Adapting to economic crisis: firm boundary and location effects

Abstract: This study examines how organizational form and geographic location affect a firm's ability to adapt to a severe demand shock such as that associated with the recent financial crisis. Drawing on a rich dataset of manufacturing firms in Spain, I show that while vertically-integrated firms performed better in 'steady state,' they suffered greater declines in the aftermath of the crisis. I also show that the performance difference is increasing in the level of local agglomeration economies, consistent with the argument that vertically-integrated firms derive fewer adaptation benefits from clusters. These results highlight the interaction between firm scope and location, and suggest that determining the optimal organizational form requires an assessment of the advantages and disadvantages of autonomous versus coordinated adaptation across economic cycles and geographies.

Keywords: Firm adaptation, firm scope, geographic location, industrial agglomeration, economic crisis.

1. INTRODUCTION

The financial crisis of 2008 challenged the conventional ways businesses operate, as global economic activity dropped more precipitously than at any time since World War II (Alfaro and Chen, 2012). [1] The sharp reduction in consumer demand and an accompanying credit crunch challenged the ability of managers to make the rapid adjustments necessary for sustained profitability or even continuation of their operations. Long-term plans took a back seat and short-term *adaptation* became a priority, as firms attempted to navigate the adverse conditions: production cuts, austerity plans, and cash management became the order of the day.

The problem of adaptation has been at the core of organizational scholars' intellectual inquiry for many years. Building on Williamson's (1985; 1991) seminal work, numerous studies have explored the different adaptation features of market and hierarchy (i.e. vertical integration) and the conditions under which each organizational mode is beneficial or detrimental (Wernerfelt, 1997, 2004; Novak and Stern, 2008; Forbes and Lederman, 2010; Costinot, Oldenski and Rauch, 2011). This literature has identified a fundamental trade-off between the two organizational modes: the market is superior in terms of autonomous adaptation while hierarchy facilitates coordinated adaptation. Consideration of this trade-off in the context of an economic crisis raises intriguing questions about the link between organizational form and firm performance during a downturn. To the extent that responding to crisis disproportionately calls for one type of adaptation over the other, we should expect to see different short-term changes in performance depending on the degree of vertical integration of the firm. .

[1] GDP fell by 4.5 percent in industrial countries and world trade plunged by over 40 percent in the second half of 2008.

A different stream of research grounded in the field of economic geography suggests that the *location* of a firm's operations may also impact its ability to adapt to an economic downturn. A robust finding emerging from this literature is that concentration of industrial activity in a geographically-bounded cluster creates external economies, or "agglomeration benefits" (Marshall, 1920): thick pools of specialized suppliers and labor as well as rich knowledge spillovers increase the productivity of firms in densely-populated clusters (Rosenthal and Strange, 2004). Although firm adaptation has not been an explicit focus of research in this tradition, a natural inference is that thick input markets associated with agglomeration may facilitate rapid adaptation in the face of an economic shock, thus benefiting firms located in dense clusters.

Building on insights from these two scholarly traditions, I examine how organizational form and geographic location together affect a firm's ability to adapt to the severe demand shock associated with the recent global economic crisis. I argue that agglomeration economies shape the structure of resource opportunities[2] available in the market, while organizational form influences the extent to which a firm can capitalize on these opportunities. I contend that analysis of this interplay between locational and organizational advantages offers new insights into firm adaptation and performance.

The empirical context of my study is the manufacturing sector in Spain, one of the countries hardest hit by the global economic crisis. Drawing on rich financial data for almost two thousand firms in twenty manufacturing industries over a five-year period (2005-2009), I explore the extent to which organizational form and agglomeration economies shape a firm's ability to

[2] The structure of resource opportunities refers to the configuration of production factors (inputs, labor and knowledge) that may be accessible to agents in a particular geographic location.

adapt to the severe demand shock of 2008. The ocurrence of the unexpected shock allows me to identify how the two dimensions independently and together influenced the firm's ability to make adjustments and adapt to new demand and supply conditions.

The empirical patterns are striking. First, vertically-integrated firms suffered greater performance declines in the immediate aftermath of the crisis relative to their more market-based (non-integrated) counterparts, all else equal. This performance differential is driven primarily by relative changes in variable production costs rather than by changes in fixed costs, sale volume, or prices in end product markets. Second, agglomeration economies increased the performance differential between vertically-integrated and non-integrated firms, consistent with the argument that the benefits of agglomeration are not homogeneous across organizational forms.

It is important to note that these findings do not imply that vertical integration is a *per se* inferior mode of organization. Indeed, in absolute terms, the vertically integrated firms in the study were, on average, performing better than their non-integrated counterparts before the economic meltdown. The lesson then is that the gains from coordinated adaptation under normal demand conditions may impose a disadvantage in some states of the world – most particularly during a sharp economic downturn – and in some geographic locations. Determining the optimum organizational form thus requires an assessment of the relative advantages and disadvantages of autonomous versus coordinated adaptation with respect to business cycles and location characteristics.

The remainder of the paper is organized as follows: In Section 2, I briefly review the prior literature that illuminates how firm boundaries and agglomeration economies shape adaptation to a changing environment, and derive hypotheses predicting how these dimensions

influence firm performance during a severe economic downturn. Section 3 describes the empirical setting, variables and analysis. In Section 4, I present and discuss the results. Section 5 explores the robustness of the empirical findings. Section 6 concludes.

2. THEORY DEVELOPMENT AND HYPOTHESES

2.1 Boundaries of the firm and adaptation

The distinctive adaptation attributes of market versus hierarchy are rooted in differences in commitment levels between exchange partners (Williamson, 1983). In market transactions, each party seeks to maximize his individual expected profit, taking into consideration the structure of opportunities available in the market. Commitment to a particular partner tends to be weak (Williamson, 1985), as in each period, buyers and suppliers observe the prevailing supply and demand conditions and decide whether to continue, renegotiate or terminate current agreements. If a bargaining outcome is not satisfactory, the parties may decide unilaterally to switch to an alternative buyer or supplier. Timely renegotiation and flexibility to exploit changing market opportunities in an autonomous fashion thus constitute the basis for adaptation under the market mode (Novak and Stern, 2008).

While facilitating unilateral adaptation, the relatively weak commitment to an exchange partner in market transactions may lead to undesirable consequences under some circumstances. Weak commitment introduces uncertainty into a relationship as transactions may fail even after the supplier has made investments in production assets. This may be a trivial problem if the agent can redeploy the assets to an alternative buyer without loss. However, as a well-established theoretical and empirical literature shows, this may not be feasible for idiosyncratic assets and inputs built to the buyer's specifications. Under these circumstances, weak commitment leads to

inefficient investment by suppliers (Williamson, 1985; Lafontaine and Slade, 2007) and potential pricing distortions (Williamson, 1983).

Vertical integration arises as a means to solve this efficient investment problem by creating a strong commitment to the exchange partner.[3] A hierarchical interface also appears as an arbiter to enforce this commitment. The supplier and buyer, now under the same organizational boundary, 'sink' their investments in physical and human capital knowing that the counterpart is bound to honor commitments to deliver and/or take delivery of inputs, in almost all demand states (Williamson, 1983; Ahmadjian and Oxley, 2011).[4] Joint interest thus characterizes the trading relationship, and the administrative authority associated with hierarchy reduces the risk of diverging interests and autonomous reactions. As a result, jointly-efficient investment levels and coordination constitute the basis for adaptation under vertical integration (Wernerfelt, 1997, 2004; Novak and Stern 2008; Forbes and Lederman, 2010; Costinot, Oldenski and Rauch, 2011).

Consider now what happens during an economic crisis. A severe demand shock results in increased competition on the supply side and thus lower prices. Under market transactions, non-integrated manufacturers start mobilizing the new supply and demand conditions as levers to improve exchange agreements. They may cancel input orders, pressure suppliers to reduce mark-ups, switch to suppliers that offer cheaper alternatives, and/or threaten current suppliers that they will switch if exchange agreements are not improved. Suppliers must adjust their offerings to the increasingly adverse market conditions or risk losing their relative competitiveness and being

3 In principle, long-term contracts could solve the uncertainty in the relationship. However, since contracts are inherently incomplete and costly to enforce (Crocker and Masten, 1991; Crocker and Reynolds, 1993; Maskin and Tirole, 1999), they may not safeguard the primacy of cooperative over self-interested actions when the latter pre-empt an advantage.

4 This argument does not rule out states where divestiture may be the optimal action.

selected out of the market. Under vertical integration, exchange partners know they have to work things out together and that 'going it alone' is not a viable response when one considers not only the short-run impact on performance but also the stream of future profits inside a strong relationship. And while integrated producers can use their coordination advantage to introduce adjustments to productive processes and/or market products (Wernerfelt, 1997, 2004; Novak and Stern 2008), adjustments of this nature typically involve multiple iterations and evaluation cycles before becoming viable options. As such, their implementation requires a relatively longer horizon to deliver performance benefits.[5]

Putting these arguments together suggests that when an economic crisis hits, the performance of vertically integrated firms will decline faster in the short term relative to non-integrated counterparts, since coordinated adaptation measures take longer to deliver benefits. The strong commitment between transacting agents mutes the firm's ability and/or willingness to renege on or renegotiate agreements already in place, or otherwise to exploit the modified structure of opportunities available in the market. Formally, I propose

H1: *The short-term decline in performance following a negative demand shock will be greater for vertically-integrated firms than for non-integrated firms.*

2.2 Agglomeration economies and adaptation

A large body of work with roots in economic geography has shown how industrial agglomeration shapes economic performance. The main finding has been that firms located in proximity to other organizations in the same or related industries benefit from pooling of specialized suppliers

[5] Novak and Stern (2008) document this dynamic trade-off in the automotive industry. They show that non-integrated firms display higher performance (i.e. quality rating for seven automobile systems) every time a vehicle goes under a major model change (i.e. short-term effect). But vertically-integrated firms display greater performance increases over the lifecycle of each model (long-term effect).

and labor as well as from knowledge spillovers within the cluster (Marshall, 1920; Rosenthal and Strange, 2001; Ellison, Glaeser, and Kerr, 2010). Such agglomeration economies[6] are locally confined and attenuate sharply with distance (Jaffe, Trajtenberg, and Henderson, 1993; Rosenthal and Strange, 2003, 2008). By tapping into these location-specific economies, firms may develop advantages in terms of productivity and innovation relative to rivals outside the cluster.

Many of the benefits of industrial agglomeration come from the rich structure of resource opportunities available in the local market. Industrial agglomerations offer rich pools of specialized suppliers that provide a wide variety of intermediate goods and services suited for a broad array of preferences and needs. This rich pool of providers in the firm's proximity is important to reduce input prices and transaction costs (e.g. search and transport cost) as well as to facilitate a good matching between buyers and suppliers (Holmes, 1999; Grossman and Helpman, 2002). The benefits from input-market thickness also have non-trivial effects on firm and industry productivity in the long run (Bartlesman, Caballero, and Lyons, 1994). In general, thick input markets are seen to unleash a rich and diverse set of supply chain possibilities for industry participants.

Industrial agglomerations also give rise to thick labor markets as specialized workers are attracted to carry out the productive activities associated with a geographic region (Baumgartner, 1988; Garicano and Hubbard, 2009), leading to superior labor productivity (Glaeser and Mare, 2001) and localized human-capital externalities (Hanson, 2001). Thick pools of skilled and high-

[6] Other scholars have also explored agglomeration costs. These manifest in two ways, higher labor and land cost (Glaeser and Mare, 2001; Hanson, 2001) and increased competition in product markets (Baum and Mezias, 1992; Alcacer, 2006). In this sense, productivity gains from having access to superior production factors in industrial agglomerations may not result in higher profitability of firms.

quality workers improve a firm's access to specialized talent suited to its specific labor requirements and allow it to better adjust employment levels according to demand fluctuations: firms know that if they lay off workers today, they have a good chance to find skilled employees at low search and training costs in the future (Helsley and Strange, 1990).

Finally, industrial agglomerations also offer rich knowledge spillovers. Geographic concentration of a productive activity increases the probability and speed of formal and informal interaction among economic agents (Jaffe, Trajtenberg, and Henderson, 1993; Saxenian, 1994; Glaeser, 1999). Authors have pointed out that spillovers explain why knowledge-intensive industries and productive activities tend to be more clustered geographically (Audretsch and Feldman, 1996; Alcacer, 2006). The literature agrees that knowledge spillovers, though difficult to trace and measure, represent an important vehicle for the growth of regions, industries and firms.

In addition to providing productivity benefits under steady demand conditions, we might conjecture that agglomeration economies also facilitate adaptation in the face of an economic downturn. A rich set of market resources allow firms to adjust their production factors in a relatively opportune and inexpensive fashion: Thick input markets are more likely to provide suitable and cost-efficient supply alternatives, serving as both levers to renegotiate agreements and real options that may be exercised to reduce production costs. Thick labor markets also enable firms to make timely lay-off decisions and thus reduce labor according to demand conditions. Conversely, in locations where specialized labor is relatively scarce, the manufacturer has to delay the lay-off decision since it is less likely to find suitable workers in the future. Finally, rich knowledge spillovers in geographic locations may also have an effect on firm's adaptation ability. The rich generation and informal exchange of ideas increases the

probability that a particular firm will discover and implement effective measures to cope with adverse demand conditions. Together these arguments suggest that following hypothesis:

H2: *The short-term decline in performance following a negative demand shock decreases in the level of agglomeration economies in the vicinity of the firm.*

2.3 Agglomeration economies, boundaries of the firm and adaptation.

Considering the adaptation features of different organizational forms alongside the benefits associated with agglomeration allows us to generate additional insights into adaptation and performance during a downturn. As discussed above, one of the primary benefits of agglomeration is improved matching of buyers and suppliers (Grossman and Helpman, 2002). In the context of a negative demand shock, good matching has greater direct and indirect value to the non-integrated firm given its relatively weak commitment to current exchange partners. As prevailing prices decline in the face of the demand shock, the pool of alternative suppliers become relatively more attractive, increasing the buyer's bargaining power in current relationships and potentially allowing for renegotiation of existing contracts. If the buyer opts out of an existing relationship, a thick pool of specialized suppliers increases the probability of finding a well suited exchange partner in a timely fashion.

A vertically integrated firm benefits less from the efficient 'rematching' associated with thick resource markets in an agglomeration due to its binding commitments to related suppliers: Commitment to work things out internally effectively decouples the vertically integrated firm from changing opportunities in surrounding resource markets. This argument thus implies the following hypothesis:

H3: *The effect of agglomeration economies on short-term changes in performance following a negative demand shock is weaker for vertically integrated firms than for non-integrated firms.*

3. EMPIRICAL ANALYSIS

3.1 Data

My empirical analysis exploits a rich firm-level dataset, obtained from the annual 'Encuentra Sobre Estrategias Empresariales'[7] (ESEE) conducted in Spain by Fundacion Sepi with the support of the Ministry of Industry and Energy. The survey examines twenty industries in the manufacturing sector. One of the salient features of ESEE is its representativeness, combining characteristics of both a census and a survey. It includes all the firms with over two hundred employees operating in the country, together with a probabilistic sample of firms with ten to two hundred employees. This broad coverage offers advantages over previous studies where data has been restricted to large publically listed firms (e.g Lieberman and Dhawan, 2005; Forbes and Lederman, 2010; Ahmadjian and Oxley, 2011).

The level of industry participation reported in the ESEE data is equivalent to 3-digit NAICS with a few cases in which the industry definition is equivalent to 4-digit NAICS.[8] Table 1 presents the complete list of industries that are examined in the survey. I also supplement this data with information from the Central Companies Directory published annually by the Instituto

[7] Survey on Business Strategies.
[8] The industry classification follows the statistical classification of economic activities in the European Community (NACE for its French acronym). The twenty industries included in the ESEE can be easily mapped onto the North American Industry Classification System (NAICS).

Nacional de Estadística'[9] (INE) to compute the location variables in each of the seventeen autonomous communities[10] (hereafter locations) included in the sample.

[Insert Table 1 here]

The initial unbalanced panel comprises a total of 2,718 manufacturing firms operating in Spain at some time over the period 2005 – 2009. This initial sample includes 9,970 firm-year observations. Missing data filing and outlier exclusions yield 2,631 firms operating in the study period for a minimum of two and maximum of five years. This gives an effective sample of 9,456 firm-year observations. Although the data is at the firm level, 86 percent of the firms correspond to single-plant operations, a feature which simplifies the analysis of the agglomeration effect. [11]

3.2 Empirical Approach

The performance effects of organizational form and agglomeration are difficult to identify empirically under normal demand conditions: We would expect that a profit-maximizing firm anticipates the heterogeneous effect of alternative organizational forms and agglomeration economies on profits and chooses both the location and organization that maximizes the discounted expected value of future profits given its own endowments and competitive position. Simple cross-sectional comparisons between firms that have selected a location-organization pair will thus fail to identify the performance implications of either organizational form or

[9] National Statistics Institute.
[10] Autonomous community is the first level of political division of Spain. Its average size represents about 15% of the average area of a state in the US or 4% of a province in Canada. Spain is divided in seventeen autonomous communities and two autonomous cities. The ESSEE excludes the latter.
[11] ESEE provides information at the firm level. Firms with multi-plant operations may have their plants located across different autonomous communities. The dataset identifies these multi-plant firms but not the individual plant locations. After dropping these set of firms from the sample, the empirical results remain qualitatively invariant.

agglomeration. Identification requires variation that is exogenous from the firm's perspective. An unexpected demand shock meets this criterion.

My empirical approach exploits the exogenous demand shock associated with the global financial crisis, which hit the Spanish economy in 2008 but whose impact became more evident in 2009. For the first time since 1993, the real growth of the Spanish economy showed a negative rate with a contraction magnitude without precedent: real GDP grew only 0.9% in 2008 –and suffered an absolute decline of 3.7% in 2009. The manufacturing sector suffered the worst impact with a contraction of almost 15% of total output value in 2009 (http://www.ine.es). [12] The severe contraction that the Spanish economy experienced in 2008 and 2009 (and which continues to date) was largely unanticipated and was almost certainly orthogonal to organizational form and firm locations that resulted from strategic decisions made well in advance of the onset of the crisis.

3.3 Variables and estimating equations

Dependent variables: The measure of performance that forms the dependent variable in most of the analysis reported below is Return on Assets (***ROA***), measured as EBITDA divided by the value of total assets in each year. To further unpack the mechanisms driving the performance differences among firm types, I use ***Variation of Input Prices*** as the dependent variables in supplementary analysis. All variable definitions as well as their correlations and descriptive statistics are shown in Tables 2 and 3 respectively.

[Insert Table 2 here]

[12] The firms in the ESSE survey examined here lost -23.2% of their sales in 2009 after having lost -7% in 2008.

Independent variables: i) Vertical Integration ($\boldsymbol{VI_i}$): My focus in this paper is on backward integration defined as in-house production of intermediate inputs. Following previous work in economics and strategy (Tucker and Wilder, 1977; Levy, 1985; Barney et al, 1992; Holmes, 1999; Lieberman and Dhawan, 2005), I measure the level of vertical integration by the ratio of added value over total sales. The rationale for this measure is that vertical integration reduces the proportion of purchased inputs relative to in-house production, thus increasing the ratio of added value to sales. $\boldsymbol{VI}$ is a dummy variable that equals 1 if the firm's average ratio of added value over total sales during the five-year period is above its own-industry average over the same period, 0 otherwise.[13] Exploiting within-industry variation is important to avoid potential distortions from systematic difference in levels of added value across industries.[14]

ii) Agglomeration ($\boldsymbol{AGGLOMERATION_{jkt}}$): Following the tradition in agglomeration research (Head et al., 1995; Shaver and Flyer, 2000), I proxy agglomeration economies using the number of establishments in a particular industry and location divided by the nation-wide total number of establishments in the same industry.[15]

iii) Negative demand shock ($\boldsymbol{SHOCK_t}$): To capture the impact of the negative demand shock I use a dummy variable that takes a value of 1 if the year is 2008 or 2009, and 0 otherwise.

In addition to these variables featured in the hypotheses, the regressions reported below include a range of control variables as summarized in Table 2.

[13] The results are robust to alternative cut-off points: median, top quartile and 90th percentile.
[14] A discrete variable is conceptually appropriate since my research objective may be interpreted as examining systematic variation between polar forms of economic organization. It is also convenient to reduce potential collinearity problems between the main independent and control variables.
[15] I choose a measure based on establishments rather than employment because this is not available at the dataset level of industry and location disaggregation due to the country's disclosure provisions.

[Insert Table 3 here]

The estimation equations are:

$$DV_{it} = \alpha_1 VI_i * SHOCK_t + \beta X_{it} + \mu_t + \delta_k + \eta_i + \varepsilon_{it} \quad (1)$$

$$DV_{it} = \alpha_3 VI_i * AGGLOMERATION_{jkt} * SHOCK_t + \alpha_2 AGGLOMERATION_{jkt} * SHOCK + \alpha_1 VI_i * SHOCK + \beta X_{it} + \theta Z_{kt} + \mu_t + \eta_i + \varepsilon_{it} \quad (2)$$

The subscript i, j, k and t index the firm, the industry, the location and the time period respectively. DV_{it} represents the performance metric to be evaluated at the firm-year level (see above). The explanatory variables of interests are: i) $VI_i * SHOCK_t$, the interaction of vertical integration and the demand shock; ii) $AGGLOMERATION_{jkt} * SHOCK_t$, the measure of agglomeration economies also interacted with the shock, and; iii) $VI_i * AGGLOMERATION_{jkt} * SHOCK_t$, the interactive effect of VI, agglomeration economies during the shock. X_{it} and Z_{kt} represent vectors of firm- and location-level control variables respectively, whose values vary over time. μ_t, δ_k, and η_i capture years, location and firm fixed effects respectively.[16] ε_{it} is an individual and time-variant error term.

If the proposed hypotheses are correct, faced with the shock, integrated firms will suffer greater performance declines relative to non-integrated firms (H1), industrial agglomeration will provide positive net benefits, on average decreasing the expected performance decline (H2), but vertically integrated firms will be less able to capture these benefits (H3). Thus, we should expect to find $\alpha_1 < 0$, $\alpha_2 > 0$ and $\alpha_3 < 0$.

[16] Notice that μ_t captures the effect of the *SHOCK* common across firms. Similarly, η_i captures the individual effect of VI_i under regular demand conditions. α_1 then captures the marginal effect of VI_i during the *SHOCK*.

4. RESULTS

4.1 Main Results

Examination of the raw data provides a first view of the performance of vertically-integrated and non-integrated firms in the face of the demand shock. Figure 1 presents average ***ROA*** by year and firm type. The pattern is striking. Before 2008, the ***ROA*** of vertically integrated firms was on average 3.4 percentage points higher than their non-integrated counterparts, a statistically significant and economically important profitability advantage. In 2008, this performance differential shrank slightly, to 3.1 percentage points, before disappearing altogether in 2009 (the gap was no longer statistically significant in this year). Although quite crude, this evidence suggests that the two firm types are indeed responding in different ways to the economic crisis. To explore these patterns more systematically, we now turn to the econometric analysis.

[Insert Figure 1 here]

Table 4 presents the main empirical results. This table explores the performance implications of organizational form (H1), agglomeration economies (H2) and the interplay between the two (H3) in the face of a demand shock. Looking at the effect of organizational form, model 1 introduces the first variable of interest, $VI{*}SHOCK_t$, together with the firm, year and location fixed effects.[17] This model provides strong support to H1: the negative and significant coefficient at the one percent-level demonstrates a more severe impact of the demand shock on vertically integrated firms compared to non-integrated firms. Model 2 adds the time-varying control variables. The coefficients of control variables are largely as one would expect (see more below). The relative disadvantage of vertically integrated firms also holds at the same

[17] Note that the main effect of ***VI*** and ***SHOCK*** do not appear in the regression since they are absorbed in the firm and years fixed effects respectively.

level of statistical significance and economic importance. The point estimate (α_1) implies that, during the crisis, vertically integrated firms lose on average 1.8 percentage-points in ***ROA*** relative to otherwise-similar non-integrated firms.

[Insert Table 4 here]

The next two models examine the effect of agglomeration economies, first in isolation (model 3) and then in conjunction with organizational form (model 4). The main effect of agglomeration on firm performance is positive and significant in these models as we would expect. In particular the results in model 3 imply that a one-standard deviation increase in the level of geographic concentration of an industry in a given location is associated with a 2.6 percentage point increase in the ***ROA*** of firms operating in that industry and location. While selection issues prevent any inference of causality here, this result is consistent with prior findings on the benefits of agglomeration, and the implication of these benefits for firms` location choices.

The results in models 3 and 4 provide no support for the hypothesized relationship between agglomeration and firms` ability to adapt to economic crisis, however. The coefficient on the variable $AGGLOMERATION_{jkt} * SHOCK_t$, is insignificant in each case. The coefficient on the three-way interaction, $VI_i * AGGLOMERATION_{jkt} * SHOCK_t$, in model 4 is also insignificant. Indeed, in model 4, even the main effect, *VI*SHOCK*, becomes insignificant. Before concluding on this issue, however, it is useful to consider additional specifications that address the high level of multi-collinearity among the main effects and the various interaction

terms – and also allow for the possibility of nonlinear or threshold effects in the influence of agglomeration economies.[18]

To address this issue, in models 5 through 8 I split the sample into four quartiles of own-industry agglomeration. Model 5 compares the within-firm *ROA* variation of vertically-integrated versus non-integrated manufacturers in locations in the top quartile of agglomeration in their respective industries (Q4). This specification generates evidence of a statistically significant and economically important performance differential between the two forms of economic organization in these locations: the estimated effect implies that the integrated structure reduces the ROA by 2.6 percentage-points during the demand downturn. Models 6 through 8 follow the same empirical approach with the sub-samples of firms in locations in the third (Q3), second (Q2) and first quartiles (Q1) of own-industry agglomeration. These models reveal no evidence of a systematic performance differential between organizational forms at these lower levels of own-industry agglomeration. Together, models 5 through 8 provide support to H3. Vertically-integrated firms have less ability to benefit from location-specific externalities. But, this disadvantage becomes manifest only after the agglomeration economies surpass a certain threshold – the effect does not increase linearly with industrial agglomeration.[19]

The coefficients on the control variables are quite consistent across models and largely in the direction one would expect. Inter-temporal increases in the value of assets, number of employees and import intensity are negatively related to changes in ***ROA***, while sales are

[18] The correlation between the 3-way interaction and *VI*SHOCK* is close to 0.8.

[19] In supplementary analysis available upon request, I perform a specification which substitutes the continuous measure of AGGLOMERATION in the triple-way interaction with a dummy variable that equals one for the sub-sample of firms in locations at the fourth quartile of own-industry agglomeration (Q4). This specification also finds the short-term performance disadvantage of vertically-integrated versus non-integrated firms in industrial clusters at conventional significance levels.

positively related to profitability. Supplier concentration – i.e., the concentration of a firm`s purchases among a few suppliers – is an interesting case, as it is positively related to profitability in most models. Thus in this sample, concentrating purchases in a few suppliers does not appear to lead to excessive increases in supplier bargaining power, but rather to greater price discounts and/or a reduction in the administrative cost of managing multiple relationships.

4.2 The mechanism

I now turn to the theorized mechanism that may be driving the performance differential between vertically integrated and non-integrated firms. The theory suggests that this gap arises because of differences in the adaptation measures adopted under each organizational form in the face of crisis. The market prioritizes renegotiation of exchange agreements and exploitation of supply opportunities. Vertical integration focuses on coordinated adjustments to internal processes. The data allows us to make some additional inferences about market-based adaptation by looking at what happens to input prices during the economic meltdown.

Table 5 does just this, by examining the relation between organizational form and a firm`s ability to renegotiate agreements and exploit supply opportunities after the crisis strikes. Here, the dependent variable is *Variation of Input Prices,* defined as the percentage change in prices paid for materials and other supplies from year t-1 to t (see Table 2 for full definition)**.** Model 1 introduces the main variable of interest, $VI{*}SHOCK_t$, together with the firm, year and location fixed effects. Model 2 adds the time-varying control variables. Models 3 through 6 implement the same specification as in model 2 but on the four sub-samples described above.

[Insert Table 5 here]

Models 1 and 2 provide evidence of the theorized differential negotiation ability between the two firm types, with vertically-integrated firms being less able to renegotiate input prices after the demand shock. Estimates imply that hierarchy-based adaptation adds an average of 0.7 percentage-points to the prices paid for intermediate inputs after the shock in comparison to market-based adaption. Similar to the findings in Table 4, models 3 through 6 reveal heterogeneity across the four levels of agglomeration. In particular, the relative advantage of non-integrated firms in renegotiating input prices happens only in the sub-sample of firms sited in the most agglomerated locations (Q4) where the suppliers' pool is the thickest. Vertically-integrated firms in this sub-sample started paying input prices that were relatively more expensive by 2.2 percentage-points than those paid by non-integrated firms in the same sub-sample. Therefore, the main results in the previous section appear to be driven to a significant extent by the firm's heterogeneous ability to renegotiate current supply agreements and/or exploit new opportunities.[20]

5. ROBUSTNESS CHECKS

I perform a series of robustness checks to explore potential alternative explanations for the observed results and to probe the robustness of the proxy used for vertical integration, $\boldsymbol{VI_i}$. One potential concern that can be ruled out from the simple analysis of raw data shown in Figure 1 is heterogeneity in firm's unobserved 'quality:' if it were the case that vertically-integrated firms were, on average, 'inferior' (e.g., having poor technologies or management) and these firms

[20] The coefficients on the control variables are interesting and arguably warrant further analysis beyond the scope of this paper: For example, inter-temporal variation in sales and assets is positively related to input price increases. The economics literature has documented a positive correlation between plant size, price charged in end markets and price paid in input markets in steady state conditions (Kugler and Verhoogen, 2012). The rationale has been that unobserved input quality and its interaction with firm capabilities drive these correlations. The above results suggest that this empirical fact holds not only in levels across firms but also in changes within firms.

performed even worse during the crisis, then the observed effect of organizational form on profitability during the crisis could be spurious. The raw data suggests this is not the case: Figure 1 shows that vertically-integrated firms were performing consistently better than their counterparts before the demand shock. They were delivering an average ***ROA*** that exceeded that of their non-integrated counterparts by 3.4 percent between 2005 and 2007.

A second alternative explanation relates to systematic differences in changes in prices charged in end markets. If firms with higher ratios of added value to sales also have more room to reduce prices and still cover production cost, their profitability may fall more sharply in relative terms during the crisis.[21] Model 1 in Table 6 tests for the potential confounding effect of prices. The specification is the same as in Table 4, model 2 but replaces ROA with the percentage change in product prices[22] in end markets as the dependent variable. The results show that after the shock, product prices of vertically-integrated firms in fact *increased* relative to those of non-integrated firms. The point estimate implies that the integrated structure adds a positive 1.1 percentage-points to product prices compared to their counterparts. This is consistent with the theorized rigidity with respect to adjustments to the variable costs of production, which limits their competitiveness and ability to reduce prices and still sustain profitable margins. Therefore, the loss of profitability does not appear to stem from heterogeneity in prices charged in end markets.

[Insert Table 6 here]

[21] Notice that vertically-integrated firms were not doing worse in absolute terms after the crisis.
[22] This is defined as the weighted change of the effective product prices of the firm's products against the previous year (Paasche index). Price increases have positive sign.

Finally, we explore the possibility that other sources of unobserved heterogeneity results in more profitable firms performing relatively worse than less profitable ones after the demand shock. To rule out this possibility, model 2 performs a falsification test by including the organizational form interaction together with a profitability interaction, $(ROA_i > \overline{ROA_j}) * SHOCK$.[23] These results confirm that the temporal performance disadvantage is driven by organizational form rather than by the previous level of profitability.[24]

Next I turn to the robustness of the results to alternative measures of vertical integration. In models 3 through 7 of Table 6, vertical integration is measured using the ratio of purchases of materials to total production cost. This measure captures the idea that vertical integration reduces the purchases of materials per dollar spent in the production of the final goods, so that vertically-integrated firms have lower ratios. Unlike the proxy based on value added, this measure is completely orthogonal to profit margins. Other studies have proxied this ratio indirectly by using accounting measures of expenses and net profits (e.g. Tucker and Wilder, 1977; Barney et al, 1992). ESEE offers a remarkable advantage since one can observe the precise amounts spent in purchases of materials for production. In models 3 through 7, VI is a dummy variable that indicates whether the firm's ratio is below its own-industry average ratio.[25]. The results using this proxy for vertical integration produces results that are qualitatively similar to those in Table 4, confirming the relative performance disadvantage of vertically-integrated firms as well as their lower ability to benefit from location-specific externalities.

[23] This is a dummy variable that equals 1 if firm's ROA is greater than its own-industry average ROA, 0 otherwise.
[24] The $(ROA_i > \overline{ROA_j}) * SHOCK$ interaction reaches significance at the 10- percent level when I exclude the organizational form interaction. But, the former loses all significance once I introduce the latter. This pattern may reflect the fact that vertically-integrated firms were on average more profitable than non-integrated ones.
[25] The results are also robust to median and first quartile as cut-off points. Benchmark models with the value-added definition of vertical integration are models 2 (whole sample) and 5 through 8 (sub-samples) in Table 4

Finally, I also address a potential attrition problem in the sample. The dataset is an unbalanced panel with an average of 64 firms exiting the panel every year. Moreover, the probability of exit from the sample is not the same for all firms: economic theory suggests that firms exit the market when their productivity is below a certain threshold (Olley and Pakes, 1996). To address this issue, I implement a two-stage technique. In the first stage, a probit estimation models the probability of exit in any given year. A firm in a given industry exits the sample when its unobserved productivity is lower than an exogenously given minimum. The unobserved productivity is increasing in the investments in capital goods conditional on observed state variables (i.e. revenues, assets, employment, age, capital structure). [26] In the second stage, I estimate the main estimating equation (1) including the Mills' inverse ratio from the first stage as indicated in Heckman (1979). Models 8 and 9 present the results on the whole sample and on the sub-sample of firms in locations at the top quartile level of agglomeration (Q4). The inference remains qualitatively invariant and the point estimates indeed increase slightly.[27]

6. DISCUSSION AND CONCLUSIONS

The empirical results reported above shed new light on the source of differences in firms' ability to adapt effectively and maintain profitability in the face of a severe economic downturn. By focusing on a particularly severe and unpredictably economic shock I am able to a large extent, to avoid the usual selection problems associated with endogenous decisions, i.e., whereby profit-maximizing agents choose both location and organizational form that maximizes its expected utility given its own endowments. My empirical approach exploits the exogenous variation in

[26] Investments in capital goods guarantee the exclusion restriction needed for identification without relying on functional form.

[27] Results unreported in Table 6 shows again that the relative performance disadvantage does not happen in the other three sub-samples (Q3, Q2 or Q1).

agglomeration benefits during an episode of unexpected economic downturn. Therefore, I am able to identify the unexplored causal relationship between governance mode and industrial agglomeration on firm's adaptation and performance.

The patterns that emerge from this analysis are quite striking. I find that vertically-integrated firms are significantly slower to reduce variable costs of production following the crisis, leading to a greater reduction in profitability as compared with their non-integrated counterparts, at least in the short term. Thus, it appears that vertically integrated firms focus their adaptation efforts on the implementation of coordinated internal adjustments, while non-integrated firms focus more on renegotiation of exchange agreements and autonomous exploitation of new supply conditions, resulting in immediate reductions in input prices. These results thus bolster the findings from previous research, that the process of internal adjustment requires more iterations and a relatively longer time horizon to generate benefits (Novak and Stern, 2008) and highlight once again the fundamental trade-off between coordinated vs. autonomous adaptation that is fundamental to the choice between hierarchy and markets (Williamson, 1991; Wernerfelt, 1997, 2004; Costinot, Oldenski and Rauch, 2011).

The results of the study generate several important but nuanced managerial implications. First, it is important to emphasize that the empirical findings do *not* imply that vertical integration in general leads to lower performance. Indeed, the vertically-integrated firms in this sample were performing better on average than their non-integrated counterparts before the economic meltdown; the effect of the crisis was to close the profitability gap between the two types of organization. Given the selection issues discussed above we can say little about the general profitability implications of one organizational form over the other. However, one important implication that can be derived from our results is that, in determining the appropriate

level of vertical integration in a particular context, decision makers must recognize that the gains of enhanced coordinated adaptation under regular demand conditions will impose a cost under some other states of the world as adjustment to rapidly changing demand and other external conditions is inevitably impaired. This short-run cost may be high and in some situations may even put firm survival at risk. Determining the optimum organizational form thus requires an assessment of the need for autonomous versus coordinated adaptation across the entire economic and business cycle.

A further managerial implication of the study is that it would behoove managers of vertically-integrated firms to prepare for such predictable difficulties in 'crisis management' even while operating under 'regular' economic conditions, by creating a 'resource buffer' with which to weather the storm. The results here suggest that on average the short-term disadvantages associated with vertical integration are more than offset by long-term advantages from superior coordination and internal capabilities (in those cases where decision-makers have chosen to vertically integrate). Thus, decision-makers in vertically-integrated firms should not panic during times of economic crisis and, in particular, should not dismantle the relationships and processes that are at the core of their long-term adaptive capability.

The paper also contributes to the strategy literature by highlighting an overlooked relationship in prior empirical work, between the boundaries of the firm and location-specific economies. Geographically bounded resources enable firms to organize their productive activities in particular ways. If a firm plans to launch an operation with narrow vertical scope, an industrial agglomeration may be the optimal location given its rich structure of backward and forward supply chain opportunities. If the firm prefers a stand-alone operation for which external resources are less essential, it may be worth considering less congested locations with saving

opportunities in terms of land and labor cost. My empirical results suggest that vertically-integrated firms are less able to take advantage of the changing supply conditions in their proximity. Self-sufficiency thus decouples the organization from emerging opportunities in surrounding input markets.

It is important to note that, as with the result on vertical integration, this finding does not imply that industrial agglomerations *per se* are inferior locations for all vertically-integrated firms. Indeed, my results show that an increase in agglomeration for a given industry in a given location is positively correlated with an increase in profitability for both vertically-integrated and non-integrated firms. Despite the temporal disadvantage with external input suppliers, the empirical patterns suggest that vertically-integrated firms are able to reap some sort of benefits from location-specific externalities under steady-state conditions. This result is consistent with findings in the agglomeration literature showing that spillovers have strong productivity effects on employees (Ciccone and Hall, 1996) and manufacturing plants (Henderson, 2003). However, in the light of the interplay between boundaries of the firm and location-specific economies revealed in this paper, vertically-integrated firms may still be less prone to choose industrial concentrations ex ante. Fully unpacking the factors that drive the joint decisions of vertical integration and location choice thus represents an important opportunity for future research.

In short, this paper is one of the first efforts to provide systematic evidence on how organizational form moderates the ability of firms to benefit from the agglomeration economies available in dense industrial clusters and respond effectively in the face of a severe economic shock. In today's increasingly complex world of shifting locational advantage and economic instability this is a concern of utmost importance to managers and strategy scholars alike. This

study takes us one step on the road to understanding of these issues; I look forward to joining with others in the journey ahead.

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Table 1: Observations by industry

No.	Industry	Firm-year	%
1	Meat Product Manufacturing	295	3.1%
2	Food and Tobacco Manufacturing	890	9.4%
3	Beverage Manufacturing	214	2.3%
4	Textile and Clothing Manufacturing	658	7.0%
5	Leather and Allied Product Manufacturing	250	2.6%
6	Wood Product Manufacturing	361	3.8%
7	Paper Manufacturing	329	3.5%
8	Printing and Related Support Activities	475	5.0%
9	Chemical Manufacturing - including Pharmaceutical and Medicine	641	6.8%
10	Plastics and Rubber Products Manufacturing	491	5.2%
11	Non-Metallic Mineral Product Manufacturing	758	8.0%
12	Primary Metal Manufacturing	309	3.3%
13	Fabricated Metal Product Manufacturing	1,214	12.8%
14	Machinery Manufacturing	568	6.0%
15	Computer and Electronic Product Manufacturing	206	2.2%
16	Electrical Equipment, Appliance and Component Manufacturing	404	4.3%
17	Transportation Equipment Manufacturing	473	5.0%
18	Other Transportation Equipment Manufacturing	222	2.3%
19	Furniture and Related Product Manufacturing	472	5.0%
20	Other Manufacturing Industries	226	2.4%
	ALL INDUSTRIES	**9,456**	**100.0%**

Table 2: Variables definition

Variables	Definition	Expected sign on ROA[1]	Justification
Main variables			
ROA	Earnings before interest, taxes, depreciation and amortization over value of assets x 100		
Variation of Input Prices	Estimated percentage change of prices paid for materials and other supplies between years t and t-1 (increases have positive sign).		
Added Value to Sales	Sum of sales and variation in product stocks, minus purchases of materials consumed in production and external expenses, over sales, x 100		
VI	Dummy = 1 if the firm's average ratio of added value to sales in the five-year period is above its own-industry average, 0 otherwise.	Ambig.	Each firm chooses the organizational form that mazimixes its own utility.
AGGLOMERATION	Proportion of industry j establishments in location k x 100	+	Agglomeration economies increase firm productivity.
SHOCK	Dummy = 1 if the year is 2008 or 2009, and 0 otherwise.	-	Economic shock decreases demand.
Firm-specific controls			
Assets	Value of total assets in million euros.	-	By construction, assets reduce the ROA ratio.
Sales	Value of total sales in million euros.	+	Sales usually increase operating profits.
Employment	Sum of full-time and half of part-time workers (on December 31st) and avg. number of eventual	-	Employment increases labor cost.
Liabilities/Equity	Ratio of book value of liabilities over that of equity in euros x 100	Ambig.	Leverage may increase profitability. But, it may also signal deterioration of a firm's operations.
Customer concentration	Ratio of sales to its three main customers over total sales x 100	-	Customer concentration increases buyer bargaining power.
Market share	Weighted sum of the company's market-shares in the markets in which it sells its products x 100	+	Market share decreases rivalry among competitors.
Supplier concentration	Percentage of the purchases to the three biggest suppliers x 100	-	Supplier concentration increases supplier bargaining power.
Import intensity	Value of imports over total sales x 100	Ambig.	Imports may provide access to low-cost inputs. But, it may also re-allocate profits to low-tax countries.
Export intensity	Value of exports over total sales x 100	+	Export intensity is positively correlated with firm productivity.
Location-specific controls			
Δ Establishments	Percentage change in the number of establishments in industry j and location k between years t and t-1.	Ambig.	Establishments growth may correlate with opportunities but also with competition.
Δ GDP	Percentage change of GDP in location k between years t and t-1.	+	Economic growth increases demand.

[1] In within-firm regressions.

Table 3: Pairwise correlations and descriptive stats.

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1	VI	1.00												
2	AGGLOMERATION	-0.05*	1.00											
3	Assets	-0.06*	-0.01	1.00										
4	Sales	-0.12*	-0.02*	0.43*	1.00									
5	Employment	-0.11*	-0.02	0.46*	0.87*	1.00								
6	Liabilities/Equity	-0.03*	0.01	0.01	0.03*	0.05*	1.00							
7	Customer concentration	0.11*	-0.09*	-0.01	0.02	-0.01	-0.01	1.00						
8	Market share	-0.04*	-0.03*	0.08*	0.10*	0.13*	-0.00	0.01	1.00					
9	Supplier concentration	0.07*	-0.08*	-0.07*	-0.07*	-0.15*	-0.01	0.27*	-0.00	1.00				
10	Import intensity	-0.23*	0.06*	0.11*	0.22*	0.21*	-0.01	-0.02*	0.14*	-0.05*	1.00			
11	Export intensity	-0.13*	0.08*	0.07*	0.14*	0.18*	-0.02	-0.01	0.09*	-0.14*	0.34*	1.00		
12	Δ Establishments	0.01	-0.22*	0.01	0.02*	0.03*	0.01	0.05*	0.07*	-0.00	-0.02	0.02	1.00	
13	Δ GDP	-0.01	-0.03*	-0.00	0.02*	0.02*	0.01	-0.00	0.01	0.01	0.01	-0.03*	0.18*	1.00
	Observations	9,456	9,456	9,456	9,456	9,455	9,456	9,408	9,178	9,397	9,438	9,444	9,456	9,456
	Mean	0.46	0.13	105.00	71.00	228.91	6.40	0.44	0.09	0.46	0.09	0.19	-0.01	0.02
	Standard deviation	0.50	0.10	695.00	341.00	737.04	58.89	0.28	0.17	0.23	0.15	0.27	0.04	0.03

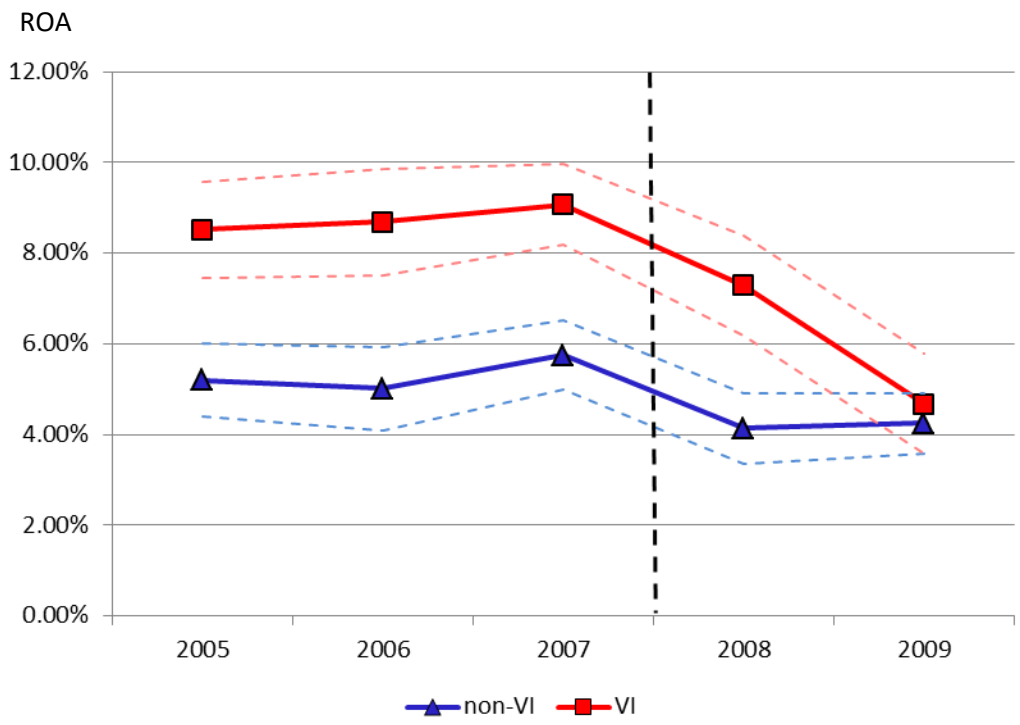

Figure 1: ROA by year and organizational form[28]

[28] Dotted lines show 95-percent confidence intervals.

Table 4: The effect of vertical integration and agglomeration on ROA

	DV = ROA							
Variables	**Whole sample**				**Q4**	**Q3**	**Q2**	**Q1**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Assets)		-6.85**	-6.88**	-6.81**	-8.82**	-6.06**	-11.74**	-4.24**
		(0.61)	(0.61)	(0.61)	(1.30)	(1.33)	(1.38)	(1.30)
Log(Sales)		20.22**	20.23**	20.23**	25.47**	10.98**	19.63**	26.80**
		(0.75)	(0.75)	(0.75)	(1.84)	(1.59)	(1.68)	(1.52)
Log(Employment)		-10.44**	-10.33**	-10.43**	-14.37**	-7.50**	-5.19*	-15.34**
		(1.06)	(1.06)	(1.06)	(2.48)	(2.21)	(2.52)	(2.25)
Liabilities/Equity		-0.00	-0.00+	-0.00	-0.03*	0.01	-0.11**	0.01
		(0.00)	(0.00)	(0.00)	(0.01)	(0.03)	(0.02)	(0.01)
Customer concentration		0.85	1.01	0.89	3.74	0.02	-1.37	0.98
		(1.46)	(1.45)	(1.45)	(3.08)	(3.35)	(3.17)	(2.93)
Market share		2.24	2.21	2.28	2.88	0.77	2.60	4.48
		(1.66)	(1.66)	(1.66)	(3.37)	(4.69)	(3.87)	(3.24)
Supplier concentration		2.82*	2.66*	2.74*	-1.41	-2.31	3.27	7.94**
		(1.30)	(1.30)	(1.30)	(2.72)	(3.13)	(2.81)	(2.61)
Import intensity		-17.14**	-17.19**	-17.18**	-12.53*	-21.05**	-21.78**	-14.72**
		(2.11)	(2.11)	(2.11)	(5.07)	(3.77)	(5.98)	(4.40)
Export intensity		-0.83	-0.60	-0.66	-1.84	-2.85	-1.39	6.83
		(1.79)	(1.79)	(1.79)	(3.52)	(3.63)	(4.27)	(4.39)
Δ Establishments		2.43	1.47	1.47	11.20	20.14	-3.45	-0.12
		(4.85)	(4.84)	(4.84)	(13.20)	(15.09)	(12.65)	(7.06)
Δ GDP		-23.25	-39.52	-43.52	-212.98	-78.86	105.85	-33.19
		(46.71)	(48.43)	(48.41)	(269.54)	(121.15)	(101.53)	(84.19)
AGGLOMERATION			27.02**	27.13**				
			(10.25)	(10.24)				
VI*SHOCK	**-1.97****	**-1.81****		**-0.71**	**-2.61***	**0.34**	**-0.97**	**-1.62**
	(0.58)	**(0.56)**		**(0.94)**	**(1.23)**	**(1.30)**	**(1.26)**	**(1.19)**
AGGLOMERATION*SHOCK			**-2.33**	**0.93**				
			(3.12)	**(3.95)**				
VI*AGGLOMERATION*SHOCK				**-9.41**				
				(6.09)				
Time & firm fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location fixed-effect	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Observations	9,456	9,098	9,098	9,098	2,115	2,363	2,234	2,386
R-squared	0.02	0.14	0.13	0.13	0.19	0.09	0.16	0.20
Number of firms	2,631	2,567	2,567	2,567	597	667	630	673

Standard errors in parentheses. ** p<0.01, * p<0.05 (2-tailed test)

Table 5: Mechanism driving the performance disadvantage

	DV = Variation of Input Prices					
Variables	**Whole sample**		**Q4**	**Q3**	**Q2**	**Q1**
	(1)	(2)	(3)	(4)	(5)	(6)
Log(Assets)		1.03**	0.21	1.52*	0.64	1.49*
		(0.36)	(0.95)	(0.73)	(0.75)	(0.74)
Log(Sales)		1.51**	0.14	1.26	2.27*	1.65+
		(0.44)	(1.34)	(0.88)	(0.91)	(0.87)
Log(Employment)		-1.30*	-0.56	-1.86	-0.78	-1.04
		(0.63)	(1.80)	(1.23)	(1.37)	(1.28)
Liabilities/Equity		-0.00	-0.00	0.02	-0.00	-0.00
		(0.00)	(0.01)	(0.01)	(0.01)	(0.00)
Customer concentration		0.59	3.17	1.09	0.29	-0.29
		(0.86)	(2.23)	(1.89)	(1.72)	(1.67)
Market share		0.89	-0.98	1.23	2.73	3.18+
		(0.98)	(2.44)	(2.58)	(2.10)	(1.85)
Supplier concentration		0.09	-1.83	2.66	1.64	0.43
		(0.76)	(1.97)	(1.73)	(1.54)	(1.49)
Import intensity		-1.94	-4.69	0.24	-3.77	-2.45
		(1.24)	(3.66)	(2.07)	(3.24)	(2.52)
Export intensity		-0.42	-0.06	-1.28	-3.05	1.86
		(1.06)	(2.54)	(2.05)	(2.32)	(2.51)
Δ Establishments		-6.35*	-9.95	-16.92*	1.82	-7.00+
		(2.85)	(9.60)	(8.38)	(6.87)	(4.04)
Δ GDP		-19.79	227.08	107.58	-41.22	-56.68
		(27.45)	(194.92)	(66.95)	(55.41)	(48.05)
VI*SHOCK	**0.71***	**0.66***	**2.17***	**0.06**	**0.83**	**1.11**
	(0.32)	**(0.33)**	**(0.89)**	**(0.72)**	**(0.68)**	**(0.68)**
Time & firm fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Location fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,367	9,024	2,095	2,342	2,217	2,370
R-squared	0.09	0.1	0.11	0.09	0.12	0.1
Number of firms	2,631	2,566	596	666	630	674

Standard errors in parentheses. ** p<0.01, * p<0.05 (2-tailed test)

Table 6: Robustness checks

	DV=	DV = ROA							
Variables	**Δ Product Price**			**Q4**	**Q3**	**Q2**	**Q1**		**Q4**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(Assets)	0.38	-6.83**	-6.92**	-8.91**	-6.04**	-11.85**	-4.26**	-6.54**	-10.26**
	(0.23)	(0.61)	(0.61)	(1.30)	(1.33)	(1.38)	(1.30)	(0.81)	(1.91)
Log(Sales)	1.93**	20.26**	20.21**	25.24**	10.94**	19.64**	26.86**	22.88**	22.35**
	(0.29)	(0.75)	(0.75)	(1.85)	(1.59)	(1.68)	(1.52)	(0.99)	(2.37)
Log(Employment)	-2.16**	-10.39**	-10.46**	-14.35**	-7.60**	-5.21*	-15.32**	-11.63**	-10.76**
	(0.41)	(1.06)	(1.06)	(2.48)	(2.21)	(2.52)	(2.25)	(1.40)	(3.37)
Liabilities/Equity	-0.00	-0.00	-0.00	-0.03*	0.01	-0.11**	0.01	0.00	-0.25**
	(0.00)	(0.00)	(0.00)	(0.01)	(0.03)	(0.02)	(0.01)	(0.01)	(0.07)
Customer concentration	-0.69	0.85	0.95	3.75	0.06	-1.22	1.10	-0.86	1.79
	(0.56)	(1.46)	(1.45)	(3.08)	(3.35)	(3.17)	(2.92)	(1.87)	(3.94)
Market share	-0.13	2.20	2.24	2.79	0.66	2.63	4.48	2.02	3.39
	(0.64)	(1.66)	(1.66)	(3.37)	(4.68)	(3.87)	(3.24)	(2.34)	(4.85)
Supplier concentration	-0.36	2.83*	2.78*	-1.27	-2.38	3.27	7.87**	1.18	4.71
	(0.50)	(1.30)	(1.30)	(2.73)	(3.13)	(2.81)	(2.60)	(1.74)	(3.84)
Import intensity	-1.08	-17.18**	-17.09**	-12.69*	-21.00**	-21.59**	-14.56**	-14.33**	-15.16*
	(0.80)	(2.11)	(2.11)	(5.07)	(3.77)	(5.97)	(4.40)	(3.17)	(6.83)
Export intensity	-0.59	-0.85	-0.82	-1.96	-2.86	-1.50	7.06	-2.77	-3.52
	(0.69)	(1.79)	(1.79)	(3.52)	(3.63)	(4.27)	(4.38)	(2.39)	(4.93)
Δ Establishments	-0.91	2.39	2.58	11.81	19.94	-3.03	-0.06	-0.33	7.12
	(1.86)	(4.85)	(4.85)	(13.20)	(15.09)	(12.66)	(7.06)	(6.17)	(19.83)
Δ GDP	-41.51*	-24.64	-25.34	-242.57	-83.96	107.54	-33.27	-5.84	-259.51
	(17.86)	(46.72)	(46.73)	(270.00)	(121.15)	(101.57)	(84.19)	(62.05)	(338.26)
Selection term								0.02	-0.50
								(1.21)	(1.90)
VI*SHOCK	**1.05****	**-1.70****	**-1.66****	**-2.52***	**-1.01**	**-1.04**	**-1.58**	**-2.23****	**-2.99***
	(0.21)	**(0.57)**	**(0.56)**	**(1.24)**	**(1.29)**	**(1.27)**	**(1.19)**	**(0.65)**	**(1.48)**
$(ROA_i > \overline{ROA_j})$* SHOCK**		**-0.71**							
		(0.57)							
Time & firm fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location fixed-effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,911	9,098	9,098	2,115	2,363	2,234	2,386	5,930	1,361
R-squared	0.11	0.14	0.14	0.19	0.09	0.16	0.20	0.16	0.19
Number of firms	2,554	2,567	2,567	597	667	630	673	2,002	595

Standard errors in parentheses. ** p<0.01, * p<0.05 (2-tailed test)