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EIF SME Access to Finance Index

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Abstract[1]

This EIF Working Paper outlines the methodology underlying the new EIF SME Access to Finance (ESAF) Index. This newly developed index aims at monitoring developments in SMEs' access to financial resources in the EU and is going to be periodically updated. It fills a gap as such an index does not exist. Composite indicators can be a useful tool in the policy maker's toolbox, as they are able to summarise a complex phenomenon in one summary statistics that is straightforward to track over time, or compare between countries. However, composite indicators also have the reputation of being black boxes. Therefore, we strive for transparency by motivating all methodological considerations made throughout the construction of the ESAF Index.

[1] This paper is based on an internal report produced in the context of an LSE Capstone project, authored by Bonggyu Chae, Li He, Mari Landsem, Chavi Meattle and Jacob Simunovic and supervised by Professor Stephen Jenkins. We thank the researchers for the very good cooperation. All remaining errors are our own.

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1 Introduction

This EIF Working Paper outlines the methodology behind the EIF SME Access to Finance Index (ESAF), a composite indicator that was developed in cooperation with the London School of Economics (LSE) and first introduced in the European Small Business Finance Outlook, a semi-annual EIF Working Paper (see Kraemer-Eis et al, 2016a).[2] The indicator provides a convenient tool to compare and benchmark country performance in the context of SMEs' access to finance in the EU.

Policy focus on SMEs' access to external financing sources is driven by the premise that SMEs are often more financially constrained than large firms (Beck and Demirguc-Kunt, 2006), even though they are generally regarded to be important contributors to economic growth. SMEs account for approximately 99.8% of all enterprises in the non-financial business sector and create 67% of total employment in the EU. Together, SMEs produce more than half of value added in the EU (Kraemer-Eis et al., 2017). The financial constraints facing SMEs are typically attributed to market and institutional failures. For example, small firms may be unable to put forward high quality collateral, they may have fewer administrative resources to provide adequate reporting and transparency about their credit-worthiness, or they may lack the brand equity that larger firms enjoy amongst creditors. These issues are often aggravated for young innovative enterprises, which mainly rely on equity finance to fulfil their growth potential (see Kraemer-Eis et al, 2016b). All of these factors contribute to the problem of asymmetric information between SMEs and their financers, which in turn leads to credit rationing and sub-optimal lending to viable SMEs (Darvas, 2013; Kraemer-Eis, Schaber and Tappi, 2010; Öztürk and Mrkaic, 2014).

The development of a composite indicator is a useful exercise, as it summarises this complex and multidimensional phenomenon of SME access to finance in one simple and easily interpretable statistic for policy-makers and other stakeholders. There are nevertheless reasons to exercise caution when evaluating composite indicators, as they can be misleading if poorly constructed or misinterpreted. The Organisation for Economic Co-operation and Development (OECD) Handbook on constructing composite indicators therefore suggests that "indicators must be seen as a means of initiating discussion and stimulating public interest" (OECD, 2008). Accordingly, this paper meets with these concerns by outlining and motivating the methodological considerations underlying the ESAF Index.

We are not the first to construct a composite indicator that aims to measure SMEs' access to finance in the EU, with the "SME Access to Finance Index" (SMAF) and the ECB's "Perceived External Financing Gap Indicator for SMEs" being two notable examples (European Commission, 2012; Ferrando et al., 2013). The latter index uses only perception-based subindicators, measuring movements rather than levels, rendering it less suitable for cross-country benchmarking exercises. The SMAF index, on the contrary, utilised a wider variety of subindicators and did allow for cross-country comparisons. However, it was discontinued in 2012. The ESAF Index aims to fill

[2] The content of this EIF Working Paper is largely based on the final report of a project that has been conducted by a team of Master of Public Administration (MPA) students from the London School of Economics (LSE) in collaboration with the EIF's Research & Market Analysis (RMA) division in the context of an EIB Institute Capstone Project (see Box 1).

that void by re-introducing a composite indicator, periodically updated, that summarises the state of SME financing in Europe for all EU28 countries.

Box 1: What is a Capstone Project?

A Capstone project is a consultancy student project executed by students from a master program in a European University and coordinated by the EIB institute, in cooperation with EIB Group staff. Projects have a resolutely operational approach and enable students to undertake a real-life consulting project on topics relevant to the EIB Group. At the same time, they allow EIB Group staff to carry out useful and often directly applicable operational research. For this Capstone project, the EIF's Research and Market Analysis division teamed up with five students from the LSE's Master of Public Administration (MPA) program. The Capstone project is part of the MPA core curriculum and it is designed to ensure that students have an intensive and closely supervised experience of working in a group on a real-world public policy project.

1st Project Phase

During the first phase of the project, a literature review of seminal papers and reports by experts in the field revealed that there is no universal or objectively superior approach for constructing a composite indicator. However, there is agreement among experts on certain best practices.

2nd Project Phase

Three major composite indicators/studies on SMEs' access to finance were evaluated: the SME Access to Finance Index (SMAF), the Perceived External Financing Gap Indicator for SMEs (Gap), and the OECD Scoreboard. The analysis of the SMAF in particular served as a fertile basis for the methodological choices and considerations that guided the third phase of the project.

3rd Project Phase

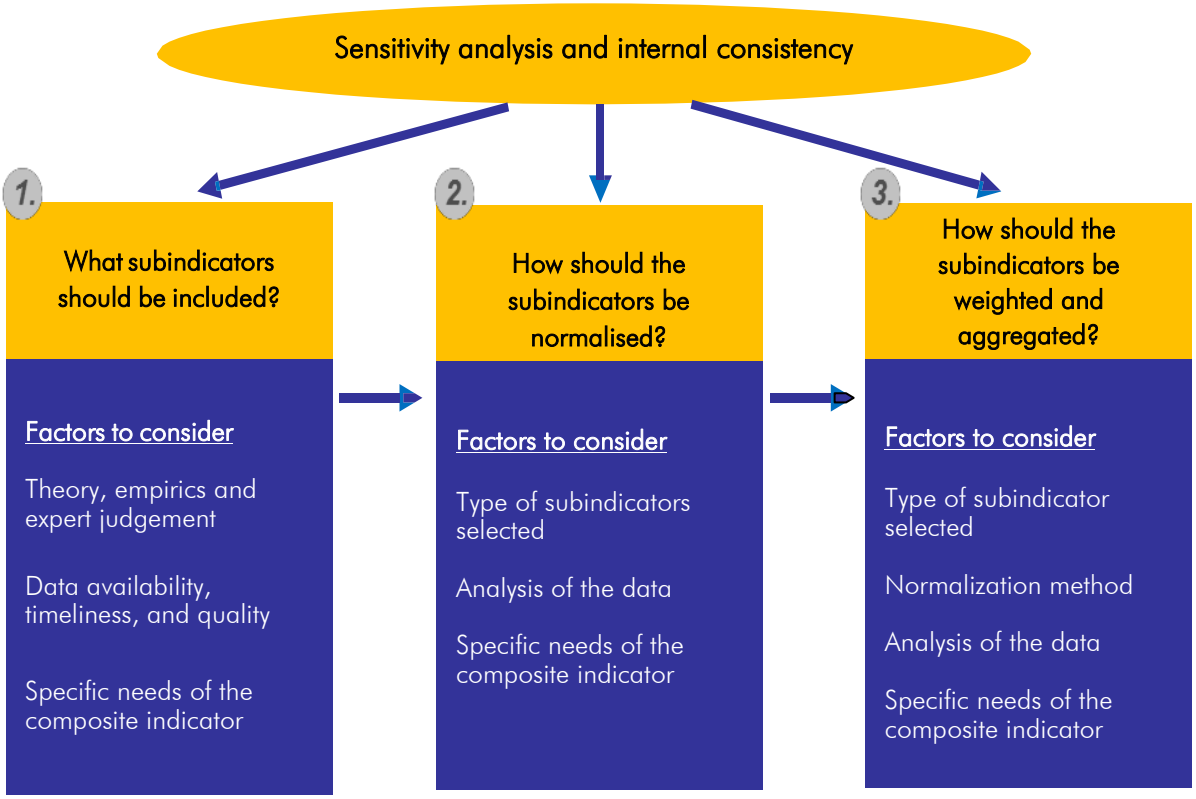
During this final phase, the researchers proceeded with the actual construction of the indicator, leveraging on the literature review from phase 1. Three key decisions were made pertaining to (1) selection of subindicators, (2) picking a normalisation method, and (3) allocating weights and aggregating the subindicators to arrive at a single summary statistic. The robustness of the resulting composite indicator was tested using sensitivity analysis. Finally, the students drafted an extensive report that summarised the entire process and documented all decision made during the projects' process. Consequently, this report served as the basis for the current working paper.

2 Methodological considerations

A literature review of seminal papers and reports (Atkinson et al., 2002; Booysen, 2002; Freudenberg, 2003; Nardo et al., 2005; OECD, 2008; Saisana and Tarantola, 2002; Sharpe, 2004) reveals there is no universal or objectively superior approach for constructing a composite indicator. Many of the decisions in the process entail a significant amount of subjectivity. However, there is agreement among experts on certain best practices.

The first step in constructing a composite indicator requires a precise definition of the phenomenon being measured (Atkinson et al., 2002). Once the phenomenon is properly defined, there are essentially three key decisions that must be made. Figure 1 provides an overview of these key decisions and makes clear that an index is not unidirectional, but rather iterative. This process ensures that the final measure is robust and transparent. Following initial methodological choices, a sensitivity analysis tests the robustness of the results to the chosen methodology. Based on the outcome, the methodology is reconsidered if deemed necessary. In addition, an internal consistency assessment checks whether the composite indicator's theoretical structure is in consonance with the statistical one.[3]

Figure 1: Considerations in constructing a composite indicator



[3] More details on this can be found in Annex 3.

2.1 Defining SME access to finance

A definition of access to finance serves as the starting point for our subindicator selection process. For the purpose of this project we define SME access to finance in terms of the *availability and cost* of different financing instruments (see Claessens and Tzioumis, 2006, for a similar definition).[4] Availability refers to the supply of external capital, its type, range and quality, and SMEs' capabilities to access it. Evidently, cost refers to the price of acquiring financing.

2.2 Subindicator selection

2.2.1 Criteria

Selecting subindicators to describe the phenomenon of interest is a defining step in the construction of a composite index. Much of the criticism of composite indicators pertains to the often subjective and ad-hoc process by which subindicators are selected. Therefore, developers should be transparent in their selection criteria. Five factors are critical in assessing whether a subindicator is feasible for inclusion (Adelman and Morris, 1972; Booysen, 2002; Freudenberg, 2003; Jacobs et al., 2004; Nardo, et al., 2005; OECD, 2008; Saisana and Tarantola, 2002).

1. Theory, empirics and expert judgement: The selected subindicators should be relevant to the phenomenon being measured. Experts and academic literature should be leveraged upon to help establish evidence-based links between subindicators and the output of interest.

2. Timeliness and accessibility of the data: Subindicators are only as valuable as the data available. Data must be accessible on a timely basis so that the composite index can be updated regularly and continuity is ensured.

3. Data quality: The data should ideally be objective and stem from a reliable source. Data completeness is also an important consideration, *i.e.* missing observations must be factored in when evaluating quality. Dataset coherence is also important. The data should be comparable over time and across entities, depending on the needs of the composite indicator. Lastly, the statistical quality of the data should be considered. For example, survey data administered with biased questions and a suboptimal sampling method should be viewed with scepticism.

4. Specific needs of the composite indicator: The indicator should take into consideration the unique needs of stakeholders. The stakeholder may for example express a desire for specific subindices to be included in the composite indicator. Just like a composite indicator, its subindices have a normative interpretation. Subindicators that belong to a given subindex must be selected to properly reflect this interpretation. Another common consideration is interpretability, the ease with which the target audience can understand the subindicator, taking into account the trade-off between sophistication and clarity.

5. Sensitivity analysis and internal consistency: Sensitivity analysis and internal consistency will be discussed in depth in section 3.3 and Annexes 3 and 4. The results of the composite indicator

[4] SME access to finance can be defined as the availability of supply of quality financial services at reasonable cost (Claessens and Tzioumis, 2006).

should not be significantly affected by alterations in methodological considerations. Large changes in the composite indicator's outcome should be a cause for further investigation.

2.2.2 Selected subindicators

Three main categories of subindicators were identified: Loans, Equity, and Credit and Leasing. In addition to the financial subindices, we chose to include an additional subindex capturing SMEs' institutional and macroeconomic environment. Institutional factors like the quality of a country's legal system and the strength of its information systems are frequently cited as determinants of access to finance (Beck et al., 2004; Laeven and Woodruff, 2007). Similarly, macroeconomic factors such as business cycle fluctuations are also shown to be associated with SMEs' access to finance (Holton et al., 2013; Masiak et al., 2017). All variables related to institutional and macro-economic factors are aggregated into a fourth subindex labelled Macro Factors.

Subsequently, we assessed more than a 100 subindicators as potential proxies for SME access to finance. Potential candidates were identified by inspecting various data sources (used by related composite indicators, World Bank, Eurostat) and the relevant literature. Because the indicators need to be constructed at the country-level and updated on an annual basis, only publicly available country-level datasets with a broad coverage of EU Member States were consulted. Each potential subindicator was systematically evaluated against the five criteria listed above. Figure 2 lists the chosen subindicators for each of the 4 subindices. Together, these instruments capture the most important SME financing instruments (Figure 3). Annex 1 provides a detailed description of the rationale behind the choice of each of the selected subindicators.

Figure 2: Selected Subindicators

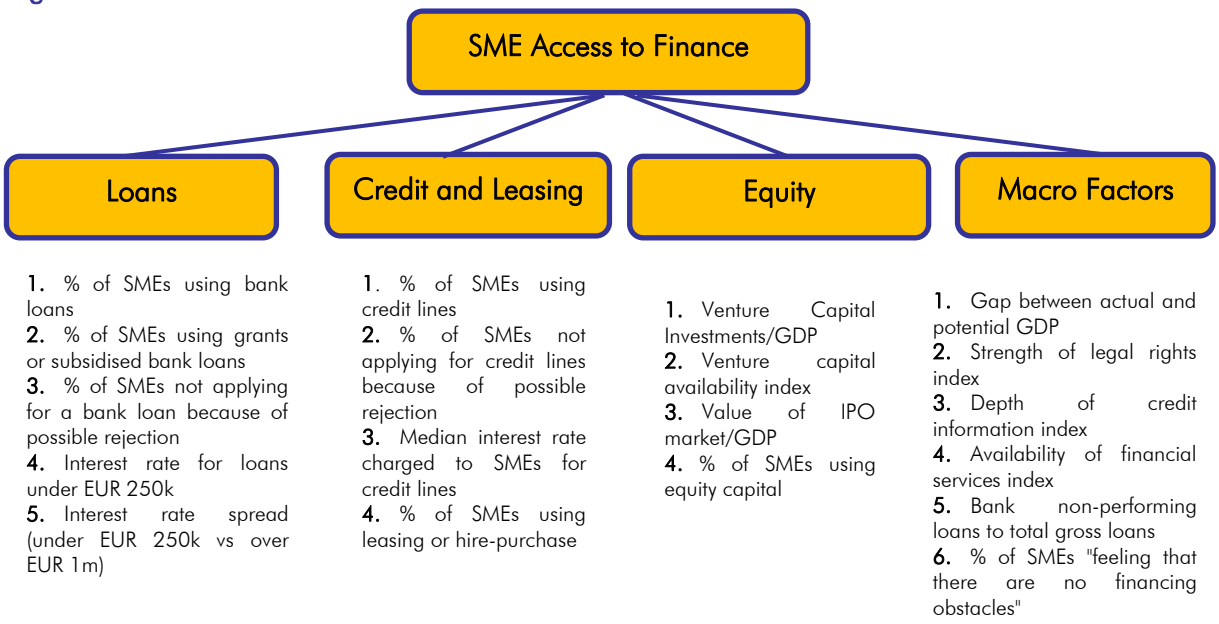
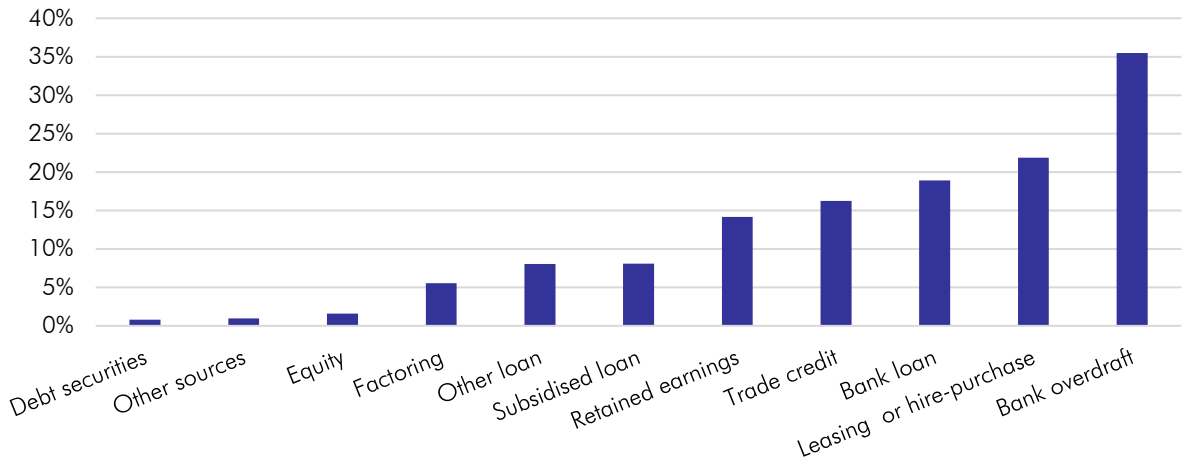


Figure 3: Percentage of SMEs that reported the following financing instruments to be relevant (2017)



Source: ECB SAFE data

While data completeness was a crucial factor in the selection process, occasional instances of missing data may occur. We deal with missing observations via the Last Observation Carried Forward method, which uses the last observed value to impute the missing observation.

2.3 Methodological considerations

2.3.1 Min-Max normalisation method

Before proceeding with the process of weighting and aggregating, subindicators must be placed on a comparable scale. There exist a number of normalisation methods to choose from, each of which has its own advantages and disadvantages. The optimal normalisation approach will depend on the properties of the underlying subindicators as well as the needs of the composite indicator. Depending on the requirements of the data at hand, a number of normalisation options present themselves: standardisation, Min-Max, simple ranking, categorical scaling, distance to a reference value, or cyclical scaling.[5]

The Min-Max method was selected as the baseline approach. This method has the added benefit of ensuring that all values are between 0 and 1. This makes it particularly suitable to be used in combination with geometric aggregation, which requires positive values (see section 2.3.3):

$$distance\ from\ the \min and\ max = \frac{observation\ value - minimum\ value}{maximum\ value - minimum\ value}$$

Because the min-max method is sensitive to outliers, we applied winsorisation[6] at the 5% level to each subindicator.

[5] For elaborate discussions on the pros and cons of different normalisation methods, see Ebert and Welsch (2004); Freudenberg (2003); Nardo et al. (2005); OECD, (2008) and Saisana and Tarantola (2002).

[6] Winsorisation removes outliers and replaces them with a pre-specified percentile value of the data. Winsorisation at the 5% level was selected to ensure that no sub-indicator values are above the 95th percentile or below the 5th percentile. This percentile value is subjectively selected, but given the distribution of our data, we found that this was a reasonable threshold.

2.3.2 Equal weighting

The ESAF Index is based on an equal weighting scheme; the most frequently applied weighting method (OECD, 2008). As the name suggests, this method assigns equal weights to all subcomponents of the composite indicator. This is implemented both at the individual subindicator level, as well as at the subindex level. The equal weighting method holds intuitive appeal and can be easily conveyed to a non-technical audience, which is helpful to secure broad visibility.

2.3.3 Geometric aggregation

The most common aggregation technique is linear aggregation, which simply adds up all normalised and/or weighted subindicators (Nardo et al., 2005). When using linear aggregation, a necessary and sufficient condition for theoretical consistency is that the subindicators are "preference independent" (OECD, 2008). An additive aggregation procedure implies full compensability: a very low score on one subindicator or subindex can be fully compensated by a sufficiently high score on another indicator. Therefore, weights in linear aggregation can be interpreted as trade-offs or substitution rates for different subindicators (Munda and Nardo, 2003). For the purpose at hand, this is not a desirable property. For example, SMEs typically rely on many different forms of external financing simultaneously and a shortage of one type cannot always be fully compensated by means of other external financing sources.

Geometric aggregation addresses the problem of full compensability that is inherent to additive aggregation techniques. When subindicators are geometrically aggregated, compensability is limited for subindicators with low values. To improve the overall ranking in the composite indicator, a low score on a given indicator must be compensated with much higher scores on the other subindicators, vis-à-vis additive aggregation techniques (OECD, 2008). Hence, geometric aggregation weighs more subindicators that see the country performing poorly, as they exert higher marginal impacts on the composite indicator. This aggregation method is still *partially* compensable and therefore assigned weights must still be seen as trade-offs rather than measures of importance (Munda and Nardo, 2005). In sum, geometric aggregation essentially ensures that countries that attain good results on the composite indicator do so because they generally do well on all subindicators, instead of excelling on just a subset.

$$geometric\ aggregation = \left(\prod_{i=1}^{n} value_i \right)^{\frac{1}{n}}$$

3 A new composite indicator of SME access to finance in Europe: Results and sensitivity analysis

3.1 The 2016 results

In this section we present the main results of our baseline approach (see Box 2). In addition to aggregate cross-country comparisons, the indicator also reveals interesting insights into different aspects of the SME financing situation in a given country. Figure 4 presents the overall composite indicator result and subindex scores for each country in 2016. With a few exceptions, the results are broadly in line with expectations. Sweden leads the ranking, driven by good performance on all individual subindices. Finland comes in second, followed by Germany and the United Kingdom. Unsurprisingly, Greece closes the ranking, ranking last in three out of four of the individual subindices.

Box 2: Process summary

- Step 1: Winsorisation at the 5 % level
- Step 2: Normalisation by Min-Max method
- Step 3: Equal weighting
- Step 4: Geometric aggregation

While it is not possible to a priori predict the exact ranking of individual countries, it is natural to uphold expectations based on prior knowledge about countries' general economic performance. Obviously, general economic conditions are not a perfect proxy for SME financing conditions and hence deviations from expectations should not necessarily be a cause for concern. Nevertheless, we elaborate on two individual cases that did not perform according to expectations to make explicit an important consequence of our choice for the geometric aggregation method.

The Netherlands comes in relatively low in the aggregate composite indicator ranking, taking up 12th place with an indicator value that is on par with some of the countries that have recently been under distress as a consequence of the financial and sovereign debt crisis, such as Spain and Ireland. It also underperforms compared to its geographical neighbour Belgium, despite the latter's worse macro and equity score. The Netherlands' low score is largely driven by its poor performance in the loans subindex (see also Figure 5). This was caused by several factors: a high interest rate size spread and a low percentage of SMEs using grants or subsidised bank loans. The theoretically motivated choice for geometric aggregation implies the Netherlands cannot compensate for its poor performance on the loan subindex with a high score on the equity subindex, in which it ranks fifth.

A similar observation holds for Italy, whose disappointing overall ranking was driven by subpar performance on the equity side (low amount of VC investments and low value of the IPO market) and the macro environment (low depth of credit information). Similar to the Dutch case, this illustrates how the high loan subindex score is in itself insufficient to compensate the low score attained on the equity subindex.

Figure 4: The 2016 ESAF Index

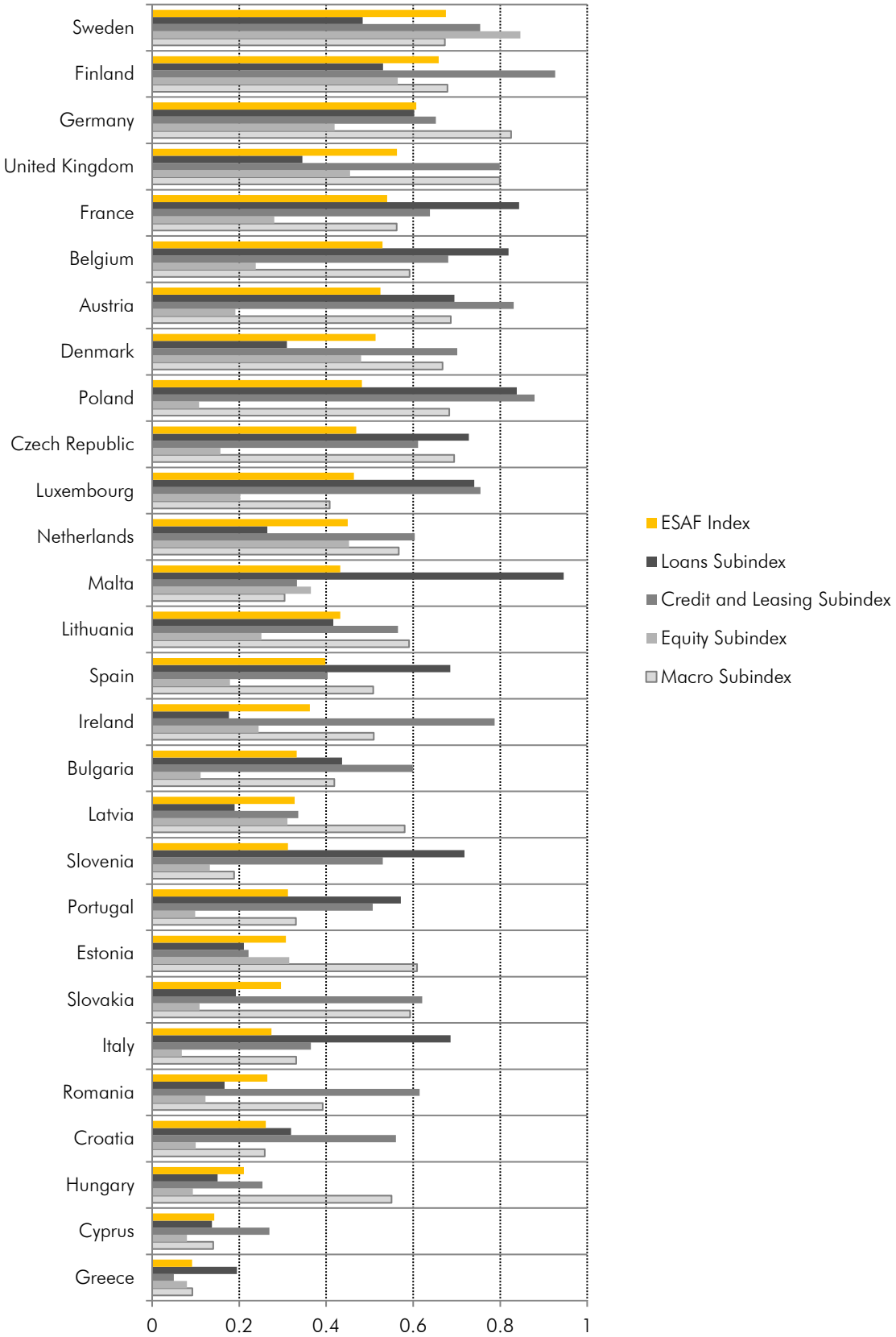
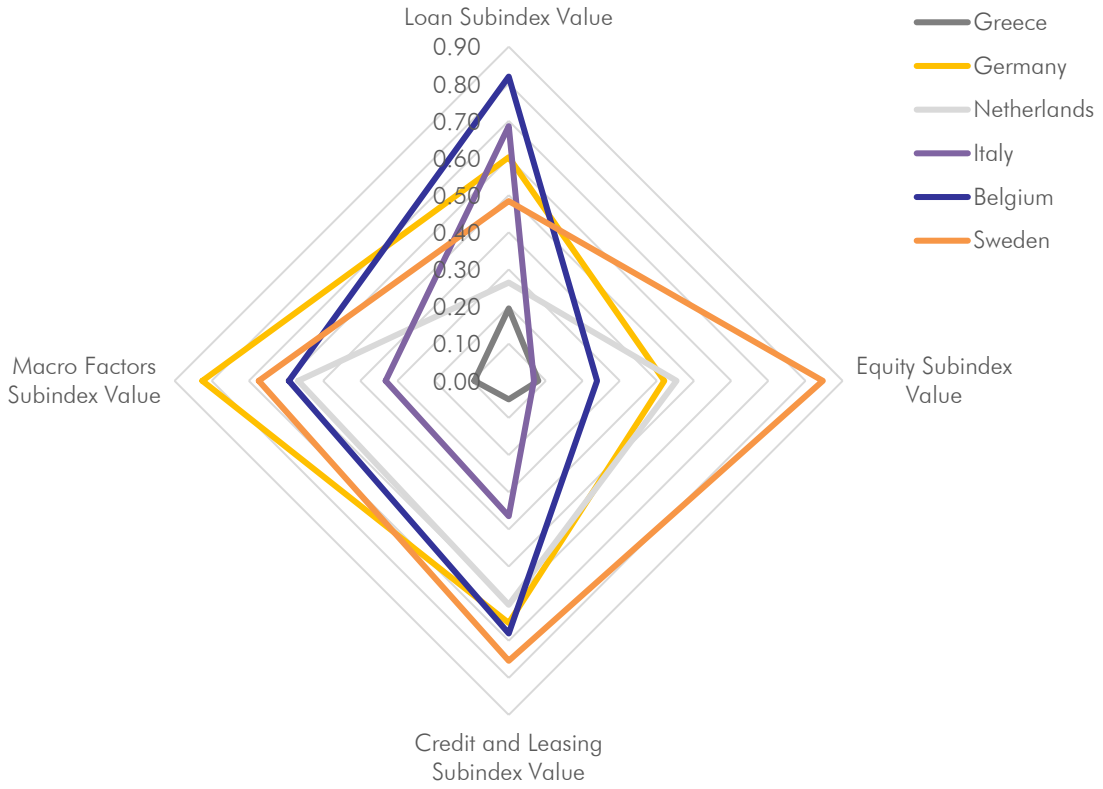


Figure 5: The 2016 ESAF subindices (examples for selected countries)



3.2 Evolution over time

Figure 6 represents the 2016 value of the composite indicator (orange dots) for each of the EU-28 countries and illustrates how it evolved since 2013 (grey dots). Comparing 2015 to 2016, the countries experiencing the biggest set-back in their ESAF index were Latvia, the United Kingdom and Sweden (see Figure 8 for an elaboration). The biggest improvements were recorded for the Czech Republic, Denmark and Bulgaria. The results also reveal that Greece has experienced a gradual deterioration of its index value. This contrasts to the general economic recovery the country has been experiencing in recent years.

While it is clear from Figure 6 that the absolute value of individual countries' ESAF Index is relatively stable over time, there is some degree of time variation in country *rankings*. Figure 7 digs deeper into the dynamics of the country rankings by plotting the 2013 country ranking against the 2016 country ranking. Points to the north-west of the 45-degree curve indicate a deterioration of a country's ranking, while all points to the south-east indicate an improvement. The change in the relative position is measured by the vertical distance to the 45 degree curve, as indicated by the red and green arrows. There are a number of countries that shifted significantly within the distribution, both upwards and downwards: Estonia (-6) and Latvia (-7 places) both slid down in the hierarchy significantly. On the other hand, Spain, Czech Republic and Sweden (+6 places) improved their relative positions. While there is no real pattern of polarisation or conversion noticeable, one additional result that catches the eye is the deterioration in the ranking of the 2013 top 4 countries (red circle).

Figure 6: The ESAF Index: Country comparison and evolution over time

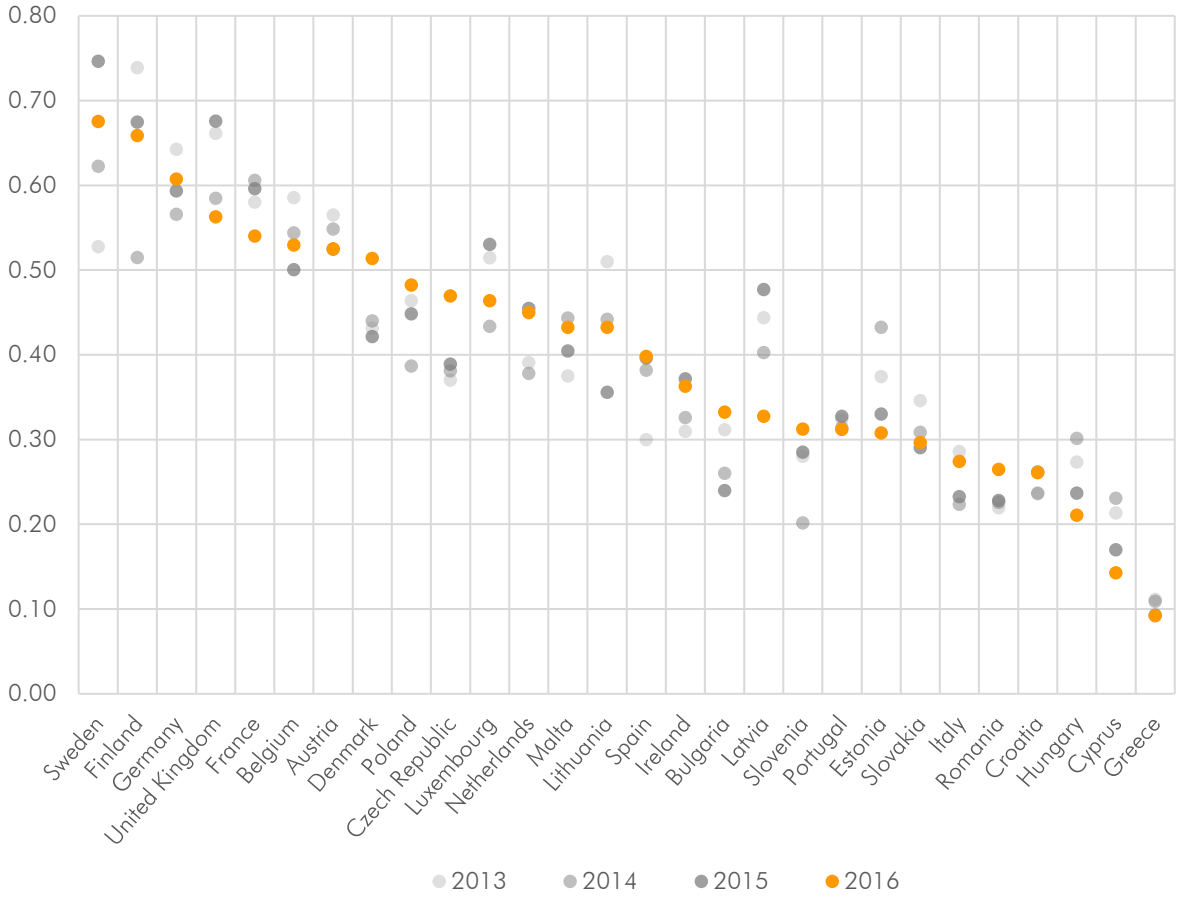


Figure 7: The ESAF Index: ranking comparison, 2013 vs 2016

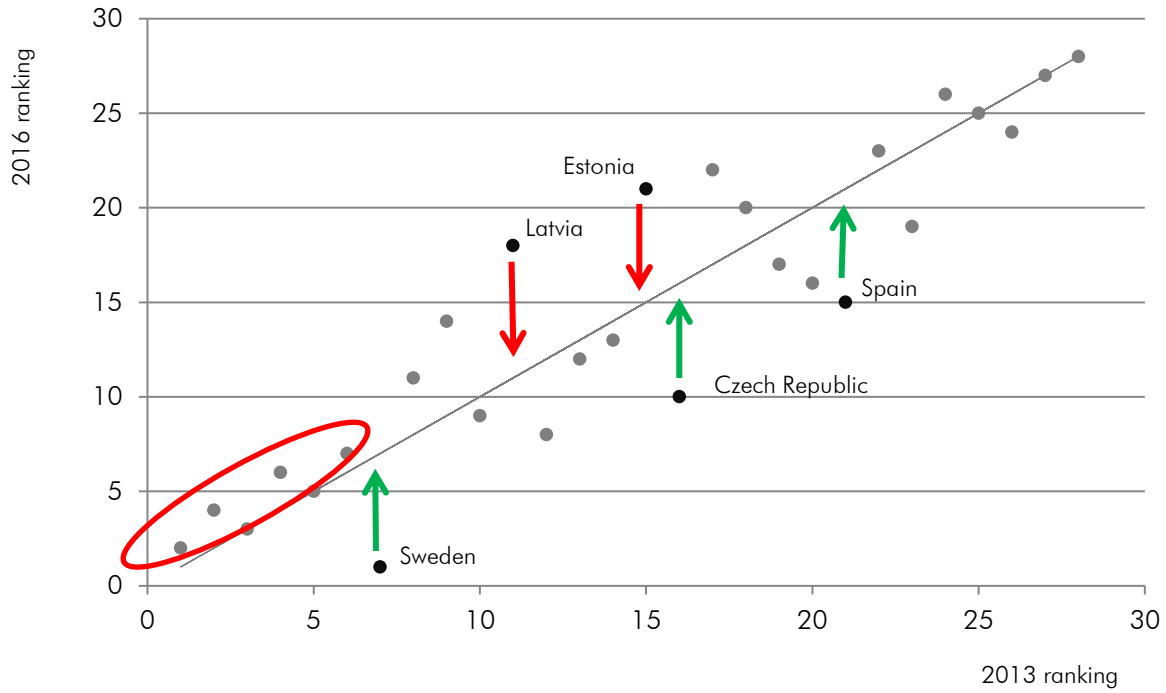


Figure 8: Evolution over time of the subindices for:

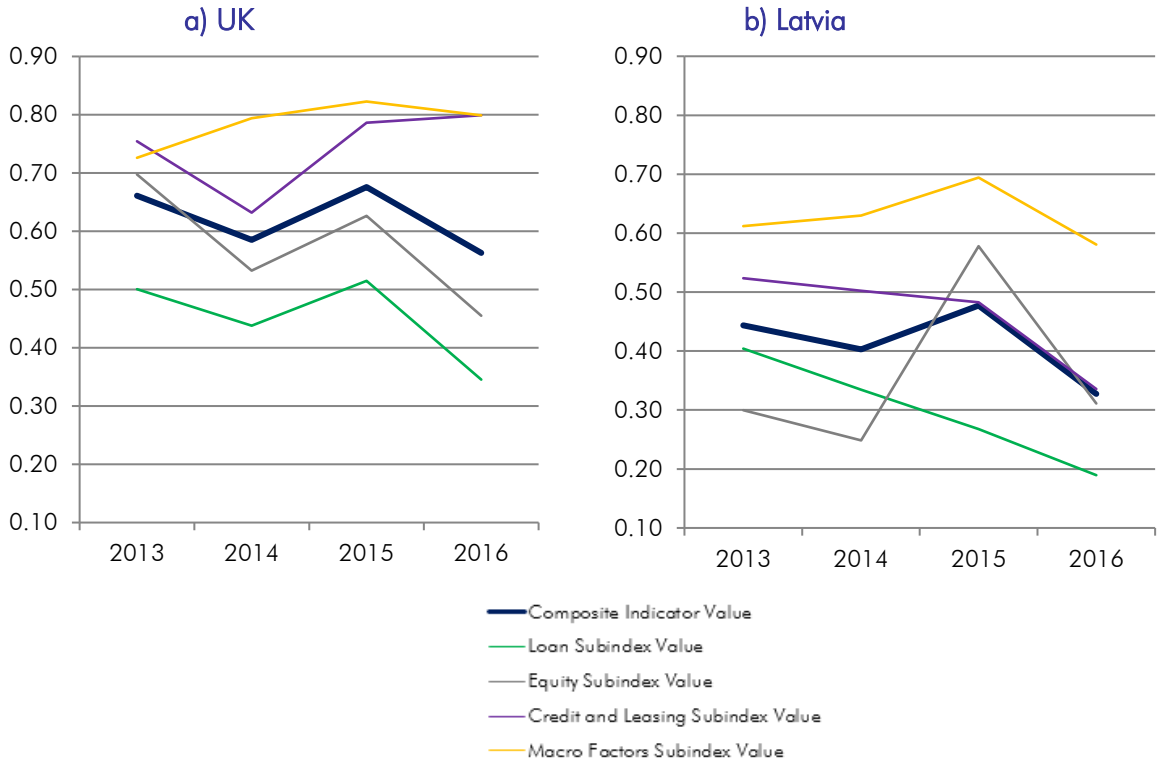


Figure 8 illustrates the evolution over time of the different subindices for two individual countries: the UK (left-hand panel) and Latvia (right-hand panel), the two countries which experienced the strongest deterioration in the value of their aggregate index from 2015 to 2016. For Latvia the deterioration was driven by poor performance on all four subindices. For the UK, the Credit and leasing subindex and the Macro subindex stayed roughly constant, while the situation on the loan and equity markets deteriorated significantly.

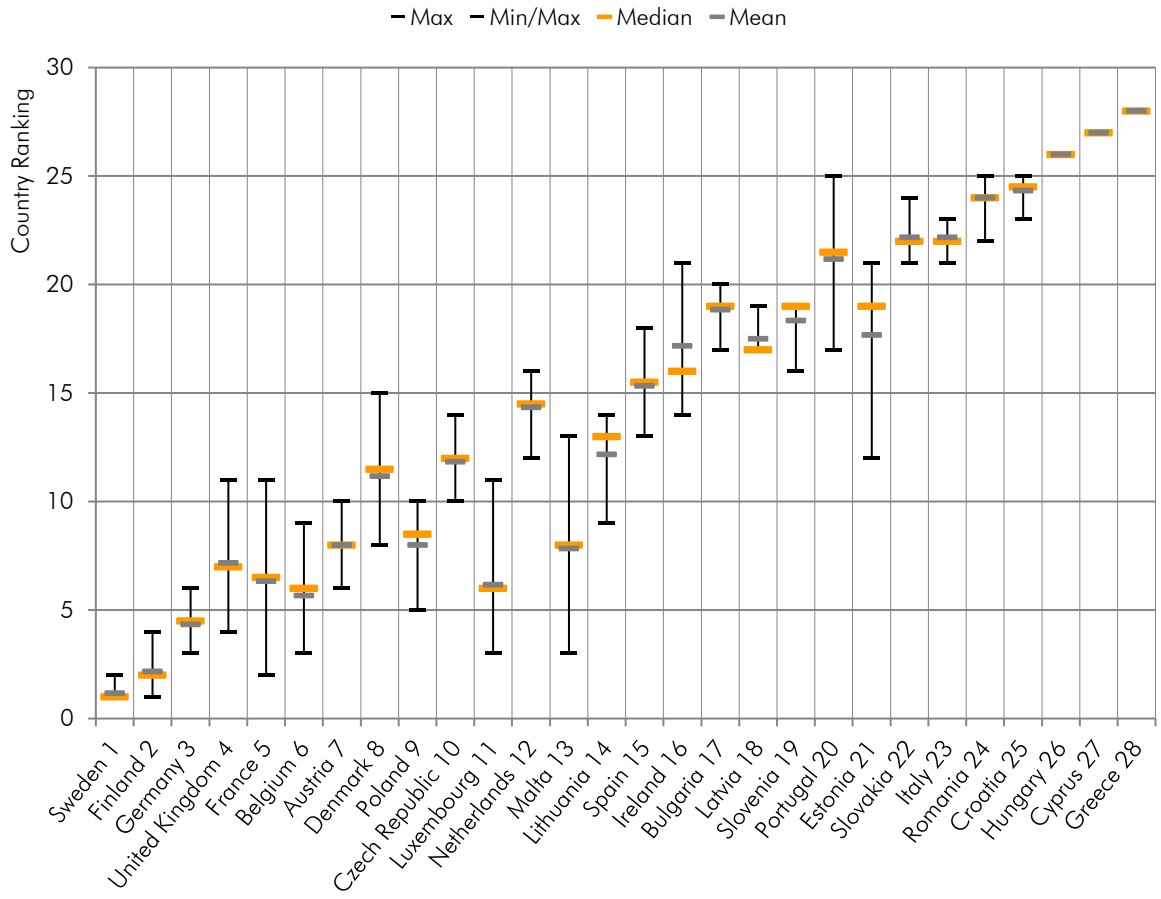
3.3 Sensitivity Analysis

This section reports the results from the sensitivity analysis. We test the robustness of the indicator's outcome across a number of different methodological choices by varying the normalisation and aggregation methods or the chosen weighting scheme. The sensitivity analysis will focus on the *ranking* of countries, because it is not always possible to compare the value of the aggregate index itself across methodological specification.

Robustness of ranking for different methodological choices

Starting from the baseline methodology, we experimented with one variation in the normalisation method (standardisation[7]), two weighting combinations (BAP and AHP[8]) and two additional aggregation methods (Linear Aggregation and MCA[9]). Figure 9 shows for every country the minimum, maximum, average and median rankings from this set of specifications. The countries are sorted according to the ranking that emerged from the baseline approach.

Figure 9: Ranking results across different specifications, distribution and standard deviation



[7] Standardisation is one of the most common approaches to normalization (Freudenberg, 2003). This method converts all variables to a common scale and assumes the data is normally distributed with a mean of zero and a standard deviation of one.

[8] BAP, or Budget Allocation Process, is a weighting method in which experts are asked to allocate a 'budget' of 100 points to a set of selection subindicators. This exercise was executed with the help of six experts internal to the EIF. For an elaboration on this method, see Nardo et al. (2005). AHP, or Analytical Hierarchy Process, is also an expert-based weighting method where experts are asked to systematically compare pairs of subindicators. The results of this exercise are summarised in a pairwise comparison matrix that shows the relative importance of one subindicator against every other subindicator and serves as a basis to calculate the corresponding weights using an eigenvector technique (OECD, 2008). Table A4.1 lists the resulting weights of a BAP/AHP weighting exercise.

[9] MCA, short for non-compensatory Multi-Criteria Aggregation, is a weighting/aggregation scheme that avoids the theoretical implementation of full compensability and the interpretation of weights as trade-offs. It also avoids the need to standardise the subindicators. MCA uses a pairwise comparison of countries for all individual subindicators to derive a frequency matrix through which a point system leads to a country ranking (OECD, 2008).

The results are encouraging and the composite indicator seems fairly robust over different methodological specifications. At the bottom and the top of the 2016 ranking, methodological choices do not have a significant impact on the results. In the middle of the ranking, however, the outcome of the indicator is more sensitive to variations of the methodology. This is driven by the fact that the baseline indicator values of countries in the mid of the ranking lie close to one another, so that limited changes in the indicators' outcome produce larger variations in the country ranking.

Annex 4 contains three additional graphs in which the sensitivity in the *ranking* outcome is tested for changes in normalisation technique (Figure A4.1), the weighting scheme (Figure A4.2) and the aggregation method (Figure A4.3). Most commonly, a methodological change does not result in a shift in a country's ranking. However, sometimes a significant rank change does occur. These shifts generally take place in the middle of the distribution, where the outcome values of the aggregate indicators are very similar. Unsurprisingly, shifts in ranking are more pronounced for countries that record an unequal score on their subindicators, since changing the weighting scheme and/or the aggregation procedure alters the contribution of individual indicators on the aggregate outcome.

4 Concluding remarks

This paper outlines the methodology underlying the new EIF SME Access to Finance (ESAF) Index. This newly developed index aims to monitor developments in SMEs' access to financial resources; as such an index does not exist, it fills a gap. Composite indicators can be a useful tool in the policy maker's toolbox, as they are able to summarise a complex phenomenon in one summary statistics that is straightforward to track over time, or compare between countries. However, composite indicators also have the reputation of being black boxes. Therefore, we strive for transparency by motivating all methodological considerations made throughout the constructing of the index.

An essential first step in the construction of any composite index is the selection of subindicators. Each subindicator was assessed and selected based on five eligibility criteria and the resulting set of indicators provides a comprehensive overview of SMEs' access to finance possibilities. Subindicators were grouped into four subindices: three categories representing the bulk of SMEs' financing needs: Loans, Equity, and Credit and Leasing; and a fourth subindex, Macro Factors, that serves as a proxy of the general economic financing environment in which they operate. Subindices and subindicators are equally weighted, normalised using the min-max normalisation method and geometrically aggregated.

The challenge of condensing a complex multi-dimensional phenomenon like SME access to finance into a single statistic makes it particularly important to back-test the resulting outcome by means of robustness checks. The results of this exercise revealed that the ESAF Index is sufficiently robust to changes in methodological choices.

We plan to update the indicator on a yearly basis. The results will be published in the European Small Business Finance Outlook (see Kraemer-Eis et al., 2017), EIF's semi-annual publication that provides a comprehensive overview of European SMEs' external financing situation.[10] By ensuring transparency and continuity, it is our hope that the ESAF Index will become a trustworthy monitoring tool for SMEs' access to finance situation among European policy makers and academics alike.

[10] The results published in this paper slightly differ from the results published in Kraemer-Eis et al. (2017), because of the exclusion of four survey based variables whose underlying sample size was too small for some countries to ensure comparable results over different periods. Those four variables are: "% of SMEs with rejected loan applications", "% of SMEs that applied for bank loans, but received less than 75% of the requested amount", "% of SMEs with rejected credit lines" and "% of SMEs that applied for credit lines, but received less than 75% of the requested amount".

List of acronyms

- AFME: Association for Financial Markets in Europe
- bn: billion
- EC: European Commission (also: COM)
- ECB: European Central Bank
- EIB: European Investment Bank
- EIF: European Investment Fund
- ESBFO: European Small Business Finance Outlook
- EU-28: the 28 EU Member States
- EUR: Euro
- GDP: Gross Domestic Product
- IPO: Initial Public Offering
- IRF: Initial Rate Fixation
- k: thousand
- m: million
- OECD: Organisation for Economic Co-Operation and Development
- PE: Private Equity
- RMA: Research and Market Analysis
- SAFE: Survey on the Access to Finance of Enterprises
- SME: Small and medium sized enterprise
- UK: United Kingdom
- US: United States
- USD: US dollar
- VC: Venture Capital
- ESAF: EIF SME Access to Finance
- LSE: London School of Economics
- SMAF: SME Access to Finance Index
- MPA: Master of Public Administration
- BAP: Budget Allocation Process
- AHP: Analytical Hierarchy Process
- MCA: Multi-Criteria Aggregation

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Annex 1: Selected Subindicators

Table A1.1: Subindicators in the Loan Subindex

Subindicator	Rationale	Data
% of SMEs using bank loans	Bank loans are important for SME finance. They constitute 68% of total SME financing in terms of volume (AFME, 2015). The subindicator serves as an indicator for finance availability. The subindicator is based on data from survey on the access to finance (SAFE), a large sample survey of SMEs conducted by the ECB and the European Commission which covers approximately 16,000 SMEs in EU.	SAFE
% of SMEs using grants or subsidised bank loans	Public financial support is important for SME finance. Government guarantees and sponsored loans constitute 6% of total SME financing in terms of volume (AFME, 2015). Studies have shown that government subsidies alleviate credit constraints for SMEs (Öztürk and Mrkaic, 2014). This subindicator serves as an indicator for finance availability.	SAFE
% of SMEs not applying for a bank loan because of possible rejection	How discouraged firms are in applying for loans can indicate the ease with which firms expect to acquire bank loans. It can also reflect the general functioning of the SME finance market.	SAFE
Interest rate for loans under EUR 250k (floating rate with IRF up to 1 year)	Interest rate is a direct measure of the cost of borrowing. Lending up to EUR 250k is considered a proxy for lending to SMEs and is thus a representative rate (Menton and Sherman, 2014).	ECB Bank Interest Rate Statistics
Interest rate spread (under EUR 250k vs over EUR 1m for floating rate with IRF up to 1 year)	The interest rate spread between large loans and small loans reflect the credit conditions and difficulty for SMEs to obtain funding in a given country (OECD, 2015).	ECB Bank Interest Rate Statistics

Table A1.3: Subindicators in the Credit & Leasing Subindex

Subindicator	Rationale	Data source
% of SMEs using bank overdraft, credit line, or credit card overdraft	Credit is a key component of SME financing. SAFE data reveals that credit lines are frequently used by SMEs (ECB, 2014). The percentage of firms using credit lines can serve as a subindicator for finance availability.	SAFE
% of SMEs not applying for a bank overdraft, credit line, or credit card overdraft because of possible rejection	The level of discouragement in firms that are in applying for credit is used as an indication of the functioning of the SME credit finance market.	SAFE
Median interest rate charged to SMEs for credit line or bank overdraft application	Credit lines and bank overdrafts are important sources of financing for SMEs. The interest rate is a good indicator of the cost of credit for SMEs.	SAFE

Table A1.3, continued:

% of SMEs using leasing or hire-purchase	Leasing is a highly relevant financing tool for SMEs (Kraemer-Eis and Lang, 2012). The percentage of firms using leasing serves as a proxy for finance availability.	SAFE

Table A1.2: Subindicators in the Equity Subindex

Subindicator	Rationale	Data Source
Venture Capital Investments/GDP	Private equity is important for SME finance. Venture capital (VC) can be important for start-ups when debt markets are unavailable. 95% of total VC investment volume and 99% of deals are concentrated in SMEs (EVCA, 2015). Venture Capital Investments refers to the total venture capital investments volume in the country of portfolio company. The subindicator is based on data from a large sample survey of firms conducted by Invest Europe (former European Venture Capital Association, EVCA) which covers 91% of equity capital under management in Europe.	Invest Europe
Venture capital availability index	This subindicator reveals firms' perceived access to VC. The subindicator is based on data from a survey of over 14,000 business executives from 144 countries conducted by the World Economic Forum.	World Economic Forum Global Competitiveness
Value of IPO market/GDP	IPO activity is an important indicator on the health of a country's equity market (EVCA, 2015). The subindicator is based on data that includes IPOs, regardless of where the headquarters of the company are located (i.e. if it is European or non-European). "Value" is defined as the total proceeds in EUR.	Association for Financial Markets in Europe (AFME)
Percentage of SMEs using equity capital	Equity capital important for SME finance. Equity capital constitutes 8 % of total SME financing in terms of volume (AFME, 2015). The percentage of firms using equity can serve as a subindicator for finance availability.	SAFE

Table A1.4: Subindicators in the Macro Factor Subindex

Subindicator	Rationale	Data source
Gap between actual and potential GDP	Holton et al. (2013) find that banks tighten credit conditions when the real economy is weaker and in the face of higher private sector debt levels. Keeping all other factors constant (borrower quality, etc.), the business cycle can help explain variation in credit supply. Bernanke, Gertler, and Gilchrist (1996) also find that in the onset of a recession, borrowers facing high agency costs (typically SMEs) receive a relatively lower share of credit (flight to quality). The output gap was used as an indicator rather than GDP growth, because it measures levels and not relative changes over time. This is necessary for cross-country comparisons to be meaningful.	European Commission and National Statistical Office
Strength of legal rights index	A number of empirical studies have drawn connections between the legal environment and business lending (Beck, Demirguc-Kunt and Maksimovic, 2005; Beck and Demirguc-Kunt, 2006; Kumar, Rajan and Zingales, 1999; Laeven and Woodruff, 2007; Berger and Udell, 2006). In particular, commercial laws that specify the property rights associated with a commercial transaction are important for SMEs. The judicial and bankruptcy environments determine how well these laws are enforced in commercial disputes and in bankruptcy resolutions (Berger and Udell, 2006). This subindicator is based on a questionnaire administered to financial lawyers and verified through analysis of laws and regulations as well as public sources of information on collateral and bankruptcy laws by the World Bank. The strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. The subindicator can thus measure relevant aspects of the quality of a country's legal system as it pertains to business.	World Bank Doing Business Index
Depth of credit information index	A seminal paper by Stiglitz and Weiss (1981) describes how imperfect information can cause credit rationing in the bank lending market. Empirical literature also confirms that there is a relationship between the information environment (accounting standards, credit bureaus, access to historical credit information etc.) and financing conditions (Beck et al. 2004). The depth of credit information index measures rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries. The index is built by the World Bank.	World Bank Doing Business Index
Availability of financial services index	This is a broad perception based question that can indicate how stakeholders experience the state of access to finance.	World Economic Forum Global Competitiveness Index

Table A4, continued:

Subindicator	Rationale	Data source
Bank non-performing loans to total gross loans	There is a link between defaults in the economy and willingness to invest in and lend money to SMEs. A large portion of non-performing loans pertains to SMEs, and as such this subindicator can reflect the riskiness of the sector more broadly.	World Bank World Development Indicators
% of SMEs "feeling that there are no financing obstacles"	This is a broad perception based question from the SAFE that can indicate how stakeholders experience the state of access to finance.	SAFE

Annex 2: Ranking subindices, 2016

Figure A2.1: *Loan subindex*

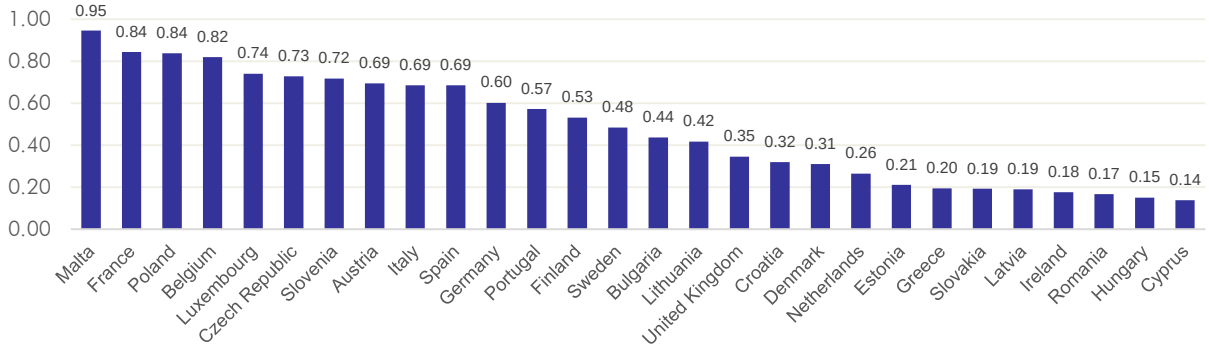


Figure A2.2: *Credit and leasing subindex*

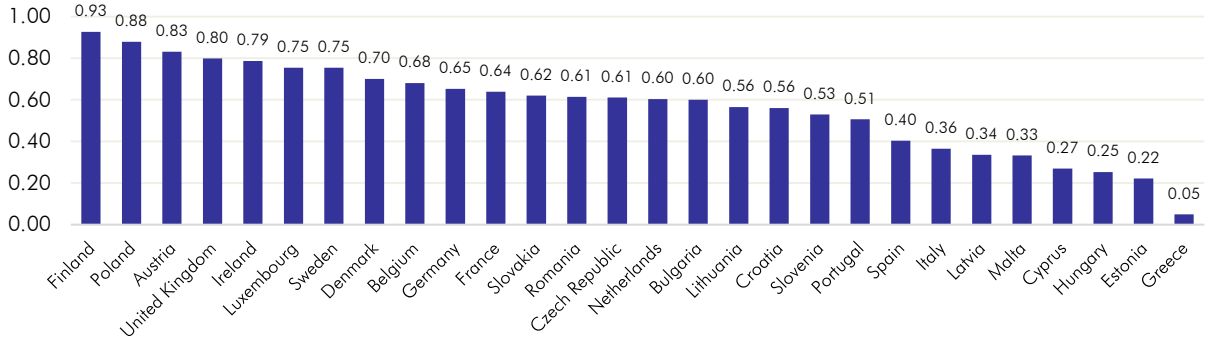


Figure A2.3: *Equity subindex*

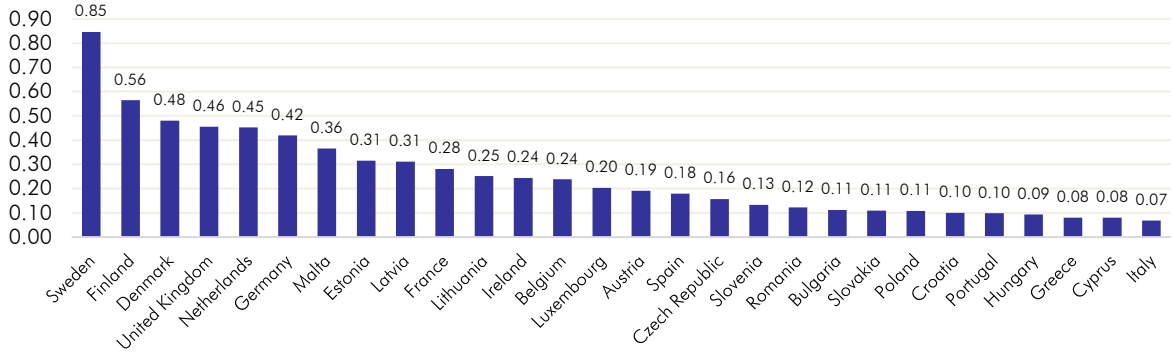
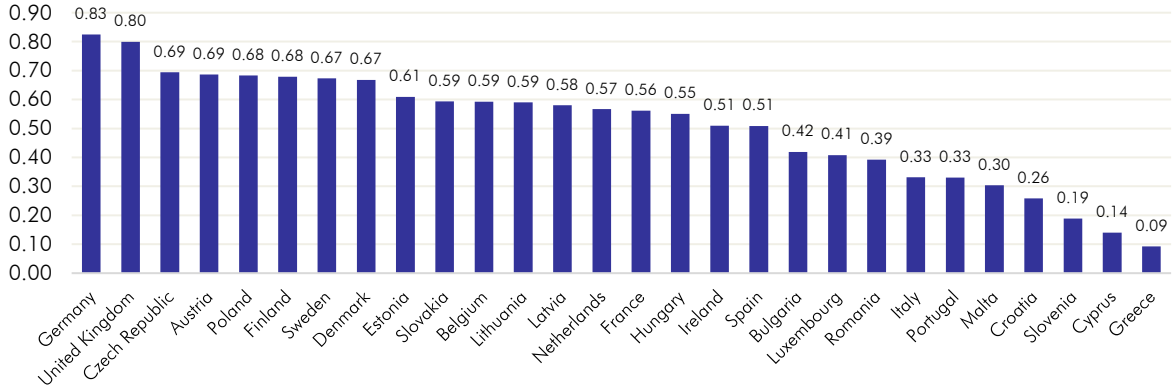


Figure A2.4: Macro subindex



Annex 3: Internal Consistency

Purpose

Internal consistency is an essential step that aims to assess whether a composite indicator is internally sound and consistent from a statistical perspective. The purpose of a consistency check is to ensure that the theoretical structure of a composite indicator is in consonance with the statistical one. This entails assessing the internal validity and consistency of the composite indicator and its subindices, and whether they are well defined by the selected subindicators. There are many ways to conduct an internal consistency check. Two common methods will be described in the subsequent paragraphs (Saisana, 2008).

First, the statistical dimensions of the framework should be evaluated. This helps ascertain whether it is statistically supported to decompose a composite indicator into the given number of subindices. In less technical terms, this involves checking whether the structuring of a composite indicator into subindices makes sense from a statistical perspective. For example, if a statistical analysis reveals strong correlation between two or more subindices, it is likely that these are reflective of the same underlying phenomenon/mechanism, and as such they should be combined. This is mostly carried out using Principal Component Analysis (PCA) for quantitative subindicators and non-linear PCA for qualitative (or a mixed set of) subindicators. This allows us to validate statistically the inclusion of subindicators within subindices and subindices within the overall composite indicator.

Second, associations between the composite indicator and its components should be assessed. This involves performing a simple correlation analysis between the composite indicator scores obtained and its subindices and subindicators respectively. It is generally advisable to have positive correlation coefficients across subindicators unless there is a solid theoretical justification for the presence of trade-offs between the subindicators. Booysen (2002) suggests that a subindicator, which is weakly correlated with the composite indicator, should be excluded from the framework. Generally, a subindicator with a correlation coefficient of less than 0.30 is considered weakly correlated.

Correlation analysis is a widely used tool in confirming the mathematical design of indices. However, these results should be interpreted with caution. This is mainly because a strong correlation does not necessarily imply that the subindicator captures a causal and relevant mechanism for the phenomenon of interest. According to Saisana and Saltelli (2008), any random variable could potentially show a strong correlation with the composite indicator without actually having any causal impact. Consequently, these results should be corroborated with the sensitivity analysis of the composite indicator.

Results of Internal Consistency on our New Composite Indicator

Since our data set does not meet the criteria for performing PCA, we perform a correlation analysis between the overall composite indicator, the four subindices and the nineteen subindicators to assess the conceptual framework of the composite indicator. The results are presented in Table A3.1 and Table A3.2.

Table A3.1: Correlation coefficients between composite indicator and its subindices (2016)

	ESAF Index	Loans subindex	Equity subindex	Credit and Leasing subindex	Macro subindex
ESAF Index	1				
Loans subindex	0.507***	1			
Equity subindex	0.751***	0.025	1		
Credit and leasing subindex	0.764***	0.315	0.390**	1	
Macro subindex	0.766***	0.109	0.551***	0.595***	1

Notes: significance at the 1% level (***); 5% level (**) and 10% level (*)

One aspect of an internally consistent indicator concerns the correlations between the aggregate index and its subindices. The correlation coefficients between the composite indicator and the four subindices all reveal to be positive and significant at the 1%-level. This rules out the presence of trade-offs between the composite indicator and the subindices.

The second element to consider is represented by the correlations between the different subindices. All subindices are positively correlated to one another, yet all to a moderate extent. The strongest correlations are the ones between the macro subindex on the one hand, and the equity and credit and leasing subindices on the other. The least associated subindices are loan and equity, which exhibits a correlation of 0.025, not significantly different from zero. This result indicates that the four subindices likely account for different aspects of SME access to finance, yet partially overlap and are not entirely separable.

Table A3.2 extends the correlation analysis to include the 19 underlying subindicators. Almost all of the subindicators exhibit moderate correlation with the composite indicator, with the exception of 'percentage of SMEs using grants or subsidised bank loans' (0.041, insignificant). However, the correlation of this subindicator with the associated subindex is positive and significant (0.55). For this reason, it is reasonable to keep this subindicator in the composite indicator. Also in the macro subindex, two subindicators are only weakly correlated with the aggregate composite indicator: 'Depth of credit information index' and 'Strength of legal rights index'. The 'Strength of legal rights index' is even negatively correlated with the aggregate index, although the correlation coefficient is not significantly different from zero. However, both indicators are significantly positively correlated with their associated subindex, so we choose not to omit them. The correlation coefficients of all other subindicators with respect to both the composite indicator and their respective subindices have the expected signs.

Table A3.2: Correlation coefficients between the composite indicator, subindices and the subindicators

	Indicators	Direction of association	Composite Index	Associated subindex
Loans Subindex	Percentage of SMEs using bank loans	+	0.204	0.814***
	Percentage of SMEs using grants or subsidised bank loans	+	0.041	0.553***
	Percentage of SMEs not applying for a bank loan because of possible rejection	-	-0.662***	-0.611***
	Interest rate for loans under EUR 250k (floating rate with IRF up to 1 year)	-	-0.648***	-0.764***
	Interest rate spread (under EUR 250k vs over EUR 1m for floating rate with IRF up to 1 year)	-	-0.159	-0.618***
Equity Subindex	Venture Capital Investments / GDP	+	0.471**	0.557***
	Venture capital availability index	+	0.711***	0.735***
	Value of IPO market / GDP	+	0.354*	0.525***
	Percentage of SMEs using equity capital	+	0.163	0.390**
Credit & Leasing Subindex	Percentage of SMEs using bank overdraft, credit line, or credit card overdraft	+	0.410**	0.579***
	Percentage of SMEs not applying for a bank overdraft, credit line, or credit card overdraft because of possible rejection	-	-0.633***	-0.767***
	Percentage of firms using leasing or hire-purchase	+	0.714***	0.637***
	Median interest rate charged to SMEs for credit line or bank overdraft application	-	-0.280	-0.522***
Macro factors Subindex	Gap between actual and potential GDP	+	0.372*	0.377**
	Strength of legal rights index	+	-0.037	0.396**
	Depth of credit information index	+	0.016	0.373**
	Availability of financial services index	+	0.756***	0.666***
	Bank non-performing loans to total gross loans	-	-0.736***	-0.761***
	Percentage of SMEs "feeling that there are no financing obstacles"	+	0.696***	0.581***

Notes: significance at the 1% level (***); 5% level (**) and 10% level (*)

Annex 4: Sensitivity analysis

Table A4.1: Weighting schemes of the participatory weighting methods

Subindicators	AHP Averages	BAP Averages
Loans	**42.8%**	**39.2%**
% of SMEs using bank loans	11.6%	11.5%
% of SMEs using grants or subsidised bank loans	4.1%	4.2%
% of SMEs not applying for a bank loan because of possible rejection	8.5%	8.4%
Interest rate for loans under EUR 250k (floating rate with IRF up to 1 year)	9.3%	8.0%
Interest rate spread (under EUR 250k vs over EUR 1m, floating rate, IRF <1y)	9.3%	7.0%
Equity	**22.2%**	**22.5%**
Venture Capital Investments / GDP	7.6%	7.1%
Venture capital availability index	6.6%	5.8%
Value of IPO market / GDP	2.7%	3.4%
Percentage of SMEs using equity capital	5.3%	6.2%
Credit & leasing	**19.0%**	**21.7%**
% of SMEs using bank overdraft, credit line, or credit card overdraft	3.3%	5.2%
% of SMEs not applying for a bank overdraft, credit line, or credit card overdraft because of possible rejection	5.5%	4.9%
Median interest rate charged to SMEs for credit line or bank overdraft application	6.3%	6.9%
% of SMEs using leasing or hire-purchase	3.8%	4.7%
Macro	**16.0%**	**16.7%**
Gap between actual and potential GDP	2.9%	4.4%
Strength of legal rights index	1.4%	1.9%
Depth of credit information index	2.0%	2.2%
Availability of financial services index	3.2%	2.9%
Bank non-performing loans to total gross loans	3.3%	2.8%
Percentage of SMEs "feeling that there are no financing obstacles"	3.2%	2.4%

Figure A4.1: ranking sensitivity, baseline specification vs standardisation normalisation

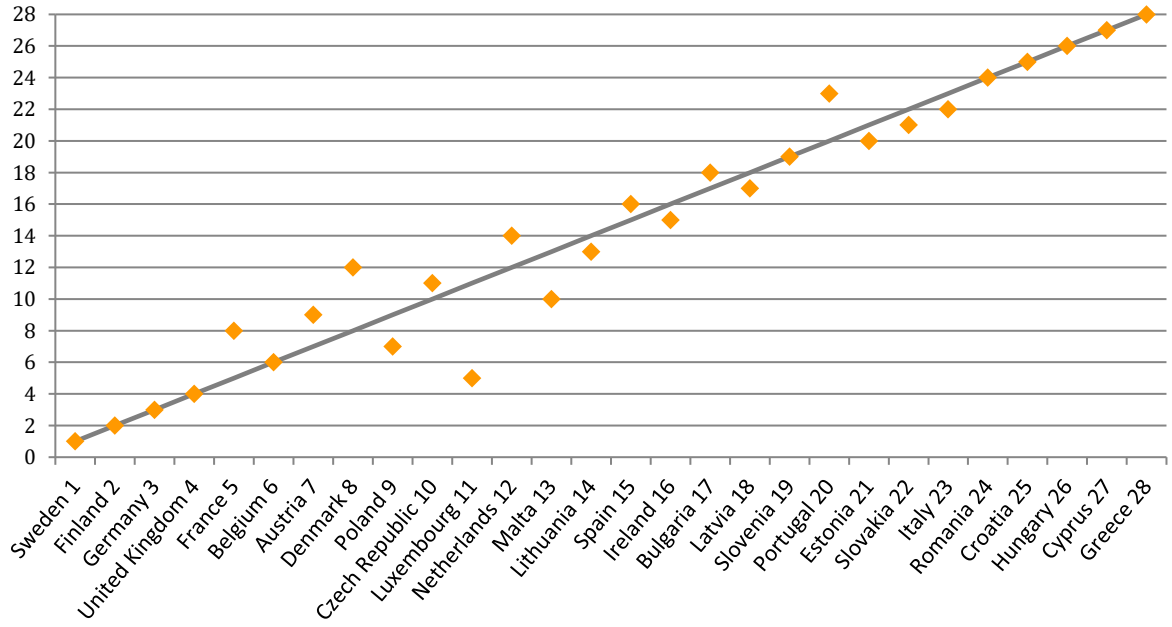


Figure A4.2: Ranking sensitivity, baseline specification vs BAP/AHP weighting

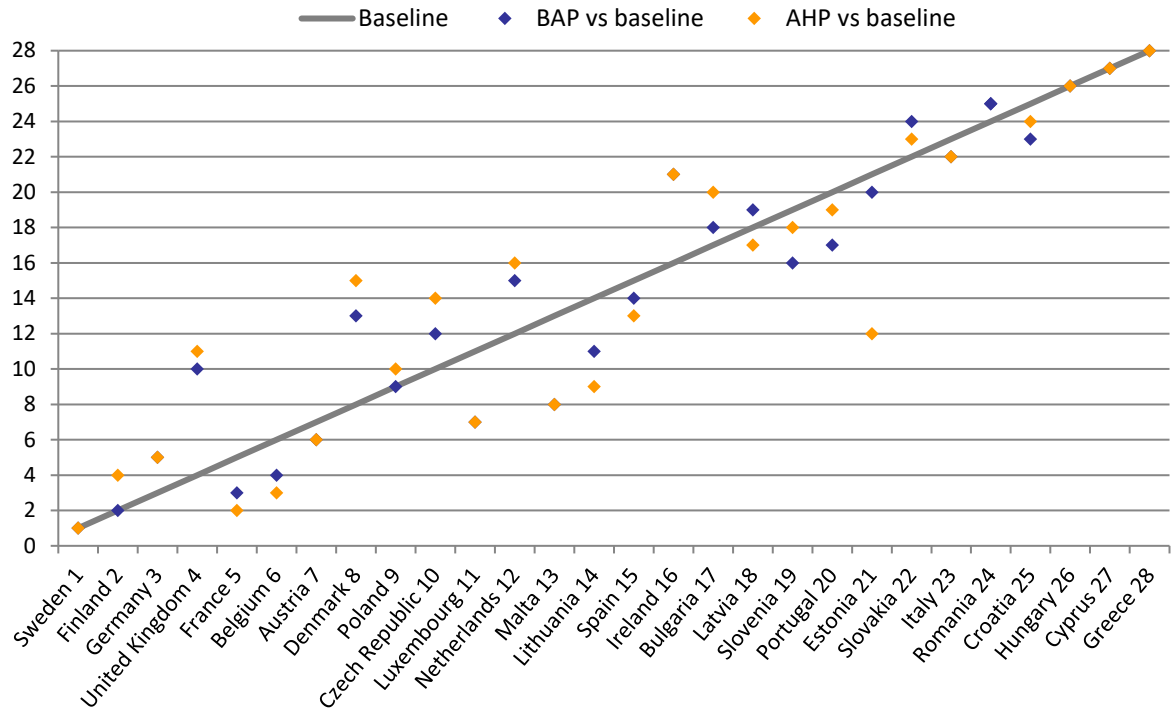
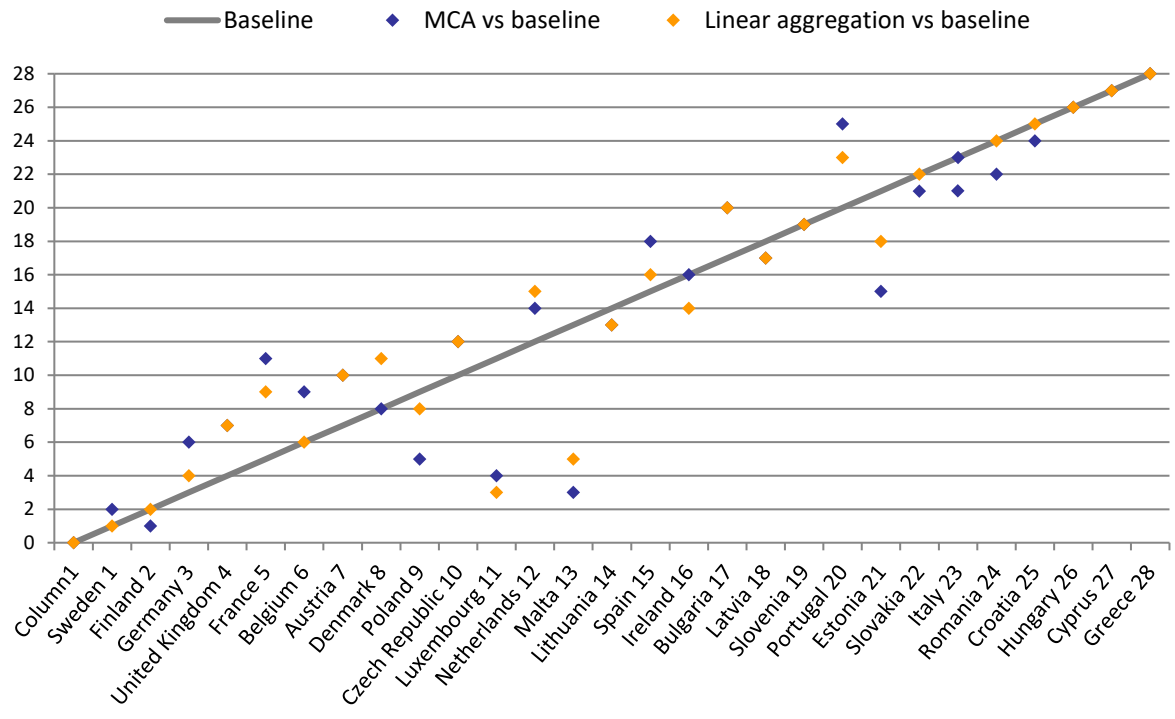


Figure A4.3: Ranking sensitivity, baseline specification vs MCA/linear aggregation



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