Effect judgment and effectiveness estimation of anti-dumping duty – an example of the case of canned mushroom

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Abstract

The paper aimed to provide a method for accurate estimation of the Anti-Dumping (AD) tax. Having used the case of canned mushrooms, exported from Indonesia to the United States as an example, the paper presented methods for effective judgment and accurate estimation of the AD. By having done so, it provided AD policy makers with a scientific and fair AD tax which, at the same time, would incorporate legislation that will prevent abuse of AD taxation system. The paper further analysed the impact of AD tax on the trend of export; the spread of related indicators between a taxable situation and a non-taxable one through the Chow test and other methods. Final results provided AD users with logical basis and method support.

Keywords: SOFC, discrete sliding mode, control, DC/AC, converter

1 Introduction

Anti-Dumping (AD) is the main reason that leads to trade conflict and even trade war in the international business environment. From 1995 when the World Trade Organization (WTO) was established to the end of 2012, 4230 AD complaints were filed in the world. AD measures including duties were taken against an astonishing 2719 of these cases. The AD measures vary from case to case, some of which are original, triggered, for relief, protective, or even retaliatory. But no matter what the purpose is, each country believes they have just been caused for its punitive actions while the defending countries believe they did nothing wrong. Thus, AD measures have become very controversial or even the most controversial trade measures. However, it is still a licensed trade remedy means in terms of WTO law and rule. In our opinion, there are several reasons that AD measures have been criticized. First, anti-dumping is defined despite its obscured evidences. Second, one country took AD measures into their own hands while another used it as revenge. Lastly, one country took AD measures so aggressively the targeted country could not reasonably accept the conditions. The first and second reasons we just mentioned exemplify how these countries violate WTO regulations. Therefore, they shouldn't fall under WTO jurisdiction. This paper focuses on the analysis of AD caused by the third reason. Even though this type of AD is legitimate in reality, these actions are ineffective because they crossover certain trade relief limits. So, evaluating AD duty's effect based on confirming AD duty-caused export variation of Countries accused of dumping will provide theoretical guidance for reasonable estimating of the appropriate rate.

2 Research literature review

As one of the important trade measures in the latter half of the 20th century, AD has become a hot topic discussed in both academia and industry from domestic and overseas. Among numerous of studies related to AD, we can sum them up as follows:

Firstly, the study of the AD trade restrictions effect. The AD trade restriction effect is the direct effect of AD measures on the exports of the countries which are accused of dumping. The research has shown the decline of export volume in the accused country. The direct and indirect evidences can be found in the research of Vandenbussche and Zanardi [1] who used the gravity model to analyse the gross trade volume data between 1980 and 2000 and Bao's [2] research on the impact of China's AD policy on GDP.

Secondly, the study of AD trade diversion and trade deflection effects. Although there has been an increasing number of research on this, the conclusions are not all the same. For example, Durling and Prusa [3] paper on hot rolled steel anti-dumping case (1996-2001) and Feng Zongxian & Xiang Hongjin (2010) 's research on European and American AD measures have shown opposite conclusion.

Thirdly, the study of AD relief effect. Similar to the above mentioned studies, such studies also have shown quite different conclusions. For example, the study of Bao [5] in the 1997 - 2004 Chinese anti-dumping case analysis and Corinne M. Krupp and Susan Skeath (2002) used seven TSUSA (United States Tariff) and eight SIC (Standard Industrial Classification) tariff empirical data have shown different conclusions. Despite of the different study objectives, we cannot arbitrarily consider the two conclusions are totally opposite to each other. The reason

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is that single variable like market share or import volume cannot fully measure the relief effect.

Lastly, the study of the impact of AD research methods. Eaton and Grosman [7] first used the metrology method to analyse the effect on negative impact on certain industries. Since then, scholars such as Prusa [8], Bao [4], Xiang, Ke and Feng [9] have done such researches from different perspectives with different techniques to analyse the impact of AD on trade, which have provided evidences and references for other researchers.

Obviously, the existing studies of the AD trade effect have already provided good references. However, the study can be furthered because of the imperfect setting of AD duty. A statistic method should be applied in this case. Therefore, this paper utilizes Chow test in the AD effect study. Besides, VAR model is applied to obtain the time features from different AD duties to get the general idea of how to set the AD duty.

3 Research ideas and steps

The effect of AD duty is the key to judge if AD duty rulings trade remedy function works and if it functions properly, the former is a matter of judgment, the latter is measurement of the problem. Therefore, this paper will follow the logic of "effect judgment – efforts to measure".

3.1 CHOW TEST ON THE EFFECT OF AD DUTY

Although the analysis on simple data changing across time can provide evidence that if a country's export-related industries are affected by the import country's anti-dumping duty, it still does not seem sufficient and convincing. The reason is that even if there is a decline in export volume or product price in the accused country, there is no way to prove such decrease is directly related to AD. In other words, if the decline happened before being imposed AD duty, the AD duty just maintained the downward trend, and thus we cannot prove the AD duty has significant impact on export at time series level.

Under such circumstances, unless we can see a spike in time series trend, we cannot make the argument that AD duty is the cutoff point on the change of export trend for accused Dumping country. Therefore, Chow test should be applied in this case. Chow Test is used to determine the variation of independent variables when given a series of time period. It breaks the whole time period into two parts, before and after, and F-test is used to test both parts to determine if the cutoff point is significant on the change of trend.

For the anti-dumping duty, if we take the point of time when AD duty is imposed as cut-off point, some parameters such as import volume associated with the products involved in the import party will be used. Chow test is used to analyse such time series data and we observe the changes to determine its statistical significance on AD duty trade effects.

Firstly, we choose parameters such as price, export volume etc. of the country whose products are imposed AD duty;

Secondly, we apply logarithmic transformation on such data and use OLS regression. Then, we conduct heteroscedasticity and correlation test on the regression equation.

Lastly, in the adjusted regression model, we apply Chow test on multiple time points, and observe the P value and F value at 1% significance level. If the P value is less than 0.01, then it is considered trend mutation effect occurs, meaning the AD duty has changed the original development trend of the product concerned.

3.2 THE VAR MODEL IN AD DUTY EFFECT MEASUREMENT

Chow test is used to measure if AD duty will change the structure and trend of original model, and VAR model is applied to further analyse the impact of AD duty. VAR model uses lag value transformation to change the univariate autoregressive model to multivariate time series self-regression model. With Chow test results, the VAR model can be used to predict the normal trend of export volume and price for a country if they were not being imposed AD duty. Then we compare the predicted value to actual value to measure the effectiveness of AD duty. Below are the test steps in details:

Firstly, take export price and export volume as endogenous variables and constant term as exogenous variable, we use AIC and SC criteria to determine the lag periods P;

Secondly, build autoregression model with lag periods p, and obtain the estimation results;

Lastly, we take Chow trend mutation point of time as cut off point, then use VAR model to predict the original trend with transformed price and export volume. With the comparison of predicted value and actual value, we can obtain the basic idea of the effectiveness of AD duty.

4 The determination of AD duty effect and Chow Test

4.1 DATA SELECTION AND PREPARATION

We take the 1998 AD cases (average tax rate of 14.1%) US against Indonesia canned mushrooms (HS Code: 2003100053) as an example to investigate the mutation effect on the product involved and estimate the impact of Indonesia canned mushroom export decline caused by AD duty. We apply Chow test on total 36 periods of time series data including export volume and export price of the canned mushrooms before/after AD duty (See Tables 1 and 2). The data source is from the U.S. Department of Commerce Bureau of Foreign Trade Statistics Database, and the data analysis tool used here is Eviews7.0.

The original data is listed in Tables 1 and 2.

TABLE 1 Mushroom export quantity from Indonesia to the U.S. (Tons)

t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}	t_{11}	t_{12}
64.8	49.1	106.2	167.5	225.6	605.9	424.8	541.9	418.9	49.2	253.7	240.0
t_{13}	t_{14}	t_{15}	t_{16}	t_{17}	t_{18}	t_{19}	t_{20}	t_{21}	t_{22}	t_{23}	t_{24}
215.1	116.7	195.8	179.5	225.7	44.6	79.9	16.9	11.7	36.2	25.6	65.7
t_{25}	t_{26}	t_{27}	t_{28}	t_{29}	t_{30}	t_{31}	t_{32}	t_{33}	t_{34}	t_{35}	t_{36}
56.2	94.5	76.2	179.6	154.9	129.8	166.4	65.8	155.7	146.9	135.8	77.2

TABLE 2 Mushroom export price from Indonesia to the U.S. (Thousands of USD)

t_1	t_2	t_3	t_4	t_5	t_6	t_7	t_8	t_9	t_{10}	t_{11}	t_{12}
1417.4	1887.7	1810.5	1744.7	1,956.8	1,956.3	2,084.3	1,970.6	1,858.9	2,359.1	1,406.9	1,547.7
t_{13}	t_{14}	t_{15}	t_{16}	t_{17}	t_{18}	t_{19}	t_{20}	t_{21}	t_{22}	t_{23}	t_{24}
1,422.4	1,651.5	1,254.0	1,267.9	1,204.6	1,359.9	1,277.0	1,280.2	1,210.4	1,593.5	1,643.6	1,542.6
t_{25}	t_{26}	t_{27}	t_{28}	t_{29}	t_{30}	t_{31}	t_{32}	t_{33}	t_{34}	t_{35}	t_{36}
1,304.9	1,607.5	1,476.3	1,538.6	1,897.8	1,741.6	2,134.4	2,063.5	1,954.9	1,997.4	1,772.3	1,836.5

Now we build a model in which the dependent variable is export volume *Y*, and independent variable is export price *X*, the regression model is $y = \alpha + \beta x_t + \varepsilon_t$, after Least-squares regression based on the log transformation, the parameter estimation results is below:

$$\begin{matrix} \ln \hat{y}_t = & -7.0530 & +1.5909 \ln \hat{x}_t \\ & (-1.1915) & (1.9902) \end{matrix}, \quad (1)$$

$$\hat{R}^2 = 0.1043 \; DW = 1.0755 .$$

From the Equation (1) we can find that $\hat{R}^2$ is small, and *DW* is around 1, this indicates that the fitting effect is not so good meaning there are some possible problems of heteroscedasticity and autocorrelation. Now we turn to deal with heteroscedasticity and autocorrelation.

4.1.1 Heteroscedasticity test

The validity of parameter estimation subject to the heteroscedasticity.

Here we use method of Breusch-Pagan-Godfrey through Eviews 7.0 to test heteroscedasticity. The result is listed in Table 3. The results in Table 3 show that we cannot reject the original hypothesis, namely, there is no heteroscedasticity.

TABLE 3 Results from Breusch-Pagan-Godfrey test

F-statistic	0.716611	Prob. F(1,34)	0.4032
Obs*R-squared	0.743102	Prob. Chi-Square(1)	0.3887
Scaled explained SS	0.415589	Prob. Chi-Square(1)	0.5191

4.1.2 Autocorrelation test and correction

Here we adopt Correlogram-Q-statistcs in Eviews 7.0 to test autocorrelation. The result is shown Figure 1.

It is not difficult to find that only the partial correlation coefficient's histogram of the first period of the model is beyond the dashed part, showing the first-order auto-correlation phenomenon.

So, introduce *AR*(1) in the model, the corresponding parameter estimation results is below:

$$\begin{matrix} \ln \hat{y}_t = & 15.4230 & -1.4362 \ln \hat{x}_t & 0.7412 AR(1) \\ & (2.4150) & (-1.6760) & (6.2823) \end{matrix}, \quad (2)$$

$$\hat{R}^2 = 0.1043 \; F = 12.5577 \; DW = 1.0755 .$$

Though the absolute number of the impacts of export price and initial export quantity on export is not the same, its basic trend is analogous to the basic results by Zhang Hua (2010) through building the following model with panel datas.

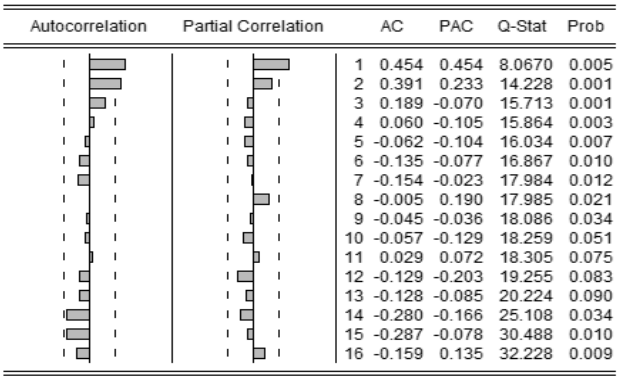

FIGURE 1 Autocorrelation and partial correlation

$$y_{it} = \alpha_{0i} + \alpha_{1i} t_{it} + \alpha_{2i} x_{it} + \alpha_{3i} y_{i(t-1)} + \varepsilon_{it} . \quad (3)$$

Its eventual regression results is as following:

$$\hat{y} = 1.050372 - 0.453271 \hat{t} - 0.412267 \hat{x} + 0.722975 \hat{y}_{t-1} . \quad (4)$$

From the adjusted OLS model above we can see that *F* value is significant. *DW* is around 2, which eliminates the problem of the first order autocorrelation. One thing to notice is $\hat{R}^2 = 0.4393$, which is not very significant. The Reasonable explanation for this is that due to the short-term volatility of the export volume and export price for the products involved, the goodness of fit is not very satisfactory in the entire 36 periods of time, which reflects the fact that the occurrence of unexpected events potentially break the sequence of the original law. Therefore, to adjust the OLS model in a correct way lays the foundation for Chow test.

4.2 CHOW TEST

Based on the adjusted OLS model, we choose 10-27 period of time to conduct Chow test, the result is below:

TABLE 4 Chow mutation point test

Time point	F test value	P test value	Time point	F test value	P test value
10	0.7704	0.5199	19	3.7679	0.0213
11	2.3940	0.0887	20	4.5222	0.0102
12	3.1167	0.0413	21	3.0433	0.0446
13	3.2556	0.0358	22	3.7308	0.0221
14	3.0108	0.0461	23	1.0204	0.3980
15	2.8977	0.0519	24	1.7576	0.1773
16	3.4633	0.0289	25	1.5592	0.2205
17	3.7328	0.0220	26	1.3930	0.2648
18	6.0587	0.0025	27	1.0425	0.3885

We can see from Table 4 that the p value is less than 0.01 at the 1% level of significance at period 18. Therefore we reject the null hypothesis which is interpreted as no structure change in the regression equation, and period 18 is the time when US imposed AD duty against Indonesia canned mushrooms. Therefore, we believe the AD duty against Indonesia canned mushroom directly lead to a change in the export price and volume. In addition, after taking the differences between two of the regression sequence data before and after the cut-off point, we discovered that slopes of the regression equations changed greatly. All the evidences have confirmed that the AD duty against Indonesia canned mushroom has caused a significant impact. Therefore, we can draw the conclusion that the AD duty against Indonesia canned mushroom has statistical significance on the trade between US and Indonesia.

5 The measure of anti-dumping duties' effectiveness based on VAR model

The traditional econometric approach is based on economic theories to describe the relationships among variables. However, economic theories are usually not sufficient to provide rigorous descriptions for these dynamic relationships. Moreover, endogenous variables can appear in either the left or right side of the equation, making estimation and inference become more complex. To solve these problems, a non-structural method is applied to building the model describing relationships among variables. Therefore, the vector auto-regression model, represented by the unstructured equation, is selected in this thesis to analyse the problem.

Chow mutation-point test is to test whether the impact from external events, e.g. anti-dumping duties, would change the structure and trend of the original model. So based on Chow test, vector auto-regression (VAR) model can be used to measure AD's effect.

5.1 THE DETERMINATION OF LAG PERIODS

In an ideal model, the AIC and SC are supposed to be very small. So by comparing the values of AIC and SC in models adopting different hysteresis, the ideal lag period, which makes the model's both AIC and SC values are relatively small, can be selected to adjust the explanatory variable. In this case, the AIC and SC values of each lag period are listed in Table 5.

TABLE 5 AIC and SC values of each lag period

	lag period one	lag period two
AIC	26.0049	26.1048
SC	26.6770	26.5583

Obviously, the minimum AIC value (26.0049) can be obtained when adopting lag period one, while the SC value also reaches the minimum (26.6770) simultaneously. So the ideal lag period is one.

5.2 PARAMETER ESTIMATION VIA VAR MODEL

To establish VAR model, this thesis sets export volume as the explanatory variable *Y* while export price as the independent variable *X*, regarding these two as endogenous variables while the acquiesce constant term *C* in Eviews 7.0 as the exogenous variable. When adopting lag-period-one endogenous variable, VAR model built has the following results:

$$\begin{matrix} Y = & 0.5500Y(-1) & +0.1322X(-1) & -145.8603 \\ & (4.1248) & (2.1499) & (-1.4700) \end{matrix}, \quad (5)$$

$$\hat{R}^2 = 0.4529 \quad F = 15.0708,$$

$$\begin{matrix} X = & 0.6162Y(-1) & +0.5225X(-1) & +700.4231 \\ & (2.0791) & (3.8459) & (3.1760) \end{matrix}, \quad (6)$$

$$\hat{R}^2 = 0.421173 \quad F = 13.36972.$$

Identifying and testing the model is regarded as an important segment to determine whether they meet previous hypothesis and satisfy economic significance. Testing the above VAR model via Granger causality test is to examine whether one certain lagged variable can be introduced to the equation. If the introduction of one lagged variable had influence on the other variable, then these two variables have Granger causality. Table 6 below shows the test results:

TABLE 6 Results from Granger causality tes

	Excluded	Chi-sq	df	Prob.
Dependent variable: Y	X	4.622031	1	0.0316
	All	4.622031	1	0.0316
Dependent variable: X	Y	4.322450	1	0.0376
	All	4.322450	1	0.0376

Table 6 presents the test statistics and probability of each endogenous variable with respect to the other endogenous variable via Granger causality. When first viewing variable *Y*, from the test results we know that the Granger causality (*Y* to *X*) is significant (significance level is 0.05). Similarly, the Granger causality of *X* to *Y* is also significant.

5.3 THE PREDICTION OF THE ORIGINAL TREND AFTER CHOW MUTATION POINT VIA VAR MODEL

When introducing lag-period-one export volume and price of Indonesian canned mushrooms to the VAR model, regarding Chow trend-mutation point as time-demarcation point, and applying the VAR model to predicting the original Indonesian canned mushroom export volume and price trend (under the condition of no anti-dumping duties) after the mutation point (Period 18-36), we can obtain the trend curves shown in Figures 2 and 3 respectively.

In Figures 2 and 3, after the trend-mutation point 18, the blue line represents the actual export volume and export price trend respectively when anti-dumping duties were imposed, while the red line represents the estimated export volume and export price trend with no imposition of anti-dumping duties.

Thus the distance between these two kinds of lines either in terms of export volume or in terms of export price can indicate the extent of AD's trade-restriction effect. Further speaking, the relative position, shapes and interrelationships of these two kinds of lines after the trend-mutation point 18 represent features of AD duties' impacts from the perspective of the time, structure and degree.

Specifically in Figure 2, after Point 18, the estimated original trend of Indonesian canned mushrooms export rises slowly. At Point 18 when the U.S. started to impose anti-dumping duties on Indonesian canned mushrooms, the distance between the red and blue lines increase in the following 4 time units, indicating the AD's short-term impact on export volume was significant in this time period, which can be attributed to the price pressure brought by anti-dumping duties on canned mushrooms export business in Indonesia.

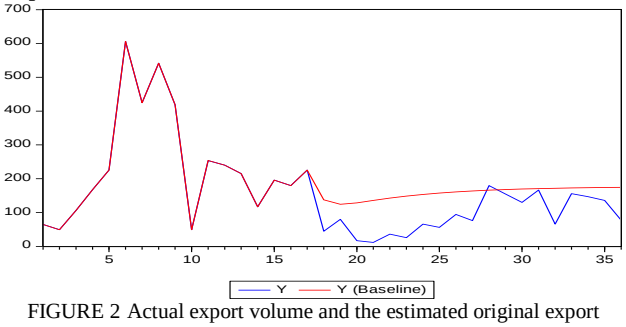

FIGURE 2 Actual export volume and the estimated original export volume (Tonsn)

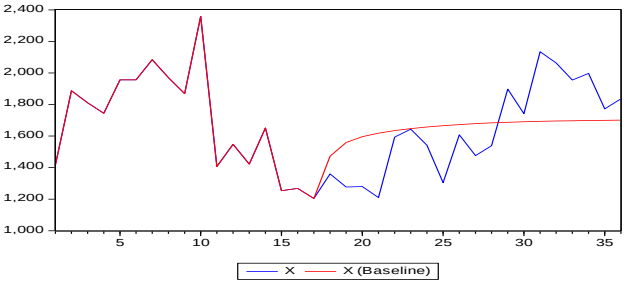

FIGURE 3 Actual export price and the estimated original export price (Thousands of USD)

As time goes on, even though the distance is gradually reduced, the blue line is always under the red line, indicating the existence of the AD's long-term effect on Indonesian canned mushrooms export volume to the U.S. While in Figure 3, Period 28 can be regarded as the cutoff time point--during the period 18-28 the spread between red and blue lines is positive but afterwards it turns negative, indicating the actual price fluctuations caused by imposing anti-dumping duties were lagging. It is noteworthy that before the AD'simposition (Period 18), both the export volume and price fell sharply the significant decline of export price did not bring the growth of export volume and the export volume and price in the period 8-18 showed a positive correlation, indicating the AD's imposition had trade-investigation effect, which started to appear 10 periods before the anti-dumping policy implementation and lasted for this period. Thus the AD's impact from the import country on the product export in this case was not only originated from anti-dumping duties, but also derived from the anti-dumping measures in broad terms, e.g. the previous case investigation. So more comprehensive and accurate assessments of AD's effects from various aspects are urgent, and further sustained attention and in-depth research from both the academic sector and real industries are highly needed.

6 Conclusions and implications

Chow mutation-point test can examine whether structural changes will appear at a certain point. Such principle and function can be applied to judge a certain economic policy's function. In this paper, we use Chow mutation-point test to analyse the data of US-Indonesia canned mushroom case. We find that the original export trend was

interrupted by the external event at the mutation point, namely, imposing anti-dumping duties. Further analysis show that the negative short-term impact the accused companies suffered was particularly significant within the 4 time periods since imposing anti-dumping duties, then the negative impact gradually weakened but never disappeared, the actual export level was still below the normal development level.

Trade remedy is approved by WTO as an option for maintaining trade justice. How to play its positive role precisely largely depends on whether the implementation of specific measures is able to accurately reach the critical point of two opposite trade effects that is to maximize the trade-remedy effect but not to go beyond it. This is an ideal solution in theory but quite difficult to achieve in practice especially for those quite controversial trade-remedy measures such as the anti-dumping and countervailing ones for various aspects should be fully considered, from whether the measures can play the right role, to the eventual effects on trade justice and order. The idea of Chow point-mutation test and its extensions can be used to not only determine the trade effects, but also measure the significance of such effects based on the structural variation from the test results. Furthermore, in this way you can also pre-design trade-remedy effectiveness. Therefore, based on specific circumstances, it can be widely applied to pre-design and effect judgment of trade and even other economic and social policies, thus minimizing the negative influence of such policies.

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