Competing for Relationships: Markets and Informal Institutions in Sierra Leone*

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This Version: January 24, 2015
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Abstract

A body of literature suggests that relationships affect contractual and market outcomes, but how does market structure affect the economics of relationships? This paper provides microeconometric evidence that upstream market structure affects the value of downstream relationships between retailers and buyers. In our setting, a monopoly ice manufacturer sells through independent retailers to fishermen buyers in Sierra Leone. We demonstrate that a shock that increases upstream competition among manufacturers improves the contractual terms offered by retailers to buyers. Under the monopolistic manufacturer, we document that late deliveries are common due to outside demand shocks. To help mitigate this uncertainty, retailers prioritize loyal customers when faced with shortages, and buyers respond by rarely switching retailers. When manufacturers compete, prices fall, quantities increase and services improve with fewer late deliveries. Entry upstream also disrupts collusion among retailers by increasing the value of competing for buyer relationships. Competing retailers expand trade credit provision as a new basis for loyalty, and stable buyer relationships reemerge after a period of intense switching. The findings suggest that market structure shapes informal contractual institutions, and that competition can increase the value of relationships.

JEL classification: L14, L22, D23, D42, 012

Keywords: Market Structure, Relational Contracts, Informal Institutions

*Steven Tadelis, Ernesto Dal Bo and Edward Miguel provided invaluable guidance and support, and we thank Michael Callen, Lorenzo Casaburi, Frederico Finan, Avner Greif, Ethan Kapstein, Asim Ijaz Khwaja, Jeremy Magruder, Ameet Morjaria, Gautam Rao, Andrei Shleifer, Santiago Truffa, Reed Walker, Oliver Williamson, Christopher Woodruff, Noam Yuchtman, Owen Zidar and seminar participants at UC Berkeley, Harvard, IGC Growth Week and NEUDC for insightful comments. We also thank Niall O'Cathasaigh, Tom Cairnes and the Ice Ice Baby team for assistance in implementing the project. Abhay Aneja, Anthony Mansaray, Osman Nabay, James Polit and the Sierra Leone country team at Innovations for Poverty Action provided excellent research assistance. Support was provided by the Clausen Center for International Business and Policy, the International Growth Center, the Private Enterprise Development in Low-Income Countries Initiative, and the Weiss Family Fund for Research in Development Economics.

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‡PhD (Harvard), 2014.

1 Introduction

Relationships help mitigate transactional hazards, particularly when contracts are incomplete. Repeated interactions form the basis for informal contractual institutions that allow agents to reward cooperation and punish deviations within the relationship. A theoretical literature demonstrates how relationships and informal institutions can determine market structure and practices.[1] Recent empirical work - mainly focused on emerging economies - has shown that relationships are associated with improved contractual terms such as credit provision and the prioritization of deliveries (McMillan and Woodruff, 1999b; Macchiavello and Morjaria, 2012; Antràs and Foley, 2014). Yet little is known about how market power affects the economics of relationships, including how much value is created within the relationship and which contractual institutions emerge to distribute the potential surplus.

In this paper, we provide microeconometric evidence that upstream market structure affects the value of downstream relationships. We present a model combining imperfect competition by upstream manufacturers with a market-share contest by retailers who provide trade credit to attract downstream buyers. Under monopolistic manufacturing, retailers collude to maintain the provision of trade credit at low levels and use delivery prioritization to secure buyer loyalties. Manufacturer entry expands the market size and reduces late deliveries, leading retailers to compete for buyer relationships. Competing retailers expand trade credit provision as a new basis for buyer loyalty, utilizing the fact that credit requires a level of inter-temporal trust that can best be sustained inside a relationship.

We test this theory using a novel dataset on high-volume ice sales to 154 fishermen buyers in Sierra Leone, who have long-lived relationships with the ice retailers selling for a local monopolistic ice manufacturer. We find that a shock that induces upstream entry by several ice manufacturers leads to improved contractual terms for fishermen buyers in both price and timeliness. Ice manufacturer entry also leads to increased provision of trade credit by retail-

[1] For example, Baker et al. (2002) extends seminal work by Williamson (1975, 1979) to show how relationships determine where the firm ends and the market begins. Also, historical economic analysis by Greif (1989, 1993, 2006) explores how informal institutions shaped the development of modern markets.

ers, but only where multiple ice retailers compete for buyer relationships. Consistent with the model, we observe a period of intense switching of buyer relationships after manufacturer entry, followed by the reemergence of stable relationships as credit provision increases.

Low-income countries are characterized by many market frictions that help make relationships and informal institutions important. These emerging markets often entail uncertainty and instability, weak formal contractual enforcement, and insecure property rights (Collier and Gunning, 1999; McMillan and Woodruff, 1999a; Johnson et al., 2002). Low-income countries are also characterized by concentrated market power in upstream industries (Venables, 2010).[2] In such challenging settings, ongoing relationships help support informal contractual institutions to address transactional hazards. Focusing on the effect of market structure on informal contractual institutions enables us to provide original empirical evidence of how upstream market power limits the set of contractual transactions that can be realized.

Sierra Leone is a compelling environment to examine how markets develop when relationships are important. When it emerged from a 10-year civil war in 2002, the country had much of its infrastructure destroyed and a large internally displaced population, highlighting a challenging business environment (Bellows and Miguel, 2006). Since then, economic activity and firm productivity has steadily recovered as trade and investment flows have grown (Collier and Duponchel, 2013).[3] Sierra Leone's ice industry is a simple product market that represents several major themes from previous work on manufacturing in sub-Saharan Africa, such as high capital costs, supply chain risk and the importance of business relationships (Bigsten et al., 2000; Fafchamps et al., 2000; Fafchamps, 2004). Furthermore, observing the ice industry during a period of rapid market expansion provides new insight into the mechanisms through which upstream market power affects the value of downstream relationships.

A key challenge to studying informal relationships is that appropriate statistics are rarely

[2]While data on market structure in low-income countries is generally lacking, detailed research surveying the origins of large firms in Ghana, Ethiopia, Tanzania and Zambia further supports that African industrial sectors often entail a small number of leading companies (Sutton and Kellow, 2010; Sutton and Kpentey, 2012; Sutton and Olomi, 2012; Sutton and Langmead, 2013).

[3]While the 2014 Ebola outbreak in the Mano River region countries of Guinea, Liberia and Sierra Leone poses a large economic and humanitarian challenge, the data from this paper focus on the prior period.

available, particularly in developing economy contexts like Sierra Leone. To enable the empirical analysis described above, we established partnerships with the incumbent ice manufacturer, its competitors, and the independent ice retailers in order to collect a transaction-level panel dataset of informal contracts with fishermen buyers. The data allows us to track identities of the retailer and fishermen buyer, contractual terms (price, quantity demanded and credit terms), and contractual outcomes (quantity delivered and timeliness of delivery) over an 18-month period from January 2013 to July 2014. We also managed a team of enumerators conducting detailed baseline and biweekly follow-up surveys with fishermen to record assets and expenditures, ice usage, and fishing trip outcomes. Finally, we conduct interviews with all of the major upstream manufacturers and retailers, providing a qualitative history that helps complement our quantitative analysis with additional insight into mechanisms.

This data collection allows us to establish several stylized facts. We document that late deliveries are common under the monopolistic ice manufacturer - on average delayed by a half day - and buyers remain loyal to retailers despite systematic poor performance. Approximately 26% of deliveries are late during the first six months of 2013, which is prior to new manufacturer entry, and survey data confirms that fishermen experience worse fishing outcomes when exposed to lateness. Exploring the sources of lateness, we differentiate between internal factors under the manufacturer's direct control (e.g. issues with machines, vehicles or workers) and external factors such as outside demand shocks for ice sales to non-fishermen sources, and demonstrate a strong positive relationship between outside demand and late deliveries to fishermen. We present evidence for two main sources of buyer loyalty by examining one fishing wharf, Goderich, that supports multiple retailers under the monopolistic manufacturer. We demonstrate that retailers in Goderich respond to delays in manufacturer deliveries by strategically prioritizing their most loyal buyers. Those designated as "loyal customers" move up between 2-3 places in the prioritization queue. Finally, we document that retailers are colluding to maintain low trade credit levels and restrict competition for customers, thus limiting buyers' outside options and further cementing existing relationships.

Next, we show that entry by new ice manufacturers results in improved contractual terms in both price and timeliness for fishermen buyers. We exploit a shock that improves the financing terms available to new manufacturers in procuring costly ice production machinery, leading to the establishment of several new ice factories serving fishermen over a half-year period. Midway through our data collection, a Sierra Leonean entrepreneur established a new venture importing industrial ice machines, greatly reducing the procurement and financing costs of purchasing this equipment. Prior to this entrepreneur's arrival, ice manufacturers had to contract directly with foreign machine sources, visit their facilities abroad, and pay 50% of cost upfront, and 50% on delivery; the ice machine importer offered local sales agreements with financing terms of 50% upfront, 25% on delivery, and 25% six months into production.[4] Consistent with our model's predictions, we document increased price competition and fewer late deliveries corresponding to the arrival of new manufacturers in each of the fishing wharves. Each additional manufacturer is associated with a 5-6% fall in price, and the overall frequency of late deliveries falls to 1% during the first six months of 2014. Our results are robust to restricting attention to year-on-year comparisons and to separately examining the main effects in each wharf.

Finally, we demonstrates that ice manufacturer entry also helps disrupt collusion among ice retailers, leading to more switching by fishermen buyers across retailers and increased credit provision. The size of the retail market expands due to increased capacity and lower prices, making deviation to steal customers more tempting. Meanwhile, lateness has fallen, removing a key market friction that motivated buyer loyalty. Higher credit provision increases the value of retailer relationships to buyers and thus serves two purposes, incentivizing the buyer to switch retailers while also providing a new rationale for loyalty. We exploit temporal variation in the number of ice manufacturers and cross-sectional variation in the number of ice retailers in each fishing wharf to demonstrate that trade credit only increases where both manufacturers and retailers compete in Goderich. In the remaining two wharves

[4] A secondary source of increased entry into ice manufacturing involves horizontal expansion by package water and ice cube distributors who have large cash reserves allowing them to self-finance machinery costs.

where retailers are monopolists, credit levels do not change after new manufacturer entry despite lower prices and reduced lateness, suggesting that increases in Goderich are not solely due to retailer pass-through.[5] In Goderich, we observe a 75 percentage point increase in the number of fishermen who have switched retailers at least once after manufacturer entry. Correspondingly, weekly credit provision levels increase up to 29 percentage points in Goderich after manufacturer entry, while no significant changes are correspondingly observed in the other wharves with monopolistic retailers. To address concerns about autocorrelation within a small number of wharves, we also implement the wild cluster bootstrap inference correction recommended by Cameron et al. (2008), Cameron and Miller (2013) and Webb (2013). While short of conventional levels of significance, the p-values from this conservative approach are in a range that suggests our findings are unlikely to be due to random chance.

This paper's findings have important implications for theory and policy. Recent theoretical work on relational contracts emphasizes the tradeoff between mitigating holdup and facilitating transactions and reducing the potential scope of trade, with implications for intra-relationship loyalty and inter-relationship market structure (Board, 2011; Barron, 2013). Our results emphasize an alternative direction in which changes in upstream market structure directly affect the value of downstream relationships. Namely, under upstream monopoly, frequent production shortages provide the basis for delivery relationships between retailers and buyers that allow loyal customers to mitigate the uncertainty of late deliveries. And after upstream competition increases the market size, expanded credit relationships between retailers and buyers emerge as a new basis for customer loyalty. Our work also provides rigorous microeconometric evidence consistent with recent macro-level work by Asker et al. (2013), who argue that demand volatility is a key driver of dispersion across countries in the marginal revenue product of capital, and Michaillat and Saez (2013), who stress the importance of trade frictions in leading firms to build long-term relationships. With our focus on weak institutional environments we are closely related to Dixit (2007), though our

[5] We document in interviews that when ice retailers are monopolists, they extract rents from increased competition by ice manufacturers while new retailer entrants have difficulty establishing trading relationships.

attention to how informal institutions respond to increasing market development is distinct.

We also integrate and extend two literatures on the costs of monopoly power and the constraints to private enterprise growth in low-income countries, which have generally remained separate. In our context, the cost of monopoly includes more than inflated prices and restricted output relative to the competitive levels, or the welfare implications of associated rent-seeking behavior (Tullock, 1967; Posner, 1975). We demonstrate that monopoly power by either manufacturers or retailers is a sufficient condition to worsen contractual terms, in our setting limiting the timeliness of manufacturer deliveries and the provision of retailer trade credit, respectively. This informal channel for monopoly power to constrain firm growth is very salient in low-income countries, where previous work has largely emphasized the importance of property rights, credit constraints and uninsured risk in limiting private sector development (Johnson et al., 2002; Bigsten et al., 2003; De Mel et al., 2008; Karlan et al., 2012). Furthermore, we distinguish between cooperative and collusive relationships, showing that in our setting it is the collusive relationships between retailers that break down with the onset of upstream manufacturer competition, while cooperative relationships between retailers and buyers prove more resilient.

Our work builds on the foundation provided by the economic literature on relationships and exchange. A growing body of empirical work addresses the importance of long-lived relationships in determining firm-level outcomes such as trade credit provision or prioritization of deliveries (Fafchamps, 1997, 2004; McMillan and Woodruff, 1999b; Antràs and Foley, 2014). Our work is complementary, noting that even in a context of long-standing relationships, collusion and market power may restrict credit to inefficient levels. Macchiavello and Morjaria (2012) provide evidence from the Kenyan rose export sector that reputational incentives play a central role in determining firm delivery decisions following a large supply shock associated with the 2007 Kenyan election violence. Initially, our setting involves frequent supply shocks that also highlight the value of delivery relationships, but we demonstrate how informal institutions evolve as market development reduces the risk of late deliveries.

Finally, two recent papers closely related to our own, Macchiavello and Morjaria (2014) and Casaburi and Reed (2014), provide cross sectional evidence on how competition affects credit provision that complement our time-series findings. Studying coffee farmers in Rwanda, Macchiavello and Morjaria (2014) find evidence that the presence of more coffee washing stations in a given geography are associated with fewer relational contracting practices such as supply of agricultural inputs and post-harvest credit transactions. Their paper emphasizes side-selling concerns under which intra-relationship buyer-seller trust breaks down due to the presence of outside spot markets, and as a consequence buyer credit provision decreases with more buyer entry. In our three-tier supply chain, credit is provided instead by sellers (retailers), and we find that as manufacturer entry expands the retailer market size, competing retailers respond by increasing credit provision to secure buyer relationships. Casaburi and Reed (2014) find evidence that cocoa farmers in Sierra Leone working in an area with more traders receive more credit provision, which they explain with a model of pass-through. In our paper, a simple model of pass-through is not consistent with the lack of increased trade credit provision we observe in markets where retailers are monopolists, highlighting the importance of inter-retailer collusive relationships in explaining our results.

The remainder of the paper is structured as follows. The next section provides background on our research setting, and the details of ice manufacturing, retailing and fishing in Sierra Leone. Section 3 presents a theoretical framework and derives predictions that we test in the data. Section 4 describes the data. Section 5 quantifies the effect of increased upstream manufacturer competition on downstream contractual terms. Section 6 concludes.

2 Background

A former British colony located along the coast of West Africa, Sierra Leone is a low-income country with an estimated GDP of $4.93 billion (2013) and a population of approximately 6 million. Approximately two-thirds of the labor force is engaged in agriculture, which

contributes over one-third of the country's gross domestic product (Johnson et al., 2013). Fishing is a vital sector in Sierra Leone, accounting for approximately 10% of GDP and composing approximately 30,000 artisanal fishermen distributed along the country's coastline using over 8,000 boats (Bank, 2006, 2009). Fishing is divided into two sectors: industrial operations, with larger vessels fishing further out to sea that typically freeze fish on board for export, and small-scale (artisanal) fishing operations that serve the domestic market. All of the fishing activities described in this paper involve artisanal fishermen. Sierra Leone's coastal waters support shrimp, cephalopods, demersal species (e.g. snappers, groupers), small pelagic species (e.g. herring) and large pelagic species (e.g. tunas, barracudas). Fishing production is highest during the country's dry season from October to June, as the heavy rainy season between July and September poses additional risks to fishermen at sea.

2.1 Downstream Market: Freetown Fishermen

Over the past decade, a selection of artisanal fishing firms located in the Freetown Peninsula have developed a specialized approach to fishing production that makes use of the local availability of ice. Making use of large boats equipped with wooden iceboxes, the fishermen are able to conduct multi-day journeys. Without ice to keep their catch fresh, the fishermen must either specialize in lower value fish that can be sold dried, or conduct short overnight fishing trips to avoid the potential for spoilage. Given the fixed costs of organizing each fishing trip, ice is a simple technology offering scale economies to the fishermen, but unpredictability around the timeliness of ice deliveries constrains its usage.

Artisanal fishermen typically demand ice deliveries in the morning immediately before going to sea, and will make orders the day prior to departure with their local ice retailer. Because fishermen and retailers do not have access to large freezers or a reliable supply of electricity, they cannot reliably store the ice and thus require prompt delivery. If the ice is not delivered on time, the fishermen lose part or all of the day at sea, paying both wages of the fishermen they have retained for the day, and the opportunity cost of their own time and

capital. After fishermen have made specific investments such as equipping their boats for ice fishing, they have few options in addressing this risk of late ice deliveries. The monopolistic manufacturer does not offer refunds for late deliveries, which are difficult to predict.

We study three fishing wharves on the Freetown Peninsula, the locations of which are highlighted in Figure 1. Tombo Wharf (W1) is the largest artisanal landing on the peninsula, representing approximately 250 large fishing boats, though only about 15% of these vessels regularly purchase ice. While Tombo represents the largest potential market for ice sales to fishermen, it is also located approximately one hour's drive away from the Freetown city area where the monopolistic ice manufacturer is located and thus particularly affected by late deliveries. The remaining two wharves, Aberdeen (W2) and Goderich (W3), are located within short driving distance of the monopolistic manufacturer's location in Freetown. Aberdeen supports about 100 large fishing boats, of which approximately 30% regularly purchase ice. Goderich is the largest market for fishermen sales for the monopolistic ice manufacturer, with approximately 200 large fishing boats, of which almost 50% regularly purchase ice.

2.2 Upstream Market: Ice Manufacturing and Retailing

Like many manufacturing industries in sub-Saharan Africa, the industrial production of ice requires relatively large capital investments and high operating costs - two important barriers to entry. In particular, large-scale crushed ice production equipment like those used by these suppliers are custom-assembled by manufacturers in a few countries such as China, Germany or Italy. Capital investment requirements for a 13-ton daily capacity industrial ice machine typically exceed $100,000, with limited available sources of domestic financing. By contrast, the machinery for ice cube production is smaller and cheaper, leading to increased competition here. In the case of the monopolistic ice manufacturer discussed below, payment terms for its industrial ice machine were 50% upfront and 50% on delivery, and required a personal visit to their international facilities to agree on final terms. Given the unreliable supply of public electricity in Sierra Leone, ice suppliers must also invest in large diesel

generators with expensive daily fuel costs in order to ensure a steady production schedule.

2.2.1 Monopolistic Manufacturer

Ice Ice Baby ("IIB") is Sierra Leone's largest ice manufacturing company, selling crushed ice to artisanal fisherman and other vendors for use as cold storage, and purified cubed ice to restaurants and grocery stores for public consumption. The company produces from its 29-ton capacity facility based in the western area of the capital Freetown and is wholly owned by ManoCap, a private equity fund manager that operates in Sierra Leone, Liberia and Ghana. IIB was founded in 2005 by two Sierra Leoneans recently returned from the diaspora, and launched its initial production in fall 2006. ManoCap acquired the business in 2008 and expanded its production with capital investments and professional management.

At the start of our data collection in January 2013, IIB served as the monopolistic manufacturer supplying independent retailers (called "agents") based at the three fishing wharves mentioned above.[6] Retailers source orders, collect money from fishermen, and then buy ice directly from the manufacturer with their own working capital. Upon receipt of payment, the manufacturer arranges delivery to the retailer's wharf, where ice is distributed to fishermen. Fishermen can also purchase directly from the factory, but then they must show up in person, pay a higher price, and organize their own delivery, so it is uncommon for them to do so.

However, IIB often faces difficulty delivering ice to all wharves early in the morning when fishermen typically need it. At the start of our data collection in 2013, delays lasting half a day or more are common and the manufacturer was unable to satisfy all of its fishermen demand in a timely fashion. In interviews, fishermen reported that late deliveries had been a problem for several years prior to the start of our data collection. Lateness for fishermen derives from two main sources: capacity constraints at the ice factory and the unpredictable

[6] When IIB entered the market in 2006, it initially competed with two smaller existing suppliers with outdated equipment to serve the artisanal fishermen market, but they were unable to sustain their operations and soon exited the market. In addition, in 2012 IIB stopped serving a fourth fishing wharf located in Murray Town when a government sponsored fishing business was established there with its own ice facilities.

nature of outside demand. Capital equipment at the factory must be maintained and mechanical problems with the ice machines, generators, and delivery vehicles occur frequently. As the public electric grid is unreliable, the factory must rely on expensive diesel generators to power its production process. Likewise, factory labor supply can be unpredictable, with employees showing up late or reporting sick, disrupting the implementation of daily production plans.

In addition to these time-varying sources of capacity constraints, the factory faces a difficult planning problem in addressing outside demand. While fishermen orders are generally placed a day in advance and aggregated through the retailers, other sources of demand are much less reliable and experienced directly by the factory. Restaurants and bars, supermarkets, parties and other vendors often make large, unpredictable same-day orders and have a substantially higher willingness to pay for immediate service. In the context of time-varying capacity constraints, these outside demand shocks often bind, forcing the factory to prioritize available inventory between fishermen and the outside market. As the average price per kilogram of ice sold to the outside market is about twice as high as the price to fishermen retailers, factory managers regularly prioritize outside demand orders, leading to lateness for the fishermen. Because ice is a non-durable good, and the manufacturer controls delivery at the market, retailers are unable to build inventories to protect against late deliveries.

The manufacturer sets the retail price of ice to fishermen and offers a wholesale price to the retailers, granting them a fixed commission on each 30 kg bag of ice sold. Interviews and survey data collection with fishermen confirm that this retail price is understood and followed in the market, mostly due to retailer concerns that deviating from the rule will lead to complaints from disadvantaged customers. Also, the manufacturer and retailers report that price stability is an important determinant of fishermen long-term demand, and hence have forgone an auction for ice sales. Whenever the manufacturer is responsible for shortages or lateness in the supply of ice to retailers, retailers also make rationing allocations among their customers. Retailers indicate that rationing decisions are typically made based on the

value of the business relationship, the order in which deliveries were made, and whether that order was paid for in advance. We present empirical evidence supporting this claim below.

Retailers often provide trade credit to their customers, allowing them to pay for a portion of their expenses after the time of order at 0% interest. In practice, trade credit repayments take place over a wide interval of time, from the time of delivery, to the return of a fishing trip, to several weeks later. Retailers report that the common determinants of credit provision include the value of the business relationship, reliability in paying back previous debt, and the stability of the fisherman in his business. On the demand for trade credit, retailers report that fishermen who have recently experienced a bad trip are more likely to request credit, particularly given that ice is the final purchase made before a trip departs.[7] Retailer trade credit provision is partly financed by a monthly line of credit from the manufacturer. If a retailer should exceed the monthly credit line, the manufacturer will withhold payment of the retailer's commission until the outstanding debt has been cleared. Thus, trade credit is nearly costless for retailers to provide up to a certain threshold, but the cost rises afterwards as it begins to impact the retailer's working capital. Given the observed demand for credit from fishermen, it is clear that retailers find themselves on the costly part of the curve.

Relationships between retailers and their customers play a key role in this market context. IIB recruited its retailers directly from the fishing wharf communities, and fishermen report having known their retailer for an average of 9 years even while only buying ice from him for about half that time. Fishermen invest in retailer relationships to minimize lateness and rationing, and we present evidence below that retailers reward loyal customers with prioritized deliveries. Retailers also indicate that trade credit is a useful tool for promoting customer loyalty, as the repeated interaction involved in sustaining a lending relationship helps deters customer switching across retailers and makes credit default uncommon.

In addition to the vertical relationships between retailers and fishermen, we document the importance of horizontal relationships among the three retailers who operate in the

[7] Alternative sources of credit available to fishermen are limited. Local banks will not offer credit lines to the fishermen, and informal lenders (e.g. Susu accounts) charge a weekly interest rate of 2-3%.

Goderich wharf. In interviews, these retailers report the existence of a collusive agreement that restricted competition for fishermen customers. Specifically, retailers agreed to maintain exclusive territories over existing customers, so as to avoid making competing offers to customers. This agreement was supported by the existence of a single manufacturer, which limited potential sources of ice for new retailers and enabled the retailer cartel to handle transitions. In one retailer's words: "the main reason was to prevent the agents to compete among themselves with the same wharf. This is why we the agents agreed that IIB cannot get more than 3 agents here at Goderich. Even if an agent wants to quit, he can recommend another person and we should approve because we want an agent that is dependable."[8]

2.2.2 Entry and Competition

Here we describe a shock that set into motion the chain of events explored in this paper. Given interviews, we can note that the shock was unexpected to the participants and unrelated to underlying fundamentals in any of the fishing wharves. As noted above, the crushed ice manufacturing market has high fixed costs associated with the acquisition and financing of required machinery, which served as an important barrier to entry. Two factors played an important role in overcoming this restriction on entry. First, in late 2012, a Sierra Leonean entrepreneur with an established business importing refrigerators and air conditioners for the regional consumer market decided to diversify into importing industrial ice machines. The importer offered local buyers an opportunity to purchase without costly travel, and with attractive leasing terms that helped smooth the otherwise lumpy investment decision. In practice, this entailed adjusting the standard payment terms from 50% upfront and 50% on delivery, to 50% upfront, 25% on delivery, and 25% six months into production. The importer experienced considerable demand for his services, helping to establish six new ice production facilities around Freetown between early-2013 and mid-2014, including several focused on serving fishermen.

[8]Interview with research associate James Polit, October 2014, Goderich Wharf, Freetown, Sierra Leone.

Second, an existing set of firms operating in Sierra Leone's water packaging and cubed ice market, which have lower entry costs, were able to gradually build up sufficient cash reserves from these business lines to finance the necessary large capital investments. From the perspective of these competitors, horizontal differentiation into the crushed ice market provided an attractive opportunity to diversify their revenue streams while leveraging existing investments in land, buildings, managerial capacity and sales networks.

As a consequence of these two factors, four manufacturers with industrial crushed ice machines chose to enter the three fishing wharves already served by IIB. The first two new manufacturers self-sourced and self-financed their expansion into industrial ice production, while the remaining two utilized the importer's sourcing and financing services. The exact timing of the start of sales for each factory to artisanal fishermen depended on a variety of idiosyncratic factors, such as the recruitment of skilled staff, the maintenance and repair of machinery, and the limited attention of senior managers or owners. While IIB was aware of the possibility of competitor entry into the artisanal fishing market, the factory owners and management indicated in interviews that they did not consider new entry to be a likely outcome prior to the fact and that they were unaware in advance of the timing of entry.

Figure 2 presents the timing of entry by each of the four new manufacturers who competed with IIB, the original monopolistic manufacturer, for serving the demand of artisanal fishermen in the three fishing wharves. It also shows the corresponding decisions of IIB to lower price across all three wharves, in particular following the entry of lower-price competitors into Goderich and Aberdeen. Manufacturer 2 originally started operations in May 2012 as a packaged water distributor based in the near vicinity of the Tombo, and began selling cubed ice in May 2013 to local bars and hotels. After procuring a crushed ice machine, it launched sales in Tombo beginning in late-August 2013.[9] Manufacturer 3 began operations in February 2013 serving cubed ice to the general public from its location in central

[9]As Figure 2 shows, the incumbent manufacturer, IIB, did not respond immediately to the entry of Manufacturer 2 in Tombo. This was partly due to the fact that Tombo is the most distant wharf served by IIB with a maximum of only one delivery per day. In addition, Manufacturer 2 chose not to compete on price, using its spatial advantage to maintain a high price against the prospect of immediate deliveries.

Freetown, and then began selling cubed ice to fishermen in both Goderich and Aberdeen simultaneously starting in late-October 2013.[10]

Manufacturer 4 began operations in May 2012 as a packaged water distributor and added cubed ice sales in December 2012. While intending to enter the fishermen market earlier, they faced delays in procuring their crushed ice machine and recruiting skilled staff, some of who came from IIB's staff. Manufacturer 4 launched crushed ice sales in Aberdeen nearby its factory location in December 2013, and then expanded to Goderich in April 2014. Manufacturer 5 started both cubed and crushed ice operations in January 2014 from a location near the Goderich. After selling crushed ice to the general public for several months, Manufacturer 5 began crushed ice sales to fishermen in Goderich in March 2014, with plans to enter Aberdeen and smaller wharves around Freetown in the future. Appendix Figures A1, A2, and A3 show the entry timing and pricing decisions of all manufacturers broken down by Tombo, Aberdeen and Goderich, respectively. As we discuss in the results on price competition below, the common presence and coordinated pricing of IIB in all three wharves contributed to competition spillovers from the entry of manufacturers in outside wharves. For example, IIB maintained the same prices across all three wharves, so prices dropped in Tombo in response to additional entry in Goderich and Aberdeen.

3 Theoretical framework

In this section, we develop a theoretical model that links competition in upstream manufacturer and retailer markets to the contractual terms faced by downstream buyers. Based on our empirical setting, manufacturers compete on quantities to determine aggregate supply, while retailers compete on credit provision to secure their share of the buyers in a market. Using a standard Cournot model, we show that more competition among manufacturers results in lower prices and higher aggregate quantity sold. An implication of the model is

[10]For logistical reasons, fishermen customers prefer crushed ice to Manufacturer 2's cubed ice product, and factory mechanical issues led them to exit Goderich in December 2013 and Aberdeen in February 2014.

that manufacturer competition also reduces late deliveries. We then focus on two categories of inter-temporal relationships: collusive interactions among multiple retailers seeking to restrict the level of competition for customers, and cooperative interactions between a retailer and a buyer to prioritize deliveries or sustain credit provision in the absence of external enforcement. We find that upstream manufacturer competition disrupts collusion among retailers, leading to increased credit provision by retailers. Once a retailer extends more credit to a customer, the relationship they forge may become more valuable.

We begin by examining the relevant decision problem facing economic actors at three levels of the supply chain: the manufacturer, the retailer and the downstream buyer. We model the decision problem of N manufacturers (each denoted by M_i), as a Cournot game in which the inverse demand, $P(Q)$, is a function of aggregate quantity, Q, and manufacturer M_i chooses a level of production, q_i taking into account a constant marginal cost, $m > 0$, and a commission paid to the retailer on each sale, $\alpha > 0$:

$$\max_{q_i} \pi_{M_i} = (P(Q) - m - \alpha)q_i \tag{1}$$

The α commission reflects the imposition of retail price maintenance by manufacturers, under which retailers do not have discretion in setting the retail price. This special case amounts to fixing the difference between the retail price faced by buyers and the wholesale price faced by retailers to equal α, which we treat as an exogenous parameter.[11]

We model the decision problem facing two symmetric retailers (each denoted by R_j) who have a revenue function $\mathbb{R}$ that take α as an input and a cost function $\mathbb{C}$ that takes as an input r, the marginal cost of providing credit to each buyer. Both $\mathbb{R}$ and $\mathbb{C}$ also depend on aggregate quantity, Q, the share of the each order that the first retailer provides on credit,

[11] In our empirical setting, retailers abide by the retail price and do not offer special discounts to their buyers. Interviews suggest two main reasons for this practice: first, both manufacturers and retailers report buyers will react negatively to price volatility by reducing future purchases of the good, and second, retailers express concern that price discounts offered to some buyers will have to be shared with all customers. Furthermore, most retailers are former fishermen, so α can be interpreted as tracking the reservation earnings under this option of outside employment.

$c_j \in [0,1]$, and the symmetric credit decision of the competing retailer, $c_{-j} \in [0,1]$.

$$\max_{c_j \in [0,1]} \pi_{R_j} = \mathbb{R}(\alpha, Q, c_j, c_{-j}) - \mathbb{C}(r, Q, c_j, c_{-j}) \tag{2}$$

Finally, we consider a continuum of downstream buyers (fishermen) with mass 1, which we model as firms facing a common production function, $Y(Q)$, who act as price takers for a market price of their output, p_F. For simplicity, output depends solely on the quantity of the intermediate good demanded, Q, which they purchase at price P.

$$\max_{Q} \pi_B = p_F Y(Q) - PQ \tag{3}$$

3.1 Manufacturer Competition

With manufacturers competing in a Cournot game, we assume a linear inverse demand function, $P(Q) = A - BQ$, for analytic convenience. Given the buyer's decision problem in (3), this is equivalent to assuming a quadratic functional form for the production function.[12] Using standard approaches, we derive the following expressions for price and quantity as a function of exogenous parameters A, B, m, α, and the number of manufacturers, N. Observe below that price is decreasing in N, while aggregate quantity is increasing in N.

$$P^\star = \frac{A - mN - \alpha N}{N+1} \qquad Q^\star = \frac{(A - m - \alpha)N}{B(N+1)} \tag{4}$$

Next, we discuss the implications of the model for the issue of late deliveries. As discussed in the above background section, under the monopolistic manufacturer idiosyncratic production problems (e.g. machine breakdowns) and demand shocks from outside markets often led to shortages in available production capacity, which in turn lead to shortfalls in the available supply for the buyers' market and subsequent late deliveries. We define the probability that

[12] This can be shown using $Y(Q) = aQ - bQ^2$, on the range $Q \in [0, \frac{a}{b}]$ where $a, b > 0$ are arbitrary scalar values. Substituting into Equation (3) and solving yields $P(Q) = A - BQ$, where $A = ap_F$ and $B = 2bp_F$.

an upstream shock to the manufacturer leads to late deliveries for buyers as $p \in [0, 1]$, and note that a further implication of new manufacturer entry is that p should fall, or $\frac{dp}{dN} < 0$.[13] The micro-foundations for this assumption rely on each new manufacturer increasing the total capacity in the industry, and also introducing a new idiosyncratic likelihood of production problems or outside demand shocks. More formally, we can write $p = \prod p_{M_i}$, so that the total probability of lateness is the product of the independent probabilities that each factory is capacity constrained. This directly implies that the available supply will be more likely to satisfy buyers' aggregate demand as the number of manufacturers increases.

3.2 Retailer Competition

We proceed by solving for retailer decisions on credit provision in the context of a repeated market share game. First considering the per-period game, our main assumption is that a share of buyers, $0 < \gamma < 1$, are completely credit constrained each period and can only purchase using the trade credit from the retailer, but that the retailer cannot differentiate the γ types from the $(1-\gamma)$ types who will accept any credit offered but purchase whether or not they receive credit.[14] We adopt a perfectly discriminating contest, assuming that buyers purchase from whichever retailer offers them a higher credit level, though while the $(1-\gamma)$ types enjoy their full demand, the γ types purchase only as much as they can afford based on the retailer's credit provision. Retailer profits are as follows:

$$\pi_{R_j}(c_j) = \left\{ \begin{array}{ll} \alpha(Q/2)[(1-\gamma)+\gamma c_j] - c_j r(Q/2) & \text{if } c_j = c_{-j} \\ \alpha Q[(1-\gamma)+\gamma c_j] - c_j r Q & \text{if } c_j > c_{-j} \\ 0 & \text{if } c_j < c_{-j} \end{array} \right\} \tag{5}$$

If both retailers offer the same amount of credit, they split the market evenly, each

[13] We assume that lateness is a temporary cost imposed on fishermen that does not affect long-term demand, and thus does not affect the market equilibrium.

[14] In our empirical setting, credit constraints vary greatly over time due to the stochastic nature of fishing production processes, making them difficult for retailers to independently verify. The parameter γ can thus also be interpreted as the probability that any given buyer is credit constrained in a given period.

receiving $\alpha(Q/2)$ times the share of the market served. The share of the market served depends on the choice of c_j, given that $(1-\gamma)$ are going to buy either way but the remaining γ will only buy up to the share of credit provided, $c_j \in [0,1]$. The total cost of credit provision is $c_j r(Q/2)$, as each retailer ends up only providing credit c_j at marginal cost r to their half of the market. Note that the total cost does not depend on γ as credit goes to all customers regardless of type. In the second case, when $c_j > c_{-j}$, retailer R_j claims the entire market, where the share of the market served depends on the choice of c_j as above. Observe that this also would be the case if a retailer were a monopolist in a given market and thus faced no competition for customers. Finally, when $c_j < c_{-j}$, retailer R_j loses the market to a competing retailer and receives nothing.

We restrict attention to $\alpha\gamma < r < \alpha$, which defines the range of values for which collusion among retailers is profitable and yet retailers would want to provide credit only to the γ share of credit constrained types if possible. To see this, first consider a retailer's decision if he could target only the γ credit-constrained types. In this scenario, the retailer earns α and pays r for each unit of credit provided, so his participation constraint is given by $r < \alpha$. Now if the retailer cannot identify the γ credit-constrained types (as is the case here), he will earn instead $\alpha\gamma$ while still paying r on each unit of credit provided, implying that collusion to restrict credit provision will be profitable if $\alpha\gamma < r$.

Next, we use the payoffs from the per-period game as parameters in an inter-temporal cooperation game played by the two retailers. We consider three cases, a "Retail Competition" case to the stage game where both retailers provide full credit, $c_j = c_{-j} = 1$, a "Retail Collusion" case where both retailers provide zero credit, $c_j = c_{-j} = 0$, and a "Defection" case where retailer R_j steals the entire market with $c_j = \epsilon$ while $c_{-j} = 0$. In the final case, we assume that retailer R_j faces a one-time fixed cost of deviating from the collusive equilibrium, denoted with κ, which can be interpreted as a mobilization cost of stealing customers.

Retailer R_j's profits are:

$$\begin{aligned}
\pi_{R_j}^{COMPETITION} &= (Q/2)(\alpha - r) \\
\pi_{R_j}^{COLLUSION} &= (Q/2)(\alpha(1-\gamma)) \\
\pi_{R_j}^{DEFECTION} &= Q\alpha(1-\gamma) - \kappa
\end{aligned} \tag{6}$$

Observe that as $\alpha\gamma < r$, profits are strictly higher in the collusion case than the competition case, but for arbitrarily small values of κ the defection case will provide the greatest payoff.[15] A standard repeated game approach provides the necessary condition below for the collusion outcome of zero credit provision by both retailers to be dynamically incentive compatible, where δ represents the common discount factor of both retailers.

$$\frac{\pi_{R_j}^{COLLUSION}}{1-\delta} \geq \pi_{R_j}^{DEFECTION} + \frac{\delta \pi_{R_j}^{COMPETITION}}{1-\delta} \tag{7}$$

Solving for δ yields a minimum patience level required to sustain collusion, $\Phi(Q)$.

$$\delta \geq \frac{Q\alpha(1-\gamma) - 2\kappa}{2Q\alpha(1-\gamma) - Q(\alpha - r) - 2\kappa} \equiv \Phi(Q) \tag{8}$$

When collusion is not possible because δ is below this threshold, retailers play the competition equilibrium offering full credit provision. The threshold is a function of aggregate quantity, Q, and other parameters that are exogenous. As it can be easily shown that $\Phi(Q)$ is increasing in Q, more patience is required to sustain collusion as the aggregate quantity grows, providing a direct link between manufacturer competition and retailer competition.

3.3 Buyer Relationships

Buyers and retailers form valuable relationships in the context of repeated purchases. Ongoing relationships help retailers dampen demand volatility through a steady flow of purchases,

[15] More formally, we require that $\kappa < \alpha(1-\gamma)/2$ for the one-time payoff of defection to be attractive.

providing a rationale to incentivize buyer loyalty. We consider two instruments available to retailers for promoting loyalty: delivery prioritization and credit provision.

The expected cost of late deliveries is $p\omega$, where p is the above probability of a supply shock and $\omega > 0$ is the buyer's cost of delay. Imagine a retailer has the option to fulfill some but not all of their orders on time after a supply shock, and must choose a rationing rule. Consider two candidate rules: a random prioritization rule in which each order has an equal probability of being delivered on time, and a loyalty-based rule in which buyers who bought from a given retailer in previous periods are more likely to receive their delivery on time with ties among loyal customers decided randomly. As retailers earn a fixed commission for each purchase, they choose a rule to maximize their number of buyers. Buyers choose the retailer offering the lowest likelihood of exposure to late deliveries. Once a buyer has bought from a given retailer in the past, it follows that a loyalty-based rule weakly dominates a random prioritization rule, and is strictly better whenever there are non-loyal buyers in the pool.[16]

Credit provision can also provide a potential rationale for buyer loyalty. Credit provision can be modeled as a trust game in which retailers provide buyers with the ability to pay in the future at some risk of default. In a weak institutionalized environment, such cooperation fundamentally relies on the logic of repeated interactions, in which future interactions can be conditioned on past behavior - namely, the prospect of a breakdown in trade deters the risk of default. As discussed above, buyers face a probability γ of being credit constrained in each period, and are thus likely to choose a retailer on the basis of who announces the most generous credit policy. Recall that a credit constrained γ-type faces a constrained production choice, $Y(cQ) - PcQ$. If two retailers, R_j and R_{-j}, make competing generalized credit offers c_j and c_{-j}, then we know from above that buyers will choose whichever retailer offers more credit. But if retailers attempt to differentiate by offering higher credit levels to

[16]More formally, consider a sequence of events in which each retailer announces a rationing rule, each buyer chooses a retailer to place orders, a supply shock is realized, and then retailers fill orders according to their rules. Further, assume the number of buyers is distributed equally across retailers. If all buyers are loyal, then a buyer will have a equal probability of being prioritized by returning to a retailer who rewards loyalty relative to a retailer who uses a random allocation rule. If some buyers are not loyal to that retailer, they will not be prioritized, raising the effective probability of prioritization among the retailer's loyal buyers.

their customers who have paid them back in the past, this provides a potential new friction to increase buyer loyalty.

Taking these considerations into account, a reduced form approach that represents the combined value of these two instruments to promote loyalty is an endogenous switching cost, η, paid by the buyer whenever changing retailers between successive periods. For convenience, we assume that a retailer will prioritize loyal customers following a supply shock with probability 1, so that switching to a new retailer implies an expected delivery cost of $p\omega$. The switching cost of credit provision is given by probability of credit constraints, γ, times the difference in profit outcomes under two competing credit offers, $[(p_F Y(c_j Q) - Pc_j Q) - (p_F Y(c_{-j} Q) - Pc_{-j} Q)]$, where R_j is the incumbent retailer and R_{-j} is the new retailer. Note that depending on the relative values of c_j and c_{-j}, this second term could be positive or negative, implying in turn that the entire expression for η could also be positive or negative, reflecting the potential benefits or costs to switching retailers.

$$\eta = \underbrace{p\omega}_{\text{Lateness}} + \underbrace{\gamma[(p_F Y(c_j Q) - Pc_j Q) - (p_F Y(c_{-j} Q) - Pc_{-j} Q)]}_{\text{Credit}} \tag{9}$$

The above formulation of switching costs allows some brief observations in the context of the discussion in the previous two sections of late deliveries and credit provision. First, whenever $\eta > 0$, we should not observe switching of buyers across retailers. Under the monopolistic manufacturer, p is high, implying that late deliveries are common, and retailers collude to restrict credit provision, with $c_j = c_{-j} = 0$. Hence, η will be positive and switching will be uncommon. But as new manufacturers enter, p will fall, with late deliveries becoming less common, and retailers will find it more difficult to collude on restricting credit provision given the growing market size. During the transition from the no-credit equilibrium to the high-credit equilibrium, buyer switching should occur whenever η is negative, implying that the new retailer's credit offer exceeds the incumbents offer. But once the high-credit equilibrium is reached, buyer switching should decrease as retailers' credit offers equilibrate.

3.4 Predictions

Combining the above discussions of manufacturer competition, retailer competition and buyer relationships, we can now develop a set of predictions to guide our empirical analysis of the transition from monopoly to competition in the upstream manufacturing industry.

Proposition 1. *Increased competition among manufacturers will result in lower prices, higher aggregate quantities and fewer late deliveries.*

Proof. From the equilibrium conditions in Equation (4) above, we can directly show that $\frac{dP}{dN} < 0$ and $\frac{dQ}{dN} > 0$. In addition, the condition $\frac{dp}{dN} < 0$ directly states that the frequency of late deliveries will fall as the number of manufacturers increases. □

Proposition 2. *As manufacturer competition increases the aggregate quantity to be sold, competing retailers will increase credit provision while monopolistic retailers will not.*

Proof. Recall that where retailers are monopolists, they do not face a competitive pressure to increase credit provision. But where multiple retailers serve a market, they can lose buyers to alternative retailers offering higher levels of credit. As the number of manufacturers, N, increases, we note from above that aggregate quantity, Q, will also increase. But retailer collusion to restrict credit provision becomes more difficult as aggregate quantity increases, $\frac{d\Phi(Q)}{dQ} > 0$. Integrating the manufacturing and retailer stages, we note that aggregate quantity, Q, increases in the number of manufacturers, N, implying that the patience threshold to sustain retailer collusion, $\Phi(Q)$, also increases in the number of manufacturers. Thus, a sufficiently large increase in manufacturer entry will lead to an increase in credit provision as retailers transition from the collusion equilibrium to the competition equilibrium. □

Implication 1. *Increased competition among manufacturers will reduce the incentives for loyalty, temporarily leading to more switching by buyers across retailers.*

As discussed above, incentives for loyalty are reorganized following the onset of manufacturer entry, as the probability of lateness, p, is falling in the arrival of each new manufacturer

that adds additional capacity. During the period of equilibrium transition from retail collusion to retail competition, retailers may be offering different levels of credit provision to buyers. As retailers settle into the high-credit equilibrium, buyer switching should decrease as the difference between credit offers decreases and retailers begin to condition credit levels on buyer loyalty. By increasing credit provision levels, retailers provide a short-term benefit to credit-constrained buyers and a new rationale to motivate future business interactions.

4 Data and Descriptive Statistics

From January 2013 until June 2014, we organized a large-scale original data collection exercise with actors at all levels of the supply chain: upstream ice manufacturers, mid-level ice retailers, and downstream fishermen buyers. With manufacturers, we observe data on price schedules and quantities produced and sold. Within the incumbent manufacturer, we observe daily aggregate totals of ice produced and daily aggregate sales data, broken down by retailer or other customer. We recently received similar data from each of the four competitor manufacturers, and it will appear in a future draft of this paper. In addition, we conduct interviews with the leadership of each ice factory on strategic decisions related to competition and policies on production, delivery, credit, and other industry context.

We also observe transaction level data from the original five independent retailers serving the incumbent manufacturer on their informal contracts with fishermen customers, including the buyer identity, contractual terms (price, quantity demanded, credit), and contractual outcomes (quantity delivered and timeliness).[17] We do observe sales by these retailers that are sourced from competitor manufacturers. Since the incumbent manufacturer data includes daily aggregates for each retailer, we independently verify that the individual orders and deliveries they report are closely correlated to the aggregate supply and payments noted by the factory managers. In addition, we conduct interviews with each of the original five

[17] Similar high-quality transaction data is not available for the other retailers who enter following manufacturer entry, but we document that their aggregate sales are limited and thus unlikely to bias our estimates.

retailers on their strategic decisions, and collect rankings of their customers across multiple dimensions including buyer loyalty.

Finally, we use the original retailer records to create a sample of all current fishermen customers of the incumbent manufacturer, and conducted a face-to-face baseline survey in April 2013. The baseline survey includes information about respondent demographics, fishing practices, experience with the ice retailers, assets, expenditures, and social network ties. We were able to locate and survey all current regular customers at the time of the baseline survey, and continued to add new fishermen customers to our survey data collection as they entered the sample. Starting in May 2013 and continuing until July 2014, fishermen received brief follow-up biweekly phone surveys that addressed their fishing trips over the past two weeks, including the use of ice, the selection of retailers, and fishing trip outcomes. An endline survey in July 2014 collected updated assets and expenditure information, as well as recall data for fishing practices and outcomes over the previous two and a half years.

Table 1 summarizes the demographic variables associated with our sample of respondents. With an average age of 40 years, and over 15 years of years of fishing experience, about sixty percent of the fishermen respondents owned their own fishing boat and over eighty percent served as boat captain for regular trips.[18] Fishermen reported that a typical month during the dry season involved almost 10 trips, and that they had known their ice agent retailer for an average of nine years. In the high frequency data, we observe that the average planned trip length is almost 3 days, with one-quarter of trips not involving ice. The average ice purchase was 460 kilograms (∼$75 using the ice prices at the start of the data), though this rises to 615 kilogram (∼$85) conditional on making an ice purchase. Average trip gross margins, defined as total trip revenues minus total trip expenses (including labor costs), were approximately $110, with a large standard deviation of about $150.[19]

[18] As our sample was defined as customers of the ice retailer and not by the owners or captains of boats, these are not mutually exclusive groups. This sample of 150 fishermen customers includes 26 owners who are not captains, 59 captains who are not owners, with the remainder fitting into both categories.

[19] About 14% of trips had negative profits, reflecting the risky production process in fishing.

5 Results

In the results that follow, we consider the effects of upstream manufacturer entry on multiple features of downstream contracts: prices, lateness and credit provision. In each of these categories, we demonstrate that a shock that increases upstream competition among manufacturers improves the contractual terms offered by retailers to buyers. We exploit the panel nature of our data and the plausibly exogenous timing of manufacturer entry to perform empirical event study analyses to quantify the magnitude of changes in downstream contracts. Before doing so, we document that under the monopolistic manufacturer late deliveries are common, yet relationships between retailers and buyers are stable. When manufacturers compete, prices fall and services improve with fewer late deliveries. Competition by manufacturers triggers competition among retailers, leading to increased buyer switching across retailers followed by increases in trade credit. Consistent with our theoretical model, these increases in trade credit provision only take place where multiple existing retailers serve a wharf, as is the case in Goderich. When retailers are monopolists in a wharf, as is the case in Aberdeen and Tombo, we observe no corresponding increase in trade credit.

5.1 Lateness and Delivery Relationships Under Monopoly

First, we document that late deliveries are common under the monopolistic ice manufacturer, and buyers remain loyal to retailers despite systematic poor performance. From January to June 2013, prior to the start of the rainy season, approximately 26% of fishermen orders were delivered late, often entailing a half-day delay to the planned departure of the fishing trip. Fishermen indicated in focus group discussions that the unpredictability of late deliveries made it difficult to plan for future trips, and imposed real costs on their fishing production. In Figure 4 we observe the daily ice production totals in kilograms for IIB, the incumbent manufacturer, and the aggregate share of orders arriving late to all fishing wharves. It is striking to note the daily variation in the likelihood of late deliveries during Jan-June 2013.

In exploring the sources of lateness, we differentiate between internal factors under the manufacturer's control (e.g. issues with machines, vehicles or workers) and external factors such as outside demand shocks for ice sales to non-fishermen sources. In interviews, fishermen were most likely to report issues with machines, vehicles or workers as the proximate cause of late deliveries, but retailers were aware that an important component of late deliveries was the level of demand from outside markets. Figure 5 shows the separate time series for IIB's sales to fishermen and non-fishermen customers, where fishermen sales include retailer aggregate orders and a small number of direct sales to fishermen at the factory location. We observe that the two are positively correlated due to seasonal patterns - for example, during the rainy season from July to September, demand drops for both sources - and that both contain a high level of daily variation.

To demonstrate how outside demand shocks affect late deliveries to the fishermen, we aggregate our administrative data on factory production and retailer deliveries by wharf, w, and day, d. We then estimate the following regression, which includes time-varying weather controls, X_d, and wharf fixed effects, η_w interacted with year by month fixed effects, τ_m.[20]

$$\text{Lateness}_{wd} = \theta_1 \text{Log(Non-Fishing Sales)}_d + \eta_w * \tau_m + X_d' \beta + \epsilon_{wd} \tag{10}$$

In the above equation, Lateness_{wd} measures the fraction of fishermen orders which are delivered late to a fishing wharf, and $\text{Log(Non-Fishing Sales)}_d$ measures the log of daily factory sales (in kilograms) to non-fishing sources of demand.[21] The results from this specification, shown in column (1) of Table 2, show a strong positive correlation, which can be interpreted as an 1% increase in outside demand is associated with a 5.2 percentage point increase in the share of orders delivered late during the production period prior to new manufacturer entry. The magnitude of this relationship increases to 10.8 percentage points in column

[20] Time-varying weather controls include average daily temperature, rainfall and windspeed on the day of ice order, which are factors that fishermen report are important in their trip planning process.

[21] While we do not have a direct measure of non-fishing demand, interviews with factory management confirm that sales to non-fishing sources are a reasonable proxy for non-fishing demand given a willingness to prioritize non-fishing orders.

(2) when restricting attention to the Jan-June 2013 period prior to the 2013 rainy season. In interviews with IIB factory leadership, the underlying mechanism here appears to be a practice of prioritizing the allocation of production to time-sensitive outside demand with higher profit margins over the repeated high-volume but lower margin fishermen demand.

In Figure 6, which focuses on the Goderich Wharf served by multiple retailers, we observe that buyers rarely switch between retailers during the period of common late deliveries prior to new manufacturer entry. In interviews, fishermen were reluctant to criticize their retailer for poor performance, often directing responsibility on the manufacturer for late deliveries. While sensible in the context of monopolistic retailers in Tombo and Aberdeen, this response appears puzzling in the context of Goderich where buyers might attempt to induce additional retailer effort ensuring timely deliveries from the manufacturer through the threat of switching to an alternative retailer with less lateness.

One factor in explaining this outcome is the importance of delivery relationships in which retailers prioritized their most loyal customers, namely those who would not purchase from an alternative retailer, on days in which late deliveries were likely. In Table 3, we document this strategic prioritization in order to reward loyal buyers and strengthen relationships. We restrict attention to Goderich Wharf in the period between January and October 2013 prior to new manufacture entry, and only consider days on which some orders are delivered late but others are delivered on time. We find that a retailer's designation of a fisherman as a "Loyal Customer" is positively correlated with having their order prioritized to arrive on-time.[22] The magnitude of the prioritization is approximately equivalent to moving up three places in the prioritization queue (i.e. the sequence in which the retailer received orders) in column (2) without controlling for retailer identity or time period, or 2.2 places in the queue in column (6) when including fixed effects for retailer and week.

[22] Approximately 74% of fishermen customers were designated as loyal by the three retailers in Goderich wharf in a survey completed in September 2013 prior to new manufacturer entry into Goderich wharf.

5.1.1 Changes in Market Structure

Figure 3 shows the pre- and post-competition market structure of each of the three fishing wharves. The onset of upstream competition resulted in limited successful entry into the retailer market, and existing retailers were able to maintain a dominant market position. Turning to the figure, Tombo and Aberdeen, shown in panels (A) and (B), respectively, each start out with a monopolistic manufacturer and a monopolistic retailer, while Goderich in panel (C) has three retailers. This pre-existing cross-sectional difference in retailer concentration is due to market size and the proximity to the factory location. Tombo, which has more fishermen than Goderich but is further away, only receives one retailer, as does Aberdeen, which is closer to the incumbent manufacturer's factory location but smaller than Goderich. The existence of pre-existing differences in retailer concentration in this setting prior to manufacturer entry is ideal for testing the predictions about retailer competition developed in the theoretical section above. Recall that varying retailer concentrations implies differential predictions on the provision of trade credit after new manufacturer entry, where we expect credit provision to rise in Goderich due to increased retailer competition, but not in Aberdeen or Tombo.

As of July 2014, we observe in Tombo that both the incumbent Manufacturer 1 and the competitor Manufacturer 2 are selling through the same original retailer. Citing concerns about pricing power from the new upstream manufacturers that had located nearby to Tombo, Retailer 1 in Tombo negotiated to continue to receive next day deliveries from the original monopolistic supplier while taking same-day orders from the new upstream supplier. In Aberdeen, despite the entry of two new retailers, only the original retailer from the pre-competition period is actively making sales in July 2014. Retailer 2 in Aberdeen accepted an offer from Manufacturer 4 to receive a higher commission on each sale in exchange for a debt contract. This resulted in a de facto exclusive territory for Manufacturer 4 in Aberdeen, though Retailer 2 reserved the option to order from Manufacturer 1 whenever

Manufacturer 4 faces difficulty meeting demand.[23] And in Goderich we observe that the two largest original retailers, 3 and 4, continue to sell for the incumbent Manufacturer 1 while also directing orders to the competitor Manufacturer 4.[24] The last entrant to the upstream market, Manufacturer 5, conducts sales through its own exclusive agent, Retailer 8.

It is noteworthy that the total number of retailers does not change in each market when comparing June 2013 to June 2014, which is useful for ruling out specific effects due to changes in retailer concentration. In general, we observe that despite the entry of several new manufacturers, there is limited successful entry by new retailer intermediaries. In interviews, manufacturers, retailers and fishermen highlighted the role that existing relationships played as a barrier to new retailer entry. New manufacturers were reluctant to introduce new retailers where incumbent retailers had existing relationships with their buyers and were willing to sell for more than one factory. Incumbent retailers were then better positioned to offer reliable access to ice across multiple factory sources, and could use existing relationships as a basis to compete for buyers through improved credit provision. And fishermen expressed reluctance to engage new retailers who might later exit the market and could not provide competitive credit terms.

5.2 Effects of Manufacturer Entry on Prices and Lateness

In the first main result of the paper, we find that increased competition among ice manufacturers leads to improved market outcomes for fishermen buyers in terms of price and timeliness. We exploit the timing of manufacturer entry, which we attribute to changes in the capital stocks and financing terms available to procuring costly ice production machinery, and not to any underlying changes in the fishing wharves served by the incumbent manufacturer. Consistent with our model of imperfect competition, we document lower prices and

[23] Manufacturer 3 and the associated Retailer 6 left the market after several months of unsuccessful efforts to attract customers, and efforts by Manufacturer 1 to introduce a new retailer, 7, to the market were also largely unsuccessful. Retailers 6 and 7 reported that it was hard to convince fishermen to leave Retailer 2.

[24] Manufacturer 3 only briefly served this market, making sales directly to fishermen customers in a spot market, before exiting. Retailer 5, who served the market prior to the onset of upstream competition, took an extended hiatus from the wharf, directing his small number of customers to source from other retailers.

fewer late deliveries following the arrival of new manufacturers in each of the fishermen markets. Future paper drafts will include results on the change in aggregate quantity, pending digitization of competitor manufacturers' data.

Table 4 documents the effect of manufacturer entry on changes in average prices faced by fishermen purchasing from the original five retailers who served the incumbent manufacturer. We include data on all fishermen purchases recorded by these retailers, including orders sourced from competitor manufacturers, though our results are robust to only selecting IIB orders. We aggregate this transaction data by wharf, w, and week, t, and calculate the log of the mean price paid for ice in each market in each week as our dependent variable. We then estimate the following regression, which includes wharf fixed effects, η_w, where the key explanatory variable is the number of manufactures operating in a given wharf.

$$\text{Log(Average Price)}_{wt} = \theta_1 \text{Number Manufacturers}_{wt} + \eta_w + \epsilon_{wt} \tag{11}$$

In columns (1) and (2) of Table 4, we show that each additional manufacturer is associated with a 5-6% fall in price, depending on the time period used. The common presence and coordinated pricing of IIB in all three wharves contributed to "competition spillovers" from the entry of manufacturers in outside wharves. In columns (3) and (4), we include control for the number of unique manufacturers selling in outside wharves, demonstrating that approximately half of the decrease in price can be attributed to competition spillovers from entry into other wharves.[25] Finally, in columns (5) - (8) we test for differential effects in Aberdeen and Goderich wharves, which unlike Tombo are located in the western coast of Freetown closer to the bulk of manufacturers. When including a control for the number of outside manufacturers, we do find evidence that price competition effects were more intense in this area, with each contributing 2-3% lower prices per new manufacturer. However, the difference between the estimated coefficients for the interaction terms with

[25] As Appendix Figures A1, A2, and A3 demonstrate, this is particularly helpful for understanding the falling prices in Tombo and Goderich during periods in which local price competition was limited.

Aberdeen and Goderich wharves is not significant, which suggests that the larger market size and larger number of retailers in Goderich did not lead to differentially greater price competition. In Table A1, we find qualitatively similar results when restricting attention to each wharf individually.

With respect to the effect of manufacturer entry on late deliveries, we note that late deliveries recorded by the five original retailers in January-June 2014 fell to only 1% of all orders. In columns (3) and (4) of Table 2, we confirm the magnitude of this drop as almost 25 percentage points. We do not observe empirical evidence of differential effects by each additional manufacturer in a market. Consistent with this, in interviews the retailers report using their relationships with competing manufacturers to smooth shocks to supply and demand, often checking the capacity of each manufacturer to supply orders on a given day and threatening to redirect orders to a competitor if deliveries arrived late. Returning to Figure 4, it is striking to note the visual decrease in the propensity for late deliveries after manufacturer entry into Goderich and Aberdeen. While there is a major decrease in lateness during the rainy season from July-September when overall production decreases at the factory, lateness returns again as orders pick up after the rainy season. Late orders then drop dramatically following manufacturer entry and competition, and do not return to their previous levels when comparing January 2014 - July 2014 to the prior year.

5.3 Manufacturer Entry and Retailer Competition

In the third main result of the paper, we show that ice manufacturer entry also triggers increased competition by ice retailers, leading to sharp increases in the provision of trade credit and more switching by fishermen buyers across retailers. We exploit temporal variation in the number of ice manufacturers and cross-sectional variation in the number of ice retailers in each fishing wharf to demonstrate that trade credit only increases where both manufacturers and retailers compete in Goderich. The separate comparison of credit provision by retailers in Goderich to both Aberdeen and Tombo allows us to rule out alternative explanations

such as a general increase in the availability of credit due to new manufacturers, which is also discounted in interviews with retailers. Instead, retailers emphasize the breakdown of a collusive agreement in which both promised not to steal customers, as deviation became more tempting when the size of the market expanded and ice became readily available following new manufacturer entry. Furthermore, with priority delivery relationships no longer present as an incentive for customer loyalty, retailers expand credit provision in the hopes of providing a new friction to reduce the incidence of buyer switching.

Figure 6 documents the onset of buyer-retailer switching in Goderich following the entry of Manufacturer 3 in late-October 2013. There exist only a handful of switches documented prior to new manufacturer entry in Goderich involving approximately five fishermen without expressed retailer loyalties, but more than 200 switches involving about 80% of the 86 fishermen customers in Goderich afterwards. The cumulative probability of switches rises sharply after manufacturer entry, and only begins to level off as the end of data collection approaches in June 2014. The corresponding density of switches shows large spikes of switching in early 2014 and a gradual decline toward the end of data collection in mid-2014.[26]

Figure 7 shows the total credit line extended each week by all five original retailers serving the original monopolistic supplier to their fishermen customers.[27] Note that the Retailers 3, 4, and 5 in Goderich (shown with dotted lines) provide comparable aggregate levels of trade credit to Retailer 2 in Aberdeen, while Retailer 1 in Tombo provides the consistently lowest level of credit. Following manufacturer entry in Goderich, we observe a dramatic increase in credit provision by Retailers 3 and 4, corresponding roughly to the time in which buyer switching began to decline. This is consistent with self-reported retailer strategies to use increased credit as an incentive for buyer loyalty.

In Table 5, we estimate the effect of manufacturer competition on credit provision in each

[26]In Appendix Table A2, we document the average likelihood of switching retailers in Goderich is approximately 10% per week following manufacturer entry. However, this estimate is only a lower bound given that we do not have data on the identities of fishermen customers purchasing from other retailers who entered Goderich after the onset of manufacturer competition.

[27]We convert credit figures to US dollars with the average exchange rate of 4200 Leones during this period.

of the three wharves. The main prediction of our theoretical model is that retailer credit should only expand in Goderich, where more than one retailer competes for customers, and not in Tombo and Aberdeen, where retailers serve as monopolists. As above in the results on price competition, our data includes all orders from fishermen purchasing from the original five retailers, including purchases recorded by these retailers from competitor manufacturers. Again as above, our results are robust to restricting attention only to orders sourced from IIB, providing additional confidence that the results are not driven by increasing availability of credit due to new manufacturer entry. After collapsing our data to the fisherman-week level, we estimate the following regression equation, where an observation is the aggregate orders by a fisherman f in wharf w in week t.

$$\begin{aligned}\text{Credit } (\%)_{fwt} = \theta_1 \text{Manufacturers } (>1)_{wt} * \text{Goderich } (=1)_w + \\ \theta_2 \text{Manufacturers } (>1)_{wt} * \text{Aberdeen } (=1)_w + \\ \theta_3 \text{Manufacturers } (>1)_{wt} + \phi_f + \tau_m + \epsilon_{fwt}\end{aligned} \tag{12}$$

We include fishermen fixed effects, ϕ_f and year by month fixed effects, τ_m to control for the effects of time-invariant customer characteristics as well as arbitrary time trends. As the theoretical model is premised on a breakdown of collusive relationships following manufacturer competition, we include a dummy variable Manufacturers $(>1)_{wt}$ that equals 1 whenever more than one manufacturer is present in a market rather than the number of manufacturers.[28] In columns (1) and (2) of Table 5, we observe a positive but statistically insignificant effect of manufacturer competition on credit provision. In columns (3) and (4), we observe that Aberdeen and Goderich are associated with between 12-14 percentage points greater trade credit provision than Tombo. And in columns (5) and (6) we test Specification 12 from above, finding a large, positive and significant increase in credit provision in Goderich following manufacturer competition, but no corresponding significant change in

[28] We observe similar results when using a dummy variable for the onset of manufacturer competition in a wharf, suggesting our results are unaffected by the subsequent exit of manufacturers in Aberdeen wharf.

either Aberdeen or Tombo. The magnitude of this effect is 19 percentage points when using the entire time period of data, or 29 percentage points when restricting to the year on year comparison between January-June 2013 and January-June 2014. In Appendix Tables A3 and A4, we replicate this finding using both number of orders and amount of credit provided as the dependent variable; the credit increase is equivalent in magnitude to about one-third of an average order or about 18 dollars per fisherman-week.

We find no evidence to support potential concerns that manufacturer entry or other unobserved factors may be directly affecting retailers credit provision decision outside the competition for buyer relationships, for example through expanded credit lines. First, we note in the data that almost no orders from the original five retailers for manufacturers other than IIB are provided on credit. In interviews with retailers and manufacturers, we establish that each new manufacturer established its own policy on credit lines to retailers, but that all were more restrictive than IIB and that retailers generally did not find them attractive. Second, we confirm that our results in Table 5 are not affected when restricting attention only to IIB orders. And third, we find no evidence in our interviews of changing availability of alternate, non-manufacturer sources of credit available to retailers in Goderich, adding further confidence to the comparisons provided by Aberdeen and Tombo.

Finally, we acknowledge that there may be concerns about our approach to inference if there is a high degree of intra-cluster correlation in outcomes within each wharf. Given our small number of wharves, we implement the wild cluster bootstrap inference correction recommended by Cameron et al. (2008), Cameron and Miller (2013) and Webb (2013) to cluster at the wharf level. Specifically, we first impose the null hypothesis when estimating the model in columns (5) and (6) of Table 5, then randomly select from Webb's six-point distribution of weights to generate new pseudo residuals over 999 iterations, and finally calculate a counter-factual distribution of Wald statistics under the null hypothesis.[29] By comparing the original sample Wald statistics to this distribution, we are able to obtain a p-

[29]Following the alternative enumeration approach in Webb (2013) provides nearly identical results.

value (but not a standard error) for testing the significance of our main result under the more strict requirement of clustering at the fishing wharf level. As we show in Figures 8 and 9, the wild cluster bootstrap p-values corresponding to coefficient of interest in columns (5) and (6) of Table 5 are .144 and .188, respectively. While these figures are short of conventional levels of statistical significance, we note that the wild cluster bootstrap is a very conservative correction and that the p-values are in a range that suggests our results are unlikely to be due to random chance.

6 Conclusion

Ongoing relationships allow suppliers and buyers to overcome transactional hazards. While previous literature has focused on how relationships affect contractual and market outcomes, our analysis highlights the effect of upstream market structure on the value of downstream relationships. In our setting of ice sales in Sierra Leone, we find that that a shock that increases entry by upstream manufacturers leads not only to lower prices and fewer late deliveries, but also to increased competition by downstream retailers to secure buyers' loyalty. The onset of manufacturing competition expands the downstream market size, disrupting a collusive arrangement used by retailers to limit business stealing. During the equilibrium transition, buyers switch retailers multiple times in search of better credit provision terms, and an informal institution that rewarded loyalty with fewer late deliveries is replaced with an expansion in trade credit relationships. Thus, we observe a transition in the distribution of trade surplus that rewards the "long side of the market" (MacLeod and Malcomson, 1989), as benefits from trade move from the monopolistic manufacturer to the downstream retailers and buyers after the onset of competition. In particular, we observe that while average prices and lateness decrease everywhere following new manufacturer entry, credit provision only increases in the one wharf, Goderich, where multiple existing retailers also compete.

Our findings have broad relevance to those interested in promoting growth and enhanc-

ing social welfare in emerging economies. In this work, we demonstrate that the costs of upstream market power exceed the well-known effects on price and quantity to include frictions on the formation of downstream relationships and the provision of services such as trade credit. We demonstrate sizable improvements in contractual terms following competition, suggesting large externalities from market power that may serve to constrain firm growth. We also find that market power matters at each level of the supply chain, with retailer competition appearing just as important as manufacturer competition in explaining credit provision increases. Given the high concentration of market power in upstream industries in low-income countries, our results suggest that policymakers should pay close attention to promoting entry and competition. And for the firm strategy audience, we provide direct evidence of the institutional sources that make relationships important in thin markets. Our findings indicate that managers in emerging economies where contract enforcement is limited must account for the value of downstream relationships in forming their business strategies, particularly where future competition for relationships is likely.

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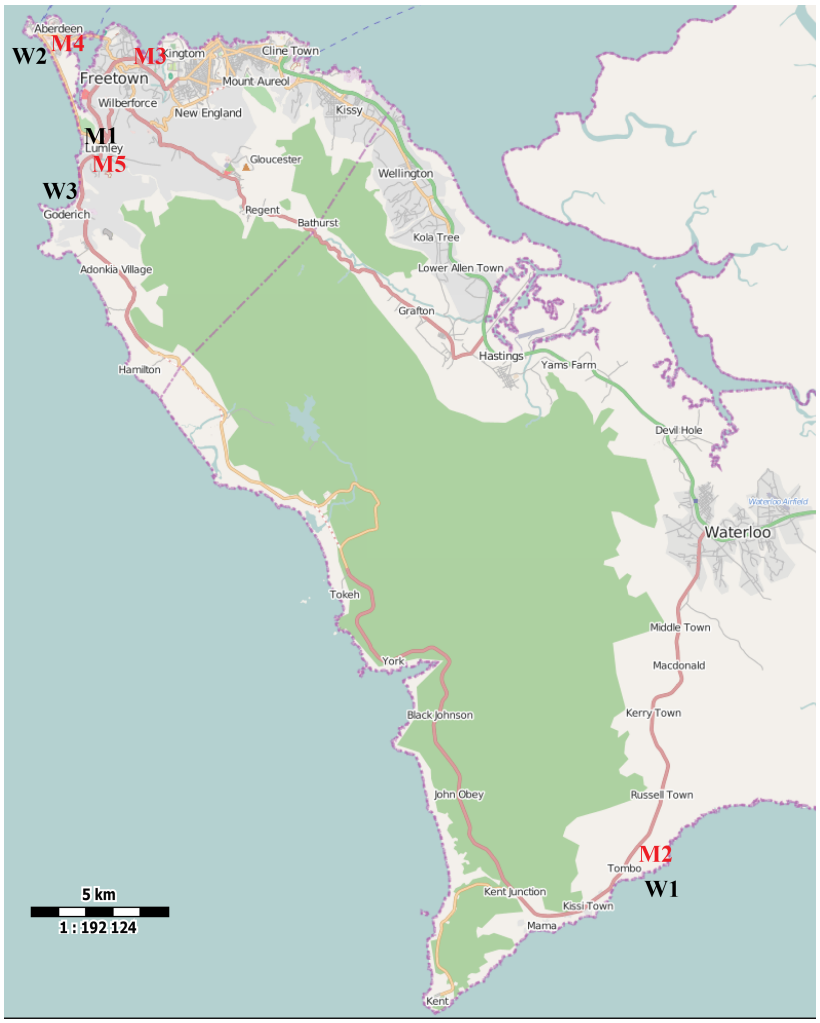
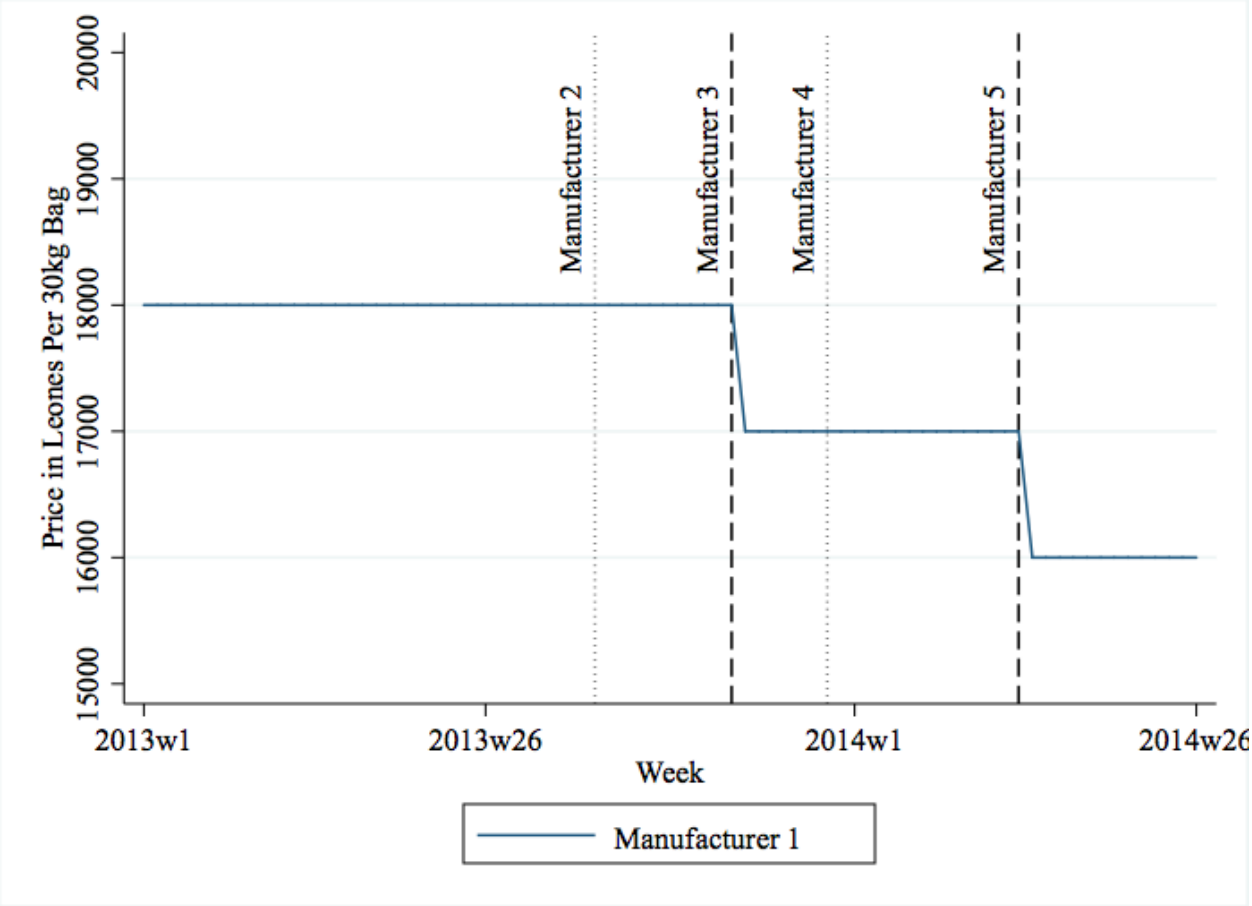
Figures and Tables

Figure 1: Map of Freetown Peninsula, Sierra Leone



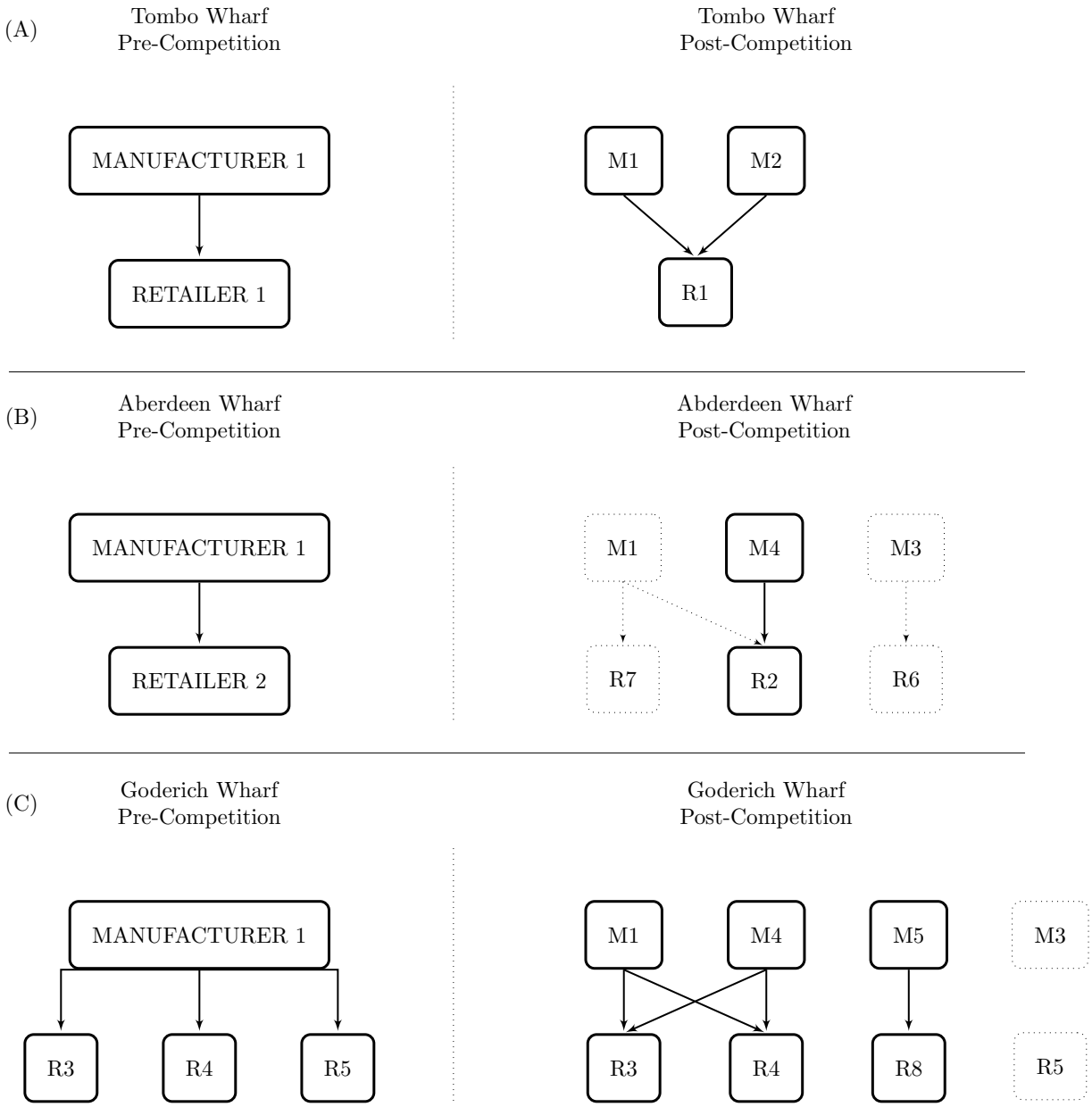
Notes: Map shows the approximate location of three major fishing wharves served by the ice factories: Tombo (W1), Aberdeen (W2) and Goderich (W3). It also shows the factory locations of the incumbent manufacturer (M1), and the subsequent competitor manufacturers (M2, M3, M4, M5), which are numbered in the order of entry and highlighted in red text. See paper text for more details.

Figure 2: Entry and Price Competition, All Wharves



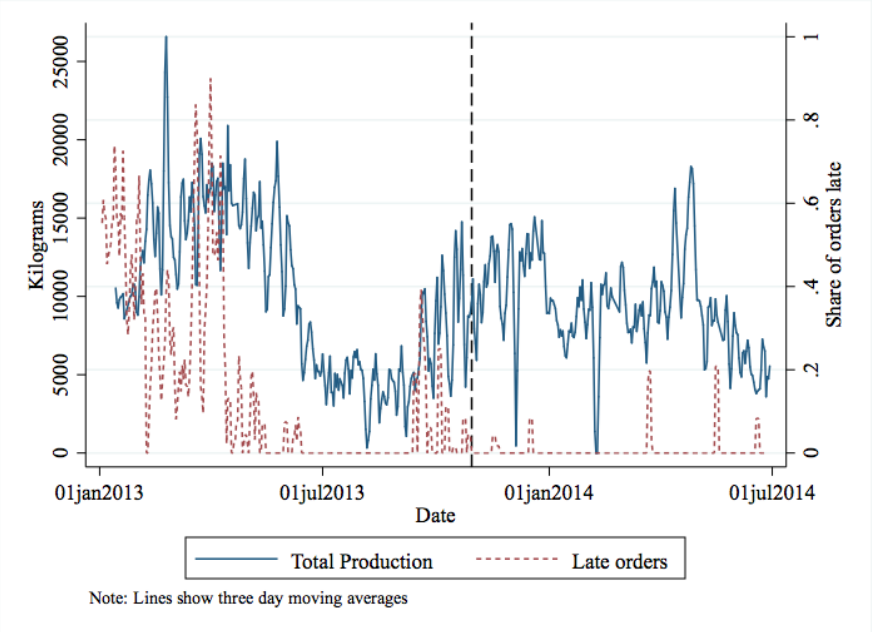
Notes: Y-axis shows the incumbent manufacturer's retail price per 30 kilogram bag of ice sold to fishermen in all three wharves (Tombo, Aberdeen and Goderich). Vertical lines mark the first date of ice sales by a competitor manufacturer in one or more wharves. The dark vertical lines corresponding to price competition are associated with the simultaneous entry of Manufacturer 3 into Goderich and Aberdeen wharves, and the later entry of Manufacturer 5 into the Goderich wharf. The light vertical lines are associated with non-price competition entry by Manufacturer 2 into the Tombo wharf and Manufacturer 4 into Aberdeen wharf. See paper text for more details.

Figure 3: Market Structure Pre- and Post-Competition, All Wharves



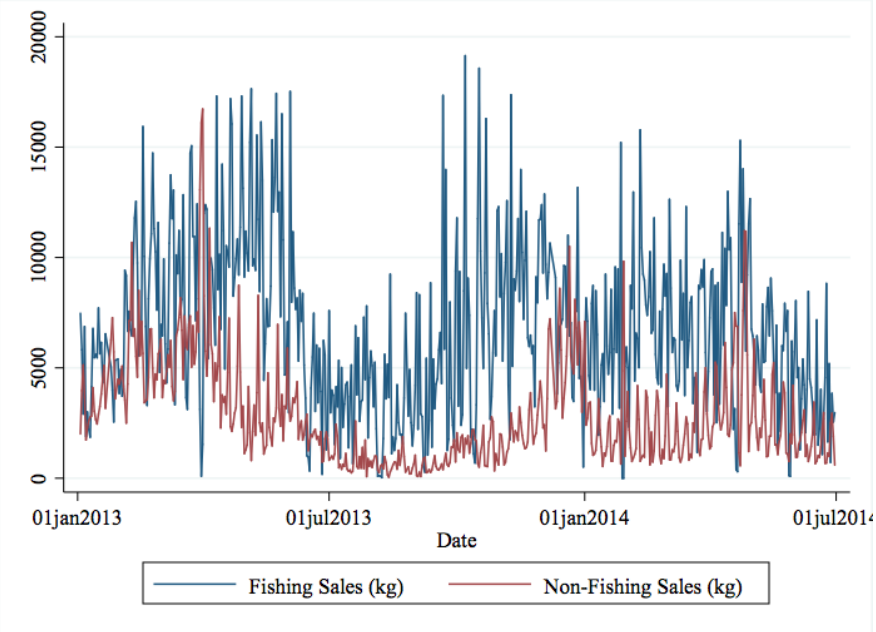
Notes: This figure presents the market structure of manufacturers and retailers in each of the three wharves prior to the onset of new manufacturer entry and then again in July 2014. Both before and after manufacturer entry, Tombo and Aberdeen wharves have monopolist retailers, while Goderich has multiple competing retailers. Dotted boxes signify manufacturer or retailer exit from market as of July 2014.

Figure 4: IIB Production Levels and Lateness



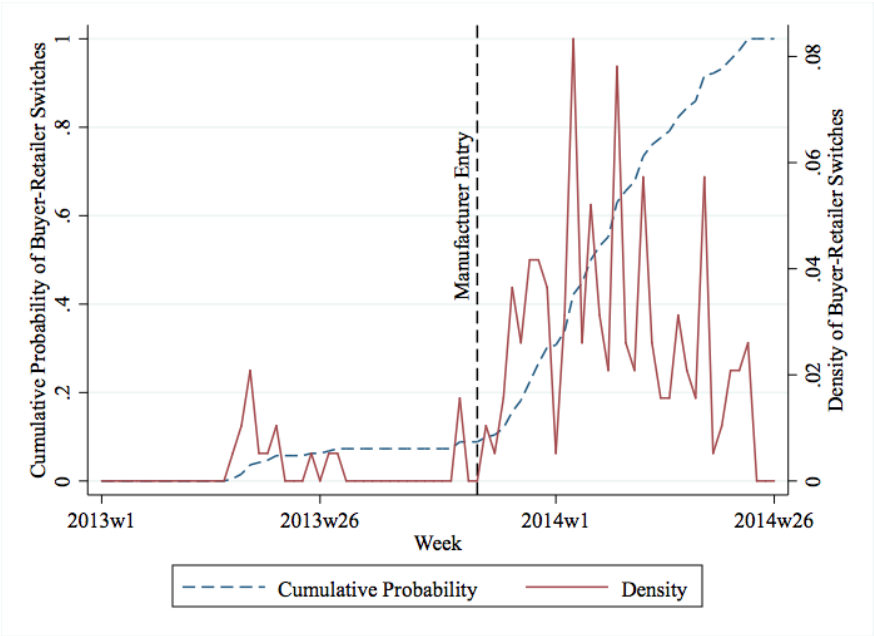
Notes: This figure presents the aggregate production levels and share of orders delivered late to fishermen by the incumbent manufacturer, IIB. The vertical dashed line marks the first date of ice sales by Manufacturer 3 in Goderich and Aberdeen wharves, corresponding to the start of price competition. See paper text for more details.

Figure 5: IIB Sources of Ice Demand (kg)



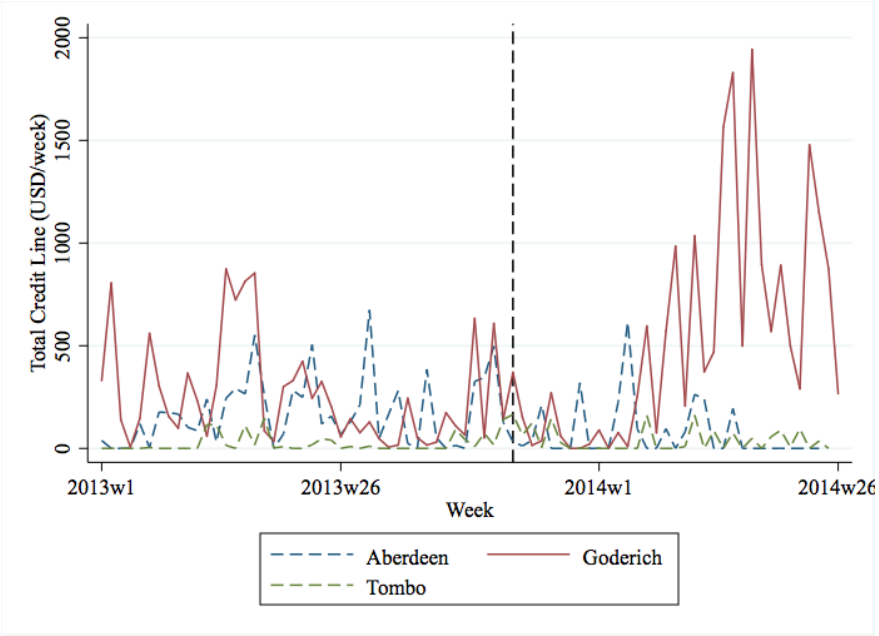
Notes: This figure presents the aggregate ice sales in kilograms by the incumbent manufacturer, IIB, to two sources of demand: fishermen and non-fishermen sources.

Figure 6: Buyer-Retailer Switching, Goderich Only



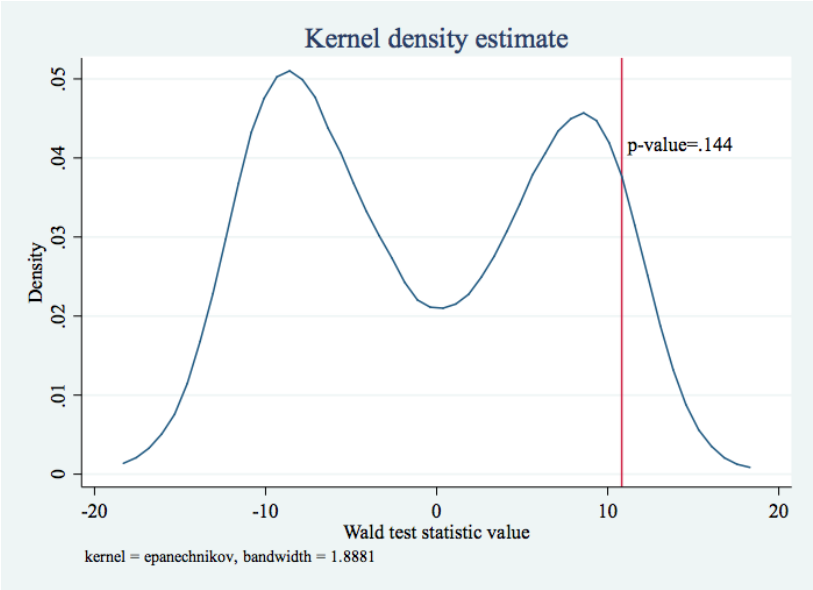
Notes: This figure presents the cumulative probability and density of buyer-retailer switches observed in Goderich wharf during the data collection period. The vertical dashed line marks the first entry by a new manufacturer in Goderich and Aberdeen.

Figure 7: Credit Provision, All Wharves



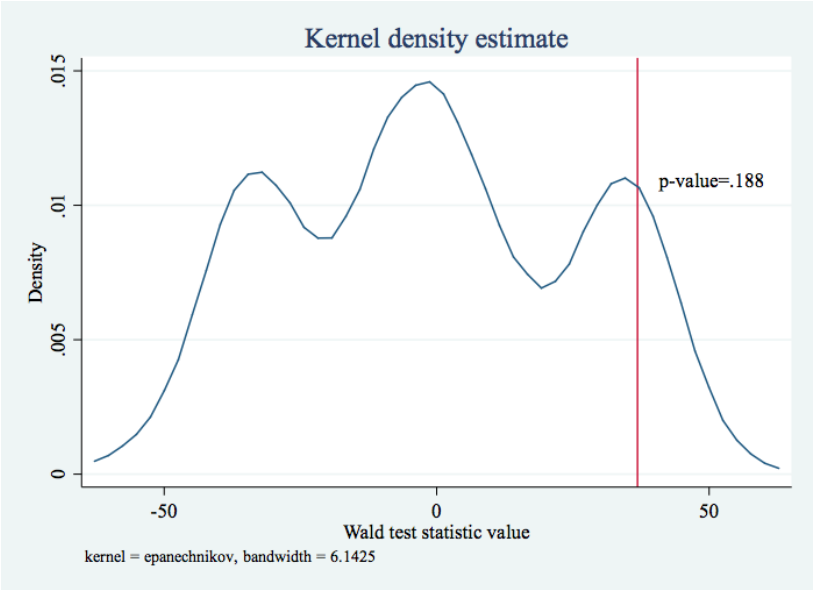
Notes: This figure presents the aggregate credit provision in US dollars provided by retailers in each of the three wharves during the data collection period. The vertical dashed line marks the first entry by a new manufacturer in Goderich and Aberdeen.

Figure 8: Wild cluster bootstrap results for Table 5 column (5)



Notes: This figure presents the distribution of Wald test statistic values calculated using the Wild cluster bootstrap method for Table 5 column (5). The vertical line marks the value of the original sample Wald statistic. See paper text for more details.

Figure 9: Wild cluster bootstrap results for Table 5 column (6)



Notes: This figure presents the distribution of Wald test statistic values calculated using the Wild cluster bootstrap method for Table 5 column (6). The vertical line marks the value of the original sample Wald statistic. See paper text for more details.

Table 1: Summary Statistics - Survey Data

Variable	Mean	Std. Dev.	Min	Max	N
Age	40.28	9.44	24	82	143
Head of Household	0.97	0.18	0	1	148
Years Fishing Experience	17.29	8.77	1	47	150
Own Fishing Boat	0.61	0.49	0	1	150
Captain of Fishing Boat	0.83	0.38	0	1	150
Number of Fishing Trips Per Month	9.63	10.71	2	86	149
Years Known Ice Agent	9.07	7.13	1	40	142
Years Bought from Ice Agent	4.44	3.35	1	20	143
Planned Days Per Trip	2.93	1.24	1	7	4565
No Ice Purchase for Trip (=1)	0.24	0.43	0	1	4565
Ice Purchase (kg)	460.48	353.39	0	1650	4565
Trip Gross Margins (dollars)	110.6	152.07	-345	1748	4492

Notes: Demographic and fishing experience data from baseline survey of fishermen above the separating line, with fishing experience data from high frequency survey below the separating line. See paper text for more details.

Table 2: Outside Demand and Lateness

	Share Late Orders		Share Late Orders	
	(1)	(2)	(3)	(4)
Log Non-Fishing Sales (kg)	0.052*	0.108*		
	(0.030)	(0.057)		
Manufacturer Entry (=1)			-0.246**	-0.241**
			(0.114)	(0.113)
Time Period	Pre-Entry	Jan-Jun 2013	All	Jan-Jun 2013 & 2014
Mean Dep Var	0.19	0.26	0.12	0.15
# Weeks	44	26	78	52
# Observations	615	441	1155	819
R-Squared	0.45	0.40	0.48	0.48
Weather Controls	YES	YES	YES	YES
Wharf FE	-	-	-	-
Calendar Month FE	-	-	-	-
Wharf by Month FE	YES	YES	YES	YES

Notes: Dependent variable is the share of fishermen orders delivered late in a given wharf, and an observation is a fishing wharf-day. Deliveries data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturer. Log Non-Fishing Sales (kg) is the natural logarithm of the kilogram total of all non-fishing ice sales made by the incumbent supplier on that day. Manufacturer Entry (=1) is a dummy variable that equals one following the entry of the first competitor manufacturer into that wharf (see paper text for details). Weather controls include average daily temperature, hours of rain, and average windspeed. Time period covers the period prior to the entry of the first competitor manufacturer when noted as "Pre-Entry," and covers January 2013 to June 2014 when noted as "All." Regressions include weather controls, wharf fixed effects, calendar month fixed effects and wharf by calendar month fixed effects as noted. Robust standard errors, clustered at week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: Prioritized Deliveries (Goderich Only)

	Priority (=1)		Priority (=1)		Priority (=1)	
	(1)	(2)	(3)	(4)	(5)	(6)
Loyal Client (=1)	0.31***	0.25**	0.31***	0.24**	0.31***	0.24**
	(0.09)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Order Rank (#)		-0.08***		-0.10***		-0.11***
		(0.02)		(0.02)		(0.02)
Order Size (kg)		-0.00		-0.00		0.00
		(0.00)		(0.00)		(0.00)
Paid In Full (=1)		-0.06		-0.09		-0.07
		(0.11)		(0.12)		(0.13)
Wharf Sample	Goderich		Goderich		Goderich	
Time Period	Jan - Jun 2013		Jan - Jun 2013		Jan - Jun 2013	
Mean Dep Var	0.52	0.52	0.52	0.52	0.52	0.52
# Observations	191	191	191	191	191	191
R-Squared	0.04	0.13	0.05	0.17	0.10	0.25
Agent FE	NO	NO	YES	YES	YES	YES
Week FE	NO	NO	NO	NO	YES	YES

Notes: Dependent variable is a dummy variable for whether a fisherman's order was prioritized for ontime delivery on a day in which late deliveries were made at his wharf. Sample only includes Goderich wharf and is limited to days with late deliveries. Time period covers from January 2013 to June 2013, prior to the entry of the first competitor manufacturer into Goderich wharf. Loyal Client (=1) is a dummy variable that equals one if the retailer reported that this fisherman would only buy from him even if other ice supply was available. Order Rank measures the sequence in which a fisherman's order were recorded on a given day for a given retailer. Order Size (kg) is the quantity of ice demanded by the fishermen. Paid In Full (=1) is a dummy that equals one if a fisherman paid upfront for his entire order. Regressions include agent fixed effects and week fixed effects as noted. Robust standard errors, clustered at the retailer-fishermen pair level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Retail Price Competition and Spillovers

	Log Price		Log Price		Log Price		Log Price	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# Manufacturers	-0.054***	-0.057***	-0.031***	-0.028***	-0.043***	-0.059***	-0.011**	-0.005
	(0.004)	(0.004)	(0.002)	(0.001)	(0.006)	(0.009)	(0.005)	(0.011)
# Outside Manufacturers			-0.029***	-0.032***			-0.030***	-0.035***
			(0.002)	(0.003)			(0.002)	(0.003)
# Manufacturers * Aberdeen (=1)					-0.019	-0.008	-0.026**	-0.027*
					(0.012)	(0.018)	(0.010)	(0.015)
# Manufacturers * Goderich (=1)					-0.010	0.007	-0.021***	-0.025**
					(0.008)	(0.010)	(0.006)	(0.010)
Time Period	All	Jan-June	All	Jan-June	All	Jan-June	All	Jan-June
Mean Dep Var	9.77	9.76	9.77	9.76	9.77	9.76	9.77	9.76
# Weeks	78	51	78	51	78	51	78	51
# Observations	219	143	219	143	219	143	219	143
R-Squared	0.53	0.56	0.73	0.75	0.54	0.57	0.74	0.76
Wharf FE	YES	YES	YES	YES	YES	YES	YES	YES

Notes: Dependent variable is the log average price paid for a 30kg bag of ice in a wharf, and an observation is a wharf-week. # Manufacturers is the count of ice manufacturers serving a wharf, # Outside Manufacturers is the count of ice manufacturers active only in other wharves, Aberdeen (=1) is a dummy variable that equals one for Aberdeen wharf, and Goderich (=1) is a dummy variable that equals one for Goderich wharf. Price data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturers. Time period covers January 2013 to June 2014 when noted as "All," and covers January 2013-June 2013 and January 2014-June 2014 when noted as "Jan-Jun." Robust standard errors, clustered at the week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Retailer Credit Provision

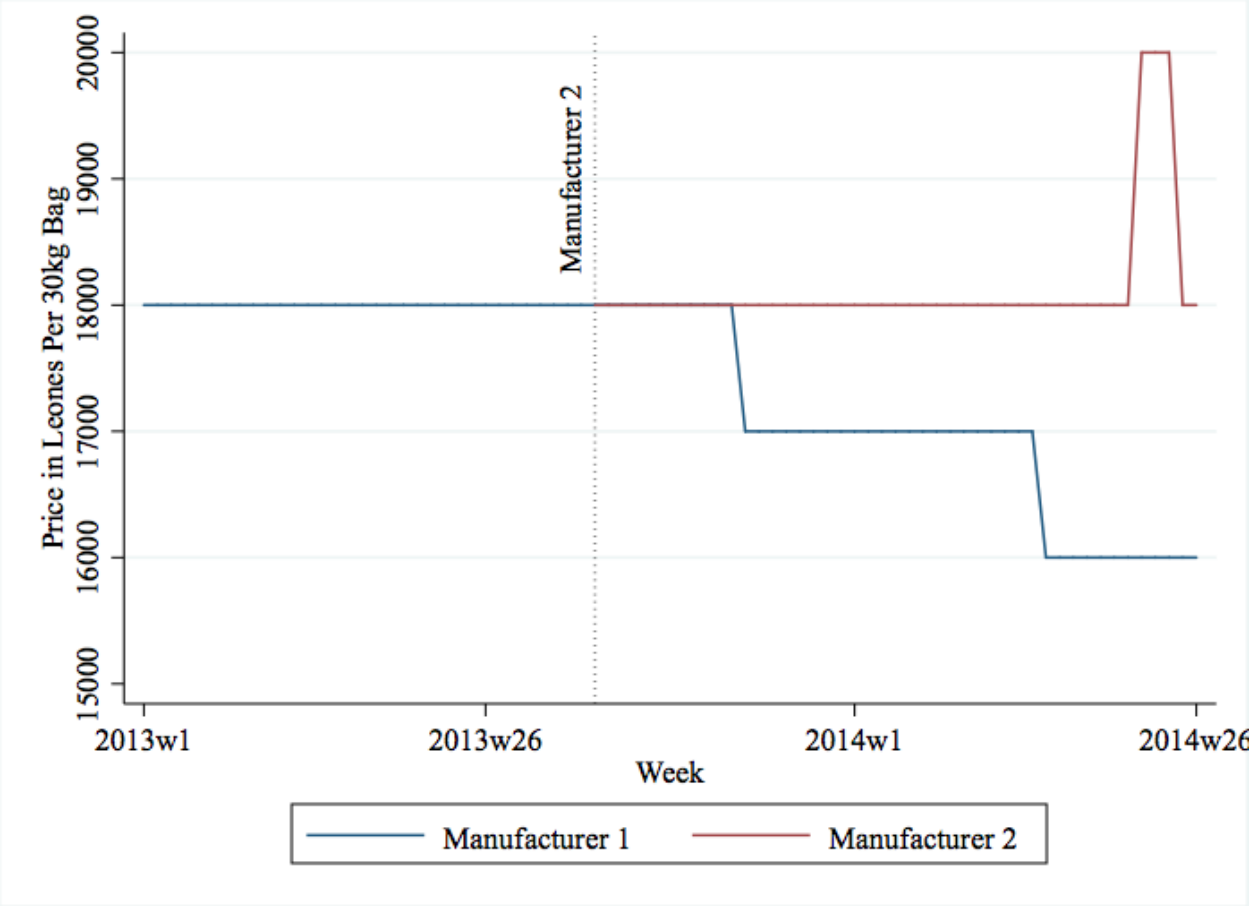
	Credit Provision		Credit Provision		Credit Provision	
	(1)	(2)	(3)	(4)	(5)	(6)
Manufacturers (> 1)	0.05	0.07			-0.02	-0.05
	(0.04)	(0.06)			(0.03)	(0.05)
Aberdeen (=1)			0.12*	0.13	0.09	0.04
			(0.07)	(0.09)	(0.08)	(0.10)
Goderich (=1)			0.14*	0.14	0.03	-0.03
			(0.08)	(0.11)	(0.09)	(0.12)
Manufacturers (> 1) * Aberdeen (=1)					-0.03	-0.02
					(0.03)	(0.04)
Manufacturers (> 1) * Goderich (=1)					0.19***	0.29***
					(0.05)	(0.05)
Time Period	All	Jan-June	All	Jan-June	All	Jan-June
Mean Dep Var	0.11	0.12	0.11	0.12	0.11	0.12
# Weeks	78	51	78	51	78	51
# Observations	3977	2935	3977	2935	3977	2935
R-Squared	0.13	0.15	0.13	0.15	0.15	0.19
Calendar Month FE	YES	YES	YES	YES	YES	YES
Wharf FE	-	-	-	-	-	-
Fishermen FE	YES	YES	YES	YES	YES	YES

Notes: Dependent variable is the fraction of fisherman's total payment to retailer made on credit, and an observation is a fisherman-week. Manufacturers (> 1) is a dummy variable that equals one if more than one manufacturer is making sales in a fisherman's wharf, Aberdeen (=1) is a dummy variable that equals one for Aberdeen wharf, and Goderich (=1) is a dummy variable that equals one for Goderich wharf. Credit data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturers. Time period covers January 2013 to June 2014 when noted as "All," and covers January 2013-June 2013 and January 2014-June 2014 when noted as "Jan-Jun." Regressions include calendar month fixed effects, wharf fixed effects, and fishermen fixed effects as noted. Robust standard errors, clustered at week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Online Appendix - Not for Publication

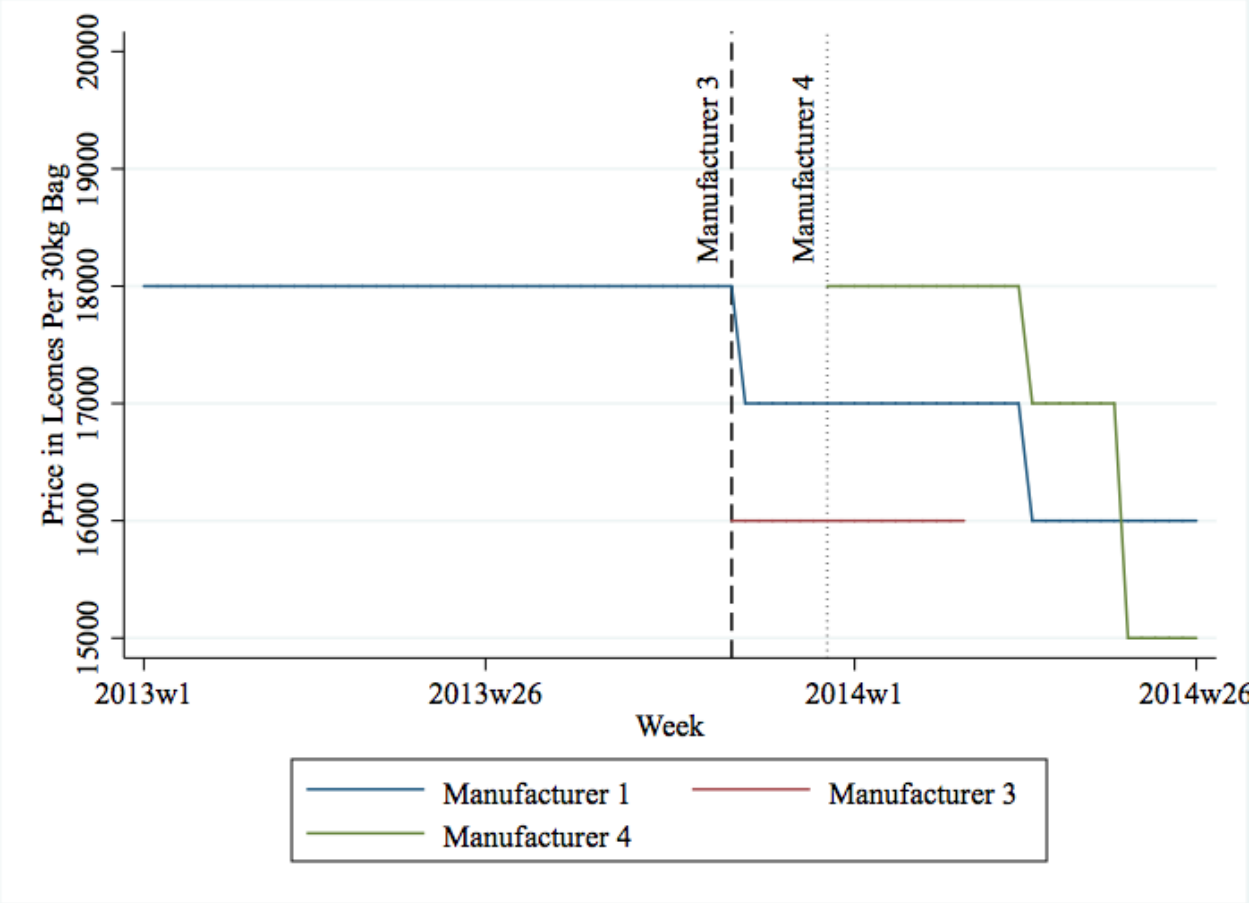
Appendix Figures and Tables

Figure A1: Entry and Price Competition, Tombo Wharf



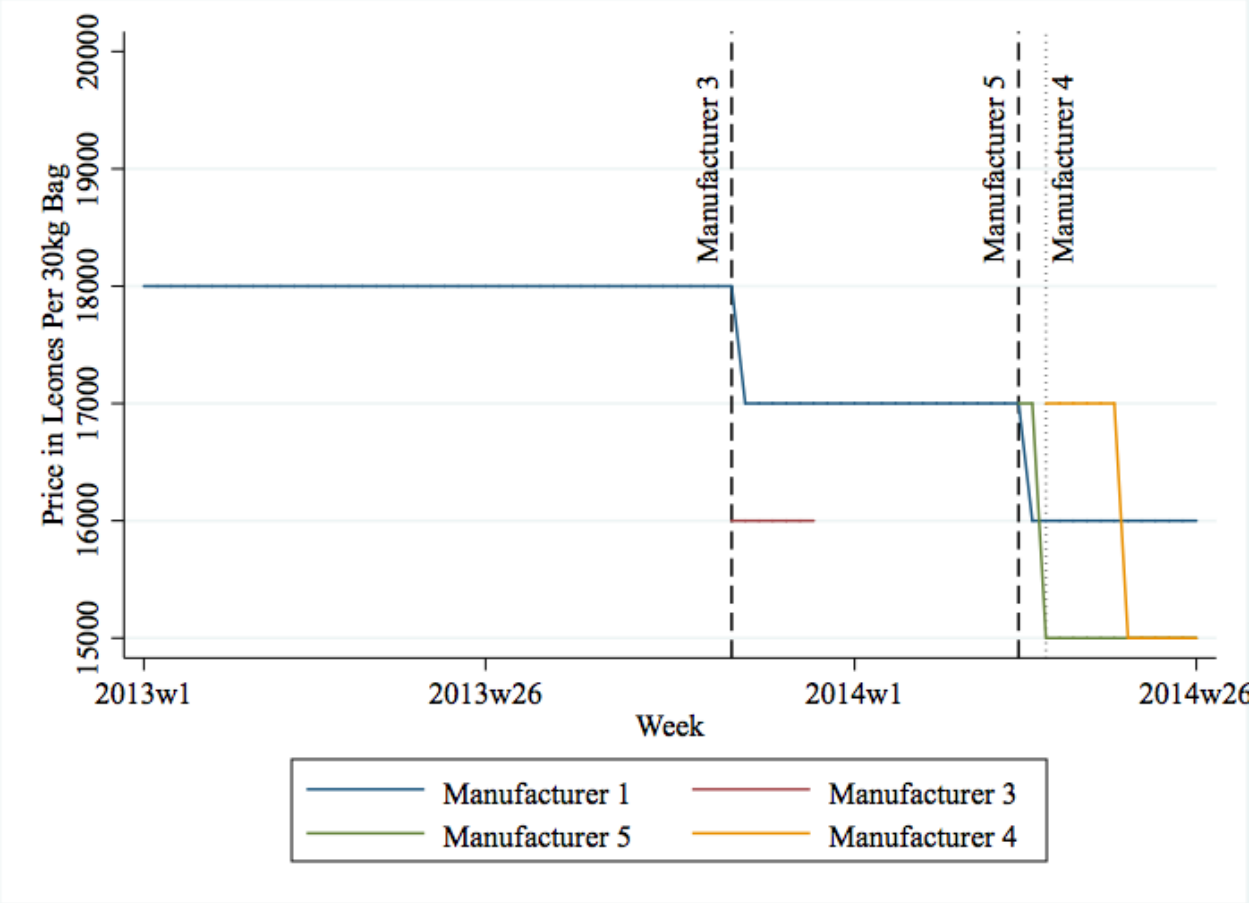
Notes: Y-axis shows the manufacturer's retail price per 30 kilogram bag of ice sold to fishermen in Tombo wharf. Vertical lines mark the first date of ice sales by a competitor manufacturer in one or more wharves. See paper text for more details.

Figure A2: Entry and Price Competition, Aberdeen Wharf



Notes: Y-axis shows the manufacturer's retail price per 30 kilogram bag of ice sold to fishermen in Aberdeen wharf. Vertical lines mark the first date of ice sales by a competitor manufacturer in one or more wharves. See paper text for more details.

Figure A3: Entry and Price Competition, Goderich Wharf



Notes: Y-axis shows the manufacturer's retail price per 30 kilogram bag of ice sold to fishermen in Goderich wharf. Vertical lines mark the first date of ice sales by a competitor manufacturer in one or more wharves. See paper text for more details.

Table A1: Retail Price Competition and Spillovers - Wharf Breakdown

	Log Price		Log Price		Log Price	
	(1)	(2)	(3)	(4)	(5)	(6)
# Manufacturers	-0.043***	-0.013**	-0.062***	-0.020**	-0.053***	-0.037***
	(0.006)	(0.005)	(0.010)	(0.008)	(0.002)	(0.002)
# Outside Manufacturers		-0.028***		-0.053***		-0.023***
		(0.008)		(0.010)		(0.002)
Wharf Sample	Tombo		Aberdeen		Goderich	
Time Period	All	All	All	All	All	All
Mean Dep Var	9.77	9.77	9.76	9.76	9.76	9.76
# Weeks	66	66	75	75	78	78
R-Squared	0.36	0.56	0.48	0.74	0.70	0.91

Notes: Dependent variable is the log average price paid for a 30kg bag of ice in a wharf, and an observation is a wharf-week. # Manufacturers is the count of ice manufacturers serving a wharf, and # Outside Manufacturers is the count of ice manufacturers active ony in other wharves. Price data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturers. Time period covers January 2013 to June 2014 when noted as "All," and covers January 2013-June 2013 and January 2014-June 2014 when noted as "Jan-Jun." Robust standard errors, clustered at the week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A2: Buyer-Retailer Switching

	Switch Retailer (=1)		Switch Retailer (=1)	
	(1)	(2)	(3)	(4)
Manufacturer Entry (=1)	0.03***	0.05***	0.10***	0.10***
	(0.01)	(0.01)	(0.04)	(0.04)
Wharf Sample	All	All	Goderich	Goderich
Time Period	All	Jan-Jun	All	Jan-Jun
Mean Dep Var	0.02	0.03	0.04	0.04
# Fishermen	154	154	86	86
# Weeks	78	51	78	51
# Observations	10192	6348	5538	3447
R-Squared	0.02	0.02	0.04	0.03
Calendar Month FE	YES	YES	YES	YES
Fishermen FE	YES	YES	YES	YES

Notes: Dependent variable is a dummy variable for whether a fishermen switched to a new retailer for ice purchase relative to last period, and an observation is a fisherman-week. Data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturers. Manufacturer Entry (=1) is a dummy variable that equals one following the entry of the first competitor manufacturer into that wharf (see paper text for details). Time period covers January 2013 to June 2014 when noted as "All," and covers January 2013-June 2013 and January 2014-June 2014 when noted as "Jan-June." All regressions include calendar month fixed effects and fishermen fixed effects. Robust standard errors, two-way clustered at fishermen and week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Retailer Credit Provision

	Credit Orders (#)		Credit Orders (#)		Credit Orders (#)	
	(1)	(2)	(3)	(4)	(5)	(6)
Manufacturers (> 1)	0.07	0.09			0.01	-0.01
	(0.05)	(0.08)			(0.04)	(0.06)
Aberdeen (=1)			0.23**	0.23	0.23*	0.17
			(0.11)	(0.15)	(0.12)	(0.16)
Goderich (=1)			0.17	0.14	0.08	-0.03
			(0.11)	(0.15)	(0.12)	(0.16)
Manufacturers (> 1) * Aberdeen (=1)					-0.09*	-0.08
					(0.05)	(0.06)
Manufacturers (> 1) * Goderich (=1)					0.18***	0.30***
					(0.07)	(0.07)
Time Period	All	Jan-June	All	Jan-June	All	Jan-June
Mean Dep Var	0.19	0.19	0.19	0.19	0.19	0.19
# Fishermen						
# Weeks						
# Observations	3977	2935	3977	2935	3977	2935
R-Squared	0.11	0.13	0.10	0.12	0.12	0.15
Calendar Month FE	YES	YES	YES	YES	YES	YES
Wharf FE	-	-	-	-	-	-
Fishermen FE	YES	YES	YES	YES	YES	YES

Notes: Dependent variable is the number of fishermen payments to retailer made on credit, and an observation is a fisherman-week. Manufacturers/Retailers (> 1) is a dummy variable that equals one if more than one manufacturer/retailer is making sales in a fisherman's wharf. Credit data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturers. Time period covers January 2013 to June 2014 when noted as "All," and covers January 2013-June 2013 and January 2014-June 2014 when noted as "Jan-Jun." Regressions include calendar month fixed effects, wharf fixed effects, and fishermen fixed effects as noted. Robust standard errors, two-way clustered at fishermen and week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A4: Retailer Credit Provision

	Total Credit ($)		Total Credit ($)		Total Credit ($)	
	(1)	(2)	(3)	(4)	(5)	(6)
Manufacturers (> 1)	5.54	9.93*			1.89	3.10
	(3.34)	(5.73)			(2.75)	(4.44)
Aberdeen (=1)			19.29**	20.99**	19.52**	16.58
			(8.12)	(9.93)	(8.61)	(10.65)
Goderich (=1)			8.38	7.60	2.84	-1.56
			(5.51)	(6.69)	(6.32)	(8.14)
Manufacturers (> 1) * Aberdeen (=1)					-6.18	-3.12
					(4.02)	(4.70)
Manufacturers (> 1) * Goderich (=1)					11.91***	18.09***
					(4.28)	(4.69)
Time Period	All	Jan-June	All	Jan-June	All	Jan-June
Mean Dep Var	10.20	11.05	10.20	11.05	10.20	11.05
# Fishermen						
# Weeks						
# Observations	3977	2935	3977	2935	3977	2935
R-Squared	0.09	0.10	0.09	0.10	0.10	0.12
Calendar Month FE	YES	YES	YES	YES	YES	YES
Wharf FE	-	-	-	-	-	-
Fishermen FE	YES	YES	YES	YES	YES	YES

Notes: Dependent variable is the total amount of fishermen payments to retailer made on credit in US dollars, and an observation is a fisherman-week. Manufacturers/Retailers (> 1) is a dummy variable that equals one if more than one manufacturer/retailer is making sales in a fisherman's wharf. Credit data includes purchases from the original five retailers serving the incumbent manufacturer, and does include sales by these retailers on behalf of other manufacturers. Time period covers January 2013 to June 2014 when noted as "All," and covers January 2013-June 2013 and January 2014-June 2014 when noted as "Jan-Jun." Regressions include calendar month fixed effects, wharf fixed effects, and fishermen fixed effects as noted. Robust standard errors, two-way clustered at fishermen and week level, in parentheses. *** p<0.01, ** p<0.05, * p<0.1.