Scope and Performance: A Natural Experiment in Firm Focus[*]

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We exploit a natural experiment to examine how a reduction in scope, or focus, influences firm performance. 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 leads to sharply lower productivity in a firm's legacy business, anchovy fishing. The effects are larger in firms that were more intensively integrated into mackerel before the ban. The results suggest that reducing the scope of the firm destroys synergies between internal activities but does not instantaneously eliminate coordination costs. The negative productivity effect, however, attenuates over time, which suggests that firms adapt their organizational systems in response to changes in firm scope.

1. Introduction

How does firm scope influence performance? One branch of the literature on scope emphasizes how diversification destroys value in multi-product, multi-business firms (Lang and Stulz 1994, Berger and Ofek 1995). Strategic theories of firm scope, on the other hand, study how managers create synergies in diversified firms through harmonizing their product or business unit portfolios (Teece 1980, 1982; Levinthal and Wu 2010).

Lending support to the strategic theory of firm scope, Campa and Kedia (2002) and Colak and Whited (2007) demonstrate a crucial problem with many early diversification discount studies: the endogeneity of firm scope confounds selection and treatment effects. Villalonga (2004) discusses an even more fundamental problem with the extant research on firm scope.

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Aggregated financial data, such as the COMPUSTAT data used in the early empirical work on diversification, creates biases that can only be addressed using more fine-grained data.

Yet the evidence continues to mount that diversification is costly, in the sense that it creates coordination costs—the costs of managing intra-organizational interdependencies (Gulati and Singh 1998): Lamont (1997) exploits a natural experiment to show that internal capital markets may be inefficient in the sense that managers are less responsive to business unit-level performance than markets; Schoar (2002) uses micro-data to find that diversification distracts managers, leading to lower productivity in firms' existing plants; and Zhou (2010) shows that the complexity of interdependencies increases coordination costs in diversified equipment manufacturers.

While the diversification discount literature and the strategic theory of firm scope offer rich, and sometimes contradictory, predictions, they are rarely discussed as complementary frameworks or tested jointly, leaving a significant gap in our understanding of how firm scope influences performance. This paper addresses this gap in the literature by proposing a conceptual framework that takes both synergies and coordination costs seriously and employing empirical methods that facilitate causal inference about the impact of firm scope on performance.

Our baseline model of the impact of scope on performance distinguishes between the predictions of the diversification discount literature and the strategic theory of firm scope in the context of firm focus. Since the diversification discount literature predicts that diversification destroys value by increasing coordination costs, it follows that a reduction in scope should create value by eliminating coordination costs. The strategic theory of firm scope makes the opposite prediction. Diversification creates value by creating synergies; therefore, an exogenous reduction in firm scope should destroy value because it eliminates synergies.

To shed light on the joint predictions of the two theories, we consider how the pattern of returns should differ across firms and over time, using both theories in an integrated manner. The key insights that allow us to separately identify the core predictions of the different theories are about the persistence of coordination costs and synergies. Because diversified firms typically create synergies by developing deeply embedded routines and processes that sublimate product-level efficiency for the greater good of the firm, synergies are achieved at the cost of product-level inefficiencies. In the presence of organizational rigidity, coordination costs will tend to persist in firms, at least in the short-run, even after a reduction in firm scope renders the old routines obsolete. By contrast, because synergies are contingent on joint production, they are evanescent and disappear when firm scope is reduced. While coordination costs are expected to persist, following a reduction in firm scope, they should not be permanent; if firms adapt their organizational systems to best fit the scope of the firm, coordination costs should diminish over time.

We define firm scope by operational breadth in our empirical context, and exploit a natural experiment to identify the impact of a reduction in scope on firm performance, using fine-grained micro-data. Specifically, we study changes in the productivity of ships in Peruvian fishing firms that were forced to focus their operations on anchovy fishing in 2002 due to a regulatory ban on mackerel fishing for fishmeal.

To identify the strength of synergies compared to coordination costs, we examine how the ban on mackerel fishing influenced the productivity of the firm's core (anchovy) fishing operations. Our tests are particularly convincing because the shock to firm scope (i.e., being forced to disband mackerel fishing operations) is exogenous; the data are granular—we observe performance weekly at the ship-level for all firms in the industry; and our physical measure of productivity is unusually precise as we can measure physical output per physical unit of input.

The results show that an exogenous reduction in firm scope causes ship-level productivity during anchovy season to fall by 12% relative to firms that historically focused only on anchovy. Consistent with the idea that synergies and coordination costs increase with the intensity of integration, the productivity effect is more negative in firms that were more actively involved in mackerel fishing before the ban. Importantly, the effect of a reduction in scope attenuates over time, which suggests that even while coordination costs are sticky in the short-run; in the long-run, firms adapt organizationally to remediate outdated routines and processes associated with the firm's legacy diversification strategy.

The paper makes three main contributions to the literature on firm scope. First, we develop a simple framework that distinguishes between the predictions of the diversification discount literature and the strategic theory of firm scope in the context of a reduction in firm scope, and exploit a natural experiment to identify the causal effect of a reduction in firm scope on firm performance. Our core results strongly support the strategic theory of firm scope. Second, we develop testable predictions about the mechanisms underlying coordination costs and deliver micro-organizational evidence that the intensity of integration between products mediates the effects of firm scope on productivity. Finally, we show that coordination costs are not eliminated instantaneously following a reduction in firm scope; however, over time firms efficiently adapt their organizational systems to fit with the corporate scope of the firm.

2. Theory

A number of papers find that reductions in scope (e.g., divestitures, spinoffs, product rationalization efforts) tend to improve overall performance of the firm by reducing coordination costs associated with broad scope (Wernerfelt and Montgomery 1988; John, Lang and Netter 1992; Comment and Jarrell 1993; Dittmar and Shivdasani 2003). The hypothesized mechanism at work, in the foregoing literature, closely follows the logic of the diversification discount literature (Lang and Stulz 1994, Berger and Ofek 1995): managers diversify excessively without regard for synergies, which destroys value. Diversification overwhelms senior managers (Schoar 2002), creates inefficient internal capital markets (Lamont 1997) and unwieldy bureaucracies

(Rajan, Servaes and Zingales 2000); therefore, undoing the effects of diversification by reducing the scope of the firm should create value.[1]

The strategic literature on firm scope concurs that focus tends to create value but offers a different mechanism: reducing the scope of the firm leads to improved performance because firms *choose* to eliminate underperforming products or business (Markides 1992, Siggelkow 2003, Berry 2010). The logic for the strategic theory of firm scope, in the context of a reduction in scope, mirrors the strategic theory in the context of diversification: a positive relationship between performance and changes in firm scope is expected because managers choose firm scope in an attempt to create synergies between business units or products (Teece 1980, 1982; Levinthal and Wu 2010).

The different assumptions about the relative importance of (bad) managerial incentives versus (good) managerial selection processes provide a basis for distinguishing between the predictions of the diversification discount literature and the strategic theory of firm scope, in the context of a reduction in firm scope. The strategic theory of the firm scope predicts that a reduction in scope leads to higher performance because well-intentioned, capable managers recognize when coordination costs exceed synergies and act to redress this problem. By contrast, in the diversification discount view, a reduction of focus leads to higher performance because managerial inefficiencies associated with the joint ownership of different divisions creates coordination costs in excess of synergies.

While strategic theories and the diversification discount literature are often considered in isolation, the theories can easily be integrated into a simple unified framework that generates testable predictions about the relative magnitude of synergies versus coordination costs. We summarize the framework using simple notation that helps clarify the key points of contrast between these theories. Given a focused firm that generates a baseline profit level π_f,

[1] In an interesting twist on the idea that managers destroy value by expanding the scope of the firm too much, Feldman (2010) uses the logic of the diversification discount literature to propose that managers might just as easily destroy value by focusing the firm too much.

diversification creates synergies $S>0$ and coordination costs $C>0$; the diversified firm generates profits π_d according to:

$$(1) \quad \pi_d = \pi_f + S - C.$$

If managers choose complementary product portfolios, then synergies will exceed coordination costs, $S>C$. If managers are willing to destroy value to expand the scope of the firm for private gain, then coordination costs will exceed synergies, $C>S$.

Using (1) to develop predictions about how a reduction in firm scope influences performance is straightforward. If managers are forced to eliminate a product from their portfolio the change in firm profits can be characterized by: π_d - π_f = S-C; the reduction in scope will increase profit when $C>S$ and will reduce profit when $S>C$. Thus, the diversification discount literature and the strategic theory of firm scope generate sharply different predictions in the context of an exogenous reduction in firm scope. Stating Hypothesis 1 from the perspective of the strategic theory of firm scope, while allowing the predictions of the diversification discount to form the null hypothesis, we propose that when a firm's legacy products received some positive fraction of the net benefits of diversification *(S - C) ex ante*, an exogenous reduction in firm scope harms the performance of the firms remaining products. [2]

Hypothesis 1: An exogenous reduction in firm scope reduces the productivity of the firm's legacy operations.

[2] It is possible, of course, that the jettisoned product captured all of the benefits of diversification, while the costs of diversification fell entirely on the remaining products, in which case the performance of the remaining products would increase following an exogenous reduction in firm scope, even though overall firm profits fell. In developing Hypothesis 1, we assume the costs and benefits of diversification are roughly proportional to the size of a product line.

Hypothesis 1 proposes a test of a relatively unusual event—an exogenous reduction in firm scope—but the implications of this hypothesis are quite general, as an exogenous reduction in firm scope reveals information about a firm's *ex ante* endogenous scope decisions. Thus, Hypothesis 1 fundamentally distinguishes between the predictions of the strategic theory of firm scope and the diversification discount literature. On the other hand, the fact that synergies exceed coordination costs, $S>C$, need not invalidate the idea that diversification is costly, in the sense that it creates coordination costs, $C>0$.

To evaluate how coordination costs influence the returns to scope we build on and extend prior research establishing that coordination costs tend to increase with the extent and intensity of integration. Coordination costs exist because firms alter their organizational routines and practices to sublimate individual sub-units of the firm to the greater good of the enterprise (Zhou 2010; Dessein, Garicano and Gertner 2010). Thus, synergies and coordination costs tend to be correlated, as the intensity of integration between products or business units increases both synergies and coordination costs simultaneously (Jones and Hill 1988). If synergy and coordination costs are both increasing in the intensity of integration, and coordination costs are subject to organizational rigidity, in the sense that organizations cannot instantaneously efficiently alter their organizational practices to adapt to organizational changes (Leonard-Barton 1992, Rawley 2010), then a reduction in firm scope will lead to a temporary drop in the firm's performance relative to its long-run performance level. Thus, our second hypothesis predicts that productivity will fall more in firms with more intensively integrated product lines following a reduction in firm scope.

Hypothesis 2: A reduction in firm scope will lead to larger negative productivity effects in firms with more intensively integrated product lines.

Hypothesis 2 provides a mechanism for a key argument in the diversification discount literature—coordination costs reduce the returns to diversification. The key assumption in the hypothesis is that organizational rigidities preclude the firm from instantaneously eliminating coordination costs following a reduction in firm scope. Firms may not be able to instantaneously eliminate coordination costs due to physical rigidities, like the cost of 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 (Lippman and Rumelt 1982). In the next section (Section 3, below), we provide institutional details consistent with the idea that coordination costs arise in the fishing industry due to causal ambiguity about the returns to corporate routines, but that firms learn how to adapt their practices following a reduction in scope to eliminate the vestiges of coordination costs over time. Our next hypothesis tests this assumption explicitly by taking a closer look at inter-temporal performance patterns following a reduction in firm scope.

In the context of diversification, prior research has shown that increasing firm scope taxes the efficiency of legacy routines and processes; yet, firms adapt to the challenge by efficiently altering their business practices (Capron, Dussauge and Mitchell 1998; Capron, Mitchell and Swaminathan 2001; Rawley and Simcoe 2010). If a reduction in firm scope also strains the internal organization of the firm by rendering legacy routines and processes inefficient, then firms will face an organizational adaptation challenge when they reduce their scope of operations. In particular, coordination costs associated with the legacy routines and processes will continue even after the scope of the firm is reduced as predicted by Hypothesis 2. 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, the short-run organizational challenges of a reduction in firm scope also represent a long-run organizational adaptation opportunity. Since we expect that firms will adapt their organizations strategically, it follows that they will re-orient their routines and processes and redeploy their resources efficiently to reflect the diminished scope of the firm, and coordination costs will, therefore, attenuate over time. If synergy destruction occurs immediately once a product or business unit is removed from the firm's portfolio, then a reduction in firm scope will generate a well defined temporal pattern in firm performance, which can be stated as a hypothesis: the negative shock to firm performance, following a reduction in firm scope, will attenuate over time.

Hypothesis 3: Negative productivity shocks associated with a contraction in firm scope will attenuate over time.

Hypothesis 3 examines the role of organizational adaptation in managing coordination costs associated with changes in firm scope. Taken together, our overarching framework features coordination costs as a key driver of firm scope decisions, as suggested by the diversification discount literature; yet, the theory developed also reinforces the role of well-informed and capable mangers in firm scope decisions, as in the strategic theory of firm scope.

3. Institutional context

3.1 The Peruvian fishing industry

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.

The vessels used to catch anchovy and mackerel are called purse seiners. Purse seiners catch fish by surrounding a fish shoal with a net that is then closed at the bottom by tightening a rope. The fineness of the mesh of the net determines the smallest size of fish that will be caught. Most fishing trips are completed within a single 24-hour period. While different types of ships are superior for fishing for certain species, beyond altering the mesh of the net, other physical adjustments to ships are relatively minor. Thus, the refocusing effects we study are best characterized as firm-level organizational effects.

Although the Peruvian sea is one of the most diverse in the world, most of the industry activity revolves around a single species, anchovy (*engraulis ringens*), which is primarily fished for fishmeal. While anchovy are mainly distributed in dense surface aggregations that are accessible to fishers, and are slow to avoid predators, they 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. Firms are prohibited 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 eight million tons per year, though anchovy populations still vary over time due to exogenous biological conditions.

Historically, mackerel-based products were the second major intermediate product of the Peruvian fishing industry. A key feature of mackerel is that it tends to follow and feed on anchovy, thus 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).[3] On the other hand, firms that fish for both mackerel and anchovy face a more complex

[3] Duarte (1992) notes that it is common for there to be synergies (as well as coordination costs) associated with fishing for different species within the same firm.

set of organizational tasks and assets. Because anchovy and mackerel typically are more abundant at different times of the year, diversified firms must perform complex maintenance operations, as their boats operate year-round, and face additional coordination costs in staffing, planning and operating activities, while firms that focus on anchovy manage a narrower set of tasks and assets and have the luxury of an off-season to plan, perform fishing boat maintenance, and coordinate their staff and ships. Interviews with industry experts suggest that information obtained about the location of anchovy schools while fishing for mackerel can be valuable, while maintenance, staffing, planning and operational issues can be quite sophisticated, providing a plausible basis for the types of synergies and coordination costs about which we hypothesize.

Prior to 2002, there were no meaningful restrictions on the use of mackerel: it could be used for fishmeal or for any human-consumption product 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 fishmeal focused almost exclusively on anchovy during the anchovy seasons (95-98% 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.

3.2 The ban

On September 5, 2002, the President of Peru signed a bill banning mackerel from use in fishmeal or fish oil production permitting it to be fished exclusively for human consumption products.[4] 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 firm organization in the pre-ban period reflects any hedging toward the new mackerel regime. Moreover, press reports suggest the details of the mackerel ban were not widely anticipated.

[4] Decreto Legislativo N. 001-2002-PRODUCE, published in the national legal gazette El Peruano on 6 September 2002. The species covered by the rule are jack mackerel (*Trachurus murphyi*) and mackerel (*Scomber japonicus*); hereafter, they are referred to as “mackerel” for brevity.

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 in perpetuity. Thus, the ban created an exogenous and permanent reduction in firm scope.

Figure 1 shows the impact of the ban on mackerel fishing graphically. From January 1999 until just prior to the ban on mackerel, tens 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.[5] We exploit the natural experiment provided by the mackerel ban to investigate the causal effects of a reduction in firm scope on firm performance.

Although we cannot observe organizational routines directly in our data, anecdotally there is ample evidence of persistence in corporate organizational routines following the ban, which suggest that firms cannot efficiently instantaneously adapt their organizational processes following a change in scope. In particular, the processes used to schedule and allocate ships to fishing zones are complex routines that are contingent on the characteristics of individual ships (i.e., size and speed), the characteristics of other ships in the same fleet, as well as dynamic competitive and environmental factors like the location of the target biomass, the location of other fleets' ships, and the strength and direction of ocean currents. While the scheduling and allocation process relies in part on sophisticated decision support tools, like satellite tracking systems and computerized algorithms, industry participants also note the importance of tacit knowledge in guiding corporate planners. Since experience-based heuristics guide scheduling and allocation decisions, the efficiency of the processes is vulnerable to exogenous environmental changes (i.e., the ban on mackerel) that subtly alters the costs and benefits of the firm's routines in ways that are non-obvious even to expert managers. For example, when diversified firms possessed better information about where anchovy was massing, they systematically dispatched

[5] Because it was anchovy season during the second quarter and early part of the third quarter of 2002, there was very little mackerel fishing activity in the quarter just prior to the ban (Quarter -1 in Figure 1).

fast "runner" ships to anchovy schools, located further from port, while sending slower ship to fish close-in waters. However, without asymmetric information about biomass location, the old routines proved to be sub-optimal for legacy diversifiers. Indeed, we note that the productivity of diversified runners are disproportionately negatively affected by the ban.[6]

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 985 ships that reported fishing for fishmeal at least once during the sample.[7]

Our 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 169 tons, and the standard deviation is 231 tons, though distribution of catches is very broad: from 0.04 tons to 2,816 tons. There is also substantial heterogeneity in the holding capacity the ships in our dataset. The mean hold size of a ship is 181m^3, but the broad average includes tiny fishing boats with 8m^3 holds to enormous ships with

[6] Results are available from the authors upon request.

[7] For consistency, we eliminate from the analysis a small fraction of ships that change ownership at any point during the sampling period (1995 and 2005), though including these ships has no meaningful effect on our results.

868m^3 of storage capacity. Weekly storage capacity exhibits an even broader dispersion, from 8 m^3 to 4,023 m^3 as ship utilization acts as multiplier when transforming ship level variables to the ship-week level; ships in our data go on 3.3 fishing expeditions 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. 35% 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.

Our main empirical tests follow an event study format where the event of interest is the ban on mackerel fishing for fishmeal in September 2002. We compare post-ban productivity against pre-ban productivity within ship to measure the impact of the ban on changes in productivity. Our main sampling frame begins on January 1, 2001 and continues through December 31, 2003, so that we have twenty months of pre-ban observations and sixteen months of post-ban observations on which to base our statistical estimates. The sampling frame chosen represents our best effort to include enough pre-ban and post-ban information to accurately estimate the impact of the ban on productivity, without swamping the tests with noisy data generated at points distant in time from the ban; however, using annual calendar time is admittedly somewhat arbitrary. We explored a number of alternative sampling frames including using symmetric pre-ban and post-ban periods, or using all pre-ban history regardless of how long we track post-ban performance effects, 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

We follow the standard approach for measuring total factor productivity, as detailed in our next section and Appendix. 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.[8] 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. $REFOCUS_{jt} \equiv BAN_t \times DIVERSIFIED_j$, 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 before the ban, and is zero otherwise. 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 production synergies and operational coordination costs in the extraction phase of the industry, as opposed to economies of scope /diseconomies of scope in downstream marketing and distribution processes. Besides ship, time and location fixed effects, our other key control variable is capital deployed k per ship i, per week t, where k_{it} = log(storage capacity$_i$ x number of fishing trips a ship takes per week$_{it}$).

We develop two measures that capture different aspects of the intensity of integration. The first is a measure of the firm's exposure to the shock, based on total tonnage of mackerel the firm extracted in the pre-ban period by quartile $\{EXPOSURE^1_j, \ldots, EXPOSURE^4_j\}$ that non-parametrically capture cross-sectional variation in the effect of the ban by magnitude of the firm's mackerel operations.

We also measure how closely interrelated the firm's anchovy and mackerel operations were by constructing a variable, $INTERRELATION_j$, that is equal to the number of days a firm

[8] Fishmeal can include more than 35 different species of fish, such as catfish, Pacific menhaden, and flying fish. However, during anchovy season, anchovy is king, representing more than ninety-five percent of all catches (by weight). We include all species caught in our dependent variable before and after the ban in our empirical tests, as we are interested in evaluating the overall productivity of fishing operations (during the anchovy season). To obviate concerns that our results are driven mechanically by the ban on mackerel, we show in the robustness tests that the results are unchanged if we measure productivity exclusively based on anchovy catches.

switched from fishing for anchovy to fishing for mackerel or vice versa.[9] To facilitate a straightforward interpretation of the (skewed) distribution of *INTERRELATION*, we normalize the measure to be mean zero and have a standard deviation equal to one at the firm level (Greenstone, Hornbeck and Moretti 2010). Anchovy and mackerel require different net systems, so boats are outfitted to catch either mackerel or anchovy, never both, and changeovers are time consuming, and therefore, costly during anchovy season. Thus, changeovers during anchovy season represent an important signal about the extent to which the product operations of the firm are jointly coordinated.

Finally, to measure the time path of coordination costs, 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, $SEASONS_s$, s ={0,1, . . . ,5}, where seasons are defined by the Peruvian fishing authority. We interact *SEASONS* with *REFOCUS* to capture the marginal effect of the ban on productivity over time by season.

5. Empirical Strategy

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 decision to change the scope of the firm. We are fortunate to have such a shock in this study in the form of an exogenous reduction in firm scope, as the Peruvian regulatory ban completely eliminated mackerel fishing for fishmeal in September 2002.

Our first hypothesis predicts that exogenous reductions in firm scope, as opposed to endogenous refocusing, should destroy synergies between products because firms intentionally bundle products together within the firm to create value, and, therefore, any synergies created by integration are destroyed if the firm is forced to remove these products from its portfolio. To test

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

Hypothesis 1, we develop an econometric model of scope and performance that captures the causal effect of a reduction of firm scope on productivity, 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), λ is a ship fixed effect, T is a week fixed effect, and G is a fishing zone location fixed effect:[10]

$$(2)\ y_{it} = \alpha + \beta_k k_{it} + \lambda_i + T_t + G_{it} + \beta_R\, REFOCUS_{jt} + \upsilon_i.$$

Standard errors are robust and clustered at the firm level in (2) and in all of our subsequent specifications. In the Appendix, we derive explicitly how our main specification (2) estimates the percentage change in a firm's productivity from a reduction in scope.

The differences-in-differences estimator β_R in (2) delivers an unusually precise estimate of within-firm changes in productivity from a reduction in firm scope. Specification (2) not only controls for all sources of time-invariant ship-level heterogeneity, it also controls for changes in the extensive margin (i.e., variation in weekly ship utilization), all sources of temporal variation in the average productivity of all ships by week, and location-specific variation in catches.[11] Thus, β_R can be interpreted as the change in productivity of the average ship in the average diversified firm's fleet following the ban, controlling for that ship's average productivity, and the average productivity of all other ships in the same fishing zone during the same week, relative to the average change in productivity all fishing ships during the same week.[12]

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[10] We coded the coastline into four meaningfully different fishing zones, defined by latitude bands as described by industry experts. We also 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.

[11] 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 $REFOCUS_{jt}$.

[12] If firm-level fixed costs are proportional to ship capital, β_R can also be interpreted directly as a change in firm profitability net of changes in market prices for output.

To the extent that some coordination costs are eliminated immediately following a reduction firm scope, specification (2) estimates a lower bound on how much synergy is destroyed by focusing the firm. While we cannot precisely estimate the full extent of synergy destruction from reducing the scope of the firm, the sticky nature of coordination costs creates an opportunity for us to identify the mechanisms that underlie the costs of integration.

To estimate the effect of the intensity of *ex ante* integration on the impact of a shock to the scope of the firm on performance, we include measures in (2) that (a) capture the magnitude of the firm's mackerel business and (b) proxy for the extent of operational interdependence between mackerel and anchovy. The estimating equation for (2a) includes the four *EXPOSURE* dummies in (2), while the estimating equation for (2b) includes the interaction term *REFOCUS x INTERRELATION* in (2).

To estimate the persistence of a negative productivity shock following refocusing, we include the full set of *REFOCUS x SEASON* dummies in (2). By construction, the *REFOCUS x SEASON* dummies also serve to capture the time path of organizational adaptation after the ban.

6. Results

6.1 Core results

Figure 2 previews our main result by showing kernel density plots of productivity for diversified and focused firms before and after the ban on mackerel. The top panel reveals that the productivity distribution of firms that fished for both anchovy and mackerel is shifted to the left of the productivity distribution of firms that fish exclusively for anchovy in the pre-ban period, reflecting the fact that diversified Peruvian fishing firms pay a price in terms of lost productivity for being diversified. Following the ban, the productivity gap between formerly diversified firms and firms that had always been focused on anchovy increases (see bottom panel), suggesting that the ban on mackerel fishing adversely impacted the productivity of formerly diversified firms.

Table 2 provides statistical evidence of the negative effect of reducing the scope of the firm on ship-level productivity. Column 2.1 shows the impact of the ban on ship-week level productivity by comparing the productivity of ships, in formerly diversified firms during the sixteen months immediately following the ban, compared to all other ship-weeks beginning twenty months prior to the ban. The pooled cross-sectional estimate of the ban on ship-level productivity for firms that were previously diversified is -15.5%. Including ship fixed effects in column 2.2 delivers within-ship estimates of changes in productivity, following the mackerel ban for all previously diversified firms of -12.4%. Both pooled cross-sectional and differences-in-differences effects are precisely estimated. To put the economic effects of the loss of synergies from the reduction in scope in perspective, a 12.4% reduction in productivity in the average ship-week translates into approximately a 21-ton reduction in fish caught per ship-week or 9% of one standard deviation of output. The effect of *REFOCUS* on productivity can be interpreted as a lower bound on synergy destruction since coordination costs are also (weakly) reduced following a reduction in firm scope.

To shed light on the mechanisms leading to the decrease in productivity following the reduction in firm scope, we examine whether anchovy productivity falls more in firms that were more intensively involved in mackerel fishing pre-ban. Figure 3 graphically displays the change in the kernel density distribution of productivity by the magnitude of the firm's mackerel operations. Firms with the greatest exposure to the mackerel ban (Panel 1) appear to have been more negatively affected by the ban than firms with little exposure (Panel 2).

Table 3 shows regression results testing for the marginal impact of *EXPOSURE* on productivity (see column 3.1). As expected, firms in the top two *EXPOSURE* quartiles suffered a significant drop in their productivity after the reduction in firm scope (-18.5% and -27.3%, respectively). Firms in the second quartile suffered a smaller reduction in productivity (-11.0%), while firms with the least *EXPOSURE* to mackerel fishing experienced no statistical change in productivity. Although it is surprising that the point estimate on *EXPOSURE* is more negative for firms with the second highest level of exposure compared to the most exposed firms, inter-quartile comparisons reveal that the difference in the relative change in productivity between the top two quartiles is not statistically significant. Unfortunately, the difference between the top and the second quartile is not statistically significant either. However, the differences between the top three quartiles and the bottom quartile are reliably different from zero, and the difference between the second and third quartile is statistically significant at the 1% level. Thus, column 3.1 demonstrates that the difference-in-difference result of Table 2 is robust to unpacking the treatment variable into quartiles by magnitude of exposure to the treatment, but only offers a moderate level of support for Hypothesis 2.

Stronger evidence in favor of the intensity of integration is obtained when we proxy for intensity of integration with a micro-organizational variable that captures the degree to which operations were interrelated *ex ante*. Column 3.2 shows that the coefficient on the term *REFOCUS x INTERRELATIONS* is -0.163 and is significant at the 5% level. The interpretation is that a one standard deviation increase in the number of days in which there was at least one ship that was switched from anchovy to mackerel fishing (or vice versa)—an increase of approximately 3%, or 7-8 additional changeovers per season[13]—was associated with an additional 16.3% decline in productivity, relative to a baseline rate of -12.3% in all firms that were forced out of the mackerel business. In column 3.3, we show that the magnitude of the effect is sensitive to the inclusion of firms that changeover the most frequently. Excluding the top 5% of firms in the *INTERRELATION* distribution yields a precise, but smaller point estimate on *REFOCUS x INTERRELATION* of -5.4%. Overall, Hypothesis 2 receives strong confirmation using *INTERRELATION* as a proxy for intensity of integration.

To test the prediction of Hypothesis 3 that the negative productivity shock associated with reducing the scope of the firm attenuates over time, we extend the post-ban treatment period

[13] The season is approximately 100 days long, and the average firm has about 250 ship-days per season. Therefore, a 3% increase in changeovers represents 7-8 additional changeovers per season. There were three anchovy fishing seasons between September 2002 and December 31, 2003.

to the end of the data set (2005) and examine how the productivity effects change by season. Table 4 shows two versions of the test. The first (column 4.1) extends our core sampling frame from 2001-2003 to 2001-2005, and measures the effect of a scope reduction on productivity by fishing season. Column 4.2 runs the same regression with the full pre-ban period as well (1999-2005). The results, which are nearly identical across specifications, reveal that the negative productivity shock associated with reducing the scope of the firm attenuates over time, albeit in a seemingly abrupt fashion. In the first three seasons following the ban, the point estimates of the productivity effect remain almost constant in the 14-16% range; however, by the fourth season after the ban *(REFOCUS x $SEASON_{+3}$)*, the effect of the reduction in firm scope is fully played out—it disappears never to return again.

Although our framework does not make a prediction about the precise pattern of organizational adaptation, it would be interesting to be able to test whether organizational adjustments were achieved abruptly or actualized gradually over time in our context. Unfortunately, our tests are not precise enough to distinguish statistically between performance effects in the first three seasons. Thus, we can only claim that firms are less productive than they were pre-ban for three seasons before reaching their pre-ban productively levels again.

Column 4.3 offers some corroborative evidence that coordination costs attenuate over time. The estimate of the effect of the reduction in firm scope through 2003 is in the 12% range (Table 2, column 2.2), while the effect through 2005 is only 6.5%, though still precisely estimated.

6.2 Robustness checks and limitations

We perform a number of auxiliary regressions to verify our main results. We summarize the four most important robustness checks briefly in this section and show the results in Table 5.

To be sure our results are not being driven by an arbitrary sampling period, we include the entire forty-four months of pre-ban data for the same 400 firms in our main sample, and find that doing so has little effect on the point estimate on *REFOCUS*—the point estimate is -13.7% and is precisely estimated (please see column 5.1).

We also verify that our results are not being driven by a decline in non-anchovy catches during anchovy season. Clearly, mackerel landings must fall following the ban. However, our specification ensures that there is no mechanical relationship between the ban and the drop in productivity. Indeed, 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 extensive margin of asset utilization.[14] Therefore, our measure of productivity properly uses total tonnage of fish extracted during anchovy season as our main dependent variable. Still, we want to be sure that the relationship between mackerel and anchovy is driving our result, since the biological synergy between these two species provides an intuitive rationale for why many firms fish for both species, and for why the ban leads to negative productivity effects in those firms. Column 5.1 shows the impact of the ban on productivity for anchovy catches only. The point estimate of minus 11.2% is only slightly lower than the estimate in regressions on total tonnage, and continuous to be precisely estimated.

The hypothesized synergy and coordination costs we describe operate at the level of the product, and, therefore, could exist even for small firms that operate a single ship; but, the hypothesized mechanisms are more intuitive in multi-ship firms. Thus, we want to be sure our results are not being driven by singe-ship firms. Therefore, we run a robustness check where we drop the 220 firms in our sample that operated a single ship during our sampling frame, restricting the sample to multi-ship firms. Column 5.3 shows that restricting the sample to multi-ship firms, (with an average of 4.2 ships), generates a precise point estimate of -11.4% on the coefficient on *REFOCUS*, which is very similar to the full sample results.

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[14] Since firms must plan for mackerel fishing by changing the nets on their boats, mackerel cannot simply be a byproduct of anchovy catches. It is also worthwhile to note that there is no statistical change in the extensive margin during anchovy season following the ban. This result is predictable since firms focus extensively—even exclusively—on fishing for anchovy during anchovy season.

Finally, to be sure that our results are not driven by extreme values that might be caused by spurious reporting errors in the data, we eliminate the top 1% and bottom 1% of ship-week observations by productivity, calculated as the residual in specification (2) excluding the *REFOCUS* term. Column 5.4 shows that the results are stable to excluding outliers as the coefficient on *REFOCUS* actually increases slightly to -15.1%. The results are robust to deeper cuts in the productivity distribution as well.

While this research exploits unusually rich data, one important limitation of this work is that we do not observe coordination costs directly; rather, we infer that coordination costs are sticky based on the institutional details and performance patterns of fishing firms. Furthermore, our analysis will reveal little about agency costs rooted in incentive problems that lead managers to misallocate capital toward horizontal expansion knowing *ex ante* that diversification will be inefficient (Jensen and Meckling 1976). The productivity effects we study capture operational coordination costs that persist once mackerel is jettisoned. Thus, this analysis identifies the *ex post* costs of horizontal integration arising from interdependencies between activities in the multiproduct firm.

Another possible criticism of this work is that our context is not particularly conducive to finding evidence of a diversification discount. Most fishing firms are small private firms where there is little separation between ownership and control, which would seem to obviate a narrow agency theory-based diversification discount argument. Still, the diversification discount literature is often interpreted to apply broadly. Indeed, the conceptual basis for a diversification discount is often based on *ex post* operational coordination costs: operational diseconomies of scope (Comment and Jarrell 1995), managerial distraction costs (Schoar 2002) and influence costs (Rajan, Servaes and Zingales 2000), where the costs of diversification arise after the firm expands. While we find evidence that coordination costs represent an important offset to synergies, on average synergies exceed coordination costs in the diversified fishing firms we study. Thus, the evidence supports the idea that managers anticipate synergies and coordination costs associated with diversification, strategically manage the horizontal boundary of the firm to create value, and adapt to environmental shocks that upset their well-crafted strategies.

7. Conclusion

This paper examines how a reduction in firm scope influences firm performance, 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 exogenously removing a product from a firm's portfolio destroys value—productivity fell by 12% in firms that were forced to reduce their scope. Moreover, the productivity effects are significantly more negative in firms that more intensively integrated their anchovy and mackerel operations before the ban. Finally, we show that the negative productivity effect persists in the short-run, but it attenuates over time.

Taken together, the evidence supports the strategic theory of firm scope. Firms appear to bundle products together within the firm to exploit synergies between products, which are lost when the products are no longer produced together. However, a central idea from the diversification discount literature is also borne out in the data: diversification creates coordination costs. Moreover, coordination costs are persistent but not permanent, firms adapt to changes in firm scope over time so that the costs of changing the boundary of the firm are not permanent. A key implication of the findings is that organizational rigidity influences the efficient scope of the firm.

This research has implications for scholars and practitioners alike. While we advance the idea from the strategic theory of firm scope that managers systematically extend the horizontal boundary of the firm to create synergies, we also provide evidence that interdependencies between business units create costly coordination costs that are persistent in the short-run. Scholars will want to carefully consider the inter-temporal relationship between synergies and coordination costs when evaluating the impact of firm scope on performance. Furthermore, we also reinforce the importance of measurement and empirical design in studies of firm scope.

Strategy research is increasingly concerned with well-identified results that facilitate causal inference. By combining micro-data with a natural experiment, we offer one potential pathway for future empirical research on firm scope. For corporate managers, this research suggests that integrated analyses of synergies and coordination costs are likely to be fruitful when considering changes in firm scope. While synergies offer exciting opportunities for value creation, the persistence of coordination costs introduces a note of caution: firms may end up paying for synergies long after they have disappeared.

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Appendix: Measuring productivity and estimating productivity effects

The standard production function with two inputs capital K and labor L is:

(A1) $Y = AK^{\beta\_k}L^{\beta\_l}$,

where Y is a physical output measure A is total factor productivity in quantities (TFPQ).[15] Holding the ratio of capital and labor fixed[16] and taking logs we can re-write (A1) as:

(A2) $y = a + \beta_k k$,

where variables written in lower case letters in (A2) are the natural logarithms of variables written in capital letters in (A1); for example a represents TFPQ.

If the marginal productivity of capital is constant over time for any given asset i, one can separately estimate the time-invariant and time-varying components of TFPQ. For example to estimate the time-invariant component of TFPQ Λ_i, and time-varying component of TFPQ η_{it}, $TFPQ_{it}=A^{\{\Lambda\_i + \eta\_it\}}$, one can use the regression:

(A3) $y_{it} = \alpha + \lambda_i + \beta_k k_{it} + e_{it}$,

where, t indexes time, $\lambda_i \equiv \Lambda_i a$, $e_{it} \equiv \eta_{it} a$, and α is a constant.

Breaking $TFPQ$ down further into time-invariant Λ, time-specific τ, location-specific Γ, scope-related ρ, and idiosyncratic ε components we have:

(A4) $TFPQ_{it} = A^{\{\Lambda\_i + \tau\_t + \Gamma\_it + \rho\_jt + \varepsilon\_it\}}$,

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[15] Foster, Haltiwanger and Syverson (2008) discuss the shortcomings of revenue-based measures of TFP and show that physical measures of TFP, or total factor productivity in quantities (TFPQ), are superior to revenue-based measures of TFP. Our estimates of outputs (Y=tons of fish) and inputs (K=capacity x trips) are in quantities, thus, we are estimating the impact of a reduction in firm scope on changes in TFPQ. Note that our output measure Y is not mix adjusted for the relative value of different species of fish. While there is cross-sectional variation in market prices for different species of fish, mackerel and anchovy prices are highly correlated over time (84%) and quite similar on average (4% average difference). Given the relatively small volume of non-anchovy species in our data (about 5%) adjusting for species mix would have a very small impact on our estimates of productivity. Furthermore, mackerel prices are usually higher than anchovy prices so mix adjusting productivity would lead to larger estimates of synergy destruction.

[16] Our interviews with ship captains and industry executives confirmed that ship-level production is Leontief in the Peruvian fishing industry. 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, within-ship capital and labor are used precisely proportionally.

where j indexes firms.

We can estimate each component of *TFPQ* in (A4) just as we did in the two component case (A3) using:

$$\text{(A5)}\ y_{it} = \alpha + \beta_k k_{it} + \lambda_i + T_t + G_{it} + \beta_R REFOCUS_{jt} + \upsilon_{it},$$

where, in our context, $\lambda_i \equiv \Lambda_i a$ is a time-invariant ship-specific effect, $T_t \equiv \tau_t a$ is a week fixed effect, $G_{it} \equiv \Gamma_{it} a$ is a location fixed effect, $REFOCUS_{jt} \equiv \rho_{jt} a$ captures the effect of a reduction in scope on productivity, α is a constant, and $\upsilon_{it} \equiv \varepsilon_{it} a$ measures unexplained variation in *TFPQ*. Equation (A5) is the same as our empirical specification (2) above.

Figure 1: Mackerel Ban and Fishmeal

The figure plots the quarterly catches of mackerel for fishmeal in thousands of tons (1 ton = 1,000 kilos) before and after the ban, covering the period 1999-2005.

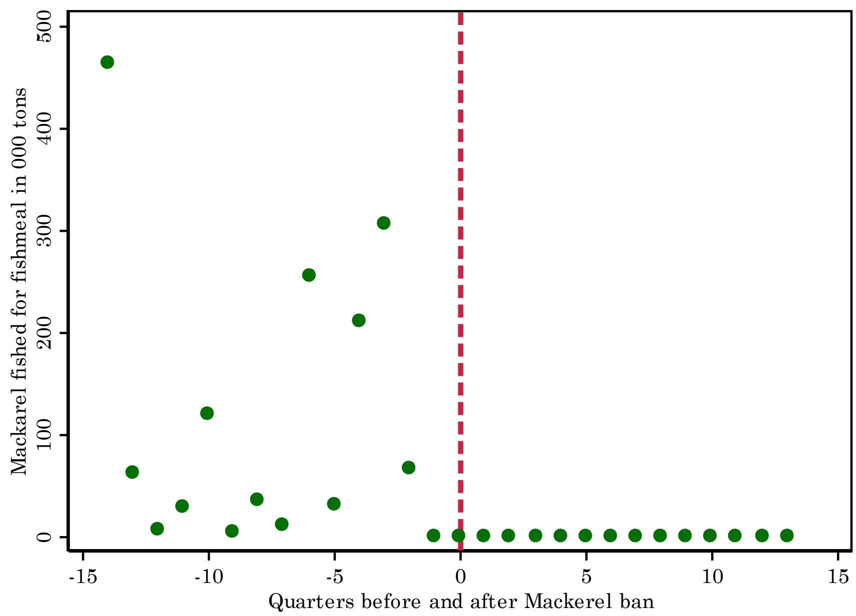
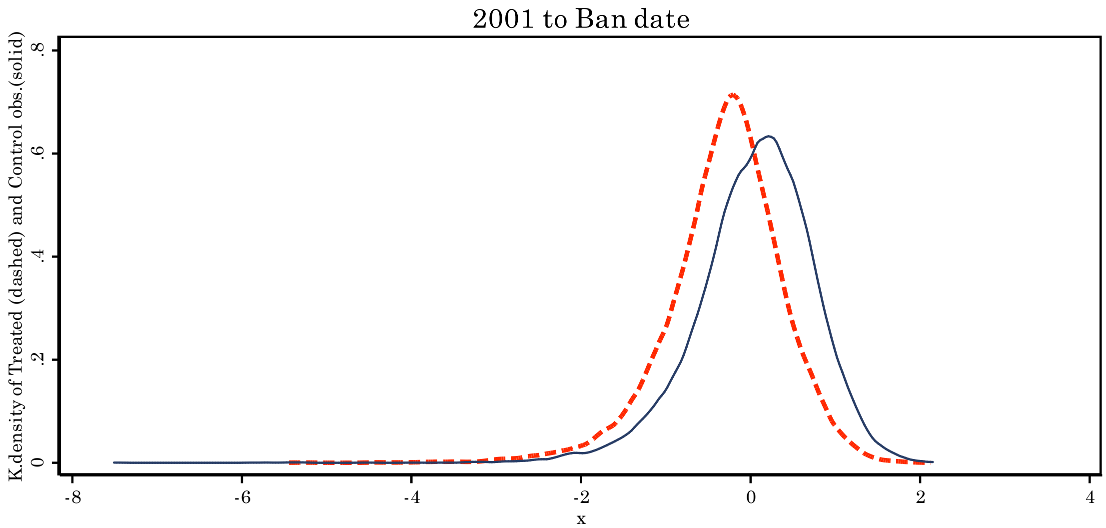


Figure 2: Distribution of Productivity before and after the Ban

The figures plot kernel densities of the residual of regressing output (fish tons) on capital, week dummies, fishing zone dummies, and ship fixed effects as defined in Table 1 and equation (2) without the *Refocus* term. The density for diversified firms is shown in the dashed lines, while the density for control observations are shown in the solid lines.



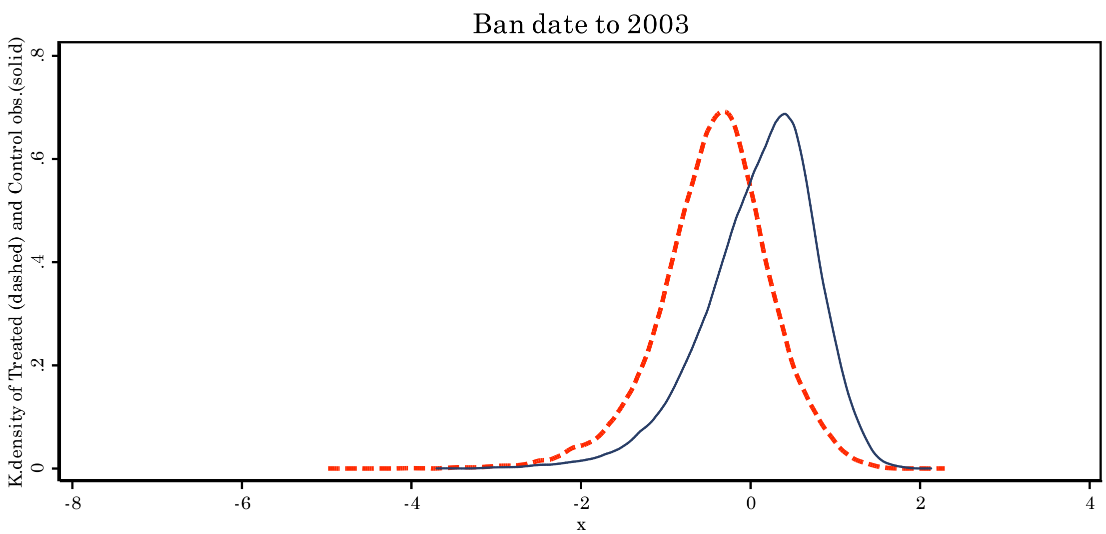
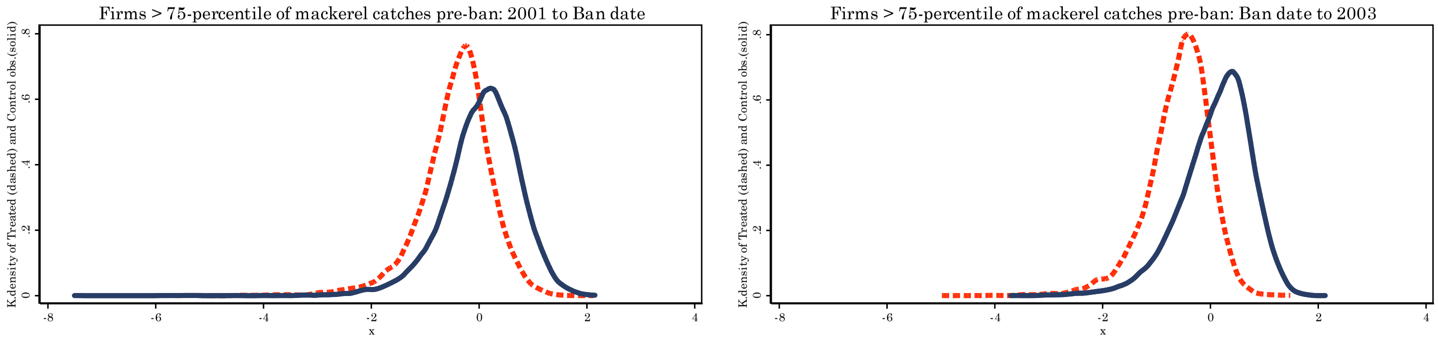


Figure 3: Distribution of Productivity in High and Low Exposure to Treatment

The figures plot kernel densities of the residual of regressing output (fish tons) on capital, week dummies, fishing zone dummies, and ship fixed effects for firms at different levels of exposure to treatment, as defined in Table 1 and equation (2) without the *Refocus* term. Panel 1 uses firms that fished more than the 75^{th} percentile ($Exposure_j^4$) of mackerel catches for fishmeal before the ban as the treated observations (in the dashed line). Panel 2 uses firms that fished more than zero but less than the 25^{th} percentile ($Exposure_j^1$) of mackerel catches for fishmeal before the ban as the treated observations (in the dashed line). Both panels use firms without catches of mackerel for fishmeal before the ban as the control observations (in the solid line).

Panel 1



Panel 2

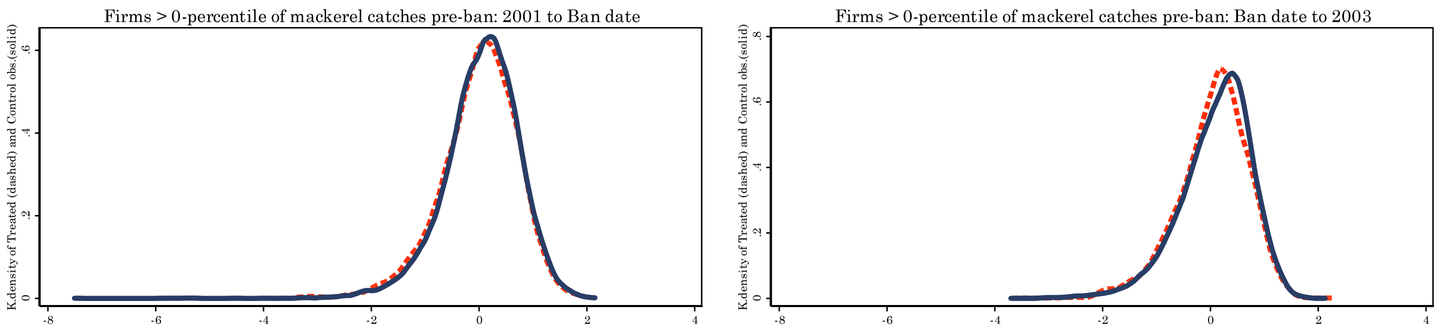


Table 1: Summary Statistics

The source of all variables is the proprietary Fishing System database of the Ministry of Production. The ship-week level variables are reported for the anchovy seasons in the period 2001-2003 for all ships that do not change ownership in that period, the main sample for the tests. Y_{it} is calculated over all catches of anchovy or any other species. K_{it} is the total use of the ship's capacity, defined as the fixed storage capacity in cubic meters multiplied by the number of trip the ship makes (one per day). A ton of anchovy fits almost exactly a cubic meter. *Diversified*, the treatment variable equal to one when any ship of the firm has fished mackerel for fishmeal before the ban. *Ban* is equal to one after 5 September 2002. *Refocus* is the interaction of Diversified and Ban. *Exposure*$_j^n$ is a dummy equal to one if the firm is in the n-th quartile (4 being the largest) of mackerel for fishmeal catches before the ban, conditional on having fished more than zero mackerel. *Interrelation* is an index based on the frequency of species changes in a firm's ships' daily trajectory before the ban regardless of the anchovy season; this variable is normalized to have mean zero and standard deviation one at the firm level, trimming the top 5% of outlier firms. The fishing zones divide the Peruvian coastline in four parts according to geographical differences across zones and the clustering of plants far from the dividing points. Some of these ship-week level variables are also reported at the ship or firm level. The bottom section of firm-level variables describes summary statistics for each quartile of exposure to the ban.

	Mean	Std. Dev.	Min.	Max.
Ship-week level variables (n=30,294)				
Y_{it}=tons of fish	168.84	230.64	0.04	2816.49
K_{it}=ship storage capacity	403.51	480.75	8.32	4023.18
Utilization (fishing trips per week)	3.32	1.75	1.00	8.00
Diversified	0.43	0.50	0.00	1.00
Ban	0.50	0.50	0.00	1.00
Refocus	0.20	0.40	0.00	1.00
Exposure$_j^4$	0.07	0.25	0.00	1.00
Exposure$_j^3$	0.03	0.17	0.00	1.00
Exposure$_j^2$	0.05	0.21	0.00	1.00
Exposure$_j^1$	0.06	0.24	0.00	1.00
Interrelation	-0.05	0.96	-0.57	3.85
Fising zone north of parallel 9°S	0.55	0.50	0.00	1.00
Fising zone $9° < x < 11.2°$S	0.33	0.47	0.00	1.00
Fising zone $11.2° \leq x < 16°$S	0.08	0.27	0.00	1.00
Fising zone south of parallel 16°S	0.05	0.21	0.00	1.00
Ship level variables (n=985)				
Ship storage capacity (in cubic meters)	180.59	153.37	8.32	868.27
Firm level variables (n=400)				
Diversified (dummy: fished for mackerel)	0.35	0.48	0.00	1.00
Number of ships	2.41	4.46	1.00	61.00
Pre-ban Mackerel for fishmeal in tons:				
For Exposure$_j^4 = 1$	34277.46	40793.21	2819.54	176181.40
For Exposure$_j^3 = 1$	815.94	466.58	307.18	1832.89
For Exposure$_j^2 = 1$	127.33	63.55	58.44	280.53
For Exposure$_j^1 = 1$	23.10	13.75	2.40	55.40

Table 2: Refocus and Productivity

This table reports estimates of equation (2) using the data described in Table 1. Observations are at the ship-week level. The ban on mackerel for fishmeal occurred on 5 September 2002. The models use standard errors clustered at the firm level.

Dependent Variable:	Log(Y_{it})	Log(Y_{it})
Sample Years:	2001-2003	2001-2003
	(2.1)	(2.2)
Refocus	-0.155^{***}	-0.124^{***}
	(0.03)	(0.03)
Diversified	-0.008	
	(0.04)	
Log (K_{it})	1.042^{***}	1.272^{***}
	(0.01)	(0.01)
Ship Fixed Effects	No	Yes
Week Fixed Effects	Yes	Yes
Fishing Zone Fixed Effects	Yes	Yes
R^2	0.75	0.81
n	30294	30294
N clusters	400	400

***, **,* are 1%, 5% and 10% levels. Heteroskedasticity-robust standard errors clustered by firm are shown in parentheses.

Table 3: Mechanisms for the Effect of Refocus on Productivity

This table reports estimates of equation (2) using the data described in Table 1 and the proxies described in Section 4.2. Observations are at the ship-week level. The ban on mackerel for fishmeal occurred on 5 September 2002. Model 2 uses *Interrelation* as described in Table 1 but without trimming the top 5% firms in terms of this index. Model 3 uses the trimmed version of the index. All models uses standard errors clustered at the firm level.

Dependent Variable:	Log(Y_{it})	Log(Y_{it})	Log(Y_{it})
Sample Years:	2001-2003	2001-2003	2001-2003
	(3.1)	(3.2)	(3.3)
Refocus		-0.123^{***}	-0.087^{***}
		(0.03)	(0.03)
Refocus×Exposure$_j^4$	-0.185^{***}		
	(0.06)		
Refocus×Exposure$_j^3$	-0.273^{***}		
	(0.05)		
Refocus×Exposure$_j^2$	-0.110^{**}		
	(0.04)		
Refocus×Exposure$_j^1$	0.020		
	(0.04)		
Refocus×Interrelation		-0.163^{**}	-0.054^{**}
		(0.07)	(0.02)
Log (K_{it})	1.271^{***}	1.273^{***}	1.271^{***}
	(0.01)	(0.01)	(0.01)
Ship Fixed Effects	Yes	Yes	Yes
Week Fixed Effects	Yes	Yes	Yes
Fishing Zone Fixed Effects	Yes	Yes	Yes
R^2	0.81	0.81	0.81
n	30294	30294	30032
N clusters	400	400	386

***, **,* are 1%, 5% and 10% levels. Heteroskedasticity-robust standard errors clustered by firm are shown in parentheses.

Table 4: Refocus and the Dynamics of Adaptation

This table reports estimates of equation (2) using the data described in Table 1 and interacting *Refocus* with dummies for anchovy fishing seasons after the ban, as described in Section 4.2. The ban on mackerel for fishmeal occurred on 5 September 2002, at the beginning of Season_0. Observations are at the ship-week level. All models use standard errors clustered at the firm level.

Dependent Variable:	Log(Y_{it})	Log(Y_{it})	Log(Y_{it})
Sample Years:	2001-2005	1999-2005	1999-2005
	(4.1)	(4.2)	(4.3)
Refocus	0.033	0.011	-0.065^{**}
	(0.05)	(0.04)	(0.03)
Refocus× Season_0	-0.147^{***}	-0.149^{***}	
	(0.05)	(0.05)	
Refocus× Season_{+1}	-0.151^{***}	-0.147^{***}	
	(0.06)	(0.05)	
Refocus× Season_{+2}	-0.166^{***}	-0.160^{***}	
	(0.04)	(0.04)	
Refocus× Season_{+3}	0.013	0.019	
	(0.04)	(0.04)	
Refocus× Season_{+4}	-0.014	-0.015	
	(0.03)	(0.03)	
Refocus× Season_{+5}	-0.041	-0.039	
	(0.03)	(0.03)	
Log (K_{it})	1.262^{***}	1.259^{***}	1.261^{***}
	(0.01)	(0.01)	(0.01)
Ship Fixed Effects	Yes	Yes	Yes
Week Fixed Effects	Yes	Yes	Yes
Fishing Zone Fixed Effects	Yes	Yes	Yes
R^2	0.82	0.83	0.83
n	52482	66425	66425
N clusters	400	400	400

. ***, **,* are 1%, 5% and 10% levels. Heteroskedasticity-robust standard errors clustered by firm are showed in parentheses.

Table 5: Robustness Checks

This table reports estimates of equation (2) using the data described in Table 1. Observations are at the ship-week level. The ban on mackerel for fishmeal occurred on 5 September 2002. The first model is the same as the main model but expands the sample years back to 1999. The second model uses exclusively anchovy catches in the anchovy season to construct the dependent variable. The third model drops all single-ship firms. The fourth model uses the baseline specification but drops the top 1% and bottom 1% observations by productivity, that is, the residual in equation (2) excluding the *Refocus* term. All models uses standard errors clustered at the firm level.

Dependent Variable:	Log(Y_{it})	Log(Y_{it})	Log(Y_{it})	Log(Y_{it})
Sample Observations:		Anchovy Catches	Multi-ship firms	Excluding outlier observations
Sample Years:	1999-2003	2001-2003	2001-2003	2001-2003
	(5.1)	(5.2)	(5.3)	(5.4)
Refocus	-0.137^{***}	-0.112^{***}	-0.114^{***}	-0.151^{***}
	(0.03)	(0.03)	(0.04)	(0.03)
Log (K_{it})	1.266^{***}	1.263^{***}	1.265^{***}	1.205^{***}
	(0.01)	(0.01)	(0.01)	(0.01)
Ship Fixed Effects	Yes	Yes	Yes	Yes
Week Fixed Effects	Yes	Yes	Yes	Yes
Fishing Zone Fixed Effects	Yes	Yes	Yes	Yes
R^2	0.83	0.81	0.81	0.84
n	44237	29744	21118	29774
N clusters	400	398	180	399

***, **,* are 1%, 5% and 10% levels. Heteroskedasticity-robust standard errors clustered by firm are shown in parentheses.