Sanitary and Phytosanitary Measures and its impacts on trade

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Abstract

This paper studies the sanitary and phytosanitary (SPS) measures and its impact on imports in the country that imposes such restrictions. Unjustified use of SPS measures are discouraged by WTO SPS Agreement but due to its technical complexity, it is used by countries to restrict trade. This paper will consider case of SPS imposition in India, in July 2011 on HS 0407 products. It uses Synthetic Control Method proposed by (Abadie & Gardeazabal, 2003), alongside difference in difference methodology to study the impact of SPS measures on trade volumes. The two methodologies used in the paper shows that the imposition of SPS easure has led to decline in imports of the HS 0407, globally.

Keywords: Sanitary, Phytosanitary, Trade, Non-Tariff Barriers, Synthetic Control, Difference in differences

Introduction

With rapid increase in trade volumes among countries, its importance for global economy is quiet evident. Countries trade with each other which benefits both the partner countries. Different theories suggest that trade helps countries to specialize in products, and use their abundant factor more efficiently. Variety of goods available to consumers also increase after trade which improves standard of living of the people.

It has always been debated in global arena, whether trade actually benefits both the partner countries. There are groups of people who propose that trade benefits only the nation which exports its commodities, while the importing nation has to suffer in terms of the competition to domestic producers, employment opportunities, and other economic challenges. People with such mercantilist views always support exports while criticise imports.

There are different methods employed by such countries to restrict import of commodities. Import restrictions can be broadly classified as -

> **Tariff Barriers** - Applying high taxes on imports, which in turn increases the cost of imports, reduce their flow into the country. Tariffs can be of two types - Specific Tariffs and Ad Valorem Tariffs.
>
> **Non-Tariff Barriers** - Instead of imposing taxes (or say custom duties) on imports, countries impose some non-monetary restrictions on imports, which makes it difficult for exporting countries to maintain its export volumes with the country that imposed the restriction. Different kinds of non-tariff measures to restrict imports include - Complex/discriminatory Rules of Origin, Quality conditions imposed by the importing country on the exporting countries, Unjustified Sanitary and Phyto-sanitary conditions, Unreasonable/unjustified packaging, labelling, product standards, Complex regulatory environment, Occupational safety and health regulation etc.

Usually these (non tariff barriers) are not directly imposed as restriction on imports but these are proposed to maintain quality of imports and maintain safety and health regulations, but countries use it with wrong purpose of restricting imports.

This paper tries to study the impact of sanitary and phytosanitary (SPS) measures on trade flow among countries, considering imposition of SPS measure in India, in July 2011..

Sanitary and Phytosanitary Measures
WTO Uruguay Round, 1995

With the establishment of WTO in 1995, it passed The Agreement on the Application of Sanitary and Phytosanitary Measures (or the "SPS Agreement") which sets the basic rules for food safety and animal, and plant health standards. It allows countries to independently set their own regulations to restrict the import of products which hinder the health and safety standards of the country. But, at the same time it also says that such regulations must be based on science which should be applicable only to extent necessary to protect human, animal or plant life or health. Any kind of arbitrary or unjustified impositions of SPS measures by countries to restrict import is discouraged.

The agreement still allows countries to use different standards and different methods of inspecting products. These SPS measures can take many forms, such as requiring products to come from a disease-free area, inspection of products, specific treatment or processing of products, setting of allowable maximum levels of pesticide residues or permitted use of only certain additives in food. Sanitary (human and animal health) and phytosanitary (plant health) measures apply to domestically produced food or local animal and plant diseases, as well as to products coming from other countries.

However, due to complex nature of SPS measures, these are misused by the governments to restrict imports, in order to protect the domestic producers from economic competition, rather that for health protection. This paper tries to study the impact of sanitary and phytosanitary (SPS) measures on trade flow among countries. It considers the case of SPS policy measure implementation by India on its product HS 0407 in July 2011. It imposed the restriction on imports of bird eggs, in shell fresh preserved or cooked, stating the reason that it wants stop spread of avian influenza. The objective of this study is to check whether the imports of product HS0407 reduced in India after imposition of SPS measure or not. It compares the change in trade volume of India with other countries considered for study. Other countries are selected to form control group such that the countries have not imposed any such trade restriction on our product in study i.e. product belonging to HS 0407.

Literature Review

Various studies have been done to study impacts of tariff measures on trade volumes. But, there are not many studies concerned with the impact of non tariff trade barriers like SPS measures, Anti-dumping policies, Technical barriers to trade etc. Gonzalo E. Snchez & Patricia A. Vargas study, *"Estimating the impact of technical barriers to trade : The case of perfumes and toilet waters in Ecuador"*, used difference in difference methodology along with synthetic control methods to study the impact of SPS measures in Ecuador. In their study, they found that the import volume significantly decreased in period after imposition of SPS measures in Ecuador in the products influenced.

Data Source

Most of the data collected in the study is from the rich database of World Trade Organisation (WTO). Its i-tip database provides data for various indicators of trade. Data can be obtained for specific country, trade in specific products among countries, and data on various restriction imposed by countries. It also provides the countries which specifically gets affected by different barriers to trade. Data can be obtained on different countries about various trade barriers. Data for monthly imports is collected from UN monthly COMTRADE database. It provides monthly data on trade volumes (i.e. imports and exports) among countries, differentiated by products using HS codes.

Model

This study uses the difference in difference methodology to estimate the impact of SPS measures on the trade flows. For this study, two groups are formed - treatment and control group. The treatment group is one which imposed the SPS measures to restrict trade in products while the control group is the other one which is free from such barriers. Also, for empirical exercise two periods are taken for study, one pre-treatment period i.e. before the imposition of SPS measures and post-treatment period i.e. after imposition of SPS measures.

In the case under study, the treatment group includes India, which imposed some SPS restriction on its product category with HS 0407, in July, 2011. Here the pre-treatment period is of 7 months from January 2011, to July, 2011 and the post treatment period is also of 7 month duration ranging from August 2011 to February, 2012. Control group consisted of other countries in study which have not imposed any restriction on its product code HS 0407 during the period of our study. This ensures that the control groups import has not got influenced by any policy change in the respective country.

In many cases treatment and control groups do not follow parallel trends, i.e. both can have different kinds of economic, political, social or other shocks which can influence the behavior of treatment and control groups differently. In such cases, we cannot directly study the impact of policy measures on the treatment and control groups as it will be a biased estimate.

In order to correct this anomaly, this paper will try to use "Synthetic Control" method to construct an appropriate control, which by construction is not affected by the policy under study but is affected by other external shocks. Abadie & Gardeazabel (2003) used the synthetic control method in their study to form a control group. Idea behind using synthetic control is that a combination of units often provides a better comparison for the unit exposed to the intervention than any single unit alone. So, a synthetic control group is formed by taking weighted average of all the control group members to resemble the treatment group before policy change.

If there are j members in control group then, we assign weights W = $(w_1, w_2, ..., w_j)$ to the j members such that $w_j \geq 0$ and $\sum w_j = 1 \ \forall j$. Let us form a matrix of the measures of imports in pre-treatment period (for K different years), X_1 i.e. a (Kx1) vector of pre-treatment imports of K years in treatment group. Now, X_0 be the (KxJ) matrix which contains the value of same variables for J control groups. V (KxK)be a diagonal matrix with non-negative components reflecting the importance of different imports i.e. it allows different weights to the imports of different year.

$$W^* = \min(X_1 - X_0W)'V(X_1 - X_0W) \tag{1}$$

So, we choose a W^* to minimize the above equation. Once, we find the appropriate W^* we construct the counterfactual (in the absence of policy changes) or synthetic control for treatment group as -

$$Y_1^* = Y_0W^* \tag{2}$$

where ,

Y_1 = (Tx1) matrix whose elements are import values for T years in treatment region.

Y_0 = (TxJ) matrix whose elements are import values for T years in control regions.

Here, synthetic method allowed us to construct a synthetic treatment group which gives the path to be followed by treatment group if no policy changes has taken place. Results of this method is used alongside difference in difference approach to study the causal effect. Difference in difference approach tries to study the impact of policy changes by comparing pre-treatment and post treatment period among treatment and control groups.

$$lny = \alpha + \beta Mon + \gamma T + \delta Mon * T \tag{3}$$

where,

y = import of product on which SPS measure has been imposed.

Mon = Dummy variable for treatment period

where,

$Mon = 0$ for pre-treatment year

$Mon = 1$ for post-treatment year

T = Dummy variable for Treatment and Control group

where,

$T = 0$ for control group

$T = 1$ for treatment group

Based on the model proposed, we can tabulate various possible cases

	T = 1	T = 0	Differences
Mon=1	$\alpha + \beta + \gamma + \delta$	$\alpha + \beta$	$\gamma + \delta$
Mon=0	$\alpha + \gamma$	α	γ
Differences	$\beta + \delta$	β	δ

Here, in the above matrix first we tried to find the differences between treatment and control group in the right most column, where treatment year is fixed and then difference between the pre-treatment and post-treatment year is found in the bottom row (with treatment and control groups fixed). Finally the bottom-right corner shows the difference in difference of the two differences found. This is the crucial term for our study as it represents the change in the imports after treatment period and between treatment and control group. Positive values of the difference in difference variable γ suggest that the impact of policy change is positive on both the treatment and control group. We observed that the difference in difference variable, γ, is the coefficient of interactive term in the model used in study, so the positive coefficient of the interactive term suggests that the policy change impacted the control and treatment group positively and hence the policy change is desired.

Methodology

Based on the model defined above, we can conduct the difference in difference study on our data collected for India and other countries on their import volumes for period varying from Jan'11 to Feb'12, where the SPS measure was imposed in Jul'11. The difference in difference model is -

$$\ln y = \alpha + \beta Mon + \gamma T + \delta Mon * T \tag{4}$$

First, we need to select among the pooled OLS, Fixed Effect and Random Effect Model for our study. We will use Hausman test to verify whether Fixed Effect Model or Random Effect Model is appropriate. The hypothesis of Hausman Test is

$$H_0 : \text{Random Effect Model is appropriate.}$$
$$H_A : \text{Fixed Effect Model is appropriate.}$$

Results obtained from Hausman Test are -

```
. hausman fe re

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+----------------------------------------------------------------
         mon |    .2157879     .2157879        1.39e-16        1.32e-09
        mont |   -.8829705    -.8829705        1.11e-16               .
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(2) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.00
                Prob>chi2 =      1.0000
                (V_b-V_B is not positive definite)
```

Here, we can see that the P-value is 1, i.e. we cannot reject the null hypothesis and hence, the Random effect model is appropriate.

Now, we need to perform the Breusch Pagan test, to check whether Random Effect Model or Pooled OLS is appropriate.

Hypothesis of a Breusch Pagan Test is -

$$H_0 : \text{Homoskedasticity.}$$
$$H_A : \text{Heteroskedasticity.}$$

Results obtained from Breusch Pagan Test are -

```
. xttest0

Breusch and Pagan Lagrangian multiplier test for random effects

        lny[srid,t] = Xb + u[srid] + e[srid,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                     lny |   2.435248       1.560528
                       e |   .1097226        .331244
                       u |   2.094524       1.447247

        Test:   Var(u) = 0
                              chibar2(01) =   1626.60
                           Prob > chibar2 =    0.0000
```

So, here we reject the null hypothesis of Homoskedasticity i.e. we can say that Random Effect Model is appropriate.

Based on the output of Hausman test and Breusch Pagan test, we observe that Random Effect Model is appropriate. Hence, we run the Random Effect Model on our data. The results of the Random Effect Model is given on the next page. It could be observed using P-values of the variables that the variable mon and mont are significant at 5% while the variable t is significant at 10% significance level.

The results obtained in the difference in difference principle shows the coefficient of the interactive term of the month and treatment variable is negative. The negative value of the variable mont shows that there has been an overall negative impact on the imports of HS 0407 product due to imposition of SPS measure i.e. the imports declined in the pre treatment period for the treatment unit i.e. India.

```
. xtreg lny mon t mont, re

Random-effects GLS regression                   Number of obs      =       280
Group variable: srid                            Number of groups   =        20

R-sq:  within  = 0.1412                         Obs per group: min =        14
       between = 0.1805                                        avg =      14.0
       overall = 0.1786                                        max =        14

                                                Wald chi2(3)       =     46.38
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         lny |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         mon |   .2157879   .0406197     5.31   0.000     .1361746    .2954011
           t |  -2.520382    1.49039    -1.69   0.091    -5.441492     .400728
        mont |  -.8829705    .181657    -4.86   0.000    -1.239012   -.5269293
       _cons |   14.02625   .3332613    42.09   0.000     13.37307    14.67943
-------------+----------------------------------------------------------------
     sigma_u |  1.4472469
     sigma_e |    .331244
         rho |  .95022217   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Synthetic Control Method

Another method used in this paper is Synthetic control method, where a synthetic control group is formed and is compared with treatment group. It compares the pre-treatment period of the control and treatment group and based on that it provides weight to different control group elements so as to create a synthetic control group which resembles closely with the pre treatment period of the treatment group. Then, these weights are used to create the synthetic control group in post treatment period i.e. it shows us the pattern the treatment group would have followed in case the policy has not been implemented, in our case, if the SPS measure has not been imposed.

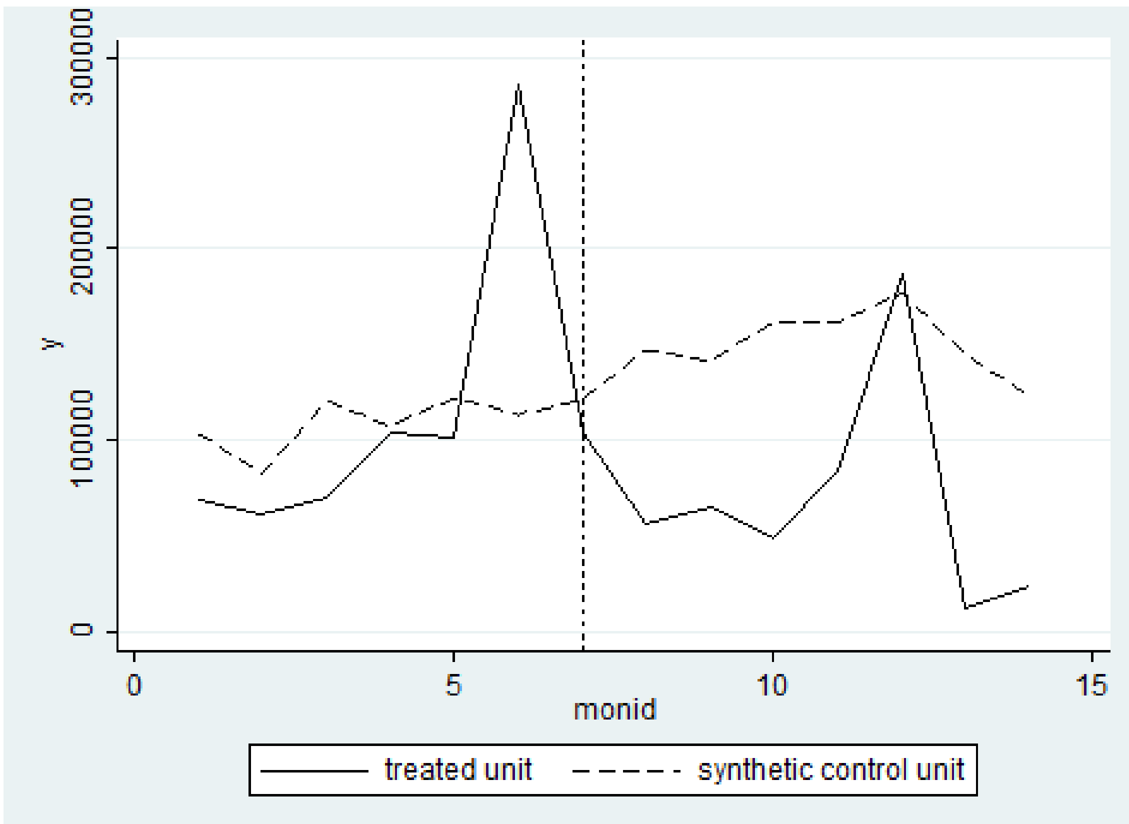
Based on this model, we obtain weights for different elements of the control group. The weights for the different control group element has been given in the Table on next page.

This table shows two different weights for each country, Weight_lny and Weight_y, these weights are obtained using different outcome variables. Weight_lny is the weight obtained when we formed the synthetic control group using lny as the outcome and the predictor variables. On the other hand, Weight_y provides the weights obtained for different countries in control group, when y (i.e. import volumes) is used as the predictor and the outcome variable. Weights provided to different countries are arranged in descending order (of Weight_lny) in the table.

Weight_lny value shows us that New Caledonia (47.9%) and Rwanda (36.3%) explains most of the pre treatment period imports of the treatment group i.e. India. Other countries like Norway, Paraguay, Mozambique , Luxembourg etc. comes next but, they explain less then 2% of the imports in India. Similarly, most of the weight_y is explained using Rwanda (92%) and others explain very less.

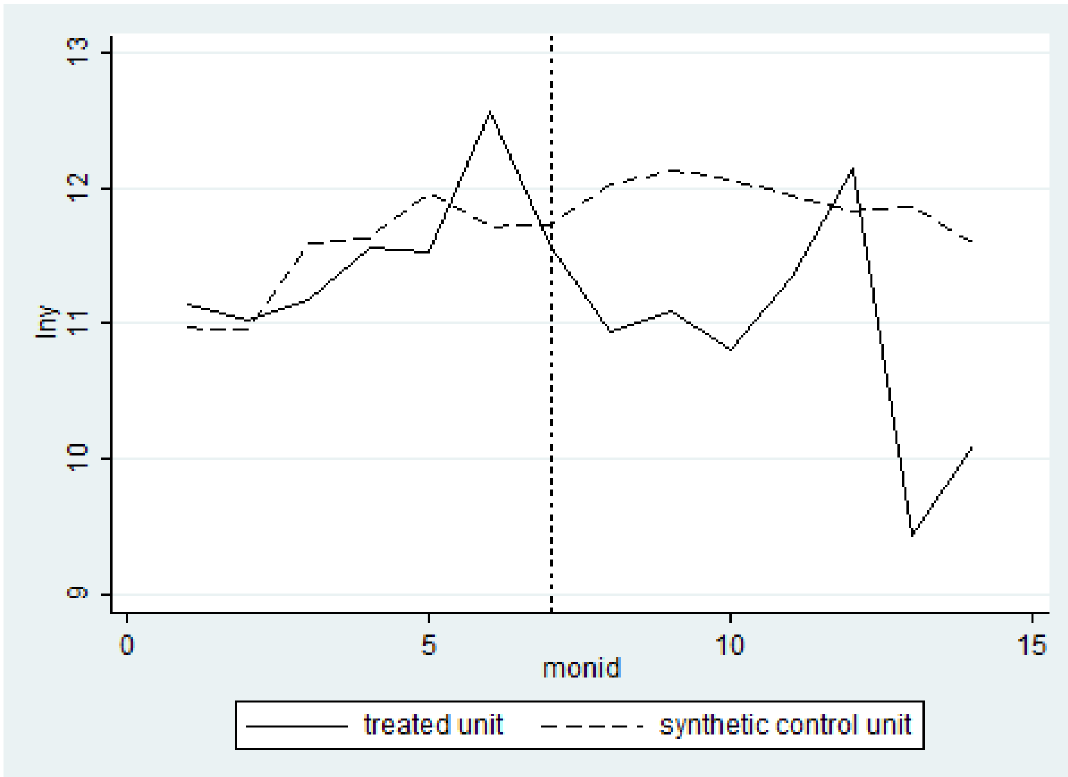
Country	Weight_lny	Weight_y
New Caledonia	0.479	0.044
Rwanda	0.363	0.92
Norway	0.02	0.007
Paraguay	0.015	0.004
Mozambique	0.014	0.003
Luxembourg	0.013	0.003
Croatia	0.012	0.002
Turkey	0.011	0.002
Greece	0.01	0.002
Portugal	0.01	0.002
Slovakia	0.01	0.002
Denmark	0.008	0.002
Hungary	0.008	0.002
Czech Republic	0.007	0.001
Italy	0.005	0.001
Poland	0.005	0.001
France	0.004	0.001
Netherlands	0.002	0
Singapore	0.002	0

Using the weights obtained using synthetic control method, we create a synthetic control group , let's say synthetic India, which gives the trajectory of imports in India, in post treatment period, if the SPS measure has not been imposed. The trajectory followed by this synthetic India is compared with the actual treatment group in the figure below.



This compares the import volume in India with Synthetic India. We can see that the import followed similar trends in pre treatment period in both the treatment unit and synthetic India. But, in post treatment period Imports in synthetic India shows an increasing trend, while it fell in treatment unit.

Another comparison is shown using the lny as the outcome variable in the figure below. It basically scales down the import variable and hence provides a better comparison of the change in trend among the two, i.e. treatment unit and synthetic control unit. It also reduces the impact of two shocks in imports in treated unit.



This also shows the some trend as was observed with the import volume as outcome variable. Here, the synthetic India follows treated unit closely in pre treatment period. Imports in treated unit starts declining after imposition of SPS measure while it increases for the synthetic India. Both of graph confirms that the imposition of SPS measure has resulted in decline of imports in India.

Conclusion

This paper studied the impact of the imposition of Sanitary and Phytosanitay measure on HS 0407 product, in India, in July 2011. To study the impact, it first used the difference in difference methodology, which showed us that the overall impact of SPS measure on import volume is negative, i.e. the SPS measure led to decline of imports of HS0407 in India, as well as in other importing countries. So, we can say that the measure resulted in decline of its import in all the countries.

This paper also focused on the synthetic control method, provided by Abadie, Hainmueller (2003). This method created a synthetic India based on import data of other countries, which assumes that no SPS measure has been imposed. This synthetic India is compared with the actual treated unit. Ignoring two shocks in imports in the treatment unit, the trajectory of imports in synthetic unit followed closely the treatment unit. In the post treatment period, the imports varied between treated unit and synthetic India. This shows that the imports declined significantly due to imposition of SPS measure.

References

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Appendix

This section consists of details on data, and codes used in the paper. All the study has been done using Stata.

Different Countries included in study are -

Treatment Group : India

Control Group : Croatia, Czech Republic, Denmark, France, Greece, Hungary, Italy, Luxembourg, Mozambique, Netherlands, New Caledonia, Norway, Poland, Paraguay, Portugal, Rwanda, Singapore, Slovakia and Turkey.

Codes

Import the data in Stata

tsset srid monid : Defines the Panel Data

Hausman Test

xtreg lny mon t mont, fe : Runs Fixed Effect Model

estimate store fe : Stores Fixed Effect Model in fe

xtreg lny mon t mont, re : Runs Random Effect Model

estimate store re : Stores Random Effect Model in re

Hausman fe re : Runs Hausman Test

Breusch Pagan Test

xtreg lny mon t mont, re : Run Random Effext Model first

xttest0 : Run Breusch Pagan Test

Synthetic Control Method

ssc install synth, replace all : Install Synth Package in Stata

Synth Package Source : http://web.stanford.edu/ jhain/synthpage.html

tsset srid monid : Define Panal Data

synth lny lny, trunit(1) trunit(7) figure : Runs Synthetic Control Method