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Using synthetic indicators to assess the quality of macroeconomic statistics via mirror data

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Abstract

The quality of the geographical breakdown in the balance of payments and related statistics (such as international trade in goods, trade in services and foreign direct investment (FDI) statistics) can be assessed by means of comparisons with mirror data in order to assess bilateral asymmetries. Although such comparisons are performed on a regular basis, they tend to focus on pairs of countries and are not sufficient to determine which of the countries involved has better data. This paper describes three synthetic indicators that have been developed with a view to assessing whole groups of countries. In the specific context of an economic union's external account, they allow us to assess the quality of geographical breakdowns by country and the contribution that an individual country makes to the aggregate asymmetry for that group of countries. Those indicators are applied in the context of euro area FDI statistics.

JEL classification: C82, E01, F21, F23.

Keywords: asymmetries, mirror data, balance of payments, foreign direct investment

Non-technical summary

The main principles and standards that guide the production of the euro area statistics compiled by the European Central Bank (ECB) are set out in the Statistics Quality Framework (SQF) and quality assurance procedures published on the ECB's website.[1] The quality of statistical output is analysed on a regular basis, looking at methodological soundness, compliance with timeliness requirements, reliability and stability, internal consistency, and external consistency/coherence with other comparable statistical domains. In particular, the quality of geographical breakdowns is of vital importance in order to produce reliable balance of payments (b.o.p.) and international investment position (i.i.p.) statistics. One way that this can be assessed is by means of comparisons with mirror data. A typical feature of statistics where the geographical location of the counterparty is captured (e.g. b.o.p./i.i.p., trade in goods, trade in services or FDI statistics) is that they provide, in principle, for two independent observations of the same phenomenon. When these two observations do not match, an asymmetry arises.

Significant bilateral asymmetries adversely affect the quality of official statistics and their usability as a basis for sound policy advice. When the data reported by partner countries contradict each other, the analysis of the economic relationship between those countries becomes questionable. Traditionally, measures of asymmetry have focused on pairs of countries, analysing the magnitude and direction of the bilateral differences between geographical partners. Such bilateral comparisons often fail to lead to a resolution of the problem, as they do not provide any indication as to the figure that is more likely to be reliable. Follow-up measures in response to large bilateral asymmetries typically involve partners sharing microdata and metadata on a case-by-case basis in order to try to reconcile the recording of the most important cross-border transactions and positions.

The indicators proposed in this paper go beyond conventional measures of bilateral asymmetry, as they assess the recurrent or structural dimension of asymmetries between a country and a group of counterparties. They provide an overview of how well the geographical breakdown provided by that country matches the total mirror information available. These measures can be applied to any dataset where mirror data are available and any group of countries (e.g. euro area countries, European Union (EU) countries, regional groupings, or global groupings such as the G20. A key aspect of these measures is that they are suitable for summarising and comparing the quality of the geographical dimension over time.

Asymmetries within aggregate euro area data significantly affect the overall quality of the euro area balance of payments dataset (as measured by net errors and omissions), thereby hampering our ability to interpret and analyse it. In addition, intra-euro area asymmetries in the financial account reduce the reliability of the assessment of euro area financial integration, for which one would expect asymmetry-free intra-euro area figures (i.e. one would expect the claims of euro area

1 See the details of the SQF and the ECB's quality assurance procedures.

residents vis-à-vis other euro area residents to be equal to the liabilities of euro area residents vis-à-vis other euro area residents). Applying these three synthetic indicators to FDI transaction data allows us to identify structural and one-off features of these asymmetries and establish a scoreboard providing country-level feedback on identified quality issues.

The synthetic indicators presented are produced on a regular basis within the ECB in order to monitor the quality of national quarterly b.o.p. data, and their results are shared with euro area country compilers in order to facilitate a feedback mechanism and reduce bilateral and aggregate asymmetries. Several initiatives aimed at curbing asymmetries in FDI transactions within the euro area and the EU make active use of these synthetic indicators in order to assess the effectiveness of their efforts. Indeed, analysis of the values recorded for these indicators before and after action targeting identified asymmetries will give a general indication of the success of such initiatives. The results of the application of the synthetic indicators to FDI transaction and position data are also one of the quality indicators displayed in the ECB's annual quality report (see ECB, 2019), which reviews the quality of national b.o.p. and i.i.p. data. There, they complement the traditional analysis of asymmetries at intra-euro area aggregate level, taking the form of a scoreboard with a traffic light system and indicating any need for countries to monitor their data more closely and investigate discrepancies vis-à-vis counterparties.

Analysis of the application of these three synthetic indicators to quarterly FDI transaction data gives us important insights into the asymmetries affecting euro area countries. By and large, countries that require follow-up measures and closer interaction with partner countries tend to be those where it is known that a significant percentage of FDI flows through special-purpose entities (SPEs). SPEs are regularly used by multinational enterprises (MNEs) and individuals to channel funds across euro area financial centres, with those flows being highly sensitive to the adjustment of regulatory, fiscal and taxation regimes in home and host countries. Obtaining comprehensive information and correctly reporting the operations of SPEs with a quarterly frequency can be challenging for statistical authorities and is one of the main reasons for affected countries' overall poor performance in respect of the synthetic indicators. Revising the collection framework for SPEs could be one solution for countries with structural asymmetry issues within the euro area, while more timely information and the establishment of large case units could help with the analysis of large quarter-specific MNE operations.

1 Introduction

Since 2009, the G20 have supported several international efforts aimed at addressing major data gaps revealed by the global financial crisis in the context of the Data Gaps Initiative (DGI). The second phase of that initiative (DGI-2) began in 2015 with a focus on the regular collection and dissemination of comparable, timely, integrated, high-quality and standardised statistics for policy purposes. Its 20 recommendations are grouped together under three main themes: (i) monitoring risk in the financial sector; (ii) vulnerabilities, interconnections and spillovers; and (iii) data sharing and communication of official statistics. A better understanding of cross-border linkages, connections and exposures requires efforts to increase the granularity of existing datasets along several dimensions. In particular, datasets covering cross-border investment flows and positions can enhance their information potential by providing details of issuer and investor sectors, providing more information on the financial instruments involved, and improving geographical coverage of reporters and the bilateral counterparties reported.

Improving the granularity of existing macroeconomic datasets in this way brings enormous added value to researchers and policymakers and allows economic and financial phenomena to be studied across several dimensions of interest (e.g. across sectors, instruments and geographical areas). Two recent examples of influential studies made possible by the enhanced granularity of macroeconomic datasets are Lane and Milesi-Ferretti (2017) on international financial integration and Alstadsæter et al. (2018) on wealth in tax havens. Although those two papers focus on different issues and draw on different datasets, they both use newly published bilateral geographical information on cross-border investment to produce their estimates and findings.

As well as increasing the information available to researchers and policymakers, the availability of more granular macroeconomic data also offers an opportunity for statisticians to validate and improve the quality of a dataset along an additional dimension: using mirror information. In this context, mirror data refers to the existence of different sources capturing the same economic phenomenon. For example, the value of the loans that a country's banking sector grants to the resident corporate sector can be obtained from both (i) data reported in banks' balance sheets on the loans granted to firms and (ii) firms' survey responses on loans obtained from the banking sector. Thus, mirror data analysis, in the context of statistical quality management, involves validating the outcomes obtained from a particular data source using mirror information obtained from a different statistical source. Mirror data can also be used to enhance the information content of a dataset, by drawing on the mirror source in order to fill in gaps. An obvious example relates to macroeconomic data for the household sector, whose financial holdings and liabilities are normally obtained from the counterparty information provided by banks, insurance corporations, etc.

According to Silva and Pradhan (2019), mirror data analysis tends to either (i) compare different statistical domains applying similar concepts within a given

country, or (ii) compare reporting countries' treatment of the same statistical data. Our paper focuses on the latter, as we are interested in analysing the quality of the geographical dimension of macroeconomic statistics. A typical feature of statistics where the geographical location of the counterparty is captured (e.g. b.o.p./i.i.p., trade in goods and services, FDI or portfolio investment statistics) is that they can, in principle, provide for two independent observations of the same phenomenon. For example, for an FDI transaction between two countries, one data observation is provided by the investing country, and a corresponding (but independently observed) data point is provided by the recipient country. Where the two countries use comparable methodologies to collect and compile data, the two observations should be the same. Where this is not the case, however, statistical discrepancies may arise. In the context of cross-border statistics, these discrepancies are called "statistical asymmetries". Significant bilateral asymmetries adversely affect the quality of official statistics and their credibility and usability as a basis for sound policy advice.

Conventional measures of asymmetry focus on indicators comparing pairs of countries, analysing the magnitude and direction of the bilateral differences between geographical partners. Such bilateral comparisons often fail to lead to a clear resolution of the problem, as they do not necessarily provide an indication of which figure is more likely to be reliable. Also, they are difficult to summarise in the form of higher-level aggregates, so they become difficult to analyse. Follow-up measures in response to large bilateral asymmetries typically involve sharing microdata and metadata between partners on a case-by-case basis in order to try to reconcile the recording of the most important cross-border transactions and positions. However, as noted by Fortanier and Sarrazin (2016), the increasing complexity of global production and financing arrangements (e.g. factory-less producers, merchanting, processing and transfer pricing) have, in turn, increased the complexity of the measurement process, as well as the scope for asymmetries. Large cross-border operations (such as complex production chains, corporate and financial restructuring within MNEs, mergers and acquisitions, and large-scale investment plans) typically involve goods, services, intellectual property and financial flows moving across a number of countries. Consequently, it is often not enough to disentangle asymmetries on a bilateral basis, since several countries may be affected by those operations, resulting in asymmetric recording across several pairs of countries. In order to validate and improve the geographical dimension of cross-border statistics, it is therefore important to extend the analysis of mirror data (and their asymmetries), moving from a purely bilateral perspective to a framework that allows us to study the overall geographical quality of a country's data by comparing it with the full set of bilateral counterparties.

The indicators proposed in this paper go beyond conventional measures of bilateral asymmetry, as they assess the recurrent or structural dimension of asymmetries between a country and counterparty countries. They provide a synthetic overview of how well the geographical breakdown provided by that country matches the available mirror information. They also make it possible to analyse different and complementary features of asymmetric recording within the group of partners. These measures can be applied to any dataset where mirror data are available and any group of countries (e.g. euro area countries, EU countries, regional groupings, or global groupings such as the G20).

The contribution made by our paper is twofold. First, we propose a novel framework for analysing the quality of the geographical dimension of bilateral data provided by a group of partner countries. This novel framework (i) allows the identification of complementary aspects of asymmetries within the group of countries, (ii) supports analysis of whether asymmetries are structural or of a more transitory nature, and (iii) allows easy monitoring and comparison of the quality of the geographical breakdown across countries and over time. Second, we provide in-depth analysis of asymmetries affecting the euro area balance of payments, with a particular focus on its direct investment component. In this respect, we show how the application of these synthetic indicators can provide useful information that goes beyond traditional analysis of bilateral asymmetries and can complement initiatives aimed at improving the quality of b.o.p. data.

Box 1

Balance of payments and international investment position statistics

The balance of payments is a statistical statement that summarises economic transactions between residents of an economy and non-residents during a specific period of time. The international investment position, meanwhile, is a statistical statement that shows, at a specific point in time, the value and composition of financial assets of residents of an economy that represent claims vis-à-vis non-residents and liabilities of residents of an economy to non-residents.

The balance of payments and the international investment position, together with other changes in financial assets and liabilities accounts, make up an economy's international accounts. These provide an integrated framework for the analysis of an economy's international economic relationships, including its international economic performance, exchange rate policy, reserve management and external vulnerability. In the context of increasing globalisation, a country's ability to participate in global activity is an important indicator of its performance and competitiveness. Consequently, external accounts are very important in terms of understanding global flows and levels of competiveness. At the same time, some components of the balance of payments (such as the current account balance or the net international investment positions) are key surveillance indicators in terms of identifying and monitoring external macroeconomic imbalances.

The balance of payments consists of several accounts, which are distinguished according to the nature of the economic resources (e.g. goods, services, income or financial resources) provided and received by the economy in question (see Table A).

Table A

Standard presentation of the balance of payments

Account	Subaccount/functional category
Current account (CA)	Goods
	Services
	Primary income
	Secondary income
Capital account (KA)	Non-produced non-financial assets
	Capital transfers
Financial account (FA)	Direct investment
	Portfolio investment
	Financial derivatives and employee stock options
	Other investment
	Reserve assets
Net errors and omissions (E&O)	

The current account shows flows of goods, services, primary and secondary income between residents and non-residents. Goods cover all moveable goods for which changes of ownership (between residents and non-residents) occur (e.g. general merchandise). Services cover services produced through an arrangement made between a producer resident in one economy and a consumer or group of consumers resident in another (e.g. manufacturing services, travel and financial services). Primary income represents the return that accrues to resident institutional units for their contribution to the production process or for providing financial assets and renting natural resources to non-resident institutional units (e.g. compensation of employees, dividends and interest). Secondary income pertains to those current transfers between residents and non-residents that directly affect the level of gross national disposable income and thus influence the economy's ability to consume goods and services (international cooperation and workers' remittances).

The capital account shows credit and debit entries for transfers of non-produced non-financial assets (such as sales of licences and marketing assets) and capital transfers (such as debt forgiveness) between residents and non-residents.

Net acquisition and disposal of financial assets and liabilities between debtor (creditor) residents and creditor (debtor) non-residents are included in the financial account of the balance of payments. Related stocks of assets and liabilities are included in the international investment position. Financial transactions and positions are classified primarily on the basis of the type of investment or functional category (i.e. direct investment, portfolio investment, other investment, financial derivatives or reserve assets) and then also broken down on the basis of the resident sector and the financial instrument involved.

FDI is cross-border investment whereby a resident of one economy has control of – or a significant degree of influence over – the management of an enterprise that is resident in another economy. Portfolio investment is defined as cross-border transactions and positions involving debt or equity securities that are not included in direct investment or reserve assets. Other investment is a residual category which includes positions and transactions that are not included in direct investment, portfolio investment, financial derivatives or employee stock options. Reserve assets are external assets that are readily available to – and controlled by – monetary authorities for the purposes of meeting

balance of payments financing needs, intervening in foreign exchange markets to influence the currency's exchange rate, and for other related purposes (such as maintaining confidence in the currency and the economy). Financial derivatives (other than reserves) and employee stock options largely coincide with the corresponding financial instrument classes. This category relates to risk transfers rather than the supply of funds or other resources.

Although the various accounts of the balance of payments should be balanced, imbalances result, in practice, from imperfections in source data and compilation. Such imbalances, which are calculated as the net balance in the financial account minus the corresponding item derived from the current and capital account, are labelled as net errors and omissions.

The remainder of the paper is organised as follows. Section 2, after briefly discussing traditional measures of bilateral asymmetry, introduces a novel framework for analysing asymmetries based on a set of three summary indicators: the Internal Country Geographical Quality Indicator (ICGQ), the External Country Geographical Quality Indicator (XCGQ) and the Relevance Indicator (RELV). A numerical example is provided to show how the various indicators can complement each other by signalling different aspects of the quality of the geographical breakdown in a dataset. Section 3 discusses possible reasons for asymmetries in the euro area b.o.p. and uses synthetic indicators to study asymmetries in FDI transaction data. Section 4 provides concluding remarks and looks at possible areas for further research.

2 Methodology

2.1 Traditional analysis of asymmetries

Asymmetries in the geographical dimension of macroeconomic datasets are not a new phenomenon, as they are an intrinsic feature of datasets for which mirror information exists. Asymmetries can be analysed on the basis of three geographical dimensions: a bilateral dimension, an intra-aggregate dimension and a global dimension. Analysis at bilateral level involves comparing the data of two partner countries. This is the point of departure for the most common type of study, as it allows for an in-depth study of the specific reasons for asymmetries between the pair of countries in question. Where analysis focuses on asymmetries within an economically significant aggregate (be it aggregate data for the EU, the euro area or the G20), what is of interest is the intra-group discrepancy stemming from asymmetric recording by the countries comprising the aggregate in question. Eurostat (2006), one of the first studies to focus on the evolution and composition of intra-EU asymmetries in the current account of the balance of payments, is a good example of this approach. In the final level of analysis, asymmetries may also emerge at the global level, despite the fact that economic concepts should net out globally. Lane and Milesi-Ferretti (2007), for instance, show that measured global liabilities exceed global assets, leading to the inherently contradictory conclusion that the world as a whole is a net debtor.

Box 2
Statistics on international trade in goods and services

International trade in goods and services is defined as transactions in goods and services between residents and non-residents.

International trade in goods statistics (ITGS) summarise, on a monthly/quarterly basis, exchanges of goods across international borders. Exports and imports of goods are presented by product group on the basis of the Broad Economic Categories (BEC) classification and main trading partners, and measured both in terms of value and as indices of volume and unit value. Owing to differences in terms of definitions, classification, coverage and time of recording, external trade data (particularly for imports) are not fully comparable with the goods item in the balance of payments statistics. However, they constitute an essential source for the compilation of balance of payments statistics and national accounts.

Traditionally, ITGS are based on the data that customs authorities collect on trade transactions between countries. Customs declarations are used as the basic data source for statistical purposes, providing detailed information on exports and imports of goods with a geographical breakdown.

ITGS are an important data source for many public and private sector decision-makers at global, EU and national level. For example, at EU level, extensive use is made of international trade data for multilateral and bilateral negotiations within the framework of the common commercial policy (e.g. in order to define and implement anti-dumping policies, and to evaluate the evolution of the Single Market).

International trade in services statistics are produced by partner economy and by service category. The term “services” covers a heterogeneous range of intangible products and activities that are difficult to summarise within a simple definition. Services are the result of a production activity that changes the nature of the consuming units (transformation services) or facilitates the exchange of products or financial assets (margin services). Services are often difficult to separate from goods, with which they may be associated to varying degrees.

The provision of services often requires physical proximity between customers and suppliers (e.g. in the case of accommodation services). At the same time, services are increasingly being supplied by electronic means (over the internet, by phone/email, etc.). Services may also be supplied through foreign affiliates in a host country (e.g. when a non-resident bank creates a subsidiary in the host economy in order to supply banking services).

Services play a major role in all modern economies: an efficient service sector is crucial for trade and economic growth, as well as being vital for the dynamism and resilience of the economy. In an age of increasingly interconnected economies, enterprises may operate in several countries at once and have trading partners all over the world. This is also reflected in the rising importance of cross-border trade in services. In this context, international trade flows have become more complex, forming global value chains.

Studying asymmetries normally involves looking at a specific dataset and trying to quantify the extent of any asymmetries and investigate their principal causes. Traditionally, literature has developed around datasets on trade in goods, owing to the historical availability of large sets of bilateral time series. One notable example in this regard is the seminal work by Feenstra et al. (1999) on the causes of discrepancies in China-Hong Kong trade statistics. However, in recent years (thanks, in part, to the greater geographical granularity of several macroeconomic datasets on cross-border flows), that literature has expanded to cover other domains as well. Fortanier et al. (2017), for example, study asymmetries in data on bilateral trade in services and provide a framework for constructing a balanced dataset (i.e. one that is free of asymmetries). Meanwhile, Angulo and Hierro (2017) analyse existing asymmetries in bilateral direct investment positions as evidenced by the Coordinated Direct Investment Survey (CDIS). And Ortolani and Rucaj (2009) look at global asymmetries in remittance data, providing in-depth analysis of discrepancies between Italy and Albania.

Studies are also carried out on a regular basis by the statistical agencies responsible for compiling cross-border datasets, in order to explain the main reasons for discrepancies between their data and those published by their main partners. For example, Central Statistics Office (2016) focuses on explaining asymmetries between Ireland and the United States in terms of FDI. Office for National Statistics (2018) assesses discrepancies between UK trade data and those of the country’s most important commercial partners (the United States, Ireland, Germany, France, the Netherlands, Belgium and Luxembourg). Bureau of Economic Analysis (2018) presents the differences between US trade statistics and those of the United States’ main bilateral partners. And Eurostat (2019) shows the evolution of asymmetries in the

bilateral EU-US current account, with a particular focus on trade in goods and services.

Different studies have used different ways of measuring asymmetries, with those measurement techniques falling into three broad categories: size indicators, bilateral ratios and multilateral ratios. Table 1 lists the main types of measurement technique, showing their mathematical formulae,[2] categorisation, main features and main uses. All of these measures equal zero in the absence of asymmetries, with higher figures denoting greater asymmetry.

Most studies that look in detail at discrepancies between a specific pair of countries use signed size indicators, which are the most immediate indicator and the easiest to calculate. Moreover, the sign of the discrepancy over time can provide useful information on possible structural under/over-reporting by a country relative to its partner. When the focus is on comparing measures of asymmetry across several country pairs, the use of a bilateral index can help to put the discrepancy into context: an asymmetry between two country pairs will have a different meaning in terms of the quality of data if it has a small denominator, rather than a large one. When the focus shifts from analysis of country pairs to analysis of overall asymmetries within a certain geographical group of countries, using a multilateral asymmetry index provides a quick summary measure of the overall size of the asymmetries affecting the group of countries in question.

Table 1

Summary of measures of asymmetry

Type of measurement technique	Formula	Category	Main features
Asset or liability (absolute) asymmetry	$A_{i,c} - L_{c,i}$ $L_{i,c} - A_{c,i}$ $\lvert A_{i,c} - L_{c,i} \rvert$ $\lvert L_{i,c} - A_{c,i} \rvert$	Size indicator	Indication of the sign and size of the asymmetry, calculated on either the assets or the liabilities side for the reporting country: allows asymmetries on the two sides of the accounts to be analysed separately. When positive (negative), indicates over (under)-reporting by country i relative to country c data. When calculated using absolute values, this allows the ranking of asymmetries between country pairs.
Absolute asymmetry	$w\lvert A_{i,c} - L_{c,i} \rvert + (1-w)\lvert L_{i,c} - A_{c,i} \rvert$	Size indicator	Indication of the overall absolute size of the asymmetry between the pair of countries. The weight w is normally set at 0.5. This allows discrepancies between a pair of countries to be summarised in a single indicator.
Asset or liability asymmetry index	$\frac{A_{i,c} - L_{c,i}}{\frac{A_{i,c} + L_{c,i}}{2}}$ $\frac{L_{i,c} - A_{c,i}}{\frac{L_{i,c} + A_{c,i}}{2}}$	Bilateral ratio	Indication of the relative size of the bilateral asymmetry relative to an anchor measure used as a denominator. In this example, it is the average size of investment flows between the pair of countries, but different variables can be used as a denominator (e.g. GDP or the value of stocks of investment).
Absolute asymmetry index	$\frac{\lvert A_{i,c} - L_{c,i} \rvert + \lvert L_{i,c} - A_{c,i} \rvert}{\frac{A_{i,c} + L_{c,i}}{2} + \frac{L_{i,c} + A_{c,i}}{2}}$	Bilateral ratio	Indication of the overall absolute size of the asymmetry between the pair of countries, relative to the average size of the investment flows declared by the pair of countries.
Multilateral asymmetry index	$\frac{\sum_i \sum_c \lvert A_{i,c} - L_{c,i} \rvert}{\sum_i \sum_c \frac{A_{i,c} + L_{c,i}}{2}}$	Multilateral ratio	Indication of the overall size of the asymmetries between a group of countries $i = 1,..,N$ and the group of counterparties $c = 1,..,M$. The discrepancy is measured relative to the average flows reported.

Note: A country pair is defined as reporting country i and its counterparty country c. The relationship between the pair is defined as a financial investment relationship: reporting country i has both assets A_(i,c) and liabilities L_(i,c) vis-à-vis counterparty country c; counterparty country c has, in turn, both assets A_(c,i) and liabilities L_(c,i) vis-à-vis country i. Readers who are more familiar with trade literature can conceptualise this as exports/imports, rather than assets/liabilities.

2 The lexicon used in Table 1 and the remainder of the paper is taken from the balance of payments.

2.2 A novel approach: a set of synthetic indicators

In our view, measures of the quality of geographical data should (i) be simple to apply and extend, (ii) be easy to interpret, (iii) provide reasonably robust results, and (iv) provide a basis for country-level feedback on data quality. The approach followed here seeks to overcome the problem of assessing where the fault lies for any given pair of countries. It considers that comparison with the full set of mirror data for partner countries will provide an indication of whether (a) the reporting country or (b) the countries providing mirror data should investigate the quality of their (bilateral) data. The rich set of information obtained through multiple bilateral comparisons is thus synthetised in indicators summarising the quality of the geographical breakdown provided by a particular country. The indicators provide summary values for each country involved in the analysis and for each of the periods under consideration. This is an important feature, as it allows feedback on data quality to be provided at country level, as well as allowing analysis over time.

We propose three synthetic measures based on this approach, with each of them capturing a different aspect of the quality of the geographical breakdowns provided by countries. Although the results for each indicator can be analysed independently, we suggest that the three indicators are used in combination as a unique framework analysing complementary aspects of the quality of the geographical breakdown within a group of countries. The three measures are as follows:

- **Internal Country Geographical Quality Indicator (ICGQ):** a measure that provides information on the accuracy of a bilateral geographical classification
- **External Country Geographical Quality Indicator (XCGQ):** a measure that provides information on the accuracy of a country's intra/extra-group geographical classification vis-à-vis mirror data from the group
- **Relevance Indicator (RELV):** a measure that relates the total of all bilateral asymmetries involving a country to the total asymmetry for the group of countries providing bilateral data

The formulae for the three measures are listed below on the basis of the following:

i is the country to which the quality index applies; c is the counterparty country; and w is a predefined weight that applies to all countries, which by default is equal to 0.5, reflecting the fact that our synthetic indicators give the same weights to asymmetries on the reported assets and reported liabilities sides.[3] $\sum_c |A_{i,c}|$ reflects the sum of the absolute values of the assets reported by country i vis-à-vis all the remaining c countries present in the group in question. Likewise, $\sum_c |L_{i,c}|$ reflects the sum of the absolute values of the liabilities reported by country i vis-à-vis all the remaining c countries present in the group in question. $\sum_c |A_{i,c} - L_{c,i}|$ measures the sum of the absolute bilateral asymmetries for the assets of country i vis-à-vis its counterparties,

[3] A different calibration of the weighting factor would reflect the allocation of a different default level of importance to one of the two sides of the accounts. At one extreme, a weight of *w*=1 would mean that only the asymmetry between the assets of the reporting country and mirror liabilities mattered for the analysis; the opposite would happen with a weight of *w*=0.

and $\sum_c |L_{i,c} - A_{c,i}|$ represents the sum of the absolute bilateral asymmetries for the liabilities of the same country i vis-à-vis its counterparties.

The **ICGQ** is expressed as follows:

$$ICGQ_i = \left[w \frac{\sum_c |A_{i,c} - L_{c,i}|}{\sum_c |A_{i,c}| + \sum_c |L_{c,i}|} + (1-w) \frac{\sum_c |L_{i,c} - A_{c,i}|}{\sum_c |L_{i,c}| + \sum_c |A_{c,i}|} \right] \quad (1)$$

This assesses the quality of the geographical breakdown of country i vis-à-vis each of the counterparty countries in the sample. It measures the accuracy of the geographical classification within the sample of countries where bilateral data are provided by aggregating absolute bilateral asymmetries. It shows high values where a country has particular problems matching the mirror data of most of its counterparty countries, either through bilateral misallocation or through under or overestimation. This provides a measure of the quality of geographical detail, assessed at the most granular level.

The **XCGQ** is expressed as follows:

$$XCGQ_i = \left[w \frac{\left|\sum_c A_{i,c} - \sum_c L_{c,i}\right|}{\sum_c |A_{i,c}| + \sum_c |L_{c,i}|} + (1-w) \frac{\left|\sum_c L_{i,c} - \sum_c A_{c,i}\right|}{\sum_c |L_{i,c}| + \sum_c |A_{c,i}|} \right] \quad (2)$$

This measures the absolute difference between the total sum of the intra-country group values reported by country i and the total sum of the mirror data. It provides an indication of over/under-reporting by the country under consideration vis-à-vis the entire group of counterparty countries as a whole, and it highlights problems with regard to the overall intra/extra-group geographical allocation, as well as more general problems of coverage. This measure is thus especially relevant for assessing the quality of countries' contributions to the overall quality of the external accounts for regional aggregates.

The **RELV** is expressed as follows:

$$R_i = \frac{\sum_c |A_{i,c} - L_{c,i}| + \sum_c |L_{i,c} - A_{c,i}|}{\sum_i \sum_c |A_{i,c} - L_{c,i}|} \quad (3)$$

The Relevance Indicator places the findings for the first two indicators in context, as it measures each country's impact on the overall intra-group asymmetry. It is intended to complement the first two measures by indicating the countries which have the greatest impact on measured bilateral asymmetries. For example, in the case of asymmetries within a geographical aggregate for an economic or monetary area (such as the EU or the euro area), the Relevance Indicator will provide an assessment of a country's contribution to the overall asymmetries within the regional aggregate.

The three measures can be applied by period to any specific country i that is part of the geographical aggregate under consideration, and all of them fall within the range

[0, 1]. This allows us to easily compare results across countries and summarise results in a clear way using scoreboards. Results can be communicated using a traffic light system, with colours corresponding to predefined ranges of figures. When indicators for a certain country fall within the red range, for example, that country should be invited to take action (e.g. by initiating exchanges with partner countries in order to understand and resolve asymmetries); a second range of figures (yellow range) indicates that improvements may possibly be needed; and a third range (green range) means that there is no urgent need for action. This will establish a feedback loop from the indicators to the country data and help to improve the overall quality of the dataset under consideration.

2.3 Numerical example

A stylised numerical example is presented here in order to illustrate the behaviour of the three measures. We consider five countries (C1, C2, C3, C4 and C5), which are part of a regional grouping (G5), with all of them reporting bilateral transactions in assets and liabilities. Table 2 contains the information that is used to calculate the ICGQ, XCGQ and RELV indicators for C1. The table covers three different reporting scenarios for C1, in order to show how results can vary and highlight the complementary nature of these measures in terms of analysing different aspects of the quality of the geographical breakdown of macroeconomic statistics.

The blue column in Table 2 lists the counterparty countries. For each of the three reporting scenarios, the first column shows the data reported by C1 vis-à-vis each of the counterparty countries, the second column shows the mirror data reported by each counterparty vis-à-vis C1, and the third column displays the absolute bilateral asymmetries. The top half of the table looks at reported assets for C1, while the bottom half looks at reported liabilities. Please note that the remaining bilateral data in the dataset are assumed to be constant in the three scenarios and have values within the range of +/- 500. This means that bilateral flows which do not involve C1 as either reporting country or counterparty are the same under all three scenarios and therefore cause the same amount of asymmetries.

Table 2

Three different scenarios for country C1

(EUR billions)

	Counterparty	C1 – Scenario 1			C1 – Scenario 2			C1 – Scenario 3		
		Rep.	Mirr.	|asym|	Rep.	Mirr.	|asym|	Rep.	Mirr.	|asym|
Assets	C2	200	300	100	-300	300	600	-300	300	600
	C3	-55	-70	15	70	-70	140	3,700	-70	3,770
	C4	3,400	3,700	300	-3,700	3,700	7,400	-3,000	3,700	6,700
	C5	30	30	0	-30	30	60	-30	30	60
	Total G5	3,575	3,960	415	-3,960	3,960	8,200	370	3,960	11,130
		Rep.	Mirr.	|asym|	Rep.	Mirr.	|asym|	Rep.	Mirr.	|asym|
Liabilities	C2	1,200	1,300	100	-1,300	1,300	2,600	-1,000	1,300	2,300
	C3	-25	-40	15	40	-40	80	2,500	-40	2,540
	C4	1,000	1,300	300	-1,300	1,300	2,600	-1,200	1,300	2,500
	C5	10	10	0	-10	10	20	-10	10	20
	Total G5	2,185	2,570	415	-2,570	2,570	5,300	290	2,570	7,360
	ICGQ	0.07			1.00			0.99		
	XCGQ	0.06			0.97			0.31		
	RELV	0.33			0.89			0.92		

Source: ECB calculations.

In Scenario 1, we can see that individual bilateral asymmetries involving C1 are modest relative to the overall size of the data reported by C1. Consequently, both the ICGQ and the XCGQ indicate relatively good results. The RELV score of 0.33 tells us that asymmetries involving C1 are significant, but do not account for a large percentage of total intra-G5 asymmetries.

In Scenario 2, we can see that C1 fails to match any of its counterparties' data, reporting the same figures, but with the opposite sign. The ICGQ therefore reaches its maximum level (1.00), indicating that C1 has extreme difficulties matching its counterparties' bilateral data and signalling a need for further analysis. The same is true of the total values obtained by adding up all bilateral data for the G5 group: the figures for C1 and its partner countries are the same, but with opposite signs. The XCGQ value is therefore close to 1, indicating a very large discrepancy in total intra-G5 data. The RELV indicator now reaches a very high level (0.89), indicating that C1 is making a large contribution to intra-group asymmetries.

In Scenario 3, we can see that the situation as regards bilateral asymmetries is fairly similar to that seen in Scenario 2. C1 again achieves almost perfect bilateral mismatches with its partners' data by construction, producing an ICGQ score very close to 1. However, the XCGQ measure now yields a relatively good result, as the discrepancies between reported and mirror figures for total intra-G5 data are relatively small compared with the absolute amounts reported. Scenario 3 captures a situation where C1 shows sizeable differences in the bilateral geographical allocation of its data (relative to the bilateral information provided by its counterparties), but still manages to achieve intra-group totals that are comparable to those obtained from counterparties' bilateral information, implying that C1's intra/extra-group breakdown does not seem to

have severe quality issues. Still, the RELV indicator indicates that C1 remains highly relevant (with a value of 0.92), making a very large contribution to total intra-group bilateral asymmetries.

3 Application to euro area balance of payments data

3.1 How asymmetries affect the quality of euro area b.o.p. data

The ECB compiles and publishes the euro area's balance of payments and international investment position, applying concepts and definitions that are in line with the sixth edition of the IMF's Balance of Payments and International Investment Position Manual (BPM6).[4] These statistics depict the euro area's economic relations with the rest of the world, with the euro area regarded as a single economy. Euro area b.o.p. data are compiled by summing up the individual b.o.p. statistics of each euro area country vis-à-vis non-euro area countries.[5] Cross-border transactions/positions of euro area countries vis-à-vis each other are therefore excluded.

A crucial element for the compilation of reliable euro area b.o.p. statistics is thus the accuracy of the geographical distribution in the underlying country data. The correct identification of the counterparty of a b.o.p. transaction (e.g. whether a transaction carried out by an Italian resident has as its counterparty a resident of Germany or a resident of Switzerland) is of fundamental importance for the compilation of euro area b.o.p. data: in the first scenario, that particular transaction would not contribute to the euro area's balance of payments; in the second scenario, it would. For transactions in goods and services, the identification of counterparties in b.o.p. transactions seems intuitive, with counterparties corresponding to the previous/new owner of goods and the provider/purchaser of services. For financial transactions, however, the geographical identification of the counterparty should be based on the debtor/creditor principle (in contrast to the transactor principle). For example, if a euro area resident purchases a US government bond from a British bank, the counterparty of the euro area resident (the creditor) is the US government (the debtor) – not the British bank. If the geography of cross-border transactions between euro area countries is captured inconsistently by the different national compilers involved, this may lead to an overall discrepancy at euro area level and the emergence of intra-euro area asymmetries. Since intra-euro area credits and debits should be equal, as should intra-euro area assets and liabilities, intra-euro area asymmetries are defined as a situation where net intra-euro area transactions are not equal to zero (i.e. they are not totally consolidated). The size of intra-euro area asymmetries is thus an important indicator of the quality of euro area b.o.p. statistics and is closely monitored by the ECB.

In addition to being an indicator of quality per se, the presence of intra-euro area asymmetries also has an indirect effect on the quality of euro area b.o.p. statistics by contributing to overall b.o.p. net errors and omissions. Under the vertical and

4 See Balance of Payments and International Investment Position Manual.

5 Details of the compilation of euro area b.o.p./i.i.p. data can be found in ECB (2016). The remainder of this paper will focus solely on b.o.p. data, but similar considerations and analysis can be applied to the stock data presented in the i.i.p.

horizontal double-entry bookkeeping system underpinning the b.o.p., the net financial account should be identical to the current and capital account balance. If imbalances emerge owing to imperfections in source data and compilation systems, net errors and omissions (n.e.o.) are present. The size, direction and persistence of n.e.o. are, therefore, some of the most important indicators of the quality of b.o.p. data. To see how intra-euro area asymmetries affect the euro area n.e.o., we can mathematically break the euro area n.e.o. down into its component parts.

Each euro area country sends the ECB its contribution to the euro area b.o.p. Those country contributions comprise the transactions of each euro area country vis-à-vis partner countries outside the euro area (termed "counterparty J8"). The euro area b.o.p. is generally obtained by summing up the contributions of all euro area countries. Net errors and omissions at euro area level are recorded when the euro area's net financial account is different from the balance in the euro area's current and capital account:

$$n.e.o. = FA - CKA \tag{4}$$

where FA represents the net financial account and CKA denotes the current and capital account balance. In turn, the euro area FA and CKA are obtained as the sum of all euro area country contributions vis-à-vis non-euro area partners (J8):

$$n.e.o. = \sum FA^{J8} - \sum CKA^{J8} \tag{5}$$

Given that, for each country, data against the rest of the world (W1) equals the sum of transactions with non-euro area countries (J8) and euro area countries (I8), equation 2 can be expressed as:

$$n.e.o. = \sum FA^{W1} - \sum FA^{I8} - \left(\sum CKA^{W1} - \sum CKA^{I8}\right) \tag{6}$$

The term $\sum \mathrm{FA}^{\mathrm{W1}} - \sum \mathrm{CKA}^{\mathrm{W1}}$ corresponds to the sum of national errors and omissions, whereas the terms $\sum \mathrm{FA}^{\mathrm{I8}}$ and $\sum \mathrm{CKA}^{\mathrm{I8}}$ represent intra-euro area asymmetries in the financial account and the capital and current account respectively. In light of this, equation 3 can be expressed as follows:

$$n.e.o. = \sum n.e.o._{national}^{W1} - AS^{I8} \tag{7}$$

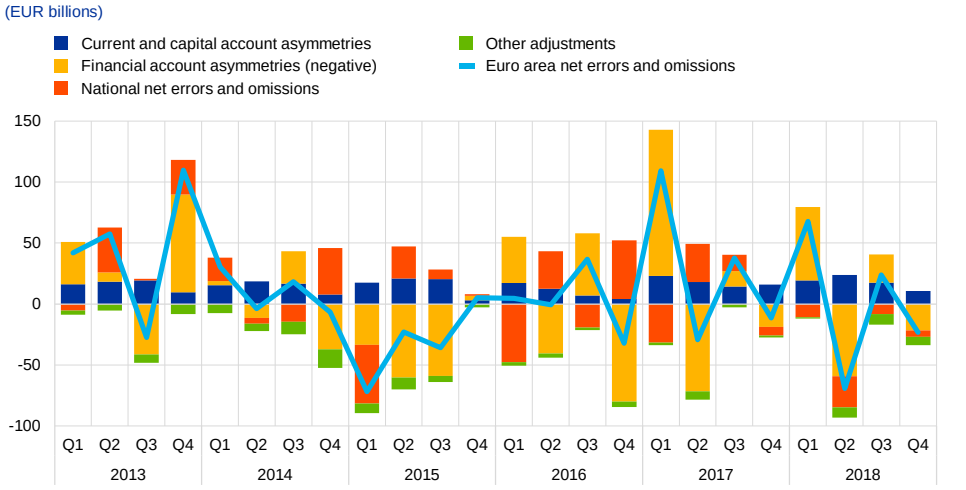
Moreover, the ECB performs a series of adjustments at aggregate level to increase the reliability of the euro area data – the main adjustment being an estimation of foreign holdings of euro banknotes, which constitute a liability for the euro area as a whole. The euro area n.e.o. is thus explained by the components shown in equation 8 below:

$$n.e.o._{.}^{I8} = \sum n.e.o._{national}^{W1} - AS^{I8} \mp other\ adjustments \quad (8)$$

Chart 1 shows the contributions that the various components make to the quarterly euro area n.e.o.[6] Intra-euro area asymmetries in the financial account are systematically the main contributor to the overall euro area n.e.o. This is an indication of the difficulty of recording intra-euro area financial transactions in a consistent manner. It is also clear that national n.e.o. can be very significant in specific quarters, highlighting the problems that countries have in achieving consistency in the recording of the financial and non-financial sides of the b.o.p. Asymmetries in the current and capital account also make substantial regular contributions.

Chart 1

Components of euro area net errors and omissions



Source: ECB calculations.

As a final remark, large net errors and omissions make it difficult to interpret the euro area b.o.p. In particular, the presence of intra-euro area asymmetries is problematic for researchers studying the financial integration of the euro area,[7] as they need financial indicators that assume the existence of asymmetry-free intra-euro area b.o.p. data.

3.2 The size and components of intra-euro area b.o.p. asymmetries

BPM6 contains internationally agreed methodological guidelines and standards that seek to ensure a common framework for compiling b.o.p. data. That last edition of the

6 Please note that the euro area n.e.o. in Chart 1 does not correspond to the euro area n.e.o. that is published by the ECB in the BPM6 dataset, as a final adjustment is normally made to those data (reducing the size of euro area n.e.o. on the basis of a statistical model) before publication. For more details, see Euro area balance of payments and international investment position compilation.

7 See the 2018 version of the ECB's "Financial integration in Europe" report.

manual was revised in parallel with the System of National Accounts 2008 (SNA 2008) to ensure consistency between external and domestic macroeconomic statistics. Since 2014, all euro area countries have used BPM6 as the basis for their compilation of b.o.p. data, thus ensuring a common methodological basis for their contributions to euro area b.o.p. statistics. Guideline ECB/2011/23[8] sets out the requirements that national compilers must comply with in order to report high-quality national b.o.p./i.i.p. data to the ECB for the purpose of compiling euro area aggregates.

Although the compilation process is based on a common methodological framework, bilateral asymmetries can still emerge across euro area country data, mainly owing to:[9]

- differences in the interpretation/implementation of the guidance provided in manuals (e.g. where countries have different ways of implementing the guidance that BPM6 provides on the reporting and compilation of reinvested earnings on FDI income in cases involving chains of ownership);
- information asymmetries between statistical compilers that lead to structural difficulties when seeking to capture one side of a particular economic phenomenon (e.g. where compilers receive direct information from banks and tax authorities on household assets in the country in question, but have less reliable information on household assets abroad);
- differences between data collection systems that lead to differences in coverage (e.g. where there is a need to use grossing-up techniques in addition to direct reporting);
- differences in the classification of items across the breakdowns available in the dataset (e.g. where loan transactions within a corporate group are wrongly classified as “other investment” instead of “direct investment”);
- discrepancies in the recording times for transactions (e.g. where a country reports operations later than it should have done);
- incorrect identification of a counterparty and/or its place of residence (e.g. through use of the transactor approach instead of the debtor approach);
- differences in the understanding and handling of complex transactions (e.g. cross-border corporate restructuring operations by large MNEs).

As the ECB is responsible for the compilation and publication of euro area b.o.p. data, our focus here is on the question of how the accumulation of bilateral asymmetries between euro area countries results in intra-euro area asymmetries. In fact, the existence of bilateral asymmetries does not necessarily affect the quality of the euro area aggregate (e.g. where all of the bilateral asymmetries cancel each other out at the aggregate level). In the next few paragraphs, we will investigate the emergence of

8 See Guideline ECB/2011/23 of 9 December 2011 on the statistical reporting requirements of the ECB in the field of external statistics (recast), OJ L 65, 3.3.2012, p. 1.

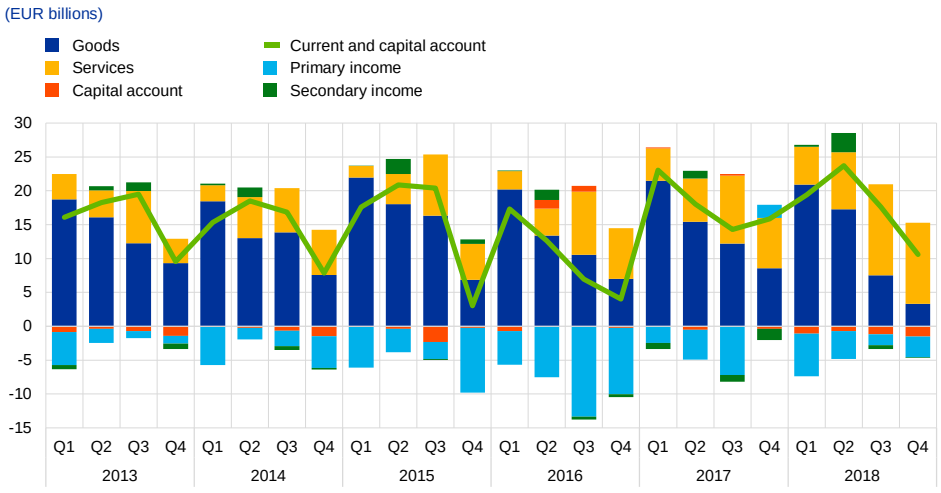
9 This list looks at the main reasons for asymmetries in euro area b.o.p. data. Please note, when extending this analysis of asymmetries to cover data on positions, that an important role is also played by differences in the valuation of positions.

intra-euro area asymmetries in the current and capital account and the financial account. As net intra-euro area transactions should equal zero, deviations from zero signal the presence of aggregate asymmetries.

Chart 2 shows that, in the period from the first quarter of 2013 to the fourth quarter of 2018, current and capital account asymmetries (green line) were always positive, indicating a structural over (under)-estimation of intra-euro area credits (debits). This asymmetry fluctuates within a range of €5 billion to €25 billion, showing some seasonal movement. Moreover, when looking at the breakdown by component, some structural biases can be seen: positive asymmetries in goods and services accounts, and negative asymmetries in the primary income account.[10] The asymmetries in secondary income and the capital account are relatively minor and seem to follow a more random pattern.

Chart 2

Intra-euro area asymmetries in the current and capital account



Source: ECB calculations.

Asymmetries in goods are the largest contributor. Their positive sign is in line with trends at a global level, where, according to IMF (2019), the world has a "trade surplus with Mars", owing to the fact that data coverage is slightly better for exports than it is for imports. Moreover, asymmetries in goods show a clear seasonal pattern: they are higher in the first quarter and then decline over the remaining three quarters. This behaviour may stem from structural differences in the recording of seasonal transactions in the first quarter of each year.

Services and primary income also show sizeable asymmetries (always positive in the case of services; nearly always negative in the case of primary income), which may stem from differences in counterparties' understanding of the nature of certain underlying transactions. Most of the asymmetry in primary income is in fact due to asymmetries in FDI income; there are sometimes structural misclassifications between FDI income and services. This situation can arise when cross-border flows

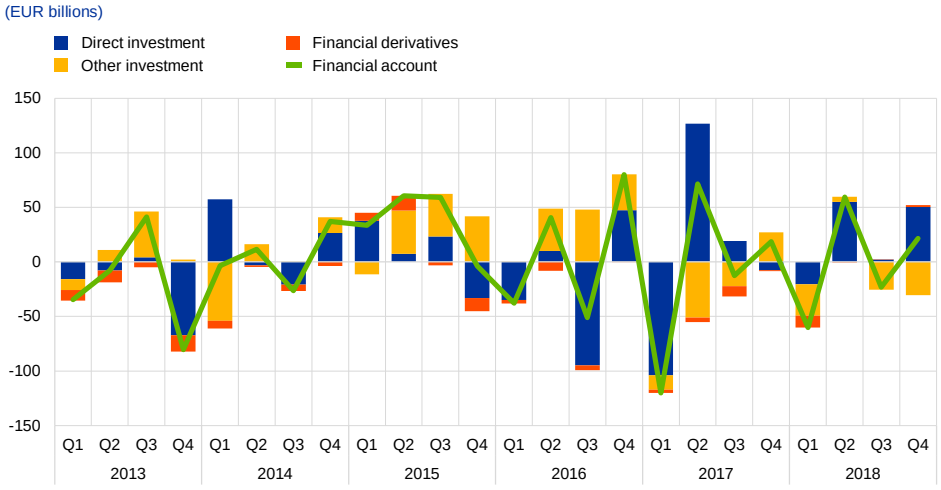
[10] The only exception here is the fourth quarter of 2017, in which the primary income account made a positive contribution.

relating to intellectual property product (IPP) assets, research and development (R&D), and professional and management consultancy services take place within complex multinational groups. Depending on the structure of the multinational group in question, transfer pricing behaviour, cross-border services flows and the allocation of property rights in respect of assets may be wrongly classified as FDI income flows (or vice versa). Another possible reason for the persistently negative asymmetry in primary income could be the difficulty, for euro area countries' compilers, of obtaining a complete picture of the size and geography of assets abroad (particularly as regards the income generated by those assets). This will lead to a structural under-estimation of investment income credits relative to investment income debits.

Turning our attention to the intra-euro area asymmetries in the financial account of the balance of payments, Chart 3 shows that overall asymmetries (green line) are larger in size than those of the current account, as well as being much more volatile: the average absolute value over the period from the first quarter of 2013 to the fourth quarter of 2018 is around €40 billion, with absolute asymmetries in excess of €100 billon being recorded in three periods and changes in the sign of asymmetries being observed in 17 of the 24 quarters in question.

Chart 3

Intra-euro area asymmetries in the financial account



Source: ECB calculations.

A breakdown by functional category shows that direct investment and other investment are the main contributors, while financial derivatives show visible asymmetries only in specific quarters.[11] Periods where asymmetries in direct and other investment offset each other alternate with periods where their contributions to the overall asymmetry have the same sign. Offsetting behaviour typically signals a misclassification of certain financial flows across functional categories. In particular, if a compiler does not recognise an entity as being part of an FDI relationship, it will typically record all inter-company lending between the two entities under other

[11] By construction, reserve assets and portfolio investment do not show asymmetries at euro area level. Reserve assets only reflect asset values, while portfolio investment (and related income) does not show asymmetries owing to the residual compilation approach at euro area level. For further information regarding the compilation of euro area b.o.p. data, see ECB (2016).

investment, rather than direct investment. However, if the counterparty recognises the existence of an FDI relationship, all of the relevant financial flows will be classified as FDI. This misclassification between FDI and other investment can be particularly relevant when complex corporate MNE structures involve several layers of affiliated companies and/or large financing operations are carried out through fellow enterprises (i.e. enterprises which are part of the same corporate group), but without any relevant cross-equity participation. From a time series perspective, we can also see that the largest asymmetries in FDI data were recorded in specific quarters in 2016 and 2017, where they can be linked to specific corporate operations carried out by large MNEs. Thus, the complexity of such corporate events poses significant challenges for compilers of macroeconomic statistics.

Box 3
FDI statistics

The primary means of classification for financial transactions, positions and income in the international accounts is by functional category, taking into account some aspects of the relationship between the parties involved and the motivation for investment.

FDI is a category of cross-border investment which is associated with a resident of one economy (direct investor) being able to exercise control or a significant degree of influence over the management of an enterprise (direct investment enterprise) which is resident in another economy. FDI tends to be associated with strategic long-term relationships, since, in addition to financial funds, direct investors may also provide know-how, technology, management and marketing. Furthermore, enterprises in a direct investment relationship are more likely to trade with and finance each other. Direct investment may also allow the direct investor to gain access to the economy of the direct investment enterprise, which it might otherwise be unable to do.

The “lasting interest” characteristic of direct investment is evidenced where the direct investor holds at least 10% of voting rights in the direct investment enterprise. Direct investment enterprises may be (i) subsidiaries (in which case, the direct investor will hold over 50% of voting rights), (ii) associates (in which case, it will hold between 10% and 50% of voting rights) or (iii) quasi-corporations such as branches (which are effectively 100% owned by their respective parents).

Once a direct investment relationship between a resident and a non-resident entity has been established, direct investment statistics cover all cross-border transactions and positions between those enterprises. FDI includes direct investment positions (equity and debt), direct investment income flows (distributed earnings, reinvested earnings and interest income) and direct investment financial flows (equity and debt). Market value is the preferred conceptual basis for measuring both direct investment positions and transactions (flows).

Direct investment data can be broken down on the basis of the type of relationship between the investor and the recipient entity: investment by a direct investor in its own direct investment enterprise; reverse investment by a direct investment enterprise in its own direct investor; or investment between resident and non-resident entities (fellow enterprises) which are controlled/influenced by the same parent, but with neither fellow enterprise controlling/influencing the other.

Direct investment statistics are presented in the international accounts in terms of assets and liabilities, in line with the presentation of other functional categories, with data organised according to whether the investment relates to an asset or a liability. An alternative presentation (directional principle) focuses on the direction of the direct investment relationship and is mostly used in annual FDI datasets. In that case, direct investment is shown as either direct investment abroad (outward investment) or direct investment in the reporting economy (inward investment).

3.3 Using synthetic indicators to assess the quality of FDI transactions

The analysis of intra-euro area asymmetries in the previous section showed that asymmetries in the financial account are particularly sizeable and that transactions in FDI are the main contributor in most quarters. Against that background, the synthetic indicators presented in Section 2.2 can provide compilers with useful information, allowing them to better assess the quality of national contributions to the geographical aggregate.

An important prerequisite for the application of those synthetic indicators is the availability of bilateral data, as the proposed indicators compare bilateral information with mirror data. In the context of the euro area b.o.p., the number of euro area countries voluntarily reporting bilateral data has steadily increased, and coverage is now almost complete for FDI transactions. Currently, 17 of the 19 euro area countries regularly provide quarterly bilateral data for intra-euro area FDI transactions. Only Greece and Slovakia are missing,[12] but their limited weight in terms of total euro area FDI means that their potential contribution to intra-euro area asymmetries is assumed to be negligible. This assumption is supported by available mirror data (i.e. data provided by other euro area countries vis-à-vis Greece and Slovakia), as well as by analysis of the impact that missing bilateral data have on total intra-euro area FDI asymmetries. In addition, reporting countries are allowed to report non-allocated intra-euro area data: if this amount is large, the interpretation of the indicators may be distorted. Consequently, we consider, as a quality check, that bilateral transactions vis-à-vis other euro area countries should account for at least 80% of the total intra-euro area transactions reported by that country. If this is not the case, bilateral data involving that specific country are supressed for the relevant period.[13] Chart 4 shows the difference between total intra-euro area asymmetries as calculated on the basis of intra-euro area country contributions vis-à-vis the euro area aggregate (I8) and intra-euro area asymmetries calculated from the sum of available bilateral data.

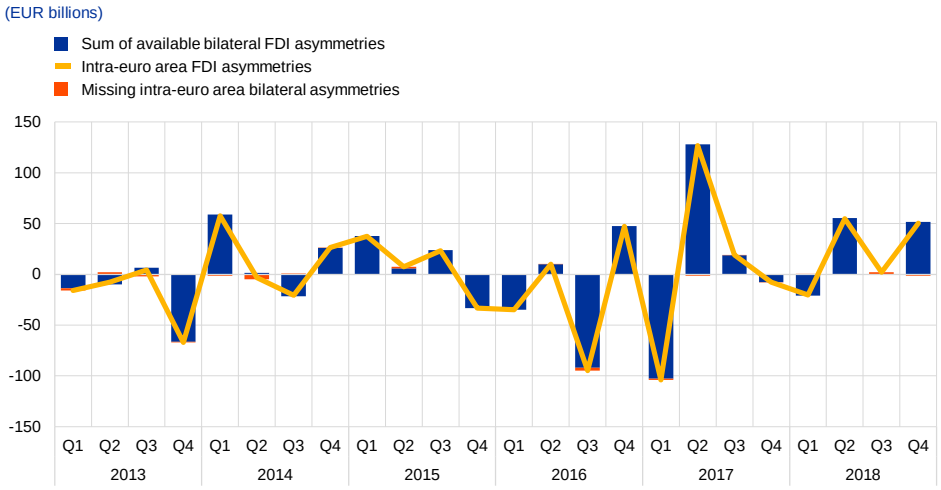
12 Data for Finland are available for all reference periods as of the first quarter of 2015. Bilateral data requirements for euro area countries have been included in Guideline ECB/2011/23 on the statistical reporting requirements of the ECB in the field of external statistics, so all bilateral data necessary for the calculation of these indicators will be available by March 2021.

13 Data for the period from the first quarter of 2015 to the fourth quarter of 2018 indicate that this only applies to around 3% of observations and is thus a good indication of the quality of the bilateral detail provided by each country relative to the intra-euro aggregate provided. That time period will be the main review period for the remainder of this paper, as it provides the best available time series, with a uniform number of countries providing data on intra-euro area bilateral FDI transactions.

The difference (red bar in the chart) stems from missing bilateral data[14] and is negligible over the whole of the time period in question.

Chart 4

Impact that missing data have on FDI asymmetries



Source: ECB calculations.

Applying the three synthetic quality measures (ICGQ, XCGQ and RELV) to the available bilateral dataset for FDI transactions for the period from the first quarter of 2015 to the fourth quarter of 2018 gives us the detailed results presented in tabular form in Appendix A. In presenting these results, a traffic light approach is adopted, as discussed in Section 2.2. Table 3 shows the ranges that are applied for the ICGQ and the XCGQ, which are based on historical analysis of the distribution of results for these indicators. The RELV indicator, meanwhile, shows how important data pertaining to a given country are to the overall intra-euro area asymmetry. Thus, the value for this indicator is directly correlated with that country's contribution to the total intra-euro area asymmetry. No normative ranges have been established for this indicator, but a RELV result in excess of 0.2 implies that the country in question is involved in 10% or more of total intra-euro area asymmetries. Such countries are strongly encouraged to make considerable efforts to improve data quality by comparing their approach with those of mirror countries (irrespective of the results for the other two indicators).

We can see from Tables A.1 to A.3 (see Appendix A) that the results for FDI transactions are characterised by high levels of variability, both across countries and within countries over time, particularly for the ICGQ indicator. This is an indication that, for most countries, the correct geographical attribution of FDI flows can be strongly affected by specific transactions in particular quarters. In addition, across the range of euro area countries, there is no clear evidence of an overall trend for the indicators over time. One would have expected that, thanks to the revision process, data for earlier periods would have better geographical consistency (and thus lower ICGQ and XCGQ values).

[14] This also includes any geographical discrepancies between the country contributions vis-à-vis I8 and their available intra-euro area bilateral data.

Table 3

Ranges for follow-up measures

Indicator	Regular monitoring (green)	Improvement needed (yellow)	Immediate action (red)
ICGQ	0.0 to 0.5	0.5 to 0.7	0.7 to 1.0
XCGQ	0.0 to 0.2	0.2 to 0.5	0.5 to 1.0

Source: ECB calculations.

In order to summarise in a meaningful way the vast amount of information obtained, Chart 5 shows the distributional properties of the ICGQ, XCGQ and RELV measures using box plots. Those box plots are ordered on the basis of the median value for each country.

For the measure of internal quality (ICGQ), only three countries have median values below 0.5. Two countries have median values above 0.85, and all of the remaining countries have median values between 0.45 and 0.75. Thus, widespread improvements are needed as regards the correct identification of bilateral counterparties. It is interesting to see that the two countries with the worst median scores (Malta and Cyprus) also have relatively low levels of dispersion around the median. Ireland is in a similar situation, with a relatively high median value (above 0.6) and strong clustering of data points around that value. For these three countries, therefore, the ICGQ indicator identifies structural problems when it comes to matching the geographical details provided by other euro area countries. For the remaining countries, a much greater degree of variability is observed, suggesting that bilateral asymmetries may not be a structural phenomenon, but may have a strong influence in specific quarters. This may be an indication that specific corporate events have had a strong impact on the FDI data of several euro area countries. Indeed, large and complex corporate events (e.g. corporate restructuring by MNEs or transfers of IPP assets) can have a large impact on FDI flows across multiple euro area countries. As these events are difficult to capture in a consistent way across compilers, the countries in question may see their ICGQ indicators deteriorate as a result. As regards the measure of external quality (XCGQ), no country has a median value in excess of 0.5, which would indicate a need for immediate action. This can be explained by the fact that the XCGQ is less stringent than the ICGQ in terms of the correct identification of the geographical counterparty: what matters here is the comparison between the intra-euro area total obtained by aggregating reported bilateral data and the intra-euro area total obtained by aggregating mirror data. As discrepancies in bilateral flows may cancel each other out in the aggregate (as shown in the examples in Section 2.3), the XCGQ indicator is thus an indication of the quality of the intra-euro area breakdown provided by each reporting country. The results for the XCGQ show very high levels of dispersion around the median for all countries, showing that most countries alternate between quarters with good results and quarters where immediate action is required to understand aggregate mismatches with mirror data. Here, too, Ireland, Cyprus and Malta are the three countries that have the most problems matching partners' aggregate data.

To put those findings into context, we now turn to the results for the RELV indicator, which measures each country's contribution to the overall asymmetry stemming from

bilateral data. Three countries (the Netherlands, Luxembourg and Ireland) stand out as the countries that systematically contribute the most to intra-euro area asymmetries in FDI transactions, with median values of between 0.4 and 0.5. Similarly, those three countries' results for the ICGQ and XCGQ indicators often show a need for follow-up measures and improvement as regards the matching of bilateral and aggregate data.

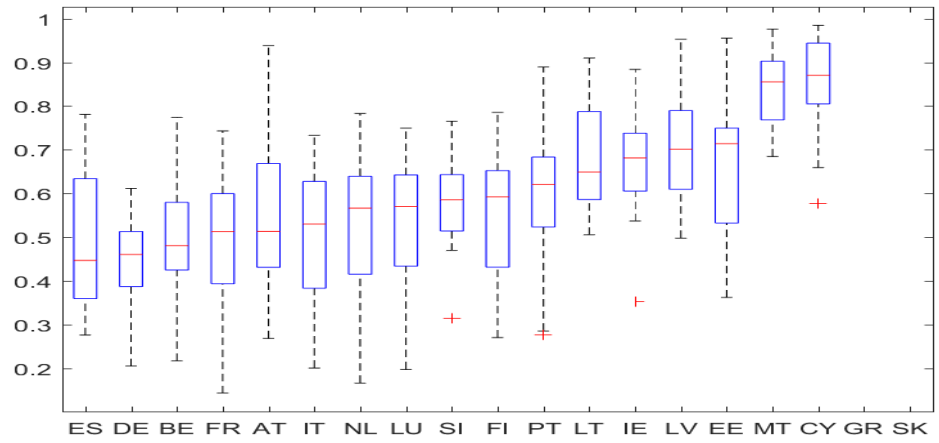
Combined analysis of the three synthetic measures gives us important insight into the asymmetries affecting euro area countries. By and large, the countries that require follow-up measures and closer interaction with partner countries tend to be those where it is known that a significant percentage of FDI flows through special-purpose entities. The Netherlands, Luxembourg and Ireland all have large numbers of SPEs, while Malta and Cyprus face particular challenges in covering these entities.[15] SPEs are regularly used by large MNEs to channel funds across euro area financial centres, with such flows being highly sensitive to the adjustment of regulatory, fiscal and taxation regimes in home and host countries. Obtaining comprehensive information and correctly reporting the operations of SPEs with a quarterly frequency can be challenging for statistical authorities and is one of the main reasons for countries' poor performance overall in respect of the synthetic indicators. Revising the collection framework for SPEs could be one solution for countries with structural asymmetry issues within the euro area, while more timely information and the establishment of large case units could help with the analysis of large quarter-specific MNE operations.

[15] See ECB, 2019 for further details.

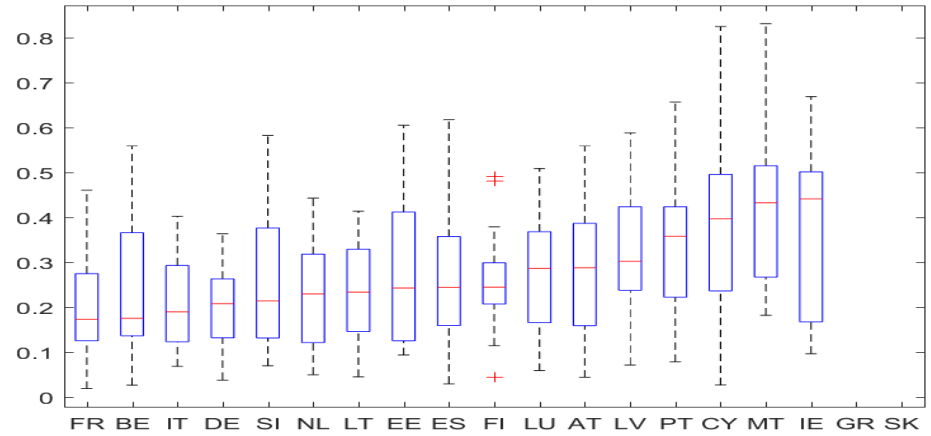
Chart 5

Summary results for synthetic indicators

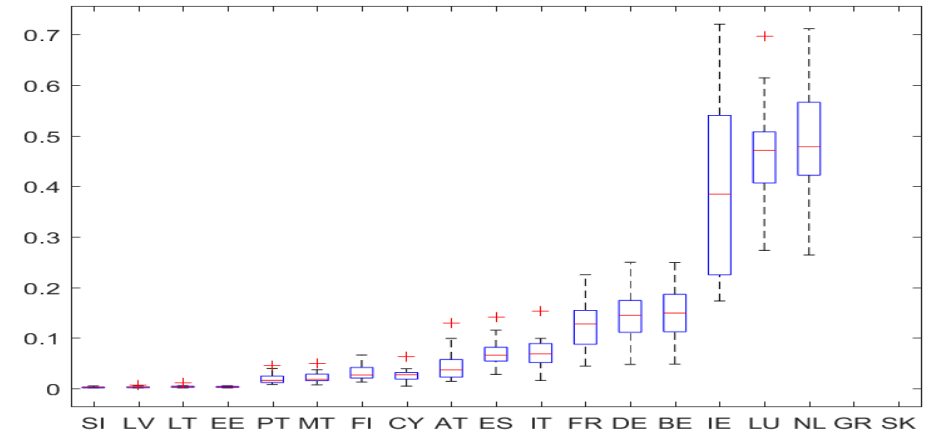
a) ICGQ – FDI transactions



b) XCGQ – FDI transactions



c) RELV – FDI transactions



Source: ECB calculations.

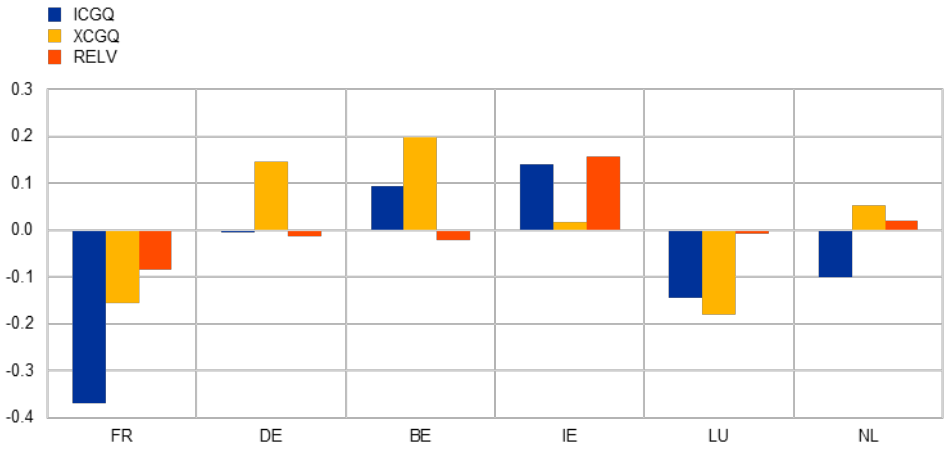
If we look at the difference between the results for the last quarter and the median findings, we can see how developments in a specific quarter differ from the structural

level for a given country. Specifically, we can measure, for each country, whether the results for a given quarter are above or below the country-specific structural level. Chart 6 shows the results of this exercise for the fourth quarter of 2018 (the latest available data point) for the six countries with the largest median values for the RELV indicator over the review period (France, Germany, Belgium, Ireland, Luxembourg and the Netherlands). Looking at the three countries which usually make the largest contributions to total intra-euro area asymmetries, we can see that the fourth quarter of 2018 was a particularly bad quarter for Ireland, with its RELV score far above its long-term trend. The contributions that the Netherlands and Luxembourg made to total intra-euro area asymmetries were much more in line with those countries' long-term trends. On the other hand, France's contribution to euro area asymmetries was smaller than usual.

Chart 6

Developments in Q4 2018 for the three measures

(differences between results for Q4 2018 and long-term structural trends)



Source: ECB calculations.
Note: A negative value indicates an improvement relative to the country's long-term structural trend; a positive value indicates deterioration.

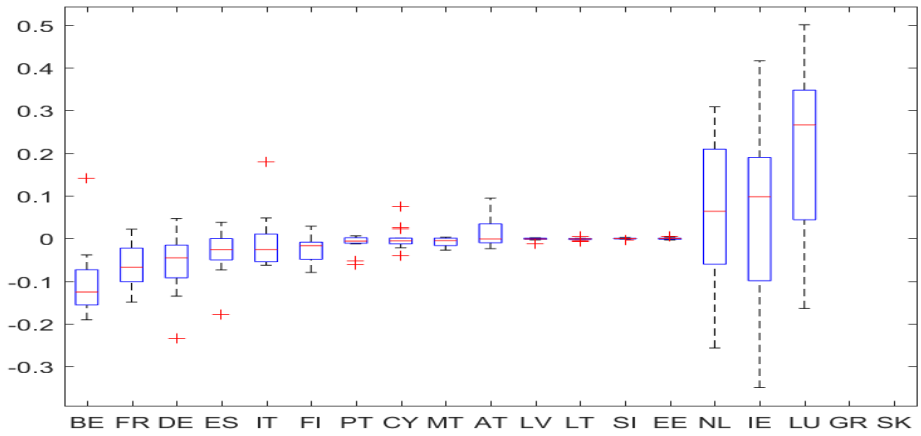
Data on FDI can reflect transactions in either equity or debt instruments. We can apply the synthetic indicators to those two components in turn, thereby obtaining further insights into countries' behaviour in respect of asymmetries. This analysis looks only at the RELV indicator, as we want to investigate systematic differences in countries' contributions to total intra-group asymmetries depending on the financial instrument considered. The box plots in Chart 7 show the results for our sample of countries, with each data point representing the difference between the RELV value calculated using data on equity and the RELV value calculated using data on debt instruments. Thus, a country with a positive median value systematically makes a larger contribution to overall intra-euro area bilateral asymmetries in respect of equity than it does in respect of debt instruments. The three countries that are identified as the largest contributors to overall asymmetries in FDI transactions (the Netherlands, Luxembourg and Ireland; see Chart 5.c) also record significantly positive values in this assessment. At the opposite end of the spectrum, there is another group of three countries that are also particularly relevant for FDI asymmetries: Belgium, Germany and France. These three countries make larger contributions in respect of debt instruments than they do in

respect of equity. On the basis of this evidence, we can conclude that asymmetries in FDI equity are more concentrated than asymmetries in FDI debt instruments. While 75% of all intra-euro area asymmetries for equity are explained by bilateral data involving the Netherlands, Luxembourg and Ireland, asymmetries involving those three countries only account for around 50% of total intra-euro area asymmetries for debt instruments, and there are three other countries (Belgium, Germany and France) that are systematically involved in around 30% of such asymmetries.

Chart 7

Differences between RELV values for equity and debt instruments

(difference between equity and debt instruments)



Source: ECB calculations.
Note: A negative value indicates that the RELV score for equity is smaller than the RELV score for debt instruments; a positive value indicates that the RELV score for equity is larger than the RELV score for debt instruments.

4 Conclusion

Analysis of asymmetries is of fundamental importance when seeking to improve the quality of statistics with a geographical dimension (such as b.o.p./i.i.p. or trade statistics). When measured at the level of a regional aggregate (e.g. a euro area aggregate), asymmetries provide an indication of the quality of the regional aggregate in question and the quality of its geographical breakdown.

Traditional measures of asymmetry focus on comparing the bilateral data of individual pairs of countries, looking often at a specific point in time , whereas the synthetic indicators presented and applied in this paper contribute to a better understanding of regional asymmetries in macroeconomic data for a particular period and over time. Indeed, they allow us to study the relationship between a country's data and the full set of bilateral mirror data. The three indicators presented here allow us to isolate different types of asymmetry within the geographical aggregate under consideration (bilateral discrepancies, regional discrepancies and contributions to overall asymmetries). Thus, combined analysis of the three indicators helps us to summarise different aspects of the geographical quality of bilateral data and allows country-specific follow-up strategies to be formulated.

Asymmetries within aggregate euro area data significantly affect the overall quality of the euro area balance of payments dataset (as measured by net errors and omissions), thereby hampering our ability to interpret and analyse it. Additionally, intra-euro area asymmetries in the financial account also reduce the reliability of the assessment of euro area financial integration, for which one would expect asymmetry-free intra-euro area figures (i.e. one would expect the claims of euro area residents vis-à-vis other euro area residents to be equal to the liabilities of euro area residents vis-à-vis other euro area residents). Applying this set of synthetic indicators to FDI transaction data allows us to identify structural and one-off features of those asymmetries and establish a scoreboard providing country-level feedback on identified quality issues. The indicators are useful in terms of isolating specific quality issues in a particular reporting period or identifying more structural issues in one of the component series. Ideally, this information should help compilers to focus on one-off issues in particular periods and identify structural issues, with a view to remedying such issues in the medium term and reducing intra-euro area asymmetries.

The synthetic indicators presented here are produced on a regular basis within the ECB in order to monitor the quality of national quarterly b.o.p. data, and their results are shared with euro area country compilers in order to facilitate a feedback mechanism and reduce bilateral and aggregate asymmetries. Several initiatives aimed at curbing asymmetries in FDI transactions within the euro area and the EU make active use of these synthetic indicators in order to assess the effectiveness of their efforts. Indeed, analysis of the values recorded for these indicators before and after action targeting identified asymmetries will give a general indication of the success of such initiatives. The results of the application of the synthetic indicators to FDI transaction and position data are also one of the quality indicators displayed in the

ECB's annual quality report (see ECB, 2019), which reviews the quality of national b.o.p. and i.i.p. data. There, they complement the traditional analysis of asymmetries at intra-euro area aggregate level, taking the form of a scoreboard with a traffic light system and indicating any need for countries to monitor their data more closely and investigate discrepancies vis-à-vis counterparties.

The methodology developed here could be used to analyse asymmetries in data pertaining to any aggregate. The only limitation relates to the availability of bilateral data. Indeed, the analysis of asymmetries in respect of a given economic or geographical aggregate (e.g. FDI data for the G20) requires full bilateral data for the countries comprising the grouping in question. That being said, if a few bilateral pairs are missing, the indicators can still be applied, by making some simplifying assumptions regarding the structure of the missing bilateral asymmetries (e.g. by using counterparty data in place of the missing country data, thus assuming zero asymmetries for that particular country pair).

The next step in the development of this methodology for the analysis of asymmetries could involve the use of a more robust calibration exercise to identify the ranges requiring follow-up measures for ICGQ and XCGQ scores. Given that these are relative indicators, which assign a score between 0 and 1 depending on the size of the relevant measure of bilateral asymmetry relative to the size of the reported data, some further reasoning should also be taken into account in the definition of traffic light ranges for the various datasets under consideration.

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Appendices

A Detailed results for synthetic indicators

Table A.1

Internal Country Geographical Quality Indicator

Date	AT	BE	CY	DE	EE	ES	FI	FR	IE	IT	LT	LU	LV	MT	NL	PT	SI
2015Q1	0.77	0.43	0.66	0.26	0.42	0.46	0.56	0.31		0.36	0.65	0.44	0.53		0.49	0.29	0.64
2015Q2	0.61	0.59	0.86	0.50	0.80	0.67	0.67	0.64	0.62	0.63	0.53	0.61	0.77	0.87	0.70	0.28	0.63
2015Q3	0.59	0.35	0.88	0.61	0.36	0.28	0.27	0.55	0.35	0.52	0.51	0.20	0.67	0.95	0.17	0.68	0.72
2015Q4	0.47	0.22	0.94	0.46	0.73	0.48	0.68	0.42	0.69	0.63	0.76	0.59	0.65		0.65	0.52	0.51
2016Q1	0.46	0.33	0.79	0.40	0.72	0.59	0.48	0.39	0.54	0.73	0.82	0.59	0.60	0.78	0.58	0.54	0.52
2016Q2	0.79	0.53	0.78	0.49	0.75	0.36	0.34	0.60		0.60	0.57	0.69	0.76		0.62	0.83	0.68
2016Q3	0.71	0.77	0.84	0.61	0.71	0.43	0.58	0.74	0.74	0.56	0.68	0.67	0.50		0.78	0.53	0.54
2016Q4	0.27	0.46	0.82	0.51	0.82	0.43	0.62	0.60	0.67	0.41	0.83	0.54	0.95	0.91	0.53	0.61	0.77
2017Q1	0.44	0.42	0.87	0.38	0.72	0.39	0.38	0.51	0.55	0.50	0.73	0.40	0.70	0.83	0.64	0.63	0.31
2017Q2	0.62	0.61	0.89	0.41	0.44	0.28	0.79	0.37	0.73	0.20	0.58	0.55	0.80	0.85	0.56	0.63	0.47
2017Q3	0.40	0.56	0.89	0.39	0.65	0.70	0.62	0.60	0.88	0.54	0.61	0.68		0.88	0.63	0.78	0.49
2017Q4	0.39	0.47	0.58	0.35	0.75	0.68	0.52	0.64	0.82	0.33	0.91	0.53	0.87	0.89	0.57	0.43	0.56
2018Q1	0.46	0.58	0.98	0.52	0.58	0.78	0.60	0.42	0.62	0.73		0.61	0.51	0.70	0.36	0.59	0.61
2018Q2	0.56	0.45	0.97	0.20	0.64	0.33	0.63	0.40	0.61	0.63	0.61	0.75	0.83	0.68	0.27	0.63	0.53
2018Q3	0.42	0.49	0.95	0.58	0.48	0.47	0.75	0.51	0.73	0.49	0.80	0.31	0.70	0.76	0.30	0.68	0.64
2018Q4	0.94	0.58	0.98	0.46	0.96	0.36	0.37	0.14	0.82	0.21	0.63	0.43	0.74	0.98	0.47	0.89	0.64

Table A.2

External Country Geographical Quality Indicator

Date	AT	BE	CY	DE	EE	ES	FI	FR	IE	IT	LT	LU	LV	MT	NL	PT	SI
2015Q1	0.53	0.08	0.23	0.08	0.11	0.35	0.30	0.05		0.16	0.29	0.27	0.25		0.28	0.10	0.09
2015Q2	0.21	0.56	0.46	0.23	0.48	0.41	0.28	0.18	0.10	0.13	0.04	0.37	0.45	0.26	0.35	0.20	0.37
2015Q3	0.55	0.17	0.49	0.19	0.09	0.16	0.21	0.27	0.17	0.19	0.14	0.06	0.07	0.49	0.12	0.66	0.58
2015Q4	0.20	0.03	0.19	0.36	0.18	0.19	0.49	0.17	0.64	0.37	0.23	0.51	0.30		0.32	0.24	0.18
2016Q1	0.32	0.13	0.25	0.20	0.10	0.43	0.18	0.19	0.47	0.40	0.41	0.29	0.27	0.51	0.15	0.35	0.19
2016Q2	0.56	0.14	0.49	0.24	0.29	0.21	0.22	0.46		0.29	0.16	0.37	0.33		0.44	0.48	0.38
2016Q3	0.34	0.42	0.29	0.28	0.60	0.30	0.11	0.30	0.43	0.11	0.26	0.28	0.10		0.32	0.37	0.07
2016Q4	0.21	0.18	0.50	0.18	0.26	0.23	0.48	0.14	0.27	0.26	0.33	0.14	0.34	0.52	0.18	0.43	0.15
2017Q1	0.09	0.38	0.52	0.12	0.44	0.14	0.29	0.14	0.45	0.18	0.40	0.22	0.35	0.55	0.38	0.42	0.10
2017Q2	0.30	0.36	0.25	0.21	0.22	0.03	0.25	0.11	0.60	0.07	0.11	0.33	0.49	0.39	0.25	0.34	0.28
2017Q3	0.28	0.10	0.49	0.06	0.18	0.25	0.04	0.39	0.10	0.26	0.20	0.07		0.28	0.21	0.30	0.20
2017Q4	0.04	0.16	0.13	0.15	0.58	0.62	0.24	0.28	0.67	0.10	0.09	0.34	0.50	0.83	0.12	0.08	0.12
2018Q1	0.12	0.24	0.55	0.36	0.14	0.37	0.21	0.23	0.50	0.29		0.46	0.14	0.18	0.10	0.38	0.39
2018Q2	0.06	0.28	0.03	0.04	0.39	0.16	0.30	0.14	0.36	0.19	0.32	0.41	0.30	0.29	0.05	0.47	0.23
2018Q3	0.32	0.14	0.82	0.24	0.11	0.34	0.38	0.10	0.14	0.31	0.18	0.19	0.23	0.19	0.05	0.16	0.36
2018Q4	0.43	0.37	0.34	0.35	0.34	0.14	0.23	0.02	0.46	0.10	0.41	0.11	0.59	0.48	0.28	0.39	0.38

Table A.3

Relevance Indicator

Date	AT	BE	CY	DE	EE	ES	FI	FR	IE	IT	LT	LU	LV	MT	NL	PT	SI
2015Q1	0.08	0.20	0.03	0.15	0.00	0.08	0.06	0.16		0.06	0.01	0.52	0.00		0.64	0.01	0.00
2015Q2	0.05	0.23	0.03	0.08	0.00	0.07	0.02	0.22	0.23	0.08	0.00	0.48	0.00	0.01	0.43	0.04	0.00
2015Q3	0.06	0.14	0.03	0.16	0.00	0.05	0.02	0.13	0.17	0.06	0.00	0.58	0.00	0.02	0.51	0.04	0.00
2015Q4	0.03	0.05	0.03	0.08	0.00	0.03	0.01	0.05	0.25	0.05	0.00	0.70	0.00		0.71	0.01	0.00
2016Q1	0.10	0.11	0.02	0.11	0.00	0.06	0.04	0.14	0.22	0.09	0.00	0.49	0.00	0.02	0.58	0.01	0.00
2016Q2	0.13	0.25	0.06	0.17	0.00	0.08	0.04	0.20		0.10	0.01	0.46	0.00		0.47	0.03	0.00
2016Q3	0.04	0.16	0.02	0.11	0.00	0.06	0.02	0.14	0.40	0.07	0.00	0.42	0.00		0.55	0.01	0.00
2016Q4	0.06	0.18	0.03	0.18	0.00	0.07	0.03	0.19	0.19	0.15	0.00	0.38	0.00	0.05	0.46	0.02	0.00
2017Q1	0.02	0.11	0.01	0.19	0.00	0.06	0.02	0.14	0.43	0.05	0.00	0.27	0.00	0.03	0.64	0.02	0.00
2017Q2	0.01	0.07	0.00	0.05	0.00	0.03	0.07	0.06	0.72	0.02	0.00	0.61	0.00	0.01	0.34	0.01	0.00
2017Q3	0.02	0.17	0.02	0.14	0.00	0.09	0.02	0.12	0.37	0.07	0.00	0.41		0.04	0.49	0.03	0.00
2017Q4	0.02	0.11	0.04	0.12	0.00	0.14	0.03	0.09	0.42	0.04	0.00	0.49	0.00	0.03	0.45	0.01	0.00
2018Q1	0.02	0.16	0.02	0.25	0.00	0.08	0.03	0.08	0.59	0.08		0.38	0.00	0.01	0.29	0.01	0.00
2018Q2	0.03	0.13	0.03	0.17	0.00	0.05	0.04	0.12	0.55	0.07	0.00	0.49	0.01	0.02	0.26	0.01	0.00
2018Q3	0.04	0.23	0.04	0.22	0.00	0.12	0.04	0.12	0.22	0.10	0.00	0.40	0.01	0.02	0.42	0.02	0.00
2018Q4	0.03	0.13	0.03	0.13	0.01	0.04	0.01	0.04	0.54	0.03	0.00	0.46	0.00	0.02	0.50	0.02	0.00

B List of country names and codes

Country name	ISO 2 code
Austria	AT
Belgium	BE
Cyprus	CY
Germany	DE
Estonia	EE
Spain	ES
Finland	IE
France	FR
Greece	GR
Ireland	IE
Italy	IT
Lithuania	LT
Luxembourg	LU
Latvia	LV
Malta	MT
The Netherlands	NL
Portugal	PT
Slovenia	SI
Slovakia	SK
Euro area	EA

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