EUROPEAN CENTRAL BANK

EUROSYSTEM

Statistics Paper Series

Laurent Carlino, François Coppens,
Javier González, Manuel Ortega,
Sébastien Pérez-Duarte, Ilse Rubbrecht,
Saskia Vennix

Decomposition techniques for financial ratios of European non-financial listed groups

No 21 / May 2017

Contents

Abstract

Analysis of consolidated accounting data of European listed groups shows significant differences in some key ratios between countries. However, the figures do not reveal whether these differences result from a distinct composition of the countries' populations in terms of branches of activity (structural effect) or from intrinsic disparities in the behaviour of groups from various countries. This paper will address this issue using ratio decomposition techniques. A comparative overview of decomposition methodologies available in the literature will be provided, as well as an in-depth description of the methodology used. This will be applied to decompose the difference in the financial debt ratio, the equity ratio and the EBIT margin across countries for one specific year and to consider any dissimilarities in financial debt ratios over a limited period of time. The study will be based on the data available in the ERICA dataset from the European Committee of Central Balance Sheet Data Offices (ECCBSO), which includes accounting data of listed groups from Austria, Belgium, France, Germany, Greece, Italy, Portugal and Spain. The aggregate ratios of each country will be compared against a benchmark composed of the aggregate ratios for the eight countries together.

JEL codes: C43, L22, L25, M4.

Keywords: decomposition analysis, decomposition techniques, financial ratios.

Non-technical summary

The ERICA Working Group (WG) of the European Committee of Central Balance Sheet Data Offices (ECCBSO) is responsible for maintaining a database of the consolidated accounts of around 1,000 listed non-financial groups.

The ERICA database contains group data for eight countries: Austria, Belgium, France, Germany, Greece, Italy, Portugal and Spain. All listed non-financial groups follow the IFRS accounting standard and thus are in principle directly comparable between countries. Moreover, the ERICA WG has created a platform to convert the accounting information available in the annual reports of the groups into a standardised format. The platform also checks the data with a set of quality controls that guarantee their accuracy. The ERICA data are considered representative, since they cover between 87% and 100% of the revenue of the total population of non-financial listed groups.

The report published yearly by the ERICA WG using the ERICA database covers the field of financial and economic analysis through the use of consolidated accounts, i.e. accounts of complex groups containing several subsidiaries in which intragroup elements (e.g. loans between subsidiaries or with the parent company) are eliminated.

The use of consolidated data for economic analysis of this sort is a rather new development, and several challenging issues have to be tackled. For example, analyses of these consolidated accounting data show significant differences in some key financial ratios between countries. However, the figures do not reveal whether these differences result from a distinct composition of the countries' populations in terms of branches of activity (structural effect) or from intrinsic disparities in the behaviour of groups from various countries.

This report investigates the importance of the structural and intrinsic effects in three key financial ratios of listed groups, namely the financial debt ratio, the equity ratio and the EBIT margin (earnings before income and tax), both across countries and over time. These three ratios are used to describe the financial structure and performance of the groups. The financial debt ratio is the ratio of all financial debt to the balance sheet total, the equity ratio is the ratio of total equity to total assets, and the EBIT margin is the ratio of EBIT (profit from operating activities) to revenue (comprising sale of goods, provision of services, royalties, dividends and other revenues).

The methodology used to identify the structural and intrinsic effects stems from a large literature on the decomposition of ratios, originating from the theory of index numbers, used in particular for the analysis of price indices. Several decompositions are possible depending on the type of index being used, the number of factors, the nature of the elements and the properties that are required of the decomposition. In the case of the ERICA database, the main decomposition used is the one known as the Marshall-Edgeworth method, which has the properties of symmetry (time and factor reversal) and aggregation.

The decomposition exercise by sector is carried out on the one hand on all three ratios for the data of 2014, comparing across countries, and on the other on the changes in the financial debt ratio between 2009 and 2014, by country.

The results show that in 2014 in most countries, at an aggregate level the intrinsic effects are larger than the structural ones, with a few exceptions. Sectoral differences can be important within each country for the financial debt and equity ratios, while the EBIT margin is more affected overall by intrinsic factors.

Looking in more detail, the aggregate financial debt ratio by country ranges from 26.3% to 43.5%. The structural effect is small in most countries – except in Belgium and Germany – though this hides offsetting elements between sectors, where the structural component within each sector dominates in most countries except France. The equity ratio ranges from 29.1% to 39.5%; the structural effect explains most of the difference in Greece, Portugal and Spain, while at sector level the intrinsic effect is only large in France (and is offset across sectors in the other countries). The EBIT margin ranges from 3.4% to 13.0%, and the structural effect is only important in Italy and Spain. Even at sector level, the main impact is more intrinsic than for the other two ratios. Overall, in these decompositions the energy and industry sectors have the largest impact on the ratios.

The results of the temporal decomposition between 2009 and 2014 show that intrinsic effects dominate the changes in the financial debt ratios, with strong structural effects at sector level that nevertheless cancel out at country level. In contrast with the analysis of the 2014 ratios, the services sector makes the largest contribution to the total change.

The report concludes that it is important to differentiate between intrinsic and structural effects in the analysis of aggregate financial ratios, by looking at the sectoral information and carrying out the analysis for each ratio; the analysis is enriched by extracting and focusing on intrinsic effects.

1 Introduction

In its annual report ERICA WG (2015b), published in December 2015 by the European Committee of Central Balance Sheet Data Offices (ECCBSO), the ERICA Working Group presents the results of the analysis of around 1,000 listed non-financial groups' consolidated accounts available in the ERICA database[1]. This report addresses the field of financial and economic analysis using data from non-financial groups. The use of consolidated accounts by ECCBSO members had been a regular source of information for risk assessment, one of the functions developed by the national central banks.

The use of consolidated data for economic analysis is nevertheless charting rather new territory; therefore, the three annual reports published since 2013 (ERICA WG (2013), ERICA WG (2014), ERICA WG (2015b)) have explored what kind of aggregate analysis could be performed based on the annual consolidated accounts data for the largest European non-financial listed groups. The report disseminated in 2015 has opened up a new approach: the analysis of the performance of listed European groups according to the country where the parent company is based. Nevertheless, in doing this the following factors must be borne in mind: ERICA groups are multinationals, so the performance of the groups belonging to a country does not necessarily reflect the performance of the country itself. That said, once this new approach was introduced, the need for new tools for the analysis was clearly evident. This is precisely the focus of the document in your hands.

The report ERICA WG (2015b) shows that the aggregate figures for the financial structure and/or profitability of groups from various countries often reveal significant differences in key indicators at national level. However, these differences are not necessarily intrinsic disparities due to national features of corporate behaviour. Some of the differences could be explained by a diverse composition of the national populations: in some countries, large firms are over-represented, in other countries, industrial firms are under-represented. If large groups tend to behave differently compared with medium-sized or small firms, and if industry groups tend to behave differently to energy or construction groups, (part of) the difference in a specific indicator might be explained by a distinct composition of the national set of groups. This paper addresses this issue by means of a decomposition technique.

Taking the financial debt ratio as an example, a lower aggregate financial debt ratio in (the non-financial groups in) one country might be explained either by lower indebtedness in e.g. all sectors, or the explanation might be that debt-intensive sectors are under-represented. In the former case the differences are called *intrinsic*, while in the latter case they are called *structural*. In other words, structural differences refer to a comparison between sectoral weights, whereas intrinsic differences refer to a comparison between sectoral ratio values. One can also

[1] The eight countries taking part in the ERICA database project are: Austria, Belgium, France, Germany, Greece, Italy, Portugal and Spain.

distinguish the changes in ratios over time. Decompositions will be analysed for the (aggregate) financial debt ratio, the (aggregate) equity ratio and the (aggregate) EBIT margin. To avoid a comparison of each pair of countries, each individual country is compared against a benchmark consisting of all eight countries as a whole (EU-8). For further details, please refer to Section 3.3.

The financial debt ratio's changes over time (2009-2014) will also be broken down into a structural and an intrinsic effect. Due to statistical limitations the data were "enriched", as explained in Section 4.2.2.

The next chapter describes the data that are used in this paper, as well as the ratios that are used in the decomposition exercise. Chapter 3 contains an overview of the methodology. In the fourth chapter, differences in the three aggregate ratios across countries are broken down. A decomposition over time is also carried out for one of the ratios. The results are summarised in Chapter 5.

2 Dataset used to decompose ratios

The dataset used to decompose ratios within the scope of this paper is based on the ERICA database[2]. ERICA (European Records of IFRS[3] Consolidated Accounts) is a database compiled by the ERICA Working Group of the ECCBSO (European Committee of Central Balance Sheet Data Offices[4]) with information on the consolidated accounts of non-financial listed groups from eight participating countries: Austria, Belgium, France, Germany, Greece, Italy, Portugal and Spain. In what follows, the designation EU-8 refers to this group of eight countries.

2.1 Main reason to choose ERICA

Pursuant to EU Regulation 1606/2002/EC, European listed groups are obliged to establish their consolidated financial statements in accordance with International Financial Reporting Standards (IFRS). More than 14 years ago, when this EU Regulation was published, several European countries decided to join forces and set up a working group to analyse the impact of IFRS. In order to learn what it was all about, the working group developed a standard format as a translation of the IFRS bound volume into separate accounting elements. The working group started to try out and test this standard format with real data for each country in order to be able to improve it. However, to exploit the data more in depth, it was necessary to create a database (ERICA).

As a result, the accounting information that is captured by the ERICA database is established on the basis of the same accounting framework and can thus be considered to be as harmonised as possible. Indeed, differences in valuation rules (where several options are allowed under IFRS) or national differences in tax legislation between the EU member states prevent 100% comparability of IFRS accounting data. The ERICA database has been compiled by transferring the accounting information available in the annual reports of the groups to a standardised format and checking in a single platform with a set of quality controls that guarantee the accuracy of data. This approach further improves harmonisation and comparability, which is the main reason why the ERICA database was chosen to be used in this study. It means that different accounting frameworks cannot be a reason for differences in key ratios between countries. Differences in the economic environment (such as tax legislation), however, could actually be a reason for such differences.

---

2 For more information, please refer to ERICA. However, the ERICA database is currently only available to the national central banks that provide data to ERICA and to the ECB. For an exhaustive list of variables available in ERICA, please refer to Annex 1.

3 International Financial Reporting Standards.

4 More information is available at www.eccbso.org.

2.2 Compilation of the dataset

To fit the purpose of this study, the ERICA database was manipulated slightly. The database classifies all groups into sectors of activity. The classification into four different sectors depends on the NACE code[5] of the main activity[6] of the groups, as follows:

- Industry (NACE codes 07 to 33)
- Energy (NACE codes 05, 06, 35 and 36)
- Construction (NACE codes 41 to 43)
- Services (NACE codes 37 to 39 and 45 to 63 and 68 to 82).

Firms with other NACE codes – i.e. agriculture, forestry, fishing, financial and insurance activities, public administrations, education, human health, social work, arts, entertainment, recreation, households, extraterritorial organisations and other service activities – are recognised as “not classified”. As the sector of activity is the main criterion in the decomposition of the ratios, all groups that are not classified into one of the four branches were removed from the dataset. This implied the elimination of 37 records for the period 2009-2014 (within a total of 6,800 groups), including four groups in 2014.

Since the ERICA database contains accounting information from as many listed groups as possible (from the participating countries), some groups that are included in ERICA have a parent company whose consolidated accounts are also part of the ERICA database. Hence, these groups are included twice, once as a separate sub-group and once as part of the parent group. This study focuses on the comparison between countries. Therefore, double accounting specifically applies should the parent group and sub-group come from the same country. In order to detect such double-counted sub-groups, the ERICA database includes a variable “double_country” which indicates sub-groups for which the parent group belongs to the same country. Eliminating double accounting within one country resulted in the omission of 280 records for the period 2009-2014, including 34 groups in 2014.

[5] The Statistical Classification of Economic Activities in the European Community, commonly referred to as NACE (from the French term “nomenclature statistique des activités économiques dans la Communauté européenne”), is the industry standard classification system used in the European Union. The current version is revision 2 and was established by Regulation (EC) No 1893/2006. It is the European implementation of the United Nations' International Standard Industrial Classification of all Economic Activities, revision 4.

[6] Measured in terms of revenue.

2.3 Description of the dataset

Table 1

Number of groups in the dataset by country for the period 2009-2014

Country	2009	2010	2011	2012	2013	2014
Austria	52	23	45	44	43	41
Belgium	30	30	80	76	76	76
France	446	431	410	328	332	332
Germany	223	280	302	302	294	210
Greece	27	55	50	50	49	50
Italy	183	186	176	149	155	169
Portugal	40	39	38	37	37	36
Spain	30	30	108	108	106	99
Total	1031	1074	1209	1094	1092	1013

Source: ERICA database.

As already mentioned, the ERICA database is fed by the eight European countries that take part in the ECCBSO's ERICA Working Group, namely Austria, Belgium, France, Germany, Greece, Italy, Portugal and Spain. **Table 1** shows the number of groups included in the dataset for each country for the period 2009-2014, after exclusion of non-classified groups and double-counted groups (at country level). The table shows that, in Belgium and Spain, the number of groups incorporated into the ERICA database is quite small in 2009 and 2010 compared with later years. The same is true for Greece in 2009. These three countries did not have a database when the ERICA database was being set up. As a result, the data were imported manually for a limited number of groups with a good coverage[7] of the total population. Greece has increased its numbers since 2010, while Belgium and Spain have raised the number of imported groups since 2011 in order to enhance the coverage of the sample. Finally, all countries cover the majority of their total population of non-financial listed groups. The figures highlight the significance of French and German groups in ERICA: almost 54% in terms of the number of groups in 2014. The dataset thus reflects the heavier weight of France and Germany at an economic level.

The core common elements included in the ERICA database are mainly some general characteristics data, the balance sheet (statement of financial position), the statement of comprehensive income and some variables of the cash flow statement. The database is fed by the national central banks of the participating countries, except for Italy where Banca d'Italia has an agreement with Centrale dei Bilanci (a member of the Cerved group) under which the latter contributes to the database. In all cases, the sources of the data are the annual reports that are made publicly available by the respective groups. Each year Y covers all financial statements with a closing date that falls in the period 1 April Y to 31 March Y+1.

[7] The 30 Belgian cases represented 84% of the share capital of the total population. the 30 Spanish cases represented 76% of the equity and 86% of the revenue, while the 27 Greek cases represented 73% of the capitalisation of the total population in 2009.

As mentioned above, the database covers the majority of non-financial listed groups in Austria, Belgium, France, Germany, Greece, Italy, Portugal and Spain. These groups each represent several individual companies, ranging from 2 to over 200. The subsidiaries of the parent entity can be resident in a different country than the parent and can also belong to a different sector than the parent. However, the whole group is always assigned to the country of incorporation of the parent entity and to its main activity based on the group's segment information. This means that results by country are not representative for the national economies, as most groups' figures include amounts from foreign subsidiaries.

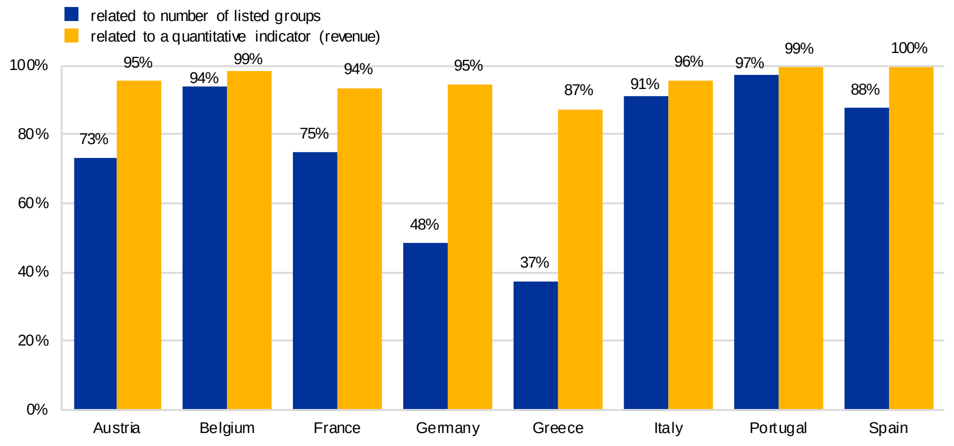
All groups in the database are classified into size classes. The three size classes are based on the groups' turnover, as follows:

- Small groups (turnover of less than EUR 250 million)
- Medium groups (turnover of EUR 250 million or more, but below EUR 1,500 million)
- Large groups (turnover of EUR 1,500 million or more).

2.4 Representativeness of the dataset

Chart 1

Representativeness of the dataset in terms of group numbers and revenue



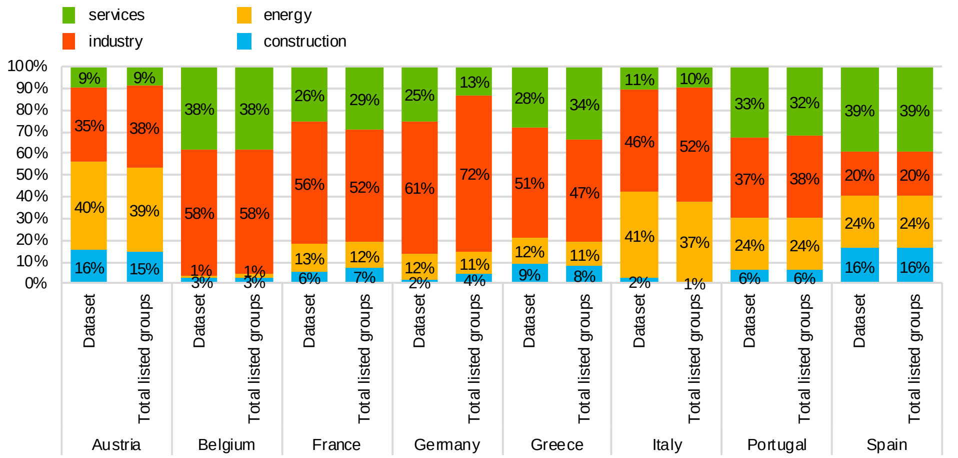
Source: ECCBSO (ERICA WG).

As explained above, the dataset used in this paper excludes some additional groups (compared with ERICA). It is therefore worthwhile to check the representativeness of the groups under review. As the figures regarding the population of listed groups in each country do include doubles (i.e. groups that are part of another group in the same country), it should be pointed out that the coverage rates below slightly underestimate the true representativeness in each country. In terms of group numbers, the coverage for 2014 ranges from 37% in Greece and 48% in Germany to 94% in Belgium and 97% in Portugal. In terms of a quantitative indicator (revenue), however, the coverage is very high for all countries, ranging from 87% in Greece to almost 100% in Spain, Portugal and Belgium (see **Chart 1**).

Chart 1 shows that the ERICA database does not include the entire population of non-financial listed groups in each country. Groups may be omitted for several reasons. The database is only compiled once a year and no updates are made on prior periods. This means that annual reports that cannot be processed in time will not be part of ERICA. This is not necessarily due to a delay in reporting, but can also be due to a different reporting date (statements as at 31 March will be available later than reports as at 31 December) or a delay in processing.

Chart 2

Representativeness of the dataset in terms of sector composition



Source: ECCBSO (ERICA WG).

As this paper examines the impact of sector composition within the different countries, it is important to verify whether the sector compositions within the different countries are representative of the respective countries' populations. **Chart 2** shows the representativeness of the dataset for 2014 in terms of sector composition, based on total revenue generated per sector. The sectoral breakdown of the non-financial listed European groups differs greatly from country to country. Industry is especially important in most of the countries except for Spain. The construction sector accounts for a large part of the market in Austria and Spain, while in other countries it plays a minor role. The energy sector has a high share of total revenue in Austria, Italy, Portugal and Spain, ranging from 24% to 39%. Finally, the services sector is important in almost all countries, but especially in Spain and Belgium. **Chart 2** shows that the dataset is well balanced in most countries. Only in Germany is the services sector over-represented at the expense of industry, while in Greece and France it is the other way around. In Italy, the larger share in the energy sector is offset by a lower share in the industry sector.

2.5 Description of the ratios

Since the 2007-2008 financial crises badly hit the banking sector, on which commercial lending activity to non-financial entities depends, the European Central Bank has had an increasing interest in the financial structure of financial and non-financial groups. For this reason, the study will scrutinise the level of the financial debt ratio and equity ratio of non-financial listed groups active in the eight countries for which information is collected in the ERICA database. An extra ratio, the EBIT margin, will also be considered, since that figure gives an idea of the operational performance of the groups concerned, with the aim of benchmarking the decomposition methodology on a ratio that uses flow data from the profit and loss account.

For each country and for the EU-8, an aggregate[8] figure will be calculated for the three financial ratios mentioned, as described in detail in the methodology chapter. A definition of the ratios can be found in Annex 2.

2.5.1 Financial debt ratio

The financial debt ratio is a solvency indicator that measures a group's financial liabilities as a percentage of its balance sheet total. The numerator is the sum of all current and non-current interest-bearing borrowings defined as borrowings from financial institutions, bonds issued, convertible borrowings, finance leases and other interest-bearing borrowings such as financial liabilities against related parties (as regulated by IAS 24), commercial paper or factoring. Borrowings from financial institutions refer to bank borrowings and bank overdrafts. Convertible borrowings are amounts of money borrowed by the group that can be converted into shares or into bonds according to the investors.

The financial debt ratio does not consider trade payables, provisions for employee benefits including termination benefits, restructuring or legal proceedings provisions, onerous contracts provisions, environmental provisions, deferred tax liabilities, hedging liabilities, accrued payroll and amounts due to employees, dividends to pay or advances received as money paid by clients for goods or services to be delivered by the group.

As such, this financial debt ratio shows a company's ability to pay off its financial liabilities with its assets. The higher the ratio, the more leveraged the group is, implying greater financial risk. At the same time, leverage is an important instrument that can be used for growth if the business finds sustainable uses for the financial debt. A lower ratio usually refers to more conservative financing with an opportunity to borrow in the future at no significant risk.

[8] The aggregate ratios of each country are obtained by taking the sum of the numerators of all groups active in that country and dividing it by the sum of their denominators. The aggregate ratio is therefore the weighted average of each ratio at the level of each group, whose weight is each group's share in the total value of the ratio's denominator. As such, aggregate ratios present the situation from a macro- and mesoeconomic angle.

The financial debt ratio is a fundamental solvency ratio because bank creditors are always concerned about being repaid. When companies borrow more money, their financial debt ratio increases and banks will be less willing to lend them money unless at a much higher interest rate. Companies with higher financial debt ratios would be better off looking at equity financing to expand their operations.

2.5.2 Equity ratio

A second measurement of solvency is the equity ratio, calculated as the ratio of total equity to total assets. Total equity consists of the equity attributable to the shareholders of the parent group and the equity linked to non-controlling interests. The last part contains shareholders' equity attributable to owners other than the parent company which do not have a controlling stake in the group (according to IFRS 10 BCZ155).

The equity ratio is an indicator of a firm's degree of financial independence. The higher the ratio, the lower the firm's financial debt ratio and the larger the buffer – comprising equity capital – for repaying creditors. In other words, the degree of financial independence measures the robustness of the firm's capital structure. A higher ratio implies a bigger chance that, in the event of bankruptcy, the equity will be sufficient to absorb the liquidation losses and repay much of what is owed to creditors. Companies with a higher degree of financial independence will generally pay lower interest charges on their financial debts (because the risk is lower), and that enables them to retain more funds for investment or for the distribution of dividends. This makes it easier for firms with greater financial independence to obtain bank loans or raise funds on the capital market.

It is important to stress that the equity ratio can be influenced by the choice of method for recognition and subsequent valuation of assets, liabilities and provisions. Reporting goodwill, accounting for capitalised development costs and registering deferred tax assets on tax losses carried forward can all affect the equity ratio.

2.5.3 EBIT margin

The EBIT (earnings before interest and tax) margin is an operational performance indicator, as it measures the return on revenue. The ratio divides profit from operating activities by revenue. According to IAS 18, revenue can arise from the sale of goods, the rendering of services, revenue from construction contracts and interests, royalties and dividends earned from the use of entity assets by others.

As such, the EBIT margin gives an idea of the firm's relative efficiency after deduction of all operating expenses including depreciation, amortisation and impairment losses. It provides an indication of the firm's ability to achieve a positive operating result from the proceeds of sales and rendering of services after deduction of all operating costs, excluding interest and income tax expenses, since they cover factors other than the profitability of operations.

It is important to mention that the EBIT margin can be affected by specific events in a branch of activity as well as by firm-specific expenses. To be more precise, revenue can be affected by changes in volumes, prices or exchange rates, while operating profit can also be impacted by major changes in raw materials prices, new collective labour agreements, capitalised research and development costs or restructuring policy within a company.

3 Methodology

3.1 Aggregate ratios

This study analyses financial ratios (of IFRS groups) at a country (i.e. aggregate) level. A financial ratio relates one financial quantity (e.g. equity) in the numerator to another one (e.g. total assets) in the denominator. If, for (IFRS) company c, the numerator of the ratio in year t is $n_c(t)$ and the denominator is $d_c(t)$, then the company's ratio is $r_c(t) = \frac{n_c(t)}{d_c(t)}$.

Let $C_i(t)$ be the set of all companies in a country i at year t, and $S_1, S_2, \dots S_n$ be a sectoral breakdown of these companies. By convention, we will denote aggregate values with capital letters and use subscripts to indicate the country and the sector in the country, so $N_{ij}(t)$ is the sum of the numerators of the companies in sector S_j of country C_i, and similarly for $D_{ij}(t)$. In the same way, $N_i(t)$ is the sum of the numerators of the companies in country C_i, and similarly for $D_i(t)$. The aggregate ratio r_i for country C_i is defined as:

(M1)

$$r_i(t) = \frac{N_i(t)}{D_i(t)} = \frac{\sum_{j=1}^{n} N_{ij}(t)}{\sum_{j=1}^{n} D_{ij}(t)} = \frac{\sum_{c \in C_i} n_c(t)}{\sum_{c \in C_i} d_c(t)} = \frac{\bar{n}_{C_i}(t)}{\bar{d}_{C_i}(t)}$$

The aggregate ratio for the country is thus equal to the sum of the numerators of all companies in the country, divided by the sum of the denominators, and likewise it is equal to the arithmetic average of the numerator divided by the arithmetic average of the denominator[9].

3.2 Structural and intrinsic effects

3.2.1 Decomposition of the aggregate ratio

Equation (M1) can be rewritten as $r_i(t) = \frac{\sum_{j=1}^{n} N_{ij}(t)}{D_i(t)} = \sum_{j=1}^{n} \frac{N_{ij}(t)}{D_i(t)} = \sum_{j=1}^{n} \frac{N_{ij}(t)}{D_{ij}(t)} \frac{D_{ij}(t)}{D_i(t)}$. Note that $r_{ij}(t) = \frac{N_{ij}(t)}{D_{ij}(t)}$ is the value of the ratio for sector j in country i and $\sigma_{ij/i}(t) = \frac{D_{ij}(t)}{D_i(t)}$ is the share (in terms of the quantity in the denominator) of sector j in the total economy of country i. Thus, we can rewrite (M1) as:

(M2)

$$r_i(t) = \sum_{j=1}^{n} r_{ij}(t)\sigma_{ij/i}(t) = \underbrace{r_{i1}(t)\sigma_{i1/i}(t)}_{contribution\ sector\ 1} + \underbrace{r_{i2}(t)\sigma_{i2/i}(t)}_{sector\ 2} + \dots + \underbrace{r_{in}(t)\sigma_{in/i}(t)}_{sector\ n}$$

9 This "ratio of the means" is to be distinguished from the "mean of the ratios". The latter is more often used as the ratio of the characteristic company in the sector, while the former is more often used in comparisons at the macroeconomic level (see, for example, McLeay and Fieldsend (1987)).

Equation (M2) breaks down a country's aggregate ratio r_i into a sum of sectoral contributions $r_{ij}(t)\sigma_{ij/i}(t)$, and each sector's contribution can itself be decomposed into

(a) a factor representing the ratio value for sector j in country i r_{ij} (i.e. an intrinsic component);

(b) a factor that is sector j's share in the economy of country i $\sigma_{ij/i}$ (i.e. a structural component).

As an example (see **Table 2**), let us consider two countries, country 1 and country 2[10], each sub-divided into four sectors (construction, energy, industry and services) and for which the values for $r_{ij}(t), \sigma_{ij/i}(t)$ and $r_{ij}(t)\times\sigma_{ij/i}(t)$ (where $i = 1$ for country 1 and $i = 2$ for country 2) are given in the '*Ratio*', '*Share'* and '*Sectoral contribution*' columns of **Table 2**. The *Sectoral contribution* column is the product of the *Ratio* and *Share* columns. The aggregate ratio for country 1 is (see formula (M2)) the sum of the sectoral contributions of the four sectors or 0.305; for country 2 it is 0.435.

Table 2

Example data for two different countries

Sector	Ratio	Share	Sectoral contribution
Country 1			
Construction	0.353	0.047	0.016
Energy	0.276	0.231	0.064
Industry	0.295	0.481	0.142
Services	0.344	0.241	0.083
Country 2			
Construction	0.469	0.074	0.035
Energy	0.486	0.464	0.225
Industry	0.433	0.274	0.119
Services	0.300	0.189	0.057

Using a stacked bar chart, the sectoral decomposition for both countries would be represented as in the right-hand side sub-chart of **Chart 3**. Note that each sector's contribution is itself the product of the sectoral ratio and the sectoral share (see formula (M2) and **Table 2**). This product of two factors $r_{ij}(t)$ and $\sigma_{ij/i}(t)$ could be shown geometrically as the surface of a rectangle with base $r_{ij}(t)$ and height $\sigma_{ij/i}(t)$. The stacked bar chart in the right-hand side sub-chart of **Chart 3** is thus a "simplification" of the left-hand side sub-chart of **Chart 3**; the latter represents each product $r_{ij}(t)\times\sigma_{ij/i}(t)$ as the surface of a rectangle (one for each sector $j \in$ $\{\text{Construction}, \text{Energy}, \text{Industry}, \text{Services}\}$) with base $r_{ij}(t)$ and height $\sigma_{ij/i}(t)$, while the former uses rectangles with the surface (proportional to) $r_{ij}(t)\times\sigma_{ij/i}(t)$ but with all rectangles having the same base length.

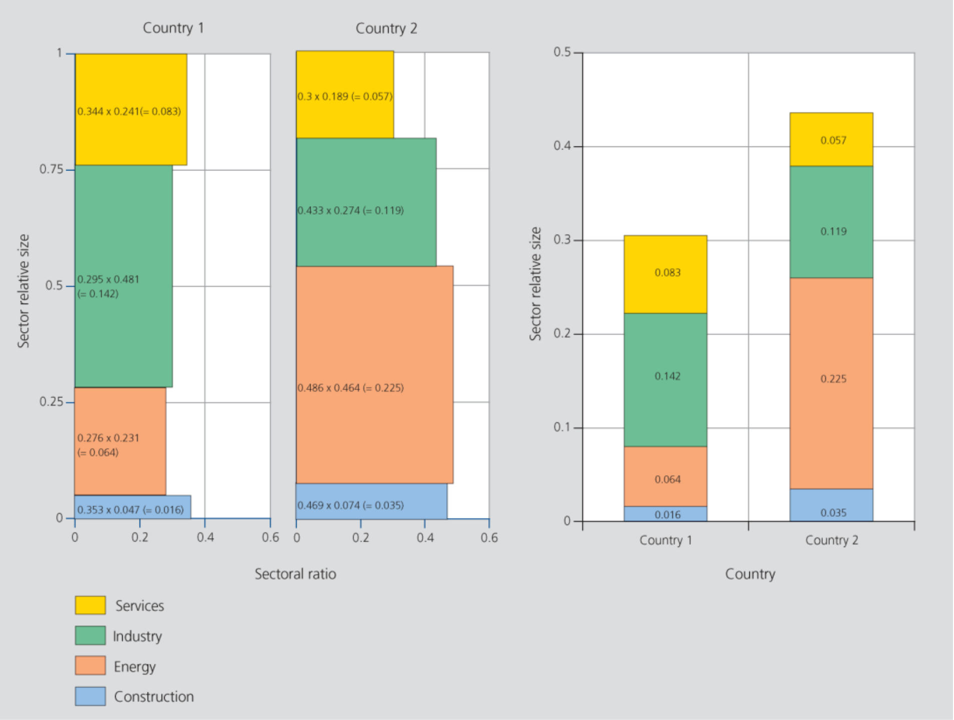
10 This example is based on fictitious data.

The right-hand side sub-chart of **Chart 3** decomposes the aggregate ratio of both countries into sectoral contributions, but compared with the left-hand side sub-chart, information about the components of the contributions is lost. If we compare the differences between the ratio in both countries, the right-hand side sub-chart shows the differences in sectoral contributions. The left-hand side sub-chart also reveals information as to whether this difference is the result of differences in sectoral shares and/or differences in sectoral ratio values. For example, the sub-charts of **Chart 3** both show that in country 1 the service sector contributes 0.083 to the aggregate ratio, while in country 2 this is 0.057. The left-hand side sub-chart additionally shows that while the ratio values (i.e. the horizontal base of the yellow rectangle) are similar (0.344 in country 1 and 0.3 in country 2), the share of the service sector is larger in country 1 than in country 2 (0.241 vs. 0.189, measured as the vertical height of the rectangles). The contribution of the service sector to the aggregate ratio is therefore larger in country 1 than in country 2, but this is because of the larger share of the service sector in country 1. Hence, the difference is due to a structural effect.

These differences will be analysed algebraically in the next section.

Chart 3

Illustration of the bivariate decomposition (left-hand side) and univariate decomposition (right-hand side)



Source: ECCBSO (ERICA WG).

3.2.2 Decomposition of differences in aggregate ratios

Using the ERICA database, aggregate ratios (for IFRS listed groups) will be computed for several countries and at several points in time. The goal is then to analyse the differences in the ratios along two dimensions: (a) cross-country comparison: a country C_i is compared against the benchmark C_0 and we would like to decompose, at a given point in time, the difference in the aggregate ratios, i.e. $r_i(t) - r_0(t)$ into a term that depends on the differences[11] in the sectoral ratios $r_{ij}(t) - r_{0j}(t)$ and the differences in structure $\sigma_{ij/i}(t) - \sigma_{0j/0}(t)$; (b) temporal decomposition: at two points in time, t_0, t_1 and for one country C_i, we would like to decompose the differences in the aggregate ratio r_i, i.e. $r_i(t_1) - r_i(t_0)$ into a term that depends on the differences in the sectoral ratios $r_{ij}(t_1) - r_{ij}(t_0)$ and the differences in structure $\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)$.

These are typical index decomposition problems and several breakdowns are possible. One of the simplest decompositions can be found as follows; starting from formula (M2) for a temporal analysis and taking into account that $r_{ij}(t_1) = r_{ij}(t_0) + \left(r_{ij}(t_1) - r_{ij}(t_0)\right)$ and that $\sigma_{ij/i}(t_1) = \sigma_{ij/i}(t_0) + \left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right)$, it is easy to see that[12]:

(M3)

$$r_i(t_1) - r_i(t_0) = \sum_{j=1}^{n} \left[\underbrace{\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right) r_{ij}(t_0)}_{structural\ for\ sector\ j} + \underbrace{\left(r_{ij}(t_1) - r_{ij}(t_0)\right)\sigma_{ij/i}(t_0)}_{intrinsic\ for\ sector\ j} + \underbrace{\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right)\left(r_{ij}(t_1) - r_{ij}(t_0)\right)}_{residual\ for\ sector\ j} \right]$$

In other words, the ratio difference can be broken down into three components for each sector, namely (a) a *structural component* that depends on the differences in shares of the sector at t_0 and t_1, (b) an *intrinsic component* that reflects the difference in the sectoral ratio and (c) a *mixed term* that is both structural and intrinsic. As the aim was to find "pure" structural and "pure" intrinsic components, this decomposition is not perfect because of the residual (mixed) term.

The basic idea behind this decomposition is easy to understand: to find out the impact of one factor (e.g. the change in $\sigma_{ij/i}$ between t_0 and t_1) while keeping the other one constant and equal to its value in the starting year ($r_{ij}(t_0)$). This "keeping values constant and equal to the value in the base year t_0" has earned the title of *Laspeyres decomposition*[13]. According to the above analysis, the *Laspeyres decomposition* is imperfect.

For one particular sector *j*, this decomposition is shown geometrically in **Chart 4** (see *Kesicki (2012)*). The change is equal to the coloured areas $A + B + D$. Note that area

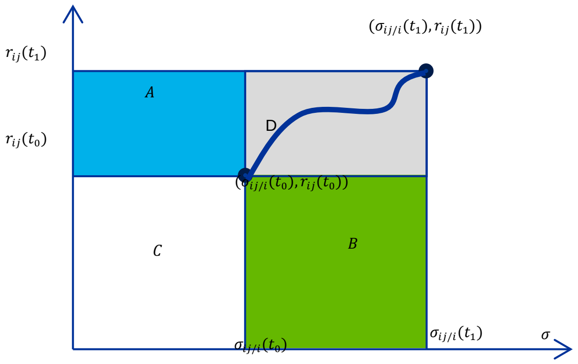
[11] One can choose to decompose the differences in ratio, i.e. $r_1(t) - r_0(t)$, or the ratio of the two ratios, i.e. $r_1(t)/r_0(t)$. The former is called an "additive decomposition", while the latter is called a "multiplicative decomposition". We will use additive decompositions in this study, because we are analysing (absolute) differences in the ratios.

[12] This decomposition has been used in Coppens (2010), for example.

[13] Similarly, a *Paasche decomposition* can be defined by "keeping values constant and equal to the value in the end year t_1".

A is equal to $\left(r_{ij}(t_1) - r_{ij}(t_0)\right)\sigma_{ij/i}(t_0)$, area *B* is equal to $\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right) r_{ij}(t_0)$, and area *D* is equal to $\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right)\left(r_{ij}(t_1) - r_{ij}(t_0)\right)$. In other words, the intrinsic effect, structural effect and residual for sector *j* found in the equation (M3), respectively.

Chart 4
Graphical representation of decompositions for sector j



Source: Adapted from Kesicki (2012).

The above decomposition is not perfect (see, for example, Ang et al. (2003)) in the sense that, besides an intrinsic and a structural effect, there is also a residual effect. Note that the imperfect decomposition is not symmetric, i.e. the (absolute values of) intrinsic and structural components will be different when one computes $r_i(t_1) - r_i(t_0)$ versus the decomposition of $r_i(t_0) - r_i(t_1)$.

There are several ways to transform this imperfect decomposition into a perfect one, depending on how area *D* is spread over areas *A* and *B*. The next section gives an overview of these perfect[14] decomposition methods along with their advantages and drawbacks.

3.2.3 Choice of the decomposition method

The transformation of the imperfect decomposition into a perfect one is in essence a distribution of the area of rectangle D in **Chart 4** over areas A and B. Note that the upper right-hand corners of rectangles C and D represent the situation of sector *j* at t_0 and t_1 respectively. One possible way to divide up area D between A and B would be to draw a straight line from $(\sigma_{ij/i}(t_0), r_{ij}(t_0))$ to $(\sigma_{ij/i}(t_1), r_{ij}(t_1))$ and allocate the area above the line to A and the area below the line to B. This would mean making the implicit assumption that the path between the times t_0 and t_1 would have been along that straight line. Many such assumptions are possible (e.g. the curved line in **Chart 4**), and in that sense the perfect decomposition depends on the assumption that is (implicitly) made about this time path. This is why some authors oppose

[14] Some authors have doubts about the desirability of these perfect decompositions, see, for example, Muller A. (2007).

perfect decomposition methods. For example, Muller (2007) argues that it is better to make the residual explicit rather than to redistribute it. Other authors (e.g. Ang (2004), Ang and Zhang (2000)) prefer perfect decomposition methods because they have more desirable properties (symmetry, ease of interpretation), especially when the residuals are large compared with the main effects.

Depending on the method used to distribute the residual (or, equivalently, the assumption made about the time path followed) different decomposition methods arise. Ang (2004) gives an overview of several such methods and compares them in terms of their characteristics and a number of "desirable properties". The different methods can be divided into two main groups: one linked to the *Divisia index*, the other to the *Laspeyres index* (see **Chart 5** for an overview of additive[15] decomposition methods).

The *Laspeyres*-linked decomposition methods simply divide up the residual according to simple rules, e.g. half of the residual is assigned to the intrinsic effect and the other half to the structural effect. Using formula (M3), we then find that $r_i(t_1) - r_i(t_0)$ can be written as:

$$\sum_{j=1}^{n} \underbrace{\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right) r_{ij}(t_0) + \frac{1}{2}\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right)\left(r_{ij}(t_1) - r_{ij}(t_0)\right)}_{structural\ for\ sector\ j} + \underbrace{\left(r_{ij}(t_1) - r_{ij}(t_0)\right)\sigma_{ij/i}(t_0) + \frac{1}{2}\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right)\left(r_{ij}(t_1) - r_{ij}(t_0)\right)}_{intrinsic\ for\ sector\ j}$$

After some manipulation, one finds:

$$r_i(t_1) - r_i(t_0) = \sum_{j=1}^{n} \left[\underbrace{\frac{r_{ij}(t_1) + r_{ij}(t_0)}{2}\left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0)\right)}_{\text{structural}\ for\ sector\ j} + \underbrace{\frac{\sigma_{ij/i}(t_1) + \sigma_{ij/i}(t_0)}{2}\left(r_{ij}(t_1) - r_{ij}(t_0)\right)}_{\text{intrinsic}\ for\ sector\ j} \right]$$

This decomposition is called the *Marshall-Edgeworth decomposition* (Edgeworth (1925), Marshall A. (1887)). The geometric interpretation of this formula is that (see **Chart 1**) rectangle D is split into four equal rectangles by drawing the two centre lines. Two of the four rectangles are added to the intrinsic effect and the other two to the structural effect. Another option would be to draw the diagonal of rectangle D and add the part above the diagonal to the intrinsic effect and the part below to the structural effect. This is known as the *Shapley/Sun decomposition* (Sun (1998), Albrecht et al. (2002)). If there are only two factors (r and σ), both decompositions are identical.

The *Divisia*-linked methods approximate an integral: assuming that the curved line in **Chart 4** is the (unknown) time path, the ratio difference can also be written as an

15 In the case of financial ratios, absolute differences (e.g. $(r_i(t_1) - r_i(t_0))$ between ratios are computed and therefore *additive* methods are used. *Multiplicative* decomposition methods decompose relative differences between ratios (e.g. $r_i(t_1)/r_i(t_0)$).

intrinsic effect that is area A plus the part of D above the curved line and a structural effect that is area B plus the part of D below the curved line:

$$r_i(t_1) - r_i(t_0) = \sum_{j=1}^{n} \left(\underbrace{\int_{\sigma_{ij/i}(t_0)}^{\sigma_{ij/i}(t_1)} r_{ij}(\sigma_{ij/i}) d\sigma}_{structural\ for\ sector\ j} + \underbrace{\int_{r_{ij}(t_0)}^{r_{ij}(t_1)} \sigma_{ij/i}(r_{ij}) dr}_{intrinsic\ for\ sector\ j} \right)$$

Both integrals are similar and of the type $\int_{x(t_0)}^{x(t_1)} f(x)dx = \int_{t_0}^{t_1} f(x(t)) \frac{dx(t)}{dt} dt = \int_{t_0}^{t_1} x(t) f(x(t)) \frac{1}{x(t)} \frac{dx(t)}{dt}$ which is equal to $\int_{t_0}^{t_1} x(t) f(x(t)) \frac{dln(x(t))}{dt}$. Using this result in the above equation, one finds that (the (t)-argument is dropped to simplify the notations):

$$r_i(t_1) - r_i(t_0) = \sum_{j=1}^{n} \left(\underbrace{\int_{t_0}^{t_1} r_{ij}\sigma_{ij/i} \frac{dln(\sigma_{ij/i})}{dt} dt}_{structural\ for\ sector\ j} + \underbrace{\int_{t_0}^{t_1} r_{ij}\sigma_{ij/i} \frac{dln(r_{ij})}{dt} dt}_{intrinsic\ for\ sector\ j} \right)$$

Note that $r_{ij}\sigma_{ij/i}$is the contribution of sector j to the aggregate ratio of country I (see equation (M2)), which if we denote as V_{ij}, we find that:

$$r_i(t_1) - r_i(t_0) = \sum_{j=1}^{n} \left(\underbrace{\int_{t_0}^{t_1} V_{ij} \frac{dln(\sigma_{ij/i})}{dt} dt}_{structural\ for\ sector\ j} + \underbrace{\int_{t_0}^{t_1} V_{ij} \frac{dln(r_{ij})}{dt} dt}_{intrinsic\ for\ sector\ j} \right)$$

If $V_{ij}(t)$ is assumed to be approximately constant between t_0 and t_1, i.e. $V_{ij}(t) \cong \bar{V}_{ij}, \forall t \in [t_0, t_1]$, then this becomes

$$r_i(t_1) - r_i(t_0) \cong \sum_{j=1}^{n} \left(\underbrace{\bar{V}_{ij} ln\left(\frac{\sigma_{ij/i}(t_1)}{\sigma_{ij/i}(t_0)}\right)}_{structural\ for\ sector\ j} + \underbrace{\bar{V}_{ij} ln\left(\frac{r_{ij}(t_1)}{r_{ij}(t_0)}\right)}_{intrinsic\ for\ sector\ j} \right)$$

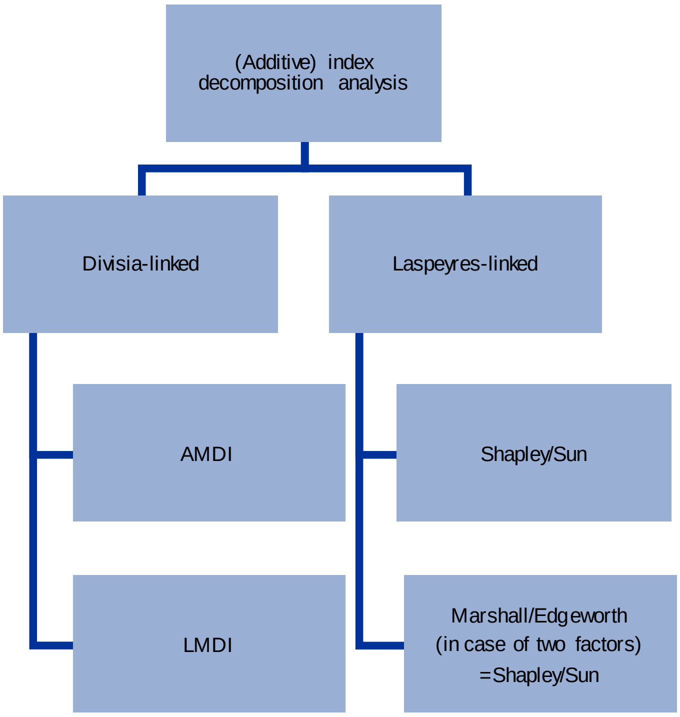
Depending on the choice of the approximation $\bar{V}_{ij}$, alternative decomposition methods arise. For $\bar{V}_{ij} = \frac{1}{2}\left(V_{ij}(\mathrm{t}_1) + V_{ij}(\mathrm{t}_0)\right)$, we find the *Arithmetic Mean Divisia Index (AMDI) decomposition* (see Boyd et al. (1988)). For $\bar{V}_{ij} = \left(\frac{V_{ij}(\mathrm{t}_1) - V_{ij}(\mathrm{t}_0)}{ln\left(\frac{V_{ij}(\mathrm{t}_1)}{V_{ij}(\mathrm{t}_0)}\right)}\right)$, the *Logarithmic Mean*[16] *Divisia Index (LMDI) decomposition* is found (Montgomery (1937), Sato (1976), Ang and Choi (1997)).

---

16 The logarithmic mean of two positive numbers x, y is defined as $L(x,y) = \frac{x-y}{\ln(x)-\ln(y)}$ where 'ln' is the Napierian logarithm. Their arithmetic average is defined as $\frac{x+y}{2}$.

Chart 5

Overview of (additive) decomposition methods



Source: Based on Ang (2004).

Chart 5 is based on the figure in Ang (2004), which is limited to additive decompositions. The Laspeyres decomposition with a residual term is not included because Ang (2004) does not recommend the conventional Laspeyres index method that "*was used by energy researchers in the early 1980s. This method often gives large residuals the size of which can be several times larger than the estimated effects*". Moreover, as will be argued below, the method does not pass the time and factor reversal tests that index number theory considers "desirable".

Granel (2003), Ang (2004) and Kesicki (2012) judge the different decomposition methods from different angles such as theoretical soundness, and from a practical point of view the ease of use and ease of understanding/interpretation.

Theoretical soundness is based on the theory of index numbers where the desirability of a decomposition method is evaluated using several tests (see, for example, Vogt and Barta (1997), Granel (2003), Fisher I. (1922)). The most important tests in our context are: (a) the *time reversal test*, which checks the symmetry with respect to t_0 and t_1, i.e. whether the decomposition of $r_i(t_1) - r_i(t_0)$ into intrinsic and structural effects yields the same (but with opposite signs) decomposition as $r_i(t_0) - r_i(t_1)$, and (b*) the factor reversal test*, which is passed when the decomposition does not include a residual. The Laspeyres method fails both tests.

From a practical point of view the desirable properties are ease of use and ease of interpretation. From that perspective, the Marshall-Edgeworth decomposition has an advantage over LMDI, albeit this advantage only holds in the case of two factors (this is the case for the decomposition of financial ratios). For practical purposes it is important to note that AMDI fails to handle zero values. LMDI also uses logarithms and therefore may have problems with zero and/or negative values. In the context of financial ratios, zero and negative values cannot be excluded. Ang and Liu (2007a) and Ang and Liu (2007b) show how LMDI can deal with such values. Nevertheless, it is our opinion that this special treatment of non-positive values increases complexity and has a negative impact on the ease of interpretation.

Consequently[17], our preferred solution lies in the branch of Laspeyres-based methods where Ang (2004) recommends the Shapley-Sun method (Albrecht et al. (2002), Sun (1998)). However, when the decomposition involves only two factors the Shapley-Sun method is identical to the Marshall-Edgeworth method. Nevertheless, to check the robustness of our results against the choice of method we will compare the outcomes of the Marshall-Edgeworth decompositions with the LMDI decomposition results and the results (more specifically the size of the residual) in the Laspeyres decomposition (see Annex 3). The properties of the decomposition methods are summarised in the following table.

Table 3

Properties of the (additive) decomposition methods:

	Laspeyres-linked methods			**Divisia-linked methods**	
	Laspeyres	Marshall-Edgeworth	Shapley-Sun	Arithmetic Mean Divisia Index	Logarithmic Mean Divisia Index
Time reversal	No	Yes	Yes	Yes	Yes
Factor reversal	No	Yes	Yes	Yes	Yes
Ease of interpretation	No	Yes	No	No	No
Zero value handling	Yes	Yes	Yes	No	No *
Negative value handling	Yes	Yes	Yes	No	No *
		With two factors Marshall-Edgeworth and Shapley-Sun methods are identical			**Results for additive and multiplicative decompositions are related**

* There are methods for zero and negative value handling, in our opinion they significantly increase the complexity.

3.2.4 Temporal and cross-country decomposition

From the definition (M2), it follows that one can analyse ratio changes across two different dimensions: across time and across countries.

The Marshall-Edgeworth decomposition, for temporal comparisons, is defined as follows:

(M4)

[17] Granel (2003) uses a more quantitative method, based on the 'analytic hierarchy process' (Saaty (2008)), to determine weights for the different criteria and scores for each decomposition method in order to decide on the preferred method.

$$r_i(t_1) - r_i(t_0) = \sum_{j=1}^{n} \left[\underbrace{\frac{r_{ij}(t_1) + r_{ij}(t_0)}{2} \left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0) \right)}_{\text{structural sector j}} + \underbrace{\frac{\sigma_{ij/i}(t_1) + \sigma_{ij/i}(t_0)}{2} \left(r_{ij}(t_1) - r_{ij}(t_0) \right)}_{\text{intrinsic sector j}} \right]$$

Formula (M4) decomposes the change over time into an intrinsic and structural effect by sector. Combining over sectors the aggregate intrinsic/structural effect is defined as in (M5):

(M5)

$$r_i(t_1) - r_i(t_0) = \underbrace{\sum_{j=1}^{n} \frac{r_{ij}(t_1) + r_{ij}(t_2)}{2} \left(\sigma_{ij/i}(t_1) - \sigma_{ij/i}(t_0) \right)}_{aggregate\ structural} + \underbrace{\sum_{j=1}^{n} \frac{\sigma_{ij/i}(t_1) + \sigma_{ij/i}(t_0)}{2} \left(r_{ij}(t_1) - r_{ij}(t_0) \right)}_{aggregate\ intrinsic}$$

For cross-country comparisons[18], this decomposition is defined as:

(M6)

$$r_i - r_0 = \sum_{j=1}^{n} \left[\underbrace{\frac{r_{ij} + r_{0j}}{2} \left(\sigma_{ij/i} - \sigma_{0j/0} \right)}_{structural\ sector\ j} + \underbrace{\frac{\sigma_{ij/i} + \sigma_{0j/0}}{2} \left(r_{ij} - r_{0j} \right)}_{intrinsic\ sector\ j} \right]$$

The aggregate intrinsic/structural effect is defined as:

(M7)

$$r_i - r_0 = \underbrace{\sum_{j=1}^{n} \frac{r_{ij} + r_{0j}}{2} \left(\sigma_{ij/i} - \sigma_{0j/0} \right)}_{aggregate\ structural} + \underbrace{\sum_{j=1}^{n} \frac{\sigma_{ij/i} + \sigma_{0j/0}}{2} \left(r_{ij} - r_{0j} \right)}_{aggregate\ intrinsic}$$

With regard to cross-country comparisons, Ang et al. (2015) studies the application of index decomposition to spatial (i.e. cross-country) decompositions, in particular the differences with respect to temporal decompositions. The first issue is the need to harmonise the data from the different regions. With our ERICA/IFRS data this should not be problematic. Moreover, data for different regions show more variability than data over time, therefore perfect decomposition is important. Finally, the symmetry of the decomposition (i.e. the decomposition of the difference between country 1 and country 2 should be equal but opposite to that between country 2 and country 1) is greater than in temporal analysis.

3.3 Cross-country analysis: the benchmark

Ang et al. (2015) further analyses presentation issues. For a set of countries, one can compare any pair of countries (which becomes impractical as the number of countries increases) or compare each country against a benchmark. They

18 As cross-country comparisons are at the same point in time, we will omit the time argument for presentation purposes.

distinguish between three approaches: (a) a *bilateral-regional approach* where each pair of countries is compared. This is simple and practical when the number of countries is small. As the number of countries increases, the number of country pairs grows exponentially. As the decompositions are conducted between any pair of countries, it is difficult to draw conclusions for the entire group; (b) a *radial-regional approach* where all countries are compared against a reference country called the "benchmark". This solves the issue of the exponential growth in the number of comparisons as the number of countries increases. One inconvenience of this approach is the choice of a benchmark and the dependence of the results on this benchmark. In addition, direct comparisons between countries are difficult; (c) a *multi-regional approach*, which is very similar to the "radial-regional" model but with two differences. Firstly, the benchmark is defined as the "average country". Secondly, the differences between any two countries are defined "indirectly" via the benchmark. So, if r_i is the aggregate ratio for country C_i and r_0 is the aggregate ratio for the benchmark, each country's divergence from the benchmark, i.e. $r_i - r_0$, is first decomposed using formulas (M6) or (M7), then the intrinsic effect of the divergence $r_i - r_j$ is defined (indirectly) as the difference between the intrinsic effects of $r_i - r_0$ and $r_j - r_0$, i.e. $(r_i - r_0)_{intr} - (r_j - r_0)_{intr}$. The structural effects are then defined in the same way as $(r_i - r_0)_{str} - (r_j - r_0)_{str}$. This approach avoids the disadvantages of the two previous methods. In addition, the direct differences in relation to the benchmark can be used for performance ranking.

In practice, two approaches (Ang et al. (2015)) are used for the average benchmark: (a) each country is compared against a benchmark that is the average of all the countries; (b) each country is compared against all the other countries, i.e. the benchmark is the average of all countries excluding the one studied. The latter approach lacks a common basis for comparison and poses some interpretation problems.

In this study we will use the "multi-regional" approach, choosing the benchmark as the average of all the countries, i.e. as in the "multi-regional" approach.

3.4 The level of disaggregation

Several 'levels of decomposition' are possible: sector, size class or a combination of the two. The total (temporal or cross-country) difference in aggregate ratios will not depend on the decomposition level, however: as a lower decomposition level corresponds to another definition of the "structure", the decomposition of the total difference into a structural component and an intrinsic component (for each 'sector') will generally be different. A higher level of aggregation will imply fewer structural effects, and in the extreme case of the level of detail being the country itself (not sub-divided into sectors) it is obvious that there can only be differences in ratio (i.e. intrinsic effects).

This study computes all the decompositions at sector and size class level and defines the intrinsic/structural effect at the higher level as the sums of the detailed intrinsic/structural effects. There are four different sectors and three size classes within each sector.

A (sector, size class) combination may happen to be present in the benchmark C_0 but absent in a particular country C_i. In this case, formula (M6) shows that, for this (sector, size class) combination, there will be a structural component and an intrinsic component. In our opinion, from an interpretation point of view it is better to reallocate the whole effect for the (sector, size class) combination to the structural component.

4 Decomposition of ratios applied to an IFRS dataset

4.1 Cross-country analysis for 2014

In this chapter, differences in the aggregate financial debt ratio, the aggregate equity ratio and the aggregate EBIT margin between non-financial listed groups of different countries will be decomposed for one specific year, namely 2014. The aggregate ratios of each country, calculated by means of formula (M1), will be compared against a benchmark consisting of the aggregate ratios for the eight countries together (EU-8). By means of formula (M2), the contribution of the different sectors of activity to the aggregate ratios can be determined. It should be highlighted once more that differences in a sector's contributions between countries are the result of two underlying components (see Sections 3.2.1 and 3.2.2. in the methodology section): (a) the weighted financial ratio of the sector in the country is different (intrinsic effect), or (b) groups from the sector have a similar ratio in both countries but the share of the sector in the country is different (structural effect).

This chapter aims to analyse the differences in aggregate ratios between countries and to disentangle these divergences into differences in the sectoral structure of the countries or in the sector ratios. Taking the financial debt ratio as an example, some sectors are known to have incurred less financial debt than others. Therefore, a lower aggregate financial debt ratio for a country might result from (a) over-represented low-debt sectors (structural effect), or (b) a lower financial debt ratio for similar sectors (intrinsic effect).

It should be stressed that structural differences observed in this paper are not necessarily representative for the national economy, but for the listed groups of the country. Indeed, this paper only takes into account non-financial listed groups. Since, in terms of number of companies, they represent only a minor part of the economy, their structural characteristics do not necessarily reflect the situation in the country as a whole. Moreover, listed groups are entirely assigned to the country of incorporation of the parent entity, but their activities can be spread among many other countries through their subsidiaries.

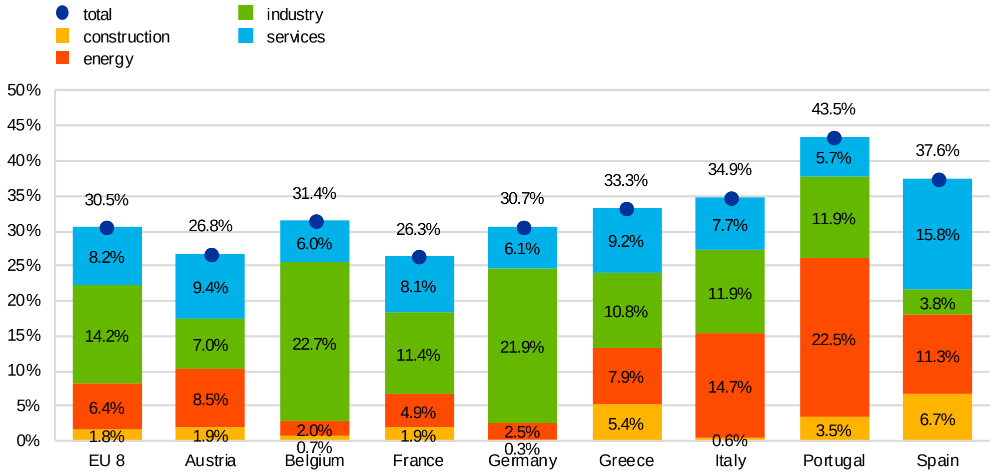
For each ratio under review, both the intrinsic and structural impact of each sector on the aggregate ratio will be measured by means of formula (M6) for each country separately. Each part will be closed by a summary table of the main conclusions for each country.

4.1.1 Financial debt ratio

The aggregate financial debt ratio of European non-financial listed groups varies significantly from country to country (**Chart 6**). For all eight countries taken together, the aggregate financial debt ratio equals 30.5%, which corresponds more or less to the aggregate financial debt ratio of German groups. French and Austrian groups have the lowest financial debt ratio of between 26% and 27%. In Portugal, meanwhile, non-financial listed groups tend to get into financial debt more easily, with this category of debt representing on average 43.5% of the balance sheet total.

Chart 6

Absolute contribution of the different sectors to the aggregate financial debt ratios in 2014



Source: Own calculations based on ERICA DB.

Chart 6 shows the absolute contribution of the different sectors of activity to the aggregate financial debt ratios. In Austria for instance, the aggregate financial debt ratio (26.8%) is the sum of the contributions from the services sector (9.4%), the industry sector (7%), the energy sector (8.5%) and the construction sector (1.9%). In Belgium and Germany, more than 70% of the financial debt ratio is attributable to industry. This sector contributes the most in France and Greece as well, but to a lesser extent. In Portugal and Italy, the largest contribution comes from the energy sector, whereas in Spain and Austria the services sector has the largest weight. In most countries, with the exception of Greece and Spain, the construction sector has only a minor impact.

The (asset-weighted) indebtedness of Austrian non-financial listed groups is lower than that of all EU-8 groups together (**Chart 6**). The chart shows that the main difference lies in the contribution of industry groups (7.2% lower). This is partially offset by the contribution of energy groups (2.1% higher) and, to a lesser extent, services groups (1.2% higher). As pointed out in the chapter on the methodology, these sectoral differences may result from structural differences (the share of industry in total assets is lower in Austria than in EU-8) or from intrinsic differences, meaning that the indebtedness in the industry sector is lower (see 3.2.2. in the methodology section).

The structural and intrinsic impact of each sector on the national aggregate financial debt ratios is visualised in **Chart 7**. The decomposed difference is calculated as the EU-8 ratio minus the country-specific ratio. As a result, positive effects mean that the financial debt ratio at country level is smaller than the EU-8 financial debt ratio. Likewise, negative effects mean that the national financial debt ratio is larger than the benchmark. Note that, for each sector, the sum of the intrinsic impact and the structural impact is equal to the difference between the absolute contribution of that sector to the EU-8 ratio and the absolute contribution of that sector to the country-specific ratio, displayed in **Chart 6**.

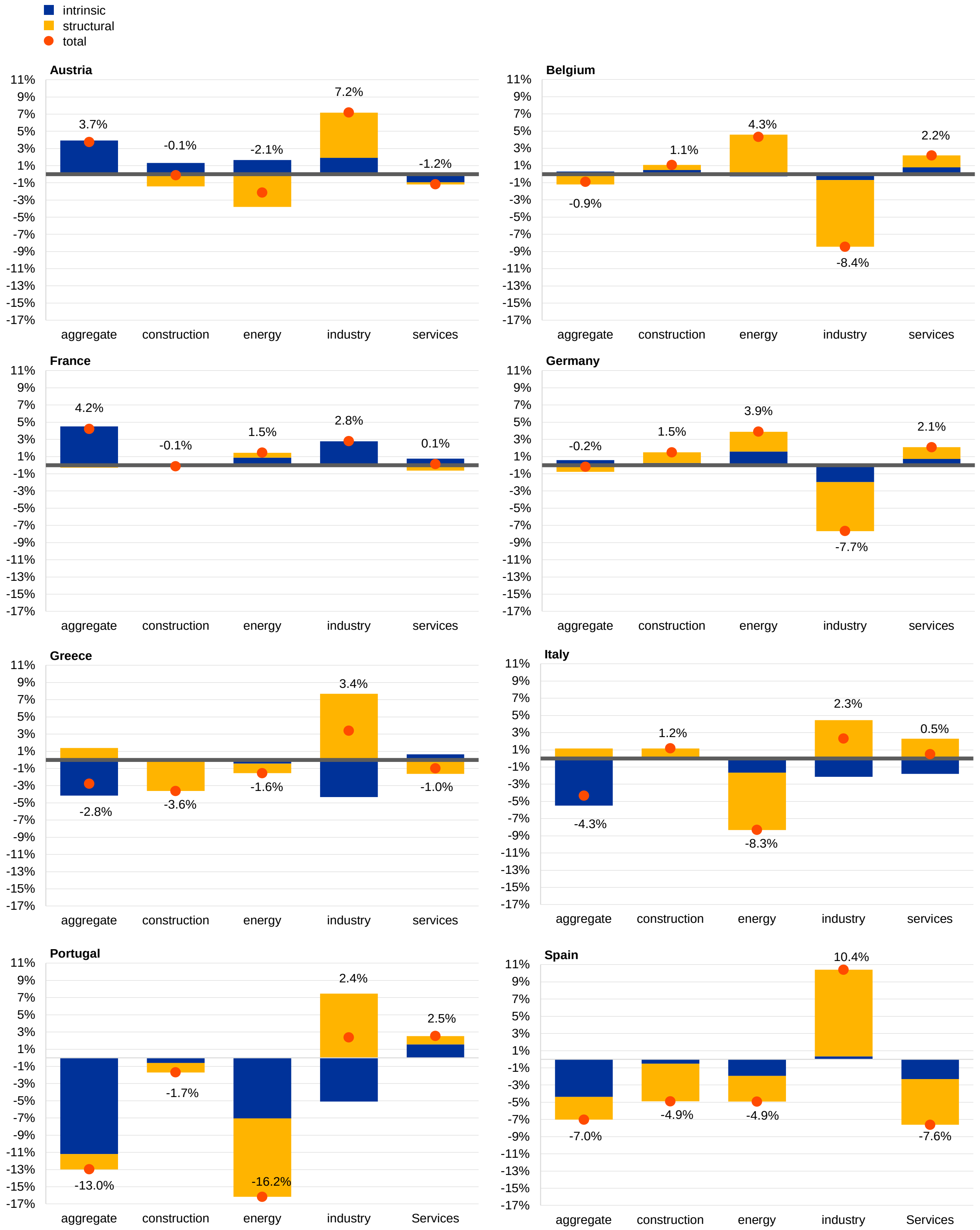
The sample for **Austria** shows that the lower contribution of industry groups is the result of both effects: their share (in total assets) is lower in Austria than in EU-8, and the same is true of their (asset-weighted) indebtedness. The (asset-weighted) indebtedness is also lower for Austrian energy groups, but is more than offset by a larger share in total assets. It must be highlighted that Austria's sample includes only three listed energy groups and only three listed construction groups. The largest energy group (OMV) and the largest construction group (Strabag) significantly influence the aggregate ratios at sector level. By contrast, Austrian services groups seem to be more indebted than the benchmark. In the Austrian services sector, the smaller share of large groups is offset by a larger share of medium-sized and small groups.

Comparing the aggregate financial debt ratio of **Belgian groups** against the European benchmark, **Chart 6** shows that the Belgian financial debt ratio is 0.9 percentage points higher at 31.4%. The sectoral decomposition reveals significant differences at sector level. The share of the industry sector (in terms of total assets) in Belgium is much larger, but this is almost fully offset by smaller shares of the other sectors. In industry, the negative structural impact is enhanced by a slight intrinsic impact. Here, the aggregate ratio is significantly influenced by Belgium's largest listed industry group, Anheuser-Busch InBev. More detailed analysis in terms of sector size indicates that both the structural and the intrinsic effects are mainly attributable to large groups only, with the exception of the energy sector as Belgium does not have large listed energy groups.

Of the eight European countries under review, **French groups** are least indebted (26.3%). The difference between the French financial debt ratio and the EU-8 financial debt ratio is principally attributable to less financial debt in all four sectors, although only to a minor extent in construction (**Chart 7**). The lower indebtedness is most pronounced in industry. The lower aggregate financial debt ratio in the energy sector is strongly influenced by the two largest energy groups, EDF and Engie. In the services sector, several large groups push the aggregate financial debt ratio upwards, but it remains below the EU-8 level. Both the structural impact and the intrinsic impact can be reduced to large groups only, with the exception of the structural effect in the services sector: France has a larger share of medium-sized services groups. As French groups have a large weight in the aggregate EU-8 figures, it is worthwhile repeating the decomposition exercise with a European benchmark excluding France. Exactly the same conclusions can be drawn, however; the only change is in the size of the difference, as the aggregate financial debt ratio of EU-7 excluding France is larger than the aggregate financial debt ratio of EU-8. The relative importance of the effects remains the same.

Chart 7

Decomposition of the differences in the aggregate financial debt ratio in 2014: EU-8 minus each country



Source: Own calculations based on ERICA DB.

There is a gap of only 0.2 percentage points between the aggregate financial debt ratio of EU-8 and that of **German groups**, which amounts to 30.7%. However, there are marked differences at sector level due mainly to the share of each sector (**Chart 7**). The structural effect is largest in industry, as this sector dominates the population (see **Table 1**) of German listed groups. All structural effects can be traced to large groups, with the exception of the services sector. The smaller share of German services groups is more pronounced in the medium-sized class. In all four sectors, the structural impact (either positive or negative) is enhanced by an intrinsic impact. In industry, the aggregate financial debt ratio is strongly influenced by some large groups with relatively high financial debt, such as Volkswagen, Daimler and BMW. Comparison against a European benchmark excluding Germany leads to the same conclusions, as was also the case with France. The differences are slightly more pronounced, though, as the aggregate financial debt ratio of EU-7 excluding Germany is somewhat smaller than the aggregate financial debt ratio of EU-8.

The aggregate financial debt ratio of **Greek groups** lies 2.8 percentage points above the European benchmark at 33.3%. At an aggregate level, Greek groups seem to be more indebted, but at sector level the weight of each sector plays a bigger role (**Chart 7**). The negative intrinsic impact can be mainly observed in industry. Greek industry groups have in general taken on a relatively high amount of financial debt. Greek services groups also have significant amounts of financial debt. However, the aggregate financial debt ratio in the services sector is pushed downwards by the largest (in terms of total assets) group, Hellenic Telecommunications. This implies that the intrinsic impact in the services sector is positive instead of negative. Analysis of the decomposition of the difference in aggregate financial debt ratio at a more detailed level, i.e. the combination of sector and size, reveals that the effects are not entirely attributable to large groups only. In the construction sector the larger share is down to medium-sized groups, while in the services sector it results from a larger share of medium-sized and small groups.

The aggregate financial debt ratio of **Italian groups**, standing at 34.9%, is 4.4 percentage points higher than the EU-8 aggregate financial debt ratio. The higher financial indebtedness of Italian groups is due to intrinsic effects at an aggregate level, but a different composition of the sample in terms of sector of activity leads to significant divergences at sector level (**Chart 7**). A higher level of financial debt is observed in industry, services and the energy sector. Industry's aggregate financial debt ratio is adversely affected by two large groups: Exor and Saipem. Exactly the same situation is noted in the services sector due to the relatively high financial debt of Telecom Italia and Atlantia. The energy sector also shows a marked negative structural impact. In terms of total assets, the energy sector accounts for more than 45% of the Italian sample. Both structural and intrinsic effects per sector are mainly attributable to large groups.

Portuguese groups are the most indebted compared to the other European countries under review. On aggregate, the higher Portuguese financial debt ratio is mainly due to intrinsic effects (**Chart 7**). The higher level of financial debt is most marked in the energy sector, but greater indebtedness is also observable in industry. In the services sector, meanwhile, the intrinsic impact is positive but less pronounced. The aggregate financial debt ratio in the services sector is influenced favourably by Jerónimo Martins and CTT - Correios de Portugal. The latter has hardly any financial debt. In the energy sector, the structural effect enhances the intrinsic effect. This sector contains only two listed groups. However, the largest one (EDP) represents 41.6% of the total Portuguese sample in terms of total assets. Both the structural and the intrinsic effects can be traced mainly to large groups.

Although less pronounced, **Spanish groups** also have an aggregate financial debt ratio that lies clearly above the EU-8 level, standing 7.1 percentage points higher at 37.6%. Both structural and intrinsic effects play a role, but the former have an influence in both a positive and a negative way (**Chart 7**). In the services sector, the financial debt ratio is strongly affected by Telefónica, the largest Spanish group (in terms of total assets). Its financial debt represents nearly half of the balance sheet total. In the Spanish energy sector, Iberdrola (largest energy group) has a favourable impact, but the financial debt level in the Spanish energy sector is still significantly above the financial debt level in the EU-8 energy sector. All effects, both structural and intrinsic, can be principally assigned to large groups. Medium-sized and small groups have only a minor impact.

Table 4 summarises the main results of the decomposition exercise for the aggregate financial debt ratio. The second column reveals for each country whether the difference between the EU-8 financial debt ratio and the country-specific financial debt ratio is - at an aggregate level - due mostly to intrinsic or structural effects. In the third column, the same question is asked but at sector level. For each country, the absolute values of the intrinsic impact per sector and the absolute values of the structural impact per sector are summed up. The impact with the highest number is displayed. If the main impact at sector level is structural, while the main impact at an aggregate level is intrinsic, it means that the structural effects at sector level largely offset each other. The last column shows for each country the sector for which the financial debt ratio diverges the most from the EU-8 sectoral financial debt ratio. For the aggregate financial debt ratio, it is clear that intrinsic effects are most common at an aggregate level, while structural effects explain most of the differences at sector level. Differences are most pronounced in the industry sector, and to a lesser extent in the energy sector.

Table 4

Overview of the results of the decomposition of the differences in the aggregate financial debt ratio

Country	Main impact at an aggregate level	Main impact at sector level	Sector with largest impact
Austria	Intrinsic	Structural (offset)	Industry sector
Belgium	Structural	Structural	Industry sector
France	Intrinsic	Intrinsic	Industry sector
Germany	Structural	Structural	Industry sector
Greece	Intrinsic	Structural (offset)	Construction sector
Italy	Intrinsic	Structural (offset)	Energy sector
Portugal	Intrinsic	Structural (offset)	Energy sector
Spain	Intrinsic	Structural (offset)	Industry sector

Source: Own calculations.

4.1.2 Equity ratio

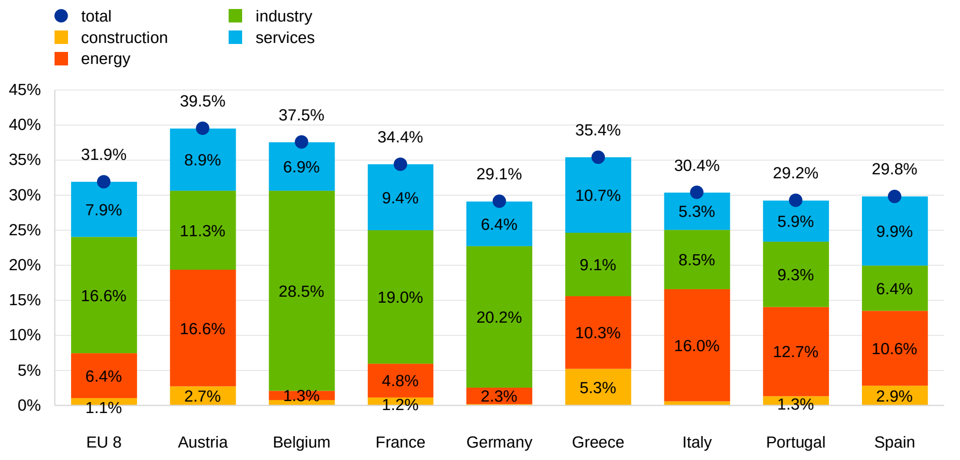
The aggregate equity ratio of European non-financial listed groups varies significantly from one country to another (**Chart 8**). For the eight countries (EU-8) altogether, the aggregate equity ratio equals 31.9%, but the spread between the minimum and the maximum comes to more than 10 percentage points. Italy's equity ratio (30.4%) is closest to the EU-8's. Germany and Portugal have the lowest equity ratios (29.1% and 29.2% respectively), while Belgian and Austrian groups seem to be the ones with the highest degree of financial independence. Their equity ratios are 37.5% and 39.5% respectively.

Chart 8 shows the absolute contribution of the different sectors of activity to the aggregate equity ratios: while industry makes the largest contribution in Belgium (28.5%), France (19.0%) and Germany (20.2%), energy is the biggest contributor in Austria (16.6%), Italy (16.0%), and Portugal (12.7%). Industry actually accounts for more than 70% of the ratio in Belgium, while energy accounts for more than 53% in Italy. Energy is also slightly more important in Spain (10.6%). Greece is the only country where the services sector makes the biggest contribution to the equity ratio.

The proportion of equity used to finance assets of Austrian non-financial listed groups is higher than for EU-8 groups. The chart shows that the main difference lies in the contribution of energy groups (10.2 percentage points higher), industry groups (5.3 percentage points lower) and, to a lesser extent, construction groups (1.6 percentage points higher). These sectoral differences may result from structural differences (e.g. the share of energy in total assets might be higher in Austria than in EU-8) or from intrinsic differences, meaning that the proportion of equity in the energy sector is higher (see **Chart 3** in the methodology section).

Chart 8

Absolute contribution of the different sectors to the aggregate equity ratios in 2014



Source: Own calculations based on ERICA DB.

The structural and intrinsic impact of each sector on the national aggregate financial debt ratios are shown in **Chart 9**. The decomposed difference is calculated as the EU-8 ratio minus the country-specific ratio. This means that when the spread is positive, the equity ratio is smaller at country level than at EU-8 level, and vice versa.

Note that, for each sector, the sum of the intrinsic impact and the structural impact equals the difference between the absolute contribution of that sector to the EU-8 ratio and the absolute contribution of that sector to the country-specific ratio, as displayed in **Chart 8**.

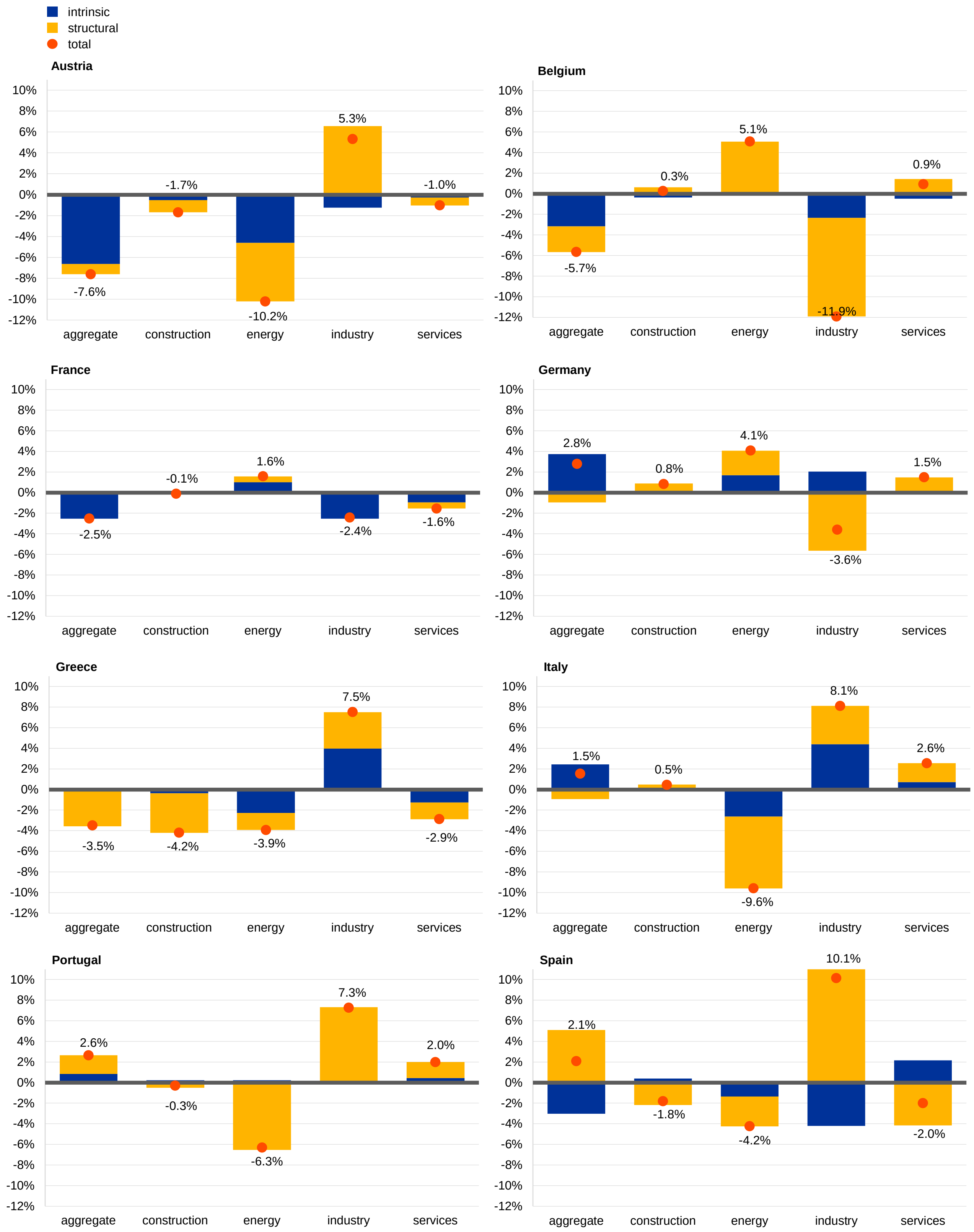
The sample for **Austria** shows that the higher contribution of energy groups is the result of both effects: their share (in total assets) is higher in Austria than in EU-8, and the same is true for their solvency. The Austrian sample includes only three listed energy groups, each with one of the largest equity ratios at sector level. As for Austrian industry groups, the equity ratio is slightly higher than the European benchmark. It is more than offset by a smaller share in terms of total assets. The equity ratio of Austrian services groups is larger than that of the benchmark. Construction groups are more solvent and have a larger share in Austria. A more detailed analysis in terms of sector size shows that in the services sector, the bigger share in terms of total assets of large groups is more than offset by the smaller share found in medium-sized and small groups.

Comparing the aggregate equity ratio of **Belgian** groups against the European benchmark, **Chart 8** shows that the Belgian equity ratio is 5.6 percentage points higher at 37.5%. However, the sectoral decomposition shows that there are major differences. Industry is a much bigger contributor to the country's ratio than in the benchmark, while the energy sector has less impact. **Chart 9** reveals that the higher contribution of Belgian industry groups is the result of a combined effect: their share is higher than in the EU-8 benchmark while the same is true for their equity ratio. This ratio is highly influenced by Belgium's largest listed industry group, Anheuser-Busch InBev. The energy sector's contribution is smaller in Belgium than in the benchmark for largely structural reasons, i.e. its share in the Belgian sample is smaller in terms of total assets. In terms of sector size, the effects seen in the industry sector and in the energy sector are mostly due to large groups.

When the aggregate equity ratio of **French** non-financial groups is compared against the European benchmark, **Chart 8** shows that the French equity ratio is 2.5 percentage points higher at 34.4%. The analysis of the sectoral decomposition highlights the fact that this difference between the European benchmark and the French ratio is primarily attributable to industry. **Chart 9** reveals that the higher contribution of French industry groups is due only to the intrinsic effect, in other words the relative proportion of equity used by French industry groups to finance their assets is bigger than that in the EU-8 benchmark. This intrinsic effect can be largely explained by the significant influence of the largest French listed company, Total. The difference in the energy sector is also due to a larger share and a higher equity ratio. Services groups have a higher solvency ratio than in EU-8, while for energy groups the opposite is observed. In terms of sector size, all the intrinsic effects are due to larger groups, whereas medium-sized groups mostly have an impact on the structural effects.

Chart 9

Decomposition of the differences in the aggregate equity ratio in 2014: EU-8 minus each country



Source: Own calculations based on ERICA DB.

The equity ratio of **German** groups (29.1%) is 3.2 percentage points below the European benchmark, meaning that they have a smaller degree of financial independence. **Chart 8** shows that while industry makes a higher contribution, all the other sectors make a lower contribution. **Chart 9** highlights the fact that the industry sector has more weight in terms of total assets than the other sectors, which explains why the contribution of this sector is higher. It is nevertheless slightly offset by the fact that these groups tend to use relatively less equity than their peers in the EU-8 benchmark. Volkswagen, Daimler and BMW, the biggest German listed industry groups, have a low equity ratio. The difference in the services sector is mainly due to the fact that it has less weight in terms of total assets, whereas the difference seen in the energy sector is the result of a combined effect: while their share in the total German assets is smaller, energy groups tend to use relatively less equity. Both structural and intrinsic effects in each sector are mainly attributable to large groups.

Chart 8 shows that the equity ratio of **Greek** groups (35.4%) is 3.1 percentage points higher than the EU-8 benchmark. As illustrated in **Chart 9**, the differences observed in the energy and services sectors are due to a combined effect: their share is higher than in the EU-8 benchmark while the same is true for their equity ratio. The industry sector presents the same combined effect, but in a negative way: both the share and the equity ratio are lower. In terms of sector size, the effects are not only due to larger groups: medium-sized and small groups also have an influence. This is especially true in construction and industry, where medium-sized groups influence the structural effects.

As presented in **Chart 8**, **Italian** groups have a higher aggregate equity ratio (30.4%) than the EU-8 benchmark. While the energy sector makes the second-highest contribution of all countries, all the other sectors make a lower contribution to the aggregate equity ratio. **Chart 9** shows that the high contribution of the energy sector is mainly due to a structural difference, even if it is supplemented by a large intrinsic effect. It means that the share of energy groups in total assets is higher in Italy than in EU-8. In addition, the two largest Italian energy groups, ENI and ENEL, have a high equity ratio. The situation in the other sectors, and in particular the low contribution of the industry sector, is also explained by the fact that the share of Italian industry groups in total assets is lower in Italy than in EU-8 and that the Italian industry sector has a lower equity ratio. The largest industry group, EXOR, does indeed have a very low equity ratio. In terms of sector size, we can see that these effects are mostly due to larger groups, with medium-sized and small groups only having a small influence.

The proportion of equity used to finance **Portuguese** non-financial listed groups is lower than that for EU-8 groups. It is 3.1 percentage points lower than the benchmark. This is mostly due to the low contribution of the industry sector, while the energy sector's contribution is higher than the benchmark. **Chart 9** shows that the two effects are structural. This means that the industry sector has less weight in terms of total assets, whereas the opposite is true for the energy sector. This is due to the fact that the largest Portuguese group in the sample, EDP, is an energy group.

In terms of sector size, these effects are mainly driven by larger groups. Small and medium-sized groups don't appear to have lots of influence.

The equity ratio of **Spanish** non-financial groups (29.8%) is 2.1 percentage points lower than the EU-8 benchmark. This can be explained by the low contribution of the industry sector. By contrast, the other sectors have higher contributions. **Chart 9** shows that the low industry contribution is mainly due to the fact that this sector has less weight in terms of total assets. It is slightly offset, however, because Spanish industry groups have a higher solvency ratio than EU-8's. The energy sector has a combined positive intrinsic and structural effect, while the larger weight of the services sector is slightly offset by the fact that these groups are less equity intensive. This is largely explained by Telefónica, the largest group in the sample.

For the aggregate equity ratio – as was the case for the aggregate financial debt ratio – it is clear that intrinsic effects are most common at an aggregate level, while structural effects explain most of the differences at sector level (**Table 5**). Differences are most pronounced in industry, and to a lesser extent in the energy sector. Both structural and intrinsic effects in each sector are mainly attributable to large groups.

Table 5

Overview of the results of the decomposition of the differences in the aggregate equity ratio

Country	Main impact at an aggregate level	Main impact at sector level	Sector with largest impact
Austria	Intrinsic	Structural (offset)	Energy sector
Belgium	Intrinsic	Structural (offset)	Industry sector
France	Intrinsic	Intrinsic	Industry sector
Germany	Intrinsic	Structural (offset)	Energy sector
Greece	Structural	Structural	Industry sector
Italy	Intrinsic	Structural (offset)	Energy sector
Portugal	Structural	Structural	Industry sector
Spain	Structural	Structural	Industry sector

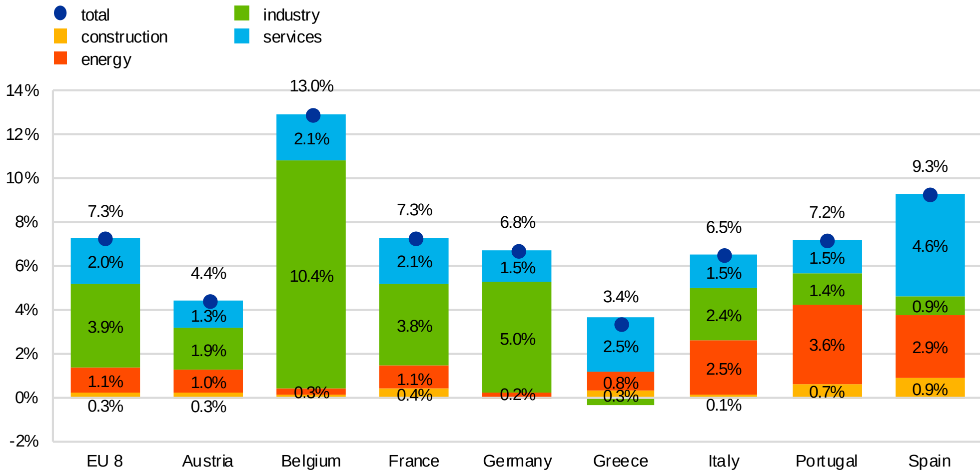
Source: Own calculations.

4.1.3 EBIT margin

The aggregate EBIT margin captures the pre-tax operating return on revenue of European non-financial listed groups, considering it an indicator of both relative efficiency and profitability. The left-hand column in **Chart 10** shows this pre-tax operating return on revenue for the EU-8 benchmark, which amounts to 7.3%. It is close to the return achieved by French (7.3%) or Portuguese groups (7.2%) and slightly higher than the profitability of German (6.8%) and Italian groups (6.5%). For the countries compared, the aggregate EBIT margin ranges from 3.4% for Greek groups to 13% for Belgian groups.

Chart 10

Absolute contribution of the different sectors to the aggregate EBIT margin in 2014



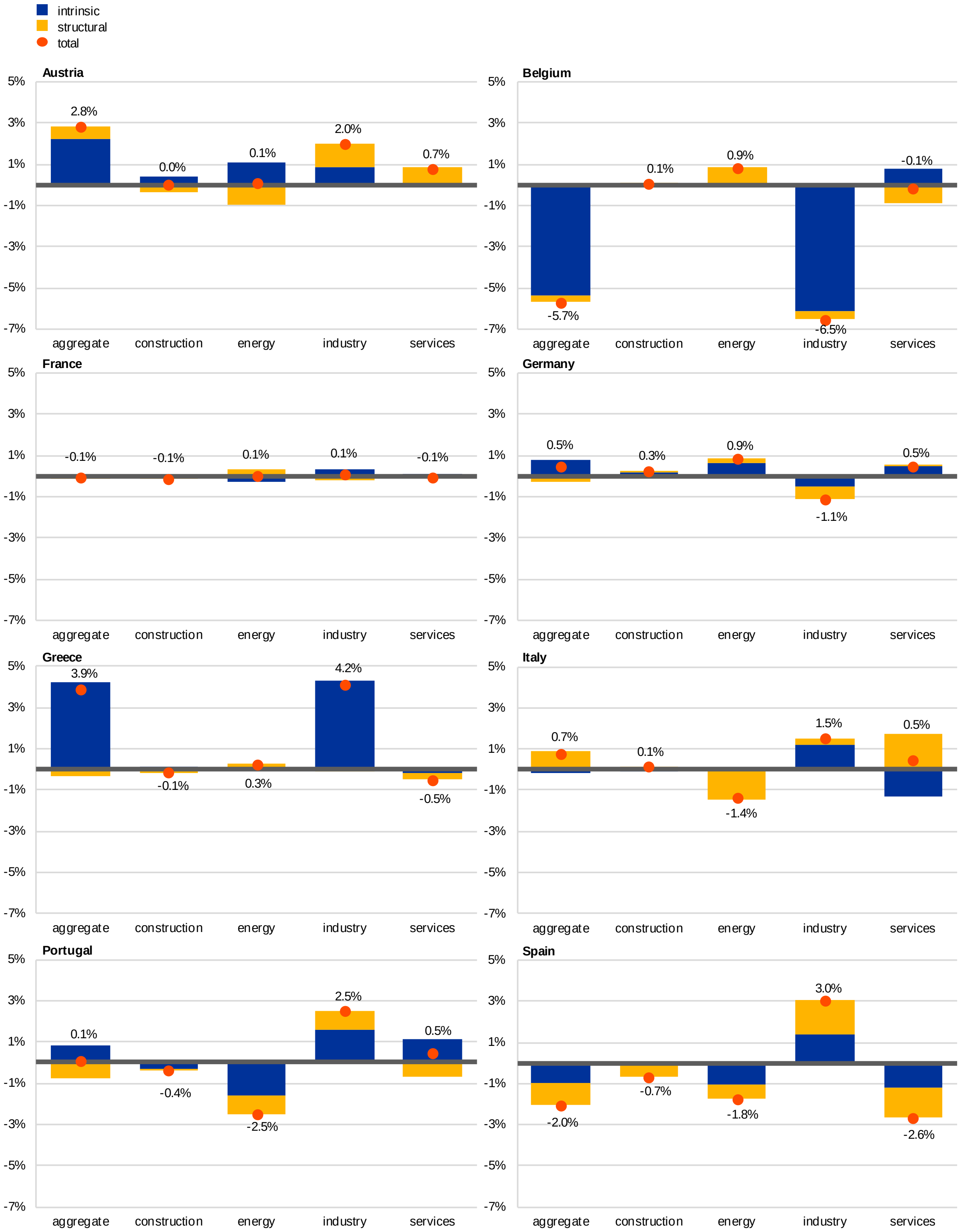
Source: Own calculations based on ERICA DB.

The absolute contribution of the sectors of activity to the aggregate EBIT margin of each country during 2014 is also shown in **Chart 10**. The highest aggregate EBIT margin during 2014 of 13% for Belgian groups is explained, in order of contribution, mainly by industry (10.4%) and services (2.1%), and to a lesser extent by energy (0.3%) and construction (0.2%). In relative terms, industry is by far the most important contributor for Belgian and German groups, accounting for 80% and 74% respectively. It is also the main sector for Austrian and French groups, but with a lower contribution to the EBIT margin of 53% and 52% respectively. By contrast, it is important to highlight the (slightly) negative contribution of the industry sector for Greek groups to their aggregate profitability measure. The energy sector in Portugal and Italy accounts for most of their aggregate EBIT margin, specifically 50% and 38% respectively. In Italy, the relative contribution of the industry sector also amounts to 36%. Services are the most important contributor to the aggregate profitability measure of Greek and Spanish listed groups. Finally, we should highlight the minor role played by the construction sector in the aggregate profitability measure of any of the analysed countries.

The structural and intrinsic impact of each sector on the national aggregate EBIT margin is depicted in **Chart 11**. The decomposed difference is calculated as the EU-8 ratio minus the country-specific ratio. This means that when the spread is positive, the EBIT margin is smaller at country level than at EU-8 level (negative impact), and vice versa. Note that, for each sector, the sum of the intrinsic impact and the structural impact equals the difference between the absolute contribution of that sector to the EU-8 ratio and the absolute contribution of that sector to the country-specific ratio, as displayed in **Chart 10**.

Chart 11

Decomposition of the differences in the aggregate EBIT margin in 2014: EU-8 minus each country



Source: Own calculations based on ERICA DB.

The revenue-weighted profitability ratio for **Austrian** non-financial listed groups (4.4%) is lower than that of the benchmark (7.3%). The difference amounts to 2.8 percentage points. An analysis of the sectoral contribution shows that this is due to industry (2 percentage points) and services (0.8 percentage points) groups. **Chart 11** shows that for the industry sector there is an important structural effect (higher share of revenues in EU-8) but also an important intrinsic effect (EBIT margin of industry groups is lower in Austria than in EU-8), with both effects attributable to large industry groups. For services groups the explanation is mainly structural. While **Chart 10** shows almost no difference for energy groups, **Chart 11** shows that this results from an offsetting structural and intrinsic effect in large energy groups. These Austrian energy groups have a lower EBIT margin, but their share in revenues is larger than that of the benchmark. The findings for the construction sector are similar but less pronounced.

The aggregate EBIT margin of **Belgian** groups is the highest of all countries under review. It is 5.7 percentage points above the EU-8 benchmark at 13%. **Chart 10** shows that the difference compared with the benchmark can mainly be allocated to industry groups. **Chart 11** shows that this is due to industry groups' profitability, which is well above the EBIT margin of EU-8 industry groups. The main reason for this is the higher profitability of large industry groups, reinforced to a minor extent by a higher revenue-weighted share of medium-sized and large industry and large services groups. As already stated above with regard to the indebtedness ratio, Belgium's largest listed group, Anheuser-Bush InBev, has a huge influence on the aggregate EBIT margin. **Chart 11** also shows that Belgian services groups have a lower profitability than those in EU-8: this is not shown in **Chart 10** because it is offset by a larger share in revenue of Belgian services groups.

French listed groups have an aggregate revenue-weighted EBIT margin of 7.3%, almost identical to the EU-8 benchmark. The sectoral contributions (**Chart 10**) are also similar. A more detailed analysis of the intrinsic and structural effects in **Chart 11** reveals that French energy groups, such as EDF and Engie among others, are more profitable than the benchmark, but this is offset by a lower share of this sector in overall revenues. The opposite is true for industry groups, which can be explained by large groups such as Total.

German listed groups are 0.5 percentage points lower than the benchmark, achieving a pre-tax operating return on revenue of 6.8%. This difference (**Chart 10**) is the result of a higher contribution from industry groups (1.1 percentage points) offset by a lower contribution from energy groups (-0.9 percentage points). **Chart 11** shows slightly larger sectoral profitability in industry (intrinsic) compared with its benchmark, particularly in large groups, offset by a lower EBIT margin in large energy and services groups. The same is true for the larger share of the German industry sector, which is partially offset by the lower share in the other sectors. This industry sector pattern is due to the main German automotive groups (Volkswagen, Daimler and BMW).

The difference between **Greek** listed groups' aggregate profitability and the benchmark amounts to 3.9 percentage points. The aggregate EBIT margin for Greek listed groups is thus 3.4%. Industry is a negative contributor to the aggregate Greek profitability ratio (**Chart 10**). **Chart 11** reveals that this is due to a lower performance of Greek industry groups, particularly as a result of a lower EBIT margin in large industry groups.

In the case of **Italian** listed groups, the aggregate EBIT margin is 6.6%, 0.7 percentage points lower than the EBIT margin calculated for the benchmark (7.3%). The contribution of Italian listed energy groups to country-level profitability is higher than the benchmark (+1.4 percentage points), but this is offset by the lower contribution of industry groups (-1.5 percentage points). The difference for industry groups is mainly intrinsic. The Italian industry sector has a lower profitability than that of EU-8 (**Chart 11**), mainly due to the poorer performance of large industry groups. Services groups appear to be more profitable, however. The latter effect is not visible in **Chart 10** because it is offset by a structural effect in the services sector (**Chart 11**). This is particularly true for large services groups. The large energy group ENI and the large industry group Exor are the main drivers of performance in their respective sectors.

The aggregate EBIT margin for **Portuguese** listed groups is 7.2%, almost the same as the benchmark. **Chart 10** shows that the contribution of industry groups is 2.5 percentage points lower, while that of energy groups is 2.5 percentage points higher. More detail is provided in **Chart 11**. The EBIT margin is lower for industry groups (both effects in large groups) and higher for energy groups (both effects in large groups). The profitability (intrinsic) of service groups, particularly large ones, is lower than that of EU-8. Galp (industry) and EDP (energy) have a significant influence on the result of their sectors.

The aggregate pre-tax operating return on revenue for **Spanish** listed groups is 9.3%, which is 2 percentage points higher than the comparable profitability of the EU-8 listed groups under review. As **Chart 10** shows, the difference can be attributed to industry groups (-3 percentage points), services groups (+2.6 percentage points), energy groups (+1.8 percentage points) and construction groups (+0.6 percentage points). All four sectors show structural differences (**Chart 11**), mainly in large groups, but also intrinsic effects: while large Spanish industry groups are less profitable, large energy and services groups are more profitable. Telefónica and Inditex have a positive influence on performance in the service sector, while Repsol contributes significantly to the lower performance ratio in the industry sector.

For the aggregate EBIT margin, it is clear that intrinsic effects are most common at an aggregate level, while both effects play a role at sector level (**Table 6**). Differences are most pronounced in the industry sector.

Table 6

Overview of the results of the decomposition of the differences in the aggregate EBIT margin

Country	Main impact at an aggregate level	Main impact at sector level	Sector with largest impact
Austria	Intrinsic	Structural (offset)	Industry sector
Belgium	Intrinsic	Intrinsic	Industry sector
France	Intrinsic	Structural (offset)	Construction sector
Germany	Intrinsic	Intrinsic	Industry sector
Greece	Intrinsic	Intrinsic	Industry sector
Italy	Structural	Structural	Industry sector
Portugal	Intrinsic	Intrinsic	Energy sector
Spain	Structural	Structural	Industry sector

Source: Own calculations.

4.2 Analysis of the financial debt ratio over time

In this part of the analysis, the aggregate financial debt ratio of each country will be considered between 2009 and 2014. 2009 is the first year for which the ERICA database contains a stable number of non-financial listed groups. 2014 is the year for which the database contains the most recent financial data at the time the study was undertaken. In order to have an adequate dataset to carry out an analysis of the aggregate financial debt ratio over time, we have to be aware of some characteristics of the ERICA database and as such propose certain adaptations to improve the time series.

4.2.1 Data polishing

Considering **Table 1** in Section 2.3 – in which the number of IFRS groups included in the ERICA dataset is shown for each country and year in the period 2009-2014 – a break in the time series is noted for Greece, Belgium and Spain. While the database contains only 27 Greek groups for 2009, that number has doubled since 2010. A similar break is visible for Belgium and Spain, since only 30 Belgian and 30 Spanish groups were incorporated in the dataset for 2009 and 2010, while that number has expanded considerably since 2011 and stood at 76 Belgian and 99 Spanish groups in 2014[19]. Given that the samples for 2009 in each of the three countries have good coverage, the analysis over time for these three countries is based on a sample consisting of a fixed set of all IFRS groups available in the ERICA dataset for 2009, followed over the other years until 2014, further referred to as a “fixed sample”.

[19] Before 2011, the compromise of countries participating in ERICA WG was to obtain and feed manually into the ERICA database the largest listed groups of the country (30 per country). Since these countries developed their own databases at national level within their national central banks they have included almost the full set of listed groups in the ERICA database, so the ERICA database has benefited from coverage of nearly the entire population.

Another characteristic of the ERICA database is that the figures for non-financial listed IFRS groups relating to a specific accounting year t are compiled once a year at the beginning of September of the year t+1, based on the accounting information available at that moment. So far, no updates for prior accounting periods have been made. This implies that the data for some IFRS groups relating to a specific accounting year t may be missing when annual reports could not be processed on time, i.e. before September of the year t+1. Since the temporal analysis of the financial debt ratio (2009-2014) focuses on the breakdown into an intrinsic and a structural effect, and since the aim is to measure the structural effect as purely as possible, an "enrichment" of the database for 2009 and 2014 is advisable. This is carried out by making the following improvement. A correction is added for the non-financial listed IFRS groups active in 2009 for which no accounting data is considered in ERICA for 2009 since they could not be processed on time. If accounting figures for these groups are known for 2010, these are copied and used as the accounting data for 2009. The same procedure is applied for missing IFRS groups for 2014. Where omissions were not processed on time (although they did exist in 2014) and are therefore not considered in the database for 2014, but accounting data for 2013 is available, these data are copied and used as the accounting data for 2014. As such, the mismeasurement of the structural effect will be as limited as possible.

4.2.2 Temporal analysis

For each country separately, the change in the aggregate financial debt ratio is deduced from the aggregate ratios calculated via formula (M1). The calculation of the financial debt ratio for Belgium, Greece and Spain is based on a fixed sample. For the other countries the "enriched database" is used to measure the aggregate financial debt ratios.

The analysis in this chapter seeks to study the evolution of the aggregate financial debt ratio between 2009 and 2014 for each country by considering the changing contribution of the different sectors of activity within the country, as described in formula (M2). The contribution of each sector to the composition of the aggregate financial debt ratio of each country (2009-2014) is shown in **Chart 12**. The objective is to distinguish whether the change in the aggregate financial debt ratio over time is due to modifications in the sectoral structure of the country (structural effect) or to a change in the indebtedness policy of the sectors themselves (intrinsic effect). This temporal decomposition method is applied by means of formula (M2), and the results can be seen in **Chart 13**.

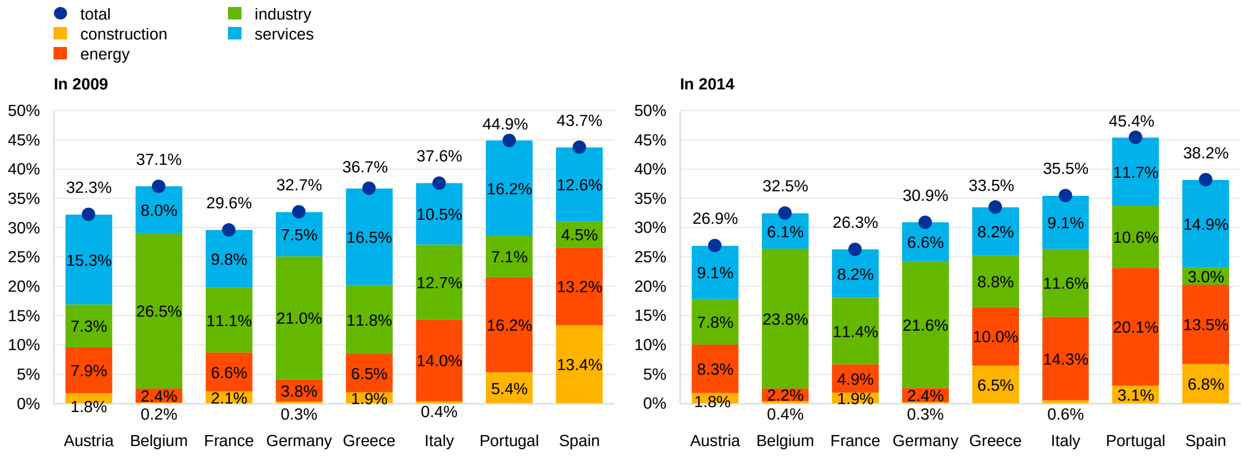
Chart 12 illustrates that, for all countries apart from Portugal, the aggregate financial debt ratio fell between 2009 and 2014. This means that non-financial listed IFRS groups borrowed less money in 2014 to finance their activities than in 2009. While German, French and Austrian groups are characterised by a more modest aggregate financial debt ratio in both 2009 and 2014, Portuguese and Spanish groups have a higher ratio. In Spain and Portugal, groups tend to use more financial debt to finance their business activities. Spanish groups made the biggest change in their financing behaviour, however, with their aggregate financial debt ratio dropping sharply by 5.5 percentage points between 2009 and 2014, while Portuguese groups maintained a high ratio over the entire period. Their aggregate financial debt ratio even shows a small increase.

Austria

Chart 12 illustrates that Austrian groups were characterised by a strong drop in their aggregate financial debt level (-5.4 percentage points), falling from 32.3% in 2009 to 26.9% in 2014. This drop is especially visible in the contribution of the services sector, which declined by 6.3 percentage points, and was only very marginally offset by an increase in the contribution of the industry (+0.5 percentage points) and energy (+0.4 percentage points) sectors.

Chart 12

Contribution by sector to the aggregate financial debt ratio of each country in 2009 and 2014



Note: The aggregate financial debt level for Belgium, Greece and Spain is based on a fixed sample. The calculation of the aggregate financial debt level for the other countries is based on the "enriched" ERICA database. As a result, the financial debt level in 2014 differs from the one in the cross-country analysis.
Source: Own calculations based on ERICA database.

The temporal decomposition method, illustrated in **Chart 13**, explains that the falling contribution of the Austrian services sector is the result of a combined effect: a small fall in the real indebtedness of services groups (intrinsic effect of -0.5 percentage points) and a diminishing share due to the downsizing or even disappearance of some large services groups, especially those active in real estate (structural effect of -5.8 percentage points). Notwithstanding the small rising portion of industry groups (+0.5 percentage points) in the aggregate financial debt ratio, a decline in the indebtedness (-0.6 percentage points) of those groups is visible. Although the contribution of the Austrian energy sector to the aggregate financial debt ratio did increase, an important deleveraging process of -1.9 percentage points (intrinsic) took place and was especially noticeable in the OMV Aktiengesellschaft Group that operates a gas pipeline network in Austria and gas storage facilities in Austria and Germany. This extensive group reduced its debt financing considerably over the period 2009-2014.

At an aggregate level, Austria saw a modest fall of -3.1 percentage points in its indebtedness between 2009 and 2014.

Belgium

Based on the fixed sample for Belgium, the analysis shows a fall of 4.6 percentage points in the aggregate financial debt ratio from 37.1% in 2009 to 32.5% in 2014 (**Chart 12**). The fall results from a declining contribution from industry (-2.7 percentage points) and services (-1.9 percentage points). **Chart 13** shows that Belgian industry groups made a genuine deleveraging effort to the tune of -4.3 percentage points (intrinsic), which was partially offset by a higher weight in terms of total assets (structural effect of +1.5 percentage points), while in the services sector the declining contribution is entirely explained by the lower weight of the services sector in terms of total assets (-2 percentage points). The real deleveraging process in Belgium is especially strong from 2009 until 2011. One of the reasons for this is the government's "notional interest deduction" scheme[20].

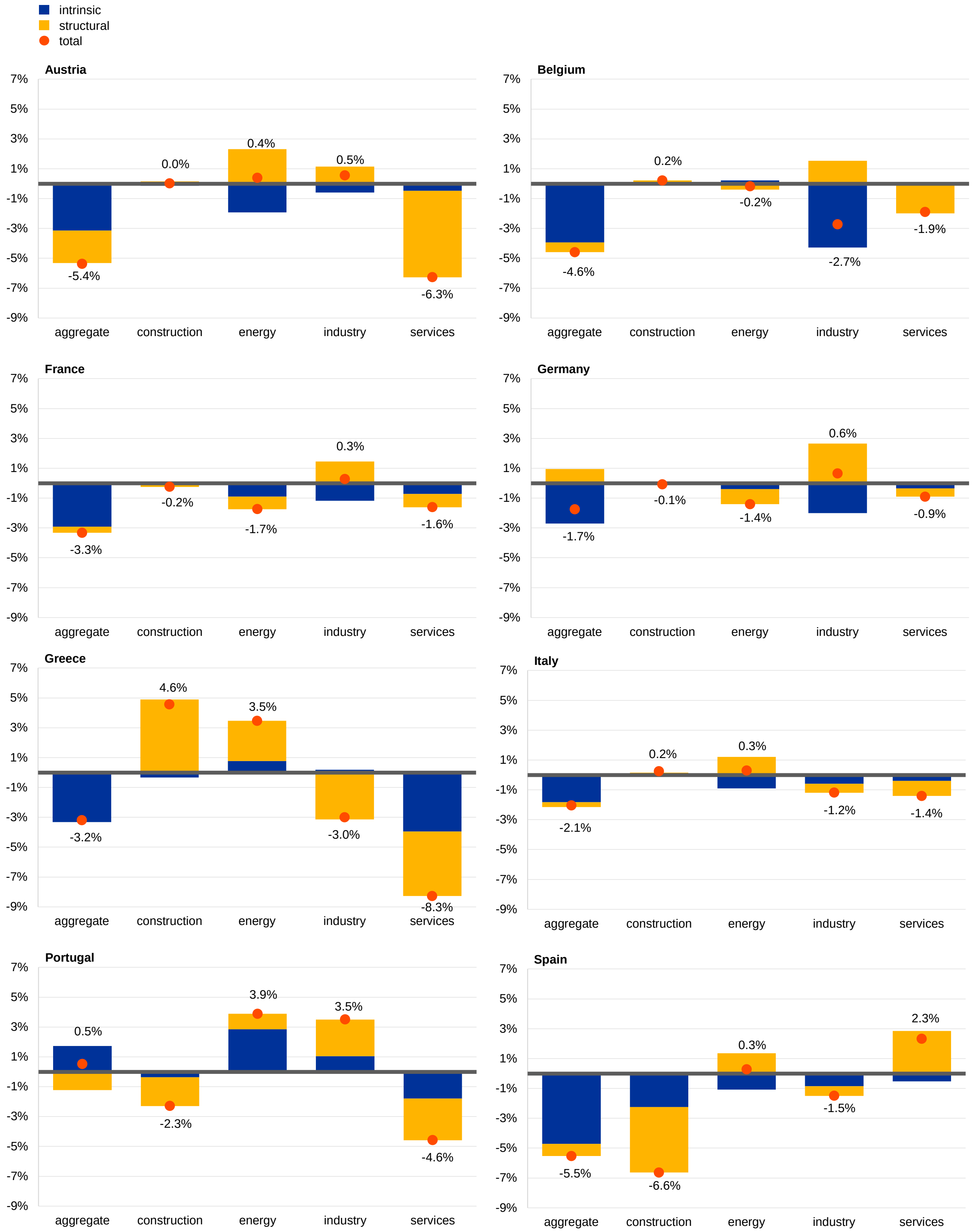
France

French non-financial listed groups have the lowest aggregate financial debt ratio of all the countries, falling from 29.6% in 2009 to 26.3% in 2014 (**Chart 12**). Although non-financial groups in France seem to have a relatively healthy financial situation, they still reduced their financial debt level by a total of 3.3 percentage points. The biggest decline can be seen in the contribution from the energy and services sectors (-1.7 percentage points and -1.6 percentage points respectively). **Chart 13** explains that groups in both sectors became less indebted due to a real deleveraging effort by large groups, reinforced by the fact that these sectors slimmed down their total assets over time. The biggest deleveraging process is seen among industry groups (-1.2 percentage points), something which could not be deduced from **Chart 12** since the intrinsic effect was completely offset by an increasing weight in terms of total assets (structural effect of +1.5 percentage points). Despite the modest growth in the industry contribution, the aggregate financial debt level in the industry sector stayed quite low at 23.8% in 2014, strongly influenced by the financial debt ratio of the Total group. There appears to be a reduction in the indebtedness of all French groups, although there is a difference in the magnitude of the decline.

[20] Notional interest deduction is a government measure introduced in Belgium in 2005. It concerns a tax allowance for risk capital. This implies that groups that finance their activity via equity can benefit from a tax deduction. In the last few years this measure has become less attractive, on the one hand because the basic interest rate used for the deduction has declined year-on-year since 2011, and on the other because since the 2013 tax year firms have no longer been able to carry forward to a later year any interest in excess of the tax base (Rubbrecht and Vivet (2015)). For more details on the measure itself, please refer to Burggraeve et al (2008).

Chart 12

Temporal decomposition of the aggregate financial debt ratio between 2009 and 2014 for each country



Note: Calculations for Belgium, Greece and Spain are based on a fixed sample. Calculations for the other countries are influenced by a rough correction.
Source: Own calculations based on ERICA database.

Germany

Although German groups already had a modest aggregate financial debt ratio of 32.7% in 2009, they still reduced their level of financial indebtedness to 30.9% in 2014 (**Chart 12**). This drop seemed to be mainly provoked by the declining contribution of energy (-1.4 percentage points) and services (-0.9 percentage points). **Chart 13** reveals that the lower contribution of the two sectors is a result of both effects: their share in total assets decreased and their asset-weighted indebtedness fell. Although not noticeable in **Chart 12**, an important deleveraging process was especially visible in the German industry sector (intrinsic effect of -2.0 percentage points). However, this was completely offset by the increasing weight in terms of total assets (structural effect of +2.7 percentage points). The strong intrinsic impact in industry was heavily influenced by some large groups such as BMW, Daimler and Volkswagen.

Greece

Based on the analysis of the fixed sample in Greece, a reduction in the aggregate financial debt ratio can be observed, from 36.7% in 2009 to 33.5% in 2014 (**Chart 12**). The decreasing contributions from services (-8.3 percentage points) and industry (-3.0 percentage points) are responsible for this, albeit partially offset by the increasing role played by construction (+4.6 percentage points) and energy (+3.5 percentage points).

Chart 13 explains that the falling contribution of the services sector is due partly to a major financial debt reduction process (-3.9 percentage points) and partly to a considerable decrease in the weight of the sector in terms of total assets (-4.3 percentage points). The declining contribution of the industry sector is entirely explained by the sector's diminishing weight in terms of total assets (-3.1 percentage points). A number of big services and industry groups have moved their headquarters out of Greece to a different country owing to excessive constraints on borrowing capital from Greek banks to finance their business activities. Other services and industry groups switched their main activity out of their respective branch.

The growing contribution of construction to the aggregate financial debt ratio is mainly explained by the increasing weight of the sector (+4.9 percentage points), as some groups did change their main activity. The Mytilineos Group, for example, which is active in three main operating business segments (metallurgy & mining, construction and energy) switched its main activity from manufacturing to construction by further expanding its subsidiary METKA, a leading and highly specialised energy, procurement and construction (EPC) contractor in Greece and abroad. The increasing contribution of the energy sector is mainly attributable to the rising weight in terms of total assets of one big energy group, Public Power Corporation. This group revalued its operating fixed assets under IAS 16 in 2014, after they had already been revalued in December 2009.

Italy

Starting from an initial aggregate financial debt ratio of 37.6% in 2009, Italy underwent a fairly limited corporate deleveraging process (-2.1 percentage points) to 35.5% in 2014 (see **Chart 12**). The biggest drop seems to stem from the contribution of services (-1.4 percentage points) and industry (-1.2 percentage points), in both cases resulting from a double effect (**Chart 13**): a fall in the weight in terms of total assets and a real deleveraging process. There was also a reduction in the indebtedness of energy groups (-0.9 percentage points), due entirely to the two biggest energy groups, Eni and Enel. This intrinsic effect is not visible in **Chart 12** because it was completely offset by the increasing energy share (structural effect of +1.2 percentage points).

Portugal

Although Portuguese groups had the highest aggregate financial debt ratio in 2009 (44.9%) of all the countries surveyed, they still increased their financial indebtedness to 45.4% in 2014 (see **Chart 12**). This increase is visible in the rising contribution of the energy (+3.9 percentage points) and industry (+3.5 percentage points) sectors, which was to a large extent offset by the declining contribution of services (-4.6 percentage points) and construction (-2.3 percentage points).

Chart 13 shows that the growing contributions of energy and industry are a combined effect of a larger share of the two sectors (+1 percentage point in energy, +2.5 percentage points in industry), while they became more leveraged over time (+2.8 percentage points in energy[21], +1 percentage point in industry). The declining services contribution can be explained partly by a real shrinkage in borrowed capital to finance activity (-2.8 percentage points) and partly by the declining weight of the services sector in terms of total assets (-1.8 percentage points). This downward trend was mainly due to the disappearance of a major services group from the ERICA database: a takeover bid for Brisa, Portugal's largest transport infrastructure company, led the group to exit the stock exchange in 2013. The fall in the contribution of the Portuguese construction sector (-2.3 percentage points) can be explained by the declining weight of construction groups in terms of total assets (-1.9 percentage points) because some groups[22] switched their main activity out of construction.

At an aggregate level it seems that Portuguese groups face some disincentives to deleverage, since they are characterised by an aggregate intrinsic effect of +1.7 percentage points.

---

[21] The behaviour of the Portuguese energy sector is determined entirely by the big energy group Energias de Portugal.

[22] Grupo Soares de Costa changed its main activity from construction to services in 2014, while Martifer's core business was switched from construction to industry in 2013.

Spain

Chart 12 illustrates that the Spanish groups available in the fixed sample have seen the largest decline (-5.5 percentage points) in their aggregate financial debt ratio from 43.7% in 2009 to 38.2% in 2014, although Spanish corporate financial debt was still at a high level in 2014 compared with other European countries. This drop is especially visible in the contribution of construction (-6.6 percentage points) and industry (-1.5 percentage points), partially offset by the growing services contribution (+2.3 percentage points).

Chart 13 clarifies that the falling contribution of the Spanish construction sector in the aggregate financial debt ratio is explained by a shrinking weight of the sector (-4.4 percentage points) at the same time as a real deleveraging process (-2.2 percentage points). This is not surprising given that the Spanish real estate market bubble has led to deleveraging by businesses connected with construction activities.

Since the collapse of the real estate market spread to the rest of the Spanish economy by dragging down other sectors, real financial debt reductions were also seen in other sectors, but to a lesser extent, in order to achieve a less credit-dependent economic growth pattern (Ortega and Peñalosa (2012)). The decreasing contribution of Spanish industry is mainly explained by a genuine deleveraging process reinforced by a decline in its share. The growing contribution of services resulted from its increasing weight in terms of total assets (+2.8 percentage points) that was barely offset by a negative intrinsic effect, which implies a slight lowering of industry groups' financial debt. Energy groups also reduced their financial debt (intrinsic effect of -1.1 percentage points), although this was completely offset by their increasing weight in terms of total assets (positive structural effect of +1.4 percentage points). As a result, the contribution of the energy sector to the aggregate financial debt level was virtually unchanged in 2014 compared with 2009.

Table 7
Overview of the results of the decomposition of the aggregate financial debt ratio of each country over time (2009-2014)

Country	Main impact at an aggregate level	Main impact at sector level	Sector with largest impact
Austria	Intrinsic	Structural (offset)	Services sector
Belgium	Intrinsic	Intrinsic	Industry sector
France	Intrinsic	Structural (offset)	Energy & services sectors
Germany	Intrinsic	Structural (offset)	Energy sector
Greece	Intrinsic	Structural (offset)	Services sector
Italy	Intrinsic	Structural (offset)	Services sector
Portugal	Intrinsic	Structural (offset)	Services sector
Spain	Intrinsic	Structural (offset)	Construction sector

Source: Own calculations.

The results of the temporal decomposition analysis of the aggregate financial debt ratio of each country are summarised in **Table 7**. The second column shows for each country whether the change in the aggregate financial debt ratio over time - at an aggregate level - can be explained by any real shift in the deleveraging process (intrinsic effect) or by structural changes in that country. The third column illustrates the same thing at sectoral level[23]. In almost all of the countries the main effect at sector level is structural, while at an aggregate level it is intrinsic, since structural effects at sector level largely offset each other. The change in the financial debt ratio over time is most pronounced in the services sector. The results show that with the exception of Portugal, all countries did go through a real deleveraging process (intrinsic) between 2009 and 2014. On top of this corporate debt restructuring process, there was a change in the types of financial debt used by non-financial listed IFRS groups to borrow capital.

4.2.3 Shift in type of financial debt

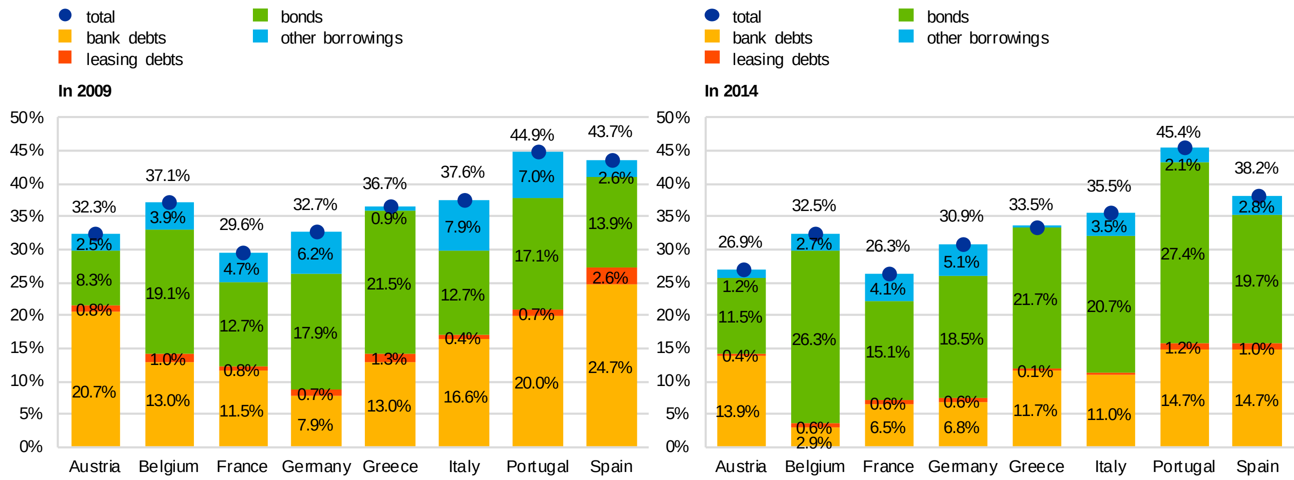
By considering the composition of the numerator of the financial debt ratio of each country over time, one can analyse the role of the different elements of financial debt over time and how they influence the financial debt ratio. It should be recalled that the total amount of financial debt is the sum of all bank debts, bonds issued, leasing debts and other interest-bearing borrowings owed by listed groups.

Chart 14 compares the contribution of the different types of financial debt to each country's aggregate financial debt ratio for 2009 against the situation in 2014. In most countries the fall in the aggregate financial debt ratio is largely explained by the declining contribution of bank debts. In many countries this trend goes hand in hand with an increase in the proportion of corporate bonds issued by groups. Because of the financial debt crisis in Europe, and the fact that banks became more cautious about lending money, listed groups went looking for an alternative way to finance their activities. So, external funding was raised by issuing more corporate bonds.

[23] For each country, the sum of the absolute values of the intrinsic effects measured at sector level is compared against the sum of the absolute values of the structural effects also measured at sector level. The biggest impact is mentioned.

Chart 14

Contribution of the various types of financial debt to the aggregate financial debt ratio of each country for 2009 and 2014:



Note: Calculations for Belgium, Greece and Spain are based on a fixed sample.

Within countries there is a big difference in the shares of bank debt and corporate bonds as components of the total financial debt figure. Groups in Belgium rely much more on corporate bonds as a means of borrowing (81% share in 2014) than groups in the other countries, especially in the case of large Belgian industry and services groups. The trade-off between borrowing from banks and issuing corporate bonds was seen in almost all groups studied in the ERICA database.

5 Conclusion

Reasons for starting the research paper. The recent use of country-based ratios in the analysis developed by the ERICA WG in its annual report (concerning listed non-financial European groups) put the need for a review of ratio analysis techniques on the group's agenda.

Need to identify a methodology for comparing country data and temporal series (objective). The need to compare and explain differences between countries in key economic and financial ratios derived from IFRS accounting data led to the search for and identification of a ratio decomposition methodology that could be applied to the analysis of economic and financial ratios obtained from any accounting dataset.

Overview and choice of methodology. In order to better understand this methodology, a comparative overview of different ratio decomposition techniques was provided. The Marshall-Edgeworth decomposition, a branch of the Laspeyres methods, was finally chosen.

Dataset and chosen ratios. This methodology was applied to the ERICA dataset to analyse the differences in the debt ratio, equity ratio and EBIT margin across countries. Dissimilarities in debt ratios across two time periods were also studied.

Reasons for choosing these ratios. With regard to cross-country analysis, debt and equity ratios (figures from the statement of financial position, i.e. stocks) are key factors in the analysis of solvency and leveraging/deleveraging in the recent financial crisis, while the EBIT margin is a ratio that uses flow data from the profit and loss account. The time series analysis (2009-2014) concentrated on the debt ratio given its importance for national central banks' analytical work.

Benchmark and breakdown. For the cross-country analysis, the decision was made to compare each country against a multi-regional average country as a benchmark. In all cases, cross-country and temporal analysis, the ERICA dataset was disaggregated, computing all the decompositions at sector level (four kinds).

General findings (structural and intrinsic effects). This paper has shown the importance, when using a dataset of diverse sectors of activity, of decomposing the differential (between two countries, or between two years) of an aggregate ratio into:

1. a term that reflects the differences in the sectoral ratios themselves (the "intrinsic" effect);

2. a term derived from the dissimilarities in their structure (the "structural" effect), referring to the isolation of movements in the ratios due to changes in the relative importance of the sectors of activity among countries and/or their changes over time.

Some specific findings. The detailed, top-down analysis of the cross-country and temporal comparisons in this paper has shown the importance of producing decomposition data to better understand the real behaviour of one country[24] (or a set of listed groups from a given country) or sector of activity. To sum up, the following conclusions can be drawn (using the four summary tables provided at the end of each part of Chapter 4):

1. In this kind of analysis it is necessary to differentiate between intrinsic and structural impacts. It is important to decompose the figures obtained at an aggregate level into their intrinsic and structural components as explained above, to better understand whether the impact is due mainly to changes in the value of ratios or to changes in the structure of the analysis population.

2. Knowing these two components by country is not enough: detail by sector of activity is also required. The main impact at an aggregate level for a given country (either its trend between two years or its differential to the average country), whether intrinsic or structural, also needs some additional detail for study at sectoral level, because drilling down may produce a different result due to offsetting between sectors of activity. In other words, a country could indicate that the intrinsic effect is predominant, while detail by sector of activity in the same country could at the same time point to the structural effect due to offsetting between different sectors of activity.

3. Sectoral analysis would benefit from using the intrinsic components. The use of aggregate ratios to analyse the differential behaviour of different sectors of activity compared with other countries or years can hide information (due to the mix of changes in ratio values and changes in the composition of the population), so a better approach would be to use their intrinsic component. For example, the deleveraging process analysis would benefit from concentrating on the “intrinsic” figures to better understand which sectors of activity cut their financial debt ratios, isolating other components due to changes in the weight of sectors of activity.

4. The decomposition has to be analysed for each ratio. The summary tables provided in Chapter 4 demonstrate that the intrinsic and structural impacts are different for each ratio. Although the changes in the population of listed groups (the main driver of the structural component) are the same whichever ratio is analysed, the decomposition methodology provides structural components specific to each ratio.

The way ahead, new tool for the future and enhanced research by the ERICA WG. Finally, taking into account the technical boundaries in the scope of this paper, the aforementioned findings allow the group to implement a strong methodological tool for future and enhanced research, such as the ERICA Study Series, in order to

---

24 Results and trends observed for non-financial multinational groups studied in this paper do not necessarily reflect the performance of the whole non-financial corporate sector in the countries considered (i.e. financing resources can be obtained in international financial markets or a group’s main EBIT margin contribution could come from an international market).

broadly and deeply explain not only the ratio decomposition results but also their reasons.

Annex 1

Table A

List of ERICA variables (2014 database)

General characteristics and employment

Code	Name	Text / Numeric
G001	1. Name of reporting period	text
G019	2.1. Name of the parent entity	text
G002	2.2. National identification code of the parent entity	text
G029	2.3. ERICA identification code of the parent entity	text
G010	Legal form of the parent entity	text
G031	2.4. ISIN identification code of the parent entity	text
G032	2.4. EGR identification code of the parent entity	text
G033	2.7. LEI Code of Parent Entity	text
G012	2.6. Country of incorporation	text
G020	3.1. Name of the ultimate parent entity of the group	text
G0200	3.2. National identification code of the ultimate parent entity of the group	text
G0201	3.3. ERICA identification code of the ultimate parent entity of the group	text
G0203	2.4. ISIN identification code of the ultimate parent entity	text
G0202	2.4. EGR identification code of the ultimate parent entity	text
G0101	3.6. Legal form of the ultimate parent entity of the group	text
G0121	3.7. Country of the ultimate parent entity of the group	text
G003	4. Nature of financial statements (consolidated or individual)	text
G004	5.1. Yearly or interim financial statements	text
G005	5.2. Date of the beginning of the reporting period (yyyy-mm-dd)	text
G006	5.3. Date of the end of the reporting period (yyyymm)	numeric
G061	5.4. Number of months of the reporting period	numeric
G007	6. Presentation currency (ISO code 4217)	text
G008	7. Level of precision in financial statement's figures	text
G0150	8.1. Sector classification of the reporting entity (four digits NACE code) (a)	text
G01501	Activity 1 : NACE code (four digits)	text
G01502	Activity 2 : NACE code (four digits)	text
G01503	Activity 3 : NACE code (four digits)	text
G01504	Activity 4 : NACE code (four digits)	text
G01601	Activity 1 : Revenue	numeric
G01602	Activity 2 : Revenue	numeric
G01603	Activity 3 : Revenue	numeric
G01604	Activity 4 : Revenue	numeric
G017	9. Listed companies	text
G0171	Share Price	numeric
G0172	Number of Shares	numeric
G021	10. Data previous period	text
G026	11. Opinion on the financial statements given by the auditor	text
G091	12. Information about employment	text
G027	12. Number of employees average over period	numeric

Code	Name	Text / Numeric
G028	12. Number of employees at end of period	numeric
G081	13.1. Method of presentation of cash-flow statement	text
G082	13.2. Subsequent measurement of property, plant and equipment	text
G088	13.3. Subsequent measurement of investment property	text
G089	13.4. Method of presentation of statement of other comprehensive income	text
G090	14. Business combinations	text
cc_960	1. Capitalized borrowing costs / interest expenses	numeric
cc_146	2. Gains (losses) on financial instruments designated as hedges	numeric
cc_145	3. Fair value gains (losses) from financial instruments	numeric
G02111	1.1. Reason of recalculated data: IAS 19	text
G02112	1.2. Reason of recalculated data: IFRS 9	text
G02113	1.3. Reason of recalculated data: IFRS 10-11-12	text
G02114	1.4. Reason of recalculated data: IFRS 14	text
G02115	1.5. Reason of recalculated data: IFRS 15	text
G02116	1.6. Reason of recalculated data: IFRIC 21	text
G0212	2. Reason of recalculated data: Voluntary change in accounting policy (IAS 8)	text
G0213	3. Reason of recalculated data: Correction of prior periods errors (IAS 8)	text
G0214	4. Reason of recalculated data: Reclassification (IAS 8)	text
G0215	5. Reason of recalculated data: Business Combinations (IFRS 3)	text
G0216	6. Reason of recalculated data: Non Current Assets Held For Sale and discontinued Operations (IFRS 5)	text
G0217	7. Reason of recalculated data: Other Reason/Open Field	text
cc_101	4.1. Variation of renevue by reasons (absolute values): Organic growth / decrease	numeric
cc_102	4.2. Variation of renevue by reasons (absolute values): Exchange Currency	numeric
cc_103	4.3. Variation of renevue by reasons (absolute values): Changes in perimeter	numeric
cc_104	4.4. Variation of renevue by reasons (absolute values): Other	numeric
cc_1041	4.4.1. Variation of renevue by reasons (absolute values): Other Reasons/Not Classified	numeric
cc_3001	5.1. Additions to intangible assets	numeric
cc_3002	5.2. Additions to tangible assets	numeric
cc_3003	5.3. Additions to non current financial assets	numeric
listing	Listing of reporting entity	text
Income	Format of income statement (by nature or by function)	text
double_global	Double accounted in Erica	text
double_country	Double accounted entity with parent entity from the same country	text
double_sector	Double accounted entity with parent entity from the same sector	text
size	Size classification of the group	text
sector	Sector classification of the group	text
year	Year of the report	numeric
Periodtype	Type of period data	numeric
source	Source of data	text

Table B

List of ERICA variables (2014 database)

Income statement by function

Code	Name	Text / Numeric
cc_10_20	1a. Gross profit	numeric
cc_10	1a.1. (Operating) Revenue	numeric
cc_20	1.a.2. (-) Cost of sales	numeric
cc_11	1b. Other operating income	numeric
cc_112	of which, income from goverment grants	numeric
cc_113	of which, impairment reversals	numeric
cc_21	2. (-) Operating expenses	numeric
cc_210	2.2 (-) Distribution costs	numeric
cc_211	2.2 (-) Research and development costs	numeric
cc_212	2.3. (-) Administrative expenses	numeric
cc_213	2.1. (-) Restructuring costs	numeric
cc_219	2.4. (-) Other operating expenses	numeric
cc_15	3. Gain (loss) in changes in fair value of non-current assets	numeric
cc_10_22	4. Profit (loss) from operating activities	numeric
cc_14	5. Net financial result	numeric
cc_242	5.1. (-) Finance costs	numeric
cc_2420	of which, (-) interest expense	numeric
cc_142	5.2. Financial income	numeric
cc_1420	of which, interest earned on loans and deposits	numeric
cc_145_147	5.3. Gains (losses) from financial instruments	numeric
cc_950	5.4. Exchange differences recognised in profit or loss	numeric
cc_141	5.5. Profit (loss) from investments in related parties	numeric
cc_143	of which, share of profit (loss) of associates and joint ventures accounted for equity method	numeric
cc_169_269	6. Other non-operating income (expense)	numeric
cc_10_26	7. Profit (loss) before tax	numeric
cc_27	8. (-) Income tax expense (income)	numeric
cc_10_27	9. Profit (loss) after tax from continuing operations (before non-controlling interests)	numeric
cc_18	10. Profit (loss) from discontinued operations, net of tax	numeric
cc_10_28	11. Profit (loss) (before non-controlling interests)	numeric
cc_29	12. (-) Profit (loss) attributable to non-controlling interests	numeric
cc_10_29	13. Profit (loss) attributable to owners of parent	numeric
cc_222	1. (-) Employee expenses	numeric
cc_223	2. (-) Depreciation and amortisation	numeric
cc_224	3. (-) Impairment losses, total (not reversals)	numeric
cc_2242	of which, (-) impairment losses from goodwill	numeric
cc_12_221	4. Changes in inventories of finished goods and work in progress	numeric
cc_13	5. Work performed by the enterprise and capitalised	numeric
cc_220	6. (-) Raw materials and consumables used	numeric
cc_225	7. (-) Research and development costs	numeric

Table C

List of ERICA variables (2014 database)

Income statement by nature

Code	Name	Text / Numeric
cc_10_13	1. Operating revenue	numeric
cc_10	1.1. Revenue	numeric
cc_11	1.2. Other operating income, total	numeric
cc_112	of which, income from government grants	numeric
cc_113	of which, impairment reversals	numeric
cc_12_221	1.3. Changes in inventories of finished goods and work in progress	numeric
cc_13	1.4. Work performed by the enterprise and capitalised	numeric
cc_22	2. (-) Operating expenses	numeric
cc_220	2.1. (-) Raw materials and consumables used (a)	numeric
cc_222	2.2. (-) Employee expenses	numeric
cc_223	2.3. (-) Depreciation and amortisation	numeric
cc_224	2.4. (-) Impairment losses, total (not reversals)	numeric
cc_2242	of which, (-) impairment losses from goodwill	numeric
cc_225	2.5. (-) Research and development [by nature]	numeric
cc_226	2.6. (-) Restructuring costs	numeric
cc_239	2.7. (-) Other operating expenses	numeric
cc_15	3. Gain (loss) in changes in fair value of non-current assets	numeric
cc_10_22	4. Profit (loss) from continuing operations before tax, finance and other related costs	numeric
cc_14	5. Net financial result	numeric
cc_242	5.1. (-) Finance costs	numeric
cc_2420	of which, (-) interest expense	numeric
cc_142	5.2. Financial income	numeric
cc_1420	of which, interest earned on loans and deposits	numeric
cc_145_147	5.3. Gains (losses) from financial instruments	numeric
cc_950	5.4. Exchange differences recognised in profit or loss	numeric
cc_141	5.5. Profit (loss) from investments in related parties	numeric
cc_143	of which, share of profit (loss) of associates and joint ventures accounted for equity method	numeric
cc_169_269	6. Other non-operating income (expense)	numeric
cc_10_26	7. Profit (loss) before tax	numeric
cc_27	8. (-) Income tax expense (income)	numeric
cc_10_27	9. Profit (loss) after tax from continuing operations (before non-controlling interests)	numeric
cc_18	10. Profit (loss) from discontinued operations, net of tax	numeric
cc_10_28	11. Profit (loss) (before non-controlling interests)	numeric
cc_29	12. (-) Profit (loss) attributable to non-controlling interests	numeric
cc_10_29	13. Profit (loss) attributable to owners of parent	numeric

Table D

List of ERICA variables (2014 database)

Statement of Comprehensive Income

Code	Name	Text / Numeric
cc_10_28	11. Profit (loss) (before non-controlling interests)	numeric
cc_592	II. OTHER COMPREHENSIVE INCOME FOR THE PERIOD	numeric
cc_59201	1. Exchange differences on translation	numeric
cc_59202	2. Available-for-sale financial assets	numeric
cc_592021	of which, gains (losses) arising during the period	numeric
cc_592022	of which, reclassification adjustments for gains (losses) included in profit or loss	numeric
cc_59203	3. Cash flow hedges	numeric
cc_592031	of which, gains (losses) arising during the period	numeric
cc_592032	of which, (-) reclassification adjustments for gains (losses) included in profit or loss	numeric
cc_59209	4. Gains (losses) from hedges of net investments in foreign operations	numeric
cc_59204	5. Gains (losses) on revaluation	numeric
cc_59205	6. Actuarial gains (losses) on defined benefit plans	numeric
cc_59206	7. Share of other comprehensive income of associates and joint ventures accounted for using the equity method	numeric
cc_59207	8. Other income and expense recognized directly in equity	numeric
cc_59208	of which, reclassification adjustments - transferred to income statement	numeric
cc_5922	9. Income tax relating to other comprehensive income	numeric
cc_596	II.I. Other comprehensive income that will not be reclassified to profit or loss	numeric
cc_592061	3. Share of other comprehensive income of associates and joint ventures accounted for using equity method that will not be reclassified to profit or loss	numeric
cc_59602	4. Remaining other comprehensive income that will not be reclassified	numeric
cc_59221	5. Income tax relating to other comprehensive income that will not be reclassified	numeric
cc_597	II.II. Other comprehensive income that will be reclassified to profit or loss	numeric
cc_592062	5. Share of other comprehensive income of associates and joint ventures accounted for using equity method that will be reclassified to profit or loss	numeric
cc_59603	6. Remaining other comprehensive income that will be reclassified	numeric
cc_59222	7. Income tax relating to other comprehensive income that will be reclassified	numeric
cc_590	III. TOTAL COMPREHENSIVE INCOME FOR THE PERIOD (I + II)	numeric
cc_5901	1. Attributable to owners of the parent	numeric
cc_5902	2. Attributable to non-controlling interests	numeric

Table E

List of ERICA variables (2014 database)

Assets

Code	Name	Text / Numeric
cc_3	I. ASSETS, NON-CURRENT, TOTAL	numeric
cc_30	1. Property, plant and equipment, net	numeric
cc_300	1.1. Land and buildings	numeric
cc_301	1.2. Plant and equipment, net	numeric
cc_309	1.3. Remaining property, plant and equipment, net	numeric
cc_303	1.4. Construction in progress and payments in advance, net	numeric
cc_310	2. Investment property	numeric
cc_32	3. Intangible assets, net	numeric
cc_320	3.1. Goodwill, net	numeric
cc_321	3.2. Development costs, net	numeric
cc_322_323	3.3. Computer software, copyrights, patents and other industrial property rights, service and operating rights, net	numeric
cc_328	3.4. Remaining intangible assets	numeric
cc_33_42	4. Biological assets, total	numeric
cc_34	5. Investments in related parties	numeric
cc_340	of which, equity accounted investments	numeric
cc_35	6. Deferred tax assets	numeric
cc_36	7. Other financial assets, non-current	numeric
cc_37	of which, derivatives (including hedging assets), non-current	numeric
cc_39	8. Remaining assets, non-current	numeric
cc_390	of which, non-current trade receivables	numeric
cc_4	II. ASSETS, CURRENT, TOTAL	numeric
cc_41	10. Inventories	numeric
cc_43	11. Other financial assets, current	numeric
cc_44	of which, derivatives (including hedging assets), current	numeric
cc_45	12. Current tax receivables (only income tax)	numeric
cc_460	13. Trade receivables, net	numeric
cc_4601	of which, receivables arising from construction contracts	numeric
cc_48	14. Cash and cash equivalents	numeric
cc_491	15. Remaining assets, current	numeric
cc_47	of which prepayments, current (prepaid expenses, among others)	numeric
cc_40	9. Non-current assets and disposal groups held for sale or held for distribution to owners	numeric
cc_3_4	ASSETS, TOTAL	numeric

Table F

List of ERICA variables (2014 database)

Liabilities and equity

Code	Name	Text / Numeric
cc_50_56	I. EQUITY, TOTAL	numeric
cc_50_55	A. Equity attributable to equity holders of parent	numeric
cc_50	1. Share capital	numeric
cc_51	2. Share premium	numeric
cc_54_55_527	3. Retained earnings	numeric
cc_527	of which, legal and statutory reserves	numeric
cc_52	4. Other reserves	numeric
cc_521	4.1. Translation reserves	numeric
cc_522	4.2. Revaluation reserves	numeric
cc_523	4.3. Hedging reserves	numeric
cc_524	4.4. Available for sale reserves	numeric
cc_526	4.5. Reserve of remeasurements of defined benefit plans	numeric
cc_528	4.6. Remaining reserves	numeric
cc_53	5. (-) Treasury shares	numeric
cc_56	B Non-controlling interests	numeric
cc_569	C. Other equity interest	numeric
cc_6_7	II. LIABILITIES,TOTAL	numeric
cc_6	A. Liabilities, non-current, total	numeric
cc_60_61	6. Financial liabilities, non-current	numeric
cc_603	of which, borrowings from financial institutions, non-current	numeric
cc_604	of which, finance leases, non-current	numeric
cc_601	of which, bonds, non-current	numeric
cc_62	7. Deferred income, non-current	numeric
cc_620	of which, government grants, non-current (classified as deferred income)	numeric
cc_64	8. Provisions for employee benefits, non-current	numeric
cc_63	9. Other provisions, non-current	numeric
cc_67	10. Deferred tax liabilities	numeric
cc_65_69	11. Remaining liabilities, non-current	numeric
cc_66	of which, derivatives (including hedging liabilities), non-current	numeric
cc_690	of which, trade payables, non-current	numeric
cc_7	B. Liabilities, current, total	numeric
cc_71_72	12. Financial liabilities, current	numeric
cc_713	of which, borrowings from financial institutions, current	numeric
cc_714	of which, finance leases, current	numeric
cc_711	of which, bonds, current	numeric
cc_73	13. Deferred income, current	numeric
cc_730	of which, government grants, current (classified as deferred income)	numeric
cc_75	14. Provision for employee benefits, current	numeric
cc_74	15. Other provisions, current	numeric
cc_77	16. Current tax payables (only income tax)	numeric
cc_780	17. Trade payables	numeric
cc_7801	of which, liabilities arising from construction contracts	numeric
cc_790	18. Remaining liabilities, current	numeric

Code	Name	Text / Numeric
cc_781	of which, advances received	numeric
cc_761	of which, derivatives (including hedging liabilities), current	numeric
cc_70	19. Liabilities included in disposal groups held for sale	numeric
cc_50_7	EQUITY AND LIABILITIES, TOTAL	numeric
cc_58950	1. Dividends distributed to owners	numeric
cc_970	2. Proposal of dividends to be distributed to owners	numeric

Table G

List of ERICA variables (2014 database)

Statement of cash flows

Code	Name	Text / Numeric
cc_80	I. CASH AND CASH EQUIVALENTS, BEGINNING BALANCE	numeric
cc_81	II. NET CASH FLOWS FROM (USED IN) OPERATING ACTIVITIES	numeric
cc_814	of which, operating cash flow from discontinued operations	numeric
cc_82	III. NET CASH FLOWS FROM (USED IN) INVESTING ACTIVITIES	numeric
cc_824	of which, investing cash flow from discontinued operations	numeric
cc_81_82	IV.FREE CASH FLOW (II + III)	numeric
cc_83	V. NET CASH FLOWS FROM (USED IN) FINANCING ACTIVITIES	numeric
cc_834	of which, financing cash flow from discontinued operations	numeric
cc_84	VI. NET INCREASE IN CASH AND CASH EQUIVALENTS (II + III + IV)	numeric
cc_85	VII. EFFECT OF EXCHANGE RATE CHANGES ON CASH AND CASH AND EQUIVALENTS	numeric
cc_86	VIII. EFFECT OF CHANGES IN SCOPE OF CONSOLIDATION ON CASH AND CASH EQUIVALENTS	numeric
cc_87	IX. CASH AND CASH EQUIVALENTS, ENDING BALANCE (I + V + VI + VII)	numeric
cc_88	X. ADJUSTMENTS TO RECONCILE WITH THE STATEMENT OF FINANCIAL POSITION	numeric
cc_89	XI. CASH AND CASH EQUIVALENTS AS REPORTED IN THE STATEMENT OF FINANCIAL POSITION	numeric

Table H

List of ERICA variables (2014 database)

Statement of changes in equity

Code	Name	Text / Numeric
cc_580	I. BALANCE, END OF PERIOD N - 1	numeric
cc_581	1. Prior period adjustements to equity, total	numeric
cc_582	II. RESTATED BALANCE, END OF PERIOD N - 1	numeric
cc_583	1. Issue of shares	numeric
cc_584	2. (-) Capital reduction	numeric
cc_585	3. Equity increase (decrease) resulting from a business combination	numeric
cc_586	4. Operations with treasury shares	numeric
cc_587	5. Conversion of debt to equity	numeric
cc_588	6. Remaining movements in equity not related to income or expenses	numeric
cc_589	7. (-) Dividends	numeric
cc_590	8. Total comprehensive income for the period	numeric
cc_580_2	III. BALANCE, END OF PERIOD N	numeric

Annex 2

Table

Definition of the aggregate financial ratios

Ratio		ERICA DB variable	Name
Equity Ratio	Numerator (N)	cc_50_56	Total Equity
	Denominator (D)	cc_3_4	Total Assets
	Ratio = N/D x 100		
Financial Debt Ratio	Numerator (N)	cc_60_61 + cc_71_72	Financial Debt
	Denominator (D)	cc_3_4	Total Assets
	Ratio = N/D x 100		
EBIT Margin	Numerator (N)	cc_10_22	EBIT (Earnings Before Interest and Taxes)
	Denominator (D)	cc_10	Revenue
	Ratio = N/D x 100		

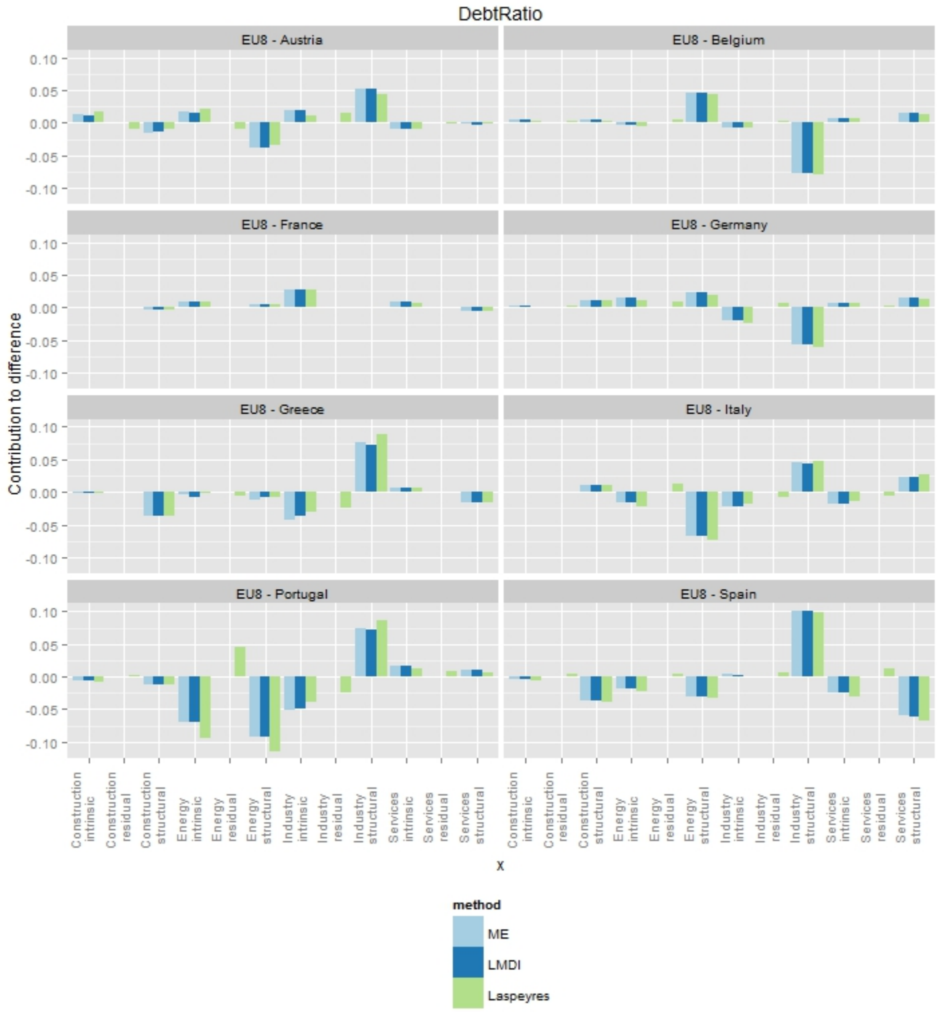
Annex 3

The figure below assesses the robustness of the analysis with respect to the method used. Each panel shows the decomposition of the difference in a country's financial debt ratio compared with EU-8 for different decomposition methods: the Marshall-Edgeworth method (ME), the Logarithmic Mean Divisia Index method (LMDI) and the Laspeyres method.

The horizontal axis shows the different sectors and the type of effect (structural or intrinsic and, for Laspeyres only, the residual term). For example, in the top left-hand panel one can see that for EU-8 - Austria, the intrinsic effect for the construction sector ("Construction intrinsic" on the horizontal axis) using a Marshall-Edgeworth decomposition (light-blue bar on the left) and the intrinsic effect using the LMDI decomposition (dark-blue bar on the left) are almost equal, while the intrinsic effect computed using the Laspeyres decomposition is slightly higher. The residual in the construction sector ("Construction residual" on the horizontal axis) is (obviously) zero for the ME and LMDI methods and slightly negative in the Laspeyres method.

The figure shows that the light-blue bars (ME) and the dark-blue bars (LMDI) are very similar, implying that the choice between ME and LMDI has almost no impact. The results for the Laspeyres method are slightly different from ME and LMDI (due to the residual term), but the "direction" of each effect does not change. We may therefore conclude that the results are robust with respect to the method used.

Debt Ratio


DebtRatio
EU8 - Austria
EU8 - Belgium
EU8 - France
EU8 - Germany
EU8 - Greece
EU8 - Italy
EU8 - Portugal
EU8 - Spain
Contribution to difference
0.10
0.05
0.00
-0.05
-0.10
Construction intrinsic
Construction residual
Construction structural
Energy intrinsic
Energy residual
Energy structural
Industry intrinsic
Industry residual
Industry structural
Services intrinsic
Services residual
Services structural
x
method
ME
LMDI
Laspeyres

References

Albrecht J., François D and Schoors K. (2002), “A Shapley decomposition of carbon emissions without residuals”, Energy Policy, Vol. 30, Issue 9, pp. 727-736.

Ang B.W. (1995), “Multilevel decomposition of industrial energy consumption”, Energy Economics, Vol. 17, Issue 1, pp. 39-51.

Ang B.W. and Choi, K.-H. (1997). “Decomposition of aggregate energy and gas emission intensities for industry: a refined Divisia index method”, The Energy Journal, Vol. 18, Issue 3, pp. 59–73.

Ang B.W. (2004), “Decomposition analysis for policymaking in energy: which is the preferred method?”, Energy Policy, Vol. 32, Issue 9, pp. 1131-1139.

Ang B.W. and Na Liu (2001), “A new energy decomposition method: perfect in decomposition and consistent in aggregation”, Energy, Vol. 26, Issue 6, pp. 537-548.

Ang B.W. and Na Liu (2007a), “Negative-value problems of the logarithmic mean Divisia index decomposition approach”, Energy Policy, Vol. 35, Issue 1, pp. 739-742.

Ang B.W. and Na Liu (2007b), “Handling zero values in the logarithmic mean Divisia index decomposition approach”, Energy Policy, Vol. 35, Issue 1, pp. 238-246.

Ang B.W, Liu F.L. and Chew E.P. (2003), “Perfect decomposition techniques in energy and environmental analysis”, Energy Policy, Vol. 31, Issue 14, pp. 1561-1566.

Ang B.W., Xu X.Y and Bin Su (2015), “Multi-country comparisons of energy performance: the index decomposition approach”, Energy Economics, Vol. 47, pp. 68-79.

Ang B.W. and Zhang F.Q. (2000), “A survey of index decomposition analysis in energy and environmental studies”, Energy, Vol. 25, Issue 12, pp. 1149-1176.

Balk B.M. (1996), “Consistency-in-aggregation and Stuvel indices”, Review of Income & Wealth, Vol. 42, Issue 3.

Balk B.M. (2003), “Ideal indices and indicators for two or more factors”, Erasmus Research Institute of Management, Erasmus University Rotterdam, and Methods and Informatics Department, Statistics Netherlands.

Balk B.M. (2005), “Divisia price and quantity indices: 80 years after”, Statistica Neerlandica, Vol. 59, Issue 2, pp. 119-158.

Boyd G.A., Hanson D.A. and Sterner T. (1988), “Decomposition of changes in energy intensity: A comparison of the Divisia index and other methods”, Energy Economics, Vol. 10, Issue 4, pp. 309-312.

Burggraeve K, Jeanfils Ph., Van Cauter K. and Van Meensel L (2008), “Macroeconomic and fiscal impact of the risk capital allowance”, National Bank of Belgium - Economic Review.

Coppens F. (2010), “The increased volatility of electricity prices for Belgian households”, National Bank of Belgium - Economic Review.

Diewert W.E. (2007), “Index Numbers”, Working Paper No 2007/02, Centre for Applied Economic Research, University of New South Wales.

Edgeworth F.Y. (1925), “Papers relating to political economy”, Vol. I, Royal Economic Society, MacMillan and Co.

ERICA WG (2013), “European non-financial listed groups: analysis of 2012 data”, European Committee of Central Balance Sheet Offices, December.

ERICA WG (2014), “European non-financial listed groups: analysis of 2013 data”, European Committee of Central Balance Sheet Offices, December.

ERICA WG (2015a), “ERICA 2014 Data User’s Guide”, European Committee of Central Balance Sheet Offices, December.

ERICA WG (2015b), “European non-financial listed groups: analysis of 2014 data”, European Committee of Central Balance Sheet Offices, December.

Fisher I. (1922), “The making of index numbers”, Boston Houghton Mifflin.

Frisch R., (1930), “Necessary and Sufficient Conditions Regarding the Form of an Index Number which Shall Meet Certain of Fisher’s Tests”, Journal of the American Statistical Association, Vol. 25, Issue 172, pp. 397-406.

Granel F. (2003), “A comparative analysis of index decomposition methods”, Master’s degree thesis, Department of Industrial and Systems Engineering, National University of Singapore.

Greening L.A., Davis W.B., Schipper L. and Khrushch M. (1997), “Comparison of six decomposition methods: application to aggregate energy intensity for manufacturing in 10 OECD countries”, Energy Economics, Vol. 19, Issue 3, pp. 375-390.

Hoekstra R. and van der Bergh J., (2003), “Comparing structural and index decomposition analysis”, Energy Economics, Vol. 25, Issue 1, pp. 39-64.

Horrigan J.O. (1965), “Some empirical bases of financial ratio analysis”, The Accounting Review, Vol. 40, Issue 3, pp. 558-568.

Huerga J. and Steklacova L. (2008), “An application of index number theory to interest rates”, ECB Working Paper Series 939.

IFRS Foundation (2016), “International Financial Reporting Standards: Bound Volume”.

IMF (2014), “Country report, Spain”, Country report No 14/193, July.

IMF (2015a), “The Italian and Spanish corporate sectors in the aftermath of the crisis”, July.

IMF (2015b), “Supporting medium-term growth through corporate debt restructuring: progress, impediments and remaining challenges”, in Country report No 15/127, pp. 69-81.

Kesicki F. (2012), “Decomposing long-run carbon abatement cost curves - robustness and uncertainty”, University College London, Energy Institute, pp. 111-154.

Marshall A. (1887), “Remedies for Fluctuations of General Prices”, Contemporary Review.

McLeay S. and Fieldsend S. (1987), “Sector and size effects in ratio analysis: an indirect test of ratio proportionality”, Accounting and Business Research, Vol. 17, Issue 66, pp. 133-140.

Montgomery, J. K. (1937), “The Mathematical Problem of the Price Index”, London, P.S. King & Son, Ltd.

Muller A. (2007), “Putting decomposition of energy use and pollution on a firm footing - clarifications on the residual, zero and negative values and strategies to assess the performance of decomposition methods”, Working Papers in Economics, No 215, Gothenburg University, School of Business, Economics and Law.

Ortega E. and Peñalosa J. (2012), “The Spanish economic crisis: key factors and growth challenges in the euro area”, Documentos Ocasionales, No 1201, Banco de España.

Robinson T.R., van Greuning H., Henry E. and Broihahn M.A. (2009), “International Financial Statement Analysis”, John Wiley & Sons, Inc.

Rubbrecht I. and Vivet D. (2015), “Results and financial situation of firms in 2014”, National Bank of Belgium - Economic Review, December, pp. 67-81.

Saaty T.L. (2008), “Decision making with the analytic hierarchy process”, International Journal of Services Sciences, Vol. 1, Issue 1, pp. 83-98.

Sato, K. (1976), “The Ideal Log-Change Index Number”, The Review of Economics and Statistics, Vol. 58, Issue 2, pp. 223-228.

Sun J.W. (1998), “Changes in energy consumption and energy intensity: A complete decomposition model”, Energy Economics, Vol. 20, Issue 1, pp. 85-100.

Sun J.W. (2000), “An analysis of the difference in CO2 emission intensity between Finland and Sweden”, Energy, Vol. 25, Issue 11, pp. 1139-1146.

Van der Cruisse de Waziers A. (2005), “A study on consistency in aggregation in index decomposition analysis”, National University of Singapore.

Vartia Y.O. (1976), “Ideal Log-Change Index Numbers”, Scandinavian Journal of Statistics, Vol. 3, Issue 3, pp. 121-126.

Vogt A. and Barta J. (1997), “The making of tests for index numbers”, Physica-Verlag, Heidelberg.

Zhang F.Q. and Ang B.W. (2001), “Methodological issues in cross-country/region decomposition of energy and environment indicators”, Energy Economics, Vol. 23, Issue 2, pp. 179-190.

Abbreviations

AMDI	Arithmetic Mean Divisia Index
EBIT	Earnings Before Interest and Taxes
ECCBSO	European Committee of Central Balance Sheet Data Offices
ERICA	European Records of IFRS Consolidated Accounts
EU	European Union
IAS	International Accounting Standards
IFRS	International Financial Reporting Standards
LMDI	Logarithmic Mean Divisia Index
NACE	Nomenclature statistique des Activités économiques dans la Communauté Européenne
WG	Working Group

Acknowledgements
We would like to thank Mr Beng Wah Ang, professor at the National University of Singapore (NUS), for providing us with references of relevant papers and for the answers to the questions we asked.
We would also like to thank the members of the ERICA Working Group for proofreading and checking country-specific data.
Last but not least, we acknowledge the constructive and useful comments of the Editorial Board of the ECB Statistics Paper Series.

Laurent Carlino
Banque de France; email: laurent.carlino@banque-france.fr

François Coppens
National Bank of Belgium; email: francois.coppens@nbb.be

Javier González
Banco de España; email: gonzalez.sainza@bde.es

Manuel Ortega
Banco de España; email: manuel.ortega@bde.es

Sébastien Pérez-Duarte
European Central Bank; email: sebastien.perez_duarte@ecb.europa.eu

Ilse Rubbrecht
National Bank of Belgium; email: ilse.rubbrecht@nbb.be

Saskia Vennix
National Bank of Belgium; email: saskia.vennix@nbb.be

Postal address 60640 Frankfurt am Main, Germany
Telephone +49 69 1344 0
Website www.ecb.europa.eu

This paper can be downloaded without charge from www.ecb.europa.eu and from RePEc: Research Papers in Economics. Information on all of the papers published in the ECB Statistics Paper Series can be found on the ECB's website.

ISSN	2314-9248 (pdf)	DOI	10.2866/29655 (pdf)
ISBN	978-92-899-2835-9 (pdf)	EU catalogue No	QB-BF-17-003-EN-N (pdf)