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## Abstract

The world runs a trade surplus with itself: the reported values of exports exceed the reported values of imports. This is a logically impossible but well-known empirical fact. Less well-known is the fact that, in recent years, more than 80 percent of the global surplus is a trade surplus that the EU has with itself. In this paper, we show that this EU self-surplus amounts to a striking 307 billion Euro in 2018. It persists in goods, services, and secondary income accounts. It also exists within the Euro Area, and is strongest between neighboring countries. Around the 2004 Eastern Enlargement, the EU self-surplus quadrupled. Balance of payments data from the United Kingdom appear highly distorted. We argue that these phenomena are not only due to measurement error. Rather, a large fraction of the EU's self-surplus puzzle seems related to fraud in value added tax. The resulting loss in tax income could amount to as much as 64 billion Euro per year.

JEL-Codes: F360, F320, F240, H260.

Keywords: missing trade, VAT fraud, statistical discrepancies, current accounts.

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# 1 Introduction

The world runs a current account surplus with itself (Gros, 2017): a logical impossibility that must result from measurement error or from—possibly fraudulent—misreporting. This global current account surplus is mainly driven by the trade balance, and not by primary income statistics, which are known to suffer from measurement error. This fact—that we refer to as the world's self-surplus—has prompted Krugman (2010) to develop a humorous theory of "interstellar trade".

Less well-known, the European Union has been running massive trade surpluses with itself over years, amounting to 307 bn Euro in 2018 or 86 percent of the entire global self-surplus in 2018. The EU's self-surplus is bigger than the frequently criticized current account surplus of Germany[1], and larger than the GDP of the eight smallest EU Member States combined. It is too big to be lightheartedly discarded as an irrelevant if amusing fact. Rather, we argue that the discrepancy may result from massive fraud in value added tax (VAT) declarations, amounting to up to 64 billion Euro. Domestic transactions declared as exports are not subject to VAT. Hence, firms have an incentive to over-report export figures. On the aggregate level, this may yield a credit-bias in intra-European Balance of Payments (BoP) data and can explain the EU's trade self-surplus.

Recently, probably due to increasing international economic tensions, current account (CA) statistics have attracted unusual attention both from policy makers as well as academics. For instance, there is substantial uncertainty about whether the EU has run a bilateral CA surplus or a deficit with the US over the past decade. In times of trade conflicts, the absence of a definite answer is troublesome; see Braml and Felbermayr (2019) for an illustration and tentative interpretation of transatlantic facts. The underlying problem, however, is broader: international transaction data are of poor quality, due to negligence, strategic government manipulation, and fraud.

To the best of our knowledge, ours is the first paper that offers a systematic discussion and analysis of the EU's self-surplus.[2] We provide novel evidence by *(i)* describing the magnitudes and dynamics of the discrepancies in the intra-EU current account, by *(ii)* decomposing the self-surplus according to the sub-accounts in the current account, by *(iii)* investigating the contributions of single EU Member States, and by *(iv)* the interpretation of our findings based on forensic accounting methods. For example, we show that goods and services trade contribute almost equally to the observed discrepancy, and that the persistence of the discrepancy makes random statistical errors unlikely culprits for the patterns. As we argue later in this paper, VAT fraud is a plausible explanation for the credit-bias that is prevalent in European CA statistics.

[1] In the Euro Area, the large surpluses of Germany and the Netherlands vis-à-vis other Euro members have provoked difficult political discussions; see Gros (2012); Bonatti and Fracasso (2013); Kollmann et al. (2015).

[2] The mere fact has been highlighted by Eurostat; see Eurostat 2018, accessed on April 10, 2019.

For very good reasons, economists usually deem bilateral current account balances irrelevant from a macroeconomic perspective (Feenstra et al., 1999; Mankiw, 2018). However, they are of great importance for bilateral economic relations, in particular in the context of trade conflicts.

Discrepancies in so-called mirror data are statistical artifacts prevalent in many international data with dyadic dimension.[3] In principle, any market transaction involves the documentation of corresponding values by buyer and seller. After correct summation, balances must necessarily mirror each other: all countries' exports are equal to all countries' imports; this is a mechanical accounting process and holds true by definition. However, in reality, perfectly corresponding mirror data are the exception rather than the rule. Frankel (1978) discusses potential reasons for the worldwide current account deficit in the 60's and 70's. This debit-bias, however, has turned into a credit-bias in the early 2000's. Helbling and Terrones (2009) suggest that time lags in international transportation might lead to lagged recording of imports relative to exports; in a world of rapidly growing trade, global surpluses would be a necessary consequence. According to this explanation lengthy shipment processes and high growth rates distort trade figures. This bias should even revert, when global trade shrinks.

Considering the geographical proximity of EU Member States and the resulting possibility for land transportation, the relatively weak economic growth, as well as the fact that services trade is equally affected, leads us to assume that other reasons must lie at the heart of the observed discrepancies. Ferrantino et al. (2012) investigate discrepancies in goods trade between the US and China and link them to VAT fraud and tariff evasion. As tariff evasion can be ruled out for transactions within the EU customs union, our interpretation focuses on VAT fraud.

The remainder of this paper is structured as follows: Section 2 discusses relevant conceptual issues and reports the main finding: the self-surpluses of the EU and the Euro Area. Section 3 focuses on those Member State pairs exhibiting the most severe discrepancies and tries to identify the countries responsible. Section 4 turns to VAT fraud as an explanation for the observed discrepancies and provides an outline for a potential solution. Section 5 concludes.

[3] To be clear, in the following analysis, we do not focus on bilateral CA *imbalances* but *discrepancies*. Imbalances occur if country A and B exchange different amounts of goods and services, which is true for many country pair relationships. Statistical discrepancies occur if a transaction between A and B is recorded differently by the sender (exporter) and the receiver (importer). In other contexts, CA discrepancies describe the statistical difference between the current and the financial account.

# 2 Aggregate EU Self-Surpluses

## 2.1 Current Account Data

To provide a full picture, all main items in the current account need to be covered: goods trade, services trade, primary income, and secondary income.[4] In a world without reporting issues—where mirror data match perfectly—the following two account identities must hold:

1. All sub-accounts of the intra-EU current account sum to zero.

2. The aggregate intra-EU current account sums to zero.

Identity 1 is self-evident. If it holds, Identity 2 holds as well. Even if Identity 1 is violated, Identity 2 can still hold. This could be the consequence of demarcation problems.[5] Such demarcation problems emerge with "servitization", i.e., the increasing services content embodied in manufacturing exports caused by related software, design, financing, or maintenance tasks.[6] Also, some transactions may misleadingly appear in primary income accounts rather than in services trade accounts. This can be the case when countries do not provide services associated with intangible assets directly but through tax havens. Typically, such demarcation issues cancel each other out after aggregation.

For the purpose of the present analysis, we rely on balance of payments (BoP) data provided by Eurostat only.[7] This rules out methodological differences in data compilation or differences in the interpretation of the Balance of Payments Manual 6 (International Monetary Fund, 2009) by reporting countries.[8] Please note that for Malta data are either not recorded or not published. Values are denoted in Euro. We apply the term "discrepancy" to refer to corresponding import-export statistic which fail to match each other. Aggregate discrepancies are also referred to as *self-surpluses* or *self-deficits*, respectively. Unless not specified otherwise, imports and exports include the sum of goods and services trade. Unfortunately, primary income accounts are not accessible. Thus, we cannot provide a full picture of the total CA discrepancy. In contrast, secondary income accounts data are available and will be subject of this analysis.

[4] Primary income refers to receipts and payments of employee compensation paid to non-resident workers as well as investment income (receipts and payments on direct investment, portfolio investment, other investments, and receipts on reserve assets). Secondary income designates current transfers between residents and non-residents, i.e., payments without quid pro quo such as remittances, international cooperation payments, or cross-border fines. Cf. International Monetary Fund (2009).

[5] The different treatment of the same transaction by statistics authorities in different countries.

[6] For a broad overview, cf. Baines et al. (2009).

[7] The main data source for CA figures is the series *bop_c6_q* in the version from November 2019.

[8] Find here the IMF BPM6: www.imf.org/external/pubs/ft/bop/2007/bopman6.htm.

## 2.2 The EU's Trade Self-Surplus

First of all, we present the overall trade balance for the EU and the Euro Area with themselves. For this purpose, we sum up trade balances of all EU (Euro Area) Member States vis-à-vis all EU (Euro Area) Member States.

Figure 1 shows that both the EU and the Euro Area run substantial trade self-surpluses; evidently, Identity 1 has been violated for the past 12 years. In 2018, the total self-surpluses (goods and services) amount to 307 and 126 bn Euro, respectively. These self-surpluses equal 1.9 and 1.1 percent of the respective nominal GDP levels. The mere size of the intra-EU trade discrepancy is stunning: in absolute numbers, it is more than the combined GDP of the EU's 8 smallest economies.[9] Dynamics of the shown discrepancies reveal that these self-surpluses are persistent over time: over 12 years of observation, the EU and the Euro Area ran surpluses that cumulatively amount to 3 and 1.6 trillion Euro. While, for the Euro Area, the total discrepancy fluctuates between 0.5 and 1 percent of the GDP for almost one decade, the intra-EU discrepancy increases and now reaches levels close to 2 percent. From 2013 onward, both the EU and the Euro Area exhibit a strong growth in the services trade self-surplus. When it comes to he EU, 46 percent of the total discrepancy are due to services trade. In the case of the Euro Area this share amounts to 31 percent in 2018. Any major difference between the EU and the Euro Area can very likely be largely attributed to the United Kingdom.[10] Overall, these discrepancies can hardly result from random measurement errors; otherwise one would expect the time series to be stationary with mean zero.

Are there severe classification issues between services and goods trade in the European data? If that was the case, one balance would have to show a self-surplus and the other a self-deficit. This is not the case: for both the EU and the Euro Area, the total discrepancy of the net exports is almost perfectly equal to the total of discrepancies of the goods balance and the services balance.[11]

## 2.3 The Secondary Income Puzzle

As mentioned, data on primary income are not available. Therefore, intra-EU current account balances cannot be constructed. Thus, it is beyond the scope of our analysis to test Identity 2. However, we can aggregate the goods, services, and secondary income balances, to test if the inclusion of the secondary income balance reduces the self-surpluses. In contrast to many other advanced economies, intra-EU secondary in-

[9] According to Eurostat's nominal GDP figures for 2018.

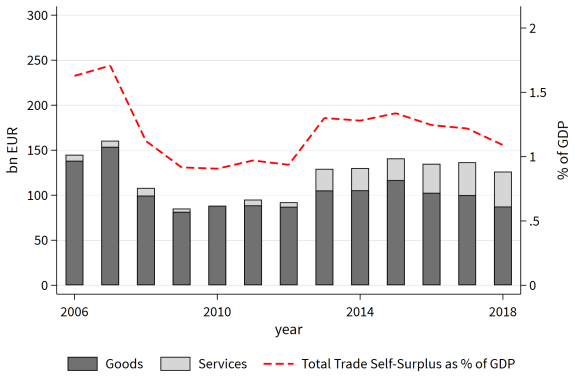
[10] Our previous analysis has shown that UK figures are also the reason for substantial service trade discrepancies of the EU with the United States (Braml and Felbermayr, 2019). Thus, the UK statistical recording of service trade not only contributes to EU–US current account discrepancies, but also distorts intra-EU BoP figures quite substantially.

[11] Net exports are constructed as the difference between exports and imports.

**Figure 1:** EU and Euro Area Trade Self-Surpluses, bn EUR and % of GDP

**(a)** EU


**(b)** Euro Area




**Source:** Data from Eurostat 2019; own calculations.

**Note:** Left scale in bn Euro refers to the bars, right scale in % of nominal GDP refers to the dashed line. Figures show balances of the goods and services trade BoP accounts.

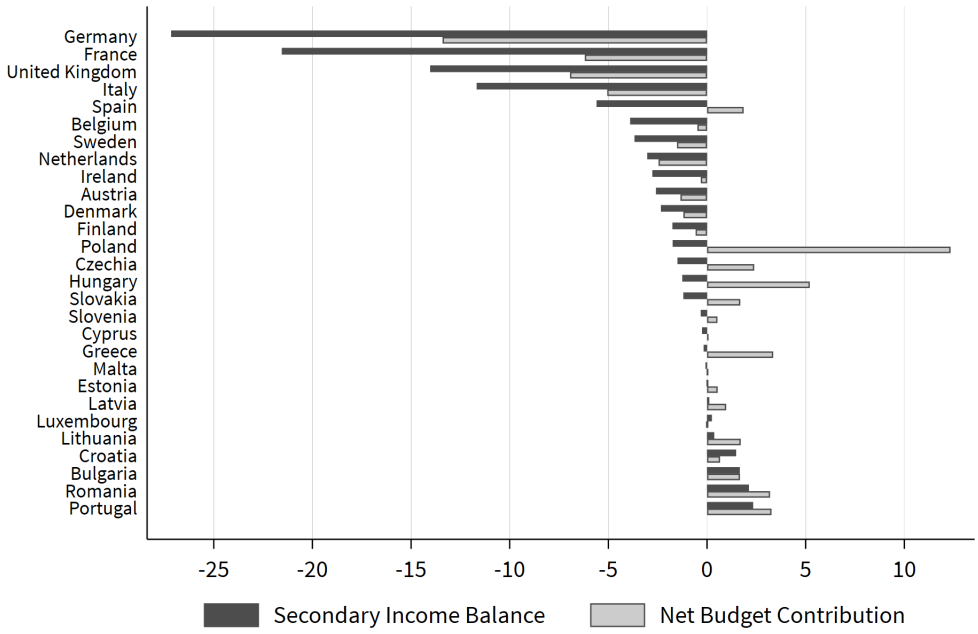
come balances are particularly informative, because the EU redistributes income among its Member States and EU migrants channel very substantial flows of personal transfers to their home countries.[12] In 2018, the aggregate secondary income balance for the EU with itself yields a self-deficit of 98.2 bn Euro, or 0.6 percent of the Union's GDP. This is remarkable: a negative secondary income balance is associated with net payments to international organizations such as the EU, direct transfers (official development aid), or any other transaction that misses the character of an economic exchange. Frankel (1978) argues that the secondary income accounts typically entail a debit-bias since negative balances indicate national generosity: net donors (recipients) may tend to over-report debits (under-report credits). Possibly, the self-surplus in the EU trade statistics may partially be offset by the secondary income account. Consequently, one must assume demarcation problems between trade and secondary income balances. This can hardly be argued.[13] Subtracting 98 bn Euro from the EU's 307 bn Euro trade self-surplus, at best only 209 bn EUR or 1.3 percent of the Union's GDP are statistically lost. For the Euro Area, the secondary income balance with itself shows a small surplus of 6.2 bn EUR.

Secondary income balances for EU Member States vis-à-vis other EU Member States consist, by and large, of net contributions to the EU budget. This illustrates why demarcation problems between secondary income and trade balances seem highly unlikely. Goods and services trade accounts result from private sector transactions, net budget contributions are the consequence of inter-governmental redistribution. Thus, assuming demarcation problems between the two is neither straight-forward nor plausible.

[12] According to Eurostat, intra-EU remittances amount to 70 bn Euro in 2018. A large fraction of this, however, is compensation of employees which accordingly is part of the primary income account.

[13] Demarcation issues may also exist between secondary income and the capital account. Nevertheless, statistical offices in EU Member States should agree on a uniform interpretation of the BPM6.

**Figure 2:** Secondary Income Balances and EU Budget Contributions, 2018, bn EUR




**Source:** Eurostat 2019, European Commission 2019; own illustration.

**Note:** The diagram shows secondary income balances of EU Member States vis-à-vis all other EU Member States. The net budget contribution is calculated as the difference between official payments to and from the EU.

A comparison of secondary income balances and EU budget contributions helps proving data consistency. This is shown in Figure 2. The following observations must not go unnoticed: first, large net contributors such as Germany, the UK, France, and Italy report negative secondary income balances twice as high as the budget contribution in absolute numbers. Second, even net recipients such as Czechia, Greece, Hungary, Poland, Slovakia, and Spain report negative secondary income balances. Third, the net contributions sum up to zero, whereas the total of the secondary income balance accounts for -98 bn Euro. Fourth, both numbers are positively correlated, the Bravais-Pearson Correlation Coefficient yields 0.8. Table 5 in the Appendix presents the data underlying Figure 2. For the sake of completeness, it also shows net personal transfers between residents and non-residents, the second core component of the secondary income account.

We can tentatively conclude the following: first, the net budget contribution and net personal transfers combined fail to sufficiently explain secondary income balances of EU Member States vis-à-vis their EU partner countries. Second, both personal transfer and budget contribution figures yield much smaller discrepancies in any direction compared to the self-deficit of the secondary income balance of 98 bn Euro. Third, the negative secondary income balances of Czechia, Greece, Hungary, Poland, and Slovakia contradict the direction of budget and personal transfers flows. Thus, even the signs of the balances

remain highly ambiguous.

# 3 Which Countries Account for the EU's Self-Surplus?

The aim of this section is to shift the focus of the analysis to the country and country pair level. This is crucial in order to draw accurate policy conclusions. More specifically, we are interested in identifying country pairs that cause particularly large discrepancies. One can plausibly argue that the quality of institutions, the nature of national tax systems, and even geography should play a role in explaining discrepancies caused by fraudulent behavior, in particular by VAT evasion. Therefore, this section serves as the empirical foundation of the interpretation outlined in Section 4.

## 3.1 Dissecting the Discrepancies

In the following analysis, we draw on Eurostat data on bilateral trade flows (goods and services) for the year 2018 .[14] Considering all 28 EU member states, we have a maximum of 756 (28×27) observations per BoP item.[15] The Eurostat BoP data yield intra-EU goods trade exports (credit) totaling 2,874 bn Euro. This accounts for 82 percent of intra-EU exports recorded by Eurostat trade statistics (Comext).[16] It becomes apparent immediately that the coverage of EU BoP data is in need of improvement. A sensitivity analysis in Section 3.5 provides a more detailed comparison of BoP and foreign trade statistics data.

Our preferred measure for bilateral discrepancies takes credit and debit positions into account. The vectors $X_{ij}$ and $M_{ij}$ are reported by country $i$, the vectors $X_{ji}$ and $M_{ji}$ by country $j$.[17] In the case of perfectly matching mirror data, $X_{ij}$ should equal $M_{ji}$ and $M_{ij}$ should equal $X_{ji}$. Let $\mathcal{E}$ denote the set of all EU Member States. Consequently, we should observe

$$\sum_{j\in\mathcal{E}}\sum_{i\in\mathcal{E}} X_{ij} = \sum_{j\in\mathcal{E}}\sum_{i\in\mathcal{E}} M_{ji}. \tag{1}$$

However, bilateral flows do not match perfectly in the data so that $X_{ij} \neq M_{ji}$ and $M_{ij} \neq X_{ji}$. Consequently the equality above fails to hold. We may define the discrepancy $\Delta_{\mathcal{E}}$ such that

$$\Delta_{\mathcal{E}} \equiv \sum_{j\in\mathcal{E}}\sum_{i\in\mathcal{E}} (X_{ij} - M_{ji}) = \sum_{j\in\mathcal{E}}\sum_{i\in\mathcal{E}} \Delta_{ij}, \tag{2}$$

[14] As our only data source we use Eurostat *bop_c6_q*. Due to data limitations, we cannot provide detailed sector specific results but focus on aggregate bilateral BoP items (goods trade account and services trade account) between EU Member States.

[15] After excluding missings—those trade flows for which neither party provides information—we lose 35 observations. For some additional trade flows, we miss data that are not available from both parties. Data reported by Malta and Spain are not available.

[16] Eurostat records total intra-EU trade based on export figures of 3,525 bn Euro in 2018.

[17] Both $X_{ij}$ and $M_{ji}$ are expressed *fob* (free on board).

where we define the absolute bilateral reporting discrepancy as $\Delta_{ij} \equiv X_{ij} - M_{ji}$. Empirically, we observe $\Delta_{\mathcal{E}} > 0$. This can be due to systematic over-reporting of $X_{ij}$ or under-reporting of $M_{ji}$.[18] As we do not know the "true" size of the trade flows between $i$ and $j$, we cannot distinguish between the two sources of misreporting. Both are possible. If we knew the true value, which assumptions could we make about the structure of the measurement error?

Assuming errors are random and multiplicative, the number of elements in $\mathcal{E}$ growing very large, would lead to $E(\Delta_{\mathcal{E}}) \to 0$. As we will show empirically, this is not true. So, errors are in fact non-random.

In the following, we express the discrepancy in a pair in relative terms as

$$\delta_{ij} = \frac{2\Delta_{ij}}{X_{ij} + M_{ji}}. \tag{3}$$

For the sake of convenience, this equation is pre-multiplied with 100%. Table 1 shows summary statistics for the observed discrepancies in bilateral BoP data for the year of 2018. Figure 5 in the Appendix illustrates these distributions graphically. Positive means and medians confirm what we know from aggregate data: the presence of a credit/export bias. For goods trade, 50 percent of the flows are outside a discrepancy range between -10 to 18 percent around the mean values. For services trade, the same is true for a range between -18 and 46 percent. The standard deviation is roughly the same in both distributions.

**Table 1:** Summary Statistics: Bilateral Discrepancies, 2018, in %

| | Min | P-25 | Median | Mean | P-75 | Max | SD |
|---|---|---|---|---|---|---|---|
| Goods Trade | -195.1 | -10.2 | 5.4 | 2.3 | 17.5 | 206.7 | 49.4 |
| Services Trade | -200.0 | -18.0 | 11.0 | 12.7 | 43.1 | 200.0 | 54.8 |

**Source:** Data from Eurostat 2019; own calculations.
**Note:** The table shows summary statistics for the distribution of discrepancies as defined in Equation 3.

## 3.2 Country Analysis

In the following, we discuss which countries appear to have the largest reporting biases. The identification of Member States who play a major role in causing the observed discrepancies is of great interest. Due to the dyadic dimension of the problem, a definite identification is difficult to achieve. As an approximation to this problem, we calculate

[18] In principle, both can be under-reported or over-reported, but to different degrees.

average country level discrepancies:

$$\delta_i = \frac{1}{n}\sum\nolimits_{j\in\mathcal{E}} \delta_{ij} \quad \text{and} \quad \delta_j = \frac{1}{n}\sum\nolimits_{j\in\mathcal{E}} \delta_{ij}, \tag{4}$$

where $\delta_i$ denotes the mean discrepancy for country $i$ being the exporter, $\delta_j$ denotes the mean discrepancy for country $j$ being the importer, and $n$ measures the number of trade partners (i.e., the cardinality of the set $\mathcal{E}$). Table 2 shows mean discrepancies per country based on Equation 4 for goods and services separately.

**Table 2:** Mean Discrepancies per Country, 2018, in %

| Country | Goods Credit | Services Credit | Goods Debit | Services Debit |
|---|---|---|---|---|
| Austria | 16.7 | 33.1 | 3.3 | 24.4 |
| Belgium | -15.8 | 27.4 | -12.8 | 9.6 |
| Bulgaria | 28.6 | -34.0 | 15.4 | -39.0 |
| Croatia | 25.9 | 11.6 | 5.3 | -42.7 |
| Cyprus | -61.9 | -79.9 | -37.5 | -73.3 |
| Czechia | -2.9 | -4.2 | -14.8 | -28.4 |
| Denmark | 6.4 | 48.9 | 3.2 | 11.5 |
| Estonia | 7.6 | 48.7 | -21.2 | 46.1 |
| Finland | 12.4 | 33.1 | -7.5 | 6.0 |
| France | -3.3 | 2.3 | -3.6 | 9.4 |
| Germany | 9.9 | -7.1 | 11.9 | -17.7 |
| Greece | 28.3 | 44.1 | 32.6 | -2.2 |
| Hungary | 7.0 | 24.8 | 11.3 | 2.5 |
| Ireland | -20.0 | -13.1 | -9.2 | -62.0 |
| Italy | 4.7 | 4.0 | -1.1 | 3.5 |
| Latvia | 10.2 | 10.5 | 9.7 | -39.2 |
| Lithuania | 12.4 | 23.3 | 10.1 | -3.1 |
| Luxembourg | 41.2 | 63.3 | 2.1 | 7.7 |
| Netherlands | 0.3 | -0.8 | -3.1 | -32.4 |
| Poland | 14.2 | 26.2 | 4.6 | 5.7 |
| Portugal | 23.1 | 34.4 | 5.9 | -10.9 |
| Romania | 13.6 | 24.2 | 15.6 | 3.5 |
| Slovakia | 10.1 | 10.0 | 5.1 | -11.0 |
| Slovenia | 23.5 | 53.8 | 23.8 | 8.2 |
| Sweden | -65.3 | -2.6 | -55.5 | -22.4 |
| United Kingdom | -8.1 | -17.4 | -8.5 | -62.4 |

**Source:** Data from Eurostat 2019; own calculations.
**Note:** Column 1 and 2 show the average discrepancy in bilateral trade for the respective country being an exporter. Column 3 and 4 show the average discrepancy in bilateral trade for the respective country being an importer. Discrepancies are defined as in Equation 4. All values refer only to BoP positions vis-à-vis EU Member States. No data is available for Malta and Spain.

As either party of a given transaction can be the source of misreporting, figures pro-

vided in Table 2 need to be interpreted cautiously. For instance, Bulgaria shows an export over-reporting bias of 29 percent on average, one of the highest observed. This bias can either be caused by 'false' reporting of exports by Bulgaria, or 'false' reporting of imports by all other countries (or, most likely, a combination of the two). Assuming all countries but Bulgaria misreport their imports, the Romanian export bias, for instance, should resemble the Bulgarian figure. In fact, it is only about half of it. The same holds true for all other individual countries. That is due to the fact that the marginal effect of one additional country pair discrepancy could change the overall country mean discrepancy only very little. Thus, the observed variation in mean export discrepancies across EU Member States is a simple and qualified indicator for country specific reporting biases.

Member States with the largest export biases (in percent) are Luxembourg (41), Bulgaria (29), and Greece (28). Germany, Europe's largest exporter, reports on average 10 percent more goods exports. The Netherlands (0.3), Czechia (-3), and France (-3.3) are those Member States with the lowest discrepancies in their goods exports. Sweden (-65), Cyprus (-62), and Ireland (-20) display a server tendency towards a substantial under-reporting of their exports. The average absolute discrepancy is 18 percent.

Discrepancies in services accounts are on average larger than in goods accounts: the average absolute discrepancy is 26 percent. Over-reporting goods exports goes along with over-reporting services exports. The two figures are significantly positively correlated ($corr = 0.62$). The most accurate reporting is performed by France (2.3) and, again, by the Netherlands (-0.8), the largest inaccuracies are observed for Cyprus (-80) and Luxembourg (63).

Table 2 demonstrates that smaller EU Member States are more likely to exhibit larger discrepancies. Indeed, absolute values of discrepancies decrease in mean trade volume: a doubling of trade volume (defined as the average of one exporter's credit and the importer's debit positions) lowers absolute discrepancies by 4.9 (goods) and 3.7 (services) percentage points. This does not come as a surprise: scale economies might also apply to statistical recording, and statistical offices might allocate resources to prioritize tackling larger trade partners. Scatter plots showing the relationship between trade volume and discrepancy are found in the Appendix (Figure 6 and 7). Also, the correlation pattern of debit and credit positions is informative: credit and debit positions are highly positively correlated ($corr = 0.85$ for goods, and $corr = 0.80$ for services). This means that countries with inflated credit accounts, also tend to over-report their debit positions. This is particularly important for interpreting discrepancies as evidence for VAT fraud, as inflated BoP accounts could be an indicator for carousel-type trade. For this purpose, however, a country pair analysis is more insightful.

## 3.3 Cross-Country Correlations

If VAT fraud is at the bottom of the self-surplus of the EU, one would expect measured VAT compliance, institutional quality or the size of the shadow economy to correlate with the mean import and export discrepancies reported above.

Figure 3 correlates our measure for country discrepancies with VAT compliance gaps estimated by Morrow et al. (2019). We observe significantly positive correlations for goods discrepancies and VAT compliance gaps but zero correlation for services. This could be an indication that goods trade discrepancies are more severely affected by VAT fraud. The correlation shows that countries with higher VAT compliance gaps tend to feature both over-reported import and export figures.

**Figure 3:** Mean Discrepancy per Country and VAT Compliance Gaps


**Source:** Morrow et al. (2019). Eurostat 2019; own calculations.

**Note:** The figure plots the VAT compliance gaps versus absolute discrepancies as defined in Equation 4 (2018 values). Fitted values according to OLS.

We do not detect a statistically significant correlation between average country discrepancies and a measure for institutional quality.[19] Thus, it appears that, in our sample, governments' ability (or willingness) to provide correct BoP data is not a function of institutional quality. We also do not find a significant correlation between average discrepancies and the relative importance of the shadow economy reported by (Medina and

[19] As a measure of institutional quality, we use the World Governance Index of the World Bank and aggregate the six sub-indexes into one combined index; see Figure 9 in the Appendix.

Schneider, 2018).[20]

Note, however, that the insights from such a cross-country analysis based on 26 observations are necessarily limited.[21] Since we are interested in international trade, the nature of the problem is inevitably bilateral. In other words: the extent of VAT fraud does not solely depend on either the exporter or the importer, but on their (potentially complex) interaction. As a next step, it is therefore crucial to conduct a bilateral country pair analysis.

## 3.4 Country Pair Analysis

This sub-section explores which country pairs are particularly prone to bilateral discrepancies. Additionally, we investigate whether neighboring countries display notably higher discrepancies—another finding that would support our hypothesis that VAT fraud plays a role in solving the self-surplus puzzle. We begin by defining the mean country pair discrepancy as

$$\delta_{ij} = \frac{1}{2}\Big(|\delta_{ij}|+|\delta_{ji}|\Big), \tag{5}$$

which is a symmetric measure in the sense that $\delta_{ij} = \delta_{ji}$. Hence, we base our analysis on 378 unique country pairs.[22] We average absolute values of flow discrepancies since positive and negative discrepancies could otherwise net out. Country pair discrepancies of goods and services trade are significantly correlated, the correlation coefficient is 0.28. Table 3 shows summary statistics of the distribution of country pair discrepancies.

**Table 3:** Summary Statistics: Country Pair Discrepancies, 2018

| | Min | P-25 | Median | Mean | P-75 | Max | SD |
|---|---|---|---|---|---|---|---|
| Goods Trade | 0.0 | 3.2 | 14.5 | 32.3 | 34.6 | 204.6 | 43.7 |
| Services trade | 0.0 | 12.8 | 30.5 | 40.4 | 55.3 | 200.0 | 37.8 |

**Source:** Data from Eurostat 2019; own calculations.
**Note:** The table shows summary statistics for the distribution of country pair discrepancies as defined in Equation 5.

Amongst the 25 country pairs show the highest pair discrepancies in goods trade, Sweden and Cyprus are listed 12 and 9 times, respectively.[23] In the services account, Cyprus is part of 11 country pairs. The country pair UK–Luxembourg is particularly striking: according to British data, the service trade volume amounts to 8.2 bn Euro; the same figure, as reported by Luxembourg, stands more than three times as large at 27.3 bn Euro. The corresponding discrepancy totals 108 percent of the mean trade volume.

[20] See Figure 8 in the Appendix.
[21] 28 EU Member States minus Malta and Spain, for which no data are available.
[22] Considering all 28 EU Member States, the number of pairs is given by $28 \times 27/2$.
[23] Cf. Table 6 and Table 7 in the Appendix for full details.

Also, the UK's service trade with Denmark worth 11.5 bn Euro (on average), shows a discrepancy of 91 percent. The trade volume of these two country pair relationships is higher than the combined trade of the other 23 country pairs with exceptionally low reporting quality.

We conclude the descriptive part of this paper with a brief regression analysis that presents insightful correlations. We regress our measure for country pair discrepancies on the mean bilateral trade volume. Moreover, we include data provided by the CEPII that are typically used for gravity estimations. Our regressions take the following form:

$$\delta_{ij} = \beta_0 + \beta_1 log(V_{ij}) + \boldsymbol{X_{ij}\mu} + \nu_i + \epsilon_{ij}, \tag{6}$$

where $V_{ij}$ denotes the mean trade volume for country pair $ij$. The vector $\mathbf{X}$ includes several country pair specific control variables: geographic distance, the presence of a common border, common language, shared history as well as differentials in VAT standard rates.[24] $\nu_i$ denotes country fixed effects taking the value one when country $i$ is part of a given country pair.

Table 4 shows the regression results. Generally, the model fit is substantially higher for goods than for services trade. As already stressed above, discrepancies decrease in trade volume; this effect remains is robust across all specifications (except for the most demanding regression on services discrepancies). The regression suggests that trade volume explains almost one fifth of the discrepancies for goods. As for services, the share of explained variance is only 11 percent. Possibly, when the volume of trade between two countries is greater, statistics are more carefully compiled.

Conditional on trade, mean discrepancies for both goods and services increase in distance; however, these effects disappear when including country fixed effects. A common border increases bilateral discrepancies by about 12 percentage points for trade in goods, a striking and robust result. We take this as indication for VAT fraud that occurs due to cross-border back and forth transactions. This effect is not present for services. Common history does not seem to have a direct impact on discrepancies. A common official language is associated with 15 percentage points increase in discrepancies. Including fixed effects, the effect vanishes.

Most importantly, differentials in VAT standard rates lead to higher discrepancies: a one percentage point increase in VAT rate differentials goes along with a 3 percentage points increase in discrepancies.[25] This is in line with our hypothesis: the higher the differences in tax rates between two countries, the greater the incentives for tax fraud. Again, with fixed effects, the effect turns insignificant. This is not overly surprising since

[24] Common history means in the case for European countries whether a country pair in the past formed a common state. For example, Croatia and Slovenia both formerly belonged to Yugoslavia. One would expect that quality of statistical recording is better in the presence of shared institutional history.

[25] The standard VAT rates in the EU range between 17% (Luxembourg) and 27% (Hungary).

**Table 4:** Regression Analysis: Country Pair Discrepancies; 2018 Cross-Section

| | Goods | | | Services | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| log Trade | -7.05*** | -5.59*** | -14.79*** | -5.83*** | -4.55*** | -8.19 |
| | (0.94) | (1.00) | (4.67) | (1.31) | (1.37) | (4.98) |
| log Distance | | 14.63*** | -5.83 | | 14.55*** | -3.05 |
| | | (4.28) | (7.49) | | (4.75) | (8.03) |
| Common Border | | 11.64*** | 12.98** | | 4.81 | 1.48 |
| | | (4.43) | (5.05) | | (6.71) | (6.74) |
| Common History | | 2.69 | 1.24 | | 11.07 | 9.49 |
| | | (5.47) | (5.59) | | (7.54) | (8.36) |
| Common Language | | 15.39** | -3.06 | | 11.38 | 5.74 |
| | | (6.52) | (8.08) | | (12.19) | (8.92) |
| $\Delta$ VAT Rate | | 3.16*** | 0.41 | | 0.92 | -0.00 |
| | | (1.20) | (1.19) | | (0.91) | (1.15) |
| Observations | 248 | 248 | 248 | 237 | 237 | 237 |
| $R^2$ | 0.18 | 0.25 | 0.59 | 0.11 | 0.16 | 0.44 |
| Country FE | | | ✔ | | | ✔ |

**Source:** CEPII 2019. Eurostat 2019; own calculations.
**Note:** Ordinary Least Square Regressions with heteroskedasticity robust standard errors. Dependend variables are country pair discrepancies as defined by Equation 5. ***, ** and * indicate statistical significance levels for p-val. $< 0.01$, p-val. $< 0.05$, and p-val.$< 0.1$.

the VAT-gap is constructed as the difference of country-i's and country-j's tax rate which is collinear to the inclusion of fixed effects.

Country fixed effects explain 28 to 34 percent of the total variance. Table 8 shows all $\nu_i$ coefficients; they can be interpreted as mean discrepancy in percentage points. These fixed effects constitute an alternative measure for quality of national data recording. Column 3 repeats this exercise with a different data source (cf. Section 3.5).

## 3.5 Sensitivity Analysis

Next, we perform a sensitivity analysis based on an alternative data base. To this end, we use 2018 trade data from the Comext database, "Eurostat's reference database for detailed statistics on international trade in goods".[26] A comparison with services trade figures from another data source would be ideal. However, Eurostat only provides services trade data based on its Balance of Payments data, which obviously makes a comparison

[26] For more information see ec.europa.eu/eurostat/web/international-trade-in-goods/data/focus-on-comext.

obsolete.

According to Comext, the EU (Euro Area) runs a self-surplus amounting to 64 (19) bn Euro in 2018. These numbers are significantly lower than those resulting from the reported Balance of Payments data. In contrast to Balance of Payments data, the foreign trade statistics (FTS) applies a different valuation method for imports and exports: imports reflect transaction values at the border of the importing economy including *cost, insurance, freight (cif)*; exports are recorded according to transaction values at the border of the exporting economy *free on board (fob)*. Thus, a bias towards higher import than export values is systemically inherent to the FTS data, while BoP statistics only comprise *fob* recorded data. Logically, one would expect zero bilateral discrepancies in BoP data and systematic import surpluses in FTS data due to *cif-fob* differentials. Both is evidently not the case, and a sizable export-bias is prevalent even in European FTS. This provides additional evidence for a systematic pattern of over-reported exports within the EU.[27]

Aside from these differences in absolute numbers, Comext data strongly support our previous findings in qualitative terms. These data display a very similar distribution of discrepancies, they allow replicating the pattern of average country discrepancies that we find in Section 2 and the same negative relationship between trade volume and discrepancies.[28] Again, Cyprus, Ireland and the UK show strong under-reporting biases. Malta, whose BoP data is not available, seems to have the most inaccurate data. For Luxembourg—at odds with the previously detected strong export-bias—a severe import-bias becomes visible. Germany, Europe's largest trading economy shows the lowest discrepancies.

Interestingly, signs of import and export reporting biases are again strongly positively correlated ($corr = 0.91$). The country pair analysis yields similar results as shown above:[29] amongst the 25 country pairs with the most inaccurate data, Cyprus appears six times; Malta even 11 times. Our regression results can largely be replicated.[30] The effects of trade volume and other covariates on the observed discrepancies are strikingly similar to our previous findings, both in terms of magnitude and significance of coefficients. We again measure a strong border effect that drives discrepancies. This finding suggests, as we explore more explicitly below, that neighboring countries are particularly prone to cross-border VAT fraud.[31]

All our findings remain absolutely robust when choosing 2017 as a reference year.[32] This is true both for BoP as well as Comext data. Hence, we are confident that the

[27] Cf. Dimitrov (2004), a Eurostat publication, for more details on methodological differences between BoP and FTS.
[28] See Figures 10 and 11 as well as Table 9 in the Appendix.
[29] See Table 10 in the Appendix.
[30] See Table 11 in the Appendix.
[31] Table 8 in the Appendix performs simple fixed effect regressions on country pair discrepancies. Magnitude and significance of the reported coefficients in Column 3 differ only very little from those in Column 1; qualitatively, they support our findings based on EU BoP data.
[32] For the sake of brevity and in order to avoid duplication, we do not discuss these results.

discrepancies shown above result from a systematic pattern that we discuss next. We have provided evidence that identifies country level and country pair level patterns in intra-EU Balance of Payments discrepancies for goods and services trade. In many cases these discrepancies are disproportionately large and seem to follow recurring patterns. Based on the evidence gathered so far, the next section attempts to unravel the EU's self-surplus puzzle.

# 4 Making Sense of the Self-Surplus Puzzle

Our findings from Section 2 and Section 3 highlight that current account data, even within the EU and the Euro Area suffer from very substantial inconsistencies. Recently, the British magazine The Economist postulated that *"Rich countries' trade statistics tend to be more reliable than those of emerging economies, where data collection is less developed"*.[33] In light of our analysis, one can question this assertion.[34] Inconsistent data make solid evidence-based economic policy advice very difficult. What is more, it could reflect a much deeper problem: fraud. Since we apply forensic accounting methods, nota bene, we can neither claim completeness nor ultimate truths but we try to collect evidence for and against our claim.

As mentioned before, not just the EU but the entire world runs a substantial trade self-surplus. This discrepancy amounts to 422 bn USD, which equals 0.5 percent of global output (or, equivalently, about 1.7 percent of world exports) in 2018, and is only slightly higher than the EU's total trade self-surplus of 363 bn USD (307 bn EUR). Hence, it appears that the EU self-surplus accounts for 86 percent of the global surplus. Figure 4 tracks the evolution of the global trade self-surplus, the EU's trade self-surplus as well as the global current account discrepancy, which consists by and large of global trade surpluses. The diagram shows that the global trade self-surplus was negative before 2004 and has increased since then, mostly in lockstep with the EU's own self-surplus. Thus, the global surplus seems not to be due to interstellar trade (Krugman, 2010). At least to a large extent, it is, in fact, made in the EU.

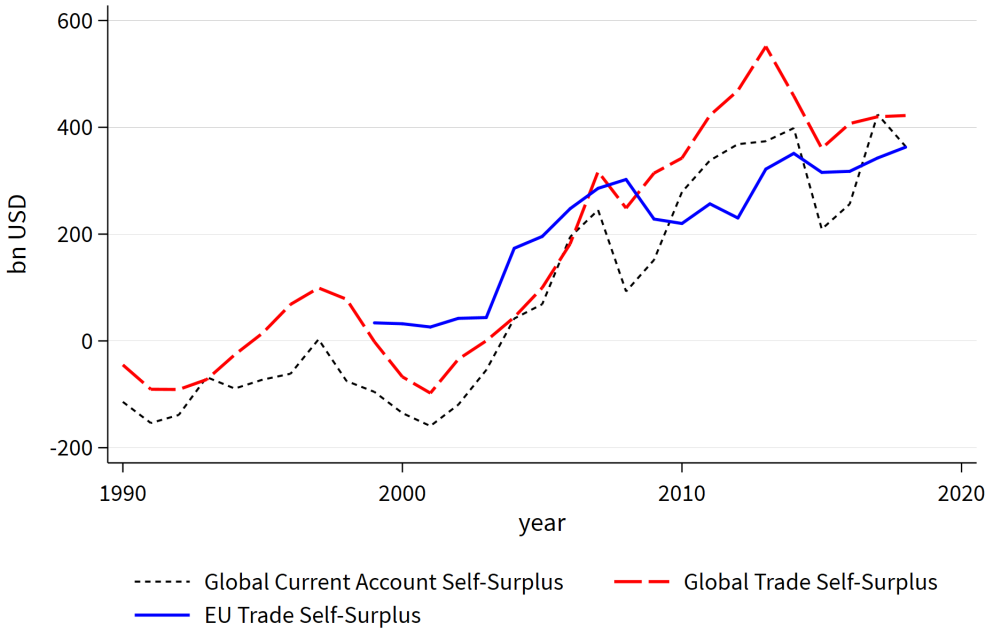
Strikingly, the global trade deficit started growing in 1993 and turned into a surplus in the late 90s. During the preceding decades, it always has been a global deficit. The year 1993 is also the starting date of the EU Single Market, which has facilitated intra-European trade substantially (Felbermayr et al., 2018). In 2004, the EU Eastern enlargement has created the world's second largest internal market. Unfortunately, comprehensive data series that would allow calculating the EU self-surplus back to 1993 are rarely available. Between 1999 and 2003, the EU self-surplus has remained very stable. Later, coinciding with the EU Eastern enlargement, it has quadrupled. Arguably, the cre-

[33] The Economist, November 12, 2011, accessed on December 20, 2018.
[34] We do not present any comparison between EU BoP data and that of emerging economies, though.

ation of the Single Market and ancillary achievements such as the Schengen Agreement or the creation of the Euro Area may have fostered VAT fraud. Indeed, in its Foreign Trade Statistics (FTS), Eurostat has been reporting a self-surplus of the EU since 1993. This is at odds with the previously discussed import-bias in FTS due to *cif-fob* differentials.

In the following, we firstly discuss alternative interpretations of discrepancies in goods trade. Second, we move to services accounts. Finally, we estimate the expected fiscal loss due to VAT fraud and outline a brief concept to improve data recording in cross-border trade.

**Figure 4:** The EU Self-Surplus in the global context, bn USD




**Source:** IMF 2019. World Bank 2019. Eurostat 2019; own calculations.

**Note:** Comprehensive EU data before 1999 are not available. The global current account and trade self-surpluses refer to the sum over all current account and trade balances, respectively. Global figures might include missing values.

## 4.1 Explaining the Self-Surplus in Goods Trade

We have shown that the EU self-surplus in goods trade exhibits a systematic, non-random over-reporting bias. Section 3 presents evidence for a high degree of variation in the quality of statistical recording across EU Member States and country pairs.

It is well known, that EU trade statistics are distorted due to the so-called Rotterdam Effect. Overseas imports entering the EU in Rotterdam and transiting to other Member States are often recorded as Dutch exports and likewise as an intra-EU import by the counterparty. This leads to inflated trade statistics with respect to the Netherlands. Discrepancies arise, however, when these overseas imports are recorded differently by the

Netherlands and the country of final destination.[35] Interestingly, we do not find evidence that the Rotterdam Effect causes discrepancies in intra-EU trade statistics: Dutch accounts on goods trade, both credit and debit, are the most accurate among all EU Member States (0.3 and -3.1 percent, respectively).

An argument made by Frankel (1978) is that current account discrepancies arise when firms try to circumvent capital controls. For intra-EU discrepancies, we can largely rule out this channel, since capital controls within the EU are rare events.[36]

One may suspect that transfer pricing has a distorting effect on intra-EU current account statistics. Even if manipulated transfer prices are used to shift corporate profits, under-priced/ over-priced transactions would not materialize in bilateral discrepancies since accurate BoP figures require correct double-entry bookkeeping, independent of artificially inflated or deflated gross values. Thus, a national trade balance would be distorted by such measures, but discrepancies in trade statistics are not a consequence thereof.

We believe that value-added tax fraud provides a more convincing explanation for BoP discrepancies. Participants of the Single Market exempt exports from value-added tax. Effectively, VAT is borne by domestic sales independent of their origin. When products enter a foreign EU Member State, VAT is levied in the destination country. That is due to the fact that consumption instead of production is the objective of taxation. Subsequently, the European VAT system is considered a growth-friendly tax, but it is apparently prone to fraud: if firms can legally declare products as exports which are in fact not exported (or re-imported), they can sell them domestically without remitting VAT to the respecitve government. The only and most directly concerned beneficiaries of over-stated exports are firms.[37]

Therefore, the European VAT system is evidently prone to tax fraud. To curb such practices, the EU Commission initiated an VAT Action Plan in 2016.[38] Assessing the damage for European tax payers, the EU Commission has estimated that a single fraud type—the so-called "missing trader"—causes annual VAT revenue shortfalls of 45 to 53 bn Euro (Fearing et al., 2015).[39]

Fedeli and Forte (2009) describe technical details of VAT fraud systems. In a nutshell,

[35] Appendix 3 in the Balance of Payments Manual 6 focuses on special issues for customs unions, economic unions and currency unions. Box A3.I is insightful for the correct recording of transactions between members of such unions, to avoid double counting or artificially inflated trade statistics of economies of consignment.

[36] Greece has temporarily introduced capital controls in summer 2015. Cyprus has introduced capital controls between 2013 and 2015. For 2018, the reference time of our analysis, no capital controls in the EU were effective.

[37] Statistical offices, of course, could technically also manipulate data. However, it is questionable why statistical offices should follow such objectives and what there incentives to do so would be.

[38] See http://europa.eu/rapid/press-release_IP-18-3834_en.htm, accessed on December 20, 2018.

[39] Please note that these numbers stem from an indirect source. The cited paper is a report for the EU Commission performed by Ernst & Young. It references an EU Commission VAT gap report, which has originally estimated the cited numbers on VAT revenue shortfalls. The original source was not traceable.

the "missing trader" practice functions as follows: A trader (Firm 2) located, for example, in, France purchases a product from Firm 1 located, for example, in Germany. This cross-border transaction is VAT-exempt. Firm 2 resells the product to a French exporter (Firm 3). For this transaction, VAT is due and must be remitted by Firm 2 to French tax authorities. Due to input tax deduction, Firm 3 reclaims the VAT payment it has made to Firm 2. Firm 3 sells the good across the border back to Firm 1 in Germany. The last transaction is again free of tax. Firm 2 does not remit the VAT, which has been rebated to Firm 3, to French tax authorities. Thereby, French tax payers have rebated VAT to Firm 3 that has never been collected. Firm 2 then "disappears"; such firms are often mailbox entities and, therefore, commonly known as "missing trader". Experts have named this fraud system "carousel". The simplest form of this fraud type, of which many ever more complex modifications exist, is graphically illustrated in Figure 12 in the Appendix.

Export and re-import should not distort trade figures but cancel out on net. However, this type of VAT fraud does involve higher than expected cross-border trade activities, potentially cumulating measurement errors. Physical shipment of goods is costly. Therefore, the expected (private) gains from fraud are highest when trade costs are minimized. Our regression results, illustrated in Table 4 and 11 (Column 2 and 3), suggest that neighboring countries have substantially higher discrepancies. Arguably, nearby countries with a common border should define the transaction cost minimum. This is suggestive evidence in favor of cross-border VAT fraud between neighboring countries. The fact that the same pattern is not observed in service discrepancies supports this claim. The structure of transaction costs for services, e.g., financial or business-to-business services, depends much less on distances and borders.

## 4.2 Explaining the Self-Surplus in Services Trade

For historical reasons, statistical regimes in the EU differ by Member State. For various reasons, data quality for goods trade is better than for services trade. First, due to the formerly lower economic importance of cross-border service trade, efforts have primarily focused on establishing international standardization for the recording of goods trade. Second, because services are exempt from tariffs, governments draw revenue only from the imports of goods. Hence, governments have always had an interest in achieving a high quality statistical recording of international goods trade.

Similarly to discrepancies in services trade between the EU and the US (Braml and Felbermayr, 2019), the United Kingdom contributes quite substantially to discrepancies in intra-EU services trade: the total EU self-surplus in services amounts to 141 bn Euro. Within the Euro Area, this figure stands by 39 bn Euro only. The British Office for National Statistics (ONS) generates trade statistics by conducting survey-based partial censuses and national projections, which evidently lead to high discrepancies (Chesson

et al., 2018).

However, high average discrepancies for countries with certain relevance for financial services indicate that this sector is particularly prone to statistical mis-recording. Table 2 (Column 2 and 4) illustrates this matter for Cyprus, Ireland, Luxembourg, the Netherlands (only Debits) and the United Kingdom. It stands out that these countries display discrepancies for credit and debit accounts that point in the same direction (Cyprus, Ireland, the UK and the Netherlands exhibit under-reported figures, Luxembourg over-reported figures). Service exports and primary income payments are, to a growing extent, substitutable and can distort BoP sub-accounts. A joint evaluation would be necessary for a final assessment. Due to data limitations, such an undertaking is not possible yet.

Figure 1 shows that the EU's mysterious self-surplus in services has increased five-fold since 2010. This sharp increase can hardly be explained by time-invariant general recording problems. We therefore suspect another trend to drive this increase: dis-intermediation and e-commerce. Services exports used to be mainly business-to-business transactions. Nowadays, consumers can purchase from foreign companies directly and the intermediator—often a domestic importer—is becoming increasingly obsolete. This is particularly true for cloud, streaming, and software services. When trade mainly consists of high-value business-to-business transactions, no systematic credit-bias occurs; but when trade increasingly entails more business-to-consumer transactions, a credit-bias becomes prevalent: the exporter records the cross-border transaction while the importer—the final consumer—does not. When low-value transactions are performed on a high scale, statistics systematically under-report true import figures. This is a direct effect of so-called de-minimis thresholds.[40] Thus, the combination of e-commerce and dis-intermediation is a growing challenge for statisticians especially in the correct recording of services transactions.

At the same time, e-commerce has also become a platform for criminals who have set up digital VAT carousel schemes. In principle, the mechanism for VAT fraud in e-commerce functions in an analogous manner as in traditional goods trade: exports are VAT-exempt. Declaring services as exports which are in fact not exported therefore materializes in non-remitted value added tax. Borselli et al. (2015) describe a case disclosed in Italy, where two large telecommunication providers became unknowingly part of a cross-border VAT fraud scheme that cost Italian taxpayers 365 mn Euro. This provides evidence that cross-border VAT fraud is not only limited to goods trade. On the contrary, it might be even more profitable in services trade due to lower transactions costs.

In the EU, statistical recording is hampered by a fundamental lack of harmonization. This is particularly true for the collection of cross-border services trade data. The exis-

[40] E.g., according to the German foreign trade legislation every transaction worth more than 12.500 Euro must be reported to the Bundesbank, who is in charge of compiling German services trade statistics. As a consequence, all payments below this threshold remain undocumented.

tence of 28 different regimes in the EU not only causes statistical discrepancies; the poor data situation also makes it easier for fraudulent parties to hide their illegal activities. To avoid unlawful practices with respect to services trade, some EU Member States, e.g., Germany have partially changed their systems of VAT collection. In contrast to the general principle, according to which the provider of a service is obliged to remit VAT, a reverse charging has been implemented.[41] Basically, it levies the duty to remit VAT to the services recipient, e.g., the final consumer. In order to fight tax fraud, Borselli et al. (2015) also recommend reforms towards a system of reverse charging.

## 4.3 Potential VAT Revenue Shortfalls

In the following, we quantify VAT revenue shortfalls for the EU. Thereby, we assume that VAT fraud is the only reason for the observed credit-bias in intra-EU BoP accounts. Given this relatively strict assumption, our estimates should be interpreted as an upper bound of the actual fiscal loss. Note, however, that there may be VAT fraud that is not detectable in international trade statistic. Hence, our estimates may even underestimate cross-border VAT fraud.

Let $X_{ij}$ be the sum of services and goods exports of country $i$ to country $j$, and let $M_{ji}$ be the imports of country $j$ from $i$, where $i$ and $j$ are both members of the EU. Let the average VAT rate in country $j$ be $\bar{t}_j$. If the entire data discrepancy were due to VAT fraud, the fiscal loss to the government in country $j$ would amount to

$$T_j = \bar{t}_j \sum\nolimits_i (X_{ij} - M_{ji}) \tag{7}$$

for all pairs $ij$ where $X_{ij} > M_{ji}$. For the EU as a whole, the aggregate loss yields

$$T = \sum\nolimits_j \sum\nolimits_i \bar{t}_j \, (X_{ij} - M_{ji}) \, . \tag{8}$$

Our data do not allow calculating $T_j$ from Equation 7, because $\sum_i (X_{ij} - M_{ji}) > 0$ is only satisfied for 18 EU Member States. However, for all Member States, we know aggregate balances vis-à-vis the EU as a whole (see Section 2.3). Let $\bar{t}$ be the GDP weighted average EU VAT rate[42], the EU-wide VAT loss can be approximated by

$$T = \bar{t} \Big( \sum\nolimits_j \sum\nolimits_i (X_{ij} - M_{ji}) \Big). \tag{9}$$

Since $\sum_j \sum_i (X_{ij} - M_{ji}) = 307$ bn Euro in 2018, with $\bar{t} = 0.21$, we arrive at about 64.5 bn Euro of taxes forfeited. As the UK's contribution to the discrepancies is most likely resulting from measurement error, not the full amount of 307 bn Euro is due to VAT fraud.

[41] German VAT Legislation, accessed on December 20, 2018.

[42] Source: Eurostat 2019. Using an average VAT rate can easily lead to an underestimation as the incentive for fraud increases in the VAT rate.

But even within the Euro Area, the discrepancy of 126 bn Euro implies an amount of fraud equal to 26.5 bn Euro; more than 70 Euro per capita. Put differently, if we assume that VAT fraud affects trade in goods only, the fiscal loss amounts to 34.9 bn Euro. From 2006 to 2018, the cumulative self-surplus for goods of the entire EU amounts to 2,047 bn Euro. Assuming an average VAT rate of only 18 percent for the entire period[43], EU budgets could have fallen short of 370 bn Euro over the past 13 years.

### 4.4 Implementing an Electronic Clearing Procedure

Trade data appear massively distorted by inaccurate measurement and fraudulent misreporting. We believe in technical solutions to tackle both. An outline of such a solution could look as follows: the implementation of an electronic clearing procedure, that documents all cross-border transactions for goods and services. Every transaction should require a two-factor authentication: first, the exporter records export value, quantity, and counterparty in the system. Second, the importer confirms transaction details. The data collected would be automatically transmitted to statistical offices and tax authorities. The reverse VAT charging, that usually applies to intra-community supply, should apply here as well. As long as the importer does not confirm the transaction, VAT liability is with the exporter. In the moment of confirmation, tax liability passes over to the importer. In this system, to avoid having to remit VAT, the exporter would urge the importer to confirm the transaction. In any case, at least one party would remit VAT. Thus, potential fraud (wrong declaration or confirmation by any of the two parties) cannot lead to non-taxation. This system is also applicable for business-to-consumers services transactions: every EU citizen could have an electronic VAT ID to pay taxes for, e.g., imported streaming services. Payments could be processed automatically by an electronic VAT App. An additional advantage of this procedure is that de-minimis thresholds would become obsolete.

## 5 Concluding Remarks

This paper reports and analyzes large inconsistencies in intra-European balance of payments data. The mere size of the mysterious EU trade surplus with itself—307 bn Euro, or 1.9 percent of the Union's GDP—is truly remarkable. This EU trade self-surplus is persistent over time. Recently, the correct recording of services trade has become an additional challenge for statisticians. The EU's secondary income account with itself not only shows high discrepancies but also contradicts estimates derived by the sum of EU budget contributions and personal transfer payments.

This paper introduces a simple measure for discrepancies on the country and country

[43] VAT rates have slightly increased over time.

pair level. Our analysis finds large heterogeneity in data accuracy across countries indicating substantial differences in governmental practices of statistical recording. According to our estimations, Cyprus, Ireland, Luxembourg, and Sweden are the EU Member States with the most inaccurate statistical regime. The Netherlands provide the most accurate data for goods trade. Accounting for economic size, British figures seem to distort intra-EU current account data most significantly. The self-surpluses for goods and services trade have increased over time and give reason to suspect that statistical regimes in the EU are systematically incapable of tracking true import and export figures.

The EU self-surplus makes up 86 percent to the global trade self-surplus of 422 bn USD in 2018. After the EU Eastern Enlargement in 2004, reported discrepancies have quadrupled. The trade self-surplus of the Euro Area accounts for only 41 percent of the EU self-surplus. Somewhat ironically, in the event of a Brexit, average data quality in the EU would improve, and the EU would account for less than 40 percent of the global self-surplus. Needless to say, the withdrawal of the UK from the EU will have substantial effects not only on the bilateral trade relationship but also on recorded data.

Applying forensic accounting methods, we find suggestive evidence that VAT fraud drives discrepancies, in particular for neighboring countries and countries with differentials in applied VAT rates. Attributing the observed discrepancies to VAT fraud, we can quantify EU-wide VAT revenue shortfalls from 27 to 35 bn Euro per year in a realistic scenario. At worst, revenue shortfalls would amount to 64 bn Euro. Finally, we link the growing importance of e-commerce and the process of dis-intermediation to rapidly growing discrepancies in services trade. For the sake of fighting tax fraud, but also to enable policy relevant research based on reliable data, we call on the institutions in charge to substantially improve quality and reliability of intra-EU BoP data. Therefore, we have outlined an electronic clearing procedure that has great potential to inhibit tax fraud and misreporting. Also, the non-disclosure or non-collection of certain BoP items (e.g. primary income) need to be tackled urgently.

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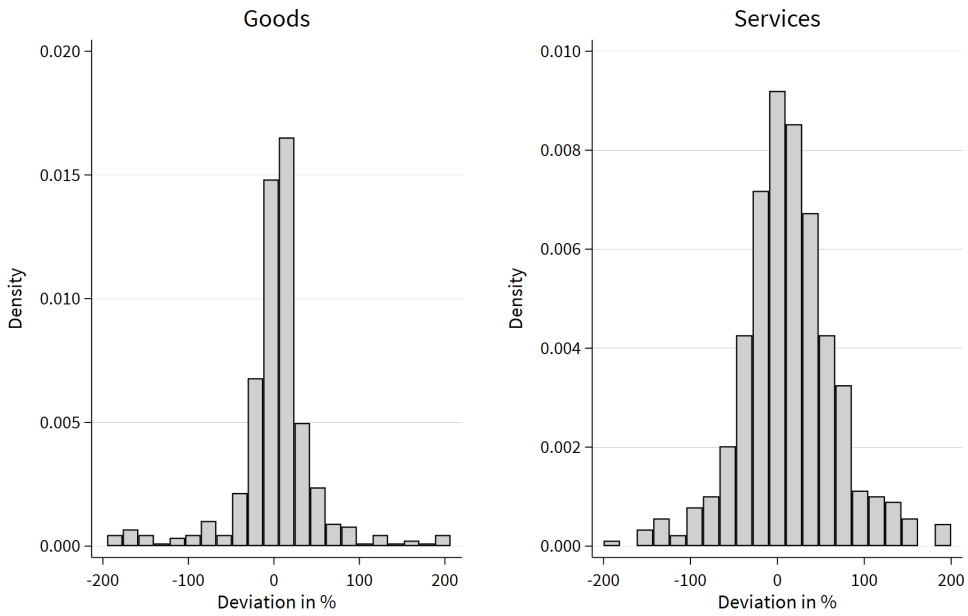
# Appendix

**Table 5:** Secondary Income Accounts by Components, 2018, bn EUR

| Country | Secondary Income Balance | Net Budget Contribution | Net Personal Transfers | Sum Column (3) + (4) |
|---|---|---|---|---|
| Austria | -2.59 | -1.35 | -0.38 | -1.72 |
| Belgium | -3.89 | -0.49 | -0.14 | -0.63 |
| Bulgaria | 1.65 | 1.67 | 0.83 | 2.50 |
| Croatia | 1.47 | 0.66 | 0.74 | 1.40 |
| Cyprus | -0.25 | 0.08 | -0.13 | -0.05 |
| Czechia | -1.50 | 2.39 | -0.03 | 2.36 |
| Denmark | -2.34 | -1.20 | . | -1.20 |
| Estonia | 0.04 | 0.54 | 0.05 | 0.59 |
| Finland | -1.75 | -0.58 | -0.11 | -0.69 |
| France | -21.55 | -6.19 | -2.33 | -8.53 |
| Germany | -27.16 | -13.41 | -2.47 | -15.88 |
| Greece | -0.17 | 3.35 | -0.06 | 3.29 |
| Hungary | -1.26 | 5.21 | 0.30 | 5.51 |
| Ireland | -2.77 | -0.31 | -0.62 | -0.93 |
| Italy | -11.67 | -5.06 | -0.29 | -5.35 |
| Latvia | 0.11 | 0.97 | 0.06 | 1.03 |
| Lithuania | 0.36 | 1.71 | 0.37 | 2.08 |
| Luxembourg | 0.24 | 0.02 | -0.09 | -0.07 |
| Malta | -0.07 | 0.05 | -0.06 | -0.01 |
| Netherlands | -3.03 | -2.46 | -0.04 | -2.50 |
| Poland | -1.75 | 12.34 | 2.44 | 14.78 |
| Portugal | 2.33 | 3.27 | . | 3.27 |
| Romania | 2.12 | 3.19 | 2.49 | 5.68 |
| Slovakia | -1.20 | 1.68 | 0.05 | 1.73 |
| Slovenia | -0.32 | 0.53 | 0.02 | 0.55 |
| Spain | -5.59 | 1.86 | . | 1.86 |
| Sweden | -3.67 | -1.52 | 0.24 | -1.29 |
| United Kingdom | -14.03 | -6.95 | . | -6.95 |
| Total | -98.23 | 0.00 | 0.80 | 0.80 |

**Source:** Eurostat 2019; own calculations.
**Note:** Column 2 shows the actual secondary income balance per country. Column 3 comprises the net budget contributions per Member State. Column 4 shows personal household transfers between residents and non-residents (BoP Series D752). Column 5 provides an estimate of the Member States' secondary income balance based on the row-wise summation of Column 3 and 4. All values refer only to BoP positions vis-à-vis EU Member States.

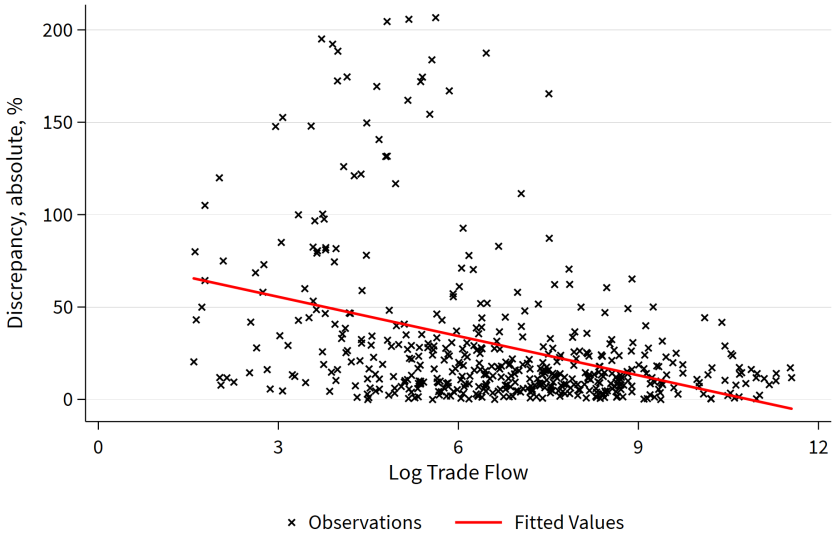
**Figure 5:** Distribution of Discrepancies, 2018, in %




**Source:** Eurostat 2019.

**Note:** The table shows the distribution of discrepancies as defined in Equation 3.

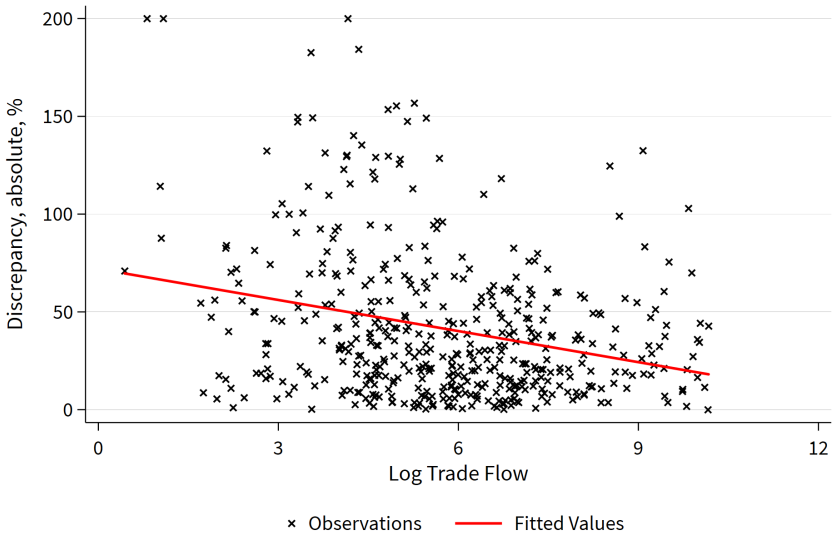
**Figure 6:** Scatter Plot: Trade Volume and Discrepancies, Goods, 2018




**Source:** Eurostat 2019; own calculations.

**Note:** The figure plots the average trade flow (logarithmic scale) versus absolute discrepancies as defined in Equation 3. Fitted values according to OLS.

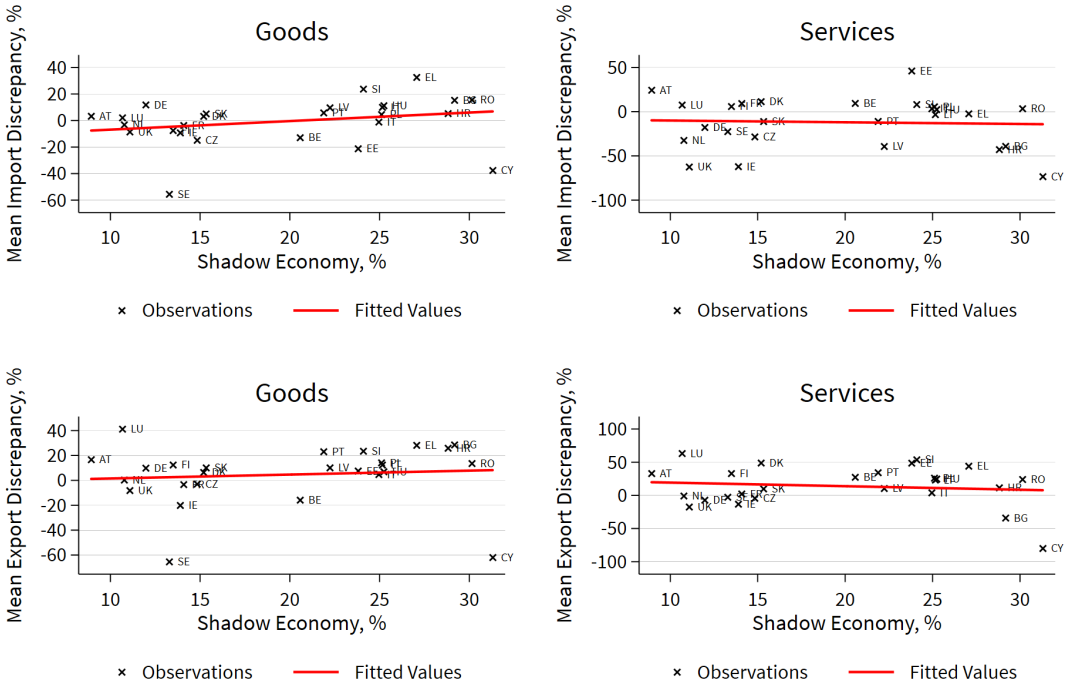
**Figure 7:** Scatter Plot: Trade Volume and Discrepancies, Services, 2018




**Source:** Eurostat 2019; own calculations.

**Note:** The figure plots the average trade flow (logarithmic scale) versus absolute discrepancies as defined in Equation 3. Fitted values according to OLS.

**Figure 8:** Mean Discrepancy per Country and Size of the Shadow Economy




**Source:** Medina and Schneider (2018). Eurostat 2019; own calculations.

**Note:** The figure plots the size of the shadow economy versus absolute discrepancies as defined in Equation 4 (2018 values). Fitted values according to OLS.

**Figure 9:** Mean Discrepancy per Country and Institutional Quality


**Source:** World Bank 2019. Eurostat 2019; own calculations.

**Note:** The figure plots a governance index (combined measure) versus absolute discrepancies as defined in Equation 4 (2018 values). Fitted values according to OLS.

**Table 6:** Country Pair Discrepancies, Goods, 2018, Bottom 25, mn EUR and %

| Country 1 | Country 2 | Trade Volume | Discrepancy |
|---|---|---|---|
| Sweden | Bulgaria | 226.2 | 187.0 |
| Romania | Sweden | 526.0 | 180.5 |
| Sweden | Slovenia | 283.7 | 173.3 |
| Sweden | Cyprus | 75.6 | 170.6 |
| Croatia | Sweden | 129.0 | 157.2 |
| Luxembourg | Sweden | 173.8 | 152.0 |
| Sweden | Greece | 362.5 | 145.7 |
| Cyprus | Hungary | 74.6 | 119.7 |
| Cyprus | Poland | 121.5 | 113.0 |
| Cyprus | Germany | 2,413.0 | 102.3 |
| Luxembourg | Croatia | 77.0 | 101.3 |
| Latvia | Sweden | 1,084.3 | 101.0 |
| Portugal | Cyprus | 46.0 | 100.3 |
| Austria | Finland | 2,978.5 | 99.4 |
| France | Slovenia | 2,305.3 | 98.1 |
| Cyprus | Lithuania | 31.8 | 94.8 |
| Sweden | Slovakia | 1,184.6 | 92.5 |
| Hungary | Sweden | 1,852.3 | 89.2 |
| Luxembourg | Hungary | 281.5 | 86.5 |
| Lithuania | Ireland | 52.4 | 81.7 |
| Sweden | Portugal | 952.3 | 81.5 |
| Ireland | Cyprus | 122.5 | 81.0 |
| Cyprus | Finland | 96.0 | 80.7 |
| Cyprus | Italy | 823.0 | 78.8 |
| Ireland | Sweden | 479.9 | 78.0 |

**Source:** Eurostat 2019; own calculations.
**Note:** Trade volume is average of a country pair's reported bilateral credit and debit positions according to BoP data in mn EUR. Country pair discrepancies are defined as in Equation 5.

**Table 7:** Country Pair Discrepancies, Services, 2018, Bottom 25, mn EUR and %

| Country 1 | Country 2 | Trade Volume | Discrepancy |
|---|---|---|---|
| Croatia | Cyprus | 2.3 | 200.0 |
| Cyprus | Estonia | 98.5 | 191.3 |
| Estonia | United Kingdom | 365.8 | 152.1 |
| Cyprus | Poland | 360.8 | 151.3 |
| Latvia | Cyprus | 100.5 | 142.2 |
| Cyprus | Lithuania | 71.5 | 140.4 |
| Cyprus | Finland | 98.5 | 139.7 |
| Hungary | Ireland | 293.9 | 128.5 |
| Belgium | Cyprus | 253.0 | 123.1 |
| Czechia | Cyprus | 128.7 | 122.5 |
| Portugal | Cyprus | 161.0 | 114.8 |
| Austria | Cyprus | 227.0 | 111.1 |
| Luxembourg | United Kingdom | 17,736.3 | 107.9 |
| Latvia | Slovenia | 14.3 | 103.1 |
| Estonia | Hungary | 26.6 | 102.2 |
| Lithuania | Ireland | 252.4 | 102.0 |
| Italy | Croatia | 1,054.5 | 100.9 |
| Croatia | Estonia | 11.2 | 98.5 |
| Romania | Ireland | 593.5 | 96.2 |
| Cyprus | Italy | 235.5 | 94.6 |
| Denmark | United Kingdom | 11,507.4 | 90.8 |
| Estonia | Czechia | 63.2 | 90.1 |
| United Kingdom | Slovenia | 294.1 | 85.1 |
| Sweden | Slovenia | 107.3 | 81.7 |
| Greece | Croatia | 44.0 | 81.6 |

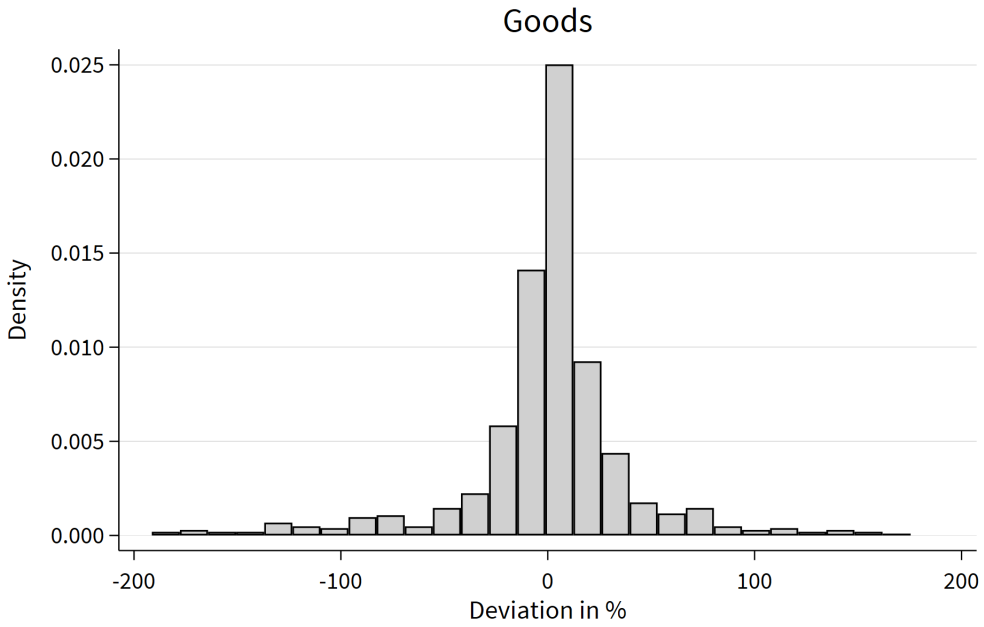
**Source:** Eurostat 2019; own calculations.
**Note:** Trade volume is average of a country pair's reported bilateral credit and debit positions according to BoP data in mn EUR. Country pair discrepancies are defined as in Equation 5.

**Table 8:** Regression Analysis: Country Fixed Effects, Discrepancies in %

| | Goods BoP | | Services BoP | | Goods Comext | |
|---|---|---|---|---|---|---|
| | (1) | | (2) | | (3) | |
| Austria | 11.5** | (4.9) | 9.3** | (4.0) | 3.9** | (1.5) |
| Belgium | 9.4** | (3.8) | 11.2** | (4.5) | 1.2 | (2.2) |
| Bulgaria | 17.1 | (14.1) | 24.0*** | (8.7) | 9.7*** | (3.0) |
| Cyprus | 66.6*** | (6.4) | 82.3*** | (12.0) | 55.7*** | (6.2) |
| Czechia | 0.7 | (4.2) | 24.5*** | (4.2) | 4.2 | (2.6) |
| Germany | 1.2 | (4.0) | 12.7** | (6.1) | -5.8*** | (2.1) |
| Denmark | -1.7 | (9.1) | 19.4** | (8.9) | 2.2 | (1.5) |
| Estonia | 11.7** | (5.4) | 36.4*** | (9.3) | 19.2*** | (4.7) |
| Greece | 22.3** | (11.2) | 8.9 | (9.3) | 12.2*** | (3.6) |
| Spain | 0.0 | (.) | 0.0 | (.) | 6.8* | (3.6) |
| Finland | 12.7** | (5.4) | 14.4*** | (4.4) | 3.3 | (2.1) |
| France | 6.3 | (5.4) | 11.2*** | (3.9) | 0.2 | (2.5) |
| Croatia | 14.4*** | (5.2) | 32.4*** | (6.8) | 10.4*** | (3.9) |
| Hungary | 11.1*** | (2.6) | 19.5*** | (5.2) | 7.5** | (3.2) |
| Ireland | 17.5*** | (4.3) | 29.6*** | (8.6) | 28.8*** | (4.6) |
| Italy | 1.9 | (3.6) | 8.0 | (5.0) | -1.4 | (2.6) |
| Lithuania | 8.2 | (5.0) | 16.0*** | (6.0) | 11.6** | (4.9) |
| Luxembourg | 60.2*** | (11.5) | 34.0*** | (10.4) | 38.9*** | (6.2) |
| Latvia | 9.7*** | (3.4) | 26.8*** | (5.6) | 10.2*** | (3.7) |
| Malta | 0.0 | (.) | 0.0 | (.) | 62.8*** | (6.1) |
| Netherlands | 9.2*** | (2.9) | 12.1*** | (4.6) | 2.5 | (1.9) |
| Poland | 1.0 | (3.9) | 12.3*** | (3.7) | 6.2* | (3.5) |
| Portugal | 15.0*** | (3.0) | 18.5*** | (3.1) | 9.8*** | (2.8) |
| Romania | 7.9 | (5.6) | 12.6*** | (4.5) | 5.3** | (2.6) |
| Sweden | 59.9*** | (12.0) | 10.2** | (4.8) | 3.7* | (2.0) |
| Slovenia | 20.9*** | (7.1) | 21.0*** | (7.4) | 11.3*** | (2.9) |
| Slovakia | 18.1*** | (5.9) | 1.7 | (6.7) | 17.3*** | (5.2) |
| United Kingdom | -0.0 | (3.4) | 27.1*** | (6.8) | 3.0 | (3.2) |
| Observations | 248 | | 237 | | 378 | |

**Source:** Comext 2019, Eurostat 2019; own calculations.
**Note:** Ordinary Least Square Regressions with heteroskedasticity robust standard errors. Country fixed effects are the only explanatory variables. Dependent variable is country pair discrepancies as defined by Equation 5 (2018 values). ***, ** and * indicate statistical significance levels for p-val. $< 0.01$, p-val. $< 0.05$, and p-val.$< 0.1$.

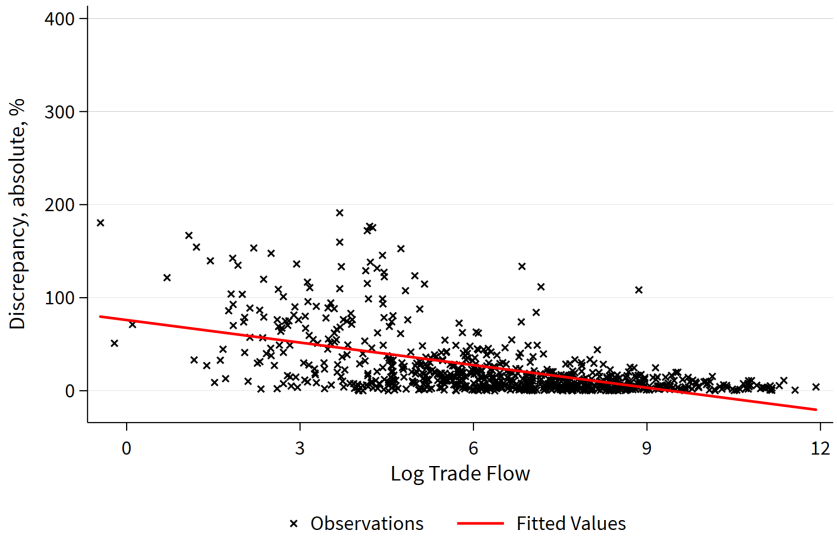
**Figure 10:** Sensitivity Analysis: Distribution of Discrepancies, 2018, in %




**Source:** Comext 2019; own calculations.

**Note:** The table shows the distribution of discrepancies as defined in Equation 3.

**Figure 11:** Sensitivity Analysis: Trade Volume and Discrepancies, Goods, 2018




**Source:** Comext 2019; own calculations.

**Note:** The figure plots the average trade flow (logarithmic scale) versus absolute discrepancies as defined in Equation 3. Fitted values according to OLS.

**Table 9:** Sensitivity Analysis: Mean Discrepancies per Country, 2018, %

| Country | Exporter | Importer |
|---|---|---|
| Austria | 3.9 | 0.6 |
| Belgium | 6.7 | 9.5 |
| Bulgaria | 17.2 | 11.1 |
| Croatia | 23.5 | 0.8 |
| Cyprus | -67.7 | -34.4 |
| Czechia | 12.1 | 10.8 |
| Denmark | -2.1 | -2.7 |
| Estonia | 9.4 | -8.3 |
| Finland | -0.2 | 6.6 |
| France | -3.8 | 2.9 |
| Germany | 2.7 | 0.7 |
| Greece | 26.3 | 10.4 |
| Hungary | 16.3 | 12.9 |
| Ireland | -24.7 | -25.6 |
| Italy | 3.0 | -2.1 |
| Latvia | 8.8 | 14.8 |
| Lithuania | 5.2 | 17.2 |
| Luxembourg | -48.3 | -27.3 |
| Malta | -72.8 | -49.1 |
| Netherlands | 13.3 | 2.1 |
| Poland | 14.3 | 3.0 |
| Portugal | 14.5 | 2.3 |
| Romania | 13.9 | 9.3 |
| Slovakia | 32.5 | 13.2 |
| Slovenia | 14.5 | 8.1 |
| Spain | 12.8 | 11.0 |
| Sweden | -12.6 | -0.4 |
| United Kingdom | -10.6 | -5.7 |

**Source:** Comext 2019; own calculations.
**Note:** Column 1 shows the average discrepancy in bilateral trade for the respective country being an exporter. Column 2 shows the average discrepancy in bilateral trade for the respective country being an importer. Discrepancies are defined as in Equation 4. All values refer only to bilateral trade vis-à-vis the listed countries.

**Table 10:** Sensitivity Analysis: Country Pair Discrepancies, Goods, 2018, Bottom 25, mn EUR and %

| Country 1 | Country 2 | Trade Volume | Discrepancy |
|---|---|---|---|
| Estonia | Malta | 9.6 | 167.1 |
| Cyprus | Poland | 191.0 | 142.3 |
| Luxembourg | Slovakia | 260.7 | 138.3 |
| Malta | Slovakia | 12.3 | 123.3 |
| Cyprus | Hungary | 76.2 | 122.0 |
| Cyprus | Latvia | 19.8 | 113.4 |
| Bulgaria | Malta | 80.9 | 110.6 |
| Croatia | Luxembourg | 82.6 | 106.6 |
| Spain | Lithuania | 1,851.7 | 103.9 |
| Malta | Slovenia | 17.4 | 101.8 |
| Cyprus | Portugal | 46.9 | 101.8 |
| Ireland | Slovakia | 215.2 | 99.5 |
| Greece | Luxembourg | 53.1 | 98.2 |
| Latvia | Malta | 9.6 | 97.8 |
| Luxembourg | Malta | 5.1 | 95.5 |
| Ireland | Malta | 89.3 | 92.5 |
| Malta | Portugal | 78.8 | 91.5 |
| Malta | Poland | 88.8 | 90.7 |
| Czechia | Malta | 45.8 | 89.1 |
| Hungary | Luxembourg | 249.2 | 88.6 |
| Cyprus | Luxembourg | 7.5 | 88.0 |
| Finland | Malta | 18.4 | 87.8 |
| Cyprus | Finland | 93.0 | 87.7 |
| Bulgaria | Luxembourg | 45.2 | 84.9 |
| Cyprus | Lithuania | 31.8 | 81.8 |

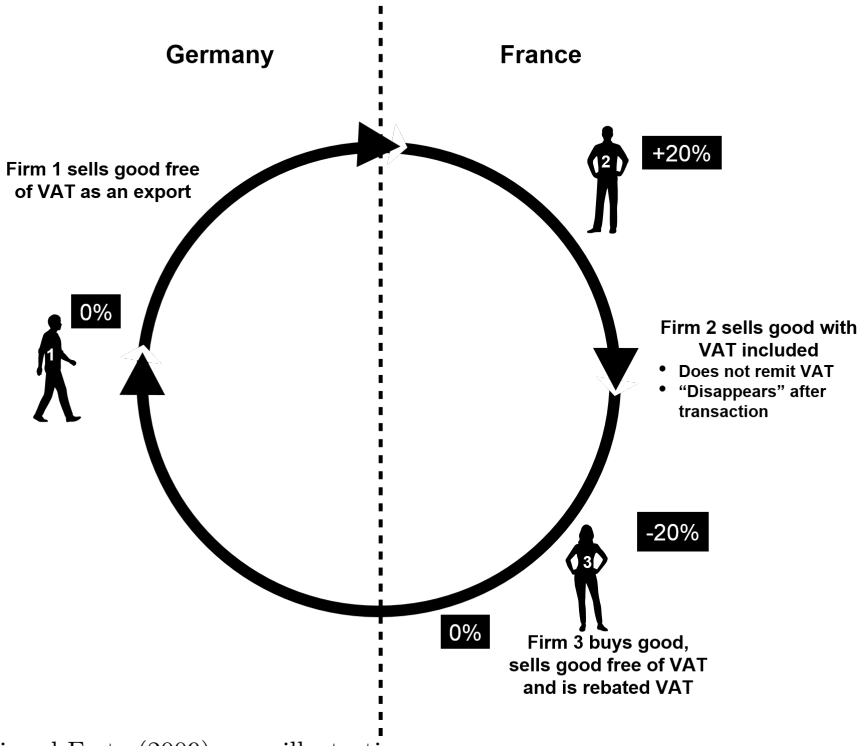
**Source:** Comext 2019; own calculations.
**Note:** Trade volume is average of a country pairs' reported bilateral exports and imports according to Comext in mn EUR. Country pair discrepancies are defined as in Equation 5.

**Table 11:** Sensitivity Analysis: Country Pair Discrepancies, 2018

| | Goods | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| log Trade | -8.11*** | -7.61*** | -3.10 |
| | (0.64) | (0.73) | (2.65) |
| log Distance | | 7.72*** | 7.60 |
| | | (2.57) | (5.26) |
| Common Border | | 9.56*** | 6.88** |
| | | (3.38) | (2.95) |
| Common History | | 2.04 | -1.90 |
| | | (4.44) | (4.66) |
| Common Language | | 11.98*** | -4.46 |
| | | (3.54) | (4.25) |
| $\Delta$ VAT Rate | | 1.31** | 0.93 |
| | | (0.58) | (0.60) |
| Observations | 378 | 378 | 378 |
| $R^2$ | 0.39 | 0.42 | 0.63 |
| Country FE | | | ✔ |

**Source:** CEPII 2019. Comext 2019; own calculations. **Note:** Ordinary Least Square Regressions with heteroskedasticity robust standard errors. Dependend variables are country pair discrepancies as defined by Equation 5. ***, ** and * indicate statistical significance levels for p-val. $< 0.01$, p-val. $< 0.05$, and p-val.$< 0.1$.

**Figure 12:** Carousel-type VAT Fraud




**Source:** Fedeli and Forte (2009); own illustration.
**Note:** The example of France and Germany are arbitrarily chosen. The carousel-type VAT fraud can apply to any EU country pair.