"The Impact of Restrictions to Export on Production: A synthetic controls approach"

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The impact of restrictions to exports on production: A synthetic controls approach*

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Abstract

This paper uses quantitative restrictions to exports implemented in Bolivia in order to investigate the impact of export restrictions on the volume of production. We apply a synthetic controls approach and show that production of cattle beef fell remarkably when quantitative restrictions are imposed. Importantly, we show that export restrictions have a negative impact not only on total production, but also on production for local market. The fact that export controls can actually harm production for local market bears important implications for the design of policies in the future.

JEL Classification Codes: F13, F42, O24, Q37, H23.

Keywords: production, exports, export controls, export restrictions, trade policy, synthetic controls.

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1 Introduction

Export taxes and quantitative restrictions to exports have long history and constitute widespread policy instruments. Most of the theoretical literature in international trade predicts that export controls in small economies yield to a reduction in exports, an increase in the production for local market, and a fall in domestic prices. In the classic framework, consumers gain from the lower price, producers lose, and some efficiency losses are generated. [1] As a result, export restrictions, in the form of prohibitions, bans, quotas or taxes are often imposed by governments as a means to increase production for local market and reduce local prices. In fact, during the last decade, many countries around the world adopted these policies in order to mitigate the impact of the increase in commodities prices (specially on agricultural and food products) and promote domestic food security.[2] In spite of the generalized use of these instruments, little empirical research has been done to document their effectiveness in increasing domestic supply and stabilizing prices. Although there have been previous efforts to estimate the impact of export controls on production (i.e: Nogués, Bailey, et al. (2008) and Nogués (2011)), our understanding about how effective are these controls on reducing exports and about how these restrictions affect production for local market is still relatively limited; specially when it comes to quantitative restrictions to exports (QRE, from now on) in small economies. Are QRE effective in reducing the volume of exports? Are QRE effective in achieving the goal of increasing production for local market? Are QRE effective in reducing local prices? These questions are still open and this paper aims to answer them. To do so, we exploit quantitative restrictions to cattle meat that were exogenously imposed in Bolivia in order to study: a) the impact of QRE on the volume of exports; b) the impact of the QRE on the volume of production; and c) the impact of QRE on production for local market.

Our empirical strategy uses the synthetic control approach developed by Abadie and Gardeazabal (2003) and extended in Abadie, Diamond, and Hainmueller (2010) in order to identify the effect of QRE on exports, the effect of QRE on production, and the effect of QRE on production for local market. In the first place, we analyze if the restrictions

[1] Abbott (2011), Gandolfo and Trionfetti (1998), Liefert, Westcott, and Wainio (2012), Mitra and Josling (2009), Shama (2011) and WTO (2010) illustrate how export taxes on local producers reduces domestic prices, but increases production for local market. As the domestic price falls, consumers are better off and producers are worst off.

[2] Anderson (2009),Kim (2010) and Martin and Anderson (2011) summarize these policies for the period between 1955 and 2007 and discusses the distortions that export controls generate. Shama (2011) and Anania (2013) review exports restrictions imposed to food products for the period 2007-2010. Abbott (2011) suggests that restriction of agricultural exports in 2007 and 2008 were designed to achieve the short-run objectives of stabilizing domestic markets.

were effective to reduce exports. Although it seems evident that QRE reduce exports, there might be problems with the design and implementation of the export controls that can affect their effectiveness. We find that the QRE were effective in reducing the volume of exports (98 %). Once we have shown that the product actually experienced a decline in the volume of exports, we proceed to study how QRE affected total production (exports + production for local market) and production for local market of cattle beef. As expected, we find that QRE yield to a reduction of 48% in the total volume of production with respect to the counterfactual outcome. This finding is in line with economic theory. In fact, if producers are not able to export, they reduce their production. However, it is less obvious how QRE affect production for local market. On this ground, we find that QRE not only affect total production, but also harm production for local market. Interestingly, in contrast with standard literature predictions, we find that producers overreact to the policy and production that is oriented to local market declines remarkably after the QRE are imposed. In particular, Bolivia's production for local market is 44% lower than what it would have been in the absence of QRE. This novel fact open a new set of questions to analyze. One potential channel is that in a context of uncertainty in the private sector, producers may produce more than the equilibrium level in order to be ready for exporting. Hence, when QRE are imposed, they lose the possibility to export and use the land for the production of other goods. Or put it differently, production oriented to local market is not exogeneous with respect to producers possibility to export.

When it comes to consistently estimate the economic consequences of QRE in small countries economies, the existing empirical literature is not extensive.[3] Exceptions for Latin American countries are some reports such as Nogués, Bailey, et al. (2008), who describe the effects of export restrictions in Argentina and show that such policies can actually worsen the economic and social performance of the country in terms of GDP and other measures. Jones and Kwiecinski (2010) evaluates the effectiveness of different policies adopted in ten emerging economies in order to mitigate the impact of the raise of international prices. Our paper contributes to these literature in several dimensions. First, to the best of our knowledge, this is the first paper that applies synthetic control methods to consistently assess the effects of

[3]Recent literature on export restrictions have focused on showing that these restrictions in the context of a big country contribute to exacerbating negative effects on world food security. Clarkson and Kulkarni (2011) studies the effect of restrictions to exports of rice in India. **?** show how a large exporter in adopting an export restriction to mitigate against a global demand shock, ensures domestic producers of an agricultural commodity realize some increase in producer surplus, while consumers do not suffer as large a decline in consumer surplus. Götz, Glauben, and Brümmer (2013) study the domestic market impact of wheat export controls in Russia and Ukraine.

export restrictions in the context of a small exporter. Under the assumption that in absence of QRE, Bolivia and its synthetic counterpart would continue having a similar trend, this approach allows to identify the causal link between QRE and production. Second, we find that QRE also causes a remarkably reduction in production for local market and we show that the policy was not effective to achieve the goal of reducing local prices either. This new fact has important implications for policy makers that are considering export restrictions to achieve the goal of increasing domestic supply in the short run.

2 The export restrictions on cattle beef

With the objective of guaranteeing food security and achieving food sovereignty, the Bolivian government imposed controls to the export of some agricultural products.[4] Most of these controls took the form of quantitative restrictions to exports (QRE) and were implemented through administrative decrees. The goal of the export controls was to increase domestic consumption through lower prices. For instance, export controls to chicken lasted for only two months. Other QRE were combined with other government policies such as maximum prices to sales in local market. Hence, for most of the products it is not possible to disentangle the effect of the QRE and maximium prices policies. However, the case of the controls imposed to cattle beef is different. The restriction to export was imposed in February 2008 through Supreme Decree 29460 and there was no other policy to affect domestic supply or domestic prices. In addition, the QRE lasted for a long period of time; in fact, the restrictions are still active. Hence, QRE of cattle beef exogenously imposed by Bolivia's government constitute an opportunity to study how QRE affect total production and production for local market.

3 Identification strategy

3.1 Synthetic controls estimates

We use a statistic method developed by Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010) in order to study a) the impact of QRE on exports; b) the impact of QRE on total production and; c) the impact of QRE on production for local market.

[4]Food sovereignty is defined as the right of peoples and sovereign states to democratically determine their own agricultural and food policies (IAASTD 2008).

Ideally, we want to consider the difference between our outcome variable (X = Volume of Exports, Q =Volume of Production, and S =Volume of production for local market) after the QRE intervention and where that variable would have been in the absence of that intervention (counterfactual outcome). In order to estimate the counterfactual scenario, we propose synthetic controls method.

The synthetic control method is based on the idea that a weighted combination of unaffected units may resemble the characteristics of the treated unit substantially better than any untreated unit alone. In our exercise, the methodology works by assigning an analytical weight to each country that has not implemented the QRE. These weights are computed in order to minimize the difference in pre-intervention outcomes (X, Q, or S) between the treated unit (Bolivia) and the pool of potential comparison countries. Hence, synthetic Bolivia is the weighted average of the untreated countries outcomes that allows to meet the assumption of parallel trends conditional on observable characteristics prior to the implementation of QRE. Therefore, under the assumption that in absence of the QRE Bolivia and its synthetic counterpart would continue having a similar trend, this approach allows to identify the impact of QRE on the volume of exports and the volume of production.

Formally, let the index $i = (1, ..J)$ denote the J countries that produce export a specific product. Without loss of generality, we assume that Bolivia is the first country ($i = 1$) and is the only one exposed to QRE. The remaining $J - 1$ countries were not affected by the intervention and constitute the set of potential comparisons used to construct synthetic Bolivia (donor pool). Define Y_{it} as the observed outcome variable (X_{it}, Q_{it}, or S_{it}) for country i at time $t \in [1, T]$. Let $t = t^{'}$ be the year in which Bolivia's government imposed the QRE. Denote with Y_{1t}^{N} the counterfactual outcome, that is, the outcome that would have been observed for the treated unit ($i = 1$) after $t^{'}$ in absence of QRE. Then, the effect of the quantitative restrictions to exports on the outcome variable is given by,

$$\alpha = Y_{1t} - Y_{1t}^{N}. \tag{1}$$

As discussed before, Y_{1t}^{N} is unobservable by definition, so we use the synthetic control method in order to consistently estimate it. In particular, given a set of non-negative weights $W = [w_2, ..., w_J]$, the synthetic control estimator of the potential outcome is defined as a weighted average of the outcomes of the countries in the donor pool:

$$\hat{Y_{1t}^{N}} = \sum_{i=2}^{J} w_i Y_{it} \quad \forall \quad t > t^{'}, \tag{2}$$

with $w_i \geq 0 \; \forall \; i = 2, ..., J$ and $\sum_{i=2}^{J} w_i = 1$.

Finally, the question about how to choose the optimal weights for each potential comparison country arises. For each country i we observe a set of k predictors of the outcome: $Z_{1it}, ...Z_{kit} \; \forall i = 1, ..., J$. Among this predictors, we may include characteristics such as GDP per capita, harvested area, and pre-intervention values of the observed outcome. The synthetic control method selects a set of weights in such way that the resulting synthetic control resembles the affected unit before the intervention along the values of the variables $Z_{1i}, ..., Z_{ki}$. Following Abadie and Gardeazabal (2003) and Abadie, Diamond, and Hainmueller (2010), we proceed to choose the weights $w^* = \{w_2^*, ..., w_J^*\}$ by minimizing the square difference between the pre-treatment values of the predictors k of the affected unit and the donor pool. That is, for $t \leq t^{'}$,

$$w^* = argmin \left\{ \left(Z_{11t} - \sum_{i=2}^{J} w_i Z_{1it} \right)^2 + \left(Z_{21t} - \sum_{i=2}^{J} w_i Z_{2it} \right)^2 + ... + \left(Z_{k1t} - \sum_{i=2}^{J} w_i Z_{kit} \right)^2 \right\}. \tag{3}$$

Once w^* is computed, the pre-intervention trend and the post-intervention trend for the outcome variable for the synthetic control can be obtained by calculating the corresponding weighted average for each year, using the donor countries with positive weights. As mentioned above, the post-intervention values for the synthetic control group serve as the estimates of the potential outcome of the treated unit. Therefore, the estimated effect of the intervention is given by,

$$\hat{\alpha} = Y_{1t} - \hat{Y_{1t}^N} = Y_{1t} - \sum_{i=2}^{J} w_i^* Y_{it} \tag{4}$$

Even though the synthetic control method chooses the optimal weights in order to minimize the square differences between the pre-treatment levels of the affected unit and the synthetic control group, there might still be differences in pre-treatment levels. In consequence, so as to account for this potential problem, we also use a difference-in-difference approach; that is, we subtract pre-treatment differences from post-treatment differences. Additionally, as the level of outcome variables varies across countries, working with normalized variables allows us to compare between the different treatments. Thus, we normalize the difference-in-difference estimates using the pre-treatment average of the synthetic control. For this reason, in the post-intervention period $t = t^{'}, ..., T$, the normalized difference between treated and synthetic control outcomes is given by,

$$\hat{\beta} = \frac{\frac{1}{T-(t'+1)} \sum_{(t'+1)}^{T} \left(Y_{1t} - \sum_{i=2}^{J} w_i^* Y_{it} \right) - \frac{1}{t'} \sum_{t=1}^{t'} \left(Y_{1t} - \sum_{i=2}^{J} w_i^* Y_{it} \right)}{\frac{1}{t'} \sum_{t=1}^{t'} \left(Y_{1t} - \sum_{i=2}^{J} w_i^* Y_{it} \right)}, \tag{5}$$

where the first term of the equation is the difference between the affected unit and its synthetic counterpart after the QRE, and the second term is the same difference in the pre-intervention period. Note that the second term of the equation approximates zero when the synthetic control group adjusts better to the pre-treatment values of the treated unit.[5]

3.2 Inference

To evaluate the significance of our estimates, we conduct a series of placebo studies by iteratively applying the synthetic controls method to every other country in the donor pool. This is an iterative procedure that provides us with an empirical distribution of estimated effects for the countries where no intervention took place. Thus, we used the unaffected countries as placebo units. By comparing the estimate for the treated with those from the placebos, we can derive the likelihood that estimate would have been observed if there was no effect. In particular, we rank the estimates obtained for every placebo and the implied p-values are constructed by computing the proportion of estimated placebo gaps that are lower to the estimated gap for Bolivia.[6]

4 Data

The main source used for agricultural data is the Food and Agrictultural Organization of the United Nations, which has the most reliable and complete data set for food production and exports. We use data for the volume of exports that covers the 1995-2011 period and data for the volume of production that covers the 1995-2012 period. We have matched this data set to the World Economic Outlook Database generated by the World Bank from which we have obtained information on GDP per capita (US$) and population.

[5]For further reference we define $\hat{\beta}_X$ the coefficient when the outcome variable is the Volume of Exports, $\hat{\beta}_Q$ as the coefficient when the outcome variable is the Volume of Production, and $\hat{\beta}_S$ the coefficient when the outcome variable is the Volume of production for local market.

[6]As there are some placebo countries that do not have a good synthetic control (ill-fitting placebo runs), we discard countries with pre-treatment differences twenty times higher than Bolivia. Results are robust if we discard differences five and ten times higher.

5 Empirical results

In this section we present the main results of the paper. First, we discuss results concerning the impact of QRE on the volume of exports. Second, we discuss the impact of QRE on the volume of production. Finally, we show how production for local market in Bolivia is affected. To conclude, we evaluate the trends in local and international prices.

5.1 Effectiveness of the intervention: Impact on exports

We begin the discussion with an analysis on how effective was the implementation of QRE on reducing the volume of exports of beef (cattle). The idea of this section is provide evidence that the policy was well implemented and affected exports. We use the methodology described above to estimate the effect of QRE on the volume of exports. In particular, the affected unit is Bolivia (i=1) and the remaining countries that are exporters of the product constitute the donor pool. The characteristics that we include as predictors for exports include the average GDP per capita between 2003 and $t^{'}$ and pre-intervention values of the volume of exports for all the years between 1995 and $t^{'}$. Intuitively, the inclusion of pre-intervention values of exports forces the synthetic control method to construct the synthetic Bolivia that best fits the export of beef trend of Bolivia, yielding to the lowest pre-treatment mean square prediction error (MSPE).

5.1.1 Quality of synthetic Bolivia for the volume of exports

Before analyzing the main results, we briefly analyze the quality of synthetic Bolivia when the outcome variable is the Volume of Exports. Pre-treatment fit between Bolivia and its synthetic counterpart is the key criterion for the credibility of our study. It indicates how well the synthetic control accounts for time-varying unobservables. In Table 1 we report the donor countries and in Table 2 we report the pre-treatment levels of the predictors for Bolivia and its synthetic counterpart. In our implementation, the synthetic control approach picks eight countries for the convex combination that construct the synthetic Bolivia. Among these countries Vietnam represents 49% of synthetic Bolivia. Even though some of the active donors may appear counter-intuitive, a convex combination of countries that are quite different from Bolivia may be the best control when those countries differ from Bolivia along distinct lines. It can be seen that the GDP per capita between Bolivia and synthetic Bolivia is quite different, but the pre-treatment match is quite apparent if we observe the lagged outcome variable predictors. The fact that synthetic Bolivia very closely track the trajectory

Table 1: Highest weighted donors in the synthetic Bolivia for exports

Donor Countries	Weights
Viet Nam	0.482
Brunei Darussalam	0.202
Azerbaiyn	0.165
Saudi Arabia	0.051
Dominican Republic	0.043
Serbia	0.031
Mexico	0.023
United Arab Emirates	0.003
Total	1.000

of the volume of exports of Bolivia for the thirteen years of pre-treatment period suggests that the synthetic Bolivia provides an accurate approximation to the volume of exports that would have been seen in Bolivia in the post-QRE period, in the absence of the intervention.

5.1.2 The effect on the volume of exports

Main results are summarized in Panel A. of Table 3 in the appendix and and we plot exports pre-treatment trends and the differences between Bolivia and its synthetic counterpart in Figure 1. The main estimates of interest are presented in column (1) of Table 3, while column (2) reports the p-value associated to those coefficients. Panel (a) of Figure 1 plots export trends of Bolivia and synthetic Bolivia, Panel (b) plots the gap between Bolivia and its synthetic counterpart and Panel(c) plots the normalized differences as well as the placebo inference.

Our results show that the percent gap between Bolivia and its synthetic counterpart is 123% in the period after the QRE were implemented. That is, Bolivia's exports of cattle beef is 123% lower than what they would have been in the absence of QRE. We can observe in Panel (b) of Figure 1 that the effect is considerably lower in the immediate aftermath of the QRE, while it becomes higher in the long run while synthetic Bolivia keeps growing. For instance, the difference in exports of beef (cattle) is about $1,500$ tonnes the first year, and increase to $2,700$ tonnes after the second year. Intuitively, the initial shock creates a gap between Bolivia and synthetic Bolivia. In the following years, the gap has been deepened as the donor countries exports continued growing.

Table 2: Beef(cattle).Balance: Predictors pre-treatment mean.

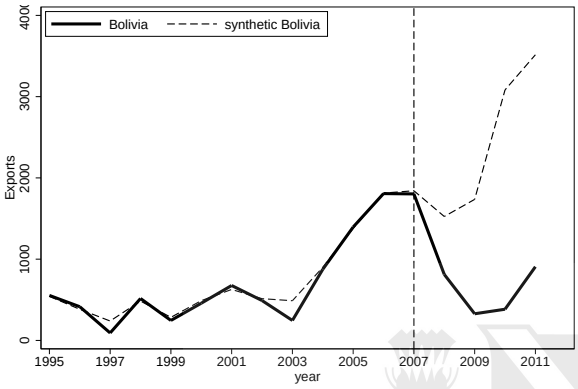
Variables	Treated unit	Synthetic
Exports (1995)	554.00	542.44
Exports (1996)	415.00	383.35
Exports (1997)	92.00	238.90
Exports (1998)	516.00	484.70
Exports (1999)	246.00	284.21
Exports (2000)	458.00	489.52
Exports (2001)	676.00	627.51
Exports (2002)	491.00	513.87
Exports (2003)	246.00	488.64
Exports (2004)	875.00	900.28
Exports (2005)	1395.00	1378.85
Exports (2006)	1807.00	1813.21
Exports (2007)	1803.00	1842.00
GDP per capita (2003)	896.64	5297.74
GDP per capita (2004)	952.12	6196.86
GDP per capita (2005)	1015.48	7434.87
GDP per capita (2006)	1196.61	8823.89
GDP per capita (2007)	1344.81	9536.32
Avg GDP per capita (2003-2007)	1081.13	7457.94

Table 3: Main results

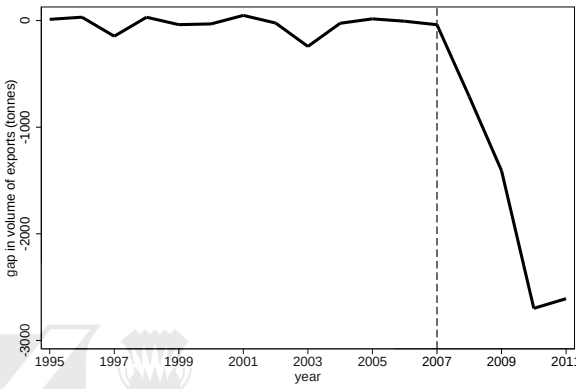
	SC estimates $\hat{\beta}$	p-value
A. Impact on exports	-98.03%	0.05
B. Impact on total production	-48.24%	0.03
C. Impact on production for local market	-44.17%	0.04

Figure 1: Trends in exports of beef,cattle (tonnes) and placebo inference

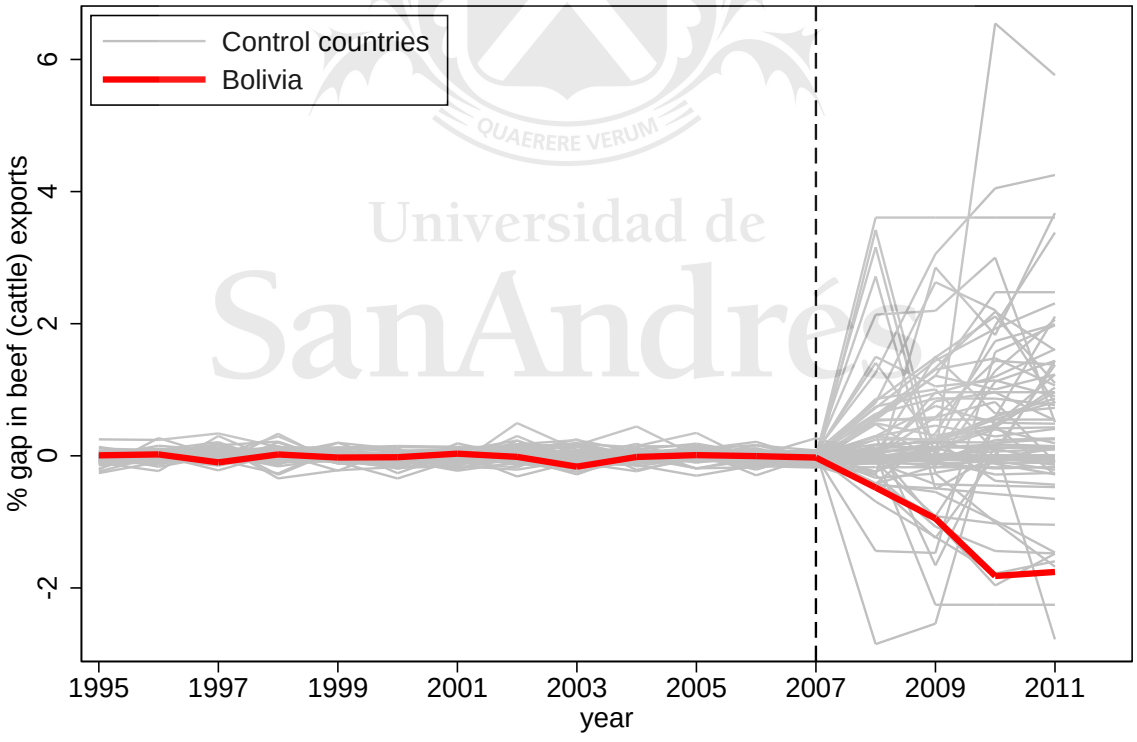
(a) Exports of beef,cattle (tonnes)



(b) Gap between Bolivia and synthetic Bolivia(tonnes)



(c) % gap in Bolivia vs placebo % gap in control countries



Notes: Discards countries with Pre-treatment MSPE twenty times higher than Bolivia's.

Table 4: Highest weighted donors in the synthetic Bolivia for production

Donor Countries	Weights
Vietnam	0.436
Serbia	0.163
Phillippines	0.138
Nigeria	0.103
Turkey	0.055
Polonia	0.048
Pakistan	0.044
Ukrania	0.013
Total	1.000

5.2 The effect of the QRE on production

Once we have identified the effect of QRE on exports, we proceed to the second step; that is, we use the synthetic controls method in order to estimate the effect of the QRE on total production. Specifically, the affected unit is Bolivia (i=1), and the remaining countries that are producers of cattle beef constitute the potential donor pool. As before, the characteristics that we include as predictors for the volume of production comprise the average GDP per capita, pre-intervention values of GDP per capita for years between 2003 and 2007, and pre-intervention values of the volume of production for all the years between 1995 and t'. Including pre-intervention values of production let the synthetic control match as better as possible to the pre-treatment trend of Bolivia.

5.2.1 Quality of synthetic Bolivia for the volume of production

Before examining the most important results, we briefly discuss the quality of the synthetic Bolivia when the outcome variable is the Volume of Production. We report the main donors selected by synthetic control in Table 4 and the pre-treatment levels of the predictors in Table 5. As in the case of exports, the synthetic control picks 8 countries and the main donor is Vietnam representing around 45% of synthetic Bolivia. In terms of pre-treatment match, from the information presented in Table 5 it is clear that synthetic Bolivia has an excellent performance in matching Bolivia's pre-treatment trend. When it comes to total production, synthetic Bolivia not only adjust very well to the outcome variable in previous years but also to Bolivia's GDP per capita.

Table 5: Beef (cattle). Balance: Predictors pre-treatment mean

Variables	Treated unit	Synthetic
Production (1995)	139597	139770.61
Production (1996	143199	143146.94
Production (1996)	155230	153832.73
Production (1997)	159794	158830.41
Production (1998)	160943	160093.18
Production (1999)	164551	166866.87
Production (2000)	168226	162612.13
Production (2001)	172000	173490.03
Production (2002)	175000	178868.08
Production (2003)	200000	204336.77
Production (2004)	244375	239605.42
Production (2005)	248680	247728.51
Production (2006)	244375	247039.53
Production (2007)	248680	247102.21
GDP per capita (2003)	950.39	896.64
GDP per capita (2004)	952.12	885.98
GDP per capita (2005)	1015.48	1044.84
GDP per capita (2006)	1196.61	1287.31
GDP per capita (2007)	1344.81	1530.15
Average GDP per capita (2003-2007)	1081.13	1093.80

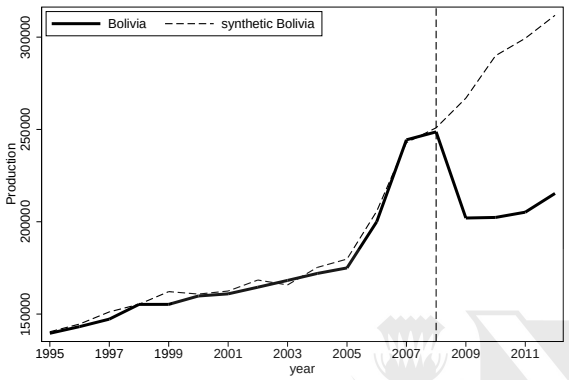
5.2.2 The effect on the volume of production

We report the coefficient for the effect of QRE on the total volume of production in Panel B of Table 3. In particular, after QRE were imposed in Bolivia, the volume of production in that country is 98% lower than the total production of synthetic Bolivia. This finding is summarized in Figure 2 where we plot pre-treatment and post-treatment levels of the outcome variable (Panel (a)), differences between Bolivia and synthetic Bolivia in absolute terms (Panel (b)) and normalized gap between the volume of production of Bolivia and its synthetic counterpart as well as Bolivia's rank in the distribution of placebos (Panel (c)).

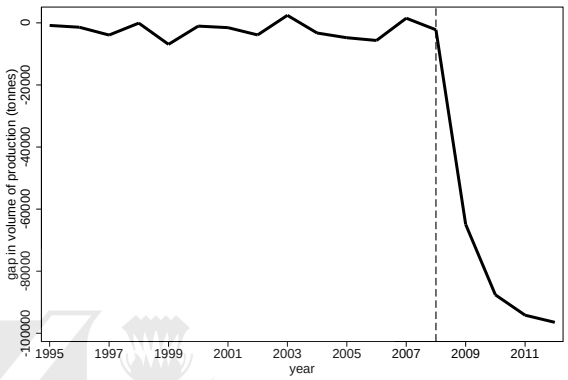
As it was the case with the volume of production, the highest effect in absolute terms is observed in the long run. As it can be observed in panel (b), the gap between production of cattle beef between Bolivia and synthetic Bolivia is around $65,000$ tonnes in 2009, and increases to $110,000$ tonnes the years after that. However, if we analyze panel (a), we see that there is an initial decline of $50,000$ tonnes in Bolivia's production (from $250,000$ to $200,000$) and then Bolivia's production remains constant while the gap is augmented because of the growth of synthetic Bolivia. We will get back to this observation in the next section when we analyze the effect on production for local market.

Figure 2: Trends in production of beef,cattle (tonnes) and placebo inference

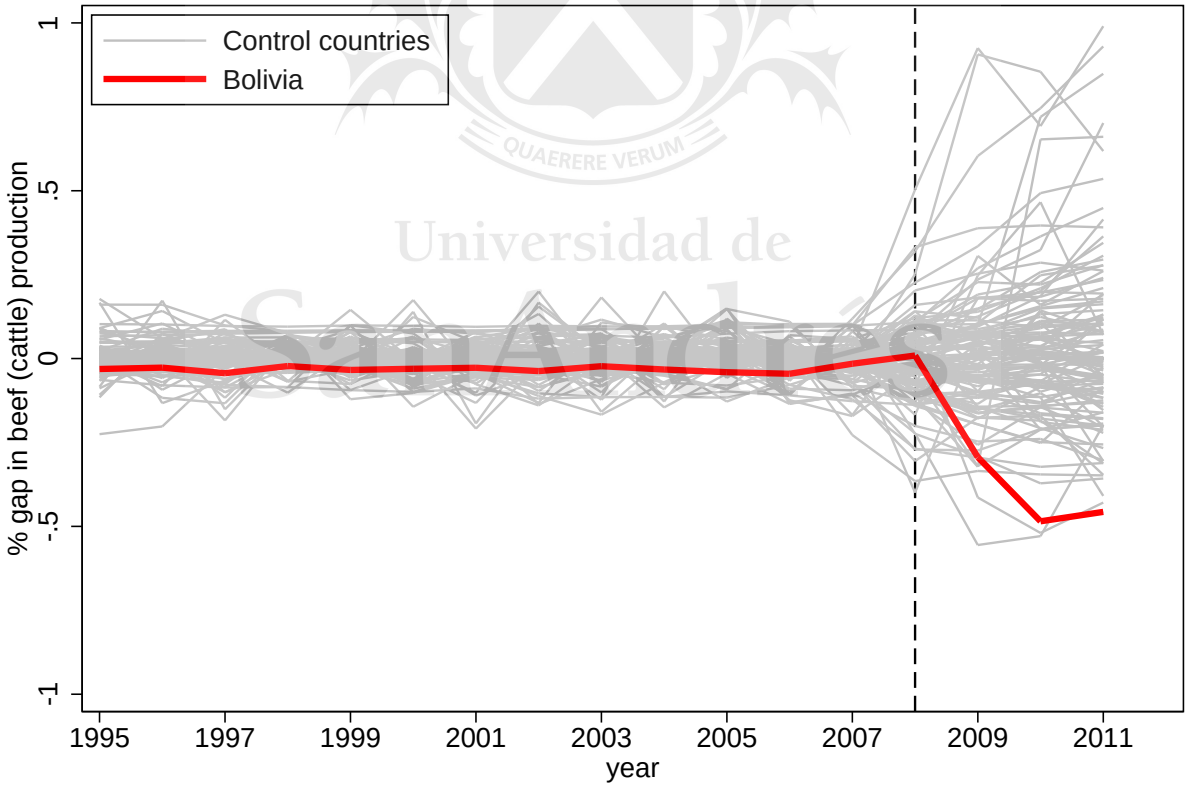
(a) Production of cattle beef (ton): Bolivia vs synthetic Bolivia



(b) Gap between Bolivia and synthetic Bolivia(ton)



(c) % gap in Bolivia vs placebo % gap in control countries



Notes: Discards countries with Pre-treatment MSPE twenty times higher than Bolivia's.

Table 6: Highest weighted donors in the synthetic Bolivia for production for local market

Donor Countries	Weights
Viet Nam	0.434
Serbia	0.288
Pakistan	0.098
Turkey	0.074
Paraguay	0.056
Polonia	0.026
Australia	0.014
New Zeland	0.010
Total	1.000

5.3 The effect on production for local market

In the previous sections we showed that QRE have a negative impact on the volume of exports and on the volume of production. Most of the literature in international trade predicts that when a small economy imposes a QRE, exports of the product fall and the total volume of production fall as well. However, even though exporters reduce their total production, theory predicts an increase in production for local market. As producers are not authorized to export, they redirect part of their production to the local market. This causes a fall in domestic prices that benefits local consumers and negatively affect producers. For instance, Liefert, Westcott, and Wainio (2012) emphasize maintaining the volume of production available for domestic sales as one of the main objectives of export restrictions. In this section, we study if the direction of the effect on production for local market is as the theory predicts.

5.3.1 Quality of synthetic Bolivia for the production for local market

Before examining the most important results, we briefly discuss the quality of the synthetic Bolivia when the outcome variable is the production for local market. We report the main donors selected by synthetic control in Table 6 and the pre-treatment levels of the predictors in Table 7. As before, Vietnam is the main donor in Bolivia synthetic control representing almost 45% of synthetic Bolivia. From the information presented in Table 7 it is clear that synthetic Bolivia has an excellent performance in matching Bolivia's pre-treatment trend. When it comes to production oriented to local market, synthetic Bolivia not only adjust very well to the outcome variable in previous years but also to Bolivia's GDP per capita.

Table 7: Beef (cattle). Balance: Predictors pre-treatment mean

Variables	Treated unit	Synthetic
Production for local market (1995)	139043	140518.5
Production for local market (1996)	142784	142259
Production for local market (1997)	147158	148361.3
Production for local market (1998)	154714	152442.9
Production for local market (1999)	155006	156883.9
Production for local market (2000)	159336	160009.9
Production for local market (2001)	160267	161565.4
Production for local market (2002)	164060	164445.5
Production for local market (2003)	167980	165275.4
Production for local market (2004)	171125	171050.8
Production for local market (2005)	173605	177813.6
Production for local market (2006)	198193	200223.3
Production for local market (2007)	242572	239904.9
GDP per capita (2003)	896.64	2756.95
GDP per capita (2004)	952.12	3310.68
GDP per capita (2005)	1015.48	3850.643
GDP per capita (2006)	1196.61	4073.433
GDP per capita (2007)	1344.81	4845.737
Average GDP per capita (2003-2007)	1081.132	3767.489

5.3.2 The effect on the volume of production oriented to local market

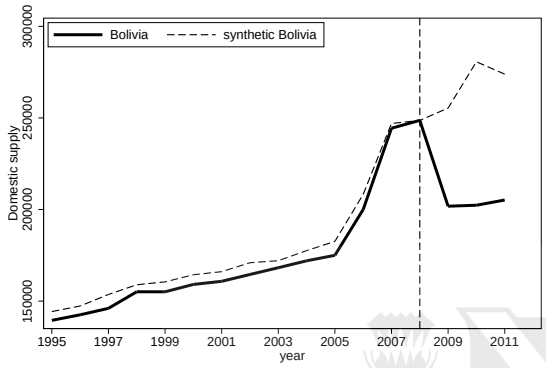
In this section we use production for local market as the outcome variable and apply synthetic controls as before. Main results when the outcome variable is the production for local market are shown in Panel C of Table 3 and we summarize the results in the panels of Figure 3.

In contrast to what standard theory predicts, we find that QRE causes a remarkable fall in the volume of production oriented to the local market. After Bolivia's government imposed the QRE, we observe a gap of around 50% between Bolivia and its synthetic counterpart. Furthermore, the inspection of panel (a) and panel (b) of Figure 2 provides insights to understand better the nature of the effect of QRE on production oriented to local market. First, notice in panel (b) that the year after the QRE were imposed, production oriented to local market declined from $245,000$ tonnes to $185,000$ tonnes. This is the direct effect of QRE on production oriented to local market. Second, notice that after this shock, production oriented to the local market remains constant throughout the following years. This fact suggests that once producers adjust their decisions to the QRE, they need not to reduce production for local market further the years after the policy.

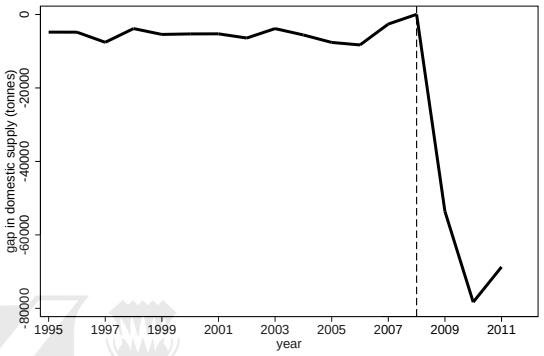
Arguably, there are demographic reasons for not expecting a constant growth in production oriented to local market. For instance, production for local market is constrained by the size of Bolivia's market. However, the initial gap between Bolivia and its synthetic counterpart cannot been explained by this demographic constraint because production for local

Figure 3: Trends in production for local market of beef,cattle (tonnes) and placebo inference

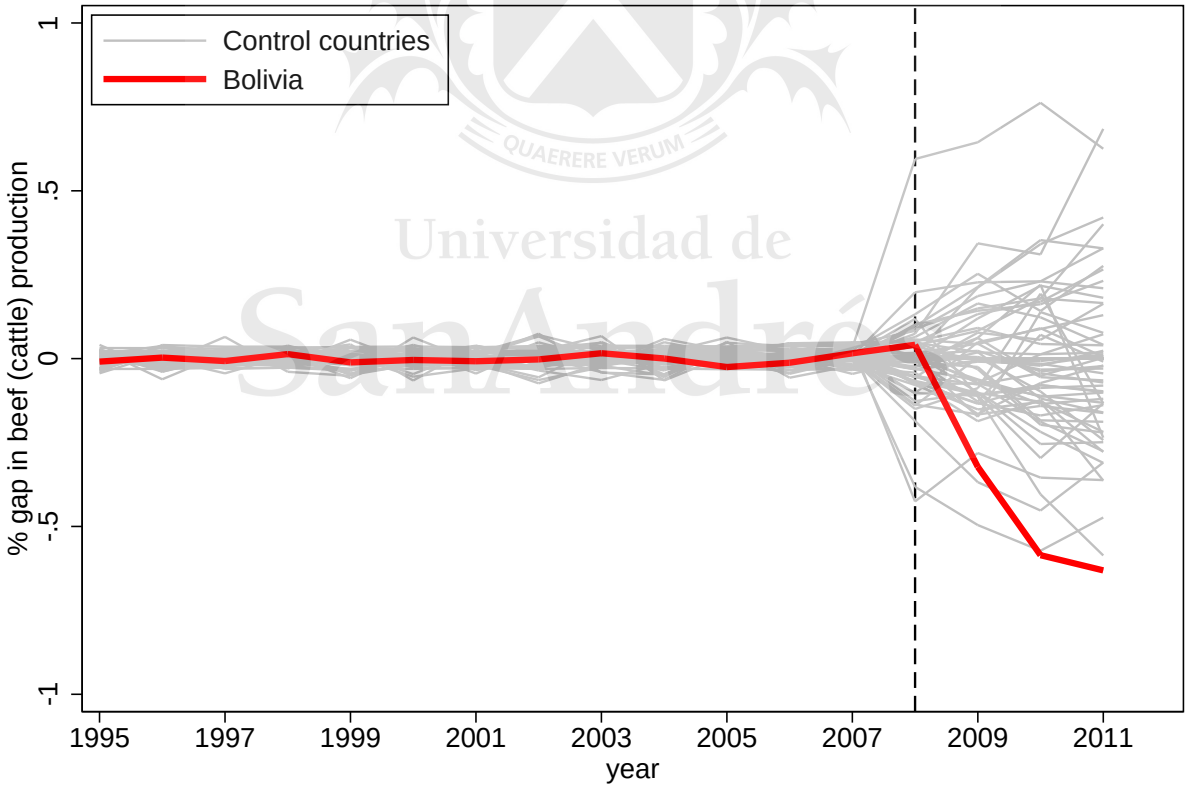
(a) production for local market of cattle beef (ton): Bolivia vs synthetic Bolivia



(b) Gap between Bolivia and synthetic Bolivia(ton)



(c) % gap in Bolivia vs placebo % gap in control countries



Notes: Discards countries with Pre-treatment MSPE twenty times higher than Bolivia's.

market has been below its historic values for the entire period. On this ground, in panel (b) we can observe that as production oriented to local market increased in the donor countries, the differences between Bolivia and its synthetic counterpart became even higher after some years. While Bolivia's production remained constant, other countries took advantages of the growing foreign market and that explain the intensification of the effect in the long run.

The fact that production oriented to local market declined after the QRE were imposed suggests that decisions about production for local market depends on the possibility of exporting. In particular, one can think that when producers decide their production for local market, they consider if there are QRE or not. If this were not the case and production for local market were exogeneous with respect to restrictions to exports, then we should observe a rise in production for local market. One potential channel for this effect is that when producers face export controls, they change their decisions and substitute one product for other. Hence, in a dynamic perspective where total production is not fixed, QRE can cause a decline not only in total production, but also in production oriented to local maket.

5.4 The effect of the restrictions on domestic prices

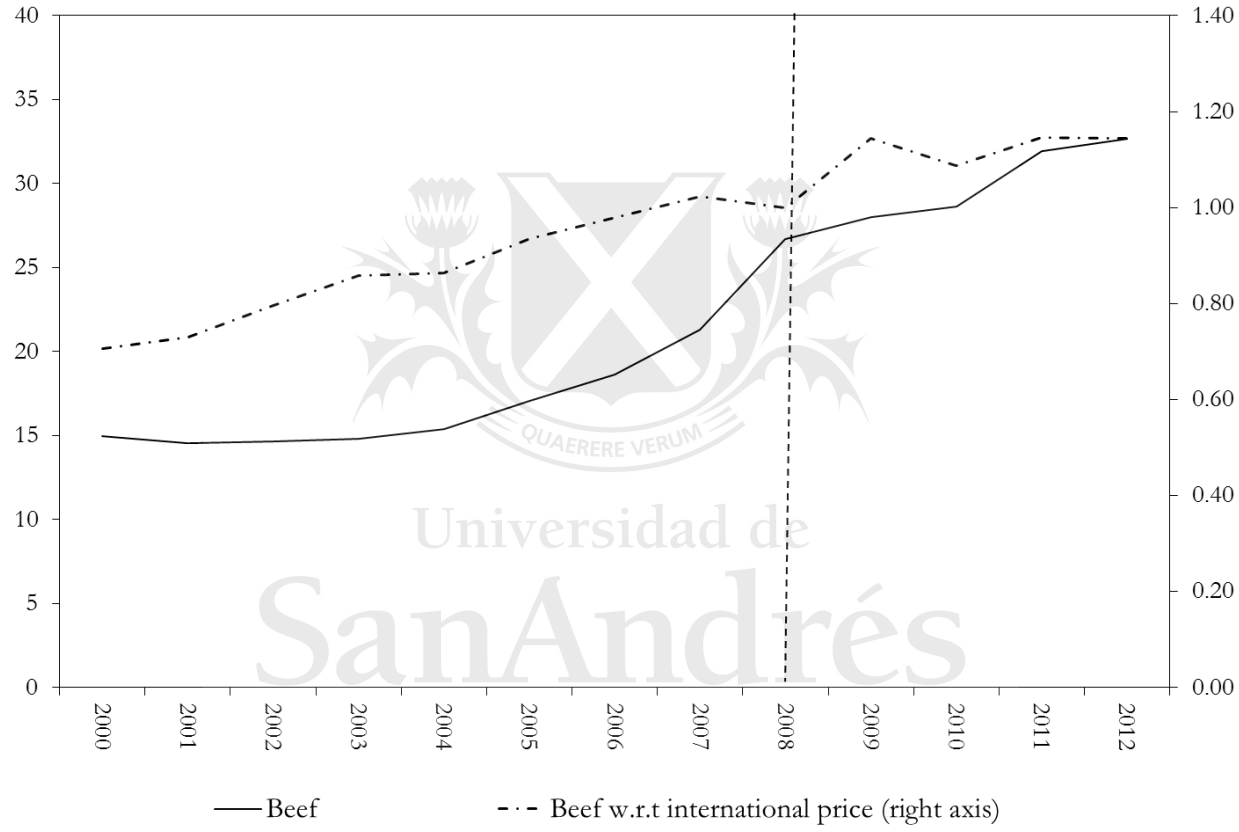
The intended objective of the QRE was to increase domestic supply and reduce prices. Previous sections show that production for the local market dropped after the QRE. Therefore given there was not an increase in imports increasing the domestic supply, the domestic price should has increased. Figure 4 confirms that the domestic price of beef increased even compared with the international price.

6 Conclusion

The prices of many food commodities have increased substantially over the past years and many developing countries reacted by imposing export controls that aimed at reducing the transmission of international price fluctuations into domestic markets, protecting consumers, and boosting domestic supply. Although theoretical literature predicts that these type of policies might be effective to achieve that goal, little research has been done to empirically document these relationships in small economies. In this paper we exploit QRE imposed by Bolivia's government in order to empirically assess the impact of export controls on different outcomes of interest and determine if QRE are actually effective instruments to achieve price stability.

We find that QRE succeed to reduce exports. As expected, we also find that the total

Figure 4: Domestic prices



Notes: The price with respect to international prices is the ratio of the index of domestic price and international price both being equal to one the year of the first restriction.

volume of production fall. However, we found that QRE fail to achieve its intended objective when it comes to domestic supply. In fact, we find that even in the context of a small economy, QRE not only reduce total production as theory predicts, but also reduce production for local market.

Results in this paper yield lessons that are relevant to policy makers that are still considering export controls as a way to increase production for local market. In a context where producers may overreact to QRE, a policy of this type may not achieve the objective of increasing production for local market, and may end up being detrimental for both producers and consumers.

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