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Job Creation in Europe: A firm-level analysis

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Abstract

This note reports an innovative state-of-the-art empirical analysis of *Job Creation in the European Union* in the same vein as the classical studies in the United States. It is based on an exceptionally large sample of firm-level employment data in the period 2004-2015 obtained from *Orbis*, a databank published by Moody's Bureau van Dijk. Consistently with our representiveness assessment, the final sample consists of firms registered in 20 out of the 28 EU Member States.

The study follows the empirical literature and defines three indicators which may be equally plausible policy objectives. The *job creation [destruction]* is the total number of jobs created [destroyed] by growing [shrinking] firms and reflects the job turnover of a market and its capacity to enhance the labour market dynamism. The *net job creation* is the difference between job creation and job destruction and captures the employment growth. The *net job creation rate* is the employment growth rate and reflects the capacity of firms of being efficient in creating new jobs.

The main findings are as follows:

- The young-SME category is the largest contributor to *net job creation* (employment growth). Moreover, its contribution to *job creation* amounts to 40 percent which is far larger than its share in employment amounting to 15 percent.
- The share of start-up firms in employment varies between 2 and 9 percent across countries with new Member States typically exhibiting larger shares. Even though to various degrees, nearly all Member States have experienced a decline of start-ups measured as the share of employment.
- With nearly 60%, high-growth firms (HGF) exhibit the largest incidence on total *job creation*. Even though the young HGFs are more numerous, mature HGFs contribute to *job creation* to a larger extent.
- Firms borrowing for the first time report *net job creation rates* of about 8 percent higher in the next three years, on average. Besides, the *net job creation rates* of firms with bank loans are less sensitive to economic cycles.

The results yield a number of policy implications. In particular, they provide empirical support to policies aimed at encouraging young firms and entrepreneurship in Europe. They also show that job creation of SME may face obstacles in their "scaling-up" development phase. Last, the impact of external financing on *net job creation rates* may vary among Member States – especially through the business cycles. These results deserve further investigation.

By providing a large-scale investigation of job creation in Europe and providing related policy tools, the report aims to contribute to the European Commission's first priority, "to boost jobs, growth and investment."

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All remaining errors are our own.

Executive summary

Creating a “*new boost for jobs, growth and investment*” in the European Union is the first priority of the Juncker Commission and was explicitly recommended in the Five Presidents Report. In order to calibrate the support to employment, European policy-makers need a state-of-the-art investigation of job creation in Europe that identifies *which* firms hold job creation potentials and *whether* these firms encounter notable obstacles. The Eurostat databanks provide aggregate statistics of employment at country, sector, and firm-size, both in levels and changes. Though, little is known at the firm level. This project aims at filling the gap.

Hence, we conduct an innovative empirical analysis of *Job Creation in the European Union* in the same vein as the classical studies produced in the United States. We use an exceptionally large sample of firm-level employment data in the period 2004-2015. The data is obtained from *Orbis*, a firm-level database published by Moody’s Bureau Van Dijk. Data limitation in *Orbis* varies substantially across countries, yet, and consistently with our employment representativeness analysis, we conduct the study on 20 out of the 28 EU Member States.

The study follows the empirical literature and defines three indicators which may be used as policy objectives.

- *Job creation* equals the total number of jobs created by growing firms in a category (e.g., country, sector, age and size); reciprocally, *job destruction* is the sum of jobs destroyed by shrinking firms.

The *Job creation* and *job destruction* represent the “gross” flows in the labour market and capture the turnover and the dynamism of the latter.

- *Net job creation* equals the difference between job creation and job destruction and captures the employment growth.
- The *net job creation rate* is equivalent to the employment growth rate and reflects the capacity of firms of being efficient in creating new jobs.

The empirical analysis yields a number of notable results. First of all, consistently with the studies in the US, we find that young-small firms exhibit the largest contribution to *net job creation* in Europe. Also, even though not the largest contributors, the contribution of young-small firms to *job creation* amounts to 40 percent, which is far above their share in total employment (15 percent). Besides, consistently with previous studies, we too find that small firms are proportionately larger *net job creators* at the European level, unless we control for age and measurement issues.

As we look at employment, the results show substantial disparities among EU Member States regarding the share of start-up firms, ranging between 2 and 9 percent, new Member States typically exhibiting larger start-up shares. Further, even though to various degrees across Member States, we observe an overall decline of start-up firms in employment.

Another striking result is that *job creation* is concentrated in a small share of high-growth firms (HGF), defined as firms with an average annual employment growth of at least 20 percent over three years. HGF account for 60 percent of total *job creation* and the result is relatively consistent across countries and sectors. The result is not as a tautology as it may sound; in fact, the HGF category is made of a tiny share of firms and as we break down the 20+ employment growth rate, the contribution to *job creation* by sub-category flattens out. Finally, even though the young HGFs are more numerous in our sample, the contribution of mature firms to *job creation* is higher – not necessarily in terms of the *net job creation*.

Another set of results show that firms which access bank loans for the first time report significantly higher *net job creation*. Newly-borrowing firms exhibit 8 percent higher *net job creation* on average three years after loan contraction. This shows that strong growth is typically accompanied by banks.

The main empirical findings are summarised as follows:

- The young-SME category is the largest contributor to *net job creation* (employment growth). Their contribution to *job creation* amounts to 40%, far higher than their share in employment.
- The share and decline of start-up firms in employment varies across Member States between 2 and 9 percent; new Member States typically exhibit larger shares. There is an overall decline of start-ups in the share of employment, with substantial disparities among Member States.
- A few High-growth firms (HGF) have the largest incidence on *job creation*, 60 percent. Young HGFs are more numerous but mature HGFs are larger contributors to *job creation*.
- Firms borrowing for the first time experience ca. 8 percent higher *net job creation rates* in the subsequent three years.

The empirical analysis provides additional results of interest. We find substantial differences in the response to economic cycles from firms according to their own characteristics – e.g., independence, size and age. In particular, we observe that the *net job creation rates* of firms with access to finance are less sensitive to economic cycles. Borrowing firms are likely to benefit from financial cushions in crisis times, but also receive support for growth. Presumably, there are variations among Member States in the impact of external financing on net job creation which deserves further investigation.

Apart from access to finance, there seem to be inherent obstacles to labour dynamics. For instance, in our sample, young SMEs located in urban areas with high population density take up a share in *job creation* proportionately higher than their share in employment. Young SMEs are those most in need of recruiting specific skilled employees; the result thus suggests that urban areas are more likely to provide such skills than non-urban areas, where labour dynamics seem more constrained.

The results yield a number of policy implications. By showing the relevance of young and small firms for *job creation* and labour market dynamics, they provide empirical support to policies aimed at encouraging young firms and entrepreneurship in Europe. By showing the existence of obstacles to growth, they also highlight that job creation of small firms may face obstacles in their “scaling-up” development phase and deserves further policy attention.

General Introduction and Overview

My first priority as Commission President will be to strengthen Europe's competitiveness and to stimulate investment for the purpose of job creation. I intend to present, within the first three months of my mandate and in the context of the Europe 2020 review, an ambitious Jobs, Growth and Investment Package.

I do not believe that we can build sustainable growth on ever-growing mountains of debt - this is the lesson learnt in the crisis that we must now heed. I also know well that it is mainly companies that create jobs, not governments or EU institutions. However, I do believe that we can make much better use of the common EU budget and of Union financial instruments [...]. We must make use of these public funds available at Union level to stimulate private investment in the real economy. We need smarter investment, more focus, less regulation and more flexibility when it comes to the use of these public funds.

Jean-Claude Juncker
President of the European Commission
A New Start for Europe: My Agenda for Jobs, Growth, Fairness and Democratic Change.
Strasbourg, 15 October 2014.

When taking over the Presidency of the European Commission, Jean-Claude Juncker set out the Ten Policy Priorities for his mandate, among which "A new boost for jobs, growth and investment" comes first. The Five Presidents Report also emphasises that "the employment and social situations vary widely across the euro area, partly as a result of the crisis but also because of underlying trends and poor performance pre-dating the crisis. [...] Efficient labour markets that promote high level of employment and are able to absorb shocks without generating excessive unemployment are essential." (J.-C. Juncker, D. Tusk, J. Dijsselbloem, M. Draghi and M. Schultz, 2015, *Completing Europe's Economic and Monetary Union*). The policy tools implemented by the so-called *Juncker Plan* consist not only in the coordination of efforts among Member States, but also the implementation of a vast Investment Plan for Europe that specifically targets job creation and growth. Bearing this purpose in mind, the plan is aimed to implement smart financial support to corporations, remove obstacles to their investment and provide visibility and technical assistance.¹

Substantial emphasis has been put on the provision of policy tools to encourage job creation, while as a matter of fact, apart from Criscuolo *et al.* (2014) who analyse OECD countries, there hardly exists any wide-scale *micro-firm level* study depicting the state of job creation in the European Union. Such knowledge is yet essential to policy making and this project is aimed to fill the gap. Indeed, we not only provide new evidence about job creation in the EU that updates and complements Criscuolo *et al.* (2014), but also we extend the number of countries and produce innovative results at the EU aggregate level. Remarkably, the project proposes techniques to construct an innovative representative dataset of employment in Europe, which constitutes a policy tool *per se* since this dataset is likely to provide scientific support to future policy decisions.

The report is constructed upon three chapters, which are strongly inter-related. Chapter 1 reviews the existing empirical evidence about job creation worldwide, especially in the United States. We emphasise the *age vs. size debate* which has been the main driver of

¹For a recent review of the Juncker Commission priorities and their implementation, see, e.g, Bassot *et al.* (2018) published by the *European Parliament Research Service*.

policy decisions since the post-war era. Historically, the belief that small firms hold the largest potential to become the main net job creators has dominated the literature and this motivated a number of major policy programmes. The so-called "*Think Small First Principle*" justifies programmes typically aimed at improving business environments and resolving SMEs funding issues due to failures in the financial system. The *Small Business Act* in the USA voted in 1953 and the European *Small Business Act* engaged in 2008 are well representative of these large scale programmes.² Besides, high-growth firms (HGFs) are found to play a prominent role in the net job creation growth and typically are young and small.

General evidence about job creation has been tested using US data. There have been major disagreements between two influential groups of researchers. On the one hand, the group led by David Birch in the 1980's and developed by the "MIT group" insists that small firms outperform other firms in terms of job creation. Birch praises the dynamism of the business environment and entrepreneurial spirit in the US that gives chances to entrepreneurs and young firms. On the other hand, the line of research initiated by Steven Davis and John Haltiwanger in the 1990s show that size is irrelevant to determine job creation, and the age of the firms has greater importance.

Chapter 2 details our sampling methodology and empirical strategy, and describes the final sample. The firm-level information, including employment, is obtained from *Orbis*, a databank published by Moody's Bureau van Dijk. Because the project intends to use innovative firm data at EU level, we are cautious that the data are representative of the European employment at non-financial corporations. The sampling procedure heavily relies on our analysis of the representativeness of the *Orbis* employment data by country and year, involving the comparison of levels and dynamics – the details are reported in the Appendix. The contribution of the representativeness analysis presented in this report resides, not only in the dataset, but also in the ability for readers to replicate the process since selection and imputation techniques are detailed. Based on our analysis, we retain 20 out of 28 EU countries, namely Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden. Despite the constrained selection of countries, our sample is representative of the EU-28 Member States with a good mix of relatively large and small economies, as well as EU accessing periods.

Chapter 3 reports the empirical analysis. Given that our study involves European data, our main objective is to identify facts and patterns of job creation in Europe and potentially differences with the United States, not so much giving a final word in any of the debates highlighted in the review. Interestingly, already in 1987, David Birch states several reasons why Europeans and Americans are different – e.g., egalitarianism and threat of failure – which would explain why Europeans are less entrepreneurial than Americans.³ Even though Europeans are likely to admit the existence of differences between Europeans and North-Americans, this view is probably exaggerated.⁴ Also, Europe has substantially evolved since the mid-80s, and entrepreneurship spirit has been brought about especially thanks

²See also COSME, the European Commission programme to support the financing of SMEs, and Horizon 2020 Work Programme 2018-2020.

³"It is difficult to accumulate wealth in a society wedded to the ideal of social and economic egalitarianism. There are prices to be paid: less private wealth means less private venture capital, which is overwhelmingly the major source for venture capital in the United States. The shortfall in private venture capital translates into a heavier reliance on institutional capital (e.g., banks, mutual funds, etc.). Institutional capital is notorious for its aversion to risk. There are other reasons discouraging entrepreneurship in Europe: a major one is fear of failure. Failure is catastrophic. To fail there is to acquire a burden of shame and guilt that may be handed down to the next generation. You are branded as somehow inferior for having tried and failed. Social and economic ostracism is almost automatic. Having failed, you are very unlikely to ever receive future financial backing." David Birch, "Are We Special?," in David Birch, *Job Creation in America*, Free Press, 1987.

⁴The "stigmatisation" of entrepreneurial failure in Europe is sometimes mentioned in the documents of the Commission as well, e.g., Press Release of the European Commission *Commission gives boost to start-ups in Europe*, 22 November 2016: "We want to help start-ups stay and grow in Europe.[...] By making it easier for them to have a second chance, without being *stigmatised* if their idea doesn't succeed the first time around."

to supportive regulation and new financing tools. Yet, the analysis exposed by David Birch has the merit of questioning whether Europe and the United-States are different, and more generally whether there are disparities amongst European countries.

The main findings from the empirical analysis are as follows. First of all, the young and small firms contribute to *job creation* proportionately more than their share in employment; 40 and 15 percent, respectively. Also, young-small firms exhibit a disproportionately high *net job creation*. Moreover, we observe that the share of start-ups in employment varies substantially across Member States, with new Member States displaying larger shares. Yet, there is an overall decline of start-ups measured by their share in employment, but this decline is uneven across countries. Another set of results shows that *job creation* and *destruction* are highly concentrated in a tiny fraction of firms, the high-growth firms (HGF) – defined as firms growing with an annual *net job creation rate* of 20 percent over a three year period. While proportionately very few, HGFs contribute as much as 40 percent of job creation. The profile of HGFs are typically young and small; yet, mature HGFs contribute to *job creation* to larger extents. We also report a set of results looking at obstacles to *job creation* and *net job creation*. Among others, we find that *access to finance* is associated with patterns of *net job creation rates*. Firms accessing bank loans for the first time report significant higher *net job creation rates*, especially young firms. Besides, *net job creation rates* of leveraged firms are less sensitive to economic cycles. Moreover, young SMEs located in urban population dense areas disproportionately contribute to *job creation* and reflect a more lively business ecosystem, where the labour markets better match skills. Finally, we observe that the response of firms to economic shocks varies in function of their characteristics, e.g., independence, size and age.

The findings have a number of policy implications.

- By showing the contribution of young and small firms to jobs, the results provide supporting evidence to the implementation of policies towards entrepreneurship supporting talents. Young and small firms contribute disproportionately to *job creation* as well as *net job creation* and deserve the attention of policy makers.
- By showing the existence of potential constraints to growth as well as the decline of start-ups in employment, the study supports the policy tools being implemented to assist firms in the start-up and scale-up phases, among others the European Commission *initiative to support start-ups and scale-ups* that was launched in 2016. Further analysis is needed in order to identify the needs for intervention.
- The fact that firms vary in their response to economic cycles in terms of employment also deserves further analysis. Size, age, independence, and access to finance, are just a few characteristics that we identified as potential determinants of the response of firms. Besides, each of the Member States probably displays a different structure, e.g., in terms of corporate ownership, that may induce a different response of the economy, as a whole. That is likely to have significant policy implications.

Chapter 1:

Job Creation: Prior Knowledge

By reviewing the existing policy and academic literature, this chapter portrays the current knowledge and evidence about job creation of non-financial corporations. We put emphasis on empirical firm-level evidence describing the economies of the European Union even though we also report findings to both historical and ongoing debates on job creation research; those would typically use US data.

This chapter is built around three essential areas of job creation. The first area aims at identifying job creation capacities at the *individual firm level*. Firm level studies identify the main characteristics of employers and job creators, and whether these characteristics vary over time, across countries and business environments. This literature has identified two main results. First, labour is chiefly employed by small and medium enterprises (SMEs); second, major net job creators are restricted to a subset of relatively young SMEs. Besides, entry-exit barriers and limited access to finance are non-trivial obstacles to corporate growth and job creation.

The second area in job creation looks beyond age and size. In fact, provided that a vast majority of young and small firms hardly ever grow, it is relevant to identify those that do grow. We first review the characteristics of the high-growth firms (HGFs) which are found to play a prominent role in the job creation dynamics and find they mainly are young and small. We then question whether founders' decisions taken before and shortly following entry signal growth ambitions; for instance, the hiring of the first employee, offering specialised or standardised products, or simply the name of the company. Finally, we review some aspects of the financial constraints and their impact on corporate growth.

The third area investigates the *relative* position of the firm within the economy and how the firm's ability to create jobs may depend on the characteristics of the other firms. The large heterogeneity in firm productivity even in the most narrowly defined sector suggests that market frictions and distortions are likely to prevent the flow of resources, including labour, from less to more efficient firms.⁵ Also, job creation and destruction – job allocation in general – have implications for the aggregate productivity and wealth of the economy.

Although low profits in recessions make the destruction of unproductive units relatively less costly, there are inherent obstacles that are likely to obstruct the reallocation of resources towards more efficient units. Obstacles to reallocation comprise regulations, e.g., size dependent policies, property rights constraints, international trade related distortions, and inefficient allocation of external funding. We illustrate this last point with the so-called zombie firm phenomenon; zombies are indebted and financially non-viable firms that are likely to receive the financial support from their banks. Unproductive zombie firms affect non-zombies since they retain resources that could be used by other firms otherwise.

Additionally, we address the phenomenon of the *falling share of labour* in corporate value added. Such pattern is observed in several countries, especially in the United-States and is becoming a source of concern for job creation. Although there is no consensus among economists as of the reasons for the falling labour share, it seems to come along with an increasing industry concentration, suggesting that competition is diminishing. Also, the fall in labour shares is concentrated among largest firms.

⁵An alternative view is that firms in a sector do not compete with each other because they compete in different markets.

1.1 Identifying Job Creating Firms: the Age-Size Debate

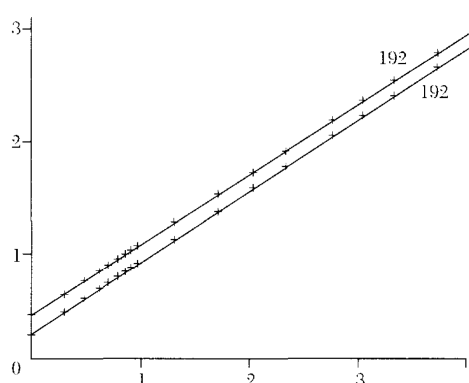
1.1.1 The size of the firm

The link between the size of the firm and its ability to create jobs is not straightforward. Some argue that *smaller* firms have greater growth capacities because, e.g., individual market shares are smaller giving them more room for growth. Instead, others may claim that *larger* firms hold the extensive know-how and financing capacities that provide them with competitive advantages over *smaller* firms to catch new business opportunities.

First empirical findings provided by Gibrat (1931) actually suggest that firm size is *irrelevant* to explain job creation. The author formulates the *Proportionate Job Creation Theory* whereby any firm in an economy is as likely to catch new business opportunities regardless of its size; as a result, firms grow at the same pace on average. The proposed empirical methodology is somewhat uncommon for today's standards. In fact, Gibrat (1931) lends from the mathematics – the *Law of Laplace* – and shows that if size group categories are affected by a large number of small changes, independent from each other, then the changes would generate normally distributed logs of firm size.⁶

Gibrat (1931) investigates French manufacturing data and finds that the logarithm of the size of firms is indeed normally distributed. Figure 1 is an illustration of Gibrat (1931) results in the case of French Manufacturing in 1920 and 1921, and shows a perfect fit with the prediction.⁷

Figure 1: Gibrat's Data for French Manufacturing Establishments in 1920 and 1921.



Note: This figure is extracted from Gibrat (1931). It reports the distribution of the logarithm of the number of employees (X-axis) of firms in French Manufacturing in years 1920 and 1921, and their respective net employment growth (Y-axis). The author builds on the *Law of Laplace* and shows theoretically that should shocks affect firms randomly across size categories, the log-distribution of firm sizes tends towards linearity.

Subsequent post-war empirical work in the 1950's and 1960's showed mixed evidence of the phenomenon but could not reject the proportionate job creation theory altogether.⁸

Nevertheless, the belief grew among policy-makers and scholars that greater growth potentials are more likely to lie among SMEs; this belief came as a justification to official policies providing small firms a favourable business environments and financial support. The *Small Business Administration* programme of subsidies and loan guarantees enacted in 1953 in the US is representative of SMEs oriented growth policies of the time.

The evidence that small firms were the largest job creators is probably best represented by the extensive work produced by David Birch in the 1970's and 1980's, especially Birch

⁶Sutton (1997) proposes a brief proof of the empirical implications of the *Proportionate Job Creation Theory*.

⁷Gibrat provided similar results in a number of sectors and geography.

⁸Geroski (1995) and Sutton (1997) provide remarkable reviews of the early empirical evidence.

(1981, 1987). David Birch uses an innovative firm-level dataset – the so-called *DMI* files published by Dun & Bradstreet (henceforth, D&B) – covering years 1969, 1972, 1974, and 1976. In his sample, the author defines job creating [*destructing*] firms between time ($t-1$) and t and within a geographic area, the firms that satisfy one of the following three distinct conditions: (i) the firm is newly established [*closed*]; (ii) the firm existed in the previous period $t-1$ and expanded [*contracted*]; (iii) the firm migrates from [*to*] another geographic area between time $t-1$ and t . Aggregate job creation [*destruction*] in a state equals the sum of new [*lost*] jobs created [*destroyed*] by job creating [*destroying*] firms; *net job creation* is the job creation net of the job destruction.

The main results are as follows. Should one classify states by net job creation rate categories and compute average destruction and creation rates by category,⁹ one would observe that the job destruction rates are stable across categories, not the job creation rates. The job creation thus seems to drive the net job creation. Moreover, about two-thirds of the net job creation in the period 1969-1976 are credited to small firms – twenty employees or less (see also Birch (1987)) – which proportionately remains greater than their share in employment.¹⁰ David Birch thus demonstrates that firms do not benefit from growth in a random fashion as suggested by Gibrat's *Proportionate Job Creation Theory*; instead, smaller firms are more likely to create jobs than larger firms. Interestingly, the author extensively argues in favour of stimulating the business environments of firms rather than providing mere financial supports: only fitting business environments will allow managers to express their talents.

The author develops an interesting discussion about the liveliness of an economy like the US economy that gives space to small firms to grow – and replace older firms. In the mind of the author, the dynamism of smaller firms features the US business ecosystem and its ability to grow talent internally. We emphasise this interpretation because it certainly constitutes a leading work in the field that in line with such an interpretation bears a number of policy implications. Besides, even though the contribution of small firms to net job creation and the specificity of the US in the field have been both questioned by subsequent studies, the young and small characteristics of net job creators is rarely questioned.

Indeed, the contribution of small firms to job creation is called into question by Davis and Haltiwanger (1996). In their influential paper, they point out that the genuine observation that job creation is negatively correlated with firm size may be due to methodological and dataset related issues. In particular, size-based job creation analyses need to control for the following issues:

1. *Size Distribution Fallacy*: firm-size classification will vary from one period to another due to reclassification of firms, and alter the firms size distribution.
2. *Regression Fallacy*: Temporary shocks to the firm employment will technically distort the size-job creation relationship in favour of smaller firms.
3. Firm size does not necessarily have similar impacts on job creation (created jobs) and *net job creation*, and need to be analysed separately.

We further explain the *regression fallacy* because the issue and associated solutions have been widely acknowledged among scholars – including ourselves; see the analysis in Chapter 2.3.1. It is a statistical pitfall due to firms' switching size categories for a single period, typically resulting from a one-shot large command from customers.

Box 1 illustrates the problem and consequences. In the example adapted from Davis *et al.* (1996a), Firm 1 benefits from a single period exceptional command from a customer and

⁹The job destruction rate is the sum of lost jobs in shrinking companies relative to the total employment; the job creation rate is the sum of new jobs in growing companies relative to the total employment. The net job creation is the job creation net of destruction.

¹⁰Notice that in Birch's sample, "virtually none of the employment change in an area is due to firms moving, in the sense of hiring a moving van and relocating."

for this reason recruits ten full time employees on temporary contracts. Firm 1 has 45 employees in Year 1 and is thus classified as a *small firm* in Year 1. In Year 2, Firm 1 employs 55 employees so that it becomes a *large firm*. Finally, in Year 3 it is classified as a *small firm* again with 45 employees. The category switching by Firm 1 has a positive impact on the job creation of *small firms* category in the period years 1 to 2, and negative on *large firms* category in period years 2 to 3. Firm 2 illustrates the opposite case, and Firm 3 is unchanged in the three periods.

Box 1. The Regression Fallacy

	Firm level			Category level		
	Firm 1	Firm 2	Firm 3	Small firms	Large firms	All firms
Year 1	45	55	60	45	115	1600
Year 2	55	45	60	45	115	1600
Year 3	45	55	60	45	115	1600
Growth, Year 2	0.22	-0.18	0	0.22	-0.09	0
Growth, Year 3	-0.18	0.22	0	0.22	-0.09	0

This table illustrates the *Regression Fallacy* described in Davis *et al.* (1996b), Chapter 4. "Small Firms" are firms with less than 50 employees in the *base year*; figures are in italics.

Firm 1 is classified as a small firm in Year 1, and its net job creation rate is 22 percent. Reciprocally the temporary drop in employment of Firm 2 – large in Year 1 – of 18 percent classifies the firm as a small firm in Year 2.

Using *base year* size distorts growth measures against temporary shocks. The solution proposed by Davis *et al.* (1996a) consists in classifying firms by the average size between the two periods, and called this measure the "*current size*."

The example provided in Box 1 shows that looking at the base year employment level results in an upward (downward) bias of aggregate small (large) firms' growth. In order to resolve the statistical issue Davis *et al.* (1996a) suggest to compute job creation and destruction rates from the base period *t-1* to period *t* relative to the average employment level in these two periods.¹¹ Davis *et al.* (1996a,b) find that once the above mentioned criteria are met with the right methodology and necessary longitudinal data requirement, large plants and firms account for most newly created jobs. Furthermore, these created jobs are likely to survive. While small firms exhibit high gross job creation rates, due to the high prevalence of job destruction, the net job creation with small firms is not high.¹²

Davis *et al.* (1996a) also argue that the dataset used by Birch "and associates" is unsuitable to the analysis for two reasons. First, its representativeness is questionable: the number of employees exceeds the number of employees in official statistics by about 8 percent. Second, the birth and death dates are misreported. For instance, firms that were subject to massive lay-offs and went bankrupt are reported with a change of ownership structure.

Neumark *et al.* (2011) conduct a thorough and updated analysis using similar data to Birch (1981) and addresses the critics formulated by Davis *et al.* (1996b). Overall, the authors

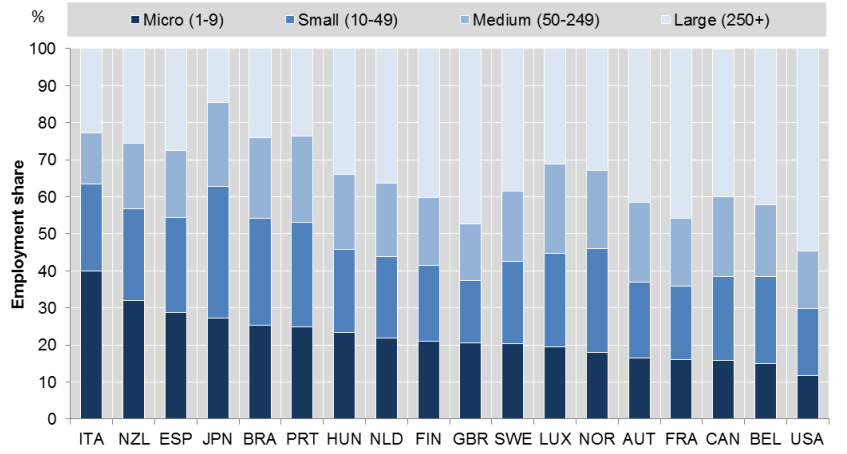
¹¹Davis *et al.* (1996b) refers to this as the "current" establishment size measure.

¹²For a detailed analysis of the regression fallacy, see e.g., Davidsson *et al.* (1998)

find results consistent with Birch (1981), namely small firms are net job creators. In fact, they use average employment based measures in order to control for the *regression fallacy*. The results provide evidence that small firms are the main net job contributors – even though at a lesser extent than using base year employment. Besides, they use the new versions firm data provided by D&B and find that the data no longer suffer from the drawbacks mentioned by Davis *et al.* (1996b).

One reason why small firms are such a focus of interest relates to the significant share of the labour force they employ. This pattern is illustrated by Figure 2 obtained from Criscuolo *et al.* (2014) for a set of OECD countries, and shows the share of employment by firm size in the manufacturing sector.

Figure 2: Share of employment by different firm size and by country.



Note: This figure is extracted from Criscuolo *et al.* (2014). It shows employment shares by firm size in manufacturing, construction, and non-financial services sectors across OECD countries in the period 2001-2011 – with some differences in the period across countries. Countries include Australia (AUT), Belgium (BEL), Brazil (BRA), Canada (CAN), Finland (FIN), France (FRA), United-Kingdom (GBR), Hungary (HUN), Italy (IT), Japan (JPN), Luxembourg (LUX), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Unites-States (USA).

Figure 2 shows that in general small firms (less than 250 employees) indeed employ the largest share of the labour force. Nevertheless, there is a wide discrepancy across countries. Large firms (above 250 employees) employ as little as about 15 percent of the Japanese labour force, and up to 55 percent in the US. Micro firms (1-9 employees) employ as much as 40 percent of the labour force in Italy, and as little as 11 percent in the US. Therefore, the observation that small firms are potentially the main contributors to the net job creation at the aggregate level is likely to have different impacts national economies.

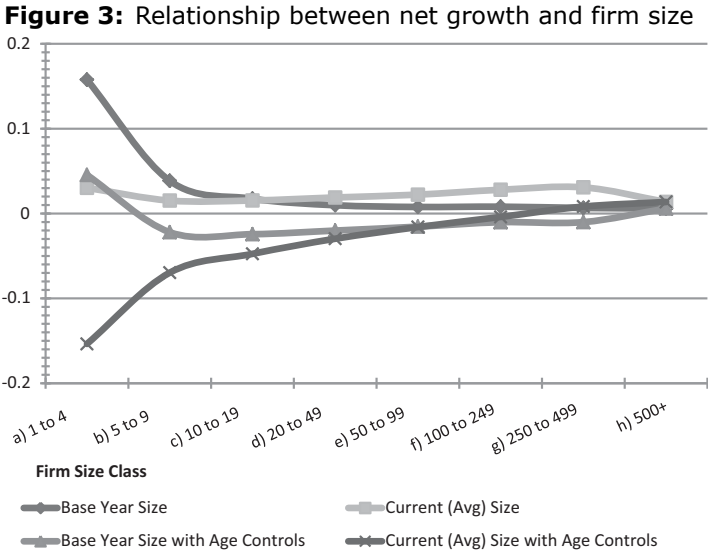
1.1.2 The age of the firm

Even though the aforementioned studies already cite age as a factor of net job creation,¹³ scholars specifically shifted their research focus from size to age in years 2000s. In their empirical study, Lotti *et al.* (2003) find that Gibrat’s *Proportionate Job Creation Theory* fails should one consider new entrants, but cannot be rejected in samples of older firms. In a recent work, Coad *et al.* (2018) finds very similar results using an autocorrelations analysis of net job creation rates at firm level: the likelihood of a firm to create new jobs decreases as it gets older. Firms initially experience higher net job creation rates in the period shortly after birth; the rates then diminish until they finally become hectic showing

¹³In fact, Birch (1981) suggests that among small firms, younger small firms are those providing with the largest share of net job creation.

negative autocorrelations. Among others, the results are explained by the selection process that falls over new entrants.¹⁴

The relationship between age, size and net job creation is well illustrated by Haltiwanger *et al.* (2013) who find a negative relationship between firm’s size and net job creation *unless* models control for age. Also, the size-job creation relationship is substantially mitigated whenever the measure of net job creation rate controls for the *regression fallacy* by using *current size* instead of *base size*.¹⁵ Figure 3 is extracted from the article and is illustrative of the main results.



Note: This figure is extracted from Haltiwanger *et al.* (2013) and shows the relationship between size and net job creation rate. Four approaches are adopted combining two measures: net job creation rates use either the base size (*Base Year Size*) or the current size (*Current (Avg) Size*); and its for age (*with Age Controls*) or not. The horizontal axis reports the size category; the vertical axis reports the difference between the net job creation rate of the size category and that of the largest size category (500+ employees).

Figure 3 reports the firm size-growth relationships using four approaches of net job creation rate calculation. On the one hand, net job creation rates are calculated for a number of size categories using either the base or the current size – *Base Year Size* and *Current (Avg) Size*, respectively; then, net job creation rates control for age (*with Age Controls*) or not. The results show that the net job creation rates that use standard measure do decrease as the size of the firm increases, but the decline is mitigated when growth controls for age. Moreover, the negative slope is far lower using current size measure and turns positive altogether as it controls for age. Haltiwanger *et al.* (2013) thus provide empirical evidence of the existence of regression fallacy issues – for the least in their sample of US manufacturing plants – and that age matters in explaining net job creation.¹⁶

Further, Haltiwanger *et al.* (2014) show that the reason why age plays such a major role relates to extremely high growth rates at firm’s entry. Start-ups contribute substantially to job creation, both in net and gross terms. Since start-ups are usually of small size, they are mostly responsible for a detected negative relationship between size and growth. Even though start-ups grow faster than older firms of the same size, they are also more likely to exit – faster growth is thus conditioned on survival. Hence, both large (non-net) job creation and job destruction are frequent across young firms. Further, mature businesses of smaller size are more likely to downsize and exit than grow. They exhibit negative net

¹⁴See also Lotti *et al.* (2009) who argue in favour of the long-run validity of the Gibrat’s law.
¹⁵Current size is the average size between previous and current years sizes; base size is the previous year size. See previous sub-section Box 1 for a description of the regression fallacy.
¹⁶Notice that Lawless (2014) and Anyadike-Danes *et al.* (2015) document similar patterns for a set of European countries – including Austria, Finland, Germany, Norway, Sweden, UK

job creation.¹⁷ Additional work provided by (Decker *et al.*, 2016) shows that the share of start-ups (two years and younger firms) in US net job creation has decreased over the examined period 1976-2011 and the Great Recession gives an extra negative impact.

1.1.3 A comparison of the US datasets: Dun & Bradstreet vs. Census Bureau

According to leading authors the differences in the results stem from the datasets that are used for the analysis. On the one hand, the group led by David Birch uses Dun & Bradstreet's Market Identifier file (henceforth, D&B), and its new version NETS used by David Neumark; the D&B data based analyses find evidence that small firms contribute proportionately more to net job creation. On the other hand, the group that includes Steven Davis and John Haltiwanger uses the Census Bureau Longitudinal Business Database (LBD); the LBD data based analyses find evidence that size is irrelevant, and if any impact were to be found, smaller firms would contribute proportionately less.

Looking at the conception of US D&B and LBD databanks is thus relevant for our understanding and subsequent empirical analysis. Notice that even though fundamental structural differences remain, the datasets evolve over time so to address the critics.

The differences between D&B and LBD stem from the source and the way the dataset is constructed: D&B is firm-level data reporting firm-level employment while LBD is an employee-level data at the plant level.

Box 2. The US Datasets

US studies rely on two main datasets since the 1980's. Both datasets seem to report discrepancies in the results as to whether small firms are larger net job providers proportionately to their size. **The Census Bureau Longitudinal Business Database (LBD):**

The Census Bureau dataset is constructed from Social Security tax on employees, and includes any plant in the manufacturing sector that has one or more persons employed. The plant is the unit of observations, and each plant is linked to its firm. The dataset starts as early as 1963, and each year has between 300,000 to 350,000 plants yearly.

The Dun & Bradstreet Databases (D&B):

First called DMI, then a new version was provided called the NETS. Both have *firm-*, not *plant-*, level information. It covers both Manufacturing and Services sectors.

The main arguments given by Neumark *et al.* (2011) is that the new version of D&B NETS dataset covers more sectors. Haltiwanger *et al.* (2013) argues that the LBD is more precise first because it controls for parents, second, it reports "establishment" level data rather than firm level. Establishments are single production location units, while the firm may be made of several establishments.

Though, the Census Bureau LBD suffers from limitations as well. First, the survey is issued every five years. The low frequency disables the observation entries and exits in a relatively long period with non-trivial consequences for the analysis. For instance firms may appear

¹⁷Haltiwanger *et al.* (2014) highlight additional relevant methodological issues: (1) importance of accurate firm birth and death date information; (2) avoid pitfalls in identifying firm age coming from merger and change in ownership and opening a new establishment; (3) establishment age shall be given the age of the firm. Growth by a new affiliate should be counted as growth of an existing firm, not as an entry; (4) size-classification based on average employment between t and $t-1$ to avoid regression fallacy; (5) when drawing conclusions be careful of the interpretation of net and gross job creation results.

and disappear between two surveys and will never show up in the sample. Firms in a survey may exit the following year.

Another major drawback is that age is not actually observed but rather estimated by comparing surveys. Authors resolve this issue by using age categories. Moreover, in order to reduce the measurement errors, some authors opt to reduce the sample to more than five employees firms. Actually, less five employees plants are differently handled by the Census Bureau since information is not actually collected but rather imputed from information reported by the Internal Revenue Service (see further discussion about the small firms issues in Dunne *et al.* (1989)).

The description of the two datasets and their own limitations allows a better understanding of the results but also the quality of the data provided by Orbis for our analysis. In many respects, Orbis is closer to Dun & Bradstreet databases.

1.1.4 Cross-country evidence

The relevance of the dataset – but not only – justifies the cross-checking of the results with other countries where dataset are most likely built differently. As a matter of fact, the emphasis given by Haltiwanger *et al.* (2013) to control for both size and age is supported by a wide number of studies using non-US data. We provide a multi-country overview of these findings in this section and report a review of individual country studies in the Appendix 5.

Figure 4: Young firms contribute disproportionately to job creation



Note: This figure is extracted from Criscuolo *et al.* (2014), and shows job creation and destruction contribution by firm size and age in manufacturing, construction, and non-financial services sectors across OECD countries. These contributions are compared with the relative share of these firm-groups in the aggregate employment. Job creation [destruction] is the total number of net jobs created [destroyed] by job creating [destroying] firms. The period is years 2001-2011, with some differences across countries conditioned on availability.

Chiara Criscuolo proposes two major cross-country analyses of job creation among OECD countries. For their studies, Criscuolo *et al.* (2014) and Criscuolo *et al.* (2017), the authors collect micro-aggregated statistics of labour dynamics from 2001 to 2011 which they obtained for 18 countries.¹⁸

¹⁸The compiled dataset's unit of observation is not the "firm" but is defined by the dimensions of sector, firm-age and firm-size groups. For proprietary data access limitations, the programming codes were distributed to central banks and statistical offices.

The final results reinforce the common finding that, even though net job creators are essentially small firms, most employees work at medium and large firms and the majority of employment is in old firms. However, when it comes to job creation, age appears to be as – if not more – important as size. They show that young firms aged between one and five years (excluding firms in their first lifetime year) contribute proportionately more to job creation than their share in employment. This observation is valid across all 18 observed OECD countries. Besides, the age structure of small firms varies so much across countries that the share of non-growing, non-productive old and small firms also varies substantially.

Figure 4 is extracted from Criscuolo *et al.* (2014) and illustrates the role of firms in employment and job creation, by age and size categories. It shows that the net contribution to job creation is chiefly due to young and small firms.

Looking into the aggregate dynamics of the Great Recession shows that during the crisis old firms shed more jobs while young entrants and incumbents still contribute to job creation positively, though to a lesser extent than before the crisis. When the firm's weight in the population is not considered, dynamics reveal that younger firms are affected more by the crisis in both the areas of the job destruction and creation than old (ages 5 years and more) are. At the same time their recovery from the crisis was faster irrespective of their size.

Calvino *et al.* (2015) follow Criscuolo *et al.* (2014) and specifically look into the contribution of young firms to job creation and the channels through which jobs are created: start-up rate, size at entry, survival rate and growth rate of survivor firms. They demonstrate that, indeed, young firms are significant contributors to net job creation in all countries, but the channels through which they contribute vary. This suggests that policies aimed at facilitating job creation of young firms need not be uniform across countries.¹⁹

Ayyagari *et al.* (2014) conducts a cross-country analysis using the World Bank Enterprise Surveys (ES) data. The ES samples formally registered firms from over 100 countries, including emerging markets. They find that small firms have the largest shares of job creation, and the highest growth rates both in sales and employment. Importantly, the results are robust to age control, contrasting with Haltiwanger *et al.* (2013). Interestingly, small firms have the largest share of job creation in emerging markets, regardless of ages.

Anyadike-Danes *et al.* (2015) look into the role of firm size in job creation controlling for firm age. They look at a cohort of firms born in 1988 in six Northern European countries.²⁰ Consistently with other countries, small firms in their sample are many in number, report lower survival rates, and grow faster. Nevertheless, cross-country comparison shows that smallest firms in the cohort play a relatively large role in accounting for overall job creation and explain cross-country differences. Besides, the initial size distribution and the survival rates hardly explain the discrepancies in the net job creation rates.

Oberhofer and Vincelette (2013) investigate job creation in the new Member States of the European Union (EU11),²¹ and find that, construction and manufacturing were essential to net job creation before the global financial crisis, these industries were more severely affected by the financial crisis than others. Job creation is thus more volatile in some sectors than others. At the individual firm level, small and young firms show the highest net job creation rates, and the quality of the business climate is positively related to growth.

Wit and de Kok (2014) investigate job creation in 27 EU Member States using a dynamic classification method. The dynamic classification method was introduced by Davidsson *et al.* (1998) and consists in attributing the job creation or loss of a firm at the moment of the creation or loss to the respective categories around category boundaries.²² At the

¹⁹On national policies, see Calvino *et al.* (2016).

²⁰Austria, Finland, Germany, Norway, Sweden and the UK.

²¹Bulgaria, Croatia, the Czech Republic, Estonia, Hungary, Latvia, Lithuania

²²For instance, assume a firm grows from 200 to 290 employees during the year, and the size class threshold is at 250 employees. Then, the 200 to 249 growth is associated with the lower size class and the 250 to 290 growth to the upper size class.

EU level, small firms contribute on a larger scale in job creation than larger ones. Net job creation rates decrease with each firm-size class. Their results are consistent with those reported by Neumark *et al.* (2011) and, similarly to the latter, they do not control for firm age.

1.1.5 Job creation by age and size in business cycles

In the previous sections, we reported empirical evidence about job creation patterns by firm size and age. One may yet question whether job creation patterns are constant over business cycles, i.e., in economic expansions and recessions. While we established that small and young firms are the major job creators, policy wise it is a relevant question as to whether and which categories of firms enhance or smooth out business cycles.

In their influential paper, Gertler and Gilchrist (1994) analyse empirically the effects of the monetary policy on job creation of small and large firms. Monetary policy tightening (easing) is captured by an increase (decrease) in policy interest rates. Results show that monetary policy tightening is followed by significantly larger sales reduction among small firms, which also reduce inventory at a higher pace. Additionally, Sharpe (1994) finds that in monetary tightening periods, small firms reduce employment significantly more than large firms. The divergence in employment patterns relates to the divergence in access to credit: larger firms accumulate credits before shedding inventories. Kudlyak and Sánchez (2017) finds similar results in the latest 2008 Great Recession. Therefore, small firms' job creation and destruction follow the business cycles and tend to exacerbate business cycles – they are pro-cyclical.

Results presented by Gertler and Gilchrist (1994) and Sharpe (1994) are questioned by Chari *et al.* (2007) who focuses on economic recessions, rather than monetary policy only. The authors document that small and large firms respond in a fairly even fashion to economic *recessions*. Further, Mehrotra and Crouzet (2017) report that Gertler and Gilchrist (1994) results stem from the very top 1 percent of the firm size distribution, which exhibit lower cyclicalities and are large enough to drive the aggregate statistics. Interestingly, the difference in cyclicalities is not so much connected to the monetary policy as to the customer base targeted by large companies. The large companies having more diversified customer base makes them more resilient to shocks.

Moscarini and Postel-Vinay (2012) generalise the results and look at the response of firms to deviations from trends in national unemployment levels in Denmark, France and the United States. They find that large firms destroy more jobs than small firms in bad times, and create more jobs in good times. In this case, large firms worsen the downturn.

Fort *et al.* (2013) argues that similarly to size, age may affect job creation diversely across cycles. They apply a vector-autoregressive approach and present evidence that among all small firms, younger businesses exhibit different cyclical dynamics compared to those of older firms. In economic downturns, the latter turn out to be less responsive to unemployment increases than younger businesses do. Further, younger firms are more sensitive to housing price declines – which correlate with the value of collaterals – and reduce jobs even further.

In order to look at employment responses to a fall in aggregate demand, Görg *et al.* (2017) look at the role of the full distribution of the firms' size in a sector. Taking into account the distribution can be important as it provides information about the possible extent of resource allocation. They approximate size distribution by estimating industry-specific shape parameters of the productivity distributions using firm-level data from Germany, Sweden and the UK. They show that demand shocks have larger effects on employment when the sector has a lower concentration of high-productivity (large) firms. These results can be consistent with Moscarini and Postel-Vinay (2012) on the individual firm growth (larger and

more productive firms can have larger employment response), however, responses in terms of exit and entry are larger in industries with lower average productivity.

1.2 Beyond the Age-Size Debate

While young and small firms play an important role in job creation, it is also true that most of young and small firms will remain small and hardly ever grow in their lifetime. Therefore, not all small firms actually contribute to job creation to the same extent (Hurst and Pugsley, 2011; Pugsley *et al.*, 2017) and we are interested in which firms actually grow. For this purpose, we focus on the High-Growth Firms (henceforth, HGFs). We then look at the issues faced by small firms such as the hiring of the first employee. We also report a recent literature that tries to identify pre-determined factors of growth. The last section addresses the link between job creation and access to finance.

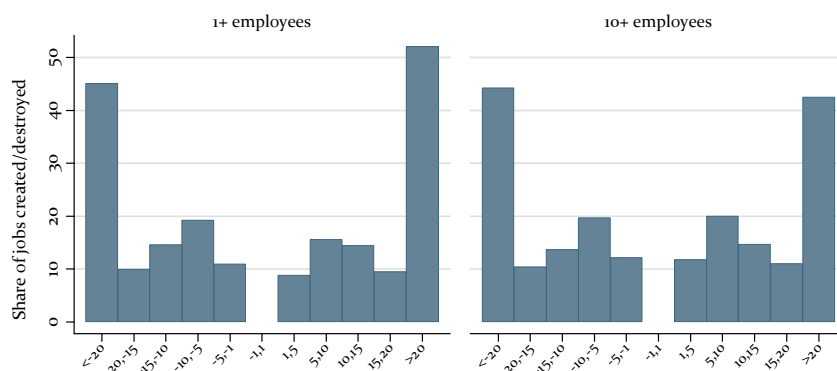
1.2.1 The high-growth firms – HGFs

High-Growth Firms (HGFs) are typically defined by the so-called Eurostat-OECD definition as firms with employment growth of 20 percent per annum over a three-year period, and at least 10 employees at the beginning of the period.²³

Incidence of the HGFs

HGFs are typically few in numbers but bring about significant shares of job creation. For instance, Birch and Medoff (1994) show that during the 1988-1992 US recession, 4 percent of the existing firms accounted for ca. 70 percent of the jobs created by pre-existing firms. The importance of HGFs to job creation is best illustrated by Figures 5 and 6, extracted from Bravo-Biosca (2016) and Bravo-Biosca *et al.* (2013), respectively.

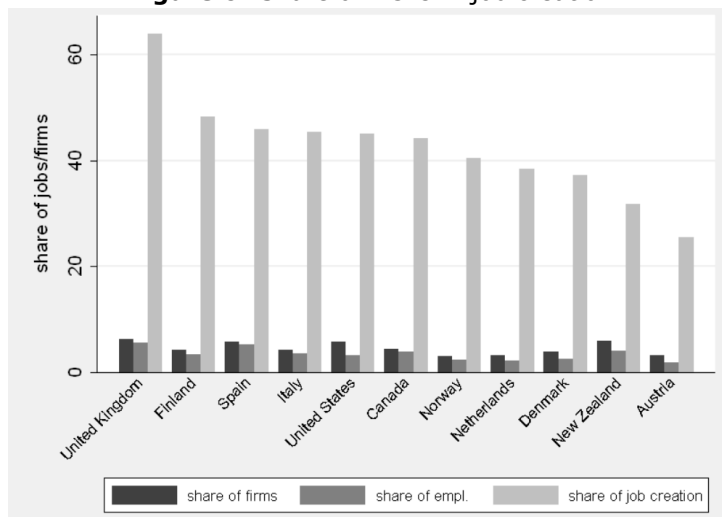
Figure 5: Distribution of job creation and destruction: the role of HGFs



Note: This figure is extracted from Bravo-Biosca (2016) and shows the share of job creation and job destruction by firm growth category; negative scale represents destruction. The columns ">20" represent the share of HGFs, years 2002-2005. The values represent averages across Austria, Canada, Denmark, Finland, Greece, Italy, Netherlands, New Zealand, Norway, Spain, UK, and US.

²³Notice that the European Commission uses a similar definition replacing 20 with 10 percent annualised growth rate.

Figure 6: Share of HGFs in job creation



Note: This figure is extracted from Bravo-Biosca *et al.* (2013) and shows the contribution of HGFs to job creation across countries. "Share of firms" is the share of HGFs in the total number of firms; "Share of empl." is the share of employment at HGFs; "Share of job creation" is the share of jobs created by HGFs. Shares are taken over surviving firms with 10+ at the beginning of the period. Countries include Austria, Canada, Denmark, Finland, Greece, Italy, Netherlands, New Zealand, Norway, Spain, UK, and US.

The figures show that the share of job creation is substantially unevenly distributed among firms when they are classified by growth rates. In Figure 5, the right-most column (" >20 ") shows that firms with the highest growth rates (20 percent) account for 40 to 50 percent of job creation. Figure 6 also shows that the contribution of HGF's to job creation varies across countries.

Featuring and Supporting the HGFs

Henrekson and Johansson (2010) observe that even though many of the HGFs are large and mature firms, HGFs typically are young and small. More importantly, HGFs drive the empirical finding that young and small firms create more jobs proportionately than their aggregate share in total employment.²⁴ Some may yet question the importance of HGFs since high-growth is not persistent and instead seems to be a one-hit wonder, unlikely to be repeated (Daunfeldt *et al.*, 2014).

Unfortunately, it is nearly impossible to predict whether and when a firm would turn HGF. Békés and Muraközy (2012) conduct such prediction exercise using financial indicators and characteristics of the firms (e.g., leverage, wage share, ownership, location, size and age) and find poor explanatory power of these variables to becoming a HGF.

Moreover, defining the high growth in *relative* (e.g., firms with growth in the top decile of the growth distribution) instead of *absolute* terms (e.g., growth rate above 20 percent) has consequences on the results. For instance, *relative* measures result in a lower likelihood of persistence of being a HGF (Daunfeldt and Halvarsson, 2015; Erhardt, 2017).

The features of HGFs are summarised into seven stylized facts listed by Coad *et al.* (2014) who review the existing empirical evidence:

1. The distribution of growth rates among firms is heavy-tailed, so that HGFs are not that rare after all.
2. A fraction of HGFs contribute to substantially large shares of job creation.
3. HGFs tend to be young but are not necessarily small.
4. Incidence of HGFs in high-tech industries is on a par with other sectors.

²⁴For other similar reviews, see. e.g., Audretsch (2012) and Ács (2015)

5. High growth is not time persistent.
6. Predicting HGFs is nearly impossible.
7. Different HGFs measures result in substantially different sets of firms and time persistence.

Bravo-Biosca *et al.* (2013) find that the likelihood that HGFs emerge in a country is related to their business environment that can be summarised in five results: (1) higher employment protection leads to less dynamic firm growth distributions; (2) creditor-friendly bankruptcy regimes are likely to reduce the overall variance of the growth distribution because it reduces the firms' willingness to take risks; (3) tight bankruptcy regulation reduces the cost of raising external finance, thus supporting corporate growth; (4) providing finance for under-performing firms can hinder reallocation and growth; (5) R&D fiscal incentives correlate with narrower growth distribution because it protects incumbents and shifts resources away from more innovative new entrants.

Brown *et al.* (2017) analyses US start-ups and whether the characteristics of the founding owner have an impact on the likelihood that the firm is a HGF. They find that firms founded by women, African-American minority and less educated are less likely to become HGFs. Though, African-American founded firms are less likely to turn HGF shortly after birth, but the gap with other groups disappears as the firm is older. Instead, prior business ownership and a larger group of founders strongly and positively increase the probability of becoming HGF, regardless of firm's age.

Lee (2014) compares high growth SME's (over 20 percent growth over a 2-year period) in the UK to firms that do not have high growth periods but are observationally equivalent and firms without observed potential to learn about perceived obstacles of growth. They find that all groups, actual and potential HGFs and firms with low potentials perceive problems with obtaining finance, cash flow and management skills as factors that hinder growth. However, firms with the potential to achieve high growth perceive regulation less of a problem than those that do not.²⁵ Lee (2014) concludes that the results might suggest that policies intended to deregulate or to reduce tax are poorly targeted at firms with the desire and potential to grow.

The Decline of HGFs

In the last decades, the entrepreneurship and business dynamics have slowed down and since the 2000s the impact of high growth young firms on job creation has also declined. Decker *et al.* (2016) compares the dispersion of growth rate distribution of US firms over time and find that the difference between the 90th and the 50th percentile growth rate decreased from 16 percent in 1999 to 4 percent in 2011. The lower gap in the growth rate distribution is due to the decline in the likelihood that new entry firms become high growth firms.²⁶ Decker *et al.* (2016) do not identify the underlying causes empirically but suggest that firms may operate below scale due to imperfect information about their productivity, demand or credit constraints. Alternatively, for young innovative firms it is more profitable to be bought by larger and mature companies than to grow as an independent firm. In a more recent paper, Decker *et al.* (2017) connect the decline in employment dynamism to the aggregate productivity slowdown in the US since the early 2000s.²⁷ They show that a share of the decline in employment dynamics goes together with diminished allocative efficiency gains and has some effect on declining aggregate productivity growth.

²⁵Regulation problems mentioned by firms include health and safety , tax-related, sector-specific, barriers, employment and environmental

²⁶To our knowledge, similar evidence has not been conclusively presented yet for the European economies, due to the limited availability of historical micro-dataset.

²⁷On the productivity slowdown see, e.g., Byrne *et al.* (2016) or Andrews *et al.* (2015)

1.2.2 The first employee hiring issue

One of the major events in a firm's lifetime and job creation process is the first hiring. Empirical investigations look into the timing decision of hiring, the consequences on performance and characteristics of the employer.

Coad *et al.* (2017) using a Danish matched employee-employer dataset show that those entrepreneurs that hire enjoy faster sales growth in the previous year and enjoy superior sales outcomes in subsequent years, while the dispersion in profits increases. They also find that the probability of hiring the first employee increases with the education of the employer, while first employees are more likely to be less educated and previously unemployed compared to those hired by incumbent firms.

Fairlie and Miranda (2017) look at patterns of transition from non-employer to employer firms using various US data sources. They find that if non-employer start-ups hire, then most of their employment is created within the first years right after birth. Hiring at later stages in the firm's lifetime is rather rare. Unlike Coad *et al.* (2017), they do not find that a higher education level of the entrepreneur would increase hiring probability. However, they find that female-owned start-ups are less likely to hire, while start-ups owned by Hispanic and Asian minorities are more likely to hire.

Finally, Henley (2005) use British panel survey data on self-employed to look into job creation ability. He finds that successful entrepreneurs are likely to have self-employed parents themselves and be more educated. He also points out the importance of housing wealth as possible source of collateral.

1.2.3 A pre-deterministic approach to job creation

Skewness in the size and the growth distribution of firms is the symptom of an extraordinary performance of a few firms. Why is the distribution dispersed and skewed even within narrowly defined industries? Holmes and Stevens (2014) argue that the predetermined heterogeneity of firms before entry is likely to play a role. To explain firm-size heterogeneity within a sector they distinguish between firms by their main products. Firms that market *specialty*, often custom-made goods often by face-to-face contact between buyers and sellers will remain small sized, while firms producing *primary*, standardized goods using mass-production techniques will or can grow large. In addition, Holmes and Stevens (2014) point out that these two types of firms are affected differently by trade and foreign competition.²⁸ These model predictions match well with empirical finding on U.S manufacturing data.

Abbring and Campbell (2005) use monthly sales histories from 305 new bars in Texas to estimate a structural model to quantify the importance of pre-entry scale decisions and future shocks to firm growth. They show that pre-entry decisions account for 40 percent of the sales variance.

Schoar (2010) argues that entrepreneurs differ in their economic objectives, and differentiates between *subsistence* and *transformational* entrepreneurship. The former relates to the needs of providing income for a living and has little, if any, ambition to grow; instead, *transformational* entrepreneurship sets goals to undertake major process or product innovation and eventually scale-up. She points out that distinguishing these two types of firms is crucial to policy; policy programmes may target *subsistence* entrepreneurship with the objective of making them *transformational* entrepreneurs. Evidence on the subsistence is also documented by Hurst and Pugsley (2011), showing that most businesses have significant non-pecuniary motivations, for example a choice of life-style ("Being your own boss").

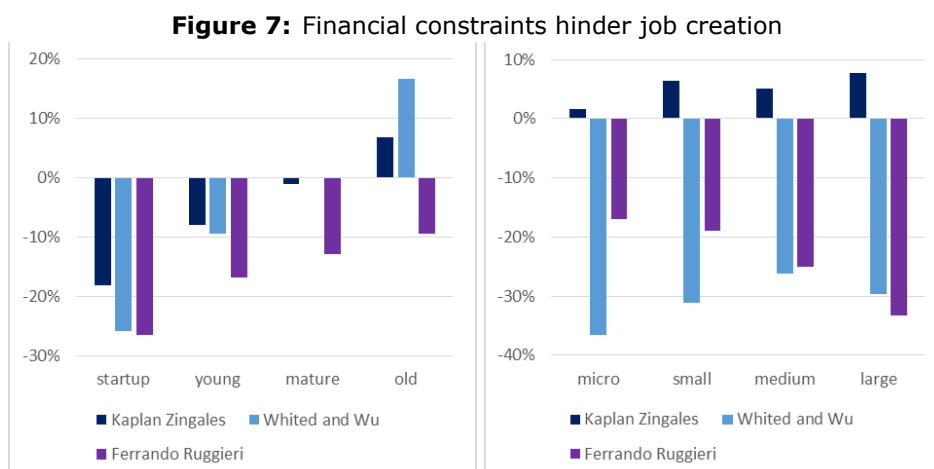
²⁸This pre-entry differentiation approach is used by Pugsley *et al.* (2017) to explain firm growth where heterogeneity and gazelles play an important role in aggregate dynamics.

Studies trying to capture ex-ante heterogeneities empirically have been recently published. For example, Belenzon *et al.* (2017) highlight that the firms, which are named after their owners' names (so-called *eponomy*), outperform other firms. Another example is Guzman and Stern (2016), who uses observables at or near the time of business registration, and constructs indices that predicts future significant growth outcomes (IPO or high value acquisition). They find that the top 5 percent highest value in their growth predictions captures about 70 percent of the actual growth events.²⁹

1.2.4 Financing corporate growth

Firms with growth and job creation potential may need external finance in order to pick up business opportunities. Yet, they may face bankers unwillingness to provide credits on demand; such firms are called *financially constrained*. Financially constrained firms are defined as firms that need or wish to obtain external financing but are faced with or perceive limitations.³⁰

Growing firms, especially high-growth firms (HGF), typically are "cash-starved" and external financing in the form of bank loans may turn to be a prerequisite for growth (Hambrick and Crozier, 1985; Storey, 1994). Growth typically implies corporate changes in the short-run, implying some degree of uncertainty and riskiness, which banks may be unwilling to finance and banks may even be an obstacle to growth (Binks and Ennew, 1996; Hölzl, 2014). Banks may be reluctant to give loans because near future changes make current risk assessment hardly reliable, and they have little control over the loaned amounts. Besides, high-growth firms typically are in relative opaque R&D intensive sectors inducing further assessment hazard. See e.g., Stam and Wennberg (2009), Mina *et al.* (2013).



Note: This figure is extracted from Hallak *et al.* (2017). It shows the effects of financial constraints on the likelihood that a firm is a HGF in the next year; HGFs are firms ranking in the top 10 percent in the employment growth distribution. The authors use three standard measures of financial constraints: Kaplan and Zingales (1995), Whited and Wu (2006) and Ferrando and Mulier (2015b). The bars report the coefficients obtained from linear probability models. Data is obtained from Orbis and covers 26 European countries in the period 2008-2013.

To assess how financial constraints affect firm growth, Hallak *et al.* (2017) use standard measures of financial constraints in their analysis of high-growth firms in Europe. They document empirical evidence that the likelihood of being a high growth firm under financial constraints is lower, but the impact is slightly lower as the firm size is larger. Nevertheless,

²⁹See Roberts *et al.* (2015) on MIT graduates in start-ups.

³⁰The indices proposed by Whited and Wu (2006) and Kaplan and Zingales (1995) have become two standard measures of financial constraints. Besides, Annalisa Ferrando formalize an index based on the ability of the firm to finance investments with debt; e.g., Ferrando and Mulier (2015a) and Ferrando *et al.* (2015). Finally, Hadlock and Pierce (2010) show that age and size are the strongest predictors of financial constraints.

financially constrained are less likely to be HGF when they are younger. The results are reported in Figure 7 which is extracted from Hallak *et al.* (2017), and show the effects of financial constraints on the likelihood to be a high-growth firm.

Besides the financial constraints and obstacles to growth, creditors may demand extra job destruction in bad times. Using plant-level Census Bureau data, Ersahin *et al.* (2017) show that financial covenant violations result in the reduction and closure of least profitable plants and business segments of the firm. Also, Falato and Liang (2016) show that covenant violations result in sharp and substantial cuts in employment in the firm, and the impact is sharper as employees have weaker bargaining power.³¹ Graham *et al.* (2016) find similar results following bankruptcy events. Finally, using micro-level data on job and bank loan contracts in Italy, Berton *et al.* (2018) show that job destruction is significantly higher following loan contraction, especially temporary jobs, suggesting that employment is used as an adjustment to loan contraction.

The results contradict the view that banks have no control rights on managerial decisions away from bankruptcy and may explain why firms are sometimes reluctant to contract loans. They may also explain the results documented by Gertler and Gilchrist (1994) who use US firms data and find that tightening of monetary policy is followed by more severe contractions in sales and inventories among small firms, even though they are able to accumulate short-term debts before the contractions. Sharpe (1994) adds evidence that capital market imperfections are responsible for such decline, as leveraged firms display larger business cycle sensitivity of employment growth. The so-called “labour hoarding” is thus determined by the ability of the firm to access external financing.³²

1.3 Job Creation and Resource Reallocation in the Economy

In this section we look beyond individual firm characteristics and ask whether job creation relates to the (re-)allocation of resources in the economy. The literature on resource allocation assumes that the availability of inputs – like labour – is limited and the production units are heterogeneous in terms of *productivity* – i.e., the capacity of generating value out of inputs.³³ Therefore, the way scarce resources are distributed among heterogeneous production units in the economy determines the aggregate wealth, and potentially job flows.

In fact, firms face continuous change in, e.g., product demand, competition and production technologies, that continuously modifies the productivity of their business units and to which firms respond by re-allocating resources in a timely fashion. Continuous reallocation of labour across business units *within* a firm is necessary to optimize wealth and thus generates job flows across business units *within* the firm. The same phenomenon is expected in a general economy where jobs are re-allocated *between* less and more productive firms – firm *entries* and *exits* are most extreme cases. It is worth noting, though, that realloca-

³¹*Financial covenants* are financial clauses in the debt contract that restrain managerial decisions, e.g., limitations in dividend pay-outs and leverage, and are meant to prevent managers from taking risk-enhancing decisions after signature. Covenant violations allow bankers to claim default and demand early repayment. Continuing operations despite covenant violations suggest that managers and bankers have reached an agreement, which is reflected in subsequent managerial decisions; such events allow to observe bankers’ preferences away from bankruptcy. See Nini *et al.* (2009) and Nini *et al.* (2012) for early work on creditors rights analyses using covenant violations.

³²Consistent with these results, a recent literature has shown that since higher firm’s riskiness result in higher employment risk, employees will require higher compensations as the firm is riskier and managers decrease risky leverage as a response. See among others Berk *et al.* (2010) in a theoretical model, and Agrawal and Matsa (2013) who use labour insurance benefits shocks as natural experiments.

³³Productivity is measured as follows. Using a sample of production units, one estimates the general production function of the inputs – typically fixed assets and employment. The unit-level productivity then equals the gap between the actual production and the value predicted by the model (in statistics, the residual terms). The lower the gap (negative values) the less productive is the business unit. It is worth noting that productivity is a “relative” not an “absolute” measure.

tion may *unrelate with* job flows if productivity enhancement occurs at the business units thanks to, e.g., the adoption of new technologies or work reorganization.

1.3.1 Reallocation and aggregate productivity: empirical evidence

Core results

The analysis of the interaction between productivity and job creation relies on the measurement of the aggregate productivity of the economy and the impact of job flows on the latter: job flows associated with enhanced aggregate productivity is interpreted as jobs being *re-allocated* from less to more productive business units. Productivity is measured as the total added value produced by combined units of fixed assets and labour – *Total Factor Productivity*, henceforth, TFP – or by full-time employee – *Labour productivity*.³⁴ The aggregate productivity is then equal to the sum of business units productivity measures adjusted by the respective weights of the business units in the total output. The main empirical evidence highlighting a link between aggregate productivity and job flows include Baily *et al.* (1992), Olley and Pakes (1996), Davis and Haltiwanger (1996), Haltiwanger (1997), and Bartelsman and Dhrymes (1998) which use the US Census Bureau Longitudinal Business Database (LBD).

The main observation is that reallocation of resources improves the aggregate productivity growth, showing that jobs are re-allocated towards more productive business units. Moreover, even though within, between, and entry-exits contribute in various extents to growth in the various sectors, reallocation typically takes place *within* sectors rather than *between* sectors, at least in the short-run.³⁵ Actually, the productivity discrepancies among production units is persistent over time and remain larger *within* than *between* sectors. Finally, the change in aggregate productivity is unpredictable – corresponding to a random-walk process.

More specifically, Baily *et al.* (1992) find that during economic growth periods, a third of the aggregate productivity growth is due to resource reallocation; actually, reallocation maintains positive effects on productivity even in periods experiencing declining aggregate productivity. More importantly for our study, Davis and Haltiwanger (1996) report that respectively about 20 percent and 15 percent of job creation is due to firms entry-exits. Finally, looking at productivity at entry and exit firms, Bartelsman and Dhrymes (1998) find that entry firms are not more productive than old firms; though, conditioned on survival, productivity increases over time. Yet, low productivity remains a good predictor of exit (Olley and Pakes, 1996).³⁶

Cross-country evidence

Bartelsman *et al.* (2004) provides a rare cross-OECD country analysis of labour reallocation and aggregate productivity enhancement.³⁷ The authors perform a “distributed micro-data analysis” of firm level data in 24 countries and apply the method proposed by Foster *et al.* (2001) [FHK] to decompose factors of productivity growth. The main results are illustrated by Figure 8 which is an extract of Bartelsman *et al.* (2004). Figure 8 shows that,

³⁴Most commonly used productivity measures rely on revenue information. These not only measure firm efficiency, but also capture market power of the firm through the mark-ups and supply-demand conditions reflected in the prices of goods sold. For a recent detailed review of the issue see Cusolito and Maloney (2018).

³⁵Nevertheless, there have been long-run and significant structural changes in advanced economies, mainly the shift from manufacturing to services.

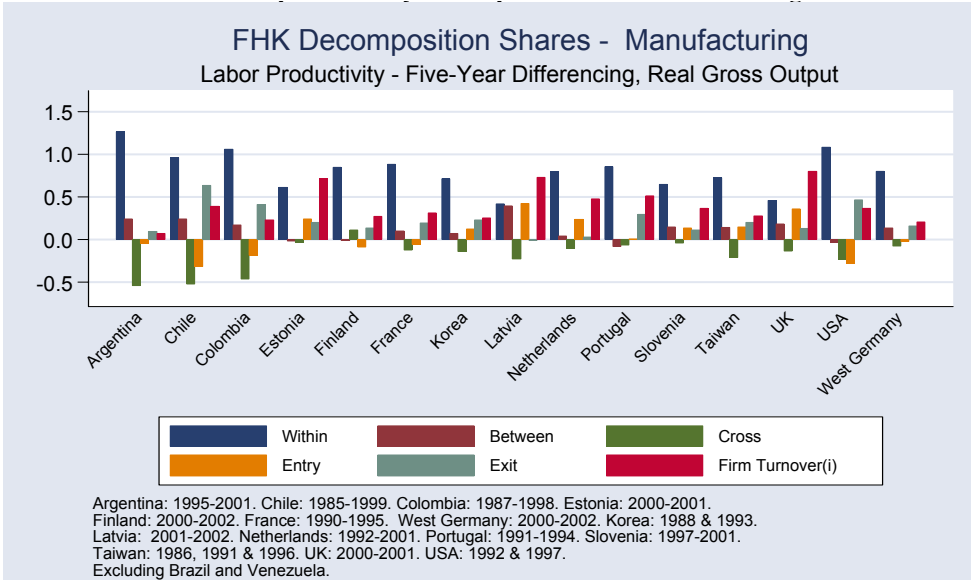
³⁶Notice that magnitudes of the effects vary across studies. Foster *et al.* (2001) provide a comprehensive review of the statistical issues that may cause such differences.

³⁷Countries include Argentina, Chile, Colombia, Estonia, Finland, France, Korea, Latvia, Netherlands, Portugal, Slovenia, Taiwan, UK, USA, West-Germany. Bartelsman *et al.* (2005) is an interesting companion paper on firm demographics in some OECD countries.

on average, aggregate productivity growth is mainly driven by productivity growth *within* firms; the pattern is stronger in European countries. Another important result is that even though the resource reallocation across existing firms varies significantly across countries, typically it is positive and small. Therefore, aggregate productivity enhancement typically occurs through the increase of the market shares of more productive firms, but also drives the between firms job flows.

Furthermore, Bartelsman *et al.* (2004) document the significant and positive contribution of *net* firms entry – the difference between entry and exits – to the aggregate productivity growth in most countries, even though the impact lies in a wide range between 20 and 50 percent. Nevertheless, while the exits below average productive firms in most countries, the entry contribution is negative in most OECD countries with noteworthy differences; European entry firms are relatively larger and more productive than in the US. Overall, market selection and learning effects are larger in the US, surviving entrants generate faster growth, and exiting firms free resources resulting in a more efficient static allocation of resources.

Figure 8: Contribution of job flows to aggregate productivity



Note: This figure is extracted from Bartelsman *et al.* (2005) and shows the Foster *et al.* (2001) [FHK] decomposition of productivity growth; the decomposition includes the following terms: (1) *Within*: the contribution of productivity growth from individual firms; (2) *Between*: the contribution from initially (un)productive firms growing (losing) market share; (3) *Cross*: the contribution from productive firms growing a market share and increasing productivity at the same time; (4) *Entry and exit*: contribution of firms entries and exits.

1.3.2 Job reallocation and productivity in business cycles

The next question we address is whether the re-allocation of employment described herein-above is constant over time, especially across economic growth cycles. In fact, job reallocation is found to be more intense in economic downturns (Davis and Haltiwanger, 1992),³⁸ even though economic shocks contribute to job destruction dynamics, less to job creation (Caballero *et al.*, 1997). To some extent, the results are consistent with the existence of *creative destruction*.

Creative destruction is a process that assumes conditions for outdated production units to be *liquidated* and substituted with more *productive* ones; this theory is put forward by Schumpeter (1939) and is sometimes referred to as the *liquidationist* theory. According

³⁸Davis and Haltiwanger (1992) define the *job reallocation* rate as the sum of job creation and destruction rates

to this theory, a recession may bring about cleansing effects for the following reasons. Suppose there are frictions preventing shift of resources from less to more productive units. By driving down the profitability of production units, recessions make those least efficient no longer viable, and as a result the latter are liquidated; the owners of those resources will have an incentive to search for other, more productive arrangements. Hence, recessions reduce inefficiencies in resource allocations by shifting resources towards more productive units (Caballero and Hammour, 1994; Cooper and Haltiwanger, 1993; Davis and Haltiwanger, 1990, 1992).

The liquidationist theory is not unequivocally supported by empirical evidence. For example, jobs are not significantly reallocated in more productive plants during recessions (Baily *et al.*, 2001; Griliches and Regev, 1995); recessions are not systematically followed by larger job creation rates, but rather by abnormally low destruction rate (Caballero and Hammour, 2005). Also, exit firms have similar productivity and size characteristics across business cycles (Lee and Mukoyama, 2015), although entry firms are relatively larger and more productive in bad times than in good times.

On the contrary, some authors emphasise that the characteristics of entry firms may negatively affect the productivity enhancement effects of job reallocation. Indeed, recessions may screen out potentially outperforming firms because of the negative experience new entrants go through, so that their beliefs about their growth potentials are downwards distorted; the so-called “scarring effect” of recession (Ouyang, 2009).

Frictions in the labour market may also hamper cleansing effects as aggregate shocks affect the process of matching of workers to vacant jobs.³⁹ Contrasting with the cleansing effect of recessions, authors thus suggest recessions have *sullying effects* on employment. The sullying effect of recessions consists in jobs being reallocated in less productive units. The hypothesis was formalised theoretically by Barlevy (2002) who argues that a search-and-match model of the labour market explains the worsening of job quality in recessions if the model controls for on-the-job search (i.e., job search by employed job seekers); thus, in such setup job-quality turns *pro-cyclical*. The intuition is as follows. In recession, fewer vacancies are created by existing firms, so that fewer jobs may improve working conditions of employed labour. As a result, in recessions reallocation across workers is slower since jobs appear with lower match quality and reallocation becomes less productivity-enhancing. In his model, Barlevy (2002) finds that the sullying effect is larger in recessions than the cleansing effect. The theory is consistent with previous results that show that jobs created during recessions are paid less and are more likely to be destroyed than jobs created during booms (Bowlus (1995); also Mustre-del-Río (2016), and Baydur and Mukoyama (2015); Fernández (2014); Nagore García and van Soest (2017)).

The Great Recession offers a laboratory for investigating the effects of extreme economic shocks. The patterns found in this period are consistent with the previous results. The COMPNET report (Fernández *et al.*, 2017) investigates firms’ growth and reallocation in Europe by looking at job creation and destruction rates over time across European countries.⁴⁰ They show that job creation flows moved similarly over time in all countries, apart from Germany, while job destruction exhibits diverse, heterogeneous patterns. Job destruction rates increased especially among new-entrant Members States during the crisis, and also among countries particularly affected by the crisis, such as Spain, Italy and Slovenia. Further, the higher is the firm’s productivity, the higher is the job creation rate, suggesting that jobs were reallocated in productive companies. Nevertheless, the process of productivity-enhancing reallocation was muted during the Great Recession.

³⁹Search-and-matching employment models by Mortensen and Pissarides (1992, 1994) show that negative shocks endogenously change the timing of reallocation because they reduce the number of matching vacancies.

⁴⁰The COMPNET gathers firm-level databases of national statistics agencies across Europe. The sample of the COMPNET Labour module covers Belgium, Croatia, Estonia, Finland, Italy, Lithuania, Portugal, Romania, Slovenia and Spain

Bartelsman *et al.* (2017) analyse a sub-group of European countries – Belgium, Estonia, Finland, Italy, Slovenia, Spain – and finds similar productivity-enhancing reallocation patterns; firms' higher initial productivity is positively correlated with input growth, in terms of both labour and capital. This effect is stronger for small firms. Yet, the productivity-enhancement effects of job reallocation fades out with the Great Recession, showing counter-cyclicality. Only the average amount of productivity enhancing reallocation takes place.⁴¹

Finance and labour reallocation

In line with the liquidationist view, the ability to retain employment depends not only on productivity but also on financial health. Giroud and Mueller (2017) using detailed US data, argue the importance of leverage in firms' response to recession. Importantly, they show that employment shedding due to leverage is not driven by underlying low productivity but to another channel. Firms with more leverage and high financial constraints are unable to protect their employment by temporary labour hoarding. The reason is that temporary labour hoarding spares the firm firing costs as well as the costs associated with the hiring of new employees (including searching and training costs).

Recently, Borio *et al.* (2016) investigate the empirical link between credit booms, financial crises and productivity growth on twenty advanced economies, including the core European countries, and over forty years using the OECD-STAN and the EU-KLEMS databases. They evaluate the correlation between productivity and share of productive firms over time and across countries using the Olley and Pakes (1996) decomposition technique. The authors find that during credit booms labour shifts to less productive industries creating cross-sectoral misallocation and undermining productivity growth. They also show that in bad times, the misallocations have a further negative impact on productivity. Both of these findings suggest a key role of finance in cyclical reallocations.

1.3.3 Resource misallocation

Aggregate productivity clearly varies across countries, and a natural question is whether the distribution of resources among heterogeneous firms explains these differences. A cross-country comparison of the extent to which resources are allocated towards more productive firms can provide an answer. In their influential paper, Hsieh and Klenow (2009) link aggregate productivity gains with the allocation of resources. Assuming that the respective allocations of labour and capital in India and China follow the US resource allocations, the gain in aggregate productivity would amount to 30-50 percent in China and 40-60 percent in India. These results show that there are potential productivity gains in India and China, and production resources are "inefficiently" allocated; this reflects the so-called *misallocation of resources*.

The next question is then, what could explain resources misallocation? Restuccia and Rogerson (2008) claim that any policy and market frictions that create or maintain heterogeneities in prices (of labour, capital or output) faced by individual producers potentially lead to significant decrease in aggregate output and productivity. The main motivations are found in market "frictions," which Restuccia and Rogerson (2017) classify in four groups:

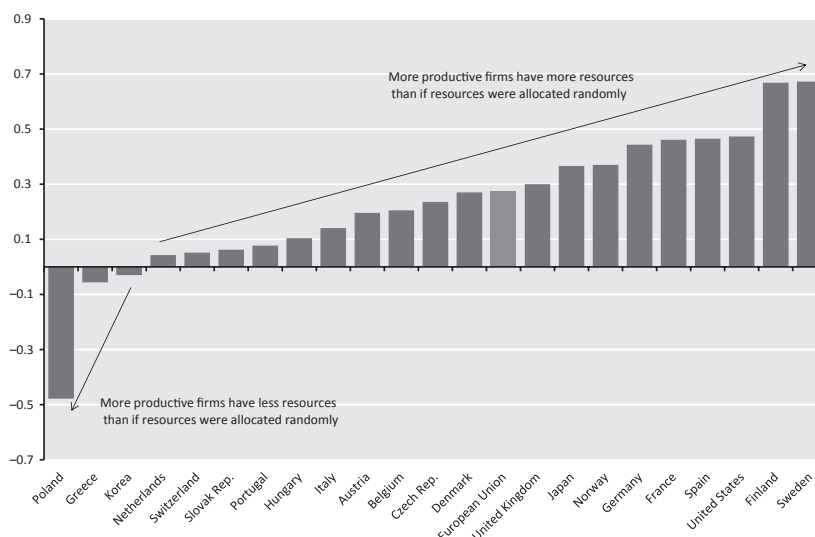
⁴¹More recent studies on the relationship between productivity and reallocation for European countries include Cantner and Krüger (2006) for Germany, Fontagné and Santoni (2015); Sandoz (2017) for France, Lopez-Garcia *et al.* (2007) for Spain, Carreira and Teixeira (2008, 2016) for Portugal, Linarello and Petrella (2016) for Italy, Dumont (2011); Vanormelingen (2017) for Belgium, Disney *et al.* (2003); Riley *et al.* (2014) for the UK, Schneider (2014) for Austria, De Loecker and Konings (2006) for Slovenia, Brown and Earle (2008) for Romania, Hungary, and Lithuania, and Harasztosi (2011); Kátay and Wolf (2008) for Hungary.

1. *Regulation*: Regulatory constraints in various markets; for instance, size dependent firing costs created by policies, housing regulations affecting movement of labour in space.
2. *Property rights*: Constraints in rights of owning properties; for instance, limits on farm size in agriculture.
3. *Trade and competition*: Limitations in trade, e.g., import quotas and trade tariffs, but also subsidies.
4. *Finance and information*: for instance, a financial system that is inefficient at allocating funding and create undue financial constraints.

To investigate cross-country differences in misallocation, Andrews and Cingano (2014) look at firm-level data from a wide range of OECD countries. They employ the static decomposition technique proposed by Olley and Pakes (1996), which is composed of an unweighted firm-level average productivity and a covariance term. The covariance term is a summary measure of the within-industry cross sectional covariance between size and productivity, and its low value implies that inputs do not flow to most productive firms. They show that employment protection, barriers to entry and bankruptcy legislation and restrictions on foreign direct investment correspond to low values of covariance terms.

The numbers are reported in Figure 9 which is obtained from Andrews and Cingano (2014). The figure reports the labour allocation effectiveness by country using the covariance term suggested by Olley and Pakes (1996). The numbers show the substantial variation in the employment allocation effectiveness across countries. Most effective countries in resource allocations are Sweden, Finland, and the United States. Least effective countries include Poland, Greece, and Korea. The European Union as a whole reports about half the allocation effectiveness of the United States.

Figure 9: Labour misallocation across countries



Note: This figure is extracted from Andrews and Cingano (2014). It shows the cross-country differences in misallocation of labour in the manufacturing sector in 2005. It also shows the capacity of respective economies to allocate labour efficiently into productive firms. The authors used the decomposition of the covariance term suggested by Olley and Pakes (1996).

As for Europe, Bartelsman *et al.* (2013) give a picture on misallocation in 7 European countries using Olley and Pakes (1996) decomposition and compare the results with the US. They find that between 1993-2001, the US had the highest covariance term, indicating highest efficiency. Western European countries show considerably lower covariance terms:

Netherlands and Germany exhibit highest efficiencies among the European countries in the sample, and Central and Eastern European countries the lowest. Romania and Slovenia report covariance terms close to zero, which is equivalent to an economy where inputs were randomly allocated to firm. Studies that focus on a single country can provide a more detailed approach. Recent examples include Benkovskis (2015) for Latvia, Dias *et al.* (2016) for Portugal and García-Santana *et al.* (2016) for Spain, Calligaris *et al.* (2017) for Italy.

While the cross-country differences reflect rankings that one would expect from GDP, changes in misallocation over time across countries are not straightforward. In fact, labour misallocation is stable in recent years for most, while capital misallocation is increasing in some European countries. Gopinath *et al.* (2017), Gamberoni *et al.* (2016b) and Franco (2017) document that while the dispersion of returns to labour across firms is stable after 2000, the dispersion of the return to capital across firms increases somewhat but most significantly in Spain and Portugal. This increase in dispersion leads to considerable losses in aggregate productivity. Gopinath *et al.* (2017) argue that the decline in the real interest rate, connected to the euro convergence process, facilitated the flow of capital to firms with high net worth but low productivity.

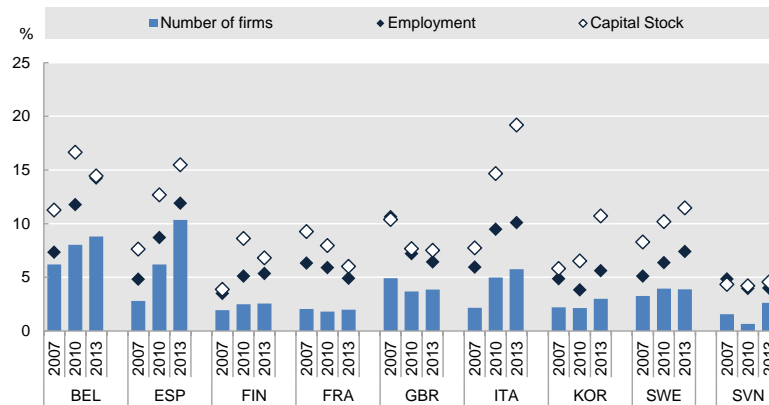
Just like policy and regulation, corruption may contribute to the resource misallocation. Gamberoni *et al.* (2016a) find that corruption plays a significant role in explaining cross-country differences in input reallocation patterns among Central and Eastern European countries. The study is based on the Business Environment and Enterprise Performance Survey (BEEPS), which is a survey of firms investigating the customs and extent of bribing officials to “get things done;” the BEEPS indicator positively correlates with resource misallocation.

Zombie firms and misallocation

The zombie firm phenomenon and its impact on other firms’ job creation is an illustration of the adverse effects of resource misallocation *between* firms. Zombie firms are financially distressed firms which receive financial support from banks, and would be liquidated otherwise. The zombie phenomenon was identified in Japan in the 1990’s by Hoshi (2006) among others. Authors identify a pool of firms, which curiously pay interest rates below the lowest market rates (so-called *negative interest rate gap*), and show that these firms are less profitable, more indebted, and more frequent in sectors with lower levels of international competition. Hence, even though these firms perform poorly, they are *subsidised* by banks and kept alive artificially, i.e., they are *walking dead*.⁴²

⁴²An essential rationale behind zombie phenomenon lies in the banking regulation. In a sample of loans extended to Japanese listed firms in the 1990’s, Peek and Rosengren (2005) find that banks with capital ratios close to regulatory thresholds are those with the highest likelihood to refinance poorly performing companies at abnormally low interest rates. This phenomenon is also called *bank forbearance*.

Figure 10: The rise of the zombies



Note: This figure is extracted from McGowan *et al.* (2017). It shows the prevalence of zombie firms and the share of employment and capital employed by zombie firms in years 2007, 2010, and 2013. Zombies are defined as ten-years or older firms and three consecutive years with negative profits after interest and before tax payments.

Even though supporting corporations in distress may be appealing to policy makers, there is empirical evidence that zombie firms produce negative externalities to healthy non-zombie firms and deter job creation overall. Unfortunately, by keeping distressed firms artificially alive, banks not only distort competition in debt markets against well-performing firms, but also distort competition in the labour and product markets. Higher competition on non-zombie incumbents and new entrants implies lower economic growth and job creation: non-zombie incumbents must increase their own productivity which they do by eliminating or discarding less productive projects (hence, employment) and potential new entrants must implement projects with higher productivity to enter the market. This is confirmed by Caballero *et al.* (2008) who find that as the share of zombies in an industry increases, non-zombie firms are less likely to grow, and more likely to enhance their own productivity; also there are fewer entrants in the industry.⁴³

McGowan *et al.* (2017) highlighted similar patterns since the Great Recession in some European countries. Figure 10 is extracted from McGowan *et al.* (2017) and shows the share of zombies in selected OECD countries in 2007, 2010, and 2013. The ratio of real assets held by zombies has increased but varies substantially across countries: in 2013 it ranged from 4 percent in Slovenia to 15 percent in Spain and almost 20 percent in Italy. Similar results were found by Hallak *et al.* (2018) in a wider set of European countries, and using more conservative definitions of zombie firms.⁴⁴

Interestingly, countries most affected by zombies are well-known for reporting productivity growth issues. In fact, even though the zombie phenomenon stems from financial system failures, it clearly affects the optimal allocation of resources in the economy. In fact, banking regulation introduces distortions in the input market that are unrelated to productivity; without such distortions, resources and jobs held by zombie firms are likely to be re-allocated into more productive firms.

⁴³The story presented by Caballero *et al.* (2008) may yet be questioned. They argue that because they are virtually close to death and have little to lose, zombie firms are extreme risk-lovers and as a result increase salaries and cut product prices; keeping them alive therefore maintains undue competition pressure on productive firms. Nevertheless, by providing cheap financing to distressed firms which keep a hope for survival, banks may actually try and avoid such daredevil attitude. Exogenous reasons for the existence of zombies such as banking regulation is thus essential to make the story plausible.

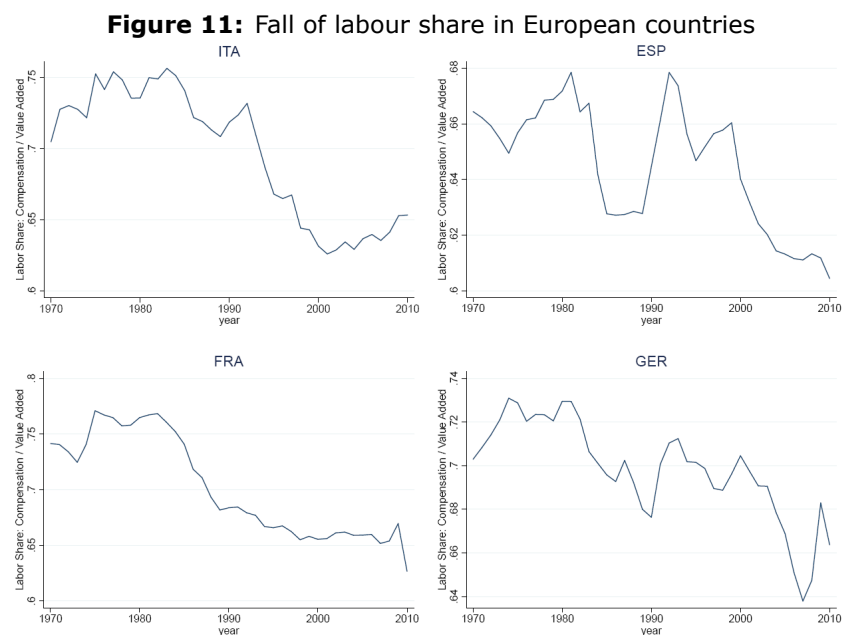
⁴⁴McGowan *et al.* (2017) and Hallak *et al.* (2018) present innovative evidence of the zombie phenomenon among SMEs, not just large and quoted firms. In their study, Acharya *et al.* (2016) confirm the existence of a booming zombie phenomenon in Europe using a reduced sample of large firms and more stringent definitions of zombie firms; they attribute the zombie phenomenon to the unconventional monetary policy implemented by the European Central Bank.

1.3.4 Falling labour share and reallocation

There is evidence that the share of the aggregate value added that remunerates labour has decreased in the last decades. The trend is documented by Elsby *et al.* (2013) for the US and by Karabarbounis and Neiman (2014) for a variety of countries. The latter show that between 1975 and 2012 the decline in labour share is detectable in 42 countries. This long-term trend is also visible across European countries. Figure 11 is an extract from Autor *et al.* (2017b) and shows the time plots of the share of compensation in value added in France, Germany, Italy, and Spain.⁴⁵ While the trend itself is well documented, there is little consensus as of the causes and consequences of the decline, including its implication for reallocation of jobs and productivity.

There might be a number of reasons as of why the share of labour in value added has been declining. Elsby *et al.* (2013) argue that a significant share of the decline in labour share is due to the sectors affected by import shocks. For example, as a consequence of increased competition of labour intensive goods from a foreign country, workers in labour-intensive industries have been relocated to other more capital-intensive sectors. This approach, however applies to the recent decline only, which was dominated by trade and manufacturing sectors.

Karabarbounis and Neiman (2014) suggests that the lower share of labour is due to the decline in the cost of capital relative to labour in relation to the technological advancement and computerization. Lower relative price of capital induces firms to shift away from labour and use relatively more real capital. However, they find that the decline in labour share is attributable to reallocation changes within industries rather than to modifications of the industry composition of the economy.



This figure is extracted from Autor *et al.* (2017b). It shows the ratio of aggregate compensation over value-added for all industries in a country.

Autor *et al.* (2017b) challenge the relative price hypothesis, arguing that relative price changes should affect all firms within an industry evenly. However, empirical evidence suggests there is no decline in labour share should the non-weighted average of labour

⁴⁵For a discussion of the falling shares in Germany and a comparison across the EU countries see also Grömling (2010) and Berger and Wolff (2017).

share ratios be considered. The decline in aggregate labour share is actually due to a composition effect driven by the behaviour of the very large firms.

Barkai (2018) extends Autor *et al.* (2017b) and highlights that the share of capital in added-value has been declining together with the labour share. The author shows in a theoretical model that such trend is possible only in the case of a decline in competition whereby net profits increase relatively to labour and real capital. In a nutshell, the decline of both capital and labour shares is due to the increase in the share of profits which is likely due to reduced competition. The results are consistent with Autor *et al.* (2017b) who found that leading large firms explain most of the decline in labour share.

To emphasise the role of the general increase in concentration within industries, Autor *et al.* (2017b) develop the so-called *superstar firms model*. In this model, firms with the highest productivity in an industry beat all competitors, and generate higher profits. As a result, the share of labour in their produced value added is lower than other firms. Besides, these top productivity firms capture and control increasing portions of product markets, and may grow to such an extent that they drive aggregate labour shares in the economy. In fact, Autor *et al.* (2017a) document a negative correlation between market concentration and the share of labour in the added value. Increase in market concentration and mark-ups in the US is being widely documented, see e.g., De Loecker and Eeckhout (2017); Grullon *et al.* (2017).

Finally, the increasing gap between the top-productive firms with other firms in the industry is documented by Andrews *et al.* (2015) in OECD countries. They show that the productivity gap between firms at the top end and other firms has widened among OECD countries, both in terms of labour and total-factor productivity. They suggest that the gap is partially explained by the lack of efficient diffusion of technologies across firms. In fact, controlling for the national institutional environments, they argue that policies supporting technology adoption, through, e.g., R&D tax incentives, R&D collaboration between business and university, and patent protection, play a significant role in reducing productivity gaps. Therefore new technologies are likely to be first adapted by the most productive firms within each country, and presumably only diffuse to other lagging firms once national top-productive firms have implemented the new technology.

The literature on competition and the remuneration of labour is drawing major attention lately among policy makers. For instance, the reduced share of labour may also be the outcome of the increasing bargaining power of a few oligopolistic players in labour markets, not only in product markets. Equity holders may thus retain a share of the value of labour away from employees. The decline in competition is yet more of a concern in the US than in Europe where such trends have not been established. This may be a topic of interest for further research in Europe.

1.3.5 Conclusions

In this chapter, we review the current knowledge about job creation. The literature has made the distinction between *job creation* and *job destruction* on the one hand, and *net job creation* on the other hand. *Job creation* is the sum of jobs created by growing firms in a category; reciprocally, *job destruction* is the sum of jobs lost by shrinking firms. *Net job creation* is equal to the difference between *job creation* and *job destruction*. *Net job creation* is equivalent to employment growth and may be calculated at the firm level or for a category of firms. *job creation* and *job destruction* are always positive while *net job creation* may be positive or negative. Firm-level dataset cannot observe the actual number of jobs created and destroyed which would equal the actual number of employees hired and lost by the firm, respectively. Employee-level dataset which identify employees, such as the Census Bureau *Longitudinal Business Dataset* would. *Net job creation rate* reflects the capacity of a category of firms to be efficient in adding employment, i.e. it equals the

“employment growth rate.” The *job creation* and *job destruction* rates reflect the turnover and dynamism of the labour market. The numbers are put in perspective with the aggregate numbers the respective shares of employment.

We identified three areas where (net) job creation may be affected. Two highlighted the firm-specific ability to create jobs; one highlighted how this ability depends on other firms. First of all, a large area has focused on the age-size debate. Authors have provided contradicting evidence: some argue small firms contribute to *job creation* and *net job creation* proportionately more than their employment share, while some underline that young firms are the main contributors. The debate has involved a discussion as of potential sample and measurement errors. Yet, there is growing consensus that while small firms may indeed be disproportionately contributors to *job creation* and *net job creation*, among all small firms, the young are those contributing most, and this is true at all size categories.

Beyond age and size, firms may be affected by a series of factors in their growth. This includes access to finance, and the capacity to display strong employment growth rates. Some studies attempt to identify “pre-deterministic” indicators of growth, such as the name of the firm. The latter assumes that new entrepreneurs vary in their initial objectives regarding growth.

Finally, the growth capacity of a firm may be determined by the overall capacity of the labour market to reallocate resources efficiently. The resource reallocation varies across economic cycles (recession and expansion); during economic downturns, less productive firms are more prone to die than in economic expansion periods, which benefit to more productive firms. Finally, some firms display a declining share of labour in total added value, and increase in financial capital remuneration, which suggests that more productive firms may actually benefit from market power.

- Small and young firms are major contributors to *job creation* and *net job creation*;
- Age and growth measurements have an impact on the results.
- There may exist pre-deterministic determinants of growth.
- In the US, labour reallocation benefits aggregate productivity.
- Even though entry-exits improves the aggregate productivity, within firms productivity gain is the main driver of productivity enhancement.

Chapter 2:

Sampling and Methodological Strategy

This chapter describes the sample and methodology used for our study. We describe the selection procedure as well as the imputation and data cleaning techniques we applied. The data quality analysis relies on the representativeness assessment of employment of which all details are reported in the Appendix. Finally, we describe the final sample.

2.1 Sample construction

Selection of firms and accounts

The study consists of an empirical analysis using micro firm-level data obtained from *Orbis*. Orbis is a databank published by *Moody's Bureau van Dijk* that collects the financial statements of any firm worldwide and includes additional firm-level information such as ownership and employment. Because they rely on bilateral contracts with a wide range of data providers, Orbis data may vary by country in their quality as well as their representativeness of official statistics. This report relies on 2017 end-of-year version of Moody's Bureau van Dijk's so-called "*historical Orbis*" product. The historical dataset is a unique file in text format that contains all employment and financial information available in Orbis at the file production date. We therefore could consult all reports for all firms and trace back to the earliest report available in Orbis.

We select all companies in Orbis registered in one of the EU-28 countries in the period 2004-2015 which report in Orbis "*industrial format*." The BvD identifier is uniquely assigned to firms by Bureau van Dijk, of which first two letters indicate the country of registration. We exclude financial services companies with 2-digit industry NACE codes between 64 and 66.

Defining firms by BvD identifiers may yet give rise to some issues. First, for some reasons, firms may change their identifiers. For example, we know that BvD identifiers build on national identifiers, e.g., tax numbers, and there might be general changes in national identifying systems; such event occurred with the Italian tax numbers in 2013. Another challenge relates to mergers and acquisitions. A firm may be acquired by another firm, and even though it continues activities regularly, the identifier may be modified. BvD keeps track of identifiers changes and are available online.⁴⁶ Yet, we rely on the historical dataset since BvD claims that it already ensures the continuity of the firms identifiers.⁴⁷

Among all selected accounts, we retain those with a closing date in years between 2004 and 2015. The coverage period is motivated by two factors. On the one hand, the quality of the Orbis dataset in terms of representativeness has increased substantially since the early 2000s with 2004-2005 being a major threshold for a number of countries. The second reason is that a number of Central European countries joined the European Union in 2004, and detailed Eurostat data is not available for these countries before this date, hindering comparison. For some countries, e.g., France and Spain, relatively longer time series is available.

⁴⁶<http://idchanges.bvdinfo.com/>

⁴⁷We did check such continuity in some instances.

Finally, we retain *unconsolidated* accounts only.⁴⁸ The reason relates to the comparison with Eurostat statistics which are constructed at “business unit” level; accounts are thus unconsolidated with subsidiaries. Moreover, consolidated accounts by definition consolidate employment of the firm and its subsidiaries; given that the subsidiaries are likely to be in the sample too, this may result in double counting of employment. Furthermore, consolidated accounts include subsidiaries located in other sectors so that one reduces the precision of the industry classification.

Orbis contains five types of accounting reports: consolidated C1 and C2, unconsolidated U1 and U2, and Limited Financial reports; Box 3 provides all details. We retain unconsolidated employment exclusively: U1 [only unconsolidated account is available] or U2 [consolidated account is also available but we retain the unconsolidated account]. Case LF represents reports with Limited Financial accounts, and cannot be classified as consolidated or unconsolidated *a priori*. Yet, since their average size of LF accounts is small, they are most likely unconsolidated.

Box 3. Consolidated and unconsolidated accounts in Orbis

Orbis reports five types of reports: unconsolidated U1 and U2, consolidated C1 and C2, and with limited financial information LF. U's and C's indicate unconsolidated and consolidated reports respectively. U1 (C1) indicates that no consolidated (unconsolidated) reports are available. U2 (C2) indicates that a consolidated (unconsolidated) report is available.

- U1 - Unconsolidated; no consolidated reports are available.
- U2 - Unconsolidated; a consolidated report is available.
- C1 - Consolidated; no unconsolidated reports are available.
- C2 - Consolidated; an unconsolidated report is available.
- LF - Limited Financial.

In our analysis of the data we noticed that “Limited Financial” format indicates unconsolidated reporting in most cases. Notice that *Limited Financial* reports may report employment, not the financial data. We also check the mix for the same firms of LF, C's and U's accounts across years, and found very few cases. For our analysis we exclude consolidated accounts.

The selection of firms and accounts may be summarised as follows:

- Non-financial firms: exclude NACE 2-digit codes 64-66;
- Retain closing date of reports in years 2004-2015;
- Unconsolidated accounts.

Provided the potential sensitivity of our sample to excessive employment due to the adding-up of unconsolidated and consolidated accounts, we screen the effects of consolidated accounts in our representativeness analysis – see the sections hereunder.

Industry classification

We use the core industry NACE classification in Orbis because, in Europe, the national classification systems closely follow the unified European NACE system. Industry classification is a “static” time-invariant item in Orbis, which means that we can know the industry at the date of download only. This may result in two major issues.

First, the classification process is relatively complex and requires revisions from time to time so to rearrange activities consistently and/or take into account new and expanding business

⁴⁸Unconsolidated accounts are accounts that ignore subsidiaries. Companies with no subsidiaries would typically have unconsolidated accounts only. Firms with subsidiaries may have consolidated, unconsolidated, or both accounts reported.

activities. In 2008, the NACE system was revised into the NACE Rev. 2 system introducing significant changes. Even though supervisors provide correspondence tables between the old and new systems, there exist no one-to-one code correspondence tables. Moreover, so that all European firms in Orbis are classified in the latest European NACE Revision 2 system introduced in 2008, and knowing a firm's sectoral classification in today's Orbis does not systematically provide the industry code in the prior system.

The second issue relates to the unobserved past industry changes of firms. In fact, firms may modify their core activities over time and be reclassified over time. This is a relatively rare event, though, but it may lead to non-trivial problems if some large firm switches industries. We controlled for this manually as we compare Orbis with Eurostat and identified a few occurrences that we fixed. Further description is available in Appendix 5.

Last, in rare occurrences, some firms do not report their sector of activities. In some countries, the absence of industry classification may be significant, in particular in Denmark, but also Estonia, United Kingdom, Ireland, the Netherlands, Romania and Sweden. Based on our experience and knowledge, these firm level limitations are common to most firm-level databanks.

Construction of a panel dataset

Firm-year level datasets require to identify a single accounting report in each year. As described in our previous section, for each firm, we select unconsolidated accounts only. The choice of the consolidation level depends on the economic phenomenon of interest. As for the employment analysis purpose of this report, we would like to compare Orbis based computed aggregates to national statistics. We report the amount of information losses due to the dismissing of consolidated accounts.

Moreover, firms may provide multiple reports at the same consolidation level in the same year. Thanks to the access to all accounts for each firms, we could identify two main reasons for multiple reporting. First, Orbis gathers information from multiple data providers. Data may stem from national sources and/or regional/local sources. Moreover, firms sometimes submit multiple annual reports within a year when, e.g., they change the "end of fiscal year" from the usual 31th December to for example 31th of March. We apply the following selection rules.

Multiple unconsolidated accounts within the same year: selection rules.

1. Reports with closing date up to June are associated to the previous calendar year.
2. Several reports with closing date after June: select the latest report.

Sometimes we observe that firm-year reports are missing. In this case, we rectangularize the dataset between the first and the last observed year of the firm and add *unfilled* extra firm-years to the dataset.⁴⁹ Note that this does not mean imputation of values per se. It only allows to identify firm-years where information or reports should be available.

Imputations

Given the panel construction of the data, we can impute missing value of employment for firm-year observations with approximations. Here we opt for two alternative strategies. Step 1 is a less invasive imputation method, while Step 2 assigns an approximate value to all firms. Step 2 enables to identify the size and the nature of the missing value problem. Step 2 is aimed at countries with serious missing variable problems.

⁴⁹An alternative approach could be to fill in the dataset with extra observation between the firms year of establishment and 2016 (last year observed in the data). In this dataset we do not take this approach, but this could be useful in a research with a different focus, e.g., analysing entry and exit.

Step 1. (Imputation). This first step imputes missing information for a firm-year when close past and future data is available. When Orbis data look as follows:

time	t-1	t	t+1
employment	16	.	25

employment for t is imputed by taking the average of the neighbouring values: $\frac{(16+25)}{2}$. This method lies on the assumption that employment increases linearly from $t - 1$ to $t + 1$. This imputing strategy can be used for multiple consecutive missing values. In this report we use it for at most three consecutive missing years. Additionally, this imputing strategy could also allow for using the same linear strategy to missing values not surrounded by known figures. For example, for the year $t + 2$ below:

time	t-1	t	t+1	t+2
employment	16	.	25	.

for $t + 2$ we could impute $25 + \frac{(25-16)}{2}$, which would assume that growth keeps the same linear path after the last observed value; similar strategy could be followed when there is no missing data at time t . Nevertheless, since we do not actually know the direction of the change after the last observed value, we might impute growth when there is a decline in reality. To avoid this bias, we impute 25 for $t + 2$; we retain this imputation strategy for firm-years only where data is available in either the previous or following year.

Step 2. (Imputation + average). The dataset still might include firms where reporting of the variable is concentrated on one or the other end of the time-line of the available reports. For example:

time	t-2	t-1	t	t+1	t+2
employment	15	12	.	.	.

In these cases we need to be more careful whether imputation does more bad than good. However in order to assess the quality of Orbis dataset and have an idea about the size and nature of the missing value problem we assign the average of the available information to the missing years. Hence, employment for $t, t + 1, t + 2$ becomes $\frac{(15+12)}{2} = 13.5$, regardless of the number of consecutive missing firm-year observations.

Notice that researchers using Orbis may opt for a more or less conservative imputation technique, depending on their research question and methodologies.

Detection of outliers

We adopt the following outlier detection technique. We look at particularly high jumps and drops in firm time series of the variable of interest where the variable returns to values close to pre-change values. Here is an example:

We detect the outlier at time t as looking for instances when employment changes to 800 (or 1/800) times its previous followed by a similar change of the opposite sign.⁵⁰ The outlier is replaced by the average of the neighbouring values.

⁵⁰The value is designed to capture misreporting of commas by a thousand.

time	t-2	t-1	t	t+1	t+2
employment	15	12	1400	20	27

A more sophisticated outlier detection for employment consists in looking at changes in average wage. This controls for actual large changes in employment, reflected in contemporaneous changes in both wages and employment. Should this be the case, the average wage would remain relatively constant. Notice that this technique cannot be used for the years around firms birth and death.⁵¹ Also, different thresholds to changes are applied gradually to detect larger and smaller outliers.

Eurostat benchmark statistics

We compare the Orbis aggregate employment with Eurostat aggregate statistics; Eurostat is the European Union official statistics authority. We use Eurostat *National Accounts* (code: *nama_10_a64_e*) and employment statistics (*domestic employee concept*) as country and sector level aggregate benchmarks; for the firm-size level employment information, we rely on Eurostat *Structural Business Statistics (SBS)* industry level information, Eurostat dataset code *sbs_na_ind_r2* for sector C (Manufacturing). Services are covered by dataset *sbs_na_dt_r2* for sector G and *sbs_na_con_r2* for Construction, dataset *sbs_na_1a_se_r2* for sectors H to N. Notice that business statistics are unavailable for sectors classified *O* to *T*. This gives rise to differences between aggregate and firm-size level analysis regarding sector Services as for the sector coverage.

From the Eurostat databank, we opted for the “Employees domestic concept” statistics which cover employees hired by “resident production units,” excluding self-employees. The choice is motivated by Orbis providing employment information mainly on incorporated economic units and hardly any for self-employees and non-incorporated enterprises.

2.2 Representativeness and Final Sample

We conduct an analysis of employment representativeness of Orbis for all EU28 Member States. Figures and analysis of all other EU-28 Member States are reported in Appendix 5. The analysis is split into four components. First, we show an overview of the employment data in Orbis, where we check the consolidation level of the reports and the impact of the imputation procedure. Second, the representativeness by levels and dynamics. Third, the representativeness by size category after weighted schemes are applied. Fourth, the representativeness by levels of sub-industries. From our analysis, we conclude that 20 out of the 28 EU member states report appropriate representativeness of employment. Based on our representativeness analysis of Orbis employment data, we retained 20 out of the 28 EU Member States: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Lithuania, Latvia, Portugal, Romania, Spain, Sweden, Slovenia and Slovakia.

Within the aforementioned countries, we further investigate Manufacturing and Services as two separate broad sectors. The European system of economic classification NACE (Revision 2) defines Manufacturing with its Section C, Divisions (two-digit codes) 10 to 33. Services is defined with Sections *F-Construction*, *G-Wholesale and Retail*, *H-Transportation*, *I-Accommodation and Food*, *J-Info-communication*, *L-Real Estate Service*, *M-Professional*

⁵¹When firm starts and management is hired first, then workers firm starts with high average wage and low number of employees before growing. When firm dies, it is likely that there is only a small employment by the end of the year but firm still pays obligations to its past employees.

Services and N-Administrative Services. We omitted economic activities such as Health care, Education, Energy, Defences and Public Administration where typically states and local authorities are responsible for a significant share of employment through non-incorporated public entities.

Eventually, our sample of employment covers the 12-year periods 2004-2015 and include 2.9 million firms in 20 EU countries. On average, our sample includes 70 million employees yearly, which are comparable to the 75 million employees reported in Eurostat. Table 1 provides a description of the sample by country. It reports the starting and end year in the sample, the number of firms and the number of employees.

Table 1: Sample Description by Country

	Code	Start Year	End Year	Number of firms	Employment	Weighted Employment	Eurostat SBS Data
Austria	AT	2005	2015	43,074	1,821,644	2,334,623	2,410,574
Belgium	BE	2004	2015	110,610	1,857,651	2,310,107	2,344,009
Bulgaria	BG	2004	2015	154,629	1,678,832	1,738,736	1,570,325
Czech Republic	CZ	2004	2014	79,619	2,573,964	3,282,646	3,093,918
Germany	DE	2006	2015	172,073	12,578,020	18,473,000	24,056,800
Denmark	DK	2004	2015	25,346	870,435	1,221,897	1,485,724
Estonia	EE	2004	2015	28,937	332,472	353,657	335,356
Spain	ES	2004	2015	466,922	587,196	1,607,084	1,761,638
Finland	FI	2004	2015	54,679	6,702,317	9,463,717	9,850,826
France	FR	2004	2013	331,655	1,152,704	1,298,459	1,327,349
Croatia	HR	2004	2015	56,921	867,615	997,512	896,970
Hungary	HU	2009	2015	172,777	1,830,739	2,188,795	2,134,193
Italy	IT	2004	2015	347,298	9,069,780	13,468,710	12,439,286
Lithuania	LT	2004	2015	8,697	527,902	719,470	737,364
Latvia	LV	2004	2015	56,683	510,050	523,619	509,760
Portugal	PT	2006	2015	242,382	2,071,968	2,622,043	2,647,881
Romania	RO	2004	2015	275,856	3,030,665	3,262,393	3,304,165
Sweden	SE	2004	2015	166,244	1,858,450	2,685,795	2,726,629
Slovenia	SI	2010	2015	44,034	406,285	490,107	522,143
Slovakia	SK	2008	2015	65,612	968,681	1,208,764	1,137,574

Note: This table reports the yearly average number of firms, employment and weighted employment in our sample by country. For instance, Austria (code AT) is represented between years 2005 and 2015, reporting 43,074 firms on average. Average weighted number of employees is 1,255,557; Eurostat number of firms is 2,410,574.

2.3 Definitions and Methodology

In this section, we define the main variables that we use in the empirical analysis. We also address the different options and the reasons why we opt for one or another. As a general rule, we try and construct the variables as closely as possible to the seminal works in the field of job creation, especially Davis and Haltiwanger (1996), Haltiwanger *et al.* (2013) and Criscuolo *et al.* (2014). For convenience, we define variables with mathematical formulas in Appendix 5.

Size of the Firm

The size of the firm is defined in *number of employees*, with no restrictions in terms of assets and sales. In Orbis, the number of employees is the number of full-time equivalent employees at the fiscal year closing date. Given that closing dates fall to a large extent on December 31, we assume that the employment figures apply to the calendar year.

As described by Davis and Haltiwanger (1996), the way size is defined may have consequences on estimates (see Chapter). Consistently with Davis and Haltiwanger (1996), we thus define two sizes of the firm, namely *base size* and *current size*. The base size is the number of employees in the year it is reported in Orbis. Current size instead is the average between the prior and the current years. For instance, the current size of firm f in 2010 is the average number between the number of employees held by f in 2009 and the number of employees held by f in 2010.

- Base Size:
Number of employees at the firm in a year.
- Current Size:
Average number of employees at the firm between prior and current years.

We classify firms in four categories according to their size – micro, small, medium and large firms. Our classification follows the official European size classification system, except that it ignores assets and sales criteria.

Firms' size group categories:

- Micro firm: *0 to 9 employees;*
- Small firm: *10 to 49 employees;*
- Medium firm: *50 to 249 employees;*
- Large firm: *250 employees and above.*

Age of the Firm

We define the age of the firm the number of years since the firm was incorporated. We set Age to 0 in the year prior to the incorporation date, and to 1 at the end of the year of incorporation date. The date of incorporation is provided by Orbis.

- Age: *Number of years since the date of incorporation.*

Though, the date of incorporation may be missing. In this case, Age equals the number of years since the first appearance in Orbis, including the years prior to our sample period.⁵²

We construct age categories consistently with Criscuolo *et al.* (2014).

Firms' age categories:

- Start-up firm: *0 to 2 years old;*
- Young firm: *3 to 5 years old;*
- Mature firm: *6 to 10 years old;*
- Old firm: *more than 10 years old.*

In some sections of our study, we simplify the classification into two categories; in this case, "Young" firms are 0 to 5 years old and "Old" firms are 6 years and older.

Job Flows at the Firm's Level

Job flows produced by a firm encompasses any *entry* and *exit* of employees in the firm; entries constitute new hiring, and exits typically are layoffs and resignations. In a year, a

⁵²JRC's subscription to Orbis has no time period limitations and some firms report in years preceding the first year in our sample. The method is consistent with studies based on Census Bureau's *Longitudinal Business Database*, since the latter reports no date of incorporation; see, e.g, Davis *et al.* (1996a) and Haltiwanger *et al.* (2013).

firm's *job destruction* is the sum of all exits and its *job creation* is the sum of all entries. The *net job creation* is equal to the difference between the job creation and the job destruction.

Notice that the Orbis dataset reports *only* the number of full-time equivalent employees in a year, so that firm-level job destruction and creation are unobserved and the net job creation is computed as the change in the number of employees between two years.⁵³

Finally, we calculate the *net job creation rate* as the ratio of the net job creation of the firm to its size; unless specified otherwise, in our study the job creation rate employs the *current size* in the denominator. Notice that by construction the net job creation rate is the employment growth rate of the firm.

Net job creation at the firm's level:

– Net job creation:

Firm's job creation minus firm's job destruction; it equals the change in the number of employees between two years.

– Net job creation rate:

Firm's job creation relative to its current size.

Aggregate Job Flows

While job creation and destruction cannot be calculated at the firm level with Orbis, respective estimates are computed for group categories of firms. The job creation [destruction] of a set of firms, say, the small firms, equals the sum of the net job creation of all small firms with positive [negative] net job creation. The *net job creation* of a group category of firms is the sum of the net job creation of all the firms in this group. The job flows at the group category level are the *aggregate job flows*.

Aggregate job flows:

– Aggregate job creation:

Sum of all firms' net job creation whenever the latter is positive.

– Aggregate job destruction:

Sum of all firms' net job creation whenever the latter is negative.

– Aggregate net job creation:

Difference between the aggregate job creation and the aggregate job destruction; it equals the sum of all firms' net job creation.

Contributions to Employment

We are interested in the contribution of a set of firms to the total job flows within, e.g., the economy. To assess the magnitude of individual contribution, we define the country-year *total employment* as the sum of all employees in *our sample* in the country and in a year. Unless stated otherwise, the total employment is the *current size* of employment of the economy which equals the average total employment in our sample between prior and current years.

⁵³It is worth noting that the Orbis dataset is similar to the databanks published by Dun & Bradstreet (D&B). Instead, the Census Bureau's Longitudinal Business Database (LBD) does provide job destruction and creation at the firm level. The reason for such a difference is due to the data source: Orbis and D&B's databanks are constructed upon firm-level reports, while the LBD is built upon individual employees Internal Revenue Service (IRS) statistics. D&B datasets are used by, e.g., Birch (1987) and Neumark *et al.* (2011); the LBD is used by, e.g., Davis *et al.* (1996b) and Haltiwanger *et al.* (2013).

- Job creation contribution:
The job creation of a group category of firms relative to the total employment.
- Job destruction contribution:
The job destruction of a group category of firms relative to the total employment.
- Net job creation contribution:
The net job creation of a group category of firms relative to the total employment.

2.3.1 Conclusions

In this chapter we detail the sampling and methodological strategy. The firm-level data are obtained from *Orbis*, a firm-level databank issued by Moody's Bureau van Dijk. We extract all non-financial corporations in the sample which report employment in unconsolidated accounts and are registered in one of the 28 EU Member States. We treat the sample by imputing missing values and picking outliers. Also, we compare the data with Eurostat employment aggregate tables in order to assess the representativeness of the dataset. We apply weighting schemes at country, year, sector, and size-level, so to match the aggregate employment in Orbis. Consistently with our assessment of the quality of the matching and the weights we applied, we retain 20 out the 28 Member States.

The final sample contains 2.9 million firms registered in the following countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Lithuania, Latvia, Portugal, Romania, Spain, Sweden, Slovenia and Slovakia. Total employment after weighting schemes are applied amount to ca. 70 million to be compared with 75 million employees in Eurostat. The sample is relatively well diversified between country size and EU entry periods.

Chapter 3:

Empirical Results

The next sections report our empirical analysis. The study is based on an exceptionally large micro-level employment data of firms in the European Union described in Chapter 1.3.5. The data is obtained from Moody's *Orbis* which has recently gained fame among policy-makers for its extensive coverage of firms worldwide. Though, given that *Orbis* database consists in a patchwork of databases stemming from a wide number of providers, its employment representativeness may be an issue for some countries. Therefore, we follow our prior representativeness analysis reported in Chapter 1.3.5, and retain those countries in our sample whose employment representativeness is adequate. The final sample includes 2.9 million firms located in 20 out of the 28 EU Member States in the period 2004-2015. The empirical analysis is split into employment, job flows and contributions of firms in various categories. The study emphasises the traditional debate between age and size characteristics of job creating firms, but also investigates additional characteristics such as ownership of firms and their location. Notice that official statistics such Eurostat the results of employment levels by size are comparable to those of Eurostat, the contribution of our work is to look at employment and job flows for a wide range of firms characteristics including age.

The analysis regarding *employment* by size shows that, even though the incidence of SMEs in our sample – defined as less than 250 employees – amounts to nearly 99 percent, their share in employment is substantially lower at ca. 65 percent. Further, while the incidence of SMEs hardly varies across countries, their employment share indeed does, suggesting non-trivial disparities among EU Member States in terms of industrial organization. The phenomenon is consistent with official statistics. Instead, the incidence of firms by age category are in line with their respective share of employment. We provide further insights about start-up companies (0-2 years old) and find that their share varies substantially across countries between 5 percent and 20 percent (four times as much). There seems to be a gap chiefly between old and new EU Member States, the latter reporting higher start-up shares. Overall, we observe a decline in the share of start-ups in EU countries – not in all countries, though.

The analysis of *job flows* – namely job creation, job destruction and net job creation – shows that, even though job creation and destruction rates vary substantially across EU Member States, the difference between job creation and job destruction within the same country is relatively thin. The average yearly net job creation rate varies between -3 percent in Spain to +2 percent in Lithuania. Further, the Manufacturing sector exhibits far lower job creation and destruction rates than Services in all countries. In our sample, the contribution of SMEs to job flows is proportionately greater than their share in employment – in both Manufacturing and Services. Taking a closer look, we observe that a large share of the job creation stems from the *young SMEs*. Actually, the majority of the job creation in Europe is concentrated in a few high-growth young SMEs.

Further insights show that ownership plays a role in the job flows; firms that are part of conglomerates contribute to job flows proportionately more than their share in employment. Interestingly, firms owned by domestic parents constitute a significant driver of job flow cycles. Besides, the analysis by location shows that young SMEs in urban areas tend to have a share in the local job creation larger than their share in employment. This suggests that beyond finance, matching skills abilities of economies play a role in job flows. Finally, we

note that newly established firms report the lowest productivity, exiting and shrinking firms report similar productivity levels, and net job creating firms are those most productive. Even though this proves European economies are well-functioning overall, the pronounced observed disparity across countries deserves further analysis.

The rest of the chapter is organised as follows. The next section describes the data and the main definitions. Section 1 looks at employment by age and size. Section 2 reports the results about job flows. Section 3 investigates the contributions of firm categories. Section 4 provides further insights about job creators. Finally, the last section concludes and suggests further analysis.

Within these sections, we introduce “*Focus Sections*” which are aimed at drawing the attention to specific topics. Focus sections include the analysis of start-ups (Section 1), the regression fallacy at the EU aggregate level (Section 2) and high-growth firms (Section 3).

3.1 Employment

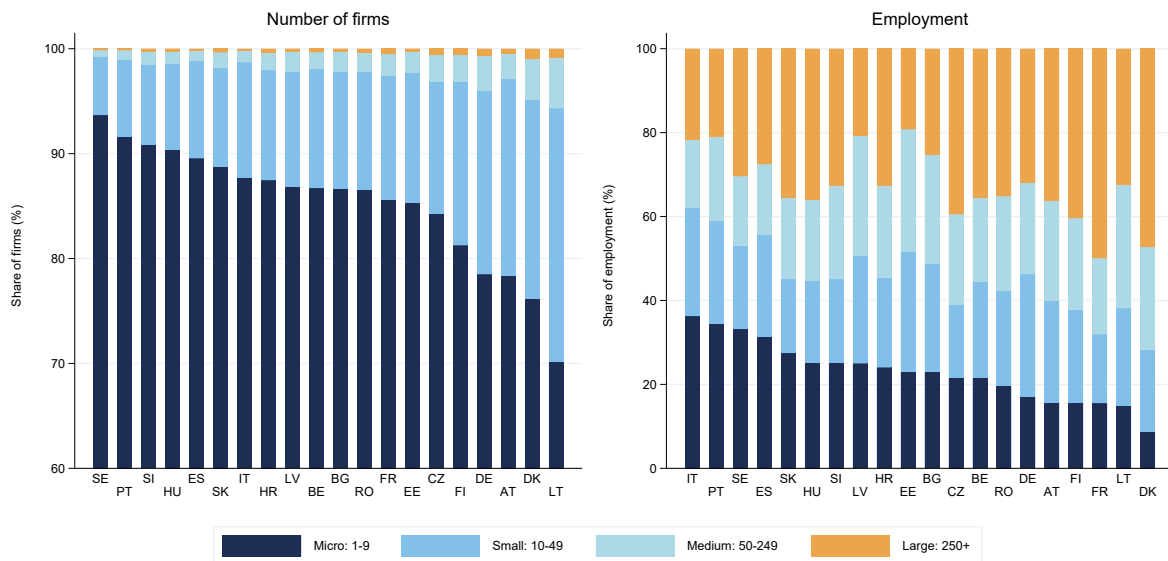
This section intends to highlight general stylized facts about employment across the European countries. The distribution by firms size is similar to the distribution in official statistics produced by Eurostat. We then report the distribution by firms age. Finally, we focus on the share of start-ups and highlight their decline in the EU.

3.1.1 Employment by size

Figure 12 reports the employment distribution in our sample for each country, by size category in the number of firms (left-hand panel) and in the share of employment (right-hand panel). The figures about firms size are comparable to the official statistics provided by Eurostat. The left-hand panel of Figure 12 shows that more than 70 percent of the firms are micro firms – i.e., employ less than ten employees – in every country. In several countries – e.g., in Sweden, Italy, Spain and Portugal – the share of micro-firms amounts to 90 percent. The share of small firms is on average 12 percent, while the share of medium size firms is 2 percent. Large firms represent less than 1 percent for any country in our sample.

While small firms are numerous, their share of employment in the economy is considerably smaller than their share the number of firms. As Figure 12 (left-hand panel) reveals that while micro-firms were more than 70 percent of all firms population in any country, their average share in employment turns to be less than 30 percent. While the average share of small firms and medium size firms are 22 percent and 20 percent, respectively. In our sample of countries, we find that the share of micro-firms is the highest in aggregate employment for Italy, Portugal and Estonia. At the same time, large firms employ on average 30 percent of the workforce. Large firms hold the largest shares of employment (above 40 percent) in France, Denmark, Finland and Germany.

Figure 12: Number of firms and employment shares by firm size



Note: This figure reports the share of each size category in the total number of firms (left-hand figure) and their respective shares in total employment (right-hand figure) by country. The countries are ranked in a decreasing order with respect to the largest size category (250+). Country codes are defined in Appendix 5.

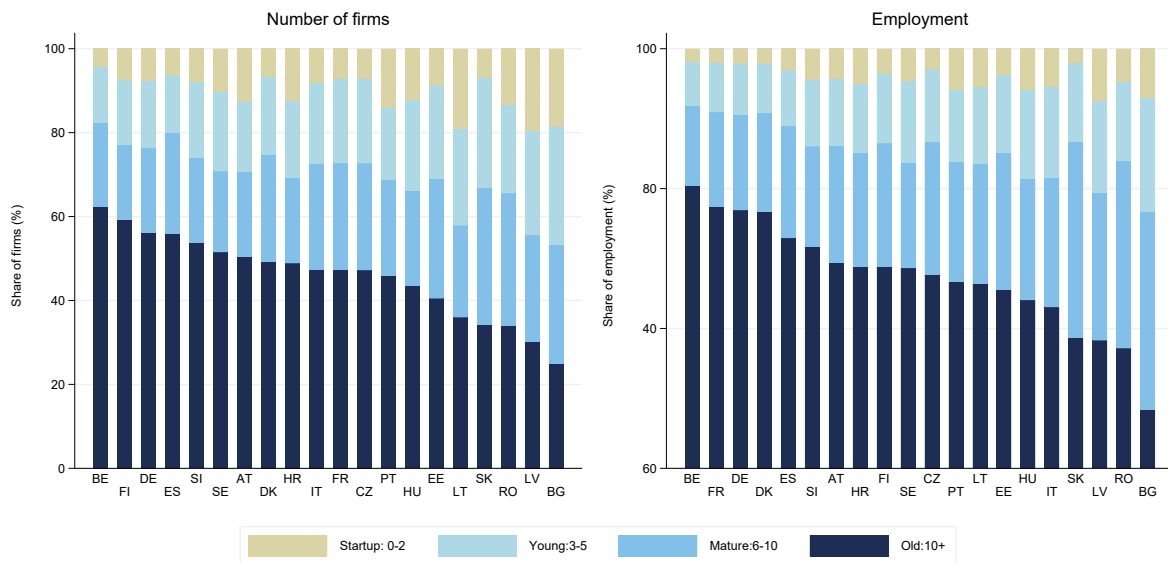
3.1.2 Employment by age

Figure 13 reports the distribution of employment by age, and portrays the economy in a different light. The left-hand panel shows the distribution of firms, and suggests that the majority of firms are older than five years. However, we find considerable cross-country variations. While on average 45 percent of all firms are old (10 years or older), the share of old firms is over 50 percent in Belgium, Finland and Germany, and less than 35 percent in Romania, Latvia and Bulgaria.⁵⁴ Interestingly, the share of start-up firms (0-2 years old) is about 10 percent; the highest start-up rates (above 15 percent) is in Bulgaria, Lithuania and Latvia, and lowest rates is in Belgium and Spain (half as much, less than 7 percent).

Figure 13, right-hand panel, reports the employment share of the age categories. It shows that the majority of the employment is held by old firms. While they constitute on average 45 percent of the firms, their average weight in aggregate employment is 70 percent. In all countries, we observe that old firms' employment share is higher than their share in the number of firms, and reciprocally for younger firms. The younger the age-category is, the larger is the relative difference. While the share of mature firms in the number of firms on average is 23 percent, their employment share is only 18 percent. The corresponding figure for the youngest age class is 10 percent and 4 percent in employment share.

⁵⁴Generally speaking, we find that in the new member states, formerly the transition economies, the average firm is younger.

Figure 13: Shares in Number of Firms and Employment by Age Category

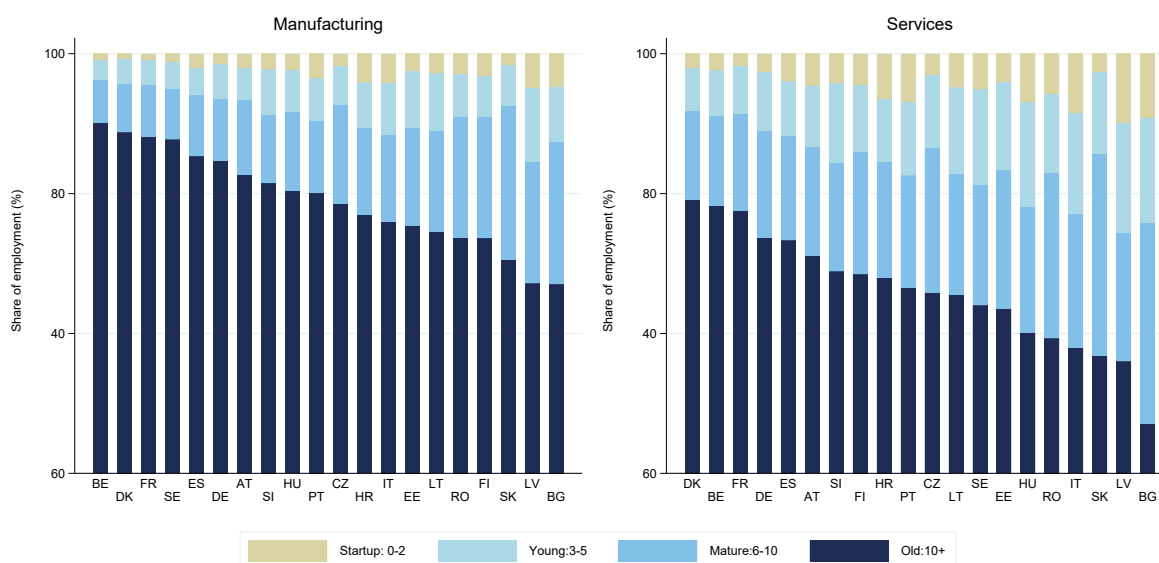


Note: This figure reports the share of each age category in the total number of firms (left-hand figure) and their respective shares in total employment (right-hand figure) by country. The countries are ranked in a decreasing order with respect to the youngest age category (Start-up: 0-2). Country codes are defined in Appendix 5.

Figure 14 reports the share of employment by age splitting our sample into the Manufacturing (left-hand panel) and Services (right-hand panel) sectors firms. We observe a similar relative importance of old firms in employment in both sectors, even though their weight is significantly higher in the Manufacturing sector. The share of employment of old firms is on average 80 percent in the Manufacturing sector, and 66 percent in the Services sector. Services sector is thus more sensitive to young firms' employment, probably showing higher easiness of entries.

In the next section, we focus on the start-ups since their characteristics convey relevant information about the easiness to conduct business.

Figure 14: Shares in Manufacturing and Services Employment by Age



Note: Figure 14 shows the share of age classes in the share of employment by country in the Manufacturing (left) and in the Services (right) sectors. The countries are ordered in decreasing order with respect to the oldest age class within each sector. Country codes are defined in Appendix 5.

Focus: The Start-up Companies

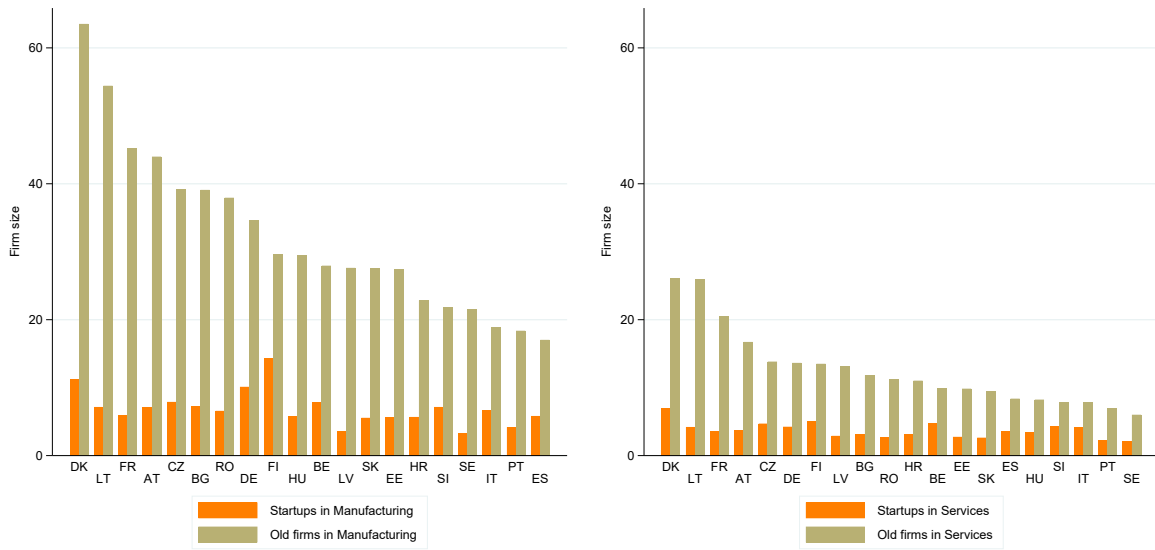
On top of creating new jobs, start-up companies constitute an important source of business renewal in an economy. Therefore, their share indicates the ability of an economy to renew and encourage entrepreneurship. We dedicate this section to start-ups and analyse whether countries display similar patterns.

We first look at the average size of start-ups (0-2 years old) and compare it with the size of old firms (more than 10 years older). The size is likely to reflect the entry costs for new firms and thus the entrepreneurship potential. For each country and sector in our sample, Figure 15 exhibits the current size of start-ups (left columns) and old firms (right columns), in the Manufacturing (left-hand panel) and the Services (right-hand panel) sectors.

Furthermore, substantial variations in the average size of start-ups in Manufacturing and Services suggest that some countries may suffer from higher entry costs and potential small entrants encounter disincentives. Interestingly, the average size of start-ups seems uncorrelated with the average size of large firms, both in the Manufacturing and the Services sectors.

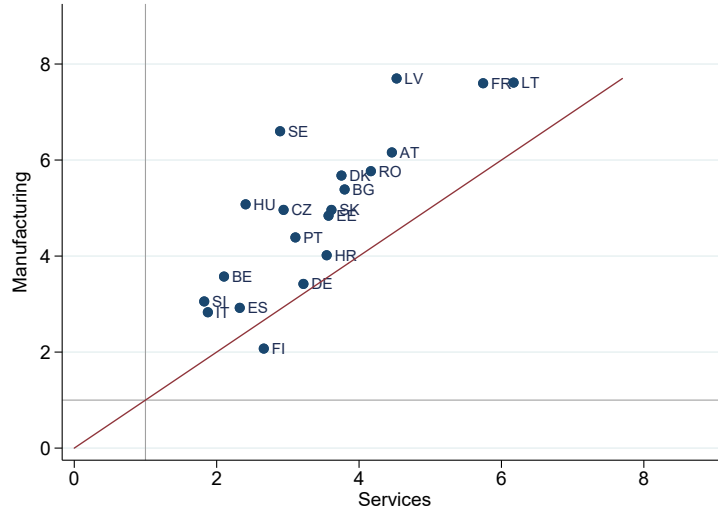
For a more direct comparison of Manufacturing and Services sectors within a country, Figure 16 provides another perspective by picturing the ratio of the size of old firms to the size of start-ups in Manufacturing and Services sectors. Each point represents the ratio in Manufacturing (vertical axis) and Services (horizontal axis) sectors. The closer the point are to the 45° red line, the closer the ratios are. Points below [above] the red line indicates that old firms are relative larger than start-ups in the Services [Manufacturing] sectors. For example, in Latvia (LV), the average old firm is nearly 8 times as large as the average start-up in Manufacturing, 4.5 times as large in Services; the LV point indeed lies above the 45° red line.

Figure 15: Average firm size grows with age



Note: This figure reports the average size of start-up (0 to 2 years old, left column) and old firms (11 years and older, right columns) firms by sector across countries. The countries are sorted decreasingly by size of the old firms. Country codes are defined in Appendix 5.

Figure 16: Average size of start-ups compared to old firms



Note: This figure shows the size-ratio of old firms to old start-ups by sector. The point are equivalent to the within sector size ratios calculated from Figure 15. Country codes are defined in Appendix 5.

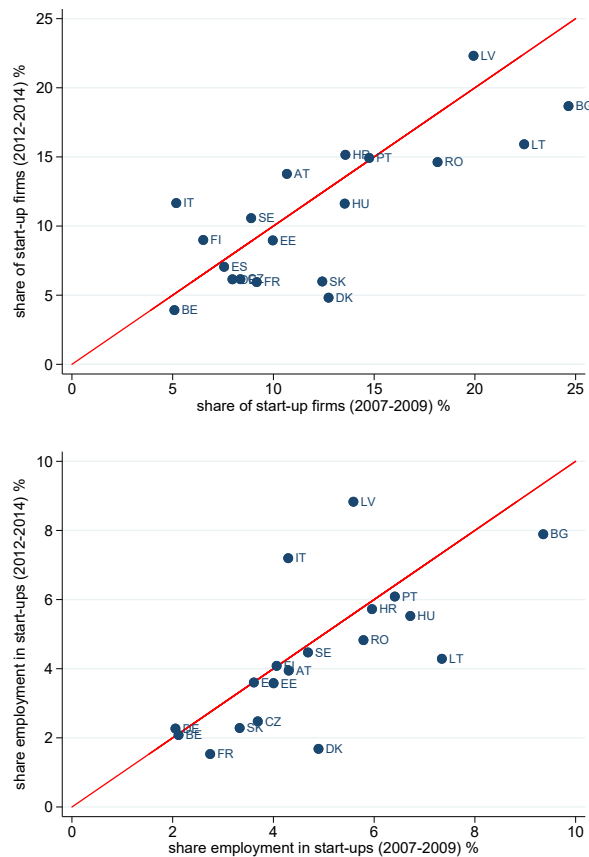
All in all, Figure 16 depicts the following stylized facts:

- In all countries, the average old firm is larger than the average start-up, both in Manufacturing and Services.
- In most countries, the size gap between the average start-up and the average old firm is larger in Manufacturing than in Services.

- In each country, the size gaps between start-ups and old groups in Manufacturing and Services are correlated.

Several studies suggest that in the recent years, especially in the aftermath of the Great Recession, the economic activity of start-ups have declined; see, e.g., Decker *et al.* (2016), Decker *et al.* (2017), Criscuolo *et al.* (2014). In order to investigate such pattern in the EU Member States, Figure 17 compares the employment share of start-ups in the two periods 2007-2009 and 2012-2014. The left-hand panel reports the share of start-ups in the total number of firms, and the right-hand panel reports the share start-ups in the total employment in our sample. We draw a 45° red line that facilitates the comparison of statistics over time: countries below [above] the 45° line indicates that the share of start-ups decreased [increased].

Figure 17: The Declining Share of Startups



Note: This figure reports the share of start-up firms in the period 2007-2009 (horizontal axis) and 2012-2014 (vertical axis). The left-hand panel shows the share of startups in the total number of firms; Right-hand panel shows the share of startups in total employment. Country codes are defined in Appendix 5.

The results suggest that for a majority of countries the share of start-ups declined or was unchanged. The largest decline is experienced by Slovakia, Denmark, Romania, Lithuania and Bulgaria. For instance, Bulgaria reported nearly 10 percent of employment in start-ups in the period 2007-2009, and 8 percent in the period 2012-2014; this amounts to a 20 percent decline. On the other end, six countries experienced an increase in the share of start-ups, namely Austria, Croatia, Finland, Italy, Latvia and Sweden. In Italy, the ratio of start-ups increased from 5 percent of employment ca. 7 percent, amounting to a substantial 40 percent increase.

We observe that those countries with the largest old-to-startup firm size ratios such as Denmark, Lithuania and France in Manufacturing, are among those countries experiencing the largest decline in start-ups. Reciprocally, countries with the lowest ratios, such as Spain, Finland, and Italy, have hardly experienced any decline in the share of start-ups – even an increase in the case of Italy.

Therefore, there seems to be a link between the ratio of old-to-startup firm size ratio and the decline in start-ups. A potential explanation is that larger old incumbents impose greater obstacles to potential newcomers: the former hold larger economies of scales and inflict higher competitive pressure on the latter. Should this be true, it implies that there are features in the business environment such as incumbents' average size that are beyond the institutional environment and may partially explain the decline in start-ups; this issue probably deserves deeper analysis.

Overall, we show that start-ups have declined in Europe on average both in the share of the number of firms and in the share of employment. Nevertheless, the patterns are very heterogeneous across countries, and there are exceptions in Italy and Latvia. Obstacles to newcomers stemming from the industrial organization of a country may partially explain the decline.

3.2 The Essentials about Job Creation and Job Destruction

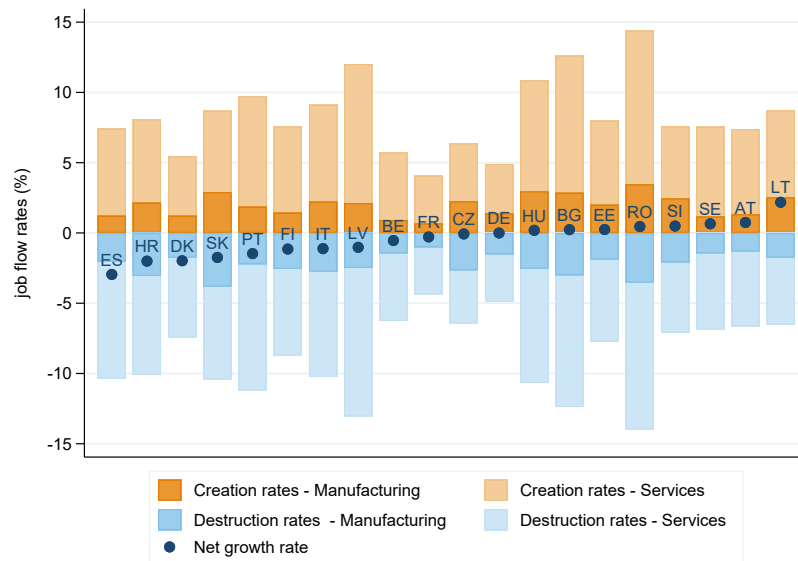
In this section we focus on the dynamics of job creation and destruction, as well as on the resulting net job creation. We first look at general figures at country and sector levels. Then, we look at age and size in detail. Interestingly, we report innovative evidence of the *regression fallacy* at the EU aggregate level which is a look-alike to the evidence in the US brought forward by Haltiwanger *et al.* (2013).

3.2.1 Job creation and destruction by country and sector

The average employment growth in our sample over the 2008-2014 period was -0.4 percent in the Manufacturing and Services sector together. However, in our sample, countries had varying experience of employment growth from a negative 3.9 percent in Spain to 2.2 percent in Lithuania. These growth rates come as a result as of the sum of job creation and job destruction processes from the firm level.

Figure 18 decomposes aggregate employment growth rate into its two margins: job creation and job destruction. The aggregate job creation rate ranges between 4 percent and 14.4 percent, while the aggregate job destruction rate (shown in negatives) also covers a similar range between 4.3 percent and 13.9 percent. This means that job creation and destruction rates are significantly higher than the net job creation rates.

Figure 18: Job creation and destruction rates by Country and Sector



Note: This figure reports the rates of job creation, job destruction, and net job creation by country. The columns are calculated as the weighted sum of firm-year values. Country codes are defined in Appendix 5.

Table 2 provides the cross-country correlations averages between job creation, job destruction, and the net job creation rates. It addresses the question as of which of job creation and destruction are stronger drivers of the net job creation. With correlation rates equal or below 0.31, Table 2 suggest that both job creation and destruction rates are poor predictors of the net job creation rates overall. Nevertheless, job destruction seems to more strongly drive the job net creation on average. Notice the strong correlation between job creation and destruction rates (correlation of 0.90) which is a redundant pattern in our results: whatever is the rate of job creation and destruction, both are very similar so that the net job creation is far below.

Table 2: Cross-Country Correlation of Growth Rates

	<i>Net Job Creation</i>	<i>Job Creation</i>
<i>Job Creation</i>	0.14	
<i>Job Destruction</i>	-0.31	0.90

Figure 18 also decomposes job creation and destruction rates into components stemming from manufacturing employment changes and to those from changes in the services sector. The high level of destruction and job creation rates compared to employment growth rates are also present across sectors. Also, sector level analysis shows that Services contribute to a larger extent to job creation and destruction in all countries. The correlation between creation and destruction persists within sectors even though there might be a lower correlation which deserves further analysis; it may reflect the capacity of employees to shift from one sector to another whenever the size of some sectors decreases.

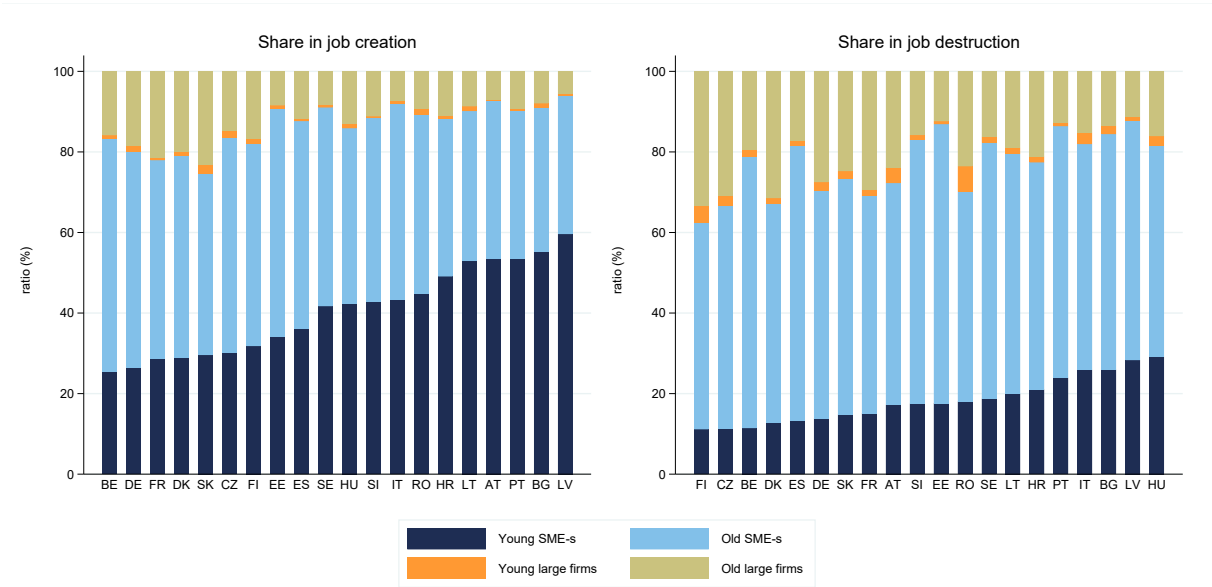
3.2.2 Job creation and destruction by age and size

This section looks at sources of job creation and destruction by decomposing aggregate job flows by firm characteristics. We look at the intersection of firm age and firm size

by creating four categories: (1) young SME's which are *start-ups* and *young* firms with less than 250 employees; (2) old SME's which are *mature* and *old firms* with less than 250 employees; (3) young large firms are *start-ups* and *young* firms with more than 249 employees (4) old and large firms are *mature* and *old firms* with more than 249 employees.

First, we look at the average share of these firm-groups in aggregate job creation and destruction by country in Figure 19. The left-hand panel shows the job creation for each of the four categories and points out that the majority of job-creation is done by SME's, on average 86 percent. The average share of young SME's in job creation is 40 percent, while that of the old SME's is 46 percent. In contrast, the share of large firms in job creation on average is 1 percent for the young and 12 percent for the large-old firms.

Figure 19: Share in Job Creation and Job Destruction - Within-Country Averages



Note: This figure shows the share of size-age groups in job creation (left-hand panel) and job destruction (right-hand panel) by countries. Country codes are defined in Appendix 5.

The share of SME's in job creation is relatively homogeneous across countries. The largest shares are obtained by Latvia and Austria (above 92 percent); the lowest shares are obtained in France and Slovakia (below 80 percent). Though, there is far more heterogeneity in the share of young SMEs. In fact, young SMEs share amounts to more than half of job creation in Portugal, Bulgaria and Latvia, while the share is slightly more than 20 percent in Belgium, Germany, and France.

SMEs are responsible for most of the job destruction as well, though, to a lesser extent than job creation: they contribute only to 77 percent of job destruction, which is substantially less than 86 percent share in job creation. Overall, SMEs are net job creators.

Also, young SME's destroy far less than they create. On average, young SMEs contribution to job destruction amounts circa 18 percent, while their contribution to job creation amounts to 40 percent on average. Remarkably, the share of old SMEs is substantially higher: 58 percent of job destruction on average, compared to 46 percent of job creation.

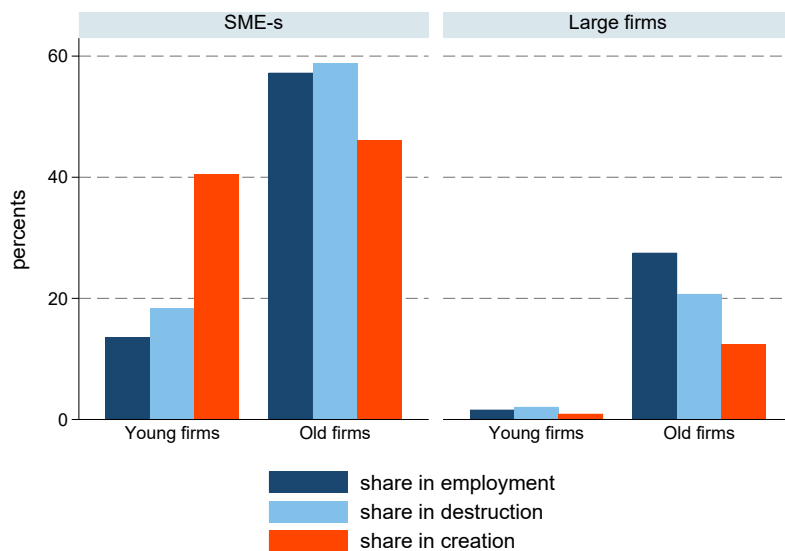
Findings may be summarized as follows.

- SMEs are the main contributors to both job creation and job destruction.
- SMEs contributions is relatively even across countries, not the split between young and old SMEs.
- Young SMEs are large net job creation contributors. New member states are those most benefiting from young SMEs job creation.

3.2.3 Creation and destruction relative to employment share

A simple assessment of job flow contributions consists in making a direct comparison with employment shares for each of the size-age categories. Figure 20 reports the cross-country average shares of job creation and destruction together with the average employment shares for each of the age-size group categories. The figure is designed in such a fashion that the comparison with Figure [15] reported in Criscuolo *et al.* (2014) is straightforward.

Figure 20: EU level job creation and destruction - Cross-country averages



Note: This figure reports the average share of firm age-size groups in employment, job destruction and job creation across countries. For each category, the dark blue bars (left) are the share in employment; the light blue bars (middle) are the share in job creation; orange bars (right) are the share in job destruction. Young firms are aged 0 to 5 years old; old firms are above 5 years old.

We find that on average SMEs hold most of the employment (69.2 percent), out of which old SME's hold 55.5 percent. Large firms hold only about 30 percent of employment and is overwhelmingly held by old and large firms. This is in line with Figure 12.

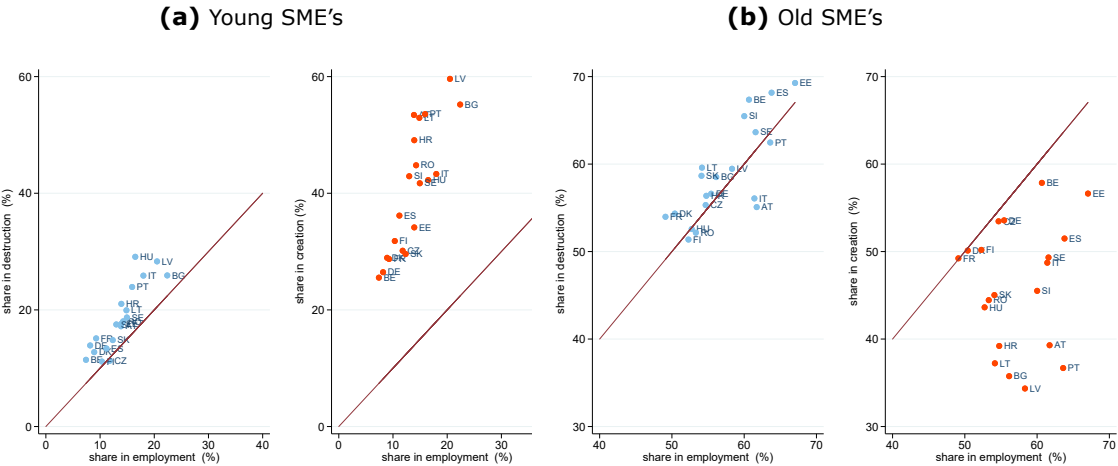
Job destruction shows a similar distribution across firms as the stock of employment, with an exception that young SMEs contribute to job destruction more than their employment share, and old firms less. At the same time the distribution of job creation across firms differs more from employment shares.

Young SMEs are responsible for a larger share of job creation than their employment share in the economy. While they only hold 13.6 percent of the jobs on average, they are responsible for job creation, 24.5 percent, nearly twice as much. At the same time, both the

groups of old SME's and large firms take part to job creation to a lesser extent compared to their importance in the overall employment.

The findings on how job flows shares relate to shares in employment stocks in the case of SMEs is observable in the great majority of countries, not only on average.

Figure 21: SME's job creation and destruction relative to employment shares



Note: This figure plots the share of SME size-age groups in aggregate job flows against their share in aggregate employment. Young are 0-5 years old firms, Old are 6 years and older firms. Each point represents a firm-size group in a country. Red lines represent the 45° line. Country codes are defined in Appendix 5.

Figure 21 contrasts creation and destruction shares to employment share on 4 scatterplots, where each point represents a firm-size group in a country. The left-hand panel on young SMEs shows that their share in job flows is higher than their share in employment, especially in the case of job creation. In countries where employment share of young SMEs account for circa 10 percent of employment in our sample, their share in job creation is more than threefold – e.g., Belgium and Germany. In countries where employment share of young SMEs is above 20 percent, e.g., in Latvia and Bulgaria, their share in job creation is over 55 percent. We find this relationship to be linear, but we do not find that higher employment share would result in increasingly more job creation.

The right-hand panel of Figure 21 looks at the old SME's. It shows that in this size-age group employment and job destruction share are related linearly, close to a one-to-one relationship. This is suggested by the finding that (blue) points are visible closely around the 45° line. In contrast, in the case of job creation, we find that for all countries flow shares are below the size-age group's share in employment. The relationship is, however, non-linear. The job creation share of the old SME's for the countries with the highest employment share in this group (over 60 percent) like Portugal, Spain and Estonia vary between 36 percent and 56 percent. For the countries with the lowest shares, e.g., France, Denmark and Finland the creation share matches employment share.

3.2.4 Entries and exits

We decompose job flows by firm size as well as firms' entry-exits with a view to observing the incidence of entries and exits in job flows. The "entry" date equals the incorporation date, and whenever the latter is missing, we set incorporation date to the closing date of the earliest report in Orbis (see details about age calculation in Section 1.3.5). The

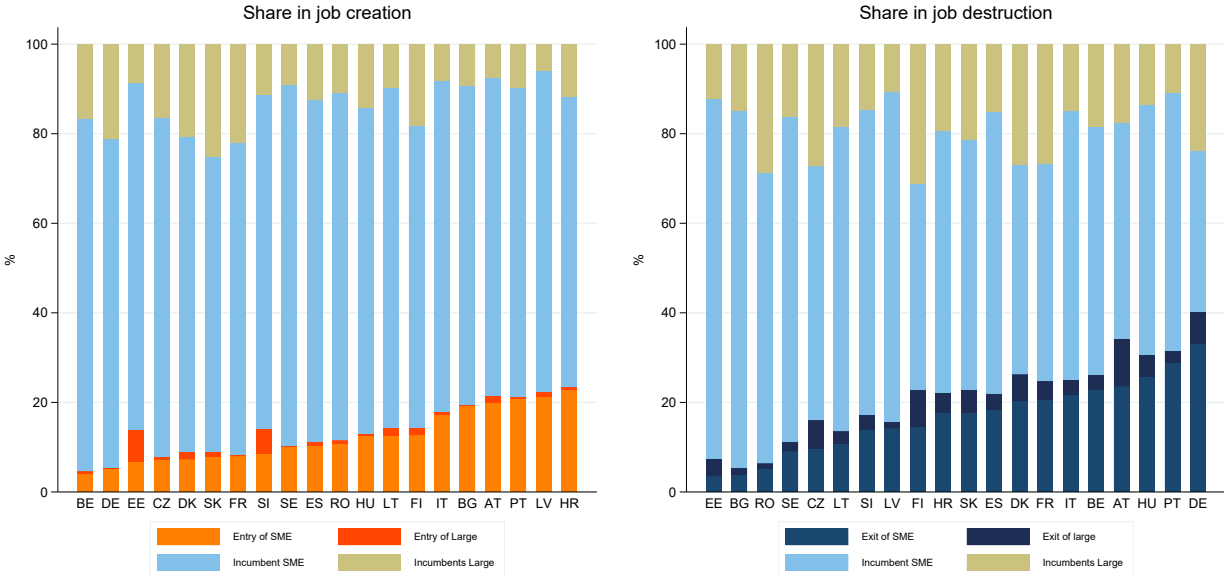
“exit” date is defined as the last date of report of the firm and we require at least three consecutive years without reports in Orbis.⁵⁵ The shares of entry-exits in job flows are reported in Figure 22. The left- and right-hand panels present, respectively, the share of entries in job creation and the share of exits in job destruction.

The figure shows that entrants are responsible for an eighth of the job creation on average: small and large entering firms provide 12 percent and 1.4 percent of the total job creation, respectively. The share of small entrants is very heterogeneous, though. It ranges from nearly 6 percent in, e.g., Belgium and Germany, to 20 percent in, e.g., Portugal, Latvia and Croatia. Notice that small incumbent firms are responsible for 73 percent of job creation, while large incumbent firms are responsible for 13 percent.

Instead, a larger share of job destruction is due to exits, 20 percent on average: 4.3 percent is due to exiting large firms, and 16.7 percent is due to exiting SMEs. The share is thus substantially larger than creation both for SMEs and large firms. Yet, large firms proportionately further contribute to job destruction than job creation.

Similarly to job creation, we also observe significant heterogeneity across countries in the relative importance of exiting firms. In Estonia, Bulgaria and Romania, the share of SME exits is less than 6 percent of the job destruction; in Austria, Portugal, Hungary and Germany, exiting firms contribute to as much as 20 percent of job destruction. Incumbent firms are responsible for the remaining share of job destruction, SME’s in 60 percent and large firms in 19 percent on average.

Figure 22: Contributions of entries and exits to job creation and destruction



Note: This figure reports the average share of entry and exit by firm size in job destruction and creation across countries. Country codes are defined in Appendix 5.

Figure 22 provides quite some information about the contribution of entrants and exiters across the European countries. On the one hand, countries with the largest contribution of SME’s to job destruction not necessarily report the largest share of SME’s amongst job creators (and reciprocally). On the other hand, the overall contribution of incumbents is substantially heterogeneous across countries: incumbents produce between 60 percent

⁵⁵It is worth noting that firms in distress and/or in bankruptcy procedure are not labeled as exited as long as they report employment in Orbis.

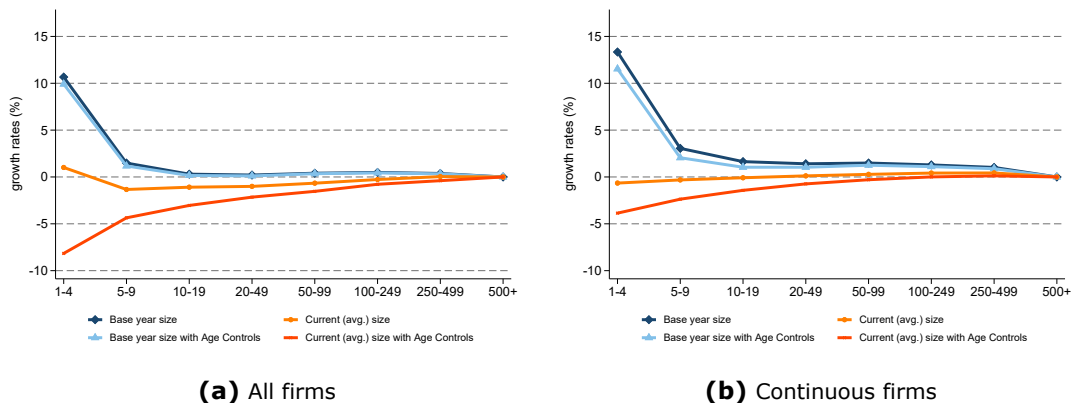
and 70 percent of job destruction in countries like Germany, Hungary, Portugal and Austria, but amounts to 90-95 percent of job destructions in countries like Estonia Bulgaria and Romania.

Focus: Regression Fallacy using EU Aggregate Data.

Throughout this study, the net job creation rates are constructed using the *current size* of firms instead of the *base size*.⁵⁶ The rationale is that using the *base size* systematically over-estimates the net job creation of smaller firms. An illustration of such a distortion is that of a firm which experiences an exceptional one-time shock in the orders from a customer and needs to employ new staff accordingly on a temporary basis. Because of the temporary hiring of new staff, the firm switches up to a higher size category in the sample in the first year, and switches back to the lower size category in the second year. All in all, even though the firm did not really change its size category, the regression would over-estimate the net job creation of the lower size category, and under-estimate that of the upper size category. Taking the average between these two years smoothens out the employment dip and prevents distortions in regression estimates.

The so-called *regression fallacy* was first described in the seminal work provided by Davis *et al.* (1996b) which motivated the now widely used current size; Haltiwanger *et al.* (2013) provides empirical evidence of the regression fallacy using US Manufacturing data as well as the importance of controlling for firm’s age. In this “Focus Section,” we produce innovative results illustrating the phenomenon in Europe using aggregate employment data.

Figure 23: Firm size vs. firm growth in the EU economies.



Note: This figure displays the relationship between net job creation (y-axis) and firm size (x-axis). The left-hand Panel (a) reports the values for all firms; right-hand Panel B reports values for continuous firms, where continuous firms are non-new entrants nor exiters. The Base Year curves use the previous year employment values of firms. The Current Size firms use the average between prior and current year size.

Figure 23 follows Haltiwanger *et al.* (2013) and reports the aggregate net job creation rates by category (see Figure 3 in Chapter 1). We design four specifications. The first and second specifications use the base size of the firm: firm size class is defined based on $n_{(i,t)}$, the number of employees in firm i at time t , and firm’s net job creation rate is defined by the ratio $(n_{(i,t+1)} - n_{(i,t)})$ to $n_{(i,t)}$. Technically, we regress net job creation rates on size category dummies, where the largest size category is dropped, so that the estimated coefficient is a comparison with the largest size category; regression estimates are weighted by size of firm. The second specification adds firm age controls to this. Instead, the third and fourth

⁵⁶As described in Section 3 and in Appendix 5, the base size is the prior year number of employees of the firm; the current size is the average number of employees between the prior and current years.

specifications use the *current size* (see Section 3 for the details). The fourth specification controls for the age of the firm. The left-hand panel uses the sample that includes entering and exiting firms; the right-hand panel excludes entering and exiting firms. Figure 23 plots the estimated coefficients of each of the specifications.

The results reported in Figure 23 based on our sample of European firms are very similar to those reported by Haltiwanger *et al.* (2013) based on US firms. Should net job creation rates use the base year, small firms would show larger growth rates; using the current size corrects the distortion. Moreover, the relationship between firm size and net employment growth is flattened if we control for the age of the firm.

Figure 23 provides the following results.

- Comparing results from base-year regressions with and without age controls shows that the negative relationship between firm-size and growth is mitigated by controlling for age. This effect is more visible when we look at continuous firms only in the right-hand panel of Figure 23.
- Changing firm-size definition from *base* to *current* size reveals the importance of regression fallacy: the negative relationship between size and growth fades out.
- Comparing EU results with Haltiwanger *et al.* (2013), we find similar patterns with US figures.

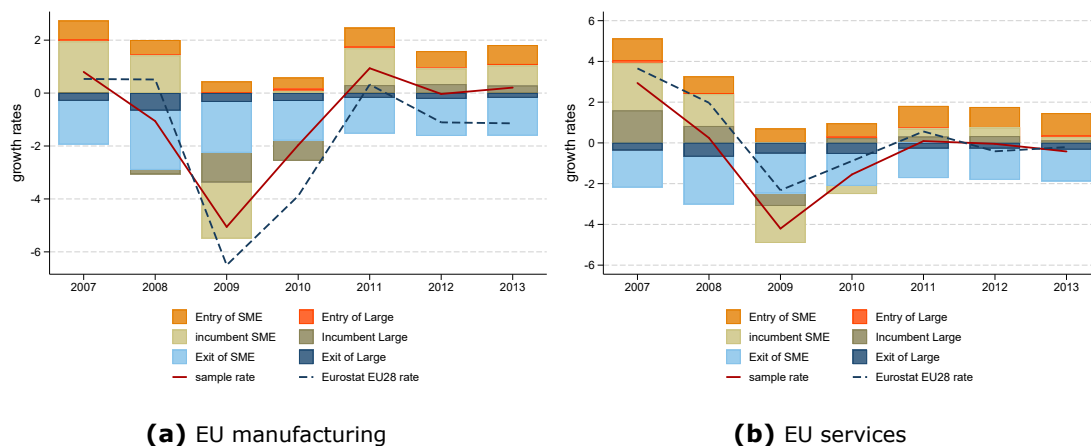
3.3 Contribution to the Total Net Job Creation

In this section, we look at whether age and size play a role in the ability of firms to become a net job creator to the economy. Thus, we look into job creation and destruction of firms of different size and age, entry and exit, and to what extent these contribute to the total net job creation.

3.3.1 Contributions by size

This section analyses the contribution of size categories to job flows. For this purpose, we aggregate contribution rates across the following firm categories: entrant SME's, entrant large firms, incumbent SME's, incumbent Large firms, Exiting SME's and large firms. We report all net job creation contributions in Figure 24 at the European Union level, in Manufacturing (left-hand panel) and Services (right-hand panel) broad sectors. Contributions are above [below] the horizontal axis if the net contribution is positive [negative], i.e., the group category is a net job creator [destructor] overall.

Figure 24: Contribution by Size to the Total Net Job Creation Rate



Note: This figure decomposes aggregate employment growth rate calculated over the sample European economies from 2007 to 2013 by sectors: NACE manufacturing sector (C) and service sectors. The continuous and dashed lines are Eurostat (NAMA) employment growth rates at EU-28 level.

Figure 24 shows the following insights:

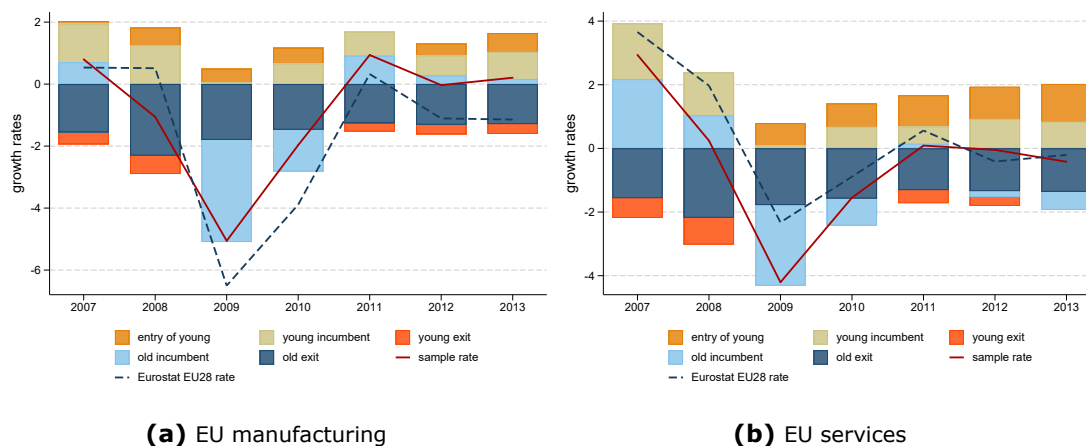
1. Incumbent SMEs play a major role in the net job creation of the EU economy. Both in the Service and Manufacturing sectors the job destruction of incumbent SME's contributed largely to the total employment growth rate.
2. The majority of the negative net job creation is due to SMEs exits.

3.3.2 Contributions by age

This section analyses the contribution of age categories to job flows. For this purpose, we aggregate contribution rates across the following firm categories: new entrants, young incumbents, young exiting firms, old incumbents and old exiting firms. We report all net job creation contributions in Figure 25 at the European Union level – notice that the figures

are *not* average figures across countries – using the 20 countries in our sample, in Manufacturing (left-hand panel) and Services (right-hand panel) broad sectors.⁵⁷ Contributions are above [below] the horizontal axis if the net contribution is positive [negative], i.e., the group category is a net job creator [destructor] overall.

Figure 25: Contributions by Age to the Total Net job Creation



Note: This figure decomposes total net job creation rates calculated over the sample European economies from 2007 to 2013 by sectors: NACE Manufacturing (C) and Services sectors. Eurostat (NAMA) rate statistics is for EU-28 countries.

As for Manufacturing, we find the following results:

- Employment has shrunk in most years.
- In all years, new firms entries (0.56 percent) and young incumbent firms (0.9 percentage points) support job creation.
- With the exception of two years, old firms – both continuing and exiting – contribute to the aggregate net job creation negatively (average: -1.5 percent).
- During the peak of the crisis in years 2009 and 2010, a large share of the fall in employment not is due to job destruction among old incumbents, but also the lack of job creation among young incumbents.

As for Services, we find the following results:

- Young firms play a more prominent role in aggregate net job creation in Services than in Manufacturing. Young incumbent firms contribution to aggregate net job creation amounts to 0.8 percent, while entrants contribution amounts to 0.9 percent.
- Exiting old firms contribute significantly negatively in every year (-1.9 percent). The contribution of old incumbent firm varies considerably over time.
- Old incumbents are strongly in line with business cycles: first, they substantially contribute to job creation ahead of the crisis, then significantly contribute to job destruction at the peak of the crisis, but have finally recovered slowly – they have not reached back the pre-crisis levels, though.
- The swing in old incumbents job creation patterns contrasts with young incumbents which continuously create jobs.

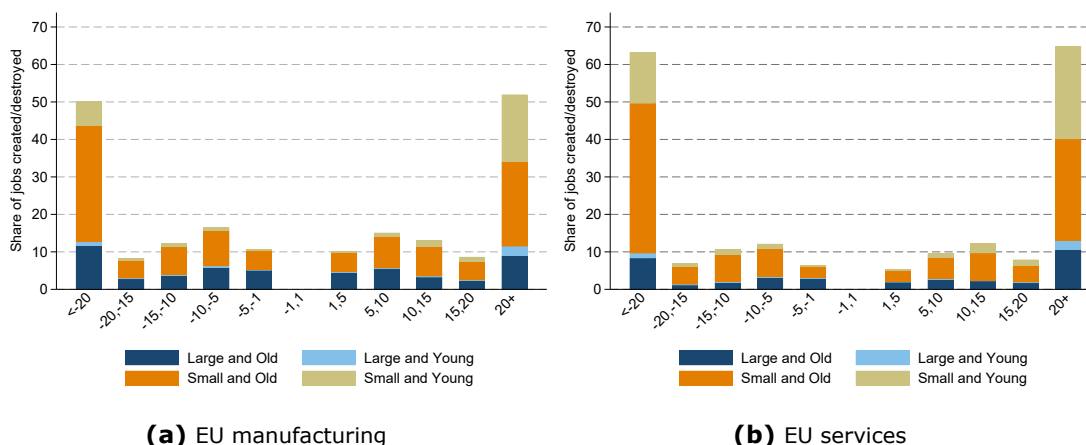
⁵⁷All the results at country-level in this section are available upon request.

Focus: Contributions of the High-Growth Firms

There is evidence that a small number of firms contribute to a large share of job creation in an economy – the so-called High-Growth Firms (henceforth, HGFs). Therefore, it is relevant to dedicate a “Focus Section” on HGFs contribution to job flows in Europe and identify their characteristics. Consistently with the so-called Eurostat-OECD definitions (e.g., OECD (2011)), we define *high growth firms*, firms with ten employees at the beginning of the period and an annualised net job creation rate above 20 percent per annum over three consecutive years.⁵⁸

In order to illustrate the contribution of HGFs to the job flows in the economy, Figure 26 reports the share of jobs created and destroyed by firms as a function of their own net job creation rates. We differentiate five categories of firms with positive net job creation rates and five categories with negative net job creation rates.⁵⁹ The category at the very right end on the horizontal axis represents the HGFs category, i.e., firms that report 20 percent yearly net job creation rate. At the other end (left-hand on the horizontal axis) we report the firms with the lowest net job creation rate (less than -20 percent). Finally, we split the sample into Manufacturing (left-hand panel) and Services (right-hand panel).

Figure 26: HGFs Contributions to the Aggregate Job Flows of the Economy



Note: This figure reports the contribution of firms to the total growth rate by net job creation rate. Horizontal axis indicates the net job creation rate category. The vertical axis indicates the share of the category in the total jobs created [destroyed] if the net job creation category is positive [negative]. The left-hand panel (a) reports Manufacturing; the right-hand panel (b) reports Services. Numbers are cross-country averages. For instance, Manufacturing firms that experience 20-50 percent net job creation rates, contribute to nearly 55 percent of the total job creation in the economy. The main contributing category is *large and young firms*; the second contributing category is *small and young firms*.

Figure 26 provides the following findings:

- HGF’s take up more than 50 percent of the job creation (among non-exiting firms) in the case of EU Manufacturing. In the Services sector, the share is above 60 percent.
- The share of job destruction is also concentrated among the firms with the largest (negative terms) net job creation rates. Such firms, less than -20 percent net job

⁵⁸Notice that the Commission regulation (EU) No. 439/2014 set the definition of high-growth enterprises as follows: all enterprises with at least 10 employees in the beginning of their growth and having average annualised growth in number of employees greater than 10 percent per annum, over a three year period. The main results are unchanged with this definition.

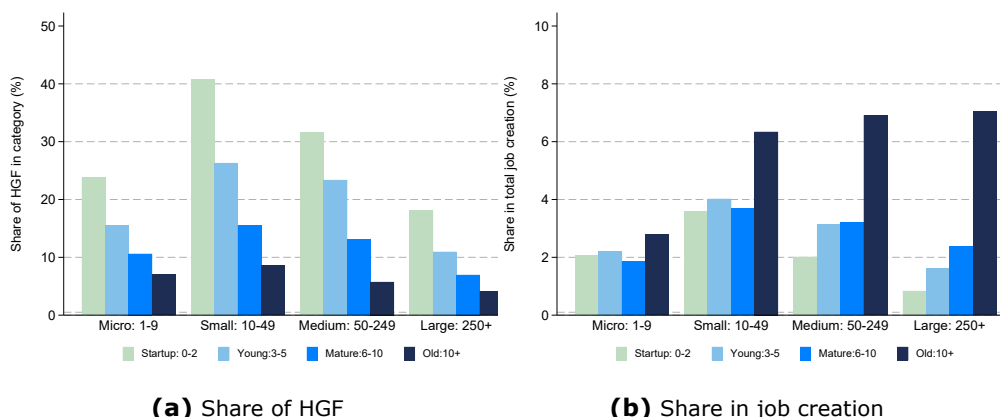
⁵⁹We use the same categories as Bravo-Biosca (2016) replicated Figure 4 in the Literature review to facilitate an easier comparison.

creation rates contribute to 50 percent of total job destruction in the case of Manufacturing, and more than 60 percent of job destruction in Services.

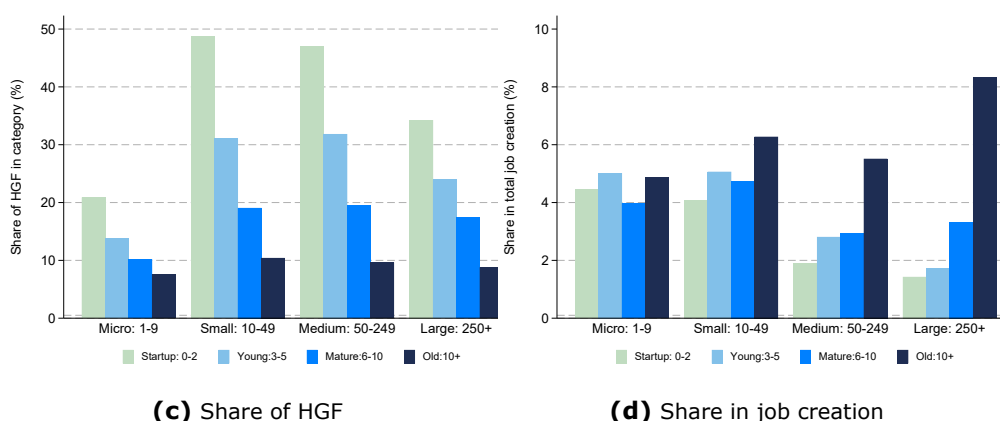
- High growth firms are not only young and small. In Manufacturing, while young-small HGFs contribute to 17 percent of the total job creation in our sample, small-old HGFs contribution amounts to 22 percent. In Services, figures are 24 percent and 27 percent, respectively. This prominence of small and old firms compared to previous results is due to the exit of many young and small firms within the first three year.
- Once we condition on the three year survival, as in Figure 26 the share of jobs created by the small-and-young and the large-and-old firms are similar in the case of Manufacturing, 22 and 24 percent respectively. In the case of the Services, small-and-young are responsible for a larger share of job creation of 30 percent, while the share of large-and-old firms in job creation is only 20 percent. In both sectors, the largest share of job creation is carried out by the small-and old, nearly 50 percent.

Figure 27: Prevalence of High Growth Firms

Panel A: Manufacturing



Panel B: Services



Note: HGF firms are defined by over 20 percent average employment growth over three years. The sample period covers years 2008 to 2015.

Figure 27 takes a closer look at HGFs and, besides depicting their shares in job creation by age and sector, it provides information as of the number of firms. Panel A and B report

Manufacturing and Services figures, respectively. For each of the two panels, we provide two sub-figures. The left-hand figure shows the share of HGF firms within a size and age category (averaged across sample period and countries). For example, the first column in Panel A left-hand figure shows that, on average, 23 percent of the micro-size start-ups that continue to exist for three years are defined as HGFs. Right-hand figures show the share in net job creation of HGF's by size and age category. For example, the first column in Panel A, right-hand figure shows that, on average, micro-size start-ups that continue to exist for three years are responsible for 2 percent of the net job creation. In the case of Manufacturing, the sum of all the values of the columns is equal to 54 percent. This value is the average share of HGFs in the net job creation by continuous firms over three years and is in line with the value of the rightmost column in Figure 26, Panel (a). The corresponding value in the case of service sectors is 66 percent.

Figure 27 provides the following findings.

- Most HGFs are young, very few are old in all size categories.
- Old HGFs contribute far more to job creation than younger firms.
- The old-young gap in job creation is thinner in Services.

3.4 Further Insights and Identification of Obstacles

In this section, we explore the job creation beyond the age and size debate and investigate specific characteristics of firms that may affect the job creation and destruction. We first look at job creation and destruction of leveraged and non-leveraged firms. We then investigate the contribution of domestically and foreign owned firms to job creation and destruction. Then we look at urban and non-urban areas; job supply and demand in non-urban areas being less intense may result in lower job creation and destruction. Finally, we look at the link between job productivity levels and the net job creation by country.

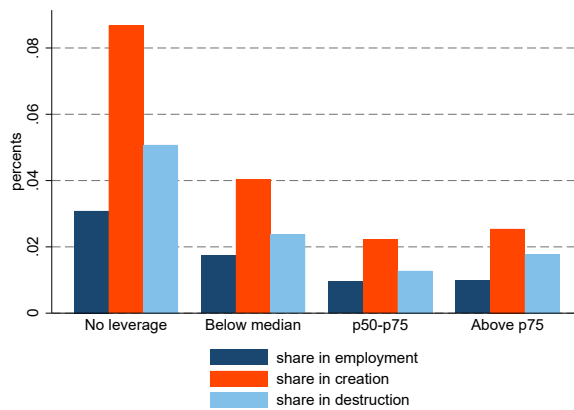
3.4.1 Financial Leverage and Job Creation

There has been substantial policy efforts to promote access to external funding in order to promote job creation. SMEs typically access external funding in the form of bank loans. Some authors yet claim that banks have a stronger negative impact on employment in firms in distress. Generally speaking, banks receive an interested are little interested in growth prospects of a firm which add on risk to the loans. Therefore, we are interested in looking at the impact of access to finance on job creation and destruction. In this section, we define leverage the share of financial debt in total assets.⁶⁰

Figure 28 reports the average job destruction and creation in our sample in function of the leverage levels of the firm. It turns out that firms without leverage ("no leverage") absorb the largest share of employment but their contribution to job destruction is close to three times as much, and creation only twice as much. Firm with low leverage (below median in our sample) report job destruction and creation far lower proportionately to their employment shares. The leveraged firms seem to produce lower job flows than non-leveraged firms.

⁶⁰Financial debt is the sum of Orbis items LOAN and LTDB. Notice that data availability implies smaller sample.

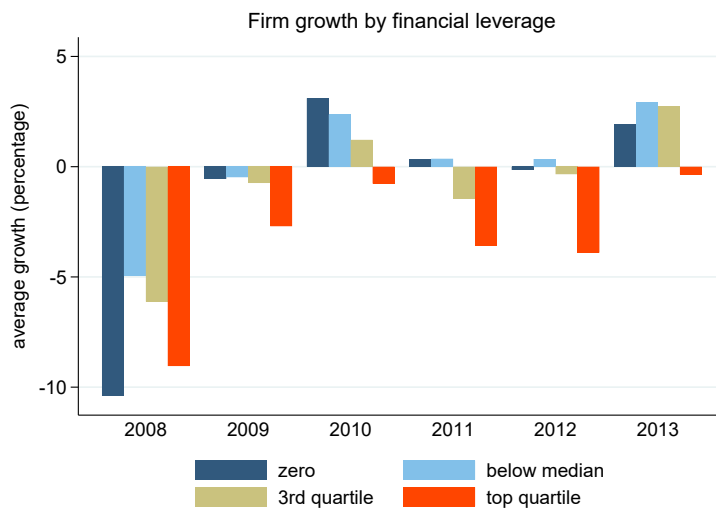
Figure 28: Small Firms: Financial Leverage, Employment, Job Creation, and Job Destruction.



Note: This figure reports the employment (left-dark blue), job creation (mid-orange) and job destruction (right-light blue) averages of young-small firms.

In order to investigate the impact of the access to loans over business cycles we look at net job creation at non-leveraged firms and leveraged firms by quartiles. The results are shown in Figure 29. In line with the previous figure, we observe that the no leverage firms display a larger volatility than below median leverage firms. Therefore, the access to finance seems to work as a buffer against economic shocks.

Figure 29: Net Job Creation by Financial Leverage



Note: Average net job creation by financial leverage quartiles. Zero: no debt in prior year; below p50: below median of all indebted firms; p50-p75: between 50% and 75% quantiles; above p75: top quartile (75% percentile); very high: financial leverage is above 75% of the total assets of the firm.

Finally, we explore whether accessing bank loans have some effect on employment growth. We construct a sample of firms which access loans for the first time: first-time borrowing firms in a year are firms reporting no loans in their balance sheet for three consecutive years prior to reporting positive loan account. We compare the employment growth rates of first-time borrowing firms with those of other firms by running an difference-in-difference

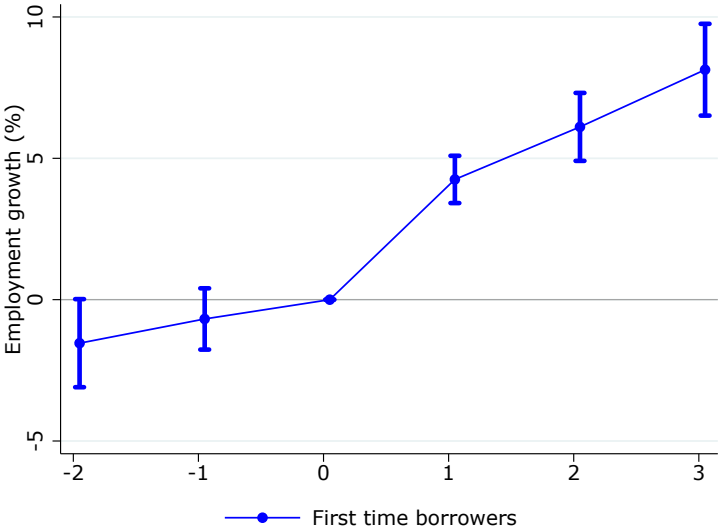
OLS regression. The model controls for the size and age of the firm, its sector of activity, the year and country of registration. We call the last year with zero leverage - year 0. The year in which the loans are contracted - year +1. We look at the coefficients obtained from the OLS estimates expressing differences across firm in employment growth from year 0 to year (-2), to year (-1), and from year 0 to (+1), to (+2) and (+3). Notice that, in order to avoid special cases, we discard firms whose new debt-to-assets ratio is above median (at sector-country-year level).⁶¹ The results are reported in Table 3 and the corresponding Figure 30.

Table 3: Firm employment changes when firms access loans for the first time

	(-2)	(-1)	(+1)	(+2)	(+3)
New Borrowing Firm	-1.539*	-0.683	4.253***	6.111***	8.134***
	[0.795]	[0.553]	[0.427]	[0.613]	[0.828]

Note: This table reports the coefficients obtained from the OLS estimates of the change in employment (%) at the firm between year 0, the year prior to first time borrowing, and the previous and subsequent years. Each coefficient is obtained from a separate regression and represent percentage point differences. A firm is defined as first time borrower if the "LOAN" item reports zero for three consecutive years before reporting positive values. The sample includes firms without loan and first-time borrower firms. The model controls for firm size, age, sector, year and country. Standard errors are clustered by firm as shown in brackets.

Figure 30: Net job creation around date: new borrowing firm.



Note: Employment growth of first time borrower compared to non leveraged firms. Growth is calculated with respect to date 0 the year before the firm contracts loans for the first time. First time borrowers are firms which did not contract any loan (leverage equals zero) in the three years prior to borrowings appearing on its balance sheet resulting in lower than p50 of sectoral leverage.

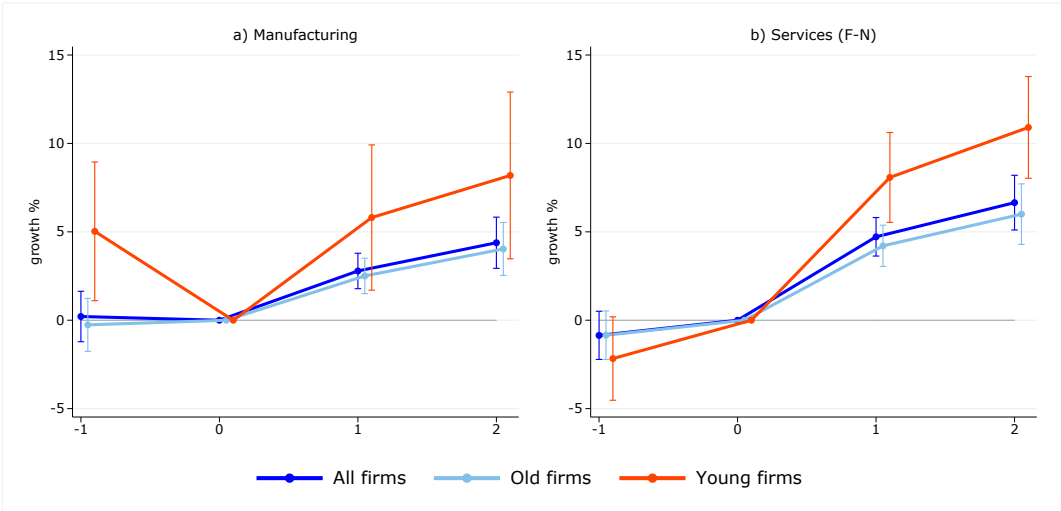
The results provide evidence that newly-borrowing firms display higher employment growth rates following the first time a loan is contracted. This difference in growth is statistically significant at the 1% level. At the year when the loan is contracted, the new-loan-

⁶¹In unreported, results we also look at new borrowing firms reporting leverage up to 75% quantile; results are unchanged.

contracting firms display growth rates about 4 percentage point higher than non-indebted firms. The size difference between indebted and non-indebted firms remains even 2 years after the loan is taken and increases over time. Bank loans thus support net job creation.⁶²

Figure 31 provides a more detailed insight into the job creation of first time borrowers. On the one hand, results analogous to those in Table 3 for below median leverage borrowers are shown for Manufacturing and Service sectors separately. On the other hand, we differentiate the growth responses to first-time loans by firm age.

Figure 31: Net job creation around date: new borrowing firm by age



Note: Employment growth of first time borrower compared to non leveraged firms, examined by age and sector. Growth is calculated with respect to date 0 the year before the firm contracts loans for the first time. First time borrowers are firms which did not contract any loan (leverage equals zero) in the three years prior to borrowings appearing on its balance sheet resulting in lower than p50 of sectoral leverage. We split the sample between Manufacturing and Services. Young are firms 5 years old or younger; Old firms are above 5 years old. Results are obtained from regressions using all firms within each industry, age specific results are obtained by interaction terms.

We find that in both sectors firms grow faster after borrowing than non-leveraged firms. Two years after taking out the loan the Manufacturing firm is about 5 percentage points, while a Service industry firm is more than 10 percentage points bigger in employment than otherwise similar firms with zero leverage. Both in the case of Manufacturing and Service sectors loan contracting results in higher employment growth in percentage points for young than for old firms. We also find that in the case of young service sector firms future borrowers exhibit higher (though not significant) employment growth than non leveraged firms. In contrast, young future borrowers in the Manufacturing seem to show a decline in growth just before they seek outside finance.

Overview

- Net Job Creation of below-median leveraged firms is less volatile than non-leveraged. Both follow business cycles.
- Leveraged and non-leveraged old-small firms display similar job flows; far different for young-small firms.
- Unleveraged young-small firms seems to display larger gaps between job creation and destruction rates. Needs further analysis.

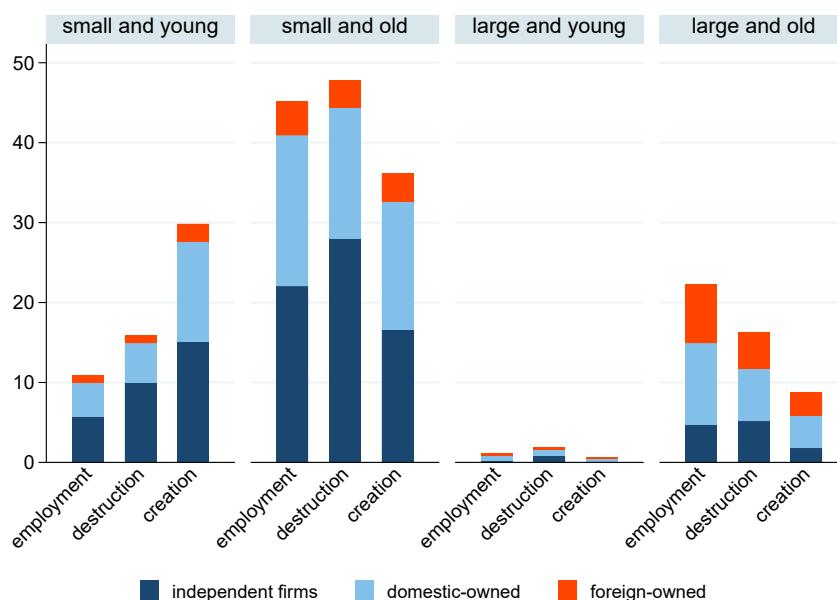
⁶²It is important to point out that comparing growth with respect to time (t) means that a negative growth differences in time t-1 means higher growth - equivalent to an employment growth from a lower base.

- Access to loans for the first time is preceded by growth. Low leverage firms continue growth: +8% after two years; not those highly leveraged.

3.4.2 Incidence of corporate independence in job flows

This section investigates the incidence of corporate independence in job creation and destruction, where corporate independence distinguishes between independent firms and subsidiaries. In the literature, there is evidence that large firms tend to reallocate jobs more easily among subsidiaries so that they may play a larger role in job creation and destruction than independent firms proportionately to their employment shares. The independence of a firm is identified in our sample thanks to the ownership information provided by the Orbis dataset.⁶³ Also, in order to identify the incidence of foreign ownership, we split the group of subsidiaries between those owned by domestic GUOs (*domestic subsidiary*) and those owned by foreign GUOs (*foreign owned*).

Figure 32: Incidence of Ownership in Job Flows



Note: This figure reports the job creation and destruction, by age, size, and dependence characteristics. In order to define the dependence characteristics, we use the information about the *Global Ultimate Owners* (GUO) provided by Orbis: the GUO of a firm is its last *corporate* owner in the chain of ownership, that holds more than 50 percent of ownership in the firm. *Independent firms* are firms with without GUOs; *Domestic subsidiaries* are firms with a domestic GUO; *Foreign owned* firms are firms with a foreign GUO.

Figure 32 reports the composition of employment stock, job creation and job destruction by corporate independence category – namely “independent,” “domestic subsidiary” and “foreign owned.” To make the figure comparable to Figure 20, we create four Age-Size firm categories that combine Young (0-5 years old) and Old (6 years and older) on the one hand, and SME’s (less than 250 employees) and large firms (250 or more employees) on the other hand.

It turns out from Figure 32 that foreign owned small-young firms contribute to job creation [destruction] proportionately more [less] than their employment share. Besides small-old

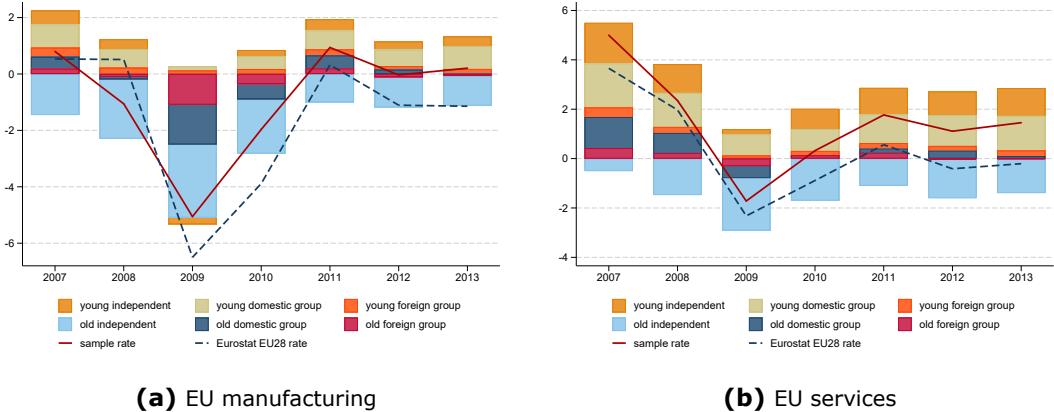
⁶³Orbis reports the so-called *Global Ultimate Ownership* (GUO), which is the final owner in the chain of ownership, and whose share of ownership – whether directly in the firm or via other subsidiaries – is above 50 percent. We retained corporate ownership only, thus excluding individuals and funds.

domestic subsidiaries are large net job creators, while small-old independent firms are net destructors of jobs. Small-old independent firms contribute to job destruction far more than their employment share, and far less in job creation; instead, small-old domestic and foreign owned firms seem to break even. Finally, among large-old firms, all three categories are negative net job creators.

One may yet wonder whether the results reported in Figure 32 are constant over time. In fact, during the crisis, parent companies may have opted for reducing employment of low-performing subsidiaries and favouring the high-performing ones; independent firms do not have such options and thus are more likely to maintain employment despite the low performance. For the same reasons, foreign parent companies have more options across countries so that they may have destroyed more jobs in a country than domestic parents. We thus apply the same classification to employment growth as in Figure 25 and report the figures across years 2007-2013 in Figure 33.

The results suggest that old independent firms have been the largest net contributors to job destruction in all years while young domestic subsidiaries have been the largest net contributors to job creation in all years. These results apply both to the Manufacturing and Services sectors. Besides, “young independent” are net job creators in all years, except in 2009 in the Manufacturing sector – and fairly positive in the Services sector. Foreign owned firms are small net contributors except in Manufacturing 2009 where old-foreign firms had an impressive increase in the share of net job destruction.

Figure 33: Contribution to Job Creation and Destruction – Ownership and Age



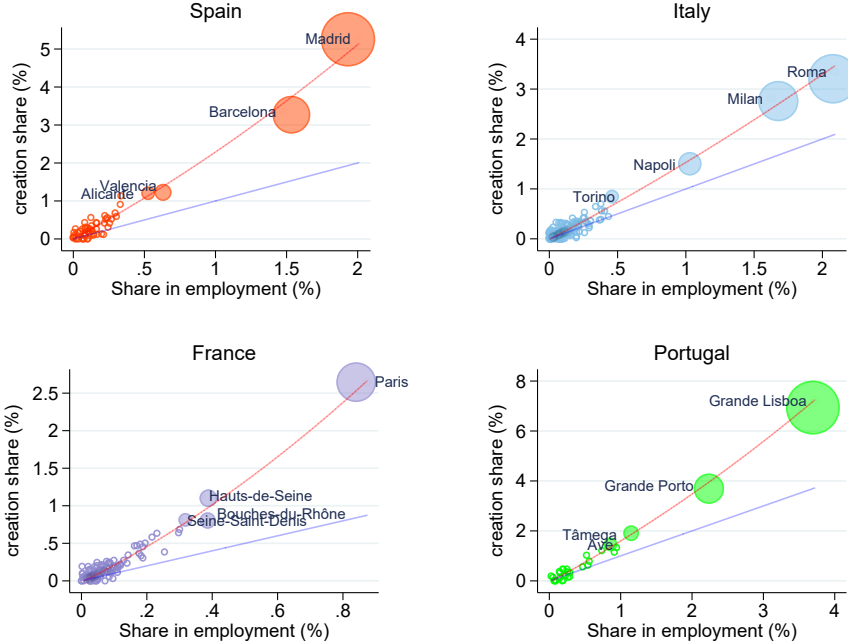
Note: This figure reports the net job creation of firms, by age, size, and ownership. Left-hand Panel (a) reports the Manufacturing sector; right-hand Panel (b) reports the Services sector.

3.4.3 Urban vs. non-urban areas

Some authors argue that the magnitude of job flows relates to the matching skills capacities of an economy in general and/or in specific business cycle phases (e.g., Kerr *et al.* (2015)). In order to investigate this hypothesis, we focus on the job creation of SMEs across NUTS3 geographic areas within countries. We are interested in a comparison between urban and non-urban areas where the labour force basis is more extensive and the business ecosystem is more dense. We suspect that, thanks to the access to a broader labour force basis, urban firms recruitment is easier so that they can substitute employees with equivalent or better skills than in non-urban areas. The same is true for urban employees: the dense urban business ecosystem gives them access to a wider range of employment options than non-urban employees, which allows to switch to more suitable jobs more frequently.

Thus, we compare the share of job creation of young SMEs with their share of total employment in our sample at NUTS-3 level.⁶⁴ We look at young SMEs only because SMEs job flows are likely to be more sensitive on the location than large firms. Moreover, an SME is less likely to actually be a headquarter which may distort the results. In Figure 34, we report the results of four selected countries – Spain, Italy, France and Portugal – which are representative of our findings.

Figure 34: Job creation and employment shares of young SME’s by location.



Note: This figure exhibits the share of young SME’s in job creation (vertical axis) against their share in employment (horizontal axis) across NUTS3 locations in four countries: Spain, Italy, France and Portugal. The green line is the 45° line. The red line is the quadratic fitting line.

Results provide evidence that young SMEs hold proportionately higher shares in job creation than their respective shares in employment in all locations. Moreover, the contribution of young SMEs is larger in urban areas, e.g., Madrid and Barcelona in Spain, and Milan and Rome in Italy. Therefore, the demographic density is a potential obstacle to job flows.

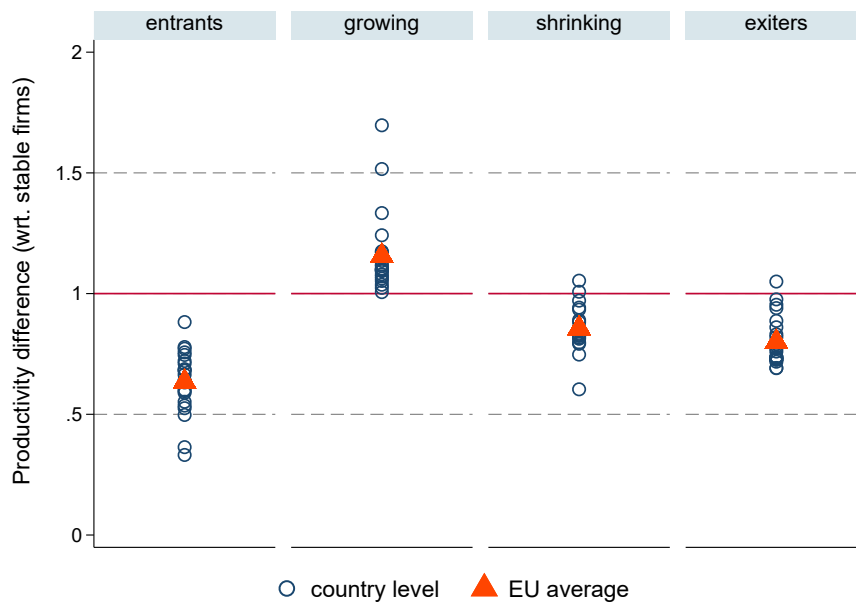
3.4.4 Productivity

In this section, we report additional results about the net job creation rates by productivity level. Theory predicts that the higher the productivity of the firm is, the more likely it creates job. We are interested not only in highlighting such a phenomenon but also to what extent it may vary across countries.

Figure 35 reports the average productivity levels of four categories of firms, namely newly established firms (*Entrants*), positive net job creators (*Growing*), negative net job creators (*Shrinking*), and exiting firms (*Exiters*). The results are obtained from regression estimates that control for years, sectors and current size of firms. The figure reports individual country estimates (circles) as well as Eurostat EU20 averages (red triangles).

⁶⁴The “Nomenclature of Territorial Units for Statistics” (NUTS) is a classification system of geographic areas. NUTS-3 level is the smallest geographic administrative level before the municipalities. For instance, in Britain NUTS-3 areas are the “counties.” Orbis reports the town of location for most of the firms in the database.

Figure 35: Net Job Creation and Productivity



Note: This figure compares labour productivity differences across firm-types within European economies in the period 2007-2013. The productivity of firms is compared with the productivity of firms reporting no net job creation (*stable firms*) represented by the red horizontal unity line. *Shrinking* firms are firms reporting negative net job creation. *Growing* firms are firms reporting positive net job creation. *Entrants* are newly established firms. *Exiters* are exiting firms. Circles are individual country averages. Red triangles are EU20 averages.

The figure suggests the following findings:

- On average, entrants are less productive than other firms. Their productivity lies between 33 percent and 88 percent of benchmark firms with no net job creation (*Stable firms*).
- The productivity of net job creation firms (*Growing*) is the highest, and is ca. 15 percent higher than the productivity of the benchmarking stable firms. In some countries, e.g., Slovakia, Czech Republic, growing firms are 30 percent more productive than stable firms.
- Firms with negative net job creation (*Shrinking*) are less productive than firms with positive net job creation (*Growing*): productivity is about ca. 85 percent of the stable firms.
- Similarly to shrinking firms, exiting firms (*exiters*) are also less productive than stable firms. The relative low productivity of shrinking and exiting firms can be considered a suggestive evidence for productivity enhancing reallocation.⁶⁵

⁶⁵Notice that the computation of the effective aggregate gain in productivity would require a representativeness analysis of the added value in Orbis similar to the one we conducted on employment. Such an assessment goes beyond the scope of this study, but could be the subject of a subsequent study.

3.5 Conclusions

The empirical analysis of job creation reported in this chapter is based on an exceptionally large micro-level employment data of firms in the European Union including 2.9 million firms located in 20 out of the 28 EU Member States in the period 2004-2015. The data are obtained from Moody's Bureau Van Dijk *Orbis*, and 20 countries were selected based on the *Orbis* representativeness assessment in Chapter 1.3.5.

The results regarding *employment* by size and age show that nearly all firms in our sample are SMEs – less than 250 employees – and their share in employment amounts to ca. 65 percent on average. The share varies substantially across countries, though, suggesting non-trivial disparities in industrial organization among EU Member States. Besides, the shares in net job creation of respective age categories are more aligned with the respective incidence in employment. We provide further insights about start-up companies (0-2 years old) and find that their share varies substantially across countries ranging between 5 and 20 percent. There seems to be a gap chiefly between old and new EU Member States: new members tend to report higher start-up shares. Yet, we observe a decline in the share of start-ups in Europe – not in all countries, though.

The analysis of *job flows* – i.e., job creation, job destruction and net job creation – shows that, even though job creation and destruction rates vary substantially across EU Member States, the difference between job creation and job destruction within the same country is relatively thin. As a result, the average yearly net job creation rate varies between -3 percent in Spain to +2 percent in Lithuania. Further, the Manufacturing sector exhibits far lower job creation and destruction rates than Services in all countries. In our sample, the SMEs contribution to job flows is proportionately greater than the share of workers they employ, in both Manufacturing and Services. Taking a closer look, we observe that a large share of SMEs job creation stems from the *young SMEs* – up to five years old. Finally, the majority of the job creation in Europe is concentrated in a few high-growth young SMEs. This result supports the implementation of policies supporting entrepreneurship among young and growth firms. Further analysis aimed to identify those firms with growth potential and whether the latter indeed need support would have important policy implications.

Further insights show that ownership play a role in the job flows. Firms that are part of conglomerates contribute to job flows proportionately more than their shares in employment. Interestingly, firms owned by domestic parents are the main drivers of the job flows cycles. Finally, we note that newly established firms are those reporting the lowest productivity; exiting and shrinking firms have similar productivity; net job creating existing firms are more productive than other firms. Nevertheless, there is substantial disparity across countries which may require additional analysis.

Conclusions and Avenues of Research

This report contributes to the first objective of the Juncker Commission that aims to promote job creation in the European Union. To our knowledge, we are the first to conduct the analysis of job creation at the European level using firm-level data of employment. Our sample is constructed using Moody's Bureau Van Dijk *Orbis*. Although *Orbis* utilisation has substantially gained in popularity among scholars in the last decade, its data coverage and quality remains uneven across countries. Thus, we gather employment information in the period 2004-2015 of all non-financial companies registered in the EU-28 Member States, and conduct our own assessment of the data representativeness and reliability by country. Eventually, our sample gathers 2.9 million non-financial corporations registered in 20 out of 28 EU Member States: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

Our empirical analysis shows the following results and policy implications.

1. Small firms are the largest employer, and contribute to job creation proportionately more than their employment share, *unless* we control for age. In fact, among small firms, the *young* ones are those creating proportionately more jobs than their share in employment. Official policies oriented towards entrepreneurship – young and small firms – are thus consistent with empirics.
2. Start-up companies contribute to employment and job creation among countries, with remarkable discrepancies. The observed decline of start-ups in most but not all Member States may reflect decline in entrepreneurship liveliness yielding a renewed need for policy interventions.
3. Among all firms, high-growth firms (HGFs) contribute to a large extent to the total job creation – HGFs are firms whose average net job creation rates are above 20 percent per annum on a three-year period; in our sample, 60 percent of job creation comes from high-growth firms. In this category of firms, many are young and small, but small- and medium-sized mature firms contribute to job creation proportionately more. Therefore, policy-makers need to address the financing obstacles that experienced firms with strong growth potential are faced with by addressing the scale-up problems. Financial markets participants are reluctant to finance risky projects requiring large funding amounts.
4. Financial support plays a role: firms accessing bank loans for the first time continue growing in the years following access to finance. Moreover, indebted firms display less volatile net job creation rates in our sample period. There may yet be differences among Member States.
5. Generally speaking, in nearly each of the country-level analyses, we find common features among countries, nonetheless with major disparities. For instance, results are uneven regarding the decline of start-up companies; the relative productivity of growing and shrinking firms vary substantially across countries too; the regional analysis of job creation shows that young and small firms located in urban areas create more jobs than those located in non-urban areas. All these results justify the conduct of European level studies of job creation so to better calibrate the European policy tools.

The analysis suggests further policy-oriented avenues of research.

1. *The Decline of the Start-ups*

The ability of an economy to renew its eco-system is essential. The analysis of the decline of start-ups has provided some insights and hints at potential policy interventions. For instance, new entrants and small firms are likely to further benefit from the EU support in economies and/or sectors where large firms dominate. Our analysis also shows substantial differences among Member States which require further investigation.

2. *The Role of Mature High-Growth Firms*

Although most high-growth firms (HGFs) are young and small, a large share of employment created by HGFs stem from mature small- and medium-sized firms. The gap between incidence and contribution may reflect the existence of obstacles at the scale-up development phase of firms; small and medium firms with valuable experience miss growing opportunities because the financial market fails in financing this market segment where both funding amounts and riskiness are high. This problem has major implications for the European Union and deserves further investigation.

3. *Access to Finance*

We observed that job flows vary substantially across countries, not so much net job flows. There is growing evidence that facilitated access to finance is a determinant of firms' growth and job creation, but also job destruction in economic downturns. Limited access to external finance may thus explain the discrepancies in job flows rates and deserves further investigation.

4. *Job Creation Monitoring Tool*

The study is aimed at picturing job creation and related obstacles in Europe. Generally speaking, our results are consistent with those provided by official statistics offices such as Eurostat and some of the key results in the literature. Further, they show substantial variations in corporate job flows in function of the characteristics of the firms and the business cycles; the patterns would hardly be captured without micro firm level data. Therefore, beyond the stylised facts highlighted by this study, job creation requires reliable measurement tools aimed at monitoring refined policy interventions. The reliability and comprehensiveness of our data would likely help constructing such monitoring tools, to the extent that additional data becomes available so that we can recalibrate the sample.

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Appendix A:

Size-Age Country Level Evidence

This appendix summarises the main empirical evidence at single country level about the link between age, size and job creation in EU-28.

Austria

Huber *et al.* (2017) find that young firms provide the largest contribution to *net* job creation. Even though small firms job creation rates – conditioned on survival – are similar to those of large firms, higher exit rates result in total negative net job creation. Moreover, the Great Recession reduced job creation rates and enhanced the relative importance of small firms.

Finland

Hohti (2000) shows that small establishments create and destroy relatively more jobs; yet, the net job creation of small and large firms are similar. Fornaro and Luomaranta (2015) document that small businesses have experienced higher growth rates on average. Moreover, large firms are more pro-cyclical compared to small ones – i.e., further reduce (increase) jobs in bad (good) times; see also Deschryvere (2008) and Ilmakunnas and Maliranta (2003).

Germany

Fackler *et al.* (2013a) and Fackler *et al.* (2013b) investigate the mortality (exit) of firms between 1975 and 2006 by size and age, and find that mortality risk falls with establishment size. Results show that determinants of exit differ substantially between young and mature, a “shadow of death” turns up well before exit: the workforce becomes more skilled, more female gender, and older. Earlier studies about Germany, see, e.g., Acs and Audretsch (1989), Wagner (1995), Brüderl and Preisendörfer (2000), and Fuchs and Weyh (2010).

Greece

Voulgaris *et al.* (2015) investigate job flows during the crisis and compare the results with those obtained in pre-crisis data (Voulgaris *et al.*, 2005). They find that, in the period 1995–99, the contribution of SMEs to net employment creation was important, with a higher profile in the high-tech and capital-intensive manufacturing sectors; also, age is negatively related to job creation. In contrast, in the recent period, although small firms continue to substantially contribute to job creation, today a majority of the creation stems from older firms.

Hungary

Earle and Telegdy (2011) analyse Hungarian data to assess a relationship between firm characteristics and net job creation. They confirm the importance of handling regression fallacy and controlling for firm age when looking at effects of firm size. Interestingly, controlling for firm age reverses the net job creation firm-size relationship, that is, large firms create more jobs. They show that in the Great Recession job creation rates remain unchanged, dynamics are driven by job destruction. Net growth decreased for exporters and foreign owned firm, but not for state-owned companies.

Ireland

Although smaller firms make an important contribution to new job creation, the contribution is driven by age rather than size (Lawless, 2014); this is consistent with Haltiwanger *et al.* (2013). In addition, the documented negative relationship between firm size and growth is valid for young firms only and fades out as firms are more mature.

Italy

There is a negative relationship between growth and size, and the relationship holds even after controlling for firm's age. Also, there exists a positive relationship between growth and export status, which fades away with age (Grazzi and Moschella, 2016).

The Netherlands:

Broersma and Gautier (1997) look at the manufacturing firms in the period 1978-1991, and find higher job creation and destruction rates among small firms. Also, large firms restructure labour force during economic downturns, unlike small firms, which restructure independently of business cycles. Jobs created by small firms during downturns are more likely to survive than those created by large firms.

Norway

Klette and Mathiassen (1996) look at the Norwegian manufacturing firms in the period 1976-1986. They find that small firms are net creators of jobs in the period and highlight the long-run importance of entry-exits.

Portugal

Damas de Matos and Parent (2016) show that in Portugal job construction and destruction rates are similar to those in the US (Haltiwanger *et al.* (2013)). Authors highlight the relevance of the type of contracts: young firms, start-ups typically create jobs using fixed-term contracts. At the same time, job destruction may be due to small but mature firms shedding jobs with open-ended contract.

Sweden

Heyman *et al.* (2018) find that, like in the US, young firms are the most important for net job creation in Sweden. Interestingly, the authors innovate by applying to productivity the approach suggested by Davis *et al.* (1996a) for job creation.

United-Kingdom

Hijzen *et al.* (2010) provides evidence on job creation and destruction in all sectors between 1997 and 2008. Small firms account for a disproportionately large fraction of job flows relative to their share of employment. Nevertheless, unlike most studies, jobs created by small firms do not have lower survival rates. Notice that there is a wide range of studies about job creation in the United Kingdom (e.g., Gallagher *et al.* (1991), and Barnes and Haskel (2002)), but most of them focus on Manufacturing.

Appendix B:

Representativeness Analysis

In this Appendix section, we describe our analysis of employment representativeness of Orbis. We describe the Austrian case in detail as an illustration of the interpretation. Figures and analysis of all other EU-28 Member States are reported in subsequent sections of the Appendix.⁶⁶ The analysis is split into four components. First, we show an overview of the employment data in Orbis, where we check the consolidation level of the reports and the impact of the imputation procedure. Second, the representativeness by levels and dynamics. Third, the representativeness by size category after weighted schemes are applied. Fourth, the representativeness by levels of sub-industries.

The analysis is constructed around four components and associated figures to each of them. Figures are reported in Appendix 5 and take the same number for each country, just like in the case of Austria in the section here above. The first component of our representativeness analysis is based on the Figure 1 and investigates whether or not limited financial accounts constitute large shares of our sample and the impact of the application of imputation and averaging techniques described in sections here above. The second component is based on Figure 2 and looks at whether there is a structural break in 2009-2010 due to the change of the sector classification system – from NACE Rev. 1.2 to NACE Rev. 2. Figure 2 supports the third component of the analysis that looks at the levels and dynamics of net job creation. We associate to this analysis macro-sectors Manufacturing and Services (Figure 3) and their sub-sectors (Figure 4).

The Austrian case

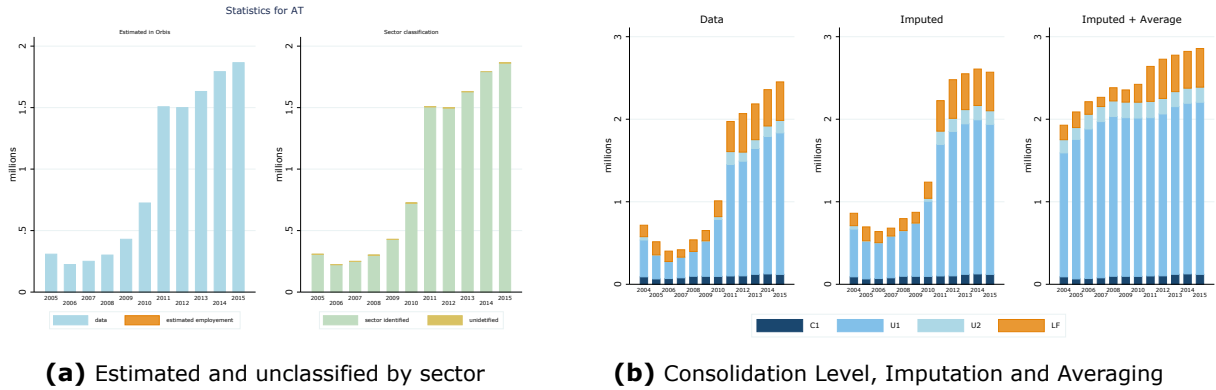
The first step of the representativeness analysis consists in looking at the sample in general, as well as at the effects of imputations and averaging. A set of four sub-figures are gathered into Figure 36 for Austria in the period 2004-2015. The first sub-figure on the left shows the distribution of employment in Orbis that Orbis indicate as “estimated” employment.⁶⁷ The second sub-figure reports the distribution of employment for which industry classification is not indicated. The third sub-figure shows the distribution of employment reported into consolidated, unconsolidated, and limited financial accounts. Finally, the fourth sub-figure shows the sample following imputations and averaging.

In the case of Austria, we observe that unconsolidated accounts provide a vast majority of the stock of employment in Orbis and that imputation has slight effects in the later years while it has in the early years. This indicates a structural change in Orbis: this break stems from substantial unavailability of employment before 2010. The feature is apparent from the last right-hand subfigure 36, which reveals that firms are actually observed in the sample in the pre-2010 years, only employment information is missing.

⁶⁶In some exceptions, whenever investigations reveal generally poor quality of data, we show the main graphs only. All graphs are available upon request.

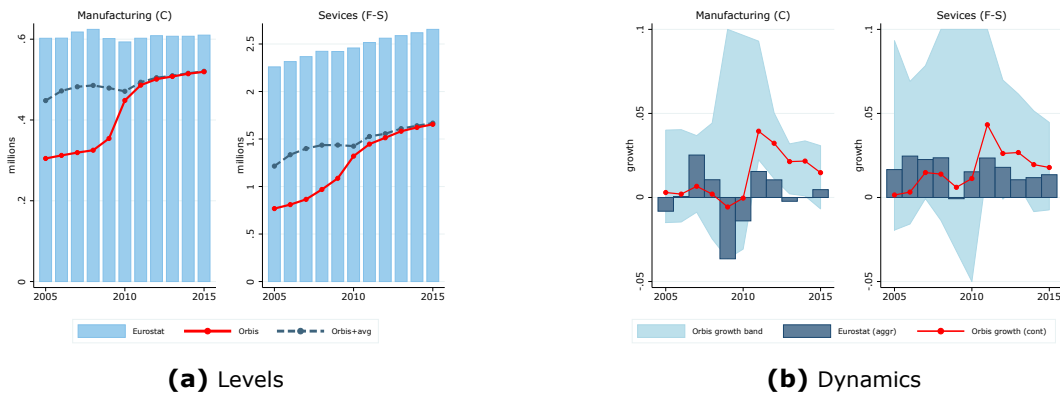
⁶⁷Orbis estimates are either directly provided by the data providers or computed by Orbis. For instance, sometimes firms are reported within a size category, without the actual number of employees; the firm then receives the average number of employees in this category reported in other firms of this category. Incidence and construction methods of estimates depends on data providers.

Figure 36: Employment in Orbis – Austria



We then turn to a comparison of our sample with Eurostat. Figure 37 looks at macro sectors Manufacturing and Services: Panel (a) compares official sector level employment aggregates from Eurostat to aggregated obtained from Orbis – red continuous line is Orbis aggregate using imputation, and blue dashed line is Orbis using imputation and averaging. In the case of Austria, we find that Orbis dataset can capture 60-80 percent of the official employment statistic.

Figure 37: Representativeness by Levels and Dynamics – Austria



The right-hand Panel (b) of Figure 37 provides valuable insights regarding the employment dynamics of the macro-sectors Manufacturing and Services. It plots three pieces of information in the graph: the aggregate net job creation rates obtained from Eurostat (dark blue bars) and the summary of three aggregate net job creation rates that we compute from our Orbis sample (red line and light blue band). We construct the aggregate net job creation rate by summing individual firms' weighted net job creation rates.

Weighted Net Job Creation Rate $_{i,t}$ of firm i in year t is defined as follows:

$$\text{Weighted Net Job Creation Rate}_{(i,t)} = \frac{\text{Change in Employment}_{(i,t)}}{\text{Size}_{(i,t)}} \times \text{Weight}_{(i,t)} \quad (1)$$

where the change in employment of firm i is the change in the number employees working at firm i between $t - 1$ and t , size is firm i 's *Current Size* – i.e., the average size – in number of employees between $t - 1$ and t ;⁶⁸ $\text{Weight}_{i,t}$ is the average share of firm i 's employment in the total employment between year $t - 1$ and t .⁶⁹

⁶⁸Notice that Size is corrected using imputation techniques, without averaging.

⁶⁹Put in formula, assuming $n_{(i,t)}$ is the number of employees hired by firm i at time t :

Nevertheless, exit and entry firms may create some issues: by definition, the prior year size of an entry firm is zero, and similarly the end of year size of an exiting firm is zero. We thus compute three separate aggregate net job creation rates: (1) retains continuing firms, and excludes entry and exit firms; (2) retains continuing and exit firms, and excludes entry firms; (3) retains continuing and entry firms, excludes exit firms.

In Figure 37 Panel (b) the red continuous line represents the net job creation rates retaining continuing firms only. The light blue coloured band reports the highest and lowest values of the three net job creations rates. The purpose of the graph is to assess whether firm-level net job creation rates represent the aggregate employment dynamics in Eurostat at satisfactory levels. In the case of Austria, dynamics are well replicated; however, the structural break in 2009-2010 limits the comparison, and entries and exits play a significant role in explaining growth variance.

The third set of pictures reported in Figure 38 compares employment levels by firm size. We split the sample between macro sectors Manufacturing and Services. We restrain Services to sectors F-N only in the case of Services due to Eurostat business statistics limitations. Also, in Manufacturing, we omit Tobacco Production (Nace 12) and Coke production (Nace 19) because the sectors are highly concentrated in most countries and for this reason, official statistics often are unreported in Eurostat SBS – because of confidentiality.

Manufacturing

- | | |
|--|---|
| Food, Drink, Tobacco: 10, 11, 12 | Ceramics, Metals: 23, 24, 25 |
| Textile, Clothes, Leather: 13, 14, 15 | Optics, Electronics, Machines: 26, 27, 28 |
| Wood, Paper, Printing: 16, 17, 18 | Motors, Vehicles: 29, 30 |
| Coke, Chemicals, Drugs, Rubber: 19, 20, 21, 22 | Furniture and others: 31, 32, 33 |

Services

- | | |
|----------------------------|-----------------------------|
| F - Construction | M - Professional services |
| G - Wholesale and retail | N - Administrative services |
| H - Transportation | P - Education |
| I - Accommodation and food | Q - Health and social work |
| J - Info-communication | R - Arts, entertainment |
| L - Real estate service | S - Other services |

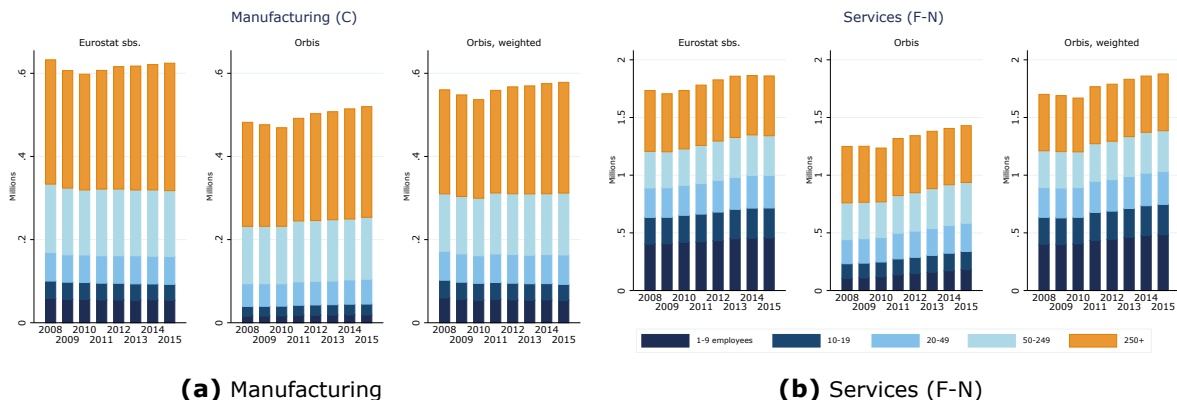
The first column of the Figure from the left depicts the Eurostat employment values, Manufacturing (ex. 12 and ex. 19) in the upper and Service sectors (F-N) in the lower panel. The second column presents the corresponding statistics calculated from Orbis dataset. We use the imputed employment plus imputed average statistics for this exercise to better account for missing employment information in Orbis.

In addition, we provide figures for the employment level comparison at a more disaggregated level in Figures 39. For the manufacturing sectors we combine NACE rev. 2. 2-digit sectors in accordance with Eurostat data availability:

$$\text{Change in employment}_{(i,t)} = n_{(i,t)} - n_{(i,t-1)}; \text{Size}_{i,t} = \frac{n_{(i,t-1)} + n_{(i,t)}}{2};$$

$$\text{Weight}_{i,t} = \frac{1}{2} \left(\frac{n_{(i,t-1)}}{\text{Total Employment}_{(t-1)}} + \frac{n_{(i,t)}}{\text{Total Employment}_{(t)}} \right).$$

Figure 38: Representativeness by Size – Austria



Analogously to the left panel of Figure 37, we provide three statistics: official employment statistics of the sector, aggregate firm level employment (imputed) and aggregate firm employment calculated from Orbis, when all still missing employment information is substituted for firm’s average employment size. Figure 39 shows results for manufacturing sectors⁷⁰ and Figure 39 for Service sector branches at the letter aggregation level.

For Austria, we find that the share of employment we capture with Orbis data varies greatly across sectors. The closest match is in the textile-clothes sector in Manufacturing, while the poorest one is in Real estate services. In fact, in Real estate services, the Orbis dataset provides higher total employment than Eurostat aggregates. This might be the result of sector misclassification in the data.

The imputation of averages reveals that in the early-period there is a large share of missing employment in all sectors. Nevertheless, imputing averages gives a fair approximation of the share of missing employment, and may even account for some level changes (see, e.g., sectors such as Textile and Clothes, Motors and Vehicles).

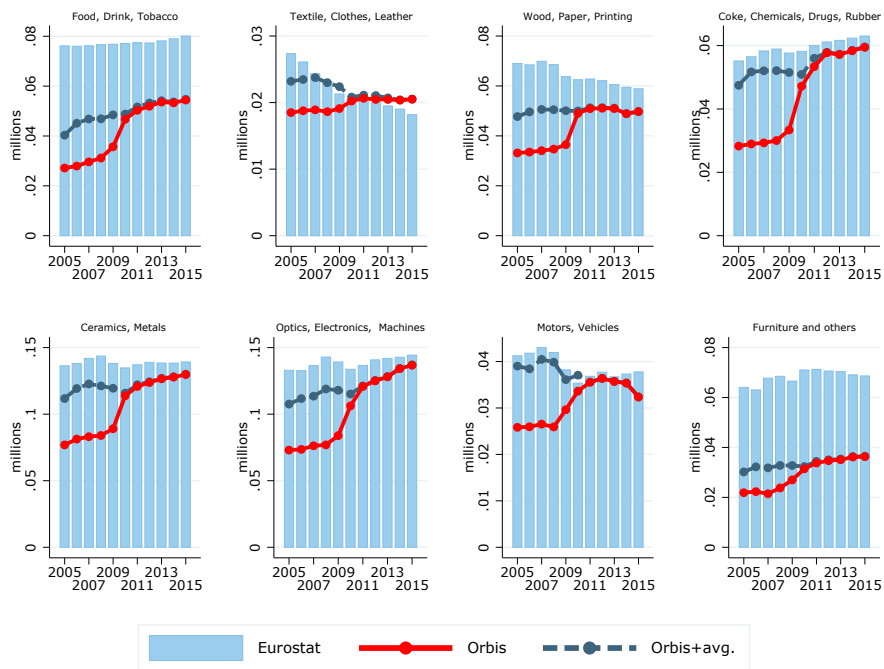
⁷⁰For brevity, we combine 2-digit NACE rev. 2. industries together

Table 4: Employment weights: Austria, NACE code 10, year 2015.

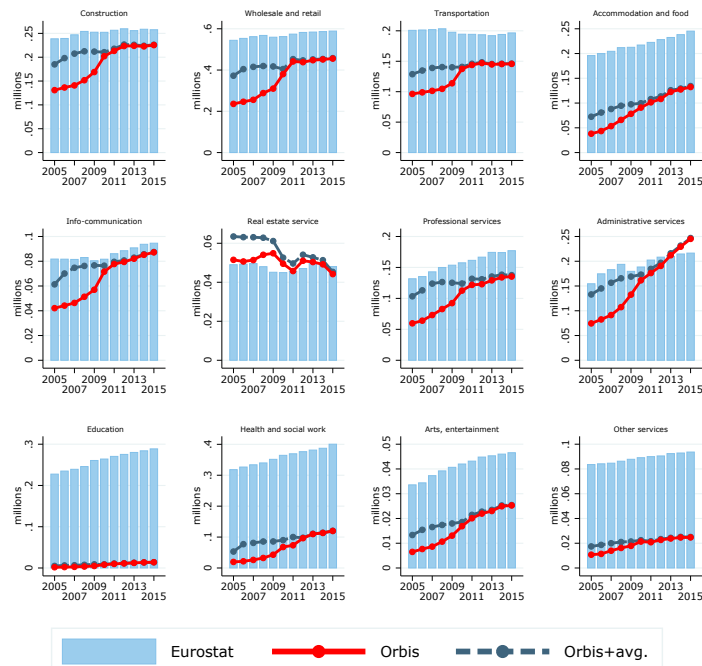
Firm Size	(1) Eurostat SBS employment	(2) ORBIS employment	(3) $\frac{\text{SBS employment}}{\text{ORBIS employment}}$	(4) Weights
0-9	8,635	1,515	5.70	5.70
10-19	8,758	2,796	3.13	3.13
20-49	13,374	7,545	1.77	1.77
50-249	21,404	18,501	1.16	1.00
250 +	22,657	16,813	1.35	1.00

Note: This table reports the weighting scheme of Austria, NACE Code 10, Year 2015, that maximises representativeness of Orbis data by firm size. Firm size categories follow Eurostat *Structural Business Statistics* (SBS). Column (1) reports the size category in number of employees. Column (2) reports EUROSTAT SBS total number of employees working at firms in the size category. Column (2) reports ORBIS total number of employees working at firms in the size category. Column (3) reports the ratio $\frac{\text{SBS Employment}}{\text{ORBIS Employment}}$, i.e., Column (2) to Column (3). Column (4) reports the weight applied to the size category; by construction, the large and medium-sized firms are systematically assigned weight=1.

Figure 39: Representativeness in Sectors – Austria



(a) Manufacturing



(b) Services (F-N)

Regarding Services, Figure 39 suggests that representativeness is somewhat more of a problem. A significant share of the Eurostat statistic is replicated by Orbis in Construction, Professional Services and Info-Communication sectors. Comparing columns (3) and (4) shows that both in the case of Manufacturing and Service sectors the small companies are under-represented for Austria. A possible remedy for this is to calculate aggregate employment statistics from Orbis using weights. In order to do this, we follow Gal (2013)

and calculate weights at the two-digit sector and firm-size category level for each year. As Gal (2013) we apply unity weights when SBS employment statistics is smaller than Orbis counterpart. In addition, we also apply unity weights for firm-sizes above 50 employees to avoid over-weighting very large firms. Table 4 displays the weighting scheme we obtained for the Austrian Manufacturing in year 2015 as an illustration.

The results obtained by using weighting-scheme as those depicted in the third column of Table 4. The results suggest that weighting can successfully replicate aggregate dynamics and firm-size structure for Austria. Notice, however, that to achieve this result we used imputed employment data in the pre-2010 years.

Short analysis of other EU28 countries

Belgium

The data contains ca. 2 million employees. We detect no structural break in the aggregate data. Imputation and adding firm level averages insignificantly alter the data. Nearly all employment data stem from unconsolidated accounts. The representativeness of employment is generally good in Belgium even at sub-sector levels. We find that the effect of NACE code changes and possible misclassification affect Furniture and Real estate services sub-sectors. As expected, Education and Health services sectors are insufficiently represented because of the employment is in public sector entities. Employment dynamics in the aggregate Manufacturing and Services sectors are satisfactory. The firm size distribution is well represented in both macro sectors. Weights are largest in Services for firms with less than 10 employees.

Bulgaria

The data contains ca. 2.5-3 million employees. Consolidated accounts play little role, nor do data imputation and averaging. The increasing statistics, especially its staggered nature with jumps in 2008 and 2013 raises some suspicions. The 2008 change in the data can be attributed to two factors. On the one hand as 2005-2008 employment is lower than official statistics in most sectors, the discrepancy between Orbis and Eurostat number might come from sample selection due to data collection by BvD. On the other hand, in the case of some sector NACE rev 1 to NACE rev 2 change caused misclassification can also play a role. We could not find any explanations to the 2013 increase in Orbis employment which does not appear in Eurostat. The increase cannot be explained by the usual suspects: there is no apparent firm population entering the dataset (excluding firms by size, legal status or incorporation type does not change this finding). There was no reporting change in the methodology how firms report employment⁷¹ nor apparent changes in the Orbis sample by reporting type, legal entity or unexpected increase in the number of firms. As for the comparison of employment levels by firm-size, in Bulgaria the employment distribution by firm size is quite good in both investigated sectors.

Croatia

Orbis total employment stemming from unconsolidated amounts to nearly 0.9 million employees. The simple imputation affects the data slightly, the additional imputation of employment average is not necessary in the case of Croatia. In the case of Croatia, the Eurostat data at NACE rev. 2 classification is only available from 2008 on. As the panels show, Eurostat data for the years 2005-2007 is missing, thus comparison cannot be

⁷¹We are grateful to Todor Davidkov from the Bulgarian Statistical Office for the help.

done. However, we find that the representativeness of Orbis for Croatia is very good for the 2008-2015 period. Both for levels and dynamics of employment.

Figures show the diversity of representativeness across sub-sectors of Manufacturing and Services. While representativeness is generally good, exceptions include Real Estate sectors and service sectors from P to S. As for the comparison of employment levels by firm-size. In Croatia the employment distribution by firm size is quite good in both investigated sectors. There is some employment not captured in the size-class 1-9, however this can be attended to by using weighting-schemes.

Cyprus

The data allow for identifying a corporate employment aggregate of about 80 thousand at the maximum when including all consolidation levels available. This falls short official statistics, since the employment in manufacturing and services should be above 0.23 million at least for the end of the examined period. In general we find the data for Cyprus not sufficiently good for national representativeness and therefore omit the presentation the detailed sector level analysis. All figures are available upon request.

Therefore, we do not retain Cyprus in the final sample.

Czech Republic

The data identify total corporate employment amounting to ca. 3 million stemming from unconsolidated accounts and 1 million from limited financial accounts. We observe sharp increase in 2010 that suggests a change in sampling method / availability of data in Orbis.

Regarding the Czech data the employment statistic of the firm must be handled with caution. Both eye-balling the data and confirmation from BvD reveals that statistics are imputed by the original data source. This is that there are preferred firm size values in the data representing mid-points of usual categories. For example, firms between 0-5 employees are given the value 3 and firms between sizes of 5-10 are given the value 7, and 15 for between 10-20. These are the most common values in the dataset, present for 77 percent of the non LF population. Other popular values include 38, 75, 150, 375, 750 and so on. This implies that most likely researchers are able to assess the size of the firm with acceptable accuracy but attempts to analyse firm employment dynamics must be carried out with great caution, if at all. Note, that this is not equivalent to the share of estimated employment discussed in the Appendix. In that case the estimation is performed by BvD and not by the original data source.

The calculated aggregate from Orbis, keeping in mind the influx of LF companies to the sample, captures the official employment mass in the case of Manufacturing between 2009-2014. In the pre-2009 years data is less satisfactory due to selection into sample or sectoral misclassification or both. As for 2015, the Orbis statistic falls short of the official statistics due to missing latest reports. Similar problems are detected in Service sectors, however the representativeness is much lower.

As for the comparison of employment levels by firm-size, employment distribution by firm size is quite good in both investigated sectors, however we find that smaller firms are have smaller share in aggregate employment as suggested by Eurostat SBS data. This is especially so in the case of Service sectors.

Denmark

The number of employees obtained from unconsolidated accounts amounts to 0.9-1.1 mil-

lion; there is a single Limited Financial account reported in 2006. Imputation has slight effects, while using averaging techniques augments employment for the later period of the data. This suggests that there may be some attrition in employment reporting over time. Orbis captures about 75-90 percent of Eurostat statistics in Manufacturing and less than 50 percent in Services. The general dynamics obtained from Orbis data captures the features of Eurostat in both sectors.

The representativeness of Orbis increases over the period. A potential reason is the pre-2008 misclassification of sectors, especially in the case of Motors, Vehicles and Textiles sectors. Orbis data are unevenly representative of Eurostat across Services sub-sectors: Construction, Info-Communication, Administrative Services, Retail and Wholesale sectors are as representative as Manufacturing; Education, Health and Arts and Other Services are poorly representative. Regarding the comparison of employment levels by firm-size, Eurostat SBS data contains a structural break in the employment statistics in the Manufacturing data between 2010 and 2011 which hinders the comparison with our data. Second, our weighting-scheme that unweights larger firms is insufficient to represent total employment – see especially Manufacturing in 2011 and later. Still, for consistency purposes, we opt not to weight large firms 250+ employees.

Estonia

Nearly all employment is obtained from unconsolidated accounts and amounts to ca. 0.35-0.40 million. The Orbis sample matches Eurostat both total employment and dynamics relatively well, except at beginning and end of period. Discrepancies at start of period stem from companies with sector classification problems in pre-NACE Rev. 2 years 2005-2008 and these firms hold a significant share of employment. Despite these shortcomings above, the general employment dynamics calculated from Orbis, seems to be able to replicate the aggregate employment dynamics of Services well and middle-period of the Manufacturing sectors as the right panel. The employment distribution by firm size is fine in both macro sectors Manufacturing and Services.

Finland

Employment obtained from unconsolidated accounts amounts to 1 million employees; Limited Financial accounts provide an additional 0.5 million employees. Orbis employment represents about 90-95 percent of Eurostat Services (F-N) and Manufacturing employment. Employment dynamics replicates rather well the official aggregate statistics. Disaggregated employment statistics also paint a satisfactory picture. In Manufacturing, we find discrepancies in the early years in Textile and Chemical and Motor vehicle sub-sectors, probably due to NACE codes re-classification in 2008. At the same time, we find that Orbis counts for more employment than necessary for professional services; we assume this is due to NACE sector misclassification. In addition, in the case of Real estate services sub-sector averaging employment for missing employment probably explains the overshooting. In fact, missing employment in these cases should possibly be treated as nil. Again, the representativeness of Services sub-sectors P-S is low. Finally, employment distribution by firm size is quite satisfactory both in Manufacturing and Services.

France

Employment obtained from unconsolidated accounts amounts to 6-7 million employees. However, the captured employment depend on data cleaning procedures. Applying the simple imputation technique can raise employment level by millions. This might call for a

careful treatment of the panel structure of firm level data for France. Employment level calculated from Orbis captures Eurostat employment levels in Manufacturing well, especially in the 2010-2014 period. Yet, micro-aggregated employment dynamics for Manufacturing is not able to fully replicate the ever shrinking size dynamics of the French manufacturing. Orbis data suggest positive growth for French Manufacturing for several years. However, the inclusion of entries and exits give a nice replication of Eurostat. Despite employment in Services obtained from Orbis is less than half of the Eurostat value, the employment dynamics can be replicated sufficiently well.

Another important note regarding French Orbis data is that towards the end of the sample period, in 2014 and in 2015, the level of calculated employment declines. This decline is higher than the one observable in Eurostat figures in the case of Manufacturing, while in the case of Services, Eurostat figures show an increase in employment rather than a decline. The right panel of figure suggests that the decline is due to missing firms. The decline in the Orbis data for 2014 and 2015 is also visible in sub-sectors in Manufacturing and Services; e.g., Real Estate services.

Employment levels for separate service sectors, where we find large across sector heterogeneity in representativeness. Sectors P-S show very low representativeness for Orbis data, while Transportation, Real Estate services data for Info-Communication is much better. Employment distribution by firm-size is good in both Manufacturing and Services for the mid-sized and larger firms; however a share of employment (30-50 percent of the size-class) is missing from micro-firms (1-9 employees).

There are two issues here that are important to mention. First, for many sectors SBS statistics are not available before 2010, for these years we applied the weighting scheme of the first available year. Second, we apply the weighting scheme estimated in year 2014 to year 2015, so that the drop in employment level in 2015 is not corrected by the weights.

Germany

The data allow for identifying aggregate corporate employment of ca. 10-20 million employees. While most of the employment comes from unconsolidated accounts, there is a considerable share from limited financial accounts as well (5-10 million), and the share varies across years. Data imputation has little effect, however, employment reporting quality considerably increases after 2010. Once, missing statistics are imputed with average we can account for a stable mass of unconsolidated employment between 2007-2014.

As we compare Orbis with Eurostat, we see that Orbis captures about half the employment both in Manufacturing and Services. Despite the relatively low share of represented employment levels, the aggregate dynamics are well reflected in Orbis, after weighting schemes are applied, both in the case of manufacturing and service sectors. Actually, Manufacturing is reasonably well represented over time. But we must keep in mind that within each sub-sectors Orbis represents about 50-60 percent of Eurostat and the structural break in the employment statistic availability in Orbis is detectable in each sector. The picture is similar in Services, even though several Services sub-sectors report relatively low representativeness. These are the usual sub-sectors – i.e., Education and Health Sectors – but also a few additional sub-sectors – e.g., Administrative Services and Professional Services. In some sub-sectors, imputation results in non-matching dynamics compared with Eurostat.

Regarding the firm-size representativeness, the employment distribution favours the larger firms. While in the case of Manufacturing there is a substantial employment missing from

the group of large firms (250+), we capture less than a third of the employment with firms hiring less than 20 employees. This issue is more visible when we look at sectors F and G in Services, where the majority of missing employment is attributable to micro and small firms. As a consequence in the case of Germany, only re-weighting even the largest of firms could replicate the Eurostat employment data.

Greece

Employment obtained from unconsolidated accounts amounts to 0.80-0.85 million employees; no employment is obtained from Limited Financial accounts. Imputation has little effect on the sample. Imputing average augments aggregate employment statistic in the pre-2009 years relatively more, suggesting enhanced reporting quality over time in Orbis. Orbis sample nearly fully replicate Eurostat employment levels in Manufacturing, while in Services Orbis captures 50 percent. Dynamics of our sample are close to those of Eurostat, suggesting that appropriate weighting result in good representation.

Representativeness is satisfactory in Manufacturing except for Optics and Electronics. In the latter cases, Orbis employment is larger which is likely due to sector mis-classification of several firms; we could not identify these firms. The figures suggest good representativeness for many sectors within Services, especially in F to N sub-sectors. We do not capture neither level nor dynamics in the case of Construction and Real Estate sectors. Also we detect, possible mis-classification for the Info-communication sector.

As for the comparison of employment levels by firm-size, the employment distribution by firm size is good in both investigated sectors for firms above 50 employees. However, a significant share of employment is not captured by the Orbis data in the case of firms with employee less than 20. This issue is there in both investigated sectors, implying that weight used for these firms would be high: for firms between 1-9 employees the weight is on average 26 across sectors, while for firms between 10-19 the average weight is 2.

Hungary

Unconsolidated employment data amount to about 2 million people. However, the size of the sample varies over time. There seems to be sampling issues and missing employment reports before 2008. While part of the imputation can help improve employment levels, the effects of imputation vary across years and sectors; see the difference between Manufacturing and Services. A detailed look at the sub-sectors of the Manufacturing and Services also indicate that data quality of Orbis for Hungary increases over time. For many sector, e.g., Info-communication, Real Estate services, Administrative services the discrepancy between statistics calculated from Orbis and Eurostat figures are minimal. Like in many other countries, in the case of Hungary, we also detect the low representativeness of Orbis in the sectors S to P. As for the comparison of employment levels by firm-size, Hungary the employment distribution by firm size is quite good in both investigated sectors. Especially, closer to the end of the examined period, where levels are more reliable.

Ireland

Employment data before 2006 is overwhelmingly coming from consolidated reports. The Orbis data improve over time: in years 2006 to 2009, the data add an extra 0.7-0.8 million employees as unconsolidated accounts increase in numbers, and after 2010, some firms start reporting both unconsolidated and consolidated employment – we retain unconsolidated employment only. As a result, before 2010 statistics calculated from Orbis are only less than half of the corresponding Eurostat figures, while the gap is close to zero after 2010.

Moreover, there seems to be some sampling change in 2006 and a structural change in the reporting in 2010. Also, firm-size representativeness analysis is unsatisfactory. Because of the underlying structural and sampling issues in the data. Applying weighting schemes might bring misleading results. Weighting schemes increase the employment level attributed to micro and small firms and can influence aggregate dynamics accordingly.

All in all, the assessment of representativeness is nearly impossible and poor, so that we exclude Irish firms from the final sample.

Italy

Unconsolidated employment data amount to 5-9 million employees with an increase between 2005 and 2015. Additionally, the data include reports on firms with limited financial accounts in the last three years. Employment data imputation has some but decreasing effects on the results. Averaging increases aggregate employment relatively more in the pre-2009 period, which suggests an increase in the quality of Orbis employment data. Representativeness in Manufacturing is satisfactory, both in levels and dynamics, even sub-sectors. In many cases the statistics calculated from Orbis matches Eurostat data almost perfectly; e.g., Optics and Electronics, Motors and Vehicles or Ceramics. In Services the quality of the representativeness is heterogeneous reflecting the presence of public entities: Education, Health and Social Work. However, in other sub-sectors, Orbis data matches Eurostat figures rather well: Info and Communication, Transportation, Wholesale and Retail. Real Estate services sector is likely to be affected by mis-classification of firms. Possibly between Real estate services and construction.

As for the comparison of employment levels by firm-size, in Italy the employment distribution by firm size is quite good in both investigated sectors above ten employees. In the lowest size class about 20-40 percent of the size class's employment is not captured by Orbis. Relatively this issue is more important in the case of service sectors and less so in the case of manufacturing. However, since there are not major data problems, applying weights can reproduce Eurostat indicated aggregate levels and dynamics of employment in both sectors for the SME sectors.

Latvia

The unconsolidated employment data account for about 0.6 million employees in years 2005-2015. Additionally, the data includes reports on firms with limited financial accounts from 2007 to 2011. The sector level analysis reveals that Orbis reflects the Eurostat statistics very well. Possibly, the differences between the Orbis and Eurostat are due to the mis-classification of sectors of some firms. Employment distribution by firm size is excellent.

Lithuania

Unconsolidated employment accounts increases from 0.25 million employees in 2005 to 0.5 million in 2015. Additionally, the data includes reports on firms with limited financial accounts from 2007 on. This latter source is suggestive of employment of a similar or even bigger size than accounted for by the unconsolidated reports. Comparing unconsolidated information to Eurostat data reveals a structural break in the sampling between 2006 and 2007. However, the level and dynamics of employment calculated from Orbis data are satisfactory from 2007 to 2015. The representativeness in Manufacturing and Services sectors are satisfactory for the period 2007-2015. For many sub-sectors Orbis statistics match Eurostat figures well: Ceramics, Optics, Furniture, Transportation and Administrative

Services. We also detect possible misclassification of firms in the Real Estate services. As for the comparison of employment levels by firm-size, the employment distribution is quite good in both Manufacturing and Services sectors with a small share of employment missing from all size classes. Once weighting scheme is employed, the levels and dynamics of employment statistics calculated from Orbis is satisfactory.

Luxembourg

Unconsolidated employment data in Orbis stem overwhelmingly from consolidated accounts. Separate investigation of Manufacturing and Services reveals changes of sampling representativeness over time, increasing continuously from 2005 to 2011. Data is reliable between 2011 and 2015 for Manufacturing. As for the Services, representativeness seems equally low along the full period, even though dynamics suggest potential reliability of the data between 2011 and 2015. Unfortunately, Eurostat data for Luxembourg is unavailable for many sectors, which constrains the comparison.

Therefore, we do not retain Luxembourg firms in the final sample.

Malta

The data suffers from sampling bias in the beginning of the period and attrition towards the end of the period. This finding is illustrated in the Figures 2 and 3 that compares Orbis data with Eurostat. In addition, sampling issues are particularly severe in Manufacturing. Notice that employment is unavailable in Eurostat for a large number of sectors, which makes further comparison impossible.

Therefore, we do not retain Malta firms in our final sample.

Netherlands

Dutch Orbis data excessively rely on consolidated accounts. About half of the employment is reported in consolidated accounts, amounting to 6-7 million employees. About two-thirds of the remaining employment comes from unconsolidated accounts, while the rest comes from limited financial reports. The level and dynamics of employment is not affected by data imputation, which suggests no sampling or structural change in the data. Orbis employment captures less than half Eurostat employment, and the dynamics in Orbis matches Eurostat's. Also, both in the Manufacturing and Services, unconsolidated employment in Orbis capture about or less than half of the employment, but the dynamics follow the Eurostat figures. The problem with the representativeness for Netherlands is better understood when we look at the data by firm-size. In the Netherlands, the largest share of employment not accounted for comes from the largest firms because the latter report chiefly at consolidated levels, and we opted to retain unconsolidated accounts only. Nevertheless, the employment levels and dynamics of the small and medium sized companies is well representative.

Therefore, despite satisfactory representativeness of SMEs, we do not retain the Netherlands in the final sample.

Poland

Employment data are obtained from unconsolidated and limited financial accounts. The representativeness of data deteriorates towards the end of the period. The missing information in reports can only partially be compensated by imputation, which suggests a drop in Orbis firms coverage. The figures show that employment levels by firm-size of Orbis hardly match those of Eurostat. The employment distribution by firm size is quite good in both

investigated sectors above the firms with employment of 20. For the small and micro firms, Orbis does not capture the upward drift of employment among these firms in Eurostat.

Therefore, we exclude the Polish firms from the final sample.

Portugal

Unconsolidated employment data amount to 2.5 million people in years 2005–2015. Imputation helps improve levels and dynamics representativeness to some extent; yet, Orbis shows satisfying levels of representativeness from 2007. The same is true at Manufacturing and Services sectors level. Sub-sectors analysis shows that most sub-sectors are representative both in levels and dynamics. There is again a potential misclassification in sub-sector Real Estate Service. As for the comparison of employment levels by firm-size, Portugal employment distribution by firm size is quite satisfactory.

Romania

Unconsolidated employment data amount to 4 million employees on average in years 2005–2015. Unconsolidated accounts constitute nearly all of employment data. Orbis captures about 60 percent of Eurostat employment and replicate dynamics in both Manufacturing and Services. These findings also apply for most of the individual sub-sectors. The employment distribution by firm size shows that Orbis is representative of all firm sizes; applying weighting schemes has only a small effect on aggregate levels and employment dynamics by firm size.

Slovakia

Employment obtained from unconsolidated accounts amounts to 0.6-1.1 million employees, and increases between 2005 and 2015; an additional million is provided by Limited Financial accounts in the 2012-2014 period.

Orbis data for Slovakia is good in terms of representativeness. Manufacturing data from Orbis captures about 70-90 percent of employment data from Eurostat, for the service sectors the similar value is about half. However, like in the case of many countries, the low representativeness of the service sectors in Orbis is coming from sectors P to S.

The comparison of Orbis and Eurostat SBS employment levels by firm-size in Slovakia the employment distribution by firm size shows that Orbis is representative of all firm sizes, applying weighting schemes has only a small effect on aggregate levels and employment dynamics by firm size. Note, however, that there is a structural break in the Eurostat data.

Slovenia

Unconsolidated employment amounts to 3.5-4.5 million employees on average between 2005 and 2015; there is a structural break between 2009 and 2010. Representativeness is satisfactory especially since 2009. The employment distribution by firm size shows the same structural break in 2010 likely due to the missing firm reports from firms with less than 10 employees.

Spain

Unconsolidated employment amounts to 7-8 million employees; there is no employment in Limited Financial accounts. In Manufacturing, Orbis captures up to 80 percent of Eurostat employment, depending on years; in Services, it captures about half of it, and discrepancies come from sectors P to S only. At the end of the time period, Services sectors F-N in Orbis accounts for more than 5 out of the about 6.5 million employees in Eurostat. The levels

and dynamics are similarly satisfactory for Manufacturing and Services (F-N). Sub-sectors analysis shows that some are nearly perfectly representative all over the time period 2004-2015, e.g., Motor vehicles, Real Estate, Construction and Info-communication Services. Finally, the distribution by firm size is satisfactory in both Manufacturing and Services even though there is a share of employment missing from the smallest size. Using weighting scheme enables us to both capture the level of employment in Manufacturing and Services and capture employment dynamics of the various firm-size categories.

Overall, the data is probably the one providing with the best representativeness amongst the five largest EU economies.

Sweden

Unconsolidated employment data amount to 2-2.5 million employees in years 2005-2015; Limited Financial accounts add an additional million employees starting in 2009. Sector level representativeness of levels and dynamics are satisfactory: Orbis captures 70 to 90 percent of Eurostat employment in Manufacturing and about 50 percent in Services. Though, as usual, low representativeness of Services in Orbis is due to sectors P to S where public entities are more common. Firm-size distribution of employment in Orbis is representative of all firm sizes, so that weighting schemes have limited effects on the aggregate levels and employment dynamics by firm size.

United-Kingdom

Unconsolidated employment data amount to 10-11 million employees. Consolidated accounts report a larger share of employment too, 11-12 million employees. Imputation has little effect on employment levels and dynamics. Despite apparent low employment share, unconsolidated employment in Orbis captures a significant share of Eurostat employment levels and dynamics, both in Manufacturing and in Services (F-N). Interestingly, in sub-sectors where Orbis captures only half of Eurostat employment, the dynamics still match Eurostat. Firm-size analysis shows satisfactory representativeness for firms 50+ employees, in both Manufacturing and Services. However, a significant share of employment is not captured by Orbis among firms with less than 20 employees. In fact, eventually the weights applied to micro and small firms turn to be high: an average weight of 20 is applied on 1-9 employees firms, and 11 on 10-19 firms.

Therefore, despite satisfactory representativeness, we exclude the United-Kingdom because of the large average weights applied on micro and small firms.

All countries overview

We proceed with a similar analysis as the one presented in the case of Austria for all countries. This section reports a summary of the analysis; the detailed analysis and pictures by country are reported in Appendix 5, together with the pictures. Table 5 pictures the analysis summary.

Group 1: Adequate Representativeness

We identify a group of twenty countries for which we find sufficient data reporting as well as representativeness. Countries include Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Italy, Latvia, Lithuania, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. In these countries, the unconsolidated employment accounted for a large share of employment even though in some countries, such as Slovakia, firms report quite some "Limited Financial" accounts – unconsolidated accounts alone yet provide fair representation of Eurostat employment.

In these countries, we find that unconsolidated accounts match Eurostat data relatively well, both in levels and dynamics. Apart from the levels and dynamics we do care about the size-distribution of firms, and that average weights by firm category remains below 10. The highest weight is 9.7 – micro firms in Lithuania Services.

Spanish employment data match Eurostat remarkably well and is probably the best among the five largest EU countries. In Manufacturing, Orbis captures up to 80 percent of Eurostat employment. Dynamics are also matching at country and sub-sectors levels. Some major sub-sectors such as Motor Vehicle and Real Estate are nearly perfectly matching.

Group 2: Adequate but Unreliable Representativeness

A second group of countries show good employment reporting, nevertheless the representativeness is insufficient or would require excessive weights. Countries in Group 2 are Greece, Ireland, the Netherlands, Poland, and the United-Kingdom. For instance, in the Netherlands largest firms report consolidated accounts almost exclusively so that even though smaller firms are well represented, it is almost impossible to obtain total employment. Large firms typically are multinational firms so that consolidated accounts are likely to include employment abroad.

The United-Kingdom is another example. Even though more than half of employment is reported into consolidated accounts, 50+ employees firms are well representative; and, actually, imputation has little effect on aggregate employment showing a fairly good reporting quality. Nevertheless, small and micro firms are poorly represented. Using weights, we could match Eurostat figures; we found weights excessive, though – micro-firms average weight equals 20.

Therefore, we decided not to use the countries in Group 2, even though some may opt otherwise.

Group 3: Insufficient data and Poor Representativeness

The third group is constituted of countries for which the data reported is very poor in the first place and as a result we did not conduct the thorough representativeness analysis by dynamics and firm size. The lack of data may be due to a few missing multinational firms which report only consolidated accounts in Orbis. This group includes Cyprus, Luxembourg

and Malta. For instance, Cyprus reports about 80 thousands firms taking all consolidation accounts, which is far below 230 thousands firms reported in Eurostat on average. Sector level analysis falls at even lower levels of representativeness. Another example is Luxembourg for which accounts are chiefly consolidated. Data would actually be reliable in Manufacturing after 2011. Here, Eurostat is short of sector level reports so that we were unable to compare the data. Provided such features, Luxembourg could not be included.

Table 5: Representativeness Summary

Country	Sufficient Unconsolidated	Country Aggregates	Sectors & Size	Reasonable Weights	Included in Final Sample
Austria	+	+	+	+	Yes
Belgium	+	+	+	+	Yes
Bulgaria	+	+	+	+	Yes
Croatia	+	+	+	+	Yes
Cyprus	-				No
Czech Republic	+	+	+	+	Yes
Denmark	+	+	+	+	Yes
Estonia	+	+	+	+	Yes
Finland	+	+	+	+	Yes
France	+	+	+	+	Yes
Germany	+	+	+	+	Yes
Greece	+	+	+	-	No
Hungary	+	+	+	+	Yes
Ireland	-	+	+	+	No
Italy	+	+	+	+	Yes
Latvia	+	+	+	+	Yes
Lithuania	+	+	+	+	Yes
Luxembourg	-				No
Malta	-				No
Netherlands	-	+	+	-	No
Poland	-	+	+	-	No
Portugal	+	+	+	+	Yes
Romania	+	+	+	+	Yes
Slovakia	+	+	+	+	Yes
Slovenia	+	+	+	+	Yes
Spain	+	+	+	+	Yes
Sweden	+	+	+	+	Yes
<i>United-Kingdom</i>	-	+	+	-	No

Note: This table summarizes the representativeness assessment. *Sufficient Unconsolidated* indicates that unconsolidated employment is sufficient; *Country Aggregates*: the sample is representative of the total employment; *Sectors & Size*: the sample is representative of employment by broad sector and firm-size category. "+" ("-") indicates (un)satisfactory assessment. The last column indicates whether we retain the country in our sample.

We compare our sample of employment with Eurostat *Structural Business Statistics* (SBS) and design weighting schemes by firm size category in order to improve its "representativeness." The procedure we adopted closely follows the procedure proposed by Gal (2013). The weights are calibrated at the 2-digit NACE sector and firm-size category level for each year and country.

Table 6 exhibits the averages of the country level weights of Manufacturing and Services for the three firm size categories, namely micro (less than 10 employees), small (10-19 employees), and small (20-49 employees).⁷²

Table 6: Weighting Schemes

Country	Code	Manufacturing			Services		
		Micro (1-9)	Small (10-19)	Small (20-49)	Micro (1-9)	Small (10-19)	Small (20-49)
Austria	AT	2.1	1.3	1.1	3.1	1.5	1.3
Belgium	BE	1.5	1.1	1.1	1.9	1.2	1.1
Bulgaria	BG	1.3	1.1	1.0	1.1	1.0	1.0
Czech Republic	CZ	4.4	1.5	1.2	3.7	1.3	1.2
Germany	DE	4.3	2.2	1.0	5.0	2.1	1.6
Denmark	DK	2.5	2.1	1.9	3.3	2.0	2.0
Estonia	EE	1.2	1.2	1.2	1.1	1.2	1.1
Spain	ES	1.9	1.2	1.2	2.6	1.4	1.2
Finland	FI	1.5	1.2	1.1	1.3	1.2	1.1
France	FR	2.2	1.4	1.3	2.5	1.5	1.4
Croatia	HR	1.8	1.1	1.0	1.7	1.1	1.1
Hungary	HU	1.4	1.1	1.0	1.8	1.1	1.0
Italy	IT	2.8	1.6	1.1	3.8	1.5	1.1
Lithuania	LT	5.8	2.3	1.3	9.7	2.7	1.6
Latvia	LV	1.0	1.1	1.1	1.1	1.0	1.0
Portugal	PT	1.6	1.1	1.1	1.8	1.1	1.1
Romania	RO	1.3	1.1	1.1	1.4	1.2	1.1
Sweden	SE	1.5	1.0	1.0	2.3	1.1	1.1
Slovenia	SI	1.4	1.1	1.0	1.6	1.1	1.1
Slovakia	SK	2.3	1.2	1.1	2.1	1.1	1.0

Note: This table reports the country level weighting schemes by country and size; weights are 2-digits NACE averages.

All in all, we observe substantial discrepancy in weights across countries and size categories which reflects the heterogeneity of the representativeness of Orbis employment data. It is no surprise that micro firms systematically receive weights above one, since micro firms tend to be under-represented in Orbis. The largest weighting numbers are given to micro firms in Lithuania in both Services (weight=9.7) and Manufacturing (weight=5.8), and Latvian data in Orbis is the most balanced data as weights are all close to one.

⁷²We systematically apply the unity weight to firms with 50 employees and above so to avoid excessive representation of large firms.

Figures

Figure 1: Levels of Employment in Orbis.

- Subfigure 1: Reported and estimated employment.
Bars split the sample between reported and estimated employment. Estimated employment is employment for which Orbis indicates the figure is an estimate.
- Subfigure 2: Industry classification reporting.
Bars are split into employment for which industry code is reported and those which have no industry codes.
- Subfigure 3: Employment by consolidation.
Bars are split into employment obtained from C1, U1, U2, and LF accounting reports in Orbis. C1: consolidated; U1 and U2: unconsolidated; LF: Limited financial report.
- Subfigure 4: Employment by consolidation, after imputation and averaging techniques are applied.

Figure 2: Representativeness by Levels and Dynamics.

- Panel A: Eurostat and Orbis data.
The figure compares Orbis employment data before and after imputations and averaging (red and blue lines), with Eurostat (bars). The Panel is split between Manufacturing (left) and Services (right).
- Panel B: Dynamics.
The figure compares Orbis employment dynamics data after imputations (red line), with Eurostat (bars). The band indicates the 90% confidence level. The Panel is split between Manufacturing (left) and Services (right).

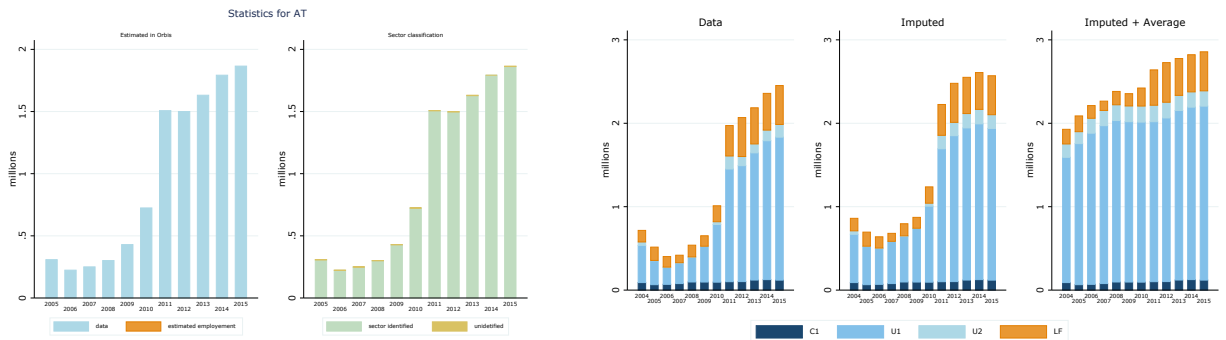
Figure 3: Representativeness by Size Category.

The figure reports the total employment in Orbis, where bars are split in size categories of firms: 1-9, 10-19, 20-49, 50-249, and 250+ employees. Panel A reports aggregate Manufacturing sector; Panel B reports aggregate Services sector. In each panel, left-hand figure reports the Eurostat SBS numbers, and right-hand figure reports the Orbis data after weights are applied.

Figure 4: Representativeness in Subsectors.

The figure reports the total employment in Orbis by subsectors. For each subsector, we report the total Eurostat employment and Orbis employment (before and after averaging).

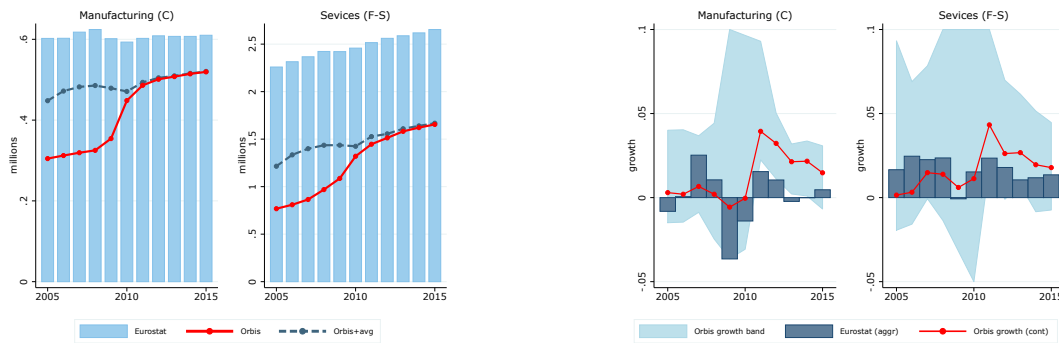
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

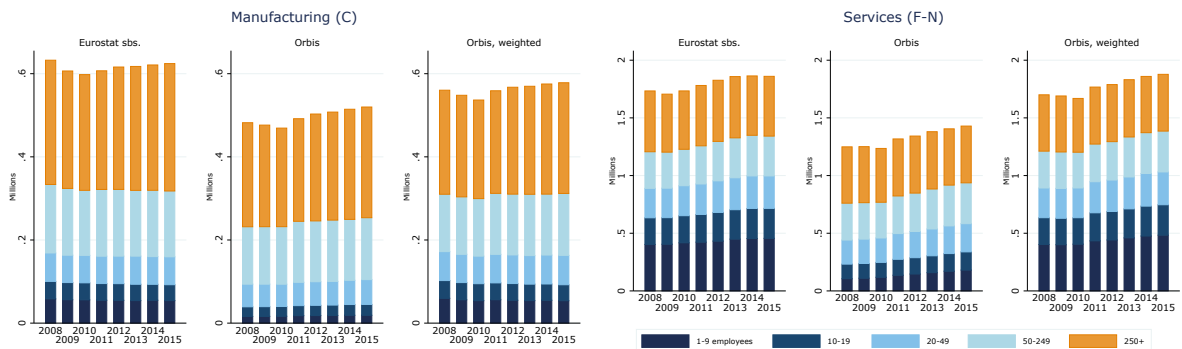
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

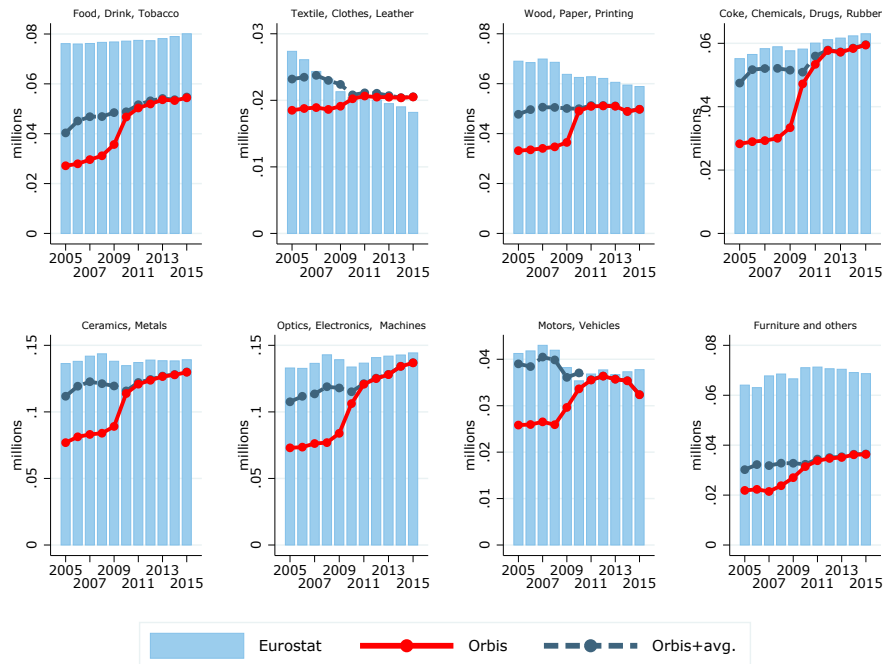


(a) Manufacturing

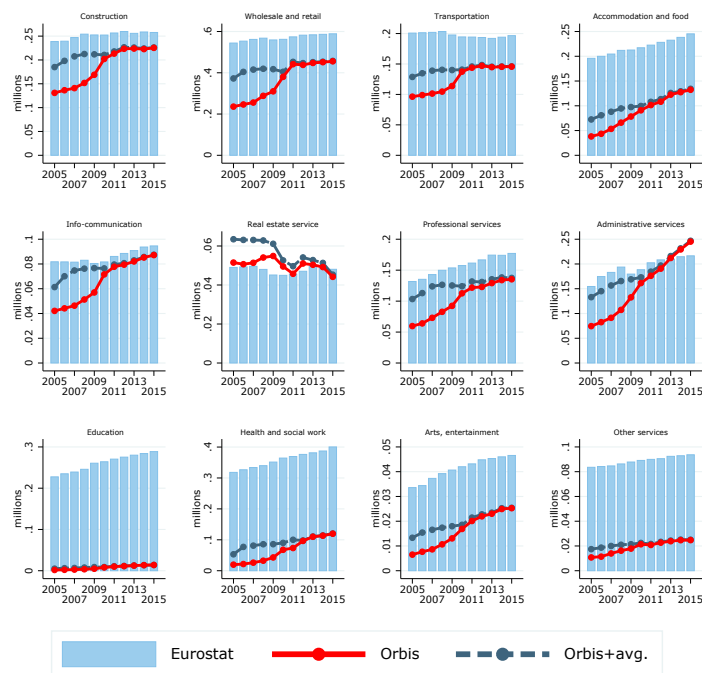
(b) Services (F-N)

Austria - continued

Figure 4: Representativeness by Levels

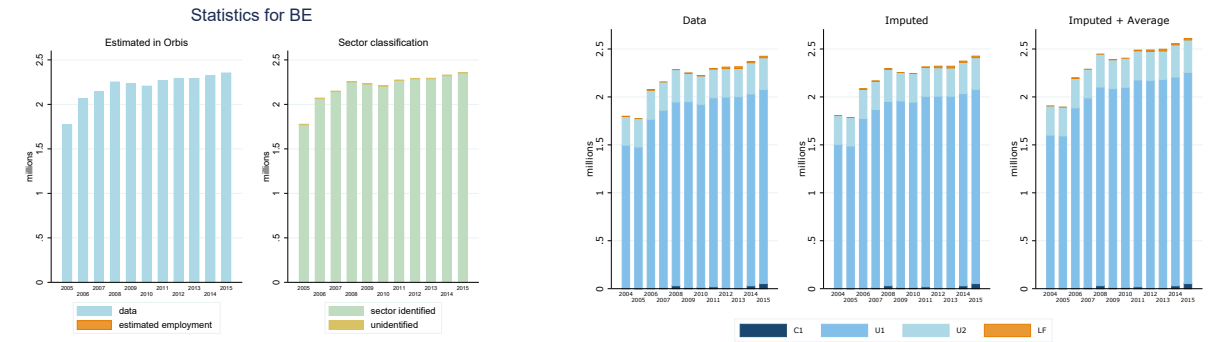


(a) Manufacturing



(b) Services (F-N)

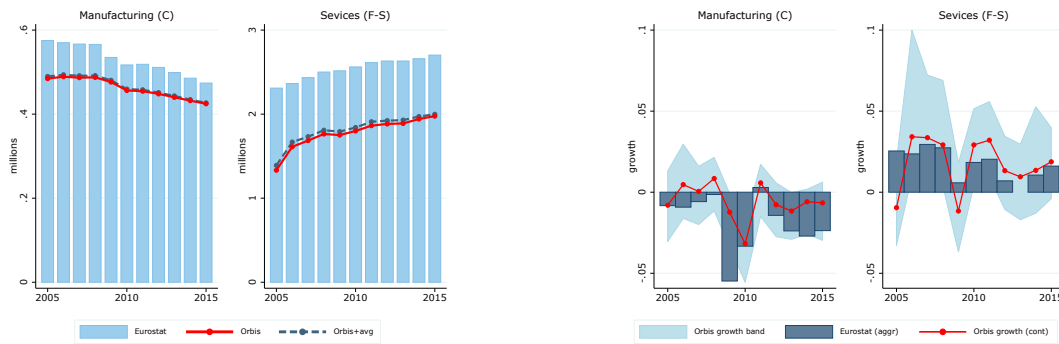
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

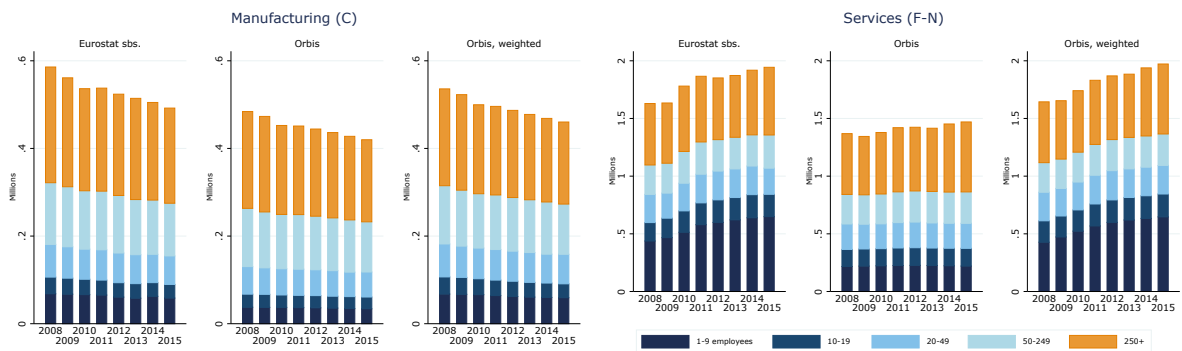
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

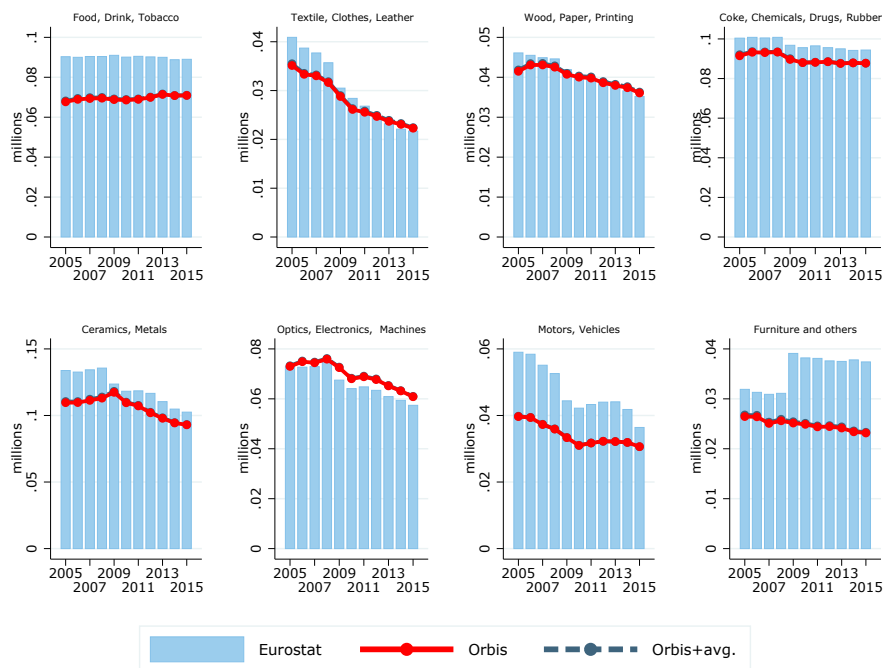


(a) Manufacturing

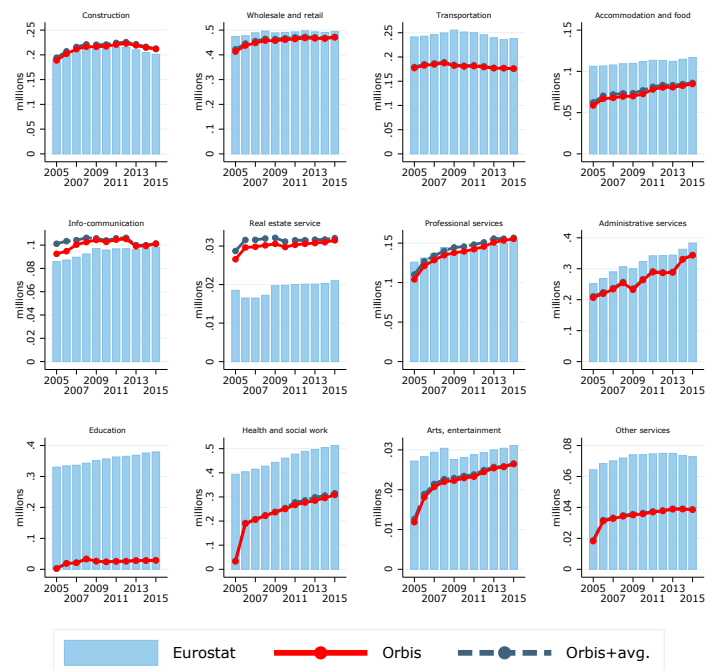
(b) Services (F-N)

Belgium - continued

Figure 4: Representativeness by Levels

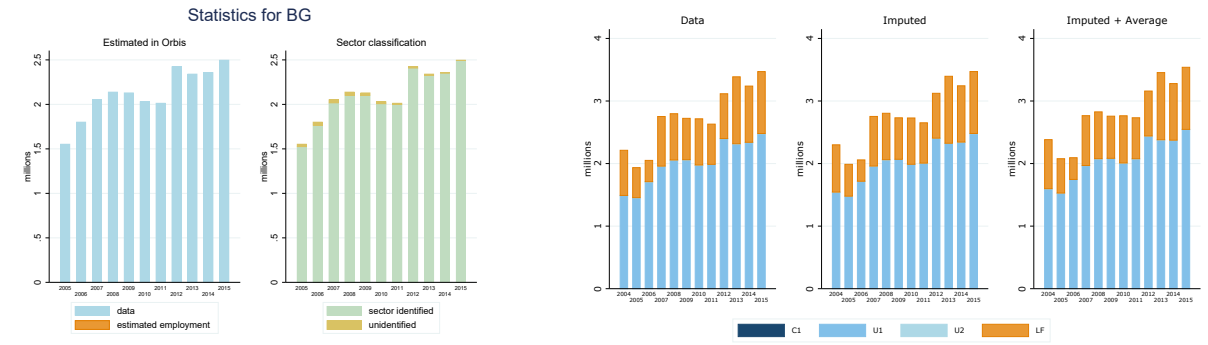


(a) Manufacturing



(b) Services (F-N)

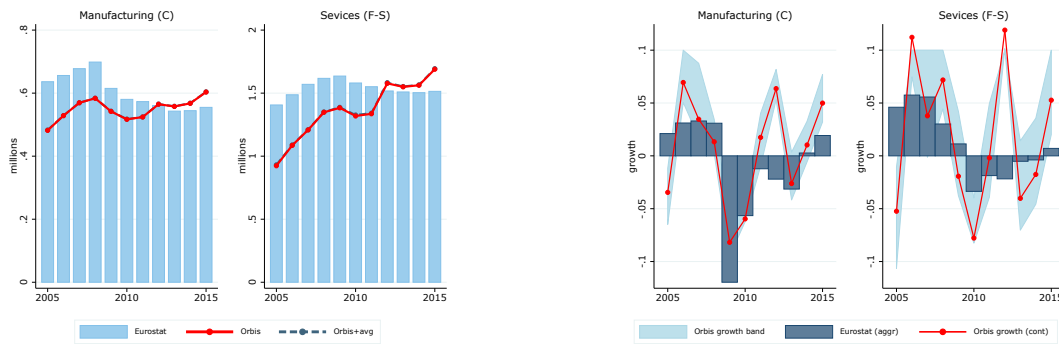
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

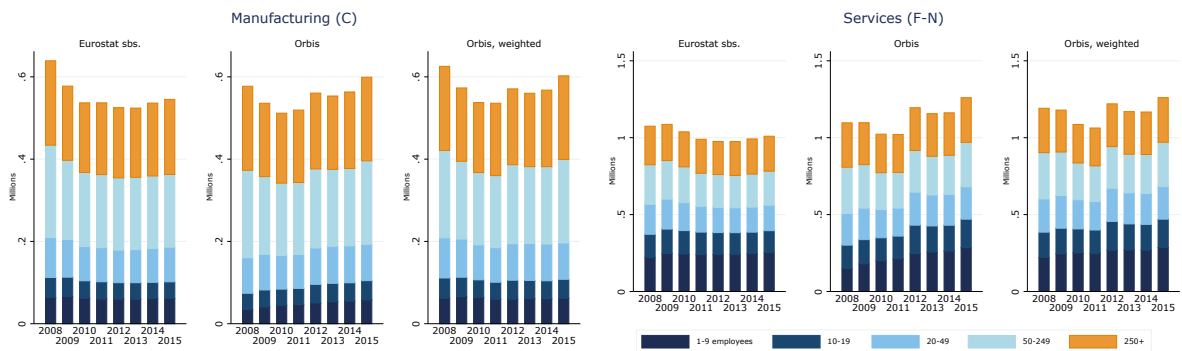
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

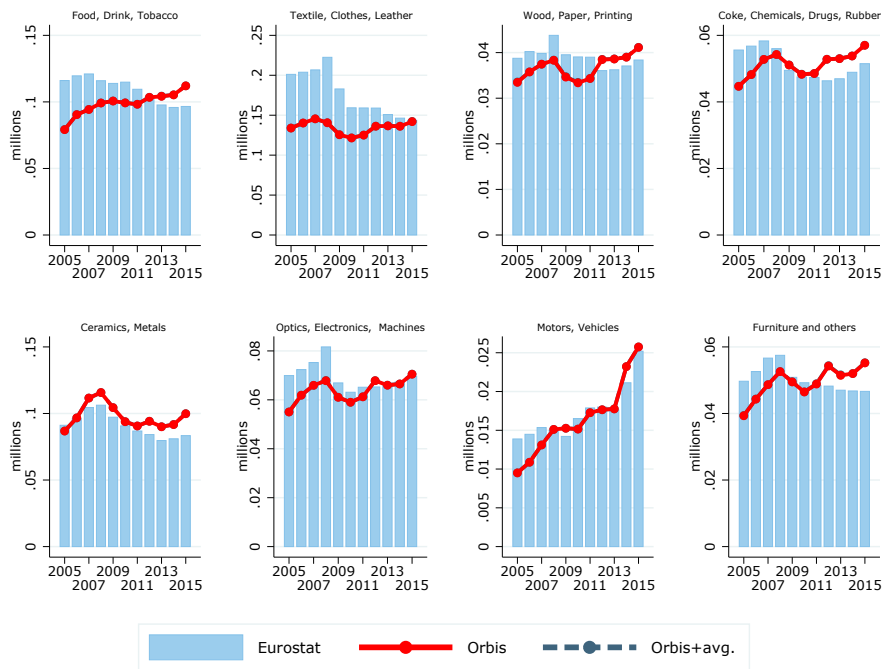


(a) Manufacturing

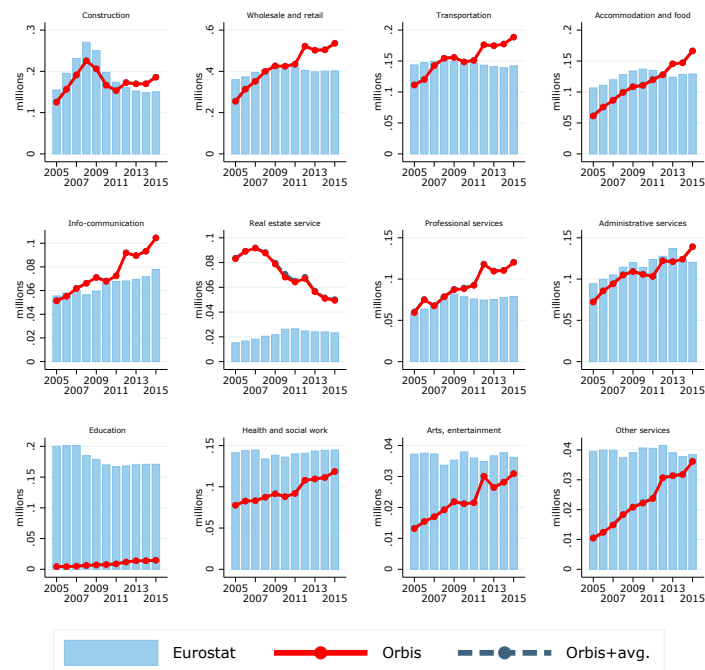
(b) Services (F-N)

Bulgaria - continued

Figure 4: Representativeness by Levels

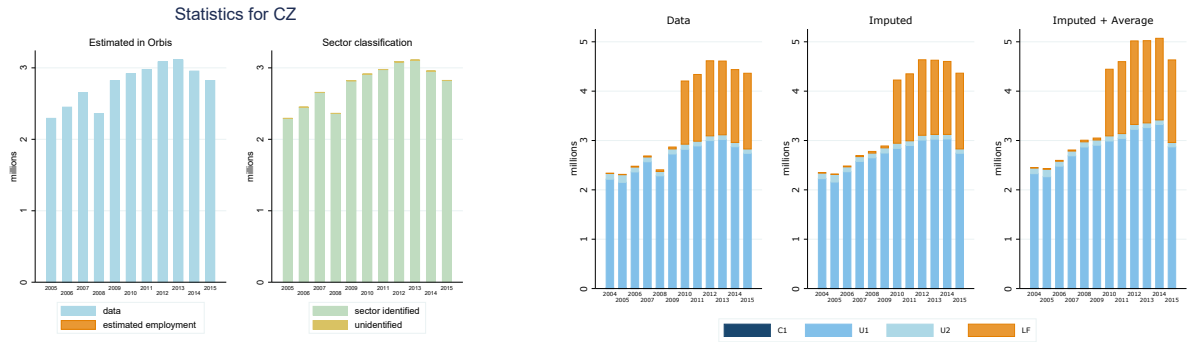


(a) Manufacturing



(b) Services (F-N)

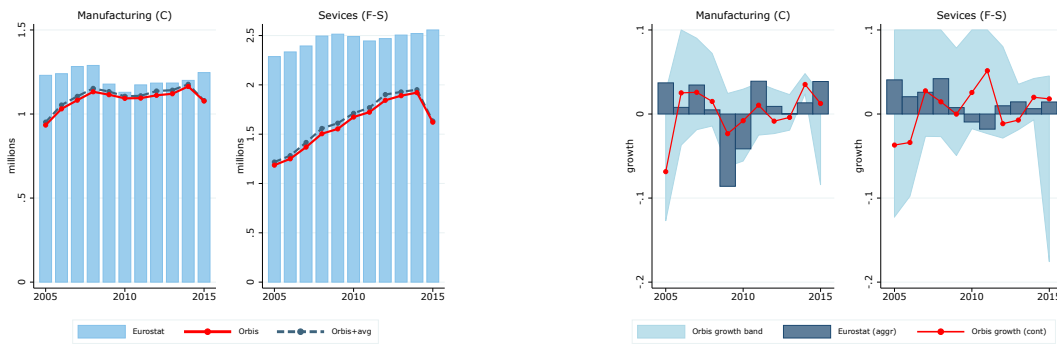
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

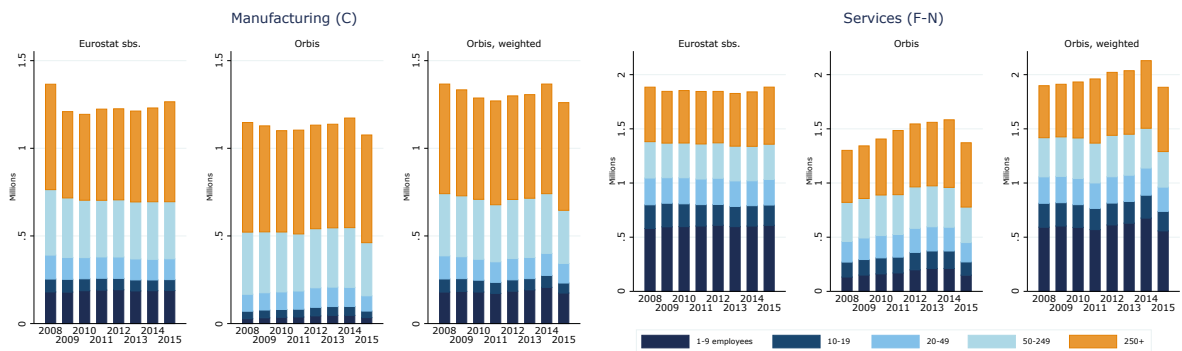
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

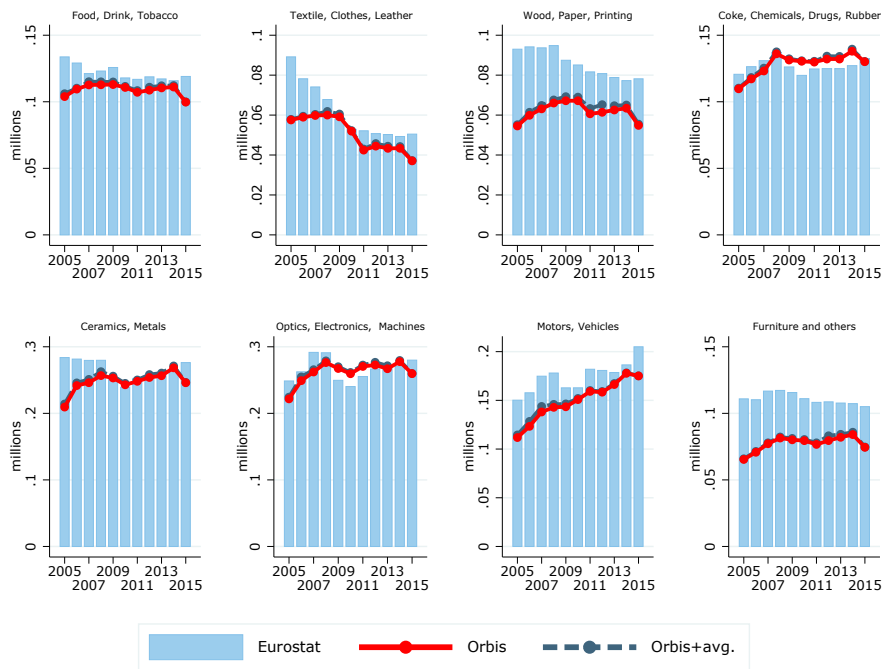


(a) Manufacturing

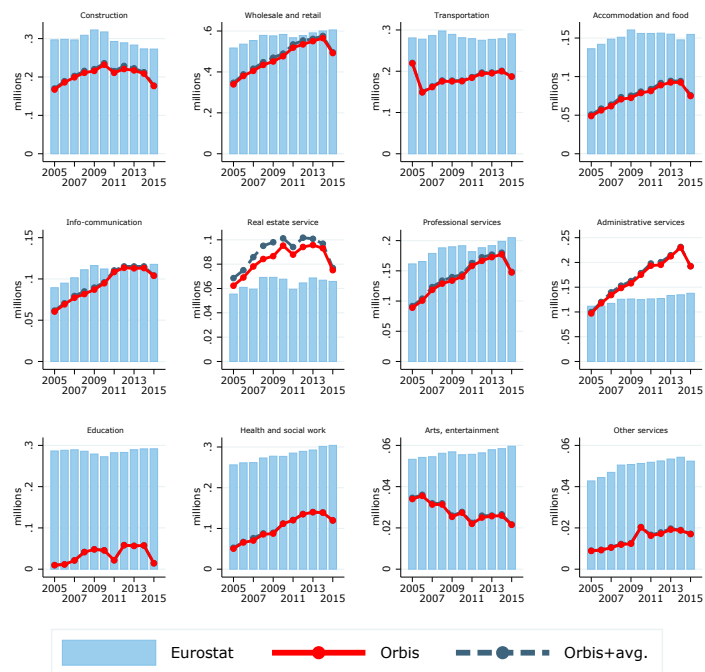
(b) Services (F-N)

Czech Republic - continued

Figure 4: Representativeness by Levels

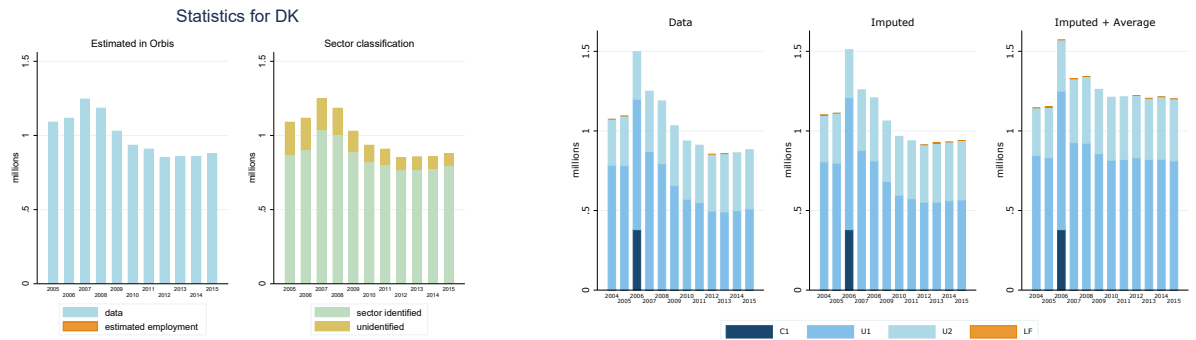


(a) Manufacturing



(b) Services (F-N)

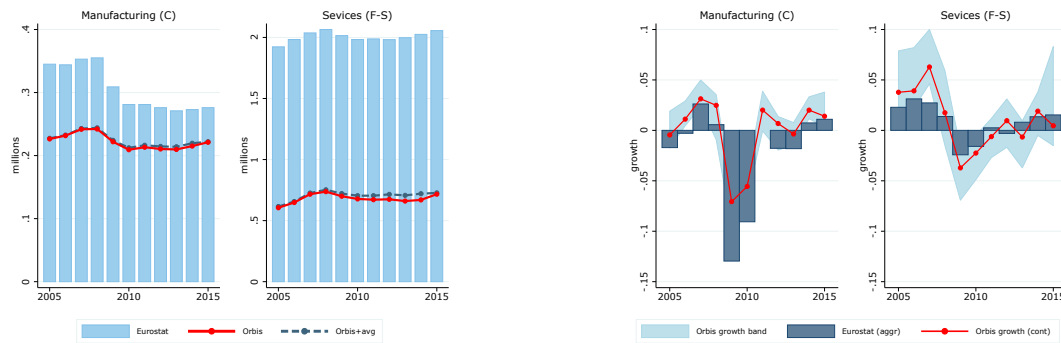
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

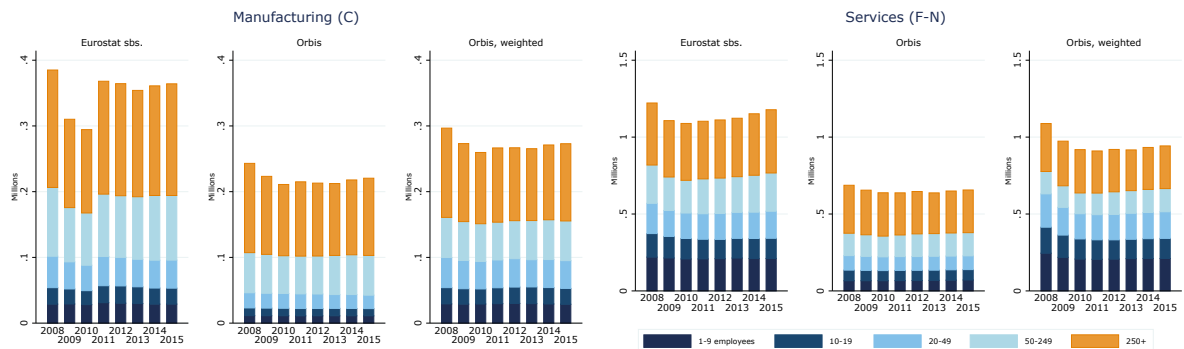
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

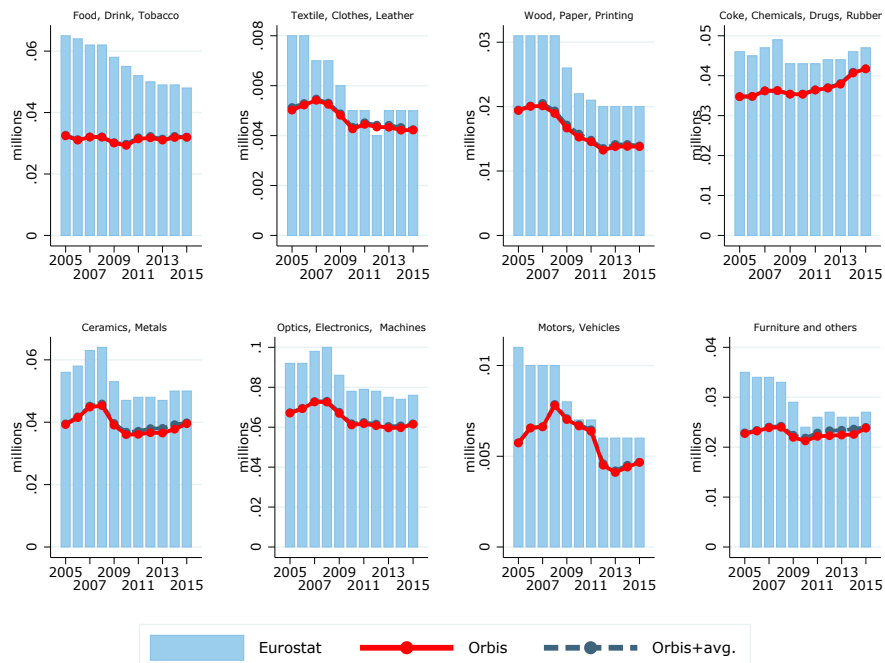


(a) Manufacturing

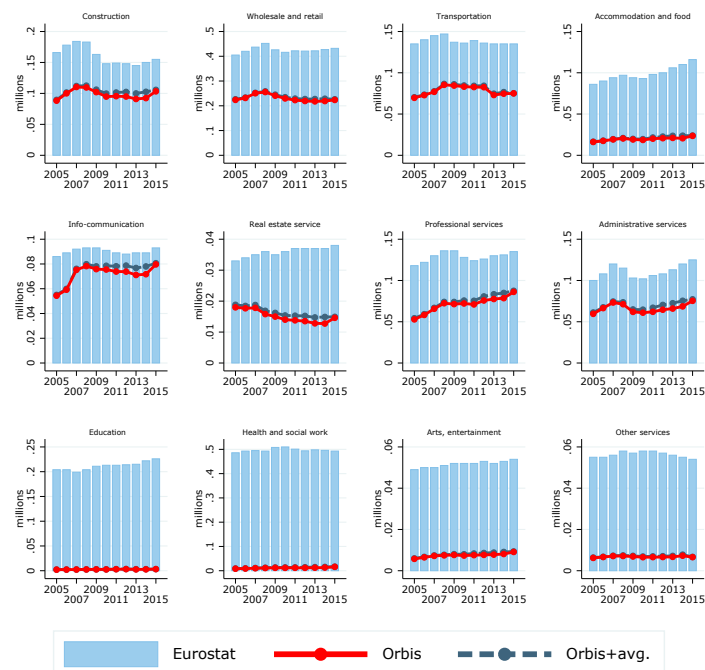
(b) Services (F-N)

Denmark - continued

Figure 4: Representativeness by Levels

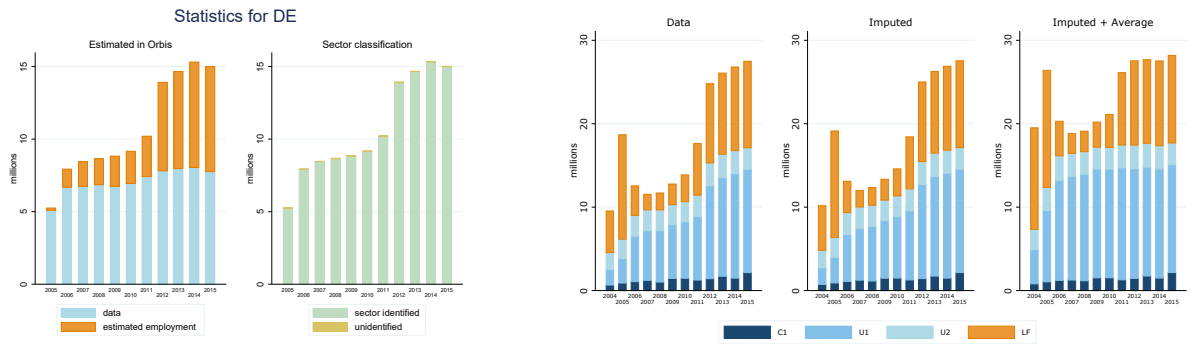


(a) Manufacturing



(b) Services (F-N)

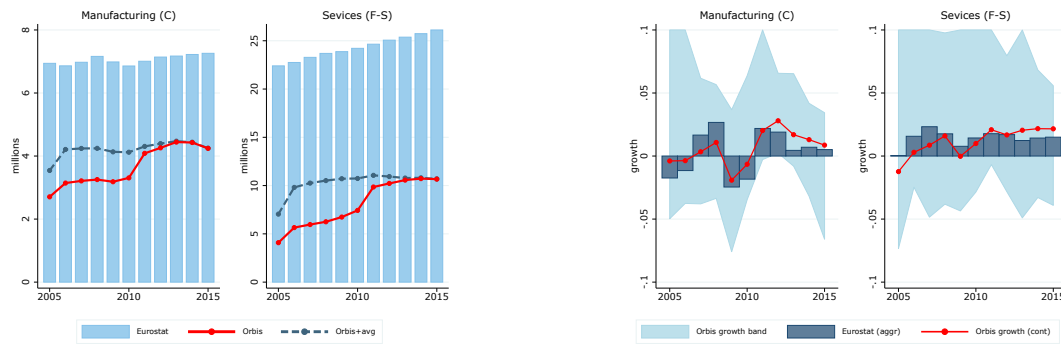
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

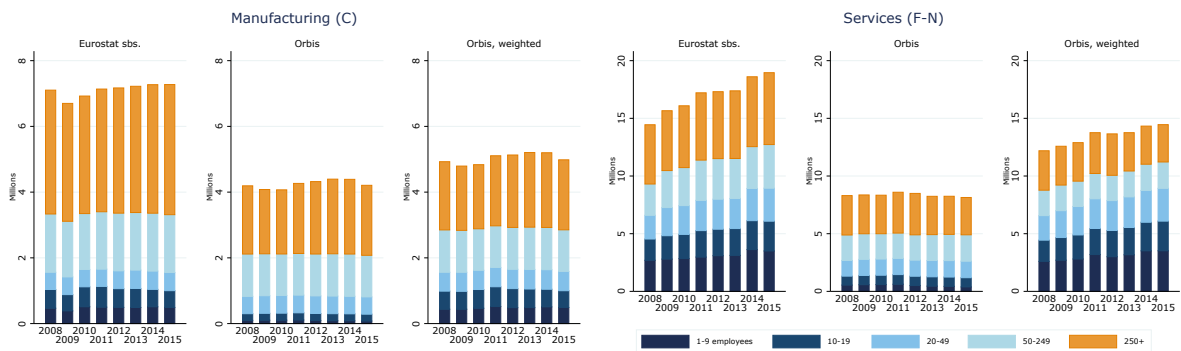
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

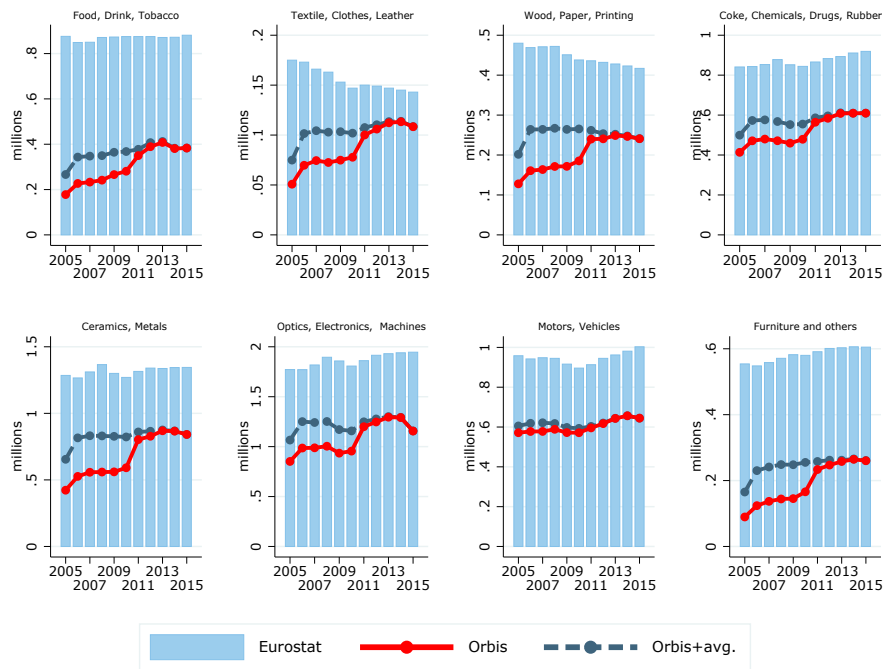


(a) Manufacturing

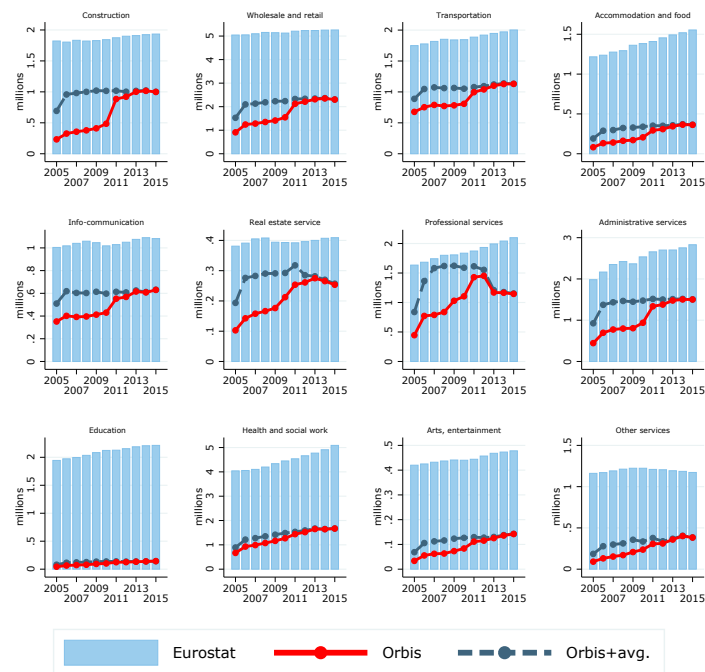
(b) Services (F-N)

Germany - continued

Figure 4: Representativeness by Levels

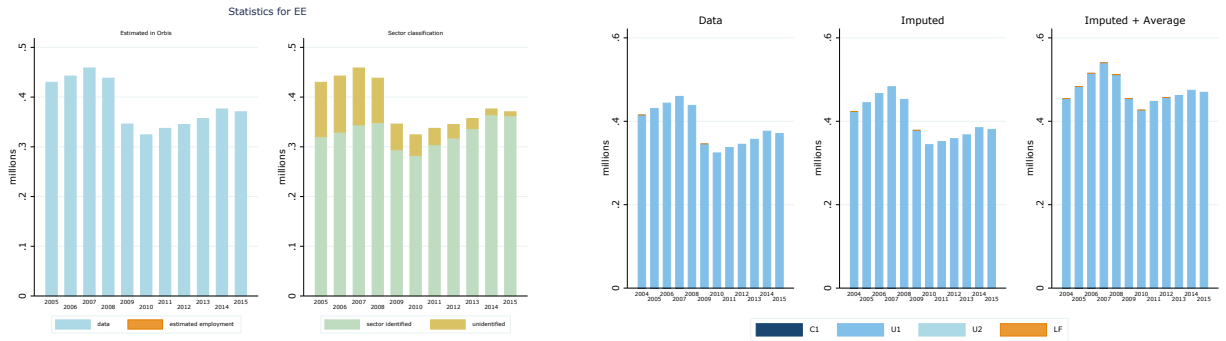


(a) Manufacturing



(b) Services (F-N)

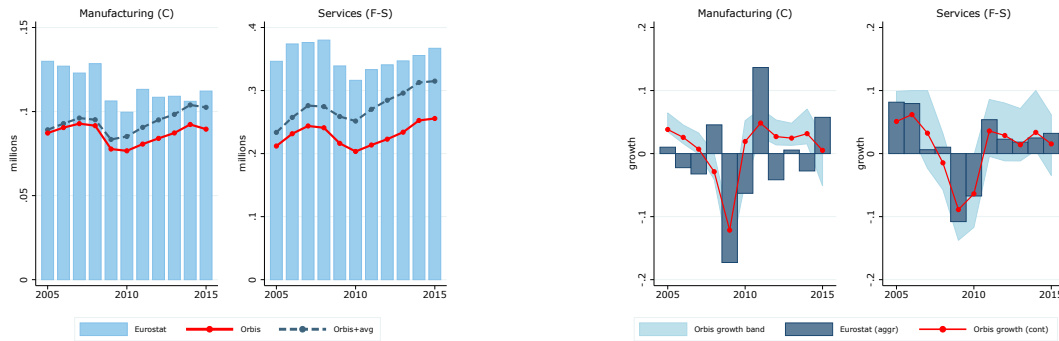
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

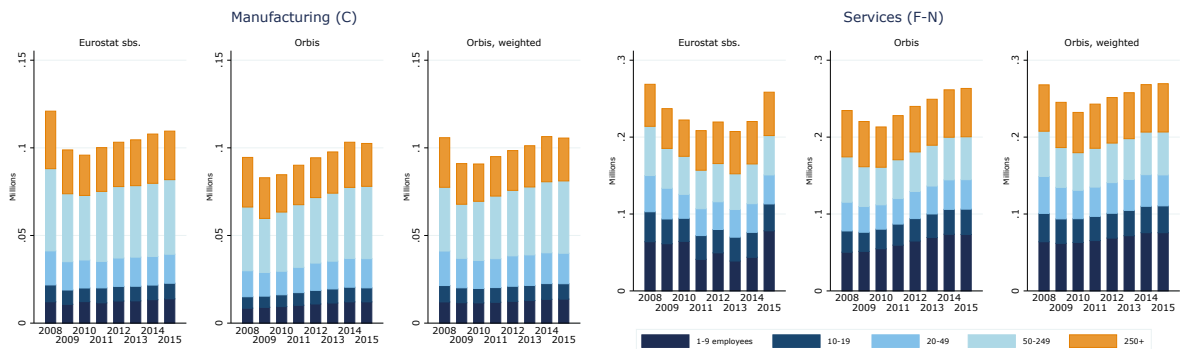
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

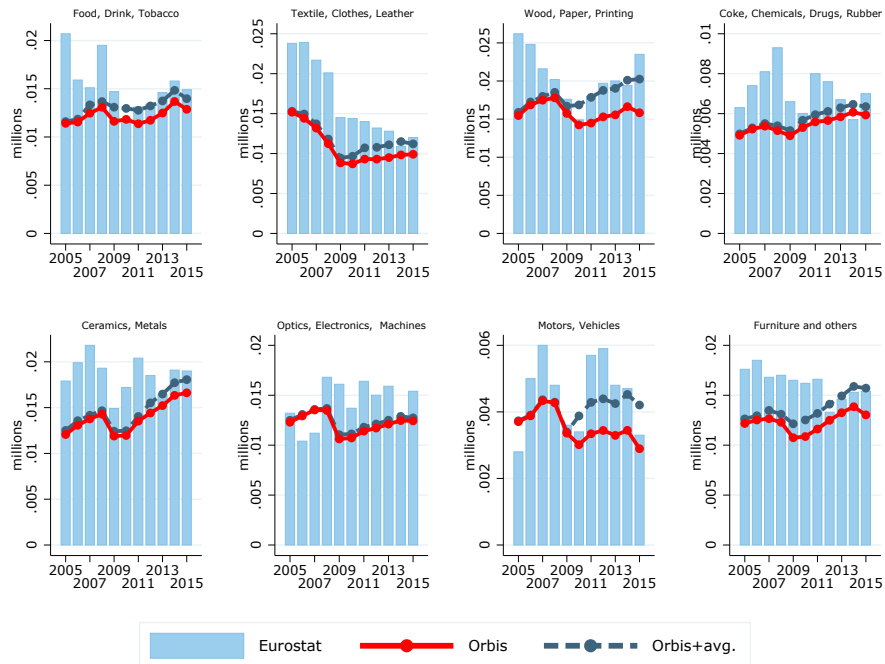


(a) Manufacturing

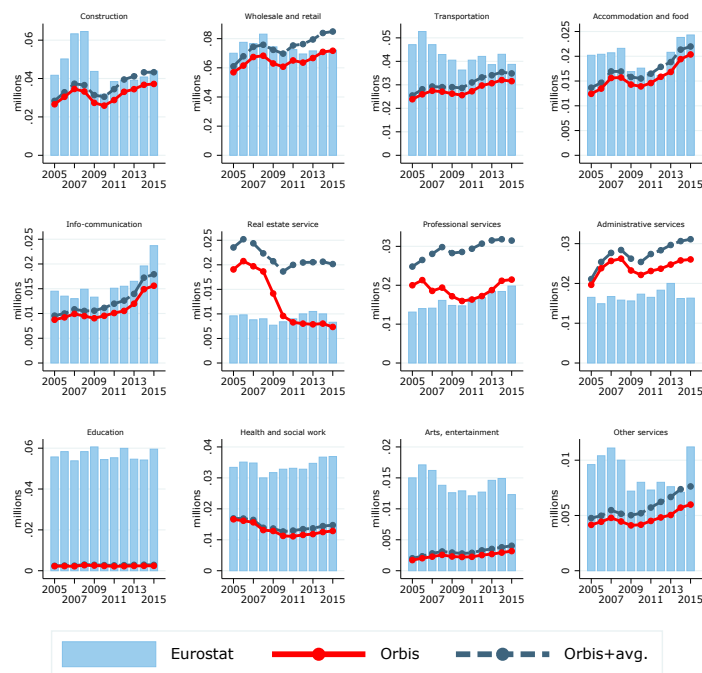
(b) Services (F-N)

Estonia - continued

Figure 4: Representativeness by Levels

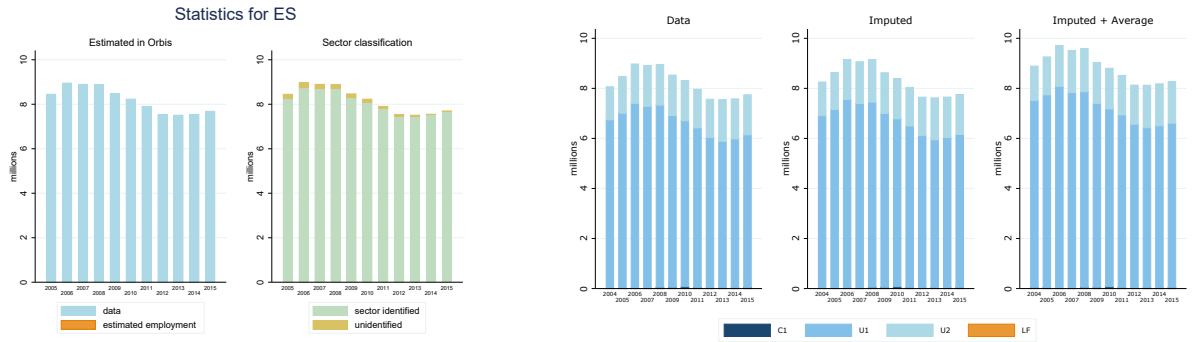


(a) Manufacturing



(b) Services (F-N)

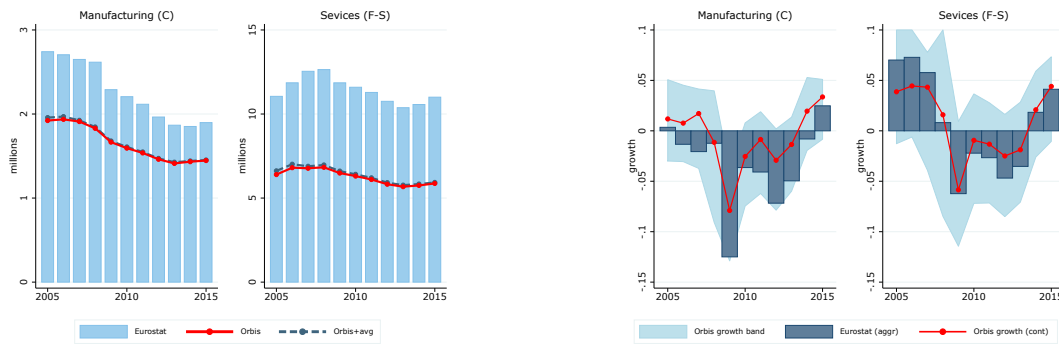
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

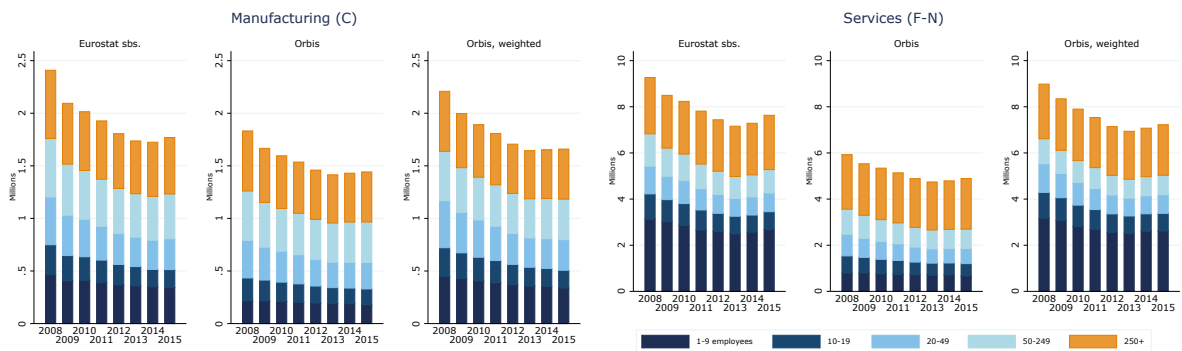
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

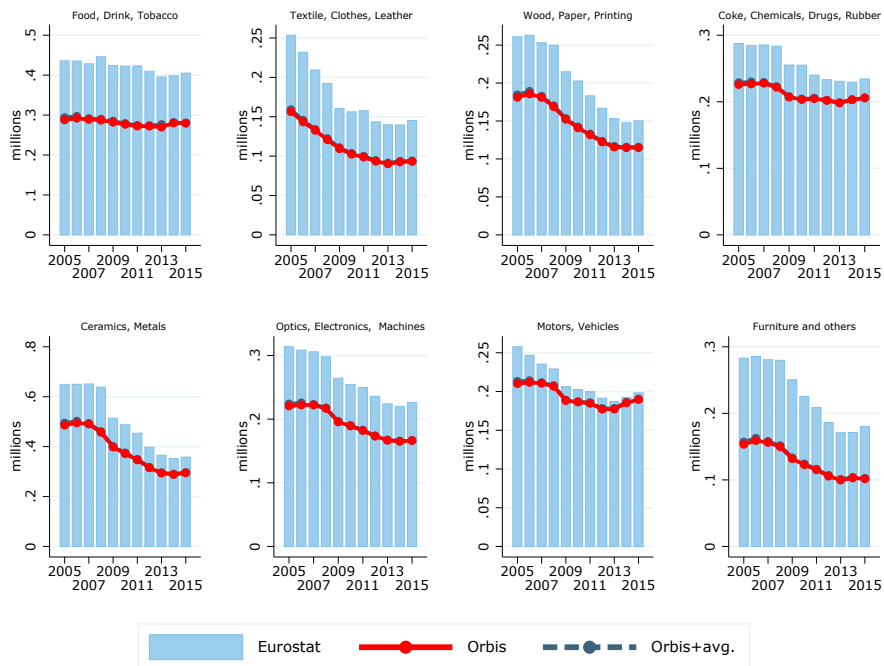


(a) Manufacturing

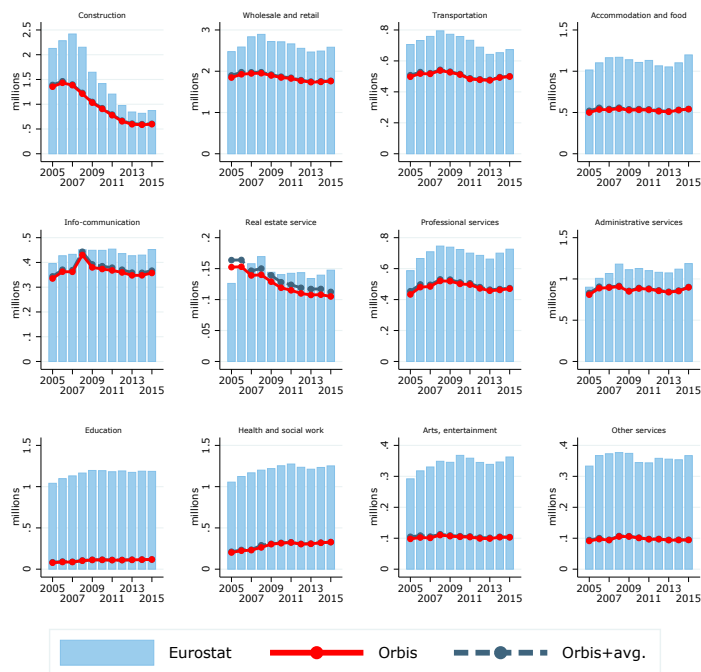
(b) Services (F-N)

Spain - continued

Figure 4: Representativeness by Levels

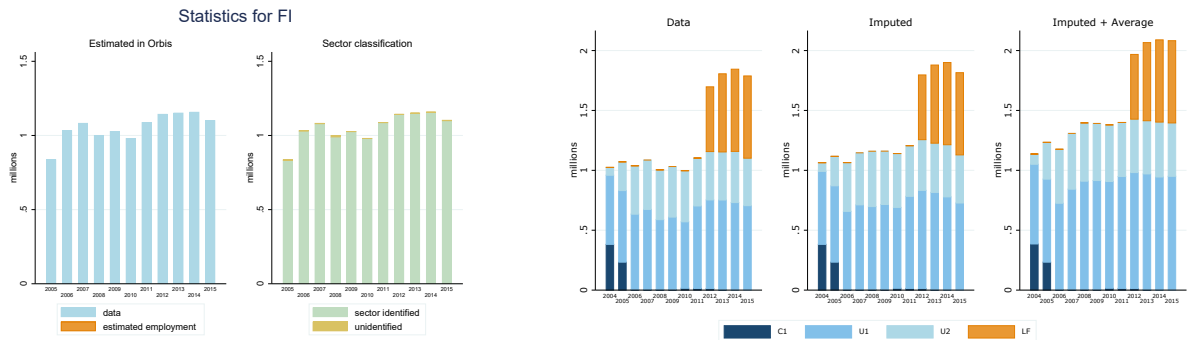


(a) Manufacturing



(b) Services (F-N)

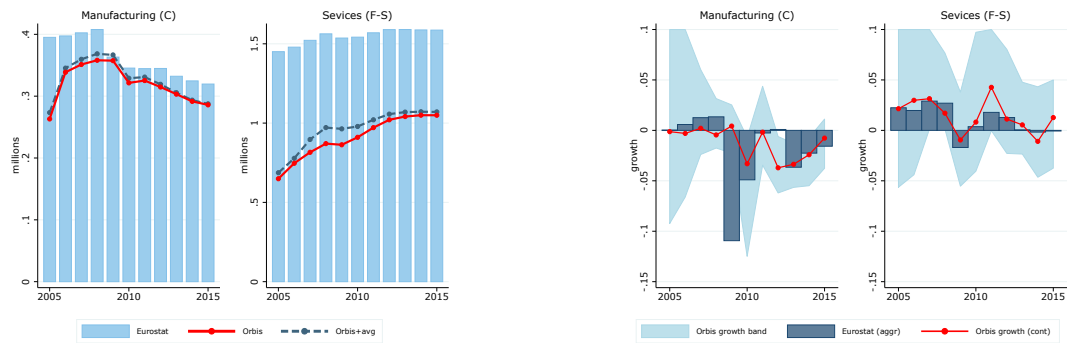
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

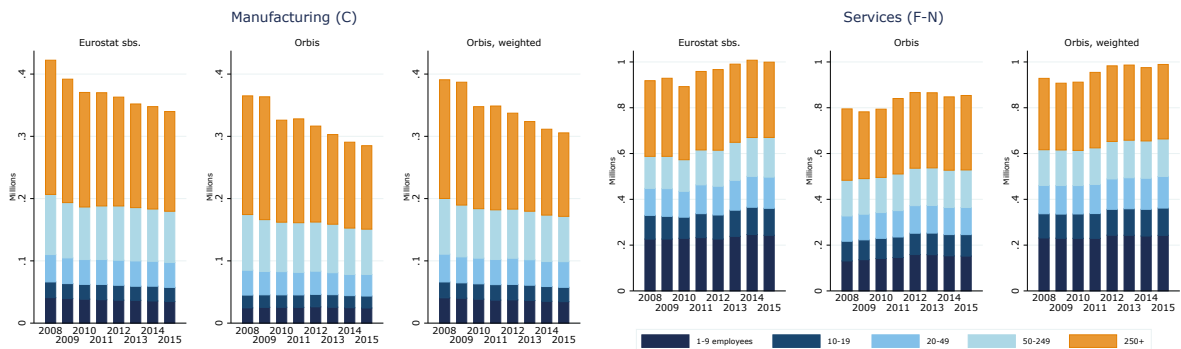
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

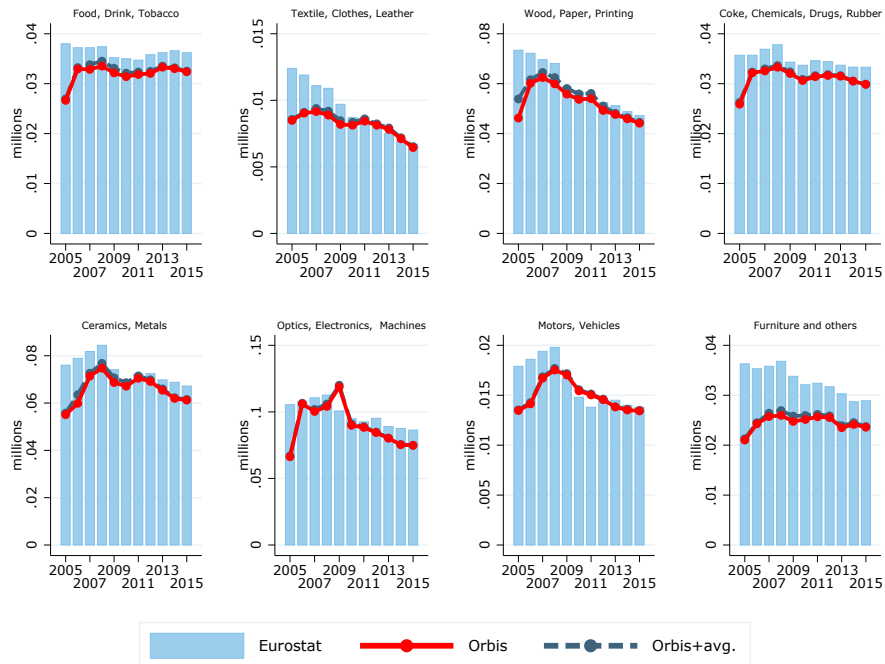


(a) Manufacturing

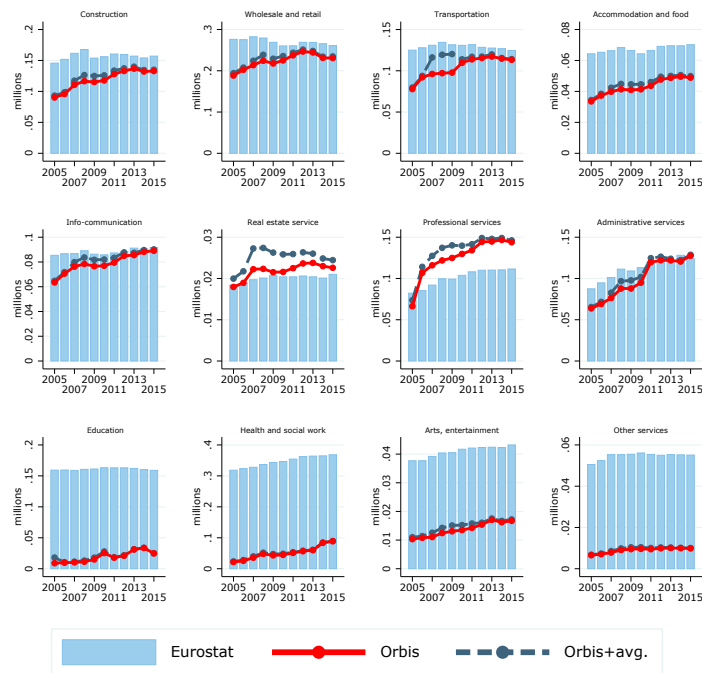
(b) Services (F-N)

Finland - continued

Figure 4: Representativeness by Levels

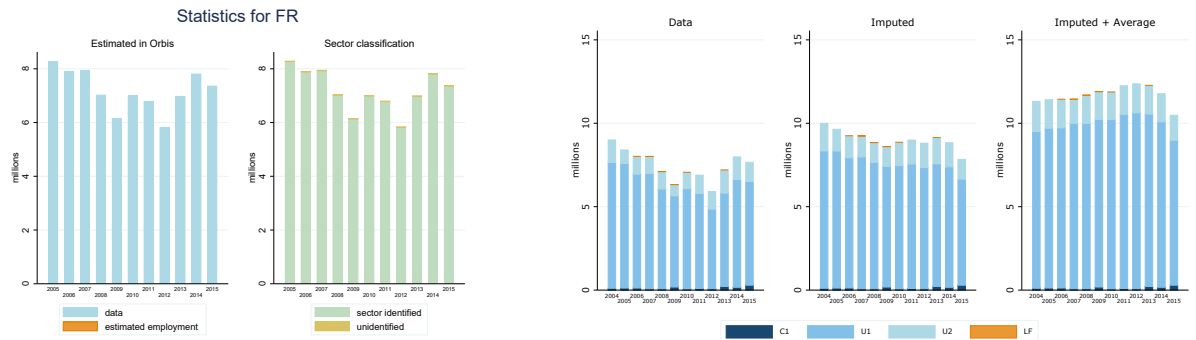


(a) Manufacturing



(b) Services (F-N)

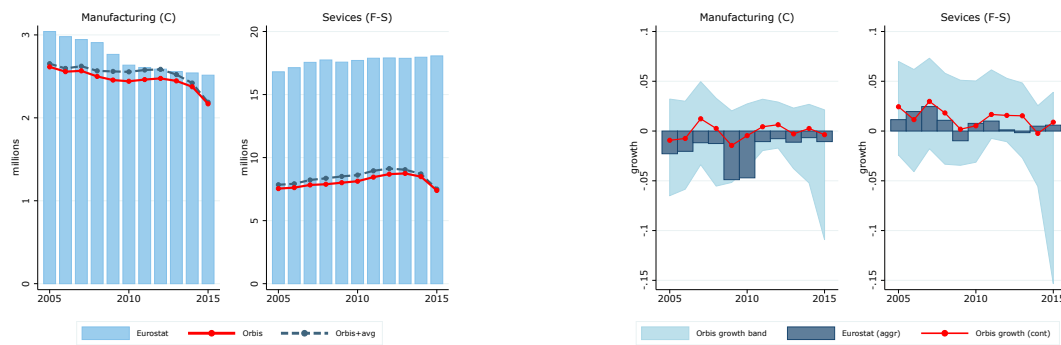
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

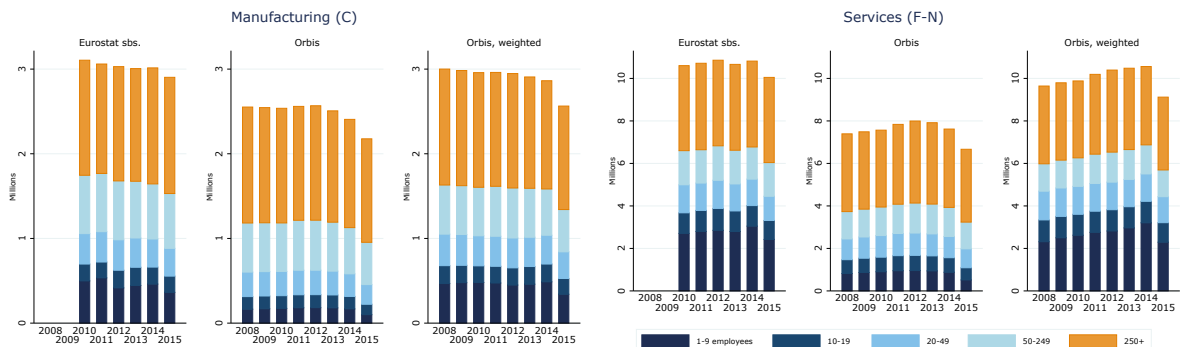
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

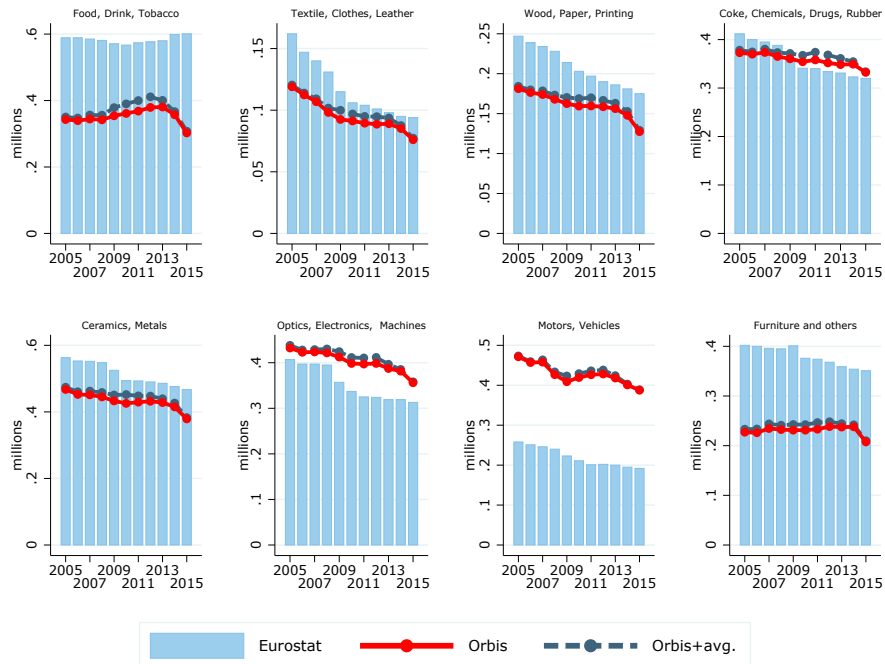
Figure 3: Representativeness by Size Category



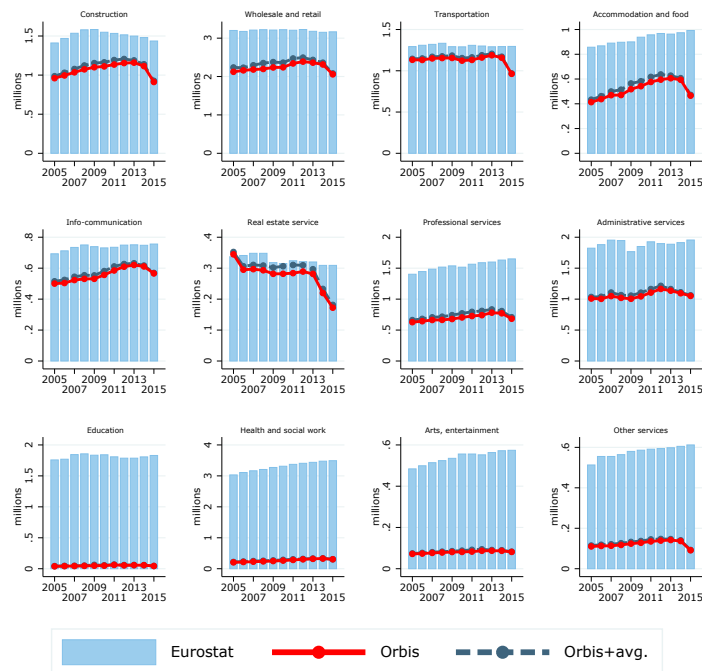
(a) Manufacturing

(b) Services (F-N)

Figure 4: Representativeness by Levels



(a) Manufacturing



(b) Services (F-N)

United Kingdom

Figure 1: Employment in Orbis

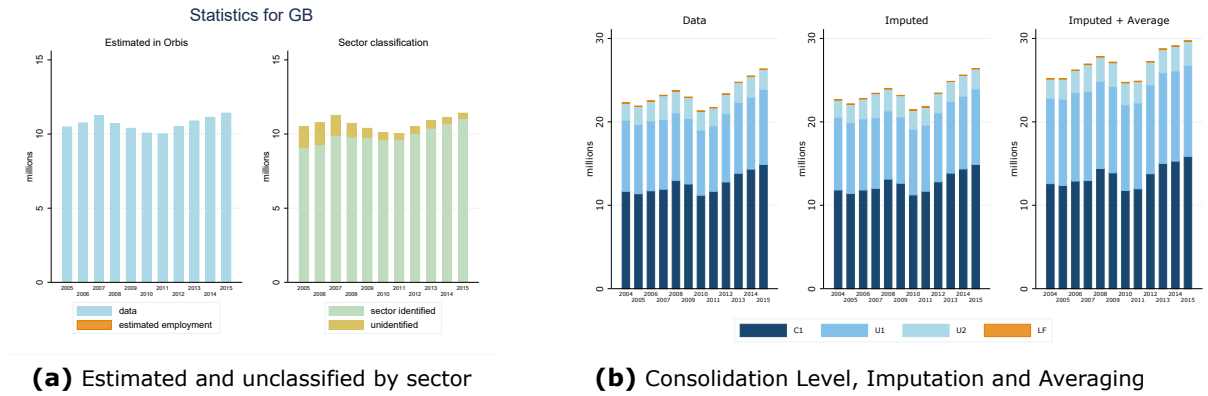


Figure 2: Representativeness by Levels and Dynamics

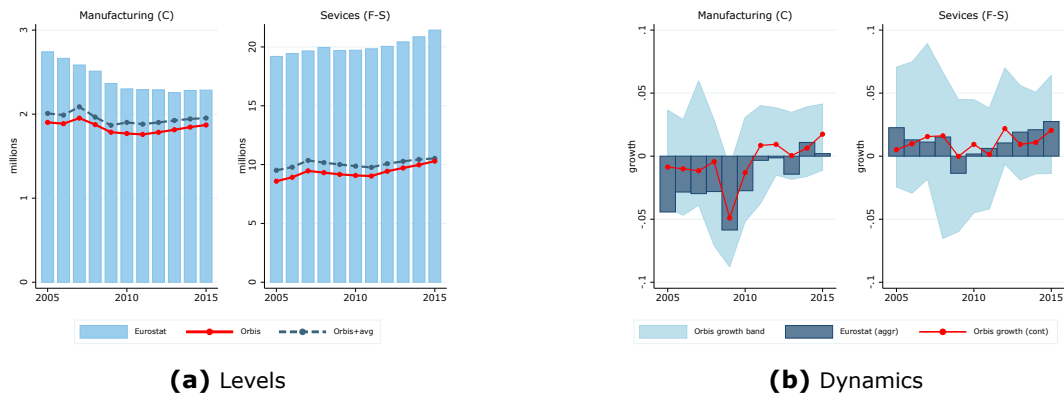
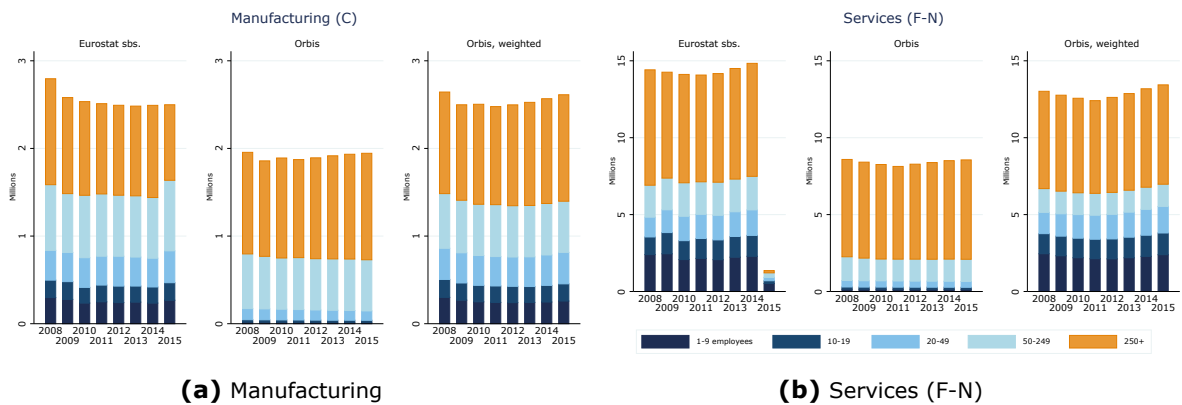
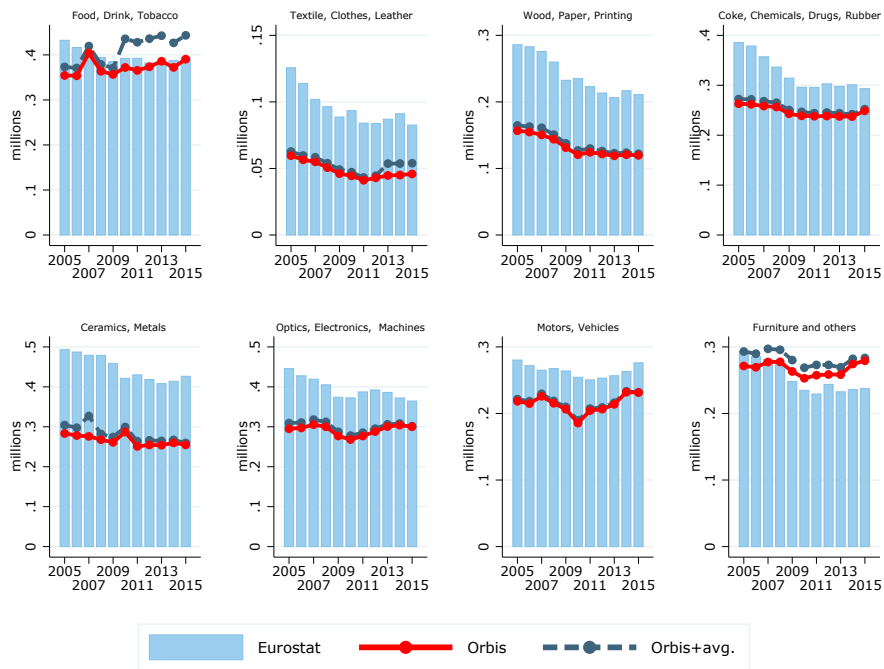


Figure 3: Representativeness by Size Category

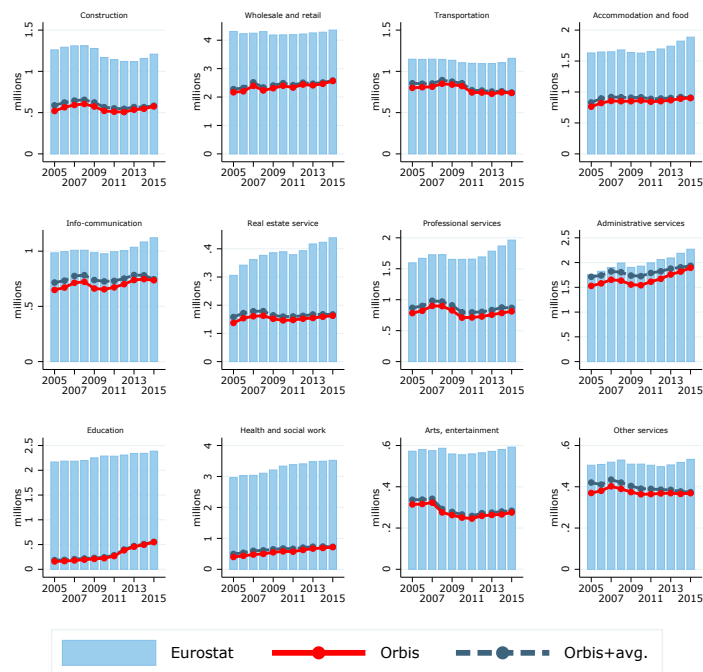


United Kingdom - continued

Figure 4: Representativeness by Levels

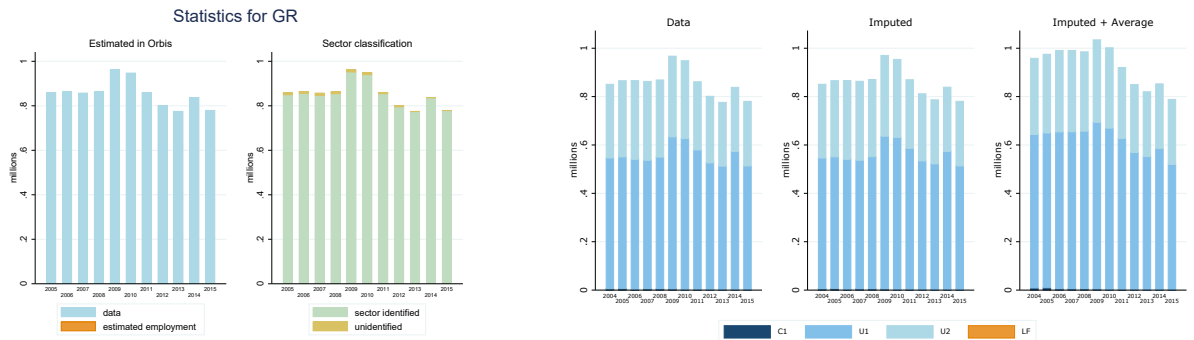


(a) Manufacturing



(b) Services (F-N)

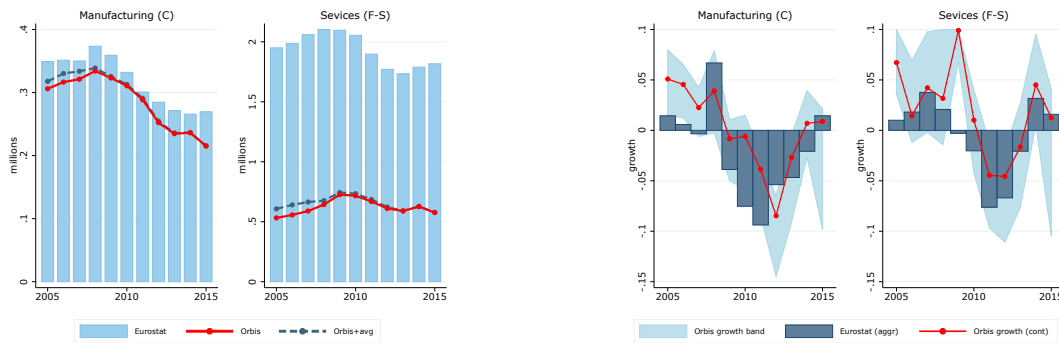
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

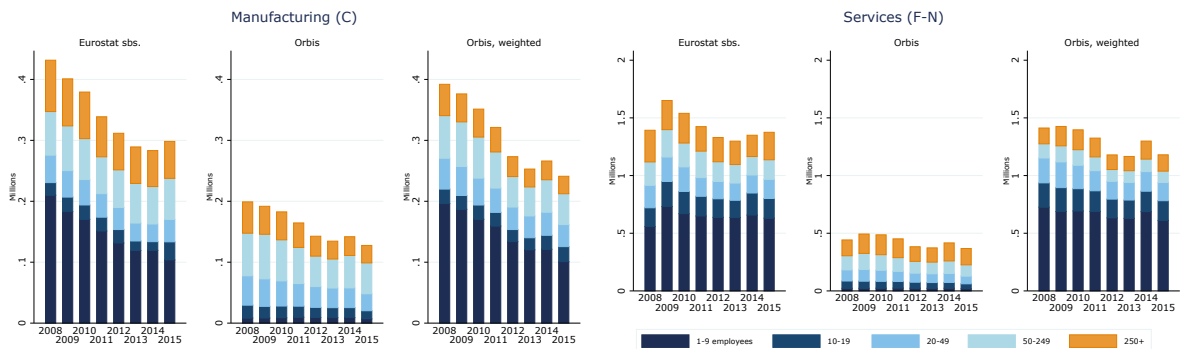
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

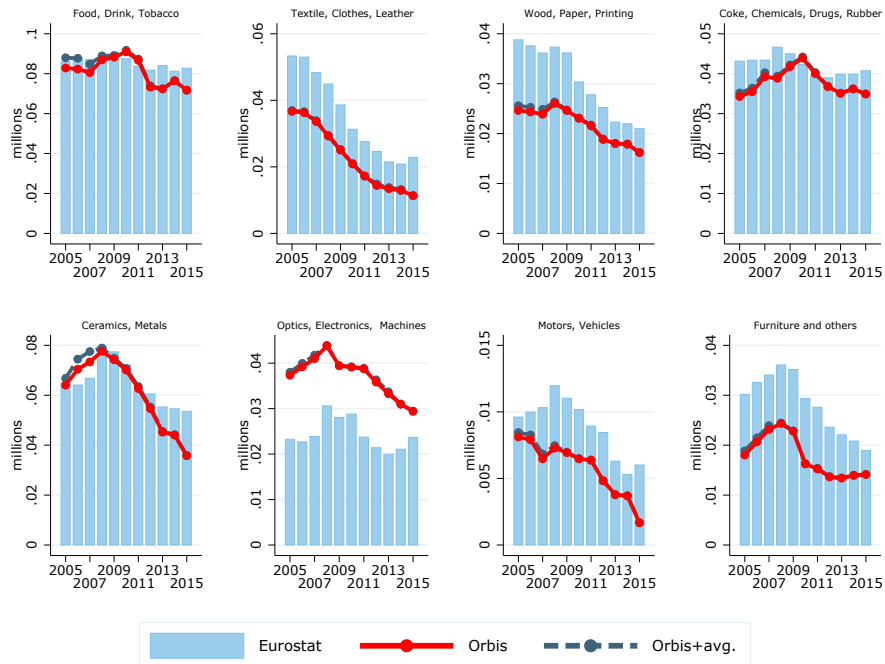


(a) Manufacturing

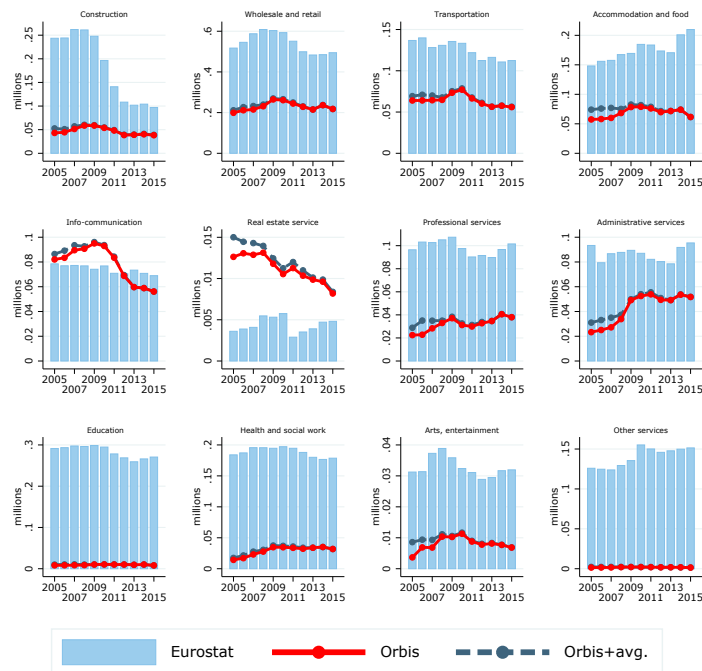
(b) Services (F-N)

Greece - continued

Figure 4: Representativeness by Levels

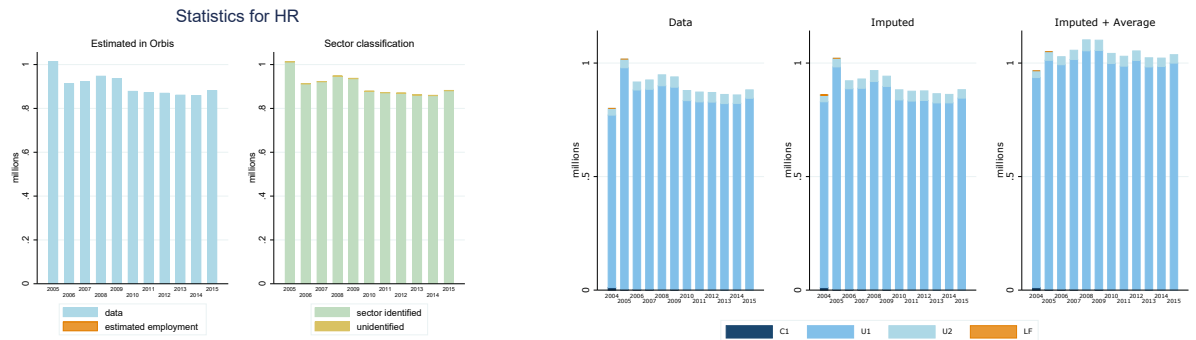


(a) Manufacturing



(b) Services (F-N)

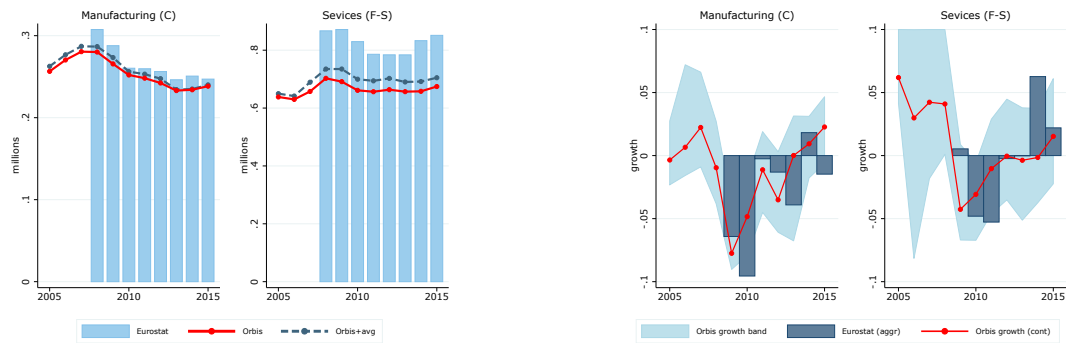
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

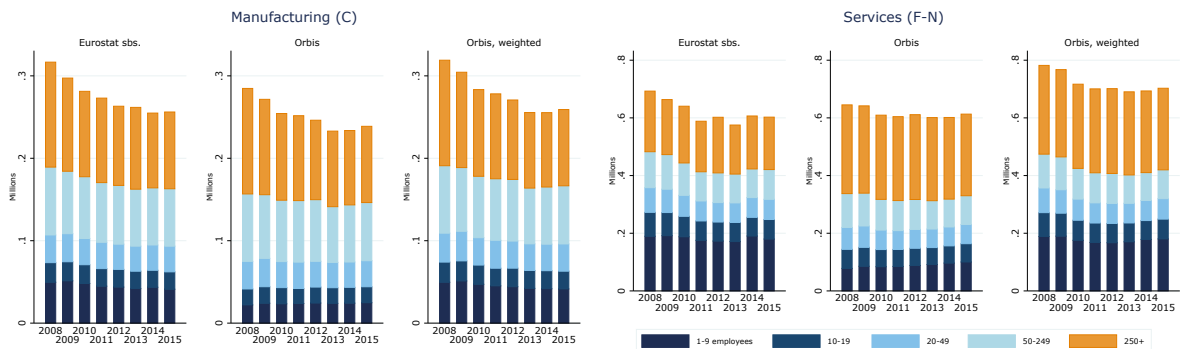
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

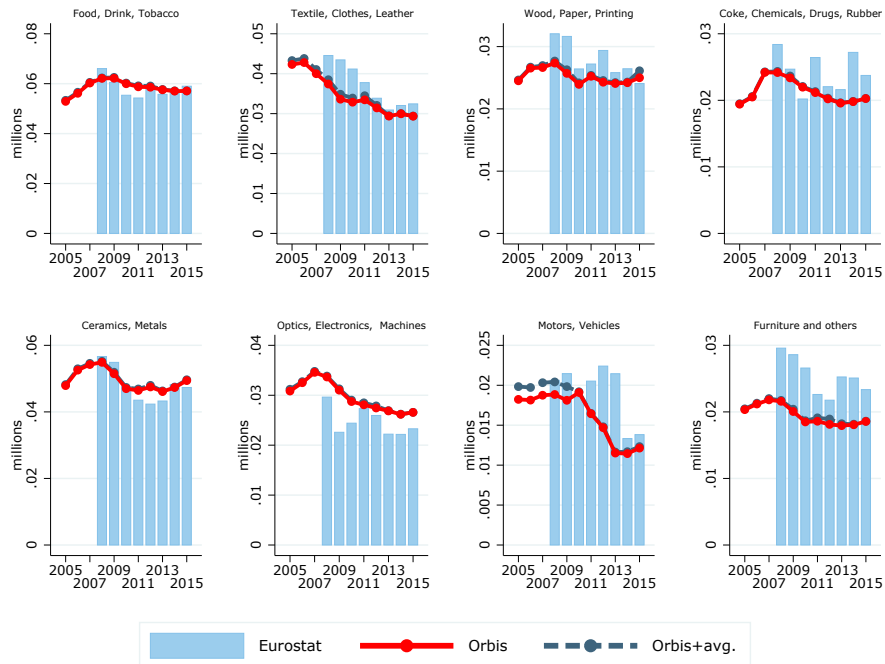


(a) Manufacturing

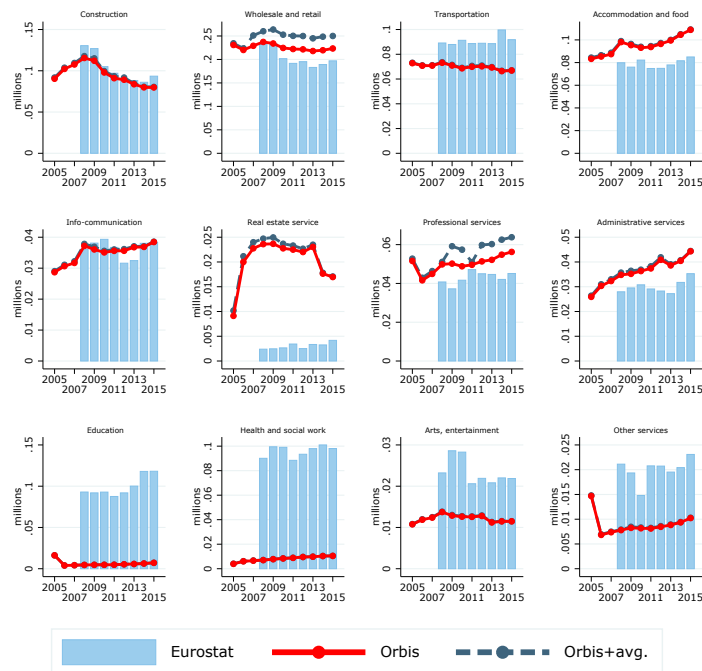
(b) Services (F-N)

Greece - continued

Figure 4: Representativeness by Levels

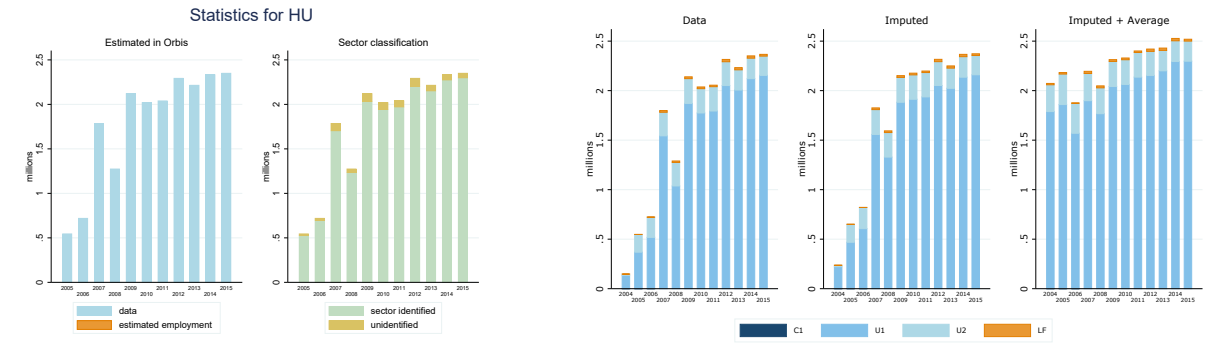


(a) Manufacturing



(b) Services (F-N)

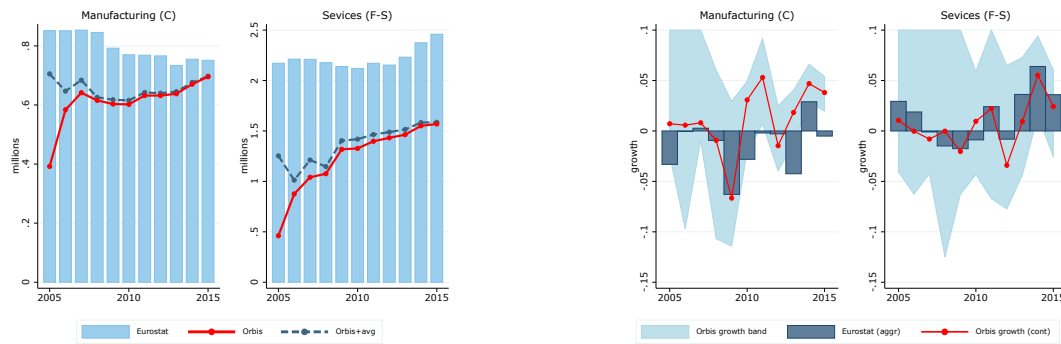
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

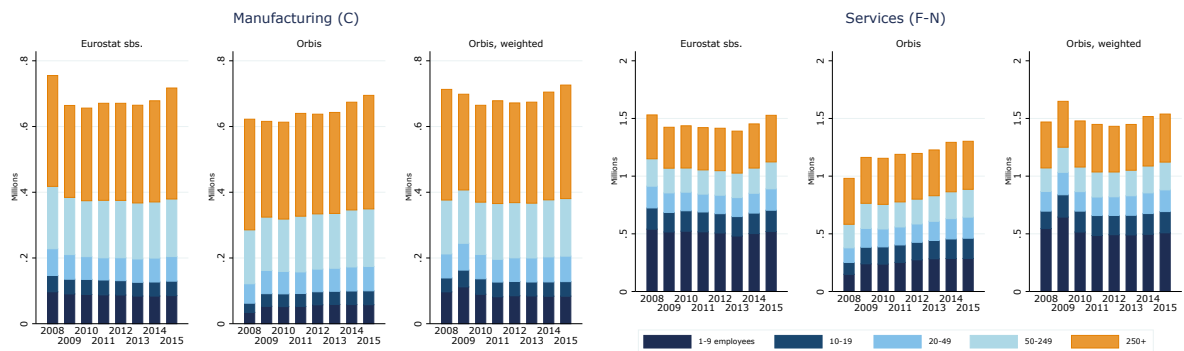
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

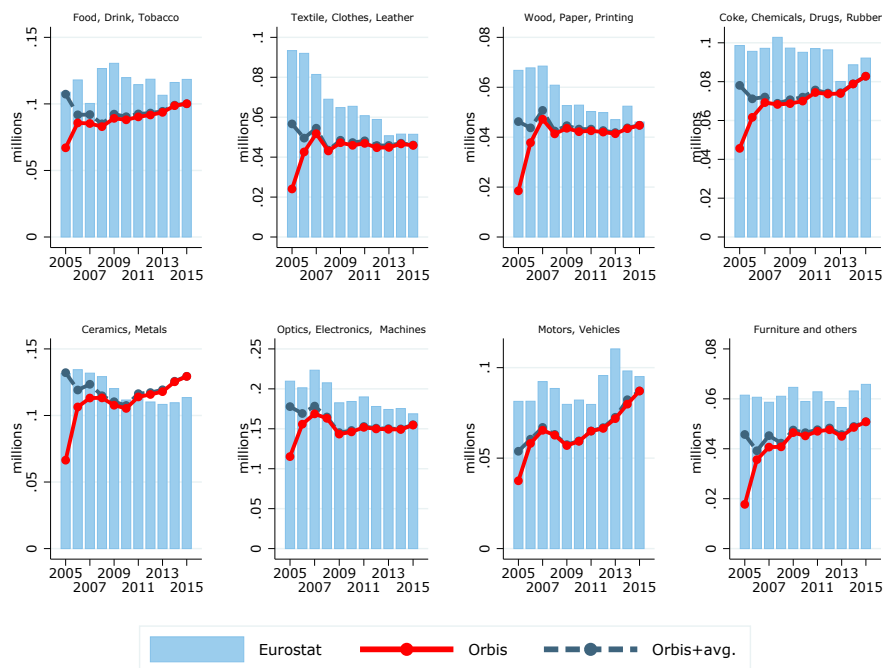


(a) Manufacturing

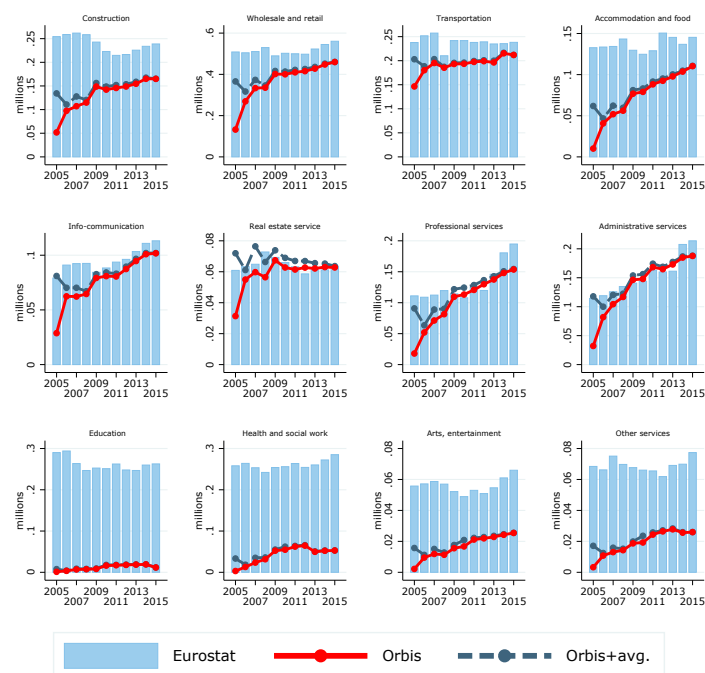
(b) Services (F-N)

Hungary - continued

Figure 4: Representativeness by Levels

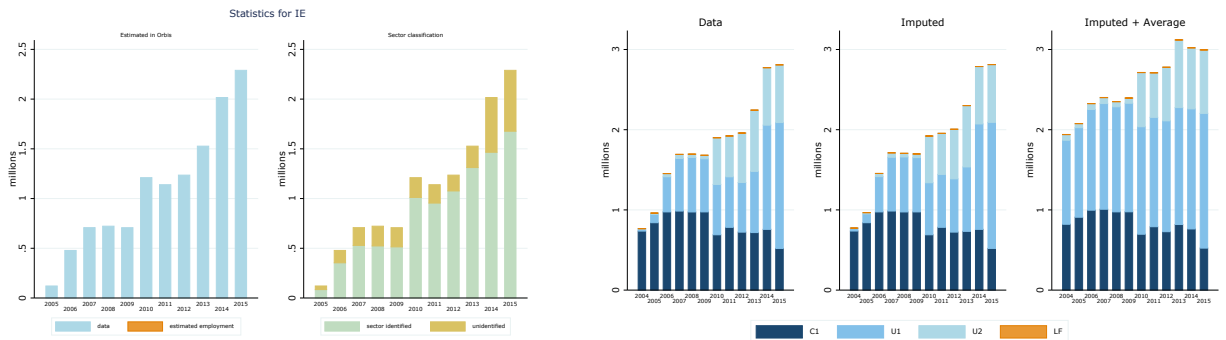


(a) Manufacturing



(b) Services (F-N)

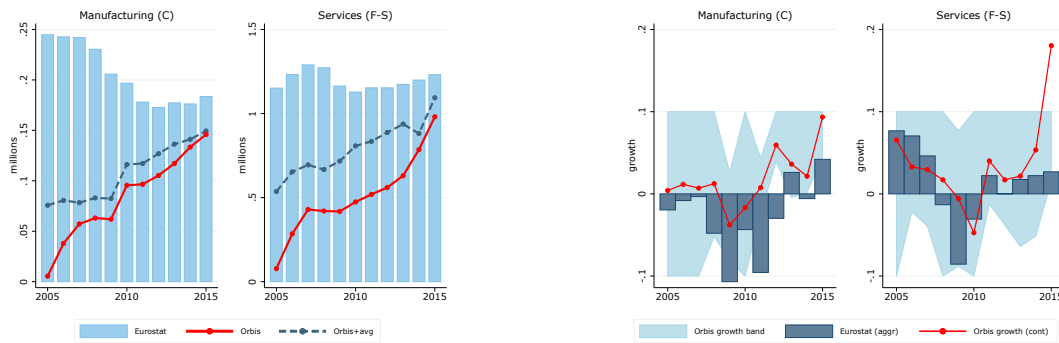
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

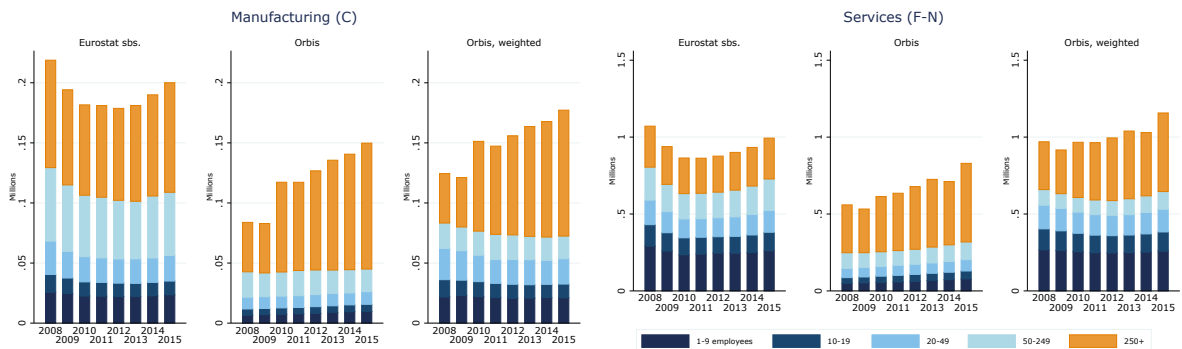
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

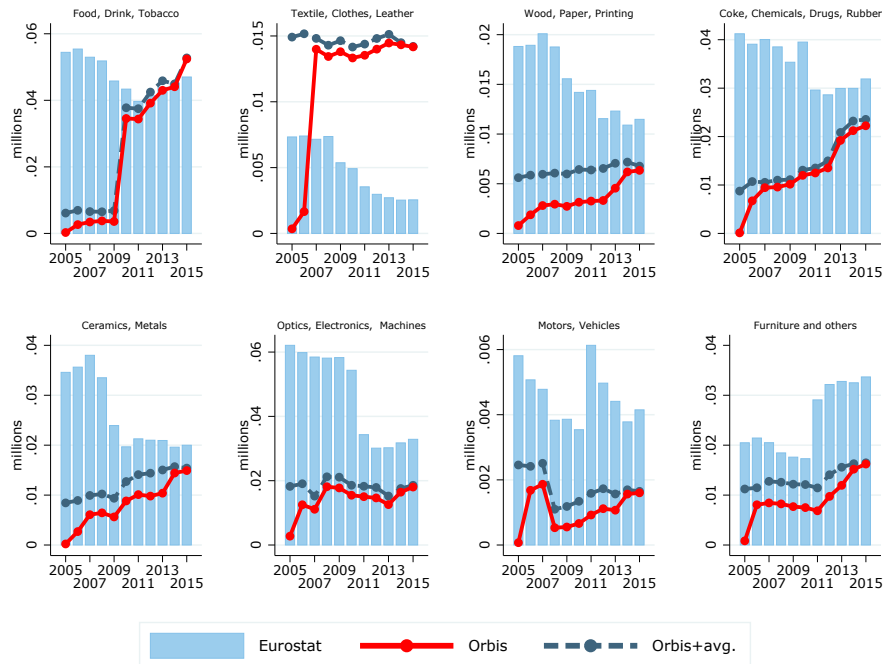


(a) Manufacturing

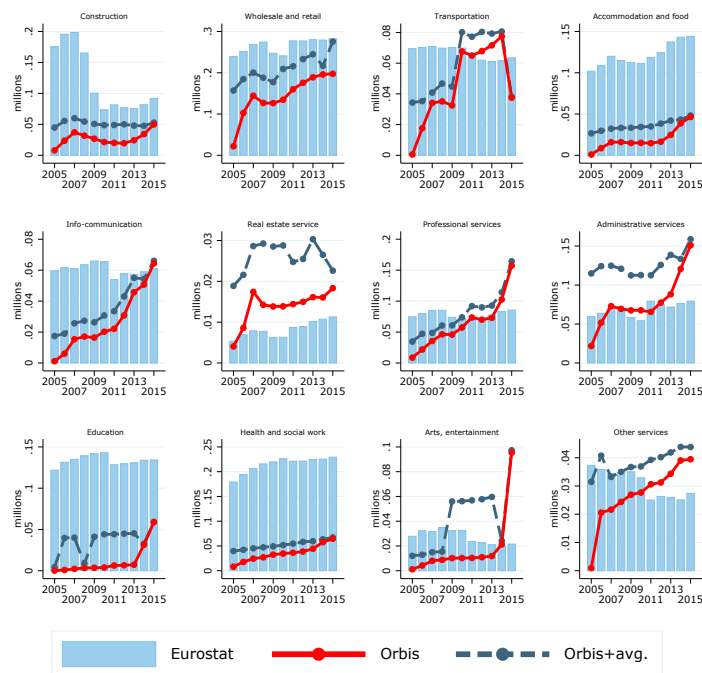
(b) Services (F-N)

Ireland - continued

Figure 4: Representativeness by Levels

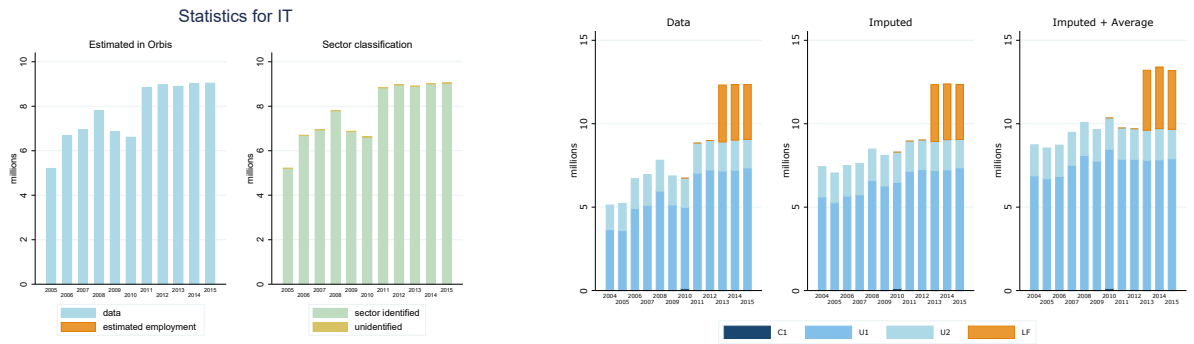


(a) Manufacturing



(b) Services (F-N)

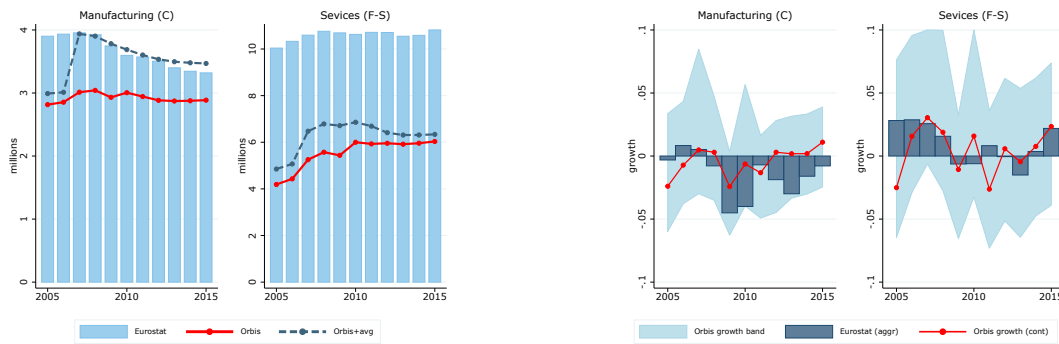
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

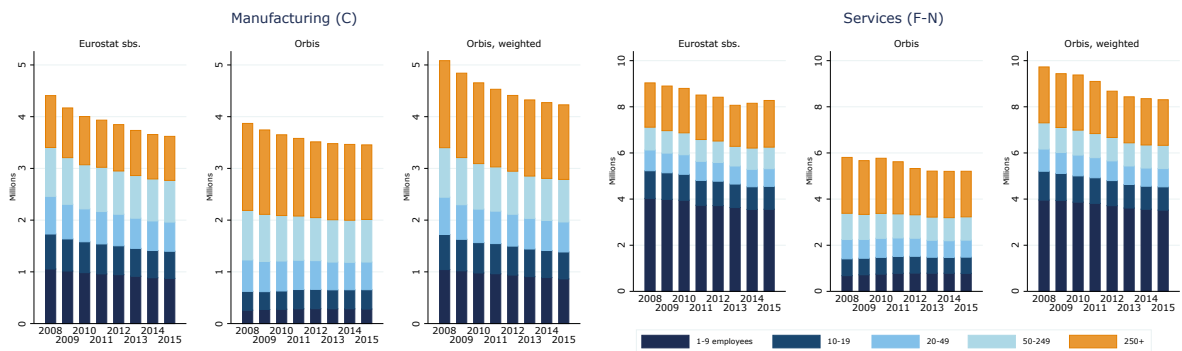
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

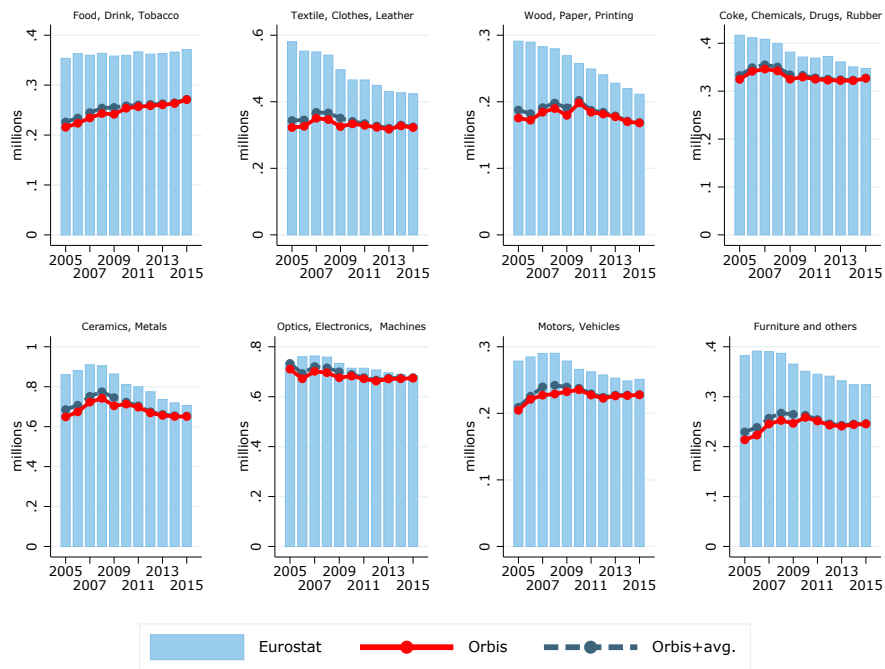


(a) Manufacturing

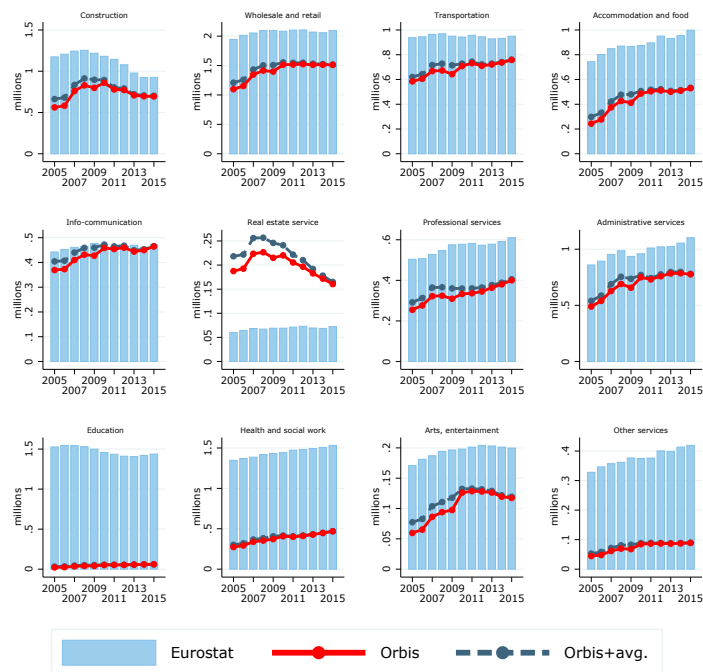
(b) Services (F-N)

Italy - continued

Figure 4: Representativeness by Levels

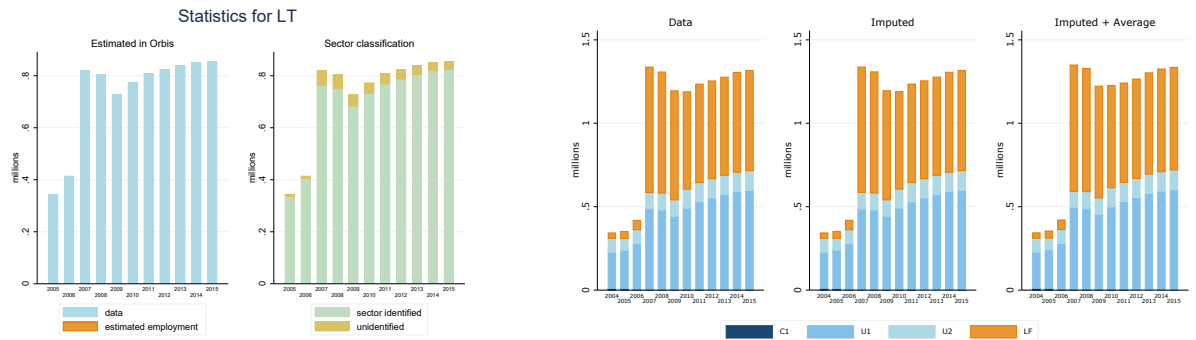


(a) Manufacturing



(b) Services (F-N)

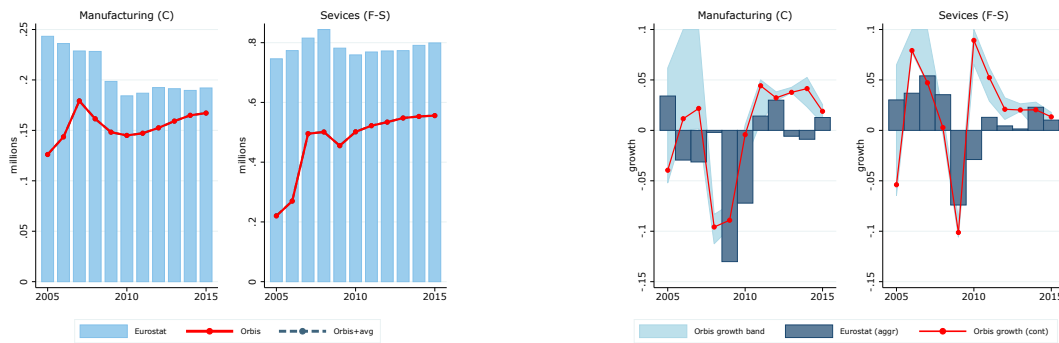
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

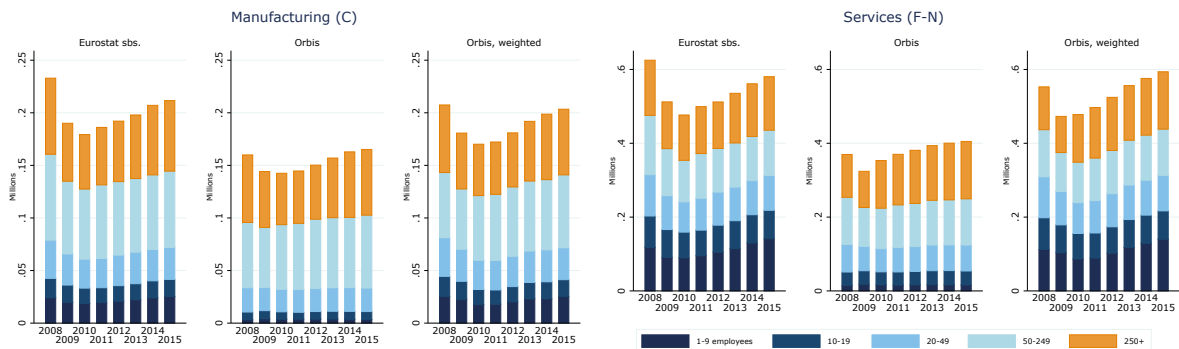
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

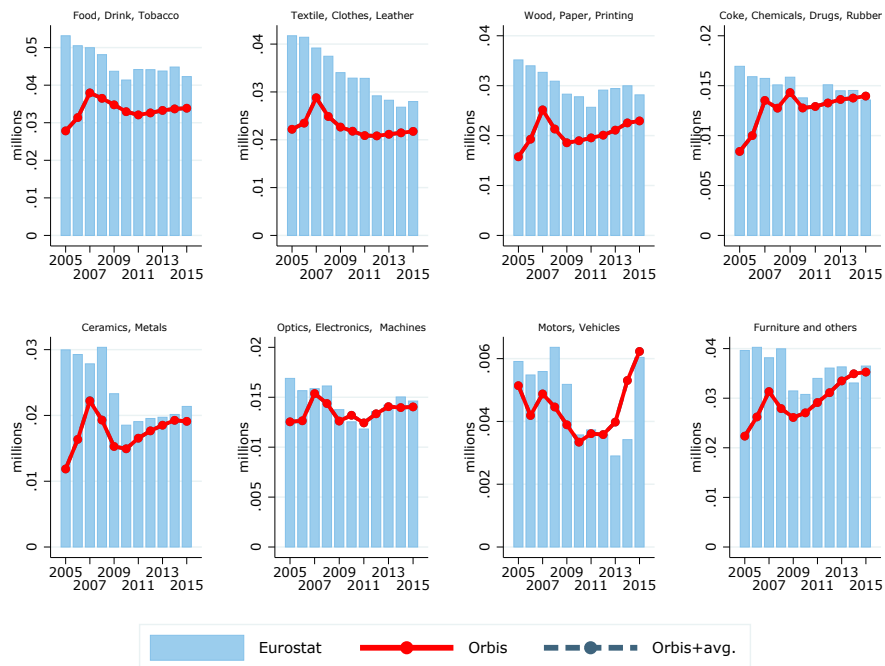
Figure 3: Representativeness by Size Category



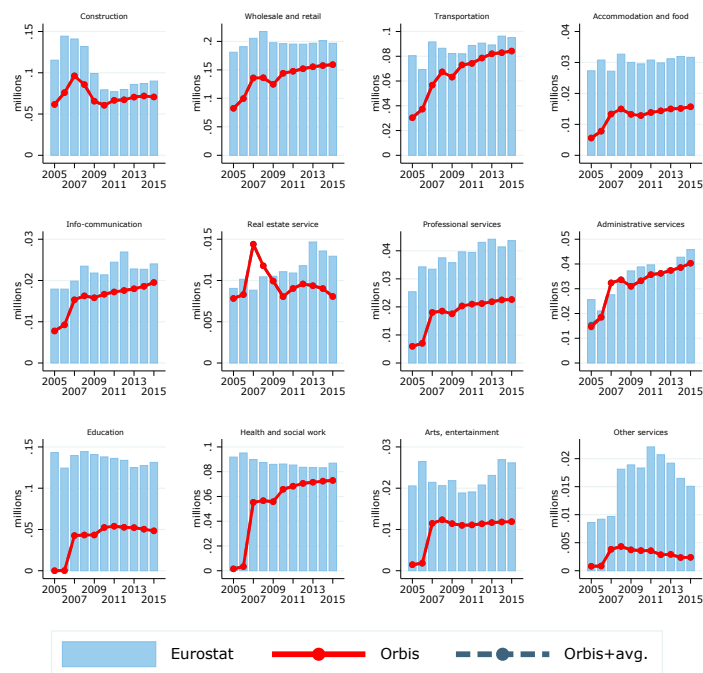
(a) Manufacturing

(b) Services (F-N)

Figure 4: Representativeness by Levels

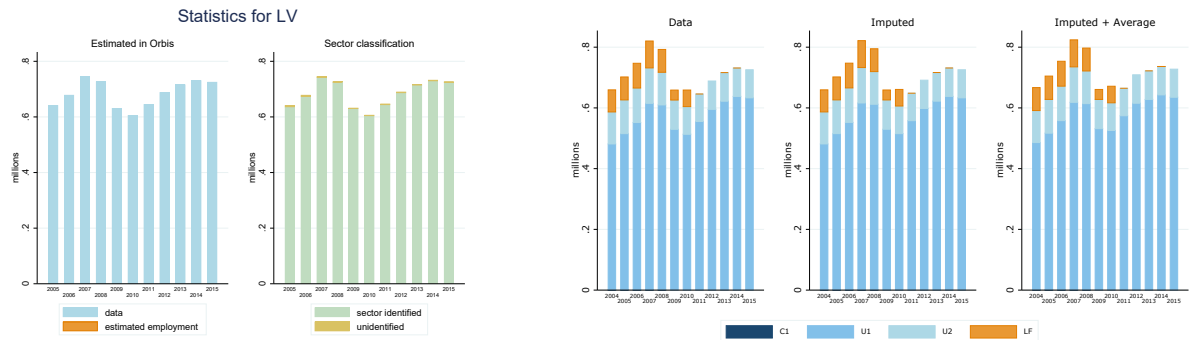


(a) Manufacturing



(b) Services (F-N)

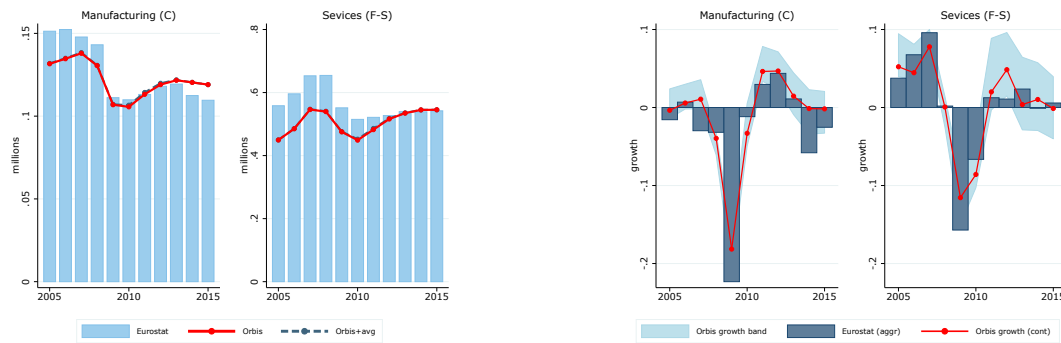
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

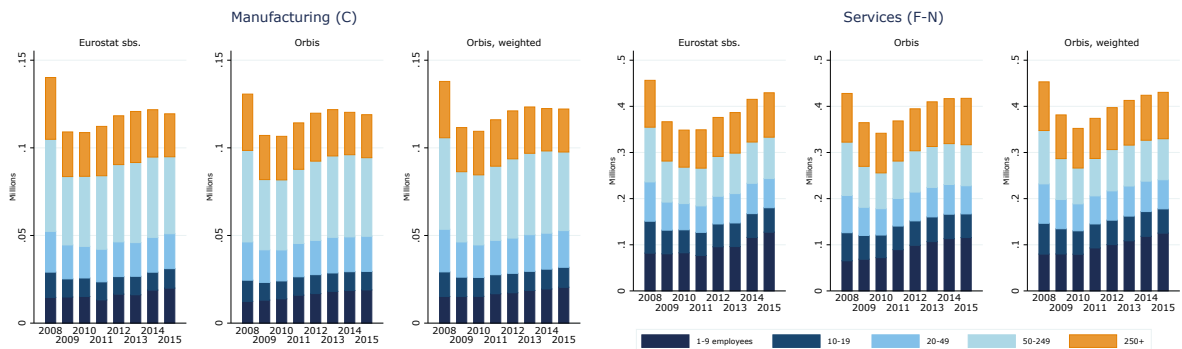
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

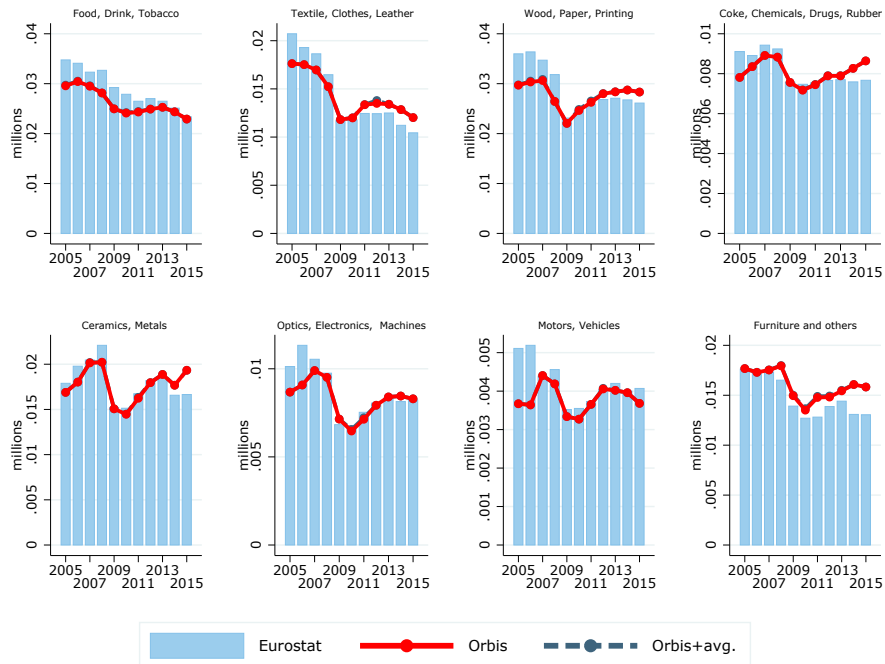
Figure 3: Representativeness by Size Category



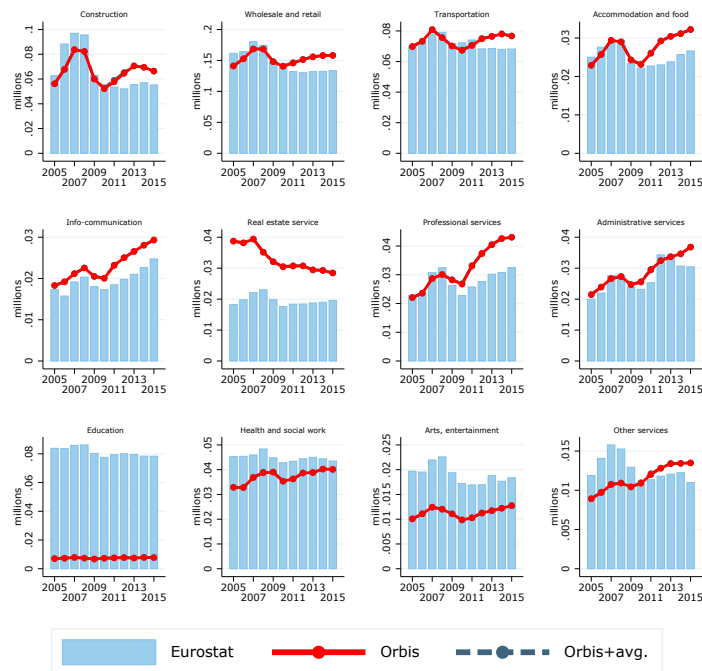
(a) Manufacturing

(b) Services (F-N)

Figure 4: Representativeness by Levels

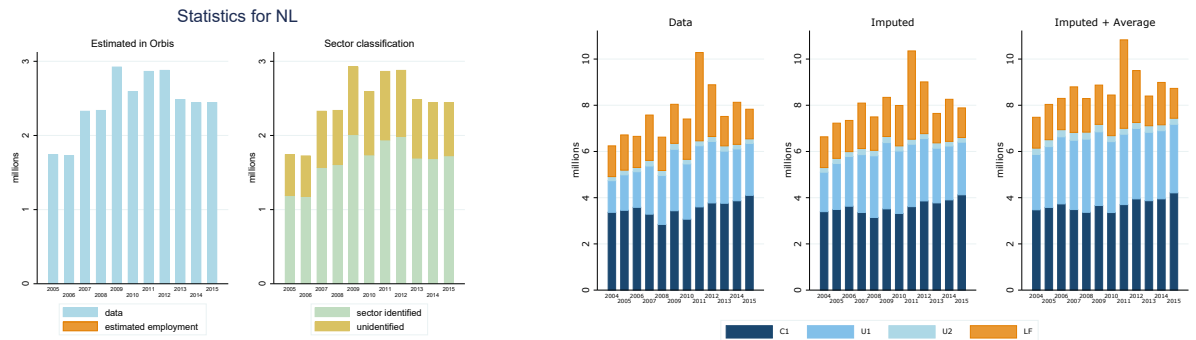


(a) Manufacturing



(b) Services (F-N)

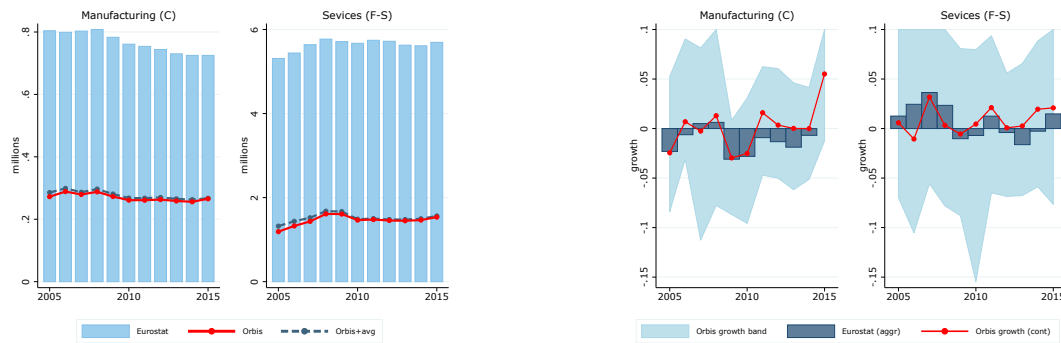
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

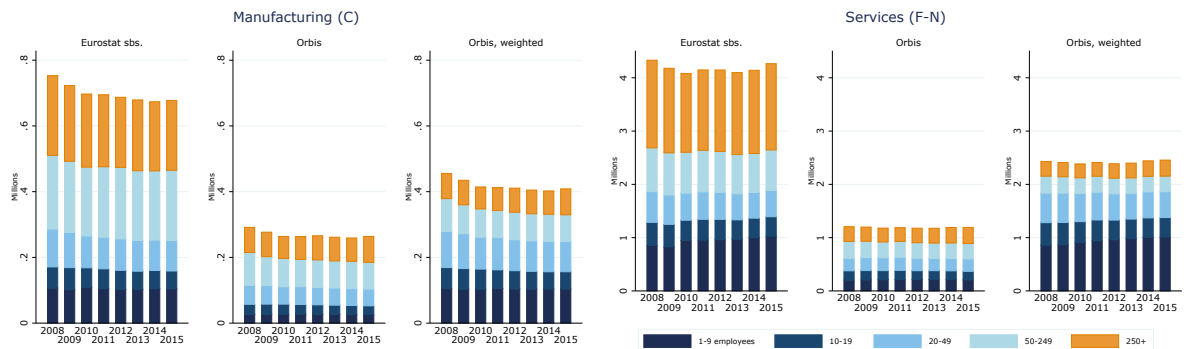
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

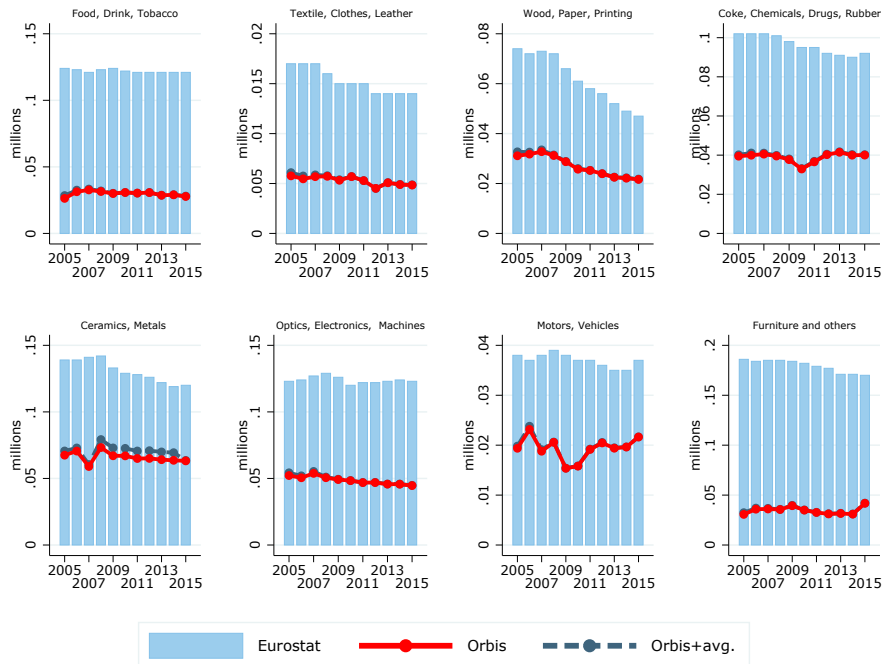


(a) Manufacturing

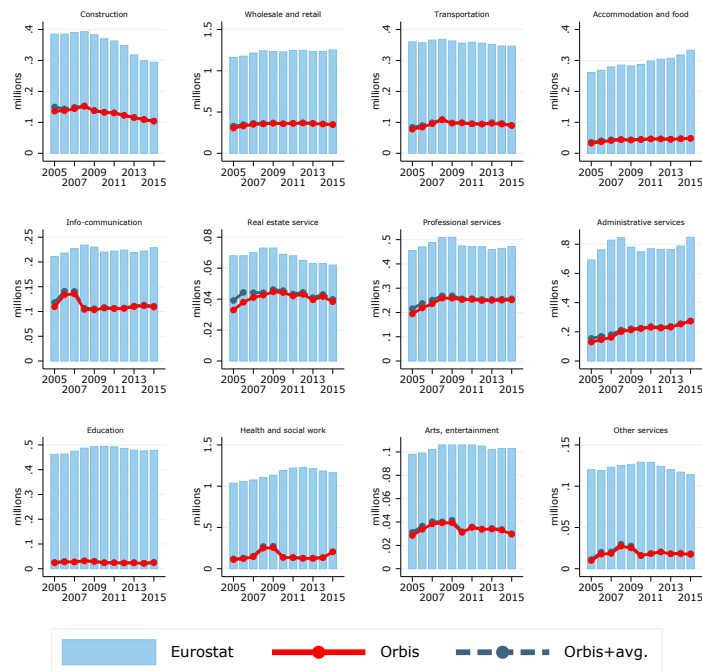
(b) Services (F-N)

the Netherlands - continued

Figure 4: Representativeness by Levels



(a) Manufacturing



(b) Services (F-N)

Poland

Figure 1: Employment in Orbis

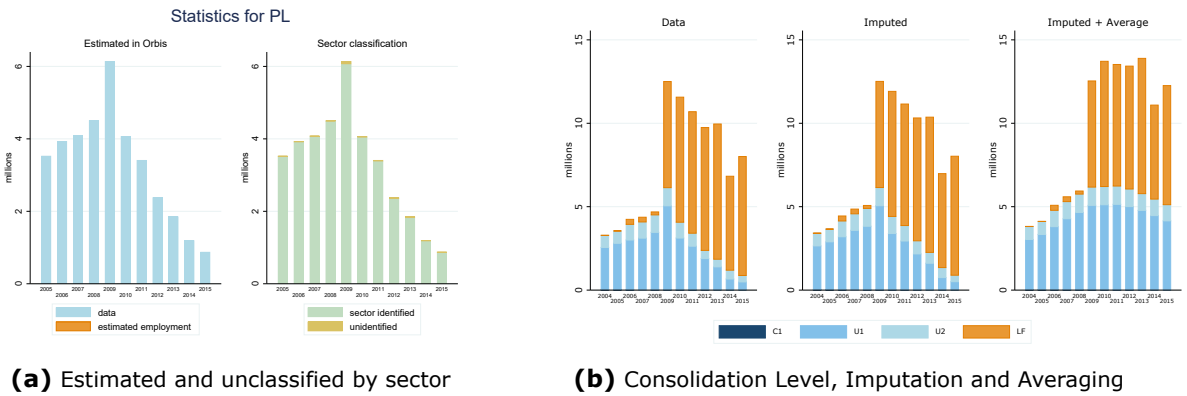


Figure 2: Representativeness by Levels and Dynamics

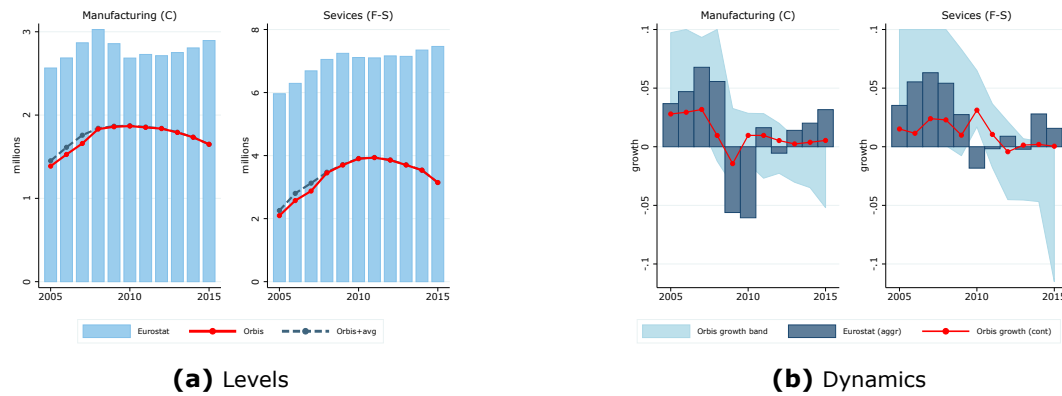
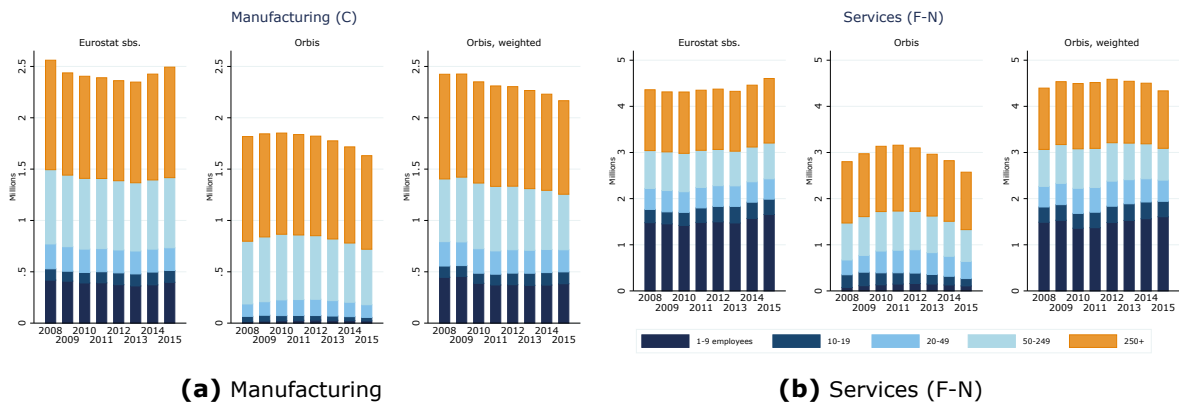
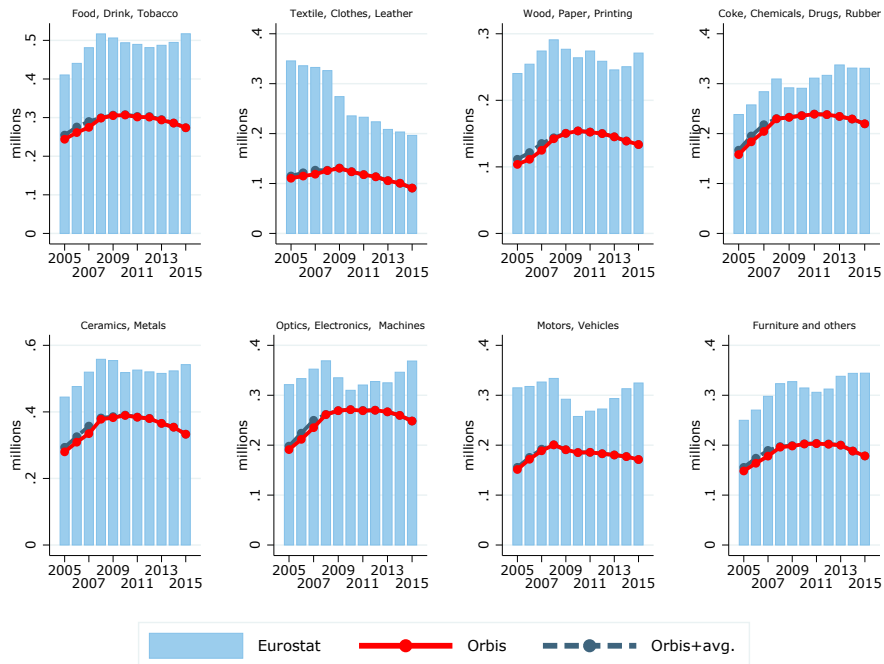


Figure 3: Representativeness by Size Category

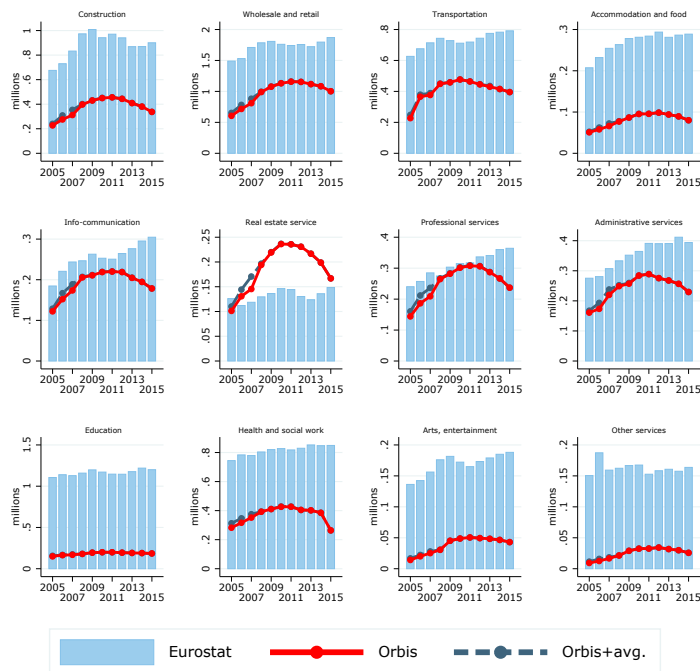


Poland - continued

Figure 4: Representativeness by Levels



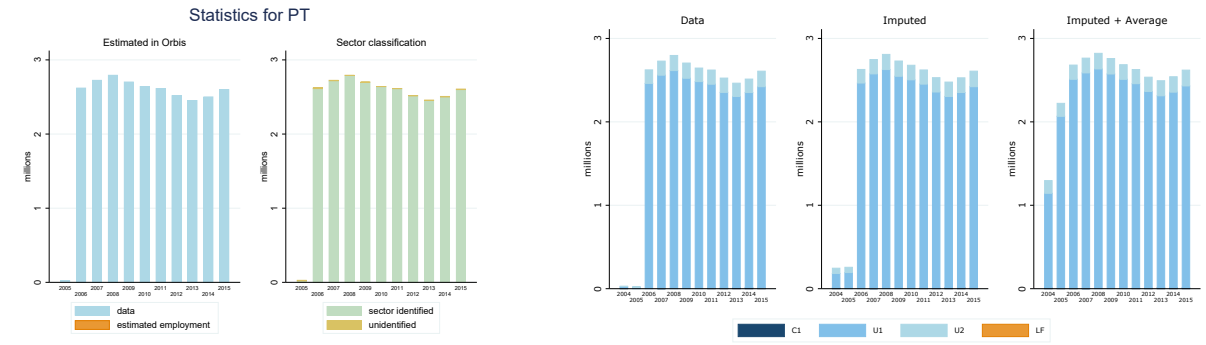
(a) Manufacturing



(b) Services (F-N)

Portugal

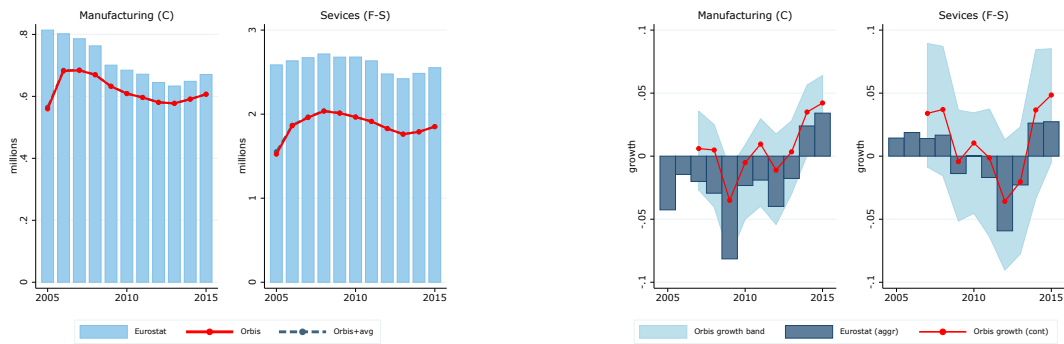
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

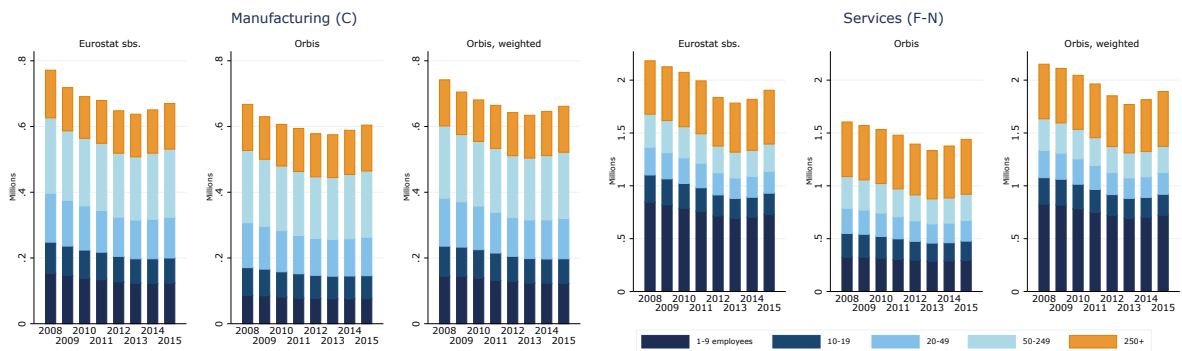
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

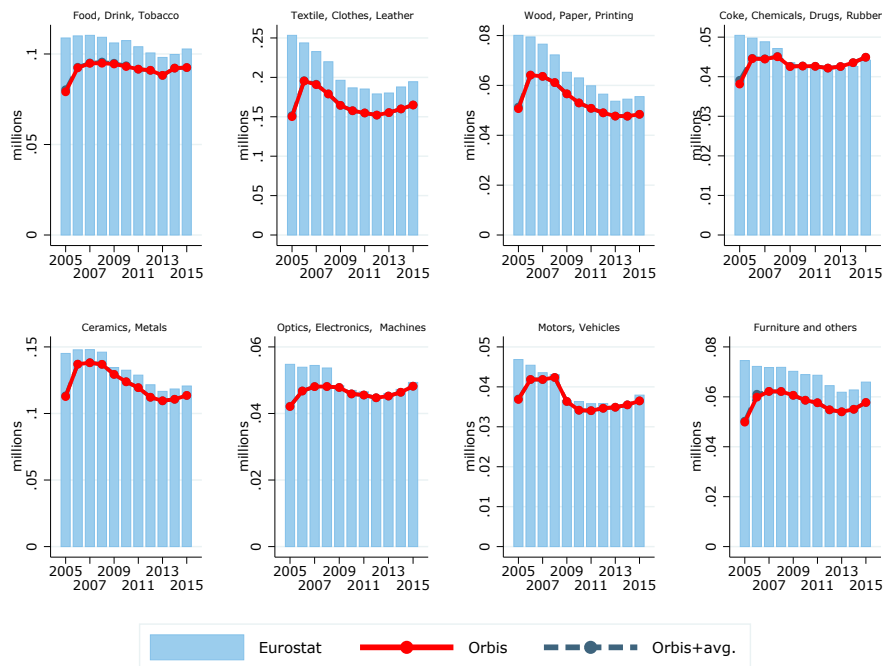


(a) Manufacturing

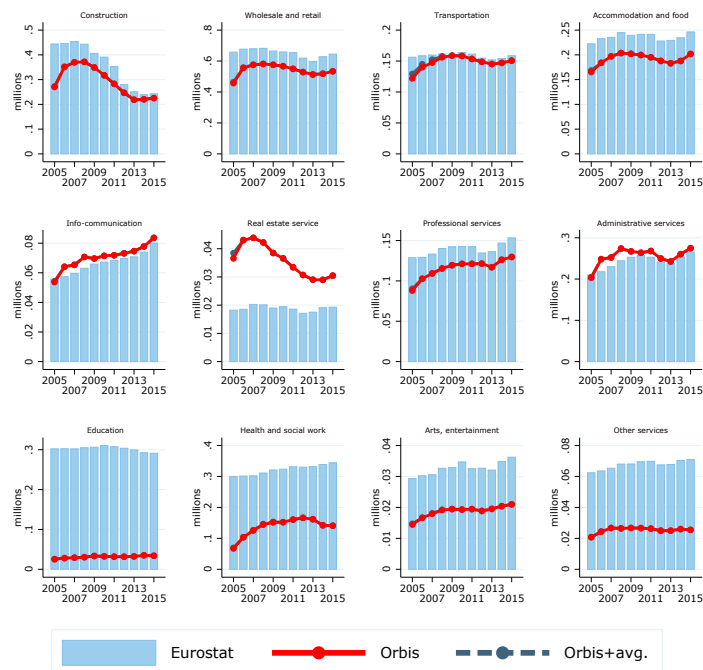
(b) Services (F-N)

Portugal - continued

Figure 4: Representativeness by Levels



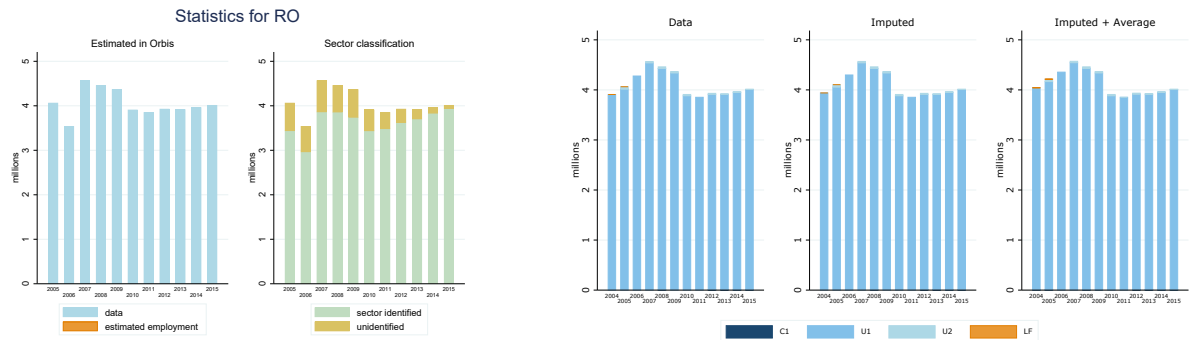
(a) Manufacturing



(b) Services (F-N)

Romania

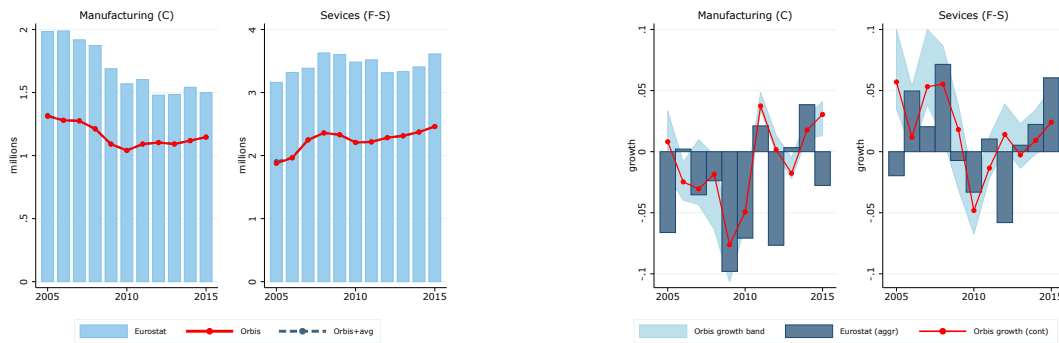
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

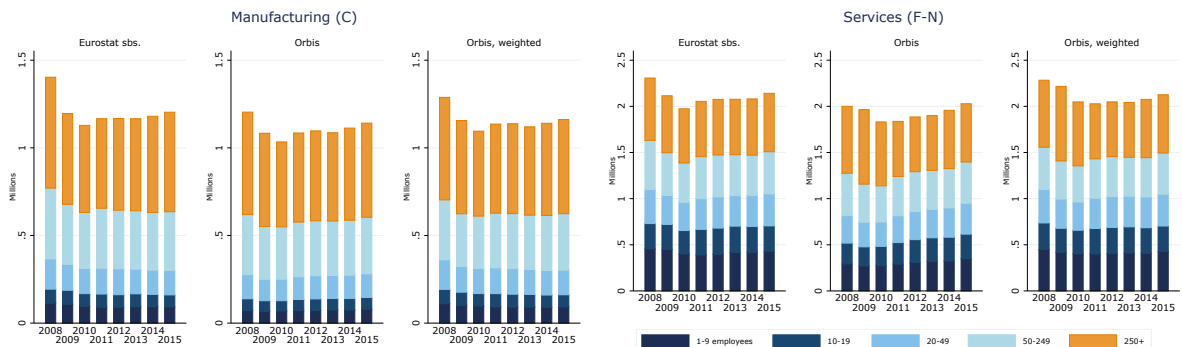
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

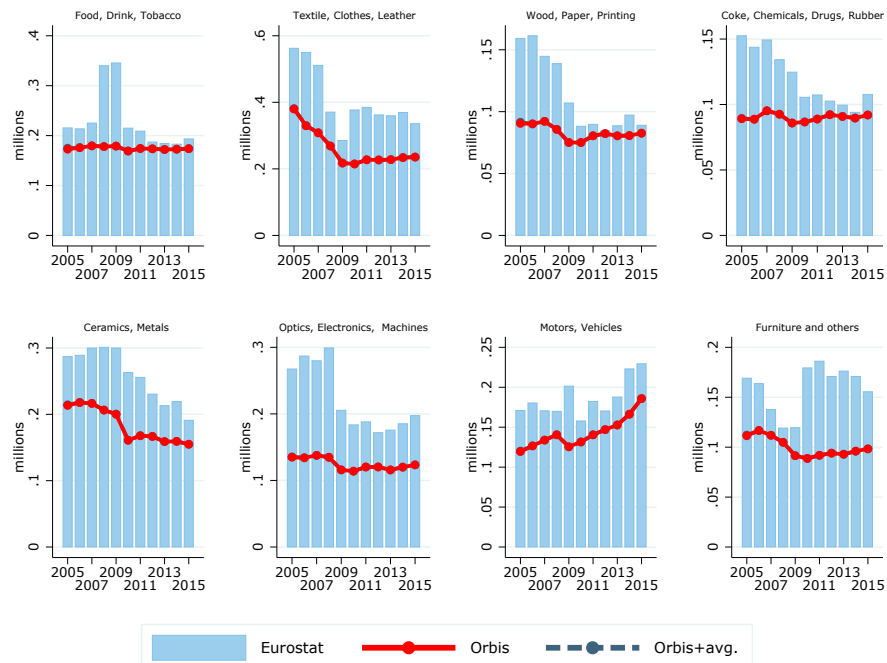


(a) Manufacturing

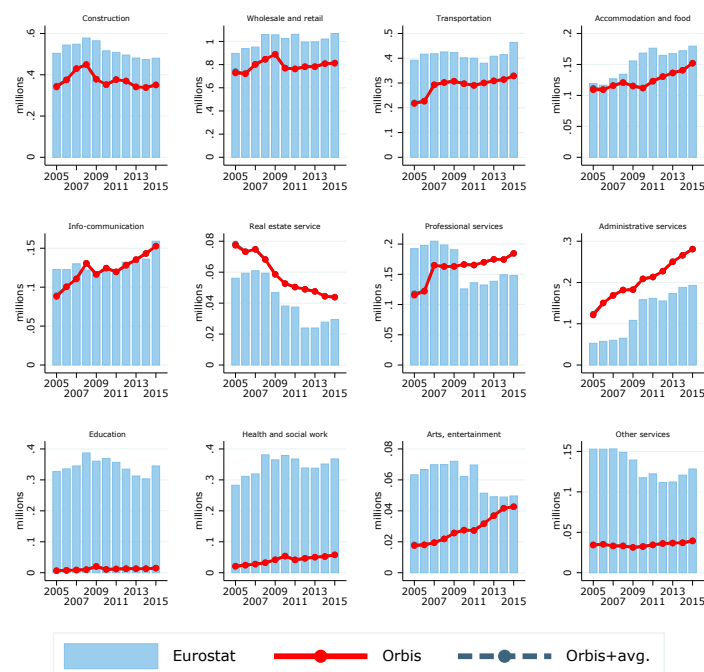
(b) Services (F-N)

Romania - continued

Figure 4: Representativeness by Levels

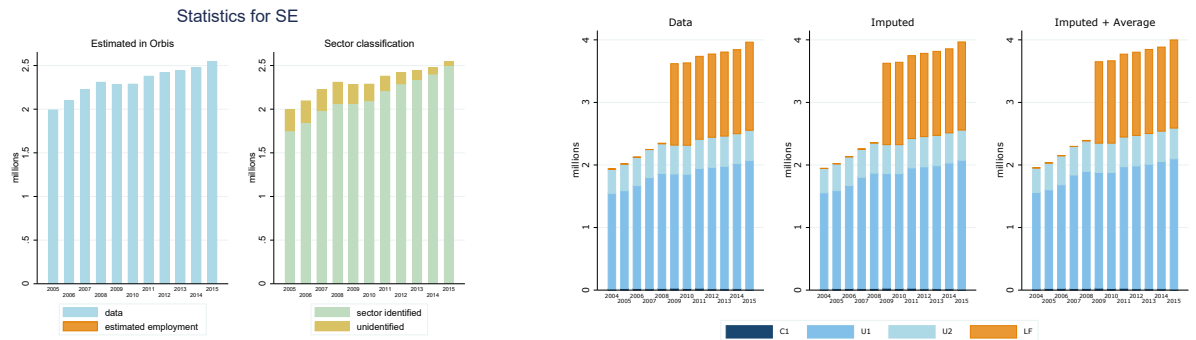


(a) Manufacturing



(b) Services (F-N)

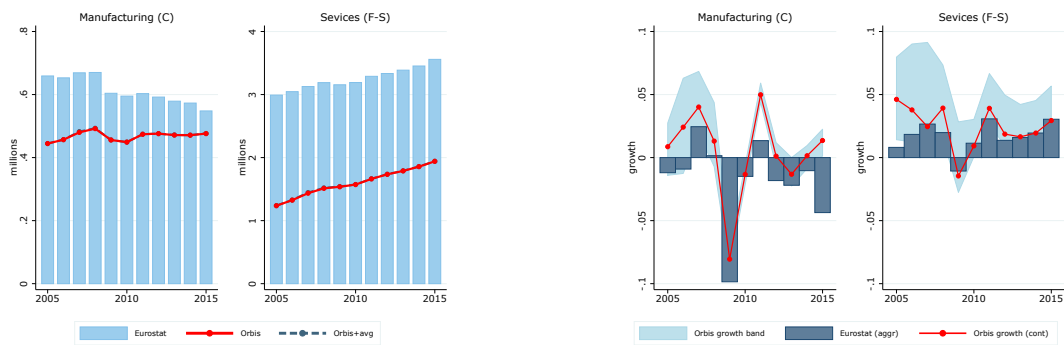
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

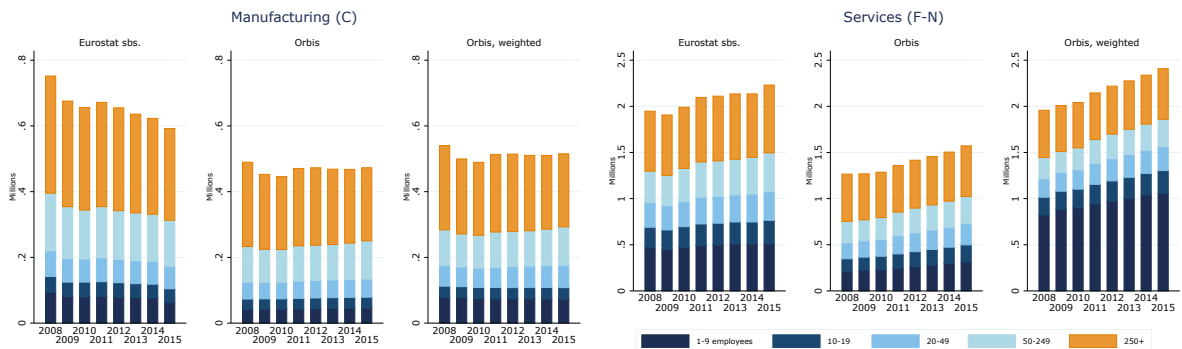
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

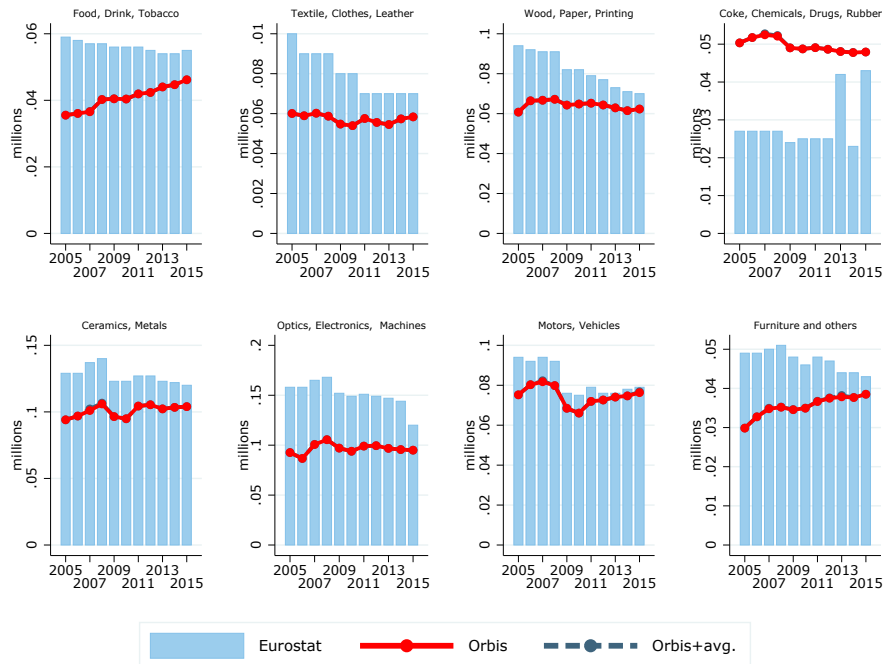
Figure 3: Representativeness by Size Category



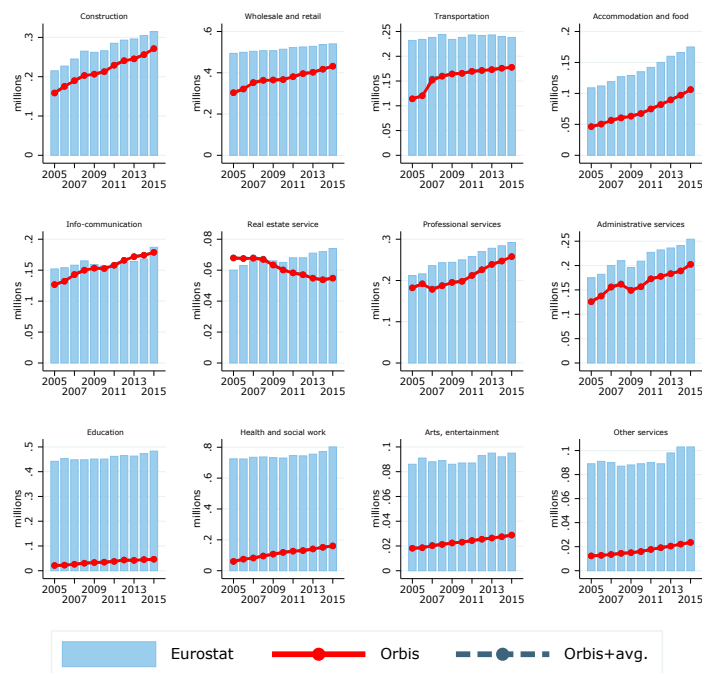
(a) Manufacturing

(b) Services (F-N)

Figure 4: Representativeness by Levels

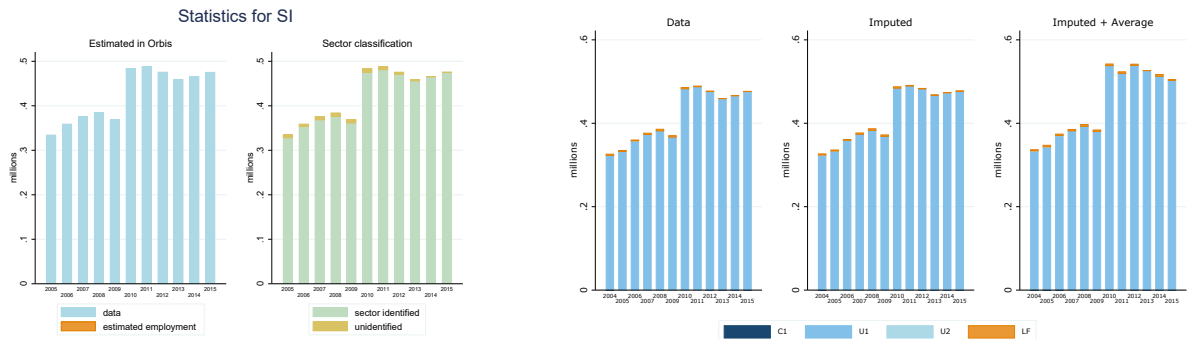


(a) Manufacturing



(b) Services (F-N)

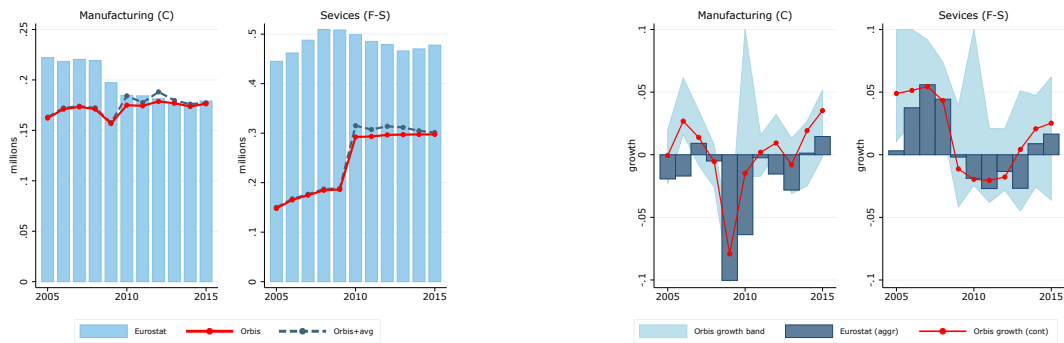
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

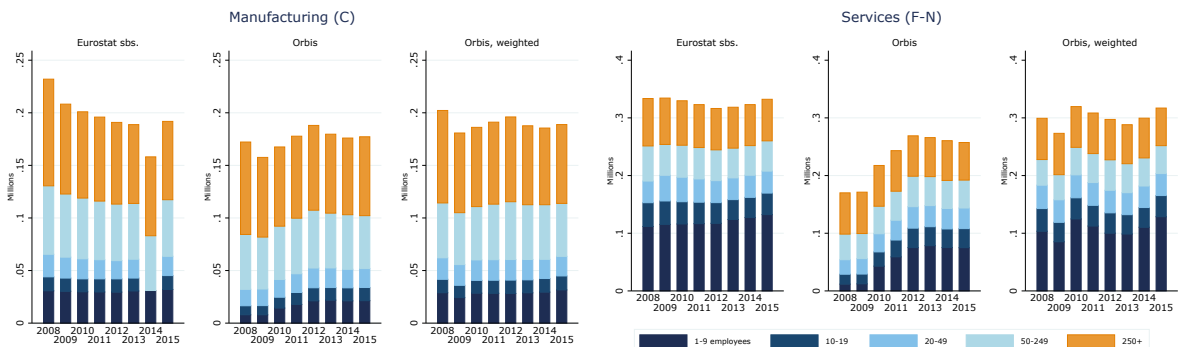
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

Figure 3: Representativeness by Size Category

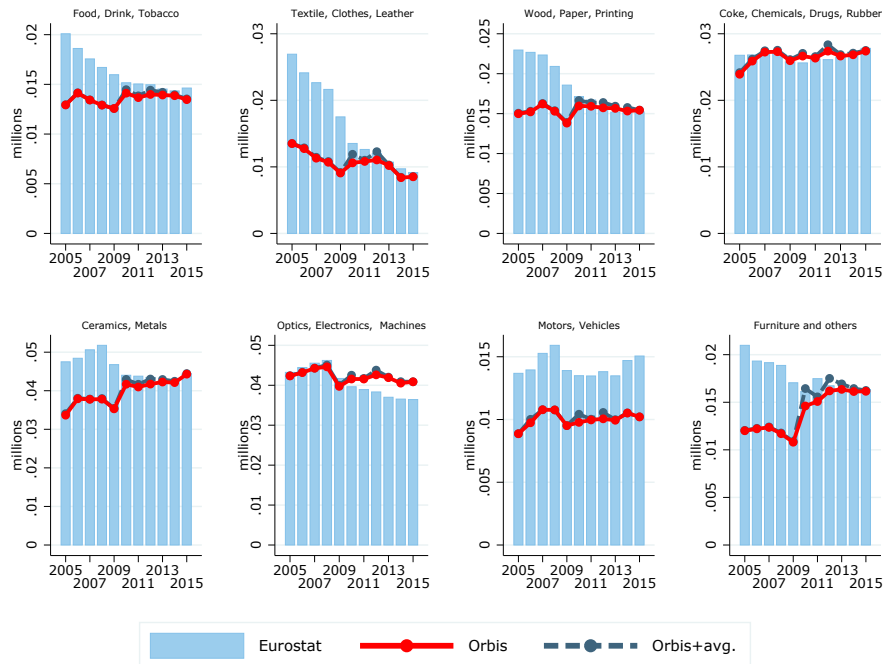


(a) Manufacturing

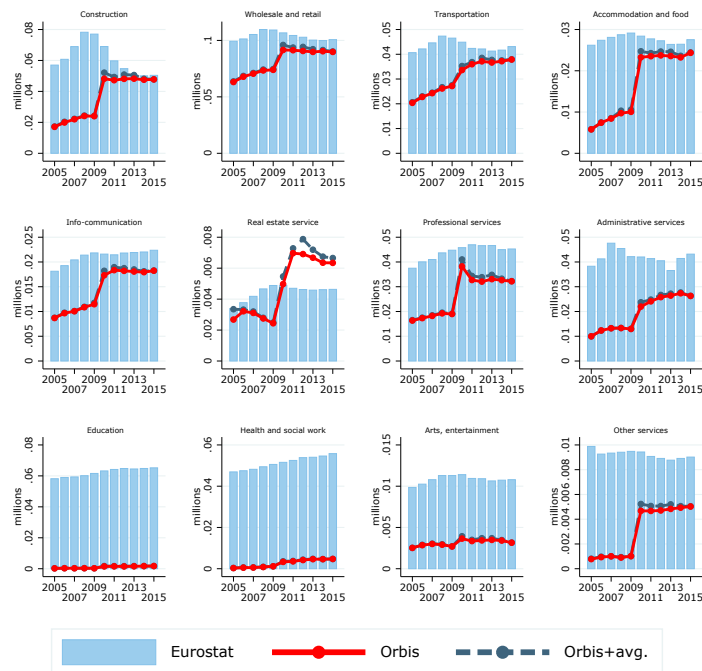
(b) Services (F-N)

Slovenia - continued

Figure 4: Representativeness by Levels

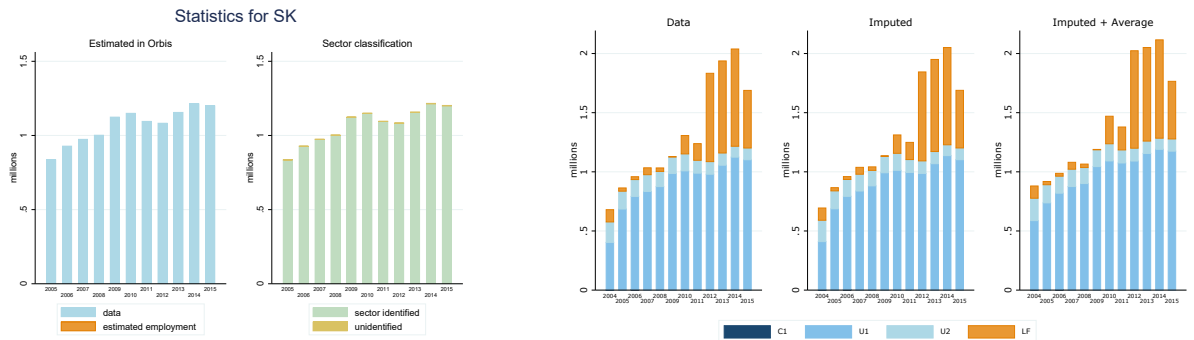


(a) Manufacturing



(b) Services (F-N)

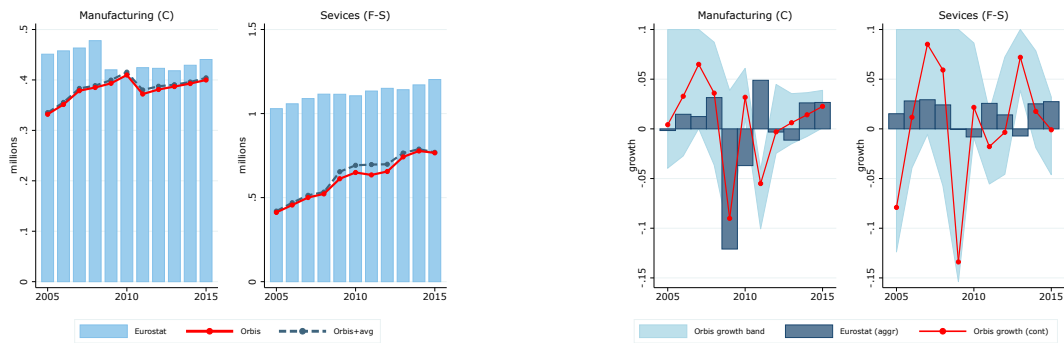
Figure 1: Employment in Orbis



(a) Estimated and unclassified by sector

(b) Consolidation Level, Imputation and Averaging

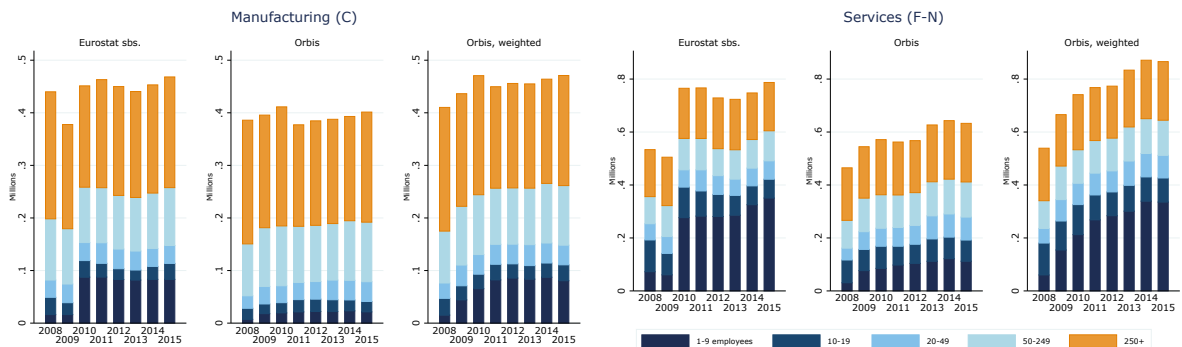
Figure 2: Representativeness by Levels and Dynamics



(a) Levels

(b) Dynamics

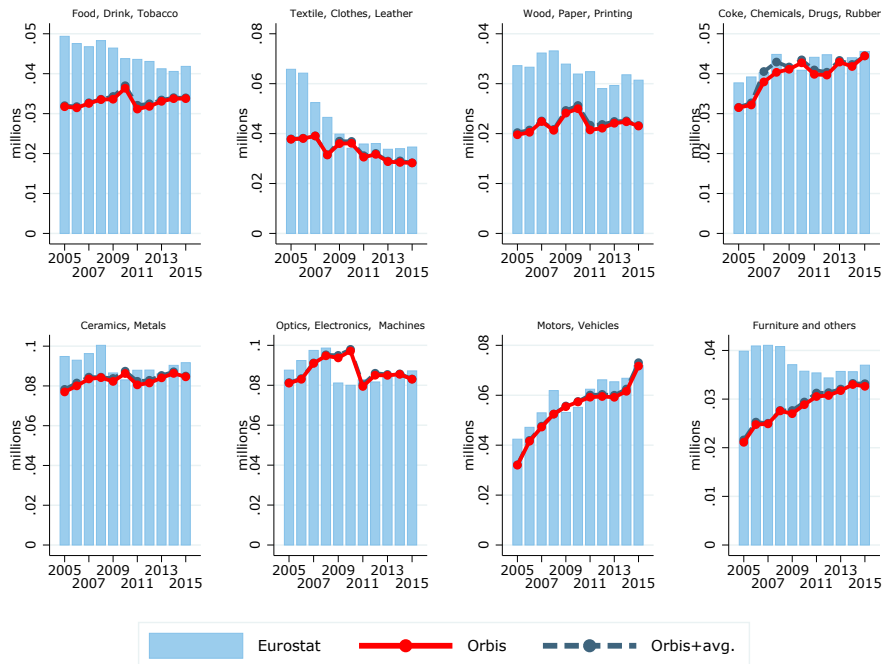
Figure 3: Representativeness by Size Category



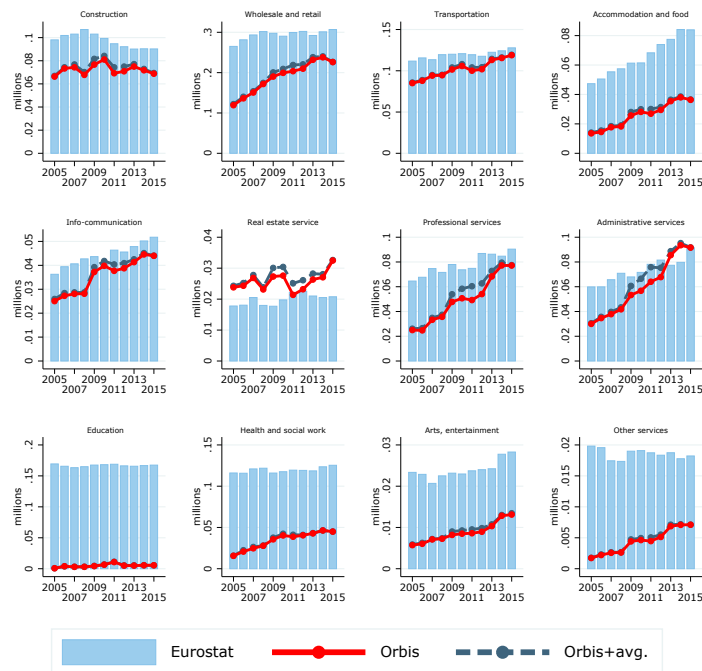
(a) Manufacturing

(b) Services (F-N)

Figure 4: Representativeness by Levels



(a) Manufacturing



(b) Services (F-N)

Appendix C:

Definitions and Formulas

Country Codes

Table 7: List of Countries and Codes

Included in the final sample		Excluded from the final sample	
Country	Code	Country	Code
Austria	AT	Cyprus	CY
Belgium	BE	Greece	GR
Bulgaria	BG	Ireland	IE
Croatia	HR	Malta	MT
Czech Republic	CZ	Luxembourg	LU
Denmark	DK	Netherlands	NL
Estonia	EE	Poland	PL
Finland	FI	United-Kingdom	UK
France	FR		
Germany	DE		
Hungary	HU		
Italy	IT		
Latvia	LV		
Lithuania	LT		
Portugal	PT		
Romania	RO		
Slovakia	SK		
Slovenia	SI		
Spain	ES		
Sweden	SE		

Definitions using Formulas

In this section we formalise the definitions presented in Section 3 using mathematics and notations.

Notations

Firm	i
Time	t
Total Employment	E_t
Universe of firms in an economy	Φ
Universe of firms in group category γ	Φ^γ

Firm: Size and Net Job Flows

Base Size:	$S_{i,t}^b$
Current Size:	$S_{i,t}^c = \frac{(S_{i,t}^b - S_{i,t-1}^b)}{S_{i,t}^b + S_{i,t-1}^b}$
Net Job Creation:	$C_{i,t} = (S_{i,t} - S_{i,t-1})$
Net Job Creation Rate:	$J_{i,t} = \frac{(S_{i,t} - S_{i,t-1})}{S_{i,t}^c}$

Aggregate Job Flows

Aggregate Job Creation:	$\sum_{i \in \Phi}^t \text{Max}(0, C_{i,t})$
Aggregate Job Destruction:	$\sum_{i \in \Phi}^t \text{Min}(0, C_{i,t})$
Aggregate Net Job Creation:	$\sum_{i \in \Phi}^t C_{i,t}$

Group Category Contribution

Job creation contribution:	$2 \times \sum_{i \in \Phi^\gamma}^t \text{Max}(0, C_{i,t}) / (E_t + E_{t+1})$
Job destruction contribution:	$2 \times \sum_{i \in \Phi^\gamma}^t \text{Min}(0, C_{i,t}) / (E_t + E_{t+1})$
Net job creation contribution:	$2 \times \sum_{i \in \Phi^\gamma}^t C_{i,t} / (E_t + E_{t+1})$

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