Employment Growth by Firm Size During the Recent Crisis in Italy: a Multifactor Partitioning Analysis

ABSTRACT The effects on employment growth in firms, grouped by size class, of the economic crisis that began in 2008 are analysed using multifactor partitioning (MFP). Italy's employment growth is decomposed into four explanatory factors: the stage in the business cycle; the effect of firm size; industry composition; and regional distribution; together with the interactions among these four effects. The interpretation of these effects is facilitated by the introduction within the MFP framework of a new decomposition of several key elements. The results show that the adopted approach and the suggested decompositions are useful to study the effect of size on employment change. This effect is found to be negative only for micro units (with less than 10 employees). For the other classes it is positive. The observed negative changes in these classes are mainly due to the business cycle and an unfavourable industrial composition.

Introduction

Understanding the determinants of firm performance has long been a very rich field of research (Coad, 2009; Hawawini, Subramanian, and Verdin al. 2003; Short et al., 2009). A body of literature has examined the relative performance effects of firm versus industry characteristics. Special attention has been devoted to the study of size effects. An independent branch of this literature investigates how employment growth varies by firm size, based on the Gibrat's law, which states that firm growth rates are independent of size (Gibrat, 1931).

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Gibrat's law has generated a large amount of research testing its validity (Sutton, 1997). A parallel largely separate literature focuses, since the work of David Birch (1979), on the role of small businesses in job creation (De Kok and De Wit, 2014; Neumark, Wall, and Zhang, 2011).

Beyond general references, studies that investigate the relationship between size and growth in periods of crisis are rather scarce. With reference to crisis periods, the impact of firm size on performance is difficult to predict. In the literature, results are rather mixed and inconclusive and spread out over different analyses of alternative performance variables. Some studies find evidence that small and medium-sized enterprises (SMEs) are better able to weather crises than larger ones (Varum and Rocha, 2013), others support the idea that SMEs may be affected by economic crises to a greater extent (McAleese and Counahan, 1979).

In general, it is expected that recessions associated with financial and banking turbulence such as the one started in 2008, that was caused by the credit crunch in the U.S. and rapidly expanded to Europe, can have disproportionate negative impacts on SMEs. Indeed, small businesses are more vulnerable to changed financial conditions (Erixon, 2009) and, thus, they can be liable to more severe employment losses. Hence, they are expected to be less resilient[*] than larger firms. Based on these considerations, this article studies whether smaller units were more negatively affected than larger units during the crisis started in 2008. Furthermore, it investigates which regions and which industry groups and interaction thereof determine the overall results. The concept of hysteresis, that refers to factors affecting long-term consequences of recession, is not discussed in this paper. It will be the topic for future research.

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[*] Refer to Martin (2012) for the notion and a discussion of the concept of resilience. Here the focus is on resistance, i.e. a system that is more resistant (less vulnerable) to shocks. For an in-depth analysis of the definitions and concepts of resilience see also Martin and Sunley (2015). Martin et al. (2016) examine how employment (at an aggregate level) in the UK regions has reacted to the four major recessions of the last 40 years.

The focus here is on the Italian case and the years 2007-2010. From the economic perspective, this is a period of crisis, characterized by significant decline of gross domestic product (GDP), considerable increase in unemployment, and a drop in exports, demand and investments. According to data from the Italian National Statistical Institute (Istat), Italian GDP growth dropped from a rate of 4.1% in 2007 to -3.1% in 2009. Unemployment rates increased from 6.2% at the beginning of 2007 to 8.4% at the end of 2009. The observed loss of employment was unequal among firm size-classes. Italy is an ideal case study to examine 2008-2010 recession because of the extreme regional disparities in economic structure and income levels. The 2008-2010 crisis was different from the previous ones that affected Italy, because of the financial reason for it. Indeed, the financial crisis had particularly severe effects on countries characterised by weak banking sectors and large public financial debts, such as Italy.

More in detail, and with reference to the Italian case and the years 2007-2010, the following research questions are addressed: (1) are smaller units more negatively affected than larger ones by the recent economic crisis in Italy? (2) Within each size class, which industries are contributing the most to the size effects? (3) Is there an interaction between the effects of size and industry and between the effects of size and region? If so, how can those be explained? (4) Are there regional differences in the above mentioned effects? How can they be explained?

The empirical analysis uses data from the Italian Business Statistical Register of Local Units (ASIA – Local units). It is worth noticing that Italy's employment data structure presents considerable disproportionalities in the distribution of industries among firms of different sizes. Service industries, for instance, are concentrated in smaller firms and manufacturing in larger firms. But these industries are also known to have different levels of resilience to economic recession. Hence any proper assessment of the differences in resilience of small and

large firms to economic shock must take full and accurate account of their industry-mix. Furthermore, it is known to be regional differences in the performance of firms by size class may reflect regional differences in the distribution of different industry types which need to be taken into account. All these types of disproportionalities call for an advanced partitioning methodology.

To answer the above research questions, taking into account industrial and regional disparities, this paper proposes the use of the Ray-Srinath multifactor partitioning (MFP) model and introduces the decomposition of some key components computed by the method to study the relationship between size and growth. This approach was first introduced by Ray (1990) and recently discussed by Lamarche, Srinath, and Ray (2003) and Ray, Lamarche, and Beaudin (2012). MFP is essentially an extension of shift-share analysis (Biffignandi, 1993). It recognizes that the observed differences in employment change in different size-classes may be due to differences in their industry-mix, regional-mix, pure size effects, business cycle and interactions between factors, and it provides a method for separating the effects due to the different components. The advantages of the MFP methodology are threefold. First, MFP does not need the specification of a model. Second, a small number of cross-tabulated data are required, without excluding the possibility that, with the availability of the longitudinal micro-data, one can carry out more sophisticated analyses. Third, in contrast with classical shift-share analysis, more accurate computations of the components of growth is provided from the use of standardised rates in MFP. Furthemore, it can be extended to more than two factors. Lagravinese (2015) uses MFP to study resilience to recessions of Italian regions, by analysing employment change during the three major recessions that affected Italy since 1970 and applying a two-way region-industry partitioning (without considering the size dimension). Ray (1996) analyses employment growth for Canada in the business cycle of 1978-1986 using a four-way MFP of employment by region, industry-group, country of ownership of firm, and

firm size class. Ray's paper documents the important contribution of small firms to employment growth over the business cycle but does not deal with the question of the resilience of small firms to economic shock.

The contribution of this study is both empirical and methodological. From the substantive point of view, this paper fills a gap in the literature on economic shock and regional resilience by dealing with the differential impact of the recent crisis on economic units of different sizes. To the best of the authors' knowledge, this is one of the few studies addressing this question in the recent economic crisis. Moreover, the study allows a better understanding of the Italian case, in which employment is mostly concentrated in micro firms. Considering that this structure is a common feature of many European countries (OECD 2009), the results of the analysis may be valuable in other contexts as well.

From the methodological point of view, it proposes the use of MFP for the study of the relationship between firm size, differences in regional and industrial composition and employment changes. Moreover, the paper introduces a new decomposition of several key components, allowing for a deeper interpretation. Particularly, it advances the application of MFP by its analysis of the interaction effects, which in most previous studies using MFP have been neglected. This is the first study to analyse the complete set of interactions and it provides a detailed template for similar studies in other countries.

The article is organized as follows. The second section describes the data, while the third section recalls the MFP approach and introduces the proposed decompositions. Results are presented in the fourth section. The fifth section provides some concluding remarks.

Data

The data source for this study is the Italian Business Statistical Register of Local Units (ASIA, Archivio Statistico delle Imprese Attive – Local units data), for the years 2007 and

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2010. The Register follows the Business Register European Union Council Regulation n. 2186/93. This database is obtained by the integration of various administrative and statistical sources and it is updated annually. It is managed by Istat. The register records the entire population of active local units operating in the manufacturing and services sectors. Economic activities related to agriculture, fisheries and public administration are excluded, as well as all units having the legal form of public institution and private non-profit institution. For each local unit, variables on identification (address), and stratification (economic activity and number of employed persons) are included. The employment level is computed as the annual average number of employed persons. The economic activity is identified according to the Italian sectoral activity classification Ateco 2007, which is the Italian version of the European classification Nace Rev. 2. The analysis considers data classified in six economic activities organized according to Ateco 2007 sections (one letter classification) as follows: Manufacturing industry (including Mining and Quarrying - B, Manufacturing - C, Electricity, gas, steam and air conditioning supply - D, and Water supply, sewerage, waste management and remediation activities – E), Construction (F), Services G-I (including Wholesale and retail trade, and repair of vehicles and motorcycles - G, Transportation and Storage - H, and Accommodation and food service activities - I), Information and communication (J), Financial, insurance and real estate activities (K-L), Services M-N (including Professional, scientific and technical activities - M, and Administrative and support service activities - N).

Concerning the spatial level of disaggregation, the present analysis is based on macro-regions (Nuts1 level): Northwest, Northeast, Centre, South, and Islands.

Data are at the local-unit level, i.e. tabulate employment growth by economic activity and region separately within each firm. This allows an effective picture of the distribution of economic activities by region and industry, overcoming the problems related to multi-located firms and firms carrying out different economic activities. Furthermore, this choice allows the

researcher to separate the behaviour of the small unit from that of the firm, so that findings are very precise.

In the present study, the size-class breakdown is based on employment and does not correspond to the European Commission definition (European Commission, 2005). This choice is related to the fact that the unit of analysis is the establishment and not the enterprise. The following size-classes are considered: 1-9, 10-19, 20-49, 50 and more persons employed. For convenience, in the following they are referred to as micro, small, medium, and large local units, respectively. As the analysis makes clear, the special grouping used in this study turns out to be important because of the very different resilience to recession of firms in the two smallest groups, the micro and small firms.

Turning to the analysis by size-class, in 2007 employment is concentrated in micro local units (49.91% of total employment). Large local units employ 25.70% of total employment, while small and medium units employ 12.58% and 11.81%, respectively.

Different employment growth rates are observed according to size-class; moreover, the actual impact on the number of employed persons varies strongly with size. Between 2007 and 2010 there was an overall loss of 424,122 employed persons. More than a half of these losses (56.46% – 239,468 employed persons) occurred in micro local units, while 31.30% were lost in large units (132,743 employed persons). Fewer losses were registered for small (9.26%) and medium units (2.98%).

Considering crude rates over the period 2007-2010 (Figure 1), large economic units registered the most heavy relative reduction (-3.17%). Micro units showed a decline of 2.94%. Small and medium units declined at somewhat lower rates: -1.92% and -0.66%, respectively.
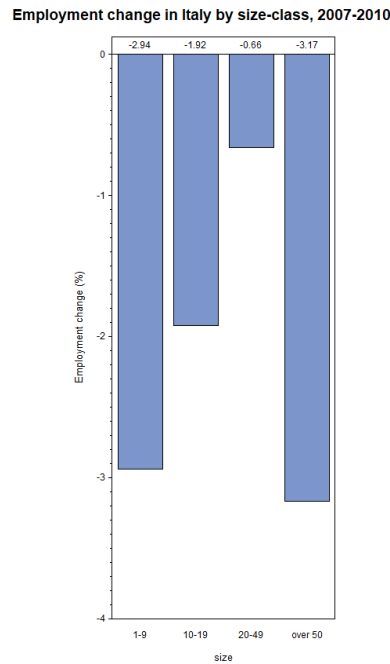
FIGURE 1. Employment change in Italy by size-class, 2007-2010.
Source: ASIA, years 2007 and 2010.

Before looking for any explanation for the observed changes, it is interesting to highlight some general characteristics of employment in Italy. Indeed, the rates of employment growth by size class are interwoven with the effects of their differing industrial and regional composition. Table 1 shows that about 30% of Italy's employment was in the manufacturing industry – which is a very high proportion compared with other European countries. Further, more than 40% of total employment in medium and large establishments was in manufacturing, while over 40% of employment in micro units was in trade, transportation, accommodation and food services (services G-I). On the contrary, micro establishments were under-represented in the manufacturing industry (15.22%) -- with respect to the corresponding weight in the national distribution (29.06%). These are the kind of disproportionalies that require data standardization and the need for MFP rather than shift-share.

Table 2 shows that employment decrease in Italy has been accounted for only by two sectors – manufacturing industry and construction – which were losing 596,642 employed persons in

total. The decline rate was -9.03% for the manufacturing industry and -8.52% for construction. The other sectors grew at the national level and overall they registered an increase of 172,521 employed persons. Financial, insurance and real estate activities grew at the rate 5.42%.

Looking at the regional distribution of employment (Table 3), regional differences in employment distribution among the size classes are small. Hence, the regional effect is not expected to help explaining the differences in employment growth by size-classes. For all size-classes, a North-to-South pattern is evident: a decreasing concentration of economic activities is observed going from Northern to Southern areas. Despite the regional disparities between North and South, regional employment losses in the 2007-2010 recession were greater in the North than in the South. Employment growth rates are negative in the North and in the Centre in each size-class. They are negative in the micro and large classes and positive for small and medium local units in the South. Growth rates are negative only for micro units in the Islands. This point is worthy of emphasis And an objective of the paper is to explain why the geography of employment growth trends was reversed in the 2008-2010 recession from the long term trends. At first sight, these results may seem rather puzzling since these are typically the least competitive regions in Italy. In general, it has been argued that regional growth rates converge in periods of growth and diverge in periods of recession (Martin, 2012; Martin and Sunley, 2015). A possible explanation for the observed rates is that remote areas, not tied into the national economy, might be less affected by the recession. So they are less affected because their regional economies are not integrated into the national economy. These results are also in agreement with those in Espa et al. (2014), even though in this case businesses are classified by two dimensions only (spatial and sectoral) over the period 2004-2009. Espa et al. (2014) attribute the higher rates of business change recorded in Southern

regions to the smaller impact of the crisis on relatively less developed regional economies. These aspects are further investigated in the fourth section.

TABLE 1. Employment in Italy by industry and size-class, 2007.

| Sectoral activity | Sectoral per cent distribution by size-class - 2007 | | | | |
| | Size-class | | | | |
	1-9	10-19	20-49	≥ 50	Total
Manufacturing industry	15.22	35.45	43.08	46.38	29.06
Construction	16.54	15.20	10.04	3.23	12.18
Trade, Transportation, Accommodation and food services (Services G-I)	43.56	34.55	31.14	23.65	35.84
Information and Communication	2.51	2.82	3.15	5.52	3.40
Financial, insurance and Real estate activities	6.74	4.10	3.38	4.74	5.50
Professional, Scientific, technical, Adm. and Support services (Services M-N)	15.43	7.87	9.21	16.48	14.02
Total percent	100.00	100.00	100.00	100.00	100.00
Total employment	8,132,738	2,049,544	1,924,464	4,187,744	16,294,491

Source: ASIA, years 2007 and 2010.

TABLE 2. Employment growth in Italy by industry and size-class, 2007-2010.

Sectoral activity	Employment growth					Employment growth rate (%)				
	Size-class					Size-class				
	1-9	10-19	20-49	≥ 50	Total	1-9	10-19	20-49	≥ 50	Total
Manufacturing industry	-126,531	-71,483	-64,539	-164,917	-427,470	-10.22	-9.84	-7.78	-8.49	-9.03
Construction	-133,501	-35,969	-8,956	9,253	-169,172	-9.92	-11.54	-4.64	6.85	-8.52
Trade, Transportation, Accommodation and food services (Services G-I)	-61,622	51,543	32,428	18,240	40,589	-1.74	7.28	5.41	1.84	0.69
Information and Communication	-6,752	-2	4,048	16,761	14,055	-3.31	0.00	6.67	7.25	2.54
Financial, Insurance and Real estate activities	58,777	1,115	5,190	-16,581	48,502	10.73	1.33	7.99	-8.35	5.42
Professional, Scientific, technical, Adm. and Support services (Services M-N)	30,161	15,514	19,200	4,500	69,375	2.40	9.62	10.83	0.65	3.04
Total	-239,468	-39,281	-12,629	-132,743	-424,122	-2.94	-1.92	-0.66	-3.17	-2.60

Source: ASIA, years 2007 and 2010.

TABLE 3. Employment in 2007 and employment growth rates 2007-2010 in Italy by region and size-class.

Regions	Employment per cent regional distribution by size-class - 2007					Employment growth rate (%) – 2007-2010				
	Size-class					Size-class				
	1-9	10-19	20-49	≥ 50	Total	1-9	10-19	20-49	≥ 50	Total
Northwest	29.49	31.56	33.90	38.44	32.57	-3.15	-2.99	-1.92	-3.02	-2.94
Northeast	22.68	26.14	28.07	25.00	24.35	-3.98	-3.03	-2.43	-4.84	-3.87
Centre	21.08	20.94	19.43	20.07	20.61	-2.96	-2.46	-1.57	-2.56	-2.64
South	18.32	14.84	13.30	12.19	15.71	-1.94	0.57	4.39	-2.63	-1.15
Islands	8.43	6.52	5.30	4.30	6.76	-1.60	3.83	7.55	0.83	0.30
Italy	100.00	100.00	100.00	100.00	100.00	-2.94	-1.92	-0.66	-3.17	-2.60
Total employment	8,132,738	2,049,544	1,924,464	4,187,744	16,294,491					

Percentages are computed with respect to totals in Tables 3 and 4, respectively.
Source: ASIA, years 2007 and 2010.

The method

To study the effect of size on employment growth, the use of multifactor partitioning (MFP) is proposed. MFP, like shift-share analysis, is a method of partitioning growth rates. First proposed in 1940 (Jones, 1940), the shift-share analysis has been widely applied to examine employment changes. MFP was introduced by Ray (1990) and it is an extension of shift-share analysis in two respects. First, it recognizes the flaw in traditional shift-share analysis in the computation of rates and provides proper standardized rates, which allow to disentangle the compositional effects. Second, it extends shift-share analysis to deal with more than two factors. This feature is especially important in the present context and allows to apply the technique to study employment by size-class.

The needs to standardise trends for compositional differences are fully recognised by statisticians in a number of fields. For example, demographers would not compare death rates without adjusting them for differences in age distribution. Similarly, the composition of small businesses is different from that of large enterprises in terms of industry-mix and regional location. Each of these compositional differences has an independent and intrinsic effect on employment growth. Thus, conclusions about the contribution of small businesses to employment growth that are based on crude rates may be quite wrong.

In the following, let i denote industry, j region, and k the size-class. By way of example, the standardized size rate between time period t and the base period 0 is computed as

$$\hat{r}_{\bullet\bullet k} = \sum_{ij} r_{ijk} \frac{E_{i\bullet\bullet}^0 E_{\bullet j\bullet}^0}{\left(E_{\bullet\bullet\bullet}^0\right)^2},$$

where r_{ijk} is the employment growth rate in industry i, region j and size-class k over the entire period 0-t, $E_{i\bullet\bullet}^0$ is the number of employees in sector i at time 0, $E_{\bullet j\bullet}^0$ is the number of employees in region j at time 0, and $E_{\bullet\bullet\bullet}^0$ is the number of employees in the nation at time 0. Notice that the weights used to compute the standardized size rate are the same for every size-

class. Thus, the standardized size rate $\hat{r}_{\bullet\bullet k}$ represents the growth rate that would have occurred in a size-class if employment in each of its industries and regions has been the same proportion as the proportion of that industry-region in the nation. The other rates are computed similarly. They are detailed in Appendix A. Notice that when another factor is introduced, standardized rates change, taking into account disproportionalities related to the new factor. Crude rates remain the same.

MFP decomposes employment change in each region, size-class and industry, ($E_{ijk}^{t} - E_{ijk}^{0}$), into different sources attributable to region, size, industry, business cycle and a number of interactions. To study the effects of size on growth, this article proposes to aggregate (sum) individual effects over size-classes, to obtain the decomposition of $E_{\bullet\bullet k}^{t} - E_{\bullet\bullet k}^{0} = \sum_{ij} \left(E_{ijk}^{t} - E_{ijk}^{0} \right)$, with $E_{\bullet\bullet k}^{0}$ ($E_{\bullet\bullet k}^{t}$) denoting the national employment at time 0 (time t). Hereunder, the decomposition at the size-group level in relative form is presented, i.e. the quantity decomposed is $r_{\bullet\bullet k} = \left(E_{\bullet\bullet k}^{t} - E_{\bullet\bullet k}^{0} \right) / E_{\bullet\bullet k}^{0}$. The decomposition entails five main effects (national share N_k, allocation effect A_k, industry-mix IM_k, regional-mix RM_k, size effect S_k) and four interactions (industry-size IS_k, size-region SR_k, industry-region IR_k, and industry-size-region ISR_k):

(1) $\qquad\qquad r_{\bullet\bullet k} = N_k + A_k + IM_k + RM_k + S_k + IS_k + SR_k + IR_k + ISR_k.$

The national share is given by $N_k = \sum_{i} \sum_{j} \dfrac{E_{ijk}^{0}}{E_{\bullet\bullet k}^{0}} r_{\bullet\bullet\bullet}$, where E_{ijk}^{0} is the number of employees in industry i, region j and size k at time 0, $r_{\bullet\bullet\bullet} = \left(E_{\bullet\bullet\bullet}^{t} - E_{\bullet\bullet\bullet}^{0} \right) / E_{\bullet\bullet\bullet}^{0}$ is the overall national rate of employment growth, $E_{\bullet\bullet\bullet}^{t}$ and $E_{\bullet\bullet\bullet}^{0}$ are the number of employees in the nation at time t and 0, respectively. N_k represents the employment change in a size-class that would have occurred if

the class had grown at the national rate. It measures the effects of macroeconomic fluctuations on employment change.

The industry-mix effect is given by $IM_k = \sum_i \sum_j \dfrac{E_{ijk}^0}{E_{\bullet\bullet k}^0}(\hat{r}_{i\bullet\bullet} - \hat{r}_{\bullet\bullet\bullet})$, where $\hat{r}_{i\bullet\bullet}$ is the standardized industry growth rate and $\hat{r}_{\bullet\bullet\bullet}$ is the standardized national growth rate. The industry-mix effect may be re-written as $IM_k = \sum_i \hat{r}_{i\bullet\bullet}\left(\dfrac{E_{i\bullet k}^0}{E_{\bullet\bullet k}^0} - \dfrac{E_{i\bullet\bullet}^0}{E_{\bullet\bullet\bullet}^0}\right)$, which clarifies that it measures the proportion of employment change attributable to the industrial composition within each size-class. A size-class with a concentration of fast-growth industries will have a favourable industry-mix effect. Conversely, a size-class with a concentration of slow-growth industries will have a negative industry-mix.

The size component is defined as $S_k = \sum_i \sum_j \dfrac{E_{ijk}^0}{E_{\bullet\bullet k}^0}(\hat{r}_{\bullet\bullet k} - \hat{r}_{\bullet\bullet\bullet})$. It measures the pure effect attributable to size, free from the effects of industry-mix, regional distribution and business cycle. It is a comparative measure of how much faster or slower firms of a given industry and region tend to grow in that size-class than in the nation. This component reflects the size competitive position and can be attributed to size advantages or disadvantages that affect employment change. Further, it is a good indicator for the dynamics of employment change in a specific size-class, since it represents the magnitude of employment change attributable purely to size.

The regional-mix effect is defined as $RM_k = \sum_i \sum_j \dfrac{E_{ijk}^0}{E_{\bullet\bullet k}^0}(\hat{r}_{\bullet j\bullet} - \hat{r}_{\bullet\bullet\bullet})$, where $\hat{r}_{\bullet j\bullet}$ is the standardized regional growth rate. It measures the proportion of employment change which can be ascribed to the regional distribution of firms within each size-class. A size-class with a concentration of firms in competitive regions will have a positive region-mix effect.

The allocation effect, given by $A_k = \sum_i \sum_j \frac{E_{ijk}^0}{E_{\bullet\bullet k}^0} (\hat{r}_{\bullet\bullet\bullet} - r_{\bullet\bullet\bullet})$, measures the extent to which the

location of economic activities enhances national growth. It is the difference between the

actual national growth rate and what would have been if all activities were distributed in

perfect proportion to total employment.

Turning to interactions, each region has specific resources and locational attributes that have a

differential value for each industry according to its needs. The industry-region interaction is

an aggregate measure of such specific advantages within each size-class and it is computed as

$$IR_k = \sum_i \sum_j \frac{E_{ijk}^0}{E_{\bullet\bullet k}^0} (\hat{r}_{ij\bullet} - \hat{r}_{i\bullet\bullet} - \hat{r}_{\bullet j\bullet} + \hat{r}_{\bullet\bullet\bullet}), \quad \hat{r}_{ij\bullet} \text{ being the standardized industry-region growth rate.}$$

The industry-size interaction is given by $IS_k = \sum_i \sum_j \frac{E_{ijk}^0}{E_{\bullet\bullet k}^0} (\hat{r}_{i\bullet k} - \hat{r}_{i\bullet\bullet} - \hat{r}_{\bullet\bullet k} + \hat{r}_{\bullet\bullet\bullet})$, where $\hat{r}_{i\bullet k}$ is

the standardized industry-size growth rate. It reflects internal economies of scale. The size-

region interaction measures external economies of scale. It is defined as

$$SR_k = \sum_i \sum_j \frac{E_{ijk}^0}{E_{\bullet\bullet k}^0} (\hat{r}_{\bullet jk} - \hat{r}_{\bullet j\bullet} - \hat{r}_{\bullet\bullet k} + \hat{r}_{\bullet\bullet\bullet}), \quad \hat{r}_{\bullet jk} \text{ being the standardized size-region growth rate.}$$

Finally, the industry-size-region interaction is a very specific agglomeration economy

measure and it is given by $ISR_k = \sum_i \sum_j \frac{E_{ijk}^0}{E_{\bullet\bullet k}^0} (r_{ijk} - \hat{r}_{ij\bullet} - \hat{r}_{i\bullet k} - \hat{r}_{\bullet jk} + \hat{r}_{i\bullet\bullet} + \hat{r}_{\bullet j\bullet} + \hat{r}_{\bullet\bullet k} - \hat{r}_{\bullet\bullet\bullet})$.

In order to allow for a deeper interpretation of the results, we propose a further decomposition

of the size-related components (S_k, IS_k, and SR_k). These decompositions will prove to be

useful to answer the research questions.

At the size-group level, this study proposes to express the size effect as

(2) $$S_k = \sum_i \left(\hat{r}_{i\bullet k} - \hat{r}_{i\bullet\bullet} \right) \frac{E_{i\bullet\bullet}^0}{E_{\bullet\bullet\bullet}^0},$$

which makes it clear that the size effect is fundamentally due to differences in industry-specific growth rates $\left(\hat{r}_{i\bullet k} - \hat{r}_{i\bullet\bullet} \right)$ between the size-groups and the nation.

As for the industry-size interaction at the size-group level, it is proposed to rewrite it as

(3)
$$IS_k = \sum_i (\hat{r}_{i\bullet k} - \hat{r}_{i\bullet\bullet}) \left(\frac{E_{i\bullet k}^0}{E_{\bullet\bullet k}^0} - \frac{E_{i\bullet\bullet}^0}{E_{\bullet\bullet\bullet}^0} \right).$$

This decomposition clarifies that this component is positive for size k if establishments in size-class k are overall concentrated in sectors where they perform better than the same sectors at the national level and under-represented in those sectors where they perform worse compared to the same sector at the national level.

Turning to the size-region interaction effect, an interesting interpretation emerges by re-writing the component as

(4)
$$SR_k = \sum_j (\hat{r}_{\bullet jk} - \hat{r}_{\bullet j\bullet}) \left(\frac{E_{\bullet jk}^0}{E_{\bullet\bullet k}^0} - \frac{E_{\bullet j\bullet}^0}{E_{\bullet\bullet\bullet}^0} \right).$$

This expression clarifies that the size-region interaction is positive for size k if local units in size-class k are concentrated in regions where they perform better compared to the overall performance of the region and under-represented in regions where they perform worse than the overall region.

Further, given that from a policy point of view it is important also to see which regions or which industry groups or interactions determine the overall results, the explicit MFP decomposition at the region-size group level is provided. The growth rates $r_{\bullet jk}$ by region and size-class are decomposed as

(5)
$$r_{\bullet jk} = N_{jk} + A_{jk} + IM_{jk} + R_{jk} + S_{jk} + IS_{jk} + SR_{jk} + IR_{jk} + ISR_{jk}.$$

where
$$N_{jk} = \sum_i \frac{E^0_{ijk}}{E^0_{\bullet jk}} r_{\bullet\bullet\bullet} \, , \qquad IM_{jk} = \sum_i \frac{E^0_{ijk}}{E^0_{\bullet jk}} (\hat{r}_{i\bullet\bullet} - \hat{r}_{\bullet\bullet\bullet}) \, , \qquad S_{jk} = \sum_i \frac{E^0_{ijk}}{E^0_{\bullet jk}} (\hat{r}_{\bullet\bullet k} - \hat{r}_{\bullet\bullet\bullet}) \, ,$$

$$R_{jk} = \sum_i \frac{E^0_{ijk}}{E^0_{\bullet jk}} (\hat{r}_{\bullet j\bullet} - \hat{r}_{\bullet\bullet\bullet}) \, , \qquad A_{jk} = \sum_i \frac{E^0_{ijk}}{E^0_{\bullet jk}} (\hat{r}_{\bullet\bullet\bullet} - r_{\bullet\bullet\bullet}) \, , \quad \text{and similarly for interactions. The}$$

interpretation of these components is similar to that outlined above. Notice that at this level of

disaggregation, the regional-mix component becomes a regional component only (R_{jk}).

Finally, for interpretation purposes, it is proposed to further decompose the region effect – at

the regional level it is just $\left(\hat{r}_{\bullet j\bullet} - \hat{r}_{\bullet\bullet\bullet} \right)$ - as

$$(6) \qquad\qquad R_{jk} = \left(\hat{r}_{\bullet j\bullet} - \hat{r}_{\bullet\bullet\bullet} \right) = \sum_i \left(\hat{r}_{ij\bullet} - \hat{r}_{i\bullet\bullet} \right) \frac{E^0_{i\bullet\bullet}}{E^0_{\bullet\bullet\bullet}}.$$

Expression (6) clarifies that the region effect (at regional level) is due to differences in

industry-specific growth rates $\left(\hat{r}_{ij\bullet} - \hat{r}_{i\bullet\bullet} \right)$ between the region and the nation.

Various critics have been addressed to shift-share analysis and they are pertinent to MFP as

well. First, standardization methods lack an underlying theory (Stevens and Moore, 1980).

However, standardisation of data does not require a theory as to how the data trends should

behave. Rather, it provides data which may be used to test theories. MFP identifies the extent

to which employment change in a size-class can be ascribed to size itself or to other effects,

which is a necessary prerequisite to understanding the mechanisms behind the observed

employment changes. Once the portion of employment change attributable to size has been

isolated, it might be analyzed by different statistical techniques to identify the reasons for the

observed shift. Second, the traditional shift-share as well as MFP measure the combined

effects of output growth and productivity growth on employment (Haynes and Dinc, 1997)

and they do not account for spatial interactions among regions (Nazara and Hewings, 2004).

Extensions have been proposed to isolate and identify the influence of labour productivity

changes on employment levels (Dinc, Haynes, and Anderson, 1998; Rigby, 1992) and to

study spatial interactions (Nazara and Hewings, 2004; Zaccomer and Mason, 2011). The authors acknowledge that labour growth productivity and spatial interactions may play a role in employment changes. However, they recognize that it is of primary importance to first properly identify the effects.

Results

Table 4 presents results on crude and standardized industrial and regional rates. The differences observed between crude and standardized rates reflect the impact of the other factors on crude rates.

TABLE 4. Crude and standardized rates, 2007-2010.

	Crude rates	Std rates
Sectoral activity		
Manufacturing industry	-9.03	-9.36
Construction	-8.52	-4.96
Trade, Transportation, Accommodation and Food Services (Services G-I)	0.69	1.04
Information and Communication	2.54	0.86
Financial, Insurance and Real Estate Activities	5.42	4.12
Professional, Scientific, Technical, Adm. and Support services (Services M-N)	3.04	4.00
Regions		
Northwest	-2.94	-2.43
Northeast	-3.87	-3.09
Centre	-2.64	-2.33
South	-1.15	-1.01
Islands	0.30	0.63

Looking at industry rates, the biggest differences are observed for construction (from -8.52% to -4.96%) and information and communication (from +2.54% to +0.86%). Standardization does not have any major effect on regional rates.

Size rates are those changing the most after standardization. The rate for micro local units moves from -2.94% to -4.06%, while it becomes higher for all the other size-classes. For medium local units, it becomes even positive (going from -0.66% to +1.63%). For small units, it goes from -1.92% to -0.07% and for large units from -3.17% to -1.16%. The growth rate rank order also changes. After standardization, micro units are the worst performing ones.

The results of the MFP decomposition at the size-class level, according to equation (1), are summarized in Table 5 in relative form. They are obtained by summing elementary components (shown in Appendix B) over industry and region and then dividing by the total number of employment in the relevant size-class in 2007. Individual effects can be converted to the corresponding number of employed persons by multiplying the rate (Table 5) by the number of employed persons in 2007 (Table 1).

TABLE 5. Partitioned rates (%) of employment growth in Italy by size-class, 2007-2010.

Growth Effect	1-9	10-19	20-49	≥ 50
Employment growth 2007-2010	-2.94	-1.92	-0.66	-3.17
Industry-mix	**1.26**	**-1.07**	**-1.54**	**-1.22**
Regional-mix	0.10	-0.03	-0.10	-0.13
Size	**-1.92**	**2.07**	**3.77**	**0.97**
Industry-size interaction	**-0.23**	**-0.59**	**-0.47**	**-0.93**
Industry-region interaction	0.04	-0.03	0.01	0.02
Size-region interaction	-0.02	-0.00	-0.15	0.19
Other	-0.04	-0.12	-0.04	0.07
National growth rate		-2.60		
Allocation		0.46		

The results show that next to the national growth effect, size and industry-mix effects dominate employment changes across firm size-groups. These are the important effects. Notice also that, compared to the other effects, the biggest contrasts in effect by size-class are in the size effect, and the industry-size interaction (presented in bold in Table 5). Thus employment dynamics, and in particular units' size structure, are not only related to the

macroeconomic cycle, but also and especially to the structural characteristics of the industrial system.

A differential behavior of micro-establishments with respect to all types of establishments larger than 10 employed persons is observed. Micro-establishments show a negative size effect and a net positive component for the industry composition. Larger establishments have opposite components, respectively.

Taking a closer look, as is evident from Table 1, about 43% of the micro-establishments are active in the trade, transportation, accommodation and food services (services G-I) sector, whereas for larger establishments the proportion of units in manufacturing industry increases. So the positive industry-mix effect for micro units evident from Table 5 comes from the fact that many of them are in the service sector and a lower proportion in manufacturing industry. Indeed, if one adds up the pure industry-mix effect and the industry-size interaction, the net effect is 1.03 and the overall industry-mix effect (i.e. adding up all industry-mix related components) is 1.07.

For the other size-classes, the industry-mix has a negative impact on the performance. It also drags down the otherwise positive size effect for these establishments (adding the pure size component and the industry-size interaction).

Turning to the size effect, the highest positive size effects are detected for small (2.07%) and medium (3.77%) establishments, whereas for large establishments this effect is much smaller (just 0.97%) and for the micro firms it is negative (-1.92%). Thus, micro-establishments are affected more importantly than larger establishments, that are better able to absorb the cyclical variation. These results provide evidence that micro, small, and medium units are affected quite differently by the crisis. Notice also that the size and industry-size interaction effects for large firms cancel each other out, whereas the regional effect (adding the size-

region interaction effect +0.19) increases it again. The benefits due to size for large units are offset by the negative trend.

The traditional MFP method does not allow to go further in the interpretation of these intriguing results. As described in the third section, the present article proposes to further decompose the size-related components to help the interpretation process. First, in order to provide an explanation to the observed size effect, and particularly the differential behavior between the micro and the orther classes, Table 6 contains industry-specific elements of decomposition (2). They are computed as the product of the difference between the standardized industry-size rate and the standardized industry rate with the total employment in each region as a proportion of the total national figure. This is one of the real contributions of the paper made possible by the further partitioning of the MFP.

TABLE 6. Decomposition of S_k (size effect) by sectoral activity according to equation (2). Each element in the table is given by $\left(\hat{r}_{i\bullet k} - \hat{r}_{i\bullet\bullet}\right)\cdot E_{i\bullet\bullet}^0 / E_{\bullet\bullet\bullet}^0$

Sectoral activity	1-9	10-19	20-49	≥50
Manufacturing industry	*-0.25*	*-0.04*	0.51	0.27
Construction	*-0.62*	*-0.74*	0.03	1.55
Trade, Transportation, Accommodation and Food Services (Services G-I)	*-1.07*	2.19	1.63	0.26
Information and Communication	*-0.14*	*-0.02*	0.25	0.17
Financial, Insurance and Real Estate Activities	0.39	*-0.14*	0.27	*-0.81*
Professional, Scientific, technical, Adm. and Support services (Services M-N)	*-0.23*	0.82	1.08	*-0.46*
S_k	**-1.92**	**2.07**	**3.77**	**0.97**

Table 6 reveals the difference in the signs for smaller and larger firms and between the goods producing and service industries, where italics is used to highlight the negative values. The biggest contrasts between the four size classes in their size effect occur in construction and services. Large firms in construction proved to be remarkably resilient to the recession and the size effect was 1.55% compared with -0.62% for micro sized construction units. For the trade, transportation, accommodation and food services (services G-I) industries, it was the

small and medium sized units that proved most resilient though the size effect for large firms was still positive (0.26%). The recession was triggered by the financial, insurance and real estate sector and this was the only sector where large firms suffered a negative size effect (-0.81%).

Interestingly, the overall negative size effect for micro-establishments is mainly attributable to trade, transportation, accommodation and food services (services G-I) (-1.07%) and construction (-0.62%). The standardized growth rate for trade, transportation, accommodation and food services (services G-I) in the micro-class is below the national level. So even though the composition in this sector is favorable for micro-establishments (since this sector is growing at the national level), trade, transportation, accommodation and food services (services G-I) go worse for micro-establishments than in general. Employment in trade, transportation, accommodation and food services (services G-I) micro-units declined even though this sector continued to grow at the national level despite the recession. This result agrees with the intuition that small service firms (like restaurants) have been hit hard by the decline in incomes and demand. As it regards construction, the performance of this sector for micro-establishments is more sensitive to the crisis since they are greatly dependent on the sector situation and they have no means to contrast arising difficulties. The large size effect registered for small and medium establishments seems to be mostly related to trade, transportation, accommodation and food services (services G-I) and professional, scientific, technical, administrative and support services (services M-N).

From the decomposition of the industry-size interaction according to equation (3), it turns out that the main (negative) contribution for large establishments to the industry-size interaction component is due to the construction sector (-1.14%). Construction for large establishments has a higher performance than the same sector at the national level ($\hat{r}_{2\bullet4} - \hat{r}_{2\bullet\bullet} = 12.69$). However, the proportion of large units in the construction sector is much lower than the same

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proportion at the national level. This means that large establishments are not concentrated in sectors where they perform better. The construction sector thus appears as a key element in understanding the observed behavior of large establishments.

Finally, the decomposition of the size-region interaction (equation (4)) reveals that the positive effect of the size-region interaction for large establishments is mainly related to the fact that they are more concentrated in Northwest (where they perform better) and under-represented in the South (where their performance is lower). Large establishments have thus benefited from the locational advantages offered from the Northern area. For Northwest, the standardized growth rate for large establishments is much higher than the standardized region growth rate ($\hat{r}_{\bullet 14} - \hat{r}_{\bullet 1 \bullet}$ =2.29) and the proportion of establishments for the large class is higher than the one at the national level ($E_{\bullet 14}^0 / E_{\bullet \bullet 4}^0 - E_{\bullet 1 \bullet}^0 / E_{\bullet \bullet \bullet}^0$ =0.059). For the interested reader, results on the decomposition of the industry-size and size-region interactions are available in the online supplementary material (Tables 1 and 2).

The results discussed up to now are aggregate results for Italy. From a policy point of view, it is important to see which regions or which larger industry groups and interactions thereof determine these overall results. Figure 2 summarizes the main results on the MFP decomposition at the region-size level, according to equation (5). The complete table is available in the online supplementary material (Table 3).

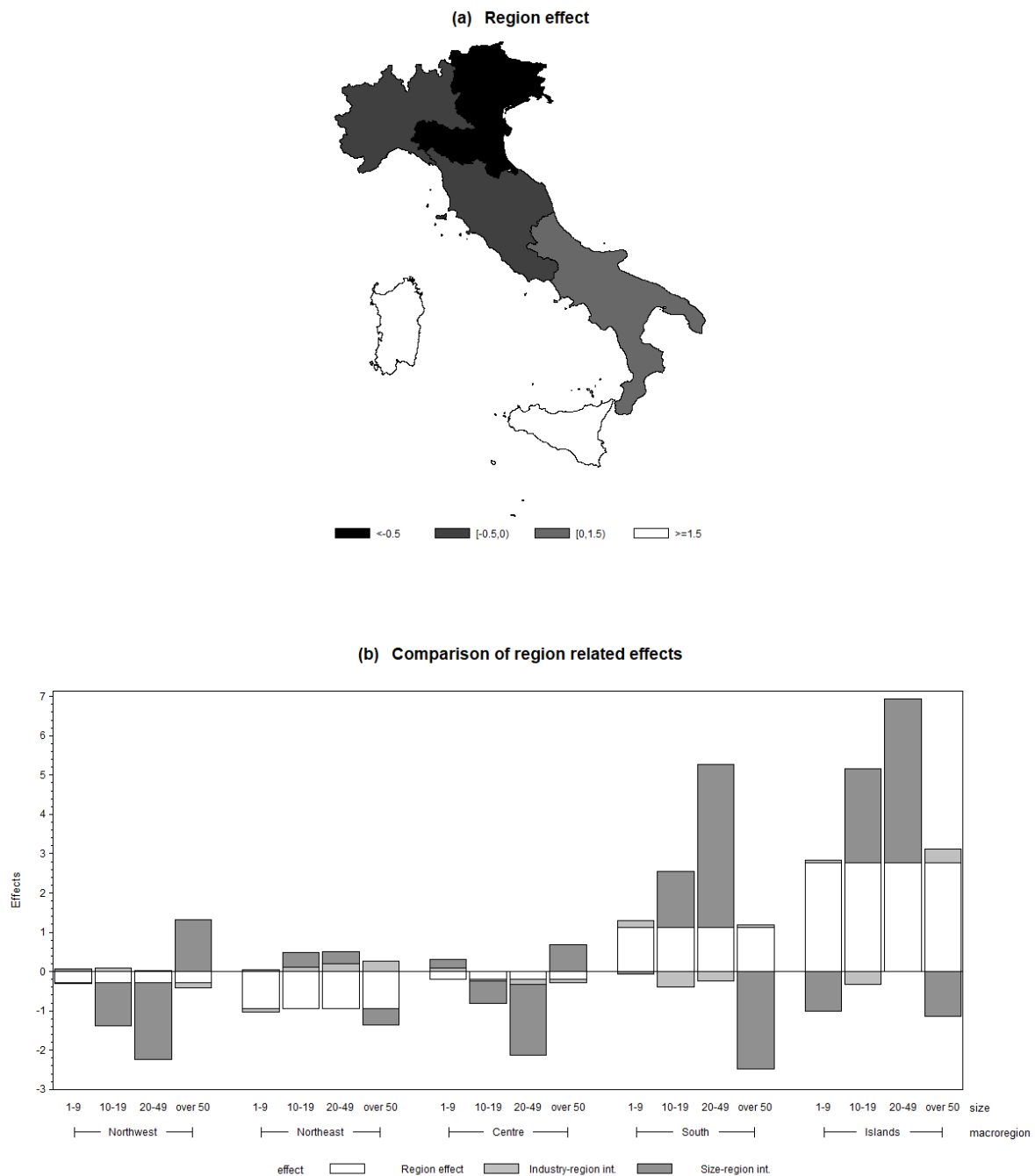FIGURE 2. (a) Region effect and (b) comparison of region, industry-region and size-region interaction effects in Italy by size-class and region, 2007-2010.

The main point to emerge is the contrast in the region effects. Notice that the region effect for any one region is the same for all size-groups in that region. Changes with respect to aggregate results are mostly related to the region effect and its interactions. What is rather

striking is the net positive region effect for South (+1.13) and Islands (+2.77). Indeed, these are typically the least competitive regions in Italy. In order to throw some light on this aspect, industry-specific elements in the regional component have been computed according to decomposition (6). Interestingly, it turns out that what differentiates South and Islands the most from the rest of Italy is the trade, transportation, accommodation and food services (services G-I) sector. Indeed, this is the most relevant (positive) component for these regions (+0.81 and +1.66, respectively). It is also the biggest negative component for Northeast and Centre (-0.49 and -0.42, respectively). Professional, scientific, technical, administrative and support services (services M-N) show a similar (but smaller) pattern. The complete table is available in the online supplementary material (Table 4).

Overall, the role played by trade, transportation, accommodation and food services (services G-I) is rather intriguing. First, they explain most of the observed size effect for micro, small, and medium units (Table 6). Second, they are differentiating Southern and Northern regions' trends. Unfortunately, it is not possible to further detail the analysis and compute separate effects for sectors G, H, and I, due to unavailability of data at this level of detail. Bianchi and Biffignandi (2015), using data classified by region and sector only (where it is possible to disentangle the effects of sectors G, H, and I, though size dimension is not considered), show that the main contribution to the positive performance of trade, transportation, accommodation and food services (services G-I) is mainly related to tourism related activities (sector I). Moreover, their positive effect in Southern regions seems to be due to sector G and tourism related activities (sector I). Further research will be undertaken to isolate the effects of sectors G, H, and I, when proper data will be accessed.

Conclusions

This research explores the relationship between firm size, differences in their regional and industrial composition, and employment change in Italy over the recent crisis period. These

relationships are examined using MFP which is extended by the introduction of a new decomposition of several key components.

From the standpoint of methodology, the paper shows that a) the MFP approach can be useful in disentangling the interwoven portions of employment change attributable to different sources, namely, business cycle, size, industrial composition, regional distribution and interactions among them; and b) the proposed decomposition of key components supports for a more informative interpretation of the results. In future studies, other factors could be added in the model (e.g. country of control) depending on data availability. Furthermore, the authors have identified issues in the present data that need further study. In particular, further research is needed to include spatial interactions and/or labour productivity changes in the context of MFP. Another interesting development would be to consider entry and exit flows separately as in Piacentino et al. (2017).

From the substantive point of view, the paper addresses an issue of great current importance, namely the relationship between firm growth and size during economic crises. It also contributes to the understanding of the growth of smaller versus larger firms during recessions. Despite the great interest in this matter, the related literature is rather scarce, especially with reference to the crisis started in 2008. Moreover, results from previous crises are not easily applicable to the current one since different recessions may have different effects.

The empirical investigation shows a heterogeneous resilience among classes to the recent crisis. In general, variations in employment growth performance are accounted for by differences in the size-class of firms, and their industry-mix. The greatest resilience is demonstrated by services with large employment declines in manufacturing and construction, though with important differences among the four size classes.

The weak performance of micro units (-239,468 employed persons between 2007 and 2010) is not due to their industry-mix, which is positive, but to a very negative size-class effect. A deeper investigation reveals that the key sector for explaining these values is trade, transportation, accommodation and food services (services G-I). Turning to large units, when looking at crude rates, they seemed to be the worst performing ones. After separating the effects, it turns out that their size has a positive contribution. MFP shows that the negative performance of large economic units in terms of employment change (-132,743) is due to the national effect, an unfavorable industry composition at the beginning of the period and diseconomies of scale (industry-size interactions), which are mainly related to the construction sector. A downsizing of large units to the medium size-class may be hypothesized. When the crisis is over, some structural changes in the production system toward the medium-sized establishments class could emerge.

When looking at crude rates, medium-sized economic units appear to register a small employment decline. MFP shows that they have the highest positive size effect, and a negative industry-mix and size-industry interaction. This shift may be due to some downsizing of large units, not only to the sectoral crisis. A similar pattern holds for small units.

To answer the research questions: (1) different size-classes are affected in a different measure by the recent crisis, with micro units affected more severely than larger establishments; (2) the biggest contrasts between the four size classes in their size effect occur in construction and services. Large firms in construction proved to be remarkably resilient to the recession, in contrast to micro-sized construction units. For the trade, transportation, accommodation and food services (services G-I) industries, it was the small and medium sized units that proved most resilient, while these sectors are also mostly responsible for the observed negative size effect for micro units; (3) the size-industry and size-region interactions are particularly

relevant for large establishments. The main contribution for large establishments to the industry-size interaction component is due to the construction sector, while the positive effect of the size-region interaction is mostly related to the fact that they are more concentrated in Northwest (where they perform better) and under-represented in the South (where their performance is lower); (4) Regional differences are observed, with South and Islands having higher region effects compared to the other regions. The analysis reveals that the key sector differentiating Northern and Southern regions' trend is the trade, transportation, accommodation and food services (services G-I) sector.

The answers to the research questions suggest some comments useful in a policy perspective. The main factor differentiating the resistance to the recent crisis in Italy is the trade, transportation, accomodation and food services sector. This sector is playing a crucial role both with respect to resilience of small and medium firms versus microfirms and with respect to regional disparities, in favour of Southern regions, where tourism is especially positively affecting resilience. Small and medium firms, particularly in the service sector, performed comparatively better in employment against the crisis, so they were more resistant. Possibly, this result overlaps the recession trend with the structural changes invoked by the digital revolution. One reason could be that these firm sizes were flexible enough in adapting their organization, especially in the services sector where innovation related to the digital economy was most straightforward and pervasive, like e-commerce, delivering tracking, hotel and flight booking and selling. Current European policy measures oriented to public services modernization, to create the right innovative services to flourish, and to maximize the growth potential of the digital economy are in line with the empirical findings of the resistance in the recession period and could be useful to help the recovery of the economy. In this sense, policy priorities set out at the European level are in line with the suggestions emerging from the present study and are expected to have great potentials for the future development of SMEs.

Resistance is expected to be followed by a recovery. Thus, a further step in the understanding of the consequences of the recession on size-classes employment growth is to investigate the long-term consequences of the recession, namely hysteresis, and identify which size-class and sector recover more rapidly than the others. This topic is left for future research.

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Appendix A

Let E_{ijk}^0 (E_{ijk}^t) denote the employment at time 0 (time t) in industry i, region j, and size-class k. Let $E_{i\bullet\bullet}^0 = \sum_{jk} E_{ijk}^0$ be the national employment at time 0 in industry i, $E_{\bullet j\bullet}^0 = \sum_{ik} E_{ijk}^0$ the total employment in region j, $E_{\bullet\bullet k}^0 = \sum_{ij} E_{ijk}^0$ the national employment in size-class k, and

$E_{\bullet\bullet\bullet}^0 = \sum_{ij} E_{ijk}^0$ the total employment in the base year in the nation.

The employment growth rate in industry i, region j, and size-class k is given by

$$r_{ijk} = \frac{E_{ijk}^t - E_{ijk}^0}{E_{ijk}^0}.$$

This is the basic ingredient for the definition of the standardized rates. Standardized rates are given by:

- Standardized industry rate: $\hat{r}_{i\bullet\bullet} = \sum_{jk} r_{ijk} \dfrac{E_{\bullet j\bullet}^0 E_{\bullet\bullet k}^0}{\left(E_{\bullet\bullet\bullet}^0\right)^2}$,

- Standardized region rate: $\hat{r}_{\bullet j\bullet} = \sum_{ik} r_{ijk} \dfrac{E_{i\bullet\bullet}^0 E_{\bullet\bullet k}^0}{\left(E_{\bullet\bullet\bullet}^0\right)^2}$,

- Standardized size rate: $\hat{r}_{\bullet\bullet k} = \sum_{ij} r_{ijk} \dfrac{E_{i\bullet\bullet}^0 E_{\bullet j\bullet}^0}{\left(E_{\bullet\bullet\bullet}^0\right)^2}$,

- Standardized national rate: $\hat{r}_{\bullet\bullet\bullet} = \sum_{ijk} r_{ijk} \dfrac{E_{i\bullet\bullet}^0 E_{\bullet j\bullet}^0 E_{\bullet\bullet k}^0}{\left(E_{\bullet\bullet\bullet}^0\right)^3}$,

- Standardized industry-size rate: $\hat{r}_{i\bullet k} = \sum_{j} r_{ijk} \dfrac{E_{\bullet j\bullet}^0}{E_{\bullet\bullet\bullet}^0}$,

- Standardized industry-region rate: $\hat{r}_{ij\bullet} = \sum_{k} r_{ijk} \dfrac{E_{\bullet\bullet k}^0}{E_{\bullet\bullet\bullet}^0}$,

- Standardized size-region rate: $\hat{r}_{\bullet jk} = \sum_{k} r_{ijk} \dfrac{E_{i\bullet\bullet}^0}{E_{\bullet\bullet\bullet}^0}$.

Appendix B

TABLE B1. MFP elementary components for Italy, 2007-2010

Region	Change				National growth effect			
	Size-class							
	1-9	10-19	20-49	≥ 50	1-9	10-19	20-49	≥ 50
Manufacturing industry								
Northwest	-38,781	-25,479	-19,680	-73,341	-9,949	-6,411	-7,552	-19,703
Northeast	-32,774	-23,003	-23,766	-40,110	-7,924	-5,579	-6,921	-15,196
Centre	-25,428	-16,125	-13,401	-28,901	-6,677	-3,738	-3,754	-7,921
South	-22,398	-6,263	-6,381	-19,015	-5,412	-2,412	-2,599	-6,162
Islands	-7,151	-613	-1,311	-3,550	-2,262	-772	-753	-1,571
Construction								
Northwest	-37,060	-7,011	-2,452	4,035	-10,237	-2,266	-1,547	-1,120
Northeast	-35,154	-6,801	-1,953	1,782	-7,726	-1,776	-1,245	-862
Centre	-28,429	-7,895	-3,243	3,871	-7,198	-1,728	-956	-575
South	-22,603	-8,716	-251	-800	-6,697	-1,592	-864	-683
Islands	-10,255	-5,546	-1,056	366	-3,159	-749	-415	-278
Trade, Transportation, Accommodation and food services (Services G-I)								
Northwest	-22,770	9,803	4,744	14,666	-24,908	-5,269	-4,825	-9,543
Northeast	-23,472	7,628	2,807	3,673	-20,589	-4,844	-4,226	-5,683
Centre	-17,807	9,425	5,993	-2,423	-19,095	-3,992	-3,252	-5,897
South	2,091	14,612	11,998	-821	-18,804	-2,883	-2,208	-3,128
Islands	336	10,074	6,886	3,146	-8,812	-1,446	-1,087	-1,527
Information and Communication								
Northwest	-2,605	-48	940	13,606	-1,845	-539	-608	-2,268
Northeast	-2,008	-259	2,490	-433	-1,157	-352	-300	-779
Centre	-1,043	-93	563	3,040	-1,258	-371	-424	-2,168
South	-882	227	-788	822	-703	-165	-194	-548
Islands	-215	172	844	-273	-342	-80	-54	-252
Financial, Insurance and Real Estate Activities								
Northwest	15,886	-851	758	-3,907	-5,134	-750	-676	-2,332
Northeast	14,861	1,886	2,941	-5,353	-3,779	-475	-361	-1,072
Centre	14,257	463	260	-3,550	-3,083	-475	-373	-1,313
South	9,371	-498	1,013	-1,701	-1,545	-319	-186	-276
Islands	4,402	116	219	-2,070	-717	-167	-95	-179
Professional, Scientific, Technical, Administrative and Support Services (Services M-N)								
Northwest	9,858	4,251	3,175	-3,679	-10,359	-1 598	-1,775	-6,934
Northeast	5,125	4,304	4,330	-10,266	-6,825	-920	-1,005	-3,657
Centre	7,762	3,688	3,943	6,472	-7,321	-867	-971	-3,999
South	5,486	2,359	5,633	8,099	-5,620	-549	-611	-2,493
Islands	1,931	913	2,120	3,873	-2,547	-264	-252	-881

Region	Allocation effect				Industry effect			
	Size-class							
	1-9	10-19	20-49	≥ 50	1-9	10-19	20-49	≥ 50
Manufacturing industry								
Northwest	1,774	1,143	1,346	3,512	-27,616	-17,796	-20,961	-54,689
Northeast	1,413	994	1,234	2,709	-21,995	-15,485	-19,210	-42,179
Centre	1,190	666	669	1,412	-18,534	-10,376	-10,421	-21,988
South	965	430	463	1,098	-15,022	-6,696	-7,215	-17,103
Islands	403	138	134	280	-6,278	-2,143	-2,089	-4,361
Construction								
Northwest	1,825	404	276	200	-11,107	-2,458	-1,679	-1,215
Northeast	1,377	317	222	154	-8,382	-1,926	-1,351	-935
Centre	1,283	308	170	102	-7,809	-1,875	-1,038	-623
South	1,194	284	154	122	-7,266	-1,727	-937	-741
Islands	563	133	74	50	-3,427	-812	-451	-302
Trade, Transportation, Accommodation and food services (Services G-I)								
Northwest	4,440	939	860	1,701	30374	6,426	5,884	11,637
Northeast	3,670	863	753	1,013	25,107	5,907	5,154	6,930
Centre	3,404	712	580	1,051	23,285	4,868	3,966	7,192
South	3,352	514	394	558	22,930	3,515	2,692	3,814
Islands	1,571	258	194	272	10,745	1,763	1,325	1,863
Information and Communication								
Northwest	329	96	108	404	2,125	621	700	2,612
Northeast	206	63	53	139	1,332	405	345	897
Centre	224	66	76	387	1,449	427	489	2,497
South	125	29	35	98	809	190	223	631
Islands	61	14	10	45	393	92	63	291
Financial, Insurance and Real Estate Activities								
Northwest	915	134	121	416	12,340	1,804	1,626	5,605
Northeast	674	85	64	191	9,085	1,143	869	2,576
Centre	550	85	67	234	7,411	1,143	897	3,157
South	275	57	33	49	3,714	767	447	662
Islands	128	30	17	32	1,724	400	228	430
Professional, Scientific, Technical, Administrative and Support Services (Services M-N)								
Northwest	1,847	285	316	1,236	24,435	3,768	4,186	16,356
Northeast	1,217	164	179	652	16,099	2,169	2,371	8,626
Centre	1,305	155	173	713	17,268	2,045	2,291	9,433
South	1,002	98	109	444	13,257	1,294	1,440	5,881
Islands	454	47	45	157	6,008	623	595	2,077

Region	Region effect				Size effect			
	Size-class							
	1-9	10-19	20-49	≥ 50	1-9	10-19	20-49	≥ 50
Manufacturing industry								
Northwest	-1,111	-716	-843	-2,200	-7,325	5,099	10,946	7,377
Northeast	-2,884	-2,030	-2,518	-5,530	-5,834	4,437	10,032	5,690
Centre	-499	-279	-280	-592	-4,916	2,973	5,442	2,966
South	2,354	1,049	1,131	2,680	-3,984	1,919	3,768	2,307
Islands	2,410	822	802	1,674	-1,665	614	1,091	588
Construction								
Northwest	-1,143	-253	-173	-125	-7,537	1,802	2,243	419
Northeast	-2,811	-646	-453	-314	-5,688	1,412	1,805	323
Centre	-538	-129	-71	-43	-5,299	1,374	1,386	215
South	2,913	692	376	297	-4,931	1,266	1,252	256
Islands	3,366	798	443	297	-2,326	595	602	104
Trade, Transportation, Accommodation and food services (Services G-I)								
Northwest	-2,781	-588	-539	-1,065	-18,338	4,191	6,994	3,573
Northeast	-7,492	-1,763	-1,538	-2,068	-15,158	3,853	6,126	2,128
Centre	-1,426	-298	-243	-441	-14,058	3,175	4,714	2,208
South	8,178	1,254	960	1,360	-13,844	2,293	3,200	1,171
Islands	9,389	1,540	1,158	1,627	-6,487	1,150	1,575	572
Information and Communication								
Northwest	-206	-60	-68	-253	-1,358	429	881	849
Northeast	-421	-128	-109	-283	-852	280	435	292
Centre	-94	-28	-32	-162	-926	295	615	812
South	306	72	84	238	-517	131	281	205
Islands	364	85	58	269	-252	64	79	95
Financial, Insurance and Real Estate Activities								
Northwest	-573	-84	-75	-260	-3,779	597	980	873
Northeast	-1,375	-173	-132	-390	-2,783	378	524	401
Centre	-230	-36	-28	-98	-2,270	378	541	492
South	672	139	81	120	-1,138	254	269	103
Islands	764	177	101	191	-528	132	137	67
Professional, Scientific, Technical, Administrative and Support Services (Services M-N)								
Northwest	-1,156	-178	-198	-774	-7,627	1,271	2,572	2,596
Northeast	-2,484	-335	-366	-1,331	-5,025	732	1,457	1,369
Centre	-547	-65	-73	-299	-5,390	690	1,408	1,497
South	2,444	239	266	1,084	-4,138	436	885	934
Islands	2,714	282	269	938	-1,875	210	366	330

Region	Industry-size interaction				Industry-region interaction			
	Size-class							
	1-9	10-19	20-49	≥ 50	1-9	10-19	20-49	≥ 50
Manufacturing industry								
Northwest	4,061	-5,429	-5,861	-426	-7	-4	-5	-14
Northeast	3,235	-4,724	-5,371	-329	2,334	1,643	2,038	4,475
Centre	2,726	-3,166	-2,914	-171	-871	-488	-490	-1,033
South	2,209	-2,043	-2,017	-133	-1,692	-754	-813	-1,927
Islands	923	-654	-584	-34	153	52	51	106
Construction								
Northwest	-12,364	-7,096	-2,100	5,043	5,741	1,271	868	628
Northeast	-9,331	-5,561	-1,690	3,880	-1,050	-241	-169	-117
Centre	-8,693	-5,412	-1,298	2,587	5,515	1,324	733	440
South	-8,088	-4,985	-1,172	3,073	-8,284	-1,969	-1,068	-844
Islands	-3,815	-2,345	-564	1,253	-5,287	-1,253	-695	-466
Trade, Transportation, Accommodation and food services (Services G-I)								
Northwest	-10,186	8,169	1,432	-964	68	14	13	26
Northeast	-8,419	7,510	1,254	-574	-3,298	-776	-677	-910
Centre	-7,808	6,188	965	-595	-7,245	-1,515	-1,234	-2,238
South	-7,690	4,469	655	-316	8,176	1,253	960	1,360
Islands	-3,603	2,241	322	-154	6,256	1,026	771	1,084
Information and Communication								
Northwest	-1,636	-552	869	3,551	1,459	427	481	1,793
Northeast	-1,025	-360	429	1,220	-101	-31	-26	-68
Centre	-1,116	-379	607	3,395	-231	-68	-78	-399
South	-623	-169	277	858	-923	-216	-254	-720
Islands	-303	-82	78	395	40	9	6	30
Financial, Insurance and Real Estate Activities								
Northwest	17,661	-1,335	319	-14,053	-1,884	-275	-248	-855
Northeast	13,002	-845	170	-6,458	3,480	438	333	986
Centre	10,607	-845	176	-7,916	960	148	116	409
South	5,316	-567	88	-1,661	-199	-41	-24	-36
Islands	2,467	-296	45	-1,078	-1,576	-366	-208	-393
Professional, Scientific, Technical, Administrative and Support Services (Services M-N)								
Northwest	1,192	2,331	2,660	-11,278	-5,602	-864	-960	-3,750
Northeast	786	1,342	1,507	-5,948	-2,885	-389	-425	-1,546
Centre	843	1,265	1,456	-6,504	3,641	431	483	1,989
South	647	800	915	-4,055	5,511	538	599	2,445
Islands	293	386	378	-1,432	847	88	84	293

TABLE B1. Continued

Region	Size-region interaction				Industry-size-region interaction			
	Size-class							
	1-9	10-19	20-49	≥ 50	1-9	10-19	20-49	≥ 50
Manufacturing industry								
Northwest	234	-2,691	-5,659	9,933	1,159	1,326	8,908	-17,131
Northeast	152	774	817	-2,421	-1,270	-3,032	-3,865	12,671
Centre	567	-829	-2,593	2,068	1,585	-889	940	-3,641
South	-128	1,327	4,135	-5,880	-1,687	917	-3,232	6,104
Islands	-873	710	1,200	-680	38	619	-1,163	448
Construction								
Northwest	241	-951	-1,160	565	-2,478	2,535	820	-359
Northeast	148	246	147	-137	-1,690	1,374	782	-209
Centre	611	-383	-660	150	-6,301	-1,374	-1,509	1,617
South	-159	876	1,374	-651	8,715	-1,561	635	-1,628
Islands	-1,220	689	662	-121	5,050	-2,603	-712	-171
Trade, Transportation, Accommodation and food services (Services G-I)								
Northwest	585	-2,211	-3,616	4,811	-2,025	-1,868	-1,460	4,489
Northeast	395	672	499	-905	2,313	-3,793	-4,538	3,742
Centre	1,622	-885	-2,246	1,539	3,515	1,172	2,743	-5,242
South	-446	1,586	3,512	-2,985	238	2,610	1,833	-2,656
Islands	-3,403	1,330	1,732	-661	-5,319	2,210	894	70
Information and Communication								
Northwest	43	-226	-456	1,143	-1,515	-242	-968	5,775
Northeast	22	49	35	-124	-13	-185	1,627	-1,727
Centre	107	-82	-293	566	802	47	-397	-1,888
South	-17	91	308	-523	661	264	-1,548	582
Islands	-132	74	87	-109	-46	-5	519	-1,036
Financial, Insurance and Real Estate Activities								
Northwest	121	-315	-507	1,175	-3,781	-627	-781	5,525
Northeast	72	66	43	-171	-3,514	1,271	1,431	-1,417
Centre	262	-105	-258	343	52	172	-877	1,143
South	-37	176	295	-263	2,311	-962	9	-400
Islands	-277	153	151	-77	2,417	51	-156	-1,062
Professional, Scientific, Technical, Administrative and Support Services (Services M-N)								
Northwest	243	-670	-1,330	3,496	6,885	-94	-2,297	-4,627
Northeast	131	128	119	-583	4,111	1,412	492	-7,849
Centre	622	-192	-671	1,044	-2,659	226	-152	2,599
South	-133	302	971	-2,379	-7,483	-799	1,058	6,239
Islands	-984	243	402	-381	-2,979	-702	233	2,772