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What value added in the trade balances of euro area financial centres?

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Abstract

Beside large capital flows, euro area financial centres feature important and growing trade surpluses. We investigate the composition of their gross trade flows and disentangle (i) domestic and foreign production content that is (ii) directly traded with final absorbing economies or embedded in intermediates that are carried to final destination by partner countries. This accounting exercise uncovers that foreign production transiting through their borders accounts for most of the surpluses of financial centres but also that the net surplus in domestic value added traded directly with final consumers is twice as large as in other euro area economies. MNEs allocate the value created globally to financial centres. They do so through transfer pricing practices which undermine the correct representation of the external position of these countries with a bearing also on the external position of the euro area. Their participation in production chains also appears oddly large. When we replace the official trade statistics with predictions based on the gravity law of trade, the surpluses of main euro area financial centres disappear.

Keywords: financial centres, profit shifting, trade balance, domestic and foreign value added
JEL-Classification: F14, F23, F40

Non-technical Summary

The role of financial centres as the hub of global financing, financial risk sharing and international capital movements, makes the size of the financial flows transiting through their balance of payments magnitudes larger than their domestic economy. In the course of the past decade their trade flows have expanded enormously, in a few cases beyond any economically reasonable number for the size of their economy. Furthermore, since exports grew constantly more than imports, their trade surpluses rapidly piled up.

On paper, this condition may indicate the presence of macroeconomic imbalances while in practice it also reflects MNEs' global operations rather than domestic disequilibria. Financial holdings and specialised subsidiaries of multinationals (MNEs) are often located in financial centres that offer favourable treatment to profit taxation and the euro area is home to several globally important ones. For these reasons the euro area statistics suffer potentially more than other regions from distortions due to MNE operations, a side effect of globalisation.

Some recent work provide first measurements of the base erosion and profit shifting (BEPS) size globally (see Bolwijn, Casella and Rigo 2018; Tørsløv, Wier and Zucman 2018). This paper contributes to the literature on MNEs activity in financial centres with a novel view on their external imbalances from a *value added* perspective. Our analysis sheds light on additional aspects of profit shifting practices through the analysis of the four main euro area financial centres: Ireland, Belgium, the Netherlands and Luxembourg.

The trade balance of euro area countries is broken down by its value added content. In particular, we separate the value contained in foreign trade transactions into the part that (i) the exporting country itself and (ii) its partner economies have produced and exported, either (iii) directly to final consumer or (iv) to intermediate importers that, after further processing, re-export elsewhere.

Our approach identifies the components of the trade balance which are most contaminated by MNEs operations and in which direction.

The bilateral break-down highlights that in order to book value in financial centres, MNEs inflate the value of domestic production exported by financial centres, possibly overpricing tasks performed there. These transfer pricing practices underpin the contribution of domestic production for final absorption in net trade balance that in financial centres is twice as large as in other euro area economies.

Moreover, the convenience of such practices is maximised when operated on the ex-factory price. This explains why financial centres act as transit for final (or almost final) production of other economies: their net trade in foreign value added absorbed by direct importer is atypically large. Finally our decomposition highlights large deficits in domestic production that is subject to further processing elsewhere. Imports from original producers

for further processing are significantly bigger than the value of the production they export for further processing.

All these operations which are likely to conceal transfer pricing practices involve, at least, the crossing of three countries and are therefore classified in the literature as global value chain (GVC) trade. Their GVC participation index is the highest in the world and financial centres appear as the most downstream positioned group of countries.

We find that financial centres are conduit economies of other's production as much as they are of financial transactions. We also suggest a correction methodology based on trade gravity estimations and encompassing indirect exports and GVC trade, that allows the recomputation of trade balances in financial centres as predicted by gravity. The largest correction is performed on the domestic production entering global value chains but directly traded with final consumers. This component especially affected profit shifting practices as it pertains to the value booked in financial centres. As a result of our corrections, the aggregate trade balance of the euro area financial centres shrinks very substantially and remains stable over time. According to our methodology, profit shifted to Luxembourg, Ireland, Belgium and the Netherlands would amount to $170 billion in 2014, not far from the $220 billion found by Bolwijn et al. (2018) for the advanced economies.

1 Introduction

Financial centres foster international capital movements, enhance access to global financing, favour risk sharing across economic agents. This typically makes the size of the financial flows transiting in their balance of payments (BoP) magnitudes larger than their domestic economy. In the course of the past decade their trade flows have also expanded enormously, in a few cases beyond any economically reasonable number for the size of their economy. Furthermore since exports grew constantly more than imports, their trade surpluses rapidly piled up.

On paper, this condition may indicate the presence of macroeconomic imbalances, in practice it reflects MNEs' global operations rather than domestic disequilibria. Activity of global companies reverberate across the external account of hosting countries and in particular on their external balances, leaving footprints in several macro statistics. Financial holdings and specialised subsidiaries of multinationals (MNEs) are often located in financial centres and the euro area is home of several globally important ones. For these reasons the euro area statistics suffer potentially more than other regions from distortions due to MNE operations, a side effect of globalisation.

Several works point out that MNEs pursue tax-optimisation on global scale by shifting value (profits) in financial centres where they receive favourable fiscal treatments and identify transfer pricing and licensing as the dominant channels (see Dowd, Landefeld and Moore 2017; Flaaen et al. 2017; Dharmapala 2019).

Some studies investigate the effects of profit shifting on macro conditions in home countries of headquarters. Overesch (2009) finds that the size of multinationals' real investments in a high-tax country is positively affected by a lower taxation of shifted profits. Guvenen et al. (2017) show that, over the past 25 years, profit shifting has subtracted each year between 0.1% and 0.25% growth to the US aggregate productivity, with strongest effects in RD-intensive industries.

The debate about global firms tax strategies has received increasing space in the news and captured policymakers attention as crawling capital taxation and rising labor tax-burden led to rising inequality in advanced economies. However authorities face several challenges in finding silver bullet evidence of MNEs misbehaviour due to the lack of micro statistics, difficulties in pricing information and communication technologies (ICT) services and royalties and to the complex schemes, involving transactions going through several jurisdictions, engineered by MNEs to escape corporate taxation.

Recent work provides first measurements of the base erosion and profit shifting (BEPS) size; globally, one estimation is obtained measuring yield differentials on foreign investments across countries and considering evidence of it the premia obtained by companies on investments in financial centres. Alvaredo et al. 2018 link the large current account surplus in low-tax jurisdictions to the favourable corporate taxation and attempt a first correction

of official BoP statistics based on mirror statistics and micro information.

This paper contributes to the literature on MNEs activity in financial centres with a novel view on their external imbalances from a *value added* perspective and sheds light on additional aspects of profit shifting practices. In particular it discusses how BEPS practices lead to a misrepresentation of positioning and participation of financial centres in global value chains (GVCs). As mentioned, moving profits implies an allocation of value produced globally to specific countries. This has repercussions on the estimated productivity, on perceived comparative advantages and aggregate production structure of financial centres. Our approach identifies what components of the trade balance are most contaminated by MNEs operations and in which direction. We also suggest a correction methodology based on the gravity law of trade that allows to recompute trade balances in financial centres as predicted by gravity.

The trade balance of euro area countries is broken down by its value added content. In particular, we separate the value contained in foreign trade transactions into the part that (i) the exporting country itself and (ii) its partner economies have produced and exported, either (iii) directly to final consumer or (iv) to intermediate importers that, after further processing, re-export elsewhere. We then compare similar decomposition across countries and unveil that main euro area financial centres (namely the Netherlands, Ireland, Luxembourg and Belgium) share a strikingly similar type of trade balance decomposition, which is not traceable elsewhere.

Some country pairs relationships are more concerned than others by MNEs activity, some components of the trade balance are more affected by global operations than others.

The bilateral break-down highlights that certain peculiarities are common exclusively in bilateral transactions concerning financial and non-financial centres; in other words low and high taxation jurisdictions. Bilateral flows are not all equally distressed by MNEs strategies and we trace back differences across countries to the extent that external statistics are plagued with global operations of MNEs.

In order to book value in financial centres, MNEs inflate the value of domestic production exported by financial centres, possibly overpricing tasks performed there. These transfer pricing practices underpin the contribution of domestic production for final absorption in net trade balance that in financial centres is the twice as large as in other euro area economies; we refer to this component of the trade balance as $DVA - DIR$ in the text.

Moreover, the convenience of such practices is maximised when operated on the ex-factory price. This explains why financial centres act as transit for final (or almost final) production of other economies, their net trade in foreign value added absorbed by direct importer is atypically large (we refer to it in the text as $FVA - DIR$). Finally our decomposition highlights large deficits in domestic production that is subject to further processing elsewhere; import from original producers for further processing is way bigger than the value of the production they export for further processing (the term is labelled as $DVA - GVC$

in the paper). Besides, all these operations which are likely to conceal transfer pricing practices, involve at least the crossing of three countries and are therefore considered by practitioners as supply chain trade. Their GVC participation index is the highest in the world and financial centres appear as the most downstream positioned group of countries.

A large and positive trade balance held in foreign production and a negative trade balance in domestic production traded abroad suggest a *"in chain"* positioning close to final consumers, relative to their trading partners.

In conclusion, financial centres are conduits economies for real transactions as much as they are of financial transactions; just a very small amount of foreign trade booked in their balance of payments is for domestic absorption.

In this paper we take up the challenge to correct official trade flows statistics of financial centres for the footprints left by MNEs. We do so by resorting to predictions of an augmented gravity model of bilateral gross exports, domestic value added exported to final consumers, and domestic value added exported through intermediary countries indirectly to final consumers. The foreign value added exported via financial centres is obtained as the difference between predicted gross exports and predicted exported domestic value added. The magnitude of global value shifted to euro area financial centres is the difference between official and predicted trade balances. Similarly we correct GVC participation and location measures.

The aggregate trade balance of financial centres in our predictions shrinks substantially and stabilise. In particular, the estimation downsizes gross exports, domestic and foreign production content substantially; the largest correction is performed on the domestic production entering global value chains but directly traded with final consumers; this component is likely to be the most affected by profit shifting practices as it pertains the value booked in financial centres. Profit shifted to Luxembourg, Ireland, Belgium and the Netherlands is found to amount all together to $170 billion in 2014, which is comparable with previous evaluations in the BEPS literature. Our strategy may not be sufficient to fully correct for BEPS practices as GVC participation of financial centres is still exceptionally high, although the positioning is definitely less downstream.

The paper introduces our novel decomposition of trade balances by the type of value added in section 2 and compares them across types of countries (financial centres versus other euro area main economies, and other large economies like the US, UK and China); it reviews GVC measures in section 3. Section 4 provides details on gravity specification augmented to control for the structure of foreign trade of the bilateral importers and section 5 discusses estimates and compute new trade balances as well as GVC measures based on predicted trade flows. We perform a series of checks on the validity of the methodology and on our findings robustness in section 6. Section 7 concludes with a review of main takeaways.

2 The Trade balance in value added

Financial centres feature very sizeable and rising trade surpluses. In countries where financial holdings and special purpose subsidiaries are concentrated, exports and imports flows are heavily influenced by systematical misreporting of intra-firm trade transactions. Transfer pricing practices result in exports overvaluation as the value added created globally by MNEs is allocated there, promoting the build up of trade surpluses in these countries. This occurs despite financial centres differ in their production systems and each exhibits its own traits in terms of activities that MNEs subsidiaries located there specialise in.

Subsidiaries and partners of global companies may be involved in merchanting, receive royalties payments on intangibles (e.g. patents, intellectual property rights and brands); in some cases insurance and leasing subsidiaries are also located in financial centres (e.g. Cyprus and Ireland). The implicit pricing of these services show up as a difference between input purchases and ex-factory prices of the product. These activities are so pervasive that they affect aggregate headline statistics.[1] Tørsløv et al. (2018) explain that transfer pricing practices in financial centres account for almost three quarters of the the discrepancy in total service balance existing within EU-trade.

Therefore, while the established literature maintain that domestic policies and monetary conditions relative to main trading partners are main determinants of external imbalances, the organisation of production networks on international and global scale is also important. In Felbermayr and Yotov (2019) words: "We do not know enough about the determinants of current account balances to set out precise numerical norms". "Policy-makers should pay more attention to establishing the conditions that make current account deficits and surpluses – and their mirror image, international capital flows – sustainable."

Resorting to a novel decomposition of trade flows by value added content, this section establishes new stylised facts on composition and patterns of trade balances in financial centres. We show that global companies contribute with their activity to determine the net trade position of financial centres in a very specific way.

There is an additional macroscopic aspect of tax avoidance strategies plaguing the international consistency of balance of payment statistics. The value of imports originated in financial centres are systematically under-reported in the balance of payment of high taxation economies. The gap with respect to the value of bilateral exports declared by financial centres give rise to an inflation of net trade surpluses in these countries. However, the stylised facts we discuss in this paper are not a by-product of such practices; in our analysis any mismatch is eliminated by taking one side, bilateral exports of reporting country, and reconstructing bilateral imports via mirror statistics. Therefore the world net trade surplus is by construction zero and bilateral imports at destination always match exactly bilateral

[1] These operations often wash out in the current account (see Avdjiev et al., 2018) but are very relevant for trade balances as they inflate export values of financial centres, hence, giving rise to very consistent trade surpluses.

exports declared at the origin. The trade surpluses of financial centres and their atypical decomposition are not caused by under-reporting.

2.1 The decomposition criteria

The goods and services we purchase and sell are composed of inputs from various countries around the world, hence the need of disentangling the different contributions to trade flows. We follow the methodology proposed by Borin and Mancini (2015) to distinguish domestic and foreign contributions and decompose gross bilateral exports into five items according to two main criteria (for further details on the underlying decomposition, see appendix A.1).[2]

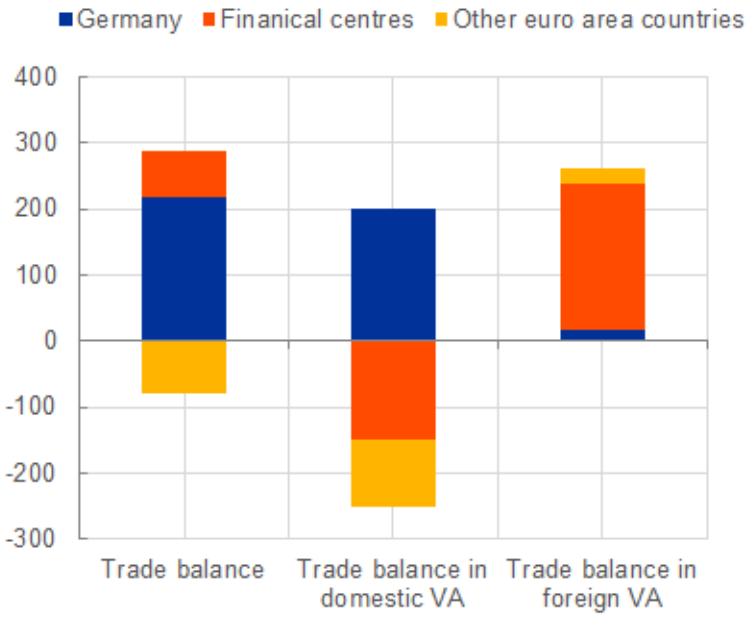
- The trade balance of each country is broken down in terms of the value added that (i) the exporting country itself and (ii) its partner economies have produced in every relevant transaction. The former component of value added is referred to as domestic value added (DVA), and the latter as foreign value added (FVA).
- An additional useful distinction of trade flows is in (i) transactions that involve final consumers (DIR) and (ii) transactions concerning intermediate stages of global production chains and involving further re-export (GVC).

This taxonomy helps understanding the mechanism generating large surpluses in euro area financial centres as well as their contribution to the creation of global value added.

In particular the external position of financial centres adds up to the total euro area surplus; differently from Germany, which is the largest contributor of all through its domestic produced value added, their surplus is entirely determined by foreign production transiting for further processing through their borders (see chart 1).

[2]The break down we apply to gross export flows by value added has two advantages over alternative methodologies; first, it is fully additive, hence, it does not generate biases in decomposing bilateral exports in domestic production and other trading partners production (foreign value added). Second, it separates exports along several dimensions into 21 finely defined categories that can be easily re-grouped depending on specific focuses. In particular it distinguishes across intermediates and final goods and services and identifies when the bilateral importer directly absorb it (also after further transformations), and in which cases goods and services are further exported by the bilateral importer to other destinations. For each of them it singles out the share of domestic value added and trading partners value added. Double counted trade is separately identified (see Borin and Mancini, 2015).

Figure 1: Net euro area trade position
as percentage of euro area GDP



Source: Eurostat.
Notes: euro area financial centres encompasses Belgium, Cyprus, Ireland Luxembourg, Malta and the Netherlands. Last observation 2018.

2.2 The origin of value added contained in trade balances

Based on the break-down of trade balances just detailed, we find out that financial centres emerge from the rest of countries for some key features. Four new stylised facts are discovered about financial centres. First, the net trade balances in domestic and foreign value added regularly take on opposite sign. Since 2000 their growth has constantly outpaced that of the overall net trade position. Second, the trade surpluses in value added stemming from *other countries* dominate the remaining net trade components (see green bars; $FVA - DIR$ of figure 2). They are made of goods and services produced elsewhere but delivered by financial centres to final consumers.

Hence, financial centres import very little foreign value added for domestic absorption but re-export large amounts of others value added to final consumers. This is not the case in other euro area countries where trade surpluses reflect primarily domestic value added that is directly traded with the final consumers (see blue bars; $DVA - DIR$ of figure 2).

Third financial centres present large deficits in the balance of domestic value added to production that is further re-exported by the bilateral importer (see yellow bars; $DVA - GVC$ of figure 2).

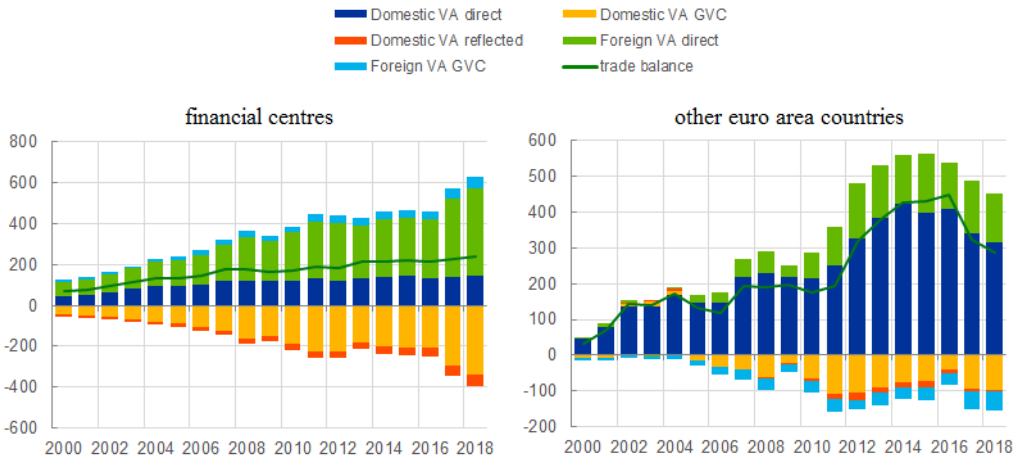
Financial centres thereby tend to perform the very last stage(s) in the production chain making them located very downstream – i.e. they are closest to final consumers – than any other participant in the global production network. They receive production for further transformation but do not export their production to other countries for additional processing; hence the large deficit.[3]

And fourth, financial centres exhibit surpluses in domestic value added exported to directly absorbing countries twice as large as in other euro area economies (see blue bars 2, $DVA - DIR$).

This is all the more noteworthy as right $DVA - DIR$ makes most of the trade balance in other euro area economies. However this is also the component most likely to be contaminated with profits (value) shifting as it concerns the value that is booked in financial centres.

The four findings do not reflect a single financial centre specificity but stems from patterns common across them (see figure 3). Despite a considerable heterogeneity in the production structure, the value added composition of their trade balance is strikingly similar in this group of countries and yet very different from any other country (compare figure 3 and 4).

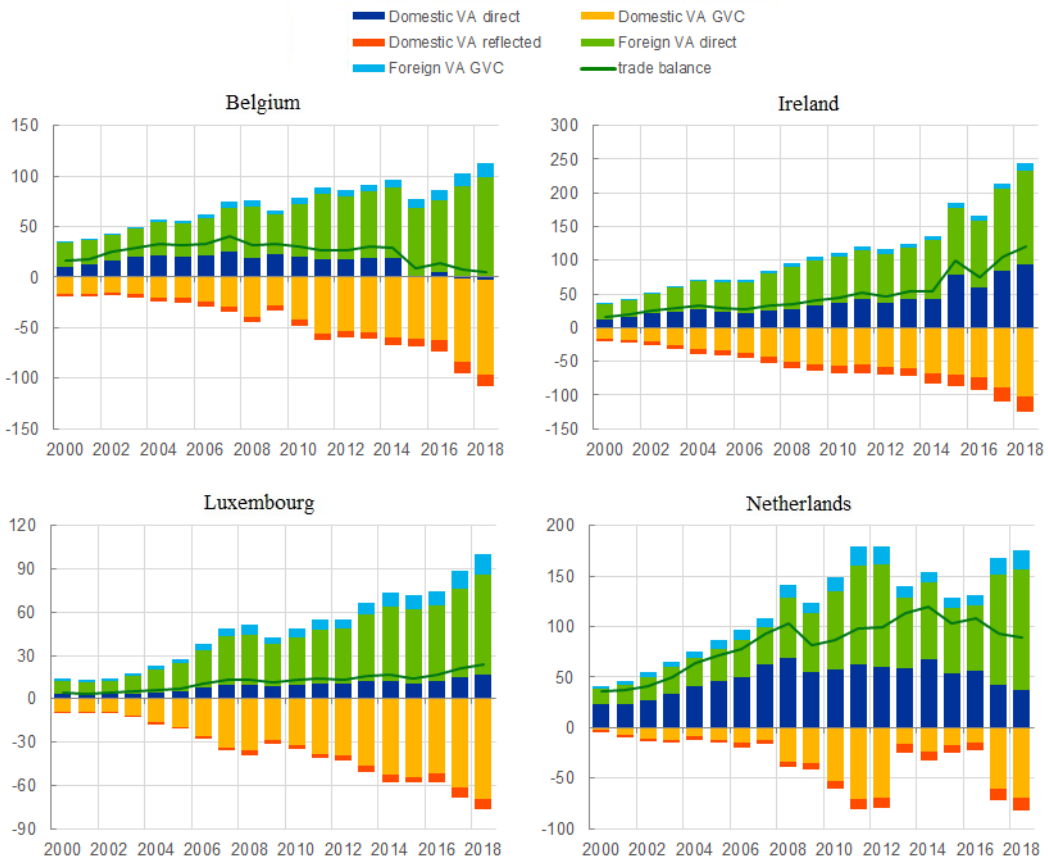
Figure 2: Decomposition of trade balance by value added content



Source: authors' computations based on WIOD and ADB MRIO tables.
Note: vertical axes expressed in billions USD.

[3]For the Netherlands some of these patterns are softened by the presence of a large, active exporting manufacturing sector.

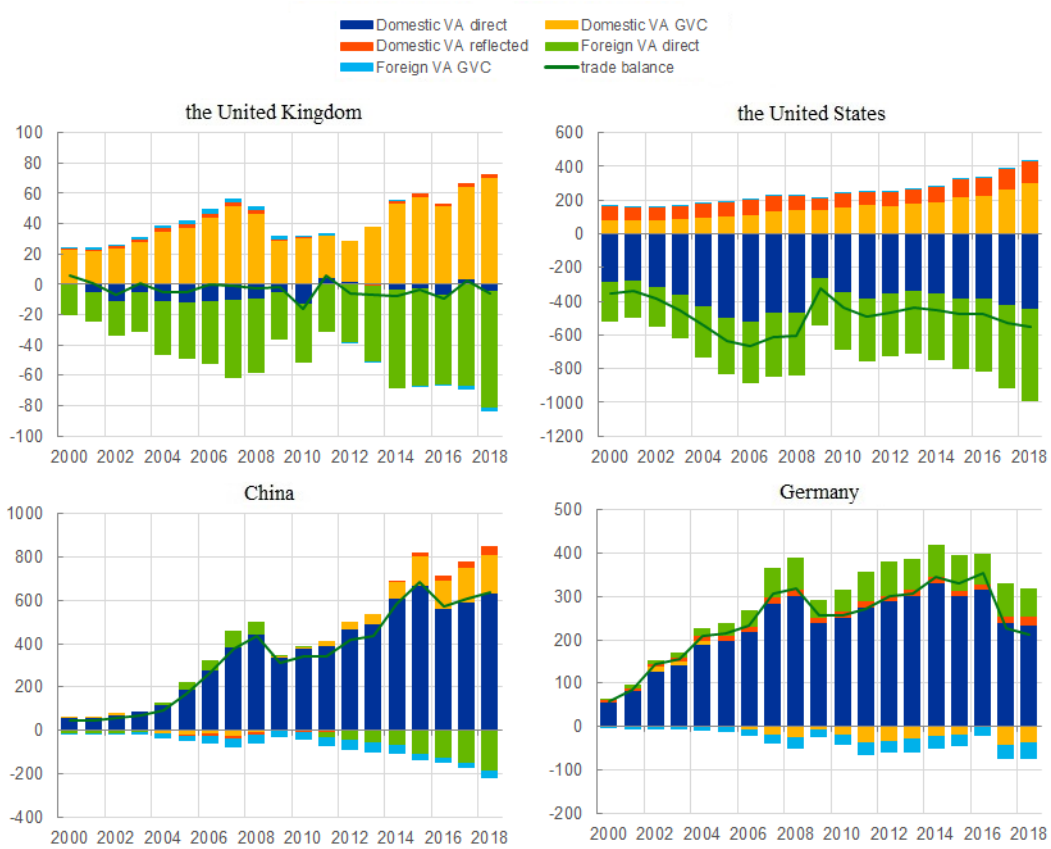
Figure 3: Trade balance in value added, financial centres



Note: vertical axes expressed in billions USD.

Source: OECD and authors' computations based on WIOD and ADB MRIO tables.

Figure 4: The value added representation of the trade balance in global economies



Note: vertical axes expressed in billions USD.
Source: authors' computations based on WIOD and ADB MRIO tables.

Let's repeat ourselves and recap: each main euro area financial centre (Luxembourg, Ireland, Belgium and the Netherlands) exhibit a constantly increasing trade surplus (see figure 3) mostly due to foreign value added traded directly with final consumers ($FVA-DIR$). They all have a mirror trade deficit in domestic value added that further requires intermediate production stages ($DVA-GVC$).

The abnormality of financial centres appears clear when compared to other countries. The trade balance components related to production chains (e.g. $FVA-DIR$, $FVA-GVC$ and $DVA-GVC$) are inflated (both deficits and surpluses) by pervasive integration of their production system into global networks. However, GVC champions like China, Germany and the US, do not exhibit such large imbalances owing to integration in production network; most of their net positions still depend on the contribution of domestic production to foreign trade transactions (see blue bars of figure 4). Noteworthy, the US runs constant deficits in the balance of domestic value added traded with final consumers but exhibit persistent surpluses in domestic value added to intermediate stages of production chains. The euro area financial centres are US counterpart in half of these foreign trade transactions.

2.3 Bilateral trade balance in value added

If goods in transit and intangibles services mask tax-avoidance strategies, then one should expect net trade positions of financial centres to primarily reflect bilateral balances with high-tax jurisdictions, thus resulting in "selective trade surpluses". In other words, transfer-pricing practices manipulate the allocation of values globally created by MNEs between high and low taxation countries, hence plaguing mainly the correct representation of these bilateral flows.

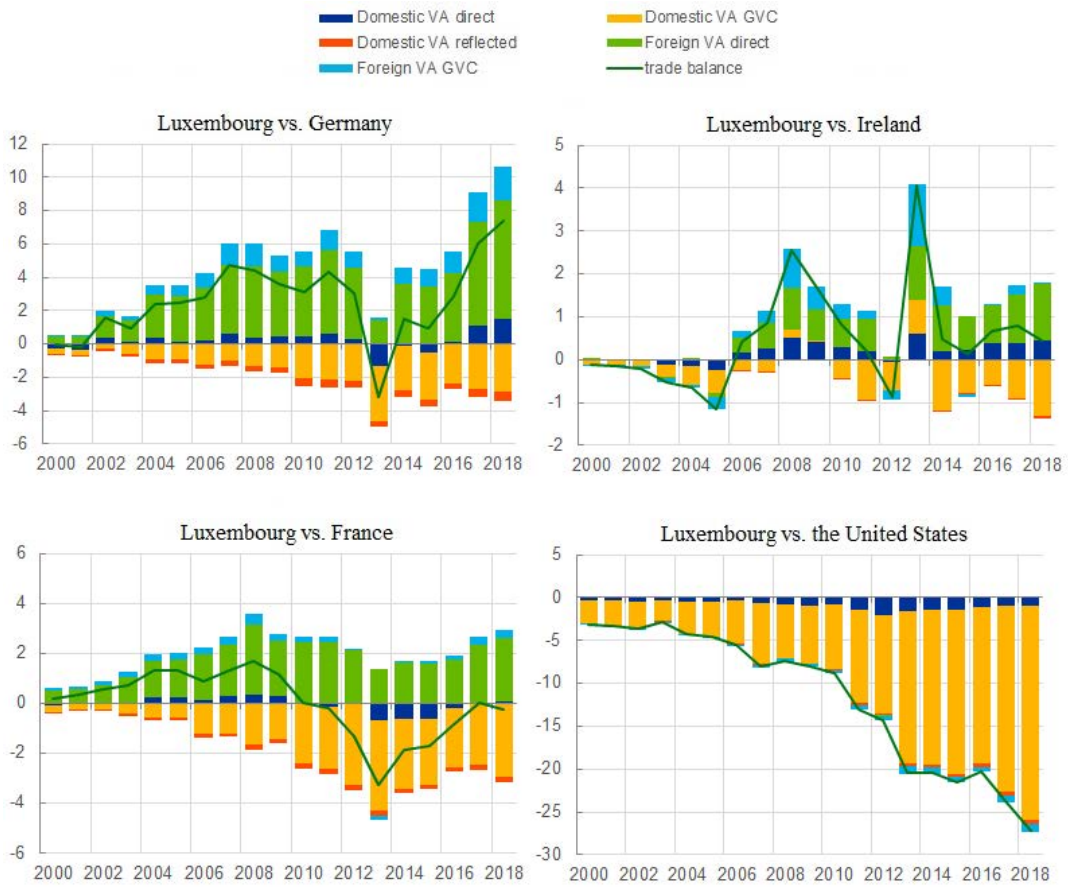
The bilateral trade balances of financial centres support this assumption. Financial centres indeed hold large surpluses only vis-à-vis high-taxation jurisdictions, especially euro area economies, whereas their positions with other financial centres are definitely more nuanced. When trade balances are expressed in terms of value added content, trade surpluses pertaining to exchanged $FVA-DIR$ pile up vis-à-vis main manufacturing countries; this is because imports of foreign production for direct absorption from these economies is negligible but exports is very substantial. Conversely high taxation jurisdiction exports to financial centres dominantly their domestic production of intermediates that are further processed ($DVA - GVC$).

Also deficits with the US consist of US domestic production, which crosses the borders of financial centres but ends up elsewhere (trade balance in $DVA - GVC$). Financial centres are integrated in value chains in a special way: they are two way transit for regional partners and one way linked to the US — they transform and re-export to the rest of the world; as a result they exhibit deficits vis-a-vis the US, that is in deficits almost vis-à-vis any other country (see figure 5, A.4.2 and A.4.3).

Differently, net trade positions vis-à-vis other low corporate-tax jurisdictions are volatile with frequent changes from surpluses into deficits.

Finally the dynamics of the bilateral trade balance between two financial centres mirror, in some occasions, developments in net trade observed between financial centres and other euro area economies. Precisely this is the case for Luxembourg where the sudden reversal from surplus to deficit in 2013 vis-à-vis Germany and France is counterbalanced by a large trade surplus emerged over the same period vis-à-vis Ireland (see figure 5).

Figure 5: The value added representation of the bilateral trade balance for Luxembourg



Note: vertical axes expressed in billions USD.
Source: authors' computations based on WIOD and ADB MRIO tables.

What may be occurring with the trade balance of financial centres is better understood through an example. Imagine that MNEs operate a strategic allocation of value created globally in order to optimise their fiscal burden. MNEs can export to a subsidiary operating in financial centres intermediate production for low price, hence, compressing profits earned in the exporting high tax jurisdictions. At the same time the subsidiary, located in the low-tax jurisdictions, adds complementary services (merchanting, royalties from brand and patents) and then re-export ($FVA - DIR$) the same goods. This time the value of complementary services is included, hence, the goods are re-exported at higher prices.

To book profits in financial centres, the complementary services are allocated large fraction of the globally created value. Intuitively the convenience of transfer pricing strategies is maximised when the economy with favourable taxation regime receives the products just ahead of final sales and supply directly final consumers abroad.

This is the price gap between production and consumer price that Timmer et al. (2015)

refer to and it can explain the large surplus identified in foreign production traded through financial centres directly with final consumers ($FVA - DIR$).

We draw two conclusions from this exercise. First, the dissection of the trade balance in value added shows that financial centres are conduits also for real transactions. A tiny fraction of their total trade is for their own domestic consumption while a significant share of their trade instead responds to different objectives, including that of escaping profit taxation. Second the reliability of official trade balance statistics in presence of integration in production network is questionable and their determinants may not be macroeconomic imbalances but global companies strategies which fall outside the room for manoeuvre of governments.

As a result of tax-optimisation strategies pursued by global firms, the measurement of financial centres participation and location in GVC is heavily biased and fictitious macro imbalances emerge which are not real.

3 Measures of GVC integration of financial centres

Standard measures of GVC participation and positioning rank financial centres as the most downstream located countries in supply networks. Such a feature remained unnoticed in previous works for a twofold reason: first, most papers focused on the fragmentation of, strictly speaking, manufacturing processes across several borders and not on the contribution of complementary services to the process. Furthermore, even when the importance of complementary services, in terms of value added to the chain, was correctly identified, financial centres did not enter the picture. We draw a parallel between this feature and the role of financial centres as transit of real transactions toward other economies.

Figure 6 plots on the horizontal axis the share of domestic value added which is only indirectly exported (e.g. the part of gross exports made of domestic production which reaches final consumers after crossing at least other two borders; $DVA - GVC$). This is commonly referred to as forward GVC participation. On the vertical axis are the figures reporting backward GVC participation. This is given by the share of foreign production contained in gross export of each country and is the sum of foreign production that transit through a country's border to reach directly the final consumer ($FVA - DIR$) and foreign production that crosses at least two more borders ($FVA - GVC$). Each point on the plot identifies a pair of forward and backward links by origin-destination pair of countries.

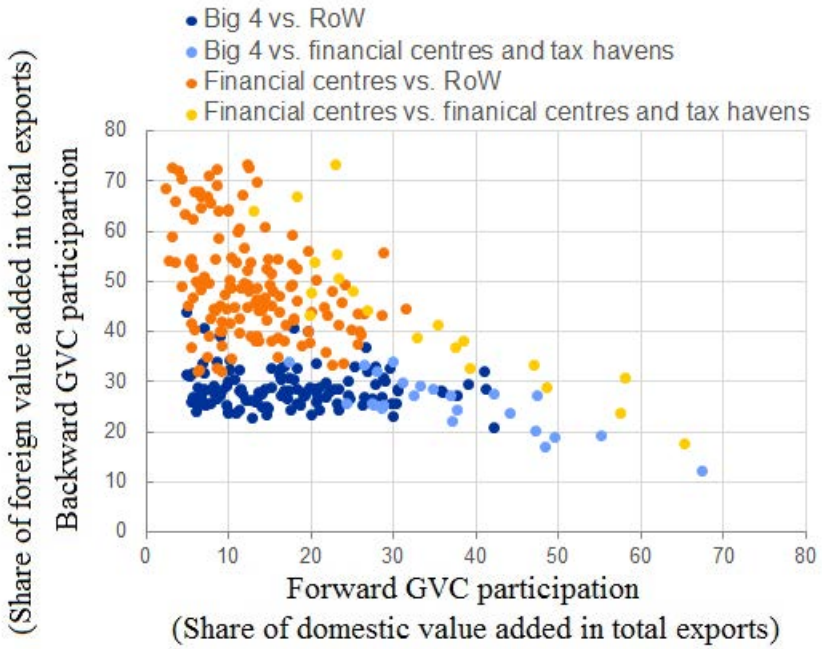
Origins are divided into two groups: the first contains the main euro area manufacturers (Big 4) and the second contains the four main euro area financial centres plus Malta and Hungary.[4] These are colour coded as blue and orange, respectively. Moreover, we single out pairs of bilateral relations between financial centres by yellow dots and in a similar manner

[4]Hungary is not a tax-havens but has put in place tax policies favouring MNEs relocation there (see Blanchard, Acalin et al., 2016).

pairs of bilateral relations between main EU countries (Big 4) and financial centres are in a lighter shade of blue. We find out that:

1. financial centres features the largest backward GVC participation of all;
2. the degree of backward participation of financial centres falls sensibly to more normal levels vis-à-vis other financial centres (e.g. less integrated with other financial centres, see yellow dots).
3. The four largest euro area economies maintain the strongest forward GVC participation with financial centres (see light blue dots).

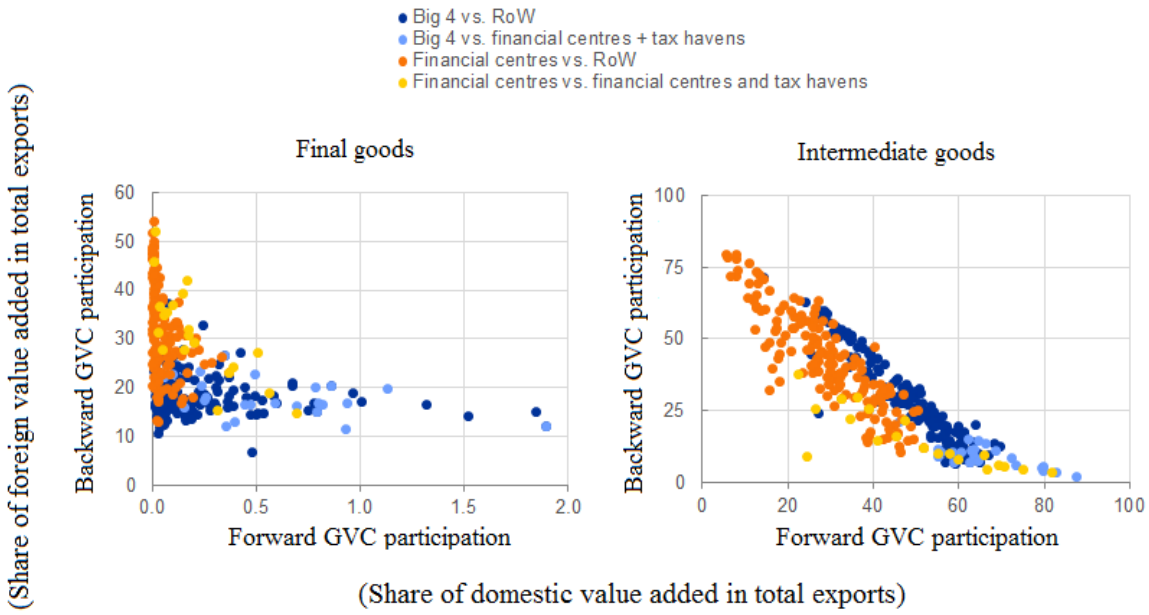
Figure 6: The participation and positioning of financial centres in GVCs



Note: Big 4 consists of Germany, Italy, France and Spain. Financial centres are Belgium, Ireland, Luxembourg and the Netherlands. Tax havens are referring to Hungary, and Malta. Total exports have been netted out of double counting. Sources: WIOD, authors' calculations

However this divide between financial centres and other countries in terms of GVC participation can be entirely traced back to finished goods produced in supply network. The GVC indices of participation and positioning converge when computed limitedly to intermediate stages of production (see figure 7). In this case, high taxation economies gain in terms of backward GVC participation and financial centres in terms of forward integration (see right hand side panel of figure 7). The positioning of financial centres in GVCs remain atypically downstream in final goods and reflects their specialisation in services which enter the chain at the end.

Figure 7: The participation and positioning in GVCs by product



Note: Big 4 consists of Germany, Italy, France and Spain. Financial centres are Belgium, Ireland, Luxembourg and the Netherlands. Tax havens are referring to Hungary, and Malta. Total exports have been netted out of double counting. Sources: WIOD, authors' calculations

These stylised facts raise more questions than they answer. Why should financial centres be less integrated with other similar economies (other financial centres)? Why do main manufacturers appear forward integrated especially with financial centres rather than with other manufacturing economies? A potential explanation is that companies aiming at minimising tax burden from a global perspective will operate strategic allocation of profits by rising the value of services supplied by financial centres at the very end of the chain. Thereby, a side effect of profit shifting is that countries, not expected to interact intensively according to the universal law governing foreign trade, appear instead fictitiously integrated. On these grounds, in order to correct BEPS distortions in GVC measures we resort to the predictive power of the gravity law.

4 Trade surpluses in financial centres according to gravity law

The gravity equation has since its introduction in 1964 (see Tinbergen 1964) been widely used to analyse determinants of bilateral trade flows, and its theoretical foundation has been further developed and justified by Anderson (1979), Bergstrand (1985; 1989) and Anderson and van Wincoop (2003) amongst others.

Despite its past proven stability and explanatory power, recent work has shown that the model cannot provide a correct assessment of the determinants of bilateral trade balances

in the light of cross-border production fragmentation within GVCs (Noguera, 2012). In a closely related paper Cuñat and Zymek (2019) apply a gravity framework to study bilateral trade imbalances with a specific focus on the United States and conclude that factors determining heterogeneity of bilateral trade balances are not yet fully understood. In this paper we show that part of this heterogeneity can be accounted by transfer practices and correct for them.

The gravity specification builds on the seminal contribution in Anderson and van Wincoop (2003) and includes inward and outward multilateral trade resistance terms among regressors. We control for the fact that bilateral exports from country i to country j depends, beside bilateral trade barriers, also on i's global remoteness that affects its possibility to supply other destinations (outward resistance) as well as $j's$ possibility to import from alternative sources (inward resistance). However, we deviate from the common approach of employing exporter and importer or exporter-time and importer-time fixed effects to control for resistances (see for instance Redding and Venables, 2004 and Feenstra, 2015). Instead, proxies for remoteness are constructed following a two-step procedure proposed by Baldwin et al. (2011), which in contrast to fixed effects does not absorb all time-varying country specific characteristics that are key to the why some countries function as financial centres.[5]

While applying gravity to gross exports is an established exercise in the literature, the application to value added trade is far less explored. We employ an augmented gravity equation to predict exports and imports of exported domestic production that enters global value chains (e.g. exports which is further processed by the importer and then re-exported ($EXP - DVA - GVC$).

Our approach builds on earlier related works (Noguera, 2012; Baldwin et al., 2011) and more recent analyses (Jang and Song, 2017; Lankhuizen and Thissen, 2019). In particular, as the primary goal of the paper is to provide a tool measuring to what extent reported international trade figures are contaminated by MNEs strategies, we control for global production network including a series of extra trade terms that describe the structure of the bilateral importer's trade with the rest of the world.

In particular, Baldwin et al. (2011) points that *the estimated coefficient on the GDPs should be lower for nations where trade in parts and components (a very rough measure for GVCs trade) is important* and suggests to include, among determinants of a country's imports, either its exports or alternatively the trading partner demand shifters. Noguera (2012) shows that countries' bilateral exports also depend on the bilateral importer aggregate imports ($IMP - DVA - DIR$ and $IMP - DVA - GVC$) netted of the imports from the country under consideration.

We follow a similar reasoning and include, among determinants of country i's $EXP -$

[5]For details of the two-step procedure of constructing the multilateral resistance term, see chapter 3 of International Monetary Fund, 2019).

$DVA-GVC$, the exports and the imports of the bilateral importer j from the rest of the world. Precisely, the equation for bilateral exports of country i to j is augmented for the bilateral importer's exports and imports in terms of production content,excluding exports to the country under consideration (i).[6]

This strategy is also corroborated by the recent work on the effect of re-exports in gravity estimations, Lankhuizen and Thissen (2019) nets exports of the re-exported quota; in this work we follow the value added along the chain by including re-exports to the rest of the world through j as additional controls ($EXP-FVA-GVC$ and $EXP-FVA-DIR$).[7]

The gravity equation takes on two specifications; a first one is applied to estimation of gross exports and export of domestic production directly to final consumers, and a second one that includes eight additional terms, representing exports and imports of the bilateral importer of domestic and foreign production. Moreover multilateral trade resistances (MRT) replace the standard use of country dummies to control for origin and destination unobservable factors (see equation 1).

$$\begin{aligned} X_{ijt} =& exp\Big[\alpha + \sum_{tr=1}^{8} \beta_{tr} ln(\gamma_{jt}^{tr}) + \beta_9 ln(Y_{it}) + \beta_{10} ln(Y_{jt}) + \beta_{11} ln(Y_{wt}) + \\ &+ \beta_{12} ln(Distance_{ij}) + \beta_{13} Language_{ij} + \beta_{14} Border_{ij} + \sum_{TA=15}^{18} \beta_r I_{ijt} + \\ &+ \beta_{19} lnMRT_{it}^{out} + \beta_{20} lnMRT_{jt}^{in}\Big] \eta_{ijt} \end{aligned} \tag{1}$$

where the dependent variable denotes, in turn, flows of gross exports from country i to country j at time t, flows of domestic produced exports from i to final importer country j ($EXP-DVA-DIR$), flows of domestic produced exports from i to country j that re-export them ($EXP-DVA-GVC$).

The first eight (γ's) terms are the bilateral importer's exports and imports in domestic and foreign value added, shipped directly to final consumer country or to other intermediary countries; they are included only in the regression of $EXP-DVA-GVC$.[8]

We maintain no a-priori on sign and magnitude of the elasticity of these eight terms. Exports of country j (the bilateral importer) enter its gross output and recent works showed it to be a better measure of aggregate demand in the presence of intermediates. The

[6] These consists of eight terms: $EXP-DVA-DIR$, $EXP-DVA-GVC$, $EXP-FVA-DIR$ and $EXP-FVA-GVC$,$IMP-DVA-DIR$, $IMP-DVA-GVC$, $IMP-FVA-DIR$ and $IMP-FVA-GVC$; for details about definitions of each component see appendix A.1).

[7] Another recent contribution by Jang and Song (2017) works out theoretical foundations of the gravity equation in the presence of trade in intermediates. It concludes that gravity remains a valid workhorse, provided gross output replaces gross value added as a proxy for aggregate demand.

[8] See the exact composition of $EXP-DVA-DIR$, $EXP-DVA-GVC$, $EXP-FVA-DIR$, $EXP-FVA-GVC$, $IMP-DVA-DIR$, $IMP-DVA-GVC$, $IMP-FVA-DIR$, $IMP-FVA-GVC$ in the appendix

elasticity aggregate exports of country j may hence be expected to be positive. Aggregate imports of country j represent a substitute to i's exports to j therefore the elasticity may be negative in this case.

Y_{it}, Y_{jt}, Y_{wt} are standard gravity terms, respectively nominal GDP of the exporting, importing country and world GDP. The first two terms capture the economic mass of the two countries which determine their trade volumes; both are expected to have positive elasticity (unitary elasticity according to gravity). World GDP is expected to have negative elasticity; intuitively bilateral trade between country i and country j decreases relative to trade with the rest of the world as the economic size of the other countries' grows.

Distance and *border* capture unobservable trade barriers and common *language* is expected to promote bilateral trade. As for the observable factors (I) we single out the trade enhancing effects of deeper economic integration by including a set of dummies which takes the value of one if the pair exporter-importer signed a free trade agreement (FTA) are members of a customs union (CU), common market (CM) and/or economic union (EU).

The final MRT variables are the inverse of outward and inward multilateral resistance terms. MRT_{out} increases when the weighted average of trade barriers faced by country i in the global market lessens. MRT_{in} captures the inverse of weighted-average trade barriers faced by rest of the world when exporting to j.

Methodology

The process of adjustment of trade balances for the bias related to operations by MNEs in financial centres, consists of three steps.

First we estimate via Pseudo Poisson Maximum Likelihood, a gravity equation of bilateral gross exports to obtain consistent, unbiased estimates even in presence of heteroscedasticity (see Silva and Tenreyro, 2006).

Second, we draw on the estimates of gross exports and re-scale accordingly the DVA and FVA content of reported gross exports. In particular, as shown in equation 2, re-scaled $EXP - \widehat{DVA} - DIR$, $EXP - \widehat{DVA} - GVC$ and $EXP - \widehat{DVA} - REF$ are constructed by multiplying reported $EXP-DVA-DIR$, $EXP-DVA-GVC$ and $EXP-DVA-REF$ for the share of predicted over actual gross exports.

$$\widehat{VA_{ijt}} = VA_{ijt} * \left(\frac{\widehat{EXP_{ijt}}}{EXP_{ijt}}\right) \tag{2}$$

The exports in value added, opportunely re-scaled to be consistent with first stage $\widehat{EXP}$, are then regressed on the same set of determinants as in equation (2). $\widehat{EXP - FVA}$ is obtained as difference between $\widehat{EXP}$, $EXP - \widehat{DVA} - DIR$ and $EXP - \widehat{DVA} - GVC$).

Third, we replace reported with estimated export values when either the exporter or the importer country is one of the six euro area financial centres.

We obtain imports as mirror statistics and compute accordingly the adjusted trade balance ($\widehat{TB}$, $TB - \widehat{DVA} - DIR$, $TB - \widehat{DVA} - GVC$ and $TB - \widehat{FVA} - GVC$).

Section 5 discusses main findings of gravity estimations and 6 comments over a series of robustness checks we performed on the validity of our methodology and stability of our estimates. Linear projections of official trade balances on estimated trade balances are reported in the appendix A.

5 Empirical Results

The predicted elasticities of bilateral export flows to standard determinants are all well behaved; the augmented gravity regressions return highly significant coefficients of the expected magnitude and sign, in line with the wide literature on gravity trade. This hold equally true for regressions of bilateral gross exports, bilateral exports of domestic value added to final bilateral importer ($EXP - DVA - DIR$) and bilateral exports of domestic value added further re-exported by the bilateral importer ($EXP - DVA - GVC$).

$EXP-DVA-DIR$ turns out more sensitive to the size of the origin and the destination country, e.g. to the bilateral economic mass (Y_{it}, Y_{jt}) than $EXP-DVA-GVC$, (estimated coefficients are 0.84, 0.89, 0.77 and 0.86 respectively, see Table 1) since the latter depends also on the macroeconomic conditions of destinations indirectly reached via intermediate importers.

Free trade agreements raise bilateral exports by 22-26%; $EXP - DVA - GVC$ are less responsive to bilateral liberalisations because trading conditions prevailing between the bilateral importer and other destinations are relevant too. Custom unions promote direct exports to final consumers but it does not significantly improves exports in chain. Conversely setting up a common market produces beneficial effects for the domestic production exported in regional value chains ($EXP-DVA-GVC$) by about 15 and specifically joining the European Union grants an additional 8% of exports to EU members.

Bilateral distance reduces exports very substantially and almost equally across content types; exports between trading partners that are 10% farer apart than the average is 6% below the average export value. Sharing the same language is confirmed an important promoting factor of bilateral exports, especially relevant for domestic production entering supply chains for further re-export (EXP-DVA-GVC) that is raised one third above the average by the common idiom. Sharing a common border instead boosts by about 50% exports to direct consumer but matters definitely less for exports entering production network (see Table 2).

The multilateral trade resistance terms are both well behaved; trade barriers faced by country i when reaching out the global market depresses more exports of domestic production to direct final consumers whereas reducing barriers that every country face in

Table 1: Standard determinants of bilateral exports

VARIABLES	(1) EXP	(2) EXP DVA DIR	(3) EXP DVA GVC
$\ln(Y_{it})$	0.772***	0.838***	0.767***
	(0.00670)	(0.00691)	(0.00725)
$\ln(Y_{jt})$	0.811***	0.892***	0.856***
	(0.00932)	(0.0103)	(0.0463)
$\ln(Y_{wt})$	-0.352***	-0.649***	-0.828***
	(0.0336)	(0.0345)	(0.0458)
FTA_{ijt}	0.220***	0.260***	0.0892**
	(0.0559)	(0.0471)	(0.0447)
CU_{ijt}	0.0480	0.155**	-0.105
	(0.0721)	(0.0738)	(0.0728)
CM_{ijt}	0.0535	0.138***	0.156***
	(0.0421)	(0.0417)	(0.0487)
EU_{ijt}	0.0624	0.108*	0.0809*
	(0.0564)	(0.0625)	(0.0472)
Observations	24,600	24,600	24,600
R^2	0.791	0.809	0.739

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2: The gravity estimations on bilateral exports, trade barriers

VARIABLES	(1) EXP	(2) EXP DVA DIR	(3) EXP DVA GVC
$\ln(Distance_{ij})$	-0.636***	-0.592***	-0.664***
	(0.0115)	(0.0106)	(0.0103)
$Language_{ij}$	0.175***	0.204***	0.356***
	(0.0324)	(0.0284)	(0.0485)
$Border_{ij}$	0.544***	0.581***	0.296***
	(0.0414)	(0.0392)	(0.0351)
$ln(MRT_{it}^{out})$	0.340***	0.462***	0.556***
	(0.0369)	(0.0374)	(0.0384)
$ln(MRT_{jt}^{in})$	0.357***	0.598***	0.266***
	(0.0400)	(0.0420)	(0.0535)
Observations	24,600	24,600	24,600
R^2	0.791	0.809	0.739

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

exporting to j positively affects primarily exports in chain ($EXP - DVA - GVC$) from i to j.

Regarding the novelty of our approach, e.g. the introduction of the trade structure of the bilateral importer in the equation for ($EXP-DVA-GVC$), we find that imports from other countries mostly tend to depress bilateral exports from i to j except when imports from i is of production from other sources and it is for final absorption in j (0.85, see Table 3).Thereby other countries are to be considered alternative sources.

The four terms representing j's exports to the rest of the world are not of immediate interpretation. The more j exports to other countries its own production directly for final absorption, or other' production (excluding i from the set of partners) for further re-export ($EXP-DVA-DIR$, $EXP-FVA-GVC$) the less it trades with i. However the exports of i to J are strengthened by the exports of the latter which is integrated in supply network. The elasticity to $EXP - DVA - GVC$ and $EXP - FVA - DIR$ are positive and highly significant. The coefficient on $EXP-FVA-DIR$ of i's $EXP-DVA-GVC$ is especially large; this can be better understood considering that in this case the domestic production of i passes through j for further processing but ends up lumped in the j's $EXP-FVA-DIR$, hence the strong complementarity between the two terms.[9]

Our analysis confirm established results of the gravity literature but also establishes some novel ones, especially on determinants of the bilateral exports of production integrated in international value chains. In particular it shows how these transactions are also shaped by the importer integration in production chains. The empirical evidence tends to support the conclusion that the integration of j with the rest of the world negatively affects bilateral exports from i, unless they concern production of these two countries integrated in GVCs.

5.1 The correction of bilateral trade balances of euro area financial centres

We rely on our estimates to obtain predicted values for bilateral trade relationship involving financial centres either as exporter or as importer, which replace the official statistics. Imports are obtained through mirror statistics and revised trade balance are the difference of estimated exports and imports.

In particular, once idiosyncrasies existing in trade flows of financial centres have been identified and eliminated by bringing their trade values in line with those predicted by trade gravity law, trade surpluses tend to disappear.

Figure 8 plots the revised trade balance for the four main euro area financial centres. Compared to the *pre-treatment* balances the Belgium's surplus in 2014 shrinks from $30 to just $7 billions, the correction for Ireland is even wider with a positive net position dropping

[9] Remember that the controls for the trade structure of the bilateral importer were constructed taking care of netting the trade flows concerning the original i exporter.

Table 3: Regression results of gravity estimation on exports, determinants of value added trade in GVC

VARIABLES	EXP DVA GVC
ln(IMP-DVA-DIR$_{jt}$)	-1.613***
	(0.145)
ln(IMP-DVA-GVC$_{jt}$)	-0.338***
	(0.0674)
ln(EXP-DVA-DIR$_{jt}$)	-1.114***
	(0.156)
ln(EXP-DVA-GVC$_{jt}$)	0.867***
	(0.127)
ln(IMP-FVA-DIR$_{jt}$)	0.846***
	(0.137)
ln(IMP-FVA-GVC$_{jt}$)	-0.570***
	(0.0949)
ln(EXP-FVA-DIR$_{jt}$)	2.306***
	(0.153)
ln(EXP-FVA-GVC$_{jt}$)	-0.382***
	(0.106)
Observations	24,600
R-squared	0.739

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

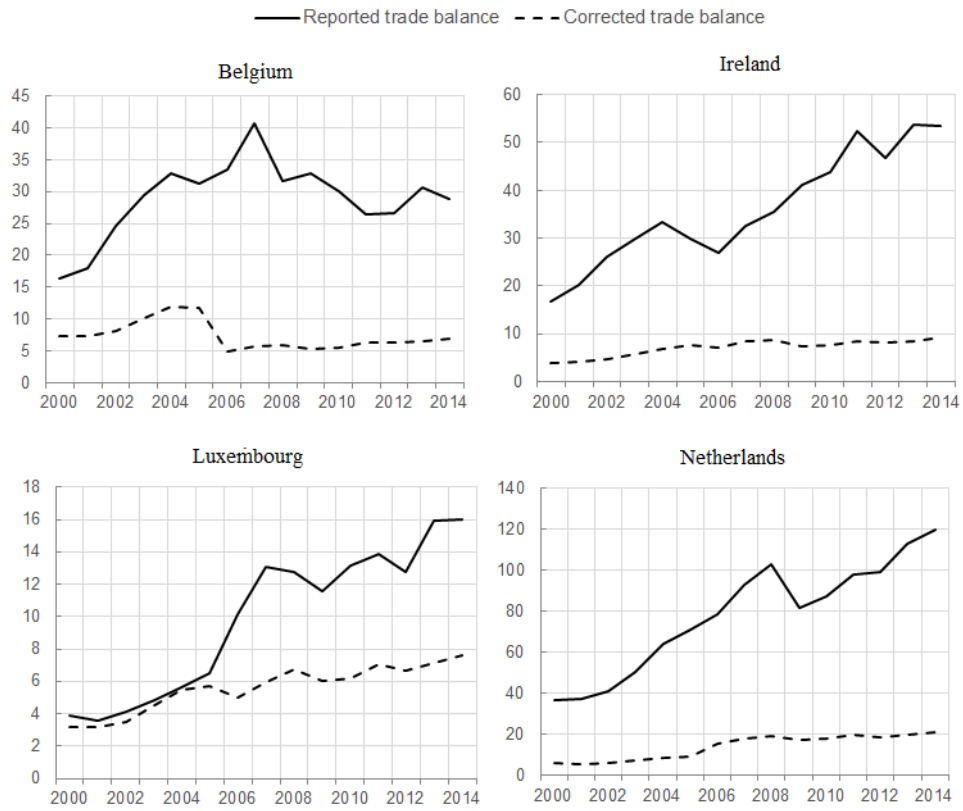
from $50 to $10 billion, while the Netherlands undergoes the largest surplus reduction by about 100 billion (from $120 to$20 billion). The correction for Luxembourg is not as large and a gap between reported and estimated trade balance opens only starting around 2005, hinting to some change in their role of financial centre ahead of the great financial crisis; the surplus is however cut by a half by our correction in 2014. The revisions implemented on single components are important, they halve the partial trade balances ($FVA - DIR$ and in $DVA - GVC$).

These corrections are reflected in the trade balance of all other countries, the most relevant are reported in the appendix A.6. As a result of our exercise the deficit of the US expands while the surplus of China shrinks substantially by almost $200 million. The very large correction may in this case also reflect the over-invoicing of Chinese export used to bypass capital controls. Direct investments into China, which are restricted by law, are masked through international payments to Chinese companies for exports to MNEs subsidiaries located in euro area financial centres.

A downward revision relative to the official statistics is also operated on Germany's net trade surplus, on France's and Portugal's positions and to a smaller degree on Spain's net position that zeroes from positive in 2014. No correction is implemented on Italy's net trade position which appear in line with what predicted by the gravity law. Overall the correction depends on how off from projected trajectories are the reported bilateral exports between financial centres and other countries.

The total correction for the four euro area financial centres sums up to about $170 billion in 2014; such amount is comparable to the estimates on the amount of profit shifted globally obtained through different methodologies. For instance Bolwijn et al. (2018) uses FDI transactions of special-purpose entities (SPEs) located in financial centres and estimates pre-taxes profits to be between $330-450 billion, of which two thirds pertaining to advanced economies and one third to emerging economies. Tørsløv et al. (2018) use differential in foreign investment yields to correct the official income balance (which turns from a positive 0.3% to a -0.3% of euro area GDP). They also use mirror statistics to correct for under-reporting of imports from financial centres. Their revised figures for the euro area net trade surplus as a whole are not major, summing to half a percentage point of euro are GDP (from almost 5 to above 4%, see Figure A.5.1 in the appendix). Also in their case like in our exercise, the largest correction are operated on the trade balance of the Netherlands and Ireland.

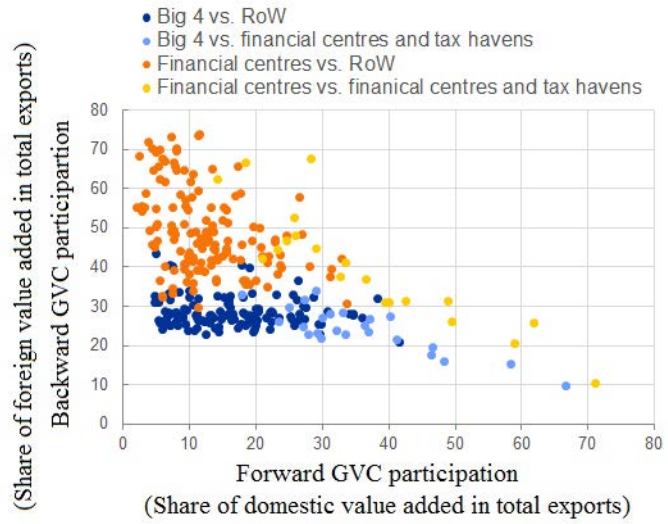
Figure 8: Revised trade balance of the four main euro area financial centres



Note: vertical axes expressed in billions USD.
Source: OECD and authors' computations based on WIOD tables

At last we also recompute the correct position and location of financial centres and compare them with other main euro area economies. Their participation to GVC remain backward oriented and downstream located but definitely to a lesser extent than before our reassessment, and some heterogeneity across bilateral positions is restored (see figure 8 and 2).

Figure 9: Corrected participation and positioning of financial centres in GVCs



Note: Big 4 consists of Germany, Italy, France and Spain. Financial centres are Belgium, Ireland, Luxembourg and the Netherlands. Tax havens are referring to Hungary, and Malta. Total exports have been netted out of double counting. Sources: WIOD, authors' calculations

6 Robustness

We carry out four different robustness checks on our gravity estimations. Each validation exercise has been performed on the three components of exports flows considered in the paper.

Beside robustness validation, we have preliminarily linearly projected reported on predicted trade balances (see results in A.3) and verified that gravity predictions prove strongly correlated with official figures (coefficient about unity for $TB-DVA-DIR$ and $\widehat{TB-FVA}$; and 0.8 on $TB-DVA-GVC$). This is a rather good result compared to previous works that failed to explain empirically net trade external positions. Davis and Weinstein (2002) refer to the "Mystery of excess trade balances" and suggests it may arise due to highly specialised intermediates and macro policies. Felbermayr and Yotov (2019) claim to have solved the puzzle of too large trade imbalances and obtained a good fit of net trade balances by imposing in the equation specification an entire set of dummies that controls for country and country pair heterogeneity. Our results are as encouraging in this respect; we still obtain good predictions of the trade balance components and compared to theirs we do not resort to dummies for country heterogeneity which would absorb a relevant fraction of variability, preventing us from identifying the full effects of a wide range of factors on trade, including bilateral and multilateral trade resistances.

Gravity specification with origin destination fixed effects. The adjustments of

trade statistics we seek through gravity estimations require to exclude, from the equation specification, fixed effects that normally control for unobservable heterogeneity across countries. They are generally particularly useful to capture any form of remoteness and barrier to trade. However the "financial centres effects", that we try to identify and correct, would be absorbed in the coefficient of country dummies, lumped together with several others. For this reason we have adopted Baldwin's approach by including multilateral resistance terms (MRT) as additional controls in the equation. They also proxy remoteness and capture unobservable barriers. We test the robustness of our estimates to the replacement of MRT with exporter and importer fixed effects. As a result, the sign and the significance of estimated elasticities are preserved; the coefficients tend to shrink in size because their interpretation is different. They are this time specifically identified based only on bilateral country-pair heterogeneity, whereas the country heterogeneity is subsumed in the fixed effect. For instance, we cannot interpret a positive elasticity on the exporter Y_{it} as evidence that richer countries trade more among themselves but as the positive effects on exports induced by an increase in the economic mass of exporter i above its average value.

Gravity on predicted values of bilateral exports. As a second check we have replaced official with predicted export flows in any bilateral relationship held by financial centres with other countries and proceeded to re-estimate the gravity on the adjusted export flows. The exercise is used to verify that misreporting by financial centres do not plague the elasticities estimated via gravity. We notice three differences compared to our benchmark regression.

- The elasticity of MRT^{in} increases, implying that bilateral exports are more sensitive to changes in trade barriers faced by other countries when exporting to j (e.g. new trade barriers depress more exports of non financial centres). Intuitively the export flows of financial centres respond to somewhat different incentives from those governing trade flows elsewhere and this makes their exports resilient to common trade barriers. An alternative and consistent explanation is that financial centres specialise in digital services that face lower obstacles to travel far.

- Exports from i to j is less sensitive to the trade structure of j.

- The significance of the EU membership is restored. The elasticities of the EU dummy are positive and significant on each export component. Therefore biases in official trade statistics of financial centres lead to perceive as less positive the effects of EU integration on regional trade.

Linear gravity specification. It is widely accepted that PPML is to be preferred over linear gravity estimations of log-linearised equations because estimates are not biased by the presence of heteroscedasticity, we however verify that our results are consistent with alternative estimation methodology, e.g. linear estimation.

PPML provides more precise and more significant estimates; in linear estimation some coefficient are oddly low (Y_{jt}) and others take on the wrong sign FTA. The only improvement is recorded in the estimation of the elasticity to distance that is equal to unity, as predicted by the gravity low.

Gravity results when substitutability across varieties changes. As a fourth and last robustness check we impose alternative values of the elasticity of substitution across varieties (σ) in the computation of the MRT terms. A value of 3 is suggested by the empirical literature that estimated this parameter; we increase and reduce substitutability across goods by raising σ to 4 and then lowering it to 2. Such changes produce the expected results: as heterogeneity across varieties falls (substitutability rises to 4), the elasticity to both MRT_{in} and MRT_{out} rises. The opposite is true when σ takes on the value of 2; lower substitutability across varieties leads to trade flows reacting less to changes in trade barriers. However, the other elasticities are overall not significantly influenced, not even those on distance, confirming robustness of our estimates to the specification of technical parameters.

Overall we conclude that our estimates are not driven by preferences for one methodology over the others.

7 Concluding Remarks

This paper contributes to the literature on global imbalances and profit shifting along two dimensions.

First it identifies unique features of trade balance common across financial centres through a novel decomposition of the value content of trade balances that opportunely distinguishes domestic production from trading partners' production; exports absorbed by the bilateral importer and export further re-exported. The decomposition highlights, for the first time the pervasiveness in the external statistics of financial centres of items transiting there but consumed elsewhere and create a parallel between their role of conduit of capitals and conduit of real products. We also make an attempt to connect regularities showing up in headline external statistics to the MNEs tax-optimisation strategies. As the business size of these companies is often bigger than the hosting economy, they shape macro statistics returning a falsified picture of these countries macro conditions and imbalances. Therefore the external position from official statistics of financial centres are to be taken with a grain of salt as well as their GVC positioning and participation computed from the inter countries input output tables.

The paper works through gravity estimations to clean reported figures for the effect of MNEs. The gravity equation is expanded to control for the effect on bilateral trade of production chains encompassing several countries. We find broad evidence that trade with other countries act as substitute of bilateral exports from i to j unless the trade flows

concern transactions of production integrated in the same value chains. In this case exports and imports of the direct importer (j) turn out complements of i's bilateral exports.

The revised trade balances suggest that profit shifting, involving main euro area financial centres exhibit a positive trend and may amount to around $170 billion in 2014. Their large surpluses disappear into more balanced position. The corrections reflect mostly important reductions in exports of their domestic production that is directly absorbed by the bilateral importer ($EXP - DVA - DIR$); this is noticeably the value booked in financial centres. Their participation in GVC is reduced but their positioning remain downstream, owing to the specialisation of these countries in end of the chain intangible services.

Our approach is an alternative, not very different in nature, to those analyses that rely on investment yield differentials across countries, or on FDI of foreign owned companies to gauge a measure of profit shifting. While our correction does not pretend to be exhaustive nor to nail down the exact amount of tax avoidance, it has the merit to look at misreporting of official statistics in financial centres from an alternative perspective and show a new direction that can be pursued in other studies.

A way forward for researchers when assessing the global magnitude of profit shifting is to rely on multiple measurement instruments and source of information, including micro data sourced directly from global MNEs' balance-sheets.

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A Appendix

A.1 The decomposition of gross exports in domestic and foreign value added

In this paper we follow the decomposition proposed by Borin and Mancini (see Borin and Mancini, 2015) as it holds two advantages on others. First it does not generate downward biases of the foreign value added in export flows nor overestimate the domestic value added in gross exports. Second it is fully additive, hence allows grouping countries at a later stage.

The 21 items were then bundled in 5 broader categories according to two broad criteria. First dividing domestic from foreign value added in exports (DVA versus FVA) and second breaking down what part of domestic and foreign is a final sale to the bilateral importer (direct trade) and what is further re-exported by the bilateral importer (GVC). As mentioned in the main text the underlying main trade balance components.

DVA-DIR Domestic value added in bilateral exports absorbed by bilateral importer.

- 1a "domestic value added (VA) in final good to the final bilateral importers"
- 1b "domestic VA in intermediate exports absorbed by bilateral importers as domestic final goods after additional processing stages"
- 2a "domestic VA in intermediate exports absorbed by direct importers as local final goods"
- 2b "domestic VA in intermediate exports absorbed by direct importers as local final goods only after further processing stages"
- EXP 3c "domestic VA in intermediate exports absorbed by direct importers as final goods from third countries"

DVA-GVC Domestic value added that is re-exported by the bilateral importer.

- 1c "domestic VA in intermediate exports absorbed by third countries as domestic final goods after additional processing stages"
- 2c "domestic VA in intermediate exports absorbed by third countries as local final goods"
- 3a "domestic VA in intermediate exports absorbed by third countries as final goods from direct bilateral importers"
- 3b "domestic VA in intermediate exports absorbed by third countries as final goods from direct bilateral importers only after further processing stages"
- EXP 3d "domestic VA in intermediate exports absorbed by third countries as final goods from other third countries

- EXP 4c "domestic VA in intermediate exports absorbed at home as final goods of a third country"

DVA-REF exports of domestic value added that is absorbed at home.

- EXP 4a "domestic VA in intermediate exports absorbed at home as final goods of the bilateral importers"
- EXP 4b "domestic VA in intermediate exports absorbed at home as final goods of the bilateral importers after further processing stages"
- EXP 5 "domestic VA in intermediate exports absorbed at home as domestic final goods"

FVA-DIR foreign VA in exports that is absorbed by the bilateral importer.

- EXP 7 "foreign VA in exports of final goods"
- EXP 8 "foreign VA in exports of intermediate goods directly absorbed by the importing country"

FVA-GVC foreign VA in exports that is further re-exported by the bilateral importer.

- EXP 9a "foreign VA in exports of intermediate goods re-exported by the bilateral importer"
- EXP 9b "foreign VA in exports of intermediate goods re-exported by a third country"

DCO Double counted exports.

- EXP 9cd "double-counted intermediate exports originally produced abroad"
- EXP 6 "double-counted intermediate exports originally produced at home"

The export data we use in the empirical analysis and in charts have been cleaned for double counted exports. Reflected exports ($DVA - REF$) is a negligible fraction of total exports, we discard it in the empirical analysis.

A.2 Data sources

The analysis relies on data from two main sources: the World Input-Output Database (WIOD, 2016 release) and CEPII (2015 release). By combining national input-output data with detailed trade statistics, WIOD constitute an analytical tool for tracing and analysing international fragmentation of production. The 2016 release consists of annual input-output tables spanning over 2000 to 2014. In our setting, WIOD data constitute the dependent variables; bilateral gross exports and five items of value added exports (see appendix A.1

for details on the underlying decomposition). The source of traditional gravity variables is the CEPII gravity database.

For the descriptive analysis, WIOD data are extended with ADB Multi-Regional Input-Output (MRIO) data for the years 2015-2018.

A.3 Table Appendix

Table A.2.1: Regression results for gravity model on export flows corrected for financial centres

VARIABLES	(1) $\widehat{EXP}$	(2) $\widehat{EXPDVADIR}$	(3) $\widehat{EXPDVAGVC}$
$\ln(Y_{it})$	0.787***	0.849***	0.771***
	(0.00641)	(0.00679)	(0.00568)
$\ln(Y_{jt})$	0.837***	0.907***	0.863***
	(0.00911)	(0.0103)	(0.0385)
$\ln(Y_{wt})$	-0.413***	-0.683***	-0.828***
	(0.0322)	(0.0341)	(0.0385)
$\ln(Distance_{ij})$	-0.661***	-0.611***	-0.701***
	(0.0111)	(0.0104)	(0.00925)
$Language_{ij}$	0.109***	0.158***	0.265***
	(0.0286)	(0.0270)	(0.0248)
$Border_{ij}$	0.626***	0.634***	0.416***
	(0.0386)	(0.0374)	(0.0300)
FTA_{ijt}	0.231***	0.271***	0.0850**
	(0.0498)	(0.0428)	(0.0388)
CU_{ijt}	0.0935	0.190**	-0.0673
	(0.0737)	(0.0742)	(0.0746)
CM_{ijt}	0.0360	0.120***	0.103**
	(0.0420)	(0.0416)	(0.0488)
EU_{ijt}	0.0934*	0.141**	0.117***
	(0.0536)	(0.0609)	(0.0424)
$ln(MRT_{it}^{out})$	0.456***	0.546***	0.696***
	(0.0362)	(0.0373)	(0.0325)
$ln(MRT_{jt}^{in})$	0.490***	0.670***	0.428***
	(0.0394)	(0.0428)	(0.0361)
ln(IMP-DVA-DIR$_{jt}$)			-1.050***
			(0.0978)
ln(IMP-DVA-GVC$_{jt}$)			-0.552***
			(0.0456)
ln(EXP-DVA-DIR$_{jt}$)			-1.001***
			(0.123)
ln(EXP-DVA-GVC$_{jt}$)			0.828***
			(0.0982)
ln(IMP-FVA-DIR$_{jt}$)			0.289***
			(0.0857)
ln(IMP-FVA-GVC$_{jt}$)			-0.0738
			(0.0560)
ln(EXP-FVA-DIR$_{jt}$)			1.967***
			(0.114)
ln(EXP-FVA-GVC$_{jt}$)			-0.397***
			(0.0839)
Observations	24,600	24,600	24,600
R^2	1.000	0.995	0.959

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.2.2: Regression results of gravity model on reported export flows, OLS

VARIABLES	ln(EXP)	ln(EXP DVA DIR)	ln(EXP DVA GVC)
$\ln(Y_{it})$	0.869***	0.926***	0.947***
	(0.0188)	(0.0184)	(0.0197)
$\ln(Y_{jt})$	0.849***	0.902***	0.258***
	(0.0173)	(0.0168)	(0.0649)
$\ln(Y_{wt})$	-0.306***	-0.694***	-0.799***
	(0.0383)	(0.0358)	(0.0634)
$\ln(Distance_{ij})$	-1.005***	-0.976***	-0.960***
	(0.0288)	(0.0283)	(0.0319)
$Language_{ij}$	0.407***	0.407***	0.403***
	(0.121)	(0.121)	(0.132)
$Border_{ij}$	0.416***	0.430***	0.560***
	(0.101)	(0.104)	(0.110)
FTA_{ijt}	-0.204***	-0.181***	-0.147***
	(0.0336)	(0.0320)	(0.0356)
CU_{ijt}	-0.0299	-0.0259	0.0113
	(0.0672)	(0.0668)	(0.0765)
CM_{ijt}	0.0410	0.0364	0.0324
	(0.0253)	(0.0240)	(0.0255)
EU_{ijt}	0.130***	0.150***	0.115***
	(0.0408)	(0.0418)	(0.0412)
$ln(MRT_{it}^{out})$	-0.261***	-0.106	-0.149
	(0.0893)	(0.0861)	(0.102)
$ln(MRT_{jt}^{in})$	0.0745	0.372***	0.754***
	(0.116)	(0.114)	(0.148)
$\ln(\text{IMP-DVA-DIR}_{jt})$			-0.246
			(0.163)
$\ln(\text{IMP-DVA-GVC}_{jt})$			0.338***
			(0.109)
$\ln(\text{EXP-DVA-DIRP}_{jt})$			0.457***
			(0.143)
$\ln(\text{EXP-DVA-GVC}_{jt})$			-0.373***
			(0.120)
$\ln(\text{IMP-FVA-DIR}_{jt})$			0.0271
			(0.158)
$\ln(\text{IMP-FVA-GVC}_{jt})$			0.237*
			(0.131)
$\ln(\text{EXP-FVA-DIR}_{jt})$			0.0127
			(0.127)
$\ln(\text{EXP-FVA-GVC}_{jt})$			0.266**
			(0.114)
Observations	24,600	24,600	24,600
R^2	0.827	0.845	0.817

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.2.3: Regression results for gravity model on reported export flows, fixed effects

VARIABLES	(1) EXP	(2) EXP DVA DIR	(3) EXP DVA GVC
$\ln(Y_{it})$	0.589***	0.668***	0.609***
	(0.0195)	(0.0204)	(0.0191)
$\ln(Y_{jt})$	0.711***	0.808***	0.388***
	(0.0189)	(0.0183)	(0.0544)
$\ln(Y_{wt})$	-0.119***	-0.461***	-0.487***
	(0.0239)	(0.0241)	(0.0490)
$\ln(Distance_{ij})$	-0.977***	-1.025***	-0.874***
	(0.0154)	(0.0205)	(0.0192)
$Language_{ij}$	-0.311*	-0.603***	-0.718***
	(0.173)	(0.170)	(0.220)
$Border_{ij}$	2.496***	2.690***	2.303***
	(0.0646)	(0.0736)	(0.128)
FTA_{ijt}	-0.00219	-0.0203	-0.0759***
	(0.0281)	(0.0249)	(0.0169)
CU_{ijt}	-0.101***	-0.0364	-0.0480*
	(0.0289)	(0.0277)	(0.0285)
CM_{ijt}	0.0220*	0.0158	0.0445***
	(0.0132)	(0.0142)	(0.0161)
EU_{ijt}	0.0574***	0.116***	0.105***
	(0.0135)	(0.0132)	(0.0138)
$\ln(\text{IMP-DVA-DIR}_{jt})$			-0.724***
			(0.136)
$\ln(\text{IMP-DVA-GVC}_{jt})$			0.0238
			(0.101)
$\ln(\text{EXP-DVA-DIRP}_{jt})$			-0.347***
			(0.111)
$\ln(\text{EXP-DVA-GVC}_{jt})$			0.174*
			(0.0943)
$\ln(\text{IMP-FVA-DIR}_{jt})$			0.429***
			(0.134)
$\ln(\text{IMP-FVA-GVC}_{jt})$			0.149
			(0.110)
$\ln(\text{EXP-FVA-DIR}_{jt})$			0.863***
			(0.0942)
$\ln(\text{EXP-FVA-GVC}_{jt})$			-0.196***
			(0.0654)
Observations	24,600	24,600	24,600
R^2	0.985	0.987	0.972

Note: Estimated with importer and exporter fixed
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.2.4: Regression results of gravity model on reported export flows, sigma=2

VARIABLES	(1) EXP	(2) DVA DIR	(3) DVA GVC
$\ln(Y_{it})$	0.759***	0.826***	0.742***
	(0.00682)	(0.00726)	(0.00683)
$\ln(Y_{jt})$	0.775***	0.842***	0.790***
	(0.00825)	(0.00895)	(0.0475)
$\ln(Y_{wt})$	-0.368***	-0.644***	-0.824***
	(0.0322)	(0.0333)	(0.0450)
$\ln(Distance_{ij})$	-0.652***	-0.596***	-0.675***
	(0.0107)	(0.0102)	(0.0102)
$Language_{ij}$	0.179***	0.171***	0.340***
	(0.0306)	(0.0266)	(0.0471)
$Border_{ij}$	0.534***	0.568***	0.290***
	(0.0404)	(0.0385)	(0.0350)
FTA_{ijt}	0.191***	0.216***	0.0818*
	(0.0549)	(0.0479)	(0.0445)
CU_{ijt}	0.0401	0.161**	-0.104
	(0.0720)	(0.0734)	(0.0729)
CM_{ijt}	0.0845**	0.190***	0.161***
	(0.0403)	(0.0402)	(0.0479)
EU_{ijt}	0.0629	0.0995	0.0565
	(0.0558)	(0.0623)	(0.0471)
$ln(MRT_{it}^{out})$	0.486***	0.507***	0.764***
	(0.0487)	(0.0472)	(0.0593)
$ln(MRT_{jt}^{in})$	0.709***	0.909***	0.470***
	(0.0543)	(0.0552)	(0.0747)
$\ln(\text{IMP-DVA-DIR}_{jt})$			-1.507***
			(0.149)
$\ln(\text{IMP-DVA-GVC}_{jt})$			-0.352***
			(0.0682)
$\ln(\text{EXP-DVA-DIRP}_{jt})$			-1.076***
			(0.153)
$\ln(\text{EXP-DVA-GVC}_{jt})$			0.858***
			(0.125)
$\ln(\text{IMP-FVA-DIR}_{jt})$			0.793***
			(0.141)
$\ln(\text{IMP-FVA-GVC}_{jt})$			-0.561***
			(0.0968)
$\ln(\text{EXP-FVA-DIR}_{jt})$			2.312***
			(0.151)
$\ln(\text{EXP-FVA-GVC}_{jt})$			-0.411***
			(0.104)
Observations	24,600	24,600	24,600
R^2	0.798	0.814	0.742

Note: Multilateral resistance terms when sigma is set to 2.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.2.5: Regression results of gravity model on reported export flows, sigma=4

VARIABLES	(1) EXP	(2) DVA DIR	(3) DVA GVC
$\ln(Y_{it})$	0.779***	0.847***	0.778***
	(0.00673)	(0.00688)	(0.00736)
$\ln(Y_{jt})$	0.820***	0.910***	0.889***
	(0.00921)	(0.0100)	(0.0461)
$\ln(Y_{wt})$	-0.347***	-0.654***	-0.826***
	(0.0341)	(0.0351)	(0.0463)
$\ln(Distance_{ij})$	-0.629***	-0.589***	-0.660***
	(0.0119)	(0.0108)	(0.0105)
$Language_{ij}$	0.140***	0.172***	0.326***
	(0.0325)	(0.0285)	(0.0471)
$Border_{ij}$	0.548***	0.584***	0.303***
	(0.0418)	(0.0395)	(0.0353)
FTA_{ijt}	0.218***	0.257***	0.0895**
	(0.0562)	(0.0474)	(0.0439)
CU_{ijt}	0.0601	0.160**	-0.101
	(0.0724)	(0.0745)	(0.0730)
CM_{ijt}	0.0514	0.122***	0.165***
	(0.0433)	(0.0432)	(0.0493)
EU_{ijt}	0.0663	0.123**	0.0903*
	(0.0567)	(0.0623)	(0.0470)
$ln(MRT_{it}^{out})$	0.234***	0.353***	0.399***
	(0.0308)	(0.0320)	(0.0282)
$ln(MRT_{jt}^{in})$	0.194***	0.389***	0.146***
	(0.0320)	(0.0338)	(0.0402)
$\ln(\text{IMP-DVA-DIR}_{jt})$			-1.672***
			(0.141)
$\ln(\text{IMP-DVA-GVC}_{jt})$			-0.338***
			(0.0669)
$\ln(\text{EXP-DVA-DIRP}_{jt})$			-1.121***
			(0.156)
$\ln(\text{EXP-DVA-GVC}_{jt})$			0.875***
			(0.128)
$\ln(\text{IMP-FVA-DIR}_{jt})$			0.865***
			(0.133)
$\ln(\text{IMP-FVA-GVC}_{jt})$			-0.571***
			(0.0928)
$\ln(\text{EXP-FVA-DIR}_{jt})$			2.304***
			(0.154)
$\ln(\text{EXP-FVA-GVC}_{jt})$			-0.375***
			(0.107)
Observations	24,600	24,600	24,600
R^2	0.788	0.807	0.736

Note: Multilateral resistance terms when sigma is set to 4.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A.4 Trade balance and export fit

Table A.3.1: Trade balance fit, reported trade balance on predicted trade balance

VARIABLES	(1) TB	(2) TB DVA DIR	(3) TB DVA GVC	(4) TB FVA
$\widehat{TB}$	0.310*			
	(0.182)			
$\widehat{TB}$ DVA DIR		1.026***		
		(0.158)		
$\widehat{TB}$ DVA GVC			0.873***	
			(0.0669)	
$\widehat{TB}$ FVA				1.003***
				(0.0987)
Observations	24,600	24,600	24,600	24,600
R^2	0.155	0.303	0.496	0.620

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A.3.2: Trade balance fit, reported trade balance on predicted trade balance. Non-financial centres

VARIABLES	(1) TB	(2) TB DVA DIR	(3) TB DVA GVC	(4) TB FVA
$\widehat{TB}$	0.234			
	(0.205)			
$\widehat{TB}$ DVA DIR		1.051***		
		(0.172)		
$\widehat{TB}$ DVA GVC			0.779***	
			(0.00624)	
$\widehat{TB}$ FVA				0.995***
				(0.147)
Observations	17,850	17,850	17,850	17,850
R^2	0.155	0.319	0.588	0.594

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

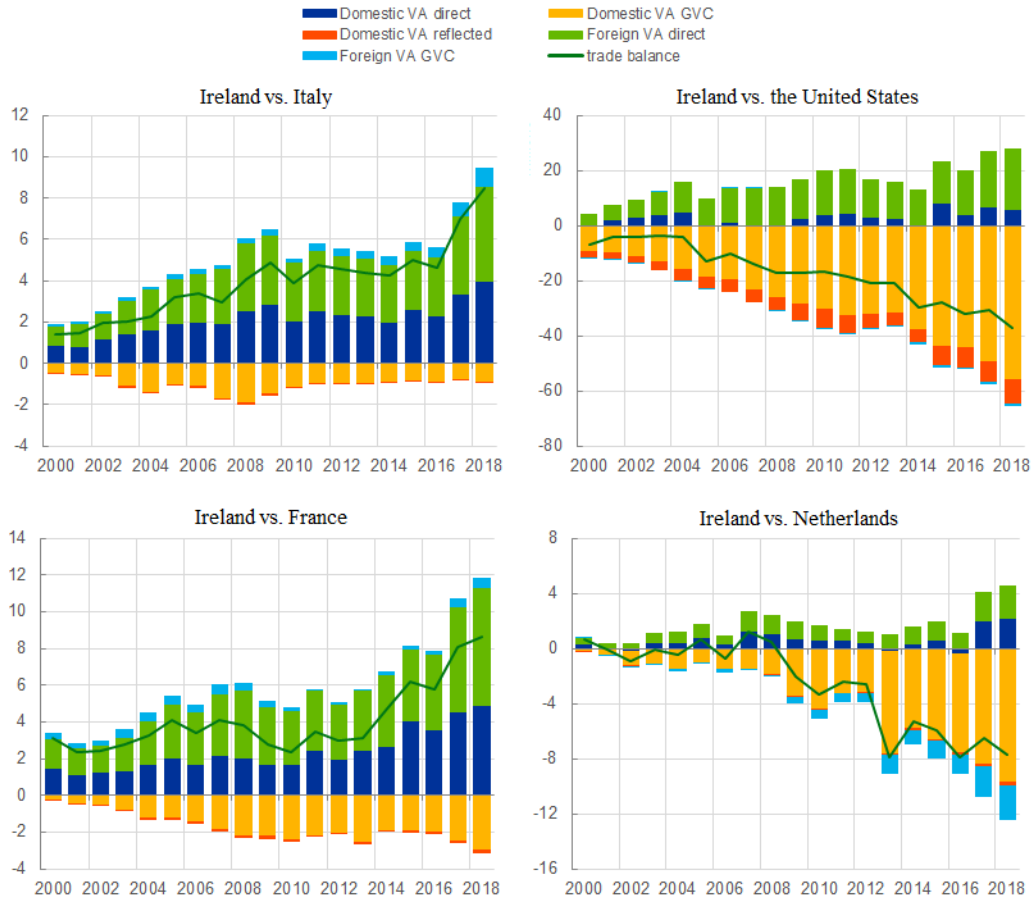
Table A.3.3: Export fit, reported export flows on predicted export flows

VARIABLES	(1) EXP	(2) EXP DVA DIR	(3) EXP DVA GVC	(4) EXP FVA
$\widehat{EXP}$	0.913***			
	(0.0765)			
$\widehat{EXP}$ DVA DIR		0.901***		
		(0.1000)		
$\widehat{EXP}$ DVA GVC			0.939***	
			(0.0508)	
$\widehat{EXP}$ FVA				0.971***
				(0.0721)
Observations	24,600	24,600	24,600	24,600
R^2	0.791	0.792	0.747	0.769

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

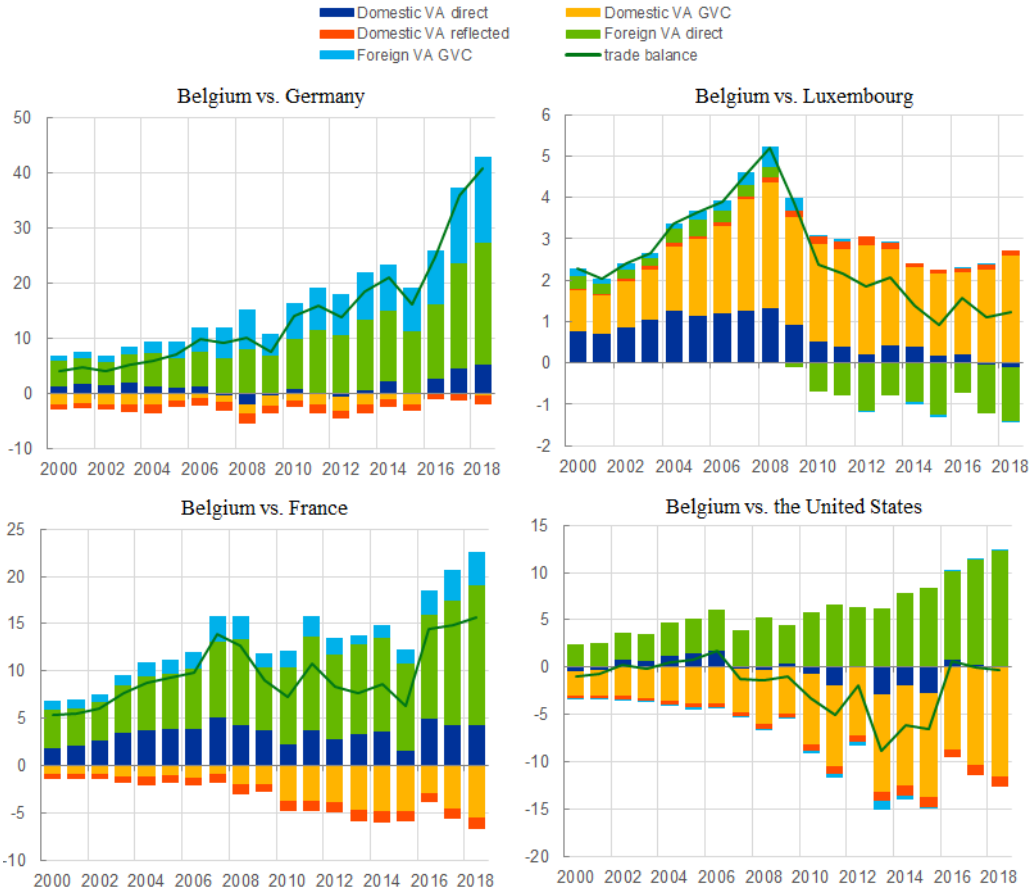
A.5 Figures

Figure A.4.1: The value added representation of the bilateral trade balance for Ireland



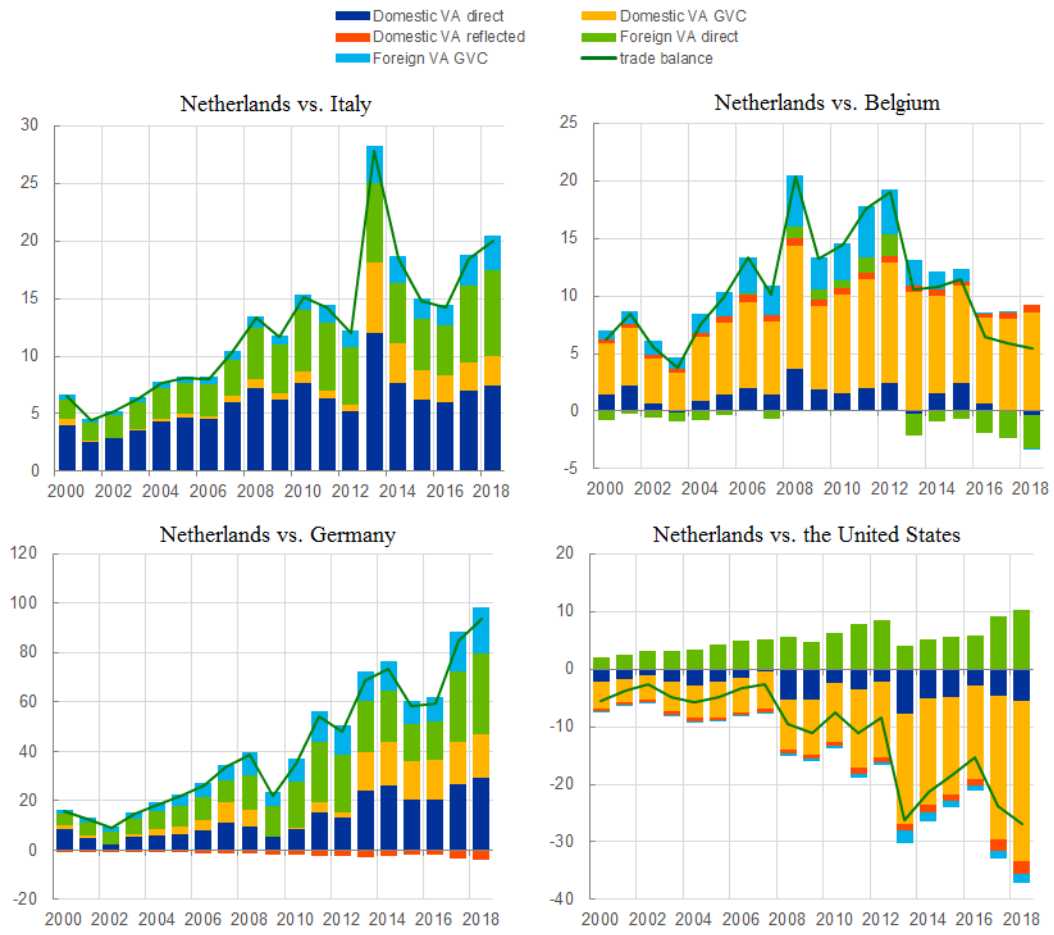
Note: vertical axes expressed in billions USD.
Source: authors' computations based on WIOD and ADB MRIO tables.

Figure A.4.2: The value added representation of the bilateral trade balance for Belgium



Note: vertical axes expressed in billions USD.
Source: authors' computations based on WIOD and ADB MRIO tables.

Figure A.4.3: The value added representation of the bilateral trade balance for Netherlands

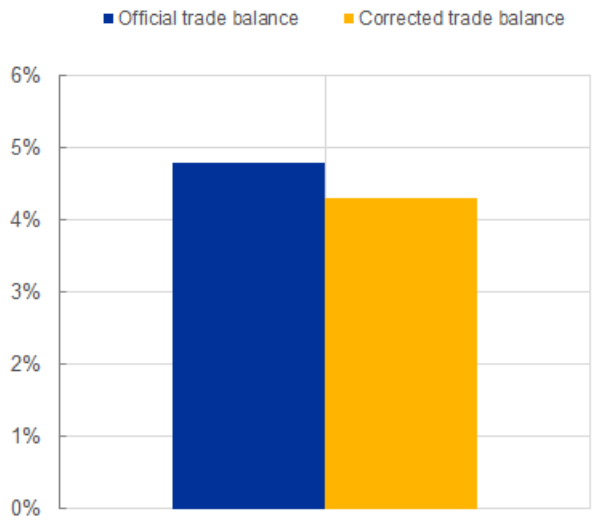


Note: vertical axes expressed in billions USD.
Source: authors' computations based on WIOD and ADB MRIO tables.

A.6 Figures

Figure A.5.1: Euro Area trade balance and profit shifting

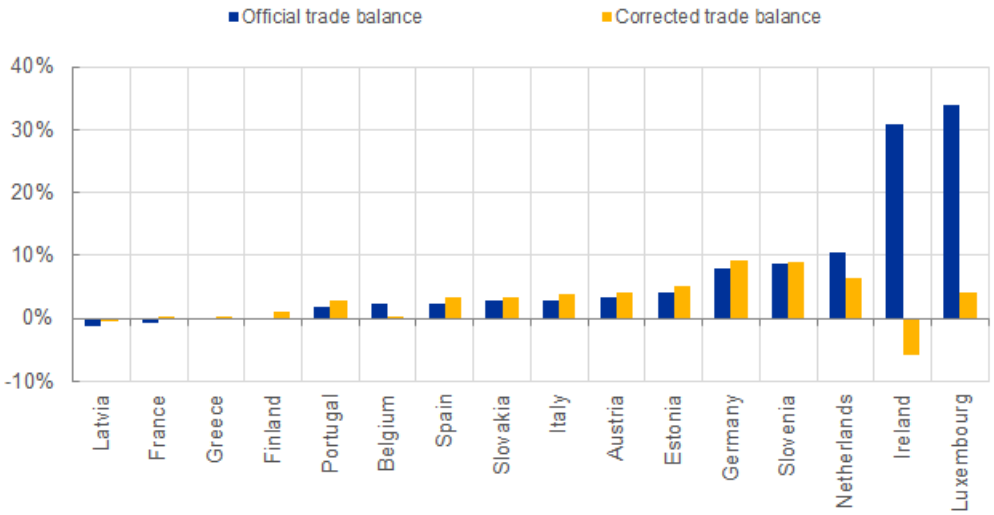
percentage of GDP



Note: Cyprus, Malta and Lithuania are excluded. Source: "the Missing Profits of Nations". (Sep 2019). Authours: Torslov, T., Wier, L., Zucman, G. and the authors' calculations

Figure A.5.2: Trade balances and profit shifting effects

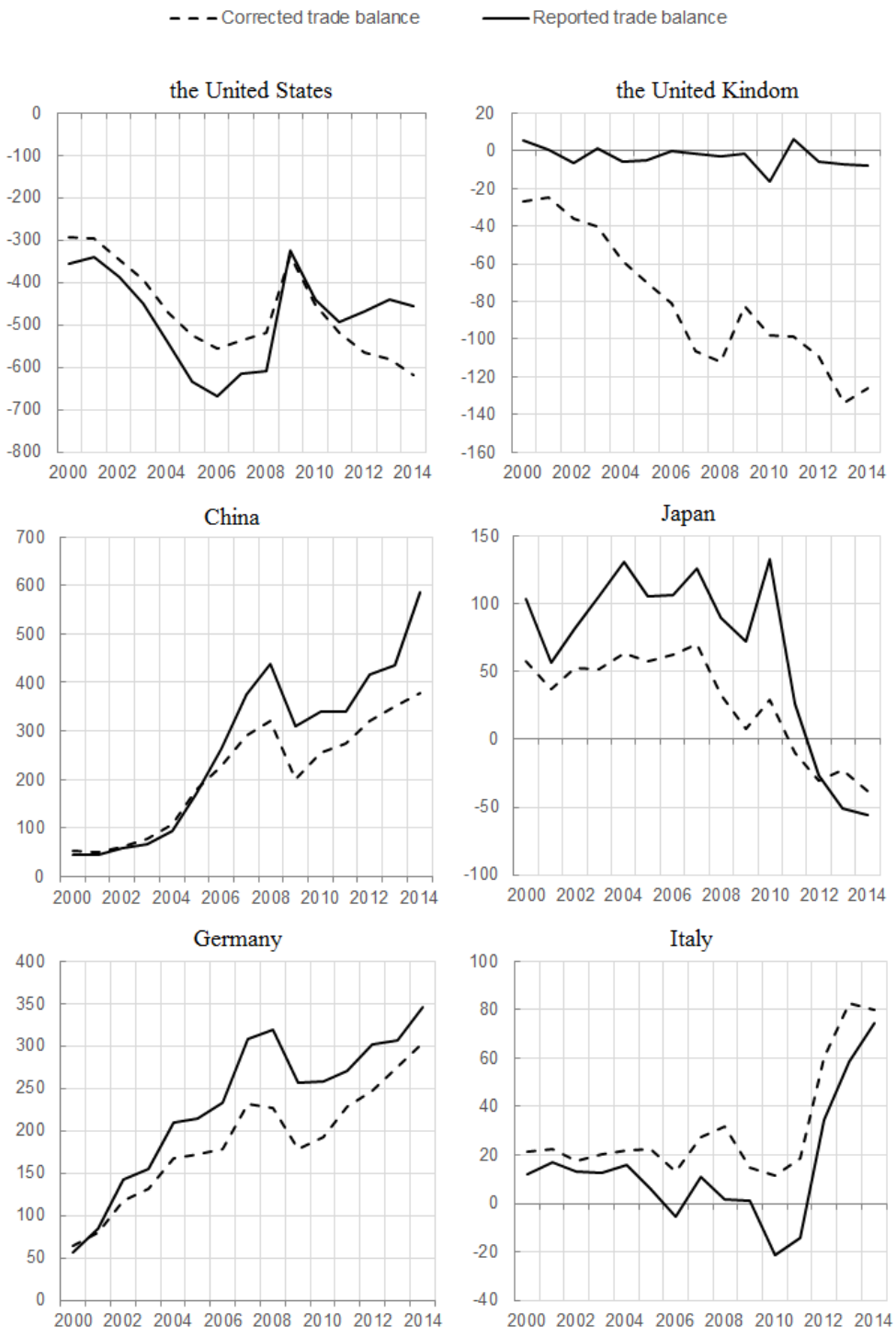
percentage of GDP

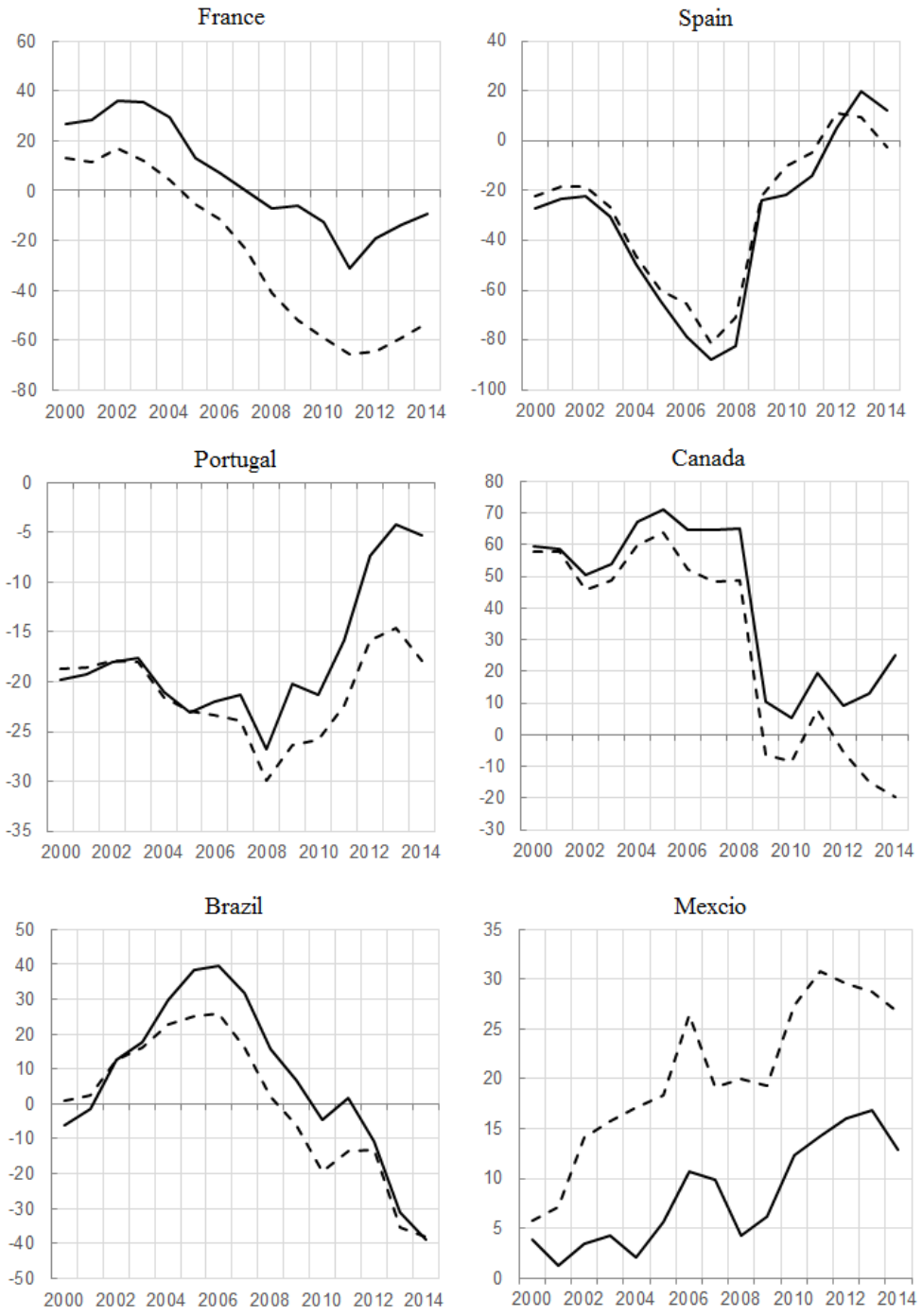


Note: Cyprus, Malta and Lithuania are excluded. Source: "the Missing Profits of Nations". (Sep 2019). Authours: Torslov, T., Wier, L., Zucman, G. and the authors' calculations

A.7 Figures

Figure A.6.1: reported and corrected trade balances





Note: vertical axes expressed in billions USD.
Source: authors' computations based on WIOD tables.

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