^{\frac{E_{ik}}{\Phi_{ik}^{1-\sigma_k}}} + \overbrace{\boldsymbol{\beta}_{jkt}}^{\frac{Y_{jk}/Y}{\Omega_{jk}^{1-\sigma_k}}} + \overbrace{\boldsymbol{\beta}_{ijk} + EPS'_{ijk,t}\boldsymbol{\delta}}^{\theta_{ijk}^{1-\sigma_k}}\}}\eta_{ijk,t}, \tag{2}$$

where the dependent variable is the value of the ith imports of k from j in period t ($X_{ijk,t}$).

We include importer–product–time and exporter–product–time fixed effects ($\boldsymbol{\beta}_{ikt}$ and $\boldsymbol{\beta}_{jkt}$) to proxy multilateral resistances in the importing and exporting countries (Yotov et al., 2016): They remove cross-section and time-series correlation (Baldwin and Taglioni, 2006). Country-pair fixed effects at the product level ($\boldsymbol{\beta}_{ijk}$)) capture time-invariant determinants of trade (e.g., distance, common language, contiguity) and do not prevent the estimation of the effects of time-varying bilateral trade policies (Egger and Nigai, 2015). The use of country-pair fixed effects also allows us to circumvent the endogeneity problems since they account for unobservable relationships between covariates proxying the endogenous trade policy (i.e., overshoot, distance, position, and dispersion indices) and the error term (Baier and Bergstrand, 2007).

The variable of interest (in log) proxying the functioning of the EPS ($EPS'_{ijk,t}$) is,[9] alternately, the overshoot, distance, position, and dispersion index. In particular, we use (i) the number of days

[9] Note that the EP is product-specific and does not vary across origins and destinations; SIVs are product- and origin-specific but do not vary across EU countries.

in a month in which SIVs are below the EP ($SIV < EP$) as the overshoot index, (ii) the distance between 92% of EP and monthly average SIVs if SIVs are below or equal to the EP as the distance index, (iii) the monthly average ($\overline{SIV}$) of the empirical distribution of SIVs as the position index, and (iv) the relative difference between the monthly mean and median of the SIVs ($\frac{\overline{SIV}-Me(SIV)}{\overline{SIV}}$) as the dispersion index. The vector $\boldsymbol{\delta}$ contains the parameters of interest, while $\eta_{ijk,t}$ is an error term assumed to be independently and identically distributed.

Equation (2) allows us to establish the overall protectionist effect on imports of the EPS when the mechanism of protection is triggered. We also perform product-specific analyses to identify potential heterogeneity in trade effects: In particular, we interact the explanatory variables with specific dummies that consider each product. All specifications are estimated using the Poisson pseudo maximum likelihood (PPML) estimator, which is robust to heteroskedastic errors and provides a natural way to deal with zeros in trade data (Santos Silva and Tenreyro, 2006). We compute the trade volume effects for indices proxying the functioning of the EPS and the associated change in the average import values. The interpretation of the estimate of the coefficient on the logarithm of the indices ($\boldsymbol{\delta}$) is the elasticity of the value of imports with respect to the indices (Yotov et al., 2016).

Robustness Check

To test whether the use of country-pair fixed effects properly accounts for potential reverse causality between imports and indices used to proxy the functioning of the EPS, we add forwarded variables, $EPS_{ijk,t+3}$ (Baier and Bergstrand, 2007). In the absence of reverse causality, the parameter associated with the forwarded variables should not be statistically different from 0.

To further address the endogeneity issue, we follow the approach used by Trefler (1993) and estimate the following equations:

(3a)
$$EPS'_{ijk,t} = e^{\{\boldsymbol{\beta}_{it}+\boldsymbol{\beta}_{jt}+\boldsymbol{\beta}_{ij}+\boldsymbol{\beta}_{kt}+X_{ijk,t}\gamma\}}\varepsilon_{ijk,t}$$

and

(3b)
$$X_{ijk,t} = e^{\{\overbrace{\boldsymbol{\beta}_{it}}^{\frac{E_{ik}}{\Phi_{ik}^{1-\rho}}} + \overbrace{\boldsymbol{\beta}_{jt}}^{\frac{Y_{jk}}{\Omega_{jk}}} + \overbrace{\boldsymbol{\beta}_{ij} + \widehat{EPS}'_{ijk,t}\boldsymbol{\delta}}^{\theta_{ijk}^{1-\rho}}\}}\eta_{ijk,t}.$$

Equation (3a) captures the effects of imports on the functioning of the EPS: Indicators based on the empirical distribution of SIVs ($EPS'_{ijk,t}$) are regressed against time-varying importer, exporter, and product fixed effects ($\boldsymbol{\beta}_{it}$, $\boldsymbol{\beta}_{jt}$, and $\boldsymbol{\beta}_{kt}$); time-invariant country-pair fixed effects ($\boldsymbol{\beta}_{ij}$); and bilateral imports (X_{ijk}). The regressors control for the strategic trading decisions made by importers (e.g., to avoid imports of low-priced F&Vs) and exporters (e.g., to circumvent EPS duties), product characteristics (e.g., perishability, seasonality), and country-pair factors (e.g., quotas, preferential EP, trade agreements).

Equation (3b) captures the effects of the functioning of the EPS on imports: Imports ($X_{ijk,t}$) are a function of time-varying importer and exporter fixed effects ($\boldsymbol{\beta}_{it}$ and $\boldsymbol{\beta}_{jt}$) and time-invariant country-pair fixed effects ($\boldsymbol{\beta}_{ij}$). The vectors $\boldsymbol{\delta}$ and $\boldsymbol{\gamma}$ contain the parameters of interest, and $\varepsilon_{ijk,t}$ and $\eta_{ijk,t}$ are error terms. In the absence of reverse causality, results of this specification should be comparable to results of the baseline model (equation 2).

To test the robustness of our indicators, we use additional variables proxying the functioning of the EPS. To complement the indicator on the distance between EP and SIVs, we also control for the effect of the distance between monthly average SIVs and 92% of EP if SIVs are above the EP. The proxies for the position index are monthly average ($\overline{SIV}$, the baseline), monthly median value ($Me(SIV)$), and monthly minimum value ($Min\{SIV\}$). The rationale is that the higher the average (or median or minimum), the higher the likelihood that SIVs are above the EP. The proxies for the dispersion index are the relative difference between the mean and the median ($\frac{\overline{SIV}-Me(SIV)}{\overline{SIV}}$, the baseline), between the mean and the minimum ($\frac{\overline{SIV}-Min\{SIV\}}{\overline{SIV}}$), and between the median and the minimum ($\frac{Me(SIV)-Min\{SIV\}}{Me(SIV)}$). The second and third dispersion indexes are more variable due to their dependence on extreme values of the distribution.

Data Description

We compiled a rich dataset comprising monthly data, from January 2000 to December 2019, for 7 of the 15 F&Vs covered by the EPS, originating in 12 exporting countries. Following Cardamone (2011), we use monthly data to account for seasonality. Goetz and Grethe (2009) find a heterogeneous relevance of the EPS among products and countries of origin: On the basis of their findings, we selected F&Vs with high (i.e., lemons and tomatoes), medium (i.e., apples and pears), and low (i.e., oranges, peaches, and table grapes) relevance. The selected exporters are direct competitors of the EU domestic producers (Cioffi and dell'Aquila, 2004): We consider exporters from the Southern Mediterranean (i.e., Egypt, Israel, Morocco, Tunisia, Turkey), Southern Hemisphere (i.e., Argentina, Brazil, Chile, New Zealand, South Africa, Uruguay), and China, the top global producer of F&Vs. By adopting a wide-ranging set of suppliers, we are able to gain a deeper understanding of the functioning of the EPS: The majority of previous studies on the trade effects of the EPS focus on only a few countries from a specific region, such as the Southern Mediterranean (Emlinger, Jacquet, and Chevassus-Lozza, 2008) or Africa (Kareem, Brümmer, and Martínez-Zarzoso, 2017).

Monthly trade data are collected from ComExt and refer to F&Vs imports of five EU countries (i.e., France, Germany, Italy, Spain, United Kingdom) from the selected exporting countries.[10] We work at the six-digit level of the Harmonized System classification (HS 6-digit), an aggregation level detailed enough to maintain distinctions among groups of products (Disdier, Fontagné, and Mimouni, 2008): In particular, we focus on imports of

- "Vegetables; tomatoes, fresh or chilled" (HS 1996: 070200),
- "Fruit, edible; oranges, fresh or dried" (HS 1996: 080510),
- "Fruit, edible; lemons (*Citrus limon*, *Citrus limonum*) limes (*Citrus aurantifolia*, *Citrus latifolia*), fresh or dried" (HS 1996: 080550),
- "Fruit, edible; grapes, fresh" (HS 1996: 080610), "Fruit, edible; apples, fresh" (HS 1996: 080810),
- "Fruit, edible; pears, fresh" (HS 1996: 080830),
- "Fruit, edible; peaches, including nectarines, fresh" (HS 1996: 080930).

We combine bilateral trade data with data on monthly EP and daily SIVs for each product originating in each exporting country. Using daily data on SIVs, we construct monthly average, median, and minimum values for SIVs to study the relationship between imports and the trends observed in the SIVs.[11] The monthly frequency of data in the final dataset is coherent with firms' shipping decisions, which can take several days and can be adjusted as a reaction to the potential application of the extra duty (or MTE) implied by the EPS. Appendix Table C1 presents descriptive statistics (i.e., mean and standard deviation) for the main variables over a restricted period (2000–2014).

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[10] Although the EPS is defined at the EU level, we account for five EU country separately in order to consider differences in the magnitude of import flows for each product originating in each exporting country.

[11] Although daily SIVs are correlated (Cioffi, Santeramo, and Vitale, 2011), the focus of this analysis is not on the structure of prices but on the positioning of prices with respect to the EP, which is correlated with the application of the extra duty.

Table 1. Standard Import Values (SIVs) below Entry Price (EP) Reduce Imports; Imports Increase with Higher Level of SIVs and Decrease with Variable SIVs (N = 10,007)

Variables	Overshoot Index 1	Distance 92% of *EP – SIV* 2	Distance *SIV* – 92% of *EP* 3	Position Index 4	Dispersion Index 5
EPS	−0.1498***	−0.3528***	0.1406**	0.1821	−1.1801
	(0.0459)	(0.0412)	(0.0550)	(0.1938)	(1.0386)

Notes: Poisson pseudo maximum likelihood (PPML) estimation of the gravity equation in equation (2). The dependent variable is value of imports. The explanatory variables of interest are, alternatively, the log number of days in a month in which SIVs are below the EP (column 1), the log distance between 92% of EP and monthly average SIVs if SIVs are below or equal to the EP (2), the log distance between monthly average SIVs and 92% of EP if SIVs are above the EP (4), the log monthly average SIVs (4), the log relative difference between the monthly mean and median SIVs (5). All specifications include a constant, importer–product–time, exporter–product–time, and country-pair–product fixed effects. Robust standard errors are in parentheses. Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Results and Discussion

Overall Effect

Table 1 reports the results of the PPML estimation of the gravity equation. They are robust to the use of different estimators: We estimate the gravity equation in equation (2) through least squares. The results show that the ordinary least squares (OLS) and PPML estimates are similar in terms of signs and statistical significance (Table S2 in the online supplement).

The overshoot index has a negative effect on imports: The more the days in which SIVs are below the EP, the lower the imports. For instance, a 100% increase in the number of days in which SIVs are below the EP (say from 1 to 2 days) should be accompanied by a 15% reduction in the value of imports (e.g., from €1,240,000,000 to €1,054,000,000 on average). The EPS acts as a barrier to F&V imports from non-EU countries when it works effectively (i.e., when SIVs fall below the EP (92% of EP) and the extra duty (MTE) is applied). In fact, the coefficient estimated for the distance between 92% of EP and monthly average SIVs, if SIVs are below or equal to the EP, implies that a 10% increase in distance decreases import values by 4% (−€50,000,000 on average). In contrast, when SIVs are above the EP (i.e., when the mechanism of protection is not triggered), imports tend to be higher: A 10% increase in the distance between monthly average SIVs and (92% of) EP is associated with imports that are 1% higher (about €12 million in value). The position and dispersion indexes, referred to the general behavior of SIVs, tend not to be correlated with trade flows.

Sensitivity Analyses

We perform sensitivity analyses to determine whether the use of country-pair fixed effects in the gravity equation properly accounts for the endogeneity between imports and the mechanism of protection (Baier and Bergstrand, 2007).[12] The results (over a selected period) confirm the absence of reverse causality between imports and indices proxying the functioning of the EPS (Tables S3–S5 in the online supplement). Our results are in line with Trefler (1993), who suggests that treating mechanisms of protection as exogenously set policy instruments yields downward-biased estimates of the impact of protection on imports.

To draw conclusions regarding the overall effect on imports of the EPS, and regarding the protectionist effect on imports when the EPS is triggered, we simultaneously estimate equations (3a) and (3b) by including separately the number of overshoots and, alternatively, the indexes of position and dispersion (Tables S6 and S7 in the online supplement). The overshoots reduce imports: A 1% increase in the number of days in which SIVs are below the EP is associated with a 0.3% reduction

[12] Sensitivity analyses are run on a sample covering the period from 2000 to 2014.

Table 2. Product-Specific Analysis: Standard Import Values (SIVs) Lower than Entry Price (EP) Reduce Import Values ($N = 10{,}001$)

Variables	Overshoot Index 1	Distance Index 2	Position Index 3	Dispersion Index 4
Apples	−0.732***	−1.114***	−0.456***	1.358***
	(0.00063)	(0.00605)	(0.00058)	(0.00204)
Lemons	0.130***	−1.248***	1.597***	0.716***
	(0.00081)	(0.00143)	(0.00089)	(0.00069)
Pears	−0.692***	−1.426***	−0.554***	−5.843***
	(0.00365)	(0.02250)	(0.00376)	(0.01430)
Oranges	−0.566***	0.787***	−1.019***	0.335***
	(0.00006)	(0.00085)	(0.00022)	(0.00102)
Table grapes	−3.371***	−0.734***	1.918***	−0.0372***
	(0.00200)	(0.00049)	(0.00092)	(0.00099)
Tomatoes	−0.192***	−0.322***	−0.0387***	−1.932***
	(0.00194)	(0.00005)	(0.00021)	(0.00669)

Notes: Poisson pseudo maximum likelihood (PPML) estimation of the gravity equation in equation (2). The dependent variable is value of imports. The explanatory variables of interest (interacted with a product-specific dummy) are, alternatively, the log number of days in a month in which SIVs are below the EP (column 1), the log distance between 92% of EP and monthly average SIVs if SIVs are below or equal to the EP (2), the log monthly average SIVs (3), the log relative difference between the monthly mean and median SIVs (4). All specifications include a constant, importer–product–time, exporter–product–time, and country-pair–product fixed effects. Robust standard errors of the order of 10-12 are in parentheses. Single, double, and triple asterisks (*, **, ***) indicate statistical significance at the 10%, 5%, and 1% level, respectively.

in imports. By interacting the indexes with the number of overshoots, we find lower estimates: A 1% increase in average SIVs is associated with a 0.015% increase in imports. When the analysis does not control for the number of overshoots, the equivalent increase is 1.059%. Similarly, the higher the variability of SIVs, the lower the imports: The equivalent marginal reduction is 9% by interacting the indexes with the number of overshoots and 19% without the interaction term.

Our results are robust to econometric specifications that control for alternative measures of the level and the variability of SIVs (Tables S6–S11 in the online supplement). The greatest coefficients are estimated for the position indices proxied by minimum SIV: It is plausible to suppose that the higher the minimum value of SIVs, the higher the likelihood that SIVs will be above the EP. The greatest impacts are found for the dispersion index computed as the relative difference between the mean and the median. Notably, the relative difference between the mean and the median is a better proxy for skewness than the dispersion index, which computed as the relative difference between the mean and the minimum: The larger the difference between average and median SIVs, the greater the likelihood of having imports. Higher values for the dispersion indices indicate higher volatility of SIVs, which are more likely to fall below the EP.

In a sensitivity analysis, we introduce country-pair–product–month fixed effects to control for seasonality. The results confirm the baseline results (Table S12 in the online supplement).

Product-Specific Effects

The results of analyses by products—reported in Tables 2 (estimation results) and 3 (trade volume effects and change in average import values)—show the regularity of the trade effects of the EPS, although with different magnitudes across products.

The coefficients estimated for the overshoot index are negative in all but one case (lemons, for which imports are positively correlated with the regressor). Put differently, in all but one specific case, the higher the number of days in which SIVs are low (below the trigger EP), the lower the imports of F&Vs from non-EU countries. The EPS is relevant for apples, pears, oranges, and

Table 3. Trade Volume Effect and Change in Average Import Values

Product	Perishability (months)	Avg Imports (€millions)	Overshoot Index *SIV < EP* (+1 day)	Distance Index 92% of *EP – SIV* (+10%)	Position Index Avg *SIV* (+10%)	Dispersion Index (Avg–Me) / Avg *SIV* (+10%)
F&Vs		1,240	−€15%; −€186 million	−€4%; −€50 million	0%; 0 million	0%; 0 million
Apples	12	1,270	−€73%; −€927 million	−€11%; −€140 million	−€5%; −€64 million	+14%; +178 million
Lemons	6	617	+13%; +80 million	−€12%; −€74 million	+16%; +99 million	+7%; +43 million
Pears	3–6	411	−€69%; −€284 million	−€14%; −€58 million	−€5%; −€21 million	−€58%; −€238 million
Oranges	3	503	−€57%; −€287 million	+8%; +40 million	−€10%; −€50 million	+3%; +15 million
Table grapes	0.5–1	858	−€337%; −€2,891 million	−€7%; −€60 million	+19%; +163 million	−€0.4%; −€3 million
Tomatoes	1.5	3,185	−€19%; −€605 million	−€3%; −€96 million	−€0.4%; −€13 million	−€19%; −€605 million

Notes: Perishability is based on shelf-life at the optimum storage conditions (by temperature or controlled atmosphere) (Gross, Wang, and Saltveit, 2016).

tomatoes, but table grapes is the most affected, with a 337% reduction in the value of imports (−€2,891,000,000 on average). When the mechanism of protection is triggered (i.e., when SIVs falls below the 92% of EP), products' import values tend to be hindered: The greater the distance between 92% of EP and monthly average SIVs, the lower the imports. The most and least impacted products are, respectively, apples (−€140,000,000 on average) and pears (−€58,000,000 on average), and oranges are favored (+€40,000,000 on average). Our results are in line with findings reported by Goetz and Grethe (2009), who highlight the relevance of the EPS for apples and pears. However, our results differ from the evidence provided by Cioffi and dell'Aquila (2004), who find no relevance of the EPS for oranges, and support the findings of Cardamone (2011), who suggest a positive effect of the EPS on imports of oranges. The divergences are partly due to differences in methodological approach: Cioffi and dell'Aquila (2004) limit their analysis to descriptive statistics and conclude that the EPS is not effective for oranges as the imports occur in periods in which the EPS is not working (late spring and summer).

Besides the general tendency in the behavior of SIVs (see Table 1), products have different responses to higher (lower) level and variability of the SIVs (i.e., position and dispersion indices). We observe that higher variability of SIVs does not impede imports of less perishable F&Vs. For instance, imports of apples and lemons increase, respectively, by 14% (+€178,000,000 on average) and 7% (+€43,000,000 on average) for a 10% increase in the dispersion index. Our findings are in line with previous studies: Emlinger, Jacquet, and Chevassus-Lozza (2008) and Emlinger, Chevassus-Lozza, and Jacquet (2010) suggest that the relevance of the EPS depends on the perishability of the products in question. These patterns point to the existence of strategic behavior: When the SIVs are below the EP, importers may delay imports of less perishable F&Vs until SIVs once again rise above the EP, a strategy that deprives the EPS of its efficacy (Goetz and Grethe, 2009; Cioffi, Santeramo, and Vitale, 2011). The rationale is that when SIVs are more variable, they tend to be below the EP only for a few periods, as compared to SIVs that are less variable. Strategically, exporters would store products when the SIV is below the EP and market them when the SIV is again above the EP. Such strategic behavior is feasible only for low perishable products and for distant countries. In support of this rationale, we found that the overshoot index is negatively correlated with the importer–exporter distance and with low or medium perishable products (Table S13, Figure S1 in the online supplement): SIVs of storable F&Vs and of products from distant countries tend to be durably above the EP, thus systematically avoiding levying the extra duty.

To sum up, our results reveal the efficacy of the protection mechanism. The EPS is a barrier to trade of F&Vs: Imports tend to decrease when SIVs are below the EP, and the effects are observed on imports of most of F&Vs. While the EPS accomplishes its protection aim for all F&Vs, its efficacy is more evident for products characterized by low perishability.

Concluding Remarks and Policy Implications

The European fruit and vegetables (F&Vs) market is governed by a complex and widely debated set of regulations. In particular, the Entry Price System (EPS), which attempts to control imports by setting a minimum price for imported goods, has been under the spotlight due to its doubtful effectiveness in limiting trade and stabilizing the domestic market. The intervention requires daily monitoring of standard import values (SIVs) in representative markets. This procedure makes the EPS expensive, complex, and of questionable usefulness (Goetz and Grethe, 2009; Santeramo and Cioffi, 2012). We investigated the extent to which the EPS affects imports of F&Vs from major suppliers, focusing on four novel indicators: the overshoot, distance, position, and dispersion indices.

We found the EPS to be an effective trade barrier that contributes to limit imports of F&Vs. On average, for each day of overshoot (i.e., SIVs are below the entry price), imports decrease by 15% (−€186,000,000). The imports of less perishable F&Vs (e.g., apples, pears, and lemons) are the most affected by variable SIVs. It is plausible that less perishable products are traded in longer distances, boosting the effects of the mechanism. Some of the most distant countries are also developing economies, and their agricultural exports tend to be highly affected by duties (Emlinger and Guimbard, 2021). The negative relationships we found between imports and the variability of SIVs suggest that suppliers may tend to adopt strategic behaviors to (temporarily) reduce imports until SIVs once again rise above the threshold EP. While previous studies have hypothesized about these strategies (García-Álvarez-Coque, Martinez-Gomez, and Villanueva, 2010; Cioffi, Santeramo, and Vitale, 2011), our analysis quantifies their impact in terms of trade values. In addition, the use of a novel approach opens the path for building a synthetic and simple price index, based on the moments of price distribution, that would be useful to infer on the efficacy and effectiveness of restrictive trade regimes.

The barrier effect of the EPS for imports of F&Vs, revealed by our analysis, calls attention to the effectiveness of this measure and the usefulness of keeping it in force, if restrictive, but ineffective. The reflection is important also in view of the key role that trade plays in enhancing the development of (global and domestic) value chains (Santeramo, Hoekman, and Jelliffe, 2023). This is particularly relevant for regional trade negotiations involving the European Union. Our findings support the bilateral negotiations of agricultural trade preferences. Many more procedures and barriers that hinder trade among countries persist in agri-food than in manufacturing sectors (see, e.g., Santeramo and Lamonaca, 2019; Beghin and Schweizer, 2021; Fiankor and Santeramo, 2023). Therefore, gaining a better understanding of the overall consequences of a nontariff barrier—such as the EPS—for agricultural trade among countries, which has been the main aim of this research, is of great policy relevance.

Further related research might focus on the analysis of the dynamics of the SIV mechanism over time. In addition, access to firm-level and transaction data might shed light on other interesting issues, such as the strategy of the exporters, who can wait for a higher SIV to enter the EU market.

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Appendix A: Existing Evidence on the Entry Price System

Table A1. Previous Studies on the Entry Price System (EPS), by Effects under Investigation

Reference	Product	Country of Origin	Methodology	Main Findings
Influence of the EPS				
Cioffi and dell'Aquila (2004)	Apples, oranges, tomatoes	Countries of the Southern Hemisphere (Argentina, Brazil, Chile, Israel, Morocco, New Zealand, South Africa)	Analysis of data related to the application of the EPS	Varying influence on a case-by-case basis
Goetz and Grethe (2009)	All fruits and vegetables (F&Vs) under the EPS	Main exporters (81 origin-product combinations)	Cluster analysis based on indicators measuring the influence of the EPS	Heterogeneous influence among products and countries of origin
Goetz and Grethe (2010)	Apples, pears	China	Cluster analysis based on indicators measuring the influence of the EPS	Relevance is temporary for apples and general for pears originating in China
Price stabiliztion effects of the EPS				
Agrosynergie (2008)	F&Vs under the EPS	Main origins	Analysis of price elasticities of demand	Stabilization effect occurs for tomatoes from Morocco, apples from China, and lemons from Turkey
Cioffi, Santeramo, and Vitale (2011)	Lemons, tomatoes	Argentina, Morocco, Turkey	Econometric analysis of the effects of the EPS on the EU prices for F&Vs	Stabiliztion effect is rather small, particularly, in the case of tomatoes imported from Morocco
Santeramo and Cioffi (2012)	Apples, lemons, tomatoes	Argentina, Morocco, Turkey	Econometric analysis of the effects of the isolation effect of an endogenous price threshold	EPS plays an insulation effect when SIVs of Moroccan tomatoes drop below the estimated threshold
Trade effects of the EPS				
Agrosynergie (2008)	Apples, artichokes, clementines, zucchini, cucumbers, oranges, pears, tomatoes, table grapes	Main origins	Analysis based on a gravity model and on a partial equilibrium model	Trade effects are product- and season-specific
Emlinger, Jacquet, and Chevassus-Lozza (2008)	70 products included F&Vs under the EPS	232 origins	Analysis based on a gravity model, considering the tariffication of the EPS	Trade effect of tariffs is negative for products under the EPS
Cardamone (2011)	Apples, fresh grapes, mandarins, oranges, pears	191 origins	Analysis based on a gravity model, using the preferential EP (proxied by a dummy) as explanatory variable	The preferential EP has a positive effect on imports of oranges only.
Garcia-Álvarez-Coque, Martinez-Gomez, and Villanueva (2010)	Clementines, cucumbers, table grapes, tomatoes	Brazil, Israel, Morocco, Turkey	Analysis based on a partial equilibrium model	Trade impacts of eliminating EP are significant for particular origins, during specific seasons, most notably for Moroccan tomatoes.
Kareem, Brümmer, and Martínez-Zarzoso (2017)	Limes and lemons, oranges, tomatoes	African countries	Analysis based on a gravity model, using the gaps between SIVs and EP	Negative effects occur for the extensive margins of trade of tomato

Appendix B: Indexes Capturing the Functioning of the Entry Price System in Literature

Table B1. Indexes Used in the Literature to Capture the Functioning of the Entry Price System

Indicator	Description	References
Ad valorem equivalent (AVE)	$ad\ valorem\ tax + \frac{specific\ duty}{import\ price}$	Emlinger, Jacquet, and Chevassus-Lozza (2008); Emlinger, Chevassus-Lozza, and Jacquet (2010)
Dummy	1 with EP (0 otherwise)	Agrosynergie (2008); Cardamone (2011)
Share of negative gap	$\frac{GAP_{(<0)}}{GAP_{tot}}$	Goetz and Grethe (2009, 2010)
Distribution's 0.05- quantile of positive gap	$\ln\left(\frac{Q_{0.05}}{sd(GAP)}\right)$	
Relative gap	$-5\% \leq \frac{SIV - EP}{EP} \leq +5\%$	García-Álvarez-Coque, Martinez-Gomez, and Villanueva (2010)
Absolute gap	SIV-EP	Kareem, Brümmer, and Martínez-Zarzoso (2017)

Appendix C: Data Description

Over the period between 2000 and 2014, in our sample, on average, imports of apples originate mostly in New Zealand, South Africa, and Chile. Argentina is the greatest exporter of lemons and pears and Morocco the most important supplier of tomatoes. Imports of oranges mostly come from Tunisia and Egypt. Similarly, Egypt is a relevant exporter of table grapes, joint with Brazil and Morocco. The EP quotas hold for apples; pears; oranges originating from Egypt, Israel, and Morocco; and tomatoes originating from Morocco. For lemons and tomatoes, it is more frequent to have a number of consecutive days ("max length") in which SIVs are below the EP: This is in line with Goetz and Grethe (2009), who suggest that the relevance of the EPS is highest for lemons and tomatoes. Across origins, the average monthly SIV is less variable for apples (from €74/100 kg for Uruguay to €106/100 for of New Zealand) and lemons (from €62/100 kg for Egypt to €91/100 kg for Chile). Overall, SIVs are more dispersed for tomatoes.

Table C1. Mean and Standard Deviation (in Parentheses) for Variables of Interest over the Period 2000–2014, Classified by Product and Origin

	EU Imports (€millions)	SIV<EP (days/month)	$\overline{SIV}$ (€/100 kg)	$\frac{\overline{SIV}-Me(SIV)}{\overline{SIV}}$
Apples				
ARG	501 (679)	0 (1)	93 (32)	0.006 (0.067)
BRA	650 (746)	0 (2)	79 (13)	0.002 (0.045)
CHL	1,993 (2,537)	0 (1)	91 (18)	−0.003 (0.042)
CHN	267 (345)	1 (2)	88 (23)	0.008 (0.063)
NZL	2,874 (5,079)	0 (0)	106 (23)	−0.002 (0.026)
TUR	6 (4)	0 (1)	84 (21)	0.021 (0.061)
URY	95 (93)	1 (2)	74 (22)	−0.001 (0.053)
ZAF	2,726 (5,186)	0 (0)	98 (21)	0.002 (0.044)
Lemons				
ARG	2,454 (3,361)	4 (6)	68 (24)	0.002 (0.034)
BRA	62 (75)	3 (4)	69 (32)	−0.007 (0.024)
CHL	306 (437)	0 (1)	91 (32)	−0.004 (0.036)
EGY	31 (39)	1 (2)	62 (14)	0.021 (0.072)
ISR	57 (70)	0 (0)	81 (28)	0.007 (0.032)
MAR	61 (79)	2 (4)	69 (31)	0.003 (0.056)
TUR	274 (497)	1 (3)	68 (20)	0.006 (0.045)
URY	326 (278)	3 (5)	72 (25)	−0.006 (0.061)
ZAF	510 (845)	2 (4)	76 (23)	0.008 (0.036)
Peaches				
ISR	147 (205)	0 (1)	146 (48)	0.001 (0.046)
MAR	197 (295)	0 (0)	250 (118)	0.000 (0.000)
TUR	65 (133)	0 (0)	130 (24)	0.000 (0.018)
Pears				
ARG	2,213 (5,015)	0 (1)	95 (39)	0.008 (0.065)
CHL	738 (1,313)	0 (2)	92 (38)	0.010 (0.042)
CHN	53 (45)	2 (3)	68 (21)	0.022 (0.074)
NZL	58 (64)	0 (0)	145 (33)	−0.024 (0.039)
TUR	18 (15)	0 (0)	118 (30)	−0.005 (0.036)
URY	204 (267)	0 (1)	74 (25)	−0.013 (0.031)
ZAF	1,112 (1,318)	0 (0)	94 (20)	−0.0001 (0.029)
Oranges				
BRA	1 (2)	2 (4)	35 (15)	−0.002 (0.020)
EGY	1,145 (1,856)	0 (1)	49 (8)	0.002 (0.042)
ISR	301 (459)	0 (0)	68 (11)	0.001 (0.027)
MAR	683 (744)	0 (0)	56 (12)	0.004 (0.051)
TUN	1,411 (1,409)	0 (1)	54 (11)	0.019 (0.038)
TUR	156 (419)	0 (1)	62 (8)	−0.008 (0.044)
ZAF	176 (525)	1 (2)	56 (15)	0.005 (0.063)
Table grapes				
BRA	3,175 (5,013)	0 (0)	224 (82)	−0.002 (0.054)
CHL	88 (84)	1 (1)	104 (46)	0.020 (0.073)
EGY	1,261 (3,354)	0 (0)	145 (35)	0.007 (0.065)
ISR	465 (727)	0 (0)	148 (29)	0.005 (0.045)
MAR	1,058 (1,096)	0 (0)	147 (38)	0.006 (0.060)
TUN	56 (95)	0 (0)	189 (45)	−0.008 (0.016)
TUR	377 (631)	0 (0)	120 (27)	0.003 (0.035)
ZAF	509 (686)	0 (0)	138 (106)	−0.009 (0.035)
Tomatoes				
BRA	3 (0.2)	3 (2)	32 (0)	0.000 (0.000)
ISR	487 (739)	1 (2)	129 (41)	0.013 (0.095)
MAR	5,385 (9,730)	5 (6)	64 (20)	0.020 (0.061)
TUN	467 (556)	2 (4)	112 (24)	0.002 (0.053)
TUR	143 (234)	4 (5)	88 (24)	0.016 (0.047)

Notes: Standard deviations are in parentheses. Acronyms are Argentina (ARG), Brazil (BRA), Chile (CHL), China (CHN), Egypt (EGY), Israel (ISR), Morocco (MAR), New Zealand (NZL), South Africa (ZAF), Tunisia (TUN), Turkey (TUR), Uruguay (URY).

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Online Supplement:
The Import Effects of the Entry Price System

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Table S1. The Entry Price System (EPS) vs. the Gate Price System (GPS)

	EPS	**GPS**
Area of implementation	EU	Japan
Markets	Fruit and vegetables	Meat
Commodity	Apples, apricots, cherries, clementines, lemons, mandarins, oranges, peaches (including nectarines), pears, plums, table grapes, artichokes, courgettes, cucumbers, tomatoes	Pork
Entry into force	1995	1971
Previous regime	Reference Price System	Quota system
Import value	Standard Import Value (SIV): proxy of import price, computed daily by the European Commission	Standard Import Price (SIP): 482.5 yen/kg, fixed by the government as the arithmetic average between upper stabilisation price (515 yen/kg) and lower stabilisation price (450 yen/kg)
Threshold price	Entry Price (EP): set by the government, variable according to product, supplier, seasonality	Gate Price (GP): Fixed SIP/1.05 = 459.5 yen/kg
Import tariff	Variable: *ad valorem* tariff with SIVs<EP *ad valorem* tariff + (EP-SIV) with EP<SIVs<0.92EP *ad valorem* tariff + MTE with SIVs<0.92EP	Mixed: 5% *ad valorem* tariff Variable levy = GP – CIF price

Source: Cioffi and dell'Aquila (2004) and Godo (2014).

The material contained herein is supplementary to the article named in the title and published in the *Journal of Agricultural and Resource Economics* (*JARE*).

Table S2. Ordinary Least Square (OLS) Estimation of Gravity Equation (2)

Variables	Overshoot Index 1	Overshoot Index (Lag) 2	Position Index 3	Dispersion Index 4
EPS	−0.120***	−0.118***	0.917***	−0.211***
	(0.037)	(0.036)	(0.109)	(0.023)
No. of obs.	6,485	6,432	6,485	3,223
R^2	0.619	0.618	0.623	0.708

Notes: The dependent variable is log of import values. The explanatory variables of interest are, alternatively, the number of days in a month in which SIVs are below the EP at time *t* (A) and *t−1* (B), the monthly average SIVs (C), the relative difference between the monthly mean and median SIVs (D). All specifications include a constant, importer-product-time, exporter-product-time, and country-pair-product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S3. Addressing Potential Reverse Causality (Baier and Bergstrand, 2007) (*N* = 6,252)

Variables	Overshoot Index 1	Position Index 2	Dispersion Index 3
EPS	−0.117***	0.842***	−0.484
	(0.038)	(0.114)	(0.474)
EPS (forwarded)	−0.013	−0.147	−0.193
	(0.034)	(0.094)	(0.384)
R^2	0.618	0.622	0.617

Notes: Ordinary least Square (OLS) estimation of the gravity equation in (2). The dependent variable is log of import values. The explanatory variables of interest (in log) are, alternatively, the number of days in a month in which SIVs are below the EP (A), the monthly average SIVs (C), the relative difference between the monthly mean and median SIVs (C). All specifications include a constant, importer-product-time, exporter-product-time, and country-pair-product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S4. Addressing Potential Reverse Causality (Trefler, 1993): EPS Equation

Variables	Overshoot Index 1 $(SIV < EP)$	Position Index 2 $((SIV < EP) * \overline{SIV})$	Dispersion Index 3 $((SIV < EP) * \frac{\overline{SIV} - Me(SIV)}{\overline{SIV}})$
Log of imports	−0.010	−0.085	−0.007***
	(0.015)	(0.075)	(0.001)
No. of obs.	1,346	6,485	6,485
R^2	0.533	0.464	0.132

Notes: Ordinary Least Squares (OLS) estimation of the EPS equation in (3.1). The dependent variables are, alternatively, the number of days in a month in which SIVs are below the EP (A), the monthly average SIVs interacted with the number of overshoots (A), the relative difference between the monthly mean and median SIVs interacted with the number of overshoots (C). All specifications include a constant, time-varying importer, time-varying exporter, country-pair, and time-varying product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S5. Addressing Potential Reverse Causality (Trefler, 1993): Import Equation (N = 6,485)

Variables	Overshoot Index 1	Position Index 2	Dispersion Index 3
Overshoot index $(SIV < EP)$	−0.180*** (0.059)	−0.261*** (0.063)	0.0003 (0.059)
Position index $((SIV < EP) * \overline{SIV})$		0.015*** (0.004)	
Dispersion index $((SIV < EP) * \frac{\overline{SIV} - Me(SIV)}{\overline{SIV}})$			−9.391*** (0.557)
R^2	0.369	0.371	0.397

Notes: Ordinary Least Squares (OLS) estimation of the import equation in (3.2). The dependent variable is logs of imports. The explanatory variables of interest are, alternatively, the number of days in a month in which SIVs are below the EP (A), the monthly average SIVs interacted with the number of overshoots (B), the relative difference between the monthly mean and median SIVs interacted with the number of overshoots (C). All specifications include a constant, time-varying importer, time-varying exporter, and country-pair fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S6. A Rise in Imports Increases the Level of the Standard Import Values (SIVs) but Lowers Its Variability When SIVs Are below Entry Price (EP) (N = 6,485)

	Position Index		Dispersion Index	
	Without Interaction Term	With Interaction Term	Without Interaction Term	With Interaction Term
Variables	$(\overline{SIV})$	$((SIV < EP) \times \overline{SIV})$	$(\frac{\overline{SIV} - Me(SIV)}{\overline{SIV}})$	$((SIV < EP) \times \frac{\overline{SIV} - Me(SIV)}{\overline{SIV}})$
Log of imports	0.008*** (0.002)	−0.085 (0.075)	−0.0005 (0.0003)	−0.007*** (0.001)
R^2	0.684	0.464	0.133	0.132

Notes: Ordinary Least Squares (OLS) estimation of the EPS equation in (3.1) without (and with) interacting the dependent variables with the number of overshoots. The dependent variables are, alternatively, the monthly average SIVs not interacted and interacted with the number of overshoots (position index), the relative difference between the monthly mean and median SIVs not interacted and interacted with the number of overshoots (dispersion index). All specifications include a constant, time-varying importer, time-varying exporter, country-pair, and time-varying product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S7. The Estimated Effects of the Level and the Variability of Standard Import Values (SIVs) Are Lower When the Estimation Is Limited to Periods in Which SIVs Are below the Entry Price (EP) Than When the Estimation Is Not Limited (*N* = 6,485)

	Position Index		Dispersion Index	
Variables	**Without Interaction Term**	**With Interaction Term**	**Without Interaction Term**	**With Interaction Term**
Index of overshoots	−0.315***	−0.261***	−0.196***	0.0003
	(0.061)	(0.063)	(0.059)	(0.059)
Position index	1.059***	0.015***		
	(0.110)	(0.004)		
Dispersion index			−19.120***	−9.391***
			(3.019)	(0.557)
R^2	0.379	0.371	0.373	0.397

Notes: Ordinary Least Squares (OLS) estimation of the import equation in (3.2). The dependent variable is logs of imports. The explanatory variables of interest (in log) are, alternatively, the monthly average SIVs not interacted and interacted with the number of overshoots (position index), the relative difference between the monthly mean and median SIVs not interacted and interacted with the number of overshoots (dispersion index). All specifications include a constant, time-varying importer, time-varying exporter, and country-pair fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S8. A Rise in Imports Increases the Level of the Standard Import Values (SIVs) (*N* = 6,485)

	Position Index					
	Without Interaction Term			With Interaction Term		
Variables	$\overline{SIV}$	$Me(SIV)$	$Min\{SIV\}$	$(SIV < EP) \times \overline{SIV}$	$(SIV < EP) \times Me(SIV)$	$(SIV < EP) \times Min\{SIV\}$
Log of imports	0.008***	0.009	0.014***	−0.085	−0.077	−0.064
	(0.002)	(0.002)	(0.002)	(0.075)	(0.075)	(0.070)
R^2	0.684	0.664	0.657	0.464	0.465	0.461

Notes: Ordinary Least Squares (OLS) estimation of the EPS equation in (3.1) using different position indexes. The dependent variables are, alternatively, the monthly average SIVs, the monthly median SIVs, and the monthly minimum SIVs not interacted and interacted with the number of overshoots. All specifications include a constant, time-varying importer, time-varying exporter, country-pair, and time-varying product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S9. The Greatest Impacts Are Estimated for the Position Indexes Proxied by Minimum Standard Import Value (SIV) (*N* = 6,485)

	Position Index					
	Without Interaction Term			Without Interaction Term		
Variables	$\overline{SIV}$	$Me(SIV)$	$Min\{SIV\}$	$(SIV < EP) \times \overline{SIV}$	$(SIV < EP) \times Me(SIV)$	$(SIV < EP) \times Min\{SIV\}$
$SIV < EP$	−0.315***	−0.321***	−0.305***	−0.261***	−0.264***	−0.268***
	(0.061)	(0.061)	(0.060)	(0.063)	(0.063)	(0.063)
Position index	1.059***	1.102***	1.253***	0.015***	0.016***	0.017***
	(0.110)	(0.110)	(0.105)	(0.004)	(0.004)	(0.004)
R^2	0.379	0.379	0.383	0.371	0.371	0.371

Notes: Ordinary Least Squares (OLS) estimation of the import equation in (3.2) using different position indexes. The dependent variable is logs of imports. The explanatory variables (in log) are, alternatively, the monthly average SIVs, the monthly median SIVs, and the monthly minimum SIVs not interacted and interacted with the number of overshoots. All specifications include a constant, time-varying importer, time-varying exporter, country-pair, and time-varying product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S10. A Rise in Imports Lowers the Variability of the Standard Import Values (SIVs) (*N* = 6,485)

	Dispersion Index					
	Without Interaction Term			Without Interaction Term		
Variables	$\frac{\overline{SIV} - Me(SIV)}{\overline{SIV}}$	$\frac{\overline{SIV} - Min\{SIV\}}{\overline{SIV}}$	$\frac{Me(SIV) - Min\{SIV\}}{Me(SIV)}$	$(SIV < EP) \times \frac{\overline{SIV} - Me(SIV)}{\overline{SIV}}$	$(SIV < EP) \times \frac{\overline{SIV} - Min\{SIV}{\overline{SIV}}$	$(SIV < EP) \times \frac{Me(SIV) - Min\{SIV}{Me(SIV)}$
Log of imports	−0.0005	−0.003***	−0.003***	−0.007***	−0.014***	−0.008*
	(0.0003)	(0.001)	(0.001)	(0.001)	(0.005)	(0.004)
R^2	0.133	0.283	0.255	0.132	0.438	0.436

Notes: Ordinary Least Squares (OLS) estimation of the EPS equation in (2.1) using different dispersion indexes. The dependent variables are, alternatively, the monthly average SIVs, the monthly median SIVs, and the monthly minimum SIVs not interacted and interacted with the number of overshoots. All specifications include a constant, time-varying importer, time-varying exporter, country-pair, and time-varying product fixed effects. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S11. The Greatest Impacts Are Found for the Dispersion Index Computed as Relative Difference between the Mean and the Median (*N* = 6,485)

	Dispersion Index					
	Without Interaction Term			With Interaction Term		
Variables	$\frac{\overline{SIV} - Me(SIV)}{\overline{SIV}}$	$\frac{\overline{SIV} - Min\{SIV\}}{\overline{SIV}}$	$\frac{Me(SIV) - Min\{SIV\}}{Me(SIV)}$	$(SIV < EP) \times \frac{\overline{SIV} - Me(SIV)}{\overline{SIV}}$	$(SIV < EP) \times \frac{\overline{SIV} - Min\{SIV}{\overline{SIV}}$	$(SIV < EP) \times \frac{Me(SIV) - Min\{SIV}{Me(SIV)}$
$SIV < EP$	−0.196***	−0.053	−0.087	0.0003	−0.183***	−0.226***
	(0.059)	(0.061)	(0.062)	(0.059)	(0.064)	(0.064)
Dispersion index	−19.120***	−5.958***	−4.256***	−9.391***	0.009	0.155**
	(3.019)	(0.735)	(0.754)	(0.557)	(0.071)	(0.076)
R^2	0.373	0.376	0.373	0.397	0.369	0.370

Notes: Ordinary Least Squares (OLS) estimation of the import equation in (3) using different position indexes (specification (iii)). The dependent variable is logs of imports. The explanatory variables (in log) are, alternatively, the monthly average SIVs, the monthly median SIVs, and the monthly minimum SIVs not interacted and interacted with the number of overshoots. All specifications include time-varying importer, time-varying exporter, country-pair, and time-varying product fixed effects. Constant included. Standard errors are in parentheses. Double and triple asterisks (**, ***) indicate significance at the 5% and 1% level, respectively.

Table S12. Sensitivity Analysis: Controlling for Seasonality (*N* = 6,485)

Variables	Overshoot Index 1	Distance 92% of EP – SIV 2	Distance SIV – 92% of EP 3	Position Index 4	Dispersion Index 5
EPS	−0.125***	−0.124***	0.154***	0.767***	−0.143
	(0.006)	(0.001)	(0.024)	(0.159)	(0.155)
R^2	0.948	0.943	0.951	0.951	0.941

Notes: Poisson Pseudo-Maximum-Likelihood (PPML) estimation of the gravity equation in (2). The dependent variable is value of imports. The explanatory variables of interest (in log) are, alternatively, the number of days in a month in which SIVs are below the EP (A), the distance between 92% of EP and monthly average SIVs if SIVs are below or equal to the EP (B), the distance between monthly average SIVs and 92% of EP if SIVs are above the EP (C), the monthly average SIVs (D), the relative difference between the monthly mean and median SIVs (E). All specifications include a constant, importer-product-time, exporter-product-time, and country-pair-product-month fixed effects. Robust standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

Table S13. Effects of Products' Perishability and Distance on the Overshoot and Dispersion Indices

Dependent Variable	Overshoot Index		Dispersion Index	
Variables	**1**	**2**	**1**	**2**
Distance	−0.031***	0.006	−0.002***	−0.002***
	(0.008)	(0.007)	(0.001)	(0.001)
Low perishability	−0.271***		−0.004***	
	(0.017)		(0.001)	
Medium perishability	−0.456***		−0.005***	
	(0.016)		(0.001)	
High perishability		0.378***		0.005***
		(0.015)		(0.001)

Notes: Ordinary Least Square (OLS) estimate. The log of importer-exporter distance is in km. Low, medium, high perishability are dummies indicating, respectively, products with a shelf life of 6–12 months, 1–6 months, less than one month. All specifications include a constant. Observations are 15,290. Standard errors are in parentheses. Triple asterisks (***) indicate significance at the 1% level.

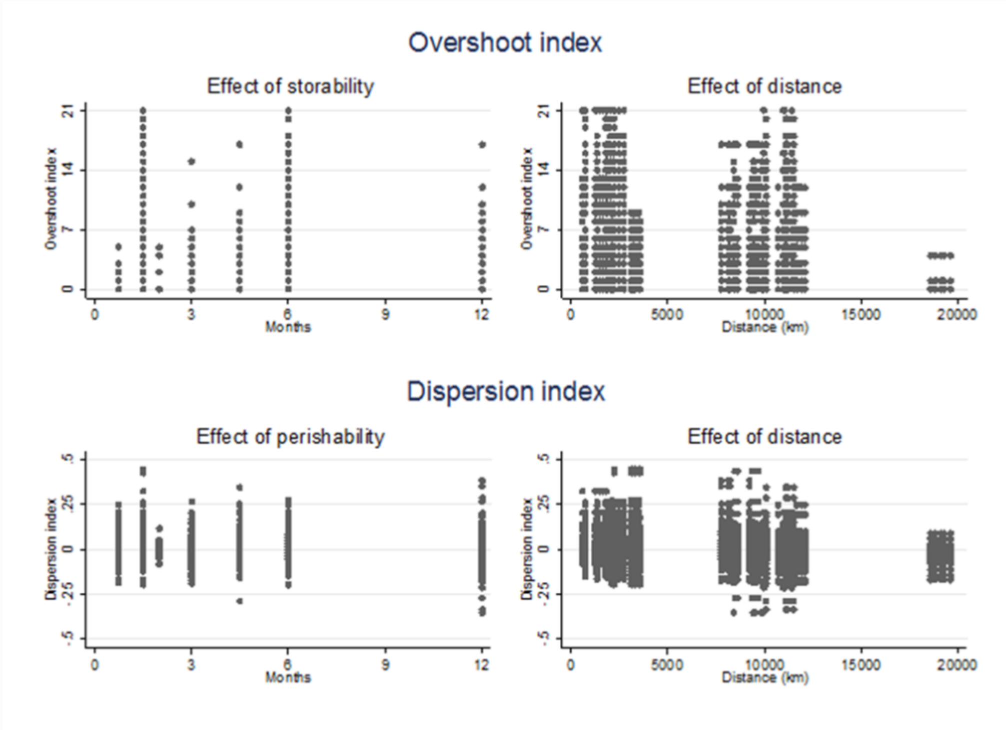

Figure S1. Effects of Products' Storability and Distance on the Overshoot and Dispersion Indices

Notes: Storability based on shelf-life at the optimum storage conditions (by temperature or controlled atmosphere) (Gross et al., 2016).