Intermediary Profits in a Time of Scarcity

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February 2022

ABSTRACT

We study the impact of scarcity on intermediary profits through an analysis of the effects of the 2011 Japanese tsunami on the U.S. used car market. The tsunami devastated Japanese new car production for several months, which we show led to a demand surge for used cars. Wholesale and retail prices on used Japanese cars rose, but dealer profits declined by $170 per car, a drop of roughly 4%. The post-tsunami temporary scarcity reduced the ratio of future collateral value to current price for these used cars, which diminished the supply of financing and weakened intermediaries' power to extract bargaining surplus from buyers.

JEL Classification: G23, G51, G33, D83

Keywords: Intermediation, Search, Collateral, Supply-Chain Shocks

Disclosure statement

*Garmaise: UCLA Anderson School of Management; Jansen: University of Utah, Eccles School of Business; Snyder: University of Utah, Eccles School of Business. We are grateful to the management team at the firm that provided the data for this research. For helpful comments, we also thank William Mann, Gonzalo Maturana, and the seminar participants at the University of Utah.

Mark Garmaise:

I have nothing to disclose.

Mark Jansen:

I have nothing to disclose.

Jason Snyder:

I have nothing to disclose.

1 Introduction

Periods of temporary scarcity induced by natural disasters, unanticipated policy shifts, supply chain disruptions, or other causes are a recurring feature of economic life. These episodes of scarcity for a set of goods, whether induced by positive demand or negative supply shocks, lead to increased prices, which generally benefit the agents holding the goods and harm those who are seeking them. Many products and assets, however, are sold in decentralized markets where intermediaries help transfer them from sellers to buyers in exchange for payment. It is not clear ex ante what impact scarcity will have on the profitability of such intermediaries, as they serve as both buyers and sellers. Understanding this impact is important for two reasons. First, restoring a market struck by scarcity to a well-functioning status requires that intermediaries have the financial capacity to operate the distribution networks they control. If intermediaries suffer from bankruptcy or financial distress due to scarcity, they may be unable to quickly return their operations to normal. Second, intermediaries meaningfully influence markets, so it is useful to understand whether they have an incentive to remedy scarcity. In this paper, we analyze the effects of scarcity on intermediary profits through a study of the U.S. auto market.

One natural intuition is that intermediaries thrive during periods of scarcity. As a recent example, the semiconductor chip shortage from 2020 to 2022 has severely restricted the ability of auto manufacturers to produce new vehicles, inducing a scarcity of new cars. Figure 1 shows that the chip shortage is correlated with substantially higher new car prices, as expected. Figure 1 also shows that the car dealers that act as intermediaries in this market have profited magnificently during the period of scarcity.

Does the compelling visual evidence in Figure 1 establish that intermediaries generally benefit from scarcity? We think not, for three reasons. First, the recent change in dealer margins may be driven by different buying modes and experiences, shifting technology, changes in market structure, or other aspects of the macroeconomic environment. In other words,

too much has changed over the last several years to attribute the increase in dealer profits solely to new car scarcity. Second, the medium-term patterns in Figure 1 from 2016 to 2020 suggest that dealer margins may not be monotonic in new car prices and that other, unobserved factors may be influencing both outcomes. Third, as shown in Figure 2, used car prices rose even more dramatically than new car prices during 2020 and 2021, but used car dealer margins increased much less than new car dealer margins. Clearly, there are market-specific features that determine the impact of scarcity on intermediary profits. Our empirical study of the relationship between intermediary margins and scarcity explores two potential theoretical mechanisms—one driven by search costs and the other by collateral requirements for buyer financing.

First, we consider the predictions of search theories. Rubinstein and Wolinsky (1987, 1990) show that if intermediaries are indispensable to trade (i.e., if buyers and sellers can trade only through them), then an increase in the number of buyers per seller leads to higher profits per unit for intermediaries. In such cases, the higher number of buyers strengthens the negotiating position of the intermediary and allows the intermediary to extract a higher price. Duffie et al. (2005), however, argue that scarcity can lead to a reduction in intermediary profits if intermediaries are not indispensable for trade. In these cases, the higher number of buyers (per available unit of the good) makes it easier for sellers to bypass intermediaries and sell directly to buyers. Recognizing their improved bargaining position, sellers increase the prices they charge intermediaries, which reduces the intermediaries' margins. We refer to this as the *bypass mechanism*.

We assess these competing theoretical arguments by evaluating the impact of scarcity on dealer profits in the U.S. used car market. The used car market is large and important. Dealers are active in this market, but sellers may also sell directly to buyers. The used car market therefore serves as a useful testing ground for the effects of scarcity. We study these effects by examining the impact of the 2011 Japanese tsunami. The tsunami had a strong negative short-term impact on the production of new Japanese cars but little effect on

non-Japanese manufacturers. This allows us to undertake a difference-in-difference analysis in which we contrast outcomes for Japanese and non-Japanese vehicles in the post-tsunami period.

We perform these tests on a data set that describes approximately 60,000 used car transactions in over 1,100 dealerships across 38 states over the period 2009–2013. The data include retail and wholesale prices and financing details. The purchase transactions were funded by a large automotive indirect-finance company.

We show that the tsunami generated a positive demand shock for used Japanese cars, as the shortage of new vehicles induced prospective buyers of Japanese cars to consider used autos instead. This led to higher wholesale prices for used Japanese cars for a period of roughly six months. We also find that retail prices for these cars increased.

Our central interest is in the impact of scarcity on intermediary profits. We find that the dealer profit per used Japanese car decreased by approximately $170 (roughly 4%) in the post-tsunami period; so, while wholesale and retail prices were rising, dealer profits were falling. Dealer margins relative to wholesale prices on used Japanese cars dropped by 2.1 percentage points (about 6%) after the tsunami. This evidence clearly favors the Duffie et al. (2005) argument that a surge in the population of potential buyers reduces profits for search intermediaries (i.e., dealers) due to the bypass mechanism.

The bypass mechanism is most important in markets where sellers can easily circumvent dealers. A seller's ability to circumvent dealers depends partly on the amount of goods available. We define "thick" markets as those where a large volume of the good is potentially for sale; in "thin" markets, by contrast, the aggregate market size is small (Gavazza, 2011). For example, the popular Nissan Sentra sedan trades in a thick market, but the Nissan 350Z sports car, which is produced at a relatively low volume, trades in a thin one. Although a similar set of dealers might be interested in either of these vehicles, a private seller is more likely to directly find a buyer for a Sentra than for a 350Z. Under the bypass mechanism, we would expect the intermediary margins to decrease more, post tsunami, for vehicles that

trade in thick markets. We show that this is true.

These findings highlight the importance of the bypass mechanism in the used car market and provide an explanation for the sharp divergence, described in Figures 1 and 2, between recent dealer margins in new and used cars. Central to this explanation is the fact that car dealers are generally indispensable in new car sales but not in used car sales. Notably, approximately 45% of used car transactions in the first quarter of 2021 took place between private parties.[1] Consistent with Rubinstein and Wolinsky (1987, 1990), we find that scarcity increased dealer margins in the new car market, where the dealers' participation is required for sales. In the used car market, where direct private sales are feasible and common, scarcity did not lead to higher dealer margins, which is is consistent with the bypass mechanism outlined in Duffie et al. (2005).

We also consider a second mechanism through which scarcity affects intermediary profits. This process emphasizes the importance of collateral-based financing for buyers. Collateral requirements are not the focus of most theories of intermediation but are of central consequence in our setting. The tsunami-related increase in Japanese used car prices was foreseeably short-term: as soon as production would return to previous levels, buyers seeking new Japanese cars would be able to find them, and used car prices would return to previous levels. As a consequence, during the immediate post-tsunami period, lenders who were assessing the collateral values of used Japanese cars (i.e., the amounts the cars might be worth in the event of a future default) likely understood that these values would be similar to the long-term average values even though the current vehicle prices were unusually high. Extensive theoretical and empirical work on the importance of collateral to lending (Hart and Moore, 1988; Gan, 2007; Benmelech and Bergman, 2009; Rampini and Viswanathan, 2010; Benmelech and Bergman, 2011; Rampini and Viswanathan, 2013; Calomiris et al., 2017; Mann, 2018; Rampini, 2019; Ramcharan, 2020; Donaldson et al., 2020) suggests that

[1] https://www.coxautoinc.com/market-insights/cox-automotive-13-month-rolling-used-vehicle-saar/, accessed January 10, 2022.

the relatively low ratio of the used cars' future collateral values to their current prices would hamper the supply of financing.

We find that this was indeed the case: LTV (loan-to-wholesale value) ratios on used Japanese cars fell by 2.3 percentage points right after the tsunami. In effect, collateral played a special role during the temporary price hikes generated by the short-term scarcity of used cars. Although current prices were higher, collateral values did not rise. This limited the ability of buyers to obtain financing and, therefore, their capacity to pay high prices. As a consequence, dealers were constrained in their ability to pass through increases in wholesale prices to their retail customers. We describe this as the *financing mechanism*.

One implication of the financing mechanism is that credit-dependent buyers would have found it especially difficult to purchase Japanese vehicles during the period of scarcity. We find evidence in support of this prediction: the high credit risk borrowers who rely most heavily on financing to purchase autos were significantly less likely to purchase used Japanese cars in the post-tsunami interval.

In sum, we propose that two channels reduced dealer margins during the post-tsunami period of scarcity. First, the introduction of new potential buyers strengthened sellers' hands in their negotiations with dealers (the bypass mechanism). Second, the reduced ability of buyers to finance used Japanese vehicles made it difficult for intermediaries to extract higher prices (the financing mechanism).

Low-mileage used cars are closer substitutes for new cars than high-mileage used cars are. We therefore expect that, under both the bypass and financing mechanisms, the tsunami-induced demand surge will have a greater effect on lightly used Japanese cars. We find that this was the case, as dealer margins and LTV ratios both dropped more for low-mileage vehicles. This finding buttresses the argument that the key driver of our results was the post-tsunami scarcity of substitutes for new Japanese vehicles after new-vehicle production was disrupted.

Our study of the financing mechanism contributes to the literature on the role of col-

lateral in consumer borrowing for real estate and auto purchases (Agarwal and Qian, 2017; Benmelech et al., 2017; DeFusco, 2018; Argyle et al., 2021). The financing channel we explore can impact retail prices in both of these markets.[2]

Our findings complement an influential body of work that argues for the importance of a collateral lending channel (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Adelino et al., 2015; Gan, 2007) under which temporary shocks raise collateral values and therefore increase the debt capacities of firms. The increased availability of financing spurs firm investment, which raises collateral values further, generating a multiplier effect on prices. In our empirical setting, by contrast, we find that collateral constraints on consumer borrowing tighten during short-term increases in wholesale prices, which serves to dampen, rather than amplify, the impact of these temporary fluctuations on retail prices. What distinguishes this paper from prior work on the collateral lending channel is our focus on how changes in the pledgeability of assets affect consumers rather than firms. We highlight that consumer collateral-based financing does not directly affect firm investment but instead helps to restrain retail price volatility. The precise effects of collateral constraints on price stability depend on the constraints' relative importance for consumers and firms.

A recent stream of research has analyzed the importance of search costs in financial markets (Vayanos and Weill, 2008; Kolasinski et al., 2013), with the role of intermediaries in ameliorating search frictions receiving particular attention (Feldhütter, 2012; Hendershott and Madhavan, 2015; Duffie et al., 2017; Chen et al., 2021). Intermediaries have been shown to play a central function in a variety of markets, including housing (Genesove and Han, 2012; Buchak et al., 2020), aircraft, patents (Hagiu and Yoffie, 2013), corporate bonds, and mortgage-backed securities (He and Krishnamurthy, 2013).

Our finding that scarcity reduces intermediary profits is likely to hold in other settings

[2]Consistent with our finding that the financing mechanism reduces LTVs during periods of temporarily elevated prices, average LTV ratios dropped by more than 10 percentage points during the surge in used car prices from 2020 to 2021 (Zabritski, 2021).

where sellers and buyers can transact privately or where buyers depend heavily on collateral when they secure financing. Under either of these conditions, scarcity engendered by a negative supply shock will reduce margins and volume for intermediaries, causing the intermediaries distress and possibly leading to their exit. This suggests that negative supply shocks will often be followed by intervals of elevated search costs, which will impede a market's return to proper functioning.

2 Data and Summary Statistics

To explore the role of scarcity on intermediary profits, we examine the retail and wholesale prices and financing of used vehicles that were purchased in 38 states in the period 2009–2013. Our data set consists of transaction-level information on pricing and financing. The loans to fund these purchases were made by a large automotive indirect-finance company. In total, we observe the prices and vehicle characteristics of 61,694 loans that were originated at 1,144 dealerships located in 693 U.S. ZIP codes, as described in Table 2. We also observe the borrower characteristics and loan terms.[3]

Table 2 presents summary statistics for prices, vehicle characteristics, buyer characteristics, and loan terms. The average vehicle has approximately 41,380 miles on it at time of sale, a wholesale value (i.e., the price the dealer paid for that particular vehicle) of $13,798, and a retail price of $17,541. The 2010 new vehicle sales in the U.S. for each make and model are provided by *Automotive News* (a Crain Communications company).

[3]The raw data extend from the 1990s to 2021 and include approximately 343,000 loans. We exclude loans outside of the five-year time window surrounding the tsunami. We also exclude a small number of observations for new cars and for loans with incomplete origination data.

2.1 2011 Japanese Tsunami

A magnitude 9.0 earthquake, the largest tremor to hit Japan since 1850, struck on March 11, 2011 off the coast of the Tōhoku region of Honshu, Japan, generating a tsunami with waves exceeding 100 feet in height. The resulting wave damage destroyed nearly everything along a 350-mile span of coastline, including over a dozen ports, and triggered a meltdown of the Fukushima nuclear reactor. Estimates of the economic damage wrought by the earthquake are on the order of US$360 billion (Ferris and Solís, March 11, 2013).

All Japanese automotive manufacturers (e.g., Honda, Toyota, and Nissan) had plants in or near the affected area, and they closed those facilities. Japanese plants that were less directly affected by the earthquake and tsunami were also forced to stop production, as earthquake-related damage to approximately 500 tier-1 and tier-2 suppliers resulted in logistics difficulties and parts shortages. Both Toyota's and Honda's Japanese-built vehicle output declined by over 60% in March; other manufacturers also experienced steep decreases. Output levels in April were even lower (Wheatley and Ramsay, July 1, 2011). Production by Japanese automakers outside Japan was also severely affected.[4] As shown in Table 1, the production decrease for Japanese manufacturers was very substantial both in Japan and North America. In contrast, non-Japanese manufacturers essentially continued manufacturing without interruption. South Korean and American automakers met some of the demand that Japanese producers could not service (Edgerton, March 9, 2012).[5]

[4]For example, Toyota's plants in China, Europe, and North America ceased production for up to three months. Toyota's North American production was impacted by a parts shortage, resulting a production loss of 500,000 vehicles. Honda's U.K. plant reduced its production capacity by 50% for almost two months and Nissan's three U.S. plants were completely shuttered for a few months.

[5]Jesse Toprak, a vice president at TrueCar.com, observed that "part of the U.S. companies' ability to pick up sales resulted from being ready with small, high-MPG cars as gas prices were rising then as now. Sales shot up for models like the Chevrolet Cruze and Ford Fiesta, along with models from Korean maker Hyundai."

Table 1
Automotive Production by Month Post-tsunami automotive production decline relative to the Jan.–Feb. 2011 rate. Sources: International Organization of Motor Vehicle Manufacturers; Japan Automobile Manufacturers Association; VDA: German Association of the Automotive Industry; Automotive News, Crain Communications.

	Mar	Apr	May	Jun	Jul	Aug
Japan Output	-46%	-61%	-37%	-4%	+3%	-7%
North America Output by Japan Mfrs	+10%	-42%	-38%	-19%	-42%	+3%
North America Output by non-Japan Mfrs	+34%	+7%	+22%	+22%	-12%	+25%
Germany Output	+27%	3%	23%	1%	1%	-14%

Lost production that was attributable to the tsunami amounted to almost 5% of global car production—approximately 2.8 million vehicles, of which 90% were from Japanese automakers (source: IHS Global Insight). The vehicle production losses of the Japanese manufacturers peaked in the second quarter, and all Japanese automakers returned to profitability from September 2011 to March 2012.

3 Theoretical Framework

Consider a model in which there are sellers, intermediaries, and buyers. We define a time of scarcity as a period in which there is an increase in the number of potential buyers per unit of the good, and we analyze the implications of scarcity for the price of the good and for intermediary profits. The motive for trade is that buyers place a higher valuation on the good than sellers do. There are also search frictions that impede the meeting of sellers and buyers when markets are not thick. Intermediaries can help relieve those frictions by buying the good from sellers at the wholesale price and selling it to buyers at the retail price. The intermediary profit is the difference between the retail and wholesale prices, and the intermediary margin is the profit scaled by the wholesale price.

The theoretical implications of scarcity depend on whether the intermediaries are indispensable to trade. We begin by assuming that trade can only occur through the medium of an intermediary (i.e., intermediaries are completely indispensable). In the simplified version of the model of Rubinstein and Wolinsky (1987) with one seller, one buyer, and one indispensable intermediary, trade takes place sequentially between the seller-intermediary and between the intermediary-buyer, and prices are determined via Nash bargaining. We introduce scarcity by increasing the number of buyers and allowing for random matching between the intermediary and any given buyer in the manner of Rubinstein and Wolinsky (1990). As shown in Rubinstein and Wolinsky (1990), as the number of buyers increases, the retail price rises. Under the bargaining model in Rubinstein and Wolinsky (1987), the single seller retains a fixed fraction of the retail price, so the wholesale price rises proportionately with the retail price. This gives rise to the implications below.

Hypothesis 1: If the intermediary is indispensable to trade, then as the number of potential buyers increases

a. wholesale and retail prices increase

b. the intermediary profit per unit increases

c. the intermediary margin is constant.

When buyers and sellers can meet on their own (i.e., when the intermediary is not indispensable), an increase in the number of potential buyers enhances the bargaining power of sellers and thereby alters the terms on which trade occurs. In the theory of Duffie et al. (2005), an increase in the number of interested buyers can be modeled as a higher hazard rate for the direct meeting of a seller with a potential consumer of the good. When the hazard rate is high enough, prices increase along with hazard rate intensity (i.e., as more potential buyers enter the market), eventually reaching a Walrasian price as search frictions dissipate. The intermediary profit, however, decreases in the number of potential buyers, as sellers can more easily circumvent the intermediary and trade directly with buyers. We

refer to this strengthening of a seller's hand in negotiating with intermediaries as the bypass mechanism. It generates the following theoretical predictions.

Hypothesis 2: If buyers and sellers can meet directly (i.e., if the intermediary is not indispensable to trade), then as the number of potential buyers increases

a. wholesale and retail prices increase

b. the intermediary profit per unit decreases

c. the intermediary margin decreases.

From a formal standpoint, Hypothesis 2a requires that the number of potential buyers be high enough (i.e., that the hazard of meeting a potential buyer be sufficiently large), but the general intuition that prices rise when counterparties find it easier to meet is straightforward and compelling. Rubinstein and Wolinsky (1987) do not consider changes in the relative numbers of buyers and sellers, but they do show that when buyers and sellers can meet on their own, an increase in the probability of their meeting reduces the markup of intermediaries, which is a similar intuition to Hypothesis 2b.

The bypass mechanism is likely to be more important in thick markets in which the quantity of goods available is large. Only for more familiar and standardized goods will direct connections of buyers and sellers be feasible.

Overall, it is clear from Hypotheses 1 and 2 that an influx of potential buyers raises prices; this is a general implication of scarcity. The impact of scarcity on intermediary per-unit profits, however, depends crucially on the ability of buyers and sellers to bypass middlemen and trade directly. We emphasize that Hypotheses 1 and 2 describe intermediaries' per-unit profits, not their overall profits. Scarcity that is driven by a negative supply shock could have quite different implications for overall profits than scarcity that is generated by a positive demand shock. In our empirical analysis, we analyze the role of intermediaries in the U.S. used car market and assess the effect of scarcity on their per-unit profits.

4 Empirical Methodology

We analyze prices, profits, and financing terms during times of scarcity using loan-level auto data. We use the following regression specification for our analysis of a sale l that takes place during period t:

$$Outcome_{lt} = \beta_0 + \beta_1 Japan_l + \beta_2 Tsunami_t + \beta_3 Japan_l * Tsunami_t + \gamma Controls_{lt} + \epsilon_{lt}, \quad (1)$$

where the variable *Outcome* represents *Wholesale Price*, *Retail Price*, *Dealer Profit*, *Dealer Margin*, and *Loan-to-Value Ratio* across various tables. In Equation (1), *Japan* is a dummy that equals 1 if the car is made by a Japanese manufacturer.[6] *Tsunami* is a dummy variable that equals 1 if the sale took place between March 15, 2011, and Sept 15, 2011. The coefficient of interest is β_3, which describes the impact of the tsunami on used Japanese vehicles.

We control for make-model fixed effects (e.g., a dummy variable if the vehicle is a Honda Civic), dealership, and month of the year effects when predicting pricing and financing outcomes. The main effect on *Japan* is absorbed by the make-model fixed effects and is not reported in our tables. To control for time trends in the data, we use two different approaches. The first is to create a trend variable for the year, starting in 2009. This variable *Year Trend* takes the value of 0 in 2009, 1 in 2010, etc. Second, in many specifications we use year or year-month fixed effects. We also construct interactions between *Year Trend* and *Japan*, to control for Japanese car specific trends, and between the month and *Japan*, to control for seasonal differences between Japanese and non-Japanese vehicle sales.

[6]The Japanese makes in our data are Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Acura, Mazda, Mitsubishi, Isuzu, Suzuki, and Scion.

5 Results

5.1 Prices and Dealer Margins

As described in Section 2.1, the 2011 tsunami caused a dramatic short-term reduction in the supply of new Japanese cars. We propose that the tsunami therefore created a positive demand shock for used Japanese cars. Given that new Japanese cars were very hard to find, we hypothesize that some of the consumers who had been considering buying a new Japanese car entered the market for a used Japanese car instead. These consumers most likely remained loyal to Japanese makes, as household-level brand preferences exhibit pronounced persistence (Bronnenberg et al., 2012). The used cars in our sample are quite young (with a median age of three years) and therefore probably served as reasonable substitutes for new cars.

To assess whether the tsunami caused a positive demand shock and created a period of scarcity for used Japanese cars, we estimate equation (1) for vehicle wholesale prices: we regress the price paid by a dealer for a used car on an indicator for the post-tsunami period (March 15–Sept 15, 2011), an interaction between the post-tsunami indicator and a dummy for Japanese cars, a linear control for the year of the sale, and fixed effects for the make-model of the car, the dealership, and the month of the year of the sale. Standard errors are double clustered by dealership and vehicle make. We find, in the first column of Table 3, a positive and significant effect of the post-tsunami–used Japanese car interaction (coefficient=427.5 and t-statistic=3.02): during the post-tsunami period, dealers purchased used Japanese cars at a premium of $427.5. This increase represents a meaningful effect compared to the $13,400 average vehicle wholesale price for used Japanese cars over the entire sample. This is clear evidence that the tsunami boosted the prices of the treated (i.e., used Japanese) cars and created a period of scarcity. As the overall supply of used Japanese cars in the U.S. was likely unaffected by the tsunami, this price increase can be attributed

to a positive demand shock generated by the reduced availability of new Japanese cars. The resulting increase in wholesale prices is consistent with the first predictions of Hypotheses 1a and 2a in Section 3.

Including year-month fixed effects has little impact on the estimated effect on the interaction, as detailed in the second column of Table 3. In the third column of Table 3, we present the results from including a control for the borrower credit score, an indicator for previous borrower bankruptcy, an indicator for borrower homeowner status, a control for the car mileage, an interaction between a Japanese car dummy and the years since 2008 (i.e., a Japan-specific time trend), and an interaction between a Japanese car dummy and the month (i.e., a Japanese seasonal control). We find a coefficient of \$361.7 and a t-statistic of 3.49. Decomposing the interaction into its month-by-month effects, we show, in the fourth column of Table 3, that vehicle wholesale prices were significantly higher for used Japanese cars in every month from April to August 2011.

In the fifth column of Table 3, we show that used Japanese cars did not sell at elevated wholesale prices in the period before the tsunami. A regression of vehicle wholesale price on an indicator for a sale in the six months before the tsunami and the interaction between this indicator and a Japanese vehicle dummy yields an insignificant result for the interaction (coefficient=-68.1 and t-statistic=-0.50). Thus, there is no apparent pre-trend in advance of the disaster.

The results in Table 3 establish that the tsunami caused a demand-driven scarcity in used Japanese cars. Hypotheses 1a and 2a both predict that retail prices (along with wholesale prices) should rise as a result of this scarcity. We test this prediction by regressing the retail price realized by the dealer on the post-tsunami–used Japanese car interaction and the standard controls. We find, in the first column of Table 4, that retail prices for used Japanese cars were indeed higher (coefficient=274.1 and t-statistic=1.82) in the post-tsunami period, confirming the retail price predictions of Hypotheses 1a and 2a. This result continues to hold when we include month-year fixed effects and borrower-level, vehicle-level, and time-trend

controls, as detailed in the second and third columns of Table 4. We show, in the fourth column of Table 4, that retail prices for used Japanese cars were generally higher from April to August 2011, but the monthly effects are only significant during two months. We do not find a significant retail price shift for these vehicles in the six months preceding the tsunami, as we detail in the fifth column of Table 4.

The tsunami raised wholesale and retail prices, as shown in Tables 3 and 4, which is consistent with Hypotheses 1a and 2a. We next assess the distinguishing predictions of Hypotheses 1 and 2, which focus on dealer profits and margins. If dealers are largely indispensable and cannot easily be circumvented, Hypothesis 1b predicts that dealer profits will increase in a period of scarcity, and Hypothesis 1c predicts that dealer margins will be constant. If, however, buyers and sellers can meet directly and with ease, Hypothesis 2b predicts that dealer profits will decrease in a period of scarcity, and Hypothesis 2c predicts that dealer margins will decline. We test these competing predictions by regressing dealer profits on the post-tsunami–used Japanese car interaction and the standard controls. We find, in the first column of Table 5, that dealer profits declined by \$180.9 (t-statistic=-2.18) for used Japanese cars after the tsunami. This is clear evidence in favor of Hypothesis 2b. The decline in intermediary profits during the tsunami-induced scarcity and price surge is consistent with the bypass mechanism: sellers could negotiate directly with buyers, and an influx in potential buyers made it easier for sellers to avoid using intermediaries. The dealers' weakened bargaining position led to lower profits per vehicle for them.

Regression specifications including month-year fixed effects, borrower- and vehicle-level characteristics, and time trend controls confirm this basic finding, as shown in the second and third columns of Table 5. Including the full set of controls, we find that the tsunami reduced dealer profits on used Japanese vehicles by \$170.1 (t-statistic=-2.41).

Note that, although dealer profits on used Japanese cars were lower in the post-tsunami period, dealers did not lose money, on average, on these transactions. The average dealer profit on all used cars over the entire sample period was \$4,488 per vehicle, and dealer

profits on used Japanese cars declined by 3.8% after the tsunami. So, average profits clearly remained positive.

The results in the fourth column of Table 5 show that dealer profits were broadly lower from April to August 2011, although only one of the monthly indicators is significant. Taking the post-tsunami period as a whole, it is clear that scarcity decreased dealers' per-vehicle profits on used Japanese cars. The results in the fifth column of Table 5 show that there was no discernible pre-trend in profits on used Japanese autos in the six months before the tsunami (coefficient=-44.1 and t-statistic=-0.64).

Given the results in Tables 3 and 5 showing that vehicle wholesale prices were higher and dealer profits were lower on used Japanese cars in the post-tsunami period, one would expect that dealer margins were also lower. We show that this is indeed true in the first column of Table 6: the tsunami reduced margins on used Japanese cars by 2.2 percentage points (t-statistic=-2.81). This finding is robust to the inclusion of month-year, borrower-level, vehicle-level, and time trend controls, as displayed in the second and third columns of Table 6. In the specification with all controls, we find a reduced margin of 2.1 percentage points (t-statistic=-3.23). Relative to the average dealer margin of 35.1%, this represents a drop of 6.0%.

Dealer margins were significantly lower in four out of the five months in the period from April to August 2011, as we detail in the fourth column of Table 6. We find, in the fifth column of Table 6, no evidence of a pre-trend (coefficient=-0.003 and t-statistic=-0.56); this finding is confirmed by the graphical evidence in Figure 3.

Tables 5 and 6 show that the bypass mechanism plays an important role in the used car market as a whole. We propose that the effect of the bypass mechanism will be stronger in the subset of vehicles for which dealers have a weaker (or no) role in facilitating sales.

In what types of markets are intermediaries dispensable? In general, search frictions for individual agents are less severe in thick markets, where a relatively large number of assets are available for trade (Gavazza, 2011). In these markets, it is feasible for buyers and sellers

to find each other, and intermediaries are not central in facilitating trade. Intermediaries are more important in thin markets, where the number of assets is relatively small.

We describe the thickness of a market for a given auto make and model by measuring the total sales of that make-model in the year preceding the tsunami (i.e., 2010).[7] Vehicles with greater previous year sales trade in thicker markets. One implication of the bypass mechanism is that the post-tsunami scarcity in used Japanese vehicles should reduce dealer margins more substantially in thick markets.

We assess the relative impact of the tsunami on thick versus thin markets by regressing the wholesale price on the triple interaction between the post-tsunami indicator, the used Japanese car dummy, and the 2010 sales of the make-model, along with all the relevant double interactions and the full set of controls. We find, in the first column of Table 7, that the effect of the triple interaction is positive (coefficient=329.8 and t-statistic=2.76). The tsunami led to higher wholesale prices especially for Japanese cars that traded in thick markets with a large number of vehicles. We also show, in the second column of Table 7, that the impact of the triple interaction on retail prices was positive.

The main test, however, regresses dealer margins on the triple interaction. We find that dealer margins were particularly low for used Japanese cars in thick markets (coefficient=-0.011 and t-statistic=-2.62), as displayed in the third column of Table 7.

Table 7 uses a continuous measure of sales. In Figure 4a and Figure 4b we employ a 100,000-unit threshold to denote thick markets; those with sales below that threshold represent thin markets. Consistent with the results in Table 7, Figure 4a shows that the tsunami had no measurable impact on dealer margins for used Japanese cars in thin markets, while Figure 4b illustrates the large negative impact of the tsunami on dealer margins on used Japanese cars in thick markets.

The results in Tables 3–7 are all broadly consistent with Hypothesis 2. They support the argument that direct sales from buyers to sellers are a viable alternative to the use

[7]Data comes from the website https://www.goodcarbadcar.net which aggregates make-model sales data.

of dealers. An increase in the set of potential buyers of used Japanese cars during the post-tsunami period therefore served to reduce dealer profits and margins, via the bypass mechanism, at a time when wholesale and retail prices increased. As expected, this effect was strongest in thick markets.

5.2 Financing

A central element of the used car market that is *not* highlighted in the theoretical framework in Section 3 is the role of financing.[8] Following the tsunami, the disruption to Japanese car manufacturing was widely recognized as temporary. Participants in the auto market most likely understood that the demand-driven, post-tsunami scarcity of used Japanese cars would be short-term. While this scarcity did boost wholesale and retail prices for six months (as we show above), market participants presumably anticipated that prices would eventually revert to long-term levels. From a financing perspective, this expected price pattern would have had implications for the collateral value of the vehicles. For lenders, the collateral value (particularly at the time of a potential future default) is a first-order consideration in setting how much financing to extend, as it determines their likely recovery amount should default occur (Hart and Moore, 1988; Rampini, 2019). We propose that, despite the elevated prices of used Japanese cars after the tsunami, lenders anticipated future collateral values that were no higher than average. As a consequence, the ratio of future collateral values to current prices would have been low, which would have reduced the fraction of the purchase price that could be financed.

We test this prediction by regressing the LTV on the interaction of the post-tsunami period and an indicator for used Japanese cars and the standard controls. We find, as described in the first column of Table 8, that LTV ratios were 2.2% lower (t-statistic=-4.72) for used Japanese cars after the tsunami. This is clear evidence that less financing was

[8]Zabritski (2021) reports that 68% of purchases of used cars less than eight years old are financed. In our sample of transactions, the median down payment relative to the purchase price of the vehicle is 4.2%.

provided and is consistent with the implications of theories of collateral and financing. This result continues to hold in specifications that include month-year fixed effects and borrower-level, vehicle-level, and time trend controls, as shown in the second and third columns of Table 8. When we include the full set of controls, we find a decrease of 2.3% in LTV (t-statistic=-6.08). We show, in the fourth column of Table 8, a significant negative impact on the LTV of used Japanese cars in four of the five months from April to August 2011. In contrast, LTVs were not unusual in the six months before the tsunami (coefficient=0.003 and t-statistic=0.49), as shown in the fifth column of Table 8 and as displayed in Figure 5.

Given the heavy use of buyer financing we observe, it is likely that retail prices were meaningfully influenced by the LTV, as the amount that resource-constrained consumers can pay dealers is largely determined by the amount of lender-provided capital. Our results showing a drop in LTV suggest that the post-tsunami decline in dealer margins on used Japanese cars may be partly due to collateral-based financing constraints on buyers.

These LTV results indicate a second channel—a financing mechanism—that drives the decrease in dealer margins during a period of scarcity: borrowing constraints limit buyers' ability to pay higher prices, which impairs the dealers' negotiating strength in their transactions with them. This avenue by which dealer profits are reduced is distinct from the bypass mechanism outlined in Section 3, and is consistent with Jansen et al. (2021).

The financing mechanism also suggests that credit-dependent buyers would have found it more difficult to purchase used Japanese cars after the tsunami. The lender assigned each buyer a composite credit risk score assessing their default probability. Buyers with higher credit risk scores presumably possessed fewer personal resources and would have been more reliant on financing to complete a purchase. If the financing mechanism is operative, then these buyers would have been less likely to purchase scarce vehicles (i.e., used Japanese cars) following the tsunami.

We begin our consideration of this question by regressing an indicator for whether a buyer purchases a used Japanese car on the post-tsunami indicator, the credit risk score, a year

trend, and month fixed effects. This analysis considers whether the buyer purchased a used Japanese car conditional on the buyer's having purchased a used car of some type. Given our focus on the choice of vehicle, we omit the previously utilized controls for make-model and Japanese-specific time trends. We find, in the first column of Table 9, that during the post-tsunami period there was a 3.0 percentage point decrease (t-statistic=-2.57) in the likelihood of a buyer's purchasing a used Japanese car, despite the surge in demand for these cars.

We hypothesize that this effect occurs because (1) our sample consists primarily of high-risk borrowers, and (2) many of the used Japanese cars that were purchased in the post-tsunami period went to less credit-dependent buyers. If true, this would be consistent with the financing mechanism. We test this prediction by regressing the indicator for a used Japanese car purchase on an interaction between credit risk and the post-tsunami indicator in addition to the previous regressors.

We find, in the second column of Table 9, a negative and significant (coefficient=-2.4% and t-statistic=-2.46) effect of the post-tsunami and credit risk interaction. That is, credit-dependent borrowers were less likely to purchase used Japanese cars when those cars became scarce, which is consistent with the financing mechanism. Including month-year fixed effects has only a minor impact on the estimated impact (coefficient=-2.3% and t-statistic=-2.38), as shown in the third column of Table 9, and leaves the qualitative conclusion unchanged.

The results in Tables 8 and 9 support the argument that the financing mechanism limited dealer margins in the post-tsunami period and restricted the ability of credit-constrained borrowers to purchase used Japanese cars.

5.3 Substitution Effects

Our central claim is that the post-tsunami demand surge for used Japanese cars arose from the scarcity of new Japanese cars. If this is correct, then demand should have increased

the most for low-mileage used Japanese cars, as they were the closest substitutes for new Japanese cars.

We test this claim by regressing wholesale prices on the triple interaction between the post-tsunami indicator, the used Japanese car dummy, and the mileage of the car (scaled by 10,000), along with all the related double interactions and the full set of controls. We find, in the first column of Table 10, that wholesale prices rose less, post tsunami, on high-mileage used Japanese cars (coefficient=-108.0 and t-statistic=-2.77) than on low-mileage used Japanese cars, consistent with the argument that the low-mileage vehicles were closer substitutes. We find that the retail prices of used Japanese cars did not vary significantly (coefficient=-61.1 and t-statistic=-1.57) with mileage, as detailed in column two of Table 10.

Our main substitution tests consider the differential responses of dealer margins and LTVs for high-mileage versus low-mileage Japanese cars. The impact of the triple interaction on dealer margins is positive and significant (coefficient=0.0073 and t-statistic=3.66), as displayed in the third column of Table 10. Dealer margins contracted most severely, post tsunami, for the low-mileage Japanese cars. The graphical counterpart of this result is displayed in Figure 6 which uses a threshold of 40,0000 miles to identify low- versus high-mileage vehicles. This cutoff was chosen as it is relatively close to the sample mean in Table 2. Figure 6 shows a sharp post-tsunami drop in dealer margins on low-mileage Japanese cars and no apparent impact on high-mileage autos.

LTV ratios also increase significantly with the triple interaction (coefficient=0.0070 and t-statistic=3.33), as we show in the fourth column of Table 10. That is, LTV ratios fell more for low-mileage vehicles. The strong and consistent results showing larger tsunami-related effects on both dealer margins and LTVs for lightly used vehicles support the claim that these autos served as more direct substitutes for new Japanese cars.

6 Conclusion

Scarcity is a common and important feature of markets, and we study its effects on the profits of intermediaries through an analysis of the U.S. used auto market. We show that after the 2011 tsunami, the disruption of new Japanese auto manufacturing led to a demand surge for used Japanese vehicles, resulting in elevated wholesale and retail prices. We find that during the post-tsunami period, the dealers that act as sales intermediaries for used Japanese cars experienced a 3.8% drop in profits and a 6.0% reduction in margins. The effects were particularly strong in thick markets in which there were a large quantity of vehicles available. These findings are consistent with the search theory argument that, during scarcity, intermediary profits decrease due to a bypass mechanism in which the introduction of new potential buyers makes it easier for sellers to circumvent dealers.

We find that intermediary margins were also affected by collateral constraints on buyer financing. Lenders recognized the post-tsunami price increases as temporary and therefore expected the cars' values to decline meaningfully, adversely affecting loan collateral. Theories of collateral suggest that under such conditions, financing will be reduced. Consistent with this, we confirm that LTVs decreased for used Japanese cars following the tsunami. The lower LTVs constrained the capacity of buyers to pay high prices, thereby reducing the intermediaries' ability to extract surplus from them; this constitutes a financing mechanism that limits intermediary profits during periods of temporary scarcity. We further show that credit-dependent buyers were less likely to purchase Japanese vehicles after the tsunami, as the financing mechanism suggests.

Dealers possess superior industry knowledge, a degree of market power, and relatively stable access to financing. In all these respects, they seem well-suited to thrive during an episode of scarcity. We show instead that when dealers are not indispensable, scarcity causes their market power to deteriorate and weakens their customers' financial positions, resulting in lower margins. This suggests that the 2020–2022 supply chain disruptions will generate

disparate profit outcomes for intermediaries, depending on the feasibility of private party sales and the credit constraints of their customers. In the used auto market in particular, the emergence of very large used car specialist firms and the stronger balance sheets of most consumers may combine to limit the negative impact of scarcity on dealer profits, relative to the 2011 post-tsunami experience.

Our findings highlight that collateral-based financing by consumers, unlike that of firms, can dampen the sensitivity of price responses to temporary shocks. A careful analysis of the complex effects of collateral limits is important for a full understanding of the propagation of price fluctuations through the economy and the relative impacts of those fluctuations on producers, intermediaries, and consumers.

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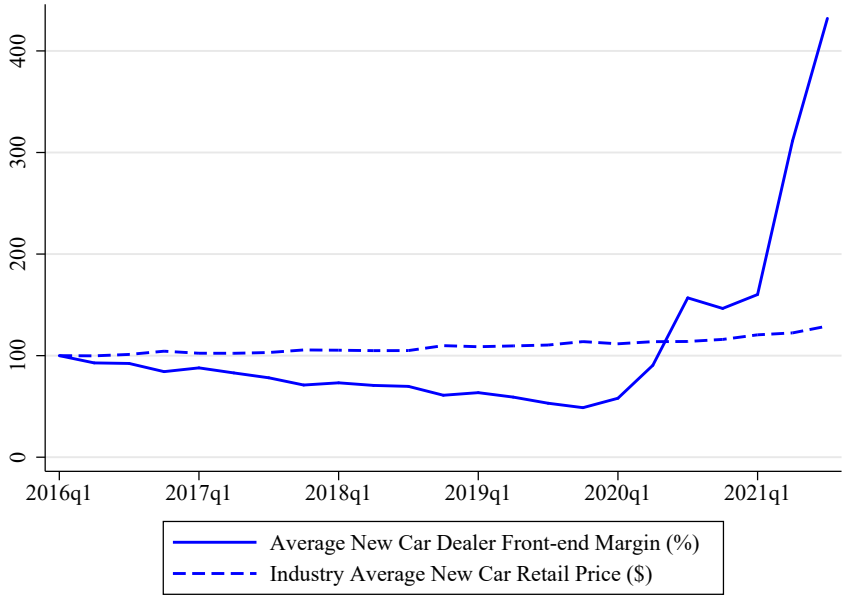
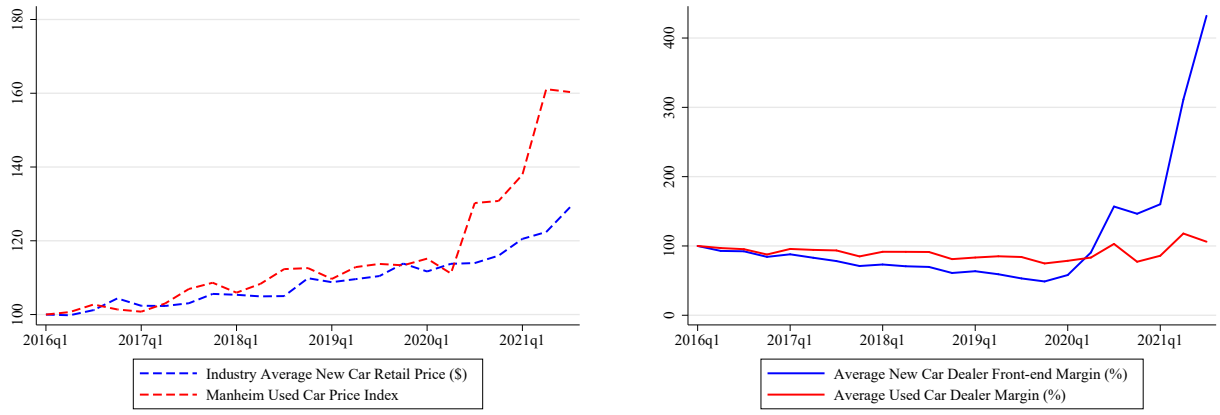


Figure 1. This figure reports new vehicle prices and dealership margins over 2016–2021 scaled so that Q1, 2016 (=100). The blue dashed line represents average retail transaction prices of new vehicle purchases excluding any manufacturers' incentives. The blue solid line represents the average front-end gross margins at U.S. dealerships on new car sales. Sources: Kelley Blue Book, Cox Automotive; Power Information Network, J.D. Power; Data accessed November 12, 2021



(a) New and Used Car Prices (2016 to 2021)

(b) New and Used Car Margins (2016 to 2021))

Figure 2. This figure reports (a) new and used car prices and (b) dealership margins by calendar quarter. The figures are scaled so that Q1, 2016 (=100). In Figure (a), the blue dashed line represents average retail transaction prices of new vehicle purchases excluding any manufacturers' incentives. The red dashed line represents the Manheim Used Car Index, which is an index of used car prices based on more than 5 million used vehicle transactions per year. Manheim reports that the used vehicle price index is independent of underlying shifts in the characteristics of vehicles being sold. In Figure (b), the blue solid line represents the average front-end gross margins at U.S. dealerships on new car sales. The red solid line represents average gross margins at U.S. dealerships on used car sales. Sources: Manheim, Cox Automotive; Power Information Network, J.D. Power; data accessed November 12, 2021.

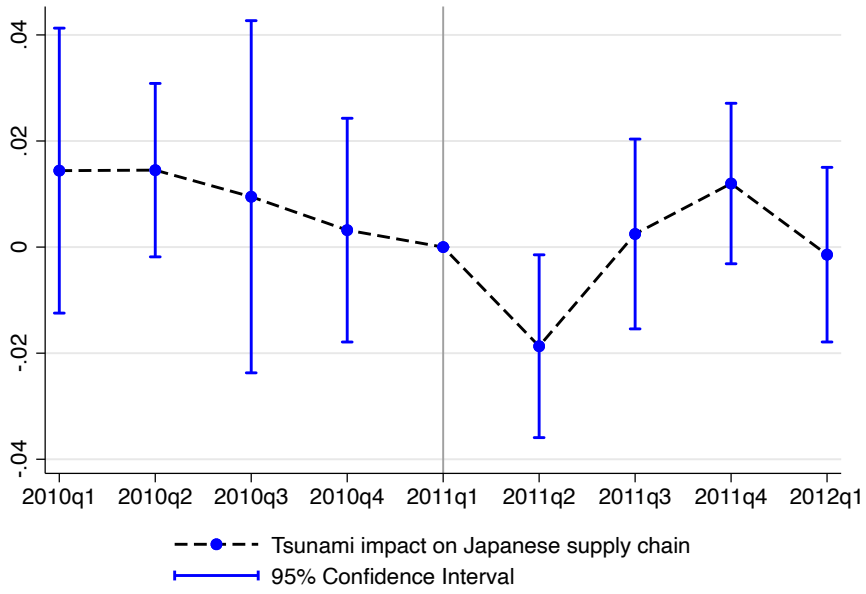
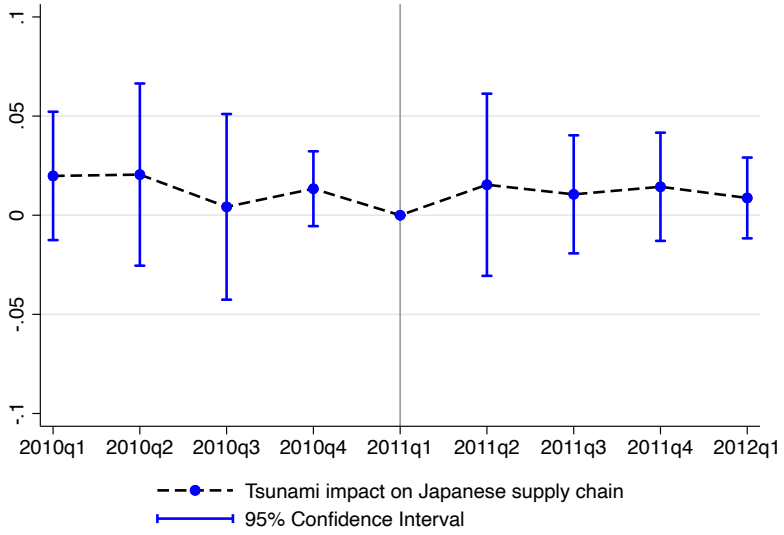


Figure 3. This figure reports differences in the dealership profit margins for the sale of used cars between Japanese makes and non-Japanese makes. The figure shows a discontinuity in the first quarter of 2011, the quarter in which the tsunami occurred (March 15, 2011). Controls include monthly income, credit score, and prior bankruptcy. Standard errors are double clustered by dealership and vehicle make.

(a) Dealer Margin for Low Sales Volume Vehicles



(b) Dealer Margin for Large Sales Volume Vehicles

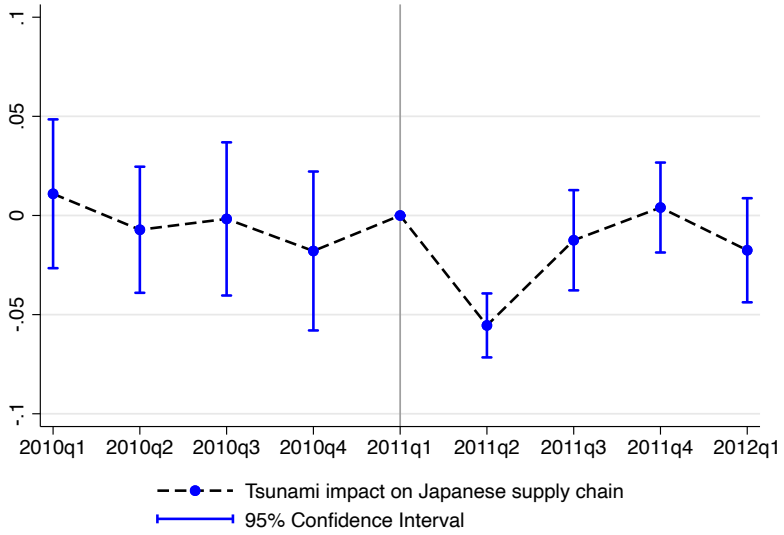


Figure 4. This figure reports differences in the dealership profit margins for the sale of used cars between Japanese makes and non-Japanese makes. The figure shows a discontinuity in the first quarter of 2011, the quarter in which the tsunami occurred (March 15, 2011). Panel a shows the results for sales of thinly traded vehicles (i.e., vehicles with annual sales volume less than 100,000 vehicles in 2010). Panel b shows the results for sales of thickly traded vehicles (i.e., vehicles with annual sales volume in excess of 100,000). Controls include monthly income, credit score, and prior bankruptcy. Standard errors are double clustered by dealership and vehicle make.

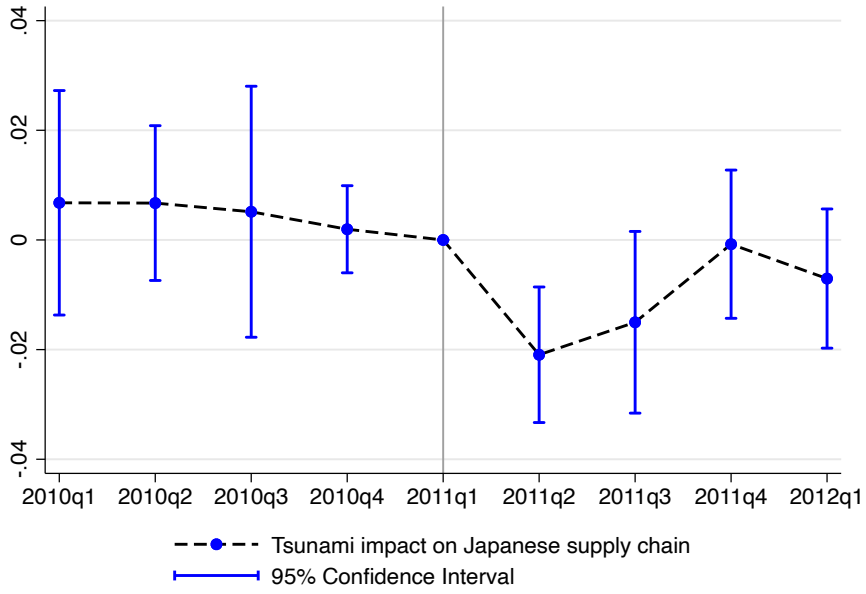
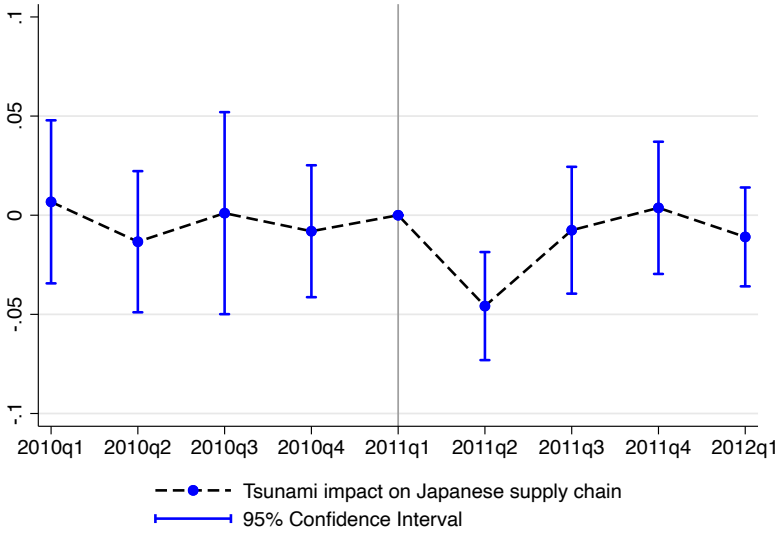


Figure 5. This figure reports differences in the loan-to-value ratio for the sale of used cars between Japanese makes and non-Japanese makes. The figure shows a discontinuity in the first quarter of 2011, the quarter in which the tsunami occurred (March 15, 2011). Controls include monthly income, credit score, and prior bankruptcy. Standard errors are double clustered by dealership and vehicle make.

(a) Dealer Margin for Low Mileage Vehicles Vehicles



(b) Dealer Margin for High Mileage Vehicles Vehicles

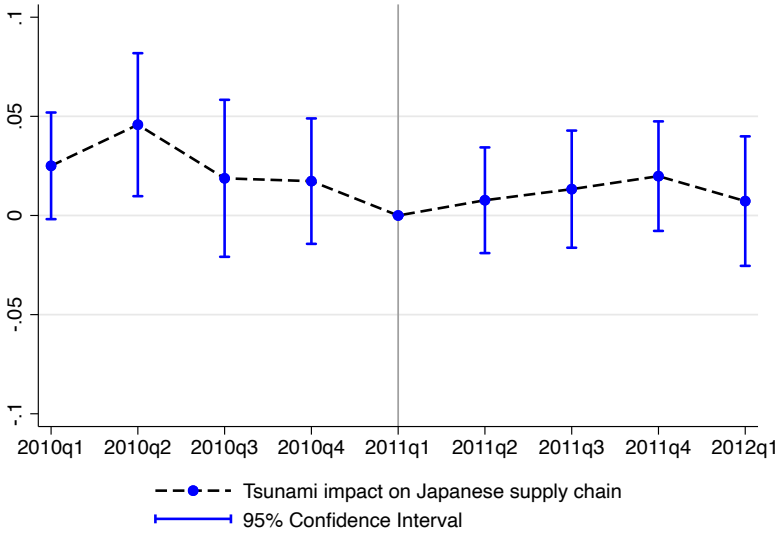


Figure 6. This figure reports differences in the dealership profit margins for the sale of used cars between Japanese makes and non-Japanese makes. The figure shows a discontinuity in the first quarter of 2011, the quarter in which the tsunami occurred (March 15, 2011). Panel a (b) shows the results for sales of vehicles with fewer (more) than 40,000 miles. Controls include monthly income, credit score, and prior bankruptcy. Standard errors are double clustered by dealership and vehicle make.

Table 2

Summary Statistics This table reports summary statistics for the sample of 61,694 auto sales transactions extended by 1,144 dealerships. Means and standard deviations are reported. The data summarizes vehicle, and dealership characteristics, and also borrower characteristics.

	mean	sd	count
Vehicle and Dealership Characteristics			
Japan	0.452	0.498	62580
Vehicle Wholesale Price	13816	3659	62580
Vehicle Retail Price	17539	3879	62577
Vehicle Mileage ('0,000)	4.138	2.092	62579
Vehicle Model 2010 Sales ('0,000)	1.323	1.100	62194
Dealer Profit Margin (%)	0.351	0.197	62577
Dealer Profit Margin ($)	4488	2307	62577
Borrower Characteristics			
Credit Risk	19.712	1.590	61096
Credit Score	533.999	44.744	61108
Loan-to-Value ratio	1.307	0.173	62574
Ch. 7 Bankruptcy	0.291	0.454	62580
Homeowner	0.094	0.292	62580
Gross Monthly Income (ln)	8.332	0.372	62580

Table 3

Difference in vehicle wholesale prices of Japanese- and non-Japanese-manufactured vehicles

This table reports estimates from panel regressions of vehicle wholesale prices of used cars on whether the vehicle is manufactured by a Japanese manufacturer during the tsunami period. The dependent variable is the wholesale price of the vehicle at the time of sale. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami is defined as one if the date of sale falls within March 15–Sept 15, 2011, and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep Var: Wholesale price	(1)	(2)	(3)	(4)	(5)
Japan * Tsunami	427.5***	427.2***	361.7***		
	(3.02)	(2.96)	(3.49)		
Tsunami	556.3***	-146.1	-82.3		
	(4.68)	(-0.96)	(-0.69)		
Year Trend	215.7***				
	(5.43)				
Credit score			0.49	0.49	0.49
			(1.64)	(1.66)	(1.65)
Ch. 7 BK prior to origination			93.0***	93.4***	93.2***
			(2.91)	(2.93)	(2.93)
Homeowner (=1) as of Date_Booking			-32.3	-32.7	-32.6
			(-1.28)	(-1.30)	(-1.29)
Gross Monthly Income (ln)			1164.9***	1165.0***	1165.6***
			(15.83)	(15.86)	(15.90)
10,000s Miles			-937.5***	-937.4***	-937.4***
			(-25.42)	(-25.41)	(-25.43)
Japan * Apr				305.7**	
				(2.62)	
Japan * May				409.9**	
				(2.24)	
Japan * Jun				531.7**	
				(2.65)	
Japan * Jul				574.6***	
				(3.08)	
Japan * Aug				339.8**	
				(2.42)	
Japan * 6 Month Prior to Tsunami					-68.1
					(-0.50)
6 Month Prior to Tsunami					0.73
					(0.00)
Adjusted R^2	0.407	0.414	0.671	0.671	0.671
Vehicle_Model	YES	YES	YES	YES	YES
Dealership	YES	YES	YES	YES	YES
Month	YES	YES	YES	YES	YES
Year	NO	YES	YES	YES	YES
MonthXYear	NO	YES	YES	YES	YES
JapanTrend	NO	NO	YES	YES	YES
MonthXJapan	NO	NO	YES	YES	YES
Observations	58773	58773	57397	57397	57397

Table 4

Difference in vehicle retail prices of Japanese- and non-Japanese-manufactured vehicles This table reports estimates from panel regressions of vehicle retail prices of used cars on whether the vehicle is manufactured by a Japanese manufacturer during the tsunami period. The dependent variable is the retail price of the vehicle at the time of sale. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami is defined as one if the date falls within March 15–Sept 15, 2011, and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year, and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep Var: Retail Price	(1)	(2)	(3)	(4)	(5)
Japan * Tsunami	274.1*	272.6*	221.6**		
	(1.82)	(1.79)	(2.06)		
Tsunami	593.2***	-22.9	31.4		
	(4.94)	(-0.18)	(0.28)		
Year Trend	377.6***				
	(8.22)				
Credit score			1.19***	1.20***	1.19***
			(2.99)	(3.00)	(2.99)
Ch. 7 BK prior to origination			102.5***	102.7***	102.7***
			(3.68)	(3.68)	(3.68)
Homeowner (=1) as of Date_Booking			-50.8*	-51.4**	-51.2**
			(-2.02)	(-2.05)	(-2.03)
Gross Monthly Income (ln)			1643.9***	1644.4***	1644.5***
			(22.82)	(22.86)	(22.88)
10,000s Miles			-971.1***	-970.9***	-971.1***
			(-27.15)	(-27.14)	(-27.17)
Japan * Apr				279.8*	
				(1.99)	
Japan * May				276.5	
				(1.41)	
Japan * Jun				149.0	
				(0.58)	
Japan * Jul				538.2***	
				(3.09)	
Japan * Aug				64.0	
				(0.53)	
Japan * 6 Month Prior to Tsunami					-132.8
					(-0.96)
6 Month Prior to Tsunami					23.4
					(0.14)
Adjusted R^2	0.404	0.411	0.645	0.645	0.645
Vehicle_Model	YES	YES	YES	YES	YES
Dealership	YES	YES	YES	YES	YES
Month	YES	YES	YES	YES	YES
Year	NO	YES	YES	YES	YES
MonthXYear	NO	YES	YES	YES	YES
JapanTrend	NO	NO	YES	YES	YES
MonthXJapan	NO	NO	YES	YES	YES
Observations	58770	58770	57396	57396	57396

Table 5

Difference in dealer profits of Japanese- and non-Japanese-manufactured vehicles This table reports estimates from a panel regressions of dealer profit margins in dollars on the sale of used cars on whether the vehicle is manufactured by a Japanese manufacturer during the tsunami period. The dependent variable is dealership margin measured in dollars. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami defined as one if the date falls within March 15–Sept. 15, 2011 and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year, and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep Var: Dealer Profits	(1)	(2)	(3)	(4)	(5)
Japan * Tsunami	-180.9**	-183.8**	-170.1**		
	(-2.18)	(-2.19)	(-2.41)		
Tsunami	1.87	93.7	56.0		
	(0.04)	(0.96)	(0.65)		
Year Trend	250.0***				
	(12.97)				
Credit score			4.80***	4.80***	4.80***
			(21.99)	(21.97)	(21.89)
Ch. 7 BK prior to origination			52.0*	51.9*	51.8*
			(1.82)	(1.82)	(1.83)
Homeowner (=1) as of Date_Booking			11.7	11.8	11.9
			(0.56)	(0.56)	(0.57)
Gross Monthly Income (ln)			1139.8***	1139.9***	1139.4***
			(24.18)	(24.22)	(24.25)
10,000s Miles			-0.63	-0.58	-0.71
			(-0.04)	(-0.04)	(-0.05)
Japan * Apr				-93.7	
				(-0.81)	
Japan * May				-221.3	
				(-1.62)	
Japan * Jun				-348.6**	
				(-2.67)	
Japan * Jul				-43.2	
				(-0.38)	
Japan * Aug				-209.6	
				(-1.64)	
Japan * 6 Month Prior to Tsunami					-44.1
					(-0.64)
6 Month Prior to Tsunami					-24.2
					(-0.18)
Adjusted R^2	0.178	0.183	0.223	0.223	0.223
Vehicle_Model	YES	YES	YES	YES	YES
Dealership	YES	YES	YES	YES	YES
Month	YES	YES	YES	YES	YES
Year	NO	YES	YES	YES	YES
MonthXYear	NO	YES	YES	YES	YES
JapanTrend	NO	NO	YES	YES	YES
MonthXJapan	NO	NO	YES	YES	YES
Observations	58770	58770	57396	57396	57396

Table 6

Difference in dealer percent margin of Japanese- and non-Japanese-manufactured vehicles This table reports estimates from panel regressions of dealer profit margins in percent on the sale of used cars on whether the vehicle is manufactured by a Japanese manufacturer during the tsunami period. The dependent variable is dealership margin measured in percent relative to the wholesale price of the vehicle. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami is defined as one if the date falls within March 15–Sept. 15, 2011, and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year, and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep Var: Dealer Margin	(1)	(2)	(3)	(4)	(5)
Japan * Tsunami	-0.022***	-0.022***	-0.021***		
	(-2.81)	(-2.79)	(-3.23)		
Tsunami	-0.016**	0.008	0.004		
	(-2.70)	(0.82)	(0.49)		
Year Trend	0.012***				
	(6.68)				
Credit score			0.00039***	0.00039***	0.00039***
			(18.12)	(18.11)	(18.02)
Ch. 7 BK prior to origination			0.0012	0.0012	0.0012
			(0.44)	(0.43)	(0.43)
Homeowner (=1) as of Date_Booking			0.0027	0.0027	0.0027
			(1.23)	(1.24)	(1.24)
Gross Monthly Income (ln)			0.060***	0.060***	0.060***
			(12.80)	(12.82)	(12.83)
10,000s Miles			0.025***	0.025***	0.025***
			(14.71)	(14.70)	(14.70)
Japan * Apr				-0.016*	
				(-2.01)	
Japan * May				-0.025*	
				(-1.74)	
Japan * Jun				-0.035***	
				(-3.31)	
Japan * Jul				-0.018	
				(-1.52)	
Japan * Aug				-0.026**	
				(-2.23)	
Japan * 6 Month Prior to Tsunami					-0.0030
					(-0.56)
6 Month Prior to Tsunami					0.0020
					(0.19)
Adjusted R^2	0.212	0.216	0.272	0.272	0.272
Vehicle_Model	YES	YES	YES	YES	YES
Dealership	YES	YES	YES	YES	YES
Month	YES	YES	YES	YES	YES
Year	NO	YES	YES	YES	YES
MonthXYear	NO	YES	YES	YES	YES
JapanTrend	NO	NO	YES	YES	YES
MonthXJapan	NO	NO	YES	YES	YES
Observations	58770	58770	57396	57396	57396

Table 7

Triple Interaction: Sales Volume This table reports estimates from panel regressions of wholesale price, retail price, and dealer profit margins on the triple interaction between *Japan*, *Tsunami*, and *Sales 2010 ('0,000)*. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami defined as one if the date falls within March 15–Sept. 15, 2011, and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year, and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Wholesale price	Retail price	Dealer Margin
Tsunami	53.9	154.6	0.0022
	(0.32)	(0.99)	(0.23)
Japan * Tsunami	-95.3	-49.6	-0.0033
	(-0.73)	(-0.34)	(-0.50)
Sales 2010 ('0,000) * Tsunami	-150.6	-132.0	0.0025
	(-1.43)	(-1.45)	(0.55)
Sales 2010 ('0,000) * Japan * Tsunami	329.8***	216.3**	-0.011**
	(2.76)	(2.04)	(-2.62)
Credit score	0.49	1.21***	0.00039***
	(1.64)	(2.98)	(18.17)
Ch. 7 BK prior to origination	91.5***	102.0***	0.0012
	(2.90)	(3.66)	(0.43)
Homeowner (=1) as of Date_Booking	-32.3	-51.8**	0.0027
	(-1.30)	(-2.07)	(1.22)
Gross Monthly Income (ln)	1166.0***	1645.3***	0.060***
	(15.77)	(22.66)	(12.80)
10,000s Miles	-937.6***	-971.1***	0.025***
	(-25.52)	(-27.23)	(14.66)
Adjusted R^2	0.671	0.644	0.272
Vehicle_Model	YES	YES	YES
Dealership	YES	YES	YES
Month	YES	YES	YES
Year	YES	YES	YES
MonthXYear	YES	YES	YES
JapanTrend	YES	YES	YES
MonthXJapan	YES	YES	YES
Observations	57216	57215	57215

Table 8

Difference in loan-to-value ratios of Japanese- and non-Japanese-manufactured vehicles This table reports estimates from panel regressions of wholesale price, retail price, and dealer profit margins on whether a low or high mileage vehicle is manufactured by a Japanese manufacturer during the tsunami period. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami is defined as one if the date falls within March 15–Sept. 15, 2011, and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year, and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep Var: LTV	(1)	(2)	(3)	(4)	(5)
Japan * Tsunami	-0.022***	-0.023***	-0.023***		
	(-4.72)	(-4.61)	(-6.08)		
Tsunami	-0.015***	0.0092	0.0062		
	(-3.57)	(1.21)	(0.98)		
Year Trend	0.015***				
	(9.42)				
Credit score			0.00014***	0.00014***	0.00014***
			(10.34)	(10.37)	(10.34)
Ch. 7 BK prior to origination			0.0043*	0.0043*	0.0043*
			(1.95)	(1.93)	(1.95)
Homeowner (=1) as of Date_Booking			-0.0070***	-0.0070***	-0.0070***
			(-2.99)	(-2.98)	(-2.99)
Gross Monthly Income (ln)			0.040***	0.040***	0.040***
			(8.92)	(8.95)	(8.94)
10,000s Miles			0.023***	0.023***	0.023***
			(14.32)	(14.33)	(14.33)
Japan * Apr				-0.016***	
				(-3.01)	
Japan * May				-0.013	
				(-1.31)	
Japan * Jun				-0.034***	
				(-4.38)	
Japan * Jul				-0.021**	
				(-2.11)	
Japan * Aug				-0.037***	
				(-4.15)	
Japan * 6 Month Prior to Tsunami					0.0030
					(0.49)
6 Month Prior to Tsunami					-0.0070
					(-0.76)
Adjusted R^2	0.245	0.248	0.303	0.303	0.303
Vehicle_Model	YES	YES	YES	YES	YES
Dealership	YES	YES	YES	YES	YES
Month	YES	YES	YES	YES	YES
Year	NO	YES	YES	YES	YES
MonthXYear	NO	YES	YES	YES	YES
JapanTrend	NO	NO	YES	YES	YES
MonthXJapan	NO	NO	YES	YES	YES
Observations	58767	58767	57391	57391	57391

Table 9

Purchases of Japanese makes by high vs. low risk borrowers This table reports estimates from panel regressions of an indicator if the car purchase is from a Japanese manufacturer during the tsunami period on borrower risk characteristics. The dependent variable, *Japan*, is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu, and zero otherwise. Tsunami is defined as one if the date falls within March 15–Sept. 15, 2011, and zero otherwise. The independent variable, *Credit Risk*, is a proprietary score from the lender indicating the riskiness of the borrower. Higher numbers indicate higher risk borrowers. Year trends are reported as well as fixed effects for month of the year, year, or month-year as reported. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Dep Var: Japan	(1)	(2)	(3)
Tsunami	-0.030**	0.44**	0.46**
	(-2.57)	(2.29)	(2.39)
Credit Risk	-0.055***	-0.053***	-0.053***
	(-5.55)	(-5.48)	(-5.49)
Year Trend	0.042***	0.042***	
	(3.93)	(3.94)	
Tsunami * Credit Risk		-0.024**	-0.023**
		(-2.46)	(-2.38)
Adjusted R^2	0.044	0.044	0.044
Month	YES	YES	YES
Year	NO	NO	YES
MonthXYear	NO	NO	YES
Observations	57402	57402	57402

Table 10

Triple Interaction: Vehicle Miles This table reports estimates from panel regressions of wholesale price, retail price, dealer profit margins and loan-to-value ratios on the triple interaction between *Japan*, *Tsunami*, and *Vehicle Mileage ('0,000)*. *Japan* is an indicator equal to one if the vehicle was manufactured by Toyota, Nissan, Lexus, Infiniti, Subaru, Honda, Scion, Mazda, Mitsubishi, Suzuki, Acura, or Isuzu. The regressions control for borrower characteristics (credit score, homeownership, prior bankruptcy, and income) and vehicle characteristics (mileage). Tsunami defined as one if the transaction date falls within March 15–Sept. 15, 2011, and zero otherwise. Fixed effects are included for make-model, dealership, month of the year, year, month-year, and month-Japan, as indicated. The regressions also control for a *Japan* dummy interacted with the year trend. Standard errors are double clustered by dealership and vehicle make. T-statistics are shown in parentheses below the coefficient estimates. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Wholesale price	Retail price	Dealer margin	LTV
Tsunami	-173.5	-274.9	-0.0100	-0.0028
	(-0.88)	(-1.28)	(-0.97)	(-0.36)
Japan * Tsunami	831.5***	463.5***	-0.055***	-0.055***
	(4.98)	(2.87)	(-4.87)	(-4.99)
10,000s Miles * Tsunami	21.5	72.8*	0.0034**	0.0022
	(0.61)	(1.99)	(2.72)	(1.56)
Japan * 10,000s Miles	213.7***	205.9***	-0.0061**	-0.0057**
	(6.27)	(6.75)	(-2.44)	(-2.21)
Japan * 10,000s Miles * Tsunami	-108.0***	-61.1	0.0073***	0.0070***
	(-2.77)	(-1.57)	(3.66)	(3.33)
Credit score	0.50	1.20***	0.00039***	0.00014***
	(1.67)	(2.98)	(18.01)	(10.26)
Ch. 7 BK prior to origination	94.7***	104.0***	0.0011	0.0043*
	(2.95)	(3.67)	(0.42)	(1.95)
Homeowner (=1) as of Date_Booking	-35.6	-53.3**	0.0028	-0.0069***
	(-1.45)	(-2.17)	(1.31)	(-2.95)
Gross Monthly Income (ln)	1165.9***	1644.8***	0.060***	0.040***
	(15.94)	(22.78)	(12.90)	(8.96)
10,000s Miles	-1053.9***	-1088.4***	0.028***	0.026***
	(-50.34)	(-44.77)	(21.12)	(22.77)
Adjusted R^2	0.674	0.647	0.273	0.304
Vehicle_Model	YES	YES	YES	YES
Dealership	YES	YES	YES	YES
Month	YES	YES	YES	YES
Year	YES	YES	YES	YES
MonthXYear	YES	YES	YES	YES
JapanTrend	YES	YES	YES	YES
MonthXJapan	YES	YES	YES	YES
Observations	57397	57396	57396	57391

Internet Appendix to: "Intermediary Profit in a Time of Scarcity"*

For Online Publication
February 2022

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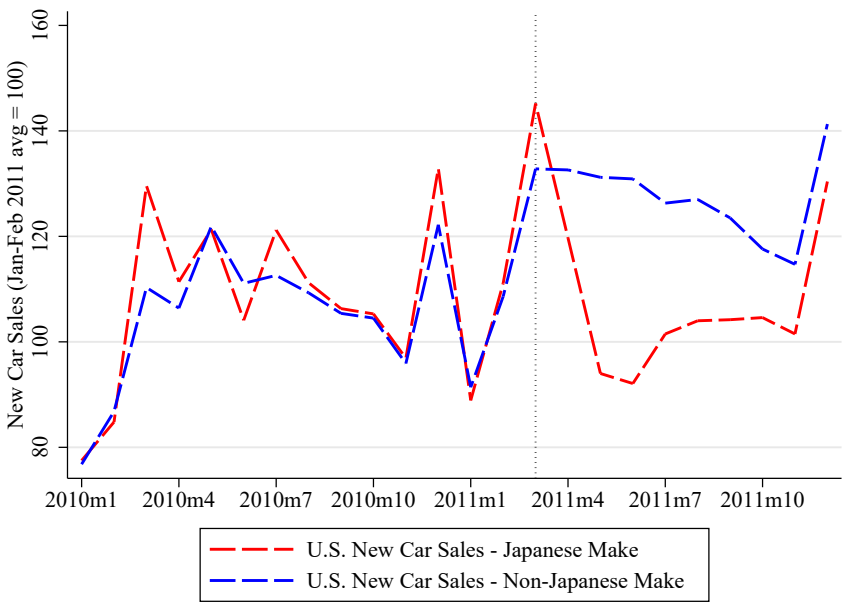

Figure IA.1

This figure reports monthly new car sales volume from January 2010 to December 2011, scaled so that January 2010 (=100). The red (blue) dashed line represents of new vehicle sales of Japanese (non-Japanese) manufacturers. The black dotted line represents the tsuanmi event in March 2011. Sources: Automotive News, Crain Communications

Table IA.1

Change in automotive production by country. Column 1 reports the change in production for 2011 relative to the 2010 rate. Column 2 reports the change in global market share of each country from 2010 to 2011. Source: Automotive News, Crain Communications

	(1)	(2)
China	4.2%	+1.3%
Japan	-13.9%	-16.2%
Germany	5.8%	+2.8%
South Korea	9.2%	+6.2%
India	7.4%	+4.4%
USA	9.0%	+6.0%
Rest of World	5.2%	+2.3%