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Quality of INTRASTAT DATA. Comparison Between the 'Old' and the 'New' EU Member States

Abstract: The Intrastat system is used for gathering statistical data on trade in goods between the EU Member States. Data from all the Member States are aggregated by Eurostat. Specifics of the data collection process are different in different countries and that is why mirror data (regarding by default the same transactions revealed in statistics of both the acquirer and supplier country) often do not match. The goal of the analysis conducted was to assess the quality of data on intra-Community trade in goods between the 'old' fifteen and the 'new' EU Member States as well as to point out these directions that influenced the observed differences in mirror data the most. The paper is a follow-up of previous research on the quality of foreign trade data.

Keywords: official statistics data quality, mirror data, intra-Community trade, EU

JEL: F14, C10, C82

1. Introduction

Along with Poland's accession to the EU, the INTRASTAT system was introduced in Poland as in every other Member State. On a country level, it is a system for collecting, aggregation, control and processing of data on trade in goods shipped between the EU Member States (known as intra-Community trade). On the Union's level, it is rather a system of public statistics on intra-Community trade. Eurostat performs data aggregation from files collected in all the Member States and disseminates the data in the form of Comext database.

The provisions on intra-EU trade statistics are laid down in two regulations: basic regulation – Regulation (EC) No 638/2004 of the European Parliament and of the Council (amended by Regulation (EC) No 659/2014) and implementing provisions – Commission Regulation (EC) No 1982/2004 (amended by Commission Regulation (EU) No 1093/2013). This set of legal acts is commonly referred to as 'Intrastat legislation' (Eurostat, 2017b).
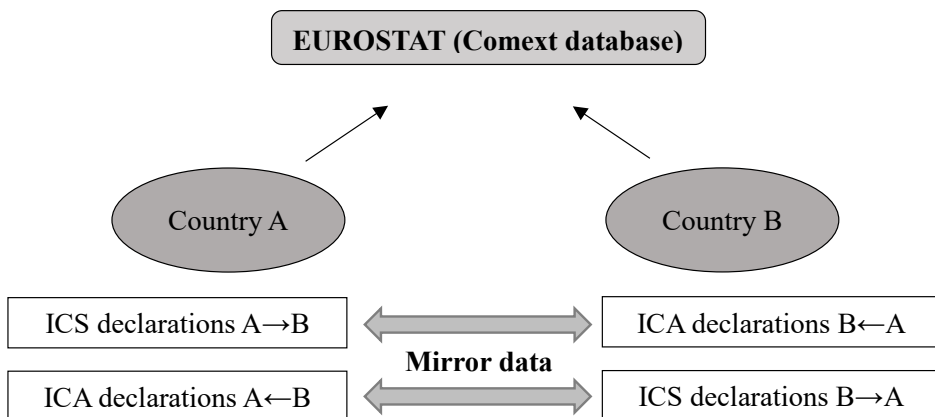

Figure 1. Mirror data on intra-Community trade
Source: own elaboration

The details of data collection procedures differ between the Member States, hence mirror data on the intra-Community supplies (ICS) and on the intra-Community acquisitions (ICA) are not fully compatible. Mirror data are information on the same transactions as recorded in official statistics of both countries of dispatch and acquisition (Figure 1). Differences in declared values of transactions between partner states measure the quality of data collected.

The aim of the analysis presented below was to assess the quality of data on intra-Community trade in goods within the old fifteen Member States and the new thirteen Member States as well as between these groups of countries and to indicate which directions have affected the observed inequalities between mirror

data the most. The authors have put forward a hypothesis that the countries of the old fifteen (EU15) as a group are different from the new thirteen (EU13) according to the quality of statistical data on intra-Community trade in goods and that we can observe higher quality of data within the EU15 countries. Dividing the EU into the 'old' and 'new' Union is straightforward from the time of accession point of view. It seems, however, that the 'old' 15 countries provide better data quality based on their long lasting experience in monitoring and correcting typical errors that exist in country-level INTRASTAT databases (since they have been in the INTRASTAT system since 1993).

2. Statistical data and research methodology

Our research was conducted with the use of Eurostat's Comext data of 2017 (as of May 19, 2018). These were values (in EUR) of dispatches and acquisitions for distinct countries as collected from individual trade transactions with all the other EU Member States[1]. The level of quality of data on trade in goods among the EU Member States is a consequence of differences between declared supply and mirror acquisition (recorded in a partner country).

In the study, two types of indices were used to measure the quality of data on intra-Community trade in goods. These two types are individual and aggregated indices described below (Markowicz, Baran, 2018).

The comparison between Eurostat's data on ICS and their mirror ICA for every pair of countries was made with the use of individual indices of data quality (in Eurostat's publications referred to as relative asymmetry (Eurostat, 2017a)), defined as follows:

$$W_E^{AB} = \frac{E_{AB} - I_{BA}}{K}, \tag{1}$$

where:

E_{AB} – declared value of dispatches (supply) from country A to country B,
I_{AB} – declared value of acquisitions by country B delivered from country A (mirror data),

$$K = \frac{E_{AB} + I_{BA}}{2} \text{ or } K = I_{BA} \text{ or } K = E_{AB}.$$

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1   The authors have presented the methodology and previous research outcomes during the II Congress of Polish Statistics organised jointly by the GUS (Statistics Poland/Central Statistical Office of Poland) and the PTS (Polish Statistical Association) in Warsaw on 10–12 July 2018.

On the other hand, comparisons of data on trade between single countries and whole groups (the old 15 or the new 13) were made using aggregated indices ($_ZW$) of data quality (asymmetry), given as:

$$_ZW_E^{A,EU} = \frac{\sum_{i=1}^{n}\left|E_{AB_i} - I_{B_iA}\right|}{K},$$

(2)

where:

E_{AB_i} – declared value of dispatches (supply) from country A to country B_i (a EU Member State),

I_{B_iA} – declared value of acquisitions by country B_i delivered from country A (mirror data),

$$K = \sum_{i=1}^{n}\frac{E_{AB_i} + I_{B_iA}}{2} \ \ \text{or} \ \ K = \sum_{i=1}^{n}I_{B_iA} \ \ \text{or} \ \ K = \sum_{i=1}^{n}E_{AB_i}.$$

In the study, values of K in formulas 1 and 2 presented above were utilised, i.e. we divided differences by the mean value of supply and mirror acquisition (which can be treated as a hypothetical value of supply). Such a policy let the authors avoid favouring one of the sides.

The individual index of data asymmetry/quality (formula 1) can take a range of values from −2 to 2. Its positive (negative) value indicates the dominant value on the supply (acquisition) side. The aggregated indices of data quality can take values from 0 to 2. The use of the absolute values of differences between supply and acquisition entails cumulating the differences and protects us from compensating those of different signs.

To verify the hypothesis built during the research, we used the Kruskal-Wallis and Dunn tests (with the Bonferroni correction). The Kruskal-Wallis test is a test of ranks for comparing distributions in k ($k > 2$) populations (Kruskal, Wallis, 1952; Domański et al., 2014). It does not need the assumptions of normality, or homogeneity of variances, and it is sometimes referred to as a non-parametric version of one-way ANOVA. The null-hypothesis assumes equal cumulative distribution functions in populations being considered. If the difference is significant, another test is applied, e.g.: the Dunn test. It is a post-hoc test for comparing multiple pairs used for indicating which of the pairs considered are characterised by a significant difference (Dunn, 1964; Pohlert, 2014).

3. Research results

The study is divided into three parts. Part one includes an analysis of quality of data on trade in goods between every pair of the EU Member States. To perform this task, a set of individual indices of data quality was used. Part two of the study refers to an analysis of data quality on trade between a country and a groups of the old/new Member States. This time aggregated indices were in use. An additional, third part of the study is a verification of the hypothesis that the EU15 countries differ significantly from the EU13 according to the quality of data declared in the INTRASTAT system.

3.1. Individual indices of data quality

For every pair of the EU Member States, individual indices of data quality between ICS of that country and mirror-ICA of its trade partner were calculated (formula 1). Figure 2. shows the lowest values of such indices – five of every group of directions, namely the EU15 to the EU15, the EU15 to the EU13, the EU13 to the EU15, and the EU13 to the EU13. The lowest values, whether positive or negative, mean the best quality of mirror data. It is worth noting that the lowest of all is the index between Polish and Slovenian data on ICS (PL-SI, –0,0004). Considering the ICS directions, the best quality of data is characteristic of transactions between the EU15 countries (the top-most group in Figure 2).
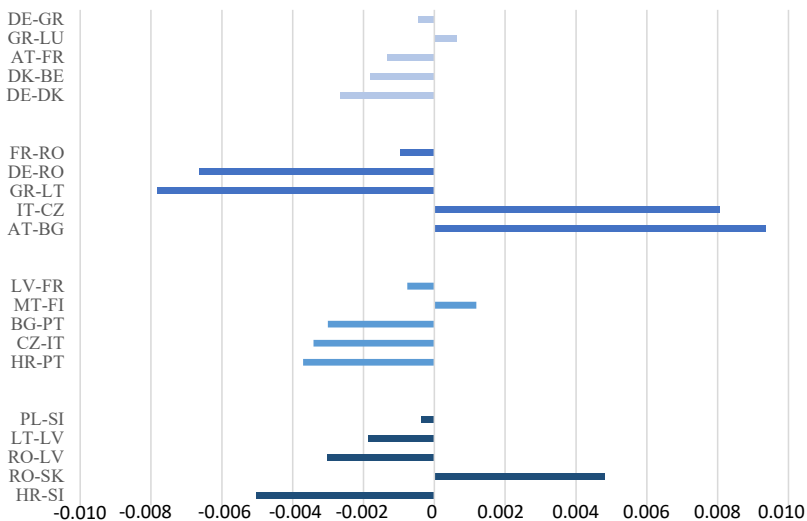

Figure 2. The lowest indices of mirror data quality among pairs of the EU Member States in 2017
Source: own study

In Figure 3, there are the highest values of these indices presented (again every group of directions represented by 5 indices). These values mean the lowest quality of mirror data in the presented pairs of countries. Among these four groups, the highest (i.e. the worst) values are for transactions between the EU13 countries, the highest two being for trade between Malta and Estonia (MT–EE; – 1.9585), and Malta and Cyprus (MT-CY; –1.9392).
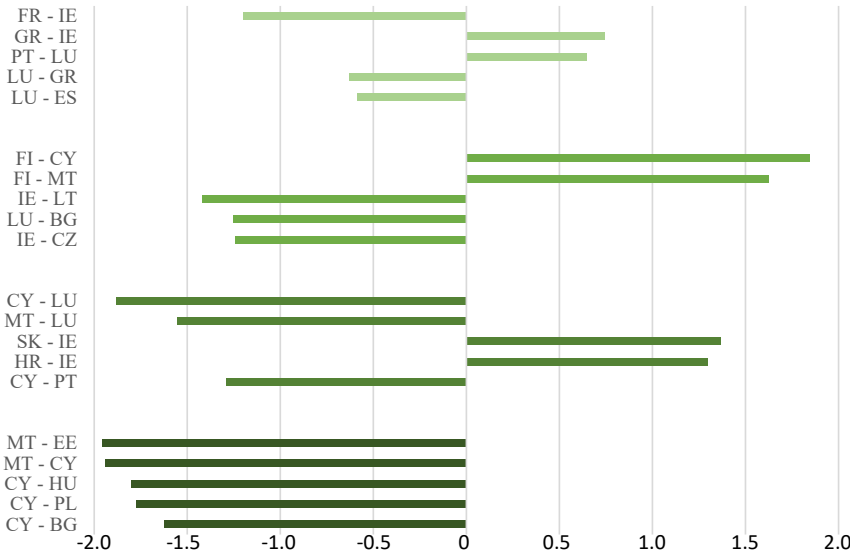

Figure 3. The highest indices of mirror data quality among pairs of the EU Member States in 2017
Source: own study

3.2. Aggregated indices of data quality

In the second stage of the study, the authors' own aggregated indices of data quality (formula 2) were used to indicate the quality of data on ICS of a specific country against aggregated mirror data from all partner countries of the EU15 or EU13 group. Figures 4–5 show values of indices calculated for the countries of the EU15 against all the countries in the EU15 and EU 13. Figures 6–7 show similar values calculated for the countries of the EU13 against the whole EU15 and EU13 groups, respectively. Values of declared ICS and mirror ICA are also shown in these charts. In the 'old' EU trade, Germany has the dominant position (Figure 4). In 2017, German ICS was the highest in the whole of the EU. The same is true of data quality. Indices for this group of countries are relatively low, from 0.052 to 0.168. In trade between the EU15 and the EU13, the prevalence of Germany is even more explicit (Figure 5). Indices are from 0.050 to 0.265 ex-

cept two: from Ireland (0.563) and Luxembourg (0.587). In the group of the 'new' Member States, their ICS both to the EU15 and the EU13 in absolute values are dominated by Poland (Figures 6 and 7). Indices are not extremely high except for those of Malta and Cyprus. In the case of ICS to the EU15, they are roughly equal to 0.4, and for ICS to the EU13 they even exceed 1, which indicates low quality of statistical data.
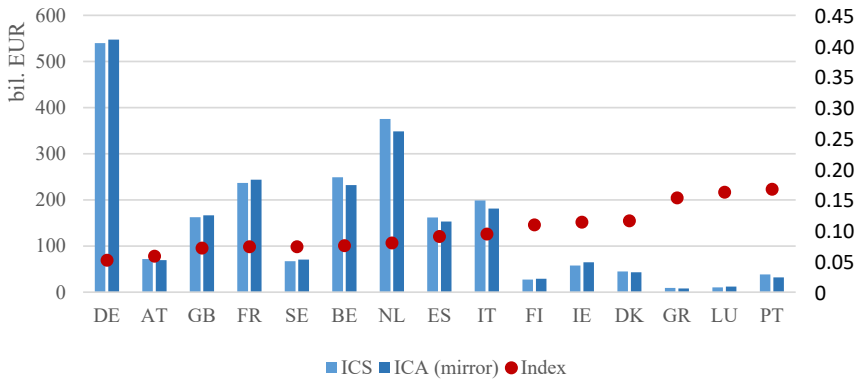

Figure 4. Aggregated indices of data quality for ICS – the EU15 in 2017
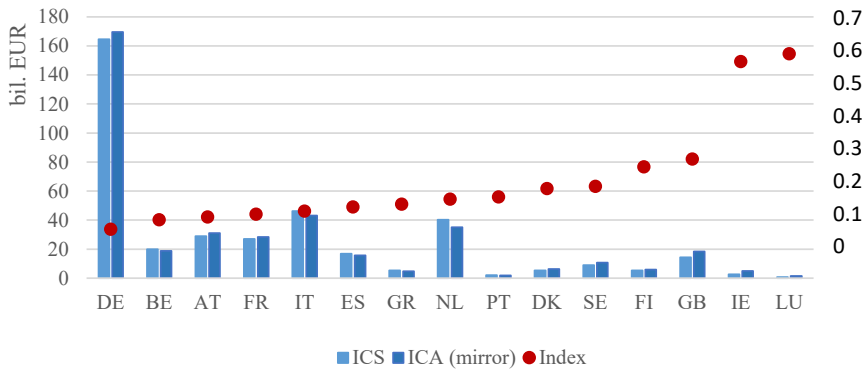
Source: own study

Figure 5. Aggregated indices of data quality for ICS – the EU15 to the EU13 in 2017
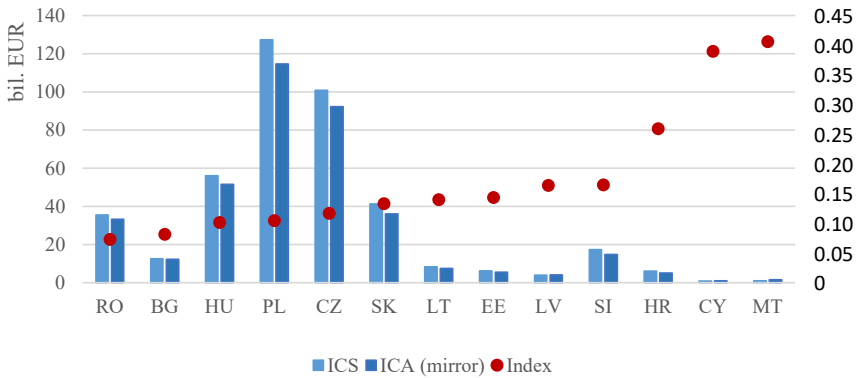
Source: own study

Figure 6. Aggregated indices of data quality for ICS – the EU13 to the EU15 in 2017
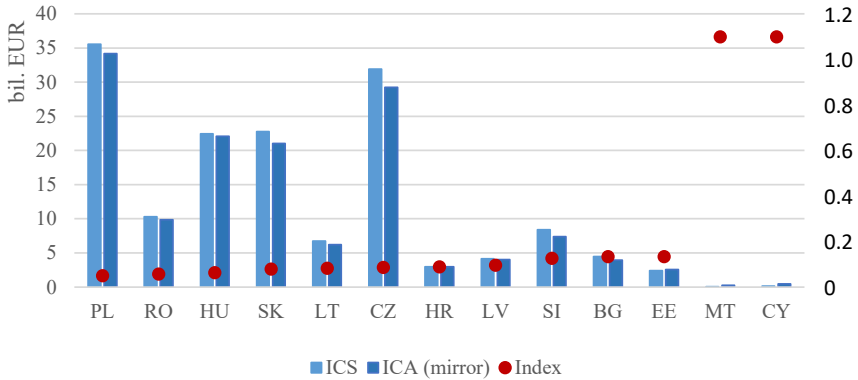
Source: own study

Figure 7. Aggregated indices of data quality for ICS – the EU13 in 2017

Source: own study

3.3. 'Old' and 'new' EU Member States – a comparison

To ascertain whether data quality differs between the 'old' EU15 and the 'new' EU13, we utilised an approach as follows. The countries were divided into two groups (the 'old' and the 'new' Member States), then individual indices of data quality fell into four groups: O-O (ICS direction: from the 'old' to the 'old' Member States; 210 indices were grouped together), O-N (the 'old' to the 'new'; 195 indices), N-O (the 'new' to the 'old'; 195 indices), and N-N (the 'new' to the 'new'; 156 indices). For such groups of indices, the Kruskal-Wallis test was performed to investigate the differences between all direction groups. Then we performed a post-hoc analysis using the Dunn test (with the Bonferroni correction for multiple comparisons) to show for which pairs of directions the differences are signifi-

cant. As an addition, we also checked whether the outcomes would still hold true if we excluded from consideration two countries: Malta and Cyprus (the countries with the lowest quality of data, outliers).

The Kruskal-Wallis test used instead of ANOVA is a good alternative to other parametric tests. There is no requirement to meet a number of assumptions. The distributions of the variables do not have to be close to the normal distribution, the groups do not have to be equal and of equal variance. However, group observations should be independent. The groups of transactions identified by us include the same countries, which suggests that the data were generated in a similar process. However, in individual countries, data are generated by obliged entities that export or import goods. In a given country, transactions in particular directions are usually carried out by different entities. Thus, it can be concluded that the individual groups are independent.

Statistical data from the Intrastat and then collectively from the Comext database are not complete data. This is the reason for the authors' research on their quality. The available data contain gaps and errors, therefore they are treated as a sample.

Figure 8 shows distributions of aggregated indices concerning transactions within the groups described above (the left panel – data for all the Member States, the right panel – without Malta and Cyprus). The least varied are indices for trade within the first group (O-O). The other groups are characterised by huge variance, even if slightly reduced after excluding Malta and Cyprus.
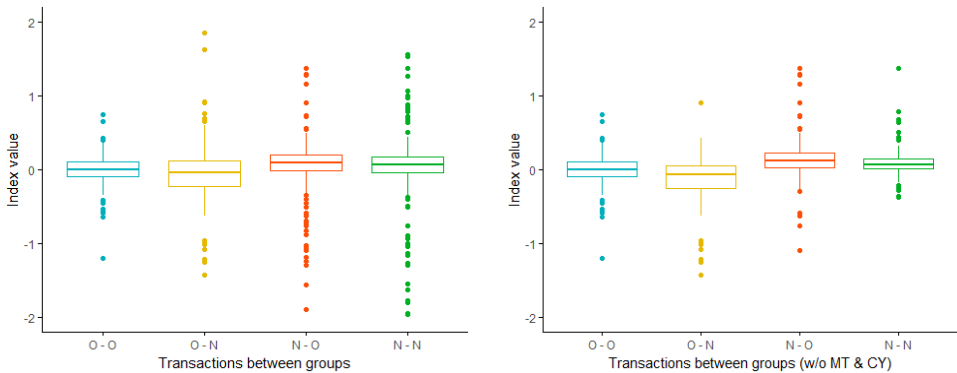

Figure 8. Comparison of groups (containing all the directions of dispatches between the 'old' and the 'new' EU)

Source: own study

Table 1 presents gathered results of the conducted Kruskal-Wallis and Dunn tests. It turns out that there are significant differences in data quality between groups of the 'old' and the 'new' Member States as ICS direction groups. The conducted analysis of all the pairs of direction groups shows no evidence of dif-

ference between N-N and N-O (i.e. ICS from the 'new' Member States, altogether and after excluding Malta and Cyprus) as well as between O-N and O-O (which renders to ICS from the 'old' Member States altogether). Based on such a verification, we confirmed existing general differences in quality of data on trade in goods between the 'old' and the 'new' EU Member States. The lack of differences between the quality indices of data on exports of goods from the new EU countries (both to the EU15 and the EU13) indicates lower quality of data on transactions of the 'new' EU13 group. Medians and quartiles of indicators for N-O and N-N directions of rotation are higher than for O-O and O-N directions (Figure 8). There is also a greater variety of index values. It can therefore be concluded that errors and data gaps appear more frequently in the mirror declarations of the EU13 traders and their trade partners.

Table 1. Results of the Kruskal-Wallis and Dunn tests

Tests		EU	EU without MT and CY
Kruskal-Wallis Test		$\chi^2 = 31.3055$ (*)	$\chi^2 = 97.3147$(*)
Dunn Test			
N-N	N-O	$Z = -0.5807$ (–)	$Z = -1.6753$ (–)
N-N	O-N	$Z = 4.0642$ (**)	$Z = 6.5617$ (**)
N-N	O-O	$Z = 2.6243$ (*)	$Z = 3.5167$ (*)
N-O	O-N	$Z = 4.9266$ (**)	$Z = 9.2092$ (**)
N-O	O-O	$Z = 3.4164$ (*)	$Z = 5.9609$ (**)
O-N	O-O	$Z = -1.6006$ (–)	$Z = -3.7852$ (**)

* Significance level 0.05; ** significance level 0.01.

Source: own study

4. Conclusions

Our research was conducted with the use of Eurostat's Comext data of 2017. Those were values (in EUR) of dispatches and acquisitions for distinct countries as collected from individual trade transactions with all the other EU Member States. The level of quality of data on trade in goods among the EU Member States is a consequence of differences between declared supply and mirror acquisition (recorded in a partner country).

The most important conclusions from the study can be stated as:

1) quality of data on intra-Community trade in goods for the EU can be assessed with the use of INTRASTAT data (declared ICS and ICA values confronted with their mirror data) using data quality indices (relative asymmetry indices);

2)   the EU15 countries are characterised by more level values of data quality indices and on average share higher data quality than the EU13 countries;

3)   the least varied are indices for trade within the first group (O-O). The other groups are characterised by huge variance, even if slightly reduced after excluding Malta and Cyprus;

4)   it is possible to separate countries of definitely lower data quality; these are Malta and Cyprus within the EU13 or Ireland and Luxembourg within the EU15;

5)   such an analysis can be used in practice – to help monitoring country-level INTRASTAT data quality; it can also be useful in finding anomalies that appear in intra-Community trade.

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Jakość danych w systemie INTRASTAT. Porównanie krajów „starej" i „nowej" UE

Streszczenie: W systemie INTRASTAT zbierane są dane statystyczne dotyczące wymiany towarowej między krajami UE. Eurostat agreguje dane pochodzące z poszczególnych państw członkowskich. Specyfika procesu pozyskiwania danych różni się w poszczególnych krajach, w związku z czym dane lustrzane (dotyczące w założeniu tych samych transakcji, odnotowanych w statystyce kraju wywozu i kraju przywozu) często się nie pokrywają. Celem przeprowadzonych analiz była ocena jakości danych o wewnątrzunijnej wymianie towarowej krajów „starej" piętnastki i „nowych" członków UE ze wskazaniem, które kierunki w największym stopniu wpłynęły na występowanie obserwowanych różnic w danych lustrzanych. Artykuł jest kontynuacją badań jakości danych dotyczących handlu zagranicznego.

Słowa kluczowe: jakość danych statystyki publicznej, dane lustrzane, handel wewnątrzwspólnotowy, UE

JEL: F14, C10, C82

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