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Centralization of strategic decisions during the Great Recession: An empirical analysis of European manufacturing firms

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Centralization of strategic decisions during the Great Recession: An empirical analysis of European manufacturing firms

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Abstract

This study analyzes which types of firm-level shocks were associated with the centralization of strategic decision-making during the recession of 2008-09. We use a unique survey dataset of more than 14000 manufacturing firms from seven European countries which includes direct information on whether the firms centralized or decentralized their strategic decision-making process. Motivated by theoretical approaches claiming that organizations under considerable stress are more likely to centralize, we use multinomial logit models to test whether firms facing a larger fall in turnover, employment, investment or having to postpone their innovations were more likely to change their decision-making process. We find evidence that employment change and postponing innovations are indeed associated with centralization even when we control for ownership, group structure, financing, management, and strategy.

JEL: M21, D22, D23

Keywords: centralization, Europe, recessions

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Stratégiai döntések központosítása a 2008-as válság alatt
Európai feldolgozóipari vállalatok empirikus vizsgálata

Bakonyi Zoltán - Muraközy Balázs

Összefoglaló

A tanulmány azt vizsgálja, hogy a vállalatokat érő sokkok közül melyek jártak együtt a stratégiai döntéshozatal centralizációjával a 2008-2009-es válság idején. Egy egyedülálló felmérés adatait használjuk, melyben hét európai ország több mint 14000 feldolgozóipari vállalatát kérdezték meg. Az adatbázis közvetlen információt tartalmaz arról, hogy a vállalatok centralizálták vagy decentralizálták a stratégiai döntéshozatali folyamataikat. Az elemzés hátterét azok az elméleti megközelítések jelentik, melyek szerint a jelentős nyomás alatt álló szervezetek nagyobb valószínűséggel központosítanak. Multinomiális logit modellekkel teszteljük, hogy azon vállalatok, amelyek bevételüknek, foglalkoztatottjaik számának vagy beruházásaiknak nagyobb visszaesését szenvedték el, vagy innováció elhalasztására kényszerültek, nagyobb valószínűséggel változtatták-e meg a döntéshozatali eljárásukat. Eredményeink arra utalnak, hogy a foglalkoztatottak számának változása és az innováció elhalasztása valóban összefügg a központosítással akkor is, ha kontrollálunk a tulajdonosi hátteret, a vállalatcsoportban elfoglalt pozíciót, a finanszírozást, a menedzsmentet és a stratégiát leíró változókra.

JEL: M21, D22, D23

Tárgyszavak: központosítás, Európa, válság

INTRODUCTION

Firms adjust to recessions on many levels. While altering the production process or looking for new sources of financing may not require radical changes, successful firms often make bold strategic decisions. Moreover, an efficient and timely reaction may also require restructuring the strategic decision-making process itself. Such organizational change may be crucial in weathering the recession, yet it can also have persistent effects on future strategy and growth. This paper focuses on such major changes, asking how many and which firms have centralized or decentralized their strategic decision-making process during the Great Recession of 2008-09.[1]

In particular, our aim is to investigate which kinds of organizational shocks affect centralization decisions. We study four types of shocks. First, turnover may fall, reflecting a decline in demand for the products of the firm. Such a shock may be considered largely exogenous from the viewpoint of the firm and may trigger centralization to cut costs and manage resources more efficiently.

The other three kinds of shocks represent decisions made by the management as a reaction to external shocks and future prospects. Hence the effect of these shocks may reflect both the expectations of managers and their preferences or strategy. The first such decision is whether to lay off employees, which we can proxy with the change in employment. This is a though decision and may reflect quite negative expectations but may also, in itself, generate additional stress and extra need for coordination in the organization. The second type of decision, cutting investments, constitutes a relatively easy way to meet short-term targets. While cutting investments may not generate much conflict, it may mean sacrificing the potential for future growth. Finally, managers may postpone innovations. The relationship between the latter decision and centralization is especially interesting because a negative relationship between centralization and innovation is often emphasized.

Studying the advantages and disadvantages of centralized and decentralized decision-making is one of the classic topics of both Economics[2] and Business literatures.[3] Another strand of literature has studied the different dimensions along which firms adjusted to recessions.[4] However, as yet, however, there is no consensus about the relationship between

[1] This has been the most serious financial crisis since the Great Depression (Reinhart and Rogoff, 2009). In 2008 and 2009, the world economy had to face a 6.5 percent decline in industrial output and a 12.8 percent decrease in international commerce. In the European Union these numbers were even larger (13.7 percent and 15 percent depression) (Békés, Halpern and Muraközy, 2011).

[2] See see Hayek (1944), Lange (1957), Hage and Aiken (1967), Child (1972), Mintzberg (1990), Ansoff (1991), Golden (1992), Nohria and Goshal (1994), Davis *et al.* (2009).

[3] See Hage and Aiken (1967), Richardson *et al.* (2002), Argyres and Silverman (2004).

[4] Albeit companies can suffer from economic crises in the long run (Reinhart and Rogoff, 2009), rapid reactions can be crucial for their survival (Nystrom and Starbuck, 1984; Smart and Vertinsky, 1984;

recessions and the direction of change in the centralization of strategic decision-making. While some researchers found that companies become more centralized during recessions or more intense competition (Pfeffer and Leblebici, 1973; Richardson *et al.*, 2002; Davis, Eisenhardt and Bingham 2009; Kunisch *et al.,* 2012), other studies claimed that such an environment is conducive to decentralization (Aghion and Tirole, 1997; Marin and Verdier, 2008; Alonso, Dessein and Matouschek, 2008; Aghion and Bloom, 2014).

This study provides empirical evidence to this debate based on a unique survey database including detailed information for 14,000 manufacturing companies from seven European countries. The database was constructed from the European Firms in the Global Economy (EFIGE) survey which directly asked firms whether they had centralized or decentralized their strategic decision-making process during 2009. Importantly, the database also contains information about the shocks during 2009 and provides details on many other firm characteristics.

We formulate four hypotheses about the effect of different shocks on centralization. In particular, we hypothesize that firms are more likely to centralize their decision-making process if they (1) face a larger fall in turnover (2) experience a larger decline in the number of their employees (3) reduce their investments (4) postpone planned innovation projects.

While we find descriptive evidence largely in line with all four hypotheses, a multinomial logit regression analysis provides evidence mainly for the second and fourth hypotheses: a 10 percentage point larger (more negative) employment shock was associated with a 1.4 percentage points larger probability of centralization, while postponing innovation increased the probability of centralization by nearly 6 percent. The decline in sales and investment is only weakly associated with centralization when we control for employment and innovation change.

By using an instrumental variables strategy we show that these findings do not result from reverse causality. We also include a number of controls to these regressions to find that the main results do not change, but many other factors – including country effects, ownership, and strategy focus – were associated with the centralization of decisions during the Great Recession.

Our paper provides several interesting conclusions and contributions to the literature. First, we offer evidence in favor of theories predicting increased centralization following large shocks. Our results are very much in line with theories emphasizing threat-rigidity as well as

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Schuh, 2012). Because of the changes in the environment, companies have to find new sources of value creation by the reallocation of resources (Fruk, Hall and Mittal, 2013). However, most companies focus on short-term achievements and act reactively rather than in a proactive way (Kunc and Bhandari, 2011). See also Smart and Vertinsky (1984), Barker, Vincent and Duhaime (1997), Wilson and Eilertsen (2010), Fruk *et al.* (2013).

an efficient search for solutions in rapidly changing complex landscapes. The estimated effects show that organizational change involving re-defining strategic decision-making may be an important margin of adjustment during recessions.

Second, many theoretical frameworks emphasize that more centralized decision-making is less conducive to innovation. Centralization during large shocks may provide an explanation for reduced innovation during recessions. This point is borne out by our finding that postponing innovations is strongly related to centralization. Consequently, managers may have to focus on maintaining the innovative capabilities of their firms during periods of increased centralization.

Third, we show evidence for the heterogeneity of this effect. Firms facing different kinds or degrees of shocks react differently. We also find evidence that suggests that reactions to a recession may differ greatly across countries and firms with different characteristics. Such heterogeneity suggests that firm-level experiences may significantly differ from industry averages, and as a result, understanding industry or macro dynamics may require studying these decisions at the firm level.

The rest of the paper is organized as follows. The next section discusses the theoretical background. Section 3 introduces our data and methodology, while Section 4 describes our results. Section 5 discusses the results and concludes.

THEORETICAL BACKGROUND

We will define centralization as the concentration of decision-making authority in the organization. Centralization can be analyzed at the three basic levels of strategic management: (1) strategy making[5]; (2) implementation[6]; and (3) control[7]. While it is possible to analyze multiple levels simultaneously[8], this paper will focus on the highest level, i.e. strategic decision-making.

Theories about the effect of recessions on centralization can be classified into two broad groups. The first group assumes that the change in the decision-making process is an optimal choice: following a change in the environment, managers act optimally when reorganizing the firm. The second group builds on behavioral theories emphasizing the psychological factors which may become dominant under increased pressure during recessions. The distinction

[5] Hage and Dewar (1973), Gates and Egelhoff (1986), Roth and O'Donell (1996), Richardson *et al.* (2002).
[6] Child (1972) Baum and Wally (2003), Lin and Germain (2003), Ling *et al.* (2008), Peng (2009).
[7] Pfeffer and Leblebici (1973), Eisenhardt (1985), Marin and Verdier (2008).
[8] E.g., Golden (1992), Colignon and Covaleski (1993), Puga and Trefler (2002), Baum and Wally (2003), Kunisch *et al.* (2012).

between these two approaches is relevant because if increased centralization during recessions is indeed suboptimal, then firms can enhance their performance by deliberately paying attention to the psychological factors underlying centralization and by regularly monitoring, and reviewing their decision-making processes.

Approaches based on optimization

When optimization is assumed (e.g., Hage and Aiken, 1967; Abbey and Dickson, 1983; Davis *et al.*, 2009), the choice is often interpreted in the context of a tradeoff between the larger efficiency of centralized firms (Ansoff, 1991; Golden, 1993; Baum and Wally, 2003; Alonso *et al.*, 2008) and the higher innovative performance of more decentralized companies (Meyer, 1982; Aghion and Tirole, 1997; Davis *et al.*, 2009; Zoghi, Mohr and Meyer, 2010).

A key construct in this literature is the model of Aghion and Tirole (1997) (A-T) which claims that delegation is optimal when chief executive officers (CEOs) are overloaded with projects (e.g., during recessions). Based on this A-T model, Marin and Verdier (2008) find that CEOs are most likely to delegate authority if there is a medium level of competition.

Other approaches emphasize the advantages of centralization. According to Staw, Sandelands and Dutton (1984) centralization strengthens the weak links in the organization. Davis *et al.* (2009) argue that it is preferable to err on the side of too much structure than on the side of too much decentralization. Dowell, Shakell and Stuart (2011) state that firms with a more centralized corporate governance structure can react to crises more effectively.

Another approach analyzes optimal choices when problem solving involves search in complex landscapes. Nickerson and Zenger (2004) argue that the optimal organizational form is determined by the type of problems the company faces. Market mechanisms are better when problems are easily decomposable, while hierarchy is more efficient when the problem is non-decomposable and the solution landscape is complex. These authors distinguish between two types of hierarchy: (1) authority-based hierarchy and (2) consensus-based hierarchy. Consensus-based hierarchy is useful if the problems are non-decomposable and the solution process needs high knowledge-interactions (e.g., new product development). Authority-based hierarchy can be optimal if the problems are nearly-decomposable, in other words, they can be solved by fewer interactions.

This approach may predict that centralization is optimal during recessions because of two reasons. First, recessions create a new economic reality by definition. As a result, the initially simple solution landscape turns into a more complex one, including more nearly-decomposable problems. Therefore, market-type organizations must become more centralized to gain efficiency. Second, timely actions may become more important during

crises, and operating consensus-based hierarchies can be rather time-consuming. As a result, centralized decision-making may perform better even if it leads to slightly sub-optimal solutions.

Behavioral approaches

One behavioral approach to the study of the problem is based on the theory about the "sense of urgency". During crises, companies have to face a changing and hostile environment (Smart and Vertinsky, 1984). According to Kotter (1995), the sense of urgency is an important determinant of whether the organizational change will be successful. A sense of urgency means that most members of the organization are forced to examine market realities and opportunities, which stimulate change. Because of the dramatic change in the competitive environment during recessions (Fruk *et al.*, 2013), the sense of urgency can be a strong motivator to restructure authority. As a greater shock may lead to an increased sense of urgency, this theory predicts that firms facing bigger shocks are more likely to change their decision-making structure. The sense of urgency approach, however, does not provide strong predictions about the direction of such a change.

Another behavioral approach that helps to understand organizational reactions to recessions is based on threat-rigidity. An important characteristic of recessions is increased uncertainty (Haddow *et al.*, 2013) which may be perceived as a threat by actors in organizations (Mone, McKinley and Barker, 1998). According to Carone and Di Iorio (2013), under stress, uncertainty, and fear, our decision-making habits differ from the cognitive schemes under normal circumstances. Threat-rigidity theorists suggest that recessions inhibit cognitive processes (Mone *et al.*, 1998) and, hence, increase the demand for control and coordination in the firm.[9]

This process may affect the behavior of both managers and employees. First, management can be motivated to centralize in order to feel more empowered to handle decline. According to Staw *et al.* (1984), under threat conditions there is a restriction in information processing and a constriction of control. The headquarters believe that they can overcome the challenge of a hostile environment by stronger control mechanisms. As Baum and Wally (2003) state, decentralized decision-making about operations improves performance, but centralized strategic decision-making can still be beneficial because it

[9] In threat situations control constrictions also emit dominant and well-learnt responses in the organization (Staw *et al.*, 1984; Baum and Wally, 2003). Fruk *et al.* (2013) also point out that during the crisis managers did not use significantly different resource reallocation mechanisms from the previous periods.

increases efficiency. As a consequence, during recessions, the management is motivated to gain more control by centralization.

Second, the employees themselves can prefer centralization in an organization under stress. Higgins and Freedman (2013) identified 20 emotional factors which influence decision-making under recessions. One example is the "sunflower reflex" which means that organizational members believe that their leaders can help them to survive the crisis. Such factors may lead employees to demand more centralized strategic decision-making (Staw *et al.*, 1984; Richardson *et al.*, 2002).

Empirical results

Companies implement a wide range of strategies during recession (Barker *et al.*, 1997), including both defensive (cost and investment reduction) and growth strategies (new products and marketing) (Wilson and Eilertsen, 2010). Barker *et al.* (1997) emphasize the importance of organizational restructuring, including the centralization of decision-making, during crisis management. Most of the studies agree, however, that cost reduction is the most prevalent reaction (Dobbs, Karakolev and Maliges, 2001).

An important result comes from the longitudinal analysis of Aghion and Bloom (2014) who find that decentralized firms performed better during recessions, which confirms the main prediction of the Aghion and Tirole (1997) model.

The contingency approach of centralization examines what kinds of contextual factors influence centralization of organizations. Such research, in contrast to Aghion and Bloom (2014), mostly found that firms are more likely to centralize during crises. Pfeffer and Leblebici (1973) point out that competition increases the need for centralization. Richardson *et al.* (2002) state that CEOs are more willing to delegate at the time of prosperity. Davis *et al.* (2009) uses a simulation model to show that when the environment is rapidly evolving erring on the side of centralization may be preferable. Based on a survey, Kunisch *et al.* (2012) found that during recessions, company headquarters increased their control over the subunits.

Importantly, the centralization of decision-making also follows secular trends. According to Marin and Verdier (2008), during the first decade of 2000s there was a decentralization trend in Europe and in the United States while Schuh (2012) has shown that we have experienced a centralization trend since 2010.

Hypotheses

The different approaches we have discussed yield different predictions about the relationship between the size of the shock faced by the firm and centralization. The Aghion-Tirole (1997) model suggests that decentralization is the optimal response during recessions, thus more serious shocks may lead to centralization. In contrast, the threat-rigidity approach suggests a positive association between the seriousness of the shocks and centralization, because of the increased psychological demand for centralization at times when people perceive increased threats. Similarly, when search in complex solution landscapes is considered, centralization may prove to be optimal in the rapidly changing landscape during crises. Finally, the sense of urgency approach suggests that shocks may trigger organizational changes but it does not provide strong predictions about the direction of change. Still, we will formulate our hypotheses based on the idea that greater shocks faced by an organization are more likely to lead to increased centralization.

Our first hypothesis takes the fall in turnover as a proxy for the general and largely exogenous fall in the demand for the products of the firm. We assume that a larger fall in demand indicates a bigger general shock, and hence, is associated with centralization.

H1. Firms facing a larger fall in turnover are more likely to centralize.

Second, the decision by the firm to lay off workers is likely to reflect a large fall in demand and negative expectations. Laying off workers, can increase centralization directly in at least two ways. First, this process usually brings about extra organization stress, which may generate a stronger demand for centralization. Second, the change in the organization itself can create additional coordination problems which may be handled by further centralization.

Our aim is to test for this additional effect of laying off workers by including the change in employment together with the fall in demand in our empirical specification. We hypothesize that layoffs increase the degree of centralization even in the case of firms where the fall in demand may be similar.

H2. Firms facing a larger reduction in their workforce are more likely to centralize even when we control for the fall in turnover.

Third, cutting investments can be a relatively easy strategy to handle problems in the short run. Such a decision may reflect the seriousness of the shock as perceived by managers and also the time horizon of these decision-makers. We will test whether this organizational shock is related to centralization with the following hypothesis: considerably

H3. Firms reducing their investment substantially are more likely to centralize their decision-making.

Another margin of adjustment is the postponement of innovations. This decision may once again reflect the expectations of managers. But, as we have discussed, many theories emphasize the negative relationship between innovation and centralization. Hence, postponing innovations can also reflect the time horizon of decisions as well as the managers' attitude to potentially innovative, decentralized mechanisms within the firm. Again, we are interested in the additional effect of this variable when controlling for the other organizational shock variables:

H4. Firms postponing innovation projects are more likely to centralize their decision-making even when controlling for demand and other shocks.

An alternative interpretation is that the different variables reflect "layers" of reaction to shocks either in terms of timing or severity. First, demand shock (proxied by the fall in turnover) is the most exogenous and hits first in time. After such a shock, the easiest way to cut costs is to "postpone" innovations or cut investments. These decisions are unlikely to generate much extra stress or a sense of urgency in the organization. If this is not sufficient, managers may be forced to implement layoffs which lead to increased organizational stress as well as financial and emotional costs, generating a sense of urgency and threat. In this respect, one may expect that employment change is a stronger predictor of centralization than the other variables.

DATA AND METHODS

In this paper we use a unique firm-level survey conducted as part of the EFIGE project. It focuses on the economic activities of European manufacturing firms in several areas such as structure, employment, export, investments, competition and finance. The survey was carried out at the beginning of 2010. The original dataset contains information about 14,759 firms (Altomonte and Aquilante, 2012, p. 6.), but we excluded those that did not provide information about change in authority or change in turnover. Therefore, the final dataset contains answers from the top managers of 14,199 companies, which constitutes a representative sample of industrial (10+ employees) firms from seven countries: Austria (389), France (2,872), Germany (2,837), Hungary (441), Italy (2,922), Spain (2,764) and the United Kingdom (1,974). The number of observations across countries and industries is shown in Table 1.[10]

[10] Not many large sample studies were published to study centralization recently (Zoghi *et al.*, 2010; Aghion and Bloom, 2014; Hong, Kueng and Yang, 2015). Our analysis of this unique dataset can be an important addition to this literature.

Table 1

Industries by country

Industry / country	Austria	France	Germany	Hungary	Italy	Spain	UK	Total
Manufacture of food products	32	191	257	46	190	376	95	1187
Manufacture of beverages	1	17	45	8	36	49	9	165
Manufacture of textiles	6	105	68	5	140	46	36	406
Manufacture of wearing apparel	7	64	19	16	154	49	26	335
Manufacture of leather and related products	1	31	11	2	93	47	8	193
Manufacture of wood and products of wood and cork	23	86	96	13	84	172	55	529
Manufacture of paper and paper products	5	79	57	15	66	28	39	289
Printing and reproduction of recorded media	21	139	139	16	78	64	110	567
Manufacture of chemicals and chemical products	5	75	60	13	81	98	65	397
Manufacture of basic pharmaceutical products and preparations	-	21	15	2	20	16	4	78
Manufacture of rubber products	17	227	200	33	153	136	113	879
Manufacture of other non-metallic mineral products	15	144	86	25	159	156	34	619
Manufacture of basic metals	10	63	55	6	75	60	31	300
Manufacture of fabricated metal products	69	828	551	93	583	519	289	2932
Manufacture of computer, electronic and optical products	19	178	165	12	102	45	91	612
Manufacture of electrical equipment	13	108	102	18	144	58	97	540
Manufacture of machinery and equipment n.e.c.	35	251	372	40	342	277	108	1425
Manufacture of motor vehicles, trailers and semi-trailers	5	84	41	10	44	61	23	268
Manufacture of other transport equipment	3	20	17	2	34	29	15	120
Manufacture of furniture	20	48	62	12	134	212	61	549
Other manufacturing	5	36	145	5	69	52	146	458
Repair and installation of machinery and equipment	2	26	28	14	14	25	7	116

Other	75	51	248	35	127	189	512	1237
Total	389	2,872	2,839	441	2,922	2,764	1,974	1,4201

Note: "Other" contains observations where the firm conducts non-manufacturing activity as well
(e.g. service activity) or the NACE 2-digit category the firm belongs to contains less than 50 observations.

Measuring centralization and shocks

Our dependent variable, the measure of change in centralization, is based on the following question: “During 2009, has strategic decision making become…,” to which managers could answer "more centralized," "more decentralized" or “nothing changed.” In the survey, centralization was defined as “the CEO/owner takes most decisions in every area” while decentralization as “managers can take autonomous decisions in some business areas”. According to this variable, 73.45 percent of firms did not change the concentration of authority, while 7.1 percent decentralized and 19.45 percent centralized during 2009.

This approach is quite simple and straightforward compared to measures used by other authors[11]. We, however, see two main advantages of this method of measurement. First, as our question concerns a change, one can be relatively confident that managers can correctly identify the general direction of change rather than the magnitude or the level of centralization. Second, our general definition can incorporate changes both in formal and informal authority (Cohen and Lachman, 1988, Nohria and Goshal, 1994; Aghion and Tirol, 1997; Adams, Almeida and Ferreira 2005).

We will use four variables to test the hypotheses.

First, we will measure the change in turnover based on the following question: “Did you experience a reduction of your turnover during 2009 in comparison with 2008?” Managers could choose from four answers: “No,” companies did not experience a reduction in turnover, "Yes, a reduction up to 10 percent," "Yes, a reduction between 10–30 percent” or "Yes, a reduction of more than 30 percent." The responses revealed that 28.5 percent of the companies did not experience a fall in turnover, 19 percent faced only moderate (0–10 %), 34.5 percent a medium (10–30%), and 18 percent a serious one. In order to ease interpretation, we generate one “continuous” variable from these categories. We do this by replacing the intervals reported in the survey (e.g., between 10 and 30 %) with an expected turnover within the interval.[12] Note that the continuous variable shows the change in

[11] Previous studies used more sophisticated scales with e.g., three (Gates and Egelhoff, 1986; Kunisch *et al.,* 2012); five (Nohria and Goshal, 1994; Roth and O’Donell, 1996; Argyres and Silverman, 2004); or seven categories (Richardson *et al.,* 2002; Lin and Germain, 2003; Ling *et al.*, 2008), while others use measures that rely less on the subjective judgment of the manager (e.g., Golden, 1992; Ling *et al.,* 2008).

12 Another option would be to use the middle of the interval, but this approach is problematic when the interval is unbounded (e.g., „more than 30 %”). To handle these unbounded intervals, we fit a normal distribution (by running an interval regression, “intreg” in Stata) with only a constant, and then predicting the conditional expected value for each interval. This approach yields quite reasonable numbers: +12.6 percent for firms reporting that their turnover did not fall, -5.1 percent for firms which reported that their turnover fell between 0 and 10 percent, -19.3 percent for firms reporting a fall between 10 and 30 percent, and -41 percent for firms reporting a fall of larger than 30 percent. The

turnover rather than the decline in turnover, hence the more positive values are associated with a smaller negative (or more positive) shock. We will follow this logic for all our crisis variables. In Table A.1 in the Appendix we show that our results are robust to including the original set of dummies instead of the continuous measure into our regressions.

We measure the change in employment based on the following question: "During the last year did you experience a reduction or an increase of your workforce in comparison with 2008? (1) yes, a reduction of … % (2) yes, an increase of … % (3) No, we did not experienced any change". The answers to this question are continuous, and we code the variable again in a way that larger values show an increase in employment. Change in investment comes from a similar question: "During 2009 has your firm reduced its planned investments in machinery, equipment or ICT?"[13] Finally, we generate a dummy which takes the value of 1 when a firm did not postpone any of its innovation projects according to its answer to the following question: "During 2009, has your firm decided to postpone investments in product or process innovation? (1) Yes (2) No."

The first three of these variables are coded in a way that they show percentage changes, i.e., +50 shows that the variable increased by 50 percent while -30 shows that the variable decreased by 30 percent. As lower values of these variables indicate a larger (more negative) shock, our hypotheses predict a negative sign for all of them in the centralization equation.

Table A.2 in the Appendix shows the correlation table of these variables. The relatively low correlation among them suggests that these variables may indeed measure different dimensions of organizational shocks, so it is probably worthwhile to study all of them, even in one regression.

Control variables

According to Wilson and Eilertsen (2010), smaller firms experienced a more serious shock during the crisis than larger ones. Obviously small firms may change their decision-making processes more easily than larger ones, so it is important to control for firm size. We do so by

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results are robust to modifications of this procedure, such as using the middle of the intervals and +10 and -40 for the two unbounded intervals.

13 Here there were two answer possibilities: „ 1) Yes, a reduction of … % (2) No." As a result, we only know the exact value of change for firms with lower investment. To approximate the change in investment for firms that did not cut their investments, we replace the variable with the conditional expected value (14 % increase) estimated with a tobit (with only a constant) for firms answering "no" for the question. In Table A.1 in the Appendix we show that our results are robust to including a dummy for firms answering that they did not reduce their investments and another one for firms reporting that they reduced their investment by 100 percent (where another potential truncation can be present).

including the following employment dummies in our regressions: 10-19 people (32 % of firms in the sample), 20-49 (41 %), 50-249 (20 %) and 250 or more (7 %).

We also include two-digit NACE industry dummies to control for the heterogeneous shocks in different industries (Békés *et al.*, 2011) as well as the possibly heterogeneous organization of firms in different sectors.[14] Country dummies are also added to control for such factors as differences in management culture (Geletkanycz, 1997), pre-crisis organization (Aghion and Bloom, 2014) and the degree of recession (Békés *et al.*, 2011; Shuh, 2012).

Estimation strategy

As our dependent variable is categorical and can take three values, one has to use a discrete choice model. In particular, we have chosen a multinomial logit model because it is relatively flexible and easy to interpret.

In the multinomial logit framework the probability that outcome k will be chosen by firm i is:

$$P(Y_i = k) = \frac{e^{x_i'\beta_i}}{\sum_{k=1}^{K-1} e^{x_i'\beta_k}} \text{ for all k.}$$

Here, x_i is the vector of explanatory variables while β_i is the parameter vector to be estimated. We always choose "no change" as the base category while "centralized" and "decentralized" are the two alternatives. Besides the parameters, we also estimate average marginal effects for easier interpretation.[15]

One potential identification problem is the possibility of reverse causality, because the decision about centralization may affect our shock variables. To check the relevance of this issue, we instrument these variables with the average fall of revenue at the four-digit industry-country level in a two-stage least squares regression (i.e., a proxy for the seriousness of the crisis at a more disaggregated level than our industry and country dummies). This industry-country level fall in turnover should be exogenous from the perspective of the firm because it is unlikely to be affected by the individual firm's centralization decision. We chose the industry-level fall in demand variable as an instrument for all of our shock variables because it if the very likely the most exogenous variable as well as a good proxy for external

[14] We created an "other" category for 2-digit industries with less than 50 observations and manufacturing firms which reported a non-manufacturing industry code. Our results are robust to dropping these firms from the sample.
[15] We use the "margins" command of Stata to do so.

demand conditions firms , and may, to some extent, determine to some extent the other variables.

Running this model requires addressing two issues. First, an instrumental variable strategy may be very complicated to use in a multinomial logit setting, therefore, we simply run a linear regression with a dummy representing whether the firm centralized or not.[16] Second, in some industry-country combinations we observe very few firms and, hence, the given firm can play a very large role in the average, which may threaten the exclusion restriction. To handle this, we always exclude the firm in question from the calculation of the industry-country level average. We also drop the observation when only one firm is present in an industry-country cell.

RESULTS

Descriptive evidence

Table 2 shows how firms facing different shocks changed their level of centralization.[17] During 2009 7.1 percent of firms decentralized and 19.45 percent of firms centralized their strategic decision-making. The probability of centralization is strongly related to all our shock measures. In terms of change in turnover, only about 15 percent of firms with an increasing turnover centralized compared to 23 percent of firms which faced a very serious fall, with the other two categories in between. The differences in this respect are even more pronounced for the change in employment: 16 percent of firms with increasing employment centralized, while this share was 31 percent for firms deciding on a large layoff. A similar pattern is found for investment (17.4 vs 23.1 %). Finally, 25 percent of firms postponing innovations centralized compared to 16.3 percent of other firms. In contrast to centralization, the relationship between these variables and decentralization is quite weak. The strongest pattern can be seen for the postponing innovation variable with 8.6 percent of postponing firms decentralizing compared to 6.3 percent of non-postponing firms.

[16] This is in line with the multinomial logit results which show that our variables are more likely to affect centralization than decentralization. Excluding decentralizing firms from this regression yields similar results.

[17] As it was discussed, the change in employment and investment variables are continuous, but we divide them into these intervals to ease the interpretation of the descriptive statistics.

Table 2

Different shocks and the centralization decision

	Decentralized	No change in centralization	Centralized	Total
No change or increase in sales	7.43	77.63	14.94	28.34
Sales decrease: 0-10%	7.79	73.76	18.45	19.16
Sales decrease: 10-30%	6.61	71.43	21.96	34.41
Sales decrease: >30%	6.78	70.40	22.82	18.18
No change or increase in employment	6.98	76.92	16.1	53.96
Employment decrease: 0-10%	7.3	72.24	20.46	22.27
Employment decrease: 10-30%	6.87	68.42	24.7	18.44
Employment decrease: >30%	8.2	60.85	30.95	5.32
No change or increase in investment	6.65	75.98	17.37	62.80
Investment decrease: 0-10%	6.9	73.53	19.57	5.61
Investment decrease: 10-30%	9.28	65.59	25.13	6.98
Investment decrease: >30%	7.67	69.21	23.12	24.61
Did not postpone innovation investment	6.26	77.49	16.26	64.02
Postponed innovation investment	8.59	66.28	25.13	35.98
Total	7.1	73.45	19.45	

Regression results

While the descriptive results of the previous subsection are suggestive, regression analysis is needed to show if the patterns arise because of a composition effect and whether the different shocks have independent effects.

Table 3 shows the results from a multinomial regression.[18] The first two columns show the coefficients when the change in turnover and labor are included as explanatory variables, while columns (3) and (4) show the average marginal effects of the same variables for the

[18] Industry dummies are not reported for brevity.

probability of decentralizing and centralizing, respectively. Columns (5)-(8) repeat this exercise with adding the change in investment and the "did not postpone innovation" dummies. When interpreting the magnitudes of the estimates, we rely on the estimated marginal effects.

Let us consider the effect of the change in turnover and employment variables first. According to column (4), a 10 percentage point larger turnover shock (-10 change in the turnover change variable) is associated with a 0.57 percentage point (s.e.=0.2 percentage point, t-value=2.793) higher probability of centralization, while the effect of a similar sized employment shock is about three times as large with a 1.6 percentage point (s.e.=0.23 percentage point, t-value=7.026) increase in this probability. These two variables are important both in economic (compared to the 19.45 % of centralizing firms) and statistical terms, in line with H1 and H2.

The larger economic and statistical magnitude of employment change suggests that, in line with our hypothesis, employment change indeed has a strong, independent relationship with centralization, either because it reflects negative expectations or the added stress and coordination problems associated with layoffs. Interestingly, and in line with these considerations, the coefficient of this variable is positive in the decentralization equation, suggesting that firms facing a large employment shock are not only more likely to centralize, but are also less likely to decentralize.

In columns (5)-(8) we add the investment and innovation variables to our regression. Again, column (8) shows the marginal effects of the variables for decentralization. The marginal effect of the investment variable has the expected sign, but is of a small magnitude. Hence, these results do not provide evidence for our hypothesis 3: when controlling for the other dimensions of the shock, we do not find an independent effect of investment change.

In contrast, postponing innovation is strongly related to centralization: firms which had to postpone an innovation project were 5.75 percentage points (s.e.= 0.74 pp, t-value=7.739) more likely to centralize than similar firms which did not have to postpone such a project. This result is large both in economic and statistical terms, and is in line with the descriptive results. This finding provides support for theories emphasizing the strong relationship between decentralized organizations and innovation. Interestingly, this variable has a negative coefficient in the decentralizing equation (-1.8 pp, s.e.=0.5 pp, t-value=3.574) as well, suggesting that firms that postpone an innovation are more likely to *change* (either centralize or decentralize) their decision-making process. This may be explained within the sense of urgency framework by assuming that postponing innovation reflects a large shock which can generate a sense of urgency.

Table 3

Multinomial logit model

	(1) Decentralized	(2) Centralized	(3) Decentralized	(4) Centralized	(5) Decentralized	(6) Centralized	(7) Decentralized	(8) Centralized
	Coefficients		Marginal effects		Coefficients		Marginal effects	
Sales change	0.00356	-0.00348	0.000281	-0.000567	0.00543	-0.00129	0.000370	-0.000270
	(0.00212)	(0.00139)	(0.000136)	(0.000203)	(0.00218)	(0.00142)	(0.000139)	(0.000207)
Employment change	0.00165	-0.0108	0.000265	-0.00163	0.00292	-0.00926	0.000326	-0.00140
	(0.00254)	(0.00159)	(0.000162)	(0.000232)	(0.00257)	(0.00161)	(0.00161)	(0.000234)
Investment change					-0.000533	-0.000797	-2.26e-05	-0.000109
					(0.000577)	(0.000376)	(3.68e-05)	(5.46e-05)
Postpone innovation inv.					-0.364	-0.417	-0.0178	-0.0575
					(0.0736)	(0.0485)	(0.00498)	(0.00743)
Employment: 20-49	0.336	0.146	0.0175	0.0164	0.333	0.139	0.0173	0.0152
	(0.0845)	(0.0535)	(0.00468)	(0.00732)	(0.0846)	(0.0538)	(0.00468)	(0.00731)
Employment: 50-249	0.736	0.451	0.0418	0.0564	0.734	0.448	0.0415	0.0554
	(0.0967)	(0.0647)	(0.00660)	(0.00972)	(0.0968)	(0.0649)	(0.00660)	(0.00969)
Employment: > 250	0.705	0.760	0.0321	0.112	0.715	0.764	0.0325	0.111
	(0.140)	(0.0896)	(0.00982)	(0.0157)	(0.141)	(0.0901)	(0.00986)	(0.0156)
France	-0.691	-0.614	-0.0365	-0.0651	-0.691	-0.613	-0.0365	-0.0650
	(0.203)	(0.152)	(0.0147)	(0.0201)	(0.204)	(0.152)	(0.0148)	(0.0201)
Germany	-0.306	-0.383	-0.0171	-0.0442	-0.302	-0.375	-0.0168	-0.0434

	(0.197)	(0.149)	(0.0148)	(0.0202)	(0.197)	(0.150)	(0.0149)	(0.0202)
Hungary	-0.575	0.262	-0.0380	0.0478	-0.570	0.273	-0.0382	0.0497
	(0.291)	(0.180)	(0.0174)	(0.0272)	(0.291)	(0.181)	(0.0175)	(0.0273)
Italy	-0.414	0.748	-0.0369	0.138	-0.414	0.752	-0.0374	0.138
	(0.204)	(0.145)	(0.0147)	(0.0212)	(0.205)	(0.146)	(0.0148)	(0.0212)
Spain	0.668	0.629	0.0492	0.0877	0.615	0.569	0.0450	0.0776
	(0.194)	(0.146)	(0.0158)	(0.0211)	(0.194)	(0.147)	(0.0158)	(0.0211)
UK	-0.488	-0.183	-0.0294	-0.0188	-0.487	-0.178	-0.0295	-0.0181
	(0.208)	(0.152)	(0.0150)	(0.0208)	(0.208)	(0.152)	(0.0151)	(0.0208)
Industry dummies	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE
Observations	14,201	14,201	14,201	14,201	14,201	14,201	14,201	14,201
Pseudo R-2	0.0511	0.0511	0.0511	0.0511	0.0566	0.0566	0.0566	0.0566
Log-likelihood	-9875	-9875	-9875	-9875	-9818	-9818	-9818	-9818

Note: The table shows the results of the multinomial logit models estimating the impact on centralization decision. The dependent variable shows whether the firm centralized, decentralized or did not change their decision-making process during 2009, with 'no change' as the base category. Columns 1 and 2 display regression coefficients, column 3 and 4 show marginal effects, while columns (4)-(8) repeat this exercise with a model where we also include the change in investment and a dummy showing if the firm postponed its innovation activities. Sales change is the modified continuous measure of decrease in turnover. Employment change is measured in percentage. Investment change is the modified continuous measure of change in investment. Postpone innovation investment is 1 when the firm did not postpone innovation investment and zero otherwise. Employment is measured with a set of dummies. In the case of countries the baseline is Austria. 2-digit industry NACE codes are included when noted. Standard errors are in parenthesis.

When including these variables, the point estimate of the coefficient of turnover changes. In the centralization equation it halves and also becomes less significant while the estimate of employment change remains similar to our previous findings. This suggests that, after all, change in employment and postponing innovations are the strongest predictors of organizational change while the other shock measures have relatively small effects when we control for all these measures.

Turning to our controls, we find some evidence that larger firms are more likely to *change* their level of centralization, as the coefficients of size dummies are positive both in the decentralization and centralization equations. The results are clearer in the case of centralization when the coefficients are gradually increasing with firm size. For example, according to the marginal effect estimates, medium-sized firms are 5.7, while large firms are 11 percentage points more likely to centralize than smaller firms with 10–20 employees. Again, these effects are large both in economic and statistical terms. This finding suggests that managers of large firms are more likely to change, and especially to centralize the strategic decision-making process of the firm.

When considering country effects, note that Austria is the base category. In terms of centralizing, we find evidence for large differences across countries. Firms were most likely to centralize in Italy and Spain, and least likely to do so in France and Germany. The difference between Italy and France is about 20 percentage points, which is again large enough both in economic and statistical terms. This effect provides evidence for the importance of country-level cultural and institutional differences when deciding to take centralization decisions.

As we have discussed already, one possible concern with this identification strategy is the possibility of reverse causality, i.e., that the centralization decision can affect our shock measures. As discussed above, we address this problem by including the four-digit industry-country level average decline in turnover as an instrument for each of the firm-level shock measures. Because we have only one instrument, we will include the shock variables one by one into separate linear probability regressions when the dependent variable is a dummy showing whether the firm centralized or not.

Results are presented in Table 4. The four blocks of the table show regressions when the different shock measures are included. In all blocks, column (1) shows an OLS for comparison, column (2) show 2SLS estimate when only the variable in question is included, column (3) shows results when size and country controls are included, while in column (4) we also add two-digit industry dummies.

The similarity of the magnitude of the estimates in this table to the marginal effects estimated in the multinomial logit models suggests that our earlier results were not a consequence of reverse causality and it was indeed the shock variables that drove

centralization. In actual fact, the results reinforce that the employment change and the postponed innovation variables are the strongest predictors of centralization. Similarly to the earlier results, these variables are important both in economic and statistical terms: a 10 percentage points larger employment shock is associated with a 3–8 percentage point larger probability of centralization, while postponing innovations may lead to 2.5–5 percent larger probability of centralization (depending on the set of controls included), while the other variables have smaller coefficients.

Table 4

Instrumental variable strategy

	(1) OLS	(2) no controls	(3) no industry controls	(4) all controls
Sales change	-0.00108	-0.00396	-0.00131	-0.00284
	(0.000188)	(0.000523)	(0.000592)	(0.00144)
Observations	13,727	13,727	13,727	13,727
R-squared	0.049		0.047	0.043
Employment change	-0.00196	-0.00827	-0.00298	-0.00628
	(0.000224)	(0.00111)	(0.00134)	(0.00321)
Observations	13,727	13,727	13,727	13,727
R-squared	0.052		0.049	0.027
Investment change	-0.000351	-0.00229	-0.000852	-0.00173
	(5.18e-05)	(0.000316)	(0.000385)	(0.000894)
Observations	13,727	13,727	13,727	13,727
R-squared	0.050		0.042	0.001
Postpone innovation inv.	-0.0699	-0.484	-0.240	-0.444
	(0.00695)	(0.0704)	(0.110)	(0.246)
Observations	13,727	13,727	13,727	13,727
R-squared	0.054		0.011	

Note: The table shows the results of the instrumental variable strategy estimating the impact on centralization decision. The dependent variable shows whether the firm centralized, decentralized or did not change their decision-making process during 2009, with 'no change' as the base category. Column 1 shows the result of the OLS estimation with employment, country and industry controls. Column 2-4 show the result of the IV strategy using various control variables. In column 2 no control variables are included, column 3 controls for employment and country, while in column 4 employment, country and industry controls are included. Standard errors are in parenthesis.

Robustness

We conduct three types of robustness tests. First, we include a number of additional controls to handle omitted variable bias. Second, we estimate our model with a multinomial probit to see whether the results are robust to the more flexible probit function. Third, we include a more flexible functional form for the turnover and investment change variables which were not continuous in the raw data.

One possible concern with our results is that both the crisis measures and centralization can be correlated with many omitted variables. In this subsection we exploit additional variables from the EFIGE dataset in order to introduce a number of controls to our main equation to see whether the main results change. First, in Table 5 we include variables measuring the ownership structure, financing, and group structure of the firm while in Table 6 we include variables which proxy management and strategy. The main results turn out to be robust to the inclusion of these controls.

Ownership. Agency theory pays a lot of attention to incomplete contracts between shareholders and management (Aghion and Tirole, 1997; Grossman and Helpman 2004). The inefficiencies generated by these contracts can vary according to the type of the shareholder. Therefore, three control variables are added to the original model: shareholder type, foreign shareholder, and family owned firm.

The variable showing the type of the most important shareholder can take the following values: 1 “Individual/Group of individuals”; 2 “Industrial firm”; 3 “Holding firm”; 4 “Bank or insurance company”; 5 “Other independent financial corporation not included in the group (private equity and venture capital)”; 6 “Public entity”; 7 “Other”. We create dummies for all these possible values of the variable with “Individual/Group of individuals” as the base category. The foreign shareholder and family owned firm variables are dummies.

Table 5

Multinomial logit – robustness check 1

	(1) Decentralized	(2) Centralized	(3) Decentralized	(4) Centralized
	Coefficients		Marginal effects	
Sales change	0.00566	-0.000593	0.000374	-0.000168
	(0.00227)	(0.00149)	(0.000145)	(0.000213)
Employment change	0.00230	-0.00949	0.000288	-0.0014
	(0.00269)	(0.00169)	(0.000171)	(0.000240)
Investment change	-0.000353	-0.000863	-1.02e-05	-0.00012
	(0.000604)	(0.000397)	(3.85e-05)	(5.66e-05)
Postpone innovation inv.	-0.333	-0.399	-0.0157	-0.0528
	(0.0768)	(0.0511)	(0.00488)	(0.00725)
Shareholder: industrial firm	-0.200	0.0405	-0.0127	0.00871
	(0.151)	(0.0933)	(0.00847)	(0.0136)
Shareholder: holding firm	-0.132	-0.152	-0.00631	-0.0192
	(0.142)	(0.0932)	(0.00863)	(0.0124)
Shareholder: bank/insurance company	0.322	0.229	0.0196	0.0290
	(0.550)	(0.391)	(0.0440)	(0.0610)
Shareholder: other financial	0.147	0.768	-0.00485	0.13
	(0.387)	(0.223)	(0.0236)	(0.0431)
Shareholder: public entity	-1.186	-0.424	-0.0471	-0.0452
	(1.024)	(0.496)	(0.0257)	(0.0579)
Shareholder: other	0.112	0.283	0.00280	0.042
	(0.211)	(0.133)	(0.0142)	(0.0215)
Foreign shareholder	-0.0199	0.218	-0.00446	0.0317
	(0.208)	(0.129)	(0.0133)	(0.0185)
Family owned	0.187	0.113	0.0104	0.0136
	(0.0874)	(0.0566)	(0.00559)	(0.00809)
Domestic affiliates	0.102	0.0536	0.00582	0.00632
	(0.111)	(0.0778)	(0.00730)	(0.0113)
Foreign affiliates	0.286	-0.00211	0.0202	-0.00482
	(0.129)	(0.0939)	-0.00982	(0.0131)
Belong to national group	0.0383	0.403	-0.00383	0.0613
	(0.122)	(0.0786)	(0.00753)	(0.0127)
Belong to foreign group	0.0912	0.385	-0.000162	0.0574

	(0.227)	(0.142)	(0.0146)	(0.0231)
External finance	0.171	-0.00712	0.0111	-0.00352
	(0.0794)	(0.0520)	(0.00508)	(0.00742)
Self-financing (%)	-0.000267	-0.000500	-9.95e-06	-6.83e-05
	(0.000894)	(0.000581)	(5.71e-05)	(8.30e-05)
Industry dummies	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE
Observations	13,187	13,187	13,187	13,187
Pseudo R-2	0.0623	0.0623	0.0623	0.0623
Log-likelihood	-9019	-9019	-9019	-9019

Note: The table shows the results of the multinomial logit models estimating the impact on centralization decision. The dependent variable shows whether the firm centralized, decentralized or did not change their decision-making process during 2009, with 'no change' as the base category. Column 1 and 2 display regression coefficients, column 3 and 4 show marginal effects. Sales change is the modified continuous measure of decrease in turnover. Employment change is measured in percentage. Investment change is the modified continuous measure of change in investment. Postpone innovation investment is 1 when the firm did not postpone innovation investment and zero otherwise. The other explanatory variables are dummy variables and described in the text. Initial centralization, employment and country controls are included, but not reported. 2-digit NACE codes are included as industry controls if noted. Standard errors are in parenthesis.

In Table 5 we do not find evidence for differences between the most frequent ownership structures, but there is some evidence that firms owned by “other” owners behave somewhat differently from family owned firms, which is the base category here. Second, we also find some evidence for more decentralization in family-owned firms: these firms are about 2 percentage points more likely to decentralize than other firms.

Finance. Leverage is an important issue in decentralization (Aghion, Room and Van Reenen, 2013). To track this effect, we include two variables, namely, whether the firm relies on external finance or is self-financing. External finance is a dummy which takes the value of 1 if the company had recurrent external financing in the period 2008–2009. Self-financing is a continuous variable measuring which percentage of investments was financed from internal sources between 2007 and 2009. In Table 5 we do not find evidence for a relationship between financing and centralization: the marginal effects are small both in economic and statistical terms.

Group organization. The SBU approach of centralization describes how headquarters and strategic business units interact (Golden, 1992; Kunisch *et al.*, 2012). If a company is part of a group, it may simply follow group policies when designing its decision-making processes. Similarly, decisions about centralization may differ between local and

multinational firms. Therefore, we add two sets of dummies showing whether the firm is a member of a business group (separate dummies for national and foreign groups) and if it has affiliates (separate dummies for domestic and foreign affiliates).

According to our estimates, firms which are part of a group were more likely to centralize than independent firms, irrespective of the nationality of the group. Indeed, group members were 6 percentage points more likely to centralize than independent firms. Having affiliates, on the other hand, does not seem to affect the probability of centralization.

Most importantly, however, the point estimates and standard errors of the main variables remain very similar to the main table. In other words, the previous results are robust for controlling for ownership, finance, and group structure.

Next we turn to the variables measuring the management and strategic characteristics of firms in Table 6.

Management. Management capabilities can influence centralization, e.g., CEOs can be motivated in maintaining the status quo (Geletkanycz, 1997) or act differently if their goals are not aligned with those of the owners (Hong *et al.*, 2015). We proxy these factors by three variables: CEO is also an owner, the age of the CEO, and whether the CEO receives performance based financial reward.

We include 3 dummies to describe the recruitment of the managers. The base category is when the CEO is also the owner; while the three dummies take the value of one (1) if the CEO came from outside the firm, (2) if she was appointed from within the firm, and (3) if other. The CEO's age is a categorical variable where the first category is under 25, the last (seventh) one is 75 or over, and the other categories cover 10 years each. Again, we create a set of dummies from this variable. The financial reward is also a dummy variable which takes the value 1 if the CEO has received financial reward for her performance.

We find that there is a difference between owner and non-owner CEOs in their willingness to decentralize: non-owner CEOs are actually less likely to decentralize by between around 2 and 3 percentage points. However, we do not find evidence for a relationship between the age of the CEO and centralization. Based on the results, it seems that CEOs receiving financial incentives are more likely to change the decision-making process: the probability of both centralization and decentralization is about 4 percentage points higher in firms where managers have financial incentives.

Strategy. Strategy influences structure (Mintzberg, 1990; Ansoff, 1991), and, as a result, centralization can also vary among companies with different strategies. Therefore, three strategic focus dummies were derived from the spontaneous answer to the question "With respect to your business, indicate the main competitive factors which will determine the success of your firm in the next years" (1) Lowering product cost; (2) Improving product

quality; and (3) Increasing brand recognition. The estimates suggest that firms with a low cost strategic focus were more likely to centralize than firms with 'other' focus. This is in line with the assumption that during recessions centralized organizations can cut costs more efficiently.

Importantly, the estimates for our key variables do not change greatly. Controlling for management and strategy variables does not change our main conclusions.

Table 6

Multinomial logit – robustness check 2

	(1) Decentralized	(2) Centralized	(3) Decentralized	(4) Centralized
	Coefficients		Marginal effects	
Sales change	0.00417	-0.000987	0.0003	-0.000210
	(0.00261)	(0.00176)	(0.000176)	(0.000252)
Employment change	0.00428	-0.00835	0.000423	-0.00128
	(0.00306)	(0.00195)	(0.000205)	(0.000279)
Investment change	-0.000265	-0.00087	-4.29e-06	-0.000122
	(0.000685)	(0.000457)	(4.60e-05)	(6.55e-05)
Postpone innovation inv.	-0.317	-0.346	-0.0161	-0.0454
	(0.0866)	(0.0590)	(0.00581)	(0.00843)
Age of CEO: 25-34 ys	-0.628	-0.187	-0.0655	-0.0103
	(0.865)	(0.853)	(0.112)	(0.143)
Age of CEO: 35-44 ys	-1.229	-0.406	-0.107	-0.0335
	(0.850)	(0.844)	(0.111)	(0.141)
Age of CEO: 45-54 ys	-1.181	-0.615	-0.101	-0.0655
	(0.848)	(0.843)	(0.111)	(0.141)
Age of CEO: 55-64 ys	-1.193	-0.603	-0.102	-0.0636
	(0.848)	(0.844)	(0.111)	(0.141)
Age of CEO: 65-74 ys	-0.953	-0.716	-0.0825	-0.0828
	(0.854)	(0.847)	(0.111)	(0.142)
Age of: CEO >75	-1.091	-0.387	-0.0986	-0.0328
	(0.896)	(0.858)	(0.113)	(0.144)
CEO: manager outside the firm	-0.145	0.173	-0.0120	0.0284
	(0.192)	(0.129)	(0.0113)	(0.0201)
CEO: manager within the firm	-0.0475	0.0738	-0.00437	0.0116
	(0.172)	(0.121)	(0.0111)	(0.0179)
CEO: other	-0.336	0.127	-0.0219	0.0239
	(0.342)	(0.206)	(0.0174)	(0.0317)
Performance based financial	0.608	0.332	0.0382	0.0387

reward	(0.0881)	(0.0647)	(0.00667)	(0.00967)
Strategy: Lowering product cost	-0.128	0.102	-0.0104	0.0169
	(0.0926)	(0.0625)	(0.00623)	(0.00897)
Strategy: Improving product quality	-0.0119	-0.121	0.00110	-0.0174
	(0.0861)	(0.0579)	(0.00579)	(0.00832)
Strategy: Increasing brand recognition	0.213	-0.00266	0.0145	-0.00376
	(0.0984)	(0.0684)	(0.00660)	(0.00979)
Industry dummies	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE
Observations	9,701	9,701	9,701	9,701
Pseudo R-2	0.0701	0.0701	0.0701	0.0701
Log-likelihood	-6719	-6719	-6719	-6719

Note: The table shows the results of the multinomial logit model estimating the impact on centralization decision. Column 1 and 2 display regression coefficients, column 3 and 4 show marginal effects. Sales change is the modified continuous measure of decrease in turnover. Employment change is measured in percentage. Investment change is the modified continuous measure of change in investment. Postpone innovation investment is 1 when the firm did not postpone innovation investment and zero otherwise. The other explanatory variables are dummy variables and described in the text. Initial centralization, employment and country controls are included, but not reported. 2-digit NACE codes are included as industry controls if noted. Standard errors are in parenthesis.

Next, in Table A.3 in the Appendix we run a multinomial probit model which is more flexible than the multinomial logit. This model yields very similar results in terms of marginal effects to the multinomial logit specification reported earlier.

Finally, as we have already mentioned, the turnover change variable is created from dummies where firms only reported intervals of turnover change. However, this manipulation may lead to functional form misspecification. In Table A.1 we include a set of dummies representing these intervals to find very similar results to the previous ones.

Functional form problems may also arise with respect to the investment change variable. First, the question is constructed in such a way that firms which did not cut their investment only report this fact rather than the magnitude of increase in their investment. Second, there is a possible truncation problem for firms which did cut their investment by 100 percent. Hence, we include two dummies for firms not cutting their investment and cutting it by 100 percent in columns (3) and (4) of Table A.1. Again, our main results do not

change, but we find that firms decreasing their investments radically were less likely to change their organization than other firms.

DISCUSSION

This study has used a unique and large dataset of more than 14,000 European manufacturing firms to study the relationship between the size of different shocks faced by the firm during the 2008-09 recession and whether the firms changed the degree of centralization of their strategic decision-making.

We have studied four measures of shocks: change in turnover, employment, investment, and whether the firm postponed an innovation project. We have found the strongest association with employment and postponing innovation: a 10 percentage point larger employment shock was associated with a 1.4 percentage point larger probability of centralization, while postponing innovation increased the probability of centralization by nearly 6 percent. The other two shocks proved to be less important when controlling for these variables. The common characteristic in the two shocks with strong effects is that they are more likely to proxy the management's expectations about the future and the time horizon of their decisions.

We have also found evidence that centralization during recessions is associated with a number of other factors. First, there are considerable differences across countries suggesting evidence for the importance of culture. Second, family-owned firms were more likely to decentralize. Third, firms which were part of a group were more inclined to centralize than independent firms. Fourth, non-owner CEOs were more likely to decentralize than owner CEOs. Fifth, firms competing with their cost level were more likely to centralize than firms with other strategic focus.

In terms of theory, the finding that larger shocks are associated with centralization may be in line with the threat-rigidity approach according to which managers centralize in a threatening environment. Centralization may also be optimal for more rapid search in a complex and rapidly changing solution landscape.

Furthermore, our results also suggest that firms in general display a centralization cycle which follows the real economy: firms centralize during crises and decentralize during upturns. Nevertheless, our results also suggest that different countries and firms follow a heterogeneous cycle. A better understanding industry or country-level dynamics may require a higher degree appreciation of heterogeneity across firms.

Several important theories suggest that the centralizing tendency during recessions may be suboptimal from the viewpoint of the firms. This implies that managers should

regularly any consciously review the decision-making process of the firm and analyze systematically the decisions taken at times when the firm is under stress.

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APPENDIX tables

Table A.

Multinomial logit with discrete sales change

	(1) Decentralized	(2) Centralized	(3) Decentralized	(4) Centralized
	Coefficients		Marginal effects	
Sales decrease: 0-10%	-0.00917	0.0555	-0.00156	0.00805
	(0.0987)	(0.0713)	(0.00701)	(0.0100)
Sales decrease: 10-30%	-0.213	0.139	-0.0161	0.0237
	(0.0953)	(0.0646)	(0.00632)	(0.00927)
Sales decrease: >30%	-0.258	0.0332	-0.0173	0.00851
	(0.122)	(0.0807)	(0.00775)	(0.0114)
Employment change	0.00220	-0.00971	0.000288	-0.00145
	(0.00262)	(0.00166)	(0.000168)	(0.000238)
Investment change	-0.00297	-0.00202	-0.000163	-0.000252
	(0.00216)	(0.00146)	(0.000138)	(0.000209)
Investment change (lower bound)	-0.663	-0.442	-0.0365	-0.0547
	(0.183)	(0.118)	(0.0117)	(0.0169)
Investment change (upper bound)	0.121	0.0183	0.00761	0.000863
	(0.259)	(0.173)	(0.0166)	(0.0249)
Postpone innovation investment	-0.333	-0.392	-0.0162	-0.0539
	(0.0749)	(0.0496)	(0.00506)	(0.00754)
Employment: 20-49	0.321	0.147	0.0168	0.0163
	(0.0854)	(0.0548)	(0.00481)	(0.00743)
Employment: 50-249	0.694	0.434	0.0394	0.0534
	(0.0984)	(0.0665)	(0.00673)	(0.00985)
Employment: > 250	0.612	0.724	0.0264	0.106
	(0.146)	(0.0932)	(0.00989)	(0.0160)
France	-0.544	-0.59	-0.0267	-0.0637
	(0.231)	(0.167)	(0.0156)	(0.0222)
Germany	-0.180	-0.346	-0.00813	-0.0413
	(0.225)	(0.165)	(0.0157)	(0.0223)
Hungary	-0.495	0.154	-0.0302	0.0288
	(0.324)	(0.202)	(0.0186)	(0.0293)
Italy	-0.295	0.756	-0.0287	0.136
	(0.231)	(0.161)	(0.0156)	(0.0232)

Spain	0.734	0.578	0.054	0.0765
	(0.222)	(0.162)	(0.0166)	(0.0231)
UK	-0.370	-0.168	-0.0210	-0.0182
	(0.235)	(0.168)	(0.0159)	(0.0229)
Industry dummies	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE
Observations	13,727	13,727	13,727	13,727
Pseudo R-2	0.0578	0.0578	0.0578	0.0578
Log-likelihood	-9471	-9471	-9471	-9471

Note: The table shows the results of the multinomial logit models estimating the impact on centralization decision. The dependent variable is described in the text. Column 1 and 2 display regression coefficients, column 3 and 4 show marginal effects. Sales decrease is a dummy variable, where the baseline value is the increase of turnover. Investment change is the modified continuous measure of change in investment. The investment change lower/upper bound takes the value 1, when the company decreased its planned investment by 10Appendi0% or 0%. Postpone innovation investment is 1 when the firm did not postpone innovation investment and zero otherwise. Employment is measured with a set of dummies. In the case of countries the baseline is Austria. 2-digit industry NACE codes are included when noted. Standard errors are in parenthesis.

Table A.2

Correlation between the different crisis measures

	Employment change	Sales change	Investment change	Postpone innovation inv.
Employment change	1			
Sales change	0.4444	1		
Investment change	0.2722	0.3201	1	
Postpone innovation inv.	0.1646	0.2041	0.3516	1

Table A.3

Multinomial probit model

	(1) Decentralized	(2) Centralized	(3) Decentralized	(4) Centralized	(5) Decentralized	(6) Centralized	(7) Decentralized	(8) Centralized
	Coefficients		Marginal effects		Coefficients		Marginal effects	
Sales change	0.00225	-0.00247	0.000301	-0.000542	0.00356	-0.000745	0.000383	-0.000249
	(0.00142)	(0.00111)	(0.000138)	(0.000206)	(0.00145)	(0.00114)	(0.000141)	(0.000210)
Employment change	-0.000128	-0.00845	0.000239	-0.00162	0.000837	-0.00724	0.000302	-0.00141
	(0.00168)	(0.00129)	(0.000163)	(0.000238)	(0.00170)	(0.00131)	(0.000165)	(0.000239)
Investment change					-0.000428	-0.000633	-2.43e-05	-0.000108
					(0.000386)	(0.000304)	(3.75e-05)	(5.58e-05)
Postpone innovation inv.					-0.265	-0.327	-0.0174	-0.056
					(0.0494)	(0.0391)	(0.00505)	(0.00754)
Employment: 20-49	0.224	0.133	0.0172	0.0183	0.222	0.127	0.017	0.0173
	(0.0550)	(0.0426)	(0.00479)	(0.00742)	(0.0551)	(0.0427)	(0.00479)	(0.00740)
Employment: 50-249	0.505	0.384	0.0405	0.059	0.504	0.38	0.0404	0.0578
	(0.0646)	(0.0517)	(0.00670)	(0.00982)	(0.0648)	(0.0519)	(0.00670)	(0.00979)
Employment: > 250	0.492	0.619	0.0291	0.113	0.499	0.621	0.0296	0.112
	(0.0952)	(0.0737)	(0.00994)	(0.0159)	(0.0955)	(0.0741)	(0.00999)	(0.0159)
France	-0.412	-0.466	-0.0281	-0.0649	-0.419	-0.473	-0.0286	-0.0659
	(0.152)	(0.127)	(0.0156)	(0.0220)	(0.152)	(0.127)	(0.0157)	(0.0222)
Germany	-0.151	-0.27	-0.00880	-0.0419	-0.151	-0.27	-0.00878	-0.0419

	(0.150)	(0.126)	(0.0157)	(0.0221)	(0.150)	(0.126)	(0.0159)	(0.0223)
Hungary	-0.290	0.109	-0.0298	0.0288	-0.300	0.102	-0.0307	0.0278
	(0.206)	(0.157)	(0.0186)	(0.0294)	(0.206)	(0.158)	(0.0188)	(0.0295)
Italy	-0.109	0.603	-0.0289	0.137	-0.118	0.6	-0.0299	0.137
	(0.152)	(0.124)	(0.0156)	(0.0231)	(0.152)	(0.124)	(0.0157)	(0.0232)
Spain	0.584	0.53	0.0579	0.0884	0.538	0.475	0.0534	0.0774
	(0.149)	(0.125)	(0.0166)	(0.0230)	(0.149)	(0.125)	(0.0167)	(0.0231)
UK	-0.263	-0.151	-0.0218	-0.0202	-0.269	-0.159	-0.0223	-0.0212
	(0.155)	(0.129)	(0.0159)	(0.0227)	(0.155)	(0.129)	(0.0160)	(0.0229)
Industry dummies	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE	2-digit NACE
Observations	13,727	13,727	13,727	13,727	13,727	13,727	13,727	13,727
Log-likelihood	-9540	-9540	-9540	-9540	-9487	-9487	-9487	-9487

Note: The table shows the results of the multinomial probit models estimating the impact on centralization decision. The dependent variable shows whether the firm centralized, decentralized or did not change their decision-making process during 2009, with 'no change' as the base category. Columns 1 and 2 display regression coefficients, column 3 and 4 show marginal effects, while columns (4)-(8) repeat this exercise with a model where we also include the change in investment and a dummy showing if the firm postponed its innovation activities. Sales change is the modified continuous measure of decrease in turnover. Employment change is measured in percentage. Investment change is the modified continuous measure of change in investment. Postpone innovation investment is 1 when the firm did not postpone innovation investment and zero otherwise. Employment is measured with a set of dummies. In the case of countries the baseline is Austria. 2-digit industry NACE codes are included when noted. Standard errors are in parenthesis.