Linking qualitative survey responses with quantitative data

Methodology, quality and data analysis from the matching of the ECB/EC Survey on Access to Finance of Enterprises and the Amadeus database

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Abstract

Timely, comparable, and good quality information on micro, small and medium-sized enterprises (SMEs) is scarce. Business surveys partially fill this gap by providing timely and harmonised data. However, there are some limitations when a survey is conducted via telephone, given the restricted length of interview and respondent's difficulties in answering questions related to the accounting concepts or statistical classifications. In this respect business registers containing financial information – even though the timeliness is less than optimal – are valuable enhancements to qualitative surveys.

This paper presents the results from the matching of the European Commission & ECB Survey on Access to Finance of Enterprises (SAFE) with Bureau van Dijk's Amadeus database. First, we describe the linking methodology, which preserves confidentiality of the respondents, and identify the most effective matching variables. Then, we examine the quality of the matching, highlighting varying success rates depending on the firm characteristics like size, sector and age. Finally, we also inspect the bias that may occur in the SAFE aggregated results when using the effectively matched sample.

Keywords: Business Registers, Small and Medium-Sized Enterprises, Record Linking, Survey Data

JEL classification: C81, C83

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1 Introduction

The information about how firms perceive their access to finance is very important for central banks, in particular, in an environment of impaired credit transmission. Small and young enterprises are by nature riskier and thus are relatively more affected by limited access to external financing (see Ferrando, Griesshaber 2011). Given that firms with less than 250 employees account for 99.8% of all firms in the euro area and that they create 69%[2] of jobs it is of high importance to analyse their financial situation in a timely manner.

The European Commission and the European Central Bank Survey on Access to Finance of Enterprises (SAFE) is a qualitative telephone survey conducted to collect timely information about the financing conditions for micro, small and medium enterprises, with a limited number of large companies also included for comparison purposes.[3]

The information collected from the survey has proven to be very useful in itself for the short-term and structural analysis of financial constraints. However, more analytical uses of the data require quantitative information about the enterprises, which would enable to measure the link between the opinion of the companies and their financial situation, in terms of turnover, indebtedness, profit developments, etc. Given the restricted length of the interview and respondents' difficulties in answering on the phone questions related to quantitative accounting elements, it is not feasible to collect this information from the company from the survey. Consequently, an alternative solution was needed: matching the results of the survey responses with individual financial information from the business register. The simplest approach would have been to use the same register as the one used for the sample that is Dun & Bradstreet (D&B). However, D&B does not have available a sufficient number of balance sheet and income account elements, whereas Bureau van Dijk's Amadeus database has the required information and covers a significant fraction of the population of enterprises. The exercise is thus a triple match, between the firms sampled from D&B, the firms participating in the survey, and the firms available in Amadeus.

Any attempt to match multiple and distinct databases will lead to some non-coverage error, arising from a variety of causes. The more different are the databases, and the more likely it is that many of the observations will either not be matched, or the quality of the match will be uncertain. An aggravating factor is the lack of a common and unique identifier shared by the different databases, which has to be circumvented by less reliable or imperfect solutions, requiring in turn an assessment of the correctness of the match.

Being able to cope with some non-matching error is in any case needed, but the statistician producing the matched data and the analyst using it first need to be convinced of the overall quality of the match and the biases or discrepancies introduced into the data by the matching process.

An additional cause of concern is the imperfect nature of the business registers and the measurement error in the survey itself. Business registers do not necessarily contain all enterprises, and even if they do, balance sheet or profit and loss statements are missing for some of them. The information on the company size, the sector, the address might be outdated or incorrect. Survey respondents may, intentionally or not, provide the inaccurate answers to the questions in the survey, including the demographic characteristics like size and sector of the enterprise.

[2] Eurostat, Structural Business Statistics, reference year 2011.

[3] Firms are classified in the SAFE by the number of employees. Micro firms have 1 to 9 employees, small firms 10 to 49, medium-size firms 50 to 249 and large firms 250 or more.

When crossing the survey and the register data, it is not an easy task to determine which piece of information reflects the true state of the company.

Finally, in some countries, business registers are of high quality and cover all non-financial corporations. In other countries, information is partial and does not cover all types of firms; particularly smaller firms may be exempted from reporting annual accounts and thus may not be included in the registers. The matched data may therefore not be a "faithful" image of the enterprise population in the same way that the initial stratified random sample was. Analysts should therefore be aware of this issue and should have the means to at least estimate the effect of the matching on their results.

In the paper we present the analysis based on the enterprises that participated in SAFE at least ones between 3rd and 10th survey round (September 2010 to March 2014). While the 10th wave is the last available, the first two waves of the survey were conducted by another survey company and the enterprises that took part only in those early waves were not included in the matching exercise.

The objective of this paper is to present the methodology and the quality assessment of this matching. In section 2, we describe the datasets used and the methodology of the match. The outcome of the matching process is presented in section 3, while in section 4 we analyse the results of the matching, both within the matched data, with the main SAFE dataset, and with the Amadeus dataset itself. The last section concludes the paper.

2 Description of the data and matching methodology

2.1 Datasets

2.1.1 The ECB-EC SAFE

The Survey on Access to Finance of Enterprises (SAFE) is a qualitative telephone survey conducted for the European Commission and the European Central Bank to assess the developments of the financing conditions of firms. A subset of the survey is run by the ECB every six months in the euro area countries. A more comprehensive version of the survey with an extended questionnaire is run every year starting in 2013 (from 2009 to 2013, every two years), together with the European Commission. The survey is conducted by an external company with the sample drawn from D&B.

2.1.2 Amadeus

Amadeus is a proprietary database maintained by Bureau van Dijk (BvD) of comparable financial information for public and private companies in Europe. It contains balance sheet and profit and loss account information on 21 million companies, combining different information providers. Not all enterprises are covered by Amadeus, and even when companies are covered, financial information might not be present (see ECB 2013, p. 115 and onwards).

2.2 The matching methodology

For the business register to be suitable for the purpose of enriching the SAFE data it must cover with sufficient quality all euro area countries and enterprises of all sizes. While there are several databases on firm-level information, they are often specific to listed companies, the largest firms or to particular sectors. The selected provider – the Amadeus database of BvD – attempts to cover all firms, from micro to large.

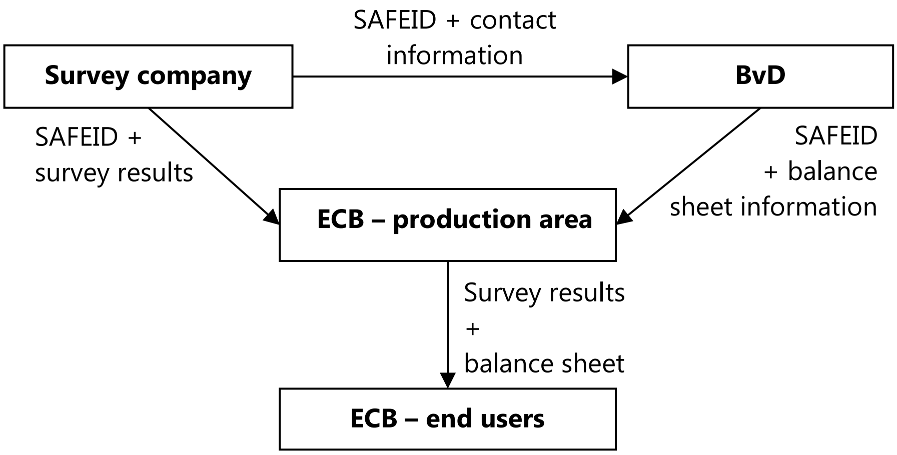
To make the matching possible, a special procedure was designed to ensure the privacy of respondents throughout the process, as this is part of the code of practice of the survey company and it has been promised to respondents during the interview. As a result, the ECB is not aware of the identity of the respondents, and cannot itself link the information from the survey to the name of the company and to external information.

Three parties are involved in the matching exercise:

- the survey company, which links the survey identification number (SAFEID) to the firm identification number (in most cases the tax ID number), name and address (and other identifiers) of each company;
- BvD, which links the firm ID, the name and address of a company with the BvD identifier (BvDEP ID), and thus to all balance sheet information available on that company in the Amadeus database, with the SAFEID provided by the survey company;
- the ECB, which links the survey responses with the balance sheet information sent by BvD through the SAFEID.

As a result, no party has the full set of information combining the confidential answers with the balance sheet information and the confidentiality of the respondents is preserved, which is graphically presented in the Figure 1.

Matching scheme preserving the confidentiality of the respondents Figure 1


SAFEID + contact information
Survey company
BvD
SAFEID + survey results
SAFEID + balance sheet information
ECB – production area
Survey results + balance sheet
ECB – end users

In order to link the companies from SAFE with those from Amadeus the information on tax ID number, company name, street, postcode, city and country are used. The variable 'outcome' identifies which information contributed to the successful match with the following categories:

1: unique match based on the tax ID number

2: unique match based on the company name, address, postcode, city and country

3: unique match based on the company name, postcode, city and country

4: unique match based on the company name and country

8: several matches based on one of the criteria, but no unique match

9: no match at all

The BvD uses the proprietary matching algorithm CINS (Company Identification Number Search) that is a mixture of exact matching (in case the company can be identified on the basis of the tax identification) and approximate matching, when the match is achieved on the basis of other information which may deviate to certain extent between two sources, such as combination of company name, address, postal code.

It should be noted that the concept is different from statistical matching, that aims at linking units which are similar with regard to certain characteristics and do not need to come from overlapping datasets. In case of SAFE dataset, this could be achieved by assigning the financial values from a donor company or averaging the values of companies in the same country, sector and size. Such attempts were undertaken for the SAFE dataset, where notably Amadeus database served as a population source for donor companies (see Ferrando, Mulier 2013). However, in this paper 'matching' refers to 'record linking' (following Eurostat 2013), where the aim is to connect the identical units from overlapping sources.

To link the records, the BvD matching algorithm first searches for potential candidates companies, which are later evaluated on the basis of similarity to the record in the source dataset. In the initial step, two datasets are 'normalized' by detecting and unifying references to legal forms, applying lowercase operator, replacing punctuation signs by a blank, converting synonyms to a simple form using synonyms dictionaries and skipping non-relevant words. The normalization rules are tailored to the specificities of the field (name, street, postcode, city, country, phone and fax, web and email, identification numbers) and may vary by country. Importantly, the BvD matching software supports local characters such as Hungarian, German or Polish and applies transliteration converting text into common and comparable script enabling cross-alphabet matching.

In the second step, the procedure applies so called n-grams, i.e. splitting text into a contiguous sequence of n characters. For matching of the SAFE, the BvD matching algorithm uses 3-grams, e.g. for "McDonald's Corporation" those are: MCD, CDO, DON, ONA, NAL, ALD, LDS, DSC, SCO, COR, ORP, RPO, POR, ORA, RAT, ATI, TIO, ION. Then the n-grams in both datasets are matched, but only the most relevant are selected and n-grams with many occurrences have lower weight in the comparison. On this basis, a proximity measure for each field from two sources is computed for given record. Then a weighted average is calculated for each record, where the weight is based on the probability of finding a company in the BvD database corresponding to the criterion being searched, i.e. the more occurrences are found, the less the field is significant. Finally, the accuracy is translated into the percentage matching score: A (excellent match - score at least 95%), B (good – score between 85 and 95%), C (fair - score between 75 and 85%), D (weak - score between 60 and 75%) and E (poor – score below 60%). Then the matching can result in: i) uniquely matched companies, ii) multiple matches of a SAFE respondent to two or more records from Amadeus, and iii) respondents not matched at all. A multiple match is considered as a single match, if among the multiple records there is only one with a high score of "excellent" or "good". In other cases the outcome is considered as no match.

3 Matching of the SAFE respondents

3.1 Overall outcome and quality of the matching process

Table 1 illustrates possible combinations of the outcomes, matching type and quality of the match for the SAFE respondents participating in the survey rounds from 3 to 10. There were almost 72,000 companies from all the countries participating in the survey (excluding Israel which is not available in Amadeus). The overall rate of successful matches is 83%. However, as will be discussed in the rest of the paper, this high matching rate hides variations by firm size and country that need to be understood and taken into account. Moreover, the high matching rate does not translate automatically into high availability of financial information at the firm level, a phenomenon that will also be highlighted in what follows.

Frequencies of matching outcomes

for SAFE respondents participating in waves 3 to 10

Table 1

		Quality												
		Single match					Multi match - considered as single match		Multi match - considered as no match			No Match		
		A	B	C	D	E	A	B	C	D	E	C	D	E
Outcome	1	9818	562	330	23	1								
	2	21421	431	31	30		1770	2713						
	3	8714	377	3	4		2317	2327						
	4	4419					2497	1023						
	8								1470	1115	55			
	9											484	1203	1320

Source: SAFE-Amadeus match, authors' calculations.

3.2 Detailed analysis of the matching

In this section, we show how the successful matching rates vary across survey waves and by different characteristics of the firms.

The overall matching rate does not differ significantly across waves (Table 2). The tax ID, which is the best way to identify uniquely an enterprise, is available for the SAFE respondents only from wave 9 onwards. This is reflected in higher frequency of "single matches" counterbalanced by a drop in the category "multiple match - considered as single match" in the last two waves.

The number of pure "no matches" has stayed stable overall, with only a small drop in the last two waves. The overall single matching rate has increased from around 80% in the first waves to 87% in the last ones, as the availability of firm identifiers common to both the sample and Amadeus has increased.

Matching rates (%)

by type of match across waves

Table 2

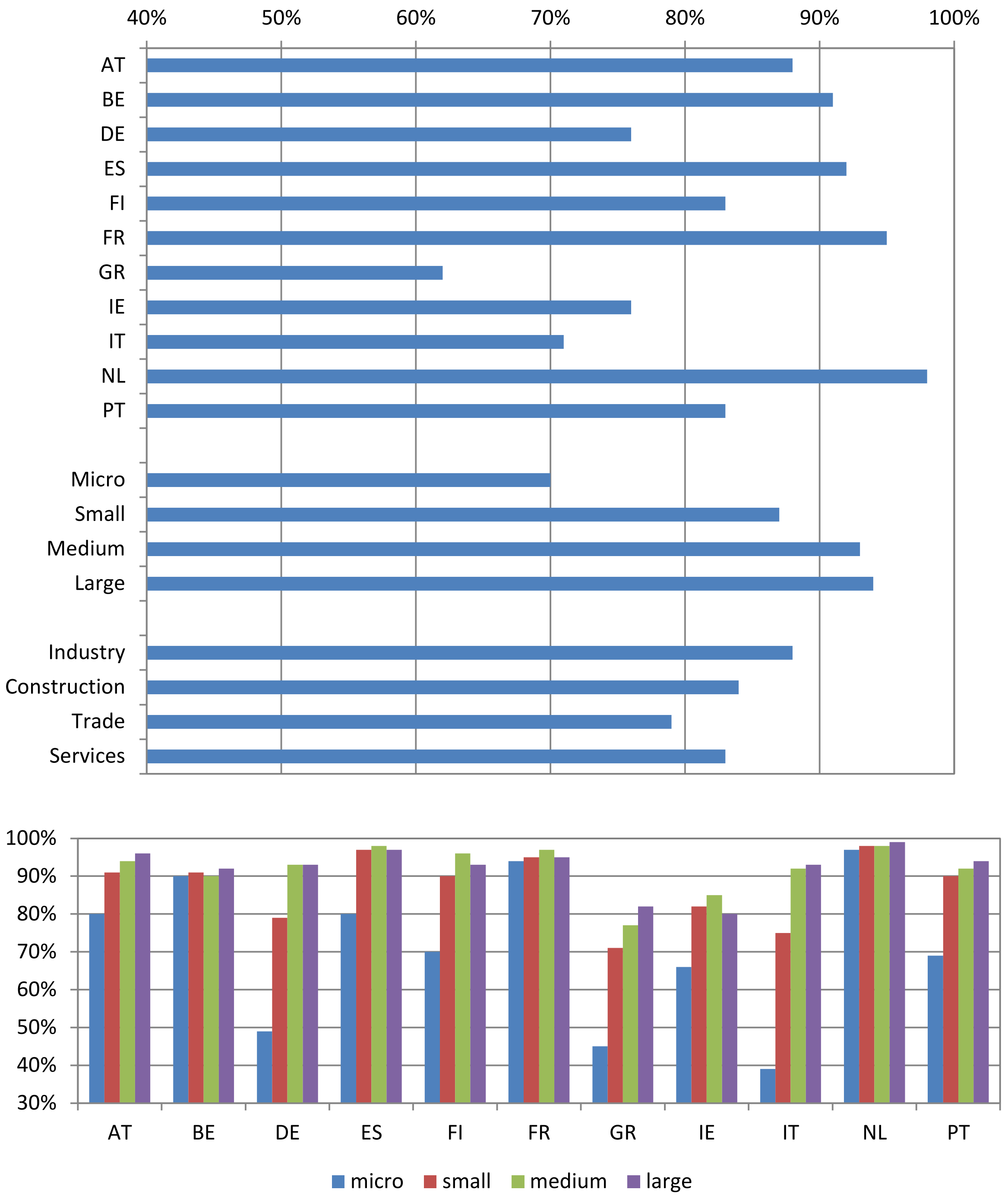
	Wave							
Type of match	3	4	5	6	7	8	9	10
Single match	51	52	61	69	64	64	77	75
Multi match - considered as single match	30	27	21	15	17	21	9	12
Multi match - considered as no match	7	8	11	5	4	3	5	3
No match	12	13	7	12	15	12	9	10

Source: SAFE-Amadeus match, authors' calculations.

Looking at the country breakdown the results are much more heterogeneous. Considering all waves jointly for the 11 largest euro area countries participating in the survey every 6 months, the success rates vary from over 90% in Belgium, Spain, France and the Netherlands to 62% in Greece. Significant differences also exist between the size classes, with large companies successfully matched in 94% cases compared to 70% for micro firms. The differences across the sectors are much less pronounced. The low matching rates for the micro companies are even more striking when analysing them at the country level. The rates below 50% were reported in Germany, Greece and Italy (Figure 2).

Matching rates by country, enterprise size and sector

Euro area, 11 largest countries, waves 3 to 10 Figure 2

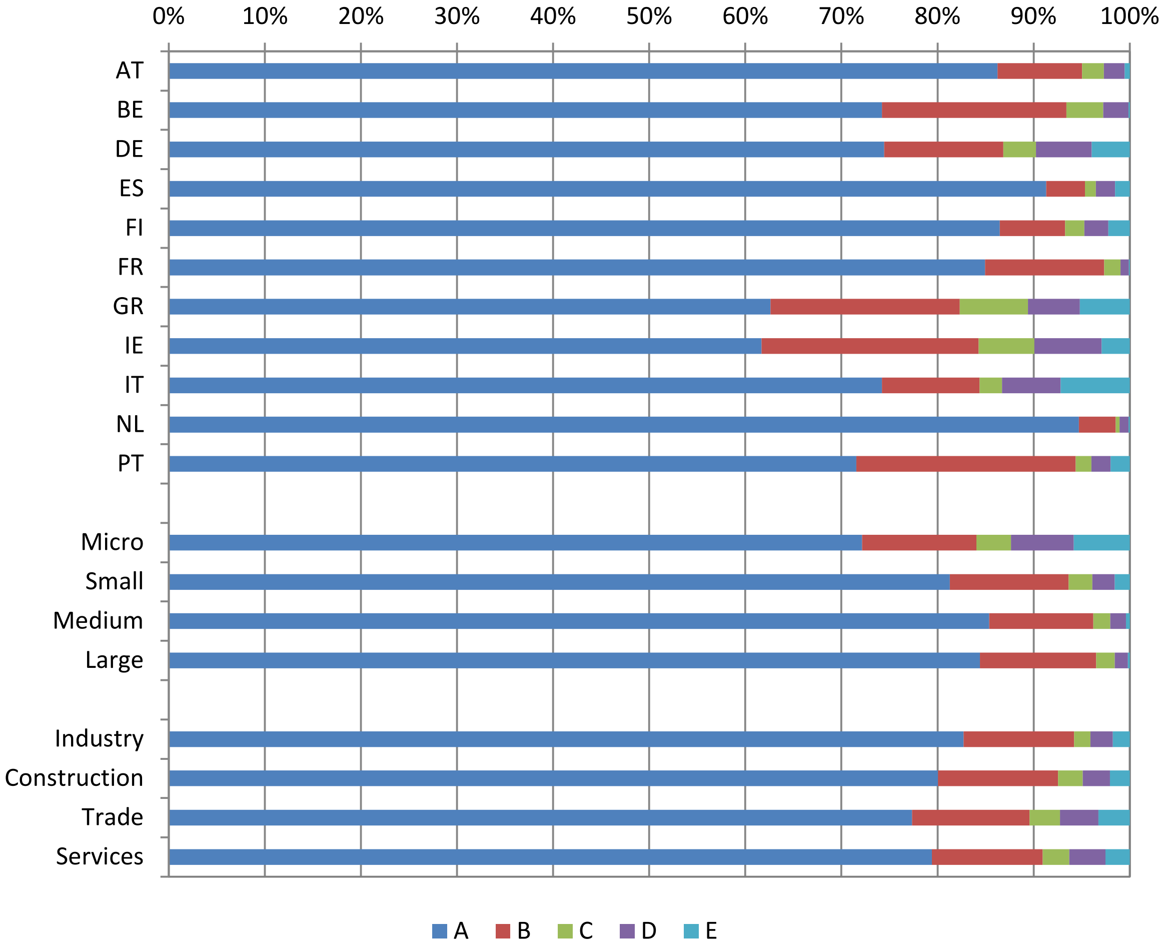


Source: SAFE-Amadeus match, authors' calculations.

Matching quality by country, enterprise size and sector

Euro area, 11 largest countries, waves 3 to 10

Figure 3



Source: SAFE-Amadeus match, authors' calculations.

4 Analysis of the matched data

4.1 Cross-validation of enterprise characteristics in SAFE and Amadeus dataset

Since the information on sector, size and age of the enterprise are available in Amadeus and they are also collected during the interview, in this section we verify the consistency of those main characteristics in both datasets. The statistics reported below are computed with reference to the period of the SAFE interview, i.e. the SAFE answers with regards to size, sector, age and turnover of the company are compared to the same variables from Amadeus reported for the year when the particular company was interviewed[4]. Consequently, the panellists are included as many times as they participated in the survey.

Sector information from Amadeus database is reported at the two digit level according to NACE Rev. 2 which was aggregated into the categories used in SAFE. The sectors are aligned in 72% of cases and there were a few instances only when it was not available in Amadeus. Concerning the size of the enterprises, measured by the number of employees and grouped into four classes, the categories overlap in 53% of cases with high percentage of companies with missing information in Amadeus. Excluding the records with the missing size, the same size classes were reported for 82% of companies.

Regarding the age, in 86% of instances the information is consistent between both sources. Most of the companies surveyed in SAFE are older than 10 years and for those the information coincides in 93% of cases. However, the younger the company and the smaller the brackets, the lower the consistency between two sources. It is also noticeable, that the respondents, who could not specify the year of incorporation during the interview belong mostly to the companies classified as older than 10 years in Amadeus. This can stem from the fact that the respondents might not be familiar with the details of setting-up the company which was created more than a decade before, especially if they have joined the company relatively recently.

As for the turnover, the variable available from Amadeus is originally continuous whereas in SAFE this information is collected in four brackets. For the non-missing observations, the categories overlap in 51% of the cases, while for as many as 38% of the companies the information is not available in Amadeus.

We also check if the lack of concordance of the categories in two dataset is related to the quality of the match. Indeed, for the single matches the share of the records with overlapping characteristics is slightly higher than for multiple matches, presumably because some companies were incorrectly linked (Table 3).

The concordance of the companies characteristics and the type of the match (%)

Euro area, 11 largest countries, waves 3 to 10

Table 3

Match	Size			Sector			Age			Turnover			All firms
	0	1	9	0	1	9	0	1	9	0	1	9	
Multi - considered as single	24	21	27	25	22	37	27	23	44	26	22	25	23
Single	76	79	73	75	78	63	73	77	56	74	78	75	77
All firms	100	100	100	100	100	100	100	100	100	100	100	100	100

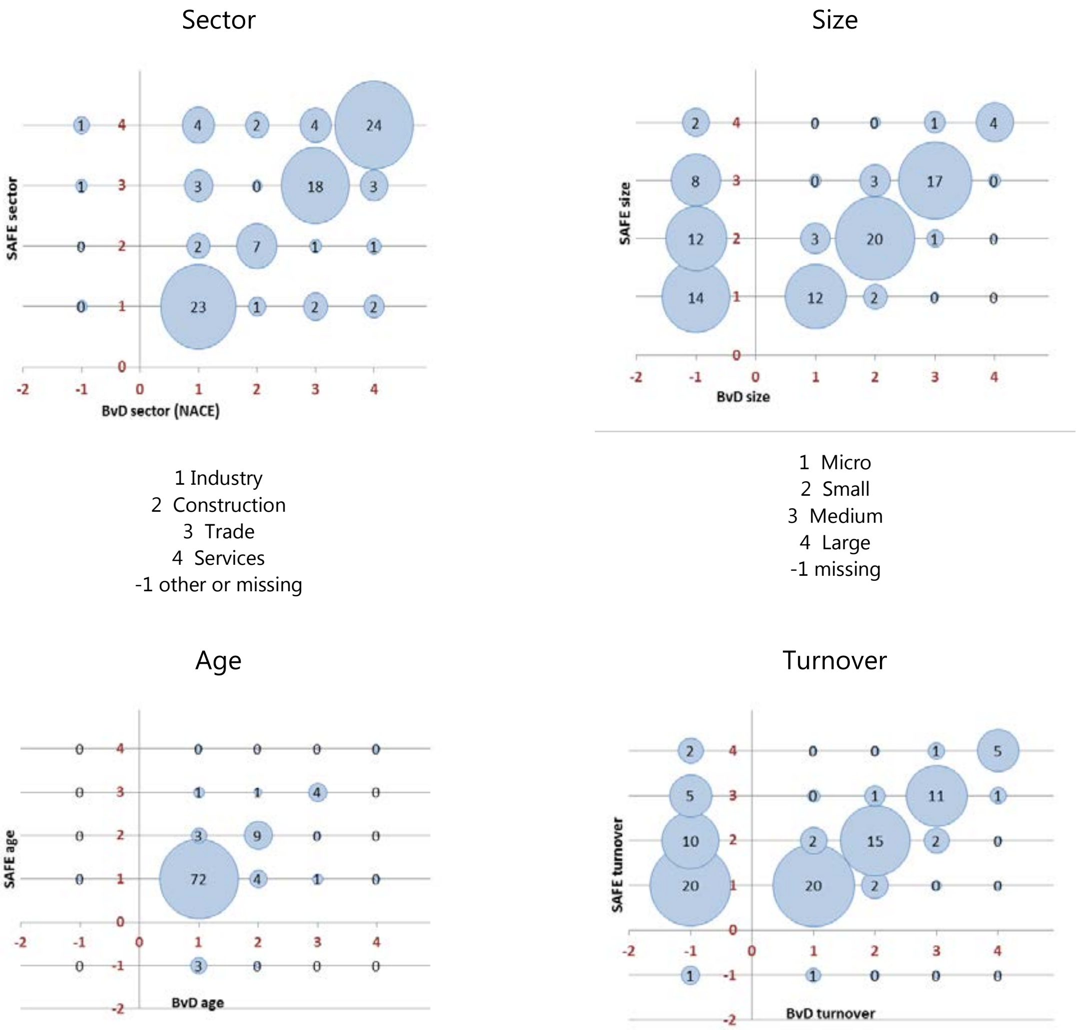
Note: 0 – characteristics belong to different categories in SAFE and Amadeus, 1- characteristics belong to same categories in both dataset, 9 – information is missing in Amadeus dataset.

Source: SAFE-Amadeus match, authors' calculations.

[4] The reference year for wave 3 is 2010, and 2011 for waves 4 and 5. For all subsequent waves (6 to 10), the reference year is 2012, since later data are of poor coverage.

Comparison of sector, size, age and turnover from SAFE and BvD (in %)

Euro area, 11 largest countries, waves 3 to 10 Figure 4



1 Industry
2 Construction
3 Trade
4 Services
-1 other or missing

1 Micro
2 Small
3 Medium
4 Large
-1 missing

1 More than 10 years
2 5 - 10 years
3 2- 5 years
4 Up to 2 years
-1 missing

Note: calculated from the year of incorporation for BvD.

1 Up to € 2 million
2 € 2 - 10 million
3 € 10 - 50 million
4 Over€ 50 million
-1 missing

Source: SAFE-Amadeus match, authors' calculations.

4.2 Availability of financial information in Amadeus

4.2.1 Relative and effective availability within the matched enterprises

Although Amadeus includes a wide choice of financial variables, the quality of the information is not free of shortcomings. The most problematic is the large number of missing values, albeit relatively high matching rate of companies on the contact information. In this section we present the availability of various financial variables over time, by country and size class.

First, we rely on the Amadeus variable indicating the type of the reporting (the categories are presented in Table 4). In most cases (86%), the financial information are reported on unconsolidated basis, mainly because the consolidated account does not exist (see Table 4). Consolidated accounts are available only for 4% of matched records, meaning that they are part of a bigger enterprise. Observations with no financial data amount to only 3% of the matched dataset, while limited financial information is available for 7% of the companies. When looking at the breakdown by size class, it is visible that missing financial data are prevalent for the micro firms. As expected the large firms are those which report on the consolidated basis most frequently.

Type of accounts available across size classes (%)

Euro area, 11 largest countries, waves 3 to 10

Table 4

	Micro	Small	Medium	Large	All firms
U1	78.8%	90.6%	86.3%	66.3%	84.1%
U2	0.2%	0.8%	2.2%	6.5%	1.5%
C1	0.1%	0.1%	0.9%	3.6%	0.6%
C2	0.4%	1.3%	5.3%	15.1%	3.3%
LF	13.7%	4.7%	3.6%	6.8%	7.1%
NF	6.8%	2.5%	1.7%	1.6%	3.4%
	100.0%	100.0%	100.0%	100.0%	100.0%

Code	Description
U1	Unconsolidated account of a company with no consolidated account
U2	Unconsolidated account of a company with a consolidated account
C1	Consolidated account of a company-headquarter of a group, aggregating all companies belonging to the group (affiliates, subsidiaries, etc.), where the company headquarter has no unconsolidated account
C2	Consolidated account of a company-headquarter of a group, aggregating all companies belonging to the group (affiliates, subsidiaries, etc.) where the company headquarter also presents an unconsolidated account
LF	Limited financial data
NF	No financial data

Source: SAFE-Amadeus match, authors’ calculations.

In the second step, we turn to availability of the selected financial variables from balance sheet (total assets, working capital, cash and cash equivalent) and profit and loss account (net income, sales). Number of employees is also included as an example of non-financial variable. Amadeus provides the financial data for the period of last 10 years with different coverage per year. The values before the year of incorporation are not counted as missing. In addition, observations with missing information on the year of incorporation in both datasets were also excluded since it was not possible to determine whether the company existed in the reference period. When looking at the main financial variables, the period between 2006 and 2011 shows the best coverage. The last year 2013 contains hardly any information which stems from the fact that companies report the financial data with a considerable time lag varying from country to country (mostly of around 6 to 12 months). In addition, up to 3 months are necessary for the data to be incorporated in the final Amadeus database[5].

From investigating the missingness patterns in matched data, it is apparent that the availability of the information at the record level is on both extremes. If a company reports financial statements, the quality is usually good - records with all 6 variables available appear most frequently, although in less than half of the matched sample. Observations with all analysed variables missing constitute almost 20% of the dataset, while additional for 10% of the companies missing values are justified, i.e. that the company did not exist at the reference period. From Table 5 is also visible that the balance sheet information is reported more diligently than profits and loss account. The difference in concept of sales and turnover[6] is minor, however, looking at the missingness patterns, it seems that sales are more frequently reported with other variables (the last two patterns shown in Table 5) and for that reason we exclude turnover in the subsequent analysis.

Missingness pattern

Euro area, 11 largest countries, waves 3 to 10 Table 5

Total assets	Working capital	Cash & cash equivalents	Net income	Sales	Turnover	Nr of employees	Frequency	Percent
1	1	1	1	1	1	1	180524	37.40
0	0	0	0	0	0	0	91676	18.99
.	.	.	.	.	.	.	48852	10.12
1	1	1	1	1	1	0	46425	9.62
1	1	1	0	0	0	0	20634	4.27
1	1	1	1	0	0	1	17196	3.56
1	0	1	0	0	0	1	11640	2.41
1	1	1	0	1	1	1	9910	2.05
1	1	1	0	0	0	1	7311	1.51
0	0	0	0	0	0	1	6057	1.25
1	1	1	1	0	0	0	4545	0.94
1	0	1	0	0	0	0	4527	0.94
1	1	0	1	1	1	1	3447	0.71
0	0	0	0	0	1	1	3426	0.71
1	1	1	1	1	0	1	2873	0.60
11	9	10	6	5	5	9	459043	95.08

Note: 1- information available, 0 – missing values (values should be reported) – justified missing values (company did not exist at the reference period)

Source: SAFE-Amadeus match, authors' calculations.

Heterogeneous coverage for the variables related to different statements is also visible in the breakdown of the availability by year of reference period (Table 6, only reference period as of the creation of a company is taken into account). Around 80% of successfully matched records have information on total assets and cash for the years with the best coverage (2006-2011), while sales are reported for around 60% of companies. All six variables are available for 47% of matched observations. However, this figure drops to under 40% when we look at the full SAFE sample, i.e. including the companies for which the match was not found.

[5] Amadeus Online User Guide.

[6] Turnover (operating revenues) is the sum of net sales, other operating revenues and stock variations.

When analysing the matched companies in each wave (see table 7), the share of missing records is stable with the exception of the most recent wave due to low coverage of the reference year 2013. The availability is also lower for the earlier waves, possibly with some companies going out of business, which is not fully captured in Amadeus database.

Regarding the size of the company, both in terms of number of employees and annual turnover, the smallest businesses have much less information available then medium and large companies (see Table 8). It can be partially explained by the legal regulations across countries that do not oblige the smallest companies to publish their financial accounts data.

Percentage of available values by year

Euro area, 11 largest countries, waves 3 to 10 Table 6

Variable	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	All firms
Total assets	68	76	82	83	83	84	84	82	71	9	76
Working capital	64	71	76	76	77	77	77	76	66	7	70
Cash & cash equivalent	66	73	80	80	81	81	81	80	69	8	73
Net income	59	63	66	66	67	67	67	66	58	7	61
Sales	54	57	60	63	64	65	66	65	56	7	58
Nr of employees	45	47	60	66	66	67	66	69	59	7	58
All 6 variables for matched	38	39	46	46	46	47	46	48	42	4	42
All 6 variables for SAFE	32	32	39	39	39	39	39	41	35	3	36

Source: SAFE-Amadeus match, authors' calculations.

Percentage of available values by wave

Euro area, 11 largest countries, waves 3 to 10 Table 7

Variable	3	4	5	6	7	8	9	10	All firms
Total assets	72	71	73	80	77	79	80	73	76
Working capital	67	66	67	74	72	73	74	67	70
Cash & cash equivalent	70	69	71	77	75	76	78	71	73
Net income	61	57	57	64	63	64	65	59	61
Sales	62	55	55	60	59	60	61	56	58
Nr of employees	57	55	55	61	59	60	61	57	58
All 6 variables for matched	44	40	39	44	43	44	45	41	42
All 6 variables for SAFE	36	32	34	37	35	37	38	36	36

Source: SAFE-Amadeus match, authors' calculations.

Percentage of available values by size and turnover class

Euro area, 11 largest countries, waves 3 to 10 — Table 8

	Size				Turnover					
Variable	Micro	Small	Medium	Large	Up to € 2 million	€ 2 - 10 million	€ 10 - 50 million	Over € 50 million	DK/NA	All firms
Total assets	66	79	80	75	70	81	80	74	71	76
Working capital	61	72	75	72	64	74	75	71	64	70
Cash & cash equivalent	63	77	79	73	67	79	79	72	68	73
Net income	49	60	71	71	52	63	74	71	55	61
Sales	46	58	67	69	51	61	66	68	50	58
Nr of employees	45	58	67	66	49	62	69	66	57	58
All 6 variables for matched	29	40	53	57	33	44	55	56	38	42
All 6 variables for SAFE	20	35	50	54	25	40	51	53	29	36

Source: SAFE-Amadeus match, authors' calculations.

Percentage of available values by country

Euro area, 11 largest countries, waves 3 to 10 — Table 9

Variable	AT	BE	DE	ES	FI	FR	GR	IE	IT	NL	PT	All firms
Total assets	59	87	66	81	86	76	60	81	88	56	82	76
Working capital	51	83	58	81	86	75	60	78	88	9	82	70
Cash & cash equivalent	57	85	65	78	83	74	60	71	88	52	82	73
Net income	18	87	26	81	86	76	60	21	88	15	82	61
Sales	30	39	37	80	86	78	60	1	88	7	81	58
Nr of employees	36	77	55	77	66	44	54	15	69	58	69	58
All 6 variables for matched	10	35	15	72	63	44	53	0	69	4	68	42
All 6 variables for SAFE	9	32	12	67	52	41	33	0	49	4	57	36

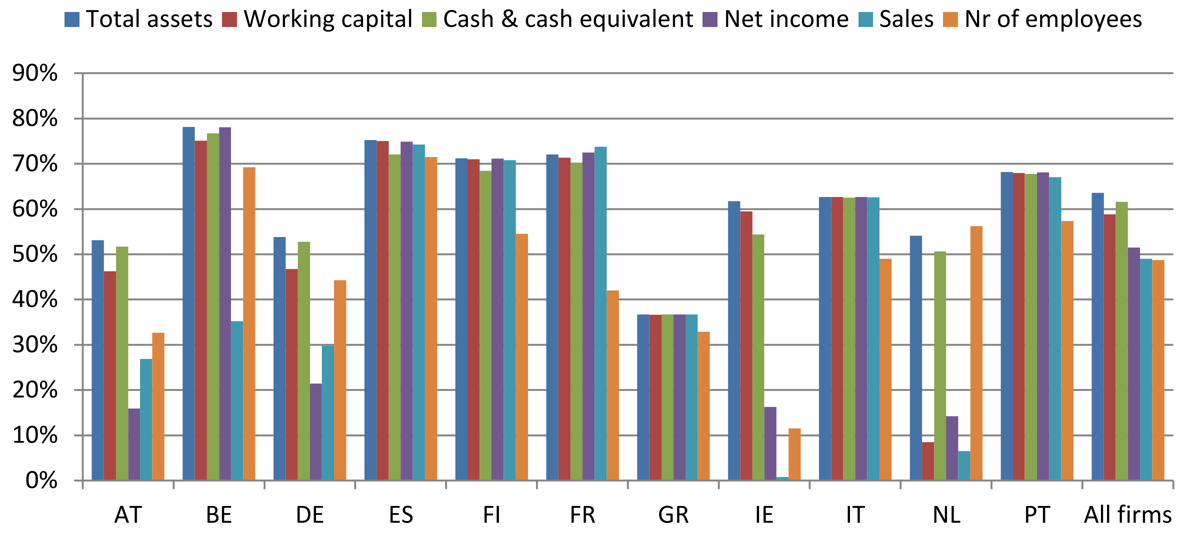
Source: SAFE-Amadeus match, authors' calculations.

The availability of the financial data is diversified across countries. Good coverage of the data exists in Finland, Italy and Portugal. In those countries and also in Greece, the coverage is similar for all selected variables, while in others it varies by type of the information. Indicators such as income and sales are mostly missing in Ireland, Germany, Austria and the Netherlands. It is worth to note that in the latter, the matching rate was the highest of all the countries (over 95%). To illustrate the final outcome, Figure 5 presents the effective availability of the financial information which is a result of the matching rate and the share of missing values in the matched data. When analysing the SAFE data, the effective coverage is the most suitable indicator to reflect the quality of the matching.

Effective coverage for the selected variables (%)

Euro area, 11 largest countries, waves 3 to 10

Figure 5



Source: SAFE-Amadeus match, authors' calculations.

4.3 Impact of matching process on SAFE estimates

In the following section we investigate to what degree the results obtained from the effectively matched Amadeus (emA) sample are in line with those based on the full SAFE sample. In order to correct for a possible bias we also apply a weighting scheme and inspect to what extent it can help to mitigate the discrepancies from the original results.

4.3.1 Variation in the effective availability leads to a biased sample

The effectively matched Amadeus (emA) sample includes the companies that have been successfully matched and for which the main Amadeus variables (i.e. 6 variables analysed in the previous section) are available in the 3-year period around the year of the survey[7]. As discussed previously, despite the overall high matching rate of 83%, the emA sample is reduced by over 50% owing to the high missing share of financial information in the Amadeus database. The emA sample includes 26,491 enterprises surveyed in waves 3 to 10 (reduced from 57,920 in the full SAFE dataset) with varying sample size across countries. In this context, the sample is particularly limited in Ireland with only a handful of companies and in the Netherlands - the country with the highest matching rate but very limited financial variables reported in Amadeus. Further analysis becomes also cumbersome for Austria and Germany, for which only less than 20% of the initially surveyed

[7] E.g. for wave 3 conducted in 2010, the emA sample would contain companies for which information is available for at least one year between 2009 and 2011. Given that 2014 data are not yet reported and 2013 data are of poor coverage, for the most recent waves (from 8 to 10) at least one year between 2010 and 2012 should be available to include the company in the emA sample.

enterprises are in emA sample. On the contrary, the highest proportion of the original sample is available for Portugal and Spain.

Across all the countries the highest loss of the initial sample is evident for micro companies, for which both the matching rates and the coverage of the Amadeus variables are the lowest. For those businesses the percentage of enterprises with sufficient amount of financial information in comparison to the original SAFE sample varies a lot, ranging from almost 0% in Austria, Ireland and the Netherlands to 63% in Portugal. Due to the lack of micro companies in emA sample Austria, Ireland and the Netherlands have been excluded from further analysis. It is also noticeable that the proportion of the original sample increases with the size classes. At the same time less variation exists across sectors, with the highest proportion for industry.

When comparing the aggregated results based on the original SAFE sample and the emA sample there are noticeable differences for the countries with a limited sample, i.e. Germany, Belgium and to a lesser extent Greece (see Figure 7). The results would point to a higher net percentage of SMEs reporting increased needs for bank loans and a much more volatile pattern in Germany and Belgium. There would be also a higher weighted percentage of the SMEs applying for a bank loan in Germany, on average by 13 percentage points (see Figure 8). Overall, it is difficult to disentangle the effect of limited sample size from country specific aspects regarding the collection of the account data in Amadeus. However, for the countries where the emA sample did not decrease drastically and is still between 50-70% of the original sample the results are in line with the SAFE benchmark. Inspecting further the changes by the size classes, the discrepancies are mostly pronounced for the micro firms. In a case of Germany, as presented on the Figure 11, the net percentage representing the difference between the percentage of enterprises reporting increase in needs for banks loans and those reporting a decrease is highly volatile. The series matches however to a higher extent the original results in case of Spain, country with the highest proportion of the original sample (Figure 10).

Comparison of original SAFE sample and effectively matched Amadeus sample by size and sector

Table 10

	SAFE sample					Effectively matched sample (% of the SAFE sample)				
	Micro	Small	Medium	Large	All firms	Micro	Small	Medium	Large	All firms
AT	1,290	1,314	859	246	3,709	0.2%	5%	51%	54%	17%
BE	1,450	1,481	662	137	3,730	12%	35%	76%	77%	35%
DE	2,412	2,475	2,343	784	8,014	3%	12%	31%	45%	18%
ES	2,428	2,474	2,356	748	8,006	57%	85%	90%	90%	79%
FI	1,432	1,430	626	115	3,603	49%	76%	88%	86%	67%
FR	2,394	2,444	2,385	801	8,024	40%	53%	62%	59%	53%
GR	1,460	1,459	656	125	3,700	19%	51%	64%	71%	41%
IE	1,430	1,429	625	118	3,602	0.0%	0%	0%	4%	0.2%
IT	2,394	2,434	2,439	738	8,005	34%	73%	89%	90%	68%
NL	1,339	1,325	852	246	3,762	0.1%	3%	15%	35%	7%
PT	1,338	1,341	850	236	3,765	63%	86%	88%	87%	78%
Total	19,367	19,606	14,653	4,294	57,920	27%	46%	63%	67%	46%

	SAFE sample					Effectively matched sample (% of the SAFE sample)				
	Industry	Construc tion	Trade	Services	All sectors	Industry	Construc tion	Trade	Services	All sectors
AT	875	336	927	1,571	3,709	34%	13%	17%	9%	17%
BE	740	464	1,119	1,407	3,730	51%	31%	34%	29%	35%
DE	2,449	787	1,470	3,308	8,014	27%	21%	16%	12%	18%
ES	1,886	971	1,911	3,238	8,006	86%	78%	74%	77%	79%
FI	781	545	579	1,698	3,603	80%	65%	67%	63%	67%
FR	2,125	728	2,518	2,653	8,024	57%	53%	51%	51%	53%
GR	647	337	2,092	624	3,700	51%	38%	36%	52%	41%
IE	745	350	1,335	1,172	3,602	1%	0%	0%	0%	0%
IT	3,842	528	1,676	1,959	8,005	78%	59%	59%	57%	68%
NL	599	391	948	1,824	3,762	14%	4%	7%	5%	7%
PT	942	468	1,065	1,290	3,765	86%	72%	75%	79%	78%
Total	15,631	5,905	15,640	20,744	57,920	58%	45%	41%	40%	46%

Source: SAFE-Amadeus match, authors' calculations.

4.3.2 Can weights correct the bias?

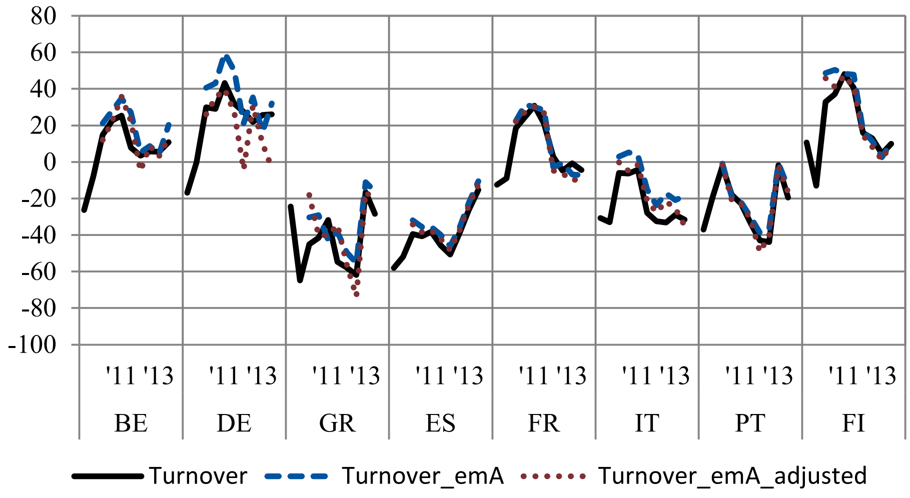
The original SAFE results are obtained by aggregating the raw data and applying the weights to restore the proportions of the population of enterprises, with regard to company size and economic activity in each country. Those weights are estimated based on the number of persons employed available from Eurostat's Structural Business Statistics (SBS) using raking method that aims to match the marginal distributions of the population (i.e. margins on size and sector classes) and minimises the distance between the initial and final weights.

In order to correct for the bias we rescaled the weights taking into account the limited emA sample. Consequently, a few enterprises from a given size and sector class may have a significant impact on the aggregates due to large weights, as in case of German sample. For almost all of the SAFE estimates presented on the Figure 6 to Figure 11, the identified discrepancies could not be corrected by the adjusted weights. Furthermore, in a few instances the deviations from the original series become even more pronounced. The overall results point to the conclusion that unbiased results cannot be obtained from the limited sample in each size class and country by applying a different set of weights. Particularly, the problem of potential bias stemming from lower coverage occurs in data for Austria, Germany, Ireland and the Netherlands, as well as for micro enterprises in all countries. However, for the sub-samples for other countries and for the larger enterprises the matched data seem to be of better quality.

In addition, limiting the analysis to fewer financial variables (in particular total assets, which have the best coverage) will improve the effective sample size. The emA sample is constructed under the condition that all six financial variables presented above are non-missing. Sales and net income have the lowest effective coverage overall and in case of Austria, Germany and Ireland these are the variables that decide about the drastic reduction of the sample size when constructing emA.

Change in the turnover situation of SMEs across euro area countries

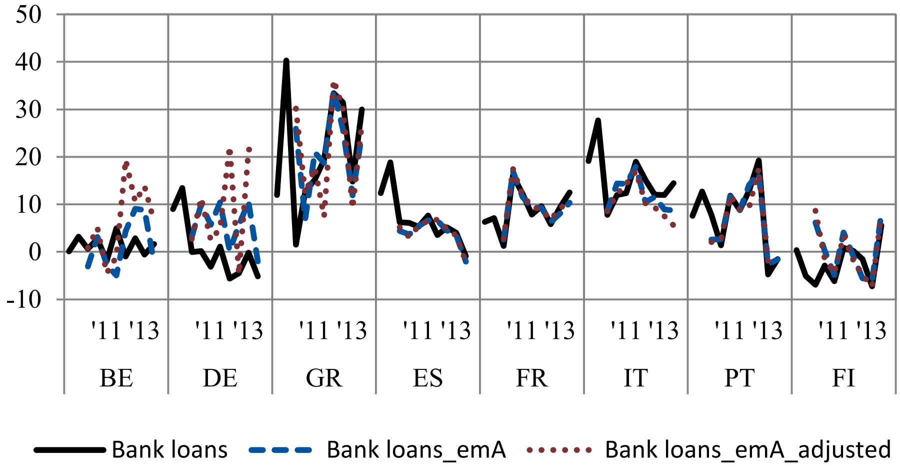
over the preceding six months; net percentage of respondents Figure 6



Source: SAFE-Amadeus match, authors' calculations.

Change in needs for bank loans of SMEs across euro area countries

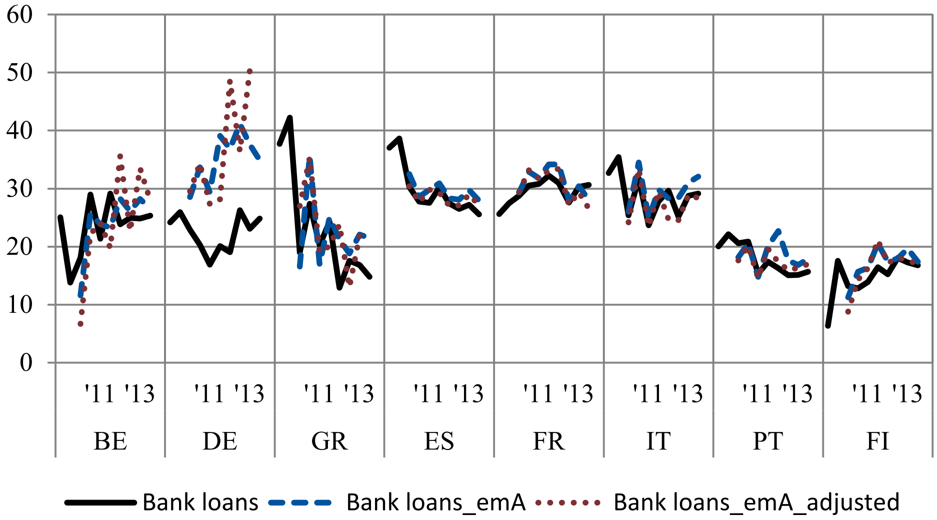
over the preceding six months; net percentage of respondents Figure 7



Source: SAFE-Amadeus match, authors' calculations.

Applications for bank loans by SMEs across euro area countries

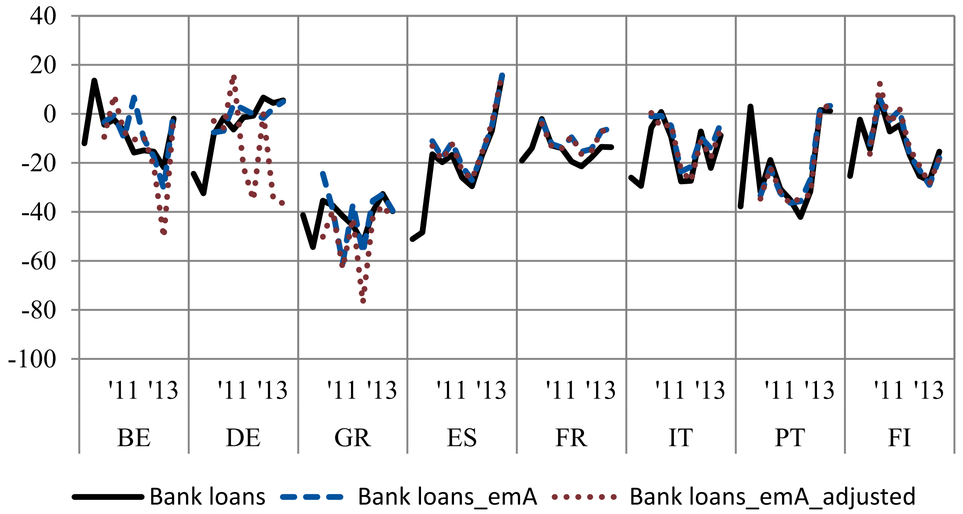
over the preceding six months; weighted percentage of respondents Figure 8



Source: SAFE-Amadeus match, authors' calculations.

Change in the availability of bank loans for SMEs across euro area countries

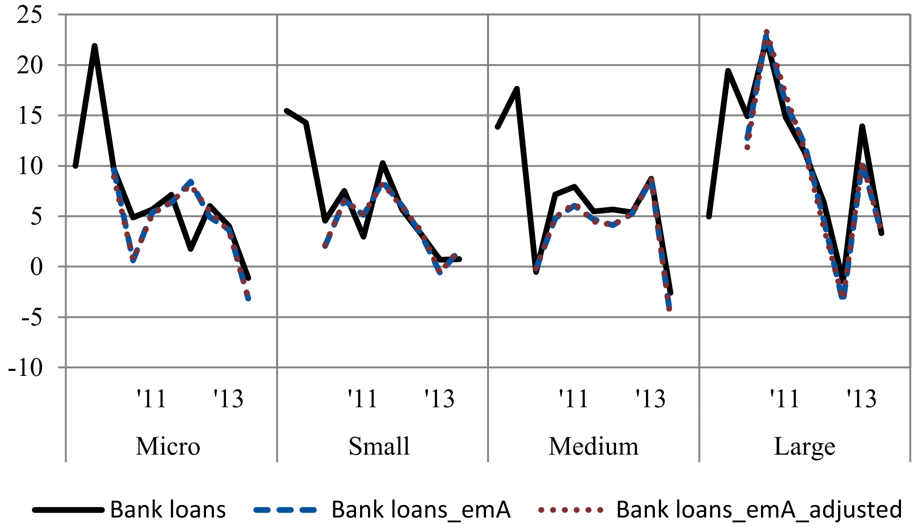
over the preceding six months; net percentage of respondents Figure 9



Source: SAFE-Amadeus match, authors' calculations.

Change in needs for bank loans across size classes in Spain

over the preceding six months; net percentage of respondents Figure 10

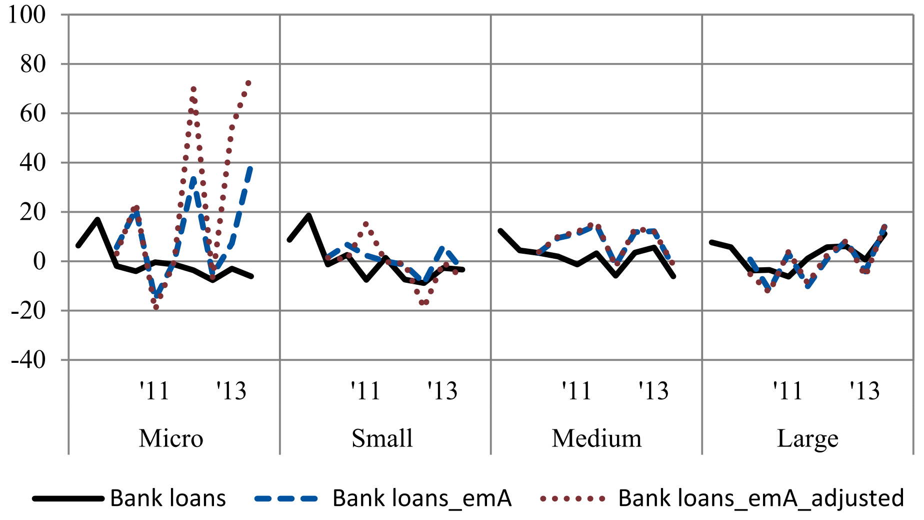


Source: SAFE-Amadeus match, authors' calculations.

Change in needs for bank loans across size classes in Germany

over the preceding six months; net percentage of respondents

Figure 11



Source: SAFE-Amadeus match, authors' calculations.

4.4 Comparison with Amadeus estimates

The matched data differ from the full Amadeus data in one main respect: the sample of the SAFE is not a simple random sample from the population of enterprises, and hence requires weighting adjustments to provide a representative, unbiased analysis of the target population. However, when using Amadeus data, it is not common practice to apply weights, and analysing the matched SAFE-Amadeus data without weighting is one of possible options.

The SAFE oversamples large firms and undersamples micro and small firms, while large firms are much better represented in Amadeus, and also have more financial information available, as the previous sections showed. In the end, it is not clear what the combination of these two effects is. Table11 shows the comparison of the structure of the matched dataset and the whole Amadeus dataset, as used in the ECB (2013) Structural Issues Report on Corporate Finance. It is clear that in all countries, in the matched sample the micro and small firms are underrepresented, with the situation of micro firms particularly dire, while the relative share of medium-sized and large firms is comparable overall but varies by country. In a few countries, large firms are underrepresented compared to medium-sized firms (Austria, Belgium, Germany, Finland and the Netherlands).

It is thus entirely predictable that the matched sample will not lead to figures that are comparable to aggregates produced from Amadeus directly.

Over-representation in the matched SAFE data vs. Amadeus (%)

Of each size class, relative to large firms

Table 11

	Micro	Small	Medium	Large
Austria	3.4	45.8	149.4	100.0
Belgium	5.4	75.2	145.7	100.0
Germany	1.4	33.7	161.1	100.0
Spain	1.9	9.9	64.5	100.0
Finland	10.1	112.0	221.4	100.0
France	1.9	17.5	89.8	100.0
Greece	14.2	41.4	97.6	100.0
Ireland	0.0	0.0	9.5	100.0
Italy	2.0	14.7	73.5	100.0
Netherlands	1.8	91.1	134.5	100.0
Portugal	2.5	19.7	67.5	100.0
Total	3.0	24.0	104.3	100.0

Source: ECB – SAFE-Amadeus match, ECB (2013) Annex 3 figures for Amadeus.

How to read this table: the share of micro firms to large firms in Austria in the matched SAFE data represent 3.4% of the same share in Amadeus.

5 Conclusion

In the paper we investigate the potential of linking the qualitative survey responses with the quantitative information from business registers to enhance the SAFE dataset. The results are mixed, with the quality of the matching varying greatly by country and the characteristics of the enterprises. In particular, the smallest businesses are underrepresented in the matched dataset and even if they are successfully matched, they exhibit the lowest coverage of the financial variables.

Overall, the balance sheet information is reported most widely with total assets available for around 76% of matched companies. If we take into account the full SAFE sample, i.e. also the companies for which successful match was not found, the coverage drops to 64%. When a study requires joint analysis of several financial variables, the share of enterprises with available information decreases drastically further – for 6 variables selected (total assets, working capital, cash and cash equivalent, net income, sales, number of employees) it amounts to 36% of the SAFE sample.

The effect of using such limited subsample on the SAFE estimates was analysed using two set of weights: i) first, with the original weights used for SAFE dataset; and ii) second, with the weights adjusted to the sample size of matched dataset. We conclude that for the breakdowns with low coverage, the weights adjustment is not able to correct for the biases stemming from distorted sample distribution. Particularly, such problem concerns data for Austria, Germany, Ireland and the Netherlands, as well as for micro enterprises in all countries. However, for the sub-samples for other countries and for the larger enterprises the matched data seem to be of better quality. In addition, a significant reduction in the sample size can be avoided by selecting smaller subset of required financial variables. A biased sample is particularly problematic, if one attempts to construct aggregates from the matched dataset. It does not, however, prevent the successful testing of certain hypotheses at the micro level – if the user is aware of the possible distortions in the sample distribution, he or she can construct the hypothesis testing so as to overcome this.

This paper presents first main findings on the quality of the matched SAFE dataset and this assessment will continue. The quality of matching might increase due to improved availability of the company tax identification number, which was not provided in the earlier waves of the SAFE. On the other hand, unfortunately a higher coverage of enterprises population in the Amadeus database cannot be expected, in particular for smaller businesses, since this group is more and more often exempted from the reporting or provided simplified and limited financial statements. However, given recent interest of policy makers in the situation of SMEs, new sources of data could become available in the future or current sources, such as business registers, can be improved with regard to quality and scope. The development in this area will be followed and investigated from the angle of enhancing the qualitative SAFE dataset with financial information, especially for micro enterprises.

At the same time, other methods of data matching can be explored. Currently, the record linking is performed by the provider of the register data. Effectiveness of other algorithms to link records can be explored, e.g. the method of probabilistic linking as described by Fellegi and Sunter. Another possible solution is the statistical matching, where the linked units do not need to be identical but only similar with regard to certain characteristics. However, given the wide scope of such methods, we leave it for future research.

6 References

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