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The Role of Export Restrictions in Agricultural Trade

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Abstract

Between 2006 and 2011, in a global context of rising food prices, many countries applied price-isolating policies. Export restrictions were among the measures most frequently applied. However, as countries are not obliged to notify WTO about the imposition of export restrictions, there is not good information about the measures applied. We fill this void by building a comprehensive database on export restrictions applied in the agricultural sector worldwide between 2005 and 2014. We name it the Export Restriction in Agriculture (ERA) database, and we use it to analyze the incidence of export restrictions by country, type of product, type of measure, and time span.

Using the ERA database, we assess the effects of export restrictions on agricultural trade and global food prices in the period 2005-2013. To do so, we estimate a disaggregated gravity model of trade where the effects of export restrictions and import tariffs on traded values and volumes allowed us to infer the existence of an effect on prices. Clear evidence of export restrictions affecting world prices is limited to a handful of sectors, and weak evidence suggests that it may exist in some other sectors. We also find weak evidence of an impact of import promoting policies on agricultural prices. These results highlights the idea that export restrictions should be addressed at the multilateral level, but negotiations on export restrictions should not be disassociated from talks on other price-insulating policies.

Keywords: export restrictions, export taxes, export bans, export quotas, agricultural prices, price-isolating policies, gravity model

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1. Introduction

Between 2006 and 2011, international prices of different agricultural commodities showed significant fluctuations and rose above the relatively low levels from previous decades. As a reaction to this, many countries applied measures to isolate domestic prices from international fluctuations. Export restrictions, which include export taxes, export bans, export license requirements, and price reference for exports, were among these measures.

In fact, such measures have been applied historically for various reasons: for environmental reasons, to improve a country's terms of trade, for food security purposes, to promote industrialization, to increase fiscal revenue, among many others. In a context of increasing food prices, export restrictions are usually applied in order to isolate domestic prices from the world market to prevent domestic prices from rising. When an exporting country imposes export restrictions, there is an excess of domestic supply, which lowers domestic prices. If the country imposing the measure is a large exporter of the good (i.e. it has market power in the global market), the measure is expect to have an impact on international prices, as export volumes fall. The increase in international prices could also take place when many small exporters apply such measures (see Bouët and Laborde 2010 for a theoretical presentation of the partial equilibrium effects of export taxes). Globally, export restrictions create distortions that have negative impacts on welfare: as Laborde, Estrades and Bouët (2013) find, removing all existing export taxes would lead to welfare gains of about 33 billion dollars per year.[1]

Given the effects of export restrictions on global welfare, many efforts were made over the last few years to get a clearer picture of the number and extent of export restraint measures applied during the food crisis, as well as their impact on food prices. OECD built a database that focus on the period 2007-2012, which includes all type of export restrictions (export taxes and surtaxes, export quotas, export bans, non-automatic licensing requirements, reference export price, other export measures). Their focus is on big countries that have an incidence on global prices (OECD, 2015). Another recent effort was the Panel Export Tax (PET) database, which includes information only on export taxes and on nine exporting countries (Solleder, 2013). Finally, Laborde, Estrades and Bouet (2013) also built a database only focusing on export taxes at the exporter/HS level, which includes all countries for which there is available information. All the available databases include information up to 2012. However, the number of new measures applied in all sectors of activity has increased in the last few years, even in a context of decreasing food prices. This highlights the need of an updated and comprehensive database on all types of export restrictions applied worldwide.

Evidence suggests that export restrictions, together with other price insulating policies, contributed to an overall increase in food prices (Mitra and Josling 2009; Headey 2011; Martin and Anderson 2012; Anderson and Nelgen 2012; Solleder 2013; Jensen and Anderson 2014; Giordani et al. 2016). Most studies focus on few markets (usually, grains and oilseeds) and on export taxes, or even consider all types of price insulating policies altogether, without differentiating between export restrictions and other policies, such as import tariff reductions. As the international debate has focused on how export restrictions should be regulated in order to prevent agricultural price

[1] These results only consider the removal of export taxes. Gains would be higher if other export restrictions were also incorporated in the analysis.

fluctuations in the future, the need for an overall assessment of the impact of export restrictive policies on one hand, and other price insulating policies on the other hand is reinforced.

The aim of this paper is to contribute to the existing literature that focuses on the role of export restrictions on agricultural trade in two ways. First, we build the Export Restriction in Agriculture (ERA) database in order to fill the information gap on export restriction measures applied in the last 10 years. We review all type of export restriction applied by all countries on all agriculture exports between 2005 and 2014. To our knowledge, it is the most comprehensive database of export restrictions applied on agricultural goods.

Second, we contribute to the evidence of how export restrictions had an impact on agricultural trade and global food prices in the period 2005-2013. To do so, we estimate a disaggregated gravity model of trade in which the effects of export restrictions and import tariffs on traded values and volumes allow us to infer the existence of an effect on prices. Clear evidence of export restrictions affecting world prices is limited to a handful of sectors, a weak evidence suggests that it may exist in some other sectors, and among most sectors we do no find an effect on prices.

In the next section, we provide an overall discussion of export restrictions and their use globally, with a focus on agricultural trade. We also discuss how trade disciplines are tackling this issue. In Section 3, we present the methodology for construction of the ERA database. The information from the database is then used to analyze the incidence of export restrictions, by country, type of product, type of measure, and time span. This is presented in Section 4 of this paper. In Section 5, we present information on agricultural trade in our period of analysis, and provide some evidence of import promoting measures applied at the same moment as export restrictions were being introduced. In Section 6, we present the gravity model used to estimate the impact of export restrictions and import promoting policies on agricultural trade and international prices. Finally, in Section 7 we draw some concluding remarks.

2. What we talk about when we talk about export restrictions

Export restrictions are trade policy instruments applied by exporting countries, with the aim of controlling or banning exports of certain products. Restrictions can directly affect the volume of exports of a product, or indirectly by increasing the cost of exporting the good. Among the former we usually find export quotas, which restrict the volume of exports; and export bans, which prohibits exports. Among the later we typically find export taxes, which can be defined in ad valorem rates, specific rates or a combination of both. Specific export taxes imply that ad valorem equivalent rates are lower if domestic prices are high.[2] For this reason, and in order to guarantee a minimum applied rate, in many cases specific export taxes are combined with ad valorem export taxes[3]. Also to guarantee a minimum rate, ad valorem export taxes are sometimes defined in terms of reference prices, usually set by the government, which means that for certain products in some countries, rates are defined as often as on a weekly basis.[4] Minimum export prices, if not applied in conjunction with export taxes, serve also as a way of controlling invoicing or the quality of exported goods. Other export restrictions comprise non-automatic export licenses, which may increase exporting costs both in time and monetarily, refuse reimbursement of value-added tax (VAT) on exports, mandatory registration of exporting firms, among others (see OECD 2015 for an exhaustive list).

Export restrictions have been historically applied on "raw" materials: minerals and metals, agricultural commodities, and wood. In this paper, we will focus on restrictions applied on agriculture products, because the logic behind the restrictions of agriculture exports may be very different than for other products.

Effects of export restrictions

Either by directly reducing the volume of exports, or by increasing the costs of exports, exports restrictions reduce export supply. As export supply is restricted or banned, domestic supply increases and domestic prices fall. Facing lower domestic prices, domestic consumption increases and welfare improves. Also, public revenue rises from the imposition of the export tax. However, domestic producers and exporters are hurt by the measure, and the net welfare effect on the country imposing the measure is negative.

This mechanism works if the country is small and does not have influence on global markets. If the country has market power in world markets, the fall in export supply due to export restrictions will reduce world supply and thus increase global prices. As a consequence, trade volumes will be reduced even more, and the exporting country gains from an improvement in its terms of trade. Thus, big countries may have an incentive to apply an optimal export tax rate that maximizes welfare. As Bouët and Laborde (2010) explain, the optimal rate will depend on the elasticities of consumption, production and trade; i.e. it is not only important to assess if the exporter has market power, but also if the exported good has substitutes in the world market. The net result on welfare

[2] The formula to estimate the AVE of specific export taxes is Specific rate/Domestic price

[3] For example, currently Russian export tax on rapeseeds is "6.5 percent, but not less than 11.4 Euro per 1 MT". Also, Kenya applies an export tax on raw hides of "80% or Sh.40 per Kg".

[4] A typical example is the export tax on crude palm oil applied by Malaysia. Tax rates are defined on a weekly basis, according to palm oil prices estimated by the Malaysian Palm Oil Board.

on the exporting country will depend on welfare gains due to gains in the terms of trade and in consumer surplus, and the exporters' welfare loss.

Under the hypothesis of an exporter with market power, the importing countries lose terms of trade, and foreign consumers lose welfare, as they now pay a higher price for the good. For this reason, export restrictions can be seen as beggar-thy-neighbor policies (Piermartini 2004). However, countries with importer market power may also behave strategically, and apply policies to retaliate against export restrictions, such as a reduction in applied tariff rates. International prices may increase even more so, leading to a "trade war" resulting in negative consequences for consumers in small countries (Bouët and Laborde 2010).

Export restrictions and agriculture products

Given the potential conflicts associated to the application of export restrictions, why do countries impose such measures?

One of the main reasons for applying export restrictions, especially regarding export restrictions in the agriculture sector, is for food security purposes. As one direct effect of imposing an export restriction is a decrease in domestic prices, export restrictions have been frequently applied in order to control inflationary pressures and guarantee domestic supply of key goods. However, as Piermartini (2004) explains, in the long run export restrictions may have the opposite effect, as they might affect investment in exporting sectors, which in turn decrease their production, resulting in higher domestic prices. For this reason, export restrictions in this context are usually applied as short term measures. As we will analyze in higher detail in the next section, this argument was frequently mentioned when countries imposed restrictions on agricultural exports during the recent food crisis.

Export restrictions lower both final consumption prices and intermediate consumption prices. Thus, another reason to apply restrictions is to encourage the development of industries based on agricultural raw materials. In this way, export restrictions work as indirect subsidies for downstream industries, which benefit from protection similar to when applying escalating tariffs. In this regard, many developing countries apply what is known as differential export taxes, e.g. export taxes with decreasing rates along the production value chain, as a reaction to tariff escalation applied by developed countries. Examples of differential export taxes are found in the soybean sector in Argentina and in the palm oil sector in Malaysia. As Bouët, Estrades and Laborde (2014) show, implementing a tax on exports of raw materials may increase welfare in the exporting country when it also exports a processed good based on the raw material. In spite of this, differential export taxes are a cause of trade distortions, but as they are seen as a response to tariff escalation applied by importing countries, both measures should be discussed together.

If the country imposing the restriction has market power in world markets, there is a terms of trade argument for applying these restrictions, which is the case regardless of the strategic behavior of trading partners (Devarajan et al. 1996). The optimal tax rate (or export quota) will be the one that maximizes welfare, and it is given by the inverse of the elasticity of demand (the rationale is the same for importers with market power applying optimal tariffs). However, as the country imposing the restrictions has a terms of trade gain, the importing countries realize terms of trade loses, and the net global effect on welfare is usually negative. Besides, if the importer is a big country, it may

retaliate by decreasing tariffs, and thus the terms of trade gains would evaporate. For these reasons, the terms of trade argument is not frequently used as justification for imposing an export restriction.

Export taxes are also applied in order to improve income distribution. As domestic prices of key staples fall as a consequence of export restrictions, poor populations may benefit from the fall in domestic prices. However, export restrictions have also an effect on factor prices, which should also be taken into account in order to estimate the effect on income distribution (Piermartini 2004). Warr (2002) applies a general equilibrium model for the Philippine economy and analyzes the argument for an export tax on the coconut sector. The author finds that the factor prices changes dominates the final consumption prices. Even when the domestic price of goods falls under an export tax, real wages of unskilled labor fall and thus poorer populations are hurt by the measure. After devaluations, some countries impose export taxes as a political economy argument to improve income distribution. Even when it is true that the exporting sector may benefit strongly from the devaluation, as Devarajan et al (1996) argue, when the opposite happens (e.g. highly appreciated currency episodes) export subsidies should be applied, but this usually does not happen.

Export taxes were historically used in order to collect revenue (see Solleder 2013 for a short historical introduction to export taxes). However, nowadays few countries collect public revenue from export taxes, and none of them collects more than 5% of public revenue from it (ICTD Government Revenue Database, Prichard et al. 2014).

Other justifications for imposing export restrictions are as a means for conservation of species and avoid deforestation; for sanitary reasons; for political reasons; among others.

Disciplines in agricultural export restrictions

In spite of the distortions that export restrictions have on world markets, export taxes are not prohibited or regulated by the WTO. As Crosby (2008) hypothesizes, the lack of any mention to export taxes within WTO agreements was either an omission or an intentionally reserved area as “policy space”. On the other hand, quantitative export restrictions are regulated, but these rules are not usually enforced. With the conclusion of the Uruguay Round in 1994, export restrictions were included in provisions at the GATT (Article XI) and at the Agreement on Agriculture (Part VI, Article 12). Article XI of GATT establishes that quantitative measures, such as export bans, quotas or licenses shall not be applied, except temporary measures “applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party.” The Agreement on Agriculture extends these exceptions by stating that countries imposing these measures shall notify the WTO and affected importing countries (see Table A1 in Annex for the GATT and AoA articles).

Two facts explain the under-regulation of export restrictions at the Uruguay Round. The first according to Laborde, Estrades and Bouët (2013) is that the mercantilist interests prevailed and protection from imports were considered of primary importance. The second according to Anania (2014) is that when the Uruguay Round was launched commodity prices were low and stocks were high, so agricultural prices were not a source of concern at that time.

In the last years, these two facts have changed and several countries have placed the focus on export restrictions, partly because import tariffs have effectively been reduced and commodity prices rose sharply in the mid-2000s. Currently, there is a call for tighter provisions regarding export restrictions. However, as many authors point out (Bouët and Laborde 2016; Gouel 2016), export restrictions may be more difficult to discipline in trade agreements than tariffs.

Two proposals within the Doha Round made an attempt to control differential export taxes. One is linked to the removal of tariff escalation on the import side (Sharma 2011), but there was no further development on the issue. G20 Summits in 2011 and 2012 decided to eliminate export restrictions and extraordinary taxes on food purchased for non-commercial humanitarian purposes, mainly by the World Food Program, but these decisions were not discussed at the WTO and represent a small proportion of food exports (Härbeli 2014). As Clapp (2009) suggests, ending export restrictions within the Doha Round cannot be achieved if negotiations do not tackle import policies as well, such as subsidies in the industrialized countries and safeguards for developing countries.

In spite of the lack of progress at the multilateral level, disciplines on export restrictions are imposed on new countries joining the WTO. As part of its accession protocol to the WTO, Ukraine agreed to progressively reduce export taxes on oilseeds and live cattle and hides (WTO 2008). Vietnam, Cambodia, China, and Armenia also undertook commitments regarding export restrictions in their Accession Protocols to WTO, although some of these commitments may have not been fully complied. For example, in its accession in 2001, China committed not to apply export taxes other than on 84 items listed, but in 2008 the country imposed export duties on 334 tariff lines (Kim 2010).

Bouët and Laborde (2016) suggest that addressing the issue at the multilateral level can improve the monitoring and notification process leading to better enforcement. This would also be good for small and vulnerable economies that import food. The authors also suggest that reaching a solution may be easier on a plurilateral basis. In a review of provisions on export restrictions included in 93 regional trade agreements (RTAs), Korinek and Bartos (2012) find that only 16% include provisions that are stricter than WTO provisions regarding quantitative export restrictions. However, more than 70% include explicit disciplines regarding export taxes, which are not included explicitly at the GATT. Regarding agriculture products, some RTAs include products for which countries may impose export restrictions (quantitative or taxes), in some cases within a specific period of time. Most RTAs allow exemptions to export restrictions when there are shortages in foodstuffs. The authors find that in general, RTA provisions on export restrictions increase transparency among members, as they usually establish a way of communicating new restrictions to other members, often in advance, thus improving predictability as well.

Disciplines on export restrictions have been included in the recent Trans-Pacific Partnership (TPP) agreement. The TPP seeks to discourage the application of export restrictions as a means of reacting to changes in world markets, but it allows temporary export restrictions on foodstuffs, as long as members notify to other members in advance. In the agreement, there is an explicit mention of food security needs in the Asian region for non-TPP countries such as Cambodia and Bangladesh.

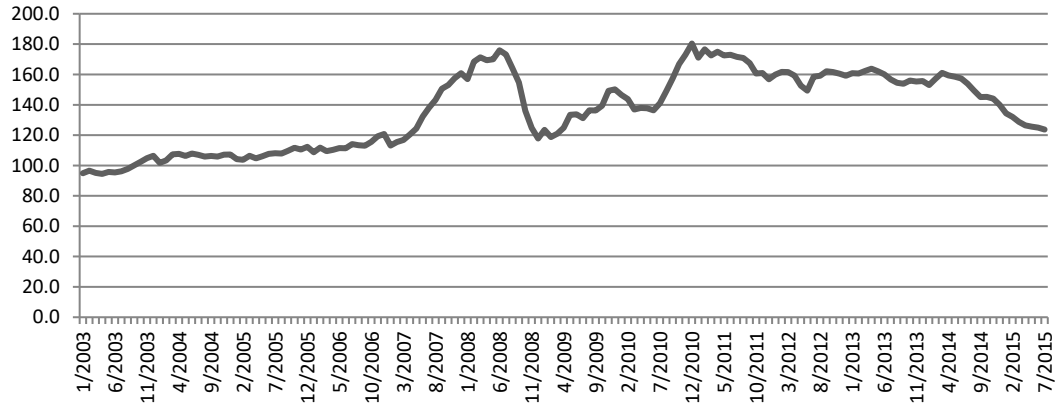
Export restrictions and the recent food crisis

Export restrictions are frequently applied in the context of rising food prices. According to WFP (2009), several countries imposed such measures during the 1970s food price crisis, as well as

during the recent food price crisis (2006-2008 – 2011-2012). Figure 1 shows the food price spikes in recent years, although different commodities seemed to be behind each spike. As Trostle et al. (2011) point out, in 2007-08 the price of rice, wheat, and vegetable oils explained most of the food price increase, whereas in 2011-12, the price of livestock, sugar, coffee, tea, fish, wool, and palm oil showed a more significant increase.

Even though the causes behind the spikes were diverse (see Mitchell 2008; Headey and Fan 2008; Piesse and Thirtle 2009; Hochman et al. 2014; Tadesse et al. 2014 for reviews of causes), according to several authors, the spikes may have been exacerbated by trade policies in general and export restrictions in particular. Since many linked factors are behind these trends, it is difficult to estimate to what extent export restrictions played a role in the recent food price spikes.

Figure 1. Real food price index. Monthly data, deflated. Index 2002-2004= 100



Source: Own elaboration with data from FAO

Some authors, applying different methodological approaches, have tried to answer this question. Yu et al. (2011) apply multi-country, multi-commodity, partial equilibrium models in order to estimate the impact of trade policy distortions –increasing export restrictions and lowering import tariffs- on the international price of key staples in 2007-2008. Their simulation results show that the trade policies applied by countries during this period increased the world price of rice by 24%, wheat by 14%, and barley by 9%, with a negative welfare effect on developing countries not applying any trade policies.

Martin and Anderson (2012) and Anderson and Nelgen (2012) estimate the impact of price insulating policies during the 1972-74 and the 2006-2008 price spikes for key agricultural goods. They observed the variation in National Assistance Coefficients (NAC) due to border measures applied on exports and imports. The authors find that during the price spikes, the NAC fell, which means that national assistance to national producers was reduced, by imposing export restrictions or reducing import protection. Under some assumptions, the authors estimate the impact of NAC changes on international prices. They find that during both price boom episodes, changes in border measures had an impact on world prices, and that in the period 2006-2008, developing countries, and exporting countries, were responsible for the majority of the impact, even though importing countries had a significant impact as well. Industrial countries reduced the incidence in 2006-2008 compared to 1972-74.

Anderson, Ivanic and Martin (2013), applying the same methodology but expanding the data to more countries, analyzed the impact of price insulating policies in 2006-2008 for four commodities: rice, wheat, edible oils and maize. Their results, which may be overstated due to model assumptions, show that price insulating policies applied by exporters as well as importers increased the world price of rice by 52 percent, wheat and maize by 18 percent, and edible oils by 31 percent.

Analyzing to what extent these type of policies contribute to the increase in prices is not an easy task, because policies are applied in the context of increasing prices, and there might be endogeneity problems. As Giordani et al. (2016) find, an increase of international prices from their reference levels have a positive and significant impact on the probability of imposing trade policies (either restricting exports or promoting imports). The authors address the endogeneity problem through two different strategies: by increasing the number of lags in the independent variables and through an instrumental variables approach. Their results show that during 2008-11, there was a "multiplier effect" of trade policies on food prices: a one standard deviation increase in overall global trade policy (equivalent to 20%) utilization increased staple food prices by a range of 22 and 56 percent. The main shortcomings of this analysis are that the authors do not differentiate between different trade policies, and they do not take into account the magnitude of the change in policies, but only the likelihood of the utilization of them.

Solleder (2013) focuses on the role of export taxes on international prices of all types of commodities, not just agricultural products. The author estimates a gravity equation in which she includes information of export taxes applied during the crisis period, thus taking into account the magnitude of trade policy changes. Results show that a 1% increase in the rate of export taxes leads to a 3.8% decrease in export quantities and a 2.8% decrease in export values; with the difference driven by an increase in export prices. These results are mainly driven by export taxes applied in the extractive sector: when the author introduced interaction dummies to differentiate across sectors, she found that the impact of export taxes on agricultural trade was not statistically significant, which might be explained by the fact that export bans and quotas are more frequently applied in the sector but are not included in the dataset.

Rude and An (2015) estimate the impact of export restrictions on food price volatility in four grain markets. Even when they do find some evidence that supports the hypothesis that export restrictions, both taxes and quantitative restrictions, had an impact on price volatility for wheat and rice in the period 2006-11, they also find that the magnitude of the impact is of the same magnitude as other factors, such as oil price variability and real interest rates. Moreover, they warn about the possibility of other unobservable factors affecting price surges, and that export restrictions are a policy response to those unobservable factors. Lastly, they do not discard the probability that other trade measures were implemented during the period of analysis, such as import tariff decreases, also had an impact on food price volatility.

In sum, there is evidence that verifies the impact of trade policies on agricultural prices. However, to our knowledge no study has analyzed the differentiated impact of export restrictions on one side and import policies on the other, taking into account all types of agricultural products. Also, no previous study distinguishes the impact of the different types of export restriction policies. In this paper, we try to overfill these gaps. In the next section we present the data and methodology applied to do so.

3. The Export Restrictions in Agriculture (ERA) database

As countries are not obliged to notify export restrictions to the WTO, there is no systematic documenting of the export restrictions applied. Therefore, in order to carry out our analysis, we first developed a comprehensive database of all export restrictions applied worldwide. We restricted the time coverage and focus on a 10-year period: 2005-2014 (with some updated information up to 2015), and we restricted the analysis to agriculture products as defined by the WTO. The database includes information on introduction of measures, as well as modifications and elimination of measures in force. We consider all types of export restrictions: export taxes, export bans, export quotas, reference or minimum prices, non-automatic export licenses, and other measures.

In order to build the database, we took information from many different sources, and in each case we checked the information with official country information when it was available. Our main sources of information were WTO Trade Policy Reviews, Global Trade Alert webpage and available databases on export restrictions: WTO Trade Monitoring Database, OECD inventory of restrictions on exports of raw materials, Agricultural Market Information System (AMIS) policy database, FAO Food price monitoring and analysis, EC Market Access Database, and Panel Export Taxes (PET) database (Solleder 2013). Only measures that were issued by legal authorities at the national level were considered.

We included short time measures, as short as few weeks, in order to capture the volatility of export restrictions, especially during the food price crisis. We also have information on extended measures.

We collected information on export restrictions at the highest disaggregated level of products as defined by each country. In most cases, they are defined at the eight- or ten-digits. Then, we converted each code to the Harmonized System 2002 (HS02) nomenclature. In some cases, this implied taking averages of taxes or quotas defined at a higher disaggregated level.

For export taxes, we include information on the type of tax applied – ad valorem, specific, or mix. As the database includes one observation per exporting country, product and year, we took averages in case export taxes were applied for a few months. We also included the average rate taking into account the number of weeks the measure was in force, and also the maximum rate applied in that year – in case exports only took place during the time the maximum rate was enforced.

We expressed all specific taxes in USD per metric ton, using exchange rates information from World Development Indicators. The database includes five variables for export taxes: average ad valorem rate, maximum ad valorem rate, average specific tax rate, maximum specific tax rate, and the number of days of enforcement in a given year.

For measures other than export taxes (i.e. export bans, export quotas, reference prices, non-automatic licenses, and other measures), we introduced dummy variables that indicate the presence of a measure, as well as a time variable showing the number of days the measure was in place. In the case of export quotas, we included the size of the quota measured in tones. We

included the maximum value, even when the quota is shared among different products at the six-digit HS level.

Finally, we also include the source of information, and when the information was available, the reason the measure was applied.

Some difficulties arose when building the database. First, not all measures could be verified in official sources. Second, in some cases the official documents were only available in the official language of the country and were difficult to translate. Third, the database does not account for countries that apply restrictions without issuing legal regulations. Finally, it is usually easier to find information about the application of a new measure than the elimination of a current one.

The result is a database which includes 555 different instances when a measure[5] was applied across 36 countries, which includes introductions, extensions, eliminations, revisions or modifications of export restrictions in the agriculture sector between 2005 and 2014. To our knowledge, this is the most comprehensive database on export restrictions to date. The database is available to the public and fills an important information gap on agricultural export restrictions.

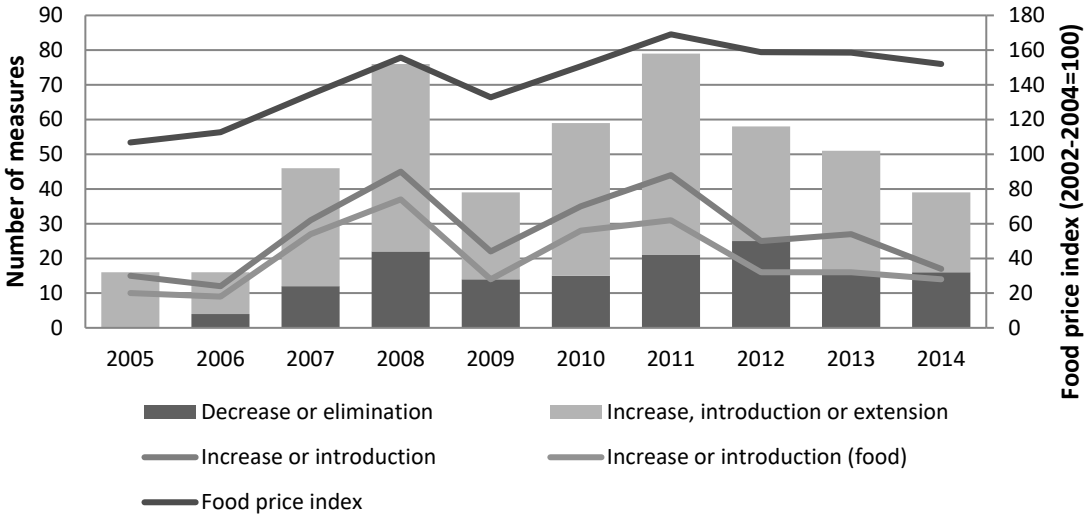
[5] By measure we mean any law, decree or resolution that introduces changes in the national regulation of export restrictions.

4. Agricultural export restrictions in 2005-2014

Of the 555 measures included in ERA database, we focus our analysis on the 273 measures that represent the introduction of new restrictions or a tightening of restrictions already in place (e.g. if a country substitutes an export tax for an export ban, if an export tax rate increases, or a decrease in an export quota).

In Figure 2 we show the number of measures introduced and removed, each year between 2005 and 2014. The number of new or extended measures exceeds the number of eliminated or loosen measures in all years. There are two peaks in the number of measures introduced: in 2008 and 2011. In those years, around 55 measures introduced, extended, or increased a type of export restriction on agriculture products. The number of measures introduced in the period is highly correlated with the value of the food price index estimated by FAO (also included in the figure).

Figure 2. Number of official measures that introduce changes in export restrictions, 2005-2014

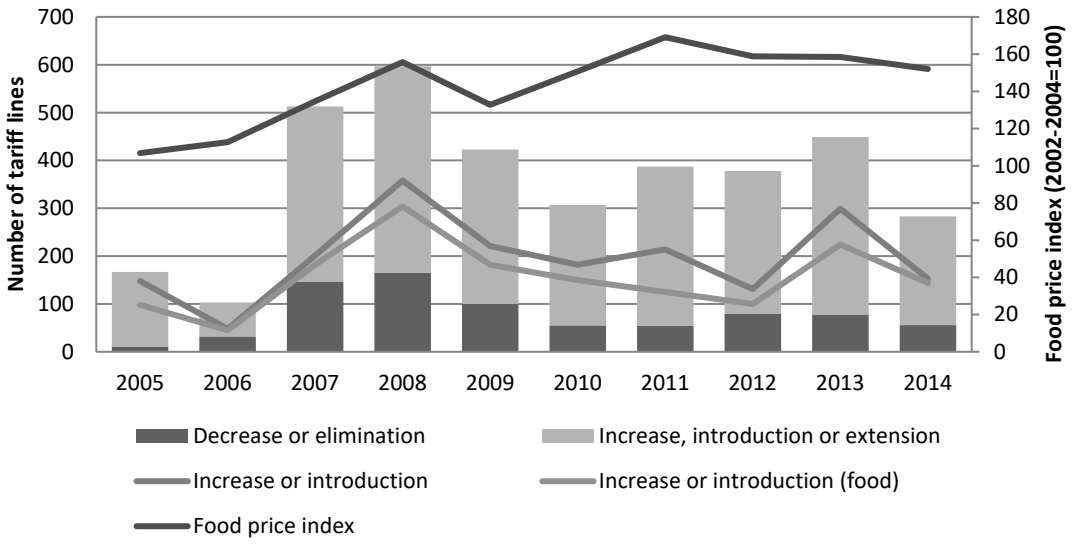


Source: Own elaboration with data from ERA

However, the number of measures does not provide an overall picture of how many products are affected, as one measure may introduce a restriction to only one product or to a large number of products. When we consider the number of products[6] affected by those measures (Figure 3), the peaks in the introduction or increase of export restrictions are in 2008 and 2013, which accounted for around 300 products. We must keep in mind that this is the number of new products affected each year, but the number of total products subject to export restrictions is much higher, especially in the latter years of our analysis. Many measures introduced in the early years of the food crisis remained in force during the whole period.

[6] By products we mean six-digit codes of HS 2002.

Figure 3. Number of products affected by official measures that introduce changes in export restrictions, 2005-2014



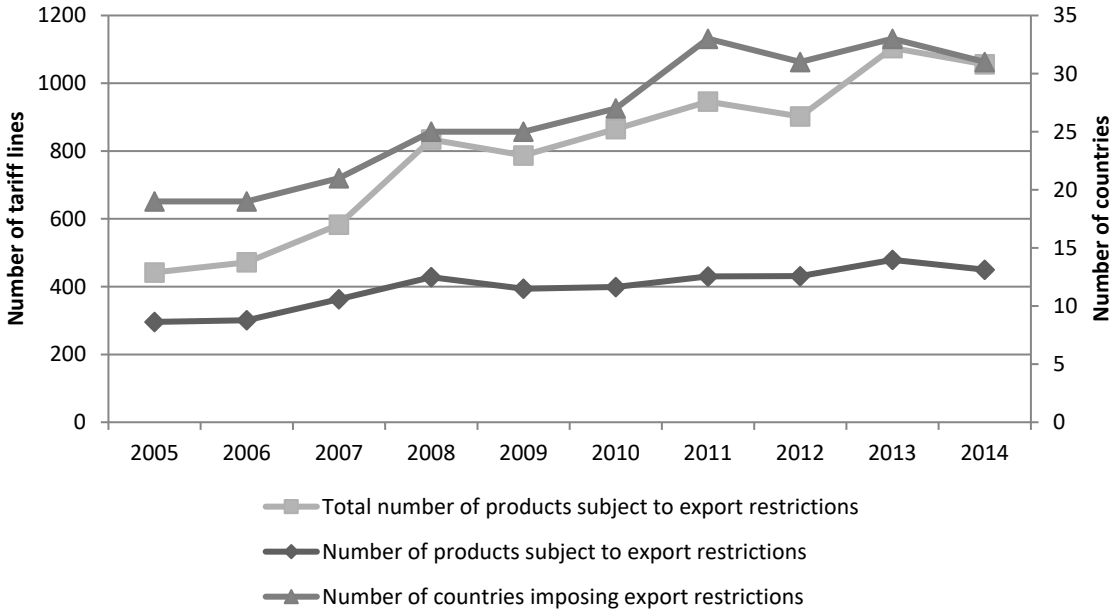
Source: Own elaboration with data from ERA
Note: products are defined at six-digit HS 2002 nomenclature

Figure 4 shows the number of products affected by any measure each year and the number of affected products multiplied by the number of countries imposing measures on those products ("total number of products"). The number of affected products increased from 2005 to 2008, stayed relatively stable until 2013, and then increased. Out of the 692 agricultural products as defined at the six-digit HS 2002 classification, 504 had some kind of export restriction in 2006-2012, which means that export restrictions were imposed almost 73% of all agriculture products in those years. This percentage is slightly higher when we consider the entire period between 2005 and 2014 where 77% of agricultural products had some sort of export restriction. Even though this figure has decreased in the later years, the percentage of agricultural products subject to export restrictions still remains high. It should be noted that a fairly high number of products (303) were already affected in 2005, before the food crisis began. In fact, some of these products are affected by measures as old as 50 years.[7]

When we consider the total number of products affected by export restrictions, the trend is increasing the entire period (2005-2014).[8] This implies that even when the number of affected products remained relatively stable, the number of countries imposing the measures increased, from 19 countries in 2005 to 33 in 2013.

[7] For example, Costa Rica introduced an export tax on coffee in 1961, and Malaysia introduced export tax on crude palm oil on 1974.
[8] That is, if two countries impose an export restriction on the same product, we count it twice in "total number of products".

Figure 4. Number of measures in force and products affected with restrictions by year, 2005-2014



Source: Own elaboration with data from ERA

Between 2005 and 2014, 36 countries imposed export restrictions. Table 1 presents the percentage of measures and products by region; the full list of countries imposing new measures is included in table A2 in the Appendix. Most countries imposing measures are developing countries; whereas a few of them are least developed countries, mainly from Sub-Saharan Africa, and only one country is an OECD member, Australia. Taking into account the number of measures applied in the period, the countries that applied the most measures are Argentina, India, and Vietnam. If we take into account the number of products affected by these measures, the top countries are China, Venezuela and Argentina.

Table 1. Measures and products affected by regions. In percentage, 2005-2014

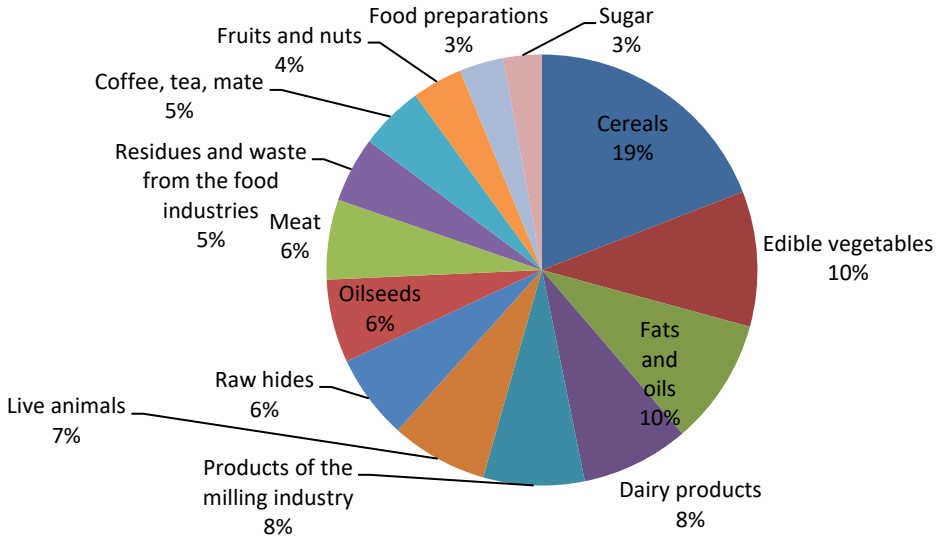
	Measures	*Products*
Latin America & Caribbean	29%	35%
South Asia	23%	17%
East Asia & Pacific	28%	32%
Middle East & North Africa	4%	2%
Europe & Central Asia	12%	10%
Sub-Saharan Africa	5%	4%

Source: Own elaboration with data from ERA
Note: Only measures that introduce new restrictions or extend restrictions in place are considered

As Figure 5 shows, the agricultural products that are mostly affected by new export restrictions in 2005-2014 are cereals, which corresponds to 19% of export restrictions applied during this period, followed by vegetables (10%), fats and oils (10%), dairy products (8%), products of the milling industry (8%), live animals (7%), and raw hides (6%). Within the cereal sector, all types of products are subject to export restrictions, especially rice, affected by 9% of the measures introduced in the period, wheat (4%), and maize (2%). Other products with heavily restricted exports are leguminous

vegetables, raw hides, milk, sugar, live swine, bovine and poultry, and cereal pellets, grains and flours.

Figure 5. Agricultural sectors affected by new export restrictions, 2005-2014



Source: Own elaboration with data from ERA

Note: We weigh measures by the number of products affected, and we include measures that introduce new restrictions, or tighten/extend measures already in place

Thus far, we have considered export restrictions without differentiating between the different types of measures. Table 2 presents the different types of export restrictions introduced during the period, and the average number of years the measure stayed in place. The measures that are more frequently applied and affect a higher percentage of agricultural products are export bans and export taxes. Export bans last on average a shorter time period, whereas export taxes usually remain in place for longer periods. On average, export taxes last 3.5 years although rates are not constant. 19% of measures introduced during the period of analysis were export quotas; however, they affected a low percentage of agricultural products (6%). On the other hand, although few non-automatic licenses were introduced during the period, they affected almost a third of agricultural products.

Table 2. Type of export restrictions introduced or extended between 2005-2014

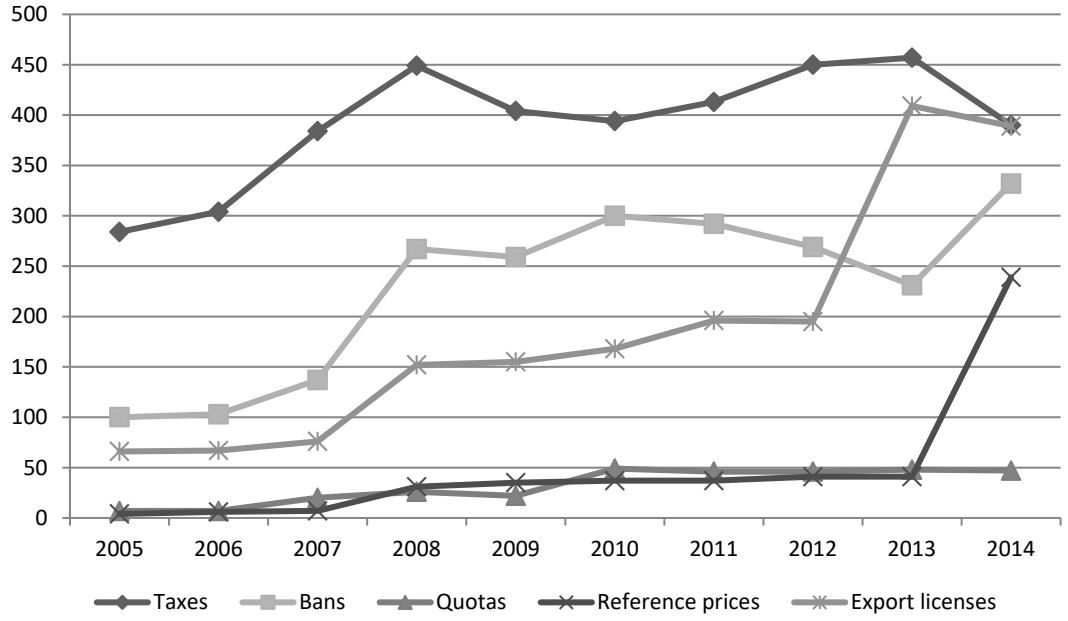
	Share of total measures introduced	*Percentage of agricultural products affected by the measure*	*Average years in force*
Export bans	35%	36%	2.5
Export taxes	23%	29%	3.5
Export quotas	19%	6%	2.6
Reference/minimum prices	11%	4%	1.9
Non automatic licenses	9%	5%	4.7
Other measures	10%	28%	4.5
Total	100%	68%	3.6

Source: Own elaboration with data from ERA

Figure 6 shows the number of products subject to export restrictions by type of measure and by year, taking into account new and established measures. Export taxes affect the highest number of products, even though the number of products affected shows some volatility: there is a peak in the number of products affected by export taxes in 2008, and another peak in 2011. The number of products subject to export bans shows an increasing trend and peaks in 2014. This peak, as well as the peak in export licenses in 2013, is mainly due to export restrictions applied by Venezuela.[9]

Quotas and reference prices are measures that are less frequently applied during the time period we considered. Even though quotas were one of the most frequently applied new measures, the number of products affected by this measure remained generally low during the period.[10] In Figure 6 we consider measures in force in one year. However, some countries substituted one type of export restriction with another within the same year. Thus, in a given year, we may be counting both measures. Consequently, the total number of products affected by export restrictions may not necessarily coincide with the numbers reported in Figure 4.

Figure 6. Type of export restrictions in force, 2005-2014



Source: Own elaboration with data from ERA

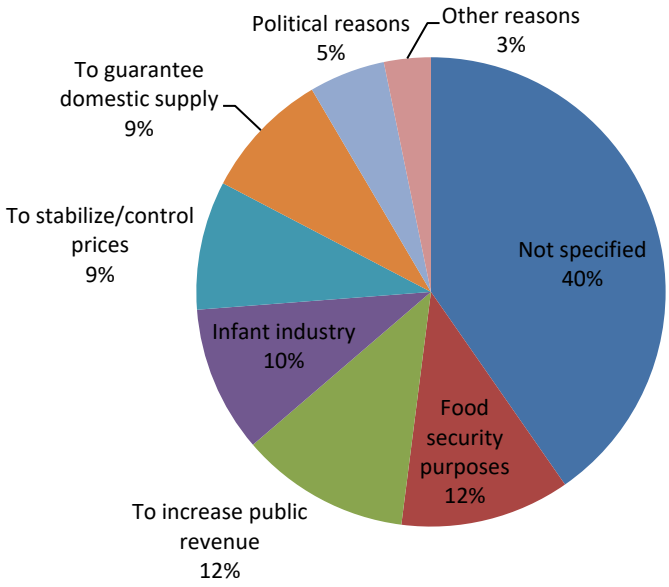
Why did countries impose export restrictions during the food crisis period? Taking into account official information, i.e. information included in the administrative measure that imposes the restriction, among the most frequent justifications are “to guarantee domestic supply”, “for food security purposes”, and “to stabilize or control domestic prices,” all of which could be considered as food security concerns. Given the context of higher food prices, it makes sense that measures were actually applied to control prices and guarantee food access. The other justifications provided

[9] A presidential from August 2014 provides that "it shall be prohibited the export or extraction of items and products of the basic food basket, supplies, medicines, and other imported goods or products to be consumed by the people." http://www.eluniversal.com/economia/140826/venezuelan-government-bans-export-of-21-food-items

[10] Reference or minimum prices are often applied together with export taxes, and in the database, we included those cases as export taxes.

are to promote an infant industry, to increase public revenue, and for political reasons. In most cases, however, no justification is given.

Figure 7. Arguments to justify the introduction of export restrictions



Source: Own elaboration with data from ERA

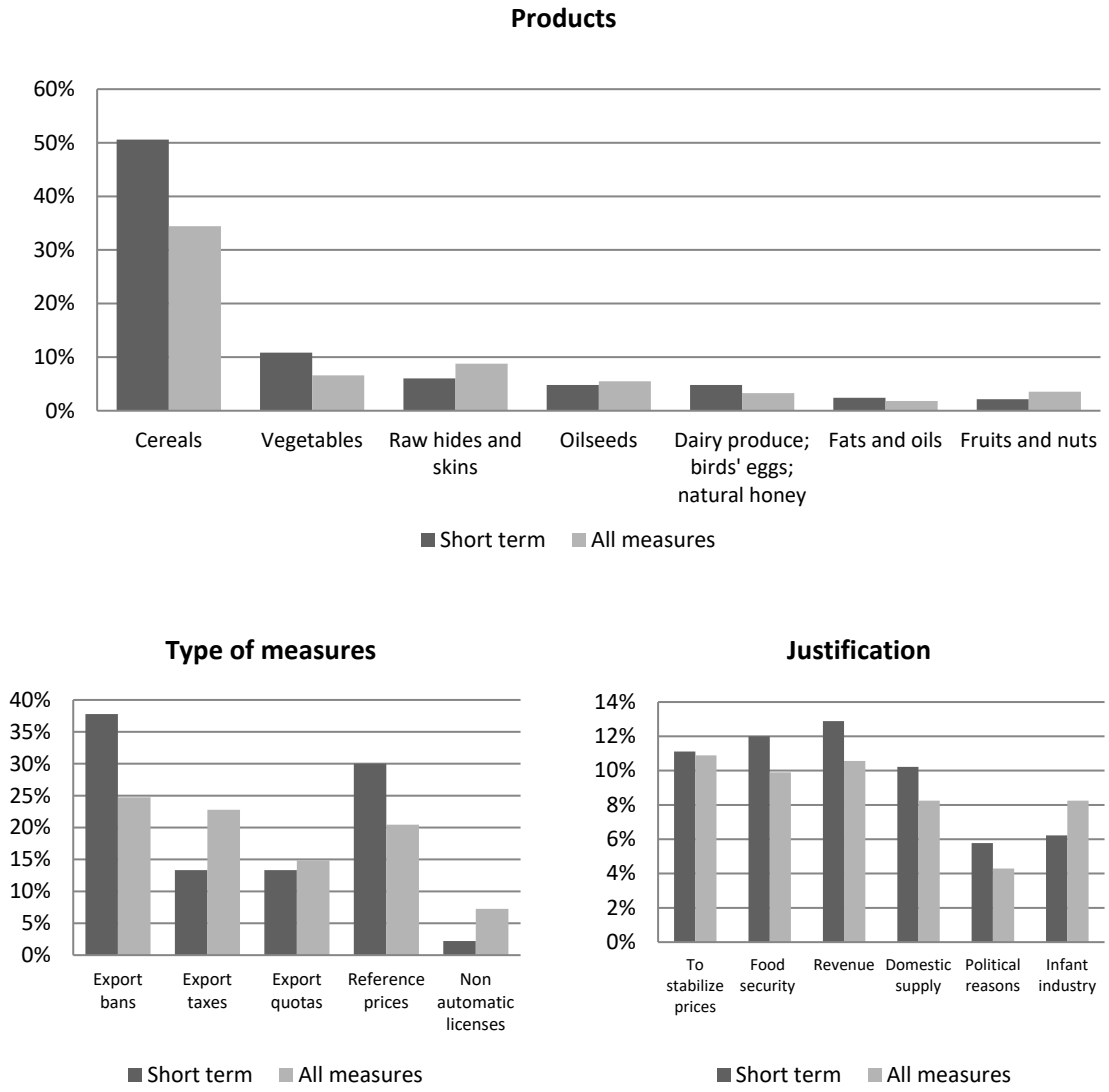
In the period of our analysis there was a significant number of measures applied for shorter time periods, even as short as few weeks. Short-term measures, defined as measures that are in place for less than 6 months, represent almost 30% of measures applied. For example, in 2007 Vietnam introduced an export ban on rice exports that lasted 6 months, which was replaced by an export quota that lasted 5 months, which was then replaced by an export tax.

The following figure (Figure 8) compares short-term measures to long-term measures, analyzing the type of products affected, the types of restrictions applied, and the arguments to justify the application of the measure. As expected, short-term measures affect mostly food products, such as cereals, vegetables, and dairy products. More than half of the short-term measures applied in the period affect cereals and 11% affect edible vegetables, the two types of products most restricted in the period.

Governments usually provide a justification for export restrictions more often when measures are for shorter periods of time. 48% of all measures do not have a justification; this percentage is reduced to 42% among shorter-term measures. The most applied justification among shorter-term measures are to increase public revenues and for food security purposes, whereas the infant industry argument is more frequently used to justify longer-term measures.

Among short-terms measures, export bans are the measure more frequently applied. 38% of short term measures that restrict exports are export bans. Export taxes, on the other hand, are usually applied for longer periods of time.

Figure 8. Short term versus long term measures: products affected, type of measures and justification



Source: Own elaboration with data from ERA

In summary, the information from our database shows that during the period 2005-2014, there was both an increase in the number of countries imposing export restrictions, as well as in the number of products affected by restrictions. Export bans and export taxes were the most popular measures, which affected mainly cereals, fats and oils, products of the milling industry, meat, and live animals. In many cases, countries justified the application of restrictions for food security purposes, especially for short-term measures. However, the infant industry argument was also present, especially for longer term measures.

5. Agricultural trade and other tariff measures in 2005-2014

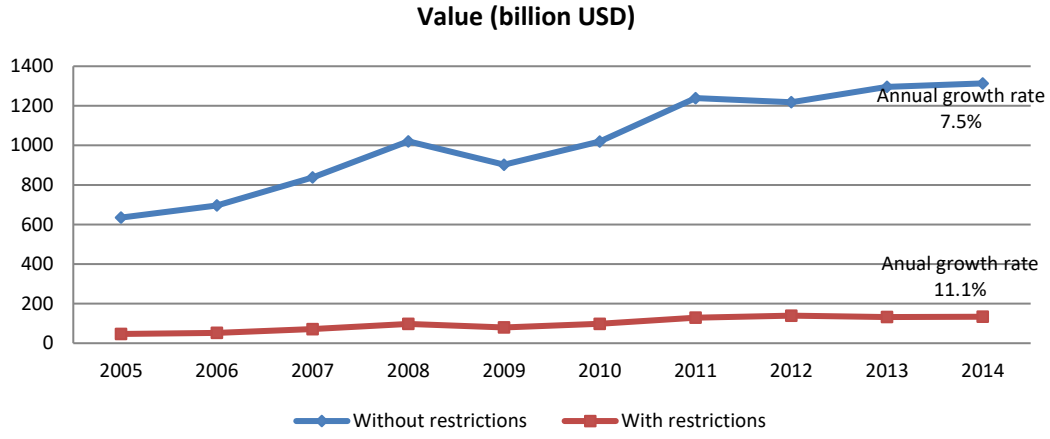
The above analysis only takes into account information from measures applied, regardless of whether they actually affect trade. Although unusual, some countries impose restrictions on

products that are not exported.[11] In order to analyze whether measures actually affect trade, we analyze the evolution of agricultural trade in 2005-2014, differentiating between exports by countries that do not impose restrictions and countries that impose restrictions.

Figure 9 shows the evolution of trade, in value and volume, in the period of our analysis. First, it should be noticed that agricultural exports subject to restrictions represent a small share of total agricultural exports: 6.8% of total value and 14% in total volume at the beginning of the period of analysis. That is, the majority of agricultural trade was not subject to any export restrictions.

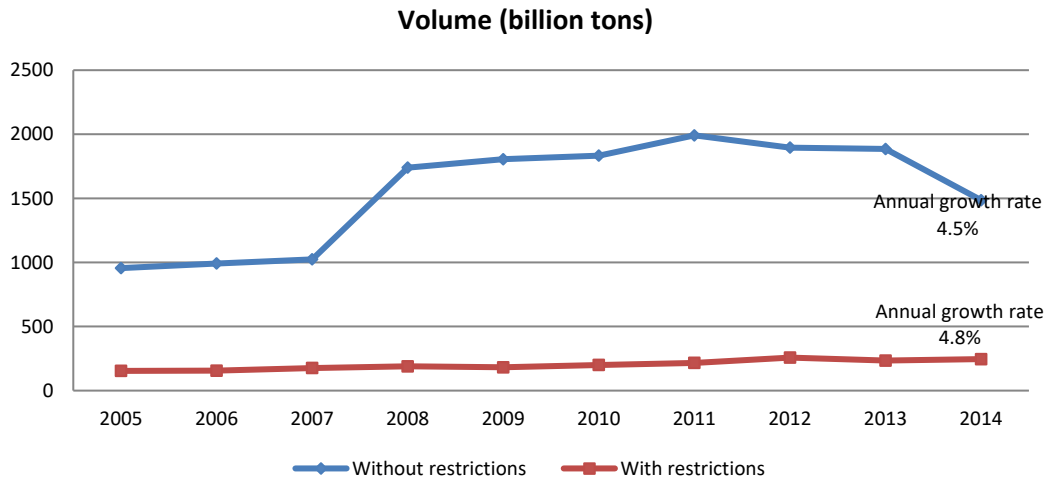
Both agricultural exports subject to restrictions and those that are not restricted show an increasing trend in the period, in value and volume. Somehow surprisingly, exports subject to restrictions increase at a higher rate during the period, although the rate is much higher in value, which may be indicating that the price of agricultural goods subject to restrictions also increased more sharply.[12] This could be due to a number of different reasons. First, it was a period of strong increase in agricultural demand, due to changing consumption patterns from income, population and urbanization increases, as well as higher demand for agricultural products used for animal feed and oilseed production (FAO 2015). Second, as exports of agricultural products tend to be concentrated in a few countries and regions, and many of those countries apply restrictions on some products, exports may have increased in spite of restrictions. Finally, we should keep in mind that for many products, world prices were at particularly high levels, and for some exporters it was still profitable to export, even under tighter export restrictions. For example take the case of soybeans in Argentina, which were heavily taxed in 2009. In spite of this, export volumes reached records in 2010 and 2011.

Figure 9. Evolution of trade in value and volume for agriculture products, for countries imposing export restrictions. 2005-2014



[11] This unusual case could happen for different reasons. One is that export restrictions completely eliminate exports. Another reason, probably more frequent, is that export taxes are sometimes defined for aggregated products, such that, when defined at a disaggregated level, exports on some products are not present. For example, one country may establish an export license on "livestock", but only export certain varieties of animals.

[12] We should keep in mind that data on volumes is less reliable than data on value, as volumes are registered in different units and conversions are not always straightforward.

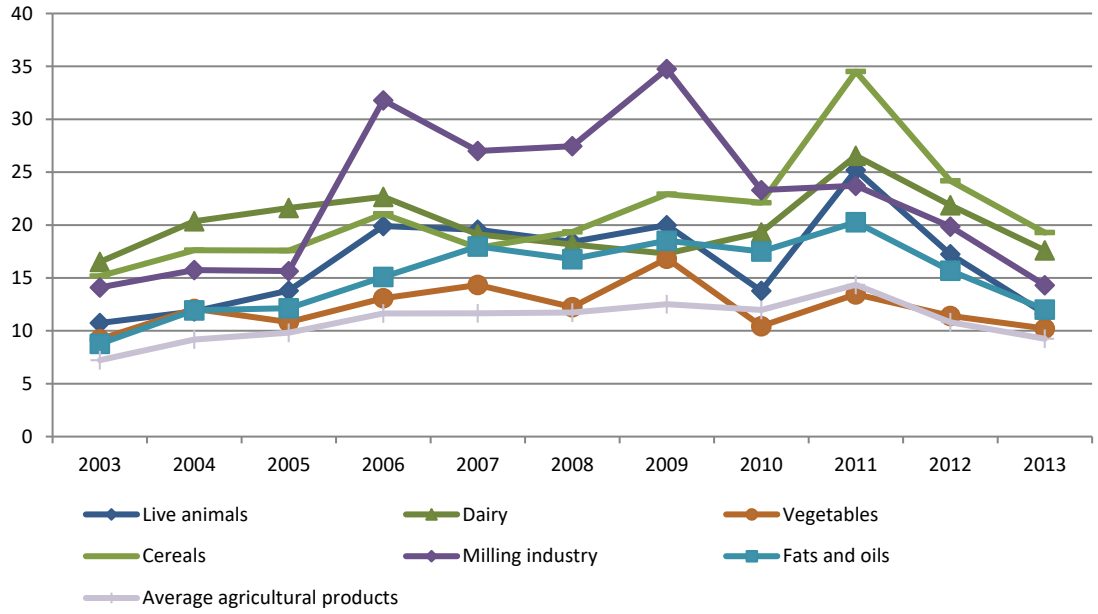


Source: own elaboration with data from BACI and ERA

As we have presented in the introduction, export restrictions were not the only type of policy applied during the price crisis in order to control domestic prices. Importing countries may also react to high world prices by decreasing applied tariffs on agricultural products, lowering domestic prices and contributing to the increase in demand. In a survey of measures applied in 2006-2008, the FAO (2008) finds that half of the countries surveyed lowered or eliminated import tariff on cereals during those years.

Figure 10 presents the evolution of the gap between bound tariffs and applied tariffs. Even when tariffs may have also decreased in recent years due to trade negotiations, in some years and for some products, the gap between bound tariffs and applied tariffs increased, which means that applied tariffs fell more than bound tariffs. This is particularly true for some products at specific point in time: the difference between bound and applied tariffs on cereals increased by 17 percentage points in 2011 compared to levels in 2003. In the case milling industry products, the difference spiked in 2006 and 2009, while in the case of cereals, the sector most affected by export restrictions, the difference spiked in 2011. The average gap between bound and applied tariffs for all agricultural products increased in the period, showing a slight spike in 2011, and fell in 2012 and 2013.

Figure 10. Difference between bound and applied MFN tariffs in selected agricultural products. 2003-2013



Source: own elaboration with data from TRAINS

As we mentioned above, trade measures, either applied on exports or on imports, will have an effect on world prices if the country imposing the measure has world market power. For this reason, we compared the probability of applying export restrictions by exporting countries with and without market power. Table 3 shows the average incidence of export restrictions in agricultural products between 2007 and 2013, differentiating between big exporters, defined as countries that export more than 25% of total exports in the period 2003-2006 for each product, and the rest of exporters. We are considering a dummy variable that takes a value of 1 if the country has an export restriction on a specific product, in a specific year, and 0 if it does not apply restrictions. On average, between 2007 and 2013, big exporters applied more restrictions than the rest of exporters. This difference is significant at the 99% level.

Table 3. Two sample t test results: probability of applying export restrictions

	Average Export Restriction	*Std dev.*
Big exporters	0.051	0.2202
Rest of exporters	0.006	0.0774

Source: own estimation with data from BACI and ERA

We also compared the mean variation in tariffs by importers with and without market power. When we compare the average change in applied MFN tariffs between 2003-2006 and 2009-2012, differentiating between big importers (countries that import more than 25% of total imports of a specific product) and the rest of importers, we see that even when tariffs fall in both groups, the average fall is more pronounced among big importers, and that the difference in means is statistically different (see table 4).

Table 4. Two sample t test results: average tariff variation

	Average Tariff Variation	*Std dev.*
Big importers	-0.2219	0.2660
Rest of importers	-0.1156	0.4854

Source: own estimation with data from BACI and TRAINS

This result, combined with results presented in table 3, show that both big exporters and big importers applied more actively trade policies in order to reduce exports or increase imports. Both types of policies might have had an effect on agricultural trade and world prices. We addressed in the next section the extent to which trade and prices were affected by these policies.

6. The effects of export restrictions on trade

As mentioned, the increasing use of exports restrictions raised important concerns about the effects of these measures on food prices. Our aim in this section is to analyze the effects that the applied measures have had in terms of reducing traded volumes or increasing prices. Lacking direct information on prices we infer the effects of export barriers on prices on the basis of their effects on traded values and volumes.

We argue that any estimation of exports restriction impacts needs to control for the mirroring barriers imposed by the importing country, generally omitted in extant studies. Tariffs have a direct negative effect on trade, and with our novel database we can show that tariffs and export taxes are negatively correlated. Since the coefficient for export restrictions is expected to be negative, we also know that the omitted variable bias is negative. This means that the estimated coefficient for export taxes when omitting import tariffs is lower than the true value of the parameter (i.e. the estimation is higher in absolute value, leading to over reject non significance).

Modelling export flows

Trade flows strongly depend on the distance between the two partners and their economic size, as claimed by the generalized use of the gravity model of trade. The distance between countries account for the differences in trade costs among bilateral pairs, and is often complemented with other factors affecting bilateral trade costs. We are specifically interested in the effects that trade policy has on trade flows, so we include import tariffs and export restrictions variables in our gravity specification.

Gravity models have long been used for analysis of international trade, since the original proposal in Tinbergen (1962) to the present. Starting with a naïve interpretation in analogy with physics, the gravity model has evolved significantly and now has a fairly solid micro-foundation (Anderson and van Wincoop, 2003). One main conclusion was revealed by its microeconomic foundation: the model needs to control for "multilateral trade resistance" to adequately gather the relative price effects which are unobserved in its usual specification. In their structural gravity model the multilateral resistance terms control for the resistances of each partner in their trade with every other country, formalizing an early contribution of Anderson (1979) stating that trade resistances shall be included in relative terms. Empirically, this is commonly done through the inclusion of country fixed effects or, when pooled in time, time-varying country fixed effects (Feenstra, 2004; Redding and Venables, 2004).[13]

The main difficulty that arises when estimating the effects of policy barriers on trade comes from the fact that protective measures tend to be applied in sectors and periods in which the potential trade flow is higher, producing a reverse causality problem that would make the estimations inconsistent.[14] This is a source of endogeneity both when explaining traded volumes and traded

[13] Two other relevant contributions are Eaton and Kortum (2002) and Helpman, Melitz and Rubinstein (2008) who reconcile the gravity model with the increasingly popular firm heterogeneity approaches. For a complete and up-to-date review of the state of the art in the estimation of gravity models, see Head and Mayer (2013).

[14] The effect of export taxes on trade being presumably negative, and the reverse causality effect (trade on export taxes) presumably positive (more protection in relevant goods), the sign of the asymptotic bias is the sign of the reverse effect, positive in our case (see e.g. Basu 2015). Thus, this asymptotic bias caused by reverse causality offsets (at least partially)

values, but the problem should be even more serious in the case of values due to the role of prices, since an increase of international prices can have a positive impact on the probability of imposing trade policies (Giordani et al., 2016). Our strategy will deal with endogeneity issues, and will also allow a flexible treatment of two potential methodological concerns, as the dynamic patterns of the effects and the differences across industries.

The election of an adequate aggregation level is a delicate matter. On the one hand, a higher disaggregation level is a better way to avoid aggregation bias when the effects are heterogeneous across sectors. On the other hand, export barriers are not so widespread and highly disaggregated estimations start to depend on individual measures (a specific measure taken by one country in one product). Our approach is somewhere in between, we use highly disaggregated data (six-digits of the Harmonized System), but we estimate at the sector level (two- digits of the Harmonized System). We thus take advantage of the granularity of our dataset, while allowing a considerable degree of heterogeneity across sectors.

Data

As presented in the previous sections, we have a fairly complete database of export restrictions, containing detailed trade policy measures on exports of agricultural products. Export restrictions have been applied by 37 countries, and they involve all the other countries in the world as destinations. Given our need to control for tariffs, an adequate estimation of the tariff effect requires the inclusion of the entire country sample as an origin of exports. Thus, we have a square origin-to-destination database for 109 countries which cover around 85% of world trade in agricultural products (the list of countries is presented in the Appendix).

Also, the inclusion of tariffs expands the relevant products sample, since it becomes important to include the whole array of 692 agricultural products and not only those where export restrictions are applied. For each origin-destination-product we observe exports (values and volumes), export restrictions, and import tariffs by year.[15] Results being obtained at the two-digit level, the array of products is divided into 33 sectors.

Regarding export measures, the set of available variables includes ad valorem tax rates, specific tax rates (with their ad valorem equivalents), and dummy variables for the existence of prohibitions, quotas, reference prices, and non-automatic licenses. For taxes, we use a variable mixing ad valorem rates and ad valorem equivalents of specific taxes (ad valorem rates take precedence in case of both types of measure being in place). More specifically, we use the maximum rate applied during the year, and we weight the resulting variable according to the percentage of the year in which any export tax has been in place. The last four policy measures are frequently substituted among each other, and this makes the estimation of each separate effect problematic. Our estimations will forego some information in order to address this issue, using a summary dummy

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the negative bias caused by unduly omitting import tariffs in the model (as done in most of the extant studies on the effects of exports taxes).

[15] We have 8,297,080 origin-destination-product panel units, which pooled for a nine-year period gives a comparatively large dataset of 74,673,720 observations.

variable which indicates the existence of at least one of the mentioned four types of export restrictions.

Turning to import tariffs, they are built on the basis of ad valorem tariffs and the ad valorem equivalents of specific tariffs taken from the TRAINS database, one of the most complete datasets for tariffs information.[16] Trade information comes from CEPII-BACI database, built with original information from the UNStat-COMTRADE dataset, and is measured in current US Dollars. BACI has the advantage of reconciling the declarations of exporters and importers on each trade flow, which reduces the amount of missing information. Also, CIF costs are removed from import values in BACI.[17]

Estimation strategy

We are able to use panel data estimation methods taking origin-destination-product triplets as our panel units. Specific unobservable effects (η_{ijh}) are to be suspected, because trade costs are likely to be different for each country-pair in each product market. Many factors explain these differences, such as distance between the members of the pair or particularities in transportation costs for every product, among many others.

As a gravity model of trade, our specification requires the inclusion of the economic size of the partners in each specific sector. Since production and consumption data are unavailable at any disaggregated level for our country sample, we compute total exports in sector h from each origin ($Xtot_{iht}$) and total imports in sector h for each destination ($Mtot_{jht}$). Regarding trade costs, the typical distance and contiguity variables together with all the time invariant origin-destination-product specific costs are subsumed in the fixed effects. Since our aim is to estimate the effects of policy measures, we extend the trade costs term to include export tax rates, an "other export restrictions" dummy, and import tariff rates.

Trade may require time to adjust to changes in trade costs, since most transactions in international trade are contracted months in advance and are costly to change. This makes static models highly restrictive, and calls for dynamic specifications allowing for a richer structure in the process of adjustment to changes in trade costs. The dynamic pattern may encompass delayed effects of trade costs on trade flows as well as some dependence of current trade on past trade. The former effect is mostly due to contract rigidities and justifies the inclusion of lagged regressors (distributed lags model); while the latter is associated to the magnitude of the difference between the new equilibrium trade level and the previous observed level, and requires the inclusion of lagged values of the dependent variable (dynamic model).

We use the customary log-linear formulation of the gravity model. Thus, in a basic setup our model is:

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[16] Nonetheless, missing data are scattered throughout the dataset (affecting 17% of our sample). Using both MFN applied and preferential rates, effectively applied rates were built for all non-missing origin-destination-product-year observations. In many cases both ad valorem and specific tariffs were found to be in place, and we decided to make ad valorem tariffs prevail based on the higher confidence on their amounts. The same criterion has been used in the case of ad valorem and specific taxes being simultaneously applied by the exporter country.

[17] For more details, see Gaulier and Zignago (2010).

$$X_{ijht} = \alpha_1 X_{ijh(t-1)} + \sum_{q=0}^{1} \beta_q Xtax_{ijh(t-q)} + \sum_{q=0}^{1} \gamma_q Xrestr_{ijh(t-q)} + \sum_{q=0}^{1} \delta_q Mtar_{ijh(t-q)} + \theta_1 Xtot_{ih(t-1)} + \theta_2 Mtot_{jh(t-1)} + \tau_t + \eta_{ijh} + \varepsilon_{ijht} \quad (1)$$

Where X_{ijht} is the log of exports of product h from country i to country j in period t; $Xtax_{ijht}$ is the log of export taxes imposed by country i when exporting product h to country j (expressed as 1+rate before transformation); $Mtar_{ijht}$ is the log of import tariffs imposed by country j when importing product h from country i (expressed as 1+rate before transformation); $Xrestr_{ijht}$ is a dummy indicating if country i is requiring non-automatic licenses, uses reference prices, imposes quotas, or applies bans in exports of product h to country j; τ_t are specific time effects, $\eta_{ij} + \varepsilon_{ijt}$ is an error term including a pair-product specific time-invariant unobserved effect and a reminder disturbance term assumed to be clustered at the pair-product (i, j, h) level.[18]

In equation (1) the depth of the dynamic part is arbitrarily set to one, and the same happens with the length of the distributed lags in the three main explanatory variables. Observe that α_1 is a first order autocorrelation coefficient; β_q and δ_q are the elasticities of exports to the q-lag of export taxes and the q-lag of import tariffs respectively; and γ_q is the semi-elasticity showing the impact of the q-lag of the existence of other export restrictions; all of them to be estimated. As might be clear, βs and γs are the key parameters of interest in this paper.

Endogeneity

Dynamic models for panel data have been increasingly used over the last two decades. A difficulty with this family of models is that the lagged dependent variable is by definition endogenous, because individual effects η_{ijh} are part of the data generation process in both current and lagged periods. Estimating the model in first differences (FD) or forward orthogonal deviations (FOD) allows eliminating the individual effects, but endogeneity remains because ΔX_{ijht} contains X_{ijht-1}, and $\Delta\varepsilon_{ijht}$ contains ε_{ijht-1}, correlated by definition with X_{ijht-1} and makes results inconsistent (Nickell, 1981). As proposed by Anderson and Hsiao (1982), under the assumption of independent and identically distributed errors, lagged levels or lagged FD/FOD of dependent variable are valid instruments given their high correlation with differences of the dependent variable and the lack of correlation with the composite error term. The only precaution needed is to avoid taking the first lag.

However, the simple instrumental variable approach does not fully exploit the available information, and more efficient estimates can be obtained through the Generalized Method of Moments (GMM), applied to dynamic panel data models by Holtz-Eakin, Newey and Rosen (1988) and popularized by Arellano and Bond (1991). Seeing the model as a system of equations, one per year, they propose to instrument each equation with a variable amount of available lags (increasing as t grows), which means that all the possible orthogonality conditions may be used. The resulting

[18] Note that taking the logarithm of exports means that we use only positive trade observations, and hence our estimations are conditional on the existence of trade. Given the model is dynamic, results are also conditional on the existence of trade in one or two previous periods. For this reason our model will not explain changes in the extensive margin of trade (trade starting or being interrupted), focusing on the intensive margin (variations in the level of trade for trading partners).

estimator is known as the Difference-GMM estimator and will be used here to estimate the dynamic panel gravity model.

A major advantage of this strategy is that it also provides a way to deal with the endogeneity of other included explanatory variables, both with internal instruments and external instruments in case they are available. The procedure to instrument these variables can be analogous to the one used for the lagged dependent variable ("GMM style") or can instrument the variables with their own lags ("IV style"). In our case this is critical, because both export taxes and tariffs are likely endogenous because of reverse causality, since countries tend to protect themselves in products that are intensely traded.

Despite these advantages, two important limitations have to be signaled. On one hand, as we have mentioned, it is theoretically important to include year-importer and year-exporter fixed effects in gravity models, since they would control for multilateral resistance terms. In the case of a disaggregated gravity model the usual recommendation is to include year-importer-product and year-exporter-product fixed effects, since multilateral resistances can vary by product and time period. However, having 109 countries and 692 products in 9 years the number of fixed effects rapidly exceeds computation capacity with standard software. Additionally, having to instrument every included variable, all the fixed effects incorporated must be added as instruments, rapidly causing a problem known as instruments proliferation which invalidates the results. Thus, we only include year fixed effects in our specifications, and we then test for robustness when including the necessary fixed effects (although we can no longer control for endogeneity).

On the other hand, it is worth noting that our dependent variable is strongly censored, since there is no trade for 93% of total origin-destination-product observations in a typical year of our sample. Censure and selection are challenging features within the framework of the dynamic panel data models. The issue is now receiving considerable attention but no consolidated method is available. An in-depth treatment of this issue goes beyond the scope of this paper.

Estimated Equation

The estimation of equation (1) in a typical specification leads to:

$$\Delta X_{ijht} = \alpha_1 \Delta X_{ijh(t-1)} + \sum_{q=0}^{1} \beta_q \Delta Xtax_{ijh(t-q)} + \sum_{q=0}^{1} \gamma_q \Delta Xrestr_{ijh(t-q)} + \sum_{q=0}^{1} \delta_q \Delta Mtar_{ijh(t-q)} + \theta_1 \Delta Xtot_{ih(t-1)} + \theta_2 \Delta Mtot_{jh(t-1)} + \tau_t + \Delta\varepsilon_{ijht} \quad (2)$$

In this case, the complete set of orthogonality conditions for equation (2) when instrumenting first differences in policy variables with their lags in levels, is given by:

$$
\begin{aligned}
E\left[X_{ijh(t-s)}\Delta\varepsilon_{ijht}\right] &= 0 && \text{for } s = 2, \dots, t-1;\ t = 3, \dots, T \\
E\left[Xtax_{ijh(t-q-2)}\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } q = 0, 1 \\
E\left[Xrestr_{ijh(t-q-2)}\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } q = 0, 1 \\
E\left[Mtar_{ijh(t-q-2)}\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } q = 0, 1 \\
E\left[Xtot_{ih(t-1)}\Delta\varepsilon_{ijt}\right] &= 0 \\
E\left[Mtot_{jh(t-1)}\Delta\varepsilon_{ijt}\right] &= 0 \\
E\left[\Delta\tau_t\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } t = 3, \dots, T
\end{aligned}
\tag{3}
$$

Alternatively, when first differences in policy variables are instrumented using GMM style, the second, third, and fourth equations in the set of orthogonality conditions (3) have to be replaced by:

$$
\begin{aligned}
E\left[Xtax_{ijh(t-q-s)}\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } q = 0, 1;\ s = 2, \dots, t-1;\ t = 3, \dots, T \\
E\left[Xrestr_{ijh(t-q-s)}\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } q = 0, 1;\ s = 2, \dots, t-1;\ t = 3, \dots, T \\
E\left[Mtar_{ijh(t-q-s)}\Delta\varepsilon_{ijt}\right] &= 0 && \text{for } q = 0, 1;\ s = 2, \dots, t-1;\ t = 3, \dots, T
\end{aligned}
\tag{4}
$$

Our preferred set of instruments varies by sector according to their performance in terms of the validity of the overidentifying restrictions (Sargan, 1958; Hansen, 1982) and the lack of serial correlation (Arellano and Bond, 1991). In some cases we use GMM style with a shorter span of lags as instruments, in other cases we use IV style with closer or farther lags as instruments, or we even use no instruments for policy variables when specification tests indicate so.

Three other variations are used to reach an adequate performance of each regression. In some cases we use forward orthogonal deviations instead of the first differences transformation. In other cases we allow for a longer dynamic structure in the model (two lags of the dependent variable). Finally, for some sectors we had to collapse the matrix of instruments in a way that makes the instrument count to increase linearly with the total number of periods.[19]

Extant results in the literature

The most direct precedent of our study is the work of Solleder (2013), who shares the aim of estimating the effect of export taxes on prices and suggests an indirect approach through the estimation of the effects on values and quantities. Since the effect of policy measures on values is a combination of their effects on quantities (expected to be negative) and prices (expected to be positive), a comparison between the effects of policies on quantities and values allow inferring their effects on prices. In an extreme case where all exporters have market power and are able to transfer e.g. export taxes to prices, the effects of taxes on quantities would be null, and thus the implicit effect on prices would be equal to the estimated effect on values (in this particular case all the tax burden is born by importers in the destination country). In the opposite extreme case all exporters are price takers and thus the effect of export taxes on prices is zero while the effect on values is equal to the effect on quantities, and exporters in the origin country bear the tax burden). We obviously expect the estimation results to lie somewhere between these two extreme cases, and

[19] This method is equivalent to projecting the explanatory variables onto the full Arellano-Bond set of instruments, while constraining the coefficients on certain lags in the projection to be null (Roodman, 2008). All the estimations were done using the command xtabond2 (Roodman, 2009) in Stata 14 MP. The computations were performed at University of Geneva on the Baobab cluster.

e.g. the similarity between the effects on values and the effects on quantities will reveal that no effect exists on unobserved prices.

Estimation Results

In Table 5 we present a summary of our baseline results, reporting the degree in which we have evidence of a price effect of each policy measure. The details of the estimated coefficients for each policy variable are reported in Table A4 in the Annex. Table A5 summarizes the instruments used in each case, as well as the length of the dynamic part and the transformation applied in each sector.[20]

The main conclusion is that the expected price effects are not observed in many sectors, and when there is some evidence it is generally weak. We refer hereafter as "strong evidence" of a price effect when we find that an export restriction reduces traded volumes more than traded values (which could even increase) or when volumes are not affected but values increase. In order to compare the elasticity of a policy measure on values and quantities, we compute a simple test for equality of means of the two estimated coefficients. In some cases there is no statistically significant difference between the two coefficients, but a seemingly contradictory result shows that one of them is statistically equal to zero, while the other is not. We will refer to these cases as having "weak evidence" of a price effect. Almost 75% of the price effects we detect fall in this last category. A final situation is when both the effect on quantities and values are significant, we fail to reject equality of the two coefficients, but there is a noticeable difference between the two, and we refer to these cases as "very weak evidence" of a price effect.

Our main results show that export taxes have a negative effect on traded volumes and a positive effect on prices for Dairy products; Live trees and plants; Edible vegetables; Oilseeds and oleaginous fruits; Fats and oils; Sugar; Edible preparations; Beverages and spirits; and Residues and waste from the food industry (Table 5).

For some of these sectors, the impact of export taxes on prices is due to only a few countries imposing export taxes. In some cases, as few as one or two: Argentina for Live trees and plants; Pakistan for Sugar, Argentina and Uruguay for Dairy products; Kenya and Nepal for Edible preparations; and Kenya and Russia for Beverages and spirits. In the case of Edible vegetables, three countries imposed export taxes in the period: Argentina on various vegetables; Nepal on lentils; and Pakistan on leguminous and potatoes. Then, for Oilseeds and oleaginous fruits; Fats and oils; and Residues and waste from the food industry, many different countries apply export taxes on various products: 5 countries apply export taxes on Fats and oils; 7 countries on Residues and waste from the food industry; and 10 countries apply export taxes on Oilseeds and oleaginous fruits.

The cases with no evidence of a price effect come from two different situations. In most occasions we have clearly similar effects on values and quantities, which means that prices are stable. In other

[20] The complete set of results, including the effects of other regressors and the specification tests, are available upon request to the authors. As a synopsis, at least one of the two over-identification tests is passed in almost all regressions at a 1% significance level (with the exception of sectors 9 and 10, quantities in sector 20 and values in sector 35 where we were unable to find an adequate set of instruments). Arellano-Bond serial autocorrelation tests show a reasonably good performance, except for sector 4. First order no autocorrelation is always rejected, as expected; and in our 66 regressions we fail to reject no autocorrelation in 14 cases (always for second order autocorrelation, with no failures in third and fourth order tests).

sectors we find that export restrictions lead to a fall in prices (a significant negative effect on values accompanied by no effects on quantities) or tariffs produce an increase in prices. These results are counterintuitive and contradict the typical predictions of the basic partial equilibrium model. One possible explanation is a composition effect, where a restriction applied to an eight-digit product leads to an increase in exports of another eight-digit product which pertains to the same six-digit category and has a higher unit value. A related rationalization would be a general equilibrium effect, where the restrictions make exporters to switch to other products in a different six-digit category in which some eight-digit products are also facing restrictions. A third is a substitution of one restriction with another, like the replacement of an export tax with an export quota which would affect the estimation of both coefficients, since the reduction of export taxes is not followed by an increase in volumes and the quota does not necessarily produce a further decrease in exports.[21]

The use of a dynamic model allows for assessing the time patterns in the price effects, which could be observed immediately (in t) or with some delay (in t+1). Also, an immediate effect can be reinforced in the following period, or contrarily, it could be a transitory effect that is quickly reverted. With the exception of Oilseeds and oleaginous fruits, in which there is a delayed effect of export taxes, in all cases the impact takes place in the same year the measure is implemented. Among Fats and oils, the effect takes place the same year the measure is implemented, and the effect is reinforced the following year.

[21] Note that blank cells do not mean that there are no price effects. In these cases the identification of the effects was not possible, because of lack of observations of the particular measure for the particular product. This can happen because measures have not been applied by any country, or they have been but very early in our time sample (and the first observations are lost because of the lags required by the model), or they have been in place but stayed unchanged during the whole period (and our model identifies this parameters on the basis of variations). As mentioned our database has some missing values in the tariff variables, and this forces to drop these observations and some export restrictions could be also lost for this reason.

Table 5. Summary of the evidence of price effects by sector, GMM Estimations.

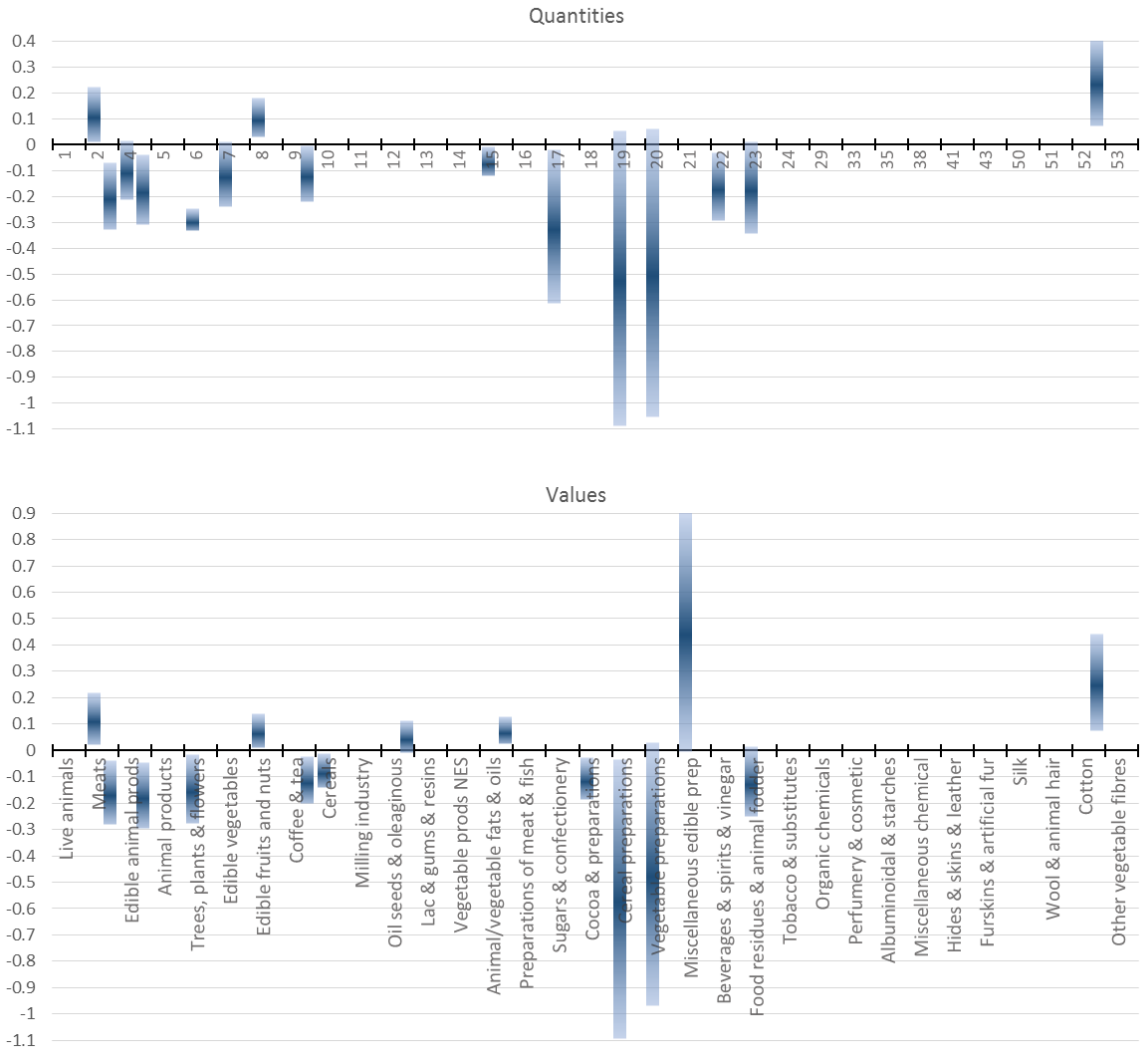
		EXPORT TAXES			OTHER EXPORT RESTRICTIONS			IMPORT TARIFFS		
	SECTOR	evidence of price effects	expected sign (increase)	dynamic pattern	evidence of price effects	expected sign (increase)	dynamic pattern	evidence of price effects	expected sign (decrease)	dynamic pattern
1	Live animals				weak	yes	in t	weak	yes	in t
2	Meat and edible meat offal	none			none			none		
4	Dairy prod; birds' eggs; natural honey; edible products of animal origin, NES	weak	yes	in t	weak	yes	in t reinforced in t+1	none		
5	Products of animal origin, NES				none			none		
6	Live tree & other plant; bulb, root; cut flowers and ornamental foliage	strong	yes	in t	none			weak	yes	in t reverted in t+1
7	Edible vegetables and certain roots and tubers.	weak	yes	in t	none			weak	yes	in t
8	Edible fruit and nuts; peel of citrus fruit or melons	none			none			none		
9	Coffee, tea, mate and spices	none						none		
10	Cereals	weak	no	in t	weak	yes	in t reinforced in t+1	very weak	yes	in t
11	Products of milling industry; malt; starches; inulin; wheat gluten	none			none			none		
12	Oil seeds, oleaginous fruits; miscell grains, seeds, fruit; industrial or medicinal plants; straw and fodder	weak	yes	in t+1	weak	yes	in t+1	none		
13	Lac; gums, resins & other vegetable saps & extracts				strong	yes	in t+1	none		
14	Vegetable plaiting materials; vegetable products NES	none			none			none		
15	Animal/vegetable fats & oils & their cleavage products; prepared edible fats; animal/vegetable	weak	yes	in t reinforced in t+1	weak	no	in t	none		
16	Preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates	none			none			none		
17	Sugars and sugar confectionery	weak	yes	in t	none			none		
18	Cocoa and cocoa preparations	weak	no	in t				weak	yes	in t
19	Preparations of cereals, flour, starch/milk; pastrycooks' products	none			none			none		
20	Preparations of vegetables, fruit, nuts or other parts of plants	none						none		
21	Miscellaneous edible preparations	weak	yes	in t	weak	yes	in t+1	none		
22	Beverages, spirits and vinegar	weak	yes	in t	none			none		
23	Residues & waste from the food industry; prepared animal fodder	very weak	yes	in t	very weak	yes	in t+1	very weak	yes	in t
24	Tobacco and manufactured tobacco substitutes	none						none		
29	Organic chemicals							none		
33	Essential oils & resinoids; perfumery, cosmetic/toilet preparations							none		
35	Albuminoidal substances; modified starches; glues; enzymes							none		
38	Miscellaneous chemical products	none						none		
41	Raw hides and skins (other than furskins) and leather	none			weak	yes	in t reverted in t+1	none		
43	Furskins and artificial fur; manufactures thereof				none			weak	no	in t+1
50	Silk							weak	no	in t
51	Wool, fine/coarse animal hair, horsehair yarn & woven fabric	weak	no	in t				none		
52	Cotton	none			none			none		
53	Other vegetable textile fibres; paper yarn & woven fabrics of paper yarn							none		

Source: own estimations

Our strategy allows to qualitatively assess the existence of price effects, but is less suitable for quantifying such effects. The magnitude of the effect on prices depends on the difference between the size of the effects on values and quantities. Figure 11 presents confidence intervals for the significant coefficients of export taxes on quantities (upper panel) and values (lower panel) in each sector. Both the impact effect (left) and the lagged effect (right) are represented in each sector when significant.

The comparison of the two panels shows that the effects on prices seem to be large in the case of Edible preparations; Sugars and sugar confectionery; Edible vegetables; and Beverages and spirits.

Figure 11. Confidence intervals for significant effects of export taxes on quantities and values



Source: own estimations

Regarding other export restrictions (bans, quotas, non-automatic licenses and reference prices), we find a positive effect on prices for Live animals; Dairy products; Cereals; Oilseeds and oleaginous fruits; Lac, gums and resins; Edible preparations; and Raw hides. For all of these products, there were export bans imposed in the period, and on some of these sectors, many countries imposed export bans. The most notable ones are Cereals, in which 18 countries imposed export bans in the period, even for a short span of time; Oilseeds and oleaginous fruits, in which 10 countries imposed export bans; Raw Hides, with 8 countries imposing bans; and Live animals, a typically heavily regulated sector, in which 7 countries imposed export bans between 2005 and 2014. We should keep in mind that all these effects are captured on the intensive margin, i.e. our estimations are not considering those cases of zero trade, as would be the case if export bans were 100% effective (for all the eight or ten-digit products in the six-digit sector, and during the whole year). This fact highlights the importance of short-time measures during our period of analysis –i.e. export bans were widespread, but usually combined with other measures and not covering all the products in the six-digit sector.

For most of the sectors in which we find a positive effect of other export measures on prices, exports were also subject to export quotas and non-automatic licenses, although less countries apply such measures compared to export bans. Unlike export taxes, other export restrictions usually have a delayed effect, i.e. the impact on prices is verified the following year that the measure is implemented.

A reduction of import tariffs has a positive effect on prices in fewer sectors, and the effect is verified the same year the reduction takes place. The positive impact on prices is verified for Live animals; Live trees and plants; Edible vegetables; Cereals; Cocoa and cocoa preparations; and Residues and waste from the food industry. In all those sectors, we observe a significant fall in applied tariffs in some years among the main importers for each sector. The fall in tariffs, which not necessarily might be a policy aimed to isolate domestic prices, is verified mostly in developed countries, although many developing countries also applied tariff reductions. For example, in Cereals, which, as already noted was one of the sectors in which many import countries reduced protection, we verify a fall in applied tariffs in Japan, European Union, Egypt, México and Korea, mainly in the years in which prices spiked. In the case of Residues and waste from the food industry, we note a fall in protection applied by the EU and Vietnam, while in the case of Live animals, the main importers, USA and EU, also reduced protection. Finally, the European Union also applied tariff cuts on Edible Vegetables and Live trees and plants; whereas India applied tariff reductions on Edible Vegetables. We should keep in mind that these are the main importers in each sector. However, many small importers also applied tariffs cuts. This is one major difference between trade policies applied by importers and exporters: as imports are usually less concentrated in a few countries compared to exports, the effect of price isolating policies on global prices is shared among more actors and responsibility is diluted. In spite of this, import-promoting policies do have an impact on global prices, at least in some sectors.

Controlling for multilateral resistances

As we mentioned, one of the main limitations in our estimation strategy comes from the fact that we are omitting origin-product-year and destination-product-year fixed effects, necessary to control for multilateral resistances. Complementing our main results, we present an alternative estimation where all the necessary fixed effects are included but we lose any chance of addressing endogeneity issues of importance.

Table A5 in the Appendix shows the alternative results, comparable to our main estimation in everything except for the use of OLS instead of IV, the estimation in levels instead of first differences, and the inclusion of origin-product and destination-product-year fixed effects. The use of origin-product-year fixed effects is precluded if we want to preserve our policy variables, since export restrictions are usually taken unilaterally and apply to all destinations, so they do not have bilateral variation and would be lost if time varying origin-product fixed effects are included.[22]

Results show that export taxes have a positive effect on the prices of few products. The impact found in our main estimation is verified only for Dairy products, Oilseeds, and Residues and waste from the food industry. In this specification, we verify a positive effect on prices in one new sector: Preparations of meat, fish or crustaceans. The impact of other export restrictions is also verified for three sectors: Cereals; Oilseeds and oleaginous fruits; and Residues and wastes from the food industry. Finally, in this specification, we do not verify a positive impact on prices obtained from a reduction of import tariffs on any of the sectors in which we found effects in our main specification. However, we do find a positive effect on prices on two new sectors: Edible preparations; and Raw hides and skins.

The fact that we are not addressing endogeneity issues in this specification makes this set of results more suspicious, and in fact estimations tend to show positive effects of trade restrictions on trade, an issue that is coherent with the reverse causality problem that arises because of countries protecting themselves in sectors with high volumes of trade or, in a dynamic approach, in sectors where exports are increasing rapidly.

Price effects and market power

A key point in the analysis of trade barriers is that only when countries have market power will the effects on global prices take place. In order to estimate the impact on trade and prices from policies applied only by exporters with market power, we restricted the sample, and we define that a country has market power in some product when his exports account for more than 15% of total world trade in this product (at the six-digit level). Table 6 presents the results of estimating equation (2) by GMM with the same strategy used in our main results, the only difference being that the country sample has been restricted to those exporters with market power in each sector.

The big picture is that results for suppliers with market power do not show stronger evidence of price effects or higher elasticities from trade barriers to traded volumes and values. Indeed, the opposite is true and evidence of price effects is scarcer than in the whole country sample, giving

[22] These estimations are done using the command reg3hdfe (Guimaraes and Portugal, 2010) in Stata 14 MP. The computations were performed at University of Geneva on the Baobab cluster. Specification details and the complete set of results is available upon request to the authors.

support to the hypothesis of an increase in international prices caused by many small exporters applying such measures (Bouët and Laborde, 2010).

The main limitation of the estimations summarized in Table 6 is that identification starts to depend on a small number of policy measures, and this can make the results less robust. In any case, Table 6 gives an additional confirmation of the low prevalence of price effects of export barriers in agriculture products.

Turning to the specific results by sector, we verify positive price effects of export taxes on Vegetable fats and oils; and Cocoa and cocoa preparations; and of other export restrictions on Live animals; Cereals; Oilseeds; and Lac, gums, resins, vegetable saps and extracts. In most cases, however, the effects of the main specification are not verified. This suggests that even without market power, some countries did affect international prices with the application of export restrictions. For example, in our main estimation we verify a positive effect on prices in Live trees and plants and Dairy products. For both products, only Argentina applied export taxes in the period of analysis. The country does not have a big participation in export markets –less than 1% in both sectors- but the effect on prices is verified nonetheless.

In the case of Oilseeds, the effect is verified, with a strong effect, in the specification of exporters with market power. This is an expected result, as exports of vegetable oils are usually concentrated in few exporters –e.g. soybean oil in Argentina (50% of volume exports in 2005-2007); sunflower oil in Argentina (22% of volume exports in 2005-2007); palm oil in Indonesia (44% of volume exports) and Malaysia (45% of volume exports); and palm kernel in Indonesia (22% of volume exports) and Malaysia (17% of volume exports). All of these countries applied export taxes on these products in at least one year in the period considered in our analysis.

Also restricting the sample to exporters with market power, we find a positive effect on international prices of Cocoa and cocoa preparations. Cocoa market is also a concentrated market, with Ivory Coast exporting 35% of Cocoa beans, 35% of Cocoa shells and 31% of Cocoa paste in 2005-2007. Ivory Coast applies export taxes to cocoa and cocoa preparations since 2005, and switched from specific tax rates to ad valorem tax rates in 2011.

Table 6. Evidence of price effects when exporters have market power

		EXPORT TAXES			OTHER EXPORT RESTRICTIONS			IMPORT TARIFFS		
	SECTOR	evidence of price effects	expected sign (increase)	dynamic pattern	evidence of price effects	expected sign (increase)	dynamic pattern	evidence of price effects	expected sign (decrease)	dynamic pattern
1	Live animals				weak	yes	in t	weak	no	in t
2	Meat and edible meat offal				none			none		
4	Dairy prod; birds' eggs; natural honey; edible products of animal origin, NES				none			none		
5	Products of animal origin, NES				none			none		
6	Live tree & other plant; bulb, root; cut flowers and ornamental foliage				none			none		
7	Edible vegetables and certain roots and tubers.	none			none			none		
8	Edible fruit and nuts; peel of citrus fruit or melons	none			none			none		
9	Coffee, tea, mate and spices	none						none		
10	Cereals	none			very weak	yes	in t	none		
11	Products of milling industry; malt; starches; inulin; wheat gluten	none						none		
12	Oil seeds, oleaginous fruits; miscell grains, seeds, fruit; industrial or medicinal plants; straw and fodder	none			weak	yes	in t+1	none		
13	Lac; gums, resins & other vegetable saps & extracts				weak	yes	in t reinforced in t+1	weak	yes	in t
14	Vegetable plaiting materials; vegetable products NES	none			none			none		
15	Animal/vegetable fats & oils & their cleavage products; prepared edible fats; animal/vegetable	strong	yes	in t	weak	no	in t reverted in t+1	none		
16	Preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates							none		
17	Sugars and sugar confectionery	none						none		
18	Cocoa and cocoa preparations	weak	yes	in t				weak		
19	Preparations of cereals, flour, starch/milk; pastrycooks' products							none		
20	Preparations of vegetables, fruit, nuts or other parts of plants							none		
21	Miscellaneous edible preparations							none		
22	Beverages, spirits and vinegar							weak	yes	in t reinforced in t+1
23	Residues & waste from the food industry; prepared animal fodder	none			weak	no	in t+1	none		
24	Tobacco and manufactured tobacco substitutes							none		
29	Organic chemicals							none		
33	Essential oils & resinoids; perfumery, cosmetic/toilet preparations							none		
35	Albuminoidal substances; modified starches; glues; enzymes							none		
38	Miscellaneous chemical products	none						none		
41	Raw hides and skins (other than furskins) and leather	none						weak	no	in t+1
43	Furskins and artificial fur; manufactures thereof				none			none		
50	Silk							none		
51	Wool, fine/coarse animal hair, horsehair yarn & woven fabric							none		
52	Cotton	none						none		
53	Other vegetable textile fibres; paper yarn & woven fabrics of paper yarn							none		

Source: own estimations

7. Concluding remarks

Between 2006 and 2011, in a global context of rising food prices, both the academia and global leaders warned about the risk of a protectionist reaction to increasing prices. In spite of this, several protectionist measures were taken during the period, aimed at isolating domestic prices from international price surges. Export restrictions, which comprise export taxes, export bans, non-automatic export license requirements, and price reference for exports, among other policies, were among the measures most frequently applied.

There is some evidence that supports the hypothesis that export restrictions may have exacerbated the food price spike. However, the existing studies do not distinguish between the different export restrictive measures, consider export restriction and import promotion policies altogether, or focus only on few agricultural goods. The aim of this paper is to fill this gap and make a comprehensive analysis of the role of export restrictions on agricultural prices during the last 10 years.

To do so, we built a comprehensive database, which includes information on export restrictions applied in the agriculture sector by all countries in the world in the period 2005-2015. The task was not easy, as countries are not obliged to notify WTO about export restrictive measures, and not all countries have transparent information in this regard. In spite of these difficulties, we constructed the Export Restrictions in Agriculture (ERA) database, which, to our knowledge, is the most comprehensive database on export restrictions applied worldwide.

Our database includes information on products affected (at the six-digit HS02 level), duration of the measure, type of measure, and justification. An analysis of the information included in our database shows that in the period 2005-2014, 36 countries took 273 measures that introduced some form of export restriction, or that increased or extended restrictions already in place. The export restrictive measures more frequently applied were export bans (35% of total measures), export taxes (23%), and export quotas (19%). On average, export taxes lasted longer (3.5 years), whereas export bans were more frequently applied for shorter periods of time.

The information from our database shows that during the period 2005-2014, there was both an increase in the number of countries imposing export restrictions, as well as in the number of products affected by restrictions. Export restrictions affected mainly Cereals, Edible vegetables, Fats and oils, Dairy products, Products of the milling industry, and Live animals. In most cases, countries justified the application of restrictions for food security purposes, especially among short-term measures.

In order to estimate the impact of export restrictive measures, as well as tariffs reductions, on international prices, we built a gravity model in a dynamic setting, using a strategy that allows addressing endogeneity issues. We estimate the differentiated impact of export taxes, other export restrictions, and tariff reduction on traded volumes and traded values for all agriculture sectors. Clear evidence of export restrictions affecting world prices is limited to a handful of sectors, and weak evidence suggests that it may exist in some other sectors. In most sectors there is no effect on prices.

We find a positive effect of export taxes as well as other export restrictions. In those sectors in which we find an effect of export taxes, only a few countries increased export taxes in the period,

which suggests that even without market power, some countries did affect international prices with the application of export restrictions. In spite of this, we also find evidence of two markets in which the market power of exporters were behind the increase in prices: Oilseeds and oleaginous fruits; and Cocoa and cocoa preparations.

Unlike export taxes, in the sectors in which we find an effect of quantitative export restrictions, we observe export bans were widespread, and export quotas were frequent. As we are not capturing the effects on the extensive margin, we are unable to assess the effects of measures producing zero yearly exports for a whole sector, but we can conclude that short-time measures, mainly export bans, had an effect on agricultural prices.

For this reason, it is extremely important to address the issue on how to discipline export restrictions at the multilateral level. Even though the most recent trade agreements tend to discipline export restrictions among its members, not addressing the issue within WTO leaves food importing poor countries in disadvantage. One first very important step is to improve information on export restrictions applied worldwide. Countries should notify WTO about measures on force and new measures implemented, and the WTO should have an information system on measures in force, such as there is already on import tariffs and non-tariff measures.

Our results also show that tariff cuts applied on some agricultural sectors have a positive effect on prices. In all these sectors, we observe a significant fall in applied tariffs in some years among the main importers for each sector, even though small importers also reduced protection. In agricultural markets, imports are usually less concentrated in few countries than exports, and thus the responsibility of price isolating trade policies is more diluted. Notwithstanding, tariff reductions have an effect on global prices, such as export restrictions have. This underlines the idea that negotiations on export restrictions in the multilateral agenda should not be disassociated from disciplines on import promoting policies, as Clapp (2009) suggests, despite the fact that, as Bouët and Laborde (2016) point out, it is more difficult to criticize a country when it reduces its protection.

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Appendix

Table A1. Provisions on export restrictions in GATT and Agreement on Agriculture

Article XI GATT (1994)	1. No prohibitions or restrictions other than duties, taxes or other charges, whether made effective through quotas, import or export licenses or other measures, shall be instituted or maintained by any contracting party on the importation of any product of the territory of any other contracting party or on the exportation or sale for export of any product destined for the territory of any other contracting party. 2. The provisions of paragraph 1 of this Article shall not extend to the following: a) Export prohibitions or restrictions temporarily applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party; b) Import and export prohibitions or restrictions necessary to the application of standards or regulations for the classification, grading or marketing of commodities in international trade
Agreement on Agriculture (1994)	**Part VI: Article 12** Disciplines on Export Prohibitions and Restrictions 1. Where any Member institutes any new export prohibition or restriction on foodstuffs in accordance with paragraph 2(a) of Article XI of GATT 1994, the Member shall observe the following provisions: a. the Member instituting the export prohibition or restriction shall give due consideration to the effects of such prohibition or restriction on importing Members' food security; b. before any Member institutes an export prohibition or restriction, it shall give notice in writing, as far in advance as practicable, to the Committee on Agriculture comprising such information as the nature and the duration of such measure, and shall consult, upon request, with any other Member having a substantial interest as an importer with respect to any matter related to the measure in question. The Member instituting such export prohibition or restriction shall provide, upon request, such a Member with necessary information. 2. The provisions of this Article shall not apply to any developing country Member, unless the measure is taken by a developing country Member which is a net-food exporter of the specific foodstuff concerned.

Table A2. Measures and products affected by country imposing export restrictions. In percentage 2005-2014

	Measures	*Products*
Argentina	17%	11%
India	12%	5%
VietNam	11%	5%
Bolivia	8%	4%
Indonesia	8%	5%
Pakistan	8%	6%
China	6%	18%
Egypt	3%	2%
Russia	3%	1%
Belarus	2%	1%
Australia	2%	2%
Kazakhstan	2%	4%
Zambia	2%	0%
Bangladesh	1%	1%
Ukraine	1%	1%
Ethiopia	1%	1%
Colombia	1%	0%
Sri Lanka	1%	2%
Serbia	1%	0%
Ivory Coast	1%	1%
Kenya	1%	1%
Kyrgyzstan	1%	1%
Macedonia	1%	0%
Myanmar	1%	0%
Tajikistan	1%	1%
Uruguay	1%	4%
Venezuela	1%	16%
Nepal	1%	4%
Morocco	0%	0%
Ecuador	0%	0%
Hong Kong	0%	0%
Moldova	0%	0%
Malaysia	0%	1%
Rwanda	0%	0%
Tanzania	0%	0%
Mexico	0%	0%

Source: Own elaboration with data from ERA

Note: Only measures that introduce new restrictions or extend restrictions in place are considered

Table A3. Countries included in the estimation database

Albania	Ecuador	Malaysia	Singapore
Azerbaijan	El Salvador	Mali	Slovakia
Argentina	Ethiopia	Malta	Viet Nam
Australia	Estonia	Mauritius	Slovenia
Austria	Fiji	Taiwan	South Africa
Bahrain	Finland	Mongolia	Spain
Bangladesh	France	Moldova, Rep.of	Sudan
Belgium-Luxembourg	Georgia	Morocco	Sweden
Bolivia	Germany	Oman	Switzerland-Liechtenstein
Bosnia and Herzegovina	Greece	Nepal	Tajikistan
Brazil	Guatemala	Netherlands	Thailand
Belize	Hong Kong (SARC)	New Zealand	Togo
Bulgaria	Hungary	Niger	United Arab Emirates
Myanmar	Iceland	Nigeria	Turkey
Burundi	Indonesia	Norway	Uganda
Belarus	Ireland	Pakistan	Ukraine
Canada	Israel	Paraguay	Macedonia
Sri Lanka	Italy	Peru	Egypt
Chile	Côte d'Ivoire	Poland	United Kingdom
China	Japan	Portugal	Tanzania, United Rep. of
Colombia	Kazakstan	Qatar	United States of America
Costa Rica	Kenya	Roumania	Burkina Faso
Croatia	Kuwait	Russian Federation	Uruguay
Cuba	Kyrgyzstan	Rwanda	Venezuela
Cyprus	Latvia	Saudi Arabia	Zambia
Czech Republic	Lithuania	Senegal	
Benin	Madagascar	Serbia	
Denmark	Malawi	India	

Table A4. Effects of policy measures on traded values and volumes

			EXPORT TAXES						IMPORT TARIFFS						OTHER EXPORT RESTRICTIONS (dummy)					
			current			lagged (1 year)			current			lagged (1 year)			current			lagged (1 year)		
			coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean
1	Live animals	Val							-0.056 **	0.0268	-0.40	-0.026	0.0324	0.09	0.212 *	0.1167	1.00	0.036	0.1329	-0.40
		Qty							-0.038	0.0342		-0.03	0.0349		0.015	0.1586		0.119	0.1636	
2	Meat and edible meat offal	Val	0.121 **	0.0502	0.06	-0.16 ***	0.0611	0.45	-0.001	0.01	-0.14	0.008	0.0112	0.08	-0.1	0.1744	0.71	-0.084	0.1431	0.64
		Qty	0.116 **	0.0542		-0.2 ***	0.0656		9E-04	0.0107		0.007	0.0123		-0.276	0.1766		-0.225	0.1677	
4	Dairy prod; birds' eggs; natural honey; edible products of animal origin, NES	Val	-0.058	0.0524	0.51	-0.171 ***	0.0633	0.04	-0.012	0.009	-0.69	-0.012	0.0098	-0.25	-0.209 **	0.0957	1.47	0.206 **	0.099	0.43
		Qty	-0.098 *	0.0579		-0.175 **	0.0682		-0.003	0.0099		-0.008	0.0104		-0.417 ***	0.1045		0.144	0.1049	
5	Products of animal origin, NES	Val							-0.206	0.2898	0.08	-0.043	0.1568	-0.26	-12.45	14.232	-0.59	7.18	6.2958	0.02
		Qty							-0.242	0.3156		0.013	0.1414		-2.49	9.1524		6.993	6.1182	
6	Live tree & other plant; bulb, root; cut flowers and ornamental foliage	Val	-0.147 **	0.0665	2.03	0.023	0.1664	-0.76	-0.031 *	0.017	-0.10	-0.006	0.0156	1.28	0.005	0.0744	0.20	-0.008	0.0777	0.14
		Qty	-0.289 ***	0.0223		0.18	0.122		-0.029	0.0212		-0.037 **	0.0183		-0.018	0.0857		-0.025	0.0983	
7	Edible vegetables and certain roots and tubers.	Val	-0.074	0.0586	0.48	-3E-04	0.048	-0.43	-0.013 *	0.0069	-0.22	-0.001	0.0072	0.05	-0.037	0.0743	0.25	-0.241 ***	0.0694	-0.29
		Qty	-0.115 *	0.064		0.03	0.0507		-0.01	0.0079		-0.002	0.0081		-0.065	0.0804		-0.211 ***	0.0773	
8	Edible fruit and nuts; peel of citrus fruit or melons	Val	0.075 **	0.0332	-0.61	0.019	0.0343	-0.01	-0.004	0.008	0.05	0.012	0.0081	0.80	0.128	0.079	0.18	-0.033	0.0737	0.17
		Qty	0.106 ***	0.0377		0.02	0.038		-0.005	0.0087		0.003	0.0088		0.107	0.0851		-0.051	0.0769	
9	Coffee, tea, mate and spices	Val	-0.02	0.0579	-1.21	-0.112 **	0.0455	0.03	-0.003	0.0165	-0.14	-0.011	0.0169	0.58						
		Qty	0.091	0.0718		-0.114 **	0.0553		0.001	0.0201		-0.026	0.0205							
10	Cereals	Val	-0.076 **	0.0329	-1.08	0.002	0.0319	-0.35	-0.064 ***	0.019	-0.51	-0.003	0.0153	-0.50	-0.116	0.0748	0.53	-0.081	0.0642	0.94
		Qty	-0.018	0.0422		0.02	0.0414		-0.049 **	0.0228		0.009	0.0191		-0.178 **	0.0891		-0.173 **	0.0738	
11	Products of milling industry; malt; starches; inulin; wheat gluten	Val	-0.436	0.3279	-1.26	-0.015	0.0853	0.34	0.059	0.1504	0.29	0.01	0.0497	0.28	-0.27	0.4091	-0.25	-0.633 **	0.257	-0.80
		Qty	-0.019	0.0367		-0.046	0.0334		0.015	0.0125		-0.004	0.012		-0.164	0.1193		-0.41 ***	0.1111	
12	Oil seeds, oleaginous fruits; miscell grains, seeds fruit; industrial or medicinal plants; straw and fodder	Val	0.012	0.0272	1.05	0.052 *	0.0314	0.15	-0.009	0.0193	-0.43	-0.026	0.0173	-0.45	0.024	0.1218	-0.16	0.197 **	0.0894	0.71
		Qty	-0.031	0.0305		0.045	0.0341		0.004	0.0228		-0.013	0.0221		0.052	0.1226		0.099	0.1041	
13	Lac; gums, resins & other vegetable saps & extracts	Val							-0.008	0.0281	-0.79	0.042	0.028	-0.29	0.127	0.1036	0.00	0.226 ***	0.0627	2.15
		Qty							0.979	1.2511		0.082	0.1348		0.195	16.668		-5.763 **	2.7869	
14	Vegetable plaiting materials; vegetable products NES	Val	0.83	2.0828	0.27	-0.128	0.2405	-0.02	0.437	0.7214	-0.48	0.253	0.2299	-0.42	0.204	3.2637	0.01	0.008	0.1341	-0.13
		Qty	-0.699	5.2397		-0.101	1.2096		1.065	1.0911		0.431	0.3548		0.01	25.602		0.032	0.1383	
15	Animal/vegetable fats & oils & their cleavage products; prepared edible fats; animal/vegetable waxes	Val	-0.008	0.0262	1.42	0.077 ***	0.0254	1.01	-0.008	0.0128	-0.04	-0.018	0.0126	-0.35	-0.137 **	0.0534	-0.65	0.01	0.0567	0.94
		Qty	-0.063 **	0.0285		0.038	0.0287		-0.007	0.0144		-0.012	0.0148		-0.083	0.0638		-0.072	0.0649	
16	Preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates	Val	-0.009	0.0559	0.15	-0.033	0.051	0.45	-0.01	0.0103	0.10	-0.026 **	0.0115	0.08	-0.312	0.3114	0.11	-0.026	0.1867	1.08
		Qty	-0.022	0.0642		-0.067	0.0558		-0.011	0.0117		-0.027 **	0.0125		-0.36	0.3188		-0.375	0.2645	

Table A4 (cont'). Effects of policy measures on traded values and volumes

		EXPORT TAXES						IMPORT TARIFFS						OTHER EXPORT RESTRICTIONS (dummy)					
		current			lagged (1 year)			current			lagged (1 year)			current			lagged (1 year)		
		coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean	coef	s.e.	equal mean
17 Sugars and sugar confectionery	Val	-0.19	0.1377	0.62	-0.131	0.1277	-0.19	-0.007	0.0116	0.24	-0.004	0.0122	0.09	-0.824 ***	0.221	0.17	-0.559	0.4882	0.18
	Qty	-0.317 **	0.1513		-0.095	0.143		-0.012	0.0139		-0.005	0.0142		-0.877 ***	0.2251		-0.684	0.4959	
18 Cocoa and cocoa preparations	Val	-0.108 ***	0.0409	-0.84	-0.015	0.0451	-1.02	-0.044 **	0.0181	-0.90	0.001	0.017	-0.44						
	Qty	-0.061	0.0378		0.048	0.0424		-0.019	0.02		0.012	0.0179							
19 Preparations of cereals, flour, starch/milk; pastrycooks' products	Val	-0.563 **	0.2702	-0.12	0.131	0.1361	-0.46	-0.008	0.0088	0.21	0.002	0.0085	-0.27	-1.718 **	0.6819	0.01	1.095 **	0.4983	-0.17
	Qty	-0.517 *	0.2911		0.226	0.1586		-0.01	0.0097		0.006	0.0092		-1.729 **	0.7576		1.224 **	0.5669	
20 Preparations of vegetables, fruit, nuts or other parts of plants	Val	-0.471 *	0.2545	0.07				-0.002	0.0061	0.42	-0.01	0.0063	-0.27						
	Qty	-0.497 *	0.2845					-0.006	0.0066		-0.007	0.0068							
21 Miscellaneous edible preparations	Val	0.449 *	0.2319	0.95				-0.011	0.0098	-1.40	6E-04	0.0106	-0.82	-0.062	0.1354	-0.28	-0.146	0.1111	1.36
	Qty	0.143	0.2263					0.011	0.0126		0.014	0.0131		-0.006	0.1516		-0.41 **	0.1595	
22 Beverages, spirits and vinegar	Val	-0.072	0.0608	1.01	0.061	0.1642	-0.35	0.008	0.0101	-0.23	0.016 *	0.0093	-0.26	-0.025	0.1507	0.17	-0.008	0.1152	0.51
	Qty	-0.164 **	0.067		0.19	0.3274		0.012	0.0133		0.021	0.0126		-0.071	0.23		-0.106	0.1571	
23 Residues & waste from the food industry; prepared animal fodder	Val	-0.119 *	0.067	0.42	-0.009	0.0318	-0.69	-0.3 **	0.1449	0.94	-0.013	0.0465	-0.33	-0.142	0.1629	-0.10	-0.62 ***	0.2072	0.64
	Qty	-0.166 *	0.0907		0.024	0.0345		-0.516 ***	0.1777		0.012	0.0591		-0.113	0.2418		-0.854 ***	0.2997	
24 Tobacco and manufactured tobacco substitutes	Val	-0.634	3.0665	0.09	-0.487	2.714	-0.50	-2E-04	0.2064	-0.63	0.045	0.0672	0.92						
	Qty	-1.001	2.9103		1.568	3.0934		0.2	0.2426		-0.049	0.0761							
29 Organic chemicals	Val							0.033	0.033	0.38	0.005	0.0296	-0.38						
	Qty							0.013	0.0402		0.023	0.0371							
33 Essential oils & resinoids; perfumery, cosmetic/toilet preparations	Val							-0.023	0.0351	-0.31	-0.001	0.0351	0.72						
	Qty							-0.006	0.0449		-0.04	0.0394							
35 Albuminoidal substances; modified starches; glues; enzymes	Val							-0.032	0.0229	0.21	-0.009	0.024	0.88						
	Qty							-0.04	0.0263		-0.043	0.0303							
38 Miscellaneous chemical products	Val	-2.216	1.5992	0.25	-1.8	1.256	-0.48	0.474	0.404	0.61	0.02	0.1152	-0.46						
	Qty	-2.81	1.7777		-0.916	1.3381		0.113	0.4367		0.101	0.1334							
41 Raw hides and skins (other than furskins) and leather	Val	0.044	0.0841	0.34	-0.111	0.1094	-0.12	-0.063	0.0662	0.44	0.015	0.0757	0.00	-0.451	0.28	0.15	-0.471 *	0.2782	-0.56
	Qty	0.003	0.0844		-0.088	0.156		-0.107	0.0732		0.015	0.0772		-0.512 *	0.2809		-0.196	0.4005	
43 Furskins and artificial fur; manufactures thereof	Val							-1.571	2.4287	0.43	-0.625	0.5792	0.45	-3.664	2.8686	-0.46	-0.795	1.4968	0.53
	Qty							-3.436	3.5986		-0.987 *	0.5475		-1.873	2.6593		-2.337	2.5045	
50 Silk	Val							-0.233	0.2745	0.83	-0.29	0.2855	0.26						
	Qty							-0.585 *	0.3197		-0.403	0.3211							
51 Wool, fine/coarse animal hair, horsehair yarn & woven fabric	Val	-2.252 **	1.1325	-0.14	0.324	1.5559	0.17	0.095	0.0896	-0.39	0.036	0.0833	-0.93						
	Qty	-2.008	1.2884		-0.06	1.5724		0.145	0.0932		0.159	0.1025							
52 Cotton	Val	-0.04	0.1166	-0.13	0.257 ***	0.0934	0.10	-0.034	0.0634	0.63	-0.025	0.0748	-0.69	0.01	0.2076	-0.15	-0.086	0.1813	-0.51
	Qty	-0.02	0.1145		0.245 ***	0.088		-0.092	0.067		0.049	0.0771		0.066	0.3011		0.06	0.2192	
53 Other vegetable textile fibres; paper yarn & woven fabrics of paper yarn	Val							-0.902	0.5996	-0.75	0.016	0.1343	0.29						
	Qty							-0.202	0.7245		-0.034	0.1033							

Table A5. Methodological details for each equation in main estimations

sector	equation	order of the dynamic part	Instruments				Transfor-mation
			for the lag/s of the dependent variable	for import tariffs	for export taxes	for other restrictions	
1	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
2	Value	1	gmm(2 3)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 3)	variables themselves	variables themselves	variables themselves	FD
4	Value	1	gmm(2 3)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 3)	variables themselves	variables themselves	variables themselves	FD
5	Value	1	gmm(2 ., collapse)	gmm(2 3)	gmm(2 3)	gmm(2 3)	FD
	Quantity	1	gmm(2 ., collapse)	gmm(2 3)	gmm(2 3)	gmm(2 3)	FD
6	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
7	Value	1	gmm(2 5)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 5)	variables themselves	variables themselves	variables themselves	FD
8	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
9	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
10	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
11	Value	1	gmm(2 .)	gmm(2 ., collapse)	gmm(2 ., collapse)	gmm(2 ., collapse)	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
12	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
13	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	L(2/3).limp_tar_mf	L(2/3).lexp_tax_max_w	L(2/3).lexp_oth_restr	FD
14	Value	1	gmm(2 .)	L(1/2).limp_tar	L(1/2).lexp_tax_max_w	L(1/2).exp_oth_restr	FD
	Quantity	1	gmm(2 .)	L(1/2).limp_tar	L(1/2).lexp_tax_max_w	L(1/2).exp_oth_restr	FD
15	Value	1	gmm(2 ., collapse)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
16	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
17	Value	1	gmm(2 ., collapse)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 ., collapse)	variables themselves	variables themselves	variables themselves	FD
18	Value	1	gmm(3 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(3 .)	variables themselves	variables themselves	variables themselves	FD
19	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
20	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
21	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
22	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
23	Value	1	gmm(3 .)	gmm(2 3)	gmm(2 3)	gmm(2 3)	FD
	Quantity	1	gmm(3 .)	gmm(2 3)	gmm(2 3)	gmm(2 3)	FD
24	Value	1	gmm(2 .)	L(2/3).limp_tar_mf	L(2/3).lexp_tax_max_w	L(2/3).lexp_oth_restr	FD
	Quantity	1	gmm(2 .)	L(2/3).limp_tar_mf	L(2/3).lexp_tax_max_w	L(2/3).lexp_oth_restr	FD
29	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FOD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FOD
33	Value	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	2	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
35	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 4)	variables themselves	variables themselves	variables themselves	FD
38	Value	1	gmm(2 .)	gmm(2 ., collapse)	gmm(2 ., collapse)	gmm(2 ., collapse)	FD
	Quantity	1	gmm(2 .)	gmm(2 ., collapse)	gmm(2 ., collapse)	gmm(2 ., collapse)	FD
41	Value	1	gmm(2 4)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 4)	variables themselves	variables themselves	variables themselves	FD
43	Value	1	gmm(2 .)	gmm(2 .)	gmm(2 .)	gmm(2 .)	FD
	Quantity	1	gmm(2 .)	gmm(2 .)	gmm(2 .)	gmm(2 .)	FD
50	Value	1	gmm(1 5)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(1 5)	variables themselves	variables themselves	variables themselves	FD
51	Value	1	gmm(2 ., collapse)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 ., collapse)	variables themselves	variables themselves	variables themselves	FD
52	Value	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
	Quantity	1	gmm(2 .)	variables themselves	variables themselves	variables themselves	FD
53	Value	1	gmm(3 .)	gmm(2 3)	gmm(2 3)	gmm(2 3)	FD
	Quantity	1	gmm(3 .)	gmm(2 3)	gmm(2 3)	gmm(2 3)	FD

Table A6. Evidence of price effects in OLS estimation with three sets of fixed effects

		EXPORT TAXES			OTHER EXPORT RESTRICTIONS			IMPORT TARIFFS		
	SECTOR	evidence of price effects	expected sign (increase)	dynamic pattern	evidence of price effects	expected sign (increase)	dynamic pattern	evidence of price effects	expected sign (decrease)	dynamic pattern
1	Live animals				none			none		
2	Meat and edible meat offal	none			none			weak	no	in t+1
4	Dairy prod; birds' eggs; natural honey; edible products of animal origin, NES	weak	yes	in t	none			none		
5	Products of animal origin, NES				none			none		
6	Live tree & other plant; bulb, root; cut flowers and ornamental foliage	none			none			none		
7	Edible vegetables and certain roots and tubers.									
8	Edible fruit and nuts; peel of citrus fruit or melons									
9	Coffee, tea, mate and spices	weak	no	in t	weak	no	in t	none		
10	Cereals	none			weak	yes	in t+1	none		
11	Products of milling industry; malt; starches; inulin; wheat gluten	none			weak	yes	in t	none		
12	Oil seeds, oleaginous fruits; miscell grains, seeds, fruit; industrial or medicinal plants; straw and fodder	weak	yes	in t+1	weak	yes	in t reinforced in t+1	none		
13	Lac; gums, resins & other vegetable saps & extracts				none			none		
14	Vegetable plaiting materials; vegetable products NES	none			none			none		
15	Animal/vegetable fats & oils & their cleavage products; prepared edible fats; animal/vegetable	none			weak	no	in t	none		
16	Preparations of meat, fish or crustaceans, molluscs or other aquatic invertebrates	weak	yes	in t+1	none			none		
17	Sugars and sugar confectionery	none			none			weak	no	in t
18	Cocoa and cocoa preparations	none						none		
19	Preparations of cereals, flour, starch/milk; pastrycooks' products	none			none			weak	no	in t
20	Preparations of vegetables, fruit, nuts or other parts of plants									
21	Miscellaneous edible preparations	none			none			weak	yes	in t
22	Beverages, spirits and vinegar	none			none			none		
23	Residues & waste from the food industry; prepared animal fodder	weak	yes	in t	very weak	yes	in t+1	none		
24	Tobacco and manufactured tobacco substitutes	none						none		
29	Organic chemicals							none		
33	Essential oils & resinoids; perfumery, cosmetic/toilet preparations							none		
35	Albuminoidal substances; modified starches; glues; enzymes							none		
38	Miscellaneous chemical products	none						none		
41	Raw hides and skins (other than furskins) and leather	none			none			weak	yes	in t+1
43	Furskins and artificial fur; manufactures thereof				none			none		
50	Silk							none		
51	Wool, fine/coarse animal hair, horsehair yarn & woven fabric	none						none		
52	Cotton	none			none			none		
53	Other vegetable textile fibres; paper yarn & woven fabrics of paper yarn							none		