China's Subsidies on Exports and USA Countervailing Duties: Empirical and Theoretical Analysis of their Market Effects and Efficiency*

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The paper assesses and quantifies the impact of unilateral commercial policies on revenue based on USA imports from China in different time periods. China's historical export subsidy policy and the USA countervailing duty protection policy after 2006 are the main concerns of the paper. A hybrid panel data set for China's representative "Top Ten Industries" is constructed as a source of economic and legal information for the analysis of the policy issue. A comparative static analysis provides a theoretical framework for representing tariffs, such as Antidumping and Countervailing duties as "offsetting duty norms", consistent with WTO principles of free and fair trade. The mathematical model allows derivation of the subsidy elasticity of trade value which can evaluate the effect and efficiency of export subsidies on the home country's revenue. The theoretically derived ratio of revenue with and without distortion suggests a method for estimating price elasticities of demand and supply. The main finding of the paper is a functional relationship between trade value, unilateral policy and the price elasticities. The total differential of trade value with respect to subsidy and tariff helps to explain frequently arising tit-for-tat trade disputes among nations when tariffs are not functioning as "offsetting duty norms".

Ⅰ. Introduction

The paper is an ex-post analysis of the commercial policies of China's subsidies on its exports and the USA countervailing duty (CVD) policy against them. A time series of data on trade flows from China to the USA from 1995 to 2008 reveals several trends that can be related to China's transitional time periods and its WTO accession in 2001. The first concern of this paper is an empirical background of China's industrial structures associated with its export subsidies to these industries, and evaluation of these policy-favored industries. Second, graphical analysis of the general theory of subsidy and tariff in the partial equilibrium framework and its mathematical interpretations will be provided for the pertinent solutions by employing an elasticity approach. Then market effects and efficiency of these unilateral commercial policies will be theoretically evaluated in terms of the elasticity concept. Finally, the empirical analysis can be used to answer "what if" questions after estimation and extrapolation of the statistical data, relying on the assumption that the past impact of a policy may give projections about what can be expected from a change in future policy. The paper pre-

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sents hybrid panel data sets for China's "Top Ten Industries" based on the international benchmark Harmonized-System (H-S) of tariff classifications, and its 2-digit H-S commodity set[1]. This paper also demonstrates international and national significances of these industries in the anatomy of China's economy by micro analysis of the macro data as a consequence.

A method of comparative static analysis discussed by Mundell (1968) will be employed to describe a policy intervention on economic activities. His target was on the change in price with respect to the change in policy, whereas the research presented here extends Mundell's analysis of the change in price with respect to the change in policy to the subsidy elasticity of trade value which could provide an additional, but a straightforward insightful result on the analysis of the efficiency of the policy. Kelly (2011) presented a simple mathematical model of antidumping (AD) and CVDs on the basis of a unit-elasticity form. His analysis was a purely non-calculus-type expression of the procedures of the legal rules, and he did not shed light on any economic consideration regarding the effect of these trade policies.

A central idea of the intended research falls within the interdisciplinary field of the philosophy of law and economics, and its focus is on multilateral trade-flows within the WTO framework which have been considered as a distortion-contaminated system. Therefore my analytical framework is a combined method as viewed from a law and economics perspective, in an effort to evaluate the economic significance of the real effects of the trade policies. By interdisciplinary analysis of such behavioral sciences, the WTO helps the multinational system to eliminate distortions so as to reduce economic uncertainty and provide a systematic-guarantee to the creation of the long-run niche market. Without objective criteria and adjusting mechanisms, it is difficult to measure how far the distorted world is from the ideal situation, and how large is the distorted part. In the system, economic incentives of nations cannot go beyond the WTO regulations; namely, in order to fulfill their WTO commitments, all economic activities of nations should be under this incentive-constraining framework. Under this concept, the distortion is usually one which goes outside the commitments. Therefore the key issues to understanding the role of the multinational system and its regulations are documentation of the incentives and how to measure them. The primary goal of the WTO is to promote development of free and fair international trade by eliminating trade distortions and externalities. If the WTO regulations and its case laws, in addition to business morality requirements, represent how the nations would like the

multilateral world system to work, then the trade flows between nations, as indicators of the real economy, demonstrate how the system actually does work. Using trade-flow data to examine a nation's economic behavior, and using case law data as information to observe a nation's legal behavior, and knowing what to measure, and how to measure it, are the keys to understanding what is really going on in the system.

China's subsidies on its export sectors include direct and indirect components that affect both the top and bottom lines of industrial operation. For example, China's currency manipulation is considered as top level government subsidy and industrial input subsidy is considered as a bottom line subsidy. These subsidies in China have been reflecting governmental dominance of the economy and from various factors including the central, provincial and municipal governments' strategic goals, patronage, corruption and even environmental degradation. Xin Huahao (辛华豪, 2011) overviewed China's formidable growth after its WTO accession and linked this growth with corporate strategy, monopoly strategy and many aspects of the industry abuse, etc in his book. He literally analyzed monopoly status of China's state-owned enterprises and considered the monopoly-behavior as a main culture of China's business ethics. Finally, he determined this culture as a serious problem for the future development. However, he neither specified any monopoly firms and type of government subsidies nor their impacts on China's economic growth. These factors also are the main reasons for the economic agglomeration in Southern China and serious political issues such as income inequality between Southern China and Big Western Resource Rich China in terms of this regionally-favored policy. Even though the subsidy as an incentive to the favored-firms is prevalent in China, as a matter of prudence the real scale and size of the subsidy is not easy to measure. And their efficiency also is doubtful because they have been strategically provided regardless of the market situation. From the traditional theory of subsidy (Johnson 1972, Becker 1971, Corden 1974, and Bhagwati 1991), it is well established that subsidy is a distortion, and economic waste is created because the cost of increasing output to expand exports exceeds the revenue earned from the exports. If that is the case, one needs to ask what would China's economy be like in the absence of subsidy, and what is the strategic purpose of this costly subsidy? Therefore it is very valuable to consider the importance of the export subsidy and CVD versus broader policy issues.

The rest of the paper is organized as follows; Section II contains empirical work for the paper and it is a central

part of the research. It provides information from China's core "Top Ten Industries" and their decomposition in China's economy. Section III is a theoretical analysis of the empirical works in terms of a policy intervention. Explaining the effects and efficiency of the policies via an elasticity concept is the main feature of this section and the paper. This elasticity model shows that the percentage change in trade value is a function of the percentage change in subsidy with a dependence on the price elasticities of demand and supply. Section IV is an estimation of the parameters such as demand and supply elasticities and distorted-trade values. The paper's main finding and conclusion is that a specific functional combination of the price elasticity of the demand and supply, denoted as the "kappa" function, is crucial for estimating market effects and efficiency of the trade policies.

Ⅱ. Empirical Background of China's Export Subsidy

1. China's industrial structures, exports and AD and CVDs they received

This section focuses on China's "Top Ten Industries" based on their proportions in domestic outputs and total exports. China's economic growth and its core industrial structures in the context of proliferation of the AD duties over the past two decades against its exports were studied by Keyimu (2011, see tables 1 and 2 below). Her research demonstrated that China's emerging economic growth over the most recent decade is paradoxical via comparing its own growth to the world without China. The research defined its crucial "Top Ten Industries" in terms of AD measures, then analyzed their exports and domestic outputs, and attributed China's formidable growth to these core industries. In 2008, these industries accounted for 85% of all industrial domestic output, and 87% of all Chinese exports. The significance and uniqueness of these "Top Ten Industries" is that they were ranked and selected in terms of the numbers of AD measures and specific duty rates they received.

Ten years after its WTO accession in 2001, China's influence can be summarized by observing that just as the WTO has had a significant impact on the development of China's economy, at least by guaranteeing market access, China's accession has also made the organization stronger. From 2001 to 2010, China's exports rose by nearly 6 times to roughly $1.57 trillion, while imports rose by nearly the same order of magnitude to $1.39 trillion, making it the world's largest exporter and second-largest importer (WTO summary data base). During the crisis that hit the global economy in 2008-2009, China's relatively stable economy was an important factor in keeping

the global recession from widening and deepening, especially as developed countries needed to look to China for their export growth. China's economic reform from 1978 and pre-WTO phenomenal growth are well analyzed by Arayama and Mourdoukoutas (1999). They attributed China's growth to its low-cost, mass-production capacity. Aside from its rapid growth, the most remarkable thing about China is openness to international trade by its WTO accession. Being a developing country, China's policy is more consistently preoccupied with the encouragement of manufacturing, and low-cost capacity has functioned as its comparative advantage. It was a crucial factor for its large-scale exports after its international market access, and to some extent this capacity also made China's exports vulnerable to AD duties worldwide.

Table 1 shows worldwide AD protectionisms among nations after establishment of the WTO from 1995 to 2008. It is obvious that China has been a target of AD initiations and measures from 1995. Despite these worldwide protections against its exports, China's GDP has grown from approximately 1/24th as large as the global GDP in 2001, to 1/14 as large as the global GDP in 2008, and to 1/12th as large in 2009, according to statistics published by the International Monetary Fund (IMF) and the United Nations (UN; UN data 2010).

Table 2 shows average AD duty rates against China's "Top Ten Industries" as determined by the total number of AD measures they have faced from 2000 to 2009. Ji Jinshan (纪尽善, 2004) has categorized Chinese export firm's overwhelming dumping activities as a problem, after its WTO accession. He analyzed the problem in the framework of supply and demand relationship and concluded that it is a result of the conflict between social productive force and relations of productions. He has interpreted the problem as a crisis of so-called surplus economy. In Chinese case, so-called surplus economy is that supply exceeded the payable demand, namely; it is a relative surplus economy rather than an absolute surplus economy in which supply exceeded all the needs of the people. In

Table 1. Worldwide AD Initiations and Measures, from 1995 to 2009

Unit: Time Frequency of Cases

	China	Korea	U.S.A.	Chinese Taipei	Japan
Initiations	761	264	205	198	155
Measures	538	164	122	128	112
% of Measures	25.5	7.8	5.8	6.1	5.3

Data Source: Global Antidumping Database (Bown, 2010)

Table 2. Average AD Duty Rates against Chinese "Top Ten Industries", from 2000 to 2009, (2-digit H-S commodity category)

Unit: Percentage of AD Duties

"Industry" Name	WTO HS hapters	WTO HS Sector	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average %
Chemical	28-38	VI	142		25	147	115	155	35	116	103	115	106
Base Metals	72-83	XV	50	176	23	80	81	38	47	8	119	95	72
Machinery	84-85	XVI	29	66				94	25	64	131	144	79
Textiles	50-63	XI		87	70			50	264	44	65	10	84
Plastic/Rubber	39-40	VII				46	50	32	18	38	107		48
Furniture	94-96	XX	69				304	198				86	164
Stone/Cement	68-70	XIII											
Wood pulp	47-49	X			165			190	258		53		166
Foodstuff	16-24	IV	52	184									118
Vehicles	86-89	XVII					384			30			207
	Average %		68	128	71	91	187	108	108	50	96	90	100

Data sources: China Statistical Year Book and WTO Statistical Summary

order to solve this problem, he suggested that China must expand its domestic demand. However, he did not shed light on "supply-side effect" of the government intervention.

The intended research employed industry-based specialization and organization for these industry selections based on the international benchmark H-S tariff classification of the World Customs Organization (WCO) associated with its specific Chapters and Sectors for the specific products which are frequently subject to AD duties[2]. In Sector XIII, Stone/Cement industries' cases there were 16 price undertakings other than AD duties for Chinese export firms. These price undertakings also function as AD duties. The system has classified products into "2-digit H-S commodity" categories for its trade data. In addition, the uniqueness of this panel data set is that these industries were selected in the sub-category of a predation framework which has not yet been done by others. Therefore the construction of this Table can be considered as a hybrid panel data set for a certain purpose. A question that might be asked is "how can China's economy be doing so well when its representative core industries are being confronted with these substantial AD duties? In the case of trade between China and the USA, a major change in trade policy took place in 2007 when the USA Department of Commerce reversed a 23-year old policy of not pursuing CVDs against Non-Market Economy (NME) countries by invoking WTO sanctioned CVDs against imports from China (World Bank Report 4560, 2008)[3]. The reality is that the USA filed a petition to

the WTO in 2005 and alleged Chinese subsidized imports have caused significant impacts on world markets by encouraging excess production and trade, depressing world prices. The cheap imports were injurious to their home manufacturers and they claimed to be losing their jobs and export earnings. As a result the USA levied a series of AD and CVDs, which offset the effects of subsidies, simultaneously against China's subsidies on its export firms. Consequently after legal case studying, the research found that China's subsidies on its exports were functioning as a backup power against the intensive proliferation of AD duties against its exports world-wide. Therefore the answer for the above question came from this evidence of China's intensive subsidies on exports of its core "Top Ten Industries".

Table 3 shows that 80% of these "Top Ten Industries", which frequently faced AD measures, have been subsidized simultaneously by different subsidy rates. As we mentioned above, these industries accounted for 85% of all industrial domestic output and 87% of all Chinese exports in 2008. In this sense, these export industries are crucial to the Chinese economic growth patterns not only from its industrial domestic output, but also from favored-export sectors as well. The practical interpretation of these subsidy rates are that, taking machinery for example, when a Chinese firm sells machinery to the USA for $100, the firm will receive a reimbursement of $131.5 dollars from the Chinese government.

Table 3. Number of USA CVD Measures and its Average Rates against China's exports from the "Top Ten Industries" which have Frequently Faced AD Measures, after 2006

Unit: Number of Cases and Average CVDs in Percentage

Industry Name	WTO HS Chapters	Year WTO HS Sectors	2007	2008	2009	2010	Average CVD(%)
Chemical	28-38	VI			1		35.8
Base Metals	72-83	XV		3	2	2	83.1
Machinery	84-85	XVI		1	2		131.5
Textiles	50-63	XI		1		1	183.5
Plastics/Rubber	39-40	VII		1			7.2
Furniture	94-96	XX				1	414.7
Stone/Cement	68-70	XIII				1	100.8
Wood Pulp	47-49	X	1	1			59.8
Foodstuff	16-24	IV					
Vehicles	86-89	XVII					
		total	1	7	5	5	127.1

Data sources: China Statistical Year Book and WTO Statistical Summary

2. Demystifying WTO trade remedy measures

Trade remedy measures of the WTO as contingency measures, imposed by the use of exception and escape clauses, are being substituted for the traditional tariff as a result of trade liberalization. The traditional tariff has its "optimum" property, and the main purpose and result of the tariff is "beggar-thy-neighbor". It goes beyond the protection function and mainly maximizes one country's welfare at the expense of other countries. However, WTO sanctioned trade-remedy measures, such as AD and CVDs are conditionally imposed and functioning as "offsetting norms" against unfair trade. The AD duties are measured against an unfair export price which is considered as "selling-below-cost", while CVDs are measured against illegal subsidies which can accelerate predatory dumping to gain a foreign market entry. The duties offset the level of trade transgression only, restoring the distorted-trade to a "level playing field" so as to guarantee Pareto-Optimality in the world point of view. Therefore, the "offsetting duty norms" function only as a method of protection.

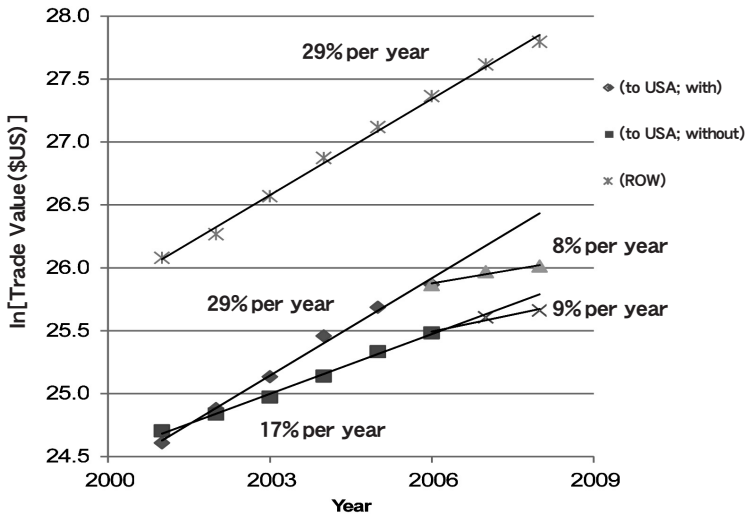
The main concern of this paper is this "offsetting norm" property of AD and CVDs, as this property is extremely important for presenting the essence of economic arguments. Unlike traditional tariffs which have created distortions in trade, the AD and CVDs are viewed as a response and not creating distortions in trade, instead rather as a norm; they precisely correct a distortion-contaminated trading system. Krugman (1997) found that trade policy debates within the WTO framework had nothing to do with the optimal tariff argument. And also Ossa (2011) established a new theory on GATT/WTO negotiations and viewed it as a response to the politically motivated protectionisms. On the other hand other economists, especially free-trade advocates, disagree with the view that these duties cannot create distortions in trade and criticize them as a political distortion to free trade[4]. Despite critics against these measures, the AD and CVD have become the most prominent expression of trade protections permitted under WTO rules, and applications of the measures, enjoying their special political status, have proliferated. Nevertheless, the measures also can be utilized as a tit-for-tat strategy for trade flows among nations, especially between China and the USA[5]. Keyimu (2009) also illustrated abusive utilizations of the AD measures for the tit-for-tat purpose, especially between the USA and China. Subramanian and Wei (2007) also criticized the WTO as it promotes trade strongly, but unevenly.

3. Significance of China's "Top Ten Industries" on its Growth

This section illuminates the role of China's subsidies as being important in both international and domestic levels. First at the international level these subsidized industries have substantial influence on China's exports. After initiation of the investigations and imposition of the CVDs, the result has been a trade deflation of Chinese exports from the USA to the Rest-of-the-World (ROW) in the international market as shown in Figure1 below. The impact of these trade-remedy measures can be inferred by examining time series of exports from China to the USA (as reported by the USA) and from China to the ROW, as reported by China.

The combined analysis of reports from China and from the USA was necessary, because reports from China used here did not provide industry level data for each country. The consistency between Chinese and American reports was encouraging. Figure 1 vividly shows a change in the direction of the Chinese industries' exports to the USA but not to the ROW. Initiations of the investigations for the CVD Measures actually began from 2005 by the USA International Trade Commission (ITC), and such initiations by themselves function as a threat of the imposition of duties on the commodities under investigation. This is one kind of positive role of the existence of the WTO regulations and rules.

Figure 1. A Time Series of Exports of China's "Top Ten Industries" to the USA and ROW (with and without subsidy) from 2001 to 2008.



Data source: Chinese Statistical Year Book and the International Trade Commission (ITC) of the USA

Figure 1. Time series of exports from China (ln[Trade Volume($)]) to the USA and the ROW from 2001 to 2008. The upper line shows a consistent growth rate of 29% per year for the entire period for ROW (*asterisks), and a linear-regression fit to the data, indicating a growth rate of 29% per year throughout the period from 2001 to 2008. The correlation coefficient is very high (0.99). China's exports to the USA, shown by the lower data series in Figure 1, have followed a more complex pattern, and it has not been monolithic. Subsidized exports (◆ diamonds; with), to the USA also grew at 29% per year from 2001 to 2006, whereas non-subsidized exports (without; ■ squares) grew at 17% per year over the same period. Beginning with the investigations of the CVDs in 2005 and after their imposition in early 2007 on subsidized imports, the growth rate fell to 8% per year (with; ▲ triangles) while the growth rate of the non-subsidized (without; Xs) imports fell to 9% per year. One factor we could note is that there are probably other effects. Growth rates were determined by linear regression between time and the logarithmic values. Correlations exceeded 0.98 in all cases.

Imports into the USA from China, as reported by the ITC of the USA were separated into two groups and two time periods, based on the CVD information summarized in Table 1 above. The first group included industries that were receiving export subsidies according to the findings of ITC CVD investigations in 2005, and as a result received CVD measures after 2006 and 2007[6]. A time series of the logarithm of trade value ($US) for the first group was further divided into two sections, from 2001 to 2006 and from 2006 to 2008 as shown by the ◆ diamonds (denoted ln(with-subsidy)) and ▲ triangles in Figure 1. Those determined to be subsidized, as explained in the text, (◆ diamonds and ▲ triangles) and non-subsidized (■ squares and Xs), and two time periods: 1) before the beginning of a new CVD policy by the USA (Pre-CVD period from 2001 to 2006) to be determined as with-subsidy period; 2) and after the beginning of the new policy (Post-CVD period from 2006 to 2008) to be determined as without-subsidized period. This is a typical counterfactual or retrospective analysis approach to estimate the effects of the subsidy on the trade value.

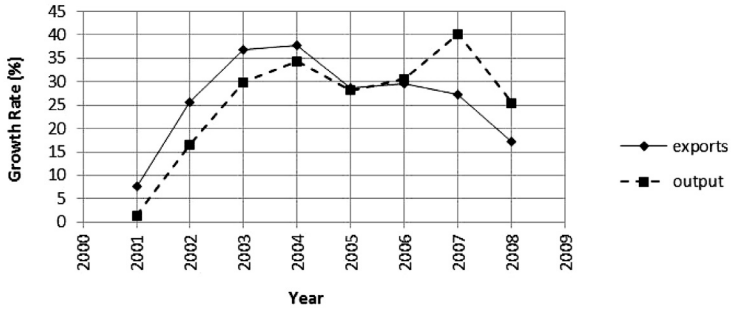
The growth rate of this first group decreased from 29% per year to 8% per year after the beginning of the CVD Measures era. The second group of industries included those not subjected to CVD measures after 2006 are considered as non-subsidized industries , were also divided into two sections, from 2001 to 2006, and from 2006 to 2008, as shown by the squares (denoted ln(without) and Xs

in Figure 1. The growth rate of this second group was 17% per year, lagging behind the first group, and then decreased to 9% per year after the beginning of the CVD measures era. It appears that the CVD not only influenced subsidized industries but also influenced the non-subsidized industries a little. Here we can say that probably there were some other reasons for the change in growth rates of the non-subsidized industries.

The trade value statistics shown in Figure 1 indicate responses to trade policies of an exporting country China, and an importing country USA. For example, the difference in short-term growth rates between subsidized and non-subsidized exports would be expected to depend on the amount of subsidy and the price elasticities of demand for, and supply of, the commodities in question. It may be reasonable to assume that the difference in growth rates is in direct response to the subsidy, because after the USA imposed WTO sanctioned trade-remedy measures on China's exports in 2006 and 2007, the growth rates of both categories fell to approximately the same amount. The decrease in growth rates from 29% per year to less than 10% per year suggest a 20% effect of subsidy on trade value, assuming an exact counter-balancing effect of the trade remedy on the subsidy, as required by WTO regulations. Alternatively, one could assume that the growth rate of the non-subsidized commodities would have increased from 17% per year to 29% per year, if they had been subsidized to the same degree and if their price elasticities were comparable.

Figure 2 shows a national level effect of the "Top Ten Industries". The Figure 2 also clearly illuminates that in the years of 2005 and 2006, there was a shift in China's two-growth-rate pattern of its "Top Ten Industries"; a shift from

Figure 2. Growth Rates of Domestic Output and Exports of China's "Top Ten Industries" from 2001 to 2008



Data Source: China's Statistical Year Book

higher export growth rates before 2005 to the higher domestic output growth rates after 2006. In reality this is the shift from an "export-led-growth" to the domestic "consumption-led-growth" pattern. Obviously, this situation is consistent with China's trade deflation from USA at year 2006 in Figure 1 discussed above. A combined analysis of these two Figures highlights the impact of USA policy change against China's exports.

The export-led nature of Chinese economic growth suggests that the profitability of Chinese exports have acted to speed up the transformation of China from traditional to modern production, which is the essence of Chinese growth. An additional benefit was increased employment for millions of unskilled workers. At the primary development stage, the export subsidy was mainly used to promote exports to get hard foreign currency and import capital goods which were the urgent needs of the Chinese first development process. Therefore, government rationally used subsidy as an incentive to its state owned enterprise (SOE) industries regardless of its efficiency. The core "Top Ten Industries" have been acting primarily to penetrate foreign markets with their cheap exports on the return with hard currency. China has maintained a persistently large positive trade balance in order to maximize employment and accumulate huge balance of foreign currency, particular US dollars, by exporting to the world much more than it imports, especially regarding the USA. To some extent, some government subsidies on exports probably were costly with the only target of accumulating foreign currency for the further international market access. In this sense, we can say that providing a subsidy with high costs is an economic loss, but a political gain for a certain purpose. In this primary development stage, the industries' cheap-export behaviors might not be analyzed in the framework of monopoly, because these industries were still price takers. Specifying these industries in the predation framework will help the research to distinguish and quantitatively analyze subsidy-favored industries and their decomposition in the China's economy. USA CVDs on China's exports were shown in Table 3 above. More detailed statistics of China's exports to the USA on specific 2-digit H-S commodities are presented here.

Table 4 shows the growth of USA imports from the "Top Ten Industries" from 1995 until 2008. They have grown from 76% to 86% of USA imports from China since 2001, and explicitly subsidized chapters grew faster than others until 2006 as shown in Figure 1.

Table 4: USA Imports from China's "Top Ten Industries" from 1995 to 2008

Unit: USD 100 Million

Industry Name	Chemical	Base Metals	Machinery	Textiles	Plastic & Rubber	Furniture & Toys	Stone & Cement	Wood Pulp	Foodstuff	Vehicles	
WTO HS Chapters	28-38	72-83	84-85	50-63	39-40	94-96	68-70	47-49	16-24	86-89	
WTO HS Sector	VI	XV	XVI	XI	VII	XX	XIII	X	IV	XVII	Total
1995	9.1	17.3	115.1	58.0	17.6	85.4	8.1	3.3	2.3	5.6	321.8
1996	10.9	19.6	133.8	60.8	19.1	102.8	9.4	3.7	2.7	5.9	368.7
1997	12.7	24.2	165.6	73.8	22.0	128.5	11.6	4.4	3.2	7.8	453.8
1998	14.5	30.6	203.9	71.2	23.8	150.4	12.8	5.8	3.0	9.8	525.8
1999	17.1	37.3	252.5	74.0	28.6	173.8	15.2	7.3	3.4	11.6	620.8
2000	18.6	47.1	329.3	80.2	33.8	203.3	19.0	10.0	3.7	20.6	765.6
2001	19.6	49.7	334.5	82.7	37.2	205.6	20.5	10.8	4.6	17.0	782.2
2002	22.9	60.2	446.3	95.9	44.5	252.9	23.9	14.0	6.4	20.8	987.8
2003	28.9	71.9	587.1	120.3	51.5	289.8	26.2	17.7	8.3	26.9	1228.6
2004	36.5	105.7	840.4	149.5	64.5	328.6	29.4	22.4	10.2	36.5	1623.7
2005	46.8	136.4	1058.2	224.5	85.3	376.2	34.0	27.7	12.7	46.4	2048.2
2006	53.2	185.5	1271.7	264.3	99.4	418.5	39.9	32.8	16.9	57.1	2439.3
2007	63.4	207.9	1407.4	311.9	113.4	483.0	43.2	38.7	20.2	67.3	2756.4
2008	96.6	240.9	1455.0	314.9	122.9	484.6	42.7	41.6	24.4	70.4	2894.0
Total	450.9	1234.3	8600.8	1982.0	763.9	3683.5	335.8	240.1	121.9	403.7	17816.9

Data sources: USA ITC data base

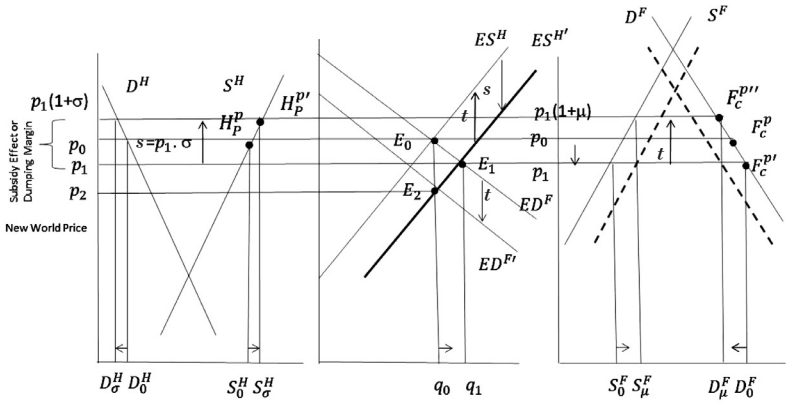
Ⅲ. Analytical Framework for China's Export Subsidy and USA CVDs against It

1. Diagrammatic Approach

This section introduces an excess supply "shock" caused or disturbed by a parameter which is considered as China's distortionary export promotion policy. The specific form of this incentive policy is export subsidies on China's symbolic "Top Ten Export Industries" as discussed in Table 3 above. This export promotion policy is an *ad valorem* subsidy proportional to the value of the exports.

Figure 3. A 3 panel Figure with demand and supply curves, price levels, and corresponding quantities for a) an exporting home country that provides an export subsidy, b) world excess demand and supply, and c) an importing foreign country. Figure 3 shows how excess supply from an exporting country and excess demand from an importing country change when the exporting country adopts a trade promotion policy through a subsidy on its exports. When this subsidy s applies, home supply increases from S_0^H to S_σ^H because of an increase in the home producer's price from p_0 to $p_1(1+\sigma) = H_p^{p'}$, which is the home

Figure 3. China's Export Subsidy and USA CVDs against It: Two Large-Country Case



country market price for its producers after subsidy, thereby causing output to rise and increasing exports as shown in panel (a) above. However, industries export at price p_1 which is lower than the world equilibrium price p_0. After their whole export process, China's government will reimburse subsidy revenue for the industries at the price of $p_1 \cdot \sigma$ as shown in panel (a). In China's market, consumers are hurt by this high price, producers in the "Top Ten Industries" gain, and government loses because it must expend money on the subsidy.

The function of the subsidy is a cost reduction from p_0(*normal cost or value*) *to* p_0 for the export-manufacturing industries in the home country, therefore this phenomena is a "sell-below-cost". It influences the excess supply curve and shifts it to the right as shown in panel (b), increasing equilibrium excess quantity to q_1 and decreasing equilibrium price to p_1 at the new equilibrium E_1. Corresponding changes in import demand of the foreign country USA, are shown in panel (c) $(D_0^F - S_0^F)$. The effect of the subsidy is to create a distorted-supply curve by creating price discrimination between home price $H_p^{p'}$ in the home country and import price $F_c^{p'}$ in the foreign country, and obviously it shows that $H_p^{p'} > F_c^{p'}$. Based on WTO rules on price comparison, this is so called international price discrimination, namely, a dumping price in the foreign country. This price discrimination is effectively a predatory price to gain a market entry in the foreign market. After this distortion, the foreign country's excess demand for imports increases due to attraction of its cheap price. In the foreign country USA, original consumers who have been consuming their domestic supply for the identical goods shift their tastes to the cheap imported goods at price $F_c^{p'}$ The cheap imports "sell-below-cost" causing a material injury to the manufacturing

industry in the foreign country. If the situation continues, the foreign manufacturing industry will face competition by this dumped-import, and furthermore the factories will stop manufacturing so that its workers will lose their jobs. In the long run, the consequence of the predation will be a creation of a monopoly by the exporters. Based on WTO rules, this situation is considered as "unfair-competition" caused by dumping. The foreign country USA has authority to impose a tariff to protect its manufacturing industry by offsetting, namely, eliminating the effect of the export subsidy s which has effectively created a predatory price. This offsetting tariff t must be in the form of CVDs, and its amount should not exceed the amount of the home country's subsidy s.

Traditional theory of tariffs is well established by Johnson (1972) and Corden (1971). Tariffs are the oldest form of trade policy and have traditionally been used as a source of government income. They were imposed by a country arbitrarily and unconditionally, and their main purpose is to maximize a nation's welfare at the expense of others. Effect of the tariff is primarily to shrink the tariff imposing country's demand for the imports. Based on this traditional theory, the CVDs reduce the tariff-imposing-country USA's excess demand in panel (b) by increasing the price of imports and its domestic supply from $(D_0^F - S_0^F)$ to $(D_\mu^F - S_\mu^F)$ as shown in panel (c). Imposition of this tariff will influence world price and create a new world price p_2. Caves and Jones (1985), Vousden (1990), Krugman and Obstfeld (1994), and Feenstra and Taylor (2008) have analyzed the revenue effect of tariff and also extended its effect to the domestic protection side and emphasized the latter effect as tariff's principle objective. This effect is shown on the excess supply side as an alternative theory for the quantity-restriction-tariff. In this modern theory, the purpose of the tariff is not only to provide revenue but also to protect particular domestic sectors. However, the AD and CVDs, being trade remedy measures for a victim country, have been imposed conditionally and contingently when importers found and legally proved "injuries" of their manufacturing industry from the subsidized-cheap imports (World Trade Reports 2009). Based on this modern theory of tariff, the CVDs also restrict the home country's excess quantity by making its import price costly, and this restriction shows its offsetting effect on the supply of the cheap subsidized-imports. Under the domestic protection policy of an import tariff t the cost of delivering imports to the consumers in the importing country increases by the amount of a tariff price $p_1(1+\mu)$. This high price shifts the distorted-excess supply curve to the left and creates a "level-playing-

field”effect by just eliminating the extra supply of the subsidy, decreasing the equilibrium excess quantity from q_1 to q_0 in panel (b). Corresponding changes in export demand from $(D_0^F - S_0^F)$ to $(D_\mu^F - S_\mu^F)$ are shown in panel (c). The economic logic here is that a tariff CVD from the foreign country only protects its home supply so as to guarantee continuation of their manufacturing system by eliminating trade transgression, namely, unfair competition. The consumers, who have shifted their tastes to the cheap imports, now shift back their tastes to the home products due to the costly imports after the tariff.

2. Corresponding Mathematical Expansion

In this section, the general structural form of the demand-and-supply functions are explained as a mathematical version of the visual model in Figure 3 based on Mundell's comparative static analysis on a shift in policy. He has analyzed a policy intervention issue on the demand schedule and demonstrated a “demand-side-effect” of this intervention on the economic structure which was suitable for the USA consumption-led development pattern. Mundell's target was on the change in price with respect to the change in policy. Arayama (2009) also employed a comparative static analysis on Toyota subsidies on Eco-car, and he found the price elasticity of car service revenue. Likewise, the paper presented here also follows a method of comparative static analysis, to compute the sensitivity of excess supply to a parameter which is considered as an export subsidy policy of China. Shen Kaiyan (沈开艳, 2012) mainly emphasized the importance of the structural adjustments and speed up transformation of the economic development. She literally described urgent changes in the mode of economic development from 2000 to 2012 in China. She just mentioned its export-oriented strategy and speed up transformation of economic development from the “supply-side effect” of the government intervention to the “demand-side effect” of the government intervention. But she did not employ any mathematical theory to prove or run any regression to empirically show the ongoing changes in China 's economic development pattern.

The research presented here extends Mundell's analysis of the change in price with respect to the change in policy to the subsidy elasticity of trade value which could provide an additional, but a straight-forward insightful result on the analysis of the efficiency of the policy. Therefore this export-promotion pattern is considered as a “supply-side-effect” of the subsidy on the economic structure which is suitable for the China's export-led development pattern. Becker's (1971) elegant explanation of the importance of the elasticity issue was on the effect of a change in price on total expenditure of

the consumers. However, the current paper's main interest and concern is on the effect of the export subsidy, as a shadow price, on the total revenue of the producers. These are two sides of the same coin. The model assumes these economic behaviors are non-linear, and it incorporates the price elasticities of demand and supply. Then the model is reduced with the purpose of determining a new equilibrium price and quantity so as to find a solution for the distorted-trade value. Consequently the model with constant price elasticities can indicate a solution to the ratio of trade values with and without subsidies, respectively.

There are two countries; Home country is the exporter and Foreign country is the importer, and both countries are large enough to influence the world price as shown in Figure 3 panel (b). For simplification transportation costs for both countries and elasticity of substitution in the Foreign country are assumed to be ignored.

Let the excess demand for imports of 2-digit H-S commodities into the foreign country (USA) be:

1) $q_D = f(p, y)$, y refers to other influences on demand, which could be a single variable such as income in the U.S., or it could refer to a vector of variables.

The excess supply of imports of the 2-digit H-S commodities from home country (China) is:

2) $q_s = g(p, z)$, and z refers to other influences on supply, which could be a single variable such as China's GDP, or it could refer to a vector of variables.

By approximating the excess supply and demand functions as being of constant-elasticity or so-called Cobb-Douglas form, and under a *ceteris paribus* assumption, an illustration is provided as follows:

The structural form of excess supply equation: China's excess supply of exports of 2-digit H-S commodities is of the following multiplicative exponential form.

$$q_s = b \cdot p^{\gamma} \cdot z^{\delta} \qquad (1)$$

where q_s is the quantity supplied at price p, b is the constant of proportionality. Here I assume $\delta = 0$, so that z has no effect.

The structural form of excess demand equation: The USA excess demand for imports from China of the 2-digit H-S commodities is of a similar multiplicative exponential form:

$$q_D = a \cdot p^{-\beta} \cdot y^{\eta} \qquad (2)$$

where q_D is the quantity of the commodity demanded by the USA importers at price p, a is the constant of proportionality. Here I assume $\eta = 0$, so that y has no effect.

Equations (1) and (2) represent the structural form of a 2-equation system of demand for imports and supply of imports. The free-trade equilibrium world price where $p = p_0$, is found and results in an equilibrium trade value as follows:

$$p_0 \cdot q_0 = \left[a^{(\gamma+1)} \cdot b^{(\beta-1)} \right]^{\frac{1}{(\beta+\gamma)}} \qquad (3)$$

The $p_0 \cdot q_0$ in (3) is considered as a non-distorted trade value before subsidy.

3. Represent an *ad valorem* Subsidy and ad valorem Tariff in the Structural Forms

The excess supply of exports to USA consumers, represented by the excess supply function $g(p,y)$, can be influenced by subsidy and countervailing duty policy decisions of the Chinese and USA governments as follows:

Suppose the home producers (China) of the exported commodity receive a subsidy amount of s for their exports from their government, allowing them to increase the quantity supplied at every price and shifting the supply curve to the right as shown in Figure 3 panel (b) above. A generalized subsidized price, at any point of the excess supply function, can be represented as $p_\sigma = p + s$ Therefore, after shifting, the excess supply equation in (1) becomes a subsidized-excess supply equation[7].

$$q_s' = b \cdot [p \cdot (1+\sigma)]^\gamma \qquad (4)$$

An interpretation of this equation is that the quantity that can be supplied at price p is increased by the amount of the subsidy, and this new excess supply curve is considered as a distorted-supply equation[8]. Therefore this export-promotion pattern is considered as a "supply-side-effect" of the subsidy on the economic structure which is suitable for the China's export-led development pattern.

Now consider the tariff effect, here as a specific CVD, on the excess supply function in Figure 3 panel (b). The subsidized-excess supply q_s' in equation (4) is found as the C.I.F price of the 2-digit H-S imports at the port of entry by first solving the distorted- supply equation for price, including the rate of subsidy, then apply an *ad valorem* CVD (μ) to this distorted price function, and then solve for the reshaped-supply function as q_s'', and express it with both subsidy and CVD as follows:

From (4), first solve for p from this distorted-supply equation. This is the subsidized price. This process is important because the CVD, which is to offset the effect of the subsidy, should be applied based on this subsidized price which is a function of the distorted-supply equation as a shadow price[9].

$$p(pre-cvd) = \left(\frac{q_s'}{b} \right)^{\frac{1}{\gamma}} \cdot \frac{1}{(1+\sigma)} \qquad (5)$$

This is the pre-cvd price with the expression of the subsidy. Second, then apply the *ad valorem* CVD μ on this general subsidized price p(pre-cvd). This process shows the mathematical nature of μ as an "offsetting duty norm" for the distorting-effect of the subsidy. It is the post CVD price, $p(post-cvd)$ with the expression of both σ and μ simultaneously.

$$p(post-cvd)=\left[\left(\frac{q_s'}{b}\right)^{\frac{1}{\gamma}}\cdot\frac{(1+\mu)}{(1+\sigma)}\right] \quad (6)$$

From (6) we can solve for q_s' the distorted-supply equation again with the expression of both *ad valorem* subsidy σ by the exporting country, and *ad valorem* cvd μ by the importing country. That is the general expression for the new and reshaped supply equation that we are looking for, and we denote it as q_s'', because it can be easily seen when subsidy and CVD are equal, the equation (7) below reverts to (1), the initial non-distorted supply function.

$$q_s''=b\cdot\left[p\cdot\frac{(1+\sigma)}{(1+\mu)}\right]^{\gamma} \quad (7)$$

Comparing (4) with (7), we can easily see that the quantity of (7) increases with the subsidy and at the same time decreases with the tariff. Note that for $\sigma=\mu$, exactly, the cvd μ is functioning as an "offsetting norm", and the new supply function in equation (7) returns to the supply function in equation (1) at the initial world supply function.

$$q_s''=q_s=b\cdot p^{\gamma} \quad (8)$$

Equation (8) shows that the trade-remedy measure, the CVDs are functioning as "offsetting norm" against unfair trade; namely, the duties offset the level of trade transgression only, restoring the distorted-trade to a "level playing field" so as to guarantee Pareto-Optimality in the world point of view. Since the imposing of duties is considered as a change in economic policy to eliminate a foreign monopoly and that market subsequently becomes competitive and more efficient, the monopolist will be worse off. This is the main concern of this paper, as this property is extremely important for presenting the essence of economic arguments on the "offsetting duty norm" which has different effects and results from the traditional optimal tariff" arguments.

4. Reduced-Form Equation for Trade Value

Now let us reduce the structural forms and solve for trade value as a function of subsidy and CVD. Set the reshaped excess supply equations in (7) equal for $q_s''=q_D$ at the new equilibrium condition where $p=p_1$.

$$b\cdot\left[p_1\cdot\frac{(1+\sigma)}{(1+\mu)}\right]^{\gamma}=a\cdot p_1^{-\beta} \quad (9)$$

After simplifying we can get the reduced-solution for a new equilibrium price p_1 and inversely quantity q_1 with the expressions of both σ and μ. Next we find a solution for the new equilibrium trade value which is also considered as total revenue, It is given as $p_1\cdot q_1$.

$$p_1\cdot q_1=\left[a^{\frac{(\gamma+1)}{(\beta+\gamma)}}\cdot b^{\frac{(\beta-1)}{(\beta+\gamma)}}\cdot\left\{\frac{(1+\sigma)}{(1+\mu)}\right\}^{\frac{\gamma(\beta-1)}{(\beta+\gamma)}}\right] \quad (10)$$

This is the solution for the distorted-trade value. The solution consists of three products in equation (10). They are the constants of proportionality, a, b and a ratio of the subsidy and tariff. These products are raised to different powers

which are composed of different functional combinations of the price elasticity of supply and demand. The main concern of the paper is the effects of subsidy and tariff, and the elasticities of supply and demand, therefore we look for quantities that emphasize the last products of the equation, a ratio of the subsidy and tariff, and ignore the constants of proportionality.

Note that (10) illustrates mathematically that the trade value increases with the subsidy σ, and decreases with the CVD μ. But the equation has a deep normative implication and can create different scenarios in reality. If on the first condition of $\sigma=\mu>0$, and $(1+\sigma)/(1+\mu)=1$, then there will be an offsetting scenario, the duty μ exactly offsets the effect of the export subsidies on the export revenue as required by WTO regulations. If the second condition is $\sigma=\mu=0$, then also $(1+\sigma)/(1+\mu)=1$, this is the free-trade world price condition. Mathematically, the result of these two conditions is the same, but in reality the latter condition is superior to the offsetting scenario. The offsetting scenario is built on heavy social costs from both home and foreign countries, such as costs of the subsidy and the costs of the CVD. They also represent a deterioration of the home country's terms-of-trade and creation of the deadweight loss.

A third scenario is that μ not only represents the CVD, but also represents AD plus CVD, when a simultaneous prosecution of the AD and CVD cases and overlap applications of the duties are allowed. In this case $\mu=$ CVD+AD and trade value decreases and this scenario has become more frequent.

By taking a ratio of equation (10), a reshaped-distorted-trade value, and equation (3), a non-distorted trade value, we can calculate a net distorted-trade value which is created by the amount of the subsidy and influenced by the price elasticities of demand and supply as noted above. The ratio will help us to judge the performance of the distortions on the trade value. The model formulation allows this ratio expression which is consistent with the Marshallian view that ratios of economic quantities can be more accurately expressed than their absolute values.

$$\frac{p_1 \cdot q_1}{p_0 \cdot q_0} = \left\{\frac{(1+\sigma)}{(1+\mu)}\right\}^{\frac{\gamma(\beta-1)}{(\beta+\gamma)}} \tag{11}$$

It is interesting to note that in the ratio of the distorted trade value (10) to the free-trade trade value (3) the constants of proportionality (a, b) do not appear. This concise ratio shown above (11) isolates the influence of the subsidy, CVD, and elasticities of demand and supply on trade value. The ratio is dependent on the subsidy, tariff and a nonlinear function of the price elasticities. This simplest model with constant price elasticities analyzed here can indicate a solution to the ratio of trade values with

and without subsidies, respectively. The power of this ratio in equation (11) can be defined as a "kappa" function for simplicity, and it has a multiplicative effect on the ratio. Further discussion of the influence of the "kappa" function is presented in the section on subsidy elasticity of trade value below. For the moment we focus on the WTO perspective of counterbalancing effects of subsidy and CVD.

5. Subsidy Elasticity of Trade Value

In order to further demonstrate the function and influence of the price elasticity of demand (β) and the price elasticity of supply (γ), the subsidy elasticity of trade value is derived next. The subsidy elasticity of the trade value can provide a straight-forward insightful result; namely, it is a sensitivity of the trade value to the change in subsidy.

From the general definition of the elasticity we know that:

$$\frac{\partial(p\cdot q)}{\partial\sigma}\cdot\frac{\sigma}{p\cdot q} \tag{12}$$

To obtain a specific subsidy elasticity of trade value we begin with the following:

$$p_1\cdot q_1 = a^{\frac{(\gamma+1)}{(\beta+\gamma)}}\cdot b^{\frac{(\beta-1)}{(\beta+\gamma)}}\cdot(1+\sigma)^{\frac{\gamma(\beta-1)}{(\beta+\gamma)}} \tag{13}$$

This equation is derived from equation (10), when $\mu=0$ and $\sigma>0$ namely, this is a distorted- trade value with subsidy on it. Take the partial derivative of (13) with respect to subsidy, and get a subsidy elasticity of trade value as follows:

$$\frac{\partial(p_1\cdot q_1)}{\partial\sigma}\cdot\frac{\sigma}{p_1\cdot q_1} = \frac{\gamma\cdot(\beta-1)}{(\beta+\gamma)}\cdot\frac{\sigma}{(1+\sigma)} \tag{14}$$

Note that if $\beta=1$, then trade value is not sensitive to a change in subsidy. In this sense, it can be analyzed that in order to get a market effect of the export subsidy, import demand elasticity for the subsidized-imports should be high.

The function $\gamma\cdot(\beta-1)/(\beta+\gamma)$ in (14) is exactly the same as in equation (10) which is called the "kappa" function for simplicity. The percentage change in total revenue given a percentage change in subsidy depends on this "kappa" function, which could have a multiplier effect on the subsidy, if the "kappa" is greater than one. This situation indicates that the percentage change in trade value would be greater than the percentage change in subsidy, which is a highly desirable result from efficiency of the policy viewpoint. An alternative of "kappa" less than one, but greater than zero, is implying an inefficient subsidy, whereas beta less than one ($\beta<1$) implies a counter-productive subsidy. Namely, the efficiency of the subsidy in increasing trade value is a function of the "kappa" term, making it a parameter or coefficient to characterize the subsidy. It is always better to achieve any given policy at a lower cost than at higher cost. The "kappa" function increases monotonically with as β and γ, that is,

as price elasticity of demand and supply increase. Therefore knowledge of β and γ is critical in terms of the dynamic efficiency of the subsidy.

6. Total Differential of Trade Value

The previous section intuitively demystified the function of CVDs as "offsetting norms" by eliminating the trade transgression and returning the distorted-trade to the world fair and free trade status. But in reality the CVD may not always function as an "offsetting duty norm", rather its rate may be bigger than the subsidy. And this situation became a new source for retaliations and tit-for-tat utilizations of the trade remedy measures, especially between China and the USA. In this case, change in the total trade value becomes sensitive to changes in both subsidy and tariff. The method of comparative statics analysis is also used to estimate the sensitivity of trade value to changes in an export subsidy from the home country and an import CVD from the foreign country.

Let $g(p,\sigma,\mu)$ represent the aggregate excess supply of exports from the home country (China), where p, σ, *and* μ represent world price, *ad valorem* subsidy rate provided by the home country, and *ad valorem* countervailing duty rate assessed by the importing country, respectively. Let $f(p)$ represent the aggregate excess demand for imports in the foreign country (USA). Equilibrium conditions are specified by equating $g(p,\sigma,\mu)$ and $f(p)$ where the quantity (q) supplied and demanded are equal. The focus in this section is on equilibrium trade value ($p\cdot q$) and its sensitivity to small changes in σ and μ. The method of comparative statics (Mundell 1968) will be used to provide insights through an analysis of the total differential of $p\cdot q$ as follows:

$$d(p\cdot q)=p\cdot dq+q\cdot dp \tag{15}$$

where solutions for dq and dp in (1) are determined by equating the total differentials of $g(p,\sigma,\mu)$ and $f(p)$ as follows:

$$q_p dp+g_\sigma d\sigma+g_\mu d\mu=f_p dp \tag{16}$$

Partial derivatives of the excess supply and demand functions are represented by g_p, g_σ, g_μ, and f_p, respectively. The solution for dp obtained from (16) is used in the total differential of the demand function to obtain a solution for dq.

Solutions for dq and dp result in the following:

$$d(p\cdot q)=p\cdot\left[\frac{f_p\cdot g_\sigma}{(f_p-g_p)}d\sigma+\frac{f_p\cdot g_\mu}{(f_p-g_p)}d\mu\right]+q\cdot\left[\frac{g_\sigma}{(f_p-g_p)}d\sigma+\frac{g_\mu}{(f_p-g_p)}d\mu\right] \tag{17}$$

A solution for (17) in terms of the price elasticities of excess supply and demand can be obtained by assuming the Cobb-Douglas-type multiplicative exponential forms for the excess supply and demand functions shown in equations (1) and (2) above. The sensitivity of trade value to small changes in σ and μ is then

expressed as follows:

$$\frac{d(p\cdot q)}{p\cdot q}=\frac{\gamma(\beta-1)}{(\beta+\gamma)}\left[\frac{d\sigma}{(1+\sigma)}-\frac{d\mu}{(1+\mu)}\right] \tag{18}$$

Fractional changes in trade value are determined by the product of two terms: The first term is a non-linear function of the price elasticities of excess supply (γ) and excess demand (β), previously identified as the kappa function, while the second represents the counter-balancing effects of changes in subsidies (σ) and countervailing duties (μ).

Note that the first term is zero if $\beta=1$, and then trade value is not sensitive to a change in subsidy nor CVD. The second term is zero when the subsidy and countervailing duty terms are equal. If the terms $d\sigma/(1+\sigma)$ and $d\mu/(1+\mu)$ are equal, then changes in the subsidy and CVD offset each other, resulting in no change in trade value. When the CVD term is greater than the subsidy term trade value, namely, trade revenue decreases and vice versa. A potential consequence of the former case is that if $\mu>\sigma$ it results in another violation from a tariff imposing country to the rule of the Agreement on Subsidy and Countervailing Duty. Consequently the exporter makes counter claims against the importer about this situation. This is one of the main sources of the ongoing proliferation of the disputes and tit-for-tat utilizations of the trade-remedy measures. This scenario includes more legal procedure on its implementations than the second case so as to create heavy social costs to the offsetting scenario and world welfare system as well. In this sense, we can say that the proliferation of these measures illustrates that the ongoing trade wars among nations are intense. As a result it is unlikely that a country could gain by practicing these measures as retaliation tools against another. The practices are only for reciprocal protectionism, and criticism against the WTO dispute settlement mechanism is also increasing. That is why the $\sigma=\mu=0$ condition is an ideal goal of free-trade and the over-arching objective of the WTO in this globalization period.

Ⅳ. Policy Implications for Export Subsidy

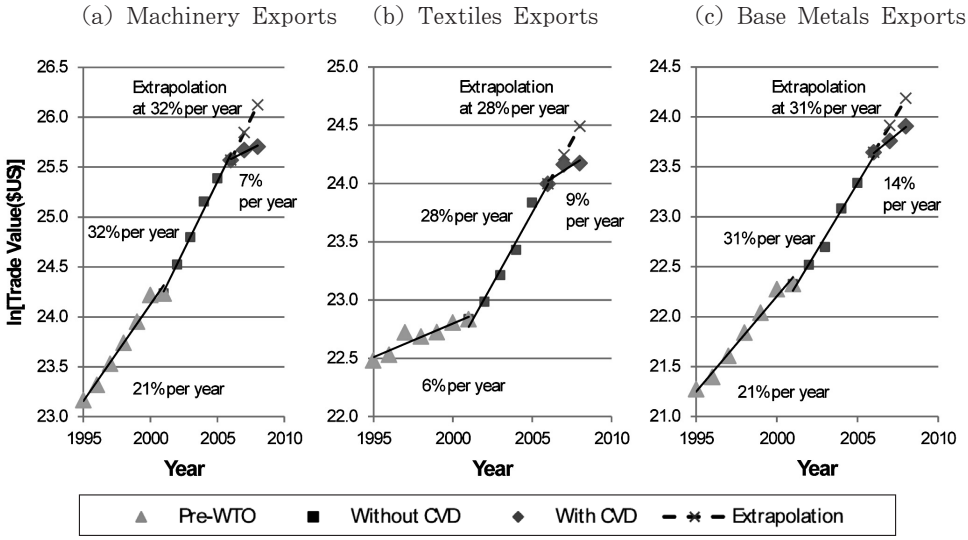
1. China's Machinery, Textiles and Base Metals Industries Exports to the USA

Data shows evidence and constructed theory provides additional insights into the effect and efficiency of subsidies, and CVDs as "offsetting norms". The main theme of the research is these hybrid date sets and their ex-post analysis that holds them as fundamental truths to evaluate policy changes in this section. When a change in trade policy is made by an exporting or importing nation the policy change is usually expected to alter trade patterns such as the price and quantity of imports and/or exports.

More detailed examinations of market effects of the policy changes for the leading three industries will be conducted in this section.

Figure 4 shows time series of the logarithm of machinery, textiles and base metals exports ($) from China to the USA based on 2-digit H-S Sectors and their Chapters. The data for machinery (Fig. 4a), H-S Sector XVI, Chapters 84-85, textiles (Fig. 4b) Sector XI, Chapters 50-63, and base metals (Fig. 4c) Sector XV, Chapters 72-83 are from Table 4 above from 1995 to 2008. These time intervals encompass 3 important periods when the ex-post growth rates, determined by OLS regression, changed: In the Pre-WTO period from 1995 to 2000 growth rates were 21% per year for machinery, 6% for textiles and 21% for base metals. In the Post-WTO Pre-CVD period from 2001 to 2006 growth rates increased for all three industries, 32% per year for machinery, 28% for textiles and 31% for base metals, when China's export subsidy policy was not directly challenged by the USA. In the Post-WTO Post-CVD period after 2006 the growth rates decreased for all three industries ; 7% per year for machinery, 9% for textiles and 14% for base metals, when the USA imposed WTO sanctioned CVDs on these imports from China. Figures 4, (a), (b) and (c) also show extrapolations of the Pre-CVD period growth rates for these 3 industries into the Post-CVD period. The extrapolated growth rates will be used in "what if" scenarios, by assuming that the Post-WTO Pre-CVD period growth

Figure 4. Time Series of Machinery, Textiles and Base Metals Exports from China to the USA from 1995 to 2008, Pre-WTO and Post-WTO periods (without and with CVD).



Data Source: ITC, USA

rates would have continued without the counterbalancing effect of the CVD policy. Comparison of extrapolated and observed trade values after 2006 will be used in the constructed theory to estimate β and γ the excess demand and excess supply elasticities for machinery, textiles and base metals industries, respectively, in the next section.

2. Estimate Demand and Supply Elasticities

In order to find the distorted revenue with subsidy, namely, Pre-WTO and Post-WTO Pre-CVD periods, the CVD is assumed to be zero. In that case the ratio of subsidized to counterbalanced trade value in equation (11) becomes:

$$\frac{p_1 \cdot q_1}{p_0 \cdot q_0} = (1+\sigma)^{\left\{\frac{\gamma(\beta-1)}{(\beta+\gamma)}\right\}} \qquad (19)$$

The $p_1 \cdot q_1$ term is estimated by extrapolating the Pre-CVD growth rates of 2006, and $p_0 \cdot q_0$ is found from the Post-CVD growth rates after 2006 for all three industries, respectively. From the constructed theory, we know that the efficiency of the subsidy policy is determined by the "kappa" function and the knowledge of β and γ is critical in terms of the policy efficiency estimation.

Table 5 lists parameters used to estimate β by assuming a value for γ, and using the value of "kappa" for each particular industry as a constraint. Take the machinery industry for example; for a one year extrapolation from 2006 to 2007 the subsidized value becomes 1.32 times larger than the 2006 value, while the observed trade value is only 1.07 times larger after the USA CVD policy. This makes the left-hand side of equation (19) equal to 1.23, as shown in Table 5 below.

Table 5 List of parameters used to estimate b and g, for machinery, textiles and base metals

General Method	Machinery	Textiles	Base Metals
$x = p_1 \cdot q_1 / p_0 \cdot q_0$	1.32/1.07=1.23	1.28/1.09=1.17	1.31/1.14=1.15
cvd(σ)	1.31	1.83	0.83
ln(x)	0.207	0.16	0.139
kappa=ln(x)/ln(1+σ)	0.247	0.154	0.230
assume	solve	solve	solve
γ	β Machinery	β Textiles	β Base Metals
0.50	2.46	1.67	2.28
0.75	1.86	1.45	1.77
1.00	1.66	1.36	1.60
1.25	1.55	1.32	1.51
1.50	1.49	1.29	1.45
1.75	1.45	1.27	1.42
2.00	1.42	1.25	1.39
2.25	1.40	1.24	1.37

This procedure assumes that all machinery imports were subject to a subsidy of 131% up to 2006 and the prices of all machinery imports were counterbalanced after that by equivalent CVDs. The resulting ratio for the distorted-revenue of the machinery industry is 1.23. This value can be combined with the known subsidy value of 1.31, from Table 3 to obtain a value of 0.247 for the "kappa" function, $(\gamma\cdot(\beta-1))/((\beta+\gamma))$. The non-linear "kappa" function will be solved for β by assuming values of γ, as shown in Table 5 above. From equation (19) it is apparent that the efficiency of the subsidy in increasing trade value is governed by the "kappa" function.

Recall the discussion on the "kappa" function in above sections, the percentage change in total revenue given a percentage change in subsidy depends on this "kappa" function which could have a multiplier effect on the subsidy, if "kappa" is greater than one. It is also known that in the case of "kappa" between zero and one, the subsidy is inefficient. Table 5 shows kappa = 0.247 for the machinery industries, and the subsidy of 131% to be in the inefficient category. The effect of the 131% subsidy in this case is estimated to increase trade value by only 23%, a low level of efficiency.

In the case of textiles industries, all textiles imports were assumed to be subject to a subsidy of 183% up to 2006 and the prices of all textiles imports were assumed to be counterbalanced after that by equivalent CVDs. The resulting ratio (1.28/1.09) is 1.17. This value can be combined with the known subsidy value of 1.83, from Table 3, to obtain a value of 0.154 for the "kappa" function, $(\gamma\cdot(\beta-1))/((\beta+\gamma))$. The non-linear "kappa" function can be solved for β by assuming values of γ, as shown in Table 5 above. For "kappa" between zero and one, the subsidy is inefficient, as the case in Table 5 shows kappa = 0.154, and the subsidy of 183% to be in the inefficient category. The effect of the 183% subsidy in this case is estimated to increase trade value by only 17%, also a low level of efficiency same as machinery industries.

In the case of base metals, all base metals imports were assumed to be subject to a subsidy of 83% up to 2006 and the prices of all base metals imports were assumed to be counterbalanced after that by equivalent CVDs. The resulting ratio (1.31/1.14) is 1.15. This value can be combined with the known subsidy value of 0.83, from Table 3, to obtain a value of 0.23 for the "kappa" function, $(\gamma\cdot(\beta-1))/((\beta+\gamma))$. The non-linear "kappa" function can be solved for β by assuming values of γ, as shown in Table 5 above. Likewise, "kappa" between zero and one, the subsidy is inefficient, as the case in Table 5 shows kappa = 0.23, and

the subsidy of 83% to be in the inefficient category. The effect of the 83% subsidy in this case is estimated to increase trade value by only 15%, also a low level of efficiency similar to the machinery and textiles industries.

Conclusion

This paper evaluates impacts of the subsidy policy on the total trade value by focusing on USA imports from China. Empirical observations both from WTO case studies and data on trade values of Chinese exports to the USA in different time periods are conducted based on Chinese crucial "Top Ten Industries". The paper follows a method of comparative static analysis to compute excess supply caused by a shift in a parameter which is considered as an export-subsidy policy. The research illustrates a functional relationship between value of trade, subsidy and its counterbalanced tariff CVD by employing an elasticity approach as a measurement of the effect of the subsidy on the value of trade. A derived model, with constant price elasticities, can indicate a solution to the ratio of trade values with and without subsidies, respectively. The main finding of this paper is to identify a "kappa" function in the constructed model which is crucial for estimating the efficiency of the effect of the subsidy on the trade value. Based on this finding, the intended research can infer that efficiency of the subsidy policy is most sensitive to the price elasticity of the demand in the foreign market. Another finding is that when tariff rate exceeds the subsidy rate, it cannot function as an "offsetting norm", and it tips the balance toward protectionism. This situation is a source for tit-for-tat utilization of the AD and CVDs, especially between the USA and China.

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Notes

1) Harmonized Commodity Description and Coding System, generally referred to as Harmonized System or simply H-S, it is a

multipurpose international product nomenclature developed by the World Customs Organization (WCO). It comprises about 5,000 commodity groups, each identified and arranged in a legal and logical structure and is supported by well-defined rules to achieve uniform classification. The system is used by more than 177 countries and economies as a basis for their Customs tariffs and for the collection of international trade statistics. The Harmonized System is governed by the International Convention on the Harmonized Commodity Description and Coding System as H-S benchmark associated with its Chapters and Sectors for the specific products.

2）United States International Trade Commission (2010) By Chapter, Harmonized Tariff Schedule of the United States, http://www.usitc.gov/tata/hts/bychapter/_1000.htm [Accessed 7.3.2010]

The WTO Agreements have also followed the H-S benchmark in their tariff and product regulations on global export industries. The H-S is also used by WTO members to classify thousands of traded products on a common basis. The System is organized into 97 Chapters and 21 Sections plus a special one. The 21 Sections represent major sectors of the world economy. Anti-dumping initiations and other WTO trade measures are reported with their HS number, making them easily categorized by economic sector.

3）In 2007, the United States Department of Commerce (USDOC) altered a long standing policy of not applying the countervailing duty (CVD) law to non-market economies (NMEs), and initiated eight countervailing and antidumping duty investigations on Chinese imports. The change brings heated debate on trade remedy policies and NME issues. Trade remedies mainly include anti-dumping, countervailing, and safeguards. The WTO permits certain responses, as contingency measures, from importing nations which can prove that they suffered material injury due to unfair trade practices.

The United States did not apply CVD to China until 2006 as China has been classified as a "Non-Market Economy" (NME) since 1981. This policy rests on two principles advanced in 1984 and confirmed by a federal appeals court (GAO, *US－China Trade: Commerce Faces Practical and Legal Challenges in Applying Countervailing Duties.* GAO-05-474, Report to Congressional Committees, Washington, D.C.: June, 2005).

4）See Kyle Bagwell and Robert W. Staiger, 2006, for an analysis of the logic of GATT/WTO rules regarding export subsidies. Their results indicate that the new WTO subsidy rules may ultimately do more harm than good to the multilateral trading system.

5）USA imposed AD and CVDs simultaneously on Chinese "Top Ten Export Industries", such as, machinery, textiles and base metal, etc, in 2007 in different high tariff rates.

Then China also imposed AD and CVD duties simultaneously on Chicken imports from USA in 2009 and on Grain Oriented Flat rolled Electrical Steel in 2010.

Ministry of Commerce of the People's Republic of China ("MOFCOM") has imposed AD and CVDs on certain automobiles from USA in Nov 20, 2011, including any and all annexes.

6）USA imports from China http://tse.export.gov/TSE/TSEHome.aspx

International Trade Administration (Trade Stats ExpressTM)

China exports to USA and ROW http://www.stats.gov.cn/english/statisticaldata

/yearlydata/
National Bureau of Statistics of China

7) Let σ be the subsidy to Chinese exports expressed in *ad valorem* terms, i.e. $\sigma = s/p$, where s is the amount of the subsidy at a given price, $p_\sigma = p(1+\sigma)$.

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