# Firm Focus and Performance: A Natural Experiment*

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We exploit a natural experiment to examine how an exogenous reduction in firm scope influences product-level performance over time. Using detailed micro-data on every Peruvian fishing firm before and after a regulatory shock that banned mackerel fishing, we find that reducing the scope of the firm led to sharply lower productivity in firms' legacy anchovy fishing business. The results suggest that diversification creates positive interdependencies between products that are eliminated when the firm refocuses its operations. However, we find that the productivity effect attenuates over time, suggesting that while firms are rigid in the short-run, in the long-run they efficiently adapt in response to changes in scope.

## 1. Introduction

Early work on firm scope found evidence that refocusing improved performance by eliminating sources of operational "interference" between business units (John and Ofek 1995, p. 105). However, recent studies have raised important questions about the interpretation of the early work on refocusing. For example, after accounting for selection effects and measurement error, Colak and Whited (2007) show that the relationship between scope reduction and performance disappears. Moreover, diversification scholars now widely agree that better data and research designs are needed to understand the mechanisms linking scope and performance (Campa and Kedia 2002, Villalonga 2004). Using fine-grained data on productivity, this paper opens up the black box of scope and performance to better understand how scope influences interdependencies between internal firm processes. Furthermore, we exploit a natural experiment to identify the causal impact of firm focus on performance.

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The paper builds on and extends the literature on scope and performance by developing two concepts from organizational theory—organizational interdependencies and organizational rigidity—in the context of a reduction in firm scope. We incorporate interdependencies and rigidities into a simple framework that guides our analysis of how a reduction in firm scope influences product performance over time. The framework shows that product-level performance will only decline following a reduction in firm scope when there are positive interdependencies between products *ex ante*. Moreover, product complementarity is a sufficient condition for a reduction in product performance when organizations are rigid in the short-run. Furthermore, if firms are rigid, but adaptable, in the long-run, product-level performance should improve over time following the initial decline.

We test these predictions using ship and product-level micro-data on Peruvian fishing firms, 41% of which were forced to focus their operations on anchovy fishing in 2002 due to a regulatory ban on mackerel fishing for fishmeal. We exploit the ban on mackerel fishing to identify the impact of refocusing on product-level (anchovy) productivity through 2005. Our empirical approach compares the change in productivity in formerly diversified firms (i.e., firms that fished for mackerel and anchovy) relative to the change in productivity in focused firms (i.e., firms that only fished for anchovy historically) before and after the ban. The results show that an exogenous reduction in firm scope causes ship-level anchovy productivity to fall by 17% during anchovy season in the year following the ban, relative to ships in firms that historically focused only on anchovy. Consistent with the idea that organizations are rigid, but adaptable, we find that the effect of a reduction in scope attenuates over time. By the fourth season after the ban, the negative productivity effect of the ban on formerly diversified firms is completely eliminated. Our tests are particularly convincing because the shock to firm scope is exogenous; the data are granular—we observe performance weekly at the ship-level for all firms in the industry; we control for ship-level heterogeneity and the endogeneity of the intensive margin (i.e., ship-level utilization rates); and our physical measure of productivity is unusually precise as we can measure physical output per physical unit of input.

The paper makes two main contributions to the literature on strategy and firm scope. First, we provide micro-organizational evidence that a reduction in firm scope eliminates positive interdependencies between products in diversified firms. While it is well established that the potential for synergies influences firm scope decisions (Teece 1980, 1982; Levinthal and Wu 2010), we believe this is the first paper to offer well-identified evidence of product-level complementarities in diversified firms.[1] Second, we show that firms do not immediately adapt to a reduction in firm scope; instead they are rigid in the short-run, yet over time they make adjustments their organizational systems to fit with their new operating environment. Organizational scholars have long posited that firms can overcome strategic challenges through adaptation (Amburgey, Kelly, and Barnett 1993; Levinthal 1997; Siggelkow and Levinthal 2003; Nickerson and Silverman 2003), but there has been little research on organizational rigidity and organizational adaptation in the context of firm scope.[2] Yet, the relationship between organizational dynamics and firm scope seems particularly important in the context of changes in firm scope when there are interdependencies between products. Thus, this paper fills a gap in the literature by showing how changes in scope influence performance in rigid, but adaptable firms.

## 2. Conceptual development

When organizations coordinate tasks, interdependencies arise because decisions made concerning one task influence the efficiency of other tasks (Rivkin and Siggelkow 2003). Interdependence is a crucial concept in the context of firm scope because diversifying firms often reorganize their processes and routines in an attempt to create complementarities between products or business units. However, as the early empirical literature on firm focus suggests, organizing around interdependencies can be costly in the sense that multi-product operations tend to interfere with stand-alone optimization (John and Ofek 1995, Desai and Jain 1999).

The theme of interference from interdependence has been echoed many times in research on scope and performance. For example, Lamont (1997) shows that internal capital markets may be inefficient in the sense that managers are less responsive to business unit-level performance than markets; Schoar (2002) finds that diversification distracts managers from their legacy operations, leading to lower productivity in firms' existing plants; and Zhou (2011) shows that complexity of interdependencies increases coordination costs in diversified equipment manufacturers. While the

[1] Activities exhibit complementarities when there are increasing marginal returns to performing them together (Holmstrom and Milgrom 1994). Cassiman and Veugelers (2006) show that internal research and development and external knowledge acquisition exhibit complementarities in Belgian manufacturing industries. Stern and Novak (2009) find that there are contracting complementarities between vertical integration decisions in luxury automobile manufacturing. Our focus, in this paper, is on product-level complementarities or increasing returns to producing two products together within the same firm.

[2] Capron, Dussauge and Mitchell (1998) and Capron, Mitchell and Swaminathan (2001) find that firms reallocate assets and other resources across business units following acquisitions. Maksimovic, Phillips and Prabhala (2011) find that firms sell, close and restructure plants after acquisitions. These papers suggest that organizational adaptation is at work in the context of an *expansion* of firm scope. Rawley (2010) shows that coordination costs are higher in incumbent taxicab firms that diversify into limousines compared with diversified *de novo* entrants, which he interprets as evidence that incumbents' organizational systems are rigid, at least in the short-run. However, there is little evidence that the same organizations are both rigid, and adaptable, in response to a change in firm scope.

extant literature has identified a number of reasons why interdependencies are difficult to manage, there has been little empirical research on the benefits of task interdependencies in diversified firms.[3] Yet, intuitively it seems likely that diversified firms would actively seek positive interdependencies between products in their portfolio.

Given that positive interdependencies should be a key driver of diversification decisions, it is surprising how little we know about how products complement one another in diversified (i.e. multi-product) firms. In this paper, we take a step toward understanding interdependencies within diversified firms by developing and testing a simple framework that explicitly considers both the costs and benefits of interdependencies in diversified firms. We use the framework to analyze how a reduction in firm scope influences product-level performance, and to consider how organizational rigidity influences the time path of performance when firms refocus their operations.

Consider the impact of firm scope on performance for a firm with two products. We denote firm $i$ as being integrated at time $t$ with a superscript $I$, where an integrated firm's profits are equal to the sum of the profits of their two products, plus any complementarities between product 1 and 2, $C_i$, while a focused firm's profits (superscript $f$) are equal to the profits of a single product. For convenience, assume the focused firm produces only product 1. The firm chooses a set of routines $R_{ij}$ for each product, where stand-alone product performance $\pi_{ij}(R_{ij})$ is strictly concave and single peaked. At time $t$ firm profits are:

$$(1)\quad \pi^I_i = \pi_{i1}(R_{i1}) + \pi_{i2}(R_{i2}) + C_i(R_{i1}, R_{i2}),$$
$$\pi^f_i \equiv \pi_{i1}(R_{i1}).$$

When there are no interdependencies between products, there can be no complementarities, $C_i = 0$, and the firm maximizes profits for each product independently at $R_{i1}^*$ and $R_{i2}^*$. Therefore, when there are no interdependencies, a firm that already produces product 1 will choose to diversify into product 2 if and only if $\pi_{i2} > 0$, which means synergies from diversification arise only by exploiting underutilized firm-specific assets like physical capacity and managerial know-how.

When product 1 and 2 exhibit interdependencies (in equilibrium), the firm chooses an interdependent set of processes $R_{ij}$ for each product that maximizes overall firm performance at

[3] Notable exceptions include Martin and Eisenhardt (2010), who investigate how managers create successful cross-business collaborations, and Feldman (2011), who shows that return on sales falls in firms that sell off their original business units.

$R_{i1}^{**}$, $R_{i2}^{**}$. Assuming away the trivial case where $R_{i1}^{**}$ corresponds exactly with $R_{i1}^{*}$, an assumption we shall maintain throughout, the existence of interdependencies implies that integrated firms will choose organizational practices for product 1 $R_{i1}^{**}$ that would not be optimal if it were a single product firm, $\pi^{f}_{i1}(R_{i1}^{*}) > \pi^{f}_{i1}(R_{i1}^{**})$, which gives rise to a cost associated with diversification, $\pi_{i1}(R_{i1}^{*})$- $\pi_{i1}(R_{i1}^{**})$, which we shall call interference costs to be consistent with the extant literature.

With interdependencies between products, synergies can potentially arise from two sources: complementarities between products 1 and 2, and from exploiting underutilized resources. Thus, the firm will rationally diversify as long as:

$$(2)\ \ \pi_{i1}(R_{i1}^{**}) + \pi_{i2}(R_{i2}^{**}) + C_i(R_{i1}^{**}, R_{i2}^{**}) > \pi^{f}_{i1}(R_{i1}^{*}).$$

Ideally, the products in a firm's portfolio would be synergistic, without creating interference costs. However, synergies are often achieved by allowing interference costs that sub-optimize one product for the greater good of the firm. Thus, the essence of diversification strategy is often about managing the tradeoffs inherent in interdependencies between products, making sacrifices along one dimension to create synergies along another.[4]

Synergies arising from interdependencies are conceptually different from synergies that arise from exploiting excess capacity in underutilized resources (Wernerfelt and Montgomery 1988), which has important implications for the study of product-level performance dynamics when the firm reduces the scope of its operations. If firms diversify to exploit underutilized resources without changing the underlying activities within the firm, product performance will be independent, and changes in one production process will have no impact on the productivity of another product. On the other hand, if two production processes are interdependent, then a change in firm scope will lead to a change in the organization of the routines that produce the other products in the firm's portfolio. While the two forms of synergies are not mutually exclusive, changes in *product-level* performance, following a change in scope, can only arise from interdependencies: complementarities or interference costs. Thus, examining product-level performance offers the opportunity to distinguish between synergies from exploiting excess capacity, and synergies from interdependencies. Moreover, with some additional structure

[4] Gertner, Scharfstein and Stein (1994) make a similar argument with respect to the costs and benefits of internal capital markets. Internal capital markets increase monitoring incentives and improve asset redeployability, but also decrease entrepreneurial incentives compared to external capital markets. In principle, our conceptual arguments apply to both operational interdependencies between business units and interdependencies in corporate finance processes, though empirically we focus on the former.

product-level performance dynamics facilitates estimates of complementarities and interference costs in diversified firms.

When there are no interdependencies between products, eliminating product 2 at time $t+1$ has no impact on the profitability of product 1. Therefore, there is no change in the profitability of an integrated firm's product 1 from a reduction in firm scope:

$$(3)\quad \Delta\pi^{I}_{i1} = \pi_{i1}(R_{i1t+1}{}^{*}) - \pi_{i1}(R_{i1t}{}^{*}) = 0,$$

where Δ indicates a change over time.

Performance dynamics are more revealing when there are interdependencies between products. Assuming complementarities can be allocated to individual products according to an operator $0<\alpha<1$, $C_{i1} = \alpha C_i$, $C_{i1} = (1-\alpha)C_i$,[5] and there is a reduction in scope at time $t+1$ we have:

$$(4)\quad \Delta\pi^{I}_{i1} = \pi_{i1}(R_{i1t+1}) - \pi_{i1}(R_{i1t}) - \alpha C_i(R_{i1t}, R_{i2t}).$$

Expression (4) says that the impact of a reduction in firm scope on the profitability of product 1 will be equal to the gains the firm can achieve by changing its organizational practices $R_{i1}$, now that product 1 need not be constrained by interdependencies with product 2, less the impact of the loss of complementarities that accrued to product 1, $\alpha C_i$, assuming firms were optimized to take advantage of interdependencies before the reduction in scope, $R_{i1t}=R_{i1}{}^{**}$ and $R_{i2t}=R_{i2}{}^{**}$. Therefore, if firms adapt their routines in response to organizational changes instantaneously without frictions, $R_{i1t+1} = R_{i1}{}^{*}$, a reduction in firm scope would lead to positive performance changes at the product level whenever there were no positive complementarities *ex ante*. Even more generally, a reduction in firm scope would lead to positive performance changes whenever a product was sublimated within a diversified firm,[6] because the firm would immediately eliminate any interference costs associated with producing the product once the other product was jettisoned. However, if firms are rigid in the sense that they not able to adapt their routines in the short-run (Hannan and Freeman 1984, Leonard-Barton 1992, Rumelt 1994, Audia, Locke and Smith 2000), the immediate effect of a reduction in scope will be to reduce product-level performance when there are complementarities between products, even if diversification created interference costs *ex ante*. Firms may not be able to instantaneously adapt due to physical rigidities, like the cost of

[5] Allocating complementarities in an accounting system is non-trivial; however, here we are referring to the "real" allocation of complementarities in an economic sense. In our empirical context, product performance is relatively straightforward to measure, so we need not be concerned about potential accounting difficulties.

[6] Sublimated means product-level profitability in a diversified firm is lower than it would have been the same firm if the firm operated that product on a stand-alone basis, $\pi_{i1}(R_{i1}{}^{**}) + \alpha C_i(R_{i1}{}^{**}, R_{i2}{}^{**}) < \pi_{i1}(R_{i1}{}^{*})$.

relocating fixed assets, or due to causal ambiguity about the returns to organizational routines or practices, particularly when practices are long-lived institutional features of the firm. If the concept of organizational rigidity applies to interdependent routines in diversified firms, product-level performance will decline when the firm refocuses its operations because interference costs persist though the effect of task misalignment ($R_{i1t+1} \neq R_{i1}^{*}$) at the product level.[7]

The effect of organizational rigidity on $\Delta\pi^{I}_{i1}$ is easy to see using our existing notation. If organizations can adapt instantaneously, in the sense that they can move from $R_{i1}^{**}$ to $R_{i1}^{*}$ immediately following a reduction in firm scope, the sign on $\Delta\pi^{I}_{i1}$ in (4) will be depend on the size of the complementarities that accrue to product 1 and the interference penalty the firm incurred from being diversified at time *t*. With flexible organizations, complementarity between products 1 and 2 is a necessary, but not sufficient, condition for a reduction in firm scope to lead to a decline in product 1 performance. On other hand, if organizations are rigid in the sense that $R_{i1t+1} = R_{i1t}^{**}$ and products 1 and 2 exhibit complementarities, $C_i > 0$, then a reduction in firm scope will lead to an unambiguous reduction in product 1 performance:

$$(5)\ \ \Delta\pi^{I}_{i1} = -\ \alpha C_{i1}(R_{i1t}^{**}, R_{i2t}^{**}) < 0.$$

We summarize the foregoing as:

*Hypothesis 1: When there are complementarities between products and organizations are rigid, a reduction in firm scope leads to an immediate decline in performance for the firm's remaining products.*

Hypothesis 1 tells us the direction of performance change, following a reduction in firm scope, when (i) products are complementary and (ii) organizations are rigid. We test both conditions empirically. Since complementarity is a necessary condition for product performance to fall, following a reduction in firm scope, we can satisfy condition (i) by showing that product-

[7] The foregoing implicitly assumes the reduction in firm scope observed is unanticipated. If a reduction in firm scope is anticipated, firms might adapt organizationally in advance of any scope changes, which would lead to ambiguous predictions about *ex post* product-level performance. While one needs an exogenous shock to scope to form a causal inference about the impact of a reduction in firm scope on product performance (and complementarities and organizational rigidity), the theory applies to endogenous changes in firm scope as well. An endogenous reduction in firm scope also destroys complementarities and exposes the firm to the costs of organizational rigidity, but these effects will be more difficult to detect empirically when the change in scope is a choice variable.

level performance falls when firms refocus. Our second hypothesis tests condition (ii) by examining inter-temporal performance patterns, following a reduction in firm scope.

While organizational rigidity implies that firms will not be able to shift away from $R_i^{**}$ instantaneously following a change in scope, if firms are adaptable in the long run, they will move toward $R_i^{*}$ over time. Given that $\pi_{i1}$ increases monotonically as firms move toward the optimal set of routines, at any time n≥2, we have:

$$(6) \quad \pi^{I}_{i1}(R_{i1t+n}) - \pi^{I}_{i1}(R_{i1t+1}) > 0.$$

Expression (6) says that firms are rigid in the short-run and adaptable in the long-run. If firms were perfectly flexible, the firm would immediately adapt its routines and processes, following a change in scope, leaving no room for any additional adaptation in the long-run: $R_{it+1} = R_i^{*} = R_{it+n}$. And, if firms were completely rigid, then there would be no change in the firm's routines and processes after a change in scope: $R_{it+1} = R_i^{**} = R_{it+n}$. Thus, expression (6) offers a prediction about performance dynamics that will hold if and only if organizations are rigid, but adaptable, which we summarize as:

*Hypothesis 2: When there are complementarities between products and organizations are rigid, but adaptable, the negative productivity effect of a reduction in firm scope will attenuate over time.*

Hypothesis 2 links the idea of the rigid, but adaptable firm to the literature on the costs of interdependencies associated with diversification. Since diversified firms with interdependent routines will accept some interference costs if diversification allows them to exploit significant complementarities between products, when the scope of the firm is reduced it leaves the remaining products exposed to any persistent interference costs. However, a reduction in firm scope frees the firm from the constraints associated with integration that it faced in the past (John, Lang and Netter 1992). Thus, as the firm re-orients their routines and processes, product-level performance should improve over time precisely because diversification creates deeply embedded interference costs that are difficult to eliminate instantaneously. While the diversification literature has traditionally treated interference costs as a negative interdependency at the corporate level that is exacerbated by unrelated conglomerate-style diversification, our framework highlights the importance of operational interdependencies between closely related products. Intuitively, interference costs at the level of the routine seems likely to be more important when a firm's operations are closely related, which probably explains why the extant literature—a literature that focuses primarily on role of the corporate center—is relatively silent on the issues of routines and rigidities. As we explain below, our study deals with closely related production processes, which are well suited to shed light on complementarities, organizational rigidity and organizational adaptation.

## 3. Institutional context

### *3.1 The Peruvian fishing industry*[8]

The Peruvian fishing industry is the second largest in world, generating about $2.5 billion in annual revenue. The industry value chain includes two vertical activities: fish extraction and fish transformation. The focus of this paper is on the extraction segment (i.e., fishing). Output is classified into two product segments: indirect human consumption, which includes fishmeal and fish oil, and direct human consumption, which includes canned, frozen and cured seafood. This paper focuses on the fishmeal and fish oil segment, which accounts for about 97% of the fish processed in the Peruvian fishing industry. While several fish species can be used in the production of products for indirect human consumption, the most common are anchovy and mackerel.

Although the Peruvian sea is one of the most diverse in the world, most of the industry activity (about 85% by weight) revolves around a single species, anchovy (*engraulis ringens*), which is primarily fished for fishmeal. Anchovy are a slow moving fish that routinely achieve a large biomass in the cool waters of the Pacific Ocean off the coast of Peru during both of its reproductive cycles each year. The anchovy population is maintained in part through strict and vigorously enforced restrictions on fishing seasons that prohibit industrial firms from fishing for anchovy in the months surrounding the reproductive cycles. Thus, the natural conditions of the Peruvian sea and the political environment restricting fishing to approximately two periods of three months each year support the highest anchovy landings in the world, around seven million tons per year, though anchovy populations still vary over time due to exogenous biological conditions.[9] Historically, mackerel-based products were the second major intermediate product of the Peruvian fishing industry (about 7% by weight).

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[8] Much of the information in this section was collected while one of the authors was a consultant to a major Peruvian fishing firm and during subsequent interviews with industry executives, ship captains and regulators.

[9] Prohibitions on anchovy fishing only apply north of the 16th parallel. However, there is little anchovy in the southern waters of Peru. In spite of the fact that firms' can fish year-round in the south, only about 4% of all anchovy landings were made south of the 16th parallel.

The vessels used to catch anchovy and mackerel are called purse seiners. Purse seiners catch fish by surrounding shoals with a net that is closed at the bottom by tightening a rope and sucking the fish in to the boat using a pump. Nets are expensive and can easily tear if dragged across the ocean floor or when pressed against the fish shoal; therefore, purse seiners must sometimes chase a group of fish for some distance before the shoal forms and stabilizes. Fishermen note that mackerel is more difficult to catch than anchovy because mackerel tends to "run" more frequently, running fast and far when it does. Thus, the minimum ship size and speed requirements for mackerel fishing exceed the minimums for anchovy fishing, which suggests diversification into mackerel is driven to a large extent by ship-level heterogeneity. (We control for ship-level heterogeneity in our empirical analysis with ship-specific fixed effects.) Different net systems are also required for anchovy and mackerel; however, beyond altering the net system, other physical adjustments to ships when switching between species are relatively minor. In all ships, diversified or not, fisherman are paid proportionately to the value of the fish they catch. Labor rates are typically set at 11-15% of sales and do not vary meaningfully over time within ship.

While utilizing fishing boats during the anchovy off-season provides a strong motivation for firms to fish for mackerel and ship-level heterogeneity influences the ability of the firm to catch mackerel, our interest in this paper is to understand how organizational interdependencies influence product-level (anchovy) productivity. There are at least two important complementarities between anchovy and mackerel fishing. First, because mackerel tends to follow and feed on anchovy, there is a natural biological synergy that firms fishing for both mackerel and anchovy can exploit—fishing for mackerel gives firms better information about the location of anchovy schools that can be exploited when the next anchovy season opens (Muck and Sanchez 1987). The second complementarity is that firms that fish year-round experience less turnover in their labor force; since fishermen tend to exit the industry when they are not working, focused firms tend to experience higher turnover.[10]

The most obvious negative interdependency for diversified fishing firms is that they must operate their boats year-round, resulting in a less well-maintained fleet during anchovy season. Importantly, diversified firms also tend to distribute their ships differently compared to focused firms, which represents an important potential source of organizational rigidity for diversified firms when they were forced to stop fishing for mackerel. While focused firms tend to cluster

[10] Focused firms might also be able to retain fishermen year-round if they fished in the unregulated south during the anchovy off-season. However, because anchovy stocks are typically far less abundant in the south, few focused firms are active year-round.

their ships closer to the shore where anchovy is abundant, but where there is also significant competition, diversified firms tend to spread their boats in order to tap into less competitive fishing grounds. The differing approaches to fleet distribution reflect both information asymmetry about farther flung anchovy fishing grounds and ship-level heterogeneity (e.g., larger, faster ships), but the relative importance of these two effects was difficult, if not impossible, to disentangle before the ban on mackerel even for large, sophisticated firms. In retrospect, it appears that the distributed model was more productive for diversified firms conditional on having asymmetric information. Today, however, industry respondents report that the distributed model has largely been abandoned, which suggests that by removing the interdependencies between mackerel and anchovy, the distributed model became inferior to the clustering approach.

### *3.2 The ban*

Prior to 2002, there were no meaningful restrictions on the harvesting of mackerel: it could be fished for fishmeal or for human-consumption and it could be fished any time of the year. However, given the relative abundance and ease of catching anchovy and the fact that fishing boats must be retrofitted with different net systems to fish for different species, firms fishing for mackerel focused almost exclusively on anchovy during the anchovy seasons (over 95% of fishing activity is directed toward anchovy during anchovy season by weight of fish caught), and then shifted their activities to mackerel fishing during the anchovy off-season.

On September 5, 2002, Alejandro Toledo, the President of Peru, signed a law banning mackerel from use in fishmeal or fish oil production, permitting it to be fished only for human consumption products (*El Peruano* 2002).[11] Our rationale for treating the ban as an exogenous shock in firm scope is based on two factors. First, while government regulation of fisheries was already in place for two other species, anchovy and hake, it had never applied to mackerel before; thus, it is unlikely that firms avoided fishing for mackerel in anticipation of a mackerel ban. In fact, the law was issued as an executive order (*Decreto Supremo*) that press reports suggest was not widely anticipated. While there were a number of decrees issued to promote fishing for mackerel for human consumption after Toledo took office in July of 2001, the ban was not discussed in the legislature, and there is no mention of banning mackerel for fishmeal in any other executive orders related to the fishing industry. The first published mention of the possibility of a ban being put in to place was in the small trade magazine, *Pesca,* in June of 2002 (Bermejo

[11] The species covered by the rule are jack mackerel (*Trachurus murphyi*) and mackerel (*Scomber japonicus*); hereafter, they are referred to collectively as "mackerel." Before the ban, less than 2% of mackerel landings were for human consumption. Interestingly, the ban had a very small effect on total mackerel landings for human consumption, perhaps because in order to fish for human consumption ships must invest in costly refrigerated holds.

2003), just three months before the ban actually went into effect, which mentioned that President Toledo was considering a ban.

Second, while the bans on anchovy and hake were limited to a few crucial months in the species' biological cycles in order to protect their juvenile populations, the mackerel rule was applied to the entire year and in perpetuity.[12] Thus, the ban created an exogenous and permanent reduction in firm scope. Based on our discussion with fishing industry participants, it appears that some firms thought the 2002 ban on mackerel would be quickly overturned by the powerful fishmeal lobby, which lends further support to the idea that the ban was unanticipated, and might also explain why firms were somewhat slow to respond organizationally to the ban.

Figure 1 shows the impact of the ban on mackerel fishing graphically. From January 1999 until just prior to the ban on mackerel, hundreds of thousands of tons of mackerel were extracted by Peruvian firms fishing for fishmeal in most quarters. After the ban, mackerel fishing for fishmeal was eliminated.[13] We exploit the natural experiment provided by the mackerel ban to investigate the causal effects of a reduction in firm scope on firm performance.

The ban destroyed complementarities between anchovy and mackerel operations, but it also freed diversified firms to address the sources of interference costs that had arisen in the multi-product firm. However, as we demonstrate below, it appears to have taken the average diversified firm well over a year to fully adjust to the new regime. What might explain why Peruvian fishing firms were rigid in the short-run? Our interviews with senior managers from several firms suggest two possible mechanisms. First, formerly diversified firms faced larger crew turnover than usual following the ban as experienced fishermen who worked in diversified firms year-round historically exited the industry or changed firms during the anchovy off-season. An increase in crew turnover necessitated changes in recruitment and training processes, which took time to implement. Second, it appears that firms did not immediately alter their fleet distribution practices. Peruvian fishing firms are very sophisticated; yet, even with all the modern equipment these firms employ, fishing remains only in part science, and it is not always clear whether one set of practices (i.e., fleet distribution practices) are superior to another. In general terms, it appears that time compression diseconomies and causal ambiguity are plausible reasons for organizational rigidity with respect to ship distribution processes.

[12] Anchovy fishing is a regulated industry with rigid barriers to entry established by the government; the mackerel ban was not accompanied by relaxed entry regulation into anchovy fishing. Anchovy fishing was (and is) also subject to relatively frequent idiosyncratic short-term suspensions to address commons problems associated with the overall biological sustainability of the species.

[13] The ban did not lead to overcapacity and/or a capacity shakeout in the anchovy segment of the industry, perhaps because there was little mackerel fishing during anchovy season. In fact, total fishing capacity during anchovy season actually increased (slightly) after the ban.

## 4. Data and measures

*4.1 Data and sample*

Our data come from Peru's Ministry of Production's Fishing System proprietary database on fishing ships and fishing activity from 1999 to 2005. The Ministry collects mandatory daily reports on each fish purchase and transaction in the country, covering all fishing trips and catch size by species and weight for each fishing ship in the Peruvian Pacific Ocean. The Ministry also records ship characteristics, such as ship storage capacity and company affiliation for each fishing boat. Our tests are based on weekly data on the weight and type of all fish for fishmeal caught during anchovy season from the full set of 1,020 ships from 453 firms that reported fishing for fishmeal at least once during the sample.

The unit of analysis for the empirical tests is the ship-week. Table 1 provides summary statistics on ship-week, ship and firm variables. The table reveals substantial heterogeneity in productive factors and firm boundaries, which underscores the importance of using micro-data when studying the effect of firm scope on productivity. The average weekly tonnage of fish caught by a ship, in our sample, is 274 tons, and the standard deviation is 330 tons, though distribution of catches is very broad: from 0.04 tons to 3,120 tons. There is also substantial heterogeneity in the holding capacity the ships in our dataset. The mean hold of a ship is 183m$^3$, but the broad average includes small fishing boats with 8m$^3$ holds to enormous ships with 868m$^3$ of storage capacity. Ships in our data go on 3.41 fishing expeditions ("trips") per week on average. At the firm level, the smallest firms have but one ship, the largest have 61 ships and the average firm operates 2.4 ships. 41% of the firms were diversified, in the sense they had at least one ship that fished for mackerel for fishmeal in the pre-ban period.

We estimate the impact of a reduction in firm scope on product-level performance using a differences-in-differences estimator that compares the within-ship changes in productivity of ships in diversified firms, before and after the mackerel ban, against within-ship changes in productivity of ships in firms that were never diversified, controlling for secular changes in productivity at a very granular (weekly) level. Under certain assumptions, changes in productivity map directly to changes in product-level profitability; for example, when firms are price takers, and production is characterized by constant returns to scale, including any unobserved fixed costs (e.g., back office administrative costs), productivity maps directly to profitability. One can see the link between productivity and profitability easily by defining the profit function in the usual way with two parameters that link profitability and productivity to the firm's diversification status and to the periods before and after the ban. Profit $\pi$ for an input and output price-taking firm $j$, in business-segment $s$ = {anchovy, mackerel}, can be represented by:

$$(7)\ \pi_j = (p_a - c_a)Y_{ja}(\theta,\sigma) + (p_m - c_m)Y_{jm}(\theta,\sigma) - F(K_j),$$
$$Y_{js} = A_{js}(\theta,\sigma)K_{js}^{\beta k}L_{js}^{\beta l},$$

where $Y$ is output in tons, subscripts $a$ and $m$ index anchovy and mackerel operations; $F>0$ is the (unobserved) fixed cost of operations, where fixed costs are increasing in total capital deployed $(K)$. The market price per ton $p>0$ and the marginal cost of harvesting an additional ton $c>0$ convert physical output into gross profit, where physical output $Y$ is generated by a production function that transforms inputs capital $(K)$ and labor $(L)$ using technology $(A)$, which can be interpreted as total factor productivity (TFP).[14] The two key parameters $\theta = \{0,1\}$ and $\sigma = \{0,1\}$ index whether the firm is operating before or after the ban, and whether the firm is diversified or focused, respectively, which fully capture of the impact of positive interdependencies and interference costs as discussed above.

It is clear from expression (7) that when firms are price takes, as they are in our setting, all the variation in product profitability within and between firms must flow through the production functions or through fixed costs. If production and fixed costs exhibit constant returns to scale (CRS), then changes in TFP completely drives changes in profits in expression (7).[15] We verify that the anchovy production function is approximately CRS at the firm and ship level, but acknowledge that we have no way of knowing if the CRS assumption might be violated with respect to fixed costs. However, even if fixed costs do not exhibit CRS precisely the mapping between our conceptual measure (profitability) and our empirical measure (productivity) of product performance appears to be quite close.[16]

Our main sampling frame begins on January 1, 1999 and continues through December 31, 2003, so that we have 44 months of pre-ban observations and sixteen months of post-ban observations on which to base our statistical estimates. We only consider weeks during the anchovy fishing season, determined by the Peruvian government, totaling 139 weeks. We

[14] Since the industry production function is Leontief within-ship, the labor term is dropped in the final specification. See the discussion of expressions (8), (9) and (10) below.
[15] To calculate the precise impact of differences in productivity on differences in profits with CRS, holding fixed costs constant, productivity also has to be scaled by gross margin = (p-c)/p.
[16] Another subtlety is that we estimate changes in productivity inclusive of changes in the marginal productivity of capital and labor that are caused by a reduction in firm scope, not necessarily changes in TFP *per se*. However, variation in factor productivity also maps directly to profitability, as can be seen in expression (7).

explored a number of alternative sampling frames including using symmetric pre-ban and post-ban periods, and found that our results were robust to a pre-ban period of any length. As we describe below, increasing the post-ban sampling period does not change the statistical significance of our results, but does influence the economic magnitude of the effect, consistent with our theoretical framework.

*4.2 Key measures*

The dependent variable in our analyses is the log of tons of fish caught per week by ship, which is reported directly to the Ministry.[17] Our main explanatory variable is a dichotomous time-varying firm-level variable, *REFOCUS*, which captures whether the ban on mackerel fishing forced a firm $j$ to reduce the scope of its operations in week $t$. $REFOCUS_{jt} \equiv BAN_t \ x\ DIVERSIFIED_j$, where *BAN* is equal to one in all periods following the mackerel ban, and zero before the ban, and *DIVERSIFIED* is equal to one if firm $j$ had at least one boat that fished for mackerel for fishmeal before the ban, and is zero otherwise.[18] The concepts of diversification and focus, in our context, are based on the operational scope of the firm with respect to intermediate product production, not product scope in terms of finished goods. Thus, our analysis is based on interdependencies in the extraction phase of the industry, as opposed to economies of scope in downstream marketing and distribution processes. Besides ship, time (week) and location fixed effects, our other key control variable is capital deployed $k$ per ship $i$, per week $t$, where $k_{it}$ = log(ship-specific storage capacity x number of fishing trips the ship takes per week).[19] By controlling for the number of fishing trips per week in our measure of capital, our measure of productivity is robust to variation in the intensive margin of asset utilization.

To measure the time path of productivity effects, we create categorical variables for each of the six anchovy fishing seasons from the date of the ban (September 2002) until the end of 2005, where seasons are defined by the Peruvian fishing authority. We interact the season dummies with *REFOCUS* to capture the marginal effect of the ban on productivity over time by season.

## 5. Empirical Strategy

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[17] Fishmeal and fish oil can include more than 35 different species of fish, such as catfish, Pacific menhaden and flying fish. However, during anchovy season, anchovy represents more than ninety-five percent of all catches (by weight). We measure productivity based on anchovy catches during anchovy season. Our results are robust to including other species in our measure of output.

[18] 85% of ships in diversified firms fished for mackerel at least once before the ban.

[19] Though we do not restrict our sample based on anchovy fishing, empirically all ships fished for anchovy before and after the ban. However, because our dependent variable is based on anchovy landings we only include in $k_{it}$ trips that resulted in anchovy catches. In other words, we exclude mackerel (and other) trips from $k_{it}$.

Because firms choose their scope, a well-identified test of the impact of a change in firm scope on performance requires exogenous variation in the scope of the firm. We are fortunate to have such a shock in this study in the form of the mackerel ban of 2002 that led to a reduction in firm scope, as the Peruvian regulatory ban completely eliminated mackerel fishing for fishmeal in September 2002. In the ideal experiment, we would randomly assign some diversified firms to become focused, while assigning others to remain diversified. We do not have a control group of formerly diversified firms that remain diversified after the ban, but we can exploit the existence of firms that remain focused throughout the sample to control for secular changes in productivity using a standard differences-in-differences approach.

Our first hypothesis predicts that a reduction in firm scope will lead to a drop in the productivity of the firm's remaining products when there are complementarities between products, and organizations are rigid. To test Hypothesis 1, we develop an econometric model of scope and performance that captures the effect of a reduction of firm scope on productivity, relative to changes in the productivity of other firms that were not directly affected by the shock, where $i$ indexes ships, and $t$ indexes weeks, $y$ is log tonnage of fish extracted from the ocean, $k$ is the log of the ship's capacity (storage capacity x trips/week), $\lambda$ is a ship fixed effect, $T$ is a week fixed effect, and $G$ is a fishing zone location fixed effect: [20]

We estimate the effect of a reduction in firm scope on product-level performance based on the standard approach for measuring total factor productivity. With two inputs capital $K$ and labor $L$, the production function for a given ship is:

$$(8)\ Y = AK^{\beta k}L^{\beta l},$$

where $Y$ is an output measure $A$ is total factor productivity (TFP). Unfortunately we do not observe labor in our data, but our interviews with ship captains and industry executives indicated that the minimum number of workers per ship is fixed by regulation based on the physical characteristics of the ship, and in practice ships do not carry more workers than what is required by law. Thus, ship-level production is Leontief in the Peruvian fishing industry: within-ship capital and labor are used precisely proportionally over time. Therefore, for any given ship, holding the ratio of capital and labor fixed and taking logs we can rewrite (8) as:

[20] We coded the coastline into four different fishing zones, defined by latitude as described by industry experts. We confirmed that reported fishing activity was indeed clustered within these zones. In the rare cases when a ship fished in two zones in a given week, we used the northern-most zone for the $G_{it}$ dummy.

(9) $y = a + \beta_k k,$

where variables written in lower case letters in (9) are the natural logarithms of variables written in capital letters in (8); for example, *a* represents TFP.

We estimate the percentage change in a firm's product-level productivity from a reduction in scope, using a differences-in-differences estimator by including 1,024 ship fixed effects $\lambda_i$, 139 week fixed effects $T_t$, and four location fixed effects $G_{it}$, along with the explanatory variable $REFOCUS_{jt}$, as in:

(10) $y_{it} = \alpha + \beta_k k_{it} + \lambda_i + T_t + G_{it} + \beta_R REFOCUS_{jt} + \upsilon_{it}$.[21]

Standard errors are robust and clustered at the firm level in (10) and in all of our subsequent specifications.[22]

The coefficient on *REFOUCS*, $\beta_R$, in (10) delivers an unusually precise estimate of within-ship changes in productivity from a reduction in firm scope relative to within-ship changes in productivity in firms that did not change their scope. Specification (10) not only controls for all sources of time-invariant ship-level heterogeneity, it also controls for changes in the intensive margin within-ship (i.e., variation in weekly ship utilization), all factors that influence ship productivity in common over time (i.e., time varying TFP, marginal productivity of capital and marginal productivity of labor) perhaps due to weather and/or the natural abundance of fish in the sea, and average location-specific variation in catches over time.[23] Thus, if changes in $k_{it}$ are exogenous, $\beta_R$ can be interpreted as the percentage change in the productivity of a firm's anchovy business due to a reduction in firm scope. To estimate the persistence of a negative productivity shock following refocusing, we include the full set of *REFOCUS x SEASON* dummies in (10).

[21] To see why *REFOCUS* captures changes in TFP when we do not observe labor, but capital and labor are used proportionately within-ship over time note that if $L=\gamma_i K$, then we can write the estimating equation as:

$$y_{it} = \alpha + \lambda_i + T_t + (B_k + B_l)k_{it} + B_l ln\gamma_i + G_{it} + \beta_R REFOCUS_{jt} + e_{it},$$

and the ship fixed effect $\lambda_i$ would absorb $\ln\gamma_i$. We thank an anonymous referee for pointing out this specification. Note also that labor is paid proportionately to the value of catches. The implication is that the week fixed effects control for common shocks to the marginal productivity of labor when measured in quantities or by real wages. Following the usual assumption that labor is paid its marginal product would obviate any labor effects in our estimates. However, as we discuss below, consistent with our hypotheses, the negative effects of increased labor turnover may also be embedded in our productivity estimates.

[22] We vary (10) to verify that production exhibits constant returns to scale at the firm level. To do so, we regress aggregate firm output $y_{it}$ on aggregate firm capital stock $k_{it}$, controlling for week fixed effects and find that the coefficient on $k_{it}$ is 0.99.

[23] The inclusion of ship fixed effects subsumes the firm-level, time-invariant $DIVERSIFIED_j$ term, and the inclusion of weekly fixed effects subsumes the firm-level, time-varying $BAN_t$ dummy, so we do not estimate these main effects separately from the interaction term $REFOCUS_{jt}$.

By construction, the *REFOCUS x SEASON* dummies also serve to capture the time path of organizational adaptation after the ban.

Our identification strategy allows us to deal with the endogeneity of refocusing. Even if $k_{it}$ is an endogenous production input, $\beta_R$ is still informative about changes in product-level productivity, though further econometric analysis, also performed here, is required to interpret the coefficient properly. [24] Because the time-invariant ship-specific component of $k_{it}$ is controlled for with ship fixed-effects, our main additional concern is with the endogeneity of the number of trips a ship takes each week.[25] If refocusing causes formerly diversified firms to change the number of trips per ship per week—their ships' utilization rate—relative to the utilization rate of ships in focused firms, $\beta_R$ could conflate changes in TFP with utilization effects. Conceptually, our hypothesis tests are valid whether the effect of the change in scope operate through a decline in TFP, the marginal productivity of capital (i.e., of each trip) and/or the marginal productivity of labor (i.e., due to increased turnover) in formerly diversified firms relative to focused firms: our main interest is with the effect of the change in scope on product performance. However, it is of great importance to understand whether any changes in the marginal productivity of capital are economically meaningful, or whether they reflect changes in business practices that have little to do with product performance. For example, if formerly diversified firms shift their fleet distribution strategy away from taking long trips that filled up ships to capacity with anchovy pre-ban, toward taking many short trips that resulted in less-than-full capacity catches after the ban, $\beta_R$ will overstate (negatively) the true economic impact of the change in scope because of the mechanical relationship between capacity utilization (catches/trip) and $\beta_R$. On the other hand, if the ban results in less efficient searching for anchovy in formerly diversified firms, then $\beta_R$ will, appropriately, capture both a decline in TFP and a real economic decline in the marginal productivity of capital caused by the reduction in firm scope.

[24] The classic concern about endogenous factor inputs in production functions is that capital utilization rates will vary heterogeneously according to unobservable (to the econometrician) demand shocks (Marschak and Andrews 1944). In our setting, firms always try to maximize anchovy catches within season, and we control directly for capacity utilization by allowing trips/week to enter into the production function. However, there is firm-specific knowledge about the location of anchovy shoals, which implies that decisions about trip length will be driven by unobservable heterogeneity across firms. If changes in trip length vary over time idiosyncratically, the variation does not pose an identification challenge. However, if it varies systematically by firm type (i.e., by formerly diversified versus focused firms) then a potential endogeneity concern arises.

[25] Ship-level capacity is capped by government regulation and cannot vary over time. Thus, the inclusion of a ship fixed effect controls for all variation in storage capacity. Since $K_{it}$ = (storage capacity)$_i$ x (number of fishing trips)$_{it}$, we are primarily concerned with the endogeneity of trips per week.

Given the nature of production in this industry, even with our extensive controls, trip length is a potential omitted variable in our production function.[26] We take two approaches to disentangle changes in real productivity from measured changes in productivity due to shorter trips. First, we exploit the fact that anchovy is subject to frequent temporary (e.g., a few days long) fishing moratoriums determined by the Peruvian government during the fishing season (*El Peruano* 1992); we instrument for the number of trips component of $k_{it}$ using the number of unrestricted anchovy fishing days per week. The instrument is exogenous to the actions of a given ship or firm, and it satisfies the exclusion restriction because regulatory restrictions on anchovy are imposed based on biological considerations (e.g., early spawning, late migration, etc.) that should be uncorrelated with the marginal productivity of a trip. Although the instrument only varies at the fishing zone-week level, not the ship-week level, it can be expected to generate a strong first stage because the off-season prohibitions on fishing for anchovy lead firms to maximize ship utilization (i.e., productive fishing time at sea) during the fishing season. To wit, fishermen call anchovy season "the Olympic race" because of the frenzied activity that begins with the opening of the season. Therefore, the temporary moratoriums should be a binding constraint with respect to ship utilization and firms should utilize their ships more heavily in the absence of such restrictions.

Second, we build on the idea in Griliches and Mairesse (1995) that econometricians should use ancillary information about the production function to interpret $\beta_R$ properly in the presence of endogenous factors of production. In particular, we examine the change in the number of trips per ship by type of firm (formerly diversified vs. focused) and use that information to gauge whether trip lengths are lengthening or shortening after the ban for formerly diversified firms relative to focused firms. While we do not observe length directly, we can exploit the fact that firms generally try to maximize productive fishing time during the anchovy season to infer that trip length is inversely proportional to the number of trips a ship takes each week.

## 6. Results

### *6.1 Baseline results*

Figures 2 and 3 preview our main results. Figure 2 shows average productivity across all ship-weeks before including ship fixed effects, before and after the ban for diversified and

[26] Unobservable fuel expenditures represent another potential omitted variable. While fuel usage is unlikely to vary meaningfully within-ship for a trip of a given length, and week fixed effects absorb any common time variation in fuel costs and weather conditions, fuel expenditures are directly proportional to trip length. Therefore, we deal with fuel usage through our controls for trip length.

focused firms during 1999-2003. Before the ban, ships in diversified and focused firms have very similar productivity levels, but after the ban, productivity in ships in diversified firms shifts down relative to ships in focused firms. To give some sense of weekly variation in productivity, we also include average weekly productivity by firm type (i.e., diversified or focused) in the figure. Pre-ban productivity effects vary widely for both focused and diversified firms, but post-ban diversified firms' productivity is consistently below focused firms' in each of the three seasons through 2003.

Figure 3 shows firm productivity distributions in kernel density plots of diversified and focused firms before and after the ban on mackerel, excluding the top and bottom 1% of the productivity distribution. The top panel reveals that before the ban, the productivity distributions of firms that fished for both anchovy and mackerel was very similar to the productivity distribution of ships in focused firms. Following the ban, the relative position of ships in formerly diversified firms has shifted to the left (downward) relative to ships in focused firms.

Table 2 provides statistical evidence of the effect of reducing the scope of the firm on ship-level productivity in diversified firms relative to focused firms. Column 2.1 shows the pooled cross-sectional estimate of the ban on ship-level productivity for firms that were previously diversified. The coefficient on *REFOCUS*, which represents the average (relative) change in productivity of ships in diversified firms is -22% and precisely estimated. The coefficient on $k_{it}$ in this regression is 1.04, which suggests slight (4%) economies of scale at the ship level.

In column 2.2 we include ship fixed effects to control for time-invariant ship-specific heterogeneity and allow the marginal productivity of capital to vary by week replacing $k_{it}$ with the interaction term $k_{it}$ x $T_t$. The coefficient on *REFOCUS* is similar at -20% and precisely estimated, though the interpretation is now stronger: *REFOCUS* represents the within-ship change in productivity for formerly diversified firms relative to focused firms, controlling explicitly for time-varying marginal productivity of capital.

Including ship and week fixed effects in column 2.3 delivers within-ship estimates of changes in productivity for ships in formerly diversified firms relative to focused firms controlling for all sources of common variation in productivity (including time-varying marginal productivity of capital and labor). Controlling for all sources of common variation in productivity instead of just time-varying marginal productivity of capital has only a slight effect on the coefficient of variation and the coefficient on *REFOCUS*, which falls slightly to minus 17%, but is still precisely estimated. To put the economic magnitude of the effect in perspective, at the ship level, a 17% drop in productivity translates into approximately a 47-ton reduction in fish caught per week or 14% of one standard deviation of output, which amounts to about $80,000 in lost revenue per ship per year.

The coefficient estimates on $k_{it}$ in the presence of ship and week fixed effects can be interpreted as the average within-ship marginal productivity of an incremental trip. Unsurprisingly, given the regulatory restrictions on anchovy season, the marginal productivity of an incremental trip is larger than unity at 1.26, which means a 1% increase in the number of trips leads to a 1.26% increase in catches. Thus, one can see that ship utilization is a choice variable only in a limited sense. If the marginal trip is valuable, firms will attempt to maximize capital utilization, and any failure to do should properly be considered a real performance effect. However, our baseline results treats ship utilization (the intensive margin) as an exogenous control variable, therefore, the differences-in-differences results can only be interpreted as evidence of productivity effects before considering endogenous utilization effects.

Column 2.4 shows the results of the 2SLS estimation to control for the endogeneity of capital utilization. Instrumenting for $k_{it}$ using the number of days without restrictions on anchovy fishing in week $t$ by fishing zone reveals that the absence of temporary restrictions is a strong predictor of capital utilization. The coefficient estimate on the instrument is positive and precisely estimated in the first stage of the 2SLS model with a t-statistic of 22. The F-statistic is 231 and the $R^2$ is 0.81, which suggests that the instrument is powerful (see the notes at the bottom of Table 2). After instrumenting for capital utilization, the coefficient on *REFOCUS* in the second stage is larger and significantly different from the baseline estimates at -25%, and is statistically significant at the 1% level. The interpretation of the 2SLS result is that capital utilization effects bias the baseline results toward zero, suggesting that our baseline estimates of the effect of refocusing on productivity are conservative.

The interpretation of the baseline results in Table 2 is that the reduction in firm scope brought on by the ban on mackerel fishing for human consumption led to an economically and statistically significant drop in anchovy productivity in firms that were formerly diversified relative to firms that had always been focused. Because firms chose to diversify into mackerel fishing prior to the ban, we cannot claim that refocusing would have had the same economic impact on firms that never diversified. However, conditional on diversifying before the ban, the results show that refocusing caused anchovy productivity to fall.

To test the prediction of Hypothesis 2 that the negative productivity shock associated with reducing the scope of the firm attenuates over time, we extend the post-ban treatment period to the end of the data set (2005) and examine how the productivity effects change by season. Table 3 shows two versions of the test. Column 3.1 extends our core sampling frame from 1999-2005, and measures the effect of a scope reduction on productivity over a longer time period than in the baseline estimates 1999-2003. Column 3.2 runs the same regression with the *REFOCUS* interacted with six season dummies one for each season after the ban. The results reveal that the negative productivity shock associated with reducing the scope of the firm attenuates over time, falling to -7% from -17% with the addition of two additional years (column 3.1). Column 3.2 shows the attenuation effect by season. In the first three seasons following the ban, the point estimates of the productivity effect are in the 14-19% range and precisely estimated;[27] however, by the fourth season after the ban the point estimate of effect of the reduction in firm scope is close to zero and is always statistically indistinguishable from zero. The apparently sudden improvement in productivity in the fourth season is probably reflective of the lagged effect of crew continuity problems, which counteracted operational improvements over time.

*6.2 Mechanisms*

One limitation of the data is that we cannot observe positive interdependencies and organizational rigidity directly; rather, we must infer these effects from performance patterns of fishing firms and from qualitative evidence. To further investigate how the broad patterns in the data fit with the concepts of product complementarities and organizational rigidity, we examine three extensions that shed some light on the underlying mechanisms behind the changes in productivity observed.

If there were positive informational interdependencies between anchovy and mackerel fishing, we should observe a larger decline in product-level performance when firms gathered more information about anchovy while fishing for mackerel. Counting the number of times firms switched between anchovy and mackerel offers one straightforward proxy for how much information firms obtained about anchovy while fishing for mackerel. Firms that switched more frequently would obtain more information about anchovy since each switch provides incremental information about the location of anchovy shoals where mackerel tend to feed. We measure the number of switches by constructing a variable, $SWITCHES_j$, which is equal to the number of times a firm switched from fishing for anchovy to fishing for mackerel or vice versa.[28] Following Greenstone, Hornbeck and Moretti (2010), to facilitate a straightforward interpretation of *SWITCHES*, we normalize the measure to be mean zero and have a standard deviation equal to one at the firm level.

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[27] For example the Season 1 effect is -0.18 + 0.04 = 0.14. The standard error is $(0.03^2 + 0.04^2)^{1/2}$=0.05.

[28] We calculate $SWITCHES_i$ at the ship-level and compute firm-level $SWITCHES_j$ by summing the ship-level measure weighted by trips per ship and dividing by the total number of fishing trips within firm *j*.

Supporting the idea of informational interdependency, Table 4, column 4.1 shows that when firms switched between mackerel and anchovy more frequently they experienced larger anchovy productivity declines post-ban. The coefficient on the term *REFOCUS x SWITCHES* is -0.14 and is significant at the 1% level. The interpretation is that a one standard deviation increase in *SWITCHES*, or 7-8 additional changeovers per season per firm, was associated with an additional 14% decline in productivity, relative to a baseline rate of -16% in all firms that were forced out of the mackerel business.[29] While *SWITCHES* is only an indirect measure of information effects, we include firm size controls in column 4.4 to verify that we are not simply picking up firm size effects with our proxy variable.

Our interviews also pointed to the possibility that formerly diversified firms experienced increased crew turnover following the mackerel ban, which suggests a second mechanism behind the drop in productivity for those firms. While the number of fisherman per ship does not vary within-ship, if the ban caused turnover to increase in formerly diversified firms, relative to focused firms, the effect of the ban might flow through directly to productivity through a labor turnover effect (i.e., a systematic drop in labor factor productivity that we pick up through $B_R$). We proxy for the potential impact of the mackerel ban on crew continuity using the firm's total tonnage of mackerel the firm extracted in the pre-ban period by quartile $\{EXPOSURE^1_j, \ldots, EXPOSURE^4_j\}$. *EXPOSURE* should be correlated with total employment of fisherman during the anchovy off season, which makes it a good proxy for potential crew turnover effects. Table 4 column 4.2 shows that firms in the top two *EXPOSURE* quartiles (4th and 3rd quartiles, respectively) suffered a significant drop in productivity after the reduction in firm scope (-23% and -26%, respectively). Firms in the second quartile suffered a smaller reduction in productivity (-11%), while firms with the least *EXPOSURE* to mackerel fishing experienced no statistical change in productivity. We also verify in column 4.5 that *EXPSOURE* is not merely a proxy for scale effects by controlling for firm size directly. Although *EXPOSURE* is a coarse proxy variable, the results do offer some support for the idea that crew turnover effects caused by the mackerel ban differentially negatively influenced performance.

One interesting implication of the positive informational interdependencies between mackerel and anchovy fishing, suggested to us during our fieldwork, is that diversified firms tended to distribute their ships differently than focused firms. Instead of sending ships to the most heavily fished waters closer to the shore, diversified firms sent ships to smaller, more distant shoals, where the fishing boats faced less competition. After the mackerel ban, fishing firm executives

[29] The sign and statistical significance of the result is robust to excluding the top firms in the *SWITCHES* distribution, but the point estimate falls substantially when the most frequent switchers are excluded.

noted that diversified firms continued operating in a similar manner, at least for a few seasons, perhaps because they had developed their organizational and operational systems around a distributed model. If ship distribution processes were indeed rigid, we would expect that trip lengths would lengthen for formerly diversified firms, relative to focused firms, as ships engaged in more time-consuming search efforts. Therefore, if ship distribution practices are an underlying driver of organizational rigidity, we should see that changes in average trips/week per ship fell in formerly diversified firms relative to focused firms after the ban.

Figure 4 provides some suggestive evidence that the mackerel ban led to longer trips (fewer trips per week) in formerly diversified firms. Diversified firms took more trips per ship per week in seven of the eight fishing seasons before the ban, but trips per ship per week were almost identical in the first three seasons after the ban. Table 4, column 4.3 shows this effect statistically using log trips as the dependent variable, *REFOCUS* as the set of explanatory variables and including ship, week and fishing zone fixed effects, we see that trips per ship per week fell by 16% in diversified firms after the ban relative to focused firms. The result, which is robust to firm size controls (column 4.6), suggests that after losing the information about the location of anchovy shoals gained while mackerel fishing, formerly diversified firms were spending more time searching for anchovy post-ban than there were pre-ban, which led to less efficient searching and longer trips during anchovy season. Taken together with the productivity results, the utilization effect suggests that inefficient capital utilization due to organizational rigidity was an important part of the reason the ban on mackerel fishing caused anchovy performance to fall in formerly diversified firms.

*6.3 Robustness checks*

The results are robust to a wide range of robustness checks. We report the most important tests in Table 5. To address concerns that firms that are forward vertically integrated into fish processing may add noise to the analysis, we eliminate these firms in column 5.1, finding a smaller yet still statistically significant negative point estimate on *REFOCUS*. Column 5.2 leaves in the sample only multi-ship firms, that is, the firms most prone to multi-asset interdependencies, without substantially altering the baseline results. In column 5.3, we introduce time-varying dummies for firm size to account for any firm scale effects on productivity; the coefficient on *REFOCUS*, though slightly smaller, is still negative and precisely estimated. To account for ship-specific trends, which cannot be modeled linearly because observations are at the ship-week level, we introduce a quadratic ship-specific weekly trend centered on the moment of the ban. Ship-specific trends leave the direction and level of significance qualitatively unchanged (column 5.4). Finally, we consider a specification that separately controls for weekly and seasonal variation in the marginal productivity of capital by extending the model in 2.2 to allow the influence of ship capacity (measured in cubic meters) on productivity to vary flexibly by season. Even in this very conservative specification *REFOCUS* remains, negative, and statistically significant (column 5.5).[30] The results are also robust to different *ex ante* sampling windows, aggregating to the firm level, and to dropping outliers.

**7. Conclusion**

This paper examines how a reduction in firm scope influences firm performance over time. Although there is a large and important literature on scope and performance, as well as great interest in the subject amongst practitioners, there is still much that we do not understand about the product-level relationships between refocusing and changes in performance. We develop a simple analytical framework for understanding how refocusing influences performance when there are positive interdependencies between products and organizations are rigid, and test the predictions of the framework in the context of the Peruvian fishing industry where a ban on mackerel fishing led to an exogenous reduction in firm scope in 2002. We show that removing a product (mackerel) from a firm's portfolio leads to a 17% decline in the productivity of the firm's remaining product line (anchovy) in the short-run (1.25 years). The results provide causal evidence of complementarities from product-level interdependencies that has been missing from in the literature on firm scope. We also show that the negative productivity effect attenuates over time, which suggests that while organizations are rigid in the short-run they are adaptable in the long-run. One important implication of rigid, but adaptable organizations, in the context of firm scope is that firm boundaries should, normatively and positively, reflect the costs of adapting the firm's processes and routines. The costs of adaptation are important both when the firm is buffeted by exogenous shocks and is forced to adapt, as in our study, and when the firm contemplates endogenous strategic choices about making changes to firm scope.

**References**

Amburgey, T., D. Kelly, W. Barnett. 1993. Resetting the Clock: the Dynamics of Organizational Change and Failure. *Administrative Science Quarterly* **38**(1): 51-73.

Audia, P., E. Locke, K. Smith. 2000. The Paradox of Success: an Archival and a Laboratory Study of Strategic Persistence following Radical Environmental Change. *Academy of Management Journal* **43**(5): 837-853.

Bermejo, A. 2003. Ministro Moralizador. Editorial. *Pesca* (3), p.3.

Campa, J.M., S. Kedia. 2002. Explaining the Diversification Discount, *Journal of Finance* **57** (4): 1731-1762.

[30] We find similar results when modifying model 2.3 to control for seasonal variation the marginal productivity of capital.

Capron, L., P. Dussauge, W. Mitchell. 1998. Resource Redeployment Following Horizontal Acquisitions in Europe and North America. *Strategic Management Journal* **19**(7): 631-661.
Capron, L., W. Mitchell, A. Swaminathan. 2001. Asset Divestiture Following Horizontal Acquisitions: A Dynamic View. *Strategic Management Journal* **22**(9): 817-844.
Cassiman, B., R. Veugelers. 2006. In Search of Complementarity in Innovation Strategy: Internal R&D and External Knoweldge Acquisition. *Management Science* **52**(1): 68-82.
Colak, G., T.M. Whited. 2007. Spin-offs, Divestitures, and Conglomerate Investment. *Review of Financial Studies* **20**(3): 557-595.
Desai, H., P. Jain. 1999. Firm performance and focus: long-run stock market performance following spinoffs. *Journal of Financial Economics* **54**(1): 75-101.
El Peruano. 1992. Ley General de Pesca. Decreto Ley 25977. 22 December 1992.
El Peruano. 2002. Decreto Legislativo N. 001-2002-PRODUCE. 6 September 2002, p. 229522-3.
Feldman, E. 2011. Selling your Heritage: Legacy Divestitures and the Hidden Costs of Corporate Renewal. *Working paper.*
Gertner, R., D. Scharfstein, J. Stein. 1994. Internal Versus External Capital Markets. *Quarterly Journal of Economics* **109**(4): 1211-1230.
Greenstone, M., R. Hornbeck, E. Moretti. 2010. Identifying Agglomeration Spillovers: Evidence from Winners and Losers of Large Plant Openings. *Journal of Political Economy* **118**(3): 485-535.
Griliches, Z., J. Mairesse. 1994. Production Functions: The Search for Identification. *NBER Working Paper No. 5067.*
Hannan, M., J. Freeman. 1984. Structural inertia and organizational change*. American Sociological Review* **49**, 149-164
Holmstrom, B., P.R. Milgrom. 1994. The Firm as an Incentive System. *American Economic Review* **84**(4): 972-991.
John, K., L.H.P. Lang, J. Netter. 1992. The Voluntary Restructuring of Large Firms in Response to Performance Decline. *Journal of Finance*, **47**(3): 891-917.
John, K., E. Ofek. 1995. Asset sales and increase in focus. *Journal of Financial Economics* **37**(1), 105-126.
Lamont, O. 1997. Cash Flow and Investment: Evidence from Internal Capital Markets. *Journal of Finance* **52**(1): 83-109.
Leonard-Barton, D. 1992. Core Capabilities and Core Rigidities: A Paradox in Managing New Product Development. *Strategic Management Journal* **13**(1): 111-125.
Levinthal, D. 1997. Adaptation on Rugged Landscapes. *Management Science* **43**(7): 934-950.
Levinthal, D, X. Wu. 2010. Opportunity Costs and Non-Scale Free Capabilities: Profit Maximization, Corporate Scope and Profit Margin. *Strategic Management Journal* **31**(7): 780-801.
Maksimovic, V., G. Phillips, N.R. Prabhala. 2011. Post-Merger Restructuring and the Boundaries of the Firm. *Journal of Financial Economics* (forthcoming).
Marschak, J., W. Andrews. 1944. Random Simultaneous Equations and the Theory of Production. *Econometrica* **12**(3/4): 143-205.
Martin, J., K. Eisenhardt. 2010. Rewiring: Cross-Business-Unit Collaborations in Multibusiness Organizations. *Academy of Management Journal* **53**(2): 265-301.
Muck, P., G. Sanchez. 1987. The Importance of Mackerel and Horse Mackerel Predation for the Peruvian Anchoveta Stock (A population and feeding model). In: D. Pauly, I. Tsukayama, eds.: *The Peruvian Anchoveta and its Upwelling Ecosystem: Three Decades of Change*. International Center for Living Aquatic Resources Management.
Nickerson, J., B. Silverman. 2003. Why Firms Want to Organize Efficiently and What Keeps Them from Doing So: Inappropriate Governance, Performance, and Adaptation in a Deregulated Industry. *Administrative Science Quarterly* **48**(3): 433-465.
Rawley, E. 2010. Diversification, Coordination Costs and Organizational Rigidity: Evidence

from Microdata. *Strategic Management Journal* **31**(8): 873-891.
Rivkin, J.W., N. Siggelkow. 2003. Balancing Search and Stability: Interdependencies Among Elements of Organizational Design. *Management Science* **49**(3): 290-311.
Rumelt, R. 1994. Inertia and Transformation. Precis of a lecture at UC Berkeley. http://www.anderson.ucla.edu/faculty/dick.rumelt/Docs/Papers/berkeley_precis.pdf
Schoar A. 2002. Effects of Corporate Diversification on Productivity. *Journal of Finance* **57** (2): 2379-2403.
Siggelkow, N., D. Levinthal. 2003. Temporarily Divide to Conquer: Centralized, Decentralized, and Reintegrated Organizational Approaches to Exploration and Adaptation. *Organization Science* **14**(6): 650-669.
Stern, S., S. Novak. 2009. Complementarity Among Vertical Integration Decisions: Evidence from Automobile Product Development. *Management Science* **55**(2): 311-332.
Teece, D.J. 1980. Economies of Scope and the Scope of the Enterprise. *Journal of Economic Behavior and Organization* **1**(3): 223-247
Teece, D.J. 1982. Towards and Economic Theory of the Multiproduct Firm. *Journal of Economic Behavior and Organization* **3**(1): 39-63.
Villalonga B. 2004. Diversification Discount or Premium? New Evidence from the Business Information Tracking Series. *Journal of Finance* **59** (2): 479-506.
Wernerfelt, B., C. Montgomery. 1988. Tobin's *q* and the Importance of Focus in Firm Performance. *American Economic Review* **78**(1): 246–250.
Zhou, Y.M. 2011. Synergy, Coordination Costs and Diversification Choices. *Strategic Management Journal* **32**(6): 624-639.

**Figure 1: Mackerel ban and mackerel catches**

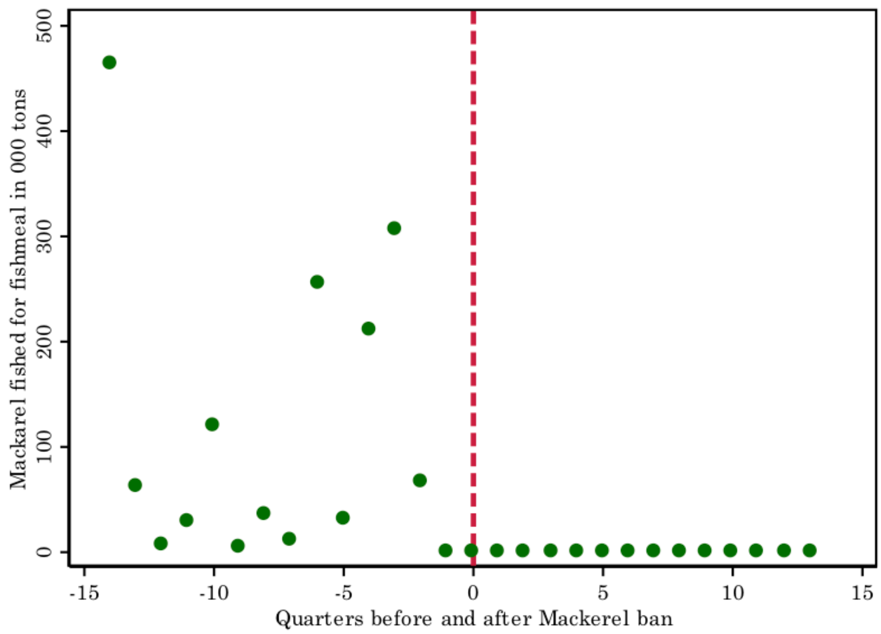
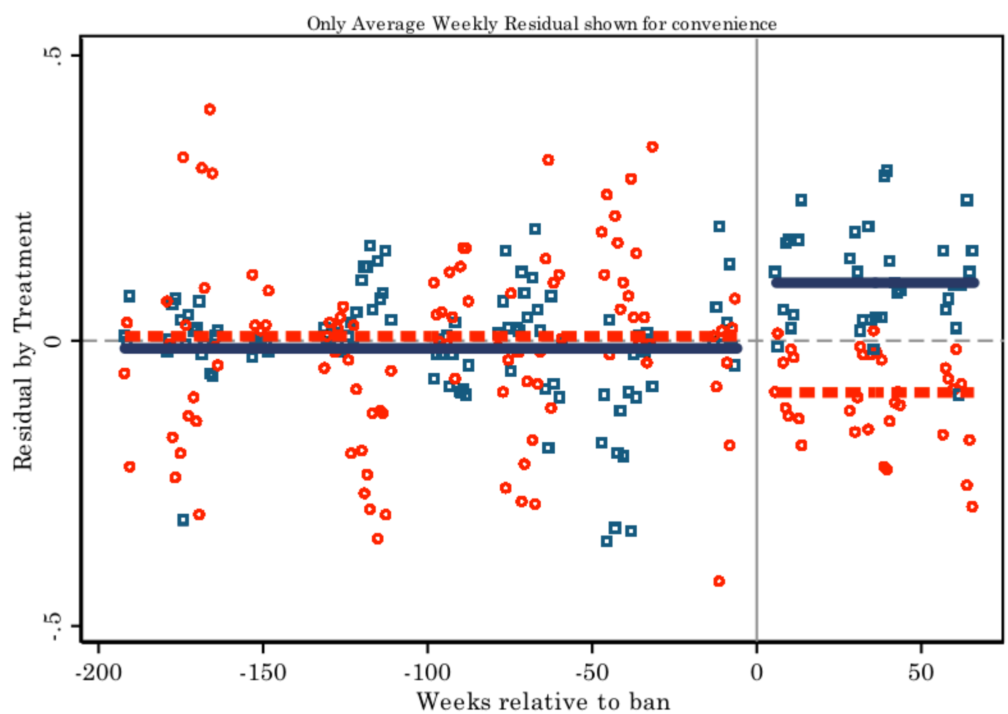
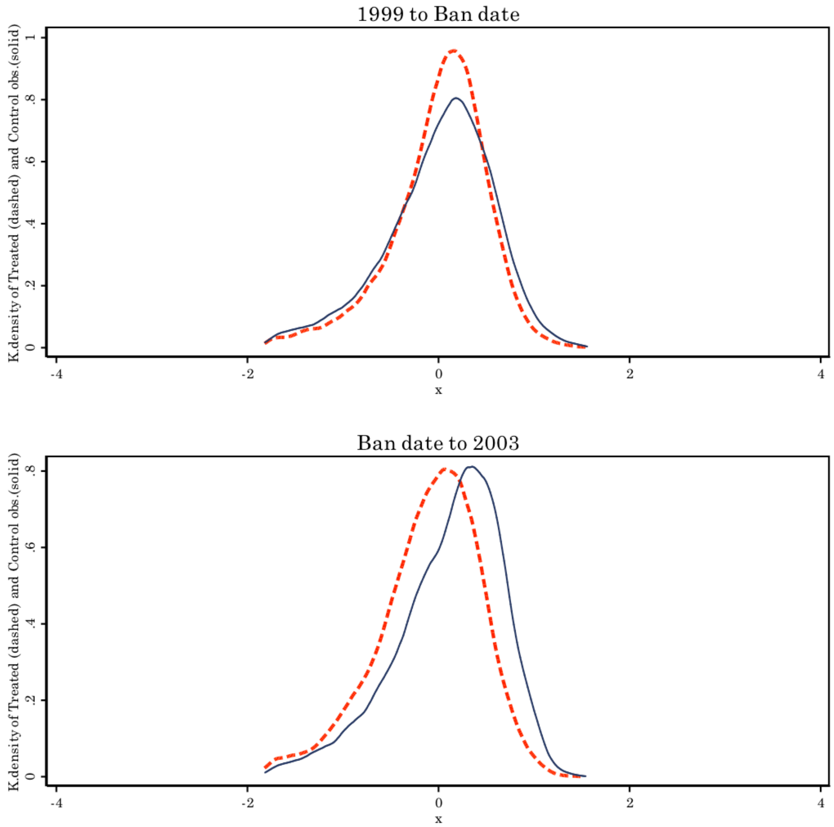



**Figure 2: Refocus and productivity**




Red dashed lines show average pre/post ban productivity for ships in diversified firms. Blue solid lines show average pre/post ban productivity for ships in focused firms. Average weekly productivity by firm type is represented by red circles for diversified firms and by blue squares for focused firms.

**Figure 3: Refocus and productivity distributions**




Kernel density plots of productivity distributions by firm type. Red dashed lines represent ships in diversified firms. Blue solid lines represent ships in focused firms.

**Figure 4: Refocus and ship utilization by season**

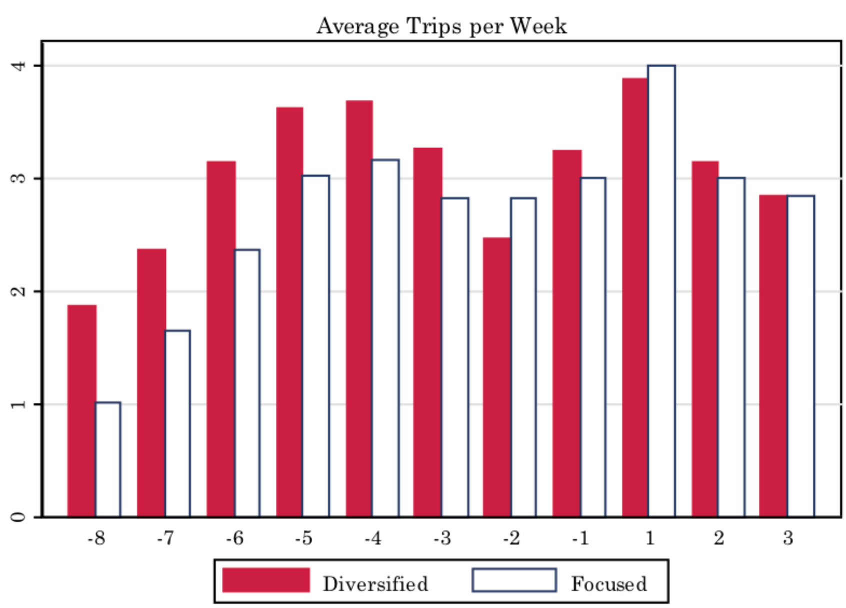


**Table 1: Summary statistics**

| | Mean | Std. Dev. | Min. | Max. |
|---|---|---|---|---|
| Ship-week level variables (*n*=58,107) | | | | |
| $Y_{it}$ = tons of anchovy caught | 274 | 330 | 0 | 3,120 |
| Refocus | 0.18 | n/a | 0 | 1 |
| $K_{it}$ = (ship storage capacity)$_i$ x $Trips_{it}$ | 609 | 625 | 8 | 6,078 |
| Trips | 3.41 | 1.74 | 1 | 7 |
| Diversified | 0.60 | n/a | 0 | 1 |
| Ban | 0.34 | n/a | 0 | 1 |
| Switches | -0.07 | 0.32 | -0.29 | 7.64 |
| Fishing zone north of parallel 9S | 0.47 | n/a | 0 | 1 |
| Fishing zone 9S<x<11.2S | 0.36 | n/a | 0 | 1 |
| Fishing zone 11.2<x<16S | 0.13 | n/a | 0 | 1 |
| Fishing zone south of parallel 16S | 0.04 | n/a | 0 | 1 |
| Ship level variables (*n*=1,020) | | | | |
| Ship storage capacity ($m^3$) | 183 | 153 | 8 | 868 |
| Firm level variables (*n*=453) | | | | |
| Diversified | 0.41 | n/a | 0 | 1 |
| Number of ships | 2.41 | 4.28 | 1 | 61 |

**Table 2: Refocus and productivity 1999-2003**

*Dependent variable = Log $Y_{it}$ = log tons of anchovy caught by ship i in week t*

| Model: | OLS (2.1) | | D-in-D (2.2) | | D-in-D (2.3) | | 2SLS† (2.4) | |
|---|---|---|---|---|---|---|---|---|
| ***Refocus*** | ***-0.22*** | *** | ***-0.20*** | *** | ***-0.17*** | *** | ***-0.25*** | *** |
| | ***(0.03)*** | | ***(0.03)*** | | ***(0.02)*** | | ***(0.03)*** | |
| Diversified | -0.00 | | | | | | | |
| | (0.03) | | | | | | | |
| Log $K_{it}$ | 1.04 | *** | | | 1.26 | *** | 0.83 | *** |
| | (0.01) | | | | (0.01) | | (0.01) | |
| Log $K_{it}$ x week f.e. | N | | Y | | N | | N | |
| Ship fixed effects | N | | Y | | Y | | Y | |
| Week fixed effects | Y | | N | | Y | | Y | |
| Fish. zone fixed effects | Y | | Y | | Y | | Y | |
| Adjusted $R^2$ | 0.81 | | 0.82 | | 0.85 | | n/a | |
| *n* | 58,107 | | 58,107 | | 58,107 | | 58,107 | |
| N clusters | 453 | | 453 | | 453 | | 904 | |

***, **, * = significant at the 1%, 5%, and 10% levels respectively.
Robust standard errors clustered by firm (models 2.1, 2.2 and 2.4) or by ship (model 2.3) shown in parentheses.
†The instrument for Log $K_{it}$ in the first stage is the number of days without restrictions on anchovy fishing in week *t* by fishing zone, the coefficient on the IV is positive and precisely estimated with a *t*-statistic of 22 (clustering at the ship level) and an F-statistic of 231. The $R^2$ in the first stage regression is 0.81.

**Table 3: Refocus and adaptation 1999-2005**

*Dependent variable = Log $Y_{it}$ = log tons of anchovy caught by ship i in week t*

| | (3.1) | | (3.2) | |
|---|---|---|---|---|
| ***Refocus*** | ***-0.07*** | *** | ***0.04*** | |
| | ***(0.02)*** | | ***(0.03)*** | |
| ***Refocus x Season 1*** | | | ***-0.18*** | *** |
| | | | ***(0.04)*** | |
| ***Refocus x Season 2*** | | | ***-0.23*** | *** |
| | | | ***(0.05)*** | |
| ***Refocus x Season 3*** | | | ***-0.20*** | *** |
| | | | ***(0.03)*** | |
| ***Refocus x Season 4*** | | | ***0.00*** | |
| | | | ***(0.03)*** | |
| ***Refocus x Season 5*** | | | ***-0.05*** | * |
| | | | ***(0.03)*** | |
| ***Refocus x Season 6*** | | | ***-0.04*** | |
| | | | ***(0.03)*** | |
| Log $K_{it}$ | 1.25 | *** | 1.25 | *** |
| | (0.01) | | (0.01) | |
| Ship fixed effects | Y | | Y | |
| Week fixed effects | Y | | Y | |
| Fishing zone fixed effects | Y | | Y | |
| Adjusted $R^2$ | 0.85 | | 0.85 | |
| *n* | 86,963 | | 86,963 | |
| N clusters | 453 | | 453 | |

***, **, * = significant at the 1%, 5%, and 10% levels respectively.
Robust standard errors clustered by firm shown in parentheses.
Note: the main effects of the season dummies are absorbed by the week fixed effects.

**Table 4: Mechanisms**

| *Dependent variable =* | *Log $Y_{it}$* | | *Log $Y_{it}$* | | *Log $Trips_{it}$* | | *Log $Y_{it}$* | | *Log $Y_{it}$* | | *Log $Trips_{it}$* | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (4.1) | | (4.2) | | (4.3) | | (4.4) | | (4.5) | | (4.6) | |
| ***Refocus*** | ***-0.16*** | *** | | | ***-0.16*** | *** | ***-0.15*** | *** | | | ***-0.15*** | *** |
| | ***(0.02)*** | | | | ***(0.02)*** | | ***(0.02)*** | | | | ***(0.02)*** | |
| ***Refocus x Switches*** | ***-0.14*** | *** | | | | | ***-0.14*** | *** | | | | |
| | ***(0.05)*** | | | | | | ***(0.05)*** | | | | | |
| ***Refocus x High exposure*** | | | ***-0.23*** | *** | | | | | ***-0.22*** | *** | | |
| | | | ***(0.03)*** | | | | | | ***(0.03)*** | | | |
| ***Refocus x Exposure quartile 3*** | | | ***-0.26*** | *** | | | | | ***-0.26*** | *** | | |
| | | | ***(0.04)*** | | | | | | ***(0.04)*** | | | |
| ***Refocus x Exposure quartile 2*** | | | ***-0.11*** | ** | | | | | ***-0.11*** | ** | | |
| | | | ***(0.04)*** | | | | | | ***(0.04)*** | | | |
| ***Refocus x Least exposure*** | | | ***0.04*** | | | | | | ***0.00*** | | | |
| | | | ***(0.03)*** | | | | | | ***(0.03)*** | | | |
| Log $K_{it}$ | 1.26 | *** | 1.25 | *** | | | 1.25 | *** | 1.25 | *** | | |
| | (0.01) | | (0.01) | | | | (0.01) | | (0.01) | | | |
| Firm size quartiles | N | | N | | N | | Y | | Y | | Y | |
| Ship fixed effects | Y | | Y | | Y | | Y | | Y | | Y | |
| Week fixed effects | Y | | Y | | Y | | Y | | Y | | Y | |
| Fishing zone fixed effects | Y | | Y | | Y | | Y | | Y | | Y | |
| Adjusted $R^2$ | 0.81 | | 0.85 | | 0.29 | | 0.85 | | 0.85 | | 0.29 | |
| *n* | 58,107 | | 58,107 | | 58,107 | | 58,107 | | 58,107 | | 58,107 | |
| N clusters | 453 | | 453 | | 453 | | 453 | | 453 | | 453 | |

***, **, * = significant at the 1%, 5%, and 10% levels respectively.
Robust standard errors clustered by firm shown in parentheses.
Note: switches and the exposure quartiles are time-invariant firm-level variables so their main effects are absorbed by the ship fixed effects.

**Table 5: Robustness checks**

*Dependent variable = Log $Y_{it}$ = log tons of anchovy caught by ship i in week t*

| Model: | No VI ships (5.1) | | Multi-ship firms (5.2) | | Firm size controls (5.3) | | Ship-specific trends (5.4) | | Seasonal *k* productivity controls (5.5) | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Refocus*** | ***-0.13*** | *** | ***-0.18*** | *** | ***-0.16*** | *** | ***-0.14*** | *** | ***-0.14*** | *** |
| | ***(0.02)*** | | ***(0.03)*** | | ***(0.02)*** | | ***(0.03)*** | | ***(0.03)*** | |
| Log $K_{it}$ | 1.25 | *** | 1.25 | *** | 1.25 | *** | 1.25 | *** | | |
| | (0.01) | | (0.01) | | (0.05) | | (0.01) | | | |
| Log $K_{it}$ x week fixed effects | N | | N | | N | | N | | Y | |
| Log $K_i$ x season fixed effects | N | | N | | N | | N | | Y | |
| Ship-specific trend | N | | N | | N | | Y | | N | |
| Firm size quartiles | N | | N | | Y | | N | | N | |
| Ship fixed effects | Y | | Y | | Y | | Y | | Y | |
| Week fixed effects | Y | | Y | | Y | | Y | | N | |
| Fish. zone f.e. | Y | | Y | | Y | | Y | | Y | |
| Adjusted $R^2$ | 0.84 | | 0.85 | | 0.85 | | 0.85 | | 0.84 | |
| *n* | 45,556 | | 42,568 | | 58,107 | | 58,107 | | 58,107 | |
| N clusters | 420 | | 203 | | 453 | | 453 | | 453 | |

***, **, * = significant at the 1%, 5%, and 10% levels respectively.
Robust standard errors clustered by firm.