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Sticky cost behaviour: evidence from small and medium sized companies

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Abstract

This paper investigates whether cost stickiness occurs in small and medium sized companies using a sample of Italian nonlisted and listed firms during the period 1999–2008. Our findings show that cost stickiness emerges only for the total cost of labour and not for selling, general and administrative (SG&A) costs, cost of goods sold and operating costs. Stickiness of operating costs is only detected in a sample of listed companies. We further contribute to the literature on sticky cost behaviour by discussing critical issues associated with the extant approach of empirical analysis and interpretation of sticky cost behaviour.

Key words: Cost stickiness; Cost behaviour; Cost asymmetry; Small and medium sized companies; Italian firms

JEL classification: M41

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1. Introduction

Over the last decade, research in management accounting has challenged the fundamental assumption that cost behaviour is symmetric for activity increases and decreases. Starting from the first empirical study by Anderson *et al*. (2003), considerable academic interest has focused on the short-run asymmetric response to activity change or cost stickiness. Costs behave as sticky when they raise more with increases in activity volume than they fall with decreases of the

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same amount. Despite a rapidly growing stream of studies seeking to document cost stickiness, the evidence has generated a debate about the validity of the theoretical constructs and the generalizability of sticky cost behaviour (Anderson and Lanen, 2009; Balakrishnan *et al*., 2011). In particular, while a more recent body of research documents several explanatory factors of stickiness at both the firm- and country-level, attention towards the size of the firm as a significant determinant of cost stickiness has been largely neglected (see Cheng *et al*., 2012 for a notable exception). In this study, we investigate whether small and medium sized companies (SMEs) exhibit cost stickiness with reference to different cost components.

The paper contributes to the literature on sticky costs in two important ways. First, prior research provides evidence that corporate governance (Chen *et al*., 2012), labour market (Banker and Chen, 2006a; Banker *et al*., 2013) and cost structure (Balakrishnan *et al*., 2011) characteristics have an impact on cost stickiness. These factors differ by firm size, suggesting more specific analyses that link firm size to cost behaviour in order to generalize the initial findings of Anderson *et al*. (2003) about the average presence of cost stickiness across companies. We therefore contribute to the extant debate by documenting the disparity between the level of cost stickiness of SMEs and the evidence reported in the literature with respect to large (public, mainly US) firms (see also Bosch and Blandón, 2011; Cheng *et al*., 2012). Second, in addition to selling, general and administrative (SG&A) costs already extensively investigated by previous studies, we extend the analysis to the behaviour of cost of goods sold, total labour cost and operating costs. All these types of costs, with more or less constraints, are adjustable by managers, and hence, they are influenced to a different extent by managerial behaviour. In addition to the analyses based on the model proposed by Anderson *et al*. (2003), we apply also the alternative measure of cost stickiness at firm-level developed by Weiss (2010). Further, the majority of prior studies in the cost stickiness literature rely on data from listed companies based in the United States. Our study is the first that we are aware of that documents cost stickiness in Italian firms, thereby adding to our understanding of cost behaviour in a developed economy previously not examined.

The empirical part of our study employs data collected from the financial statements of Italian companies in the period 1999–2008. The sample includes companies belonging to the manufacturing and trading industry, while we additionally examine a sample of listed companies for comparative purposes. We conduct several tests of cost stickiness for different typologies of costs and a variety of determinants. Our findings document the presence of stickiness only for the total cost of labour, whereas stickiness of the operating costs emerges only in the sample composed by listed companies. Our results are aligned with prior findings only when listed companies are examined. However, when we apply the same tests to SMEs, the results are not consistent with previous studies.

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The remainder of the paper is organized as follows. Section 2 provides a literature review aimed to position our paper in the extant debate on cost stickiness. Section 3 describes the empirical models, the sample and the statistical methodology. Section 4 reports the results. Section 5 concludes the study with a discussion of our findings, acknowledgement of limitations and suggestions for further research.

2. Literature review

The analysis of cost behaviour is a critical issue for supporting management decisions. Traditionally, costs are classified as fixed or variable with respect to changes in activity, giving relevance only to the magnitude of the change and not to its direction. The theoretical validity of this kind of classification is strictly linked to the time horizon, to the relevant range assumed and to contextual factors due to the economic environment. The asymmetric behaviour of costs when volume increases or decreases is investigated explicitly for the first time by Anderson *et al.* (2003), henceforth ABJ, with a sample of industrial firms. They labelled sticky those costs which raise more with increases in activity volume than they fall with decreases of the same amount. ABJ propose an alternative model of cost behaviour in which managers deliberately adjust resources in response to changes in volume in contrast to the mechanistic movement of costs with changes in volume. The empirical analysis of ABJ considers SG&A costs because sales volume drives many of the components in the model proposed. The results show that SG&A costs increase on average 0.55 per cent per 1 per cent increase in sales, but decrease only 0.35 per cent per 1 per cent decrease in sales.

Drawing from the empirical specifications adopted by ABJ, a vibrant debate emerged recently on the topic and on its generalizability. The first attempt to extend ABJ using a comparable sample examined SG&A costs and cost of goods sold to understand whether sticky cost behaviour is dependent on the absolute magnitude of revenues changes, on selected firm determinants and on industry classification (Subramaniam and Weidenmier, 2003). The mixed findings suggest a cautious approach in confirming ABJ's conclusions. A similar statement is also supported by Balakrishnan *et al.* (2004) who analyzed the effect of capacity utilization on managerial reactions to changes of activity levels. The data provided by a firm that operates a number of physical therapy clinics in the United States confirmed the significance of the variable. The existence of additional dimensions that drive cost stickiness is further corroborated after examining cost stickiness across organizations and within organizations, although with less robust evidence of cross-sectional variation (Balakrishnan and Soderstrom, 2008).

The topic of cost stickiness is also investigated in an international context, using datasets of firms located in different countries. Findings show that Brazilian listed companies exhibit more pronounced cost stickiness of SG&A

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costs than US companies (de Medeiros and de Souza Costa, 2004) and Japanese companies, considered before and after the bubble burst of 1990, thus providing similar evidence of cost stickiness to US data (He *et al*., 2010). Calleja *et al*. (2006) performed a cross-country comparison, including US, UK, French and German listed companies. They find that operating costs increase on average by 0.97 per cent per 1 per cent increase in revenues, but decrease by only 0.91 per cent for a decrease of the same amount. Moreover, the level of stickiness appears to be higher in French and German firms than UK and US firms due to their code-law governance and to a historically lower pressure from the market. Another international comparison focused on the financial industry is provided by Porporato and Werbin (2010). Collecting data from Argentinean, Brazilian and Canadian banks, which are similar in terms of cost structure and scale economies, they confirm the cost stickiness behaviour documented in ABJ. However, costs are apparently not sticky per se, yet they exhibit such behaviour when they are relevant to the main functions of the firm. In particular, Balakrishnan and Gruca (2008) examined data from the health care sector to compare the behaviour of costs related to an organization's core competency with the operating costs of supported departments not directly related with a hospital's mission. In their results, stickiness is exhibited only by costs pertaining to patient care and not to other types of costs.

Another set of studies investigated how corporate governance characteristics influence the SG&A cost asymmetry. Chen *et al*. (2012) find evidence of a positive link between the agency problem and the degree of stickiness, with strong corporate governance mitigating such a relationship. Cost stickiness impacts also on analysts' earnings forecast (Banker and Chen, 2006b; Anderson *et al*., 2007). Firms with a more pronounced sticky costs behaviour have less accurate analysts' earnings forecast than firms with less stickiness (Weiss, 2010). Cost stickiness, jointly with conservatism, is also a potential determinant of asymmetric timeliness of earnings (Banker *et al*., 2012). Further, evidence suggests that deliberate increases in the SG&A ratio have an impact on future profitability (Baumgarten *et al*., 2010). Deliberate actions are also driven by managerial incentives and impact the degree of cost stickiness (Kama and Weiss, 2013). In addition to firm-specific variables, there are also economy-wide forces that drive managerial cost adjustments. Therefore, other significant determinants of the sticky behaviour of operating costs are found among the country-specific labour market characteristics, such as the form of collective bargaining of labour contracts, the level of unemployment benefits and the strictness of employment protection legislation (Banker and Chen, 2006a; Banker *et al*., 2013).

The critical review of the theory proposed by Anderson and Lanen (2009) and their comments about the data employed for the empirical tests by ABJ and others represent a new sparkle in the debate. Using several typologies of costs, they raise key issues about the aggregation of financial data and the discrimination between managerial actions and what they call 'mechanistic'

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changes of cost behaviour. Remaining on the same line of critique, Balakrishnan *et al.* (2011) focus instead on the implicit assumptions made by the majority of the literature on the controllability of costs by managers and on possible omitted variables related to the firm-specific cost structure. With algebraic analysis, and replication of traditional models, Balakrishnan *et al.* (2011) suggest that both long- and short-term choices affect the asymmetric behaviour of costs. In particular, important elements to be considered in the analysis are the specific characteristics of a cost structure, such as the presence of fixed costs and economies of scale in variable costs. Cannon (2011) recently attempts to apply a model that eliminates committed fixed costs. Collecting data from the US airline industry, he proves that cost stickiness occurs when managers adjust capacity and output selling price. A moderate critique comes also from Banker *et al.* (2011a). Studying the impact of managerial optimism and pessimism on cost stickiness, they extend the single-period model used by ABJ to a two-period model, and they control for the fixed costs structure as suggested by Balakrishnan *et al.* (2011).

Another source of criticism refers to the generalization of the results to SMEs. Using a sample of Chinese companies, Cheng *et al.* (2012) investigate the difference in cost stickiness between large and small firms with access to capital, adjustment costs, agency problem and managerial optimism as possible determinants. The hypothesized relation between cost stickiness and firm size is confirmed by their results. A similar conclusion is reached by Bosch and Blandón (2011) in their sample of Catalan farms. Finally, a strong reply to the critiques by Anderson and Lanen (2009) and by Balakrishnan *et al.* (2011) is provided by Banker *et al.* (2011b). They build a theoretical framework analyzing the current literature and provide empirical evidence from a broad sample composed by both developed and emerging economies. In addition, they question in an analytical way the validity of the findings of Anderson and Lanen (2009) and Balakrishnan *et al.* (2011).

In summary, the lack of conclusive evidence on sticky cost behaviour from prior studies, the focus of the literature on large and listed companies and the peculiarities of SMEs as potential explanatory factors were previously neglected and motivate this study. In order to establish the presence of cost stickiness in SMEs, we draw on extant research and apply the most common used empirical tests to both SMEs and listed companies. In our exploratory approach, we therefore address the following research question:

RQ: Are the costs of SMEs, on average, sticky?

3. Empirical models

Building upon previous literature, we identified the most important models and we selected the main determinants of the sticky behaviour of costs. After

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checking for cost stickiness in general, we proceed by investigating cost behaviour in relation with time horizon, magnitude of activity, firm characteristics and finally industry.

3.1. Costs and sticky behaviour

The first step of the analysis is to test the sticky behaviour of costs incurred by companies. On this issue, as previously discussed in the literature review, there is no clear agreement also due to the consideration of different cost categories or different empirical tests. In order to make a comparison of the results, we rely on the basic model introduced by ABJ, which is often used in this type of studies (Banker and Chen, 2006a; Calleja *et al.*, 2006; Anderson and Lanen, 2009; Banker *et al.*, 2011b).

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \varepsilon_{i,t} \quad (1)$$

The most investigated cost variable is SG&A, namely selling, general and administrative expenses, but also other variables can be considered. The most similar variable to SG&A in Italian financial statements is 'services', although there is not an exact correspondence with SG&A because 'services' also include the cost of jobs executed by third parties. In this paper, we proxy SG&A with 'services' and use the label SG&A consistently with prior literature. In addition, we examine the behaviour of cost of goods sold, the cost of employees and total operating costs. As suggested by ABJ, the use of ratios between current amount and value of the previous period for all the variables allows a better cross-sectional comparison between firms with different size and industry. Both costs (*COST*) and revenues (*REV*) ratios are log-transformed to obtain a better normal distribution and enhance economic interpretation. Sticky cost behaviour is isolated by the dummy variable *D*, which takes the value '1' when revenues of the current period are decreased from the previous period, and the value '0' in the opposite case. With this formulation, the coefficient β_1 measures the change in costs, expressed in percentage terms, associated with a 1 per cent increase in sales revenue. On the contrary, when revenues decrease the dummy variable assumes value '1', and hence, the sum of the coefficients $\beta_1 + \beta_2$ measures the percentage of decrease in costs associated with a 1 per cent decrease in sales revenue. A value of β_2 equal to zero means identical upward and downward changes in costs, while a negative value indicates sticky behaviour. One limitation of the model is the use of sales revenue as approximation of the more correct volume of sales. For this reason, it is impossible to clearly distinguish the effect due to variations in prices from variations in volumes.

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As additional analysis, we adopt the alternative measure of cost stickiness proposed by Weiss (2010). The model compares the change in costs scaled by sales computed in recent periods of sales decrease with the same measure computed in recent periods of sales increase (Model 2).

$$STICKY_{i,t} = \log\left[\frac{\Delta COST}{\Delta REV}\right]_{i,\underline{\tau}} - \log\left[\frac{\Delta COST}{\Delta REV}\right]_{i,\overline{\tau}}, \underline{\tau}, \overline{\tau} \in \{t, \ldots, t-3\} \qquad (2)$$

where $\underline{\tau}$ is the most recent of the last 4 years with a decrease in sales revenue, $\overline{\tau}$ is the most recent of the last 4 years with an increase in sales revenue, REV is revenue, $\Delta REV_{i,t}$ is $REV_{i,t} - REV_{i,t-1}$ and $\Delta COST_{i,t}$ is $COST_{i,t} - COST_{i,t-1}$. Further, as in Anderson and Lanen (2009), the model excludes observations with costs that move in opposite directions compared to sales revenue. Consistently with ABJ, a negative value of the variable $STICKY$ denotes evidence of stickiness.

3.2. Costs, sticky behaviour and time

To take into account the effect of time on cost stickiness and in particular the hypothesis advanced by ABJ that stickiness is reversed in subsequent periods, we apply two different types of test. The first test is an extension of the basic model (Model 1) modified to additionally consider the revenues ratio referred to the previous period (Model 3).

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_3 \cdot \log\left[\frac{REV_{i,t-1}}{REV_{i,t-2}}\right] + \beta_4 \cdot D_{i,t-1} \cdot \log\left[\frac{REV_{i,t-1}}{REV_{i,t-2}}\right] + \varepsilon_{i,t}. \qquad (3)$$

According to ABJ, we expect similar values of β_1 and β_2 with respect to the ones calculated in the basic model. If positive, the coefficient β_3 indicates a lagged adjustment of costs for changes in sales revenue. Moreover, the coefficient β_4, if positive and lower than β_2 taken in absolute value, indicates a partial reversal of the cost stickiness that follows a revenues decline.

The second test is based on the basic model (Model 1), with the only difference that the time period is now considered as the aggregation of 2-year periods of data. If β_2 in the basic model and in the aggregated model are both negative, we expect an absolute value of the coefficient obtained in the model with aggregated periods lower than the computation made with the 1-year period.

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3.3. Costs, sticky behaviour and magnitude of activity

Because it can be posited that managers behave differently depending on the level of change in revenues, we investigate the presence of a relationship between cost stickiness and magnitude of sales activity. Subramaniam and Weidenmier (2003) find that when revenues change by <10 per cent, SG&A costs are not sticky, but beyond 10 per cent the situation is reverted showing a significant sticky behaviour. Their interpretation argues that SG&A costs vary proportionally with activity up to changes in revenues of 10 per cent. For increases in revenues beyond this level, managers must increase the capacity of the firm and as a consequence the amount of committed resources. On the contrary, managers are less able to proportionally decrease SG&A costs for declines of the same magnitude.

A little exception in the findings of Subramaniam and Weidenmier (2003), not considered significant in their paper, is the decline of cost of goods sold for largest drops in revenues as highlighted by Calleja *et al.* (2006). They argue that managers consider more convenient the renegotiation of contracts rather than the retaining of surplus resources. In particular, after assuming two different thresholds of revenues' change (one equal to 10 per cent and one more extreme equal to 25 per cent), Calleja *et al.* (2006) posit that sticky cost behaviour of total operating costs occurs when revenues declines are small. According to their findings, modest increases in activity do not require important changes in cost structure, as long as small decreases in activity are not sufficient to justify high renegotiating costs suggesting a stickiness behaviour. However, for large decreases in revenues, the costs incurred to retain surplus resources overwhelm renegotiating costs, hence suggesting a proportional cut.

Given these two contrasting results, we check this kind of relationship using the same model of Subramaniam and Weidenmier (2003) and Calleja *et al.* (2006) and two different thresholds, namely at 10 per cent and 25 per cent. The model follows the same logic of Model 1, but with four dummy variables that allow us to classify in intervals the changes in revenues (Model 4). The four dummy variables assume the following values: D_1 is 1 if the percentage change in revenues lies between −25 per cent and 25 per cent, 0 otherwise; D_2 is 1 if the percentage change in revenues lies between −50 per cent and −25 per cent or between 25 per cent and 50 per cent, 0 otherwise; D_3 is 1 if the percentage change in revenues lies between −25 per cent and 0 per cent, 0 otherwise; D_4 is 1 if the percentage change in revenues lies between −50 per cent and −25 per cent, 0 otherwise.

As additional test, we keep the same classification substituting the threshold of 25 per cent with 10 per cent. Coefficients β_1 and β_2 are the ordinary measure of increase in costs following a 1 per cent increase in revenues; more specifically, the first refers to changes in revenues between −25 per cent and 25 per cent, and the second to changes in revenues between −50 per cent and −25 per cent or 25 per cent and 50 per cent. The coefficients β_3 and β_4 are the sticky

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indicators referring to changes in revenues, respectively, between −25 per cent and 0 per cent, and −50 per cent and −25 per cent.

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \sum_{k=1}^{4} \beta_k \cdot D_{k,i,t} \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \varepsilon_{i,t}. \quad (4)$$

3.4. Costs, sticky behaviour and firm characteristics

Several firm characteristics have been previously examined as determinants of costs stickiness. ABJ considered asset intensity, employee intensity and decrease in revenues in the previous period. Results suggest that bigger firms in term of assets and employees demonstrate a more sticky behaviour and that the degree of stickiness is lower in revenues-declining periods preceded by revenues-declining periods. Subramaniam and Weidenmier (2003) and Calleja *et al.* (2006) tested the same variables, adding, respectively, measures of inventory intensity and interest ratio and measures of debt intensity, working capital intensity and return on equity.

Following the literature, the model applied in this paper includes assets (*ASSETS*) intensity, employee intensity (*EMP*), debt (*TOT_DEBTS*) intensity and a dummy variable coded as '1' when revenues declined in the previous period (*SD*). All measures of intensity are scaled by revenues of the contemporaneous year. Similarly to ABJ, the selected firm characteristics are inserted in the model as a specification of β_2 (Model 5).

$$\begin{aligned}
\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] &= \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \\
&+ \beta_3 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \log\left[\frac{ASSETS_{i,t}}{REV_{i,t}}\right] \\
&+ \beta_4 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \log\left[\frac{EMP_{i,t}}{REV_{i,t}}\right] \\
&+ \beta_5 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \log\left[\frac{TOT_DEBTS_{i,t}}{REV_{i,t}}\right] \\
&+ \beta_6 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \mathrm{SD}_{i,t} + \varepsilon_{i,t}
\end{aligned} \quad (5)$$

3.5. Costs, sticky behaviour and industry

The analysis of cost stickiness behaviour by individual industry aims at identifying potential peculiarities related to this particular firm characteristic.

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Anderson and Lanen (2009) perform this type of test using the American Standard Industry Classification (SIC) at two-digit level, finding significant stickiness behaviour in 22 of 65 industries, a significant not sticky behaviour in 13 industries and nonsignificant results in 32 industries. We adopt the Italian classification ATECO 2007[1] performing the analysis both at macro- (from code B to code G) and microlevel (from code 05 to code 47) using the same specification of Model 1.

3.6. Sample and methodology

The data utilized in this study are extracted from the database AIDA, maintained by Bureau van Dijk, which provides complete financial statements of Italian companies for the last 10 years. Before extracting data for the period 1999–2008, we filter the list excluding firms with revenues below €7 million and consolidated balance sheets in order to avoid duplicated firms in our sample. We excluded the very small companies because it is very unlikely that they have a well-defined cost structure and an organization able to timely react to changes in the trend of revenues. Compared to the samples adopted by the literature, the firms in our final sample qualify therefore as SMEs. In our analysis, we keep separated firms belonging to the manufacturing industry considered in a broad sense[2] and firms belonging to the trading industry.[3] Similarly to past studies in this stream of research, we do not consider firms from the service industry because of their different cost structure and business approach.

Once the data are extracted, a screening procedure is followed in order to obtain the final samples for the analysis. The initial sample is the same, but the screening procedure leads to different samples depending on the type of cost considered. First, cases of costs greater than revenues are deleted from the dataset, as well as potential negative observations. Second, in the attempt to clean the sample from the effects of mergers, acquisitions and other extraordinary operations, observations are dropped whenever revenues (costs) change more than 50 per cent compared to the previous year revenues (costs). After this cleaning, we proceed by removing missing data on either sales revenue/costs or isolated data in the time-series. The last step before the estimation of the regressions is to trim the top and the bottom 1 per cent of the sample, ordered by average of variable costs at the firm-level.

Table 1 shows the details of the samples' size and in particular the number of firms and observations after the screening procedure. For the manufacturing

[1] The classification ATECO 2007 is the Italian version of the European classification NACE rev. 2.

[2] Using one of the ISTAT definitions for manufacturing industry, we include companies with ATECO 2007 codes from 05 to 43 (Italian industries' classification system).

[3] ATECO 2007 codes from 45 to 47.

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Table 1
Number of firms and observations in the samples

	A	B	C	D
Manufacturing industry				
SG&A costs	19,937	155,334	15,412	95,683
Cost of goods sold	19,937	154,544	14,770	91,180
Total labour cost	19,937	152,328	15,867	109,977
Operating costs	19,937	155,542	14,335	82,279
Trading industry				
SG&A costs	12,569	92,909	9,792	57,557
Cost of goods sold	12,569	92,689	10,196	64,689
Total labour cost	12,569	90,735	9,870	61,268
Operating costs	12,569	93,147	8,394	46,164
Listed firms				
SG&A costs	244	1,620	148	741
Cost of goods sold	244	1,600	148	708
Total labour cost	244	1,635	159	819
Operating costs	244	1,696	137	603

Column A is the number of firms in the initial sample (period 1999–2008). Column B is the number of firm-year observations in the initial sample. Column C is the number of firms in the final sample. Column D is the number of firm-year observations in the final sample.

industry, starting from 19,937 companies, on average 15,096 firms with 93,280 observations (about 6.18 observations per firm) enter the regression. For the trading industry, starting from 12,569 companies, on average 9,563 firms with 57,420 observations (about 6.0 observations per firm) enter the regression. Finally, starting from 244 listed companies, on average 148 firms with 718 observations (about 4.8 observations per firm) enter the regression.

Descriptive statistics of the samples are exhibited in Table 2. Due to the screening procedure, we obtain slightly different sample composition in terms of sales revenue for each type of cost considered. Panel A presents the statistics of the samples related to the manufacturing industry. Mean of the sales revenue is around €30 million and a little lower, €25 million, when combined with the operating costs. The median in all cases is around €11 million, the lower quartile is €8 million and the upper quartile is €20 million. When examining the cases of decline from the previous period, this happens for the sales revenue in 30 per cent of the firm-periods with an average decrease of 9 per cent, for SG&A costs and cost of goods sold in 34 per cent of the firm-year observations with 10 per cent of average decline and finally with regard to total labour cost and operating expense in 25 per cent of the periods with a decrease of 7–8 per cent. The descriptive statistics for the trading industries shown in Panel B indicate a similar pattern of the manufacturing companies. SG&A costs show the highest frequency of decline, 33 per cent of the firm-periods, and magnitude of decline, 10 per cent. Values are a little lower for the cost of goods sold, while total labour cost and operating costs decline in the 24 per cent of the

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Table 2
Descriptive statistics

	Mean	Median	SD	Min	Max	Lower quartile	Upper quartile	A, %	B, %
Panel A – Manufacturing industry									
Sales revenue	30.34	11.72	209.46	0.13	20,840.00	7.95	20.78	30.97	9.25
SG&A costs	6.19	2.57	30.13	0.004	2,973.00	1.49	4.78	34.03	10.65
Sales revenue	30.95	11.84	214.85	0.13	20,840.00	8.01	21.10	30.47	8.76
Cost of goods sold	18.19	6.02	162.14	0.002	17,230.00	3.62	11.43	34.00	11.44
Sales revenue	29.00	11.39	199.18	0.13	20,840.00	7.74	20.10	30.49	9.44
Total labour cost	3.72	1.68	16.19	0.003	1,767.00	0.97	3.08	24.17	6.78
Sales revenue	25.48	11.19	146.74	0.002	17,410.00	7.65	19.57	27.19	8.72
Operating costs	23.57	10.40	128.28	0.002	15,350.00	7.10	18.26	26.67	8.64
Panel B – Trading industry									
Sales revenue	31.73	12.34	207.06	0.02	16,730.00	8.33	21.99	30.42	8.66
SG&A costs	3.03	1.12	15.92	0.003	1,650.00	0.59	2.23	33.22	10.66
Sales revenue	30.27	11.97	201.23	0.13	16,730.00	8.10	21.25	29.22	8.59
Cost of goods sold	24.29	9.22	164.92	0.003	16,460.00	6.00	16.90	31.73	9.46
Sales revenue	31.74	12.23	214.69	0.29	16,730.00	8.25	21.68	29.84	8.55
Total labour cost	1.77	0.73	7.76	0.003	383.60	0.39	1.41	22.60	7.91
Sales revenue	27.86	11.48	209.21	0.008	16,730.00	7.87	20.17	25.96	8.02
Operating costs	26.37	10.94	178.77	0.008	16,640.00	7.49	19.41	25.83	7.98
Panel C – Listed firms									
Sales revenue	1,497.00	207.30	5,957.54	2.74	87,260.00	86.44	730.60	26.22	9.18
SG&A costs	340.50	56.52	1,183.67	0.99	10,830.00	18.67	194.40	32.77	11.20

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Table 2 (continued)

	Mean	Median	SD	Min	Max	Lower quartile	Upper quartile	A, %	B, %
Sales revenue	1,689.00	224.40	6,922.51	0.17	87,260.00	95.44	679.90	25.09	8.90
Cost of goods sold	759.80	81.04	3,824.05	0.07	48,920.00	28.46	272.50	32.92	11.20
Sales revenue	1,881.00	229.40	7,273.35	3.31	87,260.00	79.03	729.40	25.98	9.69
Total labour cost	257.30	37.04	863.22	0.99	4,919.00	14.50	127.70	28.53	7.83
Sales revenue	1,497.00	207.30	7,740.65	2.74	87,260.00	94.49	984.50	17.95	6.32
Operating costs	340.50	56.52	6,450.48	1.39	68,120.00	83.96	875.40	18.80	7.62

Column A is the percentage of firm years with negative change from previous period. Column B is the mean percentage decrease across periods. Monetary amounts are expressed in millions of Euro. Due to screening procedure (see Table 1), sales revenue exhibit different statistics for each type of cost.

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observations with an amount of 8 per cent. Our descriptive evidence reveals that in the Italian context, there is a greater number of SMEs with size in terms of sales revenue significantly lower than the samples studied by ABJ, Subramaniam and Weidenmier (2003) and Anderson and Lanen (2009), which are similar to each other and based on the COMPUSTAT files. Larger firms are also considered in the study by Calleja *et al.* (2006), which includes European companies, but this is due to the choice of listed firms. The Italian listed companies, presented in Panel C, are larger than the UK firms and smaller than the German and French firms in Calleja *et al.* (2006). Sales revenue varies from €1,500 to €2,000 million with a median between €207 and €262 million. The lower quartile for sales revenue is on average €88 million and the upper quartile €780 million. The frequency and magnitude of declines from previous periods are in line with the values of manufacturing and trading firms.

The statistical analysis consists of pooled regressions, based on ordinary least squares (OLS) and conducted with the open-source software R. Each model is run for each sample and each type of cost considered. The classical assumptions underlying the statistical models are checked, in particular the autocorrelation of residuals, the presence of multicollinearity between variables and the presence of heteroskedasticity. First, from the Durbin–Watson test statistic, it can be inferred that the residuals are independent without presence of autocorrelation with the only exception of the models involving total labour cost.[4] In this case, as done by ABJ, we evaluate serial correlation in the data on a firm-by-firm basis revealing significant autocorrelation for about 6 per cent of the firms, indicating that it should not be a serious problem. Second, multicollinearity does not affect our models because the VIFs (variance inflation factors) are all between 2.1 and 2.6, well below the empirical warning threshold of 5.0. Third, in order to detect heteroskedasticity problems, we performed the Breusch–Pagan test statistic finding positive results. As in Calleja *et al.* (2006), where the same test is performed and the same problem emerges, we proceed applying White correction for the estimation of the heteroskedasticity-corrected standard errors and the associated *t*-statistics (White, 1980).

4. Findings

Our empirical tests investigate the sticky behaviour, the effect of time, the relation with the magnitude of activity, the influence of other firm characteristics and finally the association between industry and stickiness. In addition to the tests conducted by using the SMEs sample, we applied the basic model also to listed companies.

[4] The presence of autocorrelation in the model which involves labour cost is a well-recognized fact and not an issue that emerges only in our data. For instance, Blanchard and Katz (1999) and Pannenberg and Schwarze (2000) document a strong autocorrelation of wages in European countries.

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4.1. Costs and sticky behaviour

Table 3 presents the estimated values from the basic model (Model 1). A direct comparison between results is possible considering the same type of cost and the estimates for the manufacturing and trading industries. The value obtained for β_1 reveals that SG&A costs increase, on average, by 0.57 per cent for 1 per cent increase in sales revenue, the cost of goods sold increases by 1.02 per cent, which is more than the increase in revenues, the labour cost by 0.29 per cent and the operating costs by 0.96 per cent. Estimations of β_2 are all positive, with the only exception being total labour cost which shows a negative value. In particular, the value of −0.02 suggests that for a revenue decrease of 1 per cent, total labour cost decrease by 0.27 per cent ($\beta_1 + \beta_2$). This is an indicator of sticky behaviour of this type of cost. The other types of cost considered in the analysis do not show sticky behaviour. On the contrary, our findings show that for a 1 per cent revenue decrease other types of cost decline more than they increase for a growth in revenue of 1 per cent.[5]

SG&A costs show a coefficient for β_1 very similar to the results of ABJ and Anderson and Lanen (2009), but a completely reversed result for the coefficient β_2. Subramaniam and Weidenmier (2003) obtain a β_1 for cost of goods sold slightly >1 like our findings,[6] but a corresponding decreasing coefficient of negative amount which is not in line with our positive value. It is worth noting that the nonsticky behaviour exhibited by cost of goods sold in our findings is expected due to the strict link that this cost has with production levels and hence with the sales revenue. It is therefore more likely to observe an antisticky behaviour as identified by Weiss (2010). In detail, costs increase less when the volume of sales rises than they decrease when sales fall by an equivalent amount. A practical example is the case of discounts for large volume purchases of resources. The rigidity of the regulations present in the labour market suggests that a sticky behaviour of this type of cost is expected, but as a mandatory choice rather than a conscious managerial decision. Both Anderson and Lanen (2009) and our findings document a negative sticky coefficient for

[5] An additional test was conducted in order to eliminate situations in which the manager's freedom of decision is potentially altered due to financial constraints faced by the company. More specifically, we added a further filter before the original screening procedure, with the aim to include all cases showing operating costs greater than sales revenue. The results (not tabulated here) confirm the findings exhibited by the basic sample.

[6] The result might appear counterintuitive, but it is consistent with the findings of Subramaniam and Weidenmier (2003). They report a β_1 equal to 1.0139 compared to our values of 1.0204 (manufacturing industry) and 1.0235 (trading industry). Our descriptive statistics are also in line in relative terms with cost of goods sold exhibited in Subramaniam and Weidenmier (2003); while they report 63 per cent of the sales revenue in their sample, the weight over revenues in our sample is similarly close to 60 per cent (see Table 2).

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Table 3
Costs and sticky behaviour: estimations with Model 1

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \varepsilon_{i,t}$$

where REV is revenue and D is a dummy variable equal to 1 when revenues of the current period decreased from the previous period and equal to 0 otherwise.

	β_0	β_1	β_2	R^2	F
Manufacturing industry					
SG&A costs	0.0174*** (23.74)	0.6233*** (108.29)	0.0829*** (6.23)	0.34	20,770
Cost of goods sold	0.0002 (0.39)	1.0204*** (207.35)	0.0674*** (5.85)	0.67	76,720
Total labour cost	0.0379*** (71.08)	0.2810*** (70.45)	−0.0208* (−2.15)	0.15	7,547
Operating costs	0.0055*** (22.70)	0.9372*** (539.78)	0.0329*** (6.90)	0.92	398,700
Trading industry					
SG&A costs	0.0250*** (24.82)	0.5084*** (63.14)	0.0882*** (4.81)	0.21	6,428
Cost of goods sold	−0.0048*** (−14.50)	1.0235*** (395.78)	0.0089 (1.34)	0.89	224,800
Total labour cost	0.0497*** (60.22)	0.2946*** (43.43)	−0.0185 (−1.13)	0.10	2,747
Operating costs	0.0021*** (10.72)	0.9712*** (645.52)	0.0152*** (4.06)	0.97	531,900
Listed firms					
SG&A costs	0.0040 (0.46)	0.7202*** (11.13)	−0.0587 (−0.47)	0.32	140.6
Cost of goods sold	−0.0024 (−0.31)	0.8631*** (14.38)	0.0905 (0.78)	0.48	256.5
Total labour cost	0.0002 (0.03)	0.6500*** (13.75)	−0.3872*** (−4.51)	0.30	143.3
Operating costs	0.0024 (0.38)	0.8791*** (19.90)	−0.2721* (−2.21)	0.55	285.1

t-statistics are shown in parentheses. The value of the adjusted R^2 is not reported because it is equal to R^2 at two-digit approximation. *, ** and *** indicate significance at the 5 per cent, 1 per cent and 0.1 per cent levels based on two-tailed tests, respectively.

labour cost, the first being in absolute value higher than our estimation (more precisely 0.08 compared to 0.02). Concerning the operating costs, Calleja *et al.* (2006) find an increase of 0.97 per cent for 1 per cent increase in revenues, which is near to our finding, but they highlight a sticky behaviour that does not emerge from our data.

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Table 3 presents also the results obtained with the sample composed by listed companies. The coefficient β_2 associated with SG&A costs and with cost of goods sold is not significant, and for this reason, we can limit our considerations to the other two types of cost. The negative value of β_2, related to the cost of labour, means that when sales revenue increases by 1 per cent the labour cost increases by 0.65 per cent, but when sales revenue decreases by 1 per cent the labour cost decreases by only 0.26 per cent. A similar behaviour is found for the operating costs that increase by 0.88 per cent per 1 per cent increase in sales revenue, but they decrease by 0.61 per cent per 1 per cent decrease in sales revenue. This is the largest difference with previous regressions conducted with the nonlisted companies. The coefficient β_1 is only slightly lower than the previous one, while the coefficient β_2 shows a sticky behaviour that it is not present in the other samples. Furthermore, this is exactly aligned with Calleja *et al.* (2006) who find evidence of stickiness for operating costs. Excluding the US firms and considering only the European companies, they obtain an average coefficient β_1 equal to 0.985 and an average coefficient β_2 equal to −0.065. Similar values are presented in Banker *et al.* (2011b) with reference to the operating costs. The combination of the values computed for Germany, France and UK results in the mean coefficients β_1 equal to 0.876 and β_2 equal to −0.101. The inclusion of the Swedish companies changes the coefficients, respectively, to 0.846 and 0.087. Additionally, the results for Model 2, that is the alternative measure of cost stickiness proposed by Weiss (2010), are presented in Table 4.[7] The mean value of the indicator of stickiness (*STICKY*) is negative and statistically significant, providing evidence of sticky behaviour for both total labour cost and operating costs. The results confirm the findings obtained with Model 1 (i.e. ABJ model) for labour cost, but contradict the outcomes obtained for operating costs. Further, consistently with Weiss (2010), the mean value of cost of goods sold is positive and statistically significant confirming the antisticky behaviour.[8]

4.2. Costs, sticky behaviour and time

The effect of time on cost behaviour is taken into consideration in two different ways. First, we applied Model 3, which is the basic model extended to consider the previous period. Second, we estimated the basic model with the data aggregated over 2 years. On a longer time period, we expect that managers are more able to take decision about the amount of resources to cut versus the amount of resources to keep in the company, with a less pronounced stickiness

[7] We did not compute the alternative measures of cost stickiness for the sample of listed firms because there are too few observations.

[8] We conducted a validity check by restricting the sample to companies with revenues below €50 million (not tabulated here). The findings with both Model 1 and Model 2 are consistent with the reported results.

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Table 4
Costs and sticky behaviour: estimation with Model 2

$STICKY_{i,t} = \log\left[\frac{\Delta COST}{\Delta REV}\right]_{i,\underline{\tau}} - \log\left[\frac{\Delta COST}{\Delta REV}\right]_{i,\overline{\tau}}$ $\underline{\tau}, \overline{\tau} \in \{t, \ldots, t-3\}$

where $\underline{\tau}$ is the most recent of the last 4 years with a decrease in sales revenue, $\overline{\tau}$ is the most recent of the last 4 years with an increase in sales revenue, *REV* is revenue, $\Delta REV_{i,t} = REV_{i,t} - REV_{i,t-1}$ and $\Delta COST_{i,t} = COST_{i,t} - COST_{i,t-1}$.

	n	Mean	Median	SD	Lower quartile	Upper quartile	% Negative
Manufacturing industry							
SG&A costs	14,420	0.1415***	0.1349	1.9285	−0.9930	1.3060	46.71
Cost of goods sold	19,285	0.1684***	0.1424	1.3785	−0.5329	0.8589	43.87
Total labour cost	10,516	−0.0933***	−0.0893	2.1554	−1.4610	1.2800	51.86
Operating costs	17,706	−0.0530***	−0.0227	1.0156	−0.4363	0.3518	51.99
Trading industry							
SG&A costs	6,437	0.0799**	0.0855	2.1472	−1.3130	1.4620	48.47
Cost of goods sold	15,628	0.2001***	0.1252	1.0044	−0.2265	0.5836	39.97
Total labour cost	4,589	−0.2331***	−0.2073	2.3477	−1.7920	1.2990	53.69
Operating costs	9,376	−0.0298***	−0.0092	0.8336	−0.3001	0.2474	51.14

*, ** and *** indicate significance at the 5 per cent, 1 per cent and 0.1 per cent levels based on two-tailed tests, respectively.

or an amplified decrease in costs. However, we obtain inconsistent results (not reported), and it is not possible to draw conclusions about the partial reversal of stickiness in the long run. It is worth noting that a marginal decline in stickiness or a marked increase is also documented in Calleja *et al*. (2006) for French and German companies, thus revealing that the theoretical hypothesis is not perfectly confirmed by the empirical findings. Only ABJ confirm the trend for SG&A costs in their sample.

4.3. Costs, sticky behaviour and magnitude of activity

The relationship between changes in revenues and cost behaviour, with the application of Model 4, is exhibited in Table 5.

In particular, we present the results for variations <25 or >25 per cent.[9] Coefficients β_1 and β_2, which are all positive and significant, reflect the changes

[9] According to the literature (e.g. Subramaniam and Weidenmier, 2003; Calleja *et al*., 2006), we conducted the same test changing the threshold to 10 per cent. On average, the results (not tabulated here) confirm the findings obtained with the threshold of 25 per cent.

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Table 5
Costs, sticky behaviour and magnitude of activity: estimations with Model 4

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \sum_{k=1}^{4} \beta_k \cdot D_{k,i,t} \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \varepsilon_{i,t}$$

where *REV* is revenue and *D* is a dummy variable equal to 1 when revenues of the current period decreased from the previous period and equal to 0 otherwise. In particular, D_1 equals 1 if the percentage change in revenues lies between −25% and 25%, D_2 equals 1 if the change lies between −50% and −25% or between 25% and 50%, D_3 equals 1 if the change lies between −25% and 0%, and D_4 equals if the change lies between −50% and −25%.

	−25% < change < 25%		−50% ≤ change ≤ −25% 25% ≤ change ≤ 50%			
	β_1	β_3	β_2	β_4	R^2	F
Manufacturing industry						
SG&A costs	0.6985*** (84.13)	0.0582*** (3.72)	0.5834*** (103.86)	0.0486*** (4.63)	0.34	10,520
Cost of goods sold	1.1008*** (172.20)	0.0225 (1.84)	0.9707*** (205.05)	0.0320*** (3.48)	0.67	38,830
Total labour cost	0.3210*** (52.75)	−0.0565*** (−4.91)	0.2818*** (72.46)	−0.0234** (−3.16)	0.15	3,788
Operating costs	0.9296*** (348.39)	0.0289*** (5.47)	0.9414*** (557.44)	0.0428*** (11.78)	0.92	199,600
Trading industry						
SG&A costs	0.5559*** (46.94)	0.0854*** (3.79)	0.4775*** (57.53)	0.0574*** (3.65)	0.21	3,244
Cost of goods sold	1.0454*** (279.45)	−0.0007 (−0.09)	1.0124*** (393.39)	−0.0022 (−0.43)	0.89	112,700
Total labour cost	0.3455*** (36.43)	−0.0993*** (−5.46)	0.2813*** (42.90)	−0.0049 (−0.38)	0.10	1,387
Operating costs	0.9672*** (9.38)	0.0124** (2.74)	0.9738*** (662.69)	0.0225*** (6.66)	0.97	266,200

t-statistics are shown in parentheses. Adjusted R^2 are not presented in the table because they are all equal to the value of R^2. *, ** and *** indicate significance at the 5 per cent, 1 per cent and 0.1 per cent levels based on two-tailed tests, respectively.

in costs for positive changes in revenues. We observe a slight decline between the coefficient β_1, which corresponds to an increase in revenues of <25 per cent, and the coefficient β_2 that is related to increase in revenues equal or more than 25 per cent. The only exceptions to this downward trend are the operating costs for both the manufacturing and trading industry, which show an opposite trend. On this point, Subramaniam and Weidenmier (2003) find that the coefficients β_1 and β_2 of SG&A costs increase for greater increases in revenues, yet the trend cannot be confirmed for the coefficients of the cost of goods sold. Moreover, Calleja *et al.* (2006) find a slight increase in the coefficients related to the operating costs for three of the four countries investigated.

With regard to the corresponding coefficients β_3 and β_4, our results are not conclusive. Looking only at the cases in which all values are significant, we find that the coefficient for the SG&A costs decreases as the magnitude of revenues change increases. Averaging between manufacturing and trading, when revenues change by <25 per cent, we observe a decrease in SG&A costs of 0.70 per cent per 1 per cent decrease in revenues, while for changes >25 per cent SG&A costs decrease by 0.58 per cent. An opposite trend emerges for operating costs which decrease of 0.97 per cent per 1 per cent decrease in revenues if the magnitude of the change is <25 per cent, while they decrease by 0.99 per cent if the level of change is above 25 per cent.

It must be emphasized that we do not detect the presence of sticky cost behaviour. The only negative and significant coefficients are those referring to total labour cost in the manufacturing industry. In particular, we notice an increase from a value of −0.0565 associated with decreases in revenues between 0 per cent and 25 per cent to a value of −0.0234 associated with decreases in revenues between 25 per cent and 50 per cent. This means a decrease in the level of stickiness for larger decreases in sales revenue. Even if this is the only case in which both coefficients are significant, the result is not confirmed by the other coefficients in the table related to total labour cost. Concerning SG&A costs, Subramaniam and Weidenmier (2003) conclude that sticky behaviour exists for large changes in absolute magnitude of sales activity and in particular, they find relevant the threshold of 10 per cent of change. However, from their data it is not possible to draw a similar conclusion for the cost of goods sold. Moreover, Calleja *et al.* (2006) focused on operating costs and derived an opposite conclusion, thereby suggesting that sticky cost behaviour occurs when revenues declines are small.

4.4. Costs, sticky behaviour and firm characteristics

With the aim of examining firm-specific factors that could affect stickiness behaviour of costs, we apply a regression model which includes, in addition to the basic variables, also measures of asset intensity, employee intensity, debt intensity and a dummy variable indicating a decline in sales revenue happened the previous year (Model 5). Intensity is calculated by scaling assets, number of employees and total debts by sales revenue of the same year.

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Table 6
Costs, sticky behaviour and firm characteristics: estimations with Model 5

$$\log\left[\frac{COST_{i,t}}{COST_{i,t-1}}\right] = \beta_0 + \beta_1 \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_2 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] + \beta_3 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \log\left[\frac{ASSETS_{i,t}}{REV_{i,t}}\right]$$
$$+ \beta_4 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \log\left[\frac{EMP_{i,t}}{REV_{i,t}}\right] + \beta_5 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \log\left[\frac{TOT\_DEBTS_{i,t}}{REV_{i,t}}\right] + \beta_6 \cdot D_{i,t} \cdot \log\left[\frac{REV_{i,t}}{REV_{i,t-1}}\right] \cdot \mathrm{SD}_{i,t} + \varepsilon_{i,t}$$

where REV is revenue, D is a dummy variable equal to 1 when revenues of the current period decreased from the previous period and equal to 0 otherwise, $ASSETS$ is assets, EMP is number of employees, TOT_DEBTS is debts and SD is a dummy variable equal to 1 when revenues declined in the previous period.

	SG&A costs	Cost of goods sold	Total labour cost	Operating costs
Manufacturing industry				
β_0	0.0203*** (25.55)	0.0011 (1.88)	0.0379*** (65.41)	0.0055*** (20.08)
β_1	0.6256*** (106.18)	1.0361*** (219.29)	0.2926*** (70.86)	0.9365*** (491.80)
β_2	−0.0910*** (−5.45)	0.0506*** (3.51)	−0.1866*** (−14.54)	0.0906*** (15.14)
β_3 (asset intensity)	−0.2285*** (−12.14)	−0.1014*** (−6.49)	−0.0011 (−0.08)	−0.1391*** (−19.29)
β_4 (employee intensity)	0.1266*** (15.37)	0.0480*** (6.92)	0.0659*** (10.49)	−0.0037 (−1.24)
β_5 (debt intensity)	0.0289* (1.98)	0.0424*** (3.51)	−0.0196 (−1.80)	0.1279*** (22.31)
β_6 (second decrease)	0.1270*** (9.12)	−0.0555*** (−4.82)	0.2195*** (21.22)	0.0060 (0.98)
R^2	0.36	0.70	0.16	0.92
F	5,680	21,510	2,095	90,650
Trading industry				
β_0	0.0262*** (23.02)	−0.0049*** (−13.41)	0.0493*** (55.17)	0.0019*** (8.29)
β_1	0.5234*** (59.26)	1.0303*** (376.62)	0.3021*** (44.61)	0.9714*** (583.18)
β_2	0.0569* (2.30)	0.0218** (2.76)	−0.1061*** (−5.68)	0.0264*** (4.88)
β_3 (asset intensity)	−0.0514 (−1.75)	0.0066 (0.62)	−0.0505* (−2.21)	−0.0789*** (−11.90)
β_4 (employee intensity)	0.0294* (2.55)	0.0230*** (6.19)	0.0609*** (7.02)	−0.0089*** (−3.52)
β_5 (debt intensity)	0.0693** (2.75)	0.0012 (0.13)	0.0601** (3.01)	0.0676*** (12.21)
β_6 (second decrease)	0.1284*** (5.88)	−0.0184** (−2.58)	0.1761*** (10.26)	0.0153** (2.79)
R^2	0.22	0.90	0.10	0.96
F	1,600	56,770	721	119,900

t-statistics are shown in parentheses. Adjusted R^2 are not presented in the table because they are all equal to the value of R^2. *, ** and *** indicate significance at the 5 per cent, 1 per cent and 0.1 per cent levels based on two-tailed tests, respectively.

The cost of labour confirms evidence of stickiness, with a negative value of β_2, both in manufacturing and trading companies. Further, a similar behaviour is also exhibited by SG&A costs in the manufacturing sample (Table 6). In order to analyze the determinants of stickiness, we focus our analysis on samples where we found evidence of sticky behaviour. The effect of total assets is estimated by the coefficient β_3, which is significant and negative both for SG&A costs in manufacturing companies and for the total labour cost in the trading companies (-0.2285 and -0.0505, respectively). Moreover, a significant and positive sign is associated with the measure of employee intensity (β_4). In particular, in the manufacturing sample, it is equal to 0.1266 for SG&A costs and to 0.0659 for labour cost, whereas in the trading sample the coefficient is 0.0609. Opposite to asset intensity, debt intensity is positive both for SG&A costs in the manufacturing companies and for total labour cost in the trading companies (0.0289 and 0.0601, respectively). Finally, the coefficient β_6, related to the dummy variable indicating a decrease in sales revenue in previous year, is positive and on average equal to 0.1978 for total labour cost and equal to 0.1270 for SG&A costs.

According to ABJ, Subramaniam and Weidenmier (2003) and Calleja *et al.* (2006), asset-intensive firms show sticky behaviour of costs when revenues decline. In particular, high levels of fixed asset intensity increase the stickiness of SG&A, cost of goods sold and operating costs. The explanation is strictly linked with the costs faced retaining surplus resources compared to the costs for renegotiating the levels of resources. Our findings confirm these results only in the manufacturing sample for SG&A costs and in the trading sample for total labour cost. However, in contrast to the results of ABJ, we obtain positive estimates associated with employee intensity suggesting that in our setting the adjustment costs are higher for companies with a smaller number of employees. The intensity of total debts is examined by Calleja *et al.* (2006) in their sample of listed companies with a partially different model. They conclude that firms with higher levels of debt exhibit, on average, no cost stickiness because managers are pushed by creditors to meet payments with a flexible cost structure. The positive value of our estimation supports this argument, revealing that manufacturing companies with a high level of debt tend to reduce SG&A costs and that trading companies in a similar situation are more inclined to reduce the cost of labour. Lastly, the dummy variable indicating a sales revenue decrease during the previous period is positive and aligned with the findings of ABJ and Subramaniam and Weidenmier (2003). The degree of stickiness is lower in revenues-declining periods that were preceded by revenues-declining periods, confirming that managers consider the reduction more permanent after a further decrease.

4.5. Costs, sticky behaviour and industry

In order to identify specific industries with sticky cost behaviour, we apply the basic model to the companies grouped by ATECO 2007 code. In particular,

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Table 7
Costs, sticky behaviour and industry

	SG&A costs *N* (%)	Cost of goods sold *N* (%)	Total labour cost *N* (%)	Operating costs *N* (%)
Coefficient β_2				
Positive and significant	11 (29.7)	10 (27.0)	4 (10.8)	11 (29.7)
Negative and significant	2 (5.4)	1 (2.7)	4 (10.8)	1 (2.7)
Not significant	24 (64.9)	26 (70.3)	29 (78.4)	25 (67.6
N/A	3	3	3	3

N refers to the number of coefficients β_2 computed by single industry using Model 1. The percentage is computed out of 37 industries with available data. In three cases it was not possible to compute a coefficient for the following reasons: lack of a sufficient number of observations, lack of decreasing periods and lack of companies.

we perform the analysis at the macrolevel (i.e. the letter code from B to G) and at the microlevel (i.e. the two-digits code from 05 to 47). Table 7 provides a quantitative summary regarding the sign and the significance of the coefficient β_2 computed for each industry. The only macrocode for which a negative and significant coefficient is detected corresponds to the supply of electric energy, gas, steam and air conditioning. On average, at microlevel, evidence of stickiness is provided only in <5 per cent of the industries.

Anderson and Lanen (2009) conducted a similar analysis based on the SIC classification and applied to SG&A costs. They find evidence of stickiness in 22 of 67 industries. Moreover, the estimation of separate regressions for each industry is one step of the Fama-MacBeth approach suggested by Balakrishnan *et al.* (2011) in order to exclude the effect of scale economies. The second step consists in the aggregation of the coefficients across industries. The application of the second step to our data gives a positive β_2 for all the costs considered, but significant only for cost of good sold.

5. Discussion and conclusions

The doubts raised by Anderson and Lanen (2009) and by Balakrishnan *et al.* (2011) on the seminal study by ABJ on sticky cost behaviour and the prompt reaction of Banker *et al.* (2011b) recently spurred a discussion on the sticky behaviour of costs. This paper intends to contribute to this body of research showing that our results are not well aligned with the majority of studies that previously assessed the presence of cost stickiness by focusing on large or listed companies. We posit that the focus on Italian companies provides the ideal context to extend the literature on the topic because the firms in this economy are on average small or medium sized. The estimations obtained with the basic

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model applied to manufacturing and trading companies do not reveal the existence of stickiness behaviour of SG&A costs and further exhibit minimal evidence of stickiness only for the cost of labour. On the contrary, the other costs exhibit what Weiss (2010) calls antisticky behaviour, which happens when they increase less when activity rises than they decrease when activity falls by an equivalent amount. Different results occur when the same analyses are conducted on listed companies, where our findings reveal statistically significant stickiness both for the total cost of labour and operating costs. More specifically, operating costs increase by 0.88 per cent per 1 per cent increase in sales revenue and decrease by 0.61 per cent per 1 per cent decrease, whereas labour cost increases by 0.65 per cent when revenues grow by 1 per cent and decline by 0.26 per cent when revenue decreases by the same amount. These findings suggest that this kind of companies have peculiarities in terms of management and governance with respect to other companies in the same economic environment that possibly influence the behaviour of costs.

Other tests conducted on the SMEs sample considering different time horizons, and in particular aggregating periods or considering lagged effects, do not permit us to draw conclusions in line with those stated by ABJ. Concerning the relationship between cost stickiness and the magnitude of activity change, we find for labour cost a decrease in the level of stickiness for larger decreases in sales revenue. The analysis of individual industries, at macro- and microlevel and after including specific firm characteristics, confirms the absence of asymmetric behaviour of costs in the Italian context.

In conclusion, even if the presence of sticky cost behaviour is not detected from our analysis, our paper does not make the claim that cost stickiness does not exist. Rather, we suggest that future studies conducted at a different level of analysis and with a different methodology could provide further insight about cost stickiness and provide significant information for improving decision-making. The level of analysis adopted by prior studies span from cross-country comparative studies (Calleja *et al.*, 2006; Banker *et al.*, 2011b) to within-country investigations (de Medeiros and de Souza Costa, 2004; He *et al.*, 2010). In addition, single-industry (Balakrishnan and Gruca, 2008; Cannon, 2011) or single-firm cost data (Balakrishnan *et al.*, 2004) provide potential alternatives. The focus of the tests conducted so far is on firm-specific (ABJ) or on economy-wide determinants (Banker and Chen, 2006a). Only recently, Banker *et al.* (2011a) considered determinants pertaining to individual managerial traits or characteristics such as optimism and pessimism. However, their attempt to measure managerial attitudes using financial data, and in particular according to the trend of the prior period sales, is prone to criticism.

Despite the importance given to firm-specific variables, the majority of past studies focused on listed firms and the issue of firm size has been neglected for a long time. Therefore, in order to improve the findings on the topic, we propose a shift in the empirical approach followed so far, suggesting that future research should investigate the underlying cognitive factors inducing

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cost stickiness and the managerial actions resulting from it. Thus, the use of experimental methods or field studies relying upon interviews to managers that manifest this kind of behaviour would allow opening up the black box of a cost system in the attempt to better understand how managerial actions and attitudes affect cost behaviour. A different research methodology would also be useful to investigate whether the long list of determinants examined by the literature address the real, underlying causes of cost stickiness. An inappropriate level of analysis or empirical approach is a plausible explanation for the lack of agreement of past results despite a rather established stream of research.

Finally, we highlight some limitations that affect our study. Firstly, the use of sales revenue as an approximation of activity volumes is a common approach in the literature but the findings should be interpreted cautiously. Sales revenue is also influenced by changes in prices as well as by other factors and not only by management decisions. Secondly, the time horizon of our data cover at best 10 years, whereas other empirical analyses span over 20 years. Because cost stickiness reveals a behaviour that appears over time, we acknowledge that the time horizon applied in our empirical tests could be a limitation affecting our findings.

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