Turbulence, Firm Decentralization and Growth in Bad Times

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Abstract

What is the optimal form of firm organization during "bad times"? Using two large micro datasets on firm decentralization from US administrative data and 10 OECD countries, we find that firms that decentralized power from the Central Headquarters to local plant managers prior to the Great Recession out-performed their centralized counterparts in sectors that were hardest hit by the subsequent crisis. We present a model where higher turbulence benefits decentralized firms because the value of local information and urgent action increases. Since turbulence rises in severe downturns, decentralized firms do relatively better. We show that the data support our model over alternative explanations such as recession-induced reduction in agency costs (due to managerial fears of bankruptcy) and changing coordination costs. Countries with more decentralized firms (like the US) weathered the 2008-09 Great Recession better: these organizational differences could account for about 16% of international differences in post-crisis GDP growth.

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1 Introduction

What makes firms more resilient to large negative macro shocks? A recent literature has focused on firms' governance and financial and technological choices as possible factors affecting their ability to cope with sudden changes in external conditions, but much less is know about the role of firm organization. This paper focuses on how a specific organizational aspect of a firm - the extent to which decision-making is decentralized down from headquarters to plant managers - affects performance during an economic crisis. This has particular relevance following the Great Recession of 2009-08, which generated a debate over how best to organize for "recovery and survival". One common argument (the "Tsarist view") is that centralized firms were best equipped to survive the recession because of the importance of cost cutting which, due to conflicting interests within the firm, is best directed from corporate headquarters.[1] An alternative, "Localist view" is that recessions are periods of rapid change, and being decentralized provides firms with the necessary flexibility to respond to turbulent business conditions.[2]

To investigate these issues, we build two new panel datasets with explicit measures of decentralization measured prior to the Great Recession. One has firm level data across ten OECD countries (France, Germany, Greece, Italy, Japan, Poland, Portugal Sweden, the UK and US), the World Management Survey (WMS). The other is a larger dataset that we constructed in partnership with the US Census, called the Management and Organizational Practices Survey (MOPS). We combine these datasets with firm and plant performance data before and after the 2009-08 crisis.

We find compelling evidence that in sectors that were exogenously hit harder by the crisis, decentralized firms outperformed their centralized rivals in terms of survival chances as well as in their growth of sales, productivity and profits. We use both export data in the industry by country cell and a pre-recession measure of product durability to measure the shock (durable goods

[1] For example, the Economist Intelligence Unit (June 2009) wrote: "Firms should be centralizing their decision-making processes.....In a recession investments and other decisions are scrutinized more carefully by senior management and a greater emphasis is placed on projects that provide benefits across the enterprise rather than individual units." See also 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/.

[2] For example, the Economist Intelligence Unit (August 2009) wrote: "Companies have to deal with dramatically more uncertainty, complexity and ambiguity in the current recession. Success does not come from centralization. True flexibility arises when those who are closest to customers are empowered to respond to constant shifts in demand, preferences and attitudes." See also http://graphics.eiu.com/marketing/pdf/SAS_DecisionMaking.pdf

industries suffer more in recessions as consumers can postpone purchases). These findings are robust to placebo tests, a wide range of controls, and an IV strategy exploiting the fact that trust around the headquarters predicts whether a firm decentralizes (see Bloom, Sadun and Van Reenen, 2012).

In order to understand the stylized fact that decentralized firms do relatively better in "bad times", we develop a model of firm decision-making building on the Aghion and Tirole (1997) approach. The model generates the prediction that to the extent they increase turbulence, recessions make decentralization more attractive by enabling firms to better adapt to the turbulent business environment. This result is akin to those emerging from a wide class of models where higher turbulence and uncertainty increase the value of local knowledge and the benefits of decentralization.

Consistent with our model, we show that our empirical results are driven by the fact that the industries which had the most severe downturns during the Great Recession also had the largest increase in turbulence, as measured by product churn. This novel industry level measure of product churn is the rate of new product additions and subtractions built from the Census of Manufacturing micro-data. As shown in Bernard and Okubo (2015), product churn rises sharply during recessions - in a crisis firms both destroy more existing products and also create more new products.[3] Using this measure on the US Census data, we find that decentralization did not significantly protect firms from the downturn in industries which had a bad shock, but no increase in product churn. We validate these results using an alternative measure of turbulence based on the stock market volatility which is available for the international WMS sample as well as US MOPS. Alternative explanations of our results based on reduced agency problems, financial conditions, lower coordination costs, omitted variables and other factors do not seem so consistent with the data.

Overall, our paper suggests that the internal organization of firms may serve as an important mediating factor through which macroeconomic shocks affect firm performance and, ultimately, growth.

Our paper builds on an extensive prior literature. On the theory side, our paper relates to

[3] Bloom (2014) shows a large variety of datasets that suggest that turbulence and uncertainty rise in downturns. Broda and Weinstein (2010)use scanner data in 1994 and 1999-2001 to shows that net product creation is pro-cyclical. Our product churn measure is built on data from 2012-1997 and reflects both creation and destruction and exploits the variation in this across industries.

the literature on decentralization within the firm (see Gibbons, Matouscheck and Roberts, 2013, or Garicano and Rayo, 2016 for recent surveys) and incomplete contracts (see Aghion, Bloom and Van Reenen, 2014, for a survey). In particular, Hart and Moore (2005) analyse the optimal allocation of authority in multi-layer hierarchies. 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]

Our paper also relates to the existing empirical literature on decentralization and its determinants. For example, Rajan and Wulf (2006) and Blundell et al (2016)document the a movement towards flatter organizations and decentralized firms in the US and UK respectively. 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 and this caused greater delayering and decentralization. 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/turbulence 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 the cross section in French and British firm level data. But none of these papers looks at the interplay between firm decentralization, shocks and turbulence.

The paper is organized as follows. Section 2 presents the data and methodology. Section 3 establishes our main empirical finding that in times of crisis decentralized firms outperform their centralized counterparts. Section 4 develops a theoretical model which is consistent with this finding and Section 5 tests the additional predictions of the model. Section 6 explores the validity of the main results to alternative explanations and Section 7 concludes.

[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.

2 Data Description and Measurement

We start by describing in some detail our decentralization data since this involved an extensive new survey process. We then describe the accounting and administrative data matched with the survey-based measures of decentralization, the proxies measuring the severity of the Great Recession and the novel industry level measures of product churn.

2.1 Decentralization

2.1.1 Cross-country data - World Management Survey

Our international decentralization data was collected in the context of the World Management Survey (WMS), a large scale project aimed at collecting high quality data on management and organizational design across firms around the world. The survey is conducted through an interview with a plant manager in medium sized manufacturing firms.[5]

We asked four questions on decentralization from the central headquarters to the local plant manager. 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.[6] We also inquired on where decisions were effectively made in three other dimensions: (a) the introduction of a new product, (b) sales and marketing decisions and (c) hiring a new full-time permanent shop floor employee. 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 question to mean zero and standard deviation one. We then average across all four z-scores and then z-score the average again to have 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

[5] We exclude those firms where the CEO and the plant manager is the same person (this occurred in under 5% of our interviews).

[6] One reason that the main regressions control for size is that the value of this question might be mechanically greater for larger firms and plants.

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, the gender and age breakdown within the firm).

We attempt to achieve unbiased survey responses to our questions by taking 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 introduce a new product, what agreement would your plant need from corporate headquarters?"), rather than closed questions (e.g. "Can you introduce new products without authority from corporate headquarters?" [yes/no]) (see question in A1). Second, the interviewers did not know anything about the firm's financial information or performance in advance of the interview.[7] 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 250 employees) are too small to attract much coverage from the business media. 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, 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.

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 50 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

[7] 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).

country to be representative of medium sized manufacturing firms and then randomly chose the order of which firms to contact (see Appendix A for details).

Each interview took on average 48 minutes and the main wave was run in the summer of 2006. We achieved a 45% response rate, which is very high for company surveys, because the interview did not discuss firm's finances (we can obtain these externally), we had the written endorsement of many official institutions like the Bundesbank, Treasury and World Bank, and we hired high quality MBA-type students.[8]We also ran some follow up surveys in 2009 and 2010 following the same firms sampled in 2006 to form a panel which we use to look at changes in decentralization.

2.1.2 U.S. Census data - MOPS

The 2010 Management and Organizational Practices Survey (MOPS) was jointly funded by the Census Bureau and the National Science Foundation as a supplement to the Annual Survey of Manufactures (ASM). The design was based on the World Management Survey and was mailed to the establishment plant manager (see Bloom et al. 2016). The survey contained six questions on decentralization with four of these covering the same domain as WMS - plant manager autonomy over (a) capital investments, (b) hiring of full time employees, (c) product introduction and (d) sales and marketing - with two additional question on e) pay increases of at least 10%, and (f) product pricing decisions. For each question, respondents were asked to choose among three options capturing where the specific decisions were made: "only at this establishment" (coded as 3), "only at headquarters" (coded as 1), or "both at this establishment and at headquarters" (coded as 2). There were five choices for the question on autonomy in capital investments, starting with "Under $1,000" (coded as 1) up until "$1 million or more" (coded as 5). Each of these six questions was then z-scored, and then averaged, and then z-scored again. The survey also included the management questions described in Bloom and Van Reenen (2007), and some background

[8] As a check of potential survey bias and measurement error we performed repeat interviews on 72 firms in 2006, 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), with 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.

questions on the establishment and respondent.[9] **??** shows how our various samples are derived from the universe of establishments.

The MOPS survey was sent to all ASM establishments in the ASM mail-out sample. Overall, 49,782 MOPS surveys were successfully delivered, and 37,177 responses were received, yielding a response rate of 78%. The Organization Module of MOPS is only for plants where headquarters is off site - plants with headquarters on site are told to skip this section - which takes the sample to about 20,000 plants. We further require the sample to match to the 2006 ASM and 2009 ASM to calculate the main dependent variable (growth in sales) which brings the sample down to about 8,774 plants. Table **??** shows how our various samples are derived from the universe of establishments.

2.2 Accounting data

2.2.1 Cross-country WMS data

We build firm level measures of sales, employment, capital, profits and materials using accounting data extracted from Bureau Van Dijk's ORBIS. These are electronic versions of company accounts covering very large samples (close to the population in most of our countries) of private and publicly listed firms. In our baseline specifications we estimate in three-year (annualized) growth rates. We are able to build firm level measure of sales growth for at least one year for 1,330 out of the 2,351 firms with decentralization data in 2006. [10]

2.2.2 U.S. MOPS data

In addition to our decentralization data we also use data from other Census and non-Census data sets to create our measures of performance (growth in sales, productivity, and profitability). We use establishment level data on sales, value-added and labor inputs from the ASM to create measures of growth and labor productivity. As described in detail in the Appendix, we also combine capital stock data from the Census of Manufactures (CM) with investment data from the ASM and apply perpetual inventory method to construct capital stocks at the establishment level which we use to

[9] The full questionnaire is available on http://www.census.gov/mcd/mops/how_the_data_are_collected/MP-10002_16NOV10.pdf.

[10] The majority of firms without any sales data are located in the US (348 firms) where the reporting requirements for privately listed firms are weak.

create measures of total factor productivity. Finally, for profitability we use profits as a percent of capital stock, with profits defined as sales less total salaries and wages, material costs, and rental expenses.

2.3 Measuring the Great Recession

Our baseline measure of the intensity of impact of the Great Recession ("SHOCK") at an industry by country cell level 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 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. We deflate the industry and country specific export value series by a country and year specific CPI from the OECD to measure "real exports." [11]

Figure A1 shows the evolution of annualized export growth in the years preceding and during Great Recession using industry level data for all countries (for a total of 5,641 manufacturing sector by country cells). Exports were growing by about 13% in 2007 and 9% in 2008, and experienced a dramatic fall (-20%) in 2009 compared to 2008. Industry sales fell even faster than exports in 2008 and 2009. In the empirical analysis, we build empirical proxies for the Great Recession by averaging 2007 and 2006 (pre-recession) and 2009 and 2008 (in-recession) levels and calculate log differences between the two sub-periods for each three-digit industry by country cell.[12]

Since recessions typically have a greater impact on reducing the expenditure on durable versus non-durable goods (e.g. King and Rebelo, 1989) we use as an alternative variable to capture the intensity of the Great Recession shock the average durability of the goods produced in the industry, drawn from Ramey and Nekarda (2013). As a cross-sectional measure this is simply used at the 4-digit industry level, and is a continuous measure.[13]

[11] We find similar results using other measures of the shock (such as industry sales derived from aggregating firm level data in ORBIS), but trade data is attractive as it has a large external component driven by demand in world markets and is available at a detailed level for every country and industry in our sample.

[12] We also show robustness checks using discrete measure of $SHOCK$, in which we code an industry-country cell to be unity if exports fell over this period and zero otherwise.

[13] We also consider a discrete version using a dummy equal to 1 if the durability in the industry is greater than the median (and zero otherwise).

2.4 Descriptive Statistics

Table 1, Panel A contains some descriptive statistics from the WMS. The median (average) firm has 250 (574) employees and $67m ($184m) sales. Firm sales declined by about 6% per year over this time period (2011-2006). Panel B has the equivalent information from MOPS. Plants are similar to the WMS at the median (135 vs 150 in WMS) and mean (250 vs. 232 in WMS). MOPS firms are larger, however, with a mean employment of 6,833.

On average, exports fell in 51% of the industries in the sample. While the median growth rate of real exports across the whole sample is about -0.4% and -0.82% in the WMS and MOPS samples, respectively, the data shows considerable variation both within and across countries.

2.5 Measuring Turbulence: Product Churn

In the latter part of our empirical analysis, we also include changes in product churn in recession versus non recession years as a proxy for increases in market turbulence. Product churn is measured using data from the US Census Bureau's Census of Manufactures (CM). The CM, which is conducted in years ending in 2 and 7, asks manufacturing plants to list the value of annual shipments by 10-digit product code. Plants receive a list of all the product codes typically produced in their industry, along with corresponding descriptions of each code. Plants which produce products not listed on the form are instructed to write in the appropriate product code.

We then measure the amount of product churn at the plant level as the number of products added or dropped between the previous Census and the current Census, divided by the average number of products produced in both Censuses. That is, product churn for establishment i in year t is defined as:

$$\text{Product Churn}_{i,t} = \frac{\#\text{Products Added}_{i,t} + \#\text{Products Dropped}_{i,t}}{0.5\left(\#\text{ Products}_{i,t} + \#\text{Products}_{i,t-5}\right)} \tag{1}$$

Our measure of industry product churn is the average plant level product churn amongst all plants within an industry (three digit US SIC-1987) which produce at least 3 products. We restrict attention to plants with at least 3 products in order to reduce measurement error from product code misreporting.[14] Finally, in order to measure the *change* in product churn by industry during

[14] Establishments which produce the same portfolio of products in consecutive Censuses but misreport a product

the Great Recession, we calculate the change in product churn from 2007 to 2012 as industry-level product churn in 2012 minus industry-level product churn in 2007 (constructed from the 2007 and 2002 Censuses).

Note that the measure is based on plants who survived between Census years. We also constructed an alternative measure that included plants which died and entered between Census years in the construction of equation (1). In the robustness tests we report how this broader measure led to similar results.

2.6 Measuring Turbulence: Stock Market volatility

Since the product churn measure is available only for the MOPS sample, we also use as an alternative proxy for the increase in market turbulence a measure derived from the uncertainty literature. We measure the standard deviation in monthly firm-level stock market returns in an industry by year cell over population of publicly listed firms in each country. The stock returns measure of uncertainty is the most standard firm-level measure and similar to those used by Leahy and Whited (1996) for example. In a stochastic volatility model based on Dixit and Pindyck (1994) the variance of stock returns will be a good predictor of the underlying level of uncertainty. These measures are then used in changes dated as an alternative proxy for the increase in turbulence. In the US we pool at the SIC 3 digit level as there are about 2,000 publicly listed firms. In the other OECD countries there are fewer publicly listed firms so we construct the measure at the SIC 2 digit level.

3 Main results

3.1 Descriptive analysis of the main result

Our main empirical finding is illustrated in Figure 1, in which Panel A refers to the results using the cross country WMS data, and Panel B uses the US MOPS data. Panel A shows the annualized average three-year growth rate in sales for all firms included in the WMS decentralization sample computed using data ending in the years 2011, 2010 and 2009 (hence, averaging across three

code in one year will be incorrectly measured as having switched products. Product code misreporting is particularly problematic for establishments with 1 or 2 products, for whom a single reporting mistake would result in very high measured product churn. Our results are robust to using industries with plants with a lower cut-off of 2 or more products or a higher cut-off of 5 or more products.

different growth periods: 2011-08, 2010-07 and 2009-06).[15] These are all years covering the Great Recession.[16] Panel B shows sales growth for all plants in the MOPS decentralization sample (2009-06 growth rate). We exclude the 2011-08 and 2010-07 periods from the MOPS sample because the recession was over in the US in 2010.

The sample in Figure 1 is subdivided in four categories of firms. First, we split firms according to whether they experienced a drop in exports in an industry by country cell in the main Great Recession years (the 2008 and 2009 average) compared to the latest pre-recession years (2006 and 2007 average).[17] Second, we split firms by above/below the mean level of decentralization measured before the advent of the Great Recession. Not surprisingly, all our groupings of firms experienced a drop in average sales and furthermore, the drop in sales is clearly (and significantly) larger for firms classified in industries experiencing a negative export shock (compare the two bars on the right with the two on the left). However, within the group of firms experiencing a 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. In the WMS sample, for firms in an industry-country pair hit by a greater negative shock, decentralized firms had a 8.2% fall in sales compared to about 11.8% in the centralized firms, for a difference of 3.6 percentage points which is significant at the 5% level (compared to an insignificant difference of -0.1% in industries that did not experienced a shock). In the MOPS sample, the difference in differences is very similar at 3.5 percentage points, also significant at the 5% level.

The basic finding emerging from the raw data is that decentralization was associated with relatively better performance for firms facing the toughest environment during the crisis. We now turn to more formal tests of this basic result using alternative measurement strategies and controls for many other possible confounders.

[15] We use long differences to smooth over some of the transitory measurement error. The results are robust to choosing alternative methods of long differencing.

[16] 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, in Europe (where most of our WMS data is from) the crisis remained severe due to the Eurozone currency crisis and tough fiscal austerity policies through 2012.

[17] To be precise we first divide the value of nominal exports by a country and time specific CPI. We then construct average real exports in (i) 2009 and 2008 and (ii) 2007 and 2007. We then take the log difference between these two periods.

3.2 Baseline regression equation

Our baseline specification is:

$$\Delta \ln Y_{ijct} = \alpha DEC_{i0} + \beta(DEC_{i0} * SHOCK_{jc}) + \gamma SHOCK_{jc} + \delta x_{i0} + \theta_c + \phi_j + \tau_t + \varepsilon_{ijct} \quad (2)$$

where $\Delta \ln Y_{ijct}$ is the sales growth rate: the three year annualized change in ln(real sales) for firm (or plant) i in industry j in country c in end-year t.[18] DEC_{i0} is firm i 's level of decentralization (measured in the initial year of 2006 for WMS and 2005 for MOPS); $SHOCK_{jk}$ is our measure of the severity of the shock of recession in the industry-country cell; x_{i0} is a set of firm level controls also measured pre-recession (firm and plant size, survey noise 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 and the specific sample used. When we use export growth as a measure of the shock the key hypothesis we examine is whether $\beta < 0$, i.e. whether decentralized firms do relatively better in bad times. When we use product durability as a measure of the magnitude of the shock the equivalent hypothesis is that $\beta > 0$, as the more durable goods industries are expected to have the largest fall in demand.

Our underlying identification assumption in equation (2) is that in the pre-Great Recession period firms were in an initial equilibrium where they had adopted their optimal degree of decentralization (DEC_{i0}) based on their current and expected environment.[19] The $SHOCK_{jk}$ associated with the Great Recession was largely unexpected and since organizational form is likely subject to large adjustment costs firms cannot immediately respond by changing to the optimal form of organization (i.e. becoming more decentralized) in the new environment. Thus, DEC_{i0} can be considered weakly exogenous in equation (2) and we would expect decentralized firms to be at a relative advantage to their more centralized counterparts. We investigate the adjustment costs assumption by using repeat observations on decentralization for the same plants over time. We find decentralization to be highly persistent over the time in both the WMS and MOPS samples.[20] We

[18] As discussed above, for the long differences we are using the three overlapping time periods for WMS, but for MOPs we can only use one of these long differences, 2009-2006.

[19] We do not need to assume fully optimizing behavior in the pre-period, only that DEC_{i0} is weakly exogenous.

[20] We estimate that the annual AR(1) coefficient on decentralization as 0.965 in MOPs and 0.707 in WMS. The

also consider potential violations of these assumptions below (e.g. in sub-section 3.4), such as the presence of other unobservable correlated with DEC_{i0} that could cause firms to outperform in bad times.

3.3 Baseline results

Column (1) of Table 2 shows the results from estimating a simple specification including export growth as our recession shock indicator and a full set of country, year and three-digit industry dummies. A one percent increase in industry exports is associated with a significant 0.07 percentage point increase in sales growth. We also find a positive and weakly significant association between sales growth and decentralization in 2006. A one standard deviation increase in our decentralization index is associated with a 0.58 percentage point increase in sales growth (e.g. growth increases from say 2.0% a year to 2.6% a year). In column (2) we introduce an interaction term between decentralization and the export shock variable. The interaction term is negative and significant (0.042 with a standard error of 0.013), which indicates that decentralized firms shrank much less than their centralized counterparts when they were hit by a negative 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 did not grow significantly faster or slower in those sectors that had zero export growth.

The magnitudes of the coefficients are non-trivial. Consider a macro shock causing a 1% fall in exports. The coefficients in column (2) of Table 2 suggests that the sales of an average firm (with mean decentralization score of zero) will shrink three times as much as those of a decentralized firm (with a score one standard deviation above the mean).[21]Back of the envelope calculations also suggest that this matters at the macro-economic level. We can calculate how much of the post crisis differences in GDP growth performance are related to the different levels of cross-country decentralization (see Appendix B and Table A8). We calculate that greater decentralization in the

true persistence parameter is likely to lie between these as MOPs estimate is likely to be an over-estimate because of recall bias and the WMS is likely to be an underestimate because of classical measurement error. See Bloom, Sadun and Van Reenen (2016) for more structural estimation of adjustment costs in WMS also showing high degrees of persistence of organizational form.

[21] Assuming the effects were causal for illustrative purposes, the average firm will see a drop in sales of 0.062% (the coefficient on export growth) whereas the decentralized firm will see a fall in sales of just 0.020% (0.062 minus 0.042, the coefficient on the interaction).

US accounts for about 16% of America's superior GDP growth post 2012-2007 compared to the other OECD countries in our sample.[22]

Panel A of Figure 2 shows the implied marginal effect of decentralization on sales growth as a function of export growth. These plots are obtained using the coefficients reported in column (2) of Table 2. According to these estimates, decentralization has a positive association with sales growth in all industries experiencing country-industry export growth below 8%. This corresponds to two-thirds of the WMS sample in the post recession period, but only 12% of firms in the pre-recession periods (this is shown in Panel B of Figure 2). In other words, the positive association between decentralization and firm growth appear to be contingent on the wider demand conditions in the aggregate environment facing the firm, which in turn may be one of the possible reasons for the heterogeneous levels of decentralization observed in 2006.[23]

The recession shock measure is industry and country specific. Therefore, in column (3) of Table 2 we include a full set of industry dummies interacted with country dummies, as well as a set of other firm controls (measured in 2006). The linear export shock is absorbed by the industry by country dummies, but we can still identify the interaction of the shock with initial firm decentralization. Even in this demanding specification, the interaction between decentralization and the shock remains negative and significant, with a very similar magnitude to the previous column.[24]

A possible concern with the estimates is that the $SHOCK$ variable uses information dated over the same period as the dependent variable, which may give raise to an endogeneity bias. Consequently, we test for the robustness of the main results using as a proxy for the intensity of the Great Recession a measure of the durability of the products in the four-digit industry calculated prior to the recession. We include a full set of four-digit industry dummies to absorb the linear

[22] This fraction rises to 32% if we drop Sweden. Sweden is the only country in our sample to have a higher average decentralization score than the US. Since it had a worse growth performance, we estimate a big negative contribution, pulling down the cross country explanatory power of decentralization.

[23] In other work done using the WMS data (Bloom, Sadun and Van Reenen, 2012) we discuss other drivers of cross country and cross regional differences in decentralization across firms, focusing in particular on cultural factors. We exploit this source of variation in an instrumental variable approach discussed below.

[24] Other measures of the demand shock give similar qualitative results to using exports. For example, using industry output built from aggregating the ORBIS population data in the same way as exports (across the three digit industry by country cell between the 2009-08 and 2007-06 periods) generates a coefficient (standard error) on the interaction term of 0.060 (0.015).

effects in column (4). Consistent with the earlier results, the interaction between decentralization and the $SHOCK$ is positive (since more durable industries experienced greater drops in demand during the recession) and significant.[25]

Columns (5) and (6) of Table 2 repeat the specifications of columns (3) and (4) using the MOPS sample. Remarkably, although drawn from a distinct dataset, a single country (US)and different survey methodology, the results in this larger sample of plants are extremely similar to the ones reported using the cross country WMS data. The coefficients on the interaction terms are of the same sign, statistically significant and of a broadly comparable magnitude.

The results discussed so far suggest the presence of a positive relationship between firm sales growth and decentralization in the aftermath of the Great Recession. In Table 3 we explore whether this relationship persists even when we examine Total Factor Productivity (TFP), i.e. we estimate the most general econometric model of Table 2, column (3) but also control for increases in other inputs such as employment, capital and materials on the right hand side of the equation. As discussed in the introduction, some have argued that firms need to centralize during crises, so tough cost controls and efficiency-enhancing measures can be driven down throughout the company. This would imply that although decentralized firms may fare better on protecting sales revenue during downturns, they will do worse in terms of productivity.

Column (1) of Table 3 reports the baseline results for sales growth on the subsample of firms with data on inputs needed for TFP, while column (2) reports the TFP results.[26] Decentralization is also significantly and positively associated with an increase in TFP during a crisis.[27] Column (3) uses the growth of profitability (Earnings Before Interest and Tax divided by the capital stock) as the dependent variable and also finds a negative coefficient on the interaction although it is not

[25] The specification in column (4) 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 an IV specification on the sample in column (3), we obtain a coefficient (standard error)of -0.165 (0.052) on the d$ecentralization*SHOCK$interaction.

[26] The sample for the TFP regression 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 other inputs such as capital are not).

[27] The sum of the unreported coefficients on employment, capital and materials growth 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. Note that if we calculate TFP as a residual using cost shares as weights on the factor inputs and use this as the dependent variable (dropping the factor shares from the right hand side) are results are similar to those from the estimated production function.

significant at conventional levels. Column (4) investigates whether the positive association also extends to the extensive margin of adjustment, using an exit regression. The dependent variable is a dummy taking the value of one if the firm exited to bankruptcy between 2007 and 2011 and zero otherwise (the regression is a Linear Probability Model). This shows that more decentralized firms also had a significantly lower probability of exit in industries that were worse hit by the crisis. Columns (5) though (7) repeat the analysis using the MOPS data, and again finds a negative and significant coefficient on the interaction term between decentralization and the shock for sales, TFP and profits growth.[28]

3.4 Identification and robustness

A concern with the results is that our decentralization interaction is simply picking up long-run trends or proxying for some unobserved variable. To address these issues we took several steps.

Placebo test in a pre-crisis period First, we address the concern that the $Decentralization * SHOCK$ interaction may simply be picking up some other time-invariant industry characteristic associated with the magnitude of the recession and firm organization. To allay this concern, we examine the relationship between sales growth and the $Decentralization * SHOCK$ interaction in a sample including years *preceding* the Great Recession in Table 4. Finding the same results in this period would raise the concern that the $SHOCK$ dummy captures unobserved industry heterogeneity unrelated to the Great Recession such that decentralized firms always did better in certain sectors. Thus, we regard this as a placebo test. We look again at three year differences in growth but use the periods 2008-05, 2007-04, 2006-03 and 2005-02 to define the pre-recession growth rates (in column (1) labeled ("year<=2005"), and 2011-08, 2010-07 and 2009-06 (as in the earlier tables) to define the post-recession years (column (2)). Column (1) shows that the coefficient on $Decentralization * SHOCK$ is actually positive, although insignificant, in the years preceding the Great Recession. Column (2) repeats the results of the specification of Table 2, column (3). Column (3) repeats the regression on the pooled pre-crisis and post-crisis samples of the first two columns, and includes a full set of interactions with a dummy indicator taking a

[28] We have no exit data for MOPS as the survey was run in 2011 after the Great Recession, with our main results using the recall question on decentralization in 2005.

value of one for all crisis years (the three year differences from 2009-06 and later) to estimate a "differences in differences in differences" specification. The coefficient on the triple interaction $POST2006 * Decentralization * SHOCK$ interaction is negative and significant, which implies that the effect of decentralization in industries hit by the Great Recession is arising entirely from the Great Recession years. We repeated the same analysis on TFP with very similar results in the last three columns.

Instrumental variables As a second approach to investigating whether it is really decentralization (or a correlated unobservable) responsible for superior firm performance in bad times we considered an instrumental variable (IV) strategy. A potential IV is the regional variation in generalized trust in the population around the firm's headquarters. Bloom, Sadun and Van Reenen (2012) show that variations in trust is strongly predictive for decentralization and this relationship is likely to be causal. Trust is measured from the World Values Survey and is calculated as the share of individuals agreeing with the statement that "Generally speaking, people can be trusted". Trust can have a direct effect on performance in our context, but we require a stronger assumption than in Bloom et al (2012) that trust only influences a firm's performance differentially in bad times through a firm's organizational structure.

In column (1) of Table 5 we report the OLS results in the sub-sample for which we have data to construct the trust IV, showing the standard negative interaction between decentralization and the shock. In column (2) we report the reduced form showing a strong negative interaction - high trust (and hence highly decentralized) regions have firms that are less damaged by negative shocks. Finally, in columns (3) to (5) we report the two first-stages and the second stage, finding our familiar result that decentralization reduces the impact of export shocks on firms, protecting them from negative export shocks.

Other factors correlated with decentralization We also explored the robustness of our results to a series of tests related to unobserved firm and industry level heterogeneity. First, in Appendix Tables A2 and **??** we investigated whether the $Decentralization * SHOCK$ interaction captures the relevance of other firm level characteristics correlated with decentralization. Specifi-

cally we augment the baseline specification of column (3) in Table 2 with interactions terms between the Great Recession indicator and a series of additional firm level controls. These included the overall management quality of the firm, the pre-recession size of the plant and firm, skills, decentralization from the plant manager to production workers and plant manager characteristics (age, immigrant status and gender). In all instances, the coefficient on the $Decentralization * SHOCK$ interaction remained significant in both the WMS and the MOPS data even in the presence of the extra interactions.[29] We also tested whether the $SHOCK$ measure could be reflecting other industry characteristics rather than the demand fall. In Appendix Table A3 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.

Validity of Exports as a shock measure We have argued that trade changes an attractive indicator of the Great Recession shock as they are more likely to reflect what is happening to demand in world markets that being a reflection of country and industry specific supply factors. Furthermore, we have also shown above that our results are robust to alternative indicators of the shock such as the industry-specific durability measure. As a further check we estimated our models separately for exporting establishments vs. non-exporting establishments using the MOPs data (export data is not an item required in the company accounts data, so we only have it for a small subsample of the WMS firms). As expected the results are driven by the exporting plants who are most directly exposed to trade shocks.[30]

4 A simple model

To understand what might underlie the stylized empirical finding that decentralized firms do better in bad times, we develop a simple model based upon Aghion and Tirole (1997). The key idea is

[29] Although the additional variables were usually insignificant, there are exceptions. In Appendix Table A3, Decentralization from plant manager to workers exhibits as similar pattern to our main decentralization measure. This suggests that decentralizing decision-making throughout the hierarchy is beneficial during times of crisis. The management interaction is also weakly significant, although in this case the coefficient is positive. In other words, well managed firms perform relatively better in good times than in bad.

[30] For example, using the baseline MOPs specification in Table 2 column (5) we estimate a coefficient(standard error) of -0.044(0.023) on the *Decentralization*SHOCK* variable for the exporters (4,200 observations) and -0.024(0.020) for the non-exporters.

that there is a trade off between incentives and local information. Since there are agency problems between the CEO and plant manager, centralization may seem natural. But the plant manager is likely to have better local information than the CEO which is a force for decentralization. When the environment becomes more turbulent, the CEO is even less well informed than in normal times. Therefore, in our model local information becomes more important and decentralization becomes more valuable.

4.1 Basic set up

We consider a one-period model of a firm with one principal (the CEO/ central headquarters) and one agent (the plant manager).The CEO cares about the profitability of the business whereas the plant manager wants to maximize private benefits and is not responsive to monetary incentives.[31] Taking an uninformed action involves potentially disastrous outcomes, thus an action will be taken only if at least one of the two parties is informed. 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, one maximizes the agent's private utility. Other actions lead to very negative payoffs to both parties.

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 degree of congruence between the principal's preferences and the agent's preferences. If preferences coincide then the action that maximizes the private utility of the agent also yields monetary utility B to the principal; if preferences do not coincide, the action that maximizes the agent's private utility yields monetary payoff $B - k$ to the principal.

Informational assumptions: We assume that the principal knows about project payoffs with probability p , but does not know directly which action the agent actually performed. On the other hand, the agent is assumed to be perfectly informed about the project payoffs.

[31] This is to rule out implementation of a performance pay contract to overcome the principal-agent problem. Obviously, we could allow some incentive contracts and so long as these only partially deal with the agency problem, the mechanisms we describe here would still be at play.

Turbulence: Suppose that the principal can obtain an early signal of forthcoming performance, e.g. a current realization of income, at some cost C, and can then possibly decide to fire the agent if she believes that the signal is due to the agent's choosing a non-profit maximizing action. In the absence of turbulence, the signal reveals the bad action choice perfectly. But the higher the degree of turbulence, the more difficult it is for the principal to infer action choice from performance.

Thus, suppose that current performance is given by

$$y = a + \varepsilon$$

where $a \in \{a_1, a_2\}$ denotes the agent's action choice (e.g. a decision whether or not to introduce a new product[32]), with $a_1 < a_2$ and ε is a noise term uniformly distributed on the interval $[-u, u]$.

4.2 Solving the model

Suppose that the plant manager takes the non-profit maximizing action a_1 (e.g. a decision which delays the introduction of a new product). The CEO will infer the action choice from observing the signal realization:

$$y = a + \varepsilon \ ,$$

if and only if $y \in [a_1 - u, a_2 - u) \cup (a_1 + u, a_2 + u]$ and then can correct it if she has control rights, i.e. under centralization .

By Bayes' rule the probability of the CEO guessing the action choice is:

$$P(u) = \Pr(y \in [a_1 - u, a_2 - u) \cup (a_1 + u, a_2 + u]) \ , \tag{3}$$

that is:

$$P(u) = \min\{\frac{2(a_2 - a_1)}{a_2 - a_1 + 2u}, 1\}. \tag{4}$$

The probability of guessing the correct action is clearly declining in the amount of noise parameterized by u . Hence the probability that the profit-maximizing action will be taken eventually under centralization (Ω), is equal to:

$$\Omega(u) = P(u) + (1 - P(u))\alpha, \tag{5}$$

[32] Equivalently, this could be whether to drop an existing product from the portfolio or to make an investment in marketing or sales that enhances the product's value to the consumer. The key thing is that the decision has to have some irreversibility.

where p is the probability that the principal acquires the information about projects payoffs.

4.3 Centralization versus decentralization

The *ex ante* CEO's payoff under decentralization, is equal to:

$$\Pi^d = \alpha B + (1-\alpha)(B-k)$$

The *ex ante* CEO's payoff under centralization (i.e. if the CEO delegates no authority to the plant manager), is equal to:

$$\Pi^c = \Omega(u)B + [1-\Omega(u)](B-k) - C \tag{6}$$

Letting the relative value of decentralization be defined as:

$$\Delta\Pi = \Pi^d - \Pi^c, \tag{7}$$

our key result is that:

Proposition 1: $\frac{\partial \Delta\Pi}{\partial u} \geq 0$. *An increase in turbulence* u *will make decentralization more profitable,*

Proof.

$$\frac{\partial \Delta\Pi}{\partial u} = -\Omega'(u)k$$

From equation (5) $\Omega'(u)k = (1-\alpha)kP'(u)$. So:

$$\frac{\partial \Delta\Pi}{\partial u} = -(1-\alpha)kP'(u) \geq 0$$

Since from equation (4) shows that $P'(u) \leq 0$.

5 Testing the additional predictions of the model

5.1 Turbulence: Product churn and stock market volatility

We now examine the empirical validity of the additional predictions of the model by using cross-industry variations in the change in product churn after the Great Recession as a proxy for the

increase in turbulence. While this measure is available only for the MOPS sample, in later parts of the paper we experiment with alternative measures that can also be applied to the WMS sample.

Before examining the relationship between sales growth, decentralization and turbulence (as measured by product churn), we first examined whether decentralization really was greater in industries where turbulence was higher. Figure A2 shows that this is indeed the case. More formally, Table A4 finds a positive and significant relationship between decentralization (the dependent variable) and product churn, particularly for decentralization of decisions regarding product introduction and sales and marketing, as the theory would suggest (see below for more details). Furthermore, we checked whether product churn had indeed increased more in industries that experienced a larger drop in exports during the Great Recession. This is also the case in the data, as shown in Figure A3 (the slope is -0.188 and highly significant).

To investigate the empirical validity of Proposition 1, we extend our basic equation (2) to include both the change in $CHURN$ and also its interaction with decentralization

$$\begin{aligned} \Delta \ln Y_{ij} &= \alpha DEC_{i0} + \beta(DEC_{i0} * SHOCK_j) + \gamma SHOCK_j \\ &\quad + \eta \Delta CHURN_j + \mu\left(DEC_{i0} * \Delta CHURN_j\right) + \delta x_{i0} + \phi_j + \tau_t + \varepsilon_{ij} \end{aligned} \tag{8}$$

where $\Delta CHURN_j$ is the change in churn in industry j (since we estimate this regression model only in the US MOPS sample we omit the country sub-script). According to the model $\mu > 0$, since churn increases the value of decentralization. Moreover, to the extent that our export shock variable is proxying for rising turbulence during recessions, we would also expect β to drop in magnitude in equation (8) compared to equation (2).

Table 6 shows the results.[33]In column (1) we estimate the specification in column (4) of Table 2 for the subset of firms for which an industry level measure of product churn could be built. This has similar results to the overall sample, i.e. the coefficient on the interaction $DEC_{i0} * SHOCK_j$ is negative and statistically significant. Column (2) includes the $DEC_{io} * \Delta CHURN_j$ interaction instead of the $DEC_{i0} * SHOCK_j$ interaction. In line with the model's prediction, the coefficient on

[33] Since we are measuring churn between 2007-2012 (our Manufacturing Census years) we use as our dependent variable the change in ln(sales) between 2007 and 2012 which is why the sample is slightly smaller.

the interaction with changes in product churn is positive and significant, i.e. sales growth appears to have a positive association with decentralization in industries that experienced a greater increase in turbulence, as proxied by product churn. Column (3) includes both interactions. The coefficient on the interaction between decentralization and product churn remains positive and significant, while the coefficient on the interaction between decentralization and growth in industry exports drops by half in magnitude compared to column (1) and is insignificant. Columns (4) to (6) repeat the same specifications, this time using durability as an alternative industry level proxy for the Great Recession. Even in this case, the interaction between decentralization and product churn appears with a positive and significant coefficient, and its inclusion reduces the magnitude of the coefficient on decentralization and average industry durability, driving it to insignificance.

As discussed in the data section we also used the change in stock market volatility in an industry by country cell as an alternative measure of turbulence. An advantage of this measure is that it is available for the WMS as well as MOPS, but a disadvantage is that it is constructed from firms listed on the stock market. Although we have the population of such firms, they conditions they face may be less relevant to the small and medium sized enterprises in our sample. Table 7 shows the results. In column (1) we reproduce the specification in column (1) of Table 2.[34]In column (2) we use the interaction between decentralization and the change in the variance of stock market returns instead of our usual interaction. As expected from the theory the coefficient is positive and significant suggesting that decentralized firms outperform their centralized counterparts in industries where stock market volatility has increased the most. In column (3) we include both interactions. The stock market volatility interaction remains positive and significant whereas the coefficient on the export growth interaction falls by a third in magnitude and is now only significant at the 10% level. The next three columns reproduce the same specifications using the MOPS data showing a qualitatively similar pattern (although the fall in the coefficient on export growth and decentralization is smaller).

Taking Tables 6 and 7 together, it appears that decentralized firms did relatively better in industries where turbulence increased the most. At least part of the reason why decentralized firms

[34] The only difference is that we are using two-digit dummies instead of three-digit dummies to match the level of aggregation for the stock market volatility measures.

do better in bad times appears to be because the industries worse hit by the Great Recession were also those where turbulence increased the most, consistent with our simple model.

5.2 Types of decentralization

As a related experiment to shed light on the model we looked at the different sub-questions which form the overall decentralization index, as shown in Table 8. Since the Great Recession was associated with a decrease in output demand, we would expect that decentralization over managerial discretion over outputs (sales and new products) would be more important than delegation over inputs (like labor and capital). We start in column (1) by showing the baseline result of Table 2, column (3). In columns (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). In columns (4) to (6) we repeat the same exercise for the U.S. MOPS sample.[35] In both cases, the positive effect of decentralization in a crisis is primarily driven by the output related questions. This finding provides additional insight on the possible mechanism through which decentralization may positively affect firm performance during a downturn, namely the ability to better adapt to more turbulent demand conditions.[36]

One concern with these findings is the belief that in practice plant managers do not have meaningful autonomy in decisions regarding sales and marketing and product introduction, and that these decisions are typically undertaken in the marketing department of firm headquarters. It is worth recalling that while this may be the case in business-to-consumer firms which sell their goods to households directly or through retail establishments, it is less obvious in business-to-business firms which sell their manufacturing output to other firms. The latter scenario encompasses a significant share of manufacturing activity.[37]Moreover, the firms in the WMS are not that large

[35] In the U.S. sample we have 3 questions capturing plant manager decentralization for hiring and budgetary decisions in column (5) and 3 capturing plant manager decentralization for sales and marketing and product introduction in column (6).

[36] Consistent with the previous sub-section Appendix Table A5 shows that the positive interaction between decentralization and product churn is driven primarily by the sales and marketing and product introduction questions.

[37] According the Bureau of Economic Analysis, 34 percent of US manufacturing output was used as input for other manufacturing firms in 2015 (https://www.bea.gov/industry/io_annual.htm). The retail trade industry and personal consumption expenditures, which represent business-to-consumer activity, also accounted for 34 percent of manufacturing output in 2015.

(a median of 250 employees and about 2 plants), so few of them are likely to have standalone marketing divisions. MOPS plants have a median of 135 employees, but are part of larger firms (median 1,872).

6 Alternative models and channels

6.1 Do bad times reduce the costs of decentralization?

We have argued that decentralized firms perform relatively well in bad times because the crisis was accompanied by a spike in turbulence. There may, however, be alternative rationalizations of the results we have presented and we probe these alternative channels. The model in Section 4 suggested that bad times foster decentralization because of greater turbulence increasing the importance of the plant manager's local information. But the model can also rationalize the impact of a bad shock through an alternative mechanism. Imagine, for example, that bad times reduce the *costs* of decentralization because the plant manager fears that doing the non-profit maximizing action might cause the firm to go bankrupt. This could be interpreted as a lower cost to the principal of the private action of the manager, i.e. a lower value of k . One can show that:

Proposition 2. *A bad shock which reduces* k , *also increases profitability for decentralized firms, that is:*

$$\frac{\partial \Delta \Pi}{\partial k} < 0$$

This follows from the fact that $\frac{\partial \Delta \Pi}{\partial k} = (\alpha - 1)P(u) < 0$.

The intuition behind proposition 2 is that the risks of bankruptcy rise in bad times, so the plant manager is more fearful of taking actions that deviate too much from the profit-maximizing action, as he may lose her job. Hence, bad times may effectively reduce the agency problem (i.e. reduces k) and so make decentralization less costly.

To test this idea we examine environments where the firm-specific risk of bankruptcy rose rapidly in the Great Recession. We constructed several indicators of increased bankruptcy risk. For example, we used the measures of exogenous increases in exposure to financial crisis exploited by Chodorow-Reich (2014) such exposure to to mortgage-backed securities (affected by the sub-

prime crisis), a firm's pre-existing relationship with Lehman Brothers or similar "at-risk" banks. These are pre-Great Recession conditions relating to the supply of finance rather than product demand. We also used more conventional measures such as leverage ratios.

We found that these measures do predict negative performance in sales and other outcomes (see Appendix Table A6) as as in Chodorow-Reich (2014). However, in no case did including these bankruptcy risk variables (and their interactions with $SHOCK$ or other covariates) materially alter the coefficient on the key interaction of $Decentralization * SHOCK$ when included in equation (2).[38] This led us to conclude that the crisis was not leading to greater decentralization by fostering greater alignment between the central headquarters and plant manager.

6.2 The role of co-ordination costs

When there are large externalities between different plants belonging to the same firm, decentralization is likely to be more costly. For example, coordinating prices and product decisions from the central headquarters is important if one plant's products cannibalize those of other plants. To examine whether our results may reflect the importance of differences in coordination in bad times, in Tables 9 and 10 we included interactions with many measurable characteristics reflecting environments where coordination costs should be more important. These included size and whether a firm was multi-plant (so more need for coordination) and, if so, where these plants located in different countries or different states. Similarly, we looked whether a firm was producing goods across multiple sectors or whether it was part of a foreign multinational enterprise. We also considered the degree of outsourcing. In all cases the interactions were insignificant and the main interaction between decentralization and export growth remained significant. We find this unsurprising. The "Tsarist" view we sketched in the introduction suggested that recessions would *increase* the need for centralization for firms where coordination costs were high (and therefore put decentralized firms at a disadvantage).

[38] The coefficients on the Lehman Brothers variable cannot be reported due to Census disclosure rules.

6.3 Changes in decentralization over time

Recall that our identification assumption is that pre-recession decentralization is weakly exogenous and that there are some adjustment costs which mean that after the Great Recession shock firms do not immediately adopt the new optimal (more decentralized) organizational form. A corollary of our theory, however, is that firms will start moving to a more decentralized form (to the extent that they have lower adjustment costs, higher costs from centralization and/or believe the shock is likely to be long-lasting). Hence, we should expect to see some increase in decentralization for firms more exposed to the shock.

Table A7 examines this by using the change in decentralization as a dependent variable. This is a demanding specification, especially for WMS where the panel element of decentralization is limited (we have data in 2009 and 2010 for a sub-sample of the 2006 wave). Nevertheless, in both WMS and MOPS we do see a significant and positive relationship between the size of the negative shock and decentralization.

7 Conclusion

When does decentralizing power from the central headquarters to plant managers increase firm growth? We examine the responses of a panel of 1,300 firms in 10 OECD countries (WMS), and 8,700 plants in the US (MOPS) to the Great Recession which reduced demand across industries and countries in heterogeneous ways. Using pre-recession data on decentralization 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 export shocks, or exogenous predictors of these negative shocks like product durability.

We formalized a simple model where the CEO considers decentralizing product-related decisions to the plant manager. The increased turbulence that comes with bad times makes the importance of the plant manager's local information more valuable and so means decentralized firms will perform relatively better in unexpected downturns. Consistent with this model, we show that the correlation between decentralization and firm performance during the crisis is stronger in industries which experienced a greater increase in product churn and stock market volatility. This is

consistent with the idea that decentralization mattered the most in industries with greater increase in turbulence.The effects are not trivial in size. We suggest that the greater prevalence of decentralized firms in countries such as the US could account for about 16% of the different post crisis GDPgrowth patterns between OECD countries.

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?

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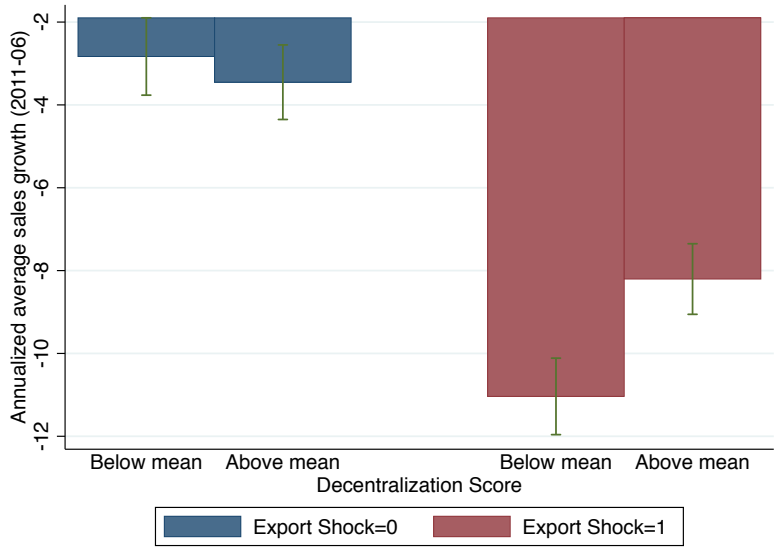
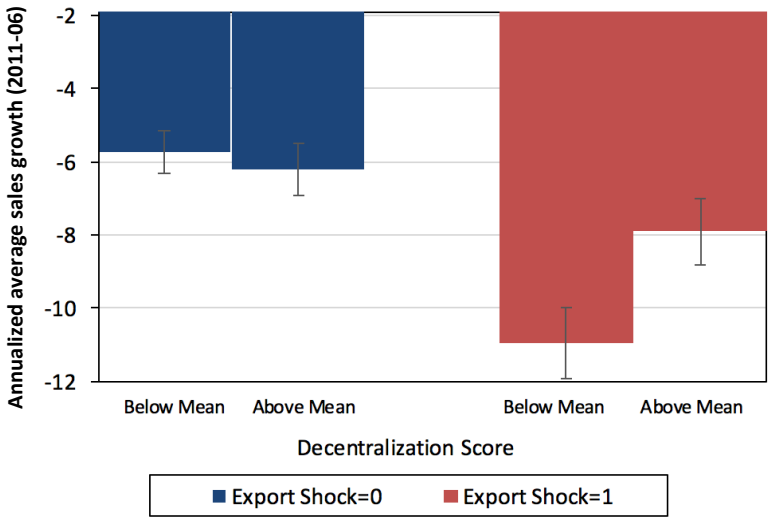
Figure 1: Changes in Sales by Shock and Decentralization

Panel A - WMS data

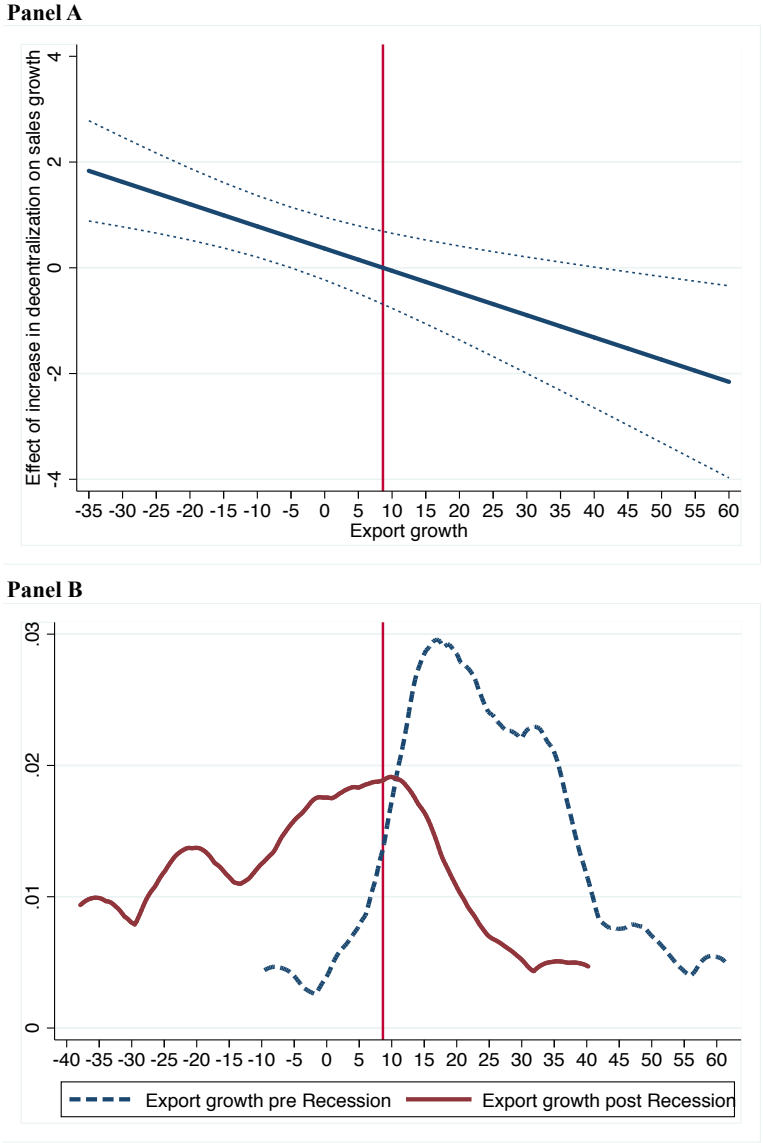


Panel B - MOPS data



Notes: Panel A uses WMS firm data from 10 OECD countries. In Panel A the bars plot annualized average of three-year firm-level change in ln(sales) over 2011-08, 2010-07 and 2009-06. 95% confidence interval bands reported. "Export Shock" is whether firms were in a country-industry cell that experienced a drop in exports in 2008 and 2009 (the main Great Recession years) compared to 2006 and 2007 (the latest pre-Recession years). Right hand side bars are industry-country cells were the shock was worst. Firms are split into whether they are decentralized (above the overall mean of decentralization in 2006) or centralized. Sample size in each bar in Panel A (from left to right) is (1) 695 observation over 296 firms; (2) 863 obs, 352 firms; (3) 736 obs, 316 firms; (4) 857 obs, 367 firms. Panel B is the same as Panel A except we just use one 2009-06 long difference for plant sales growth and decentralization dated in 2005. The sample in Panel B includes 8,774 US plants in 3,147 firms.

Figure 2: Effect of Increase in Decentralization on Sales Growth



Notes: WMS Data. Panel A plots the implied marginal effect of decentralization on firm sales growth using the coefficients in Table 2 column (2) as a function of the shock (export growth in cell). Panel B shows the distribution of firms in industry-country cells with different levels in cell). Panel B shows the distribution of firms in industry-country cells with different levels of export growth before and after the Great Recession.

Table 1: Summary Statistics

Panel A World Management Survey			
Variable	**Mean**	**Median**	**Standard Deviation**
Sales Levels ($Millions)	184.14	67.07	513.41
Sales Growth (3 years annualized log change)	-6.38	-5.81	13.31
Employment (firm)	574.39	250.00	2,144.77
Employment (plant)	232.93	150.00	254.36
% Employees with a College Degree	16.32	10.00	17.51
Decentralization Score	0.00	-0.04	1.00
Exports (continuous, % change in sector/country export in 08/09 relative to 06/07)	-1.96	-0.43	20.96
Durability (continuous, median years of service of goods produced in the industry)	13.03	10.00	19.50
Panel B U.S. Census Data - MOPS			
Variable	**Mean**	**Median**	**Standard Deviation**
Sales Levels (2009) ($Millions)	137.40	50.50	403.60
Sales Growth (3 years annualized log change)	-7.09	-6.06	18.44
Employment (firm)	6,833.03	1,872.00	12,042.47
Employment (plant)	249.81	135.00	481.91
% Employees with a College Degree	11.84	7.28	11.69
Decentralization Score	0.00	-0.17	1.00
Exports (continuous, % change in sector/country export in 08/09 relative to 06/07)	2.45	-0.82	15.95
Durability (continuous, median years of service of goods produced in the industry)	12.98	12.20	13.17

Notes: These are the regression samples used in Table 2. Panel A contains descriptive statistics from the WMS and Panel B from the MOPS.

Table 2: Decentralization and Sales Growth - Main results

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable = Sales Growth	**World Management Survey (WMS)**				**U.S. Census Data (MOPS)**	
Decentralization	0.579*	0.363	0.041	-0.460	0.570**	-0.182
	(0.302)	(0.302)	(0.417)	(0.572)	(0.225)	(0.234)
EXPORT Growth	0.069**	0.062**				
	(0.029)	(0.029)				
Decent.*EXPORT Growth		-0.042***	-0.047**		-0.035**	
		(0.013)	(0.018)		(0.015)	
Decent.*DURABILITY				0.502**		0.381***
				(0.194)		(0.091)
Firms	1,330	1,330	1,330	1,330	3,147	3,147
Observations	3,151	3,151	3,151	3,151	8,774	8,774
Controls						
Industry by country dummies			**y**			
Firm & plant employment, skills			**y**	**y**	**y**	**y**
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3	SIC3	SIC3

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country. The dependent variable is the annualized three-year change of firm ln(sales). 2011-08, 2010-07 and 2009-06 are pooled in WMS (columns (1)-(4)) and just 2009-06 in MOPS (columns (5) and (6)). Decentralization measured in 2006 for WMS and 2005 for MOPS. "EXPORT Growth" is change in ln(exports) in country by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). All columns include three digit industry (four digit in column (4)), country and year dummies and "noise controls" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration); WMS also includes analyst dummies and MOPS whether the survey was answered online or by mail). Firm and plant size are ln(employment) are skills is the ln(percent of employees with a college degree).

Table 3: Alternative Firm Level Outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	World Management Survey (WMS)				U.S. Census Data (MOPS)		
Dependent Variable	**Sales growth**	**TFP growth**	**Profit growth**	**Survival**	**Sales growth**	**TFP growth**	**Profit growth**
Decentralization	-0.017	-0.263	-0.396	1.33	0.570**	-0.082	0.192
	(0.400)	(0.357)	(1.597)	(0.913)	(0.225)	(0.164)	(0.270)
Decent.*EXPORT Growth	-0.048***	-0.033**	-0.068	-0.086*	-0.035**	-0.028**	-0.042**
	(0.017)	(0.013)	(0.065)	(0.047)	(0.015)	(0.011)	(0.019)
Firms	1,211	1,211	1,192	2,663	3,147	3,147	3,147
Observations	2,839	2,839	2,712	2,663	8,774	8,774	8,774
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3	SIC3	SIC3

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country. Sales growth is the annualized three-year change of firm ln(sales). TFP growth is the same as sales growth except we include the growth of employment, capital and materials on the right hand side of the regression. Profit growth is EBIT/capital for WMS and gross profits/capital for MOPS (where profits are measured as plant sales - wage bill - materials - rental expenses). For all these dependent variables we pool the long difference 2011-08, 2010-07 and 2009-06 in WMS and just 2009-2006 in MOPS). Survival is equal to 1 if the firm survived after 2007 and 0 if it exited to bankruptcy. Decentralization measured in 2006 for WMS and 2005 for MOPS. "EXPORT Growth" is change in ln(exports) in country by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). All columns include three digit industry by country dummies and year dummies and controls for firm and plant size, skills and "noise" controls.

Table 4: Placebo Test

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:		**Sales Growth**			**TFP Growth**	
Sample	**Year<=2005**	**Year>=2006**	**All**	**Year<=2005**	**Year>=2006**	**All**
Decentralization	0.221	0.041	0.365	-0.117	-0.263	0.038
	(0.334)	(0.417)	(0.310)	(0.306)	(0.357)	(0.262)
Decentralization*EXPORT Growth	0.005	-0.047**	0.004	0.004	-0.033**	0.004
	(0.017)	(0.018)	(0.015)	(0.015)	(0.013)	(0.012)
POST*EXPORT Growth			0.089***			0.115***
			(0.024)			(0.021)
POST*Decentralization			-0.389			-0.387
			(0.427)			(0.350)
POST*Decentralization*EXPORT Grow			-0.052***			-0.036**
			(0.019)			(0.016)
Firms	1,080	1,330	1,330	991	1,211	1,211
Observations	3,664	3,151	6,815	3,265	2,839	6,104
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country level. Sales growth is the annualized three-year change of firm ln(sales). TFP growth is the same as sales growth except we include the growth of employment, capital and materials on the right hand side of the regression. For columns (2) and (5) we use long differences 2011-08, 2010-07 and 2009-06 and in columns (1) and (4) we use long differences 2008-05, 2007-04, 2006-03 and 2005-02. Columns (3) and (6) pool all these long differences together. "POST" is a dummy taking value 1 in all years after 2006 included. Firm and plant employment are measured in 2006."EXPORT Growth" is change in ln(exports) in country by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). All columns include dummies for year and for three digit industry by country pairs, and controls for firm and plant size, skills and "noise" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration and analyst dummies).

Table 5: Instrumenting Decentralization with Trust around the Plant's HQ

	(1)	(2)	(3)	(4)	(5)
	Baseline on subsample	Reduced form	First Stage	First Stage	Second Stage
Dependent Variable	**Sales growth**	**Sales growth**	**Decentralization**	**Decentralization * Export Growth**	**Sales growth**
Decentralization	0.042				0.076
	(0.339)				(3.023)
Decentralization*EXPORT Growth	-0.042**				-0.298**
	(0.017)				(0.125)
Trust		-2.926	1.374***	7.448	
		(4.066)	(0.394)	(8.709)	
Trust*EXPORT Growth		-0.470***	0.015	1.408**	
		(0.164)	(0.022)	(0.529)	
Observations	2,990	2,990	2,990	2,990	2,990
Angrist Pischke Test (Weak identification)			8.53	5.52	
Cragg-Donald Wald F statistic					16.72
Cluster	HQ Region	HQ Region	HQ Region	HQ Region	HQ Region

Notes: *significant at 10%; ** 5%; *** 1% level. WMS data. All columns estimated by OLS except column (5) which is IV. Standard errors clustered at region where the firm's HQ is located. Sales growth is the annualized three-year change of firm ln(sales). Trust is the mean of the response in the world values survey to the question that in general, most people can be trusted in the region around the headquarters of the firm. We use this variable (and its interaction with export growth) as instrumental variables. All columns include dummies for year and for three digit industry by country pairs, and controls for firm and plant size, skills and "noise" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration and analyst dummies).

Table 6: Decentralization and Turbulence (as measured by Product Churn)

	(1)	(2)	(3)	(4)	(5)	(6)
		Exports			Durability	
Dependent Variable: Sales growth ('07-'12)						
Decentralization	0.480***	0.491***	0.576***	-0.004	0.491***	0.322
	(0.142)	(0.130)	(0.133)	(0.209)	(0.130)	(0.201)
Decentralization*Change in Product Churn		0.994***	0.886***		0.994***	0.930***
		(0.300)	(0.320)		(0.300)	(0.298)
Decentralization*Export Growth ('07-'12)	-0.014**		-0.008			
	(0.007)		(0.007)			
Decentralization*Durability				0.147*		0.082
				(0.086)		(0.081)
Observations	8,243	8,243	8,243	8,243	8,243	8,243

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry. The dependent variable is the annualized three-year change of firm ln(sales) 2012-07 Decentralization measured in 2005. "EXPORT Growth" is change in ln(exports) in country by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). All columns include three digit industry dummies, firm and plant size, skills and "noise controls" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration, and whether the survey was answered online or by mail). "PRODUCT CHURN" is the three digit industry of value of the average change in the (number of products added between t and t-5 plus the number products dropped between t and t-5)/(average number of products between t and t-5).

Table 7: Decentralization and Turbulence (as measured by Stock Market Volatility)

	(1)	(2)	(3)	(4)	(5)	(6)
	World Management Survey			U.S. Census Data (MOPS)		
Dependent Variable = Sales Growth						
Decentralization	0.208	0.421	0.289	0.3603	0.3076	0.3115
	(0.331)	(0.329)	(0.321)	(0.266)	(0.218)	(0.218)
EXPORT Growth	0.088***		0.090***			
	(0.032)		(0.027)			
Decent*EXPORT Growth	-0.034**		-0.024*	-0.030**		-0.027*
	(0.017)		(0.014)	(0.015)		(0.013)
Decent.*Change in SD(stock returns)		7.142***	6.304***		24.36***	23.20***
		(1.341)	(2.354)		(9.200)	(8.508)
Firms	1,330	1,330	1,330	3,147	3,147	3,147
Observations	3,151	3,151	3,151	8,774	8,774	8,774
Controls						
Industry dummies	**y (SIC2)**	**y (SIC2)**	**y (SIC2)**	**y**	**y**	**y**
Firm & plant employment, skills	**y**	**y**	**y**	**y**	**y**	**y**
Cluster	SIC2*Cty	SIC2*Cty	SIC2*Cty	SIC3	SIC3	SIC3

Notes: *significant at 10%; ** 5%; *** 1% level. The dependent variable is the annualized three-year change of firm ln(sales) in 2009-06. "EXPORT Growth" is change in ln(exports) in three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). Columns (1)-(3): estimated by OLS with standard errors clustered at two-digit industry by country level. "Change in SD(stock returns)" is the change in standard deviation of stock returns in two digit industry by country cell between 2008 and 2009 average compared to 2006. These columns include two digit industry by country dummies. Columns (4)-(6) estimated by OLS with standard errors clustered at three-digit industry level. "Change in SD(stock returns)" is the change in standard deviation of stock returns in three digit industry cell between 2008 and 2009 average compared to 2006. These columns include three digit industry dummies. All columns include the same set of noise and firm controls used in Table 2.

Table 8: Differences Across Decentralization Questions

	(1)	(2)	(3)	(4)	(5)	(6)
	World Management Survey (WMS)			U.S. Census Data (MOPS)		
Dependent Variable: Sales Growth						
Decentralization	0.041			0.570**		
	(0.417)			(0.225)		
Decentralization*EXPORT Growth	-0.047**			-0.035**		
	(0.018)			(0.015)		
Decentralization - Hiring & Investment		0.063			0.830***	
		(0.396)			-0.258	
Decentralization - Hiring & Investment*EXPORT Growth		-0.002			-0.005	
		(0.019)			-0.015	
Decentralization - Sales & New Products			-0.135			0.387
			(0.379)			(0.240)
Decentralization - Sales & New Products			-0.060***			-0.045***
***EXPORT Growth**			(0.017)			(0.016)
Firms	1,330	1,330	1,330	3,147	3,147	3,147
Observations	3,151	3,151	3,151	8,774	8,774	8,774
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3	SIC3	SIC3

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country level. The dependent variable is the annualized three-year change of firm ln(sales). 2011-08, 2010-07 and 2009-06 are pooled in WMS (columns (1)-(3)) and just 2009-2006 in MOPS (columns (4) to (6)). Decentralization measured in 2006 for WMS and 2005 for MOPS. "EXPORT Growth" is change in ln(exports) in country by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). All columns include three digit industry, country and year dummies and "noise controls" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration, WMS also includes analyst dummies and MOPS whether the survey was answered online or by mail). Firm and plant size are ln(employment) are skills is the ln(

Table 9: Is Decentralization Proxying for Coordination? WMS Data

Dependent Variable: Sales Growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Decentralization	0.041	0.050	0.062	0.115	0.046	0.067	0.127	-0.013	0.361
	(0.417)	(0.418)	(0.417)	(0.422)	(0.413)	(0.419)	(0.413)	(0.448)	(0.983)
Decentralization*EXPORT Growth	-0.047**	-0.047**	-0.045**	-0.046**	-0.047***	-0.047**	-0.050***	-0.046**	-0.094**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.047)
Ln(employees)*EXPORT Growth		-0.940							
		(0.816)							
Ln(plant employees)			-0.228						
			(0.513)						
Ln(plant employees)*EXPORT Growth			0.008						
			(0.021)						
No. of production sites				-0.003					
				(0.027)					
No. of production sites*EXPORT Growth				0.003					
				(0.002)					
Diversification					1.302				
					(0.898)				
Diversification*EXPORT Growth					0.027				
					(0.055)				
Multinational						-2.478*			
						(1.384)			
Multinational*EXPORT Growth						1.691			
						(1.730)			
Foreign Multinational dummy							-1.820**		
							(0.833)		
Foreign Multinational*EXPORT Growth							0.016		
							(0.039)		
Ln(share outsourced production)								-0.090	
								(0.281)	
Ln(share outsourced production)*EXPORT Growth								0.001	
								(0.012)	
Materials Share									-6.991
									(7.065)
Materials Share*EXPORT Growth									0.817**
									(0.357)
Observations	3,151	3,151	3,105	3,127	3,151	3,151	3,151	3,029	1,201
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: *significant at 10%; ** 5%; *** 1% level. Specifications are the same as Table 2 column (3) except augmented with additional variables (linear and interacted with export growth). Multinational =1 if the plant belongs to a foreign or domestic multinational. Diversified =1 if the firm has multiple primary SIC4 codes. Share of outsourced production is a question in the WMS survey. Materials share is the fraction of sales that are intermediate goods inputs (from ORBIS).

Table 10: Is Decentralization Proxying for Coordination? MOPS Data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable: Sales Growth									
Decentralization	0.570**	0.730***	0.713***	-0.120	0.303	0.229	0.780***	0.253	0.986***
	(0.225)	(0.242)	(0.245)	(0.749)	(0.355)	(0.323)	(0.297)	(0.307)	(0.288)
Decentralization*EXPORT Growth	-0.035**	-0.031**	-0.030**	-0.032**	-0.034**	-0.033**	-0.033**	-0.031**	-0.032**
	(0.015)	(0.015)	(0.015)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Multiproduct		-0.298							
		(0.583)							
Multiproduct*EXPORT Growth		0.008							
		(0.035)							
Ln(plant employment)*EXPORT Growth			0.003						
			(0.022)						
Ln(firm employment)*EXPORT Growth			0.007						
			(0.010)						
Ln(firm employment)*Decentralization				0.111					
				(0.094)					
Ln(No. of plants)					-0.530				
					(0.328)				
Ln(No. of plants)*Decentralization					0.173				
					(0.143)				
Ln(No. of states w/ plants)						0.040			
						(0.395)			
Ln(No. of states w/ plants)*Decentralization						0.269*			
						(0.154)			
Plant is in same state as largest plant							1.000*		
							(0.547)		
Same state as largest plant*Decentralization							-0.152		
							(0.349)		
Ln(No. of manufacturing industries)								-0.542*	
								(0.309)	
Ln(No. of manufacturing industries)*Decentralization								0.352**	
								(0.146)	
Plant is in same industry as largest plant									0.785
									(0.520)
Same industry as largest plant*Decentralization									-0.474
									(0.369)
Observations	8,774	8,774	8,774	8,774	8,774	8,774	8,774	8,774	8,774
Cluster	SIC3	SIC3	SIC3	SIC3	SIC3	SIC3	SIC3	SIC3	SIC3

Notes: **significant at 10%; ** 5%; *** 1% level. Specification are the same as Table 2 column (5). "Multiproduct" equals 1 if a plant produced at least two products (7-digit NAICS) in 2009 and 0 otherwise. "Ln(No. of manufacturing industries)" is the log of the number of unique primary industry codes (6-Digit NAICS) assigned to the firm's manufacturing establishments in 2009. "Plant is in same state as largest plant" equals 1 if plant is in the same U.S. state as the firm's largest plant by employment in 2009, and 0 otherwise. "Plant is in same industry as largest plant" is defined similarly with an industry defined as 6-digit NAICS code.

Web Appendices

A Data Appendix

A.1 Industry-level variables

A.1.1 Exports

We measure changes in exports in an industry by country cell using 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 given pairs of countries. We first aggregate the COMTRADE value of export data (in US dollars)from its original six-digit product level to three-digit US SIC-1987 level using the Pierce and Schott (2010) concordance. We deflate the industry and country specific export value series by a country and year specific CPI from the World Bank (2010 base year) to measure "real exports." The Export growth variable is defined as the logarithmic change in exports in 2008-09 (the average in a cell across these two Great Recession years) relative to 2006-07 (the average across the two years immediately prior to the Great Recession). The real export growth variable is winsorized at the 5th and the 95th percentile.

A.1.2 Durability

Data on the average durability of the goods produced in the industry are drawn from Ramey and Nekarda (2013). This is a continuous cross-sectional measure at the 4-digit industry level.

A.2 World Management Survey (WMS) International Data

A.2.1 Firm-level Accounting Databases

Our sampling frame was based on the Bureau van Dijk (BVD) ORBIS which is composed of the BVD Amadeus dataset for Europe (France, Germany, Greece, Italy, Poland, Portugal, and the United Kingdom); BVD Icarus for the United States, BVD Oriana for Japan. These databases all provide sufficient information on companies to conduct a stratified telephone survey (company name, address, and a size indicator). These databases also typically have accounting information on

employment, sales and assets. Apart from size, we did not insist on having accounting information to form the sampling population, however. Amadeus are constructed from a range of sources, primarily the National registries of companies (such as Companies House in the United Kingdom). Icarus is constructed from the Dun & Bradstreet database, which is a private database of over 5 million U.S. trading locations built up from credit records, business telephone directories, and direct research. Oriana is constructed from the Teikoku Database in Japan.The full WMS consists of 4 countries but because we need decentralization data in 2006 we are restricted to the 12 countries surveyed in the 2006 wave. Because we wanted to focus on mature economies we dropped China and India which left us with 10 OECD countries (France, Great Britain, Germany, Greece, Italy, Japan, Poland, Portugal, Sweden and the US).

A.2.2 The Organizational Survey

In every country the sampling frame for the organization survey was all firms with a manufacturing primary industry code with between 50 and 5,000 employees on average over the most recent three years of data (typically 2002 to 2004 for the 2006 wave). Interviewers were each given a randomly selected list of firms from the sampling frame. More details are available in Bloom, Sadun and Van Reenen (2012) where we compare the sampling frame with Census demographic data from each country and show that the sample is broadly representative of medium sized manufacturing firms. We also analyzed sample selection - the response rate was 45% and respondents appear random with respect to company performance, although larger firms where slightly more likely to respond.

In analyzing organizational 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. 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.

The construction of the degree of decentralization measures (from Central Headquarters to Plant Manager) is discussed in some detail in the text. The questions are addressed to the plant manager. We only keep observations where at least two of the four decentralization questions were answered (and we include a control for the number of non-missing questions in the set of noise controls). We drop observations where the plant manager is also the CEO (5% of firms). In cases where the Central Headquarters is on the same site as the plant we interviewed we add a dummy variable to indicate this (one of the noise controls) to reflect potentially greater monitoring. We use the data from the 2006 wave in all cases except when we analyze changes in decentralization as an outcome where we exploit the fact that we ran another wave in 2009 and 2010 for a sub-sample of firm.

A.2.3 Firm-level variables

Our firm accounting data on sales, employment, capital (fixed assets), profits and intermediate inputs came from BVD ORBIS. Whether the variable is reported depends on the accounting standards in different countries. Sales are deflated by a three digit industry producer price index. BVD has extensive information on ownership structure, so we can use this to identify whether the firm was part of a multinational enterprise. We also asked specific questions on the multinational status of the firm (whether it owned plants aboard and the country where the parent company is headquartered) to be able to distinguish domestic multinationals from foreign multinationals.

We collected many other variables through our survey including information on plant size, skills, organization, etc. as described in the main text. We also collected management practices data in the survey. These were scored following the methodology of Bloom and Van Reenen (2007), with practices grouped into four areas: operations (three practices), monitoring (five practices), targets (five practices), and incentives (five practices). The shop-floor operations section focuses on the introduction of lean manufacturing techniques, the documentation of processes improvements, and the rationale behind introductions of improvements. The monitoring section focuses on the tracking of performance of individuals, reviewing performance, and consequence management. The targets section examines the type of targets, the realism of the targets, the transparency of targets, and the range and interconnection of targets. Finally, the incentives section includes promotion criteria,

pay and bonuses, and fixing or firing bad performers, where best practice is deemed the approach that gives strong rewards for those with both ability and effort. Our management measure uses the unweighted average of the z-scores of all 18 dimensions.

Our basic industry code is the U.S. SIC (1997) three digit level—which is our common industry definition in all countries. We allocate each firm to its main three digit sector (based on sales).

A.3 U.S. Census Bureau Data: MOPS

A.3.1 Sample

Appendix Table A2 shows how our sample is derived from the universe of U.S. business establishments. The U.S. Census Bureau data on decentralization comes from the 2010 Management and Organizational Practices Survey (MOPS), which was a supplement to the 2010 Annual Survey of Manufactures (ASM). The MOPS survey was sent to all ASM establishments in the ASM mail-out sample. Overall, 49,782 MOPS surveys were successfully delivered, and 37,177 responses were received, yielding a response rate of 78%.

The MOPS contains 36 multiple choice questions, split into 3 modules: management practices (16 questions), organization (13 questions), and background characteristics (7 questions). Decentralization measures come from the "Organization" module of the MOPS. Only establishments with headquarters located off-site are instructed to answer questions in the organization module. This reduces the sample to about 20,000 establishments. We also require matches to the 2006 and 2009 ASM in order to calculate the growth rates used in the analysis. This reduces the sample size substantially for two reasons. First, all of the establishments in our sample must have been operating in both 2006 and 2009. The second reason is related to the ASM sample design. The ASM is a rotating 5-year panel which samples large establishments with certainty but also includes a random sample of smaller establishments. The ASM sample is refreshed every five years, most recently in 2009, thus we lose establishments which were in the 2009 and 2010 ASM samples and responded to the MOPS, but were not in the 2006 ASM sample. Finally, we require that respondents answer all 6 of the questions about decentralization (described below) and have positive value added and imputed capital in 2010. The final sample contains 8,774 establishments and 3,147 firms.

A.3.2 Decentralization

Our measure of decentralization is constructed from 6 questions on the MOPS (questions 18 through 23), which measure the allocation of real decision making rights between manufacturing plant managers and their central headquarters. Respondents are asked whether decisions about hiring, pay increases, product introductions, pricing, and advertising are conducted at the establishment, headquarters or both, and about the largest capital expenditure plant managers can make without authorization from headquarters. The survey asks about organizational practices in 2005 and 2010. We use information on decentralization in 2005 in the main analysis because firms may endogenously respond to the crisis in 2010 by changing organizational structures.

Each of the 6 decentralization questions is normalized on a scale from zero to one, with one being most decentralized and zero being least decentralized. For example, question 18 reads "In 2005 and 2010, where were decisions on hiring permanent full-time employees made?" There are three possible responses: "Only at this establishment" which is assigned the value one; "Both at this establishment and at headquarters" which is assigned a value of one-half; "Only at headquarters" which is assigned a value of zero. We then standardize each question to have a mean equal to zero and standard deviation equal to one, take the mean over all six standardized questions, and then standardize this mean so that it has a mean equal to zero and standard deviation equal to one.

A.3.3 Product Churn

Product churn is constructed using data come from the US Census Bureau's Census of Manufactures (CM). The CM asks establishments to list the dollar value of annual shipments by 10-digit product code. Establishments receive a list of all the product codes typically produced by establishments in their industry, along with corresponding descriptions of each code.

We start by calculating the total number of 10-digit products by each establishment in a given year, as well as the number of added products and the number of dropped products for each establishment compared to the previous CM 5 years earlier. This of course restricts the sample to manufacturing establishments which were alive five years earlier. We further restrict the sample by dropping establishments producing fewer than 3 products in both Censuses. Product churn at the establishment level is measured as the number of products added or dropped between the

previous Census and the current Census, divided by the average number of products produced in both Censuses. That is, product churn for establishment i in year t is defined as:

$$\text{Product Churn}_{i,t} = \frac{\text{Products Added}_{i,t} + \text{Products Dropped}_{i,t}}{0.5\,(\#\ \text{Products}_{i,t} + \#\ \text{Products}_{i,t-5})}$$

Industry product churn in year t is the average establishment-level product churn amongst establishments within an industry (three digit US SIC-1987). To calculate industry-level change in product churn, we simply subtract product churn in 2007 (constructed from the product data in the 2002 and 2007 Censuses) from product churn in 2012.

A.3.4 ASM variables

Directly from the ASM we obtain material inputs, shipments (deflated by a three digit price deflator) as our sales measure and the headcount of employees for labor. Real capital stocks are constructed using the perpetual inventory method, following the methodology in Bloom et al. (2014). In particular, we combine detailed data on the book value of assets every 5 years from the CM with annual investment data from the ASM. We first convert CM capital stocks from book to market value using BEA fixed asset tables. We then deflate capital stocks and investment using industry-year price indices from the NBER-CES Manufacturing Industry Database. Finally, we apply the perpetual inventory method, using the formula $K_t = (1 - \delta_t)K_{t-1} + I_t$. This procedure is done separately for structures and for equipment. However, since the ASM contains investment broken down into investment in equipment and investment in structures, but the CM does not break down capital stocks into these two components, we must apportion plant capital stocks into each component. We do this by assigning the share of capital stock to equipment and structures which matches the share of investment in equipment and structures.

B Magnitudes

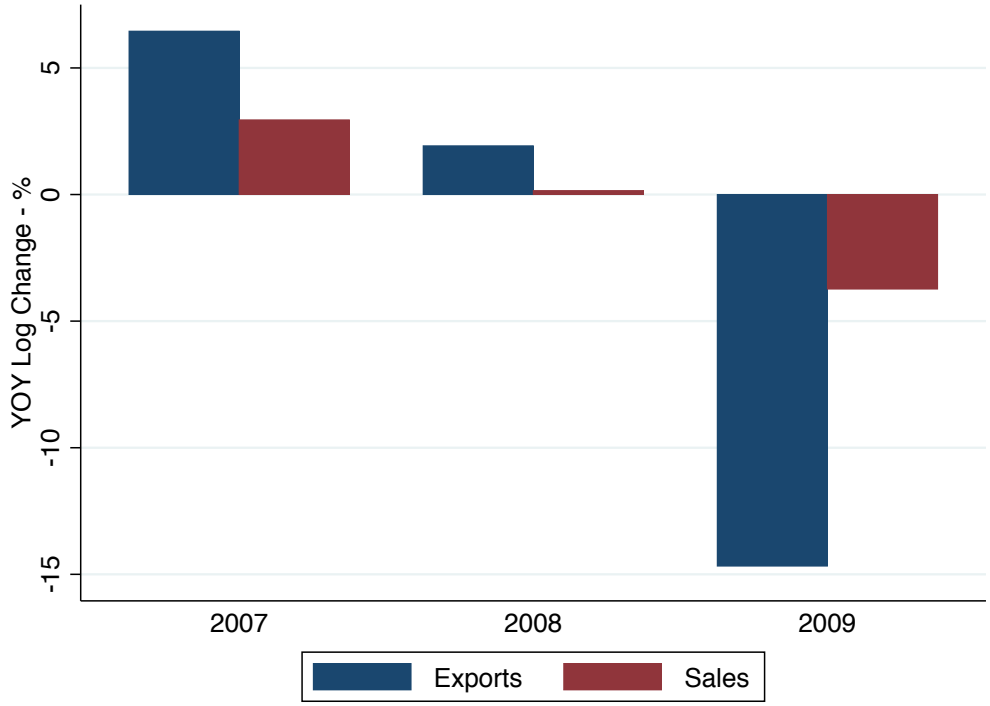
In Table A9 we consider some simple calculations of cross-country magnitudes. Our thought experiment is to consider the Great Recession as a global shock as reflected by a fall in trade. We use the US value of the shock from COMTRADE of a fall in exports of 7.7 percent. This is the empirical difference between 2009-08 vs. 2007-06 that we use as our industry-country specific shock measure elsewhere in the paper.

We take the 2006 average levels of cross-country decentralization by country (column (1) of Table A9) and the empirical estimates in column (2) of Table 2 to estimate the average annual implied effect of GDP of the shock (column (2) of Table A9). We express this relative to the US in column (3). For all countries except Sweden there is a negative relative implied effect because decentralization in the US is greater than every other country except Sweden. Column (4) displays the actual annual change in GDP growth since the start of the global financial crisis (from World Bank data)for each of our countries and then again expresses these relative to the US base in column (5). Every country except Poland (which is still in a strong catch-up phase of development) experienced a slower growth performance than the US over this period, averaging just over a third of a percentage point (base of column). Column (6) divides the column (3) into column (5) which is the fraction of relative economic performance accounted for by decentralization (note that since we are assuming a common shock, none of this difference is due to the magnitude of the crisis being worse in some countries than others).

Overall, column (6) of Table A9 suggests that an average of 16% of the post-crisis growth experience between countries is accounted for by decentralization. This is non-trivial as mentioned in the text, but it is worth noting that there is a large degree of heterogeneity between countries underneath this average. Almost all of the differential growth experience of France and Japan compared to the US can be accounted for by decentralization (96% and 95% respectively), whereas decentralization accounts for virtually none of the UK's performance. In particular, as noted above, because Sweden is more decentralized than the US we should expect it to have outperformed the US, whereas it grew about half a percentage point more slowly. If we drop Sweden, the importance of decentralization doubles to accounting for almost a third of the difference (32%). Note that the

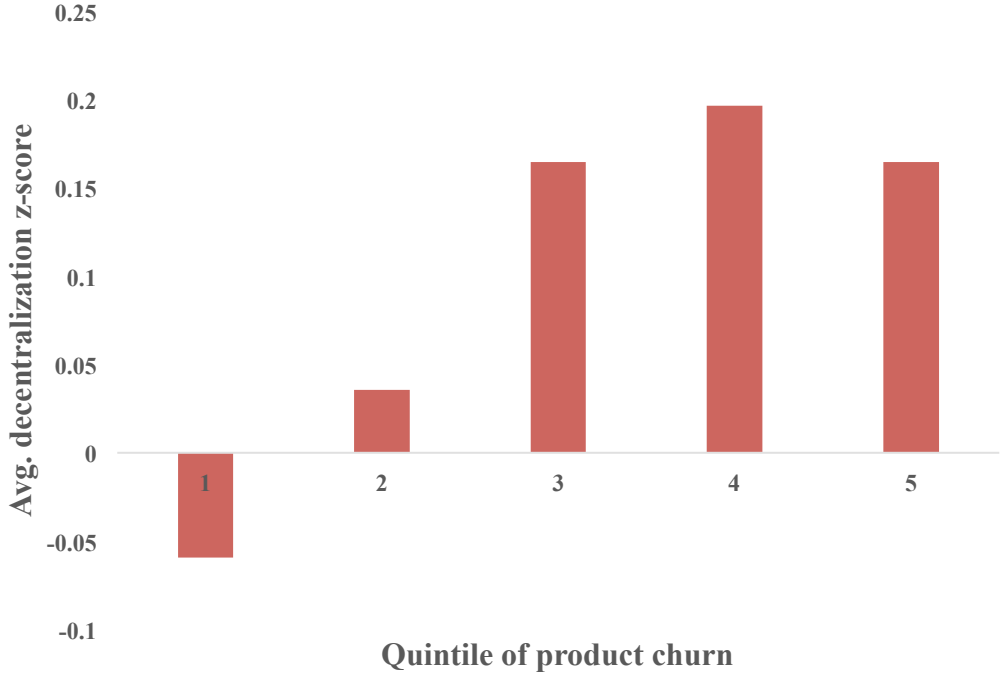
contribution is also negative for Poland, because although Poland is more centralized than the US, it grew more quickly over this time period.

Figure A1: Change in Industry/Country Exports and Sales before and after the Great Recession



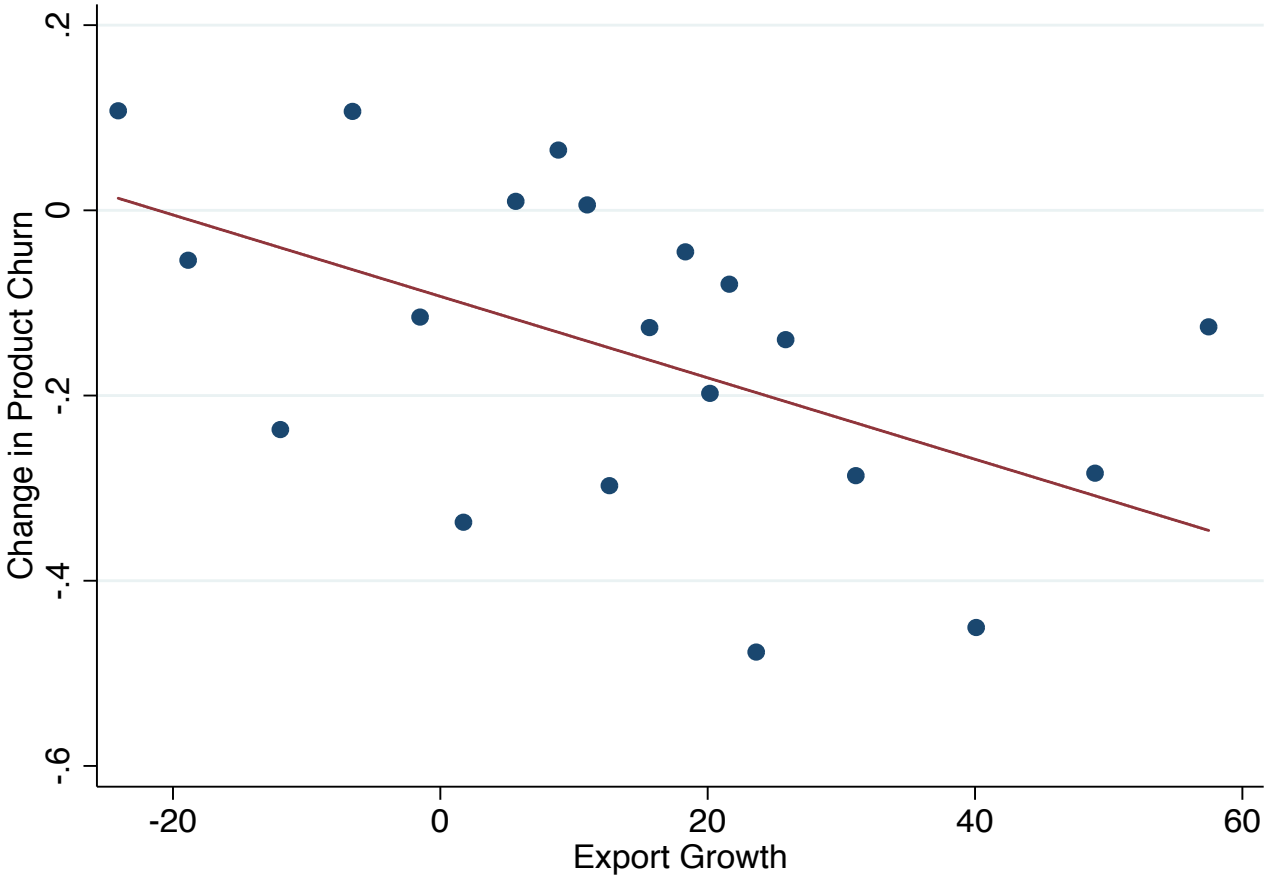
Notes: Each bar plots the yearly percentage change in real manufacturing exports. The countries included in the sample are France, Germany, Greece, Italy, Japan, Poland, Portugal, Sweden, UK and US.

Figure A2: Average Decentralization Z-score by Quintile of Product Churn



Notes: MOPS data. Industry product churn is the average of plant product churn. Plant product churn = (products added from '02 to '07 + products dropped from '02 and '07)/(0.5* products produced in '02 + 0.5* products produced in '07).

Figure A3: Change in Industry Product Churn and Export Growth



Notes: MOPS data. Change in product churn is industry product churn in 2012 minus industry product churn in 2007. Exports growth is the change in ln(exports) from 2007 to 2012. Both variables are winzorized at the 5th and 95th percentiles and measured at the level of the three-digit industry. Vingtiles plotted.

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: Robustness of results to interactions of Export growth with other firm-level variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable: Sales Growth							
Decentralization	0.041	-0.098	0.026	0.046	-0.241	0.044	-0.078
	(0.417)	(0.423)	(0.416)	(0.431)	(0.451)	(0.417)	(0.424)
Decentralization*EXPORT Growth	-0.047**	-0.054***	-0.046**	-0.043**	-0.049**	-0.047**	-0.049**
	(0.018)	(0.018)	(0.018)	(0.018)	(0.020)	(0.018)	(0.019)
Management		0.977					
		(0.664)					
Management*EXPORT Growth		0.042*					
		(0.025)					
Log(% employees with a college degree)*EXPORT Growth			0.023				
			(0.038)				
Workers' decentralization				-0.038			
				(1.015)			
Workers' decentralization*EXPORT Growth				-0.074*			
				(0.040)			
Foreign Plant Manager					0.478		
					(2.293)		
Foreign Plant Manager *EXPORT Growth					0.182***		
					(0.069)		
Male Plant Manager						-0.392	
						(1.662)	
Male Plant Manager*EXPORT Growth						0.046	
						(0.052)	
Plant Manager Age							-3.687
							(2.966)
Plant Manager Age*Export Growth							-0.104
							(0.093)
Observations	3,151	3,151	3,151	3,097	2,784	3,151	3,125
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: WMS Data. *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country level in all columns. Specifications are the same as Table 2 column (3) except augmented with additional variables from the WMS (linear and interacted with export growth). Management is the z-scored average of 18 z-scored management questions (see Bloom and Van Reenen 2007 for details). "Log(percentage employees with a college degree)" is the natural logarithm of the percent of employees with a bachelors degree. Worker decentralization is the z-scored average of 2 questions on worker autonomy. Foreign/Male plant manager=1 if plant manager is from a foreign country or male, respectively.

Table A3: Robustness of results to interactions of Decentralization with other industry-level variables

	(1)	(2)	(3)	(4)
Dependent Variable		**Sales Growth**		
Decentralization	-0.492	-0.270	0.348	-0.282
	(1.748)	(2.408)	(0.605)	(1.460)
Decentralization*EXPORT Growth	-0.039**	-0.036**	-0.040**	-0.036**
	(0.018)	(0.018)	(0.017)	(0.017)
Decentralization*Asset tangibility	2.167			
	(5.914)			
Decentralization*Inventory/Sales		2.367		
		(14.911)		
Decentralization*External finance dependency			-0.777	
			(1.556)	
Decentralization*Labor costs				2.128
				(7.732)
Observations	3,132	3,132	3,132	3,132
Number of firms	1,545	1,545	1,545	1,545
Cluster	SIC3*Cty	SIC3*Cty	SIC3*Cty	SIC3*Cty

Notes: WMS Data. *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country level in all columns. Specifications are the same as Table 2 column (3) except augmented with additional variables. "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 costs" 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).

Table A4: Decentralization and Product Churn

	(1)	(2)	(3)	(4)	(5)	(6)
	U.S. Census Data - MOPS					
Dependent Variable: Decentralization z-score						
Decentralization Questions	**All**		**Capital Expenditure, Hiring, and Raises**		**Product Introductions and Sales and Marketing**	
Product Churn	0.016***	0.016***	0.004	0.008**	0.020***	0.017***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Management		-0.010***		0.005		-0.019***
		(0.004)		(0.004)		(0.004)
Log(% employees with a college degree)		0.057***		0.044***		0.049***
		(0.004)		(0.004)		(0.004)
Log(plant employment)		0.035***		0.056***		0.006*
		(0.004)		(0.004)		(0.004)
log(firm employment)		-0.012***		-0.002		-0.016***
		(0.002)		(0.002)		(0.002)
Observations	8,774	8,774	8,774	8,774	8,774	8,774
Controls						
Industry (SIC3)		**y**		**y**		**y**
Noise		**y**		**y**		**y**
Cluster	SIC3	SIC3	SIC3	SIC3	SIC3	SIC3

Notes: MOPS Data. *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry level. The dependent variable in columns (1) and (2) is overall decentralization z-score. The dependent variable in columns (3) and (4) is the z-scored average of the z-scored measures of plant manager autonomy in hiring, capital investments, and pay raises. The dependent variable in columns (5) and (6) is the z-scored average for product introduction and marketing questions. "Product Churn" is the three digit industry level value of the average change in the (number of products added between t and t-5 plus the number products dropped between t and t-5)/(average number of products between t and t-5).

Table A5: Decentralization and Product Churn, by type of Decentralization

	(1)	(2)	(3)
		Exports	
Panel A: Decentralization of Sales, Marketing, and New Products			
Dependent Variable: Sales growth ('12-'07)			
Decentralization	0.198	0.191	0.304*
	(0.147)	(0.1518)	(0.1622)
Decent*Change in Product Churn		1.859***	1.587**
		(0.370)	(0.396)
Decent*Export Growth ('12-'07)	-0.029**		-0.011
	(0.007)		(0.008)
Decent*Durability			
Firms	3,004	3,004	3,004
Observations	8,243	8,243	8,243
Panel A: Decentralization of Hiring & Investment			
Dependent Variable: Sales growth ('12-'07)			
Decentralization	0.682***	0.692***	0.743***
	(0.169)	(0.157)	(0.166)
Decent*Change in Product Churn		0.604*	0.541
		(0.330)	(0.351)
Decent*Export Growth ('12-'07)	-0.009		-0.004
	(0.007)		(0.008)
Decent*Durability			
Firms	3,004	3,004	3,004
Observations	8,243	8,243	8,243
Cluster	SIC3	SIC3	SIC3

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry level. The dependent variable is the annualized five-year change of firm ln(sales), 2012-2007. The dependent variable in Panel A is the z-scored average of the z-scored measures of plant manager autonomy in hiring, capital investments, and pay raises. The dependent variable in Panel B is the z-scored average for product introduction and marketing questions. The variable Change in Product Churn" is measured by subtracting 2007-2002 industry product churn from 2012-2007 industry product churn. "EXPORT Growth" is the 20012-2007 change in ln(exports) by three digit industry cell. All columns include three digit industry dummies and controls for firm and plant size, skills and "noise" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration, whether the survey was answered online or by mail).

Table A6: Decentralization and Financial Constraints

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable = Sales Growth			**U.S. Census Data (MOPS)**				
Decentralization	0.417***	0.3506	0.5934	0.1752	0.2704	0.349**	0.4183***
	(0.153)	(0.76)	(0.7893)	(0.401)	(0.38)	(0.1585)	(0.1532)
EXPORT Growth	0.0099		0.0095		0.0117		0.0099
	(0.0122)		(0.0121)		(0.0119)		(0.0122)
Decent*EXPORT Growth	-0.0192*		-0.0197*		-0.0207**		-0.0193*
	(0.0106)		(0.0109)		(0.0103)		(0.0107)
ABX exposure		-0.4003*	-0.3953				
		(0.2374)	(0.2386)				
Decent.*ABX exposure		-0.0031	-0.0465				
		(0.2042)	(0.2099)				
Lehman exposure				x	x		
				x	x		
Decent.*Lehman exposure				x	x		
				x	x		
Lender health						-0.0019	0.0126
						(0.4597)	(0.453)
Decent*Lender health						0.0001	0.0243
						(0.3407)	(0.3417)
Observations	2000	2000	2000	2000	2000	2000	2000
Controls							
Firm & plant employment, skills	**y**	**y**	**y**	**y**	**y**	**y**	**y**
Cluster	Lender	Lender	Lender	Lender	Lender	Lender	Lender

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered by the firm's primary lender. The dependent variable is the annualized three-year change of firm ln(sales) from 2009-06. Decentralization is measured in 2005. "EXPORT Growth" is change in ln(exports) by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). "Lender exposure to housing bubble" is the . "ABX exposure" is the correlation of the firm's lender's daily stock returns with the return on the ABX AAA 2006-H1 index, which follows the price mortgage-backed securities issued with a AAA rating. "Lender health" is an aggregation of lender balance sheet variables including trading account losses, real estate charge-offs, and the deposits to liabilities ratio. We combine these variables into one lender health measure by normalizing each to have mean 0 and standard deviation 1, taking an average, and then normalizing this average to have mean 0 and standard deviation 1. All columns include "noise controls" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration, whether the survey was answered online or by mail). Firm and plant size are ln(employment) are skills is the ln(percentage of employees with a college degree).

Table A7: Changes in Decentralization

	(1) World Management Survey	(2) U.S. Census Data
Dependent Variable	**Change in Decentralization (2010/2009 - 2006)**	**Change in Decentralization (2010-2005)**
EXPORT Growth	-0.012**	-0.001*
	(0.006)	(0.000)
Observations	222	8,774
Controls		
Country	y	
Year	y	
Industry (SIC2)	y	y
Log firm and plant employment	y	y
Skills	y	y
Noise	y	y
Cluster	SIC3*Cty	SIC3

Notes: *significant at 10%; ** 5%; *** 1% level. Estimated by OLS with standard errors clustered at three-digit industry by country level in column (1) and just industry in column (2). The dependent variable is the 2010/2009-2006 change in z-scored decentralization in column (1) and the 2010-2005 change in column (2). "EXPORT Growth" is change in ln(exports) in country by three digit industry cell between the 2008 and 2009 average (the main Great Recession years) compared to the 2006 and 2007 average (the latest pre-Recession years). All columns include two digit industry, country and year dummies and "noise controls" (plant manager's tenure and hierarchical seniority and the interview's reliability score, day of the week and duration, WMS also includes analyst dummies and MOPS whether the survey was answered online or by mail). Firm and plant size are ln(employment) are skills is the ln(percentage of employees with a college degree).

Table A8: Decentralization and Cross-Country Growth

	1	2	3	4	5	6
	Decentralization Index	**Implied GDP Growth**	**Difference in implied GDP growth relative to US**	**Actual annual average GDP growth (2012-2008)**	**Difference in actual GDP growth relative to US**	**% of growth difference accounted for by Decentralization**
France	-0.357	-0.72	-0.453	0.24	-0.473	96%
GB	0.292	-0.28	-0.007	0.074	-0.64	1%
Germany	0.134	-0.39	-0.116	0.443	-0.271	43%
Greece	-0.801	-1.03	-0.758	-5.438	-6.152	12%
Italy	-0.242	-0.64	-0.374	-1.243	-1.957	19%
Japan	-0.642	-0.92	-0.648	0.029	-0.685	95%
Poland	-0.344	-0.71	-0.444	2.534	1.82	-24%
Portugal	-0.264	-0.66	-0.389	-1.42	-2.134	18%
Sweden	0.544	-0.1	0.166	0.567	-0.147	-113%
US	0.303	-0.27		0.714		
Average	1	-0.572	-0.336	-0.35	-1.182	16%

Notes: All GDP growth numbers in percentage points. Implied GDP growth in column (2) uses the coefficients on the model of column (2) Table 2 combined with the value of decentralization from (1) and an assumed shock of 7.7 percent (the empirical fall in aggregate US exports in the Great Recession as in our model). Actual GDP growth in column (4) is taken from the World Bank market sector GDP series. Relative values in column (3) and (5) are the simple differences from the US base. Sweden has a negative value in column (6) because it is the only country more decentralized than US, but had a weaker GDP performance. Poland has a negative value because it had faster growth than the US despite being more centralized (it is still in a catch up phase of growth).