Detecting Anti-dumping Circumvention: 

a Network Approach

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Abstract

Despite the increasing integration of the global economic system, anti-dumping measures are a common tool used by governments to protect their national economy. In this paper, we propose a methodology to detect cases of anti-dumping circumvention through re-routing trade via a third country. Based on the observed full network of trade flows, we propose a measure to proxy the evasion of an anti-dumping duty for a subset of trade flows directed to the European Union, and look for possible cases of circumvention of an active anti-dumping duty. Using panel regression, we are able correctly classify 86% of the trade flows, on which an investigation of anti-dumping circumvention has been opened by the European authorities.

Keywords: anti-dumping, circumvention, networks, world trade.

JEL codes: C55, F14, Q37.

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Non-technical summary

The widespread adoption of anti-dumping measures has induced economists to study their effects on trade flows in terms of volume and prices. Anti-dumping circumvention generally refers to an attempt by countries subject to anti-dumping to avoid paying the duties by “formally” moving outside the range of the anti-dumping duties order while “substantially” engaging in the same commercial activities as before. One type of anti-dumping circumvention occurs when exporting products subject to anti-dumping duties from third countries (re-routing).

In this paper, we adopt a network perspective to build a circumvention index that allows us to study possible events of anti-dumping circumvention when focusing on a subset of trade flows directed to the EU. We compare the structure of the network in international trade flows before and after the introduction of a specific anti-dumping duty and study the instance of a possible anti-dumping circumvention via re-routing during the period of activity of the duty. This paper contributes to the existing literature by adopting a systematic approach that does not require the user to manually identify the third country by which circumvention might happen. Relying on the complete network of observed trade flows, we analyse the possibility of an illicit practice happening via any node (i.e., a country) in our network, thus not requiring any prior knowledge or assumption.

Our results show that studying the proposed circumvention indexes via a panel regression model allows us to correctly detect 86% of the trade flows that have actually been put under investigation by the European authorities with an anti-dumping circumvention allegation. The proposed methodology could be used as an early-warning signal which might proceed with a more in-depth and thorough analysis of the trade flows patterns using administrative and accounting data.
1 Introduction

Despite the growth in international trade due to the increased integration of national economies into a global economic system as well as advancements in telecommunications and logistics, we observe persistent and even intensifying adoption of trade protection measures (Cerasa and Buscaglia, 2019; Tabakis and Zanardi, 2019). Anti-dumping intervention is often adopted by governments as a tool to protect domestic firms and industries, with strong implications for their earning management strategies (Godsell et al., 2017) and for the overall trade volumes (Egger and Nelson, 2011). “Dumping” occurs when a firm charges a lower price for the same product on the foreign market than it does in the domestic market. When it is proved that the dumped imports are damaging the competing industry in the importing country, the latter can impose anti-dumping measures to provide relief to domestic industries injured by imports. The country’s imposition of an anti-dumping duty is determined by the dumping margin, namely, the difference between the export price and the domestic selling price in the exporting country. By adding the dumping margin to the export price, the dumped price can be rendered a fair trade price.

The European Union (EU) has implemented a number of measures to protect its member state’s national economies. The implementation of such trade defence measures aims at protecting European producers from illicit export strategies from commercial partners, as well as final consumers in the EU, as documented by Juramy (2018). An anti-dumping investigation can be opened by the European authorities by their own initiative or after an official complaint introduced by an European producer. The opening of an anti-dumping investigation (also referred to as proceeding) is published on the EU’s Official Journal¹ where, among other issues, it is assessed (i) whether there is evidence of dumping, (ii) what the damage caused to European producers is, and (iii) whether there exists a causal link between the dumping and the associated economic damage. We refer to Nita and Zanardi (2013) for a detailed presentation of all steps that lead to the adoption of an anti-dumping duty by the European authorities.

The widespread adoption of anti-dumping measures has induced economists to study their effects on trade flows in terms of volume and prices, as well as company behaviour (for a recent study on firm-level effects of European anti-dumping duties, see Felbermayr and Sandkamp, 2020).

¹The archive of the EU’s Official Journal can be consulted at https://eur-lex.europa.eu/oj/direct-access.html.
Anti-dumping circumvention generally refers to an attempt by countries subject to anti-dumping to avoid paying the duties by “formally” moving outside the range of the anti-dumping duties order while “substantially” engaging in the same commercial activities as before. One type of anti-dumping circumvention occurs when exporting products subject to anti-dumping duties from third countries (re-routing). Vermulst (2015) provides an overview of the measures adopted by the EU in order to avoid the circumvention of an anti-dumping duty, advocating for more transparent and predictable anti-circumvention rules adopted at the international level.

In this paper, we adopt a network perspective to build a circumvention index to study possible events of anti-dumping circumvention. We focus on a subset of trade flows directed to the EU. While most of the official investigation procedures rely heavily on administrative and accounting data (Godsell et al., 2017), researchers have been focusing on trade flow data to detect possible cases of anti-dumping circumvention (e.g., see Liu and Shi, 2019 or Rousseeuw et al., 2019). We look at the structure of the network in international trade flows before and after the introduction of a specific anti-dumping duty and interpret changes in certain network features as an indication of possible anti-dumping circumvention (for an overview of the application of network theory to model international trade patterns, we refer to Zhou et al., 2016 and Du et al., 2017). For our analysis, we use monthly data covering the period from 2000 to 2015 from the United Nations Commodity Trade (Comtrade) statistics database (Bown, 2005). We match these data with information on anti-dumping measures and investigations extracted from the Global Anti-dumping Database, and study the instance of a possible anti-dumping circumvention via re-routing during the period of activity of the duty. We provide an out-of-sample assessment of the performance of the proposed methodology against the official investigations opened by the European authorities, which we consider as true labels for a suspicious circumvention event.

Our work relates closely to the anti-dumping circumvention of Liu and Shi (2019), who also rely on Comtrade data to study events of circumvention of anti-dumping duties by Chinese exporters. This paper contributes to the existing literature by adopting a systematic approach that does not require the user to manually identify the third country by which circumvention might happen. Relying on the complete network of observed trade flows, we analyse the possibility of an illicit practice happening via any node (i.e., a country) in our network, thus not requiring any prior knowledge or assumption. Our results show that studying the proposed circumvention indexes via
a panel regression model allows us to correctly detect 86% of the trade flows that have actually
been put under investigation by the European authorities with an anti-dumping circumvention
allegation. The proposed methodology yields an early-warning signal which might be followed by
a thorough analysis of the trade flows patterns using administrative and accounting data.

This paper is structured as follows. Section 2 reviews the existing anti-dumping literature.
Section 3 introduces the various data sources used in the analysis. The network approach to
compute anti-dumping circumvention measures is presented in Section 4 as well as the econometric
method used for detecting anti-dumping circumvention. Section 5 discusses the results and Section
6 provides some conclusions together with venues for future research.

2 Literature review

The literature on the economic effects of anti-dumping measures is wide. We re-address the reader
to Bown and Crowley (2016) and Bown et al. (2021) for two empirical studies about the trade
policies at the international level and their bilateral impact on global value chains. Egger and
Nelson (2011) use data on international trade flows from the International Monetary Fund to
investigate the impact of anti-dumping duties on trade volume, over the period 1960-2001. The
authors concluded that the volume and welfare effects have been negative, but quite modest. Baltagi
et al. (2015) review a set of estimation techniques for gravity models of bilateral trade of goods,
with a specific focus on a range of problems that arise when modelling international trade flows
such as issues of endogeneity, estimation with missing or zero trade flow data.

Numerous works have investigated international trade data for fraud detection purposes. Barabesi
et al. (2016) propose the use of the Tweedie distribution to flexibly model trade quantities and assess
the statistical performance of anti-fraud methods. Rousseeuw et al. (2019) combine the FastLTS
algorithm for robust regression with alternating least squares to detect outliers and level shifts,
and show its potential application on two real-life examples. Muhammad and Countryman (2019)
analyse the impact of fraudulent behavior on Chinese wine imports by combing information on
traded quantities and prices at the 6-digits product classification and on fraud mentions in the
media. Gara et al. (2019) study inconsistencies in the mirror statistics at the 6-digits product
classification between two partner countries to create an indicator of the potential risk of observing
an illegal transaction.

Our work is related to the work of [Liu and Shi (2019)]. These authors rely on custom data to study the circumvention of the United States (US) anti-dumping measures by Chinese exporters through trade re-routing via third countries. Their results indicate that the adoption of US anti-dumping measures is associated to a higher positive correlation between US imports from a third country and Chinese export to the same third country. The authors show that this positive correlation is stronger for trade flows subject to an anti-dumping, which is line with the idea of anti-dumping circumvention through re-routing via a third country.

3 Data

We join three main data sources: (i) bilateral trade flows from the United Nations Comtrade, (ii) information about anti-dumping measures by the World Bank Global Anti-dumping database, (iii) anti-circumvention investigations by the European Union. The first two data sources provide the full observed network of trade flow and associated anti-dumping duties that we use to build some measures of circumvention of the anti-dumping.

The Comtrade database provides data about import and exports at the 6-digit level in the Harmonised System (HS) classification for all members of the United Nations [Comtrade (2015)]. Comtrade provides the aggregates of quantity exchanged (Kg) and trade value (US Dollars, USD) at monthly frequencies starting from January 2010. For each record, we observe the trade flow type, that is import or export\(^2\) and the two partner countries. In presence of mirroring trade flows, we average between the reported values (for more details on mirror statistics using Comtrade data, see [Hamanaka (2012) and Gara et al. (2019)]. We remove all intra-EU trade flows and consider the EU as a unique trade partner. Overall, our Comtrade data consists of 205 reporting countries, 6058 commodities for an average number of approximately 1.7 million trade flows (i.e., one commodity traded from country \(i\) to country \(j\)) observed each month.

We augment the data set on trade flows with the World Bank Global Anti-dumping data set [Bown (2005)], which provides information about the date of the announcement, imposition and withdrawal of an anti-dumping measure against a partner country with respect to a set of goods

\(^2\)Comtrade provides 4 trade flow types: imports, exports, re-imports, re-exports. For simplicity, consider re-imports (re-exports) as imports (exports).
from 1980 to 2015. As for the interest of our application, we focus only on anti-dumping measures imposed by the EU. In particular, for 43 trade flows we observe either the imposition date or the revocation date (or both) of an anti-dumping measure by the EU in the period 2010-15.

In order to properly assess the performance of our detection method, we build a data set containing information about all open and ongoing anti-circumvention investigations ran by the EU. We scrape the complete history of anti-fraud investigations published on the European Commission Directorate-General for Trade website. In particular, for any investigation where we find the specific mention “anti-circumvention”, we extract the 8-digit commodity code, the countries under investigation and the publication date: there are 193 instances of investigations about anti-dumping circumvention potential events run by the EU over the period 2013-19. Grouping the investigation at the 6-digit classification level and matching it with the Comtrade data, we obtain a set of 20 trade flows that were subject to an anti-circumvention investigation by the EU over the period 2010-15. These data are not an input of our models as they are only used as a test data set in order to compare the performance of the proposed method.

Our data set consists of a very large number of unique 6-digit trade flows reported among any two countries in the world, to which we attach information about anti-dumping duties and eventual anti-dumping circumvention investigations. In order to keep the exploratory analysis within bounds, we decide to investigate the anti-dumping circumvention only on a subset of products imported by the EU. First, we keep only products with the first two digits belonging to “68, 69, 70, 72, 73, 81, 83, 84, 85”, corresponding to the macro-categories of ceramics, glass-fibres, steel, iron and electric motors and generators. We focus on this subset of series since they relate to highly capital intensive industries, whose production cannot be flexibly increased in the short run: should we observe that a country who is not a large exporter of one of these products experiences a sudden increase in export, this might indicate the potential re-routing of the commodity. Second, we consider only the time series for which the European authorities imposed and revoked an anti-dumping duty over the period in analysis. In this way, we can clearly identify a period where the trade flow is subject to an anti-dumping duty: if a circumvention of an anti-dumping duty happened, we should observe it in this time span.

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4The official investigations are published on the European Commission Directorate-General for Trade website, available at https://trade.ec.europa.eu/tdi/completed.cfm
Figure 1: Network of the observed trade flows for commodity code 690710 in December 2015. A directed edge indicates the direction of the trade flow going from the exporting country to the importer. The edge size is proportional to the monetary value exchanged.

As a result, we obtain a subset of 18 commodities of trade flows starting from January 2010 to December 2015, for which we observe the imposition and withdrawal of an anti-dumping duty over the period in analysis. Table 1 reports the trade flows in analysis, the description of the product and whether the trade flow has been subject to an investigation about anti-dumping circumvention by the European authorities as well as the country of origin. Relying on the data for official investigations about anti-dumping circumvention, we observe that 14 of the commodities in analysis have been subject of an investigation by the European authorities.

As an illustration, Figure 1 presents the observed network of trade flows for product 690710 in the last month in our analysis, that is December 2015. The network is weighted and directed, where the edge direction goes from the exporting to the importing countries, and the edge size is proportional to the monetary value of the trade flow. Out of the 205 unique countries represented in our data set, only 94 of them reported a trade flow of product 690710 in December 2015. Focusing on the trade flows directed to the EU, we observe that they are originating from 12 distinct countries, which also imported the same product from 32 third countries in the same month.
Table 1: Trade flows by HS commodity code, product description, country of origin and investigation: if yes, the trade flow has been subjected to an investigation by the European authorities.

| HS code  | Description                                                                                                                                                                                                 | Origin | Investigation |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---------------|
| 690710   | Ceramic tiles, cubes and similar articles; unglazed, whether or not rectangular, the largest surface area of which is capable of being enclosed in a square the side of which is less than 7cm                                       | China  | no            |
| 691110   | Tableware and kitchenware; of porcelain or china                                                                                                                                                              | China  | yes           |
| 701911   | Glass fibres; (including glass wool), chopped strands, of a length of not more than 50mm                                                                                                                      | China  | no            |
| 701940   | Glass fibres; woven fabrics of rovings                                                                                                                                                                       | China  | no            |
| 701951   | Glass fibres; woven fabrics (other than of rovings), of a width not exceeding 30cm                                                                                                                          | China  | yes           |
| 701959   | Glass fibres; woven fabrics (other than of rovings), n.e.s. in item no. 7019.5                                                                                                                               | China  | yes           |
| 722611   | Steel, alloy; flat-rolled, width less than 600mm, of silicon-electrical steel, grain-oriented                                                                                                                  | Japan  | no            |
| 730411   | Iron or steel (excluding cast iron); seamless, line pipe of a kind used for oil or gas pipelines, of stainless steel                                                                                            | China  | yes           |
| 730441   | Steel, stainless; cold-drawn or cold-rolled, tubes and pipes of circular cross-section                                                                                                                       | China  | yes           |
| 730490   | Iron or steel; tubes, pipes and hollow profiles, seamless, n.e.s. in heading no. 7304                                                                                                                       | China  | yes           |
| 810296   | Molybdenum; wire                                                                                                                                                                                             | China  | yes           |
| 850131   | Electric motors and generators; DC, of an output not exceeding 750W                                                                                                                                         | China  | yes           |
| 850132   | Electric motors and generators; DC, of an output exceeding 750W but not exceeding 75kW                                                                                                                       | China  | yes           |
| 850133   | Electric motors and generators; DC, of an output exceeding 75kW but not exceeding 375kW                                                                                                                     | China  | yes           |
| 850134   | Electric motors and generators; DC, of an output exceeding 375kW                                                                                                                                             | China  | yes           |
| 850162   | Electric generators; AC generators, (alternators), of an output exceeding 75kVA but not exceeding 375kVA                                                                                                | China  | yes           |
| 850163   | Electric generators; AC generators, (alternators), of an output exceeding 375kVA but not exceeding 750kVA                                                                                                    | China  | yes           |
| 850164   | Electric generators; AC generators, (alternators), of an output exceeding 750kVA                                                                                                                             | China  | yes           |
4 Methods

In this section, we present our empirical strategy to study events of anti-dumping circumvention via re-rerouting a trade flow via a third country.

4.1 Network-based circumvention measures

Consider a product \( p \). At a given point in time where the time index \( t \) runs from 1 to \( T \), we can draw a network, \( N_{p,t} \), where the nodes are the countries and the edges represent the trade flows. For any two countries \( i \) and \( j \), an edge is drawn from \( j \) to \( i \) if the former exports product \( p \) at time point \( t \) to the latter. Hence, the network is directed and weighted. The weight of each edge is proportional to the monetary value obtained from the Comtrade database.

We investigate the following hypothesis of anti-dumping circumvention by re-routing via a third country.

**Hypothesis 1:** Assuming that there is an anti-dumping duty on product \( p \) on the trade flow going from country \( j \) to country \( i \) at time \( t \), there is circumvention of the anti-dumping duty via re-routing if country \( j \) re-routes product \( p \) to country \( i \) via countries in the networks \( N_{p,t} \) other than \( i \) or \( j \).

To investigate the occurrence of circumvention of the anti-dumping duty via re-routing, we consider the network of trade flows of product \( p \) at different time points \( t \). Suppose an anti-dumping is imposed by country \( i \) on country \( j \) for product \( p \). Under Hypothesis 1 we expect country \( j \) to re-route at least part of the trade flows of product \( p \) via at least one third country, suppose country \( k \). Figure 2 shows a stylized representation of anti-dumping circumvention, where the trade patterns between \( i \) and \( j \) have changed due to rerouting through country \( k \). We can quantify the extent to which re-routing takes place by computing all possible paths connecting country \( j \) to \( i \). When an anti-dumping is in place, we expect that a shift in the distribution of the weight of all possible shortest paths connecting \( j \) to \( i \) via any third country, due to re-routing. In particular, we expect an increase in the weight of paths of length greater than 1 connecting \( j \) to \( i \).

Define \( x^{p,t}_{i \rightarrow j,k} \) as the total of USD exchanged from country \( i \) to country \( j \) via a third country \( k \) for product \( p \) in period \( t \): we obtain \( x^{p,t}_{i \rightarrow j,k} \) by summing the values of the trade flows going from country \( i \) to \( k \) and from country \( k \) to \( j \), which we obtain from the Comtrade database. The measure of anti-dumping circumvention is obtained by summing \( x^{p,t}_{i \rightarrow j,k} \) across all third countries other than
Figure 2: Expected changes in trade flows between country \( i \) and \( j \) with no anti-dumping (left) and when, in presence of an anti-dumping, country \( j \) circumvents the anti-dumping imposed by \( i \) by re-routing via a third country \( k \) (right).

\[ y_{p,t}^{j \rightarrow i} = \sum_{k \neq i,j} x_{p,t}^{i \rightarrow j,k}. \]

In the remainder, we refer to \( y_{p,t}^{j \rightarrow i} \) as the *circumvention index*. Alternatively, one could compute the \( y \) measure considering other statistics than the monetary value of the trade flow, like the exchanged quantity (in Kg), or accounting only for the last section of the route (i.e., only incoming edges into the EU). We compute the above measure on all routes between two trade partners that happen via a third country. Moving to longer paths via more than one country would allow controlling for possible re-routing paths happening via more than one country: although this could potentially bring many additional insights to the analysis, it would also increase exponentially the computational complexity of the problem. Given the exploratory nature of this work, we consider the simplest case of circumvention happening only via one other country\(^4\).

### 4.2 Econometric method

In this section, we briefly discuss the econometric methods that we employ to detect a suspicious case of circumvention of an anti-dumping measure. For a given time series \( y_{p,t}^{j \rightarrow i} \) of length \( T \), we construct a panel of controls \( y_{p,t}^{j \rightarrow i'} \), being a matrix of dimension \( T \times C_p \), where \( C_p \) is the number of controls for product \( p \). These controls correspond to the paths (of length 2) from country \( j \)

\(^4\)The data set is available on the corresponding author’s personal website https://lucabarbaglia.github.io/.
towards country $i$ for all products $p' \neq p$ whose HS commodity codes have the first two digits different from the focal product $p$. By considering products with HS code differing in the first two digits, we ensure that we have a large enough number of controls that belong to a different product category than product $p$. Moreover, we select the control time series such that they are not associated with the announcement, imposition or withdrawal of any anti-dumping duty in the time period in analysis. We exclude control time series if they have more than 10% missing/non reported entries for the monetary value of the trade flow. The number of controls $C_p$ varies across the 18 time series in analysis, ranging from a minimum of 121 controls to a maximum of 154 ones.

We pool the time series $y^p_{j \rightarrow i}$ and the respective controls $y^{p'}_{j \rightarrow i}$ and estimate the fixed-effects regression model:

$$\log(y^{c,t}_{j \rightarrow i}) = \mu^c + \beta d^{c,t} + \epsilon^{c,t},$$

(2)

where $c = 1, \ldots, C_p + 1$, and $t = 1, \ldots, T$. The index $c$ stands for either the focal product $p$ or one of the control products. We include a dummy variable $d^{c,t}$ equal to one if time point $t$ is in-between (or including) the imposition and withdrawal of the anti-dumping duty for product $c$; zero otherwise. The symbols $\mu^c$ and $\epsilon^{c,t}$ stand for the fixed effect and error term, respectively. The response is log-transformed, which is possible since it contains no zeros. Note also that the dummy $d^{c,t}$ takes the value one only in the periods in-between the imposition and withdrawal of an anti-dumping duty of the time series in analysis $y^p_{j \rightarrow i}$. Indeed, the dummy $d^{c,t}$ is zero for all controls $y^{p'}_{j \rightarrow i}$ by construction, since they are not subject to any anti-dumping duty. We test whether the estimated $\beta$ is significantly different from zero. We also consider an alternative specification of Equation (2), where we standardize the dependent variable by demeaning and rescaling.

5 Results

Figure 3 reports the standardized circumvention index defined in Equation (1) for each of the 18 time series in analysis. We report the circumvention index in analysis (in red), alongside the circumvention indexes computed for all other countries for the same product (in grey). The blue dashed vertical line indicates the date of imposition of the anti-dumping duty from the European

5As a robustness check, we also looked at other control groups. For instance, we considered all the time series of the same product originating from all other countries than the one from the suspicious time series: the resulting number of controls was much smaller and results are not reported in the paper.
Figure 3: Standardized circumvention index for the 18 products in analysis: in red the time series in analysis, in grey the circumvention indexes from other countries. The dashed vertical line corresponds to the imposition of the anti-dumping duty on the series in analysis. A * next to the commodity code indicates that the European authorities opened an investigation for anti-dumping circumvention.

authorities. If there is circumvention of the anti-dumping duty via re-routing, we expect to observe an increase in the circumvention index of the time series under analysis. Such increase could have the form (i) of one or more unexpected jumps in the circumvention index under analysis, as seems to be the case for products like 850134, or (ii) of a more stable increase in the circumvention index level, as seems to be the case for 701951.

For measuring the performance of the proposed method for detecting anti-dumping circumvention we compute confusion matrices, see Table 2. Recall that we conclude that there is suspicion of anti-dumping circumvention for the trade flow in analysis if the estimated coefficient $\hat{\beta}$ in Equation (2) is significantly different from zero. The confusion matrix reports the number of cases where
Table 2: Confusion matrices for detecting anti-dumping circumvention using panel regression. We report the number of time series in analysis where the method detects a change or not (rows), as well as whether there is an anti-dumping investigation (columns). Results for different significant levels.

| Sign. level | Under Investigation | Not Under Investigation |
|-------------|---------------------|-------------------------|
| α = 0.1     | Detected            | 11                      | 2                       |
|             | Not Detected        | 3                       | 2                       |
| α = 0.05    | Detected            | 10                      | 2                       |
|             | Not Detected        | 4                       | 2                       |
| α = 0.01    | Detected            | 9                       | 2                       |
|             | Not Detected        | 5                       | 2                       |

our methodology detects the anti-dumping circumvention (detected) or not (not detected), against the actual presence of an investigation about anti-dumping circumvention opened by the European authorities. The off-diagonal entries of the confusion matrix report the incorrect classifications. We report the result for different significance levels of the statistical test for detecting the null hypothesis of a change in the circumvention index. As expected, the lower the significance level, the harder for \( \hat{\beta} \) to be significantly different from zero, thus decreasing the number of true positives (i.e., detected and under investigation) and false positives (i.e, detected and not under investigation). Considering a significance level of \( \alpha = 0.05 \), we correctly detect 10 out of the the 14 trade flows as suspicious cases of anti-dumping circumvention. Looking at the off-diagonal entries for \( \alpha = 0.05 \), we incorrectly detect two trade flows, while we miss to detect four trade flows that were actually put under investigation by the European authorities.

Now we repeat the analysis using the standardized version of the circumvention index. Results are reported in Table 3. We observe an improvement at all significance levels. In particular, at the standard 0.05 significance level, we correctly detect 86% (12 out of 14) of the trade flows that have been subjected to an investigation about anti-dumping circumvention by the European authorities.
Table 3: Confusion matrices for detecting anti-dumping circumvention using panel regression with standardized response. We report the number of time series in analysis where the method detects a change or not (rows), as well as whether there is an anti-dumping investigation (columns). Results for different significant levels.

| Sign. level | Under Investigation | Not Under Investigation |
|-------------|---------------------|------------------------|
| $\alpha = 0.1$ | Detected 12 | 2 |
|             | Not Detected 2     | 2 |
| $\alpha = 0.05$ | Detected 12 | 2 |
|             | Not Detected 2     | 2 |
| $\alpha = 0.01$ | Detected 10 | 2 |
|             | Not Detected 4     | 2 |

6 Conclusion

Anti-dumping duties are one of the common trade protection measures used by the EU to protect its member states’ national economies. Anti-dumping circumvention happens when a country attempts to avoid paying the duty imposed by the commercial partner, for instance, by re-routing the trade flow via a third country. In this work, we study possible events of anti-dumping circumvention via re-routing on a set of products imported by the EU. Based on the observed network of trade flows among 205 partnering countries reporting bi-directional commercial exchanges, we build a *circumvention index* to map possible events of re-routing via a third country present in our sample. We then adopt a panel method strategy on the proposed circumvention indexes to classify whether any of the trade flows in analysis might be flagged as a suspicious case of anti-dumping circumvention. We assess the validity of our empirical strategy against the actual investigations opened by the European authorities: our results indicate that the proposed empirical strategy is able to correctly identify 12 out of 14 cases under investigation for anti-dumping circumvention.

Although exploratory in nature, this paper proposes a strategy to detect suspicious cases of anti-dumping circumvention relying on the observed network of trade flows. Such an approach might serve as an early-warning system for investigation authorities, who might use it to have a
first screening of all trade flows directed to their countries, and then focus only on the suspicious cases to run a thorough investigation. Future research should try to implement alternative empirical strategies to detect suspicious cases of anti-dumping circumvention, for instance adopting an approach in line with synthetic control methods (for a recent review, see Abadie 2021). Another interesting line for future work relates to studying circumvention of an anti-dumping duty via product mis-classification Vermulst (2015), rather than re-routing via a third country.
References

A. Abadie. Using synthetic controls: Feasibility, data requirements, and methodological aspects. *Journal of Economic Literature*, 59(2):391–425, 2021.

B. Baltagi, P. Egger, and M. Pfaffermayr. Panel data gravity models of international trade. In B. Baltagi, editor, *The Oxford handbook of panel data econometrics*, pages 608–641. Oxford University Press, 2015.

L. Barabesi, A. Cerasa, D. Perrotta, and A. Cerioli. Modeling international trade data with the tweedie distribution for anti-fraud and policy support. *European Journal of Operational Research*, 248(3):1031–1043, 2016.

C. P. Bown. Global antidumping database version 1.0. *World Bank Policy Research Working Paper*, (3737), 2005.

C. P. Bown and M. A. Crowley. *The empirical landscape of trade policy*. The World Bank, 2016.

C. P. Bown, A. Erbahar, and M. Zanardi. Global value chains and the removal of trade protection. *European Economic Review*, 140:103937, 2021.

A. Cerasa and D. Buscaglia. A hedonic model of import steel prices: Is the EU market integrated? *Resources Policy*, 61:241–249, 2019.

U. Comtrade. UN Comtrade database available online at https://comtrade.un.org/db/. *UN Comtrade Online*, 2015.

R. Du, Y. Wang, G. Dong, L. Tian, Y. Liu, M. Wang, and G. Fang. A complex network perspective on interrelations and evolution features of international oil trade, 2002–2013. *Applied Energy*, 196:142–151, 2017.

P. Egger and D. Nelson. How bad is antidumping? evidence from panel data. *The Review of Economics and Statistics*, pages 1374–1390, 2011.

G. Felbermayr and A. Sandkamp. The trade effects of anti-dumping duties: Firm-level evidence from China. *European Economic Review*, 122:103367, 2020.
M. Gara, M. Giammatteo, and E. Tosti. Magic mirror in my hand... how trade mirror statistics can help us detect illegal financial flows. *The World Economy*, 42(11):3120–3147, 2019.

D. Godsell, M. Welker, and N. Zhang. Earnings management during antidumping investigations in europe: Sample-wide and cross-sectional evidence. *Journal of Accounting Research*, 55(2):407–457, 2017.

S. Hamanaka. Whose trade statistics are correct? multiple mirror comparison techniques: A test case of Cambodia. *Journal of Economic Policy Reform*, 15(1):33–56, 2012.

H. Juramy. Anti-dumping in europe: What about us(ers)? *Global Trade and Customs Journal*, 13(11/12), 2018.

X. Liu and H. Shi. Anti-dumping duty circumvention through trade rerouting: Evidence from chinese exporters. *The World Economy*, 42(5):1427–1466, 2019.

A. Muhammad and A. M. Countryman. In vino ‘no’ veritas: impacts of fraud on wine imports in China. *Australian Journal of Agricultural and Resource Economics*, 63(4):742–758, 2019.

A. C. Nita and M. Zanardi. The first review of European Union antidumping reviews. *The World Economy*, 36(12):1455–1477, 2013.

P. Rousseeuw, D. Perrotta, M. Riani, and M. Hubert. Robust monitoring of time series with application to fraud detection. *Econometrics and statistics*, 9:108–121, 2019.

C. Tabakis and M. Zanardi. Preferential trade agreements and antidumping protection. *Journal of International Economics*, 121:103246, 2019.

E. Vermulst. EU anti-circumvention rules: Do they beat the alternative? *Robert Schuman Centre for Advanced Studies Research Paper No. RSCAS*, 57, 2015.

M. Zhou, G. Wu, and H. Xu. Structure and formation of top networks in international trade, 2001-2010. *Social Networks*, 44:9–21, 2016.