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The Transmission of Trade Policy Shocks through Global Value Chains: Evidence from China's Processing Trade Regime

By

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Abstract.

This thesis studies the transmission of trade policy shocks through Global Value Chains (GVCs). We develop a theoretical framework that combines elements of trade theory and supply chain management theory. Applying the model to Chinese trade data across customs regimes, we find that that trade policy shocks (measured by antidumping measures) have differential effects on exports, depending on trade regimes. Particularly, processing exports are more sensitive to trade policy shocks than ordinary exports, and pure assembly is more sensitive to trade policy shocks than import-and-assembly.

There are two main contributions of this thesis. The first theoretical contribution is that although risks and flexibilities are staple features of recent trade models, and despite intense theoretical interests in GVCs risks, there is little literature examining the transmission of trade policy shocks through GVCs. This thesis is among the first to study the trade policy shocks' differential effects on companies under different trade regimes, combining the literature that is focused on economics and supply chain management.

The second contribution is that this thesis empirically reinforces quantitative evidences and extends the literature on the transmission of trade policy shocks on GVCs. The transmission is broadly observed but rarely estimated empirically.

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1. Introduction

Global value chains (GVCs) have become a dominant feature of the world economy. In today's competitive business environment, markets are becoming more global and dynamic, customers more demanding, and business strategies more vital. Especially within the past few decades, international trade has revolutionized, widened, deepened and accelerated with the decline in transportation costs and the advances in communication technology (Grossman & Rossi-Hansberg 2006). After breaking the geographic limits, production and services are performed wherever the required materials and skills are accessible with competitive quality and cost. Today's manufacturing industry involves many companies in many countries to produce, process and assemble intermediate components and subcomponents. While companies are able to produce a product in multiple stages and locations, value is added through each stage. Due to these features, international trade volume has great potential to grow by slicing up the value chain. This phenomenon that each country specializes in particular stages of a good's production sequence is known as vertical specialization (Balassa, 1967; Hummels et al., 2001). But because of the cooperation between stages, value chains are not only vertically specialized, but also become an interwoven network.

We argue that slicing up the value chain not only adds value, but also increases the risks and vulnerability of a firm's supply chain. There are more risks involved in global supply chains than in national supply chains. Geographic distances, as well as cultural and language barriers all create obstacles that inhibit managers from orchestrating supply chains across borders. And as companies expand their GVCs across a growing number of countries, their likelihood of facing political instability increases. Moreover, from the economic perspective, along with the increased trade volume, there comes numerous links which interconnect the international networks. These links are prone to supply chain risks

and uncertainties such as disruptions, disasters, breakdowns, and macroeconomic or political changes. Meanwhile there are also increased flexibilities that allow companies to transmit the shocks between countries. And the company's level of flexibility will determine how easily it can circumvent the trade barriers other shocks. It is natural for multinational corporations (MNCs) to monitor and manage risks when searching business opportunities in GVCs across countries.

The structure and branches of MNCs also offer the possibility of operating flexibility to the network of world-wide subsidiaries. Fung et al. (2007) describe how Li & Fung, a trading company, has restructured its value chain when facing a trade policy shock:

> "On a Friday in early September 2006, the South African government announced that it would be imposing strict quotas on Chinese imports in two weeks. Li & Fung had orders already in production for South African retailers that would be affected by these changes. Managers began to look at contingency plans to move production to factories in different countries and even to move the last stage of existing orders to different end countries to satisfy non-China country-of-origin rules."

The phenomenon that firms spatially separate assembly from input production by switching assembly location abroad in order to gain the flexibility to circumvent a country-specific tariff has been termed by Ma and Van Assche (2014) to be "Tariff Shirking".

Except for the fact that tariff shirking was studied in limited number of papers, there is plenty of news and research indicating that some firms do transfer their production sites around the world in order to avoid certain quotas or tariffs. Zhang (2005) observed that Merida, a leading bicycle company, has transferred its factories from China to Vietnam, after the EU imposed the anti-dumping tariff on bicycles to mainland China. Zou (2013)

reported that Chinese glasses manufacturers are already used to the anti-dumping tariff imposed by Brazil. Some quit the Brazilian market and those who remained are exporting their products through Chile, Argentina, etc. to circumvent the tariff. When trade policy shocks occur, companies can opt to increase the retail price of their products, pause operations or relocate facilities; all of which have been proven to happen in real life cases (APICCAPS, 2012). This phenomenon of tariff shirking has been observed and this kind of operations is an advantage of MNCs, it adds value to MNCs, and it helps MNCs to react to variable uncertainties with their flexibilities.

This global phenomenon of GVCs raises policy-related questions, since trade policy plays a significant role for trade liberalization and international investment assignment. The growing fragmentation of business across borders shows significant policy implications. This brings us the interest to examine the transmission of trade policy shocks through GVCs. How does trade policy impact different manufacturing stages occurring in different countries? How do companies react to the uncertainties, like trade policy shocks? Do companies react differently if they have different levels of flexibilities? What are the possible ways to mitigate trade policy shocks?

Based on the facts and phenomena, and to shed light on our questions, in this thesis, we study the transmission of trade policy shocks through GVCs by comparing the change of export value of the firms in different trade regimes within GVCs. And in order to study that transmission, we need to combine the literature of trade and supply chain management. The reason is that in most of the trade theories, firms are assumed and considered identical. However, within GVCs, firms under different trade regimes will have different levels of flexibilities. Using theories of trade alone cannot distinguish and test the impacts of the companies under different trade regimes. At the same time, literature of supply chain rarely discusses the impacts of trade policy shocks on GVCs. Thus, by combining trade and

supply chain, it allows us to differentiate the impacts of trade policy shocks on different firms.

In order to study the relationship between trade policy shocks and GVCs, we combine the literature of trade and supply chain. By discussing the literature, we summarize that companies under different trade regimes have different levels of flexibilities within GVCs, which enables some companies to be less substitutable than the others. Thus, under trade policy shocks, companies will have different levels of sensitivities. So trade policy will have different impacts on companies under different trade regimes. To test our assumption, the empirical analysis is conducted. A simple regression model was built to analyze the relation between trade policy shocks and export value. Trade policy shocks' transmission through GVCs will be reflected on the export trade value.

We use a large dataset from China to investigate. The application to China is motivated by two important facts of China as an important economy. First is the importance of China's categorization of trade regimes in global trade, with the access and availability of China's detailed trade data. Second motivation is China being the world's biggest target for anti-dumping investigations. Analyzing the relationship between anti-dumping and the trade value of different trade regimes will help us understand the relationship between trade policy shocks and GVCs. In the following section, China's anti-dumping environment and China's trade regimes will be elaborated in detail.

1.1 China's Anti-Dumping Environment

WTO defines dumping to be "if a company exports a product at a price lower than the price it normally charges on its own home market, it is said to be 'dumping' the product" (World Trade Organization, n.d.). The WTO Agreement does not regulate the actions of companies engaged in "dumping". Its focus is on how governments can or cannot react to

dumping. That is to say, it disciplines anti-dumping actions by agreements. The definition for legal purposes is more precise. But in general, it will be judged as a "dumping" act if a government can prove the existence and the harm of a dumping action, with the calculations on how much lower a product's exporting price is than the price it is normally charged on the home market.

Amongst all countries, China is the largest target for anti-dumping. Table 1 lists the top 25 exporting countries and the number of records of them receiving anti-dumping cases from 1995 to 2015. There are in total 104 countries which have ever received at least once an anti-dumping case since 1995. China is no doubt the largest target for anti-dumping. China's total number of cases is three times the one of the second largest targeted country (South Korea). There are up and downs for China in terms of total anti-dumping cases received; but generally speaking, there is an increasing trend since 1995 and the number of cases just stays at a much higher level compared to the rest of the world. The number of cases for China hit its first peak in 2006, dropped in 2010, and the average for the most recent four years (2012-2015) is 67.

Table 1. Summary statistics of anti-dumping cases being received, by year and by country (top 25), 1995-2015

Exporting Country	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
China	20	43	33	27	43	43	55	50	53	49	53	73	61	78	78	44	51	60	75	63	71	**1123**
Korea, Rep.	14	11	15	27	35	23	23	23	17	24	12	10	13	9	8	9	11	22	25	18	17	**366**
Taipei	4	9	16	10	22	14	19	16	13	21	13	13	6	11	12	5	9	22	17	13	10	**275**
US	12	21	15	16	14	13	15	11	21	14	12	11	7	8	14	19	10	9	13	11	5	**271**
India	3	11	8	13	13	10	12	16	14	8	14	6	4	6	7	4	7	10	11	15	13	**205**
Thailand	8	9	5	2	19	12	17	12	7	9	13	8	9	13	8	5	8	10	14	9	3	**200**
Japan	5	6	14	14	22	12	14	13	16	9	7	9	4	3	5	5	5	6	11	7	8	**195**
Indonesia	7	7	9	5	20	13	18	12	8	8	14	9	5	11	10	4	5	6	7	5	6	**189**
Russia	2	7	7	13	18	12	9	20	2	8	4	5	6	2	4	2	3	3	5	4	7	**143**
Brazil	8	10	5	6	13	9	13	3	3	10	4	7	2	3	12	3	3	2	6		7	**129**
Malaysia	2	3	5	4	7	9	6	4	8	6	14	5	7	10	7	4	2	3	9	10	3	**128**
EU		1	2	4	7	9	9	10	10	3	5	3	2	4	6	9	3	5	8	8	3	**111**
Germany	7	9	13	8	11	6	9	7	3	2	2	2	4	1	3	3	2	3	7	4	4	**110**
Ukraine	2	3	4	9	9	7	6	8	3	1	5	4	1	2	3	2		3	3	4	3	**82**
Turkey	2	3	1	2	6	7	5	4	4	1		2	3	4	2	4	4	5	5	8	6	**78**
Mexico	3	5	2	9	4	1	4	1	4	3	1	2	2		5	5	3	3	6	3	6	**72**
South Africa	2	6	4	5	4	6	9	10	4		2	2	1	3	1	1	1	2	3	2		**68**
Italy	6	5	5	5	2	5	8	3	4	1	1			2	2	1	2	3	3	1	3	**62**
Viet Nam			1		1	1		3		7	3	2	2	3	3	1	3	8	3	5	12	**58**
Spain	2	4	7	7	5	6	4	2	4	1			1	1		2	1		4	3	1	**55**
Singapore	2		4		5		12	9	1	1	1	6	2		1	1		2	1	5		**53**
France		4	4	10	7	2	3	2	3	1	1	1	1	1	1	2			1	3	4	**51**
UK	6	4	6	4	2	9	6	2		1	1			3				3			2	**49**
Argentina	1			1	4	2	5	3	1	3	4	3	1	2	2	2	1	2	5	2	2	**46**
Canada	2	1	3	4		1	7	5	4	2	1	1	2	2	1	2	1		2		2	**43**

Source: Author's calculation using data from the WTO Anti-Dumping Statistics 2016. Note: All initiations notified here are at HS-2[1] level.

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[1] Based on International Trade Statistics (n.d.): "The Harmonized Commodity Description and Coding System (HS) forms the basis of the Customs Tariff. The HS was developed and is maintained by the World Customs Organization's (WCO) Harmonized System Committee (HSC). HS compliance is the mandatory classification and declaration of goods coming into or leaving board for many countries. There are multiple levels of HS code: HS-2, HS-4, HS-6, etc. HS-2 identifies the chapter the goods are classified in (e.g. HS 09 is Coffee, Tea, Mate and Spices). HS-4 identifies groupings within that chapter (e.g. HS 0902 = Tea, whether or not flavoured). HS-6 coding system is even more specific in the categorization of products (e.g. HS 090210 Green tea (not fermented) in immediate packings of a content not exceeding 661 lb)."

Table 2 summarizes China's number of anti-dumping cases and the percentage it represents worldwide by year. On average, China represent 23% of the total anti-dumping cases from 1995 to 2015. The total number of anti-dumping cases worldwide in 1995 was 157, whereas China represented 13%. Since 1996, there is an increasing trend for China in terms of number of anti-dumping cases and in terms of percentage of the world; and China hit its first peak in 2006. The total number of anti-dumping cases worldwide in 2006 was 203, whereas China represented 36%. Last year in 2015, the total number of anti-dumping cases worldwide was 230, whereas China represented 31%.

Table 2. Summary statistics of anti-dumping cases imposed against China and World, by year and percentage, 1995-2015

Year	China	World	%
1995	20	157	13%
1996	43	226	19%
1997	33	246	13%
1998	27	264	10%
1999	43	359	12%
2000	43	296	15%
2001	55	372	15%
2002	50	311	16%
2003	53	234	23%
2004	49	220	22%
2005	53	200	27%
2006	73	203	36%
2007	61	165	37%
2008	78	218	36%
2009	78	217	36%
2010	44	173	25%
2011	51	165	31%
2012	60	208	29%
2013	75	287	26%
2014	63	236	27%
2015	71	230	31%
Total	**1123**	**4987**	**23%**

The count of countries by the range of the number of cases is summarized in Table 3. Out of those 104 countries which have received at least once anti-dumping cases from 1995 to 2015, there are totally 50 countries that have received less than 10 anti-dumping cases during those 20 years. According to Table 3, most of the countries received less than 20 anti-dumping cases in total during the past 20 years. And the biggest target (i.e. China) received a total of 1123 cases.

Table 3. Summary statistics of the count of country, by the range of the number of anti-dumping cases, 1995-2015

# of Cases Range	Count of Country	% of Total
0-9	50	48%
10-19	12	12%
20-29	8	8%
30-39	8	8%
40-49	4	4%
50-59	4	4%
60-69	2	2%
70-79	2	2%
80-89	1	1%
100-199	7	7%
200-299	4	4%
300-399	1	1%
400-999	0	0%
1000-above	1	1%
Total	**104**	**100%**

Such a high percentage of anti-dumping cases applied against China would be expected if China's exports represent the same proportion of exports worldwide. But this turns out not to be the case. In 2014 China exported $2.37T, while the total world exports in 2014 was $17.6T (OEC statistics 2016). China represent 13.5% of total global exports in value. However as summarized before in Table 2, China represents a high level of 27% of world's number of anti-dumping cases in 2014.

After discussing China's anti-dumping environment, in the next section, we will talk about how China's trade is categorized and why it is categorized in that way.

1.2 China's Trade Regimes

China adopted its export processing system and started to open up to the outside world in 1978. Since then, China's trade volume has been increasing annually. In 1978, China's total imports and exports were 20.6 billion USD, but by the year 2000 the number increased to 474.3 billion USD, and the number reached 4159.0 billion USD in year 2013 (China Statistical Yearbook 2014).

Behind the huge increase lies the facts that during the past several decades, to encourage exports, China implemented various kinds of trade policies. Amongst all, one policy which has shown its great value in trade regimes is the exemption of import duties for imported intermediate inputs, if these inputs are going to be used for processing and re-exporting. Government even created Export Processing Zones (EPZs) to vertically specialize business. In an EPZ, companies import intermediate components and subcomponents to produce and export finished products. EPZs contribute a lot to the rapid growth in China's economy combining the adoption of exemption of import duties for imported intermediate inputs (International Trade Statistics 2014). This exemption policy, to a significant extent, decreases the cost of foreign intermediates. Ianchovichina (2004)

states that the exemption policies reduced the anti-export bias of China's old planned economic system and improved the competitiveness and efficiency by allowing exporters to import at international prices. In that way, this policy not only encourages China's companies to process and re-export, but also encourages foreign companies to offshore production to China because of lower costs eventually.

The tariff exemptions facilitated China's integration into the global production networks, which in turn speeded up the diversification of trade regimes in China (Lemoine and Unal-Kesenci, 2004). To evaluate the source of China's trade and to control the exemption, according to the Bureau of National Statistics and Official China Trade Statistics, and defined by China Customs, China differentiates trade into two regimes: Ordinary Trade (OT) and Processing Trade (PT), and two regimes within PT: Pure Assembly (PA) and Processing with Imported Inputs (PI).

OT consists of the ordinary unilateral imports and exports activities. The traded products are ordinary products that are sold or purchased unilaterally under Ordinary Trade. Traded products are under custom supervision. Companies have to claim for customs, receive examination, and pay tariffs when presenting required certification and documentation. Under OT, manufacturers have to pay an ad valorem tariff to the imported inputs.

PT refers to "the business activities in which the operating enterprise imports all or part of the raw or ancillary materials, spare parts, components, and packaging materials (hereinafter referred to as materials), and after processing or assembling, re-exports the finished products. It includes processing of supplied materials and processing of imported materials" (ASIANLII, n.d.). The PT regime includes two sub-categories based on different features of operations: PA and PI.

Consider there are three organizations (A, B and C) participating in an international trade world. B, as our focal company, will conduct Transaction 1 (import the inputs from A) and Transaction 2 (export the finished products to C) (Figure 1). A and C can be the same company or different ones.

Situation 1:
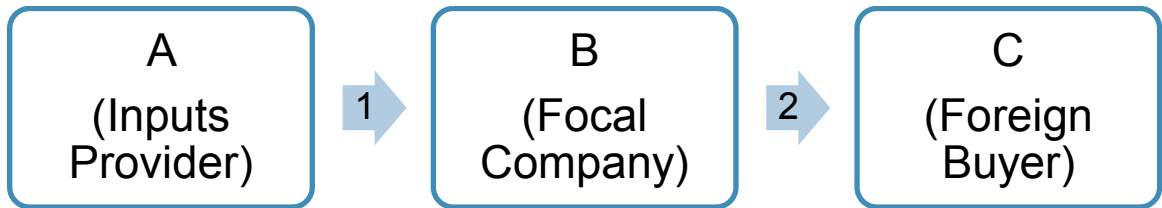
Situation 2:
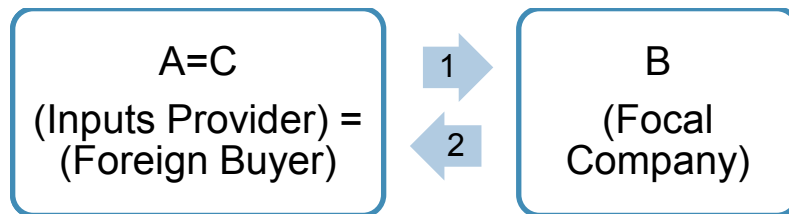
Source: Author's summary

Figure 1. Focal Companies' Position within GVCs

There are two main features in China's processing trade: one is the ownership of the plant, and the other is the management of the inputs (Feenstra & Hanson, 2004). Since the early 1980s, China has stipulated that all processing plants operate according to one of the two sub-categories: PA or PI, with the permission to shift.

The first sub-category PA, refers to "the business activities in which the imported materials are supplied by the overseas enterprise, and the operating enterprise need not pay foreign exchange for the import, but just carries out processing or assembling in accordance with the requirements of the overseas enterprise, and charges for the processing, with the

finished products being marketed by the overseas enterprise." (ASIANLII, n.d.). In the whole process, this foreign buyer does not charge for materials, it has the ownership over the inputs and it keeps the right to sell final products.

The second sub-category PI, refers to "the business activities in which the operating enterprise pays foreign exchange for the import, and exports the finished products" (ASIANLII, n.d.). The Chinese processing firm sources and pays for imported materials themselves from abroad, then processes and assembles them by using its own technology, equipment and labour and then sells finished products to a foreign buyer. In the whole process, this foreign buyer does not have control or ownership over the inputs and this foreign buyer keeps the right to sell final products.

All of the above make China a perfect setting for exploring the companies' reactions under different trade regimes within GVCs. Firstly, companies that perform under different trade regimes have different levels of economics flexibility and supply chain flexibility. Those different levels of flexibility will lead to different levels of sensitivity when the trade transactions face trade policy shocks. It is valuable to study the differential effects of trade policy shocks through GVCs under different trade regimes. Secondly, because these processing trade activities involve duty exemption (a processing firm can claim import duty exemption if and only if, at the time of importing, it shows proof of a contractual agreement with a foreign buyer to whom it will export the processed goods), and since value-added tax rebates are based on trade value under different regimes, statistics are under intensive customs monitoring, thus are quite reliable. Thirdly, concerning international trade, this level of contractual detailed data that separate trade regimes into OT and PT (PA and PA) is rarely recorded in other countries and the categorization of trade regimes will provide the possibility to analyze companies within different levels of GVCs. Fourthly, China is a national economy that is greatly integrated into the global production networks with its noteworthy trade volume. Ever since the introduction of more liberal economic policies

including the processing trade regime, under Deng Xiaoping's reform and opening-up strategy in the late 1970s, China has achieved huge accomplishments in its national economy. China's trade activities have greatly expanded, and China's economic activities have significantly grown. China transformed from a lagging economy to one of the most important suppliers of labour-intensive manufacturing in the world within a few decades. Last but not the least, China is the biggest target of anti-dumping investigations with a much larger number of anti-dumping cases than the rest of the world. The large number of cases provides us a profound database to explore trade policy shock impacts. Data wise, considering that China is the largest target for anti-dumping worldwide, and it splits trade regimes into categories, following research questions can be answered:

What is the transmission of trade policy shocks through GVCs? Will export producers in GVCs be impacted by trade policy shocks? Will export producers in different trade regimes be impacted differently? Under which trade regimes will export producers be more sensitive to trade policy shocks?

1.3 Results and Organization of the Research

To answer the above research questions, the transmission of trade policy shocks through GVCs is studied in this thesis. In order to study that transmission, we have to combine the literature of trade and supply chain. Literature on GVCs, trade policy shocks, and supply chain flexibility are explored (Section 2). According to the literature review, companies under different trade regimes will have different levels of flexibilities within GVCs, which enables some companies to be less substitutable than the others. Thus, under trade policy shocks, companies will have different levels of sensitivities and differential effects. From that, hypotheses are raised (Section 3).

To test the hypotheses, in this thesis, a simple regression model of international trade concerning trade policy shocks and trade value is built, and this model is applied to China. The application to China is motivated by the importance of China's categorization of trade regimes in global trade, by the availability of its detailed trade data, and by being the world's biggest target for anti-dumping investigations.

We exploit and match data from the World Bank's Global Antidumping Database (GAD) (Bown, 2009) with aggregated country-level data (with firm-level (2000-2006) and provincial-level data (1997-2009)) from China Customs Statistics (Section 4). According to the Bureau of National Statistics and Official China Trade Statistics, and defined by China Customs, China's trade is separated into OT and PT, also separated into PA and PI within PT.

By empirically analyzing the impacts of anti-dumping on China's export producers in different trade regimes, the research questions can be answered (Section 5). The empirical results test that trade policy shocks will impact export producers within GVCs and trade policy shocks have differential effects for companies under different trade regimes. To be more specific, trade is more sensitive to trade policy shocks for companies under PT than OT; and within PT, more sensitive under PI than PA. Under the shocks of trade policy, within GVCs, exporters have lower a tendency to choose Processing Trade over Ordinary Trade, and to choose Pure Assembly over Processing with Imported Inputs, in order to circumvent the risks coming with trade policy shocks. Trade policy shocks thus affect the choice of trade regimes of companies within GVCs.

Our study provides a bridge between two recent literatures: trade policy and GVCs. While risks and flexibilities are staple features of recent trade models, and despite intense theoretical interests in GVCs risks, there is little empirical work on how trade policy shocks as uncertainty matter for GVCs. The first contribution is that this thesis reinforces quantitative evidences and extends the literature on how companies are affected by trade

policy shocks along the GVCs, where trade policy shocks are often assumed to be severe but this is rarely estimated empirically. The second contribution is that trade policy shocks and GVCs have been broadly studied separately but not closely related to supply chain management. In this thesis, the transmission of trade policy shocks through GVCs will be explained combining the literature that is focused on economics and supply chain management. This is particularly relevant for economies that rely on trade for growth.

To summarize, the remaining thesis is structured as follows. Section 2 explores existing literature concerning the link between trade policy shocks and global value chains, with the emphasis on the literature that is focused on economics and supply chain management. Section 3 states the two main hypotheses that are developed with respect to the research questions. Section 4 describes the data and provides statistics summaries. Section 5 lays out the model and verifies predictions that are concluded from the model with empirical results. Finally, Section 6 concludes.

2. Literature Review

In this literature review, we start off by introducing the emergence of GVCs, how GVCs are motivated to be sliced up and how GVCs vertically specialize the production. This encourages companies to participate into GVCs, and specialize in different regimes of trade. The features for different trade regimes determine the level of flexibility and vulnerability. Different levels of flexibility allow companies to have different capabilities of performing under disruption risks. If companies have a higher level of flexibility, they will be less substitutable. Less substitutable companies will have higher chance to successfully perform under trade policy shocks. The companies that perform under the more flexible trade regimes will be less sensitive to the trade policy shocks.

In a recent study, Ma and Van Assche (2014) have studied the power to accomplish tariff shirking by comparing Ordinary Trade and Processing Trade. The study is discussed from an international economics and trade view by studying the effectiveness of trade policy. In this research, the relationship between trade policy shocks and GVCs is examined by adopting empirical analysis and then the results are explained combining literature that are focused on trade policy and supply chain management. Moreover, in this thesis, we not only study the first layer of trade regimes that divide trade into Ordinary Trade and Processing Trade, but also study the further layer of processing trade, which is divided into two sub-categories: Pure Assembly and Processing with Imported Inputs.

Basically, there is a tremendous literature on trade policy shocks and supply chain risk management separately. However, few articles have analyzed how supply chain flexibility can help firms mitigate trade policy shocks; also, few articles that are emphasizing mitigation methods of trade policy shocks have considered this from a supply chain risk management perspective. The importance of combining literature of trade and supply chain is that on one hand, few literature of trade distinguish between companies. Companies

under trade theories will be mostly considered identical. On the other hand, few literature of supply chain considers trade as a factor of impacts. However, literature of supply chain distinguishes between companies under different trade regimes because of different levels of flexibility. So, in order to study the transmission of trade policy shocks through GVCs, existing literature concerning the link between trade policy shocks and GVCs will be explored, with the emphasis on the literature that is focused on economics and supply chain management.

In the following sections, being firstly discussed is the development of GVCs in Section 2.1, including the rise and the risk coming along, with an emphasis on the risk of trade policy shocks. Also, the rise of GVCs motivates trade organizations to operate and specialize into different trade regimes. So, Section 2.2 & 2.3 summarize different trade regimes features based on literature that is focused on economics and supply chain management. Then we talk about trade policy shock's impact on GVCs in Section 2.4. Finally, Section 2.5 summarizes the literature review.

2.1 Global Value Chains Development

In this section, the development of GVCs will be introduced. For the past decades, there are several changes that characterize the world economy trend. Two critical features are the rise of GVCs and the risk coming along. Section 2.1.1 discusses that the rise of GVCs encourages and makes it possible for countries to specialize production vertically which can help firms gain a comparative advantage. Companies arbitrage factor cost and institutional differences across countries and companies in GVCs have the flexibilities to manage and to coordinate between subsidiaries across countries. That is amongst the main reasons that motivate companies to participate into the GVCs and to specialize in different trade regimes. However, companies are taking advantage of GVCs with sacrifices. This leads to Section 2.1.2, in which we discuss that companies and countries are facing risks

coming from trade reforms and trade barriers when joining GVCs. And companies are trying different ways to avoid the side effects of these kinds of risks.

2.1.1 Rise of GVCs

The importance of GVCs has increased dramatically. The trend can be observed from Figure 2. Because of FDI's crucial function in investible resources, capital flows, and what's more the transfer of technology, skills and managerial practices, the increasing weight of developing countries' FDI quantity stands for their increasing participation in GVCs. In 2014, 50 percent of the world's gross exports are associated with GVCs. And more than 50 percent of them are from developing countries. Developing countries not only hold a large amount of GVCs export, but also attract 50 percent of global Foreign Direct Investment (FDI) inflows in 2014 (which was only 18 percent in 2000), and contribute 32 percent of FDI outflows in 2013 (which was only 7 in 1990) (World Investment Report 2014). The development of MNCs by FDI has been a critical push for GVCs.
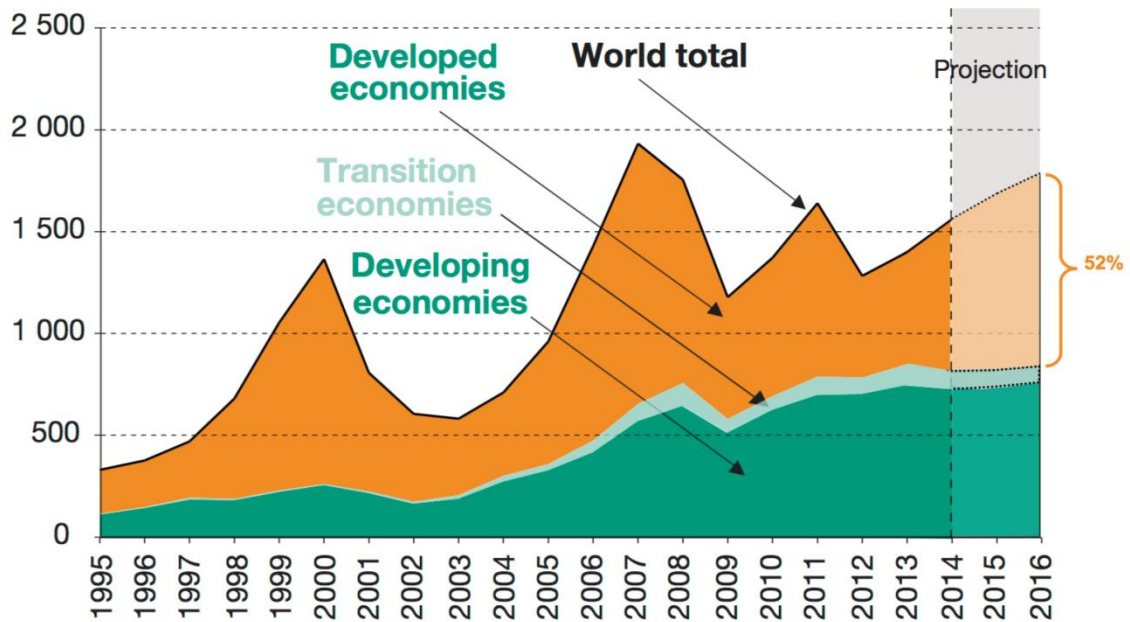
Source: World Investment Report 2014

Figure 2. FDI Inflows, Global and by Group of Economies, 1995-2013 and Projections, 2014-2016 (Billions of Dollars)

The fragmentation of operations and growing quantity of foreign inputs improve companies' productivity and competitiveness. Economic growth has been accelerated in many developing economies after trade opening period since the 1990s. While the average world GDP growth has been stable around 3.5 percent from year 1990 to 2010, Brazil increased its GDP growth from -3.1 percent to 7.6 percent, and China increased from 3.9 to 10.6 percent within the same time range (World Bank national accounts data). Faster growth makes more trade regimes available, which can accelerate GDP growth in return, by structuring the operation activities globally through specialization, investment, production, distribution and innovation in the value chain.

Value chain was first described and popularized by Porter (1985) as follows:

"The idea of the value chain is based on the process view of organizations, the idea of seeing manufacturing (or service) organization as a system, made up of subsystems each

with inputs, transformation processes and outputs. Inputs, transformation processes, and outputs involve the acquisition and consumption of resources - money, labour, materials, equipment, buildings, land, administration and management. How value chain activities are carried out determines costs and effects profits."

GVCs are not just a current phenomenon for either developing, emerging or developed economies. The concept was firstly taking shape from the mid-1990s (Gereffi, 1994). The expression "slicing up the supply chain" was first used by Krugman et al. (1995). Traditionally, the production process was simply making inputs into outputs. That is why back in 1913, products could only be exported once, and there were no re-export activities. Nowadays, the production process is more likely to be a combination of procedures that add value layer by layer.

As technology developed, the cost of communication decreased to a level that international fragmentation of the production processes is acceptable. It used to be really expensive to relocate activities worldwide, but this is no longer the case now. Different factors can support companies with different advantages (Head, K., 2004), including physical (e.g. intangible capital), intellectual (e.g., information transferring), natural (e.g., water, oil, gas, etc.), human (e.g., education, experience, etc.) and social factors (e.g., trust, norms, etc.).

With the development of computer science and fast and cheap transportation modes, companies are facing more competition not only from close competitors, but also from distant rivals. Baldwin (2003) demonstrates that due to the increasingly complex technology, users gain much more flexibility. Companies are now tending to independently design and control components, and make reliable products by working with other companies. Companies compete by specifying dominant design rules and produce excellent modules. The benefits of modularity are from variable fields (Shih, W., & Pierson, M., 2011). It brings benefits from industry-wide demand, low margin components,

increasing supplier competition and economies of scales. With the development of modularity, the labour cost and operating cost are lower, as well as lower risks and entry barriers. Basically, modularity makes slicing up the value chains possible with disadvantages coming from costs and delays due to remote communications, etc.

Although modularity slices up the GVCs, activities are often highly interlinked, an activity is usually a mix of people, technology, fixed assets, sometimes working capital, and various types of information. A country that has the right factors of production in relative abundance at the right time for a product will usually obtain a competitive advantage in making that product (Porter, 1985). So labour-abundant countries with more unskilled workers have a labour cost advantage; capital-abundant countries with more skilled workers have a capital cost advantage. R&D and marketing tend to be highly capital or knowledge-intensive, while assembly activities tend to be labour-intensive (Van Assche, 2012).

The production process happens wherever the necessary materials, resources and labours are available at competitive costs and qualities. Globalization drives companies to improve their resource allocation through outsourcing and offshoring. The value of components and services keep increasing stage by stage in different countries through the international production chains. Imports of intermediates represent a large portion of total merchandise imports, and there are significant increases in recent years. The share of imported inputs in the overall exports, and other countries' import of inputs destined to be that country's export have constantly increased for most countries (illustrated in Figure 3), which is a good representative of the development of slicing up the GVCs. In spite of the limitation that added-value exports are recorded only for a few countries, the data demonstrate that nearly 50 percent of the world's gross exports are import content (World Trade Report 2014). These quantified results show the importance of GVCs with the great changes that GVCs have brought to the business world. Also because of the international

character and because of the value the chain carries, the importance of GVCs no doubt will keep growing as time goes by.

Import Content of Exports % of Gross Exports 1995 vs. 2009
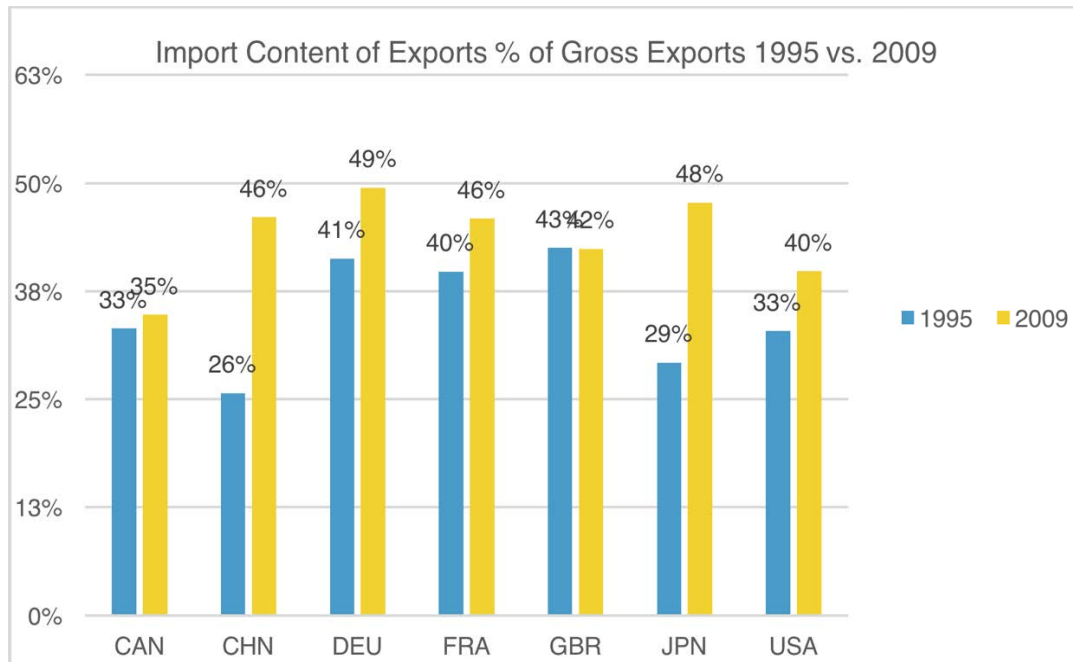
Source: Author's calculations using data from OECD Import Content of Exports 2015

Figure 3. Share of the import content of exports %[2] over gross exports, by year and by country, 1995 vs. 2009

All the development of GVCs and slicing up trends encourage and make it possible for countries to specialize production vertically which can help firms gain comparative

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[2] "Import content of exports is defined as the share of imported inputs in the overall exports of a country and of its exported goods and services used as imported inputs to produce other countries' exports. It reflects the extent to which a country is a user of foreign inputs and a supplier of intermediate inputs used in other countries' exports. The higher the foreign value-added embodied in gross exports and the higher the value of inputs exported to third countries and used in their exports, the higher the participation of a given country in the value chain. The indicator is not based on value-added trade, thus there is an overlap and potentially some double counting. This indicator is measured as a percentage of gross exports broken down by total, backward (foreign inputs in exports) and forward (domestically produced inputs used in third countries' exports)". (OECD Import content of exports indicator 2015)

advantage. The Heckscher-Ohlin Trade Theorem states that countries will export products that use its abundant factors intensively. Thus, factor abundance should determine where each activity happens. Due to the development of economies, relative factor abundance shifts over time, so the right timing is also important. A country which has the right factors of production in relative abundance at the right time for a product will usually obtain a competitive advantage in making that product. Relocating activities to a lower cost location could help companies gain competitive advantages.

As a result of relocating, "centers don't hold" (Desai, 2009). Because of the de-centering trend of the global firms, the "shape" of the firms is changing. It is transformed from a horizontal foreign direct investment to vertical and then gradually to ownership-based outsourcing decisions. In that way, companies are not only duplicating subsidiaries to push sales, it forms a chain where factors are located to act more efficiently with cost reducing to minimum. The new phenomenon is that companies are seeking the best place individually for their financial, managerial talent and legal homes (Desai, 2009). Thus, the headquarters are not necessarily in one single location, but rather in multiple ones.

As a result, the production networks are not limited by boundary constraints. Four main trends were summarized (Timmer et al., 2013) in the production of final manufacturing products. First, production has become increasingly internationally fragmented in the past two decades; second, the factor distribution in this production has shifted from low-skilled to high-skilled labour intensive products; third, value added in traditional industrial strongholds, such as US, EU, Japan, etc. remained constant while value added doubled in the rest of the world; last, advanced countries increasingly specialized in GVCs tasks performed by high-skilled workers. Those trends are indicating that the production is becoming more and more specialized. A particular concept about verticality is that a small reduction in trade barriers will lead to specializing vertically (Hummels et al., 2001). If trade grows, the vertical component of the trade grows even

more. The ability of slicing up the value chain allows a finer division of specialization when pursuing competitive advantage.

Because of the fragmentation of production, the production networks are categorized into three classes, including authority production networks, relational production networks, and virtual production networks (Sturgeon, 2001). Authority production networks rely on the authority of administrative control for governance; relational production networks tend to be built through social and spatial proximity and especially through the long-term contracting relationships between firms; a virtual production network is the firm's own distinctive model of networked production which relies on highly innovation thoughts. Those production networks have been developed over time along with the development of GVCs. And the fragmentation of production networks lead to the separation of trade regimes. Companies that have different levels of flexibilities will choose different trade regimes, and on the other hand, companies under different trade regimes will have different levels of flexibilities.

To summarize, the importance of GVCs has increased dramatically. All the development of GVCs and slicing up trends encourage and make it possible for countries to specialize production vertically which can help firms gain a competitive advantage. They arbitrage factor cost and institutional differences across countries and thus form a business network. That is amongst the main reasons that motivates China to separate its trade regimes into Ordinary Trade and Processing Trade, and even further into Pure Assembly and Processing with Imported Inputs within Processing Trade. To explain that point in detail: the network structure and features of different trade regimes enable MNCs to react to the uncertainties and risks of global markets. The network structure and features of MNCs under separated trade regimes offer variable organizational capabilities to manage and to coordinate between subsidiaries across countries with flexibility. This flexibility gives MNCs their economic advantages to deal with critical risks and uncertainties. Firms

can avoid costs from trade policy shocks by arranging the production networks strategically. This is often neglected in the literature and is going to be surveyed in detail in the following sections.

2.1.2 Risks of GVCs

The rise of GVCs has been enabled by technologies like the internet and other convenient communication infrastructures. All those improvements decrease trade costs. Global business activities arbitrage factor costs and integrate within GVCs by specializing in different trade regimes. However, companies are taking advantage of GVCs with sacrifices. Companies no longer take charge of the whole process from raw materials to finished goods; instead, they will only specialize in a part or several parts of the products, in the form of producing components or processing inputs. The vertical specialization will raise risks. In this section, risks coming along when companies join GVCs will be discussed in detail.

Since the supplier's supplier and the customer's customer are no longer within one country's boundary, not all companies have the ability or eligibility to participate in GVCs. To participate, a company must be capable of producing the qualified products at required quantity within certain time constraints; that is to say, the company must be efficient and standardized, otherwise disqualified (Chains, 2014). That creates challenges and competitions for companies to reform. Because of the global qualification constraints forced on production, companies are narrowing down the skills categories to improve its specialization. Because of the chains and layers within GVCs, companies are facing more uncertainties from remote locations.

Aside from the reforming risks that come along after joining GVCs, there are barriers when preparing to join GVCs. Risks coming from disruptions include four sources:

operational risks, risks arising from natural hazards, terrorism, and political instability. GVCs barriers under the category of political instability are generally categorized into two parts: non-tariff barriers like infrastructure barriers and tariff barriers (WTO defines tariff to be "customs duties on merchandise imports" (World Trade Organization, n.d.)). The race-to-the-bottom (RTB) theory imply that, because of the competition world-wide, companies are tending to reduce barriers to trade and controls on capital in order to win over the international investments; states will prefer the policies of the most laissez-faire country (Drezner, 2001).

In general, the world has been in the trend of trade liberalization. Free trade agreements (FTAs) were signed, established and negotiated, in order to reduce or even eliminate trade barriers globally. As a result, the world average import tariff rate decreased from 11.5% in 1995 to 6.6% in 2010 (World Bank Database). Most of the developing economies take actions to decrease the tariffs they adopt to import products too. Take China as an example, its average Most Favored Nation (MFN) tariff rate for all products has been decreasing from 42.1 percent in 1991 to 9.6 percent in 2011 (World Bank Database). And there is a significant descending trend of world's tariff. Take the simple mean MFN tariff rate as an example (illustrated in Figure 4). We run the regression for the trend and year, and get following formula:

$$Simple\ Mean\ MFN\ Tariff\ Rate = -0.0035 * Year + 0.1399$$

(R-Square = 0.91933)

Tariff rate, most favored nation, simple mean, all products

y = -0.0035x + 0.1399
R² = 0.91933
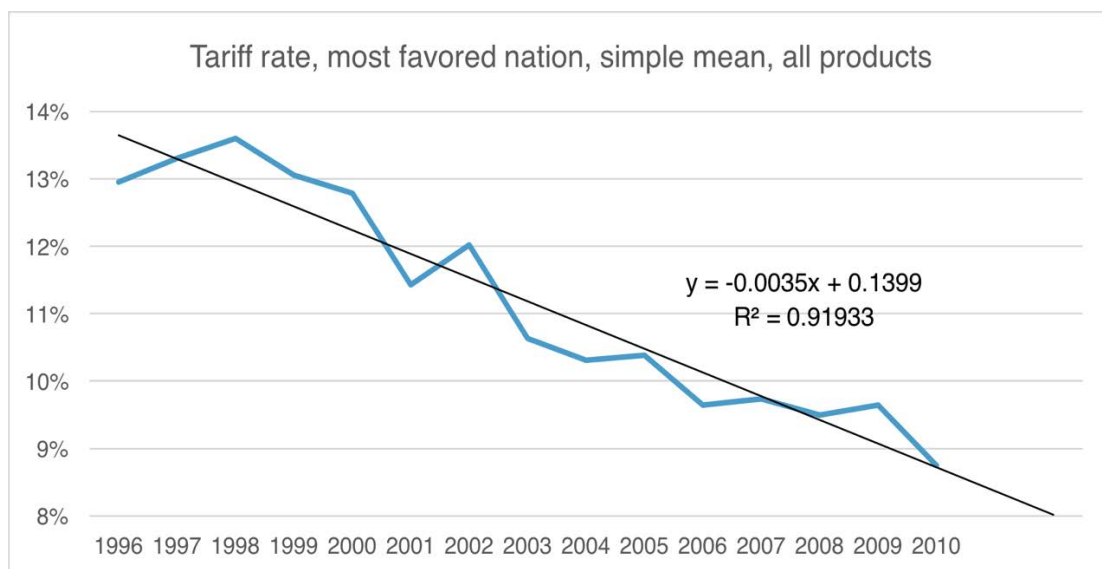
Source: Author's calculations using World Development Indicators 2016 from World Bank Database (The simple mean most favored nation tariff rate is the un-weighted average of the most favored nation rates for all products subject to tariffs calculated for all traded goods.)

Figure 4. Trend of World Simple Mean MFN Tariff Rate, 1996-2010

The increasingly global nature of macroeconomic shocks has been summarized by the WTO (World Trade Report 2014) as one of the major trends that have characterized the last decade. The reason why there are trade policies between countries is that a country intends to promote its export while protecting its import. In order to minimize the effects of barriers, countries are taking active actions to negotiate for deeper preferential trade agreements (PTAs). Intermediate inputs trade has been a critical part of international trade and economy. PTAs can help to decrease the tariffs on it. And since PTAs are aimed at global trade in nature, the agreements will eventually be enforced at a multilateral level.

A survey conducted by the Organization for Economic Co-operation and Development (OECD), the World Trade Organization (WTO) and the United Nations Conference on

Trade and Development (UNCTAD) reveals the main challenges when developing country companies join GVCs. Despite for companies' own infrastructure limit, there are logistics related challenges as well as trade related challenges, including transportation costs and delays due to remote supply, customs procedures, duties, licensing qualifications. It has been shown that countries with lower barriers are more likely to participate in GVCs (Miroudot et al., 2013).

After joining GVCs, how will companies react to GVCs risks? Ma and Van Assche (2010) found through China's processing trade that vertically specialized trade is more sensitive to trade costs changes than Ordinary Trade by controlling detailed information of the location of input production, the location of processing, and the location of further consumption. Ma and Van Assche (2014) have tested that vertically specialized trade has more flexibility than Ordinary Trade under the shock of trade policy.

To summarize, companies and countries are facing risks coming from trade reforms and trade barriers when joining GVCs. A lower barrier is more helpful for joining the GVCs, and companies and countries are taking efforts to avoid the side effects of these kinds of risks.

2.2 Trade Regimes' Features Based on Economics Focused Literature

In international trade, different companies, products, services, requirements, qualifications and locations form a complex trade network, and those criteria will decide the way that trading organizations involve in trade business. As the development of economics and economical politics, trade regimes develop along. It is very important for companies to choose wisely in which trade regimes they would like to perform based on different trade regimes features. Based on literature that is focused on international economics and trade, features of different trade regimes will be discussed in this section.

Three key features between OT and PT, also between PI and PA will be compared, which are tariff exemptions, control over materials, value added and gross margin.

Tariff exemption:

China has adopted the exemption of import duties for imported intermediate inputs, if these inputs are imported to be used for processing and re-exporting. This exemption policy, to a significant extent, decreases the cost of foreign intermediates and inputs. The tariff exemption policy not only encourages China's companies to process and re-export, but also encourages foreign companies to offshore production to China because of lower costs (Ianchovichina, 2004). The most important feature that separates OT with PT, is the tariff exemption. Companies under OT do not have the tariff exemption, whereas companies under PT have the tariff exemption.

Control over materials:

For non-imported inputs: under OT (if necessary) and PI (if necessary), companies pay for and own the components (ASIANLII, n.d.) and take the risk of purchasing inputs (e.g. the risk of price change and the risk of sales).

For imported inputs: under OT (if necessary) and PI, processing companies pay for and own imported components (ASIANLII, n.d.) and take the risk of purchasing inputs (e.g. the risk of price change and the risk of sales); while under PA, processing companies just import components without paying for the inputs while having the guarantee to receive the payment for their processing services (ASIANLII, n.d.).

For finished products: under OT and PI, since they import inputs as buyers and sell finished goods as sellers (ASIANLII, n.d.), they have the ownership over finished goods;

while under PA, foreign companies are not actually paying for the goods but more for the service of processing. In that way, processing companies are just following the instructions to process, thus having no control over finished goods.

Value added / Gross Margin:

One of the most encouraging features that motivates companies to choose OT is that with the control over the whole value chain, companies can earn the most from the business through adding value during the process of changing raw material into components, then parts, and then finished goods. Manova and Yu (2011) summarize that under OT and PI, processing companies add value through purchasing inputs, designing, manufacturing, and selling, whereas under PA, processing companies only add value through processing service.

Although companies cannot always gain the same gross margin even if they add the same value to the products, generally speaking, a higher added value will lead to a higher gross margin. This will end up in a result that the gross margin will be higher in PI companies than in PA companies in most of the cases. But at the same time, PA companies have less risk since PI companies are hedging against price fluctuation. Also, unlike OT companies who have total control, in PT, distances, human and culture issues all will increase the cost of the management of international networks. Table 4 summarizes the different trade regimes' features based on literature that is focused on international economics and trade.

Table 4. Summary of trade regimes' features based on economics focused literature

Features	OT	PT	PI	PA
Tariff exemptions	0	+ +	+ +	+ +
Control over materials	+ +	+	+ +	0
Value added / Gross margin	+ +	+	+ +	+

Note: + represents the level of how significant the feature is reflected under each trade regime. + + means significant; + means not as significant when compared to a significant regime; 0 means not significant at all; N/A means not applicable to be measured. OT is compared with PT, and PI is compared with PA.

Source: Author's summary

2.3 Trade Regimes' Features Based on Supply Chain Management Focused Literature

Not only from a foreign buyers' point of view is the exporters' selection complicated, the final selection decision will also impact the exporters' operation decisions. To study exporters' trade regimes' features under supply chain management view, trade regime's agility will be analyzed firstly. A good definition of supply chain agility is provided by Martin Christopher (2000): "Agility is a business-wide capability that embraces organizational structures, information systems, logistics processes, and, in particular, mindsets. A key characteristic of an agile organization is flexibility." Supply chain agility is an organizations' ability to use supply chain flexibility to deal with supply chain uncertainty. Thus, the discussion of supply chain management is broken down into supply chain flexibility (Section 2.3.1) and supply chain uncertainty (Section 2.3.2).

Building upon other literature on flexibility (Upton, 1994; Gupta & Somers, 1996; Lau 1996; Vokurka & O'Leary-Kelly, 2000; Duclos et al., 2003; Fisher, 2003; Gunasekaran et

al., 2004) and other literature on uncertainty (Buzacott, 1969; Svensson, 2002; Schmitz, 2004; Kleindorfer & Saad, 2005; Stecke & Kumar, 2009), supply chain agility is summarized in Figure 5. In what follows we provide the detailed discussion.

2.3.1 Supply Chain Flexibility

Despite the obvious benefits of companies having the abilities to thrive in the continuously changing and unpredictable global business environment, challenges created opportunities and flexibilities for companies to improve the complex operations and management. Dreyer et al. (2004) has tested empirically that flexibility is one of the most valuable skills when facing uncertainty in today's global competing environment where a supply chain goes beyond the firm's border and the nations' border.

Companies under different trade regimes will have different levels of flexibility. The level of flexibility is crucial to companies especially under trade policy shocks. The level of flexibility will determine how substitutable the companies are, thus determine how sensitive the companies will be when facing trade policy shocks. Aside from the literature that focuses on the economic aspects, literature that focuses on the supply chain aspects also implies that the trade regimes have impacts on companies' competitiveness.

In this section, we firstly will discuss the flexibility of different trade regimes based on literature that is focused on supply chain management. Three key types of flexibilities between OT and PT, also between PI and PA will be compared, which are upstream-focused supply flexibility, focal-company-focused operation flexibility and downstream-focused market flexibility.

Supply Flexibility:

Dickson (1996) surveyed 170 supply agents and supply managers' cases to summarize 23 criteria when buyers select exporters. Weber et al. (1991) summarise 74 papers from the supplier selection literature and conclude that there are a lot of criteria that impact suppliers' competitiveness, including cost, delivery lead time, quality and ability. Especially the importance of Just in Time (JIT) has a higher level of requirements for transport distance and delivery JIT. Those criteria make evaluating suppliers' competitiveness a complex problem. Low supply cost might result in low quality or longer lead time. High quality requirements might result in longer lead time or high cost. The key to deal with those kind of conflicts is to find the right balance and the right target, which is supply flexibility. Supply flexibility is the ability of providing the right product at the right time, at the right place, at the right price (Treacy & Wiersema, 1993).

Because PT is more vertically specialized than OT, PT is more fragmented within GVCs compared to OT, and within PT, PA more fragmented than PI. Because of the vertical specialization, companies under PT have more restrictions on the selection of suppliers compared to OT. If the criteria of supplier are not satisfying, the companies under OT can more easily switch with less cost compared to companies under PI, because OT companies have a more variable range of selection of suppliers. This leads to the conclusion that because of less restrictions, companies under OT have a higher level of supply flexibility than PT, and PI higher than PA.

Unlike companies under other trade regimes, under PA, companies only take responsibilities on one step within the GVCs: processing or assembling. PA companies do not need to deal with the supplier of raw materials separately, because the buyers of finished products are also the suppliers of raw material inputs for PA companies. There is no flexibility for PA companies concerning supply flexibility, because PA companies do not have the right to make decisions on raw materials and have to accept what is offered by the final products buyers.

To summarize, companies under OT have a higher level of supply flexibility than companies under PT; and within PT, companies under PI have some supply flexibility while PA has none.

Operation Flexibility:

Operation flexibility is seen as the ability to modify, configure, and customize operational management to adapt to the continuous changing requirements and challenges from business environment (Upton, 1994).

Firstly, as for the control of the operation processes, OT companies own the operations throughout the whole chain, thus having more control and flexibilities to change their ways and schedules of operation management; whereas PA only process and assemble components based on requirements since they only provide the process and assembly services. Since OT companies manage the whole value chain and are able to add value through different stages of the supply chain, it is possible for OT companies to change their emphasis of its operational activities to adjust to supply chain uncertainties. If there are uncertainties that block one part of revenue gathering, OT companies can break its chain and find substitutes for stages of the value chains. On the other hand, since PA companies only involve in assembling part of the value chain, they can only add value and gain profits from the practice of assembling. Compared to companies under OT, companies under PA have little flexibilities to modify the operational management within the GVCs.

Secondly, as for the control over raw materials, OT and PI companies take total possession and make decision on sourcing, selecting their suppliers and purchasing raw material; whereas PA would receive raw material from its customer without having the control over the decision on raw material. With less responsibilities and less control, companies under PA have less flexibilities on operations management.

To summarize, because of less restrictions on operational management, companies under OT have a higher level of operation flexibility compared to PI and PA. The same rule applies to PI and PA. Unlike companies under PI, there are more restrictions on raw materials and operational management for companies under PA. Companies under PI have a higher level of operation flexibility over companies under PA.

Market Flexibility:

Market flexibility determines a company's possibility to mass customize and build close relationships with customers (Duclos et al., 2003). That is to say, market flexibility is the ability to adapt to a changing market environment, including the market demand, uncertainty and needs. To get the market share, companies need to have the abilities to satisfy demand and needs of customization and configuration of products, through successful product introduction and customer negotiation.

Since OT companies are doing basic unilateral trade business, the companies under OT are open to a larger market than PT which is only focused on processing. Companies under OT are less specialized compared to companies under PI who are categorized as processing companies. Also, companies under PI are less specialized than companies under PA who are more specifically categorized as pure assembling companies. Companies under PA just receive exact demand from customers and provide assembling services as required by buyers.

To summarize, companies under OT have higher market flexibility than PT, and within PT, PI higher than PA.

After analyzing supply chain flexibility from upstream supply flexibility, to focal-company's operational flexibility and to downstream market flexibility, we conclude in Table 5 that companies under different trade regimes have different levels of flexibilities.

Table 5. Summary of trade regimes' features based on supply chain management focused literature

Feature	OT	PT	PI	PA
Supply flexibility	+ +	+	+	0
Operation flexibility	+ +	+	+ +	+
Market flexibility	+ +	+	+ +	+

Note: + represents the level of how significant the feature is reflected under each trade regime. + + means significant; + means not as significant when compared to a significant regime; 0 means not significant at all; N/A means not applicable to be measured. OT is compared with PT, and PI is compared with PA.

Source: Author's summary

Because companies under OT have higher levels of operational, market and supply flexibility than PT, companies under OT will be less substitutable than companies under PT. Thus, companies under OT are less sensitive to trade policy shocks than companies under PT.

In Figure 5, supply chain flexibilities that were discussed above are summarized to be part of supply chain agility. Meantime, different regimes will face different levels of uncertainty, as summarized in Figure 5 as well and as further discussed in the next subsection.

2.3.2 Supply Chain Uncertainty

Supply chain uncertainties are dynamic: they can result from problems of supply and demand; or from disruptions. Disruptions include three sources: uncertainties arising from natural hazards, terrorism, and political instability. For all three trade regimes when facing

uncertainties, companies all need to assess uncertainties, design and set up strategies to mitigate uncertainties, and maintain uncertainty management systems. There are several principles to follow when mitigating risks, such as senior management commitment and oversight, unite internally and externally, earn alignment and collaboration with supply chain partners and so on (Kleindorfer & Saad, 2005).

The uncertainty type that our research focuses on is trade policy shocks. It is one kind of supply chain risks that comes from political uncertainty. As Klendorfer and Saad (2005) indicated, there are several principles to follow when mitigating risks (management commitment and oversight, unite internally and externally, earn alignment and collaboration with supply chain partners, etc.). Mitigating trade policy shocks by taking advantage of value chain flexibility is a strategy that covers most of the principles. Impacting firms' inbound and outbound logistics, trade policy shocks are influential for import parties and export parties, which make it prone to both suppliers based and customers based uncertainties because of different levels of the outbound and inbound trade policy shocks.

Unlike most of the unintentional acts that cause uncertainties, like blackout or natural disasters, trade policy shock is one of the intentional acts such as union strikes, lifestyle changes, government spending shifts and so on. Trade policy shocks always come along with government regulations. Regulations regularly interrupt normal operations in the supply chain, which is similar to natural catastrophes.

Stecke and Kuar (2009) showed their insights that disruptions happening nowadays are connected to the activities in the past and future. Resilient supply chains can be created by managing the vulnerability – causing factors. Mitigation strategies can be proactive (choose safe location, robust suppliers, etc.), advance warning (increase coordination, transportation visibility, trends monitoring, etc.), coping (carry extra inventory, purchase insurance, etc.), or cost/saving trade-offs (better inventory management, etc.).

Contingency plans should be made considering power, conflict, risk uncertainty, reliability, and availability. Once a company has to deal with trade policy shocks, for example a sudden rise in the tariff for exporters, avoiding loss in production would be one of the key aims. Several solutions could be feasible. Companies can accept to pay the tariff by increasing the cost, or companies can alter their strategy by going to another production site that is not under that specific tariff.

The literature on supply chain uncertainties, vulnerability or supply chain risks is tremendous. However, most of them have put much emphasis on the uncertainty causing factors like the imbalance of supply and demand, but not on the uncertainty that trade policy can bring. Most of the literature considers flexibility as a reactive means to cope with uncertainties. The mitigation strategies suggested by the literature are mostly focused on process improvement, safety stock, etc. And when explaining supply chain flexibility measures, the easiness of shifting choice between different production sites is underestimated. There are no customized mitigation strategies to help companies deal with trade policy shocks. Plus, there is limited analysis examining the impact of trade policy shocks on GVCs in the view of supply chain management.
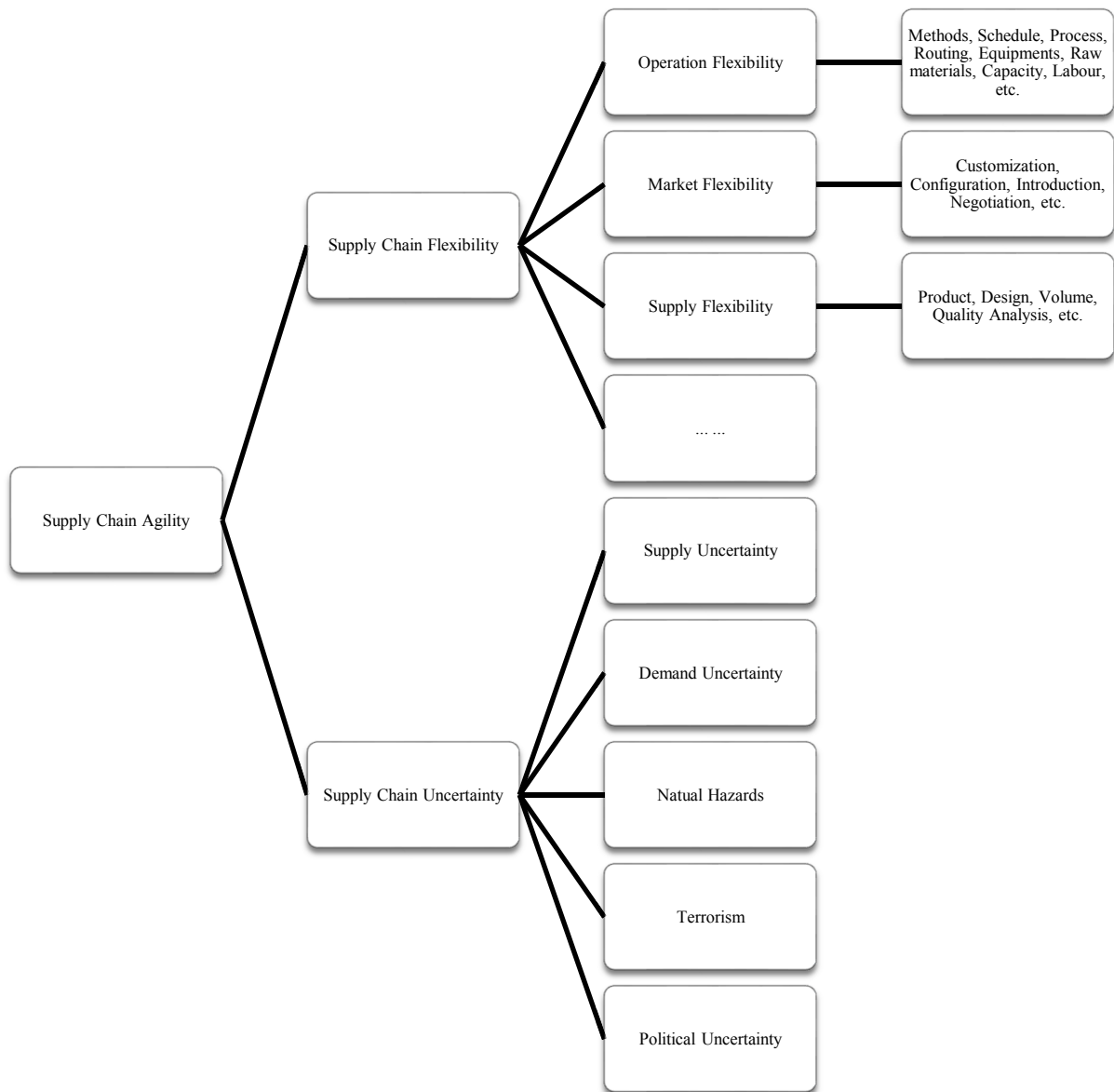
Source: Author's summary

Figure 5. Structure of Supply Chain Agility

2.4 Trade Policy's Impact on Global Value Chain

Markets are never perfect. Deregulation and liberalization do not necessarily mean a well-functioning market economy. Yi (2003) has shown that tariff reductions and vertical specialization explain more than 50 percent of the growth of trade, while, on the other hand, an increase in the tariff would bring huge impact to trade as well. Thus, international trade policy is always critical for world economy.

Markets will face challenges from uncertainty in the quality of goods and services. Khanna (2005) proved that market institutions including credibility enhancers, information analyzers, aggregators, transaction facilitators, regulators as well as public institutions can help to reduce the transaction cost. Those market institutions mostly have to have foundations of specialized knowledge and skills. They are not only economic institutions, but also political institutions. So, with the help of trade policy imposed by governmental or global institutions, transaction costs rising from information asymmetry and incentive conflicts between different business parties can be alleviated.

Public policy influences business parties, and business performance as well influences policy makers. Morash and Lynch (2002) have proved that governmental policy outcomes represent resources to MNEs. So, supply chain capabilities are not only a resource to MNEs, but also an output of governmental public policy. Supply chain capabilities and resources are fundamental for the supply chain strategy and competitive advantage. As markets become increasingly global, the whole market will develop towards integration. Marketing and supply chain will integrate as a link or align. Business partners, public policy actors, marketers and logisticians will build relationships along as the resources and capital improve. Public policy and governmental planning enable supply chain capabilities and performance. Trade policies, deregulation, or the provision of transportation infrastructure will strongly affect capabilities, thus affect supply chain performance.

Take anti-dumping tariffs as an example of trade policy shocks.

Companies who compete in the market imperfectly will sell their products to domestic markets and foreign markets using different prices, which is called "Price Discrimination", while the most seen form is dumping. "Dumping" action was firstly defined by Jacob Viner in 1923 (Viner, 1923) as "price discrimination between national markets". Based on Viner's discussions on classification of dumping, Plant (1931) has clarified dumping based on the duration of the dumping and the motive of the dumper. There is Sporadic Dumping because of dumpers' disposing of a casual overstock or unintentional behaviors; there is Short-run (Intermittent) Dumping because of dumpers' intention to maintain market or forestall completion or retaliate against dumping in the reverse direction; and there is Long-run (Continuous) Dumping because of dumpers' intention to secure economies from larger scale production than the domestic market or purely mercantilistic grounds or counter a protective duty in the export market.

WTO (World Trade Organization, n.d.) has also clarified three main forms of measures to prevent dumping: "(1) actions taken against dumping (selling at an unfairly low price) intended to equal the amount of the price discrimination between the domestic and foreign market; (2) subsidies and special 'countervailing' duties to offset the subsidies although it may not involve 'dumping' as defined; (3) emergency measures to limit imports temporarily to offset any reduction in price, designed to 'safeguard' domestic industries, where intent is proved on the part of the exporter to destroy or injure a domestic industry." WTO defines Countervailing duties (CVDs) (also known as anti-subsidy duties) to be trade import duties imposed to neutralize the negative effects of government subsidies (World Trade Organization, n.d.). They are imposed after an investigation finds that an exporting country subsidizes its exports, injuring importing producers in the importing country.

Empirical analysis was conducted by Ma and Van Assche (2014), which has successfully tested that a tariff increase can induce companies to offshore their processing

in order to shirk tariffs. Assembly is foot loose thus more sensitive to anti-dumping duties than ordinary exports.

Prusa (1996) has proved that: firstly, anti-dumping investigation will have significant impacts on trade. Even if the final decision is to reject the anti-dumping request, investigation itself instead of the final decision would cause a decrease in the import from the exporting country who receives the anti-dumping request. Secondly, anti-dumping will have impact on the limitation of trade volume. Especially for high tax anti-dumping cases, there are obvious impacts observed that anti-dumping would apply constraints on trade volume of anti-dumping initiating countries' import from anti-dumping receiving countries. Lastly, anti-dumping will encourage the transfer of trade. Even successful anti-dumping actions will cause importers to stop or decrease the importing from exporters who receive anti-dumping investigation, importers will finalize import from other countries through other trade regimes.

Based on the data analyzed by Prusa (2001), the impact of anti-dumping tariffs on trade is huge. The study gets the conclusion that import quantities will fall by 30-50 percent due to anti-dumping tariffs. And the trend of anti-dumping policy is that anti-dumping tariff disputes will continue rising and will be a key in future business. The benefit of anti-dumping tariff is attractive. That's why the United States and the European Union on one hand call for free markets, and on the other hand, shut down developing countries' markets with a trade policy while those markets are just about to efficiently operate. Developing countries as well, cannot resist the benefits that come along with anti-dumping policy. However, there are two main costs of anti-dumping protection. First is that once adopted, the impacts of anti-dumping tariff will often last for years. It takes time for exporters to be restrained and importers thus gain time advantage. Second is that anti-dumping duties are almost always remarkably large, which will have a dramatic impact on trade.

Blonigen and Prusa (2001) think that in the past 25 years, countries increased the frequency to apply anti-dumping in order to provide protection for importing countries. Trade policy shocks like anti-dumping would start its impacts on trade since the request was demanded, and the impacts will last from investigation, adjudication, and effective period. Those impacts include the spontaneous effects of trade, like trade transfers and FDI which will increase countries' trans-boundary participation in GVCs.

Companies are seeking ways to avoid trade policy shocks like tax. Countries that have higher tax advantages and lower factor advantages will probably turn into tax havens. Dharmapala et al. (2006) define tax havens as a state, country or territory where certain taxes are levied at a low rate or not at all. Head (2007) distinguishes a branch from subsidiaries by mentioning that a branch is not apart from the parent company; however, a subsidiary is separated from legal entities. He thinks that tax havens offer themselves as places with much lower tax on income compared to foreign investors' home country. Tax havens have higher secrecy levels in order to keep confidentiality. There are illegal ways of tax evasion but also legal ways of tax avoidance. The legal ways of tax avoidance can be payment delay and foreign tariffs averaging.

It is always hard to balance the importing countries' domestic market interest with the cost that importing countries save from foreign markets' lower cost factors. Trade policy, on the one hand, can be seen as a protection, on the other hand, can be seen as a barrier. The existing literature focuses on the impact that trade policy has on trade or on supply chain performance, but, somehow fails to explain in another aspect that trade policy shocks can be a push to firms to take advantage of supply chain flexibility in order to circumvent trade policy shocks.

2.5 Literature Conclusion

In a global competitive environment, companies are no longer in the competition of firm-to-firm, but rather supply chain-to-supply chain (Ma and Van Assche, 2014). The supply chain is sliced up and is made up of links in the chain which is vertically specialized. This motivates and enables companies to perform in different trade regimes (OT and PT; while within PT, PI and PA) to better utilize their comparative advantages. But if one link becomes inefficient or constrained, the supply chain as a whole has to come up with an alternative to stop it from functioning slowly or being delayed, which makes flexibility a key component for better developing supply chains and undoubtedly better organizational performance. By taking advantage of the supply chain flexibility, the supply chain vulnerability arising from trade policy shocks can be circumvented. Different aspects of flexibility levels and uncertainty levels have been discussed separately for three trade regimes, combining the literature that are focused on economics and on supply chain management.

There is a tremendous literature on trade policy shocks and supply chain risk management separately. However, most of trade literature does not distinguish companies in trade, but considers them identical. That is why it is so important to combine literature that is focused on trade and supply chain to separate the features of companies. Few articles that are focusing on trade policy shocks have illustrated the transmission of trade policy shocks through GVCs. And few articles that are focusing on slicing up GVCs have empirically studied trade policy shocks as an uncertainty to GVCs. Also, few articles that are focusing on the study of GVCs have considered using supply chain management literature to support the empirical results. This thesis will enrich the existing literature by emphasizing the combination of the literature that is focused on GVCs, trade policy shocks and supply chain agility.

3.   Hypotheses

Our goal is to examine the companies' reaction to trade policy shocks under different trade regimes' by conducting empirical analyses and by combining the literature that is focused on economics and supply chain management. By exploring the literature and studying the features of different trade regimes within GVCs, evidences are found from literature that companies under OT have a higher level of supply chain flexibilities than companies under PT. Also within PT, companies under PI have a higher level of supply chain flexibilities than companies under PA. Because of higher levels of supply chain flexibilities, companies under OT are less substitutable than companies under PT. Also within PT, companies under PI are less substitutable than companies under PA.

Built upon the conclusions of literature review, the following hypotheses are developed.

Hypothesis 1. Processing trade exports are more sensitive to a bilateral trade policy shock than ordinary trade exports.

Hypothesis 2. Pure assembling exports are more sensitive to a bilateral trade policy shock than processing exports with inputs.

4. Data

We exploit and match data from the World Bank's Global Antidumping Database (GAD) (Bown, 2009) and firm-level (2000-2006) and provincial-level (1997-2009) data which we aggregate to country level from China Customs Statistics. Our empirical analysis critically relies on combining matched data from GAD and China Customs Statistics.

The following parts will illustrate our data in more detail. This section is structured as follows:

In section 4.1 Descriptive Statistics, the database is introduced with the general information of the statistics. Then a correlation matrix is drawn in section 4.2 to have a general idea of the correlation between anti-dumping and export value. Section 4.3 provides the list of countries that applied anti-dumping to have an idea of China's closest related countries concerning anti-dumping policy. Section 4.4 shows the trend of numbers of countries that initiate anti-dumping. While Section 4.5 shows the trend of numbers of industries that receive anti-dumping. Finally analyzing industries, section 4.6 discusses if there are anti-dumping specially preferred or un-preferred industries.

4.1 Descriptive Statistics

GAD data is reported by case antidumping policy. Once antidumping occurs, it will be recorded with detailed date and specific applying country on certain trade products in the 6-digit Harmonized System to a certain destination country. For the purpose of comparison with China Customs data, GAD data between the time frame between 1997 and 2009 is collected.

China customs data reports companies' exports and imports in U.S. dollars by product and trade partner from 243 destination countries and different product classifications in the

6-digit Harmonized System (HS-6). China's 8-digit HS classification is comparable to that the U.S' 10-digit HS classification, and the 6-digit HS classification is chosen as the most disaggregated level compared to GAD. We aggregate firm-level and province-level China Customs data to country level, for the purpose of matching country level GAD data. As already explained in Section 1, due to China's duty exemption policy on PT (including PI and PA), China customs trade data distinguishes trade regimes, showing if the cross-border transactions in each and every companies are conducted under OT, PT with PI or PA. Table 6 displays three lines of data for a short preview of our database. Our data includes individual export transactions of the HS-6 product and record if anti-dumping (AD) was applied to China or not on that specific HS-6 product that was exported in that year. For example, first line in Table 6 indicates that in year 2009, China has exported a total value of 362,817 USD of HS-6 product coding 731816[3] (Iron or steel; threaded nuts) to country 502 (United States) under trade regime of PA. And in year 2009, China has not received anti-dumping for Iron or steel or threaded nuts from the United States.

Table 6. Examples of Aggregated Matched Data with GAD and China Customs

Country	Year	HS-6	Regime	AD	Exports
502	2009	731816	PA	0	362,817
502	2009	731816	PI	0	6,506,066
502	2009	732020	OT	1	7,507,043

Source: Author's calculations using data from the Global anti-dumping Database and data from China's Customs Statistics.

Table 7 summarizes the number and percentage of different trade regimes in our data sample. Out of 646,999 lines of exporting transactions that are recorded, OT takes a higher proportion than PT, and within PT, PI higher than PA.

[3] HS-6, HS-4 and HS-2 systems codes can be sourced from http://www.foreign-trade.com/reference/hscode.htm

Table 7. Summary statistics of transactions, by trade regime and by percentage, 1997-2009

	number	percentage
OT	457,913	70.8%
PT	189,086	29.2%
Total	646,999	100.0%

	number	percentage
PI	139,380	73.7%
PA	49,706	26.3%
Total	189,086	100.0%

Source: Author's calculations using data from the China's Customs Statistics.

From Table 7, we could see the total proportion of OT and PT, PI and PA from the year of 1997 to the year of 2009. But what about the development of each trade regime? In Figure 6, we firstly draw the yearly trend of the export value of total export from 1997 to 2009. From the figure, it can be seen that except for the year of 2009, when export value of China has a trend down compared to prior years, China's export value has been increasing since 1997. From the year of 1997 to 2008, the value of exports has increased surprisingly by multiple times. The great increase in trade makes it interesting to study the facts behind this phenomenon and makes China a fast-increasing economy that worth studying.

Export Value (billion $)
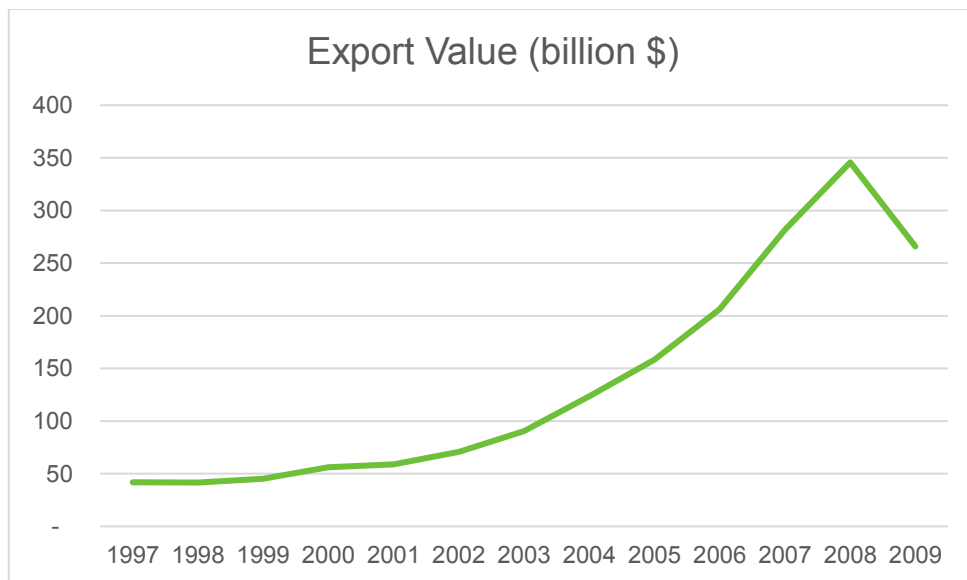
Source: Author's calculations using data from China's Customs Statistics.

Figure 6. Total Export Value, by billion dollars, by year, 1997-2009

With the possibility of separating the trade data into regimes, Figure 7 and Figure 8 were drawn to show the yearly trend of OT versus PT, and PI versus PA. From the trend of OT, PT, PA, PI separately, it can be seen that the trend of each trade regime follows the trend of total export value. Export value kept following an increasing trend in general until 2008 and felled in 2009. The influence of different trade regime to total export will be determined by the weight that is shown in Table 7. The trend of the export value shows in general how China's trade regime developed during 1997 to 2009. But from Figure 6, Figure 7 and Figure 8, we could also see that the weight that is shown in Table 7 is not always fixed. The growth of PT is not as fast as OT, and the growth of PA is not as fast as PI. Due to different growth rate of different trade regime, we could conclude that except for the year of 2009, the percentage of trade of OT and PI keeps increasing while PT and PA keeps decreasing.

Export Values (billion $) by OT vs. PT
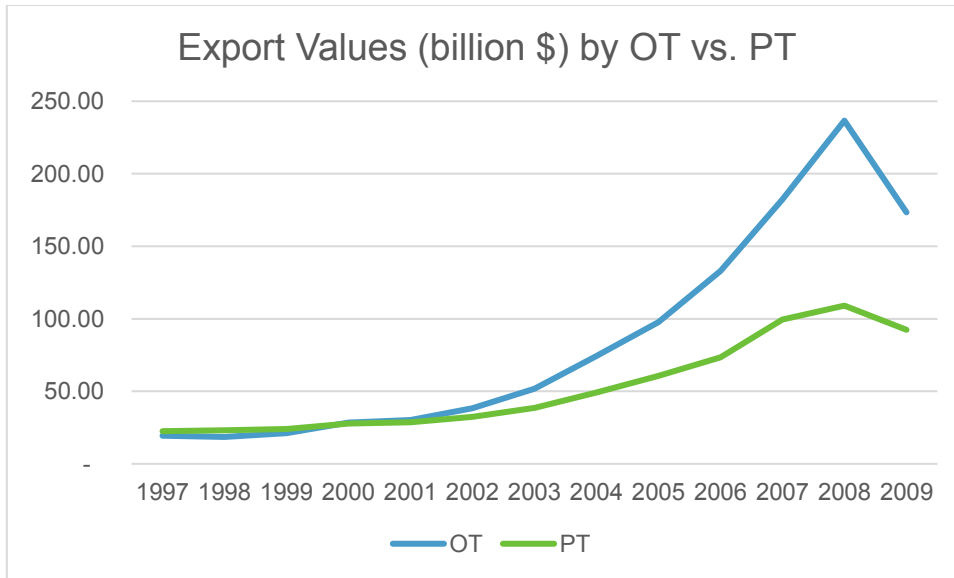
Source: Author's calculations using data from China's Customs Statistics.

Figure 7. Export Value, by billion dollars, by year and by trade regime (OT vs. PT), 1997-2009

Export Value (billion $) by PI vs. PA
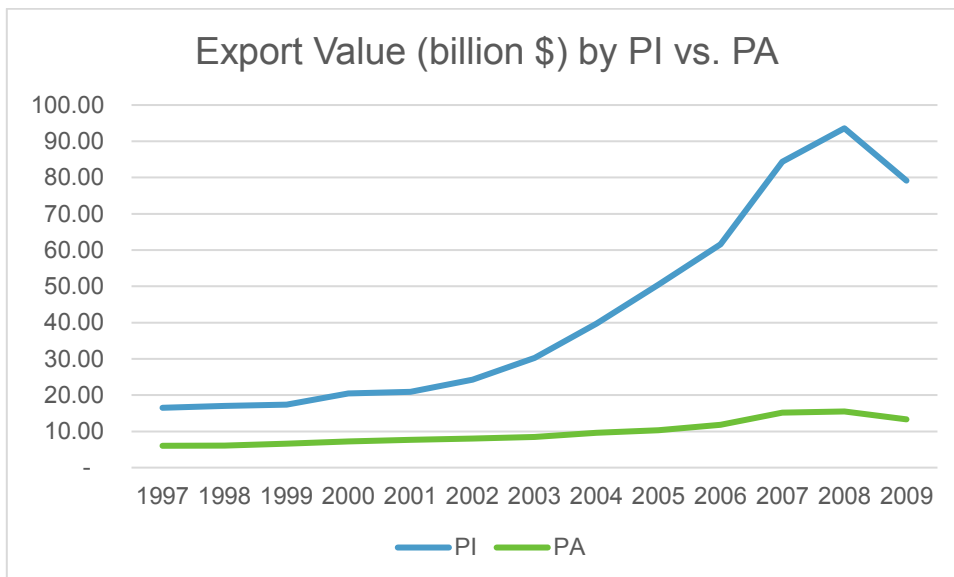
Source: Author's calculations using data from China's Customs Statistics.

Figure 8. Export Value, by billion dollars, by year and by trade regime (PI vs. PA), 1997-2009

Table 8 summarizes the descriptive statistics of our data. According to the table, the mean of AD is only 0.01 which means that in 1% of the cases, an anti-dumping policy was applied. AD is a dummy variable where 1 means that a country applies antidumping in the year for a certain industry on China, and where 0 means otherwise. Year summary shows that the year range for our data covers from 1997 to 2009. The average value of export is 2.8 million with the highest value to be 8.8 billion.

Table 8. Summary statistics of the database, including Year, Anti-Dumping, Export Values, by mean, standard deviation, median, minimum and maximum, 1997-2009

Descriptive Statistics Summary

Variable	Mean	SD	Median	Min	Max
Year	2004			1997	2009
AD	0.01	0	0	0	1
Export	2,800,000	31,000,000	85,071	1	8,800,000,000

Source: Author's calculations using data from the Global anti-dumping Database and data from China's Customs Statistics.

4.2 Correlation Matrix

According to the correlation matrix (illustrated in Table 9), the correlation coefficients between AD and export is 0.06, which means that from the full sample perspective, there is a positive relationship between AD and the export values. The relationship and the significant levels will change if we consider the different trade regimes, which will be further discussed in the following empirical result.

Table 9. Correlation Matrix of Anti-Dumping and Export Values

Correlation Matrix		
	AD	export
AD	1	
Export	0.06	1

Source: Author's calculations using data from the Global anti-dumping Database and data from China's Customs Statistics.

4.3 Summary of Countries That Applied Anti-Dumping

According to the data in Table 8, only 1% of all trade transactions ran into the situation of having anti-dumping. So, Table 10 summarizes all the countries that have applied anti-dumping on any products for China from year 1997 to 2009. The average of anti-dumping cases per country during those 12 years is 26, and the United States represent 1,762 cases amongst all, which represent 31% of all anti-dumping cases that China received from 1997 to 2009.

Table 10. Summary statistics of anti-dumping cases imposed against China at the level of HS-6, by country and by percentage, 1997-2009

Country	Cases	% of all cases
United States	1762	31%
India	757	13%
EU	697	12%
Canada	565	10%
Argentina	426	8%
Colombia	264	5%
Korea, Rep.	204	4%
Peru	168	3%
South Africa	165	3%
Mexico	143	3%
Brazil	119	2%
Australia	112	2%
Taiwan	106	2%
Trinidad & Tobago	46	1%
Israel	28	0.5%
Turkey	24	0.4%
Pakistan	23	0.4%
Venezuela	17	0.3%
Malaysia	16	0.3%
Philippines	12	0.2%
New Zealand	10	0.2%
Indonesia	9	0.2%

Source: Author's calculations using data from the Global anti-dumping Database

4.4 Trend of Numbers of Countries

Figure 9 is drawn to examine the yearly trend of the number of countries that applied anti-dumping. If one country applied multiple times anti-dumping on multiple products within one year, that country will still be counted as one, which means that there is one country that applied anti-dumping on China in that year, regardless of how many times that country applied anti-dumping. As displayed in the , there is a positive trend of the number

of countries who applied anti-dumping to China from year 1997 to year 2009. We run a regression based on the curve. The regression between year and number of countries applying anti-dumping to China is as follows:

$$Number\ of\ countries\ applying\ AD = 1.1758 * Year + 5.9231$$

(Year 0 = 1997)

(R-Square = 0.88076)
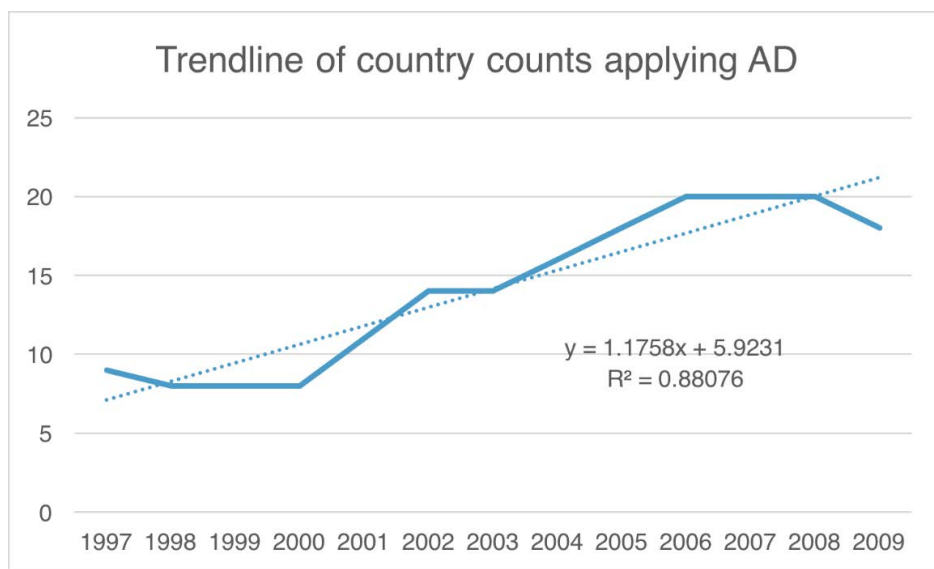
Source: Author's calculations using data from the Global anti-dumping Database

Figure 9. Trend of the number of countries that applied anti-dumping cases to China by Year, 1997-2009
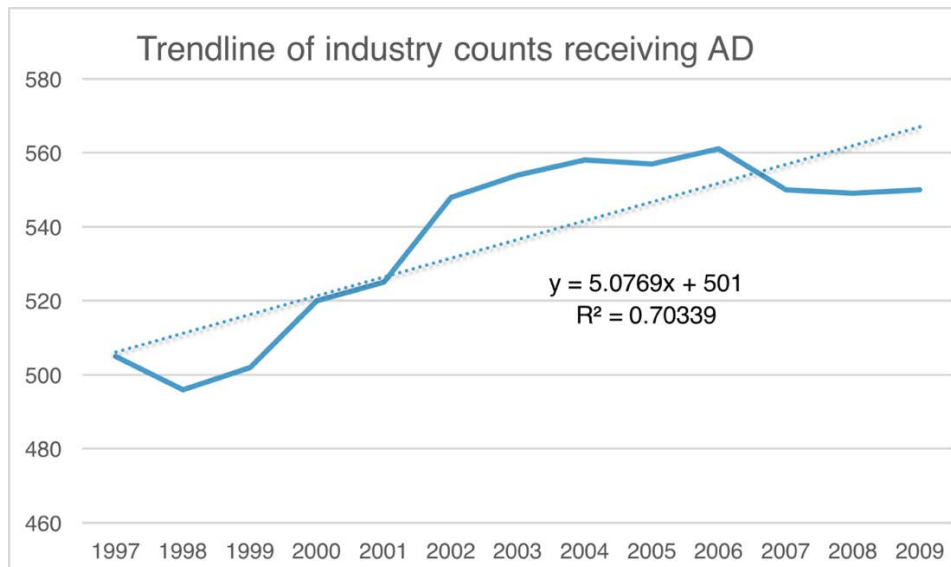
4.5 Trend of Numbers of Industries

Figure 10 is drawn to examine the yearly trend of industry's count that received anti-dumping. If one HS-6 received multiple times anti-dumping from multiple countries within one year, that HS-6 will still be counted as one, which means that there is one industry that received anti-dumping on China in that year, regardless of how many times that industry

received anti-dumping. As displayed in Figure 10, there is a positive trend in the number of industries who received anti-dumping from year 1997 to year 2009. We run a regression based on the curve. The regression between year and number of countries applying anti-dumping to China is as follows:

$$Number\ of\ indystries\ receiving\ AD = 5.0769 * Year + 501$$

(Year 0 = 1997)

(R-Square = 0.70339)

Source: Author's calculations using data from the Global anti-dumping Database

Figure 10. Trend of the number of industries that received anti-dumping cases in China by Year, 1997-2009

The reason for the increasing trend of number of countries and number of industries throughout from 1997 to 2009 can be manifold: constantly developing international trade environment, the increase of global economic, gradually completion of anti-dumping policy, countries' consciousness of using anti-dumping to protect local industry. Also from the country-specific perspective we note that China's development of trade including the

volume and the involvement from multiple perspectives will naturally lead to more exposure of policy shocks.

4.6 AD Preferred & Un-Preferred Industries

Two tables (Table 11 & Table 12) are given to analyze if anti-dumping policy is specially preferred to be applied on certain industries. They display the five categories at the product level of HS-6 that China received most (Table 11) and least (Table 12) AD on from 1997 to 2009 in total. According to the two tables, it seems that there are some specific industries that will especially attract anti-dumping, and there are some specific industries that can almost be guaranteed to be free from anti-dumping policies.

Table 11. Summary statistics of anti-dumping cases received by China, by HS-6 (top 5), 1997-2009

HS-6	Total	Description
640391	56	Footwear with outer soles of rubber, plastics or composition leather, with uppers of leather, covering the ankle
731210	50	Stranded wire, ropes and cables, of iron or steel
401120	49	New pneumatic tyres, of rubber, of a kind used for buses and lorries
870899	49	Other parts & accessories for the motor vehicles
940320	48	Metal furniture

Source: Author's calculations using data from the Global anti-dumping Database

Table 12. Summary statistics of anti-dumping cases received by China, by HS-6 (last 5), 1997-2009

HS-6	Total	Description
722790	1	Bars and rods of alloy steel other than stainless, hot-rolled, in irregularly wound coils "ECSC"
902830	1	Electricity supply or production meters, incl. calibrating meters
521132	1	Woven fabrics of cotton, containing predominantly, but < 85% cotton by weight, mixed principally or solely with man-made fibres and weighing > 200 g/m², in three-thread or four-thread twill, incl. cross twill, dyed
821192	1	Knives with fixed blades of base metal
630190	1	Blankets and travelling rugs of textile materials

Source: Author's calculations using data from the Global anti-dumping Database

Table 13 shows the number of anti-dumping cases initiated worldwide at a higher level of the HS code system (HS-2). HS-2 allows us to analyze an industry from a more aggregated perspective. It is clear that worldwide speaking, there are some industries (e.g. Base Metals) attracting more AD than other industries (e.g. Pearls). That is because of articles' features and natures.

Table 13. Summary statistics of the total number of anti-dumping cases initiated Worldwide, by HS-2 and by percentage, 1995-2014

HS-2 section name	Total	% of Total
I Live animals and products	58	1%
II Vegetable products	60	1%
III Animal and vegetable fats, oils and waxes	15	0.32%
IV Prepared foodstuff; beverages, spirits, vinegar; tobacco	65	1%
V Mineral products	76	2%
VI Products of the chemical and allied industries	961	20%
VII Resins, plastics and articles; rubber and articles	635	13%
VIII Hides, skins and articles; saddlery and travel goods	5	0.11%
IX Wood, cork and articles; basketware	98	2%
X Paper, paperboard and articles	229	5%
XI Textiles and articles	346	7%
XII Footwear, headgear; feathers, artif. flowers, fans	32	1%
XIII Articles of stone, plaster; ceramic prod.; glass	194	4%
XIV Pearls, precious stones and metals; coin	1	0.02%
XV Base metals and articles	1379	29%
XVI Machinery and electrical equipment	408	9%
XVII Vehicles, aircraft and vessels	51	1%
XVIII Instruments, clocks, recorders and reproducers	51	1%
XX Miscellaneous manufactured articles	92	2%
Total	**4756**	**100%**

Source: Author's calculations using data from the WTO Anti-Dumping Statistics 2016. Initiation date: 1995 January 1st to 2014 December 31st. Note: All initiations notified here are at HS-2 level.

5.   Empirical Analysis

In this section, a simple regression model is built and empirically results will test our hypothesis. The structure is as follows. In Section 5.1 the simple regression model is built between anti-dumping and the share of export value. Followed by Section 5.2 and Section 5.3, in which two kinds of shares are regressed separately to study the relative sensitivity of PT and OT, also the relative sensitivity of PI and PA, which test hypothesis 1 and hypothesis 2 accordingly.

5.1 Regression Model

In this session, analyses are conducted to compare the relative sensitivity of different trade regimes under trade policy shocks. To examine the impact of anti-dumping on trade under OT and PT, also under PI and PA, a regression is run by using pooled OLS to estimate the result.

We use share value in order to test the sensitivity that was introduced in the Hypothesis 1 (Processing trade exports are more sensitive to a bilateral trade policy shock than ordinary trade exports) and the Hypothesis 2 (Pure assembling exports are more sensitive to a bilateral trade policy shock than processing exports with inputs). Two shares will be discussed separately: one is the share of Processing Trade over total trade [PT/(PT+OT)] and the other is the share of Pure Assembly over Processing Trade [PA/(PA+PI)]. The increase or decrease trend in the shared value will allow the comparison between different values. If the share of [PT/(PT+OT)] have a negative trend when under trade policy shocks, it means that compared to OT, PT is more sensitive. Also, if the share of [PA/(PA+PI)] have a negative trend when under trade policy shocks, it means that compared to PI, PA is more sensitive.

Under the purpose to compare the sensitivity of companies under different trade regimes when facing trade policy shocks, the following model was constructed.

$$export\ share_{tic} = a + b * AD_{tic} + c_t + d_i + e_c + \varepsilon_{tic}$$

Where export share represents the share of export values for industry i (represented in the form of HS-6) in the year t for a specific country c. Unlike absolute value, which enables us to study the relationship between AD and companies export values under one certain trade regime, the shared of export values under different trade regimes enables us to compare the sensitivity between the trade regimes. In this model, AD is a dummy variable where 1 means that country c applies anti-dumping in year t for industry i on China, and where 0 means otherwise. To examine the impact of trade policy shocks on companies, dummy variables for year, industry and country are considered in the model. c_t is the dummy variable of year. d_i is the dummy variable of different industries. e_c is the dummy variable of different countries. ε_{tic} is the error term for year, industry, and country.

Pooled OLS is also conducted to estimate the equation by controlling the year, country and industry's effects. The White robust estimator is used in the regression for the purpose of making the result robust to heteroskedasticity mis-specification. The standard error reported in the result of regression table is the heteroskedasticity-robust standard error.

In the following sessions, two shares will be discussed separately: one is the share of Processing Trade over total trade [PT/(PT+OT)] and the other is the share of Pure Assembly over Processing Trade [PA/(PA+PI)].

5.2 Test of Hypothesis 1

Hypothesis 1. Processing trade exports are more sensitive to a bilateral trade policy shock than ordinary trade exports.

Table 14 shows the regression result of anti-dumping's impact on export value share of PT over PT+OT. AD has a negative effect on export value share of PT over PT+OT. The coefficient is -0.0059 and the test result is significant at the 10% level. The interpretation of our result is that after receiving anti-dumping from another country, the share of PT over total trade decreases. That is to say, companies under PT have a lower level of flexibility, and are more easily substitutable, thus more sensitive to trade policy shocks, compared to companies under OT.

Combining the literature that is focused on economics and supply chain management, the result can be explained by the following. Despite the fact that under OT, Chinese operating companies have to pay the import duties for their input materials without exemptions. While under PT (both PA and PI), operating companies will pay for Chinese domestic inputs and labour costs, while the import duty is waived, which means that companies under OT have much higher operation and production costs than under PT, OT companies have the control over the whole value chain and add value during the process of changing raw material into components, then parts, and then finished goods. While PT companies add value and earn profit by processing imported materials; companies under OT conduct ordinary unilateral imports or exports activities.

Concerning the supply flexibility, OT companies have the full possession of sourcing raw materials from abroad, and then exporting final products to abroad which gives OT a higher level of supply flexibility. Concerning the operational flexibility, OT companies can re-schedule and re-arrange their operation management. OT companies have more ability to adjust its operation under trade policy shocks. Concerning the market flexibility, OT

companies have to deal with not only the supplier of raw materials, but also the final products' customers, which creates more link in the GVCs than PT companies. If one link was blocked by trade policy shocks, OT companies have more alternatives and strategic goals than PT companies.

Thus, as a result, PT companies are less flexible, more easily to be substituted by other companies or other countries' similar companies, and more sensitive to trade policy shocks than OT companies.

Table 14. Empirical results of anti-dumping to share of PT over Total Export

Dependent variable: PT/(PT+OT)	
AD	-0.005871 *
Year FE	Yes
Industry FE	Yes
Country FE	Yes
Observations	646,999
R-Squared	0.2647
Root MSE	0.22746
Robust Std. Err	0.0032645
t	1.80
P>t	0.072

Note: AD = anti-dumping; FE = fixed effects; OT = ordinary trade regime; PT = processing trade regime. Coefficient is reported with robust standard errors. The individual coefficient is statistically significant at the *10%, **5% or ***1% level.

Source: Author's calculations using data from the Global anti-dumping Database and data from China's Customs Statistics.

5.3 Test of Hypothesis 2

Hypothesis 2. Pure assembling exports are more sensitive to a bilateral trade policy shock than processing exports with inputs.

Table 15 shows the regression result of anti-dumping's impact on export value share of PA over PI+PA. AD has a negative effect on export value share of PA over PI+PA. The coefficient is -0.0293 and the test result is significant at the 5% level. The interpretation of our result is that after receiving anti-dumping from another country, the share of PA over total PT decreases. Companies under PA have a lower level of flexibility, and are more easily substitutable, thus more sensitive to trade policy shocks, compared to companies under PI.

Combining the literature that is focused on economics and supply chain management, the result can be explained by the following. The fact that PI companies pay for imported components with foreign currency and own the ownership over finished goods, while under PA, processing companies just import components without paying. Under PA, Chinese operating companies don't have control on the supply side, including the sources, costs, quality, etc. of the materials. PA is a kind of basic service trade, under which operating companies can only gain the margin of assembling. Most of the added value that comes from transferring raw materials into final products are generated by other companies through purchasing inputs, designing, manufacturing, and selling; while PA are not actually paid for the goods but more for the service of processing like an entrust relationship without actual purchasing or selling actions involved. This will end up in a result that the responsibilities will be higher in PI companies than in PA companies in most of the cases. In this case PA companies are more easily replaced by other companies or other countries' similar companies when there are trade policy shocks.

Concerning the supply flexibility, PT companies have total control over materials and equipment. They can make decisions to choose materials and have more supply flexibility. While PA companies do not have any supply flexibility since they receive raw material from its customer and assemble as per their customers' requests. Concerning the operation flexibility, under PA, if trade policy shocks block companies from providing assembling services, or increase companies operating costs, PA companies will be affected directly. There is less flexibility for companies under PA to improve the operations in order to circumvent the trade policy shocks. Concerning for the market flexibility, when facing trade policy shocks, there are possibilities that buyers will go searching other countries for similar PA companies where operating costs are lower without trade policy shocks.

Thus, as a result, PA companies are less flexible, more easily to be substituted by other companies or other countries similar companies, and more sensitive to trade policy shocks than PI companies.

Table 15. Empirical result of anti-dumping to share of PA over PT

Dependent variable: PA/(PI+PA)	
AD	-0.029283 **
Year FE	Yes
Industry FE	Yes
Country FE	Yes
Observations	49,706
R-Squared	0.1046
Root MSE	0.3668
Robust Std. Err	0.0119709
t	-2.45
P>t	0.014

Note: AD = anti-dumping; FE = fixed effects; OT = ordinary trade regime; PT = processing trade regime. Coefficient is reported with robust standard errors. The individual coefficient is statistically significant at the *10%, **5% or ***1% level.

Source: Author's calculations using data from the Global anti-dumping Database and data from China's Customs Statistics.

6.   Conclusion & Directions for further Research

In this section, we firstly conclude our research, and then point out the limitations and possible analyses for future research.

6.1 Conclusion

Global value chains (GVCs) have been a key component of the world economy. The organization of international production has changed fundamentally in the past few decades. Companies decide to fragment their production processes internationally because of the improvements in information and communications technology, the reductions in transportation cost, trade liberalization, investment liberalization, and economic liberalization. As with vertical specialization of production networks, trans-boundaries business keeps adding value through stages of production, process and assembly throughout the entire value chain. Value chain networks integrate products, information, and financial flows with high efficiency.

While opportunities come with risks, companies are running into barriers of management and economic issues. Risks are increasing due to the slicing up of GVCs, and risks coming from the trade policy shocks affect the companies in GVCs. So, the global phenomenon of value chains raises political questions: What is the transmission of trade policy shocks through GVCs? Will export producers in GVCs be impacted by trade policy shocks? Will export producers in different trade regimes be impacted differently? Under which trade regimes will export producers be more sensitive to trade policy shocks?

To answer above questions, we have combined theoretical elements from both the trade and supply chain management literature. The reason is that in most of the trade theories, firms are generally assumed to have identical supply chain structures, which is unrealistic. At the same time, supply chain management studies have largely neglected the

impact of trade policy on supply chain structures. Our theoretical framework has allowed us to predict the differential impacts of trade policy shocks on companies under different trade regimes. More specifically, processing trade exports are more sensitive to a bilateral trade policy shock than ordinary trade exports; also, pure assembling exports are more sensitive to a bilateral trade policy shock than processing exports with inputs.

Using theories of trade alone cannot distinguish and test the impacts of the companies under different trade regimes. At the same time, literature of supply chain rarely discusses the impacts of trade policy shocks on GVCs. Thus, by combining trade and supply chain, it allows us to differentiate the impacts of trade policy shocks on different firms. According to the literature foundation, different companies within GVCs will be effected differently, because companies in different trade regimes have different levels of flexibility. Higher levels of flexibility will allow companies to be less substitutable and less sensitive when facing trade policy shocks.

Evidence was found from China's processing trade regime, given anti-dumping as one of the trade policy shocks that affect companies. With exploitation of matched data from the World Bank's Global Antidumping Database (GAD) and firm-level (2000-2006) and provincial-level (1997-2009) data which are aggregated to country level from People's Republic of China Customs Statistics. Pooled OLS is conducted to examine the impact of trade policy shocks on companies' export value, based on different trade regimes (Ordinary Trade vs. Processing Trade; within Processing Trade, Pure Assembly vs. Processing with Imported Inputs), by controlling the year, country and industry effects.

Our results confirmed our hypotheses. Under the circumstances that there is trade policy applied, trade policy shocks have differential effects on each trade regime individually and the empirical analyses are conducted to compare OT with PT, and PI with PA. It is evident from the empirical results that when facing trade policy shocks, companies under PT are more sensitive than companies under OT as indicated by the significant

decrease of the share of PT export value over (PT + OT) total export value; and within PT, companies under PA are more sensitive than companies under PI as indicated by the significant decrease of the share of PA export value over (PI + PA) total export value.

Thus, the conclusion is drawn that trade policy shocks have impacts on GVCs and the impacts vary across trade regimes. Compared to companies under PT, companies under OT have a higher level of flexibility, and lower chance to be substituted, and are thus less sensitive to trade policy shocks. Also, compared to companies under PA, companies under PI have a higher level of flexibility, and lower chance to be substituted, and are thus less sensitive to trade policy shocks.

There are two main contributions of this thesis. First is that our study provides a bridge between trade policy and GVCs. While risks and flexibility are staple features of recent trade models, and despite intense theoretical interests in GVCs risks, there is little empirical work on how trade policy shocks as a risk matters for GVCs. The significant results of our regression model have proved empirically that trade policy shocks have differential effects on exports, depending on trade regimes (OT vs. PT and PI vs. PA). We reinforce quantitative evidences and extend the literature on the transmission of trade policy shocks through GVCs. Second is that there is little literature examining the transmission of trade policy through GVCs. Trade policy in economics literature is often seen as a protection or barrier in order to examine its transmission through international trade, but is less seen as a motivation of companies to take advantage of supply chain flexibility. Our thesis is among the first to study the transmission of trade policy shocks through GVCs, combining the literature that is focused on economics and supply chain management.

6.2 Limitations and Directions for Future Research

Despite of the contributions, there are limitations and possible directions for future research as well. Due to the limitation of our data, for a specific country who applies AD on China for a specific HS-6 product, we only have one line of data for a specific year instead of several lines of data for a period of years, so it doesn't allow us to examine the effects of year on AD's impacts on trade by applying time-series regression. And because most of the trade policy has a certain effective period (for example, the usual effective period for anti-dumping is approximately five years for most of the cases), it is very valuable for future studies to examine if the AD's impact on trade under different trade regimes or for total trade will change throughout the effective period.

We know that under the shock of trade policy, countries will re-evaluate their trade modes, and choose the most profitable way to practice trade. There is currently now little literature or data analysis proving what is the most advantageous distribution of trade modes within one country. It would be very beneficial for trade policy makers and for companies to study how to reform their way of doing business under trade policy shocks.

Also, our result has shown that there are specific industries that will especially attract anti-dumping policy, but there are no specific industries that can be guaranteed to be free from anti-dumping policy. With a larger data base, it is possible to examine countries' preferences of anti-dumping in certain industries, and it will be interesting to study the relationship between anti-dumping preferences and the countries' trade performances of certain industries in which the countries have competitive advantages.

By considering the time impact in the analysis, it is necessary to consider the important events that form the time frame in one country's trade history. For example, China has been a member of WTO since 11 December 2001 after 15 years of negation. Joining WTO will bring both opportunities and challenges to China in all industries for all trade modes. The

way that China used to make policies and react to policies would have to be adjusted after joining WTO. Those kinds of important events will definitely have an impact on both the trade policy makers and the time frame chosen to examine results.

Besides those huge events, and due to data limitation, there are other factors that are omitted in this analysis, including the characteristics of the exporters, the regions where they are from in China, the relationship between the importers and China, and also the change of China's trade policies and exchange rate, etc. All those variables will add great value to the future studies.

7.   Reference

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