Master Thesis International Economics
Erasmus School of Economics
Erasmus University Rotterdam

Anti-dumping duty circumvention through trade rerouting: the case of China and the European Union

ABSTRACT:

This paper studies anti-dumping duty circumvention by Chinese exporters through trade rerouting via third countries or regions. Using yearly trade data for the period 2002-2014, I provide evidence that anti-duty circumventing does indeed take place. I use a multiple fixed effects model, controlling for country*product, product*time and country*time fixed effects at the same time. I find a positive relationship between European imports from third countries and lagged Chinese exports to the same third countries for products subject to anti-dumping duties. This effect is present only for trade quantity data, not for trade value data. In addition, trade rerouting is negatively related to distance from China to the third country or region. The results are robust to excluding Special Administrative Regions of China and Taiwan from the data. Exporters regularly use these regions in anti-dumping evasion practises. Finally, the results are also robust when country-product combinations that are never traded (zeroes) are excluded.

Author: J.A. Nouwen BSc LL.B.
Student number: 384039jn
Thesis supervisor: dr. A. Erbahar
Second assessor: prof. dr. J.M.A. Viaene
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1. Introduction

The use of anti-dumping measures has increased strongly over the last decades (Baran, 2015). Both U.S. President Donald Trump and the European Union have recently accused China of dumping goods on their markets (Wei, 2018; Pooler and Brunsden, 2018). Figure 1 shows all EU anti-dumping investigations over the period 2002-2014, and the countries at which they were aimed. China is by far the most investigated country (80 investigations). Other countries, like Russia (13 investigations), India (12), Taiwan (11) and the United States (10) follow at a large distance.

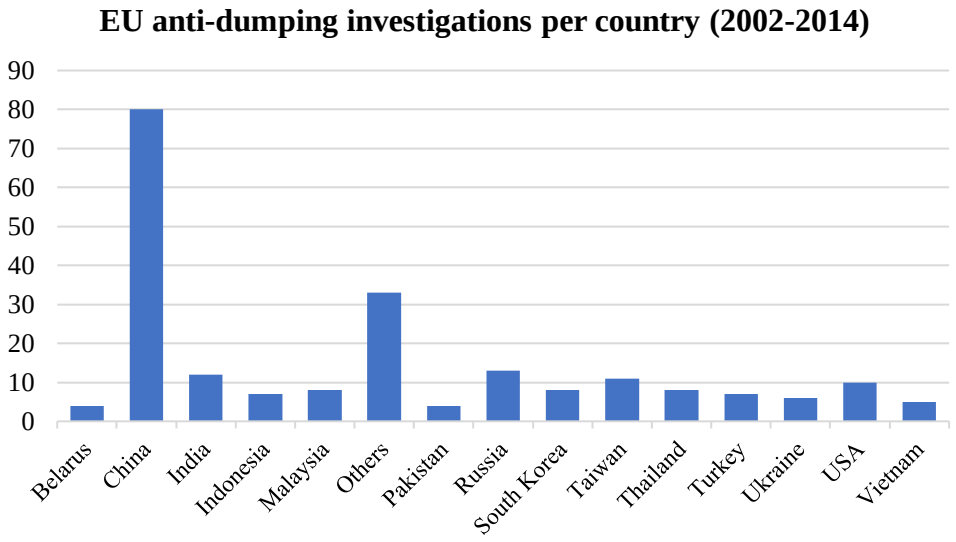

Figure 1: Number of anti-dumping investigations by the EU per country between 2002-2014
Notes: (1) based on the Global Anti-dumping Database.

In response to the anti-dumping tariffs that the United States, Europe and many other countries impose, China seeks ways to avoid those duties. One way is by rerouting goods through third countries (Shih, 2018). Instead of directly exporting goods, Chinese companies start exporting through third countries. These companies then ship the goods via the third countries to the destination. Preliminary evidence for this anti-dumping circumvention practice is found in Liu and Shi (2016).

There is quite some literature on anti-dumping circumvention, especially in the context of the European Union, suggesting that anti-dumping circumvention takes place on a regular basis. However, to the best of my knowledge, Liu and Shi (2016) are the only authors so far to provide econometric evidence for anti-dumping circumvention through trade rerouting. They use monthly trade data from 2002 to 2006 and study all anti-dumping cases filed by the U.S. to China during that period. They find a significantly positive and robust relationship

confirming the trade rerouting story. Anti-dumping duties imposed by the U.S. are associated with more exports from China to third countries and more U.S. imports from these countries for goods that are subject to anti-dumping duties (Liu and Shi, 2016).

The aim of this paper is to find additional evidence for the trade rerouting story. More specifically, I use the framework of Liu and Shi studying anti-dumping duties imposed by the EU rather than by the United States. Following Liu and Shi, I study only products exported from China. Therefore, the research question of this paper is:

> *"Are anti-dumping measures that the European Union imposed on China between 2002 and 2014 associated with trade rerouting of the same products via third countries?"*

For a couple of reasons, I chose to study the period 2002 to 2014. Firstly, China entered the WTO in 2001. Starting one year afterwards I take out most trade shocks related to this entry. Also, studying the years until 2014 makes the results more recent and thus economically relevant. Finally, a lack of monthly data requires studying more years than Liu and Shi did with their monthly data. A large amount of observations is required to get significant results and to derive policy implications from the results.

Moreover, China is chosen as exporter for several reasons. As already mentioned above, China is investigated more often than any other country for dumping goods. This is confirmed by the many papers. For example, Nita and Zanardi (2013) found that China is more often involved in anti-circumventing practices than any other country in the world. In addition, they found that countries most likely to be involved in this practice as third countries, are situated in Southeast Asia. Besides, this topic is interesting as Liu and Shi (2016) found evidence that Chinese exporters circumvent anti-dumping duties. This paper focuses on the EU as importer for a reason. Since Liu and Shi (2016) found evidence for the circumvention of anti-dumping investigations that the United States imposed, the aim of this paper is to find similar evidence for a different region. Also, the EU is one of the largest trading partners in the world, which makes this topic even more relevant.

The main results of this paper are the following. Trade rerouting via third countries does indeed take place between China and the European Union. There is a positive relationship between Chinese exports to third countries and European imports from the same third countries. This effect is only visible for products in the control group (i.e. products that are subject to anti-dumping duties) after the anti-dumping period has started. For the control group

(i.e. products in the same product group as the treatment group, but not subject to anti-dumping duties), this effect is not present. In addition, this relationship is only present in the trade quantity data, not in the trade value data expressed in dollars. The coefficient is significantly positive confirming the trade rerouting story. One-year lags are used on the right-hand side of the equation (i.e. for the Chinese exports) in all regressions to avoid the problem of reverse causality. Also, multiple fixed effects are used (i.e. country*product, product*time and country*time fixed effects) in all specifications to filter out the potential omitted variables bias. In addition, I find that the relationship between third countries' exports to Europe and imports from China is stronger for third countries nearer to China. This can be explained by the lower transportation costs of trade rerouting. Moreover, the results are robust to the exclusion of Hong Kong, Macao and Taiwan from the dataset. Taiwan and these two Special Administrative Regions of China are located closely to China and are good candidates as third countries in circumvention practices. Excluding these countries does not change the coefficient of the variable of interest. This means the results are not just driven by these three regions. Thus, circumventing does also take place via other third countries. Finally, I perform a robustness check by excluding zeroes in country*HS6 observations. Dropping these observations which are always zero, and could therefore bias the results, does not change the outcome of the results.

The structure of the paper is as follows. In the next section, the most important literature on the anti-dumping and circumvention is reviewed. Then, I describe the Data used in this paper. Next, the methodology is discussed. Then, the results and robustness checks are discussed and, finally, I will provide a conclusion and discussion.

2. Literature Review

In this section, the most important literature on anti-dumping is reviewed. The main findings from the literature in this section of the paper will ultimately lead to a preliminary conclusion. I will then test this conclusion in the remaining sections of this paper.

2.1 Trade effects of anti-dumping measures

There is a large amount of papers on anti-dumping measures and the different channels through which they affect international trade. These trade effects are mostly negative (Zanardi, 2006). Consider a tariff that Argentina imposed on product X imported from Brazil. A first and most obvious trade effect arising is a decline in Brazilian exports of product X to Argentina. This is called the *trade destruction effect* or trade dampening effect and has been empirically tested in

the past. Early empirical evidence for this trade effect is found in Staiger and Wolak (1994). They studied the impact of U.S. anti-dumping measures on domestic production and imports. They found that anti-dumping duties have a significant negative impact on imports and a significant positive impact on domestic production. Their findings thus confirm the trade destruction effect. Another confirmation of this effect is found in Prusa (2001) who studied U.S. anti-dumping measures against Japan.

A second effect of anti-dumping is the *trade diversion effect*. Argentina will start to import more units of product X for example from Chile or Colombia. After all, Brazilian product X becomes more expensive and in the case of unchanged demands, Argentinian consumers will start searching for alternative import sources of product X. Early empirical support for the trade diversion effect is found in Krupp and Pollard (1996) who studied the U.S. chemical sector. They built an econometric model to study import dynamics under the pressure of anti-dumping duties. Using monthly data at product level, they found that during 1976 and 1988 imports from other countries rose for most products subject to anti-dumping duties. Additional evidence for this effect is found in Koenings, Vandenbussche and Springael (2001) and in Romalis (2007).

In addition, the *trade deflection effect* describes an increase in exports from Brazil to another third country, i.e. Chile, Colombia or Cuba. Since Brazil's decline in exports of product X to Argentina, the Brazilians will start searching for alternative destinations for their products. Evidence for this trade deflection effect is found in Bown and Cowley (2006) who studied exports of Japan to the United States. After the U.S. imposed the anti-dumping duties, exports from Japan to third countries increased by 5 to 7%. This was the average increase of exports to third country markets, consisting of the 37 largest exporting markets for Japan such as the EU, Korea, Taiwan and China.

Finally, the *trade depression effect* describes a decrease in imports of the targeted country. Brazil will import less units of product X from for example Chile or Colombia after Argentina imposed the anti-dumping duties. Because of the anti-dumping measures, there might be a decrease in net total exports from Brazil to third countries. As Brazil now exports less units, there is thus less demand for product X that was first imported and then re-exported (to Argentina, Colombia and Chile). As a result, Brazilian imports from other third countries, for example Cuba or China, will also decline. Evidence for the trade depression effect is found in the study of Japanese exports to the U.S. (Bown and Crowley, 2007). In addition to the trade deflection effect described above, they found that Japanese exporters exported 5 to 19% less to other third countries also targeted by U.S. anti-dumping authorities.

2.2 Trade rerouting

In the section above, the four trade effects of anti-dumping measures have been described. This research focuses on an additional effect, the *trade rerouting effect*, combining the first three effects. Now let's consider the case that will be investigated in this paper. The EU imposes anti-dumping duties on Chinese products. Firstly, exports from China to the EU are expected to decline: trade destruction. Secondly, according to the trade diversion effect, a rise in EU imports from third countries is to be expected. Thirdly, following the trade deflection effect, a rise in exports from China to third countries is can be expected. The fourth effect, trade depression, goes beyond the scope of this paper, as it aims to combine only the second and the third effect. Only a potential increase in European imports from and Chinese exports to third countries is investigated. It is interesting to see if these third countries will in some cases be the same countries. Going back to the example of South American countries, the following question arises: Is there an increase in exports of product X from Brazil to Colombia and is there an increase in imports from Colombia to Argentina? This would be trade rerouting.

It is important to notice that trade rerouting is not the same as exporting product X from Brazil to Colombia and then to Argentina. If product X gets shipped from Brazil to Argentina via Colombia, the certificate of origin (C/O) is still from Brazil. It will thus still be regarded as Brazilian and therefore, the exporters pay anti-dumping duties imposed by Argentina. Trade rerouting goes further as it involves changing the C/O to circumvent these duties. The Brazilian product will receive a Colombian C/O before transport to Argentina. Obviously, this is illegal as it is meant to evade the tariff. In contrast, re-exporting and transhipment, which are not meant to evade anti-dumping tariffs, are legal. The fact that trade rerouting involves changing the C/O and the fact that it is illegal, does not deter companies from doing so. Liu and Shi (2016) show examples of Chinese companies that explicitly mention that they are willing to circumvent U.S. anti-dumping measures. These companies help with exporting products that are subject to anti-dumping measures, to a third country, for example South Korea. In addition, these companies finish custom clearance for those products, send them to warehouses where they get re-loaded to a container booked with South Korea. Then, these Chinese companies help to find a local factory where the C/O documents are changed from China to South Korea. And then, these Chinese companies help to export the product from South Korea to their final destinations. As these Chinese companies assist with obtaining all the required documents, customs in the countries of the final destinations (such as the U.S. or countries within the EU)

usually are not aware of the anti-dumping circumventing practices. Enforcement is thus difficult (Liu and Shi, 2016).

Even though econometric evidence on anti-dumping circumvention is limited to the paper of Liu and Shi, there are other papers on tariff evasion and trade rerouting. Mishra, Subramanian and Topalova (2008) built a model for firm's incentives to evade tariffs as this maximizes profits. They found that evasion practices are more likely when the quality of enforcement is lower. In addition, Rotunno, Vézina and Wang (2013) found evidence that Chinese firms used Africa as an export platform to comply with quota rules. The United States imposed quotas on Chinese clothes through the Multi Fiber Agreement in the early 2000s. On the other hand, more than 4000 different types of clothes could be exported from Africa to the United States without duties and quotas because of the AGOA – the African Growth and Opportunity Act – in the same period. Rotunno et al. (2013) find evidence that this momentary increase in African exports was, among others, driven by ethnic-Chinese firms using Africa to sell their clothes. It should be noticed, however, that the quota hopping practice is not illegal, whereas anti-dumping circumventing through trade rerouting is.

2.3 Previous evidence on anti-dumping circumvention

To the best of my knowledge, Liu and Shi (2016) are the first and only authors to provide evidence of anti-dumping circumvention using econometric methods. They studied the evasion of anti-dumping duties that the United States imposed on Chinese exports during the period 2002-2006. They find a strong positive correlation between U.S. imports from third countries and Chinese exports to the same third countries following U.S. anti-dumping actions against China. In their econometric approach, they distinguish between products subject to anti-dumping measures – treatment group – and products which are similar (i.e. products with the same HS 4-digit code) but not subject to anti-dumping measures – the control group. This approach of selecting the control group was used previously by Lu, Tao and Zhang (2013). The correlation they find between U.S. imports and Chinese exports is stronger for the treatment group than for the control group, confirming the trade rerouting hypothesis.

Moreover, Liu and Shi find that the trade rerouting effect is even stronger with certain product or third-country characteristics. Firstly, they find that geographic distance to the targeting and the targeted country is relevant. The correlation between third countries' exports to the United States and imports from China is stronger for third countries that are closer to China and the United States. Secondly, Liu and Shi find a positive association between the size

of Chinese population in third countries and trade rerouting. In these specifications, ethnic Chinese populations serve as a proxy for Chinese business and social networks as the presence of Chinese people can facilitate collusion between Chinese exporters and intermediaries in third countries. Additionally, Liu and Shi analyse different product characteristics associated with trade rerouting. More specifically, they distinguish between differentiated and non-differentiated products. They find stronger evidence for trade rerouting for non-differentiated products and they explain this by the fact that it is safer and easier to change the C/O documents of these products illegally.

A major shortcoming of the paper by Liu and Shi is that they fail to control for the endogeneities of anti-dumping. Firstly, their paper is likely to suffer from reverse causality. This is a serious issue as it is hard to test and control for reverse causality (Bosker, 2018). In their specification, they regress U.S. imports lnY_t on Chinese exports lnX_t, with controls for GDP, time fixed effects and country*product (i.e., country*HS6) fixed effects. This approach does not rule out that while Chinese exports to a third country affect U.S. imports from this third country, this effect could work the other way as well. U.S. imports from a third country could affect Chinese exports to this country. For example, if U.S. demands for Brazilian product X rises because of some endogenous U.S. factors, this puts pressure on the market for product X in Brazil. To meet this demand, U.S. imports of product X from other countries such as China rises. A second shortcoming of the paper of Liu and Shi (2016) is omitted variables bias. In their approach, they only use time (year*month) and country*product fixed effects. Even though they use a control group which consists of products similar to the products in the treatment group (i.e. the same HS 4-digit code), there could still be other variables that are driving the results. They do not control for product*time and country*time fixed effects, thus leaving the possibility that the results are driven by specific heterogeneities. Potential sources of this bias are supply and demand shocks, which could be controlled for when using product*time fixed effects. Also, the country*time fixed effects could control for specific heterogeneities such as national business cycles (Gnutzmann-Mkrtchyan and Henn, 2018). Even though they use a treatment and control group, a specification with more fixed effects is preferred.

Some papers have addressed the issue of endogeneity in the context of anti-dumping. Viegelahn and Vandenbussche (2014) point out that anti-dumping protection is unlikely to be a random policy. Firms decide whether to fill in a petition and thereby self-select themselves into anti-dumping protection. Besides, the government decides on whether to grant protection to this firm based on its own findings. The decision by the government to start a procedure at

the WTO or not is therefore most likely not-random. In addition, there could be reverse causality as anti-dumping could result in falling exports, but this effect works the other way around as well (Baran, 2015).

Baier and Bergstrand (2007) discuss endogeneity issues in the context of trade flows, where they focus on the effects of free trade agreements (FTAs). Even though the authors do not directly discuss anti-dumping, their findings might be relevant for the anti-dumping literature. They argue that trade policy is not exogenous as it suffers from endogeneity issues. Firstly, omitted variables such as GDP might affect the relationship between FTAs and trade flows. In addition, they emphasize the potential problem of reverse causality as trade flows are likely to affect the existence of FTAs. According to the authors, previous attempts to deal with these problems with an instrumental variable approach have been unsuccessful. Also, control variables might not give a full solution. Instead, they argue that a panel approach is most successful in accounting for the endogeneity.

2.4 EU anti-circumvention measures

Finally, some important papers on anti-dumping circumventing are written in a legal context. The legal framework of the EU does specifically mention anti-circumvention measures. Article 13(1) of EU Regulation 2016/1036, defines circumvention as a follows: "*A change in the pattern of trade […] which stems from a practice, process or work for which there is insufficient due cause or economic justification other than the imposition of the duty, and where there is evidence of injury […]where there is evidence of dumping in relation to the normal values previously established for the like product […]*" (European Parlement and the Council of the European Union, 2016).

According to literature, Anti-Circumvention (AC) investigations could be related to the following practices: trans-shipment of the goods, slight modification of the products and the creation of assembly operations in a different country (Puccio and Erbahar, 2016; Vermulst, 2016). The first type of AC behaviour is closely related to the trade rerouting story of Liu and Shi (2016) and has been subject to most AC investigations of the EU. Similar evidence on anti-dumping circumventing has been found for the United States (Spicer, Clarke and Horlick, 2016).

2.5 Preliminary conclusion

To conclude, the trade effects of anti-dumping are extensively discussed in the literature. Liu and Shi (2016) are the first authors to provide econometric evidence for trade rerouting as anti-

dumping circumvention measure, but they fail to control for the endogeneities of anti-dumping. In addition, there is evidence on Anti-Circumvention (AC) investigations that trans-shipping of goods happens on a regular basis, especially with Chinese goods exported to countries in the European Union. The preliminary conclusion is therefore that during 2002 until 2014 anti-dumping measures that the EU imposed have indeed led to trade-rerouting to circumvent these duties. This conclusion will be tested in the next sections of this paper.

3. Data

3.1 Anti-dumping data

The anti-dumping data is gathered from the Global Anti-dumping Database (GAD), which is provided by the World Bank (Bown, 2010). The GAD provides 34 different data sheets for different countries from 1980 to 2015. The database provides, among others, information on the targeted country and the targeted product in both HS 8-digit level and SIC 8-digit level. For this analysis, I use the HS 2002 nomenclature. Therefore, I use the HS data column rather than the SIC column. In some cases, the GAD data must be converted from HS 2007 or HS 2012 to HS 2002 using conversions tables which are provided by the UN. The information in the dataset includes initiation date, preliminary decision date, final decision date, revoke date, preliminary rate and final rate. These dates are not available for every case, as in some cases the anti-dumping tariffs have been withdrawn. The EU dataset contains more than 750 cases where the EU imposed anti-dumping tariffs on foreign products. For this paper, only the cases targeted at China between 2002 and 2014 are considered. These amount to 76 cases in total.

3.2 Trade data

The trade data used in this analysis comes from the World Bank's World Integrated Trade Solution (WITS). This source provides both Chinese exports data as well as data on the European imports. Yearly trade data is used and all data is at product level (i.e. HS 6-digit), using the HS 2002 nomenclature. When necessary, HS conversion tables are used (UN Department of Economic and Social Affairs, 2018). One major difference between the data in this paper and the data of Liu and Shi is the usage of yearly data instead of monthly data. The main reason for this difference is that I could not obtain monthly data. The usage of yearly data can make the analysis less accurate. For example, consider two anti-dumping cases, where the final decisions have been made in 2005. In the first case, the decision was made in January

2005, whereas in other cases this was done in December 2005. In the former case, most likely there already was a trade effect of the anti-dumping duties in 2005. In contrast, in the latter case, the trade effect will only have been realized in 2006. However, in both cases the duty will be considered as commencing in 2005 with yearly trade data. For the case where the decision was made in December 2005, this does not make sense as there is no large expected trade effect in 2005. On the other hand, when using monthly data, the post dummy (which I will introduce later) gets value one in January 2005 in the first case, and in December 2005 in the second case. Thus, using monthly data can improve the coefficient estimates.

Another difficulty with the trade data was the selection of third countries and regions into the sample. In principle, every country in the world must be included if it either imports from China or exports to the EU. However, the WITS database includes many former states and many country groups which are not relevant for this paper. Therefore, I set a few criteria for countries to be included in the list of third countries. Firstly, Liu and Shi (2016) excluded China and the United States from their analysis as third countries as they do not trade with themselves. Therefore, I exclude China, the European Union and countries that were part of the European Union for some time during the period 2002-2014. In addition, I did not include regions which are part of the sovereignty of a country within the European Union, such as for example Åland Islands, Aruba and Greenland. Besides, countries of which their sovereignty was part of a dispute during the period 2002-2014 are not included, e.g. the Gaza strip, Kosovo, Occupied Palestinian Territory and Yemen DR. One exception to this criterion is Taiwan, a country that is not recognized by the UN. Taiwan is included nevertheless, as this country might be used often for anti-dumping practices (Doyle, 2018). However, data for Taiwan is not reported as such by the UN. It is presented as 'Other Asia (not elsewhere specified)' instead. This is because for political reasons, the UN is not allowed to report data for Taiwan as such. Moreover, country groups such as World, Belgium-Luxembourg and Free Zone are excluded. Also, former states, such as Soviet Union, are not included as third countries. Finally, countries with less than 100,000 inhabitants are excluded, because of their limited significance for the world economy and because of the large number of observations that this analysis already has. Whereas China, the EU and all EU Member States are excluded, Special Administrative Regions in China are included. These are Hong Kong and Macao. They are included for the same reason as Taiwan: these regions are often used as third regions in anti-dumping circumvention practices (Doyle, 2018). The final sample consists of 158 countries. However, five countries do not appear in the data (zeroes), so that 153 countries are included as third

countries. A full list of all 'third' countries and territories can be found in the Table A.2 in the Appendix.

Another potential issue with the usage of the whole European Union as importer, is the fact that the size of the union has changed during the year 2002-2014. In total, thirteen countries have become EU Member States between 2002 and 2014. Using country*time fixed effects should deal with this problem as it controls all country-time specific heterogeneities. The fixed effects approach will be discussed in more detail in the Methodology section.

Besides, there were many values in the dataset are missing. In most of the observations, the third country did only either import from China (only the X variable available) or only export to the EU (only the Y variable available). This problem is solved by adding zeroes for the missing values. To overcome problems arising from taking the natural logarithm of zero, one dollar is added to the trade values which are expressed in dollars for all observations. The same is done for all observation in quantities, where there are lots of zeroes as well. This leads to the variables lnX_t and lnY_t. The measurement error of this one added dollar is expected to be minimal (Liu and Shi, 2016).

In the final dataset, the Chinese exports data (which will be the independent variable) is merged with the EU imports data (the dependent variable). The dataset is at HS 6-level and consists of more than three million observations.

3.3 Descriptive statistics

Table 3.1 on the next page provides the most important variables. This is a selection of all variables that feature in the database. The table provides the name, a shorts description and the source of the variable. In addition, Table 3.2 on the next page shows the descriptive statistics of some of the variables. It should be noted that the amount of observations is 3,791,067 for all variables. This is the size of the database before certain observations are dropped. In the Methodology section, this is explained in more detail. The variables *ln(distance_tot)* and *ln(distance_CN)* which are included in both tables, will be introduced later.

Table 3.1: Variables list and description		
Variable	**Description**	**Source**
Product_HS6	Product code specified at 6-digits	WITS
PartnerISO3	Standardized country identifier of third country	WITS
Treatment (T)	Dummy variable, which is equal to one if the product is in the treatment group	Own calculations, based on Global Anti-dumping Database
Control	Dummy variable, which is equal to one if the product is in the control group	Own calculations, based on Global Anti-dumping Database
Post (P)	Dummy variable, which is equal to one from the year after which the anti-dumping period has started	Own calculations, based on Global Anti-dumping Database
LnX - Value	Natural logarithm of Chinese exports in U.S. dollars to third country	Own calculations, based on WITS
LnY - Value	Natural logarithm of European imports in U.S. dollars from third country	Own calculations, based on WITS
LnX - Quantity	Natural logarithm of quantity of Chinese exports to third country	Own calculations, based on WITS
LnY - Quantity	Natural logarithm of quantity of European imports from third country	Own calculations, based on WITS
Ln(distance_tot)	Natural logarithm of total distance from third country to China + distance from the third country to Europe	Own calculations, based on CEPII
Ln(distance_CN)	Natural logarithm of distance from third country to China	Own calculations, based on CEPII

Notes: (1) the eleven variables in this table are the most important ones, the full database consists of many more variables.

Table 3.2: Descriptive statistics					
Variable	**Observations**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Product_HS6	3,791,067	-	-	10,110	970,600
Partner_n	3,791,067	-	-	1	153
Year	3,791,067	-	-	2002	2014
LnX - Value	3,791,067	9.135	5.133	0	24.512
LnY - Value	3,791,067	5.612	5.871	0	25.679
LnX - Quantity	3,791,067	7.438	4.995	0	27.585
LnY - Quantity	3,791,067	3.953	4.923	0	26.183
Ln(distance_tot)	3,791,067	9.561	0.383	8.984	10.357
Ln(distance_CN)	3,791,067	8.879	0.669	6.696	9.868

Notes: (1) these statistics are based on the full sample of 3,791,067 observations; (2) as explained in the Methodology section, the sample is reduced to 433,781 before running the regression as only products that are either in the treatment or the control group are included. In addition, all products that are either not exported by China or not imported by the EU are dropped. Finally, the same is done for third countries that do not export from China or import from the EU.

4. Methodology

4.1 Selecting the treatment and control group

In the empirical approach, I mostly follow Liu and Shi (2016). There are some differences, however, which I will highlight in this section. One of the first things that had to be done, was selecting the treatment group and the control group. The treatment group consist of products that are subject to anti-dumping measures. In addition, the control group consists of products which have the same HS 4-digits, but a different HS 6-digits (Lu, Tao and Zhang, 2013). These products belong to the same product category as the products in the treatment group, but they are not subject to anti-dumping measures. During the period 2002-2014, 76 cases from the EU to China were imposed. However, a substantial number of those cases should be removed from the sample for four different reasons (Liu and Shi, 2016). Firstly, I dropped cases if one of the products in that case had been subject to an earlier anti-dumping case which is already part of the sample. Secondly, cases are removed if there was no suitable control group, i.e. products with the same HS 4-code but with a different HS 6-code. Moreover, if there was a negative decision, the case is not included. Finally, I dropped the cases which have been withdrawn or terminated. A list of all cases filed by the EU against China can be found in Table A.1 in the Appendix. This includes the case IDs of these cases, together with the full treatment group, the control group, preliminary anti-dumping date and final anti-dumping date. The final sample consists of 44 anti-dumping cases.

4.2 Regressions

The baseline equation, which is similar to the model used by Liu and Shi (2016), looks as follows:

$$lnY_{cit} = \gamma_1 lnX_{ci(t-1)} + \gamma_2 Post_{t-1} lnX_{ci(t-1)} + \gamma_3 Treatment_i lnX_{ci(t-1)} + \gamma_4 Treatment_i Post_{t-1} + \gamma_5 Treatment_i Post_t lnX_{ci(t-1)} + \mu_{ci} + \mu_{it} + \mu_{ct} + \varepsilon_{cit}$$

where subscript *c* denotes a third country, excluding China or the EU (see the Data section and Table A.2 in the Appendix for all third countries or regions); subscript *i* denotes the product, specified at HS 6-level; and subscript *t* denotes time in years between 2002 and 2014. Moreover, lnY_t is the natural logarithm of EU imports from of product *i* from country *c* in year *t* and lnX_{t-1} is the natural logarithm of Chinese exports of product *i* to country *c* in year *t*-1.

Lags are used on the right-hand side of the equation as there could be lagged trade effects (Baier and Bergstrand, 2007), i.e. lagged effects of the Chinese exports to the European imports. In addition, adding lags could help to overcome problems of reverse causality, which might be present in the paper of Liu and Shi (2016). They regress lnY_t on a non-lagged variable lnX_t. However, most likely Chinese exports do not only affect U.S. (European) imports. U.S. (European) imports from third countries will drive up demand in those countries, which can increase imports from China. Using the lagged lnX_{t-1} for Chinese exports to third countries can deal with this problem. I use only one-year lags, because of the relatively small number of years (12), so that including more than one lag would lead to a relatively large amount of observations that is dropped. Furthermore, *T* ($Treatment_i$) is a dummy variable, which equals one if the product is subject to anti-dumping duties and therefore in the treatment group, and zero otherwise. Next, *P* ($Post_{t-1}$) is a dummy variable which is equal to one for the post anti-dumping period, and zero otherwise. An interaction effect is added between the *T*P* ($Treatment_i*Post_{t-1}$) dummy and the lagged Chinese exports lnX_{t-1}. However, this variable is omitted in all regressions due to collinearity with the fixed effects. Furthermore, $LnX_{t-1}*T*P$ ($Treatment_i*Post_{t-1}*lnX_{t-1}$) is the variable of interest. A positive value for its coefficient means that the trade rerouting story can be confirmed. This equation also incorporates the country*product fixed effects, μ_{ci}, the product-time fixed effects, μ_{it} and the country*time fixed effects, μ_{ct}. These fixed effects estimators are based only on variation within units and they automatically control for all observable and unobservable unit specific characteristics (Allison, 2009). Finally, ε_{cit} is the idiosyncratic error term, which contains non-included variables affecting EU imports from third countries.

The different fixed effects deserve some more explanation. The first type of fixed effects is the country*HS6 (henceforth: country*product) fixed effects. These capture all country-product specific trade determinants that are constant over time, such as distance or expenditure patterns for example (Gnutzmann-Mkrtchyan and Henn, 2018). The second type of fixed effects that is used is the HS6*year (henceforth: product*time) fixed effects. These fixed effects proxy for global product-specific shifts over time, such as changes in global demand, product life-cycles and differential productivity changes across products (Gnutzmann-Mkrtchyan and Henn, 2018). Finally, country*year (henceforth: country*time) fixed effects are used as well. These contain time-varying features of the exporter and importer, such as a trade agreement of the EU with third countries (De Benedictis and Taglioni, 2011). In addition, these country*year fixed effects control for country-time specific heterogeneities

such as national business cycles (Gnutzmann-Mkrtchyan and Henn, 2018). An example is the entry of a third country to the WTO (Tang and Wei, 2009).

Now, I will explain some of the variables in more detail. Firstly, it is important to notice that natural logarithms are used for the Y variable and the lagged X variable. Also, one dollar is added to all X and Y observations to avoid the problem of having to take the natural logarithm of zero. The measurement error is expected to be very small (Liu and Shi, 2016). When generating the post dummies, only the final anti-dumping dates are used. This is as opposed to Liu and Shi (2016) who took both the preliminary anti-dumping date and the final anti-dumping date, and then compared the results. There are two reasons why I consider only the final anti-dumping date. Firstly, for some anti-dumping cases, there is no preliminary anti-dumping date as they are bypassed, see Table A.1 in the Appendix. A second reason is that the database is aggregated at year level as there was no access to monthly data. As a result, it is harder to distinguish between the preliminary anti-dumping date and the final anti-dumping date, as in many cases, the preliminary and the final date where in the same year. The post anti-dumping period starts in the year where the anti-dumping duties was imposed. That is, for any product in the treatment group, where the final anti-dumping date was in year t, the post dummy will have the value one in year t and in all years afterwards. In all years before t, the value of the dummy is zero. Notice that the post dummy can only be equal to one in cases where the treatment dummy also has value one. As opposed to Liu and Shi, I did not include the non-interacted Treatment and Post dummies in the equation. Including these variables will make the regression specification more likely to suffer from collinearity with the three different fixed effects.

Before running the regressions, several steps are taken. Firstly, a Hausmann test is performed. This test checks if a fixed effects model is preferred over a random effects model (Torres-Reyna, 2007). The null-hypothesis is that the random effects model is preferred, the alternative hypothesis is that a fixed effects model is preferred. In addition, some adjustments should be made in the dataset, where I once again follow the approach of Liu and Shi (2016, pp. 13-14). These steps make sure that observations which are not required in the regression will be dropped from the sample. As a result, the sample size decreases tremendously. Firstly, any product which does not appear in either of the treatment group or the control group, is dropped from the dataset. As a result, only the HS 6-lines in the treatment and control group (i.e. only the affect HS 4-groups) are included in the regressions. Moreover, I dropped the products that China had never exported to any of the third countries. Similarly, I exclude any products that the EU had never imported from any of the third countries. There are several

products that China had never exported, so observations related to these products are dropped. After doing so, there are no products left that the EU had never imported.

Finally, Liu and Shi also drop the third countries to which China had never exported any of the products in the treatment or control group. I dropped these observations as well. Furthermore, there are no third countries left which have never exported to the EU so no other observations drop out. Taking these steps reduces the sample size from 3,791,067 to 433,781 observations. Notice that since the regressions are performed with lags on the right-hand side of the equations, all observations from 2002 drop out as X cannot be lagged. Therefore, the amount of observations is lower than 433,781 in all regression specifications.

The estimation method is a difference-in-difference (*diff-in-diff*) strategy, with controls for country*product, product*time and country*time fixed effects. Finally, notice that the dataset is at HS 6-digit product level (i), across third countries (c), over time (t), where only the affected HS 4-groups (i.e. only the products in the treatment group and the control group) are included in the regression equations.

4.3 Potential endogeneity issues

In this section, some potential endogeneity issues are discussed, and the way I dealt with them. Endogeneity problems can be divided into three categories: omitted variables bias, reverse causality and measurement error (Bosker, 2018). These potential issues should be considered carefully when using a difference-in-difference approach (Lechner, 2010). Firstly, omitted variables bias occurs when some variable that is added to the regression, is correlated with both the dependent variable and the independent variables. In this paper, this could be any variable that is correlated with both Chinese exports to a third country and European imports from that third country. One could think of broad economic shocks that differ over time. For example, in periods of economic prosperity, Chinese exports would be higher than in periods of recession. Similarly, European imports from that same third country would thrive and thus be high. The time (i.e. product*time and country*time) fixed effects deal with this potential source of omitted variables bias. In addition, it is likely that some countries import more from China (i.e. Chinese exports to that country are higher) and they also export more to the European Union (i.e. European imports from that country are higher). Countries that are either well developed or situated closer to China and the EU than other countries, can be good examples. Therefore, GDP of and distance to the third country could be a source of omitted variables. By adding the country*product fixed effects in the baseline specification, I most likely dealt with this problem

as this captures the country component which is relevant for differences between countries. These fixed effects thus serve as a control for both unobservable and observed unit-specific heterogeneity in the panel data (Allison, 2009; Wooldrigde, 2002). In addition to the country*product fixed effects, I included both product*time fixed effects and country*time fixed effects, as explained above. The former fixed effects control for global product-specific shifts over time, such as changes in global demand, product life cycles and differential productivity changes across products. The latter fixed effects control for control for country-time specific heterogeneities such as trade agreement and national business cycles (Gnutzmann-Mkrtchyan and Henn, 2018). Because of these multiple fixed effects, I suspect there are hardly any omitted variables that bias the results. That is also the reason why I did not use any control variables in the baseline equation. This is as opposed to Liu and Shi (2016) who did include *log(GDP)* in all their specifications. However, the country*time fixed effects (which Liu and Shi did not include) in my regressions should control for differences in GDP among countries.

Secondly, as briefly mentioned in the Literature Review and in the previous section, reverse causality could be an issue in a regression of the European imports to third countries on the Chinese exports from these third countries. After all, while Chinese exports to a third country lead to higher U.S. imports from this third country, this effect could work the other direction as well. There could be demand driven factors that drive exports from the third country to Europe. These factors could stimulate demand in that third country, driving up exports from China. This potential problem could be solved by using an instrumental variable approach. It is, however, very hard to come up with a suitable instrument, that does not violate the exclusion restriction. As the validity of the exclusion restriction is not statistically testable, using an instrument is a very large risk. It is also pointed out by Baier and Bergstrand (2007) that it is very hard to find an instrument that is exogenous and uncorrelated with trade flows. Therefore, I did not use an instrument this paper. Instead of using an instrument, Baier and Bergstrand suggest taking the first difference (i.e. lags) instead. Therefore, I use lags for the Chinese exports to overcome the reverse causality problem. After all, it is highly unlikely that European imports from a third country affect Chinese exports to that third country in the previous year. On the other hand, the lags are still useful as our lagged variable of interest is still relevant: lagged Chinese exports could very well drive European imports in the year afterwards and thus confirm the trade rerouting story.

A third and final problem of endogeneity is measurement error. When the measurement error is related to the X variable, this leads to attenuation bias or bias towards zero (Wooldridge,

2002). This could be the case when studying Chinese exports for certain countries are reported lower than they are. In addition, my datasets are very large. One potential problem that could arise, is the fact that one dollar is added to every observation before taking logs. However, as already mentioned, because of the large size of the trade values as compared to the added one dollar, this measurement error is expected to be very small.

Finally, one should notice that not only the variable lnX_{t-1} could drive the potential endogeneity, but also the treatment or post dummy as they also feature in the variable of interest. Being selected to the treatment group, in the post anti-dumping period should not affect Y (European imports from third countries) other than through the effect of anti-dumping duties. In other words, there should be no omitted variables bias, reverse causality or measurement error in the two dummies in the variable of interest. Here, once again the fixed effects are necessary as they control for any potential source of endogeneity. However, one can never be sure that these dummy variables are exogenous. It is hard to test for the endogeneity of these variables.

5. Results and robustness checks

5.1 Regression results

Before running the regressions, a test is performed to check whether a fixed effects model is preferred over a random effects model. Hausman (1978) suggested a test that calculates the differences between the fixed effects and the random effects parameters, to see which model is most appropriate. The results of this test are given in Table 1 below. Based on the F-value (2400.93) and the probability (0.00), the null hypothesis is overwhelmingly rejected. A fixed effects models is thus preferred over a random effects model in this model. This is in line with the literature review as, among others, Liu and Shi (2016) and Baier and Bergstrand (2007) use fixed effects models as well.

Table 1: Hausmann test for fixed vs. random effect

Degrees of freedom: (1)	**F-value (probability): (2)**	**Decision: (3)**
Chi2(5)	2400.93 (0.000)	Reject H_0

Notes: (1) null-hypothesis: random effects model is preferred to fixed effects model; (2) the null-hypothesis can be rejected.

Regression results

Table 2 provides the results from the regression of the baseline equation. This is done with *reghdfe*, a tool in Stata that allows for multiple dimensions of fixed effects (Correia, 2014). When using this tool, Stata automatically drops Singleton observations (Correia, 2015). These are groups with only one observation. With the multiple fixed effects, the groups are product*time, country*time and country*product. The results of the regression can be found in Table 4. In the first column, both lnX_{t-1} and lnY_t are defined as trade value in dollars, whereas in the second column, trade is defined in quantities. These units are mostly kilograms, but also items, pairs (in the case of footwear for example) and square meters are used. Finally, for some observations, no quantity measure is available. However, because of the small number of observations, I expect that the coefficient estimates are hardly affected. It should be noted that the interaction *T*P* is omitted from the regression because of collinearity with the fixed effects. Besides, the coefficient of $LnX_{t-1}*T*P$ (henceforth: the variable of interest) is not significantly positive in the first column. In the quantity data in the second column, however, there is a significant coefficient for all variables, also for the variable of interest. This is consistent with the trade rerouting story: for products in the treatment group (*T*) after the anti-dumping measures are imposed (*P*), there is a significantly positive relationship between Chinese exports to a third country in year t-1 and European imports in year t from the same country (lnX_{t-1}). In other words: Chinese exports to a third countries are more likely to be followed with increased European imports from the same countries for products with anti-dumping duties. The fact that this is only true for the quantity data, deserves some more explanation. Liu and Shi (2016) found significant results in both value and quantity data. It is not surprising, though, that in this paper, the variable of interest is not significantly different from zero for the value data. The multiple fixed effects included control for the heterogeneities in the products prices. These heterogeneities can exist in the exchange rate of the dollar, in the inflation or in other determinants of product prices. Since trade value data is quantity*price and since the quantity data gives significant results, it is not surprising that the value data does not. Therefore, most effects of prices are filtered out of the data by the fixed effects. Alternatively, these prices could change at country*HS6*year level, something that is not controlled for in this paper. However, the fact that the coefficient of the variable of interest is not significant in the value data in the left column, does not mean that we cannot infer anything from these regressions. After all, the variable of interest is significant in the right column, which indicates that trade rerouting does indeed take place at product quantity level. Since I controlled for the multiple fixed effects and

there is still a positive value for the variable of interest in the second column, this is evidence that trade rerouting did indeed take place during 2002-2014.

Moreover, the coefficient of the control group $LnX_{t-1}*P$ is also significantly positive. This positive value could be explained by the chilling or spill-over effect (Vandenbussche and Zanardi, 2010). According to this effect, products not subjected to anti-dumping but similar in the sense that they have the same HS 4-code, are affected by the trade rerouting of goods in the treatment group. As the latter products get shipped through third countries more frequently to circumvent anti-dumping duties, products in the control group could be shipped through these other countries as well. As a result, the estimated effect of anti-dumping should be even larger without the spill-over effect. In addition, the effect of anti-dumping could be larger than one would think based on the regression results. For example, products that are exported to third countries to evade anti-dumping duties, might not be reported to customs on purpose (Liu and Shi, 2016). This would thus be measurement error which negatively biases our results. The real effect of anti-dumping circumvention could thus be larger.

Table 2: Regression results: baseline equation

	Value	**Quantity**
Variables	**(1)**	**(2)**
Constant	5.769***	4.164***
	(0.149)	(0.098)
LnX_{t-1}	-0.034***	-0.029***
	(0.004)	(0.003)
$LnX_{t-1}*P$	0.038***	0.022***
	(0.004)	(0.004)
$LnX_{t-1}*T$	-0.005	-0.013***
	(0.007)	(0.007)
$LnX_{t-1}*T*P$	**-0.003**	**0.016*** **
	(0.006)	**(0.007)**
Country*HS6 fixed effects:	Yes	Yes
HS6*year fixed effects:	Yes	Yes
Country*year fixed effects:	Yes	Yes
Observations	377,486	377,486
$\mathbf{R^2}$	0.837	0.855

Notes: (1) dependent variable lnY_t refers to EU imports from third countries in logarithms in year t; (2) lnX_{t-1} refers to Chinese exports to third countries in logarithms in year t-1; (3) *P* refers to the post anti-dumping period based on the final decision dates; (4) *T* is a treatment dummy which is equal to one for products in the treatment group and zero otherwise; (5) the interaction *T*P* is omitted because of collinearity; (6) robust standard errors are shown in parenthesis, clustered at country*HS6 level; (9) ***, ** and * specify significance at 1%, 5% and 10% level.

Adding interactions with distance to the third country

The results above indicate that trade rerouting does indeed take place at product quantity level. Now, I add a continuous variable for distance to China and the EU and interact this variable with the other variables in the regression. This is done to test for heterogeneities between the different third countries. I expect that third countries geographically closer to the exporter (China) and the importer (in this paper, the EU) are more likely to be involved in the circumventing behaviour (Liu and Shi, 2016). Distance is used from CEPII database. This database contains, among others, the distance between the capitals of all countries in the world (Mayer and Zignago, 2011). These are the distances that I use in this paper. Thus, the distance between Beijing and Seoul serves as a proxy for the distance between China and South Korea. In addition, Brussels is used as the 'capital of the European Union'. This is done for two reasons. Firstly, Brussels is the centre of the European Union with official seats of the European Commission, Council of the European Union, European Council and European Parliament being situated in Brussels. Secondly, and obviously one of the reasons why all these seats are in Brussels, the city is located quite centrally in Europe. So, the distance between Brussels and Seoul is a proxy for the distance between Europe and South Korea. Liu and Shi (2016) use only the total distance of the third country to China plus the distance to the United States. I use two different variables for distance. Firstly, *ln(distance_tot)* measures the total distance between the third country (e.g. the capital of the third country) and both China (i.e. Beijing) and Europe (i.e. Brussels) in logarithms. By taking the total distance to both the exporter (China) and the importer (Europe), I follow the approach of Liu and Shi (2016). Secondly, I use the distance of the (capital of the) third country to (the capital of China) only. Therefore, the variable *ln(distance_CN)* is added. Both variables *ln(distance_tot)* and *ln(distance_CN)* are included in the descriptive statistics in Table 3.1 and 3.2. in the Data section above.

The results after adding *ln(distance_tot)* are given in column 1 and 2 of Table 3. First, it should be noticed that the amount of observations has dropped in comparison to the previous regression results in Table 2. This could be because State drops the Singleton observations, but this is not very plausible. After all, in comparison to the previous regression not much has changed. Only the distance variable is added, so there should not be a different number of Singleton observations. A more plausible reason why the amount of observation has reduced, is due to collinearity. Stata automatically drops observations that suffer from collinearity and reports them. Indeed, Stata reported that the distance variable is collinear with the country*product fixed effects. As explained above, adding these fixed effects does indeed

control for distance between countries. So, most likely, some observations are dropped due to collinearity.

A second thing that should be noticed from the first two columns of Table 3 is that the coefficient of the variable of interest is not significantly positive anymore, in neither of the two regressions. Furthermore, coefficient of $lnX_{t-1}*T*P*ln(distance\_tot)$, which is the variable of interest interacted with the distance variable, is not significant either. Ideally, the coefficient of this variable should be significantly negative, as a longer distance between countries would be associated with less circumvention because of the increased transportation costs (Liu and Shi, 2016). This negative relationship between distance and trade can be found in the negative coefficients of $lnX_{t-1}*ln(distance\_tot)$ in all specification. Nevertheless, these regressions do not confirm the robustness of the results since the variable of interest does not have the expected sign and significance. These first two columns are at most an indication that distance is indeed negatively associated with trade.

In column 3 and 4, I used a different measure for distance. I included the variable *ln(distance_CN)*, which measures the distance of the third country to China. Now, the results are much more in line with what I expected. The amount of observations has not changed in comparison to the first two columns. It is thus still lower than in the regression results in Table 2 because of the dropped Singleton observations. In column 4, where quantity data is used, the variable of interest is significantly positive. Interestingly, the size of the coefficient is much larger than it was in the regression results. The size is now 0.150, whereas it was 0.016. The reason for this difference that I included the interaction with the continuous variable for distance. The effect of the variable of interest $lnX_{t-1}*T*P$ now also depends on the interaction term $lnX_{t-1}*T*P*ln(distance\_CN)$.

In this specification, the variable of interested interacted with the distance variable $lnX_{t-1}*ln(distance\_CN)$ is significant and it has the expected negative sign. Trade rerouting is thus negatively related to distance of the third country and China. The results are different from Liu and Shi (2016). They found a negative relationship between total distance of the third country to exporter (China) and the importer (U.S.). In this paper, only the distance between the third country and exporter China seems to matter for anti-dumping duty circumvention. I think this can be explained by the different geographic location of the U.S. and the EU. Most likely the third countries that are involved in anti-dumping circumvention practices with the U.S. and the EU are the same. Many countries that often serve as third countries in trade rerouting practices, are situated in Southeast Asia. The Special Administrative Regions of China, Hong Kong and Macao, are relevant. These countries are close to China, but also situated roughly in between

China and the United States. For trade between China and Europe, this is different. The countries in Southeast Asia are not situated in between China and Europe.

Table 3: Regression results: adding interaction with distance to the baseline equation

	Value	Quantity	Value	Quantity
Variables	**(1)**	**(2)**	**(3)**	**(4)**
Constant	7.219***	4.479***	6.988***	4.576***
	(0.567)	(0.381)	(0.372)	(0.234)
LnX_{t-1}	0.307***	0.230***	0.216***	0.200***
	(0.084)	(0.080)	(0.050)	(0.045)
$LnX_{t-1}*P$	-0.237***	-0.083	-0.255***	-0.160***
	(0.088)	(0.071)	(0.052)	(0.039)
$LnX_{t-1}*T$	0.045	0.061	0.069	0.047
	(0.163)	(0.155)	(0.099)	(0.085)
$LnX_{t-1}*T*P$	**-0.068**	**0.017**	**0.117**	**0.150****
	(0.159)	**(0.132)**	**(0.098)**	**(0.074)**
$LnX_{t-1}*Ln(distance\_tot)$	-0.036***	-0.027***		
	(0.009)	(0.008)		
$P*Ln(distance\_tot)$	-0.230**	-0.039		
	(0.111)	(0.074)		
$LnX_{t-1}*T*Ln(distance\_tot)$	-0.005	-0.008		
	(0.017)	(0.016)		
$LnX_{t-1}*P*Ln(distance\_tot)$	0.029***	0.011		
	(0.009)	(0.007)		
$T*P*Ln(distance\_tot)$	-0.150	-0.092		
	(0.199)	(0.140)		
$LnX_{t-1}*T*P*Ln(distance\_tot)$	**0.007**	**-0.000**		
	(0.017)	**(0.014)**		
$LnX_{t-1}*Ln(distance\_CN)$			-0.028***	-0.026***
			(0.006)	(0.005)
$P*Ln(distance\_CN)$			-0.287***	-0.126***
			(0.074)	(0.046)
$LnX_{t-1}*T*Ln(distance\_CN)$			-0.008	-0.007
			(0.011)	(0.010)
$LnX_{t-1}*P*Ln(distance\_CN)$			0.033***	0.021***
			(0.006)	(0.004)
$T*P*Ln(distance\_CN)$			0.172	0.154*
			(0.141)	(0.090)
$LnX_{t-1}*T*P*Ln(distance\_CN)$			**-0.013**	**-0.015***
			(0.011)	**(0.008)**
Country*HS6 fixed effects:	Yes	Yes	Yes	Yes
HS6*year fixed effects:	Yes	Yes	Yes	Yes
Country*year fixed effects:	Yes	Yes	Yes	Yes
Observations	372,232	372,232	372,232	372,232
$\mathbf{R^2}$	0.836	0.854	0.836	0.854

Notes: (1) dependent variable lnY_t refers to EU imports from third countries in logarithms in year t; (2) lnX_{t-1} refers to Chinese exports to third countries in logarithms in year t-1; (3) *P* refers to the post anti-dumping period based on the final decision dates; (4) *T* is a treatment dummy which is equal to one for products in the treatment group and zero otherwise; (5) the interaction *T*P* is omitted because of collinearity; (6) *ln(distance_tot)* is the natural logarithm of the distance from the third country to China plus the distance from the third country to Europe; (7) *ln(distance_CN)* is the natural logarithms of the distance from the third country to China; (8) robust standard errors are shown in parenthesis, clustered at country*HS6 level; (9) ***, ** and * specify significance at 1%, 5% and 10% level.

5.2 Robustness checks

Dropping Hong Kong, Macao and Taiwan

Since distance to China is negatively related to trade rerouting to the EU, it is interesting to zoom into three 'third regions' which are located very close to China: Hong Kong, Macao and Taiwan are dropped. These regions are situated close to China, but slightly further away from Europe than China. Importantly, these regions are often used for circumvention purposes (Doyle, 2018). Both Hong Kong and Macao are Special Administrative Regions of China, Hong Kong got this status in 1997, Macao in 1999. Taiwan is de facto a sovereign state but is not part of the United Nations. These regions are dropped as a robustness check. I do this to make sure that the significant regression results obtained earlier are not just driven by these three regions, that could all be considered as regions of China in some sense.

Table 4: Robustness check: dropping Hong Kong, Macao and Taiwan as 'third regions'

	Value	**Quantity**
Variables	**(1)**	**(2)**
Constant	5.660***	4.065
	(0.149)	(0.098)
LnX_{t-1}	-0.034***	-0.029***
	(0.004)	(0.004)
$LnX_{t-1}*P$	0.039***	0.024***
	(0.004)	(0.004)
$LnX_{t-1}*T$	-0.008	-0.015***
	(0.007)	(0.007)
$LnX_{t-1}*T*P$	**-0.003**	**0.015****
	(0.007)	**(0.007)**
Country*HS6 fixed effects:	Yes	Yes
HS6*year fixed effects:	Yes	Yes
Country*year fixed effects:	Yes	Yes
Regions dropped:	Hong Kong, Macao, Taiwan	Hong Kong, Macao, Taiwan
Observations	361,576	361,576
$\mathbf{R^2}$	0.834	0.853

Notes: (1) dependent variable lnY_t refers to EU imports from third countries in logarithms in year t; (2) lnX_{t-1} refers to Chinese exports to third countries in logarithms in year t-1; (3) *P* refers to the post anti-dumping period based on the final decision dates; (4) *T* is a treatment dummy which is equal to one for products in the treatment group and zero otherwise; (5) the interaction *T*P* is omitted because of collinearity; (6) robust standard errors are shown in parenthesis, clustered at country*HS6 level; (7) ***, ** and * specify significance at 1%, 5% and 10% level.

The results of these regressions are given in Table 4 below. Obviously, the amount of observations is lower than before as all observations related to trade with Hong Kong, Macao and Taiwan are dropped. In addition, excluding the three regions does slightly reduce the coefficient of the variable of interest. However, in the second column with the quantity data, the results are still significant. Thus, excluding Hong Kong, Macao and Taiwan does not affect the results. In addition to these results, I also ran regressions where I dropped only one or two of these three regions. In all regressions, the coefficient of the variable of interest was positive and significant, indicating the robustness of the results. Therefore, I only added the most preferred specification where Hong Kong, Macao and Taiwan are dropped at the same time, to Table 4. This specification shows that neither of the three regions is crucial in driving the significance of the results: even when all the three regions are dropped, the results are still significant. It is therefore an indication that the results of the baseline equation are robust to excluding these three regions.

Dropping zeroes in country*HS6 observations

Finally, I performed a robustness check by dropping all country*product (i.e. country*HS6) observations that are always zero. I do this as some specific products are never traded with certain third countries or regions. These observations should not be important in driving the results of the baseline regression equations, but they might bias the results as they are all equal to zero. Therefore, these observations should be dropped (Liu and Shi, 2016). The results are given in Table 5. Firstly, it should be noted that the amount of observations drops to 265,829. Next, the results of the regression still hold. For the quantity data, the variable of interest is still positive even though it is now only significant at 10%. The positive sign confirms the results from the baseline equation. In addition, none of the coefficients switches sign, which is another indication that results are robust. The conclusion is therefore that the results obtained earlier are not just driven by zeroes that appear in the country*product observations. They are robust to excluding these observations which are always equal to zero.

Table 5: Robustness check: dropping all country*HS6 observations for which both X and Y are zeroes throughout the sample		
	Value	**Quantity**
Variables	**(1)**	**(2)**
Constant	8.093*** (0.330)	5.965*** (0.205)
LnX_{t-1}	-0.033*** (0.004)	-0.031*** (0.003)
$LnX_{t-1}*P$	0.037*** (0.005)	0.023*** (0.004)
$LnX_{t-1}*T$	-0.006 (0.008)	-0.014* (0.008)
$LnX_{t-1}*T*P$	**-0.005** **(0.008)**	**0.013*** **(0.008)**
Country*HS6 fixed effects:	Yes	Yes
HS6*year fixed effects:	Yes	Yes
Country*year fixed effects:	Yes	Yes
Observations	265,829	265,829
$\mathbf{R^2}$	0.782	0.818

Notes: (1) dependent variable lnY_t refers to EU imports from third countries in logarithms in year t; (2) lnX_{t-1} refers to Chinese exports to third countries in logarithms in year t-1; (3) *P* refers to the post anti-dumping period based on the final decision dates; (4) *T* is a treatment dummy which is equal to one for products in the treatment group and zero otherwise; (5) the interaction *T*P* is omitted because of collinearity; (6) robust standard errors are shown in parenthesis, clustered at country*HS6 level; (9) ***, ** and * specify significance at 1%, 5% and 10% level.

6. Conclusion

In this paper, I use the model of Liu and Shi (2016) to test if Chinese exporters circumvent anti-dumping measures imposed by the European Union. In their paper, they found a positive correlation between Chinese exports to third countries or regions and U.S. imports from these countries or regions for the same products. I find the same positive correlation in this paper, where EU imports are considered instead of U.S. imports. My methodology is somewhat different from Liu and Shi. Firstly, I use one-year lags on the right-hand side of the equation in this paper to avoid reverse causality. In addition, I use multiple fixed effects to filter out the omitted variables bias that may still be present in the paper of Liu and Shi. Furthermore, distance from the third country to China is negatively associated with trade rerouting, which can be explained by increasing transportation costs. I performed two robustness checks to investigate this relationship further. Firstly, I find that the trade rerouting story is robust to the exclusion of Hong Kong, Macao and Taiwan as third regions. These regions are good

candidates for anti-dumping circumvention. However, since excluding these regions does not affect the results, the trade rerouting story has also been confirmed for other third countries in the database. Besides, the positive relationship between Chinese exports and European imports is robust to the exclusion of country-product combinations that are never traded. These zeroes are dropped from the database and the results are not affected.

A first potential shortcoming of this paper is the possibility that reverse causality is still present, even though I take one-year lags on the right-hand side of the equation. This approach should be effective in filtering out most of the expected reverse causality, but one can never be sure that a paper is entirely free of this reverse causality. Using an instrumental variable approach would be most effective to make sure that there is a causal relationship between an increase in Chinese exports to country X and an increase in European imports from this country X for the same products. However, as argued before, it is very hard to find a suitable instrument that does not violate the exclusion restriction. Therefore, I do not use an instrumental variable approach. A second shortcoming of this paper is the usage of yearly data rather than monthly data. As explained before, using monthly data could lead to more accurate estimates of the coefficients. Anti-dumping cases filed in different months in the same year are treated as of the same date. Therefore, my coefficient estimates are less accurate when yearly data is used. Thirdly, a larger amount of robustness checks should be performed to test the validity of the results. One could for example distinguish between different types of products or product groups. In addition, one could look in more detail at the different third countries or regions that are involved in the circumvention practices. Finally, it should be noted that endogeneity issues could plague the treatment and post dummy variables as well. Even though I used the multiple fixed effects in all specifications, one can never be sure that these dummy variables are exogenous. It is hard to test for this endogeneity of these variables.

To conclude, this paper provides evidence that the results of the paper of Liu and Shi (2016) are not only applicable to the United States but also to the EU. More specifically, when answering the research question formulated in the Introduction, the following can be concluded. Anti-dumping measures that the European Union imposed on China between 2002 and 2014 are associated with trade rerouting of the same products via third countries. In addition, this paper convincingly argues that the EU anti-circumventing measures, as described by Puccio and Erbahar (2016) and Vermulst (2016), are not applied without a solid basis: anti-dumping circumventing from China to the EU does indeed take place.

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Appendix

Table A.1: Treatment and control groups, preliminary and final anti-dumping dates

Case ID	Treatment group	Control group	Preliminary AD Date	Final AD Date
538	292142	292111, 292112, 292119, 292121, 292122, 292129, 292130, 292141, 292143, 292144, 292145, 292146, 292149, 292151, 292159	03/03/2002	07/25/2002
554	290712	290711, 290713, 290714, 290715, 290719, 290721, 290722, 290723, 290729	03/20/2003	09/20/2003
561	293213	293211, 293212, 293219, 293221, 293229, 293291, 293292, 293293, 293294, 293295, 293299	05/07/2003	10/31/2003
568	292990	292910	09/17/2003	03/11/2004
572	390760	390710, 390720, 390730, 390740, 390750, 390791, 390799	02/21/2004	08/19/2004
574	441213	441214, 441219, 441222, 441223, 441229, 441292, 441293, 441299	05/18/2004	11/12/2004
576	550320	550310, 550330, 550340, 550390	.	03/17/2005
582	842790, 843120	842710, 842720, 843110, 843131, 843139, 843141, 843142, 843143, 843149	01/28/2005	07/21/2005
583	283660	283610, 283620, 283630, 283640, 283650, 283670, 283691, 283692, 283699	01/29/2005	07/21/2005
584	732510	732591, 732599	.	07/29/2005
589	540751, 540752, 540754, 540761, 540769	540710, 540720, 540730, 540741, 540742, 540743, 540744, 540753, 540771, 540772, 540773, 540774, 540781, 540782, 540783, 540784, 540791, 540792, 540793, 540794	03/16/2005	09/16/2005
590	293369, 380840	293311, 293319, 293321, 293329, 293331, 293331, 293333, 293339, 293341, 293349, 293352, 293353, 293354, 293355, 293359, 293361, 293371, 293372, 293379, 293391, 293399, 380810, 380820, 380830, 380890	04/08/2005	07/10/2005
591	681510, 681591, 681599, 690210, 690390	681520, 690220, 690290, 690310, 690320	04/12/2005	12/10/2005
594	731812, 731814, 731815, 731816	731811, 731813, 731819, 731821, 731822, 731823, 731824, 731829	05/21/2005	11/19/2005
601	390461	390410, 390421, 390422, 390430, 390440, 390450, 390469, 390490	06/08/2005	08/12/2005
605	291812	291811, 291813, 291814, 291815, 291816, 291819, 291821, 291822, 291823, 291829, 291830, 291890	07/30/2005	01/27/2006
611	830510	830520, 830590	01/27/2006	07/27/2006
615	411410	411420	03/17/2006	09/14/2006
619	392321	392310, 392329, 392330, 392340, 392350, 392390	.	09/29/2006
622	640320, 640330, 640351, 640359, 640391, 640399, 640510	640312, 640313, 640340, 640520, 640590	04/06/2006	10/06/2006
630	810199, 851590	810110, 810194, 810195, 810196, 810197, 851511, 851519, 851521, 851529, 851531, 851539, 851580	09/14/2006	03/13/2007
640	081110	081120, 081190	10/18/2006	04/17/2007
641	392490, 442190, 732393, 732399, 851679, 851690	392410, 442110, 732310, 732391, 732392, 732394, 851610, 851621, 851629, 851631, 851632, 851633, 851640, 851650, 851660, 851671, 851672, 851680	10/31/2006	04/26/2007
644	871495, 871499, 950691	871411, 871419, 871420, 871491, 871492, 871493, 871494, 871496, 950611, 950612, 950619, 950621, 950629, 950631, 950632, 950639, 950640, 950651, 950659, 950661, 950662, 950669, 950670, 950699	12/28/2006	06/21/2007

649	283340, 284290	283311, 283319, 283321, 283322, 283323, 283324, 283325, 283326, 283327, 283329, 283330, 284210	04/12/2007	10/11/2007
651	292620	292610, 292630, 292690	.	11/15/2007
664	841440, 841480	841410, 841420, 841430, 841451, 841459, 841460, 841490	.	03/20/2008
667	292242	292211, 292212, 292213, 292214, 292219, 292221, 292229, 292231, 292239, 292241, 292243, 292244, 292249, 292250	06/04/2008	12/02/2008
670	730630	730610, 730620, 730640, 730650, 730660, 730690	.	12/19/2008
672	200830	200811, 200819, 200820, 200840, 200850, 200860, 200870, 200880, 200891, 200892, 200899	07/05/2008	12/18/2008
678	721710, 721720, 731210	721730, 721790, 731290	11/15/2008	05/13/2009
684	730410, 730421, 730429, 730431, 730439, 730451, 730459,	730441, 730449, 730490	04/07/2009	10/06/2009
687	760711	760719, 760720	04/07/2009	10/06/2009
693	902219, 902229, 902780, 903010, 870590	902212, 902213, 902214, 902221, 902230, 902290, 902710, 902720, 902730, 902740, 902750, 902790, 903020, 903031, 903039, 903040, 903082, 903083, 903089, 903090, 870510, 870520, 870530, 870540	12/17/2009	06/16/2010
694	810296	810210, 810294, 810295, 810297, 810299	12/18/2009	06/16/2010
696	870870	870810, 870821, 870829, 870831, 870839, 870840, 870850, 870860, 870880, 870891, 870892, 870893, 870894, 870899	05/11/2010	10/28/2010
702	540220	540210, 540231, 540232, 540233, 540239, 540241, 540242, 540243, 540249, 540251, 540252, 540259, 540261, 540262, 540269	06/02/2010	12/01/2010
705	701911, 701912, 701919, 701931	701932, 701939, 701940, 701951, 701952, 701959, 701990	09/16/2010	03/15/2011
709	481013, 481014, 481019, 481022, 481029, 481099	481031, 481032, 481039, 481092	11/17/2010	05/14/2011
723	291711	291712, 291713, 291714, 291719, 291720, 291731, 291732, 291733, 291734, 291735, 291736, 291737, 291739	10/20/2011	04/18/2012
730	761519, 761699	761520, 761610, 761691	05/11/2012	11/09/2012
736	721070, 721240, 722599, 722699	721011, 721012, 721020, 721030, 721041, 721049, 721050, 721061, 721069, 721090, 721210, 721220, 721230, 721250, 721260, 722511, 722519, 722530, 722540, 722550, 722591, 722592, 722611, 722619, 722620, 722691, 722692	09/19/2012	03/15/2013
738	730719	730711, 730721, 730722, 730723, 730729, 730791, 730792, 730793, 730799	11/15/2012	05/14/2013
751	700719	700711, 700721, 700729	11/27/2013	05/14/2014

Notes: (1) all products are in HS 2002 nomenclature; (2) some cases between have been dropped from the sample for the following reasons: 1. One of the products in that case has been subject to a previous anti-dumping which is already part of the sample (the cases EUN-AD-627, 656, 666, 673, 695, 707, 712, 719 and 735); 2. No suitable control group – i.e. products with the same HS 4-code but with a different HS 6-code – is available (the cases EUN-AD-652, 663, 679, 680, 713, 737 and 747); 3. There was a negative decision (the cases EUN-AD-661 and 726); 4. Cases, which have been withdrawn or terminated (the cases EUN-AD-557, 617, 624, 627, 631, 636, 674, 675, 714, 715, 721, 729, 748, 750 and 752); (3) notice that case EUN-AD-627 has thus been excluded from the sample for two different reasons (i.e. the product has already been subject to a previous anti-dumping case and the case has been withdrawn or terminated); (4) in some cases, the preliminary anti-dumping date is bypassed.

Table A.2: All 153 'third' countries and regions			
Afghanistan	*East Timor*	*Libya*	*Serbia*
Albania	*Ecuador*	*Macao*	*Sierra Leone*
Algeria	*Egypt*	*Macedonia, FYR*	*Singapore*
Angola	*El Salvador*	*Madagascar*	*Somalia*
Argentina	*Equatorial Guinea*	*Malawi*	*South Africa*
Armenia	*Eritrea*	*Malaysia*	*South Korea*
Australia	*Ethiopia*	*Maldives*	*South Sudan*
Azerbaijan	*Fiji*	*Mali*	*Sri Lanka*
Bahamas, the	*Former Sudan*	*Mauritania*	*St. Lucia*
Bahrain	*Gabon*	*Mauritius*	*St. Vincent/Grenadines*
Bangladesh	*Gambia*	*Mexico*	*Sudan*
Barbados	*Georgia*	*Micronesia, Fed. States*	*Suriname*
Belarus	*Ghana*	*Moldova*	*Swaziland*
Belize	*Grenada*	*Mongolia*	*Switzerland*
Benin	*Guam*	*Montenegro*	*Syria*
Bhutan	*Guatemala*	*Morocco*	*Taiwan ('Other Asia')*
Bolivia	*Guinea*	*Mozambique*	*Tajikistan*
Bosnia and Herzegovina	*Guinea-Bissau*	*Myanmar*	*Tanzania*
Botswana	*Guyana*	*Namibia*	*Thailand*
Brazil	*Haiti*	*Nepal*	*Togo*
Brunei	*Honduras*	*New Zealand*	*Tunisia*
Burkina Faso	*Hong Kong*	*Nicaragua*	*Turkey*
Burundi	*Iceland*	*Niger*	*Turkmenistan*
Cambodia	*India*	*Nigeria*	*Uganda*
Cameroon	*Indonesia*	*North Korea*	*Ukraine*
Canada	*Iran*	*Norway*	*United Arab Emirates*
Cape Verde	*Iraq*	*Oman*	*United States*
Central African Rep.	*Israel*	*Pakistan*	*Uruguay*
Chad	*Jamaica*	*Panama*	*Uzbekistan*
Chile	*Jordan*	*Papua New Guinea*	*Vanuatu*
Colombia	*Kazakhstan*	*Paraguay*	*Venezuela*
Comoros	*Kenya*	*Peru*	*Vietnam*
Congo, DR	*Kiribati*	*Philippines*	*Western Sahara*
Congo, Republic	*Kuwait*	*Qatar*	*Yemen*
Costa Rica	*Kyrgyz Republic*	*Russian Federation*	*Zambia*
Cote d'Ivoire	*Lao PDR*	*Rwanda*	*Zimbabwe*
Cuba	*Lebanon*	*Sao Tome and Principe*	
Djibouti	*Lesotho*	*Saudi Arabia*	
Dominican Republic	*Liberia*	*Senegal*	

Notes: (1) initially, 158 countries and regions were selected, but five of them did not appear in the data (zeroes); (2) countries are selected based on the following criteria: 1. China, the European Union and countries which have been part of the European Union for some time during the period 2002-2014 are excluded as third countries. 2. Countries which are part of the Kingdom of a country within the European Union are excluded. 3. Countries of which their sovereignty was part of a dispute during the period 2002-2014 are excluded. 4. Regions, which are no countries or territories, such as World are excluded. 5. Former states are excluded as well. 6. Countries with less than 100,000 inhabitants are excluded, because of their limited significance for the world economy and because of the large number of observations that this analysis already has; (6) data for Taiwan denoted as 'Other Asia'. This is for political reasons as the UN is not allowed to show the data for Taiwan as such.