Never waste a good crisis? Growth and Decentralization in the Great Recession

Very Preliminary

Philippe Aghion*, Nicholas Bloom†, Raffaella Sadun‡& John Van Reenen§

August 21, 2014

Abstract

This paper argues that decentralization helps firms perform better, particularly in bad times. Our theoretical argument is that bad times increase the importance of rapid action, and improve the alignment of incentives between managers within firms. We test these ideas using 10 years of firm-level cross-country data from 2003-2011. We find that decentralization is positively correlated with sales and with TFP growth, particularly in times of crisis. This is particularly true when in firms where the CEO is offsite and the plant manager has shorter tenure - proxies for less alignment in incentives between managers. The correlation is also stronger in industries where the recession shock is combined with greater uncertainty, suggesting decentralization is particularly important in faster moving more unpredictable situations.

JEL No. O31, O32, O33, F23
Keywords: organization, decentralization, uncertainty, growth

*Harvard University, NBER and CEPR
†Stanford University, Center for Economic Performance, NBER and CEPR
‡Harvard University, Center for Economic Performance and NBER
§London School of Economics, Centre for Economic Performance, NBER and CEPR

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, 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 and uncertainty effect the growth performance of decentralized firms. This has particular relevance following the Great Recession, which generated a heated debate over how best to organize for recovery during an extreme crisis characterized by an extremely high degree of uncertainty.

One argument that was frequently heard is that centralized firms were the best equipped to survive the recession because of the importance of cost cutting, which because of conflicting interests in 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 this paper takes a two step approach. First, we build a stylized model of firm decision making with under decentralization, which allows for varying degrees of economic crisis and uncertainty. 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 economic uncertainty.

Starting with our model, this develops a dynamic version of the Aghion-Tirole (1997) - henceforth AT - model to capture the effects of uncertainty and bad shocks on the costs and benefits of delegation. A decision needs to be taken within a given time interval T by principal or his agent. The principal decides for how long (S) to look for the relevant information in

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

[2] For examples of these two different views points see X and Y.

order for him to take the decision; then he stops looking for the information and lets the agent decide in case she finds the relevant information between time S and time T. The principal seeks to maximize the monetary benefits from the firm whereas the agent seeks to maximize private benefits. The probability that the profit-maximizing action be the same as the action that maximizes the agent's private benefits, is denoted by α and it measures the degree of congruence between the principal's and the agent's preferences over actions. We assume that the agent loses all private benefits if the firm goes under. Also, with positive flow probability q the firm is hit by a bad shock, and conditional upon being hit by a bad shock, the firm goes under with some probability l if the non-profit maximizing action is taken, whereas it never goes under if the profit-maximizing action is chosen. At time zero the principal chooses the optimal stopping time S, with a higher S corresponding to a lower degree of decentralization (i.e. to more centralization).

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, as the more likely the bad shock, the more is congruence restored between the principal and the agent; second, the higher the degree of uncertainty (i.e. the lower T), the more desirable it is for the principal to delegate decision-making sooner to the agent (i.e. to lower S); third, that delegation be more performance-enhancing in bad times, is magnified when the firm faces higher (aggregate) uncertainty. Those are the predictions which we take to the data.

In the empirical part of the paper we construct a firm-level cross-country panel dataset. Our sample comprises 1312 firms from France, Germany, Greece, Italy, Japan, Poland, Portugal Sweden, the UK and the US over the period 2006-2008, delivering 3145 firm-year management observations. This is matched to detailed firm-level accounting data on sales growth and productivity, alongside data on industry uncertainty and the size of the

Great Recession shock.

Our empirics reveals four key results. First, decentralization is positively correlated with sales and with TFP growth, particularly in times of crisis. Second, the correlation between decentralization and sales/TFP growth is stronger in firms where the CEO is offsite and the plant manager has shorter tenure (congruence between principals and agents is presumably weaker in such firms). Third, the correlation is also stronger in industries where the recession shock is combined with greater uncertainty. Fourth, uncertainty per se does not seem to impact much on the effect of decentralization on firm performance·

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. 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 congruence between principals

[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

and agents by making it depend upon aggregate characteristics of the environment in which firms operate.

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 a positive correlation between decentralization and information technology. More recently, Bloom, Sadun and Van Reenen (2010) find a robust positive association between competition and decentralization using industry import competition, the inverse industry Lerner index or simply the number of perceived competitors. Similarly, 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). Also, Bloom, Sadun and Van Reenen (2013) examine the importance of culture, finding that higher levels of trust in the region where a plant is located is associated with 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 in this paper is Acemoglu, Aghion, Lelarge, Van Reenen and Zilibotti (2008). Their model also builds on AT, in that the owner of a firm can learn about the outcome of an investment decision from observing other firms in the same sector, or the information of downstream.

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.

The more precise the public information acquired through observing other firms in the same sector, the less a firm needs to delegate control to its better informed agent. Hence, in sectors with more heterogeneity, or where the firm is closer to the performance frontier, decision making control should be more decentralized. Using French and British firm level panel datasets, they show that delegation, is indeed correlated with intra-sector heterogeneity and with the firm's proximity to the technological frontier. But again that paper does not look at the relationship between decentralization and uncertainty, or exploit the natural variation in competitive conditions arising from the Great Recession.

The remaining part of the paper is organized as follows. Section 2 develops our theoretical model and derives its mains predictions. Section 3 presents the data and methodology. Section 4 presents 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 consider a continuous time 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

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

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 highly negative payoffs to the parties. Among these two actions, one maximizes monetary profitability (or efficiency) and if that action is taken the principal gets current (ex post) utility B;on the other hand, if the agent's preferred action is taken the agent's current private utility is $b + h$. 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. With probability $(1 - \alpha)$ the agent's preferred action (conditional upon the firm remaining in business) will yield utility zero to the principal while still yielding $b+h$ to the agent, and the action yielding monetary profit B to the principal will only yield private utility h to the agent. 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.

We denote by T the time horizon over which the payoff matrix - which describes the monetary and private payoffs from the n actions- remains constant. A lower T corresponds to a higher degree of volatility or uncertainty (or "urgency"). The agent has an informational advantage over the agent which we capture as follows. Once the payoff matrix changes the agents is informed at once about it (and information is soft). However, the principal takes time to learn the matrix: we denote by $F(\tau)$ the probability that the principal learn the payoff matrix by time τ, and $f(\tau)$ is the corresponding

density distribution. We also assume decreasing returns to the principal's learning process, namely $f(\tau)/(1-F(\tau))$ is decreasing in τ.

If the principal has control and gets the information about the payoff matrix at date t then the principal gets utility B flow from date t and until the termination date T. On the other hand at any time where the agent has control the principal gets an expected utility flow equal to ΩB.

The principal's problem consists in choosing an optimal stopping time $S \in [0,T]$ beyond which he will give up on acquiring the information about the payoff matrix and will instead defer the decision making process to the agent: as of time S production will start under the agent's control if by then the principal's investigation efforts have not paid out.

Thus, for given stopping rule S:

1. If the principal learns the payoff matrix before time S, then he gets flow utility B over the time interval $[t,T]$;

2. If by time S the principal has not learnt the payoff matrix, then the agent is in control and therefore the principal gets flow expected utility ΩB over the time interval $[S,T]$.

2.2 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 l if the non-profit maximizing action is taken, whereas it never goes under if the profit-maximizing action is chosen. Then, conditional upon a bad shock occurring, and in case the principal's and agent's preferences are not "notionally" congruent, yet the agent will choose the profit maximizing action whenever

$$h \geq (h+b)(1-l)$$

or

$$l \geq b/(b+h).$$

In other words, the probability of bankruptcy (if the profit-maximizing action is not chosen) and/or the agent's baseline private utility h from remaining on the job, need to be sufficiently large for the agent to choose the profit maximizing action when her preferences are not notionally congruent with the principal's preferences.

This yields

$$\Omega(q) = \alpha + (1-\alpha)q1_{(b/(b+h))}$$

where $1_{(b/(b+h))}$ is equal to one if $l \geq b/(b+h)$ and is equal to zero otherwise.

2.3 Solving the model

The optimal stopping rule maximizes firm profitability (i.e. firm performance) as measured by the expected monetary benefits:

$$\begin{aligned} u_P &= B\int_0^S (\frac{e^{-rt}-e^{-rT}}{r})f(t)dt \\ &\quad +\Omega(q)B(1-F(S))(\frac{e^{-rS}-e^{-rT}}{r}) \end{aligned}$$

Two cases must be considered:

Case 1: $l \geq b/b/(b+h)$ and $q > 0$:

In this case we have

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

and the first order condition for the optimal stopping rule when the solution is interior, becomes:

$$1 = \frac{f(S)}{1-F(S)}\frac{1-\Omega(q)}{\Omega(q)}(\frac{1-e^{-r(T-S)}}{r}). \tag{1}$$

Let

$$\begin{aligned}\theta(q) &= \frac{1-\Omega(q)}{\Omega(q)} = \frac{(1-\alpha)(1-q)}{\alpha+q(1-\alpha)} \\ g(S) &= \frac{f(S)}{1-F(S)}\end{aligned}$$

and let

$$L(S,T,q) = g(S)\theta(q)(\frac{1-e^{-r(T-S)}}{r}).$$

Equation (1) immediately implies that

$$\frac{dS}{dT} > 0$$

since the right-hand side of (1) is decreasing in S but increasing in T.

Moreover, by the implicit function theorem we have

$$\frac{dS}{dq} = -\frac{L_q}{L_S} = \frac{A}{B-\psi(S,T)}$$

where

$$\begin{aligned}A &= \theta'(q)/\theta(q) < 0; \\ B &= -g'(S)/g(S) > 0; \\ \psi(S,T) &= r\frac{e^{-r(T-S)}}{1-e^{-r(T-S)}}.\end{aligned}$$

For r sufficiently small

$$\frac{dS}{dq} < 0; \frac{d^2S}{dqdT} < 0.$$

The latter inequality results immediately from $\psi(S,T)$ being decreasing in T.

The first result says that the higher the probability of a (very) bad shock, the sooner will the principal will delegate control to the agent. The second result says that a higher probability of a (very) bad shock will lead to more delegation, all the more in a more volatile sector.

Note that a higher probability of a bad shock affects the optimal delegation (or decentralization) decision only when there is less than perfect congruence between the principal and the agent. In other words, higher likelihood of bad times makes decentralization more attractive to the principal only because it increases the degree of actual congruence between the principal and the agent, thereby reducing the potential loss to the principal from relinquishing control to the agent.

Case 2: $l < b/b/(b+h)$ or $q = 0$:

In this case actual congruence is equal to notional congruence, i.e. we have $\Omega = \alpha$, and the first order condition for the optimal stopping rule when the solution is interior, can be expressed as:

$$1 = \frac{f(S)}{1-F(S)} \frac{1-\alpha}{\alpha} (\frac{1-e^{-r(T-S)}}{r}),$$

which yields the comparative statics

$$\frac{\partial S}{\partial T} > 0; \frac{\partial S}{\partial \alpha} < 0.$$

The first comparative statics result says that the more volatility there is in the sector (or more "urgency"), i.e. the lower T, the sooner will the principal delegate to the agent, i.e. the lower S. The second comparative statics result says that the higher the degree of notional congruence α, the sooner will the principal delegate to the agent.

2.4 Wrapping up

The model thus predicts:

1. that the higher the probability of a bad shock, the more performance-enhancing it is for the principal to delegate

2. that the higher the degree of uncertainty, the more performance-enhancing it is for the principal to delegate

3. that delegation be more performance-enhancing in bad times, is even more true under higher uncertainty

These are the predictions we will now confront with cross-country firm-level evidence.

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 Surveying 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 summers of 2006 and 2008. 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 on quick 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 growth using accounting data extracted from Bureau Van Dijk's ORBIS. In our baseline specification we rely on 3 years growth rates running from 2006 to 2009 to span the Great Recession. But we also experiment with alternative timing assumptions, and whenever possible use multiple cross sections of accounting data for the same firm.

Given our interest in the relationship between decentralization and growth during the Great Recession, we restrict the sample to the 3-year differences between 2006-2009 and 2008-2011. We are able to build firm level measure of sales growth for at least one year for X out of the Y firms with decentralization data measures in 2006, and two years of more for X firms, while the sample decreases to X and Y firms respectively when we also control for

growth in capital, employment and materials.

Table X shows the basic summary statistics for the accounting data of the firms included in our sample. On average, sales declined by X% in the time period 2006-2011. The drop was larger in country X and industries Y. [need to fill in]

3.3 Measuring uncertainty

To measure industry by year uncertainty we use the average stock-market volatility of all US firms in the relevant 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)[6]. The reason stock-market volatility is for frequently used to proxy for uncertainty, is by capturing the rate of change of future expectations of firm stock-market valuations it is theoretically grounded in a stock-volatility setting, as well as being empirically informative about firms investment and hiring behavior. Our primary measure is the standard deviation of the monthly returns all CRSP firms within an industry-year, so that for example if there 10 firms in industry 2231 in the year 2001, our measure for that year would be the standard-deviation of their 120 monthly returns. Our secondary measure takes our industry-by-year mean returns to allow for potential differences in expected returns, to allow for example for some industries risk characteristics to change over time. In this case we demean by industry-year before calculating the standard-deviation.

3.4 Measuring the Great Recession

Our baseline measure of the intensity of impact of the Great Recession on an industry-by-country cell comes from the UN COMTRADE database of

[6] 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.

world trade. This is an international database of six-digit product level information on all bilateral imports and exports between any given pairs of countries. We aggregate COMTRADE data from its original six-digit product level to four-digit US SIC-1987 level using the Pierce and Schott (2010) concordance. For each 4-digit industry by country cell, we then calculate the change in exports (converted into real 2010 dollars) between the time periods 2006 and 2009.

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 X). Again, for each 4-digit industry by country cell we calculate the % change in sales over the relevant period.

Finally, given recessions have a greater impact on reducing the expenditure on durable versus non-durables 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 (). As a cross-sectional measure this is simply used at the 4-digit industry level. .

Table X shows the basic summary statistics of these alternative measures. [need to fill in with analysis of basic data]

- Top 5 and bottom 5 industries in terms of the shock
- Cross correlation of the different indicators
- Cross country correlations

4 Econometric results

The main result of our paper is illustrated in Figure X. This shows the average 3 years growth rate in sales, measured between 2006-2009 and 2008-2011 for the firms in our decentralization dataset. The sample is subdivided in four categories. First, we split firms according to whether they experienced a drop in industry/country exports in the Great Recessions years, defined

as average sales over 2008 and 2009 (the main Great Recession years) compared to 2006 and 2007 (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 graph shows, firstly, that not surprisingly all our groupings of firms experienced a drop in average sales after the Great Recession. Furthermore, the drop is clearly (and significantly) larger for firms classified in industries experiencing a decline in exports. Interestingly, within this group the decline in export is significantly larger for firms that were more centralized before the recession (XX, difference significant at the X level). The difference in differences in growth rates between the groups is X, significant at the X% level.

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

4.1 Main results

Our baseline specification is:

$$G_{i,j,c}^{t,t+1} = \alpha org_i^t + F_i + y_t + z_c + x_j + \varepsilon_{i,t},$$

where $G_{i,j,c}^{t,t+1}$ firm level, 3 years log growth rates in real sales for the years 2006-2009, 2007-2010 and 2008-2011; org_i^t is firm i's level of decentralization measured in 2006; F_i is a set of firm level controls measured in 2006 (employment, skills,..); y_t are year dummies; z_c are country dummies and x_j are 3 or 4 SIC level industry dummies. Standard errors are clustered at the industry or industry/country level, depending on the variables used to proxy for the Great Recession.

Table X shows the results of this regression starting from a simple specification including as additional controls only a full set of country, year and

three a positive and significant association between sales growth and decentralization in 2006. A one standard deviation increase in decentralization corresponds to a 0.007 increase in sales growth (standard error 0.003). In contrast, firms classified in countries and industries experiencing a decline in exports registered a 0.025 decline in sales growth, significant at the 1% level. In column (2) we introduce an interaction term between decentralization and the export shock indicator to test whether the effects of the Great Recession varied according to the pre-shock levels of decentralization. The interaction term is positive and significant (coefficient 0.012, standard error 0.005) [add calculations on magnitude of interaction using sample means]. In column 3 we add a full set of 4 digits industry dummies – this allows us to estimate the shock*decentralization coefficient only exploiting the within industry variation in the data. Even in this rather demanding specification, the interaction term is precisely estimated at is of similar magnitude (coefficient 0.016, standard error 0.007). In column (4) we further probe the robustness of the interaction term by adding a full set of firm level characteristics as additional controls (list here new covariates), leaving the coefficient on the interaction terms unchanged.

In columns (5) and (6) of Table 1, and in Appendix Table 1 we test the sensitivity of the result with respect to alternative ways of measuring the Great Recession. In column (5) we rely on an indicator measuring a drop in industry/country level aggregate sales derived from ORBIS using the same specification of column (4). The coefficient on the decentralization*shock interaction grows to 0.026, significant at the 1% level. We obtain very similar results in column (6), where we use as a proxy for the severity of the Great Recession the average durability on the goods produced in the SIC 4 industry. The idea is that this pre-determined industry characteristic is a good predictor of the severity of the Recession, providing exogenous cross-industry variation. Finally, in Appendix Table 1 we show that the results

are substantially unchanged when we adopt continuous measures (rather than indicator variables) of the intensity of the COMTRADE, ORBIS and durability as proxies for the Great Recession.

4.2 TFP

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 section we explore whether this relationship persists even when we examine a TFP specification, i.e. we estimate equation (X) controlling for simultaneous changes in employment, capital and materials. [here add reference to theories that would predict a negative relationship between decentralization and TFP during a crisis]

This analysis is presented in Table X. The sample for these regressions is smaller due to the lack of data on the additional inputs needed for the TFP specification. Column (1) shows that the crisis*decentralization is still positive and marginally significant even on this subsample. Column (2) shows that controlling for the growth rate of the other inputs leads to an increase in the coefficient of the interaction term, which now turns significant at the 5% level. Columns (3) and (4), and (5) and (6) repeat the same exercise using as proxies for the Great Recession, respectively, the change in industry sales from ORBIS and the durability index. The coefficient on the interaction terms drops from 0.046 (standard error 0.016) to 0.013 (0.008) using the ORBIS measure, and from 0.018 (0.011) to 0.009 (0.007) using the durability index.

Taken together, these results provide some support for the existence of a positive relationship between decentralization and TFP growth in times of a crisis.

4.3 Difference-in-Differences

So far we have shown evidence supportive of the fact that – consistent with the theory presented in Section X – more decentralized firms grew at a faster pace during the Great Recession. In this section we present an exactly robustness test relying on time-series variation in the impact of the Great Recession, to allay concerns this is picking up some other time-invariance industry characteristics. To allay this concern, in Table X we examine the relationship between sales growth and the crisis*decentralization interactions in a sample including years preceding the Great Recession. Column (1) shows that the crisis*decentralization coefficient is actually negative and insignificant in the years preceding the Great Recession, while Column (2) repeats the results of the specification of Table 1, column (4), finding as before a positive significant coefficient during the Great Recession. 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 the differences of differences specification. The coefficient on the crisis*decentralization*post 2006 interaction is 0.017, significant at the 10% level. In a similar spirit, in Appendix Table 2 we investigate the robustness of the main result to the introductions of other industry level characteristics interacted with the decentralization variable, again finding strongly results results.

4.4 Firm level heterogeneity

We also investigate whether the strength of the crisis*decentralization interaction varies in line with the theory discussed in Section X. According to proposition X [explain specific connection with the theory].

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 Table X, columns (2) and (3) show that – consistent with the theory - the magnitude of the crisis*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 crisis*decentralization interaction is about four times larger in plants where plant managers have been employed in the company for less than 5 years [need to revise this regression as the 5 years cutoff seems arbitrary].

Furthermore, we investigate whether the crisis*decentralization interaction capture the relevance of other firm level characteristics different from decentralization. For these purposes, in columns (6) to (9) we augment the specification with interactions terms between the Great Recession indicator and, respectively, the overall management quality of the firm (as measured in a separate part of the survey, see Bloom and Van Reenen 2007 for details), the percentage of employees with a college degree and the pre-recession size of the firm, measured in terms of full time employees. In all instances, the inclusion of these additional interaction terms are insignificant (with the exception of the crisis*management interaction, which is negative and significant at the 10% level) are insignificant and do not alter the overall magnitude and significance of the crisis*decentralization interaction.

4.5 Exploring the role of uncertainty

Finally, in Table (ZYX) we investigate the triple interaction of decentralization, the severity of Great Recession and uncertainty, to test the idea that

uncertainty particular valuable in more uncertain times when business conditions are particularly tough. Column (1) starts by replicating our baseline results from Table 2. Column (2) includes a control for levels of uncertainty and an interaction with decentralization, finding nothing significant. Column (3) contains are key triple interaction, finding that when uncertainty is high and industries are in tough conditions, that decentralized firms do significantly better, with a point-estimate of 0.329 (standard-error of 0.142) on our key interaction. Column (4) uses the alternative measure of uncertainty where we control for industry-by-year changes in average returns, again finding a similar result.

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. We test this idea by examining the response of a panel of firms in 10 OECD countries after Lehman's collapse which reduced demand across industries and countries in heterogeneous ways. Using survey data on organization and management between 2006 and 2011 we find that negative demand shocks hurt growth in centralized firms significantly more than in their decentralized counterparts. The theory predicts (and the data confirm) that decentralized firms should respond even more to the crisis when uncertainty increases. We show that the internal organization of firms has first order effects on growth.

6 References: Incomplete

References

[1] Acemoglu, D, Aghion, P, Lelarge, C, Van Reenen, J, and F. Zilibotti (2007), "Technology, Information, and the Decentralization of the Firm", *Quarterly Journal of Economics,* 122 (4), 1759-1799.

[2] Aghion, P. and J. Tirole (1997), "Formal and Real Authority in Organizations," *Journal of Political Economy*, 1–29.

[3] Bandiera, O., Barankay, I., and I. Rasul (2007), "Incentives for Managers and Inequality Among Workers: Evidence from a Firm Level Experiment," *Quarterly Journal of Economics*, 122 (2), 729–773.

[4] Bartelsman, E.J. and M. Doms (2000), "Understanding Productivity: Lessons from Longitudinal Microdata," *Journal of Economic Literature*, 38 (3), 569–594.

[5] Bloom, N. (2014), "Fluctuations in uncertainty", Journal of Economic Perspectives, 28(2), pp. 153-176.

[6] Bloom, N., Floettoto, M., Jaimovich, N., Saporta, I. and Terry, S. (2014), "Really Uncertain Business Cycles", Stanford mimeo.

[7] Bloom, N., Sadun, R., and J. Van Reenen (2010), "Does Product Market Competition Lead Firms to Decentralize?", *American Economic Review,* Papers and Proceedings, May edition.

[8] Bloom, N., Sadun, R., and J. Van Reenen (2013), "The Organization of Firms Across Countries", Quarterly Journal of Economics.

[9] Bloom, N. and J. Van Reenen (2007), "Measuring and Explaining Management Practices Across Firms and Countries", *Quarterly Journal of Economics*, 122(4), 1341-1408.

[10] Bresnahan, T.F., E. Brynjolfsson, and L.M. Hitt, "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence," *Quarterly Journal of Economics*, 2002, *117* (1), 339–376.

[11] Caroli, E., and J. Van Reenen (2001), "Skill Biased Organizational Change", *Quarterly Journal of Economics*, 116(4), 1449-1492.

[12] Dessein, W (2002), "Authority and Communication in Organizations", *Review of Economic Studies*, 69 (4), 811.

[13] Grossman, S., and O. Hart (1986), "The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration," *Journal of Political Economy*, 691–719.

[14] Guadalupe, M. and J. Wulf (2010), "The Flattening Firm and Product Market Competition: The Effect of Trade Liberalization on Corporate Hierarchies," *American Economic Journal: Applied Economics*, 2 (4), 105–127.

[15] King, R.G. and Rebelo, S.T. (1999), "Resuscitating Real Business Cycles", in Handbook of Macroeconomics, John B. Taylor and Michael Woodford (eds.), Elsevier.

[16] Leahy, J. and Whited, T. (1996) "The Effects of Uncertainty on Investment: Some Stylized Facts", Journal of Money Credit and Banking, 28, 64-83.

[17] Hart, O. (1983), "The Market Mechanism as an Incentive Scheme", *Bell Journal of Economics,* 14 (2), 366-382.

[18] Hart, O., and J. Moore (2005), "On the Design of Hierarchies: Coordination versus Specialization," *Journal of Political Economy,* 113, 675-702

[19] Pierce, Justin and Peter Schott (2010) "Concording US Harmonized System Codes Over Time", Mimeo, Yale University.

[20] Rajan, R.G. and J. Wulf, "The flattening firm: Evidence from panel data on the changing nature of corporate hierarchies," *Review of Economics and Statistics*, 2006, *88* (4), 759–773.

[21] Schmidt, K. (1997), "Managerial Incentives and Product Market Competition", *Review of Economic Studies,* 64 (2), 191-213

Figure 1 - Change in Sales by Shock and Decentralization

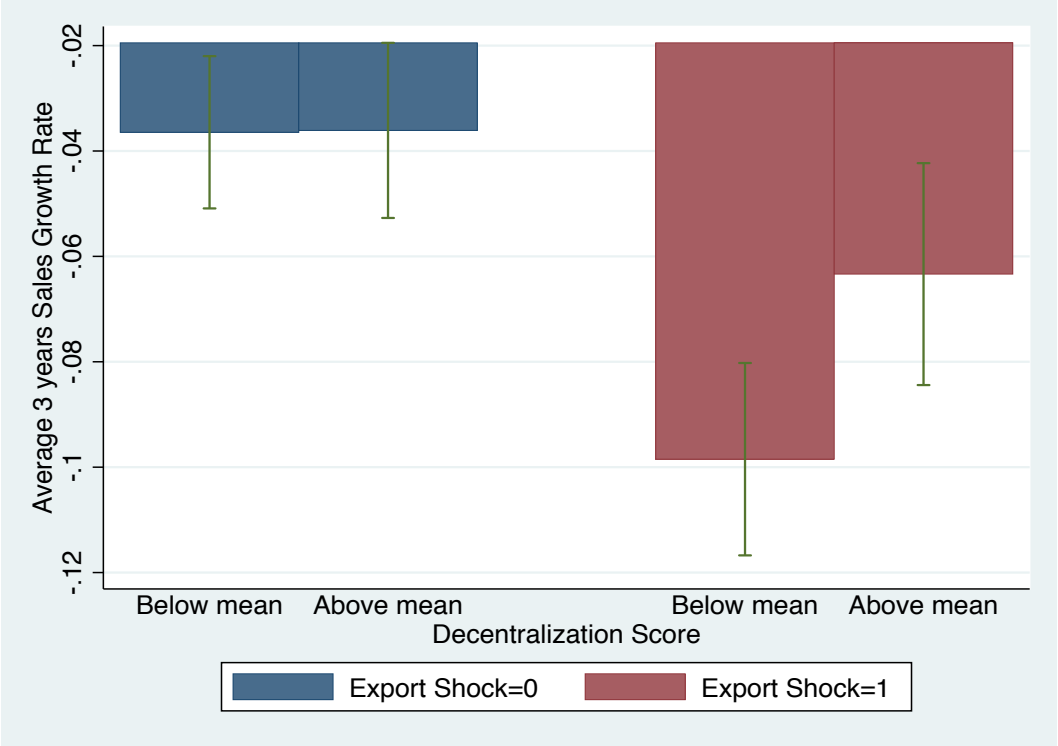


Table 1 - Decentralization and Sales Growth - Driven by bad shock industries, robust to alternative ways of expressing the shock

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Sales Growth (3 years log change)**					
	Shock by Industry (SIC3) * Country					**Shock by Industry (SIC4)**
Decentralization (z-scored)	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 dummy COMTRADE (dummy - SIC3 industry country aggregate)	-0.025***	-0.024***				
	(0.008)	(0.008)				
Decentralization*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)		0.012**	0.016**	0.017**		
		(0.005)	(0.007)	(0.008)		
Decentralization*Industry Output Shock ORBIS (dummy - SIC3 industry country aggregate)					0.026***	
					(0.008)	
Decentralization*Durability (dummy - SIC4 industry aggregate)						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	1545	1545	1545	1545	1545	1545
Controls						
Country	**y**	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**	**y**
Industry	**y**	**y**				**y**
Industry by Country			**y**	**y**	**y**	
Log employment at time t				**y**	**y**	**y**
Skills				**y**	**y**	**y**
Noise				**y**	**y**	**y**
Industry (SIC4)						
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4

Table 2 - Decentralization and TFP Growth - Driven by bad shock industries, robust to alternative ways of expressing the shock

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	**Sales Growth (3 years log change)**					
Decentralization (z-scored)	-0.009	-0.005	-0.017*	-0.006	-0.012	-0.007
	(0.009)	(0.005)	(0.009)	(0.007)	(0.010)	(0.006)
Decentralization*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)	0.038*	0.017**				
	(0.023)	(0.007)				
Decentralization*Industry Output Shock ORBIS (dummy - SIC3 industry country aggregate)			0.046***	0.013*		
			(0.016)	(0.008)		
Decentralization*Durability (dummy - SIC4 industry aggregate)					0.018	0.009
					(0.011)	(0.007)
Employees Growth (3 years log change)		0.177***		0.181***		0.167***
		(0.041)		(0.041)		(0.026)
Capital Growth (3 years log change)		0.058***		0.056***		0.045***
		(0.018)		(0.018)		(0.016)
Materials Growth (3 years log change)		0.678***		0.673***		0.683***
		(0.044)		(0.045)		(0.040)
R-squared	0.361	0.853	0.378	0.854	0.274	0.851
Observations	1125	1125	1112	1112	1107	1107
Number of firms						
Controls						
Country	**y**	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**	**y**
Industry					**y**	**y**
Industry by Country	**y**	**y**	**y**	**y**		
Skills	**y**	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**	**y**
Industry (SIC4)						
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4	SIC4

Table 3 - Decentralization and Growth - Placebo experiment

	(1)	(2)	(3)
Dependent Variable	**Sales Growth (3 years log change)**		
Sample	**Year<=2004**	**Year>=2006**	**All**
Decentralization (z-scored)	0.005	-0.007	0.007
	(0.006)	(0.007)	(0.005)
Decentralization*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)	-0.008	0.017**	-0.004
	(0.008)	(0.008)	(0.007)
Dummy=1 if year>=2006			-0.221***
			(0.036)
Dummy=1 if year>=2006*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)			-0.048***
			(0.012)
Dummy=1 if year>=2006*Decentralization (z-scored)			-0.015**
			(0.007)
Dummy=1 if year>=2006*Decentralization (z-scored)*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)			0.017*
			(0.009)
R-squared	0.321	0.304	0.440
N	3009	3145	6154
Controls			
Country	**y**	**y**	**y**
Year	**y**	**y**	**y**
Log employment at time t	**y**	**y**	**y**
Noise	**y**	**y**	**y**
Skills	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty

Table 4 - Decentralization and Growth - Robust to controlling for other interactions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	**Sales Growth (3 years log change)**							
	Baseline	**CEO onsite**	**CEO offsite**	**Plant Manager Tenure>=5 years**	**Plant Manager Tenure<5 years**			
Decentralization (z-scored)	-0.007	-0.005	-0.034**	-0.004	-0.044**	-0.010	-0.007	-0.010
	(0.007)	(0.009)	(0.015)	(0.008)	(0.018)	(0.007)	(0.007)	(0.007)
Decentralization*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)	0.017**	0.016	0.051***	0.016*	0.066***	0.021**	0.017**	0.019**
	(0.008)	(0.011)	(0.018)	(0.009)	(0.023)	(0.008)	(0.008)	(0.009)
Log(% employees with a college degree)	0.004	0.005	-0.001	0.004	0.001	0.004	0.004	0.006
	(0.004)	(0.004)	(0.007)	(0.004)	(0.011)	(0.004)	(0.004)	(0.008)
Log(employees)	-0.003	-0.007	-0.000	0.004	-0.001	-0.004	0.001	-0.001
	(0.005)	(0.006)	(0.011)	(0.007)	(0.014)	(0.005)	(0.006)	(0.006)
Management (z-scored)						0.012*		
						(0.006)		
Management*Export Shock dummy COMTRADE (dummy - SIC3 industry country aggregate)						-0.014*		
						(0.008)		
Log(% employees with a college degree)*Export Shock COMTRADE (dummy - SIC3 industry country agg							-0.007	
							(0.009)	
Log(employees)*Export Shock COMTRADE (dummy - SIC3 industry country aggregate)								-0.000
								(0.009)
R-squared	0.304	0.328	0.371	0.314	0.421	0.306	0.303	0.302
N	3145	2236	905	2379	758	3145	3144	2813
Controls								
Country	**y**	**y**	**y**	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**	**y**	**y**	**y**
Log employment at time t	**y**	**y**	**y**	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**	**y**	**y**	**y**
Skills	**y**	**y**	**y**	**y**	**y**	**y**	**y**	**y**
Industry by Country (SIC3)	**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

Table 5 - Decentralization and Growth - Effect is stronger in industry with bad shock AND greater uncertainty (robust to alternative uncertainty measures)

	(1)	(2)	(3)	(4)	(5)
Dependent Variable			**Sales Growth (3 years log change)**		
Decentralization (z-scored)	-0.006	-0.002	0.022	0.020	-0.001
	(0.008)	(0.017)	(0.020)	(0.020)	(0.012)
Decentralization*Export Shock (dummy - SIC3 industry country aggregate)	0.020**	0.021**	-0.038	-0.035	0.018
	(0.009)	(0.009)	(0.027)	(0.027)	(0.015)
Uncertainty post crisis1 (continuous)		-0.130	-0.199		
		(0.125)	(0.185)		
Uncertainty post crisis1 (continuous)*Decentralization		-0.028	-0.167*		
		(0.078)	(0.100)		
Uncertainty post crisis1 (continuous)*Export Shock (dummy - SIC3 industry country aggregate)			0.085		
			(0.239)		
Uncertainty post crisis1 (continuous)*Decentralization*Export Shock (dummy - SIC3 industry country aggregate)			0.329**		
			(0.142)		
Uncertainty post crisis2 (continuous)				-0.198	
				(0.178)	
Uncertainty post crisis2 (continuous)*Decentralization				-0.154	
				(0.095)	
Uncertainty post crisis2 (continuous)*Export Shock (dummy - SIC3 industry country aggregate)				0.092	
				(0.235)	
Uncertainty post crisis2 (continuous)*Decentralization*Export Shock (dummy - SIC3 industry country aggregate)				0.304**	
				(0.137)	
Uncertainty post crisis3 (continuous)					-0.319
					(0.389)
Uncertainty post crisis3 (continuous)*Decentralization					-0.146
					(0.228)
Uncertainty post crisis3 (continuous)*Export Shock (dummy - SIC3 industry country aggregate)					0.710
					(0.778)
Uncertainty post crisis3 (continuous)*Decentralization*Export Shock (dummy - SIC3 industry country aggregate)					0.075
					(0.313)
R-squared	0.316	0.316	0.317	0.317	0.315
N	2611	2611	2611	2611	2611
Controls					
Country	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**
Log employment at time t	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**
Skills	**y**	**y**	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

NOTE: RESULTS WEIGHTED BY NUMBER OF FIRMS IN COMPUSTAT CELL

Table 6 - Robustness on Decentralization, Shock & Uncertainty (using alternative ways to express the shock, including durability)

	(1)	(2)	(3)	(5)	(9)
	Sales Growth (3 years log change)				
Shock indicator	Comtrade, Industry*cty, dummy			Orbis, Industry*cty, dummy	Durability, Industry, dummy
Decentralization (z-scored)	0.022	0.015	0.004	0.030	0.014
	(0.020)	(0.016)	(0.013)	(0.019)	(0.013)
Decentralization*Shock	-0.038	0.009	-0.010	-0.052**	-0.002
	(0.027)	(0.025)	(0.016)	(0.026)	(0.021)
Uncertainty post crisis1 (continuous)	-0.199			-0.003	
	(0.185)			(0.134)	
Uncertainty post crisis1 (continuous)*Decentralization	-0.167*			-0.248**	-0.080
	(0.100)			(0.101)	(0.078)
Uncertainty post crisis1 (continuous)*Shock	0.085			-0.212	
	(0.239)			(0.250)	
Uncertainty post crisis1 (continuous)*Decentralization* Shock	0.329**			0.436***	0.065
	(0.142)			(0.136)	(0.119)
Uncertainty before crisis1 (continuous)		-0.262			
		(0.185)			
Uncertainty before crisis1 (continuous)*Decentralization		-0.190			
		(0.123)			
Uncertainty before crisis1 (continuous)*Shock		0.406			
		(0.343)			
Uncertainty before crisis1 (continuous)*Decentralization* Shock		0.107			
		(0.189)			
Change in uncertainty 1			-0.004		
			(0.229)		
Change in uncertainty 1 *Decentralization			-0.153		
			(0.143)		
Change in uncertainty 1 *Shock			-0.163		
			(0.292)		
Change in uncertainty 1 *Decentralization*Shock			0.416**		
			(0.181)		
R-squared	0.317	0.316	0.318	0.323	0.238
N	2611	2608	2608	2580	2522
Controls					
Country	**y**	**y**	**y**	**y**	**y**
Year	**y**	**y**	**y**	**y**	**y**
Log employment at time t	**y**	**y**	**y**	**y**	**y**
Noise	**y**	**y**	**y**	**y**	**y**
Skills	**y**	**y**	**y**	**y**	**y**
Industry by Country (SIC3)	**y**	**y**	**y**	**y**	
Industry (SIC4)					**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC4