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**The EU Self-Surplus
Puzzle: An Indication
of VAT
Fraud?**



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ABSTRACT

THE EU SELF-SURPLUS PUZZLE: AN INDICATION OF VAT FRAUD? *

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The world runs a trade surplus with itself: Exporters report larger values of exports than what importers report as imports. This is a logically impossible but well known empirical fact. Less well known, 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 self-surplus of the EU 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's self-surplus quadrupled. Balance of payments data from the United Kingdom appear highly distorted. We argue that the phenomenon is 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 loss in tax income could amount to as much as 64 billion Euro per year.

Keywords: Trade, VAT Fraud, Statistical Discrepancies, Current Accounts

JEL classification: F36, F32, F24, H26

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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 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 billion Euro in 2018 or 86 percent of the entire global self-surplus. The EU’s self-surplus is bigger than the often criticized current account surplus of Germany¹, 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. Declaring domestic transactions as exports exempts those from 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 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 runs a bilateral CA surplus or a deficit with the US over the past decade. In times of trade conflicts, the absence of a clear 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)* decomposing the discrepancy into EU Member State contributions, 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 will 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 an macroeconomic perspective (Feenstra et al., 1999; Mankiw, 2018). However, they do matter 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, for any market transaction, buyers and sellers would document the same values for each single transaction and, after correct summation, balances necessarily mirror each other. All countries' exports equal 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) addresses potential channels why the world tends to run a 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) suggests 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. This explanation assumes by construction several weeks of shipments and high growth rates to effectively distort goods trade figures. Moreover, when global trade shrinks, the bias should revert.

Given the geographical proximity of EU Member States, which enables land transportation, given relatively weak economic growth, and given the fact that services trade is affected in the same way by this credit-bias, there must be other reasons for 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. Tariff evasion can be ruled out for transactions within a customs union, so our interpretation focuses on VAT fraud.

The remainder of this paper is structured as follows: Section 2 discusses some 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, for which the most severe discrepancies occur and tries to identify which countries might cause them. Section 4 turns to VAT fraud as an explanation of the observed discrepancies, which might explain the observed discrepancies and provides an outline for a potential solution. Finally, 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 perfectly match—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, it clearly implies Identity 2. But even if it is violated, Identity 2 can still hold. This is the case if demarcation problems between sub-accounts occur, which lead to different treatment by statistics authorities in different countries. Such demarcation problems emerge with “servitization”, i.e., the increasing services content of manufacturing exports, e.g., through the embodied contributions of software, design, financing, or maintenance.⁵ Also, if, for tax reasons, countries do not provide services associated to intangible assets directly but through tax havens, such transactions may show up in the primary income accounts rather than in the services trade accounts. Typically, such demarcation issues cancel out after aggregation.

For the purpose of the present analysis, we rely on balance of payments (BoP) data provided by Eurostat only.⁶ 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.⁷ Please note that for Malta data are either not recorded or not published. Values are denoted in Euro. Whenever we use the term “discrepancy”, we mean that corresponding import-export statistics do not match each other. Aggregate discrepancies are also denoted as *self-surpluses* or *self-deficits*, respectively. Unless not specifically indicated, imports and exports include the sum of goods and services trade. Unfortunately, primary income accounts are not available and thus, we cannot provide a full picture of the total CA discrepancy. In contrast, secondary income accounts 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 represents 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 For a broad overview, cf. Baines et al. (2009).

⁶ The main data source for CA figures is the series *bop_c6_q* in a version from November 2019.

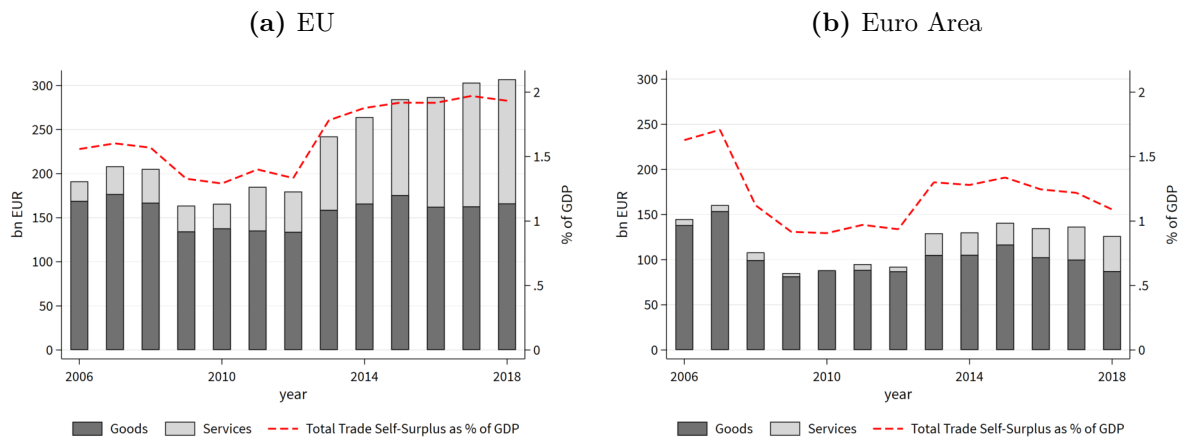
⁷ Find here the IMF BPM6: www.imf.org/external/pubs/ft/bop/2007/bopman6.htm.

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 gaps amount to 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.⁸ 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 GDP for almost one decade, the intra-EU discrepancy has increased and now reaches levels close to 2 percent. From 2013 onward, a surge in excess services trade is observed for both the EU and the Euro Area. For the EU, services add 46 percent to the total discrepancy and for the Euro Area 31 percent, respectively. Of course, any major difference between the EU and the Euro Area must be substantially due to the United Kingdom.⁹ Overall, these discrepancies can hardly result from random measurement errors; otherwise one would expect a stationary time series with zero mean.

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



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.

⁸ According to Eurostat's nominal GDP figures for 2018.

⁹ 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.

Are there severe classification issues between services and goods trade in the European data? If that was the case, one balance must necessarily show an excess surplus and the other an excess 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.¹⁰

2.3 The Secondary Income Puzzle

As mentioned, data on primary income are not available and, therefore, intra-EU current account balances cannot be constructed. Thus, it is out of the scope of our analysis to test Identity 2. However, we can aggregate the goods, services, and secondary income balances, to check if the inclusion of the secondary income balance reduces the self-surpluses. In contrast to many other advanced economies, intra-EU secondary income balances are quite insightful, because the EU redistributes income among its Member States and EU migrants channel very substantial flows of personal transfers to their home countries.¹¹ For 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 raises new questions: 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 face a debit-bias since negative balances indicate national generosity: net donors (recipients) may tend to over-report debits (under-report credits). Eventually, the self-surplus in the EU trade statistics may partially be offset by the secondary income account. Then, consequently, one must assume demarcation problems between trade and secondary income balances. This can hardly be argued.¹² But even if we do so and subtract 98 bn EUR from the EU's 307 bn EUR 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.

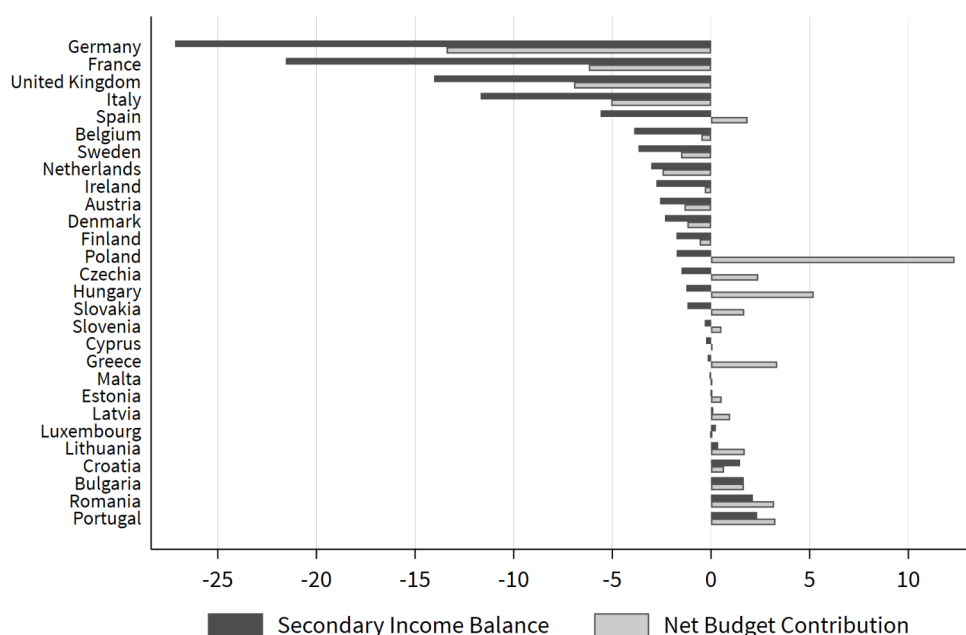
Secondary income balances for EU Member States vis-à-vis EU Member States consist, by and large, of net contributions to the EU budget. This illustrates why demarcation problems between secondary income and trade balances seem highly unlikely. Goods and services trade accounts result from private sector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

¹⁰ Net exports are constructed as the difference between exports and imports.

¹¹ According to Eurostat, intra-EU remittances amounted to 70 bn EUR in 2018. A large fraction of this, however, is compensation of employees which accordingly is part of the primary income account.

¹² Demarcation issues may also exist between secondary income and the capital account. However, even then 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 of official payments to and received from the EU.

A comparison of secondary income balances and EU budget contributions helps proving data consistency. This is shown by Figure 2. The following observations are noteworthy: 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, too. 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 provides the data underlying to 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 together 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 analysis to the country and country pair level. This is critical for 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 if they are 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 for the year 2018 on bilateral trade flows (goods and services).¹³ Therefore, with 28 EU members, we have a maximum of 756 (28×27) observations per BoP item.¹⁴ 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).¹⁵ Thus, a first finding is that the coverage EU BoP data is worth being improved. 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. We have X_{ij} and M_{ij} as reported by country i and X_{ji} and M_{ji} as reported by country j .¹⁶ Perfectly matching mirror data would imply that $X_{ij} = M_{ji}$ and $M_{ij} = X_{ji}$. Denote by \mathcal{E} the set of all EU Member States, we should observe

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

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

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

¹³ As our only data source we use Eurostat *bop_cb_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.

¹⁴ 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.

¹⁵ Eurostat records total intra-EU trade based on export figures of 3,525 bn Euro in 2018.

¹⁶ 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 $\Delta_{\mathcal{E}} > 0$, which can be due to systematic over-reporting of X_{ij} or under-reporting of M_{ji} .¹⁷ Both are possible; we cannot distinguish between the two sources because we do not know the “true” size of the trade flows between i and j . But if we knew the true value, what could we say about the structure of the measurement error?

If errors were random and multiplicative, then, as the number of elements in \mathcal{E} grows very large, we would have $E(\Delta_{\mathcal{E}}) \rightarrow 0$. As we will show, this is not true empirically. So, errors are non-random.

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

$$\delta_{ij} = \frac{2\Delta_{ij}}{X_{ij} + M_{ji}}, \quad (3)$$

which will be pre-multiplied with 100% for the sake of convenience. Table 1 shows summary statistics for the observed discrepancies in bilateral BoP data for the year of 2018. Histograms in Figure 5 of the Appendix illustrate 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 “cause” the observed discrepancies is of great interest. However, a clear identification is not straight-forward due to the dyadic dimension of the problem. As an approximation to this problem, we calculate average country

¹⁷In principle both can be under-reported or even be over-reported, but to different degrees.

level discrepancies:

$$\delta_i = \frac{1}{n} \sum_{j \in \mathcal{E}} \delta_{ij} \quad \text{and} \quad \delta_j = \frac{1}{n} \sum_{i \in \mathcal{E}} \delta_{ij}, \quad (4)$$

where δ_i denotes the mean discrepancy for country i being the exporter, δ_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 misreport its true value, figures provided

by 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 mixture of the two). In case all countries but Bulgaria misreport their imports, the Romanian export bias, for instance, should look quite similar to the Bulgarian figure. In fact, however, it is only about half of it. The same holds true for all other single countries; the reason is 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 well-suited 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 higher 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) are severely biased towards a substantial under-reporting of their exports. The average over absolute discrepancies is 18 percent.

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

Table 2 suggests 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 is not unexpected: scale economies might also apply to statistical recording, and statistical offices might allocate resources to tackle larger trade partners prioritized. 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 important for the explaining the self-surplus of the EU, one would expect that measured VAT compliance, institutional quality or the size of the shadow economy should 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 good 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.¹⁸ 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

¹⁸ As a measure of institutional quality, we use the 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).¹⁹

Note, however, that one should not expect too much from such a cross-country analysis based on 26 observations.²⁰ Since we are interested in international trade, the nature of the problem is necessarily bilateral. In other words: the extent of VAT fraud depends not only on the exporter’s or the importer’s characteristics separately, but on their (potentially complex) interaction. This is why we now move to a bilateral country pair analysis.

3.4 Country Pair Analysis

The following sub-section addresses the question, which country pairs are particularly prone to bilateral discrepancies. Additionally, we are going to highlight if neighboring countries have notably higher discrepancies—another finding that would support our hypothesis that VAT fraud plays a role in solving the self-surplus puzzle (see Section 4). We begin by defining the mean country pair discrepancy as

$$\delta_{ij} = \frac{1}{2} \left(|\delta_{ij}| + |\delta_{ji}| \right), \quad (5)$$

which is a symmetric measure in the sense that $\delta_{ij} = \delta_{ji}$. Hence, we rest our analysis on 378 unique country pairs.²¹ 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 yields 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 whose pair discrepancies in goods trade are highest, Sweden and Cyprus are listed 12 and 9 times, respectively.²² In the services account, Cyprus is part of 11 country pairs. Moreover, 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

¹⁹ See Figure 8 in the Appendix.

²⁰ 28 EU Member States minus Malta and Spain, for which no data are available.

²¹ With 28 EU Member States, the number of pairs is given by $28 \times 27/2$.

²² Cf. Table 6 and Table 7 in the Appendix for full detail.

large at 27.3 bn Euro. Also the UK 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 by a short regression analysis that shows 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:

$$\delta_{ij} = \beta_0 + \beta_1 \log(V_{ij}) + \mathbf{X}_{ij}\boldsymbol{\mu} + \nu_i + \epsilon_{ij}, \quad (6)$$

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.²³ ν_i denotes country fixed effects that take 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 that is robust over 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; 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 quite 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 higher discrepancies. Including fixed effects, the effect vanishes.

Importantly, differentials in VAT standard rates lead to higher discrepancies: a one percentage point increase in VAT rate differentials goes along with 3 percentage points larger discrepancies.²⁴ This is in line with our hypothesis: the more strongly tax rates differ between two countries, the greater the incentives for tax fraud. Again, with fixed effects the effect turns insignificant. This is not overly surprising, since the VAT-gap is

²³ 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.

²⁴ 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*** (0.94) | -5.59*** (1.00) | -14.79*** (4.67) | -5.83*** (1.31) | -4.55*** (1.37) | -8.19 (4.98) |
| log Distance | | 14.63*** (4.28) | -5.83 (7.49) | | 14.55*** (4.75) | -3.05 (8.03) |
| Common Border | | 11.64*** (4.43) | 12.98** (5.05) | | 4.81 (6.71) | 1.48 (6.74) |
| Common History | | 2.69 (5.47) | 1.24 (5.59) | | 11.07 (7.54) | 9.49 (8.36) |
| Common Language | | 15.39** (6.52) | -3.06 (8.08) | | 11.38 (12.19) | 5.74 (8.92) |
| Δ VAT Rate | | 3.16*** (1.20) | 0.41 (1.19) | | 0.92 (0.91) | -0.00 (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. Dependent 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.

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 ν_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 by making use of an alternative data base. To this end, we use 2018 trade data taken from the Comext database, “Eurostat’s reference database for detailed statistics on international trade in goods”.²⁵ Ideally, we would also want to compare services trade figures with another data source. However, Eurostat only provides services trade data based on its Balance of Payments data, which obviously

²⁵ For more information see ec.europa.eu/eurostat/web/international-trade-in-goods/data/focus-on-comext.

makes a comparison 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.²⁶

Aside from these differences in absolute numbers, Comext data strongly support our previous findings in qualitative terms. Those data generate a very similar distribution of discrepancies, they allow replicating the pattern of average country discrepancies that we have found in Section 2 and the same negative relationship between trade volume and discrepancies.²⁷ Again, Cyprus, Ireland and the UK show strong under-reporting biases. Malta, whose BoP data was not available, seems to have the most inaccurate data. For Luxembourg—at odds with the previously 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:²⁸ 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.²⁹ 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.³⁰

All our findings remain absolutely robust when taking 2017 as reference year.³¹ This is true both for BoP as well as Comext data. Hence, we are confident that the above shown

²⁶ Cf. Dimitrov (2004), a Eurostat publication, for more details on methodological differences between BoP and FTS.

²⁷ See Figures 10 and 11 as well as Table 9 in the Appendix.

²⁸ See Table 10 in the Appendix.

²⁹ See Table 11 in the Appendix.

³⁰ 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 to those in Column 1; qualitatively, they support our findings based on EU BoP data.

³¹ For the sake of brevity and in order to avoid duplication, we do not discuss these results.

discrepancies result from 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. Thus, the next section marshals the evidence gathered so far towards an attempt to making sense of 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*”.³² In the light of our analysis, one can question this assertion.³³ The inconsistent data make solid evidence-based economic policy advice very hard. What is more, it could also 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 earlier, not just the EU but the world entirely runs a substantial trade self-surplus. This discrepancy amounts to 422 bn USD, which reflects 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 contributes 86 percent to 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. The global surplus, thus, seems not due to interstellar trade (Krugman, 2010) but in fact, at least to a large extent, it is made in the EU.

Strikingly, the global trade deficit starts growing from 1993 onwards and turns into a surplus in the late 90s. For the decades before, it always has been a global deficit. The year 1993, of course, is also the starting date of the EU Single Market, which has facilitated intra-European trade quite substantially (Felbermayr et al., 2018), and in 2004 the EU Eastern enlargement has created the World's second largest internal market. Unfortunately, long and 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, and exactly coinciding with the EU Eastern enlargement,

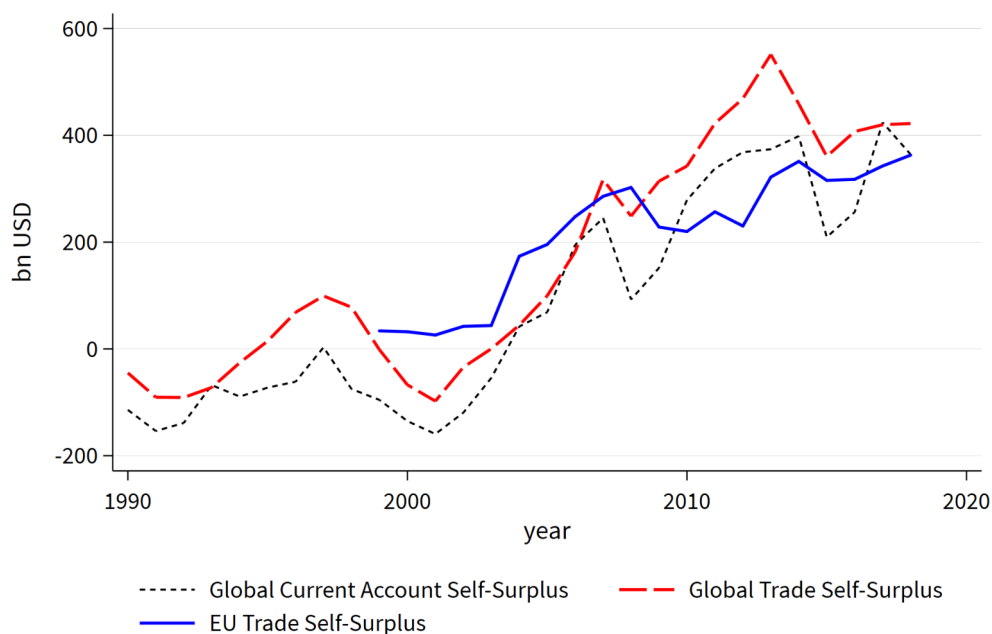
³² *The Economist*, November 12, 2011, accessed on December 20, 2018.

³³ We do not present any comparison between EU BoP data and that of emerging economies, though.

it has quadrupled. Arguably, the creation 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, Eurostat has been reporting a self-surplus of the EU since 1993. This is at odds with the above discussed import-bias underlying FTS due to *cif-fob* differentials.

In the following, we start by discussing alternative interpretations of discrepancies in goods trade. Then, 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 faces a systematic, non-random over-reporting bias. Section 3 has found 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 by the so-called Rotterdam Effect. Oversea imports entering the EU in Rotterdam and transiting to other Member States are often recorded as Dutch exports and likewise an intra-EU import by the counterparty. This leads to inflated trade statistics with respect to Netherlands. Discrepancies

arise, however, when these overseas imports are recorded differently by the Netherlands and the country of final destination.³⁴ 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 accurately measured 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. Clearly, for intra-EU discrepancies, we can largely rule out this channel, since capital controls within the EU are rare events.³⁵

One may suspect that transfer pricing has a distorting effect on intra-EU current account statistics. However, even if transfer prices were used for corporate profit shifting purposes, over-priced imports and under-priced exports can hardly materialize in bilateral discrepancies: 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. The reason is that consumption instead of production is the objective of taxation. Subsequently, the European VAT system is considered a growth-friendly tax, but it enables possibilities for fraud: if firms can legally declare products as exports which are in fact not exported (or re-imported), they sell them domestically without remitting VAT to governments. Firms are the only and most directly affected beneficiaries of over-stated export.³⁶

The European VAT system is therefore evidently prone to tax fraud. To curb such practices, the EU Commission has initiated a VAT Action Plan in 2016.³⁷ Quantifying the damage for European tax payers, the EU Commission has estimated that a single fraud type—the so-called “missing trader”—causes VAT revenue shortfalls of 45 to 53 bn Euro annually (Fearing et al., 2015).³⁸

³⁴ 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.

³⁵ 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.

³⁶ Statistical offices, of course, could technically also manipulate data. However, it is questionable why statistical offices should follow such objectives and what their incentives to do so would be.

³⁷ See http://europa.eu/rapid/press-release_IP-18-3834_en.htm, accessed on December 20, 2018.

³⁸ 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 originally has estimated the cited numbers on VAT revenue shortfalls. The original source was not traceable.

Fedeli and Forte (2009) describe technical details of VAT fraud systems. In a nutshell, the “missing trader” practice functions as follows: A trader (Firm 2) located in, say, France purchases a product from Firm 1 located in, say, 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 paid 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 to French tax authorities that has been rebated to Firm 3. 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, hence, they are commonly known as “missing trader”. Experts have given this fraud system the resounding name “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.

Clearly, 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 from 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 cost for services, e.g., financial or business-to-business services relies 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 and various reasons suggest that data quality for goods trade is better than for services trade. First, due to its lower economic importance in the past, 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 of 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 EUR while within the Euro Area this figure stands by only 39 bn. 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) shows this for Cyprus, Ireland, Luxembourg, the Netherlands (only Debits) and the United Kingdom. It stands out that these countries show discrepancies for credit and debit accounts that point in the same direction (Cyprus, Ireland, the UK and the Netherlands have 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, which is due to data limitations, not possible yet.

Figure 1 shows that the EU's mysterious self-surplus in services 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. While services exports were mainly business-to-business transactions in the past, the intermediary—often a domestic importer—is becoming increasingly obsolete as consumers are directly served by foreign companies. 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 becomes more and more business-to-consumer, a credit-bias becomes prevalent: the exporter records the cross-border transaction while the importer—the final consumer—does not. In a situation where 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.³⁹ Thus, e-commerce together with dis-intermediation is a growing challenge for statisticians especially in the correct recording of services transaction.

At the same time, e-commerce has also become a playground for criminals who have set up digital VAT carousel schemes. In principle, the mechanism for VAT fraud works analogously as for goods: exports are VAT-exempt and therefore, declaring services as exports which are not exported 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; eventually, it is even more profitable in services trade due to lower transactions costs.

In the EU, statistical recording is hampered by a fundamental lack of harmonization.

³⁹ 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 go missing in the recording process.

This is particularly true for the collection of cross-border services trade. The existence of 28 different regimes in the EU not only causes statistical discrepancies; the poor data situation also makes it easier for fraudulent users 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.⁴⁰ Basically, it levies the duty to remit VAT to the services recipient, e.g., the final consumer. Borselli et al. (2015) also recommend reforms towards a system of reverse charging for fighting tax fraud.

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 true fiscal loss. Note, however, that there may be VAT fraud that is not detectable in international trade statistics; to the extent that this matters, 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 imports M_{ji} 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 . Then, if the entire data discrepancy were due to VAT fraud, the fiscal loss to the government in country j would amount to

$$T_j = \bar{t}_j \sum_i (X_{ij} - M_{ji}) \quad (7)$$

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

$$T = \sum_j \sum_i \bar{t}_j (X_{ij} - M_{ji}). \quad (8)$$

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 whole (see Section 2.3). Let \bar{t} be the GDP weighted average EU VAT rate⁴¹, the EU-wide VAT loss can be approximated by

$$T = \bar{t} \left(\sum_j \sum_i (X_{ij} - M_{ji}) \right). \quad (9)$$

Since $\sum_j \sum_i (X_{ij} - M_{ji}) = 307$ bn EUR in 2018, with $\bar{t} = 0.21$, we are talking about 64.5 bn EUR of taxes forfeited. Arguably, the UK contribution to the discrepancies is

⁴⁰ German VAT Legislation, accessed on December 20, 2018.

⁴¹ Source: Eurostat 2019. Using an average VAT rate can easily lead to an underestimation as the incentive for fraud increases in the VAT rate.

most likely made up by measurement error and, therefore, not the full amount of 307 bn EUR is due to VAT fraud. But even within the Euro Area, the discrepancy of 126 bn EUR implies an amount of fraud equal to 26.5 bn EUR; more than 70 EUR per capita. Put differently, if we assume that VAT fraud affects trade in goods only, the fiscal loss amounts to 34.9 bn EUR. The cumulative self-surplus for goods of the entire EU from 2006 to 2018 amounts to 2,047 bn EUR. Assuming an average VAT rate of only 18 percent for the entire period⁴², EU budgets could have fallen short of 370 bn EUR 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 them both. An outline of such a solution could look as follows: An electronic clearing procedure could be implemented that documents all cross-border transactions for goods and services. Every transaction should require a two-factor authentication: first, the exporter declares export value, quantity, and counterparty to 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, the exporter would urge the importer to confirm the transaction otherwise he had to remit VAT. 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 remit 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 not be necessary any more.

5 Concluding Remarks

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

⁴² VAT rates have slightly increased over time.

contributions and personal transfer payments.

This paper introduces a simple measure for discrepancies on the country and country pair levels. Our analysis finds large heterogeneity in data accuracy across countries indicating substantial differences in governments' capabilities with respect to 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 suggest that EU statistical regimes are systematically incapable of tracking true import and export figures.

The EU self-surplus contributes by 86 percent to the global trade self-surplus of 422 bn USD in 2018. After the 2004 EU Eastern Enlargement, 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 of EU would improve, and the EU will account for less than 40 percent of the global self-surplus. Needless to say, in such a case, the trade regime of the EU with the UK changes, and that will have substantial own effects 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 EUR per year in a realistic scenario. At worst, revenue shortfalls would amount to even 64 bn EUR. Finally, we link the growing importance of e-commerce and the process of dis-intermediation to rapidly raising discrepancies in services trade. For the sake of fighting tax fraud, but also to enable policy relevant research grounded on solid data bases, 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 could make tax fraud and data misreporting very difficult. 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

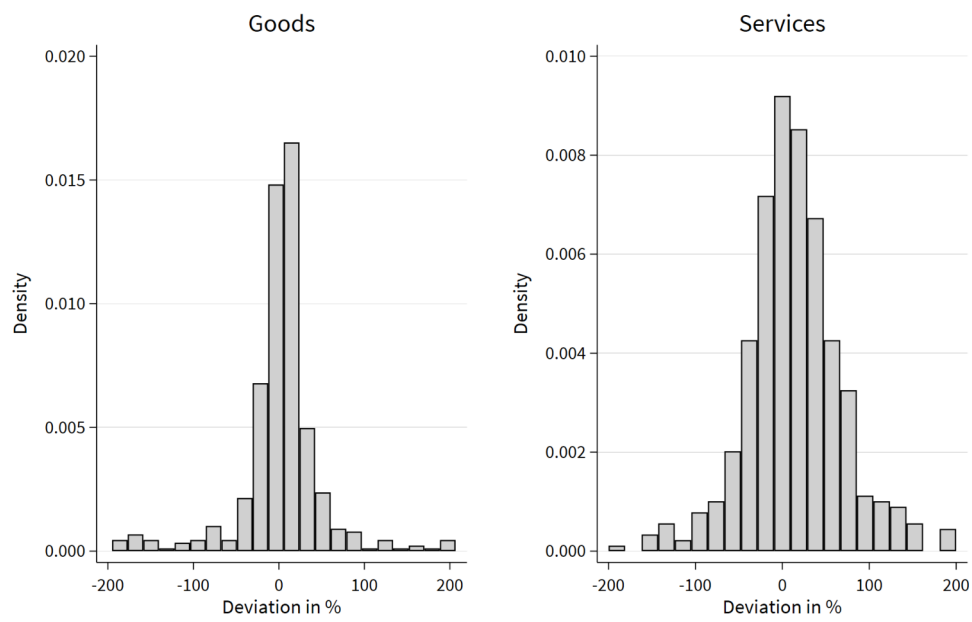
Table 5: Secondary Income Accounts by Components, 2018, bn EUR

| 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.

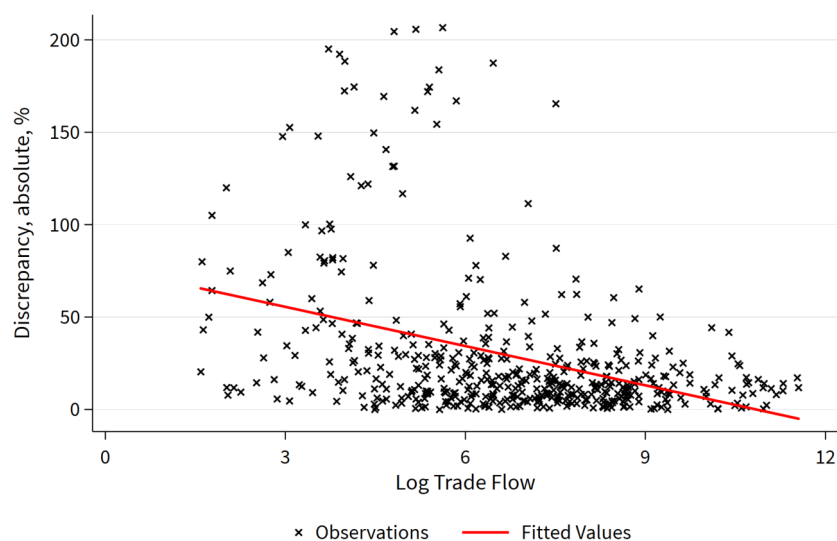
Figure 5: Distribution of Discrepancies, 2018, in %



Source: Eurostat 2019.

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

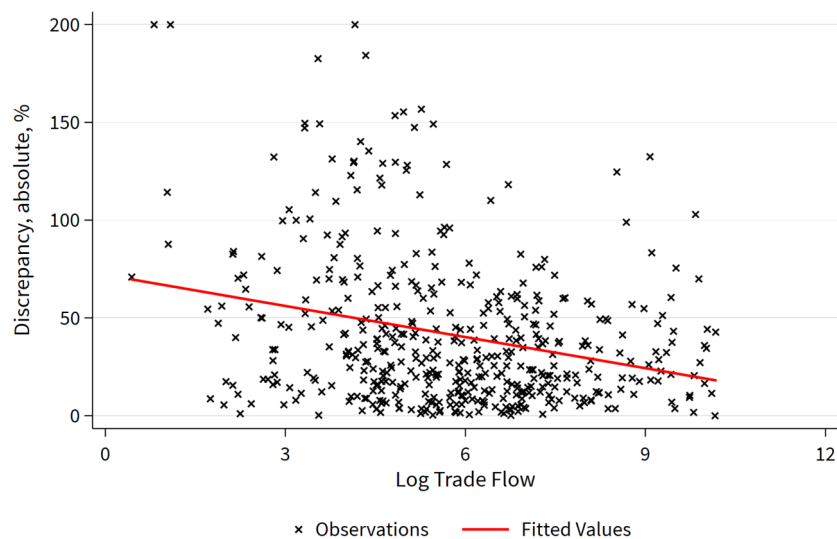
Figure 6: Scatter Plot: Trade Volume and Discrepancies, Goods, 2018



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.

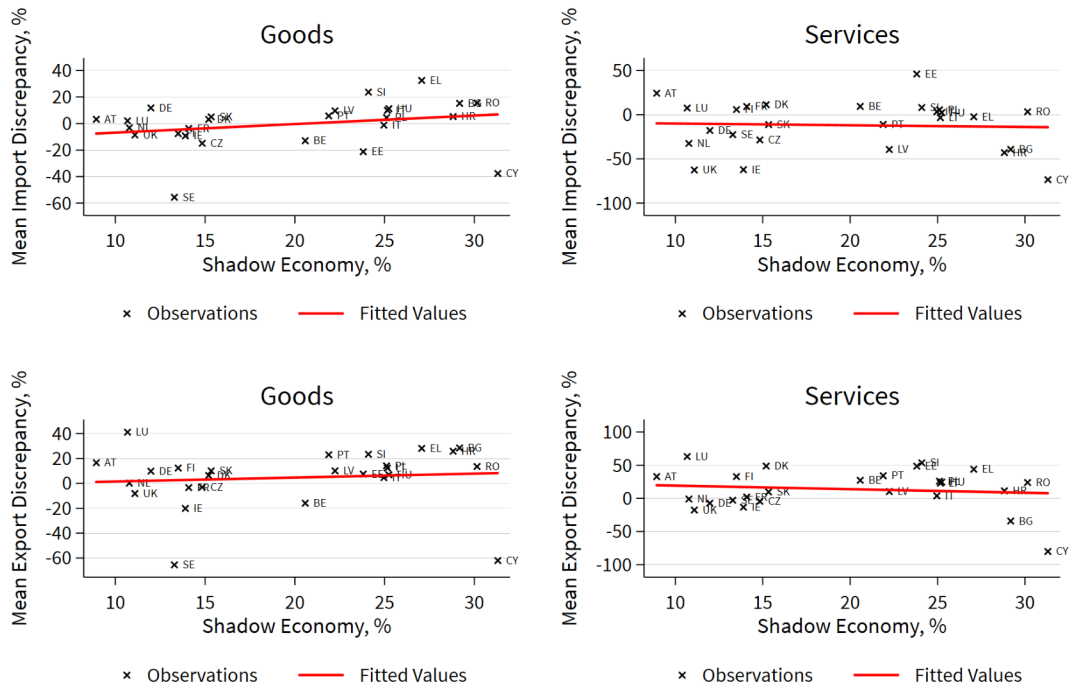
Figure 7: Scatter Plot: Trade Volume and Discrepancies, Services, 2018



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.

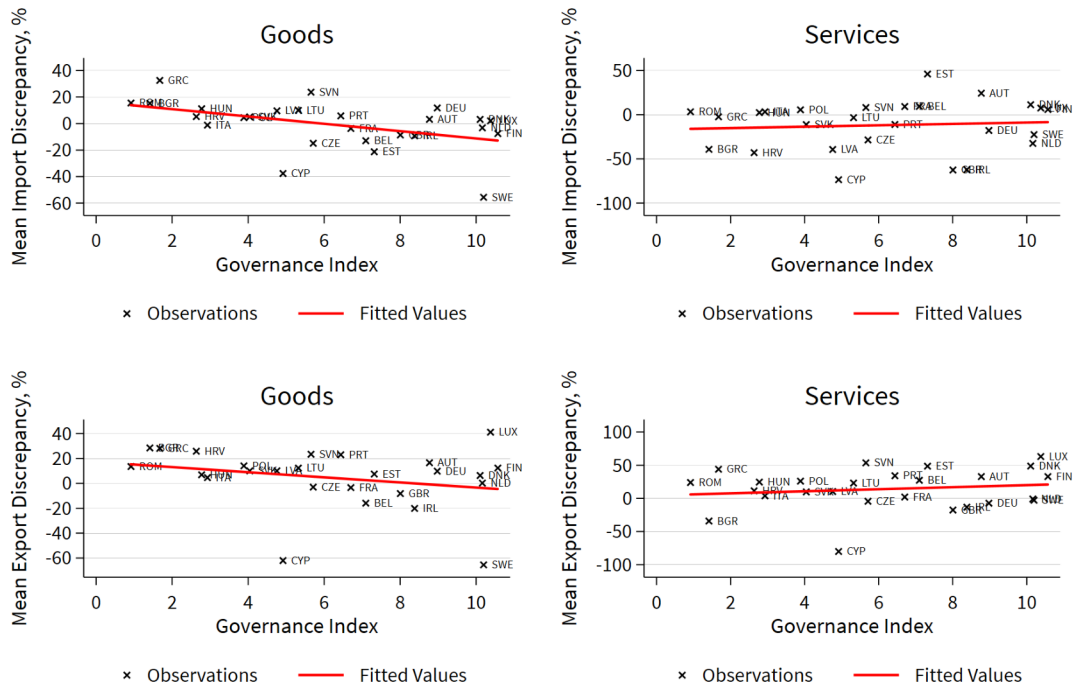
Figure 8: Mean Discrepancy per Country and Size of the Shadow Economy



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.

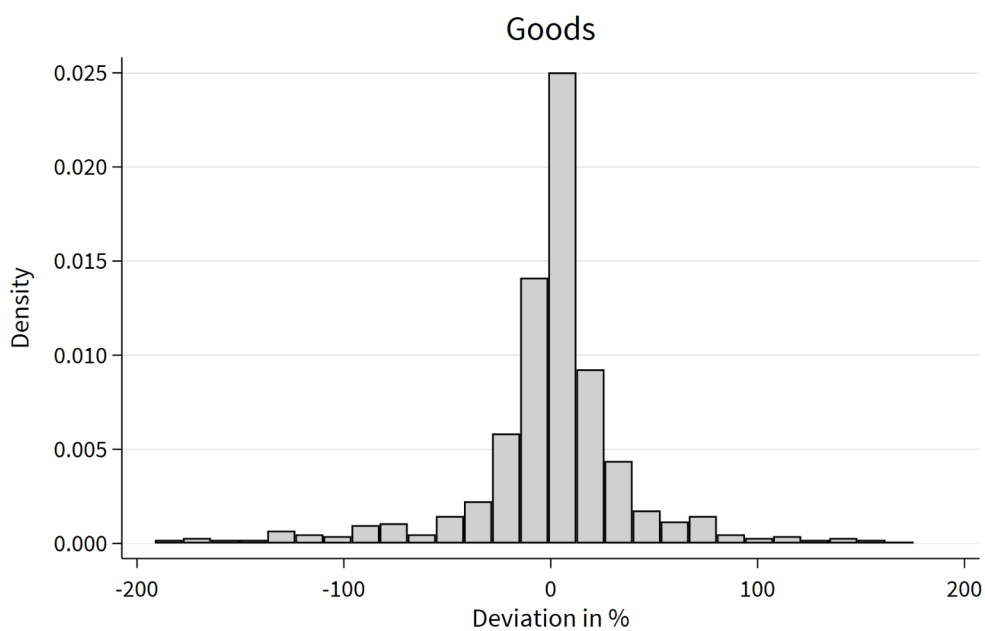
Table 8: Regression Analysis: Country Fixed Effects, Discrepancies in %

| | Goods BoP | | Services BoP | | Goods Comext | |
|----------------|-----------|--------|--------------|--------|--------------|-------|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| 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.

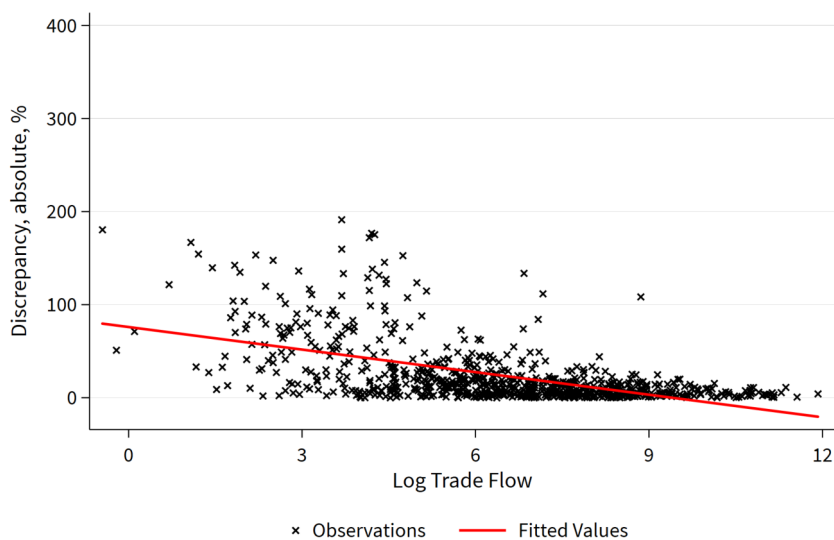
Figure 10: Sensitivity Analysis: Distribution of Discrepancies, 2018, in %



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.

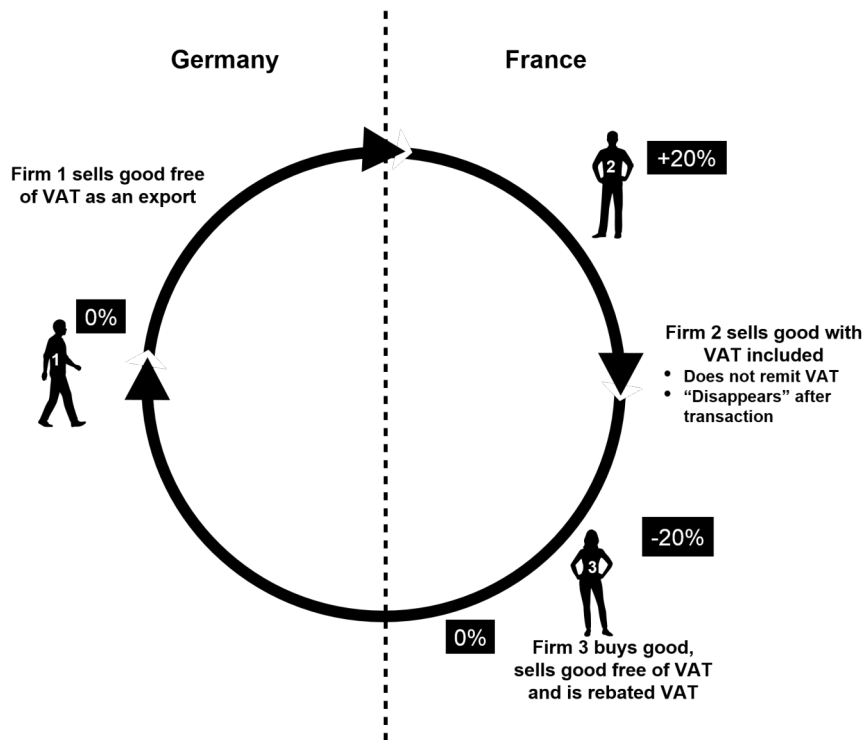
Table 11: Sensitivity Analysis: Country Pair Discrepancies, 2018

| | Goods | | |
|-------------------|--------------------|--------------------|------------------|
| | (1) | (2) | (3) |
| log Trade | -8.11*** (0.64) | -7.61*** (0.73) | -3.10 (2.65) |
| log Distance | | 7.72*** (2.57) | 7.60 (5.26) |
| Common Border | | 9.56*** (3.38) | 6.88** (2.95) |
| Common History | | 2.04 (4.44) | -1.90 (4.66) |
| Common Language | | 11.98*** (3.54) | -4.46 (4.25) |
| Δ VAT Rate | | 1.31** (0.58) | 0.93 (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. Dependent 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.