Never Waste a Good Crisis? Growth and Decentralization in the Great Recession

Preliminary

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Abstract

We argue that decentralization is particularly beneficial to firm performance in "bad times". We present a model where bad times increase the importance of rapid action, and improve the alignment of incentives of managers within firms. We test this idea exploiting the 2008-2009 Great Recession using firm-level cross country panel data combined with our survey data on firm organization. We find that: (i) decentralization is positively correlated with sales growth and with TFP growth, particularly in times of crisis; (ii) the correlation between decentralization and performance in crisis times is stronger when the congruence between principals and agents is weaker, e.g. (a) in firms where the CEO is offsite; (b) where the plant manager has shorter tenure and (c) where the level of generalized trust in the region is lower; (iii) the positive effects of decentralization in times of crisis is significantly larger in firms with leverage above the median.

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1 Introduction

Although the importance of institutions for economic development and growth is now widely acknowledged[1], less is known about growth and the internal organization of firms, and particularly how this depends on characteristics of the firms' country or sector. In this paper we focus on one aspect of this question, namely how crises effect the growth performance of decentralized firms. This has particular relevance following the Great Recession, which generated a debate over how best to organize for recovery and survival during an extreme crisis.

One common argument was that centralized firms were the best equipped to survive the recession because of the importance of cost cutting which, because of conflicting interests within the firm, is best directed from corporate headquarters. An alternative view is that recessions are periods of rapid change, and being decentralized allows the necessary flexibility to respond to uncertain business conditions.[2] To investigate these issues, this paper takes a two step approach. First, we build a stylized model of firm decision making with decentralization, which allows for varying degrees of economic crisis. Second, we build a unique new panel dataset on decentralization first-measured in 2006 (before the Great Recession), firm performance before during and after the Great Recession, and measures of the recession and of economic uncertainty (which vary by country and industry).

We develop a modified version of the Aghion-Tirole (1997) - henceforth AT - model to capture the effects of bad shocks and uncertainty on the costs and benefits of delegation. As in AT, a project needs to be chosen by a principal or his agent. The principal seeks to maximize monetary benefits whereas the agent seeks to maximize her private benefits. The probability that the profit-maximizing action be the same as the action that maximizes the agent's private benefits, which measures the degree of congruence between the principal's and the agent's preferences, is assumed to less than one.

We assume that the party in control can take action only if she is informed, and that the agent has informational advantage over the principal: namely, the agent perfectly knows the payoffs from different project choices, whereas the principal learns these payoffs with a probability which

[1] For example, Acemoglu et al (2001) and Acemoglu and Robinson (2012).

[2] For an example of arguments in favor of centralization during recessions see http://www.cimaglobal.com/Thought-leadership/Newsletters/Regional/The-CIMA-Edge-South-Asia-and-Middle-East/20111/May–June-2011/Centralised-decentralised-and-shared-services-a-comparison/. For the opposite view see http://iveybusinessjournal.com/topics/strategy/making-a-key-decision-in-a-downturn-go-on-the-offensive-or-be-defensive#.VCAKSvldV8E

decreases with the degree of uncertainty in the sector. Thus delegating control to the agent increases the probability that a project will be implemented, however, as in AT, delegation involves the risk that the agent choose a project which is not profit-maximizing.

Our main departure from AT is the assumptions that: (i) with positive probability the firm is hit by a bad shock; (ii) conditional upon being hit by a bad shock, the firm goes under with some probability if the profit maximizing action is not taken; (iii) if the firm goes under, the principal incurs a bankruptcy cost and the agent loses all private benefits. These assumptions imply that the actual probability that, if control is delegated to her, the agent will choose the profit-maximizing action (this we refer to as the *actual* congruence between the two parties), is higher than the probability that the profit-maximizing action is the same as the agent's preferred action (this we call the *notional* congruence between the principal and the agent).

This model delivers three main predictions. First, the higher the probability of a bad shock, the more performance-enhancing it is for the principal to delegate control to the agent. This is because the more likely the occurrence of a bad shock, the higher the actual congruence between the two parties. Second, the higher the degree of intrinsic congruence between the principal's and the agent's preferences, the lower the effect of a bad shock on the performance-enhancing effect of decentralization: this is because the higher the notional congruence between the two parties, the smaller the scope for bad shocks to increase actual congruence. Third, the positive effect of decentralization in bad times, is higher for leveraged firms that face a bankruptcy threat.

In the empirical part of the paper we construct a firm-level cross-country panel dataset to test these predictions. Our sample comprises around 1,300 firms in ten OECD countries (France, Germany, Greece, Italy, Japan, Poland, Portugal Sweden, the UK and US) pre and post the Great Recession. We ran a decentralization survey on these firms in 2006 and have followed their progress over time. We match in detailed accounting information to construct measures of sales and productivity growth, alongside information on uncertainty and other factors.

We show three key results. First, decentralization is positively correlated with sales growth and with TFP growth, particularly in times of crisis. This result is robust to using pre-recession product durability as an exogenous indicator of which sectors were likely to be hit hardest by the recession (expenditure on durables falls by much more than non-durables during recessions). Second, in line with the predictions of the model, we show that the correlation between decentralization and performance during the crisis is stronger when the congruence between principals and agents is

weaker, e.g. (i) in firms where the CEO is offsite; (ii) where the plant manager has shorter tenure and (iii) where the level of generalized trust in the region is lower. Third, the positive effects of decentralization in times of crisis is significantly larger in firms with leverage above the median.

Our paper builds on an extensive prior literature. On the theory side, our paper relates to the literature on incomplete contracts and the internal organization of firms (see Aghion et al, 2014 for a survey). Thus AT provide a simple static framework where the optimal degree of formal or real delegation results from the trade-off between loss of control and better information under decentralization. Using that approach, Hart and Moore (2005), HM, analyze the optimal allocation of authority in multi-layer hierarchies.[3] More recently, Dessein (2002) analyzes how the allocation of control can help incorporate the agent's information into decision-making in a situation where the agent has private information. [4]However none of these papers endogenizes the congruence between principals and agents by linking it to the business cycle.

Our paper also relates to the existing empirical literature on decentralization and its determinants. Rajan and Wulf (2006) document the evolution towards flatter organizations in the US between 1986 and 1999. Caroli and Van Reenen (2001) and also Bresnahan, Brynjolfsson and Hitt (2002) point at positive correlations between decentralization and both human capital and information technology. Guadalupe and Wulf (2009) argue that the Canadian-US Free Trade Agreement (FTA) in 1989 constitutes an exogenous increase in competition for US firms in the industries where tariffs were removed. Exploiting this policy experiment they find that competition is associated with delayering (increasing span for CEO) and that this is likely to also reflect increased delegation (using wage data). Bloom, Sadun and Van Reenen (2012) examine the importance of culture, finding that higher levels of trust in the region where a plant is located is associated with

[3]Their model is one where, by assumption, upstream agents are less likely to have ideas (having a new idea in HM is like obtaining information in AT) due to their higher span of control. On the other hand, when they have a new idea, this idea is of higher potential value also because of their higher span. HM then show that it is optimal to have "chains of commands" whereby whenever they have an idea, upstream agents (the "generalists") have priority rights to implement the idea; only if they don't have an idea can downstream agents (the "specialists") have they say on which action to implement. The intuition is that although upstream agents are more unlikely to have a new idea, having priority control rights makes sure that they are in control of all the assets downstream which in turn allows them to fully realize the idea's potential. But if they fail to have a new idea, then the next downstream agents on each branch of the hierarchy should have her say if she gets an idea, and so moving down in the hierarchy.

[4]In contrast to Aghion and Tirole (1997), there is no information acquisition effort by the agent or the principal, therefore in Dessein's model the allocation of authority is not so much a tool to motivate the agent (as in Aghion and Tirole) or give a supplier incentives to make relationship specific investments (as in Grossman and Hart, 1986). The main insight in Dessein (2002) is that in a world with asymmetric information and contractual incompleteness, the delegation of authority from a Principal to an Agent is often the best way to elicit the agent's private information.

a significantly greater degree of decentralization. But none of these papers looks at the interplay between the decentralization of firms and macroeconomic or sectoral shocks and volatility that affect congruence between top managers and downstream agents in those firms.

Closest to our analysis is Acemoglu et al (2007), whose model assumes firms can learn about the outcome of an investment decision from observing other firms. Hence, in sectors with more heterogeneity or where the firm is closer to the performance frontier - so that learning is more limited - decision making control should be more decentralized. This prediction is confirmed in French and British firm level panel data. But again this paper does not look at the relationship between decentralization, uncertainty or cyclical variations in competitive conditions.

The remaining part of the paper is organized as follows. Section 2 develops our theoretical model, Section 3 presents the data and methodology, Section 4 the results and Section 5 concludes.

2 A simple model

2.1 Basic set up

We develop a simple model to show why bad shocks make decentralization more desirable or more growth enhancing, and this all the more where there is greater urgency or uncertainty. This model embeds elements of Hart (1983) or Schmidt (1997)'s models of competition as an incentive scheme[5] into an Aghion-Tirole (1997)-type framework.

More specifically, we set-up a one-period model of a firm with one principal and one agent. The principal cares about the profitability of the business whereas the agent wants to maximize private benefits and is not responsive to monetary incentives. Taking an uninformed action involves potentially disastrous outcomes, thus only if at least one of the two parties is informed an action can be taken. Also, the agent obtains private benefits only if the firm remains in business.

There are $n \geq 3$ possible actions (or projects) and at any point in time only two of them are "relevant", i.e. avoid negative payoffs to the parties. Among these two actions, one maximizes monetary profitability (or efficiency) yielding the principal utility B, the other yields the principal zero utility. The third action leads to bankruptcy, incurring the principal a cost L. The agent gains private utility of $b+h$ if their preferred action is taken, and h otherwise as long as the firm remains in business (zero if the firm goes bankrupt).

[5] See also Bolton-Dewatripont, 2003, Ch 13, Section 13.5.

With ex ante probability α the agent's preferred action (conditional upon the firm remaining in business) will also be the action that maximizes profits (or monetary efficiency); this variable α captures the *notional* degree of congruence between the principal's and the agent's preferences: if preferences coincide then the action that brings private utility $b + h$ to the agent also yields monetary utility B to the principal. This *notional* congruence is to be distinguished from the *actual* congruence Ω which factors in the agent's concern that the firm be kept in business: indeed, maintaining the firm in business guarantees the agent a private benefit at least equal to h.

Informational assumptions: We assume that the principal acquires information about project payoffs with probability $1/m$, where m measures the degree of uncertainty in the sector. On the other hand, the agent is assumed to be perfectly informed about the project payoffs.

From notional to actual congruence: How do we move from notional to actual congruence? We assume that with flow probability q the firm is hit by a bad shock. Moreover, conditional upon being hit by a bad shock, the firm goes under with probability 1 if the non-profit maximizing action is taken, whereas it never goes under if the profit-maximizing action is chosen. Conditional upon a bad shock occurring, and in case the principal's and agent's preferences are not "notionally" congruent, the agent will choose the profit maximizing action, otherwise the firm goes under and she loses her private benefits. Thus, the actual congruence $\Omega(q)$ will relate to the notional congruence α through the equation:

$$\Omega(q) = \alpha + (1 - \alpha)q,$$

where q is the probability that the firm is hit by a bad shock (or that the firm faces a threat of bankruptcy if hit by a bad shock).

2.2 Solving the model

The expected utility of the principal under centralization (i.e. if the principal retains control), is equal to:

$$\Pi^c = \frac{1}{m}B - (1 - \frac{1}{m})qL.$$

In words: with probability $1/m$ the principal learns about project payoffs and thus chooses the profit-maximizing project; with probability $(1-\frac{1}{m})$ the principal fails to learn the project payoffs, in which case the firm goes under with probability 1 conditional upon being hit by a bad shock (which

occurs with probability q). And bankruptcy in turn involves the principal incurring bankruptcy cost L.

The expected utility of the principal under decentralization (i.e. if the principal delegates authority to the agent), is equal to:

$$\Pi^d = \Omega(q)B = [\alpha + (1-\alpha)q]B,$$

as the agent will always seek to avoid bankruptcy in that case.

Letting

$$\Delta\Pi = \Pi^d - \Pi^c,$$

we then have

$$\frac{\partial \Delta\Pi}{\partial q} = (1-\alpha)B + (1-\frac{1}{m})L > 0.$$

The second term on the right hand side of the above equation reflects an *urgency effect*, i.e. the possibility of bad shocks makes it profitable for the principal to delegate control in order to speed up decision making to avoid bankruptcy; this effect disappears when the principal learns project payoffs "immediately", i.e. when $m = 1$. The first term on the right hand side of the above equation reflects a *congruence effect*: namely, a higher probability of a bad shock helps restore congruence between the principal and the agent (i.e. it increases actual congruence of preferences between the two parties).

A second prediction is that:

$$\frac{\partial^2 \Delta\Pi}{\partial q \partial \alpha} = -B < 0,$$

thus the higher the notional congruence between the principal and the agent, the lower the positive impact of a bad shock on the profit-enhancing effect of decentralization.

These two results translate into results on the desirability of decentralizing: suppose that to move from centralization to decentralization the principal must incur some cost C. Then the above two results imply that the range of C's for which the move decentralization takes place, increases as the probability of a bad shock q increases, but the less so the more congruent in notional terms the principal's and agent's preferences are (i.e. the higher α).

A third prediction is that the higher the probability of a firm hit by a bad shock going bankrupt if the non profit-maximizing action is taken (so far we assumed this probability to be equal to one), the stronger the positive impact of a bad shock on the profit-enhancing effect of decentralization.

In particular, the positive impact of a bad shock on the profit-enhancing effect of decentralization should be stronger in highly leveraged firms.

Fourth, turning to uncertainty, we have:

$$\frac{\partial \Delta\Pi}{\partial m} = \frac{1}{m^2}(B + qL) > 0.$$

i.e. more uncertainty makes decentralization more attractive as it increases the informational advantage of the agent over the principal. Furthermore, one can compute the cross derivative $\frac{\partial^2 \Delta\Pi}{\partial q \partial m}$ which captures the interaction effect between the likelihood of a bad shock and uncertainty.

$$\frac{\partial^2 \Delta\Pi}{\partial q \partial m} = \frac{1}{m^2} L > 0.$$

In other words, more uncertainty reinforces the positive effect of bad shock on the profitability of decentralizing.

Remark: Note that the last two predictions rely on the assumption that uncertainty does not affect the payoff under decentralization. Suppose instead that:

$$\Pi^d = \Omega(q) B \frac{A}{m} - (1 - \frac{A}{m}) qL,$$

where $A > 1$. Then we still have

$$\frac{\partial \Delta\Pi}{\partial q} > 0,$$

but now

$$\frac{\partial \Delta\Pi}{\partial m} = (1 - A\Omega(q)) \frac{B}{m^2} + \frac{1 - A}{m^2} qL$$

is ambiguously signed if

$$1 > A\Omega(q)$$

whereas

$$\frac{\partial^2 \Delta\Pi}{\partial m \partial q} = -A(1 - \alpha) \frac{B}{m^2} + \frac{1 - A}{m^2} L < 0.$$

2.3 Wrapping up

Overall, our model generates the following robust predictions:

Prediction 1: The higher the probability of a (sufficiently) bad shock, the more performance-enhancing it is for the principal to delegate.

Prediction 2: The higher the notional congruence between the principal and the agent, the lower the positive impact of a bad shock on the profit-enhancing effect of decentralization.

Prediction 3: The positive impact of a bad shock on the profit-enhancing effect of decentralization requires some leverage (so that there is a real bankruptcy risk to discipline the agent).

We now confront these predictions to the data, and also analyze how uncertainty affects the impact of a bad shock on the profit-enhancing effect of decentralization.

3 Data description

We start by describing in some detail our decentralization data since this involved an extensive new survey process. We then describe out accounting data, uncertainty proxies and measures of the severity of the Great Recession.

3.1 Measuring decentralization

Our measure of decentralization is obtained through an in-depth interview with a representative plant manager from a medium sized manufacturing firm, excluding those where the CEO and the plant manager is the same person (this occurred in only 4.9% of our interviews). We asked four questions on plant manager decentralization. First, we asked how much capital investment a plant manager could undertake without prior authorization from the corporate headquarters. This is a continuous variable enumerated in national currency that we convert into dollars using PPPs. We also inquired on where decisions were effectively made in three other dimensions: (a) hiring a new full-time permanent shop floor employee, (b) the introduction of a new product and (c) sales and marketing decisions. These more qualitative variables were scaled from a score of 1, defined as all decisions taken at the corporate headquarters, to a score of 5 defined as complete power ("real authority") of the plant manager. In Appendix Table A1 we detail the individual questions in the same order as they appeared in the survey.

Since the scaling may vary across all these questions, we converted the scores from the four decentralization questions to z-scores by normalizing each one to mean zero and standard deviation one. In our main econometric specifications, we take the unweighted average across all four z-scores as our primary measure of overall decentralization.

In the same survey we collected a large amount of additional data to use as controls, including management practice information following the methodology of Bloom and Van Reenen (2007) and

human resource information (e.g. the proportion of the workforce with college degrees, average hours worked, and the gender and age breakdown within the firm). During the interview we also collected ownership information from the managers, which we cross-checked against external databases, particularly Bureau Van Dijk's Amadeus (see details below).

3.1.1 The survey process

To achieve unbiased survey responses to our questions we took a range of steps. First, the survey was conducted by telephone without telling the managers they were being scored on organizational or management practices. This enabled scoring to be based on the interviewer's evaluation of the firm's actual practices, rather than their aspirations, the manager's perceptions or the interviewer's impressions. To run this "blind" scoring we used open questions (i.e. "To hire a full-time permanent shop-floor worker what agreement would your plant need from corporate headquarters?"), rather than closed questions (e.g. "Can you hire workers without authority from corporate headquarters?"[yes/no]). Following the initial question the discussion would continue until the interviewer can make an accurate assessment of the firm's typical practices. For example, if the plant manager responded "It is my decision, but I need sign-off from corporate HQ," the interviewer would ask "How often would sign-off typically be given?" with the response "So far it has never been refused" scoring a 4 and the response "Typically agreed in about 80% of the case" scoring a 3.

Second, the interviewers did not know anything about the firm's financial information or performance in advance of the interview. This was achieved by selecting medium sized manufacturing firms and by providing only firm names and contact details to the interviewers (but no financial details). Consequently, the survey tool is "double blind" - managers do not know they are being scored and interviewers do not know the performance of the firm. These manufacturing firms (the median size was 270 employees) are too small to attract much coverage from the business media. All interviews were conducted in the manager's native language.

Third, each interviewer ran 85 interviews on average, allowing us to remove interviewer fixed effects from all empirical specifications. This helps to address concerns over inconsistent interpretation of categorical responses, standardizing the scoring system.

Fourth, the survey instrument was targeted at plant managers, who are typically senior enough to have an overview of organizational practices but not so senior as to be detached from day-to-day operations.

Fifth, we collected a detailed set of information on the interview process itself (number and type of prior contacts before obtaining the interviews, duration, local time-of-day, date and day-of-the week), on the manager (gender, seniority, nationality, company and job tenure, internal and external employment experience, and location), and on the interviewer (we can include individual interviewer-fixed effects, time-of-day, and subjective reliability score). These survey metrics are used as "noise controls" to help reduce residual variation.

In analyzing organizational and management surveys across countries we also have to be extremely careful to ensure comparability of responses. One step was the team all operated from two large survey rooms in the London School of Economics (LSE). Every interviewer also had the same initial three days of interview training, which provided three "calibration" exercises, where the group would all score a role-played interview and then discuss scoring together of each question. This continued throughout the survey, with one calibration exercise every Friday afternoon as part of the weekly group training sessions. Finally, the analysts interviewed firms in multiple countries since they all spoke their native language plus English, so interviewers were able to interview firms from their own country plus the UK and US, enabling us to remove interviewer fixed effects.

Since our aim is to compare across countries, we decided to focus on the manufacturing sector where productivity is easier to measure than in the non-manufacturing sector. We also focused on medium sized firms, selecting a sample of firms with between 100 and 5,000 workers. Very small firms have little publicly available data. Very large firms are likely to be more heterogeneous across plants. We drew a sampling frame from each country to be representative of medium sized manufacturing firms and then randomly chose the order of which firms to contact (see Appendix B for details).

Each interview took on average 48 minutes and was run in the summer of 2006. We obtained a 45% response rate, which is very high for company surveys, and was achieved through several steps. First, the interview was introduced as "a piece of work" without discussion of the firm's financial position or its company accounts (we can obtain these externally). Second, the survey was ordered to lead with the least controversial questions (on shop-floor operations management), leading on to monitoring, incentives, and organizational structure. Third, interviewers' performance was monitored, as was the proportion of interviews achieved, so they were persistent in chasing firms. Fourth, the written endorsement of many official institutions helped demonstrate to managers that this was an important academic exercise with official support. Fifth, we hired high quality

MBA-type students, which helped to signal to managers the high quality nature of the interview.

Finally, as a check of potential survey bias and measurement error we performed repeat interviews on 72 firms, contacting different managers in different plants at the same firm, using different interviewers. To the extent that our organizational measure is truly picking up company-wide practices these two scores should be correlated, while to the extent the measure is driven by noise the measures should be independent. The correlation of the first interview against the second interviews was 0.513 (p-value of 0.000). Furthermore, there is no obvious (or statistically significant) relationship between the degree of measurement error and the decentralization score. That is to say, firms that reported very low or high decentralization scores in one plant appeared to be genuinely very centralized or decentralized in their other plants, rather than extreme draws of sampling measurement error.

3.2 Accounting data

We build firm level measures of sales, employment, capital and materials using accounting data extracted from Bureau Van Dijk's ORBIS. These are electronic versions of company accounts covering the population of private and publicly listed firms. In our baseline specifications we estimate in three-year growth rates. We are able to build firm level measure of sales growth for at least one year for 1,312 out of the 2,351 firms with decentralization data measures in 2006,[6] and two or more years for 1,008 firms, while the sample decreases to 464 and 374 firms respectively when we also control for growth in capital, employment and materials.

Table 1 shows the basic summary statistics for the accounting data of the firms included in our sample. On average, firm level sales declined by 6% in the time period 2006-2011 for the firms included in our sample. The drop was larger in the UK (-12% on average) and smallest in Japan (+2%), as shown in Table A2 in Appendix. Table A3 reports the average sales growth across industries in the sample.

3.3 Measuring the Great Recession

Our baseline measure of the intensity of impact of the Great Recession ("SHOCK") on an industry-by-country cell comes from the UN COMTRADE database of world trade. This is an international database of six-digit product level information on all bilateral imports and exports between any

[6]The vast majority of non-matched firms are located in the US (348) and India (369), where it is typically harder to find high quality data for private firms.

given pairs of countries. We aggregate COMTRADE data from its original six-digit product level to three-digit US SIC-1987 level using the Pierce and Schott (2010) concordance. A second proxy is the change in industry by country sales derived from the aggregating firm accounts extracted from ORBIS, since ORBIS represents a close to a full coverage of the population of firms in each country (see Appendix A).[7]

Figure 1 shows the evolution of these variables in the years preceding and during Great Recession using industry level data for all countries manufacturing sectors (for a total of 5641 manufacturing sectors/country cells).[8] This shows that both real exports and industry sales experienced a slow-down in growth in 2008 relative to 2007, and a decline of approximately 20% for exports and 8% for sales in 2009 relative to 2008.[9]

In the empirical analysis, we build empirical proxies for the Great Recession by averaging 2006/2007 (pre-recession) and 2008/09 (in-recession) levels and calculating the growth between the two sub-periods for each 3-digit industry by country cell. In the baseline discrete measure of SHOCK we code an industry-country cell to be unity is exports fell over this period and zero otherwise, but we make sure that the results are robust to using a continuous measure of the variable.

Finally, given recessions have a greater impact on reducing the expenditure on durable versus non-durable goods (e.g. King and Rebelo, 1989) we also use an industry level measure of the average durability of the goods produced in the industry from Ramey and Nekarta (2013). As a cross-sectional measure this is simply used at the 4-digit industry level, and is a continuous measure. The discrete version is a dummy equal to 1 if the median durability in the industry is greater than one year.

Table 1 shows the basic summary statistics of these shock measures. On average, exports fell in 47% of the industries in the sample, and industry sales in 62% of them. While the average growth rate of real exports across the whole sample is 0, the data shows considerable variation both within and across countries. Table A4 in Appendix shows that the greatest drops in terms of real exports were recorded in the UK, followed by Sweden and the US. In contrast, Poland and Portugal appear

[7] In computing the ORBIS indices, we drop country, industry, year cells with less than 5 observations. The average number of observations with non missing sales for every country, year, sic 3 cell is 625 (median 198, standard deviation 1387).

[8] We obtain similar results if we restrict the sample to the US only.

[9] Note that the changes in industry/country sales derived from ORBIS are not driven by increases/decreases in the number of individual firms underlying the industry/country/year aggregates. In fact, the total number of firms used to compute the ORBIS industry/country/year aggregates is 529,254 in 2006 and 965,512 in 2009.

to have experienced positive increases. Table A5 reports the averages of these variables across industries. Table A6 shows the pairwise correlation among the different indices. Reassuringly, all three measures are highly correlated with each other.

3.4 Measuring congruence

We use several measures of congruence between the principal and agent. First, from the WMS survey we know whether the CEO was physical present in the production plant or not (i.e. Central headquarters and plant are the same), and we expect the congruence between CHQ and plant managers to be typically lower when the CEO cannot directly monitor the activities of the plant manager. Second, we also know some characteristics of the plant manager from the survey. We use the tenure of the plant manager, with the idea that the congruence parameter would be on average smaller for plant managers that have a shorter tenure in the firm. Finally, we can use measures of generalized trust in the region where the headquarters of the plant are located from the World Value Survey (see Bloom, Sadun and Van Reenen 2012). The idea is that congruence is likely to be higher in areas where trust is greater.

3.5 Measuring uncertainty

To measure industry by year uncertainty we use the average stock-market volatility of all US firms in the relevant 4 digits SIC industry-year. This is the most commonly used measure of uncertainty, with our data in fact coming directly from Table 1 of Bloom, Floettoto, Jaimovich, Saporta and Terry (2014)[10]. Stock-market volatility captures the rate of change of future expectations of firm stock-market valuations and is theoretically grounded in a stock-volatility setting, as well as being empirically informative about firms investment and hiring behavior.

Our primary measure is based on the standard deviation of the monthly returns all CRSP firms within an industry-year so that, for example, if there are 10 firms in industry 2231 in the year 2001, our measure for that year would be the standard-deviation of their 120 monthly returns. Figure 2 shows that this measure experienced a significant increase in the aftermath of the Great Recession, especially in 2008. In the empirical analysis we use as the main uncertainty indicator the average industry-level change of this metric between the period 2006/2007 and 2008/2009. Table A7 in Appendix reports averages of the uncertainty data at the 3 SIC digits level.

[10]See the survey in Bloom (2014) of this empirical uncertainty literature, including some of the earliest papers like Leahy and Whited (1996) which use firm-by-year stock-market volatility proxies.

4 Results

The main result of our paper is illustrated in Figure 3. This shows the average 3 year growth rate in sales, measured between 2006-2009, 2007-2010 and 2008-2011 for the firms in our dataset. These are all years covering the Great Recession.[11]

The sample is subdivided in four categories. First, we split firms according to whether they experienced a drop in exports in an industry by country cell in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). We also do the same calculation for sales as an alternative measure of economic activity. Second, we split firms by above/below the median level of decentralization measured in 2006 (before the advent of the Great Recession).

Figure 3 shows that - not surprisingly - all our groupings of firms experienced some drop in average sales after the Great Recession. Second, the in sales drop is clearly (and significantly) larger for firms classified in industries experiencing a decline in exports (compare the two bars on the right with the two on the left). The most interesting finding, however, is that within the industries which faced the biggest negative shock (those on the right of the figure), the decline in sales was significantly larger for firms that were more centralized prior to the recession. Decentralized firms had a 6.2% fall in sales compared to about 10% in the centralized firms. This difference of 3.7 percentage points is significant at the 5% level.

In what follows we investigate the robustness of this basic result to alternative measurement strategies and controls for possible unobservable factors at both the firm and industry level.

4.1 Sales growth

Our baseline specification is:

$$\Delta \ln Y_{ijct} = \alpha DEC_{i0} + \beta(DEC_{i0} * SHOCK_{jk}) + \gamma SHOCK_{jk} + \delta x_{i0} + \theta_c + \phi_j + \tau_t + \varepsilon_{icjt} \quad (1)$$

where $\Delta \ln Y_{ijct}$ is the growth rate: the three year change in real ln(sales) for firm i in industry j in country c in end-year t (for the long differences we are using the three overlapping time periods ending in the years 2009, 2010 and 2011 as discussed above). DEC_{i0} is firm i's level of decentralization (measured in the initial year of 2006); $SHOCK_{jk}$ is our measure of the severity of

[11] Arguably, the recession began in 2008 and was over by 2011, so we also test the robustness of the results to dropping the 2008-2011 period. One could argue that the 2007-2010 period should also be dropped as the recession was officially over in the US in 2010. However, American output and jobs were still very depressed and in Europe (where most of our data is from) the recession remained severe due to the Eurozone crisis and tough austerity policies.

the shock of recession in the industry-country cell; x_{i0} is a set of firm level controls also measured in 2006 (such as firm size and the proportion of college-educated employees); θ_c are country dummies, ϕ_j are industry dummies, τ_t are year dummies and ε_{icjt} and is an error term. Standard errors are clustered at the industry by country level, or just industry level depending on the variables used to proxy for the Great Recession. A key hypothesis we examine is whether $\beta > 0$, i.e. whether decentralized firms do better in bad times.

Column (1) of Table 2 shows the results estimating a simple specification including our recession indicator and a full set of country, year and three digit industry dummies. Firms in industries which had a negative export shock unsurprisingly shrank by more than those which did not (about 2.5%). There is also a positive and significant association between sales growth and decentralization in 2006. Since decentralization is z-scored, its mean is zero and standard deviation one.A one standard deviation increase in our decentralization index is associated with a 0.7% increase in sales growth. In column (2) we introduce an interaction term between decentralization and the export shock indicator. The interaction term is positive and significant which indicates that decentralized firms shrank much less than their centralized counterparts when they were hit by a negative exogenous shock. Hence, a firm with a decentralization index two standard deviations higher than the mean will suffer no fall in sales in the industries hit by a severe export shock. Note that the coefficient on the linear decentralization term is insignificant when the interaction term is added to the specification which indicates that decentralized firms grew no faster or slower in those sectors that did not suffer a bad negative shock.

The recession measure is industry and country specific. Therefore, in column (3) of Table 2 we can include a full set of industry by country dummies. The linear export shock is absorbed by these dummies, but we can still identify the interaction of the shock with firm decentralization. We see that even in this demanding specification the interaction remains positive and significant. Column (4) includes a number of other firm controls (dated in 2006) and shows that the interaction coefficient remains significant. Taken literally, this implies that in the industries not hit by a recession shock, being decentralized makes no difference to sales growth performance over this period.

The last two columns of Table 2 use the same specification as column (4) but use two alternative measures of the recession shock. In column (5), instead of defining industry-country cells according to their export performance we use sales information for the entire ORBIS database aggregated to

a three digit by industry cell. The interaction remains positive and significant. A concern with the estimates is that the SHOCK uses information dates over the same period as the dependent variable (2008 and 2009). This raises concerns of endogeneity bias. Consequently we consider using a measure of the durability of the products in the four-digit industry prior to the recession. We include a full set of four digit industries to absorb the linear effects in column (6). It is clear that the interaction between decentralization and the SHOCK remains positive and significant even based on this more exogenous measure of the Great Recession.[12]

In Table 3 we further explore these results by looking at the subcomponents of the decentralization index. We start in column (1) by showing the baseline result of Table 2, column (4). In column (2) and (3) we repeat the estimation using as the decentralization index a z-scored average of the two questions capturing plant manager decentralization for hiring and budgetary decisions in column (2), and for sales and marketing and product introduction in column (3). This shows that the positive effect of decentralization in a crisis is primarily driven by the latter questions, which are possibly more closely related to the ability to adapt to sudden shifts in local demand such as the ones created by the Great Recession.

We continue in columns (4) and (5) by exploring the association between decentralization and firm survival. Column (4) shows that the main results are robust when we use the Davis, Haltiwanger and Schuh (1996) growth rate, which allows for the inclusion of exitors in the sample (these are set to -.5 by construction, and the regression is estimated by Tobit ML to take this into account). Column (5) looks directly at an exit regression (the dependent variable is a dummy taking value one if the firm exited the sample between 2007 and 2011, and the regression is estimated by Probit with marginal effects reported). This shows that more decentralized firms also had a significantly lower probability of exit.

4.2 Robustness

So far we have shown evidence supportive of the fact that – consistent with the theory presented in Section 2 – more decentralized firms grew at a faster pace during the Great Recession in terms of sales and productivity. In this section we explore the robustness of this result to a series of tests

[12]The specification in column (6) can be regarded as the reduced form of an IV regression where we use durability as an instrumental variable for the shock. When we use decentralization*durability to instrument for SHOCK*durability in a 2SLS specification on the sample sample of column 6, we obtain a coefficient on the SHOCK*durability dummy of 0.053, standard error 0.020. The instrument satisfies both the underidentification and the weak identification tests (F stat=21.094).

related to unobserved firm and industry level heterogeneity.

We start our robustness analysis by investigating whether the SHOCK*decentralization interaction captures the relevance of other firm level characteristics different from decentralization. For these purposes, in Table 4 we augment the specification of Table 2, column (4) with interactions terms between the Great Recession indicator and a series of additional firm level controls which may be associated with a greater degree of decentralization. We start in column (1) by examining the role of the overall management quality of the firm (as measured in a separate part of the survey, see Bloom and Van Reenen 2007 for details). In columns (2) and (3) we repeat the same experiment with pre-recession size of the firm, measured in terms of full time employees and skills (log percentage of plant employees with a college degree). Finally, in columns (4) and (5) we explore the role of firm level geographic and industry diversification, interacting the SHOCK indicator, respectively, with a dummy taking value one if the firm is connected with other international subsidiaries and with a dummy taking value one of the firm reports multiple primary SIC codes in the ORBIS accounts. In all instances, these additional interaction terms are insignificant (with the exception of the SHOCK*management interaction, which is negative and significant at the 10% level) and do not alter the overall magnitude and significance of the SHOCK*decentralization interaction.

A similar concern is that the SHOCK*decentralization interaction may simply be picking up some other time-invariant industry characteristics associated with the magnitude of the recession. To allay this concern, in Table 5 we examine the relationship between sales growth and the SHOCK*decentralization interactions in a sample including years *preceding* the Great Recession. Finding the same results in this period would raise the concern that the SHOCK dummy could capture unobserved industry heterogeneity unrelated to the Great Recession, so we regard this as a placebo test. We look again at three year differences in growth but use the periods 2002-2005, 2003-2006 and 2004-2007, all non-recession years, to define the pre-recession growth rates, and 2006-2009, 2007-2010 and 2008-2011 (as in the earlier tables) to define the post-recession years.[13] Column (1) shows that the SHOCK*decentralization coefficient is actually negative, although insignificant in the years preceding the Great Recession. Column (2) repeats the results of the specification of Table 2, column (4). Column (3) repeats the regression on the pooled pre and post crisis sample, and includes a full set of interactions with a dummy indicator taking value one for all crisis years (2006 onwards) to estimate a kind of "differences in differences in differences" specification. The

[13]We omit 2005 from this analysis since it comprises of both pre and post recession years.

coefficient on the SHOCK*decentralization*post 2006 interaction is 0.017, significant at the 10% level. This reassures us that the significance of the decentralization*SHOCK interaction is not driven by other unobservable industry characteristics different from the demand shock created by the Great Recession.

Furthermore, while Table 2 uses discrete indicators of the Great Recession which are easy to interpret, the results are substantially unchanged when we adopt continuous measures of exports, output and durability as proxies for the Great Recession, as shown in Table A8.

Finally, we also investigated whether the SHOCK measure could be reflecting other industry characteristics rather than the demand fall. In Appendix Table A9 we show that our key interaction is robust to including interactions of decentralization with a number of other industry characteristics such as asset tangibility, inventories, dependency on external finance and labor costs.

4.3 Productivity growth

The results discussed so far suggest the presence of a positive relationship between decentralization and sales growth in the aftermath of the Great Recession. In this sub-section we explore whether this relationship persists even when we examine a "TFP specification", i.e. we estimate our baseline econometric model but also control for increases in other inputs like employment, capital and materials on the right hand side. Some management theories argue that firms need to centralize during crises, so tough costs controls and efficiency enhancing measures can be driven through the firm. This would imply that although decentralized firms may fare better on revenue during downturns, they will do worse on productivity.[14]

This analysis is presented in Table 6. The sample for these regressions is smaller due to missing data on some of the additional inputs needed for the production functions specification (in many countries revenues are a mandatory item on company accounts, but not other inputs such as capital are not). Column (1) shows that the coefficient on the SHOCK*Decentralization interaction is still positive on this sub-sample (the coefficient is actually larger, albeit with a bigger standard error). Column (2) then includes the controls for the growth rate of the other inputs, which are all positively and significantly related to output.[15] The inclusion of these inputs leads the coefficient

[14] One might doubt this immediately as we have shown that exit rates are also greater for centralized firms who were hit harder by a negative shock in the Great Recession.

[15] The sum of the coefficients is about 0.9 suggesting decreasing returns to scale (and/or market power). Measurement error may also be responsible for attenuating the coefficients on factor inputs towards zero.

of the interaction term to fall by half, but it remains significant at the 5% level. Columns (3) to (6) repeat the specifications of the first two columns but use the alternative proxies for the Great Recession as in the previous table (industry output from ORBIS and the durability index). The coefficients on the interaction terms remain positive throughout these experiments, although usually less precisely determined.

4.4 Congruence and firm level heterogeneity

We also investigated whether the strength of the SHOCK*decentralization interaction varies in line with the theory discussed in Section 2. One of the theoretical mechanisms through which our model works is that the recession increases actual (ex-post) congruence, as the agent is more worried that indulging his private interests could lead to the firm going bankrupt. Decentralizing to the local agent (the plant manager) is less costly when notional (ex-ante) congruence is higher. This motivates the idea for looking at firms where we might think notional congruence was more of a problem. These environments are where the effects of the recession on the returns to decentralization should be greatest according to the model.

This analysis is shown in Table 7. First, we analyze whether the coefficient on the interaction term varies according to the physical presence of the CEO on the production plant, as we expect the congruence between CHQ and plant managers to be typically lower when the CEO cannot directly monitor the activities of the plant manager. The results shown in columns (2) and (3) show that – consistent with the theory - the magnitude of the SHOCK*decentralization interaction is about three times larger and statistically significant when estimated over the sample of plants where the CEO is typically offsite, relative to sample in which the CEO is typically on site. Second, we exploit differences in the reported tenure of the plant manager, with the idea that the congruence parameter would be on average smaller for plant managers that have a shorter tenure in the firm. Columns (4) and (5) show that the magnitude of the SHOCK*decentralization interaction is about four times larger in plants where plant managers have been employed in the company for less than 5 years.[16] Third, we analyze whether the magnitude of the SHOCK*decentralization interaction varies with the level of generalized trust in the region where the headquarters of the plant are

[16]Note that the results are similar if we cut the sample using 10 years as the tenure cutoff between the two groups instead of 5 years. In that case the coefficient on the SHOCK*Decentralization is 0.022 (standard error 0.013) for the plant managers with tenure above 10 years, and 0.034 (standard error 0.017) for plant managers with less or equal to 10 years of tenure.

located. The analysis shown in columns (6) and (7) show that the interaction is insignificant and half the size in high trust regions (i.e. those in which the level of generalized trust is higher than that of the median level of trust in the sample) relative to low trust regions.

The theory is based around the disciplining role of the threat of bankruptcy, as a bad shock makes the agent more afraid of losing her job and so more likely to act in the interests of the firm. This effect is more important in decentralized firms where the agent has more control over important decisions. Consequently, we would only expect our model to be irrelevant for firms with little or no debt where bankruptcy is highly unlikely, even with a very bad shock. Columns (8) and (9) test this idea by splitting the sample between firms with high and low levels of debt. As the theory suggests, it is only in firms with above median levels of debt that the interaction between the shock and decentralization is significant.

4.5 Exploring the role of uncertainty

In Table 8 we investigate the role of uncertainty, to test the idea that uncertainty particular valuable in more uncertain times when business conditions are particularly tough. Column (1) starts by re-estimating our baseline results from Table 2 on the sub-sample of firms where we have uncertainty data. The basic result of the positive and significant interaction is present even on this restricted sample. Column (2) includes a control for uncertainty and its interaction with the SHOCK, which is positive as the theory predicts – but statistically insignificant. This may reflect the fact that the interaction between uncertainty and the SHOCK depends upon whether uncertainty affects more the principal's or the agent's information, which in turn may vary across firms. Column (3) shows that the SHOCK*decentralization interaction retains its magnitude and significance even when the uncertainty term is included. Column (4) contains our key triple interaction, finding that when uncertainty is high and industries are in bad times decentralized firms do significantly better, with a coefficient (standard error) of 0.332 (0.143). Columns (5) and (6) use the same specification, using the alternative measures for the severity of the SHOCK (Orbis and the durability dummy), again finding a similar result (albeit non significant when using durability).

4.6 Endogenizing Decentralization

We have assumed that decentralization is a quasi-fixed factor of the firm that is hard to change in the short-run. There is a wealth of evidence from organizational economics (e.g. Gibbons and

Roberts, 2013) that it is very hard to change organizational structures rapidly. The identification strategy in this paper is that firms are initially in some equilibrium state of decentralization when the environment unexpectedly changes with the Great Recession, whose effects are felt heterogeneously across industries and countries. Firms who were decentralized should, according to our theory (and empirics), suffer less than those who were more centralized.

Nevertheless, firms do change their organizational structures over time to some degree. A natural way to think of this is that there are costs of adjustment which will mean that the initial degree of decentralization will persist, but firms will adjust somewhat in response to the shock (assuming that there is some degree of auto-correlation of business conditions). As noted in the theory section, another implication of our framework is that firms in industries hit by a negative shock should start to decentralize. To investigate this we turn to the longitudinal element of the WMS which followed firms we surveyed in 2006 through to 2010 and re-administered the survey tool.

Table 9 contains the results of the panel data exercise where the dependent variable is the change in the (z-score) of decentralization between 2006 and 2009/10. Consistent with the theory we find that places where the negative shock was greatest were significantly more likely to decentralize.

5 Conclusion

When does decentralizing power from the CEO to middle managers increase growth? We present a model where a negative demand shock will cause decentralized firms to grow faster because they have an informational advantage in moving quickly, and because the shock (through increasing bankruptcy risk) creates a tighter alignment between the Central HQ and the plant manager, reducing the agency costs for these decentralized firms.

We test this idea by examining the growth and productivity responses of a panel of 1,300 firms in 10 OECD countries after Lehman's collapse which reduced demand across industries and countries in heterogeneous ways. Using firm-level survey data we collected on decentralization in 2006, prior to the recession, we find that negative demand shocks hurt firm growth in centralized firms significantly more than in their decentralized counterparts. This is true whether we use industry by country sales or export shocks or exogenous predictors of these like product durability (exploiting the fact that the demand for durable goods fell much more during the recession than non-durables). Second, we show that the correlation between decentralization and performance during the crisis

is stronger when the congruence between principals and agents is weaker, e.g. in firms where the CEO is offsite, the plant manager has shorter tenure and where the level of generalized trust in the region is lower. Third, we show that a degree of leverage is necessary for our results. Plants with little leverage will have very low bankruptcy risks and so our model is not relevant, whereas some debt. Finally, using our panel which tracks organizational changes, we find that industry country pairs with larger demand shocks were more likely to decentralize faster.

We see our paper as a first attempt to unravel the relationship between growth and the internal organization of firms using micro data with observable measures of decentralization. Many papers have speculated on this issue without a systematic theory linked to rich survey data. There are many directions to take the research. First, we need to look at the ways in which, in the longer-run, firms change their organizational forms. For example, as the effects of the Great Recession recede, how will the growth effects and degree of decentralization change? Second, we would like to go deeper into the relation between the debt structure of companies (and so their bankruptcy risk) and the incentives for firms to change. Finally, it would be valuable to examine the macro-economic implications of our modelling framework. Do the effects we identify matter in terms of thinking about business cycles and how economies and companies can be resilient to these adverse events?

6 References: Incomplete

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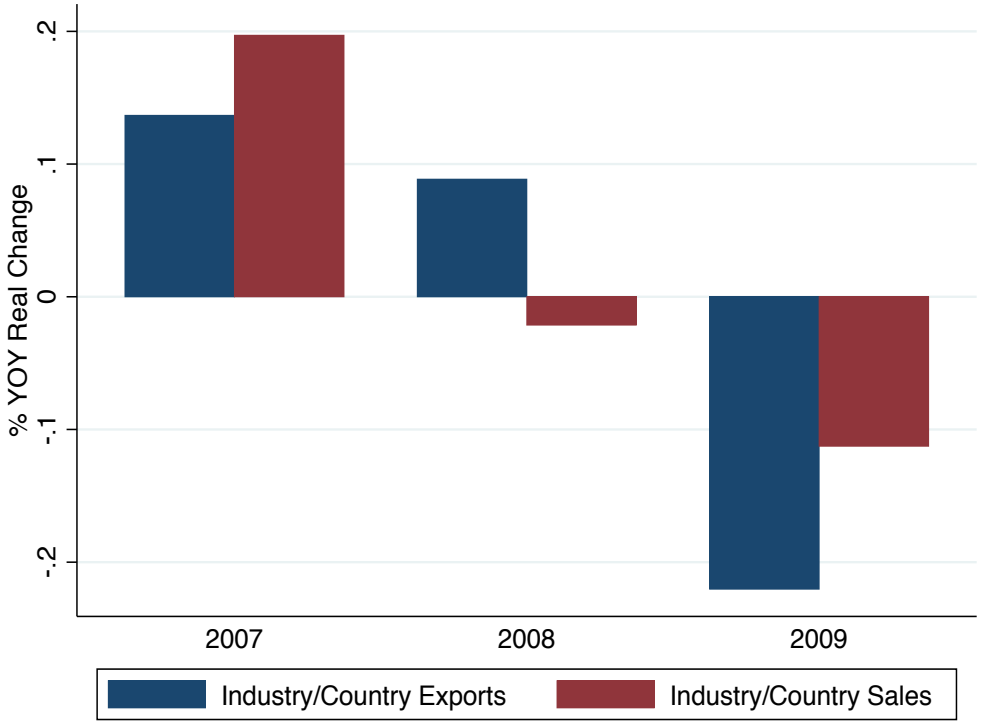
7 Appendix A: Data

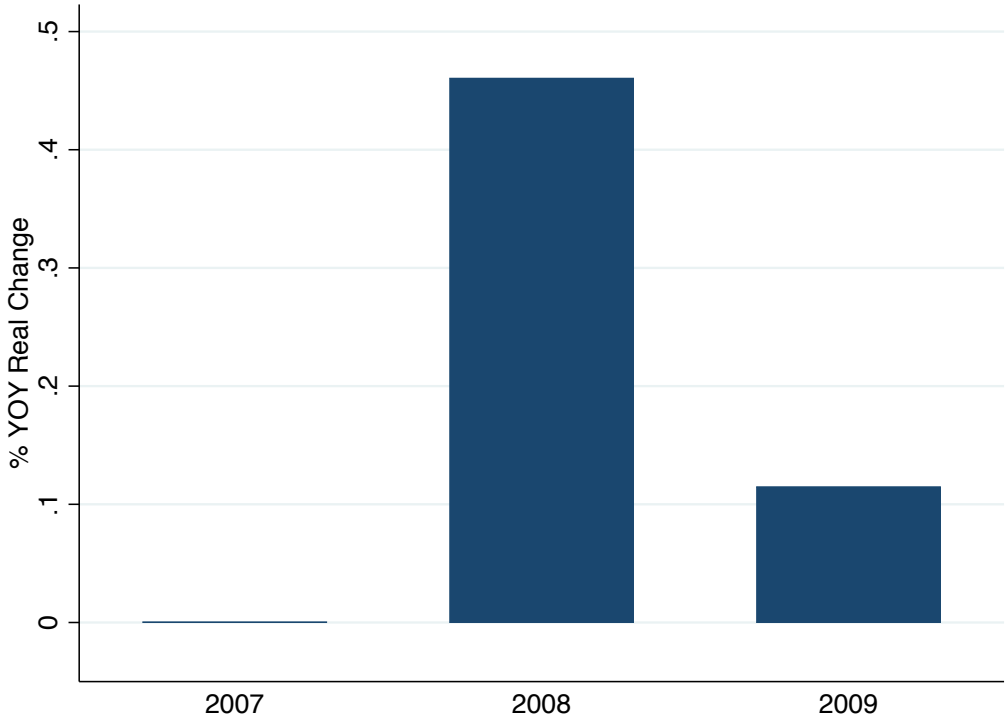
[To be completed]

Figure 1 - Changes in Industry/Country Exports and Sales before and after the Great Recession



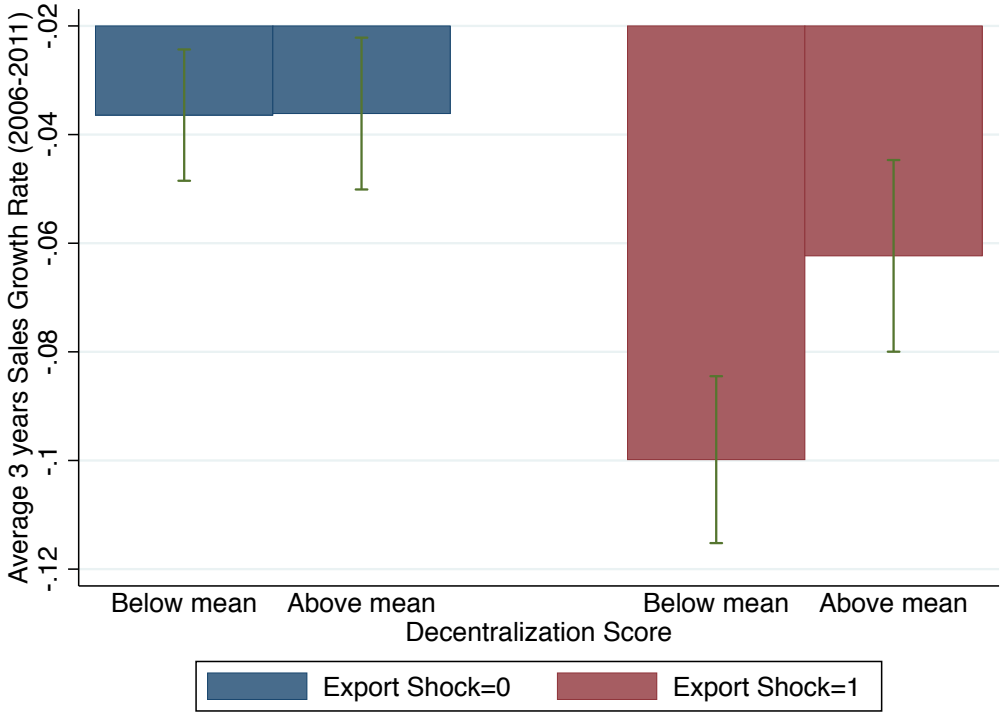
Notes: Each bar plots the yearly log change in real industry exports (left bar) and sales (right bar) between 2006 and 2009. Manufacturing only. Exports data calculated from country/industry (SIC3) aggregates built from product level data in COMTRADE. Sales data calculated using country/industry (SIC3) aggregates built from firm level data in ORBIS. The countries included in the sample are France, Germany, Greece, Italy, Japan, Poland, Portugal, Sweden, UK, US.

Figure 2 - Changes in Industry Uncertainty before and after the Great Recession (CRISP data)



Notes: Each bar plots the yearly log change in the average stock-market volatility of all US firms. The uncertainty measure is calculated from industry (SIC4) averages of the standard deviation of the monthly returns all CRSP firms within an industry-year. Manufacturing only.

Figure 3 - Change in Sales by Shock and Decentralization



Notes: Each bar plots the average of the 3-year log change in sales of the firms included in the decentralization sample computed pooling data from 2006, 2007 and 2008 (10% confidence interval bands reported). The sample is subdivided in four categories. First, we split firms according to whether they experienced a drop in exports in an industry by country cell in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). Second, we split firms by above/below the median level of decentralization measured in 2006 (before the advent of the Great Recession). The countries included in the sample are France, Germany, Greece, Italy, Japan, Poland, Portugal, Sweden, UK, US. Sample size (from left to right): 1); 1193 obs, 476 firms 2); 889 obs, 350 firms 3); 773 obs, 327 firms 4) 1077 obs, 473 firms.

Table 1 - Summary Statistics

Variable	Mean	Median	Standard Deviation	Number of Observations
Sales Levels	229636.20	65305.00	1320845.00	3932
Sales Growth (3 years Log change, 2006-2011)	-0.06	-0.06	0.14	3312
Employment (firm)	574.82	250.00	1558.35	3927
Employment (plant)	229.75	150.00	250.65	3882
% Employees with a College Degree	16.56	10.08	17.83	3607
Decentralization Score	0.00	-0.06	1.00	3932
Management Score	3.05	3.06	0.66	3932
Export shock (dummy=1 if decline in sector/country export in 08/09 relative to 06/07)	0.47	0.00	0.50	3932
Export shock (continuous, % change in sector/country export in 08/09 relative to 06/07)	0.00	0.03	0.22	3834
Industry Output Shock (dummy=1 if decline in sector/country sales in 08/09 relative to 06/07)	0.62	1.00	0.48	3880
Industry Output Shock (continuous, % change in sector/country sales in 08/09 relative to 06/07)	-0.09	-0.06	0.26	3789
Durability (dummy=1 if median years of service of goods produced in the industry>0)	0.71	1.00	0.46	3790
Durability (continuous, median years of service of goods produced in the industry)	12.72	10.00	18.79	3790
Uncertainty - Change in standard deviation of monthly returns of CRSP firms (08/09 relative to 06/07)	0.08	0.07	0.05	3089

Table 2 - Decentralization and Sales Growth - Main Results

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Sales Growth (3 years log change)						
Decentralization	0.007**	0.001	-0.004	-0.007	-0.015**	-0.006
	(0.003)	(0.004)	(0.006)	(0.007)	(0.007)	(0.006)
EXPORT SHOCK	-0.025***	-0.024***				
	(0.008)	(0.008)				
Decentralization*EXPORT SHOCK		0.012**	0.016**	0.017**		
		(0.005)	(0.007)	(0.008)		
Decentralization*SALES SHOCK					0.026***	
					(0.008)	
Decentralization*DURABILITY						0.015**
						(0.006)
R-squared	0.186	0.187	0.276	0.304	0.307	0.238
Observations	3145	3145	3145	3145	3145	3145
Number of firms	1312	1312	1312	1312	1312	1312
Controls						
Country	**y**	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**	**y**
Industry (SIC3)	**y**	**y**				
Industry (SIC3) by Country			**y**	**y**	**y**	
Industry (SIC4)						**y**
Log firm and plant employment				**y**	**y**	**y**
Skills				**y**	**y**	**y**
Noise				**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns, except for column (6), clustered by SIC4. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). The variable "SALES SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in sales in 2008/09 compared to 2006/07. The variable "DURABILITY" is a dummy taking value one if the average durability of the goods produced in the SIC4 is greater than zero years. Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree measured in 2006. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table 3 - Decentralization and Sales Growth - Robustness I

Estimation method	(1) OLS	(2) OLS	(3) OLS	(4) Tobit	(5) Probit
Dependent Variable:	Sales Growth (3 years log change)			Sales Growth (3 years DHS change)	Exit
Decentralization	-0.007			-0.005***	-0.005
	(0.007)			(0.000)	(0.042)
Decentralization*EXPORT SHOCK	0.017**			0.014***	-0.166***
	(0.008)			(0.001)	(0.061)
Decentralization - Hiring & Budget		-0.002			
		(0.006)			
Decentralization - Hiring & Budget *EXPORT SHOCK		0.003			
		(0.008)			
Decentralization - Sales and Marketing & Product Introduction			-0.008		
			(0.007)		
Decentralization - Sales and Marketing & Product Introduction*EXPORT SHOCK			0.020**		
			(0.008)		
R-squared	0.304	0.302	0.305		
Observations	3145	3145	3145	3630	761
Number of firms	1312	1312	1312	1473	761
Controls					
Country	y	y	y	y	y
Year	y	y	y	y	y
Industry (SIC3) by Country	y	y	y	y	y
Log firm and plant employment	y	y	y	y	y
Skills	y	y	y	y	y
Noise	y	y	y	y	y
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. Columns 1-6 estimated by OLS. Column 7 estimated by Tobit and Column 8 estimated by probit (marginal effects reported). Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns. The dependent variable in columns 1-6 is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The dependent variable in column 7 is the Davis and Haltiwanger (1996) growth rate including exitors in the 2006-2011 period (growth rate=-.5 for exitors). The dependent variable in column 8 is a dummy taking value 1 if the firms disappears from ORBIS accounts between 2008 and 2012. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). The variable "EXPORT SHOCK, continuous" is the continuous growth rate of exports in the SIC3 industry/country cell between 2006/07 and 2008/09. Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree measured in 2006. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table 4 - Decentralization and Sales Growth - Robustness II

	(1)	(2)	(3)	(4)	(5)
Dependent Variable					
Decentralization	-0.010	-0.007	-0.010	-0.007	-0.007
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)
Decentralization*EXPORT SHOCK	0.021**	0.018**	0.019**	0.017**	0.017**
	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)
Log(% employees with a college degree)	0.004	0.004	0.006	0.005	0.004
	(0.004)	(0.004)	(0.008)	(0.004)	(0.004)
Log(employees)	-0.004	0.001	-0.001	-0.002	-0.002
	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
Management	0.012*				
	(0.006)				
Management*EXPORT SHOCK	-0.014*				
	(0.008)				
Log(employees)*EXPORT SHOCK		-0.007			
		(0.009)			
Log(% employees with a college degree)*EXPORT SHOCK			-0.000		
			(0.009)		
MNE				0.023	
				(0.018)	
MNE*EXPORT SHOCK				-0.023*	
				(0.013)	
Diversified (multiple primary SIC codes)					0.024**
					(0.010)
Diversified*EXPORT SHOCK					-0.018
					(0.020)
R-squared	0.306	0.303	0.302	0.305	0.305
Observations	3145	3144	2813	3145	3145
Number of firms	1312	1312	1175	1312	1312
Controls					
Country	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**	**y**	**y**
Log firm and plant employment	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**
Skills	**y**	**y**	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree. Management is the z-scored average across 18 z-scored management questions (see Bloom and Van reenen 2007 for details). Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the

Table 5 - Decentralization and Sales Growth - Placebo experiment

	(1)	(2)	(3)
Dependent Variable		**Sales Growth (3 years log change)**	
Sample	**Year<=2004**	**Year>=2006**	**All**
Decentralization	0.005	-0.007	0.007
	(0.006)	(0.007)	(0.005)
Decentralization*EXPORT SHOCK	-0.008	0.017**	-0.004
	(0.008)	(0.008)	(0.007)
POST			-0.221***
			(0.036)
POST*EXPORT SHOCK			-0.048***
			(0.012)
POST*Decentralization			-0.015**
			(0.007)
POST*EXPORT SHOCK*Decentralization			0.017*
			(0.009)
R-squared	0.321	0.304	0.440
Observations	3009	3145	6154
Number of firms	1167	1312	1441
Controls			
Country	**y**	**y**	**y**
Year	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**
Log firm and plant employment	**y**	**y**	**y**
Skills	**y**	**y**	**y**
Noise	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns. The dependent variable in all columns is the three years growth rate of firm sales measured in 2002, 2003 and 2004 in column (1) and in 2006, 2007 and 2009 in column (2). Column (3) pools data across all years. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). The variable "POST" is a dummy taking value 1 in all years after 2006 included. Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table 6 - Decentralization and TFP Growth

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable			**Sales Growth (3 years log change)**			
Decentralization	-0.009	-0.005	-0.018*	-0.006	-0.012	-0.007
	(0.009)	(0.005)	(0.009)	(0.008)	(0.010)	(0.006)
Decentralization*EXPORT SHOCK	0.038*	0.017**				
	(0.023)	(0.007)				
Decentralization*SALES SHOCK			0.045***	0.013*		
			(0.016)	(0.008)		
Decentralization*DURABILITY					0.017	0.009
					(0.012)	(0.007)
Employees Growth (3 years log change)		0.177***		0.180***		0.166***
		(0.041)		(0.042)		(0.027)
Capital Growth (3 years log change)		0.058***		0.057***		0.046***
		(0.018)		(0.018)		(0.016)
Materials Growth (3 years log change)		0.678***		0.675***		0.684***
		(0.044)		(0.045)		(0.041)
R-squared	0.361	0.853	0.376	0.853	0.270	0.849
Observations	1125	1125	1098	1098	1093	1093
Number of firms	464	464	452	452	451	451
Controls						
Country	**y**	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**	**y**
Industry (SIC3) by Country	**y**	**y**	**y**	**y**		
Industry (SIC4)					**y**	**y**
Skills	**y**	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4	SIC4

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns, except for columns (5) and (6), clustered by SIC4. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). The variable "SALES SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in sales in 2008/09 compared to 2006/07. The variable "DURABILITY" is a dummy taking value one if the average durability of the goods produced in the SIC4 is greater than zero years. Skills is the log of % of firm employees with a college degree measured in 2006. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table 7 - Decentralization and Sales Growth

Dependent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Sales Growth (3 years log change)								
	Baseline	CEO onsite	CEO offsite	Plant Manager Tenure>=5 years	Plant Manager Tenure<5 years	High Trust	Low Trust	Low Debt	High Debt
Decentralization	-0.007	-0.005	-0.034**	-0.004	-0.044**	-0.006	-0.011	0.002	-0.024*
	(0.007)	(0.009)	(0.015)	(0.008)	(0.018)	(0.012)	(0.011)	(0.017)	(0.013)
Decentralization*EXPORT SHOCK	0.017**	0.016	0.051***	0.016*	0.067***	0.013	0.027**	0.010	0.042***
	(0.008)	(0.011)	(0.018)	(0.009)	(0.023)	(0.014)	(0.014)	(0.020)	(0.015)
R-squared	0.304	0.328	0.371	0.314	0.421	0.374	0.411	0.362	0.362
Observations	3145	2236	905	2379	758	1654	1335	1023	1850
Number of firms	1312	916	394	1000	310	647	528	431	746
Controls									
Country	y	y	y	y	y	y	y	y	y
Year	y	y	y	y	y	y	y	y	y
Industry by Country (SIC3)	y	y	y	y	y	y	y	y	y
Log firm and plant employment	y	y	y	y	y	y	y	y	y
Noise	y	y	y	y	y	y	y	y	y
Skills	y	y	y	y	y	y	y	y	y
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table 8 - Decentralization, Sales Growth and Uncertainty - NOTE: Uncertainty now is CHANGE

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable: Sales Growth (3 years log change)						
SHOCK indicator	**COMTRADE dummy**	**COMTRADE dummy**	**COMTRADE dummy**	**COMTRADE dummy**	**ORBIS dummy**	**Durability dummy**
Decentralization	-0.007	0.001	-0.010	0.004	0.013	0.002
	(0.008)	(0.009)	(0.011)	(0.013)	(0.013)	(0.009)
Decentralization*SHOCK	0.020**		0.020**	-0.010	-0.024	0.009
	(0.009)		(0.009)	(0.016)	(0.016)	(0.012)
Uncertainty		-0.075	-0.092	0.061	0.230	
		(0.198)	(0.193)	(0.217)	(0.215)	
Uncertainty*Decentralization		0.061	0.048	-0.151	-0.353**	-0.037
		(0.105)	(0.103)	(0.144)	(0.140)	(0.116)
Uncertainty*SHOCK				-0.212	-0.447	
				(0.199)	(0.289)	
Uncertainty*Decentralization*SHOCK				0.418**	0.672***	0.007
				(0.182)	(0.179)	(0.150)
R-squared	0.316	0.313	0.316	0.318	0.326	0.238
Observations	2606	2606	2606	2606	2563	2506
Number of firms	1076	1076	1076	1076	1055	1763
Controls						
Country	**y**	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**	**y**	**y**	
Industry (SIC4)						**y**
Log firm and plant employment	**y**	**y**	**y**	**y**	**y**	**y**
Skills	**y**	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns, except for column (6), clustered by SIC4. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. In all columns the SHOCK indicator is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). Uncertainty is the change in industry (SIC4) average of the standard deviation of the monthly returns all CRSP firms within an industry between 2006/07 and 2008/09. Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree measured in 2006. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table 9 - Changes in Decentralization (Note - change now computed as a simple difference in overall decentralization (zscored)

	(1)	(2)
Dependent Variable	**Change in Decentralization (2006 to 2009/2010)**	
Decentralization questions	**All**	**All**
EXPORT SHOCK	0.231**	
	(0.108)	
SALES SHOCK		0.167*
		(0.093)
Log(% employees with a college degree) (2006)	0.048	0.047
	(0.034)	(0.035)
Log(employees) (2006)	-0.024	-0.033
	(0.050)	(0.050)
Log(employees) - plant (2006)	0.075	0.089*
	(0.052)	(0.052)
R-squared	0.396	0.389
N	687	675
Controls		
Country	y	y
Year	y	y
Industry (SIC2)	y	y
Log firm and plant employment	y	y
Skills	y	y
Noise	y	y
Cluster	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns. The dependent variable in all columns is the change in z-scored decentralization between 2006 and 2009/2010. The variable "Decentralization (2006)" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. In all columns the SHOCK indicator is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree measured in 2006. We also control for the initial level of decentralization in 2006. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table A1 - Decentralization questions

For Questions D1, D3, and D4 any score can be given, but the scoring guide is only provided for scores of 1, 3, and 5.

Question D1: "*To hire a FULL-TIME PERMANENT SHOPFLOOR worker what agreement would your plant need from CHQ (Central Head Quarters)?"*

Probe until you can accurately score the question—for example if they say "*It is my decision, but I need sign-off from corporate HQ.*" ask "*How often would sign-off be given?*"

	Score 1	Score 3	Score 5
Scoring grid:	No authority—even for replacement hires	Requires sign-off from CHQ based on the business case. Typically agreed (i.e. about 80% or 90% of the time).	Complete authority—it is my decision entirely

Question D2: "*What is the largest CAPITAL INVESTMENT your plant could make without prior authorization from CHQ?*"

Notes: (a) Ignore form-filling

(b) Please cross check any zero response by asking "*What about buying a new computer—would that be possible?"* and then probe….

(c) Challenge any very large numbers (e.g. >$¼m in US) by asking "*To confirm your plant could spend $X on a new piece of equipment without prior clearance from CHQ?*"

(d) Use the national currency and do not omit zeros (i.e. for a U.S. firm twenty thousand dollars would be 20000).

Question D3: "*Where are decisions taken on new product introductions—at the plant, at the CHQ or both"*?

Probe until you can accurately score the question—for example if they say "*It is complex, we both play a role*," ask "*Could you talk me through the process for a recent product innovation?*"

	Score 1	Score 3	Score 5
Scoring grid:	All new product introduction decisions are taken at the CHQ	New product introductions are jointly determined by the plant and CHQ	All new product introduction decisions taken at the plant level

Question D4: "*How much of sales and marketing is carried out at the plant level (rather than at the CHQ)"*?

Probe until you can accurately score the question. Also take an average score for sales and marketing if they are taken at different levels.

	Score 1	Score 3	Score 5
Scoring grid:	None—sales and marketing is all run by CHQ	Sales and marketing decisions are split between the plant and CHQ	The plant runs all sales and marketing

Question D5: "*Is the CHQ on the site being interviewed"*?

Notes: The electronic survey, training materials and survey video footage are available on www.worldmanagementsurvey.com

Table A2 - Sales Growth (3 years Log change, 2006-2011) across countries

Country	Mean	Median	Standard Deviation	Number of Observations
France	-0.04	-0.05	0.12	201
Germany	-0.03	-0.04	0.14	381
Greece	-0.07	-0.07	0.13	318
Italy	-0.05	-0.04	0.12	133
Japan	0.02	0.03	0.09	192
Poland	-0.04	-0.04	0.14	277
Portugal	-0.04	-0.03	0.13	230
Sweden	-0.05	-0.04	0.11	395
UK	-0.12	-0.11	0.13	997
United State	-0.03	-0.02	0.15	188
Total	-0.06	-0.06	0.14	3312

Notes: The table reports the summary statistics of the 3 years firm level sales growth for the firm included in the main regression analysis broken down by country of firm location.

Table A3 - Sales Growth (3 years Log change, 2006-2011) top and bottom 10 industries

Industry (US SIC 3)	Industry name	Mean	Median	Standard Deviation	Number of Observations
Bottom 10 Industries					
339	**Miscellaneous Primary Metal Products**	-0.19	-0.15	0.09	9
239	**Miscellaneous Fabricated Textile Products**	-0.17	-0.17	0.13	16
229	**Miscellaneous Textile Goods**	-0.17	-0.11	0.18	17
271	**Newspapers: Publishing, Or Publishing And Printing**	-0.15	-0.13	0.10	12
379	**Miscellaneous Transportation Equipment**	-0.15	-0.06	0.24	6
249	**Miscellaneous Wood Products**	-0.15	-0.15	0.28	2
311	**Leather Tanning And Finishing**	-0.14	-0.17	0.15	6
274	**Miscellaneous Publishing**	-0.14	-0.15	0.10	5
331	**Steel Works, Blast Furnaces, And Rolling And Finishing Mills**	-0.13	-0.13	0.13	66
332	**Iron And Steel Foundries**	-0.13	-0.10	0.11	14
Top 10 Industries					
204	**Grain Mill Products**	0.00	0.00	0.11	32
233	**Women's, Misses', And Juniors' Outerwear**	0.02	0.03	0.02	3
328	**Cut Stone And Stone Products**	0.03	0.02	0.03	3
201	**Meat Products**	0.03	0.01	0.15	56
374	**Railroad Equipment**	0.04	0.01	0.16	13
211	**Cigarettes**	0.04	0.04	0.06	4
375	**Motorcycles, Bicycles, And Parts**	0.05	0.09	0.14	6
361	**Electric Transmission And Distribution Equipment**	0.06	0.00	0.15	24
222	**Broadwoven Fabric Mills, Manmade Fiber And Silk**	0.07	0.07		1
387	**Watches, Clocks, Clockwork Operated Devices, and Parts**	0.07	0.05	0.06	3
386	**Photographic Equipment And Supplies**	0.13	0.10	0.10	3
Total		-0.06	-0.06	0.14	3312

Notes: The table reports the summary statistics of the 3 years firm level sales growth for the firms included in the main regression analysis broken down by main industry of activity.

Table A4 - SHOCK measures across countries (means)

Type of indicator	Industry/country Exports (COMTRADE)		Industry/Country Sales (ORBIS)		Industry Durability	
	Dummy=1 if negative change	Change 08/09 relative to 06/07	Dummy=1 if negative change	Change 08/09 relative to 06/07	Dummy=1 if median durability>0	Median durability
France	0.15	0.10	0.48	0.02	0.69	10.41
Germany	0.06	0.12	0.61	-0.02	0.73	12.75
Greece	0.25	0.10	0.36	0.06	0.45	8.66
Italy	0.17	0.08	0.33	0.07	0.77	14.46
Japan	0.32	0.07	0.10	0.23	0.72	14.36
Poland	0.05	0.23	0.31	0.04	0.64	17.35
Portugal	0.13	0.17	0.37	0.06	0.69	15.02
Sweden	0.65	-0.03	0.80	-0.12	0.70	12.57
UK	0.97	-0.24	1.00	-0.38	0.75	12.47
United States	0.61	-0.02	0.52	0.01	0.87	11.02
Total	0.47	0.00	0.62	-0.09	0.71	12.72

Notes: The table reports the summary statistic of the measures used to proxy for the Great Recession Shock broken down by country.

Table A5 - Shock measures across industries - Top and Bottom 10 industries using Export Growth

Type of indicator		Industry/country Exports (COMTRADE)		Industry/Country Sales (ORBIS)		Industry Durability	
Industry (US SIC 3)	**Industry name**	**Dummy=1 if negative change**	**Change 08/09 relative to 06/07**	**Dummy=1 if negative change**	**Change 08/09 relative to 06/07**	**Dummy=1 if median durability>0**	**Median durability**
Bottom 10 Industries							
311		1.00	-0.45	1.00	-0.67	1.00	3.00
365		1.00	-0.37	1.00	-0.26	1.00	8.94
386		1.00	-0.36	1.00	-0.11	1.00	6.70
222		1.00	-0.31	1.00	-0.32	1.00	3.00
242		1.00	-0.29	1.00	-0.36	1.00	50.00
369		0.79	-0.26	0.87	-0.25	1.00	13.55
362		0.94	-0.25	0.94	-0.24	1.00	27.50
228		1.00	-0.25	1.00	-0.36	1.00	3.00
233		1.00	-0.23	0.00	0.42		
379		1.00	-0.20	1.00	-0.14	1.00	15.00
Top 10 Industries							
324		0.08	0.17	0.08	0.10	1.00	25.00
204		0.21	0.19	0.21	0.20	0.00	0.00
375		0.00	0.20	0.50	0.01	1.00	8.60
211		0.00	0.22	0.50	0.00	0.00	0.00
348		0.00	0.24	0.45	0.05	0.15	1.50
201		0.00	0.26	0.31	0.05	0.00	0.00
206		0.11	0.26	0.44	0.02	0.00	0.00
328		0.00	0.28	0.00	0.06	1.00	100.00
287		0.00	0.36	0.00	0.15	0.00	0.00
374		0.00	0.38	0.00	0.12	1.00	28.00
Total		0.47	0.00	0.62	-0.09	0.71	12.72

Notes: The table reports the summary statistic of the measures used to proxy for the Great Recession Shock broken down by main industry of activity.

Table A6 - Pairwise Correlations of SHOCK variables (p-values under coefficients)

Type of indicator	Industry/country Exports (COMTRADE)		Industry/Country Sales (ORBIS)		DURABILITY, Industry Durability	
	Dummy=1 if negative change	Change 08/09 relative to 06/07	Dummy=1 if negative change	Change 08/09 relative to 06/07	Dummy=1 if median durability>0	Median durability
COMTRADE, Dummy=1 if negative change	1.00					
COMTRADE, Change 08/09 relative to 06/07	-0.83 0.00	1.00				
ORBIS, Dummy=1 if negative change	0.48 0.00	-0.52 0.00	1.00			
ORBIS, Change 08/09 relative to 06/07	-0.60 0.00	0.63 0.00	-0.75 0.00	1.00		
DURABILITY, Dummy=1 if median durability>0	0.22 0.00	-0.29 0.00	0.22 0.00	-0.24 0.00	1.00	
DURABILITY, Median durability	0.02 0.33	-0.01 0.56	-0.02 0.33	-0.03 0.07	0.44 0.00	1.00

Notes: The table reports the paiwise correlations of the measures used to proxy for the Great Recession

Table A7 - Uncertainty measure (Standard deviation of monthly returns of CRSP firms total within industry year, 2008/2009 average)

Industry (US SIC 3)	Industry name	Mean	Median	Standard Deviation	Number of Observations
Bottom 10 Industries					
229		0.06	0.06	0.00	9
343		0.08	0.08	0.00	4
206		0.09	0.09	0.00	18
205		0.10	0.09	0.01	57
344		0.11	0.07	0.07	70
273		0.12	0.12	0.00	5
329		0.12	0.12	0.00	3
202		0.12	0.11	0.01	11
203		0.12	0.13	0.02	59
Top 10 Industries					
232		0.28	0.28	0.00	29
261		0.28	0.28	0.00	8
262		0.28	0.28	0.00	61
322		0.28	0.31	0.04	9
251		0.29	0.29	0.01	15
357		0.32	0.22	0.17	36
271		0.33	0.33	0.00	13
252		0.35	0.41	0.11	23
283		0.36	0.37	0.03	127
222		0.36	0.36	0.00	2
Total		0.20	0.20	0.07	3101

Notes: The table reports the summary statistic of the measures used to proxy for uncertainty after the Great Recession (2008 and 2009) broken down by industry of activity. Uncertainty is the industry (SIC4) average of the standard deviation of the monthly returns all CRSP firms within an industry, averaged across 2008 and 2009 CRSP data.

Table A8 - Decentralization and Growth - Robustness to using Continuous variables to express the Great Recession shock

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	**Sales Growth (3 years log change)**				
	Shock by Industry (SIC3) * Country			**Shock by Industry**	
Decentralization	-0.004	0.002	-0.005	-0.005	0.009**
	(0.006)	(0.004)	(0.005)	(0.005)	(0.004)
EXPORT SHOCK	0.016**				
	(0.008)				
Decentralization*EXPORT SHOCK (continuous)		0.038**			
		(0.018)			
Decentralization*SALES SHOCK (continuous)			0.054***		
			(0.014)		
Decentralization*DURABILITY (continuous)				0.005***	
				(0.002)	
Decentralization*EXPORT SHOCK AGG (continuous)					0.057***
					(0.021)
R-squared	0.276	0.312	0.311	0.239	0.226
Observations	3145	3060	3091	3145	3028
Number of firms	1432	1312	1279	1288	1312
Controls					
Country	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**
Industry (SIC3)	**y**	**y**			**y**
Industry by Country (SIC3)			**y**		
Industry (SIC4)				**y**	
Log firm and plant employment				**y**	**y**
Skills				**y**	**y**
Noise				**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4	SIC3

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns, except for column (6), clustered by SIC4. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is the opposite of real exports change in the SIC3 industry/country between 2008/09 (the main Great Recession years) and 2006/07 (the latest pre-Recession years). The variable "SALES SHOCK" is is the opposite of real sales change in the SIC3 industry/country between 2008/09 and 2006/07. The variable "DURABILITY" is the average durability of the goods produced in the SIC4. The variable "EXPORT SHOCK AGG" is the opposite of real exports change in the SIC3 industry between 2008/09 and 2006/07, with the average computed across all countries in the sample. Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree measured in 2006. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.

Table A9 - Decentralization and Growth - Robust to controlling for other industry level interactions

	(1)	(2)	(3)	(2)
Dependent Variable		**Sales Growth (3 years log change)**		
Decentralization	-0.004	-0.017	-0.007	-0.013
	(0.018)	(0.023)	(0.008)	(0.015)
Decentralization*EXPORT SHOCK	0.017**	0.016**	0.017**	0.016**
	(0.008)	(0.008)	(0.008)	(0.008)
Log(% employees with a college degree)	0.004	0.004	0.004	0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Log(employees)	-0.003	-0.003	-0.003	-0.003
	(0.005)	(0.005)	(0.005)	(0.005)
Decentralization*Asset tangibility	-0.009			
	(0.058)			
Decentralization*Inventory/Sales		0.062		
		(0.144)		
Decentralization*External finance dependency			-0.000	
			(0.016)	
Decentralization*Labor costs				0.036
				(0.077)
R-squared	0.304	0.304	0.304	0.304
Observations	3145	3145	3145	3145
Number of firms	1545	1545	1545	1545
Controls				
Country	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**	**y**
Log firm and plant employment	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**
Skills	**y**	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** significant at 5%; *** significant at 1%. All columns estimated by OLS. Standard errors under coefficient are clustered at the country/industry (SIC3) level in all columns. The dependent variable in all columns is the three years growth rate of firm sales measured in 2006, 2007 and 2009. The variable "Decentralization" is the z-scored average of four different z-scored measures of plant manager autonomy in a) hiring; b) capital investiments; c) product introduction; d) marketing and sales decisions, all measured in 2006. The sample includes only firms in which the plant manager is not the CEO of the firm, and is within 4 hierarchical levels from the CEO. The variable "EXPORT SHOCK" is a dummy taking value 1 if the SIC3 industry/country cell has experienced a drop in exports in 2008/09 (the main Great Recession years) compared to 2006/07 (the latest pre-Recession years). Asset Tangibility is the ratio of tangible assets, i.e. net property, plant and equipment, to total assets for the corresponding industry in the US over the period 1980-1989, computed at the ISIC 3 rev 1 level (inverse measure of credit constraints). Inventory/Sales is measured as the inventories to total sales for the corresponding industry in the US over the period 1980-1989 (measure of liquidity dependence). External finance dependency is measured as capital expenditures minus cash flow divided by cash flow for the corresponding industry in the US over the period 1980-1989 (measure of credit constraint). Labor cost is measured as the total labour costs to total sales for the corresponding industry in the US over the period 1980-1989 (another measure of liquidity dependence). Employment is the number of firm and plant level employees measured in 2006. Skills is the log of % of firm employees with a college degree. Noise controls include: the tenure of the plant manager in the company, the hierarchical seniority of the plant manager, analyst dummies, an interview reliability score assigned by the interviewer at the end of the interview, dummies for the day of the week in which the interview was conducted, the duration of the interview.