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Determining the contribution of size classes to employment growth; an application of the method of dynamic classification for the European Union

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Abstract:

In this paper we give partly new arguments why in our view the so-called dynamic classification method should be favored when determining the contribution of small businesses to job creation. To begin with, it is the only method that attributes consistently job creation or loss to the size class in which it actually takes place. On top of this, dynamic classification has two further advantages: (i) it is not vulnerable to the so-called regression to the mean bias, and (ii) only a small number of aggregated data are required to apply it.

Using dynamic classification we analyze the job creation of different size classes for the 27 Member States of the European Union. Our major findings are:

- For the EU as a whole, smaller firms contribute more to job creation than larger firms. Net job creation rates decrease with each firm size class.
- This pattern occurs in most industries but not in all: the manufacturing industry and trade industry show different patterns.
- At the level of individual countries, the net job creation rate also tends to decrease with each firm size class, but this relationship is not perfect.

Keywords: Employment growth by size class, Employment creation, Firm employment decisions.

Classification codes JEL: E24, M51, L25

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Introduction

Since the seminal studies of Birch (1979, 1981, 1987) it is a recurring question in the discipline of Small Business Economics to what extent small businesses contribute to job creation. This paper contributes to this topic in two ways. First, we provide partly new arguments why the rarely-used method of dynamic classification should be preferred for determining the contribution of small businesses to net employment creation. Second, we provide new evidence on the subject for the 27 Member States of the European Union.

How does this paper fit in the relevant literature? [1] The central message of Birch's work back in the eighties of the previous century was that small businesses are the most important source of net job creation in the United States of America. As such, his work was quite influential in policy circles (Neumark et al., 2011, p. 16).

Subsequently, in the nineties of the previous century, a debate started on methodological issues. Markedly, Davis et al. (1996) stated that researchers should take care of at least three statistical pitfalls, viz. (i) the size distribution fallacy, (ii) the confusion between net and gross job creation, and (iii) the regression to the mean bias. They concluded that – when all these statistical pitfalls were rightly addressed – smaller businesses exhibit *no* higher net job creation rates. More specifically, they concluded that Birch's results were not valid because of the regression to the mean bias.

However, the Davis et al. article was not unchallenged. In the same year Carree and Klomp (1996) stated that in all academic studies the first two pitfalls were already rightly addressed, while the influence of the regression to the mean bias was overstated by Davis et al.. Two years later, Davidsson et al. (1998) came to the same conclusion. They stated that one could argue that the regression to the mean bias was not a problem at all, but – even if one would accept it as a problem – the possible bias because of it would be small. They showed on the basis of Swedish data that small businesses create more net jobs even when correcting for the regression to the mean bias. Indeed, various other authors, e.g., Broersma and Gautier (1997), Picot and Dupuy (1998), and Voulgaris et al. (2005) come to the same conclusion. However, Hohti (2000) does not find that small establishments create more jobs.

More recently, Okolie (2004) and Butani et al. (2006) compare different rivaling methods to determine the contribution of small businesses to net job creation. Okolie (2004) concludes that results are quite different dependent on the method adopted. Butani et al. (2006) go a step further. First, they reintroduce in the literature the so-called method of dynamic classification, a method proposed originally by Davidsson (1996). Second, they go on to compare the merits of this method with a number of rivaling methods. After an extensive analysis they conclude that the method of dynamic classification is to be preferred.

Recently, Neumark et al. (2011) investigate for the United States of America whether small businesses create more jobs. They find confirmation of the Birch's results of the eighties of the previous century that indeed small businesses create more jobs. However, despite the analysis of Butani et al. (2006) they do not use the method of dynamic classification in their analysis.

[1] See Neumark et al. (2011) for a more comprehensive overview of the relevant literature. The current section is partly based on their overview.

Finally, note that the strand of literature reviewed here has developed separately from the literature on Gibrat's law albeit that this latter literature is quite related to it. See for good overviews on Gibrat's law Sutton (1997) and Audretsch et al. (2004).

We are now able to point out how this paper fits in the literature. First, we saw that – despite the arguments put forward by Butani et al. (2006) – Neumark et al. (2011) still neglect the method of dynamic classification. Hence, it seems useful to put forward new arguments why this method should be preferred. The second trigger of this paper is that the analysis of Neumark et al. (2011) is restricted to the USA. In this paper we provide new evidence on the job creation of small businesses for all 27 Member States of the European Union.

The structure of the paper is as follows. Section 2 is on methodology. The size distribution fallacy is explained, together with four rivaling methods from the literature how to solve it. We argue that one of these methods – dynamic classification – is for theoretical and practical reasons to be preferred. Section 3 zooms in on a practical advantage of the method of dynamic classification that has been overlooked so far in the literature. Contrary to other methods, dynamic classification only requires a small number of aggregated data to apply it. Section 4 describes the data that we use to determine the job creation of different size classes for the 27 Member States of the European Union. Section 5 presents the results and compares these to the recent results for the United States by Neumark et al. (2011). Section 6 concludes.

Methodology

1.1 2.1 Solving the size distribution fallacy: four methods

The net job creation or loss of a certain firm size class between two consecutive years is *not* simply equal to the difference in the level of employment in this size class between the two years.[2] This is the so-called size distribution fallacy. The term was introduced by Davis et al. (1996, pp. 301-303). It is caused by the fact that firms may cross size-class boundaries between years. More specific, the cause of – say – an increase in the employment level may not only be due to job creation of firms in the size class, but also due to firms that have entered the size class (by growing or declining). Clearly, we do not want to label the employment increase due to this latter cause as job creation by the specific size class. Hence, we should correct for it. Carree and Klomp (1996, p. 317) observe that indeed all academic studies correct for the size distribution fallacy.

To correct for the size distribution fallacy we need longitudinal data on the firm level that underlie the macro data on the employment level of size classes[3]. More specific, if we have information on the employment size of all firms in two consecutive years, we can split up the firms into two groups:

[2] In this paper we follow existing research by dividing firms into different size classes to investigate the relationship between net job creation and firm size. However, the act of dividing firms into different size classes might introduce potential biases. Neumark et al. (2011, pp. 26-27) address this point by investigating the relationship between net job creation and firm size alternatively without the introduction of size classes. This robustness test does not alter their results. Although we are not able to do such a robustness test ourselves in this paper because of lack of data, we are therefore confident that such potential biases are small.

[3] See, however, section 3 where it is shown that no longitudinal data on the firm level are needed to apply dynamic classification.

1. Firms that remain in the same size class in these two years. The job creation or loss due to these firms can be attributed straightforwardly to the size class to which they belong.
2. Firms that cross a size class boundary between these years. The question then is to which size class we should attribute the job creation or loss due to these firms.

However, the answer to this question is not straightforward. In fact, in the literature we encounter at least four rivaling methods with respect to how to classify the job creation or loss of these firms.[4]

First, you could attribute the job creation or loss of these firms to the size class to which they belong in the base year. This classification according to *base-year size* seems the most natural thing to do and indeed the three seminal studies of Birch (1979, 1981, 1987) adopt this classification method.[5]

However, Davis et al. (1996) argue that this classification method might be vulnerable to a regression-to-the mean bias (to be discussed below). To correct for it they suggest classifying firms into size classes on the basis of their average size over the two years. We will refer to this classification method as classification by *average size*.[6]

Because of symmetry reasons Okolie (2004) discusses yet another method, in which the job creation or loss of firms is attributed to the size class to which they belong in the end year. She calls this method appropriately classification by *end-year size*.

The final classification method – the so-called *dynamic* classification[7] – has received relatively little attention till now in the literature. It was introduced by Davidsson (1996) and discussed by Butani et al. (2006). The classification is dynamic in the sense that the job creation or loss of a firm is not attributed to a single size class – as is the case in the other three methods. Instead, the job creation or loss of a firm is attributed to the size class to which the firm belongs *at the moment the job creation or loss actually occurs*.

We illustrate the idea behind dynamic classification with a simple example. Consider a firm that grows from 200 to 290 employees during the year, while the size class boundary is at 250 employees. While growing from 200 to 250 the firm belongs to the lower size class. Hence, the creation of these first 50 jobs is attributed to the lower size class. Once the firm has reached the size class boundary of 250 employees, the firm enters the upper size class. Hence, when growing further from 250 to 290 employees the creation of these further 40 jobs is attributed to the upper size class.

1.2 2.2 Choice of method does matter …

The prevalence of four rivaling classification methods would not matter that much if all methods would produce approximately the same results in practice. Unfortunately, the reverse

[4] Davis et al. (1996) introduce on top of these four methods yet another method in which firms are classified on the basis of their long run average size. They call this method classification by *average size*. Because of reasons given by Carree and Klomp (1996, pp. 318-319) we do not discuss this method further here.
[5] If you have quarterly data you have a further choice between classification by *annual base size* and *quarterly base size*. See Butani et al. (2006).
[6] We follow Neumark et al. (2011) in this. Davis et al. (1996) refer to it as classification by *current size*¸ and Okolie (2004) and Butani et al. (2006) refer to it as classification by *mean size*.
[7] Butani et al. (2006, p. 6) remark that the method is also referred to as classification by *momentary size*.

is the case as becomes clear from Table 1, where we show – just as an example – the situation for the Netherlands in 1993 – 1998 (from De Kok et al. 2006, p. 29).

We can make two further observations that more or less follow from the way the various classification methods are defined:

- Classification by base-year size gives results that are most favorable to small firms, classification by end-year size gives results that are most favorable to large firms, while the other two methods give results somewhere in between.
- Classification by average size generates results that are similar to the results generated by dynamic classification. Note, however, that the theoretical basis of the two methods – and thus the ways of calculation – is quite different.

All these findings are typical and in line with results of others. See, e.g., Okolie (2004), Butani et al (2006), and Neumark et al. (2011).

Table 1 Average annual net job creation of the Dutch private sector, by size class and classification method, 1993-1998

	Size classes (number of employees)							
	Small (0-10)		*Medium sized* (10-100)		*Large* (100+)		*Total*	
Method	*abs*	*rel*	*abs*	*rel*	*abs*	*Rel*	*abs*	*rel*
Uncorrected	6	1,1%	16	1,4%	19	1,0%	41	1,2%
Corrected according to:								
- classification by base-year size	42	7,6%	8	0,7%	-9	-0,6%	41	1,2%
- classification by average size	15	2,7%	14	1,1%	12	0,7%	41	1,2%
- classification by end-year size	-13	-2,4%	25	2,1%	29	1,6%	41	1,2%
- dynamic classification	13	2,4%	14	1,2%	13	0,7%	41	1,2%

abs: absolute employment change in full-time equivalents (x 1.000);
rel: absolute employment change, as percentage of average employment level for each size class;
First the job creation is calculated from year to year. After that the results are averaged.
Source: own calculations on data of Statistics Netherlands. See for more information on the data De Kok et al. (2006).

1.3 2.3 Which method to prefer?

Ever since Davis et al. (1996) there has been a debate on the best way to attribute job creation or loss to size classes. See, e.g., Carree and Klomp (1996), Davidsson (1998), Okolie (2004), Butani et al. (2006), and Neumark et al. (2011). We will try to contribute to this debate in the following way. First, we will pay attention to a compelling and reasonable point of departure that in our opinion has not gotten due attention till now. Second, we will address the regression to the mean issue that has dominated this debate from the start.

Contributing job creation to where it actually takes place

To which size class should the job creation or loss of firms be attributed? A compelling and reasonable point of departure in answering this question is in our view the simple principle: "job creation or loss should be attributed to the size class to which a firm belongs at the

moment that this job creation or loss actually takes place". Does this principle lead to a recommendation of one of the methods? Yes, it does. Let us make this clear by an example.

Take the size class boundary at 250 employees and consider a firm that grows in one year from 200 to 290 employees (e.g. in the first quarter of the year from 200 to 250 employees and in the remaining three quarters of the year from 250 to 290 employees). Classification by base-year size attributes the creation of the 90 jobs of this firm solely to the lower size class, classification by average size does the same (for the average size of the firm is 245), while classification by end-year size attributes the whole gain of 90 jobs to the upper size class. Hence, none of these three methods attributes all 90 created jobs to the size class in which they really were created! In fact, the only method that does justice to this principle is dynamic classification: 50 of the jobs were created in the lower size class (in the example in the first quarter of the year) and are indeed attributed to it with dynamic classification, while the same holds for the remaining 40 jobs that were created in the upper size class.

Note that from this point of view classification by base-year size leads to a bias in favor of small businesses. For, job creation by small firms that cross a size class boundary, is solely attributed to the size class of small firms, while at least part of it should have been attributed to the upper size class. On top of that, job losses by large firms that cross a size class boundary, are solely attributed to the size class of large firms, while at least part of these job losses should have been attributed to lower size classes.

By the same way of reasoning it is clear that classification by end-year size leads to a bias in favor of large businesses. Finally, classification by average size does not lead to a systematic bias in one direction. For the method can favor the size class of small firms as well as the size class of large firms, dependent on the specific details.(In our example the size class of the lower size class was favored but with slightly different size values the reverse would have been the case.)

In our example, and indeed also in the empirical section of this paper, the interval between successive measurements is 1 year. Note that the discussed bias will be larger when this period is larger and vice versa.

Butani et al. (2006, p. 6) and Neumark et al. (2011, p. 18) seem under the impression that dynamic classification hinges on the assumption that growth takes place linearly through time. However, this is not true. Indeed, the method works with any other growth pattern just as well, as the next example illustrates.

Consider again the example with the size class boundary at 250 employees and a firm growing in one year from 200 to 290. Now assume a totally different growth path than in the previous example. Let us assume that in the first quarter the firm declines from 200 to 170, subsequently grows from 170 to 300 in the second quarter, declines to 240 in the third quarter, and eventually grows in the fourth quarter to the final 290. Indeed, not a linear growth pattern at all! According to the principle of attributing job creation or loss to the size class in which it occurs we get:

- first quarter: lower size class: -30;
- second quarter: lower size class: +80; upper size class: +50;
- third quarter: lower size class: -10; upper size class: -50;
- fourth quarter: lower size class: +10; upper size class: +40.

If we sum this up for the four quarters together, we indeed find a net job gain of +50 for the lower size class and +40 for the upper size class, just what we got for the first growth pattern. We conclude that dynamic classification is independent of the growth patterns of the individual firms.

To summarize, dynamic classification is the only method that consistently attributes job creation or loss to the size class in which it actually takes place, a principle both compelling and reasonable in our view. Of course, this observation is not altogether new. Butani et al. (2006, p. 14) observe more or less the same in their analysis, although they do not give the argument as much credit as it deserves in our view. However, what *is* new is the observation that dynamic classification does not hinge on the assumption of linear growth paths.

Regression to the mean bias

Davis et al. (1996) point out that some classification methods might be vulnerable to a so-called regression to the mean bias. Let us first make the potential problem clear by giving an example.

Take the size class boundary at 250 employees and consider 100 firms of which the sizes fluctuate around this boundary each year. Let's say 50 grow each year from 245 employees to 255 employees, while the other 50 decline from 255 employees to 245 employees.

Classification by base-year size leads to the assessment that the lower size class creates 500 jobs each year, while in the upper size class 500 jobs are lost. In general, in this classification method such fluctuations typically are in favor of the lower size class and in disfavor of the upper size class. Things are exactly the reverse when adopting classification by end-year size. Finally, note that the other two methods - classification by average size and dynamic classification – are immune for such fluctuations and lead to the conclusion that there is no net job creation or loss in both size classes.

In reality, part of such size fluctuations of firms around a size class boundary will be due to transitory shocks or measurement errors in the data set. If this is the source of the fluctuations, one does not want these fluctuations to have an influence on the outcome of the classification procedure. If they have, this constitutes a bias, the so-called regression to the mean bias. As shown in the example, results are biased in favor of the lower size classes when classifying according to base-year size, while the reverse is the case when classifying according to end-year size. There is no potential bias in the other two classification methods.

Davis et al. (1996) state that most – if not all – size changes of firms are due to transitory shocks and measurement errors. This leads them to conclude that the bias may potentially be quite high. However, later authors, e.g. Carree and Klomp (1996) and Davidsson et al. (1998) disagree and argue that this bias could be quite moderate. Up till now – see Neumark et al. (2011, p. 18) – there is no clear consensus to what extent the potential regression to the mean bias really constitutes a substantial problem. However, there *is* clear consensus in the literature about the fact that classification by average size and dynamic classification are not vulnerable to this potential bias. In fact, this was the major reason for Davis et al. (1996) to introduce classification by average size. With respect to dynamic classification Butani et al. (2006, p. 12) also observe that the method is not vulnerable to the potential regression to the mean bias.

Conclusion

All in all we think that the method of dynamic classification is to be preferred. First, because it is the only method that attributes consistently job creation or loss to the size class in which it actually takes place, a principle both compelling and reasonable in our view. Although this observation is not altogether new (see Butani et al., p. 14), the argument deserves in our view more emphasis than it got in their paper. In addition, we point out in this paper that dynamic classification does not hinge on the assumption of underlying linear growth paths.

A second point in favor of dynamic classification is the fact that the method is not vulnerable to a potential regression to the mean bias (Butani et al., 2006, p. 12). Although the method shares this desirable property with classification by average size (Davis et al., 1996), it constitutes a distinct advantage of the method compared to classification by base-year or end-year size.

On top of these theoretical reasons there is also a practical reason for choosing for dynamic classification: only a small number of aggregated data are needed to apply it. This is an advantage of the method that has been overlooked so far in the literature. [8] The next section will address this issue.

Dynamic classification: only a small number of aggregated data needed

The method of dynamic classification has a practical advantage that has been overlooked so far in the literature. Contrary to all other methods, dynamic classification does not require longitudinal data on the employment level of individual firms. We will first show how this works in a simple example.

1.4 3.1 Simple example

Consider only two size classes – a lower and an upper size class – with the boundary at 250 employees. During the year, employment in the lower size class has gone up with – say – 20 thousand and employment in the upper size class with 40 thousand jobs. However, we also know that during this year 100 firms grew so much that they crossed the size class boundary. This gives rise to a size distribution fallacy (see section 2). How should we correct for it?

Employment in the upper size class has increased with 40 thousand jobs. However, part of this employment gain is due to the fact that 100 firms entered the upper size class. Thus, we should subtract from this 40 thousand job gain the employment that these 100 firms had when they entered the upper size class. By definition all these firms had a size of 250 employees when they crossed the size class boundary. Hence, we should subtract 100* 250 = 25 thousand jobs from the performance of the upper size class to correct for the fact that these 100 firms entered the size class.

For the lower size class we find something similar. Here, the performance of the size class should be corrected for the employment loss of the 100 firms that grew out of the size class. They all left the size class when they grew beyond 250 employees. Hence, we should add 100*250 = 25 thousand jobs to the performance of the lower size class to correct for the fact that these 100 firms left the size class.

[8] This was already mentioned in the unpublished working paper De Kok et al. (2006).

The upshot of the above is that – when we adopt dynamic classification - we only need to know how many firms crossed the size class boundary in order to correct for the size distribution fallacy. [9] This is in sharp contract with the other classification methods in which longitudinal data are needed for the employment levels of all individual firms.

1.5 3.2 Dynamic classification: correction terms

By generalizing the argument given in the above example one can determine a general correction formula to correct for the size distribution fallacy in the method of dynamic classification. See the first row of Table 2 for a size class with lower boundary L and upper boundary U. Note that the first term in this formula corrects for the number of net crossings of the lower boundary L, while the second terms corrects for the number of net crossings of the upper boundary U [10]. It can be shown that also in the general case of more than two size classes no longitudinal firm level data are needed for dynamic classification [11]. More specific - given the chosen size class boundaries - we only need to know for each year the following aggregated data:

- the employment levels of the specified size classes (to calculate the uncorrected employment changes of the size classes),
- and the number of firms that are present in the specified size classes (to correct for the size distribution fallacy according to dynamic classification).

Table 2 Dynamic classification: correction for the size distribution fallacy

Size class [a]	*Correction terms* [b]
Size class [L, U)	-L * (ΔN) L or larger + U * (ΔN) U or larger
Micro firms [0, 10)	10 * (ΔN) 10 or larger
Small firms [10, 50)	-10 * (ΔN) 10 or larger + 50 * (ΔN) 50 or larger
Medium sized firms [50, 250)	-50 * (ΔN) 50 or larger + 250 * (ΔN) 250 or larger
Large firms [250 or more)	-250 * (ΔN) 250 or larger

a "[L, U)" denotes a size class with lower boundary L and upper boundary U, where L is included and U is excluded.
b "(ΔN) L or larger" denotes the change (Δ) in the number of firms (N) of size L or larger.

For ease of the reader we have written down explicitly in Table 2 the correction terms for the four size classes considered in the empirical part of this paper, viz. micro firms (0-10 employees), small firms (10-50 employees), medium sized firms (50-250 employees), and large firms (250+ employees). [12] Note that for micro firms only the second correction term is

[9] See for the exact data requirements for the general case the next section 3.2.
[10] The number of net crossings of a boundary is equal to the change in the number of firms above this boundary.
[11] See for more elaborations on the subject De Kok et al. (2006, pp. 27-28, 47-50).
[12] We define size classes on a continuous scale in this paper, viz. [0,10), [10,50), [50,250), [250 or more). Other papers, e.g. Butani et al. (2006), define size classes on a discrete scale, which would read for our size classes: "1-9", "10-49", "50-249", "250+". We prefer the continuous definition for two reasons. (i) It is more general because in this way you can also handle data with employment measured in full-time equivalents (that need not be in integer values). (ii) When using classification by average size or dynamic classification, it is then clear from the mere definition of the size classes how you treat e.g. an average firm size of 9.5 (when classifying by

present (because the lower boundary of this size class is zero) and that for large firms only the first term is present (because this size class has no upper boundary).

Data

To the best of our knowledge, no dataset currently exists that contains longitudinal data on the complete enterprise population for all Member States of the EU. Previously, this implied that it was not possible to correct for the size distribution fallacy, and hence, to determine the contribution of small businesses to job creation. However, as we have shown in the previous section, the method of dynamic classification can still be applied, as long as aggregated data are available on the number of enterprises and the number of employees for different size classes for each year. Such data exist at the EU level: the Annual Report Database from the European Commission.

The Annual Report Database is part of the SME performance Review, one of the main tools employed by the European Commission to monitor and assess Member States' performance in implementing the Small Business Act[13]. It includes aggregated data on six variables: the number of enterprises, number of persons employed, value-added at factor costs, gross investment in tangible goods, turnover and wages and salaries. Since 2008, the Annual Report Database is used to prepare the Annual Report on EU Small and Medium-sized Enterprises.

The Annual Report Database is constructed in several steps. First, national statistics are collected by the National Statistical Institutes (NSI) of each country involved through statistical surveys, business registers or administrative sources. Exactly how each of these three methods is applied, differs between NSI's. Next, these national statistics are gathered and combined into a EU-wide dataset. Finally, any missing values are imputed[14]. Imputations relatively often occur at low industry aggregation levels, and less often at the industry level that is used in this study.

The Annual Report Database contains aggregated data on all of the 27 Member States of the European Union. It covers four enterprise size classes[15] and eight industries. The industry classification is based on the NACE classification system[16]. This is the European standard for classification of enterprises by industry. At the highest level of aggregation, the NACE classification distinguishes 18 different sections (A – Q), eight of which define the non-financial business economy (C-I and K). The Annual Report Database is restricted to these eight sections. At a lower level of aggregation, these eight sections represent 42 different divisions. Most of the sections of the non-financial business economy include between 1 and 5 different divisions (the sections Construction and Hotels and restaurants even include only

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average size) or how you divide the firm's employment increase between size-classes when a firm grows from e.g. 8 to 12 (when using dynamic classification).

[13] The Small Business Act was adopted in June 2008. It aims to improve the overall approach to entrepreneurship, permanently anchor the 'Think Small First' principle in policy making from regulation to public service, and to promote SMEs' growth.

[14] We have not found any documentation on the type, nature or number of imputations that have been made. We therefore cannot exclude the possibility that the imputations result in a bias in the outcomes of our analysis.

[15] The enterprise is defined as the smallest combination of legal units that is an organizational unit producing goods or services, which benefits from a certain degree of autonomy in decision-making, especially for the allocation of its current resources. An enterprise can contain one or several establishments. The enterprise size classes are based on a headcount of the number of occupied persons (the sum of the number of employees and the number of unpaid people employed).

[16] For this study, we use NACE rev 1.1.

one division). The only exception is the manufacturing section that includes 23 different divisions (more than half of all divisions in the non-financial business economy).

The resulting data are publicly available from the website of the European Commission[17]. As of July 2012, the Annual Report Database covers the years 2002-2012 and consists of two separate files: the database for the Annual Report 2010/2011 (which covers the years 2005-2012) and the database for the Annual Report 2009 (which covers the years 2002-2008)[18]. As a starting-point, we use the most recent database for the Annual Report 2010/2011. The data for 2005-2007 are based on statistics obtained from the NSI's, while the data for 2008-2012 are estimates. We have excluded the estimated data from our study, with the exception of the estimates for 2008 that we use to decompose the employment creation between 2007 and 2008. To increase the time span of our study, we added data on 2002, 2003 and 2004 from the database for the Annual Report 2009. We have checked for the presence of a trend-break between 2004 and 2005 by comparing the data on employment and enterprises from both databases for the year 2005. On EU-level, the difference between the two databases is always less than 0.5%, for all of the statistics on number of enterprises or employees by size class. This suggests that a trend-break is not present. Our data thus covers the years 2002-2008.

Results

Table 3 presents net job creation levels and rates for four firm size classes, for the EU as a whole. It shows that small firms create more jobs than larger firms. This holds in absolute as well as in relative terms. As such the early results of Birch (1979, 1981, 1987) still appear to hold.

Table 3 Average net job creation and employment in the non-financial business economy of the EU, by size class, 2002-2008

	Size class (occupied persons)				
	0 to 10	*10 to 50*	*50 to 250*	*250 +*	*Total*
Average net job creation (x1000)	1,148	416	291	405	2,261
Average employment (x1000)	37,703	26,244	21,630	42,378	127,955
Average net job creation rate [a]	3.1%	1.6%	1.3%	1.0%	1.8%

a. Calculated as the average across years of the ratio of net job creation to total employment. Alternatively one could take row 1 divided by row 2. Then one gets approximately the same percentages, viz: 3.0% - 1,6% - 1,3% - 1.0% -1.8%.
Source: own calculations, based on the database for the Annual Report 2009 (for the years 2002-2004) and the database for the Annual Report 2010/2011 (for the years 2005-2008). Annual data on net job creation rates for the years 2002 – 2008 are also included in table 7 from De Kok et al. (2012)

This result is in accordance with the recent results of Neumark et al. (2011) for the United States[19]. The population that they examine differs from ours regarding the industries and years

[17] http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/index_en.htm#h2-2; accessed July 9th, 2012
[18] A third file is available on the website (database for the Annual Report 2008) but this does not include any additional data and was updated later (by the database for the Annual Report 2009).
[19] Neumark et al. (2011) present results for two different methods: classification by base year size and by average size. We take their results from the latter method as a reference. For, we know from theoretical grounds that classification by average size gives results comparable with results from dynamic classification, the method employed in this paper (see section 2 of this paper).

covered. In addition, they distinguish more (and different) size classes[20]. Nevertheless, the main results are strikingly similar. First, both the non-financial business economy of the EU (2002 – 2008) and the business economy of the USA (1992 – 2004) show an average net job creation rate of 1.8% per year[21]. Second, both studies show that the net job creation rate is lower for larger firm size classes.

Table 4 zooms in on differences between industries. The overall net job creation rates vary considerably, ranging from -2.7% for Mining and quarrying to +5.9% for Real estate, renting and business activities. The pattern across size classes shows much less variation: for six of the eight included industries, the net job creation rates monotonically declines with firm size class. The two largest industries, however, show a different pattern. In the Trade industry (24% of total employment), the net job creation rates *increase* monotonically with firm size class. In Manufacturing (27% of total employment), the smallest and largest size class show the same net job creation rate. For this industry, the net job creation rates vary the least between firm size classes.

Table 4 Average net job creation rates in the non-financial business economy of the EU, by industry and size class, 2002-2008

	Size class (occupied persons)				
Industry (NACE rev. 1.1 section)	*0 to 10*	*10 to 50*	*50 to 250*	*250 +*	*Total*
Mining and quarrying (C)	0.0%	-0.7%	-1.0%	-3.5%	-2.7%
Manufacturing (D)	-1.0%	-0.6%	-0.6%	-1.0%	-0.8%
Electricity, gas and water supply (E)	6.3%	0.9%	-0.3%	-1.0%	-0.7%
Construction (F)	3.5%	1.8%	1.8%	1.4%	2.5%
Wholesale and retail trade (G)	1.3%	1.8%	2.3%	2.8%	1.9%
Hotels and restaurants (H)	4.6%	3.6%	3.3%	1.8%	3.7%
Transport, storage and communication (I)	3.4%	3.2%	3.1%	-0.5%	1.1%
Real estate, renting and business activities (K)	8.6%	4.1%	4.3%	5.2%	5.9%
Total (C-I, K)	3.1%	1.6%	1.3%	1.0%	1.8%

The non-financial business economy of the EU includes sections C –I and K of the NACE rev. 1.1 classification of economic activities. The wholesale and retail trade (G) includes repair of motor vehicles, motorcycles and personal and household goods.

Source: Own calculations, based on the database for the Annual Report 2009 (for the years 2002-2004) and the database for the Annual Report 2010/2011 (for the years 2005-2008).

It has been suggested before that the relationship between net job creation rates and firm size may differ between industries (e.g. Audretsch et al, 2004, and Neumark et al., 2011). Our results confirm that this is indeed the case. As much of the existing literature on this topic focuses on manufacturing, we discuss the results for this industry in somewhat more detail. First, we observe that also Neumark et al. (2011, p. 24) find somewhat different results for manufacturing. Also their overall result that net job creation rates decrease monotonically for larger size classes, breaks down for manufacturing. However, whereas they still find a

[20] Neumark et al. include financial industry, cover a longer period of time, and distinguish 12 different size classes.

[21] Neumark et al. (2011) do not present an average net job creation rate across all size classes. We have therefore computed the ratio between the average net job creation for all size classes and the average employment across all size classes, based on the statistics presented in panel II of table 1.

negative rank-order correlation between net job creation and size-class, we do not find even that for manufacturing in this paper.

Table 5 Average net job creation rate in the non-financial business economy of the EU, by country and size class, 2002-2008

	Size class (occupied persons)				
Country	*0 to 10*	*10 to 50*	*50 to 250*	*250 +*	*Total*
Austria	2.8%	1.5%	1.8%	1.9%	2.0%
Belgium	2.2%	0.7%	0.9%	1.4%	1.4%
Bulgaria	5.4%	7.8%	3.9%	0.6%	4.1%
Cyprus	3.7%	4.4%	4.6%	3.3%	3.9%
Czech Republic	-1.5%	1.2%	2.0%	0.3%	0.2%
Denmark	3.0%	1.5%	1.2%	0.8%	1.5%
Estonia	7.3%	2.8%	3.1%	0.8%	3.5%
Finland	3.0%	1.5%	1.4%	0.5%	1.4%
France	3.0%	0.3%	0.1%	1.1%	1.2%
Germany	2.9%	1.6%	2.1%	0.7%	1.6%
Greece	2.1%	4.0%	1.0%	-0.5%	1.7%
Hungary	0.5%	1.2%	0.0%	-0.1%	0.3%
Ireland	7.9%	3.9%	2.5%	0.9%	3.4%
Italy	2.0%	1.3%	1.3%	1.1%	1.6%
Latvia	5.1%	3.8%	2.0%	0.6%	2.8%
Lithuania	11.3%	4.1%	2.8%	1.1%	4.6%
Luxembourg	3.6%	2.5%	2.3%	-0.7%	1.5%
Malta	-3.0%	1.5%	1.2%	-3.8%	-1.6%
Netherlands	7.6%	0.9%	-2.9%	0.7%	1.4%
Poland	1.9%	3.3%	3.4%	3.0%	2.7%
Portugal	4.1%	1.6%	1.3%	1.8%	2.6%
Romania	15.6%	5.3%	0.4%	-3.3%	2.5%
Slovakia	23.1%	1.7%	1.9%	-0.1%	3.6%
Slovenia	2.8%	1.0%	-0.8%	1.4%	1.3%
Spain	3.6%	1.7%	2.5%	3.5%	2.9%
Sweden	0.8%	4.0%	3.7%	1.5%	2.0%
United Kingdom	3.7%	0.5%	0.3%	0.8%	1.3%
Total	3.1%	1.6%	1.3%	1.0%	1.8%

Source: Own calculations, based on the database for the Annual Report 2009 (for the years 2002-2004) and the database for the Annual Report 2010/2011 (for the years 2005-2008).

The question then is why manufacturing exhibits a different pattern. This is not an easy question to answer. Of course, with respect to other industries, manufacturing can be characterized as an industry with relatively high entry barriers, a relatively high capital intensity, and relatively high economies of scales (up to a certain firm size). Audretsch et al.

(2004, pp. 305-307) demonstrate convincingly that because of these characteristics one would expect that net job creation rates would decline sharper with size class in manufacturing compared to the other industries. However, we find in this paper (and Neumark et al. to a lesser extent as well) exactly the opposite! Unfortunately, our data set does not permit a further analysis of this subject.

Finally, table 5 addresses differences between EU Member States. With the exception of Malta, all Member States show an increase in employment levels in the non-financial business economy between 2002 and 2008, with the highest net job creation rates reported for Bulgaria (4.1%) and Lithuania (4.6%).

This table also shows a negative relationship between net job creation rate and firm size class. Although only 7 of the 27 countries exhibit a net job creation rate that decreases monotonically with firm size class, the large majority of countries (24 out of 27) exhibits a negative rank-order correlation between net job creation rate of a firm size class and the ranking of that firm size class[22]. In addition, for the large majority of countries the net job creation rates are higher for the SME size class (0 to 250 occupied persons) than for the size class of large firms, and for most countries the net job creation rates for the smallest size class are higher than for the largest size class[23].

Conclusion

Since Davis et al. (1996) it is well known that it is not straightforward how to determine the contribution of small businesses to job creation. So far, many rivaling methods have been proposed in the literature to determine this contribution, without consensus about which one is to be preferred. In this paper we argue why in our view the so-called dynamic classification method should be favored. To begin with, it is the only method that attributes consistently job creation or loss to the size class in which it actually takes place. This seems a compelling and reasonable principle to us. On top of this, dynamic classification has two further advantages: (i) it is not vulnerable to the so-called regression to the mean bias, and (ii) only a small number of aggregated data are required to apply it. This latter point had been overlooked in the literature so far.

Using dynamic classification we analyze the job creation of different size classes for the 27 Member States of the European Union. Our major findings can be summarized as follows:

- For the EU as a whole, smaller firms contribute more to job creation than larger firms. Net job creation rates decrease with each firm size class.
- This pattern occurs in most industries but not in all: the manufacturing industry and trade industry – comprising approximately the half of the employment of all considered industries - show different patterns.
- At the level of individual countries, the net job creation rate also tends to decrease with each firm size class, but this relationship is not perfect. Only in 7 Member States does the net job creation rate decrease monotonically with each firm size class. However, the large

[22] For each country, we have calculated the Pearson rank-order correlation between the (rank of the) net job creation rates for the four different size classes and the ranking of the size classes (where the ranking increases with average firm size).
[23] Only the Czech Republic and Poland do not meet either one of these conditions.

majority of countries exhibit a negative rank-order correlation between the net job creation rate of a size class and the ranking of that size class.

What are the implications of our methodological findings? First, we think that the till now rarely-used method of dynamic classification should be used more often in any thorough study into the question whether small businesses create more jobs. In our view there are compelling theoretical reasons for this. On top of this, lack of data could not be prohibiting for this. On the contrary, dynamic classification needs far less data than rivaling methods.

Second, only a small number of aggregated data are required for dynamic classification, viz. the employment level and the number of firms in each size class at each time period. This is important, because it means that researchers do not need access to longitudinal firm level data to make the calculations, as is the case with rivaling methods. These aggregated numbers should be easy for statistical agencies to provide, as they don't involve difficult calculations or serious disclosure risk. Also, the analysis becomes possible for countries for which longitudinal firm level data are not available at all, such as many developing countries.

We think that our findings for the net job creation of small businesses in the 27 Member States of the European Union have the following implications. First, we now know that the early result of Birch that small businesses do create more jobs is not only still true for the United States but also for the non-financial business sector of the European Union as a whole.

However, this is not to say that the same holds true for any subset of the non-financial business sector of the European Union. On the contrary, we have found that simultaneously – sometimes large – subsets can exhibit a different pattern. Hence, the finding that small businesses create more jobs should be rather seen as a tendency than a strict law that always holds true. If you want to be certain for a certain country for a certain industry for a certain time period, the only way to be certain is to investigate that specific situation!

Still, we think that the overall message of our paper is that small businesses are important for net job creation. This should be an interesting message for policy makers as well. For this could be an argument that government should guarantee at least a level playing field for small businesses with respect to large businesses.

Finally, we address some research limitations. First, following existing research we distinguish size classes in this paper. Theoretically, the introduction of size class boundaries could produce biases. Although we cannot rule out this possibility, we do not think this is a major problem because in Neumark et al. (2011, pp. 26-27) such potential biases appeared not to be dominant.

Second, as already observed, the fact that we find for the European Union as a whole that small businesses create more jobs does not imply that this result necessarily holds for other situations. In fact, since we find that for various subsets of our sample this need not be true, there is always the possibility that for any other country, set of industries, or time period, the situation could be different.

Third, this paper only sets out to classify net job creation into size-classes in the best possible way. Otherwise stated, job growth of firms is only related to the size of firms. Of course, there are many other factors that influence firm growth, such as firm age or the motivation or the ability of the entrepreneur owning the firm. However, investigation of such other factors is beyond the scope of this paper.

Finally, and related to the third point, this paper only gives insight in *how* different size classes perform with respect to net job creation, not *why*. Answering the latter question would involve other data and another research setup. As such, research like this, does not only answer questions but also raises new ones. In this paper, for example, manufacturing appears to have an unexpected size class pattern with respect to net job creation. The explanation of this has to be left for future research.

References

Audretsch, D.B., L. Klomp, E. Santarelli, and A.R. Thurik (2004). Gibrat's Law: Are the Services Different? *Review of Industrial Organization*, 24, 301-324.

Birch, D.L. (1979). The Job Generation Process. Unpublished report prepared by the MIT Program on Neighborhood and Regional Change for the Economic Development Administration. Washington, DC: Department of Commerce.

Birch, D.L. (1981). Who creates jobs? *The Public Interest,* 65, 3-14.

Birch, D.L. (1987). *Job Creation in America: How our Smallest Companies Put the Most People to Work*. New York: The Free Press.

Butani, S.J., R.L. Clayton, V. Kapani, J.R. Spletzer, D.M. Talan, and G.S. Werking Jr. (2006). Business Employment Dynamics: Tabulations by Employer Size. *Monthly Labor Review*, 129, 3–22.

Broersma, L. and P. Gautier (1997). Job Creation and Job Destruction by Small Firms: An Empirical Investigation for the Dutch Manufacturing Sector. *Small Business Economics*, 9, 211-224.

Carree, M. and L. Klomp (1996). Small Business and Job Creation: A Comment. *Small Business Economics,* 8, 317-322.

Davidsson, P. (1996). Methodological Concerns in the Estimation of Job Creation in Different Firm Size Classes. Working Paper, Jönköping International Business School.

Davidsson, P., L. Lindmark, and C. Olofsson (1998). The Extent of Overestimation of Small Firm Job Creation—An Empirical Examination of the Regression Bias. *Small Business Economics*, 10, 87–100.

Davis, S.J., J. Haltiwanger and S. Schuh (1996). Small Business and Job Creation: Dissecting the Myth and Reassessing the Facts. *Small Business Economics*, 8, 297-315.

De Kok, J.M.P., G. de Wit, and K. Suddle (2006). SMEs as job engine of the Dutch private economy. Research Report H2000601. Zoetermeer, The Netherlands: Panteia/EIM.

De Kok, J.M.P., P. Vroonhof, W. Verhoeven, N. Timmermans, T. Kwaak, J. Snijders and F. Westhof (2011). *Do SMEs create more and better jobs?* Brussels: European Commission. http://ec.europa.eu/enterprise/policies/sme/facts-figures-analysis/performance-review/pdf/do-smes-create-more-and-better-jobs_en.pdf. Accessed 22 February 2012.

Hohti, S. (2000). Job Flows and Job Quality by Establishment Size in the Finnish Manufacturing Sector 1980-94. *Small Business Economics,* 15, 265-281.

Neumark, D., B. Wall, and J. Zhang (2011). Do Small Businesses Create More Jobs? New Evidence for the United States from the National Establishment Time Series. *The Review of Economics and Statistics*, 93(1), 16–29.

Okolie, C. (2004). Why size class methodology matters in analyses of net and gross job flows. *Monthly Labor Review*, 127(7), 3-12.

Picot, G. and R. Dupuy (1998). Job Creation by Company Size Class: The Magnitude, Concentration and Persistence of Job Gains and Losses in Canada. *Small Business Economics*, 10, 117-139.

Sutton, J. (1997). Gibrat's Legacy. *Journal of Economic Literature*, 35, 40-59.

Voulgaris, F., T. Papadogonas, and G. Agiomirgianakis (2005), Job Creation and Destruction in Greek Manufacturing. *Review of Development Economics*, 9(2), 289-301.

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