The Empirical Effects of Minimum Resale Price Maintenance

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This study is the first to estimate the empirical effects of minimum resale price maintenance (RPM) across a broad variety of products. We analyze conflicting theories using an exogenous state-level law change resulting from the 2007 *Leegin* Supreme Court decision. In states where RPM contracts are treated under the more relaxed rule-of-reason standard, prices increased. We estimate the welfare impact and find that, in aggregate, consumers are worse off in the rule-of-reason states. Though welfare decreased and prices increased, we find little support for the broad application of any particular theory.

JEL Classification: L42, D22, L10, D40, K21

For much of the past century, minimum resale price maintenance (RPM) contracts have been illegal in the United States. For that reason, empirical analysis on the effect of vertical price agreements is sparse. As noted in the literature, "the absence of significant empirical evidence is surely the greatest remaining impediment to a comprehensive analysis of RPM" (Marvel and McCafferty, 1985). This paper advances the analysis of RPM by providing the first estimates of empirical effects across a broad range of goods and by conducting tests of multiple candidate theories.

There is disagreement in the existing literature over the effects of minimum RPM on consumer welfare. The welfare-reducing view contends that vertical

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price agreements allow firms to exert market power. Several studies, such as Shepard (1978), Ornstein and Hanssens (1987), and Mueller and Geithman (1991) find evidence of such anticompetitive effects in limited product markets.[1] The opposing view is that RPM contracts can solve market failures and incentivize non-contractible behavior by retailers, enhancing consumer welfare. Ippolito (1991) identifies many RPM cases where procompetitive theory is likely to apply.

What has yet to be understood is the relative impact of the procompetitive and anticompetitive effects to consumers. Antitrust policy is determined at the state or federal level, and as such, it impacts products that have great variety in market structure. There is almost certainly heterogeneity in effects across different kinds of products. We contribute to the literature by offering the first paper to quantify the aggregate impacts of RPM across a broad variety of products. Under our assumptions, we identify the policy-relevant treatment effect of relaxing the legal treatment of RPM to a rule of reason. This effect is of interest to consumer welfare advocates such as state legislators and attorneys general, as well as to manufacturers and retailers that may want a broader understanding of the legal landscape when considering vertical price agreements.

Further, we identify products that are likely to have been affected by the change in RPM policy using a statistical approach. Within the products we identify, we test specific implications of different theories. This detailed, theory-based analysis of empirical effects is essential for understanding the motivation behind RPM contracts. This paper provides the first such analysis across several competing theories. Though our findings on this front are limited by the data, we hope that it serves as a guide to future research.

The 2007 Supreme Court decision in *Leegin*[2] established that minimum RPM agreements should be judged under a rule-of-reason standard, rather than being per se illegal[3] at the federal level. Because states vary both in their adherence to federal precedent and in their statutes regarding vertical price agreements, the decision resulted in state-by-state variation in the treatment of minimum RPM. This state-level variation allows us to identify the impact of minimum RPM on the prices and quantities of various products.

Using a relatively new dataset on consumer purchases over time and by state, we design a natural experiment to estimate the effects of *Leegin* on product

[1] For the purposes of this paper, we use a consumer welfare standard for the terms anticompetitive and procompetitive.

[2] *Leegin Creative Leather Prods., Inc. v. PSKS, Inc.*, 551 U.S. 877 (2007).

[3] A per se violation means that the conduct is prohibited whether or not there is evidence of harm.

prices and quantities. Treatment states are those that adhere strongly to federal precedent and have no state laws forbidding vertical price agreements. In these states, *Leegin* changed the legal standard for judging RPM to a rule of reason. Control states are those that have laws forbidding vertical price agreements. These laws supersede the *Leegin* decision and limit its impact on the legal standard in control states.

Our results indicate that prices and quantities have indeed changed as a result of *Leegin*. We find that 8.4 percent of products exhibited a statistically significant price increase in our treatment states, with a median increase of 5.3 percent. Additionally, 9.4 percent of products experienced declining quantities. As a result of *Leegin,* products were most likely to see a price increase combined with a quantity decrease. This combination indicates movement along the demand curve and suggests the exercise of market power. We estimate an overall price increase of 0.33 percent and an overall quantity decrease of 3.8 percent.

In addition to estimating the effects on prices and quantities, we estimate how the change in policy affects consumer welfare. We use a simple demand model to estimate a decrease in revenue and a net consumer welfare decrease of 3.1 percent.

Multiple candidate theories explain the motivations, costs, and benefits of RPM contracts, with no empirical studies to test which theories are representative of the real world.[4] In the words of Mathewson and Winter (1998), "What is the empirical evidence to differentiate across these candidate explanations? The answer is that there is not a great deal of evidence." Our main results give weight to the anticompetitive theories of minimum RPM. In addition, we test the implications of the leading procompetitive and anticompetitive theories, and we do not find broad support for the predictions of any particular theory. We believe that our results are muted by observing a mix of multiple theories across different products, but we do find that the retailer concentration is an important determinant of effective RPM policy in general. We hope these results guide future research into product-specific effects of RPM and help state antitrust divisions and legislators to assess the benefits and costs of vertical pricing agreements.

[4]For a detailed discussion, see Elzinga and Mills (2008, 2010) and Gilligan (1986).

1. Background

1.1. Dr. Miles and Leegin

After the Supreme Court's 1911 decision in *Dr. Miles*,[5] RPM was considered a per se violation under Section 1 of the Sherman Act, with some statutory exemptions.[6] In the 1950s, state fair trade laws provided firms with opportunities to create RPM contracts. During this period, the use of such contracts was extensive. Studies of RPM in the 1950s—a period of legal minimum RPM in the U.K. as well—found that almost 44 percent of consumer expenditures in the U.K. and up to 10 percent of expenditures in the U.S. were on goods subject to RPM (Overstreet, 1983). In 1975, the Consumer Goods Pricing Act[7] put state fair-trade laws back within the prohibitions of the Sherman Act, rendering RPM once more illegal. For a legal history of minimum RPM in the U.S., see Moloshok (2007).

On June 28, 2007, the Court ruled in *Leegin* that minimum RPM was no longer per se illegal.[8] In the decision, the Court acknowledged that minimum RPM agreements can increase interbrand competition and encourage the provision of demand-enhancing services. Such vertical price agreements can benefit consumers. The Court maintained that per se treatment should be reserved for categories of agreements that would almost always damage competition. As a result of *Leegin*, antitrust investigators must provide evidence of quantifiable competitive harm in order to file suit.

Roughly one year after *Leegin*, reports of "price-fixing" among firms utilizing minimum RPM began hitting newsstands. Firms mentioned in these articles include manufacturers and suppliers of childcare and maternity gear, light fixtures and home accessories, pet food and supplies, and rental cars. Sony has publicly used minimum RPM on electronics such as camcorders and video game consoles, and as of mid-2012, Sony and Samsung began enforcing minimum RPM on their televisions.[9] Other retailers do not comment on whether or not they enter minimum RPM agreements, perhaps due to negative consumer sentiment associated

[5] *Dr. Miles Med. Co. v. John D. Park & Sons*, 220 U.S. 373 (1911).

[6] See Overstreet (1983). Limited exceptions were later allowed under *Colgate* and *General Electric*. The *Colgate* decision allowed a firm to unilaterally announce a given price and withhold products from discounting retailers.

[7] Pub. L. No. 94-145, 89 Stat. 801

[8] The Supreme Court made a similar decision regarding maximum RPM in *State Oil Co. v. Khan*. 522 U.S. 35 (1997)

[9] See Ann Zimmerman, "Sony, Samsung Rein In Retailers' Discounts on TVs," *The Wall Street Journal*, May 23, 2012, available at http://online.wsj.com/article/SB10001424052702304791704577420383631021786.html (accessed November 2012).

with higher prices.[10]

This policy change has generated activity from legislators at the state and federal level. In October of 2009, Maryland passed a bill explicitly making minimum RPM agreements illegal under state law.[11] In response to a Kansas trial court decision, the Kansas House of Representatives passed a bill in 2012 explicitly allowing a rule-of-reason treatment of minimum RPM. The bill was subsequently defeated in the State Senate. Since *Leegin*, Senator Herb Kohl, whose family founded and operated the national Kohl discount chain until the 1980s, has on three separate occasions introduced bills in the Senate "to restore the rule that agreements between manufacturers and retailers, distributors, or wholesalers to set the minimum price below which the manufacturer's product or service cannot be sold violates the Sherman Act."[12]

Prominent antitrust institutions and consumer welfare advocates have also argued for the repeal of *Leegin*. The bills introduced by Senator Kohl in 2009 were endorsed by former FTC Chairman Robert Pitofsky and then-FTC Commissioner Pamela Jones Harbour. In addition, the attorneys general of 38 states submitted joint letters to Congress urging enactment of the 2009 Senate and House bills—up from the 34 state attorneys general supporting the 2007 Senate bill.[13] Consumer groups and non-governmental organizations urging the legislative repeal of *Leegin* include the American Antitrust Institute, the Consumer Federation of America, the Consumers Union, the National Consumers League, and the U.S. Public Interest Research Group.[14]

The *Leegin* decision has sparked interest in the antitrust community, extending to international policy as well.[15] However, limited empirical work has been done since the *Leegin* decision. The only recent empirical study of minimum RPM looks at video game prices after the enactment of the 2009 law that banned

[10] See, for example, Joseph Pereira, "Price-Fixing Makes Comeback After Supreme Court Ruling," *The Wall Street Journal*, August 18, 2008, available at http://online.wsj.com/article/SB121901920116148325.html (accessed November 2012).

[11] Annotated Code of Maryland Commercial Law §11-204(a)(1) (2009).

[12] Discount Pricing Consumer Protection Act, S. 2261, 110th Cong. (2007); Discount Pricing Consumer Protection Act, S. 148, 111th Cong. (2009); Discount Pricing Consumer Protection Act, S. 75, 112th Cong. (2011). Similar bills were also introduced into the House: Discount Pricing Consumer Protection Act of 2009, H.R. 3190, 111th Cong. (2009); Discount Pricing Consumer Protection Act of 2011, H.R. 3406, 112th Cong. (2011). None of the bills had been brought to a vote.

[13] See Table 15 for a list of states associated with the letters to Congress.

[14] See Joint Letter to Subcommittee on Courts and Competition Policy, Committee on the Judiciary, House of Representatives (May 18, 2009), http://www.antitrustinstitute.org/files/RPM%20Letter%20to%20Johnson5.18_051920091041.pdf (accessed July 2012).

[15] See, for example, Competition Policy International's second October issue of the Antitrust Chronicle.

RPM in Maryland, using nearby Virginia as a control (Bailey and Leonard, 2010). The authors find no statistically or economically significant effect on prices. This is not surprising, as a law enacted in a single state to ban RPM is likely to reflect an environment already hostile to such agreements. Indeed, Maryland's Assistant Attorney General Alan Barr was an outspoken opponent to minimum RPM at the time of the law's passage. Our paper contributes to the discussion by providing a broad empirical analysis and evaluations of different theories.

1.2. Theories of Minimum RPM

The theoretical literature on resale price maintenance can be divided into procompetitive and anticompetitive theories, where "procompetitive" means demand-enhancing and "anticompetitive" means an exercise in market power (i.e., a shift along the demand curve). For an insightful analysis of the theories, see Klein (2009).

1.2.1. Procompetitive Theories

Price increases accompanied by increasing quantities are indicative of procompetitive uses of minimum RPM, as they are likely the result of increases in demand, increased distribution, or increased inventories.[16] The following theories explain different ways this can occur.

- Enhancing Retailer Services by Solving the Free-Rider Problem

  By restricting price competition between retailers, RPM can incentivize firms to engage in nonprice competition by offering additional services, which may include knowledgeable personnel, in-store advertisements and displays, and post-sale services. These services increase consumer demand, which in turn increases product sales, benefiting the retailer, the manufacturer, and the consumer. The free-rider problem argues that some of these welfare-enhancing services may not be offered without the enforcement of minimum RPM. For example, shoppers may pass through service-providing retailers to gather information, only to purchase the good from a discount

[16] As explained in Marvel and McCafferty (1985) and Deneckere et al. (1996, 1997), it is not necessarily the case that prices will increase as a result of RPM. If the costs of retailer services are fixed rather than variable in the long-run, and if these services result in an isoelastic increase in demand, prices will not increase. Additionally, under the Adequate Inventories theory discussed below, the quantity-weighted average price may decrease under RPM. If prices were to fall after RPM was legalized, it would be difficult to determine if RPM was the cause. However, it still would be evidence that the rule-of-reason legality of RPM is not harmful.

retailer that can price lower as a result of saving on services. By preventing discounting, RPM eliminates the discount retailer's price advantage, solves this free-rider problem, and can increase total welfare.[17] For products where these services are important, such as televisions, computers, and refrigerators, RPM can result in a increase in quantity in addition to an increase in price.[18] Minimum RPM has become increasingly important for brick-and-mortar stores like Best Buy due to the recent growth of online retailers and warehouse club operators, such as Amazon.com, eBay, and Costco Wholesale.[19] Online retailers may be reluctant to sign RPM agreements, as a key comparative advantage over their brick-and-mortar competitors is lower prices Fabricius (2007).

- Enhancing Retailer Services via Implicit Contracts

  Klein and Murphy (1997) interpret a manufacturer's RPM policy as a "contract enforcement mechanism" to ensure that retailers supply demand-enhancing services that are not contractible and are not likely to exist otherwise. Due to monitoring costs, it is not practical to write and enforce contracts based on the retailer's performance of these services. RPM incentivizes firms to promote the products in order to meet a quantity threshold, which is easier for the manufacturer to monitor than the actual services. Dealers are motivated to comply by the future premiums received from the increased price. This use of RPM solves cases where dealers engage in free riding between the dealer and the manufacturer, in addition to the free riding among dealers discussed above.

- Increasing Retailer Distribution

  When demand is positively related to the number of retail outlets, the manufacturer has an incentive to increase the distribution of the product. The higher margin guaranteed by RPM allows outlets that would otherwise be unprofitable to sell the product. Klein (2009) provides the release of Windows 95 as an example, where Microsoft more than doubled the number of outlets from the previous release of Windows to obtain "the broadest possible distribution." Consumers benefit because they can obtain the product

[17] See Scherer (1983) and Klein (2009) for a theoretical justification of this argument. Marvel and McCafferty (1984) extend the argument beyond services into product quality, arguing that retailers with established reputations effectively certify quality for products they sell, and that RPM combined with a manufacturer's refusal to sell to low-quality stores prevents free-riding on retailer reputation.

[18] See Telser (1960) and Mathewson and Winter (1998) for more details on this theory.

[19] See Lieber and Syverson (2012) for growth rates of the online retail sector, and Basker (2007) for a discussion of Costco's growth.

more easily and they may receive additional value if reputation or network effects are present. We test this theory via two measures of distribution in Section 4.3.

- Adequate Inventories under Uncertain Demand

  Manufacturers may use the increased margins from RPM to incentivize retailers to carry larger inventories. RPM prevents retailers from slashing prices to near zero in the state of low demand, which limits losses and encourages retailers to increase their inventory. Increased inventory reduces shortages when demand is high and benefits consumers as a whole.[20] Without minimum RPM, individual retailers have an incentive to drop prices in the state of low demand, which does not increase the aggregate quantity sold but instead steals sales from other retailers. This outcome is similar to the outcome describe in Prescott's "hotels" model (Prescott, 1975). If shortages occur, minimum RPM can be Pareto improving, and the quantity-weighted average price may even fall.[21] If retailers carry sufficient inventory on their own accord, implementing minimum RPM can transfer welfare from consumers to manufacturers without affecting total welfare. The adequate inventory theory of RPM is particularly applicable when demand is highly variable or when inventories are perishable or costly to carry. We run a test for this theory in Section 4.4.

1.2.2. Anticompetitive Theories

The *Leegin* Court identified four sources of potential anticompetitive effects. If RPM is being used anticompetitively, we would expect to find price increases followed by quantity decreases. Such effects are evidence that RPM is being used to transfer welfare from consumers to either manufacturers or retailers, or both. The following theories explain how this can happen. In Section 4.2 we analyze the empirical evidence for each of these potential causes.

- Downstream Collusion

  RPM may be used to help facilitate the establishment and enforcement of a price-fixing cartel of retailers. This requires that the cartel of retailers

[20] There are distribution effects for consumers. Consumers purchasing the product when demand is low pay a higher price under minimum RPM, whereas consumers purchasing the product when demand is high benefit from fewer shortages.

[21] Without RPM, non-discount retailers offset losses from unsold products in the low state of demand by charging higher prices in the high state of demand. See Deneckere et al. (1996, 1997) for more details on this theory.

have monopsony power to ensure compliance from the manufacturer.[22]

- Upstream Collusion

  Manufacturers in a cartel could use RPM as a vehicle to reduce the profitability of offering secret discounts to retailers, thus reducing the benefit of defection. RPM also could discourage a manufacturer from cutting prices to retailers, which would remove the concomitant benefit of cheaper prices to consumers.[23] With many retail prices now available online, defection may be easier to detect. Websites such as MAPtrackers.com are devoted to "creating an easy and effective way for the monitoring of product prices across the Internet."[24]

- Exclusion of Rivals

  Rather than using additional margins to incentivize retail services, larger manufacturers may use RPM to reduce retailer incentives to carry competing products, particularly from smaller rivals or new entrants. In variations of this theory, accommodating entry results in lower retailer profits.[25]

- Forestalled Innovation

  A dominant retailer may request RPM from a manufacturer to "forestall innovation in distribution that decreases costs," thus preventing consumer-enhancing innovation by competing retailers.[26]

1.3. Minimum Advertised Price Policies as an Alternative to RPM

In practice, many firms implement minimum advertised price (MAP) policies. These policies are often attempts to actually enforce RPM, and in these instances no distinction can be made between the two kinds of policies. In many cases, however, MAP policies intend to do what the name would suggest: enforce a minimum advertised price, but allow for discounting once the customer is inside of the store. MAP policies of this nature may achieve the same procompetitive ends as RPM policies, as the restriction on advertised prices limits intrabrand competition among retailers. In addition to value-adding services, retailers can use in-store discounts to further enhance interbrand competition. We look at the support for MAP policies combined with in-store discounts in Section 4.5.

[22] See Overstreet (1983) and Rey and Vergé (2010) for formal treatments of this theory.
[23] See Jullien and Rey (2007) and Rey and Vergé (2010) for formal treatments of this theory.
[24] http://maptrackers.com/about_us.php, accessed August, 2012.
[25] See Marvel and McCafferty (1985) and Asker and Bar-Isaac (2013) for more details on this theory.
[26] See Overstreet (1983) and Marvel and McCafferty (1985) for more details on this theory.

2. Data and Empirical Methodology

2.1. Experimental Design

We evaluate price and quantity changes using a natural experiment: the law change of the *Leegin* Supreme Court decision. We use the variation in existing state law on minimum RPM to identify the impact of a regime change from per se illegality to a rule-of-reason standard. Fifteen states fall into our treatment group ("Rule of Reason" states), and nine states are identified as a control group ("Per Se" states). We use a regression analysis that controls for pre-period differences, common trends, state fixed effects, and macroeconomic variables. Our pre period is the year before the *Leegin* decision, and we analyze a two-year period starting six months after the decision.

We claim that the observed effects are from a change in the legal environment. Though we do not directly observe contracts, there is anecdotal evidence that these agreements are taking place (see Section 1). Furthermore, agreements are not necessary to cause firms to change behavior. The legal right to create and enforce such contracts may be enough to raise prices. For example, it is less costly for firms to unilaterally set price floors[27] as prosecutors and plaintiffs must now show consumer harm in addition to demonstrating that the unilateral action was in fact an agreement. Finally, we believe that our instrument is exogenous. The state statues regarding vertical price agreements and the ties between state and federal law were in place for decades before the Supreme Court decided to hear *Leegin*.[28] We do not expect states to have adopted language guiding judges to adhere to federal precedent in anticipation of a federal decision on minimum RPM. Any increase in prices is likely due to the change in legal environment resulting from *Leegin*, rather than the years-old politics that led to state-level adherence to federal law or restrictions on price agreements.

2.2. Assigning States to Treatment and Control

By selecting a group of states that are likely to treat minimum RPM under the rule of reason, we can observe how prices changed in the states where firms can most safely take advantage of the permissive environment provided by *Leegin*. These states are our treatment group. Similarly, by selecting a group of states likely to treat minimum RPM as per se illegal, we can observe how prices have

[27] Unilateral price floors were previous allowed under the *Colgate* exception.

[28] Many of these state statutes specifying the ties to federal antitrust law or specifically outlawing minimum RPM contracts were passed in the 1970s. See Duncan and Guernsey (2007) for details on the relevant state laws and statutes.

changed absent a change in law. These states are our control group. To assign states to one of these two groups, we follow the legal analysis of Duncan and Guernsey (2007) and Lindsay (2007, 2009). States with existing statues that effectively prohibit RPM presumably did not change the legal treatment as a result of *Leegin*, and are in the control group. States that, by law, adhere strongly to federal precedent, form the treatment group. These states should have adopted the rule of reason espoused in the *Leegin* decision.

For firms to benefit from agreements enforcing minimum RPM in a given region, there must be reason to believe that their behavior will not be deemed illegal by federal or state authorities. After *Leegin*, firms can safely assume that the mere existence of a minimum RPM agreement is not illegal at the federal level. Due to differences in state laws, however, minimum RPM is not treated uniformly across the country. Every state has its own antitrust statutes or consumer protection laws that regulate anticompetitive conduct, and most states do not specify whether they treat vertical pricing agreements as per se illegal. In addition, there are varying degrees to which courts in a given state are expected to follow federal precedent when interpreting statutes and laws. Some states have language in their the business and commercial codes guiding state judges to closely adhere to federal precedent. Texas law, for example, provides that its antitrust laws "shall be construed in harmony with federal judicial interpretations of comparable federal antitrust statutes to the extent consistent with this purpose." In other states, a lack of any relevant statutes or decisions from the highest state court makes it uncertain how courts will use federal precedent to interpret state laws. See Table 15 for a summary of federal adherence and minimum RPM law by state, and see Lindsay (2009) for a chart of state statues and legal decisions related to minimum RPM.

While no state had explicitly outlawed minimum RPM as of 2007, there were a number of states whose laws indicated that they would treat instances of minimum RPM as per se illegal. For example, California's Cartwright Act prohibiting trusts has been described as creating "perhaps the strongest case to be made for an existing state prohibition on minimum RPM agreements" (Lindsay, 2007). According to Duncan and Guernsey (2007), there are "eleven states whose antitrust and trade regulation statues appear to go beyond the Sherman Act in prohibiting vertical price-fixing."[29] For all but two of these states, there was no legal challenge to minimum RPM that would affect firm behavior during the

[29]The states are California, Connecticut, Kansas, Mississippi, Montana, Nevada, New Hampshire, Ohio, South Carolina, Tennessee, and West Virginia. Maryland passed a law in 2009 explicitly prohibiting minimum RPM, but as this was near the end of our data, it was excluded.

relevant period (2007-2009).[30] For these nine states, their respective attorneys general signed letters to both the House of Representatives and the Senate in support of the 2007 and 2009 bills outlawing minimum RPM. With the exception of the Nevada attorney general, they also signed the amicus brief in *Leegin* urging the Supreme Court to keep minimum RPM per se illegal under the Sherman Act. These acts by the attorneys general indicate that they are not friendly to firms engaging in minimum RPM. We group together these nine states as Per Se states, and we assume that firms do not change their behavior in these states as a result of *Leegin*.

Of the states that do not have state-specific laws against vertical pricing agreements, eighteen have laws that strongly or moderately strongly adhere to federal precedent as a guide for interpreting their own antitrust and consumer protection laws (Duncan and Guernsey, 2007; Lindsay, 2009).[31] We exclude Michigan from this group because it joined Illinois and New York in a 2008 lawsuit against Herman Miller regarding suggested resale prices.[32] Though the case ultimately ended in a settlement, the lawsuit indicated that the complaining states disapprove of vertical pricing restrictions. We also exclude Alaska and Hawaii because they are not included in the Nielsen data. The remaining fifteen states[33] make up the Rule of Reason group. Figure 2 shows a map of the United States with the Per Se group indicated in dark gray and the Rule of Reason group in light gray. Each group is diverse with respect to geographic location, which gives us greater confidence that our results are general.

2.3. Nielsen Consumer Panel Data

To perform the analysis in this paper, we use a relatively new longitudinal dataset: the Nielsen Consumer Panel Data.[34] These data include purchases across all retailers that are logged by consumers using an optical scanner. They

[30] In *Spahr v. Leegin Creative Leather Products*, No. 07-CV-187, 2008 WL 3914461 (E.D. Tenn. Aug. 20, 2008), a federal district court in Tennessee dismissed a complaint alleging that Leegin's RPM agreements with independent resellers violated federal and Tennessee law, effectively rejecting per se treatment of minimum RPM. In *O'Brien v. Leegin Creative Leather Products Inc.,* No. 04-CV-1668 (Kan. 8th Dist. July 9, 2008), a Kansas trial court rejected a per se analysis of a minimum RPM agreement and concluded that the state Supreme Court would apply the rule of reason. Because these cases were decided during the relevant period, we ignore these two states in our analysis.

[31] See Table 15 for this identification by state.

[32] *New York v. Herman Miller, Inc.*, 08-cv-2977 (S.D.N.Y. Mar. 25, 2008).

[33] Alabama, Delaware, Florida, Idaho, Iowa, Massachusetts, Missouri, Nebraska, New Mexico, Oklahoma, Pennsylvania, Rhode Island, Texas, Virginia, and Wisconsin.

[34] The dataset is available through the Kilts-Nielsen Data Center at The University of Chicago Booth School of Business. Information on availability and access to the data is available at http://research.chicagobooth.edu/nielsen.

include a number of variables per item, such as Universal Product Code (UPC), description, brand, price, retail chain code, and the first three digits of the retailer zip code.[35] The intent of the data is to provide a representative sample of consumer purchases between 2004 and 2009 that are intended for personal, in-home use. Nielsen estimates that roughly 30 percent of household consumption is accounted for by the categories in the dataset. Importantly for this paper, the dataset captures sales for products previously subjected to minimum RPM by manufacturers.[36] Further, the theories of RPM are quite general; firms have an incentive to exercise market power for any product, and nearly all retail outlets engage in promotional activity of some kind, whether through product placement or employee training.

Each of the 1.4 million unique products is organized by Nielsen into one of ten departments, and one of 1,082 product modules.[37] See Table 1 for summary statistics by department. Modules are fairly specific categories, such as "Brandy," "Light Beer," "Sleeping Aids," etc. For our analysis, we evaluate changes separately for each product module. Because the theories of RPM concern products that are branded by the manufacturer, we ignore private label or store-brand products sold exclusively by a single retailer. Roughly 29% of products are considered private label, and they are particularly represented in the Dairy, Deli, and Frozen Foods Departments.

2.4. Identifying Changes in Prices and Quantity

We implement a separate difference-in-differences model for each product module to determine the price change resulting from the *Leegin* decision:

$$\begin{aligned}\ln P_{jrst} = \alpha + \beta_1 ror_s + \beta_2 L_t + \gamma(ror_s \times L_t) + \phi \cdot macro_{st} \\ + \sum_{j'} \delta_{j'} prod_{j'} + \sum_{r'} \eta_{r'} ret_{r'} + \sum_{s'} \xi_{s'} st_{s'} + \sum_{t'} \lambda_{t'} wk_{t'} + \varepsilon_{jrst}.\end{aligned} \quad (1)$$

We control for macroeconomic variables to account for differential macroeconomic variation over the period analyzed. In this equation, $\ln P_{jsrt}$ is the log

[35] Store IDs and three-digit zip codes are provided for 33.7 percent of the 55.5 million trips in our dataset and 46 percent of the product-level observations used in our main regressions. For the other trips, we impute states using the state of the household. Within our dataset, for trips where we have the store location, 95.2 percent of purchases are made within the same state of the household. By using store zip codes where they are available and consumer states otherwise, this should result in a roughly 3 percent mismatch for states.

[36] See Overstreet (1983) and Ippolito (1991) for examples of products that allegedly have been subject to minimum RPM. See Gilligan (1986) for a list of manufacturers alleged to have utilized minimum RPM.

[37] Department code 99 ("Magnet Data") consists of 36 products without a UPC code. As there is limited information about these products, they are not used in our analysis.

price of product j sold by retailer r in state s and week t; ror_s is an indicator variable that takes the value of 1 if s is in the Rule of Reason treatment group, and 0 for states grouped as Per Se[38]; L_t is an indicator variable that takes the value of 1 after the *Leegin* decision (June 28, 2007); $macro_{st}$ is a vector of state-month log measures of total population, population unemployed, per-capita income, and gasoline prices; $prod_{j\prime}$ is an indicator variable that takes on the value of 1 if $j = j'$ and zero otherwise; $ret_{r'}$ is an indicator variable that takes on the value of 1 if the product is sold by retailer r and zero otherwise; $st_{s'}$ is an indicator variable that takes on the value of 1 if the product is sold in state s and zero otherwise; $wk_{t'}$ is an indicator variable that takes on the value of 1 if $t = t'$; ε_{jrst} is an error term. The standard difference-in-differences coefficients on ror_s and L_t are redundant with time and state fixed effects; we drop the extra covariates during estimation.

To calculate the price of a product, we take a quantity-weighted average price by state for each retailer. Our time period consists of the twelve months before *Leegin* and the two years starting six months after *Leegin*. We leave out the six months following *Leegin*, as we consider this to be a transition period for firms choosing to implement minimum RPM. Only products with sales in both the first three and last three months of our time period are included to control for any change in the mix of products offered. We run regressions with product, retailer, state, and time fixed effects, along with the aforementioned BLS and gas price covariates. We are interested in the estimate for γ, which can be interpreted as the post-*Leegin* impact on prices in states with a rule-of-reason regime. We convert the coefficients, which are in log points, to percentages. We use a similar model to determine the change in quantity resulting from the *Leegin* decision:

$$\begin{aligned}\ln Q_{jrst} = \alpha + \beta_1 ror_s + \beta_2 L_t + \mu(ror_s \times L_t) + \phi \cdot macro_{st} \\ + \sum_{j'} \delta_{j'} prod_{j'} + \sum_{r'} \eta_{r'} ret_{r'} + \sum_{s'} \xi_{s'} st_{s'} + \sum_{t'} \lambda_{t'} wk_{t'} + \varepsilon_{jrst}.\end{aligned} \tag{2}$$

Here, $\ln Q_{jrst}$ is the log quantity of product j purchased at retailer r in state s and week t. Our coefficient of interest in (2) is now μ, to reduce confusion. For both models, we drop regressions with zero degrees of freedom.

Following the recommendation of Cameron et al. (2008), we implement a Wild bootstrap procedure to evaluate the significance of our estimates. We run restricted regressions with the null hypothesis of no effect imposed (i.e., γ and μ set equal to 0). We then create artificial data by applying Rademacher weights to the resulting residuals by cluster. We run regressions (1) and (2) using 200

[38] See Section 2.2 for details on state treatment.

samples of the bootstrapped data to construct p-values.

3. Results for Prices and Quantities

In this section, we address the question of whether the *Leegin* decision had an impact on manufacturer and retailer behavior at the basic level of prices and quantities.

3.1. Summary of Price Changes

A simple examination of product prices, shown in Figure 1, reveals that prices have increased in Rule of Reason states relative to Per Se states since *Leegin*.[39] Each time series is simple average across Laspeyres quantity-weighted price indices for each product module.[40] The price paths are similar before the *Leegin* decision and diverge starting in 2008. The similarity in the pre-decision price paths mitigates concerns that treatment is exogenous.

We examine whether the changes are statistically significant in Table 2. For each module and treatment group, we use the Laspeyres indices to compare the first half of 2007 and the last half of 2009 by department. The overall difference in mean price is 1.1 percent, which has a p-value of 0.036 for the one-sided test. This differential change in prices is consistent with the increased use of RPM policies.

3.2. Main Results - Price and Quantity Effects

Our main results—those from equations (1) and (2)—can be found in Tables 3 and 4, respectively. We find a large number of statistically significant price increases across departments, both as a percentage of all modules and as relative to the number of price decreases.

Of the 986 modules tested, 8.4 percent exhibited statistically significant price increases in Rule of Reason states. On the other hand, only 5.3 percent of modules saw significant price decreases. Further, 58.6 percent of all price coefficients were positive. The magnitude of the median significant price increase within each department ranged from 1.9 percent to 10.2 percent. The results with respect to quantities were also notable: 9.4 percent of modules exhibited a significant

[39] The time series is calculated in six-month periods. The base period is the first half of 2007, before the *Leegin* decision. We keep only UPCs that have positive quantities in the first half of 2007 and the second half of 2009, for both treatment and control.

[40] Quantities are adjusted using a projection factor provided by Nielsen to account for sample bias within each Scantrack market.

quantity decrease, whereas fewer than 2 percent of modules had a significant quantity increase. A list of modules with significant price or quantity changes can be found in Appendix C.

We expect heterogenous effects on prices and quantities; for this reason, we evaluate each regression separately. For all departments except Fresh Produce, positive price coefficients were more often paired with negative quantity coefficients.[41] Our findings provide some support for the anticompetitive theories discussed in Section 1.2. It should be noted that price increases and quantity decreases may still be consistent with increased demand, as long as the demand-enhancing effect is outweighed by firms exercising market power.

3.3. Aggregate Impact

The results in the previous section estimate the impact separately by product module. From a broader standpoint, we seek to understand the overall impact of the *Leegin* decision on prices and quantities and the overall significance of the results reported in the previous section. We identify three outcomes for prices: (1) the percentage of modules with price increases; (2) the percentage of modules with statistically significant price increases; and (3) the percentage of modules with statistically significant price decreases. We focus on analogous outcomes for quantities. To analyze the joint distribution of price and quantity changes, we calculate the percentage of coefficient pairs that fall in each of the four quadrants of the price-quantity plane. We use the same aggregate measures from the 200 iterations of our randomization test to construct a simulated p-value.

Table 5 summarizes the significance of our aggregate statistics. Treatment increased the proportion of positive price coefficients and significant positive price coefficients at the 10 percent significance level. Our point estimates suggests that quantities fell, though this occurred at low levels of significance. Notably, the p-value of finding the proportion of price increases and quantity decreases that we find is 0.105, which suggests that treatment causes the combinations of price increases and quantity decreases to occur more often. We conclude that states in the Rule-of-Reason regime experienced statistically significant price increases, and that these price increases are most often combined with quantity decreases. Our findings are consistent with the anticompetitive hypothesis that a legal environment favorable to vertical price agreements will result in a exercise of market power and a decrease in consumer surplus.

Finally, we report the overall effect on prices and quantities in Table 6. We

[41] For the distribution of price and quantity coefficients, see Table 16 in the Appendix.

pool coefficients using a standard meta-analysis approach,[42] which weighs each point estimate by the inverse of the variance. We estimate an overall increase in prices of 0.33 percent and an overall decrease in quantities of 3.8 percent. The aggregate change in prices is significant at $\alpha = 0.10$, and it is economically meaningful as it averages the effects across affected and unaffected products.

4. Evaluating the Theories

The previous section provides empirical support for the claim *Leegin* led to more RPM contracts and prices increases. In this section, we will evaluate various hypotheses for the motivation and the impact of RPM contracts. For this purpose, we identify qualifying RPM modules as product modules that exhibit statistically significant price increases. These are the products for which we have some evidence that the contracts were in force. We focus on this subset to restrict our analysis to changes within the RPM framework.

Given that we are presenting a large number of test statistics, we expect to find several of them that would meet a significance threshold. Thus, we take a more cautious approach, looking at the overall picture rather than assigning great importance to any one result. Additionally, many of these test suffer from lack of power due to measurement error and a small number of candidate RPM modules. For this reason, the picture we paint should serve as guidance to future research with more detailed data.

4.1. The Effect on Quantities

Anticompetitive theories of RPM state that the primary purpose of the contract is to exercise market power, restricting quantity below the competitive level. Procompetitive theories argue for the demand-enhancing benefits of RPM, which is often, but not necessarily, associated with a quantity increase. In our data, we observe that products that have a statistically significant price increase are associated with declining quantities, with an average decline of 2.5 percent.

Table 7 shows the pooled quantity coefficient for qualifying RPM modules. The resulting estimate is suggestive but not statistically significant. The most significant declines occur in Dry Grocery and General Merchandise, with declining quantities of 3.85 percent and 4.82 percent. These estimates are toward the lower tail of the bootstrapped distributions, with significance values of 0.190

[42] We were not able to run the pooled regressions due to computational limitations and the size of the dataset.

and 0.165, respectively. As mentioned above, these tests may suffer from lack of power, as we have few potential RPM modules within each department.

Declining quantities and increasing prices are consistent with a decrease in consumer welfare. We look at the overall impact of the policy change on consumer welfare in Section 5.

4.2. Market Power

The exercise of market power is easier in more concentrated markets, as there are fewer participants to cheat on the agreement and monitoring costs are lower. However, any contract is easier to enforce in a more concentrated market due to the same reasons. In Section 1.2, we outline four cases that the Court identified as potential causes of anticompetitive behavior. To evaluate each potential cause, we use a related measure of concentration. For each product module, we calculate the pre-period five-firm concentration ratio (C5) and HHI[43] for both retailers and manufacturers across all Rule of Reason states. We also calculate the share of the largest manufacturer and the largest retailer, which would correspond to the dominant manufacturer theory of exclusion of rivals and the dominant retailer theory of forestalled innovation, respectively. We regress our measures of concentration on the estimated coefficients for prices and quantities for both all products and qualifying RPM products.

Table 8 displays the results. The evidence suggests that within qualifying RPM products a higher retailer concentration leads to greater price increases. The coefficient on retailer C5 is highly significant, and the coefficient on retailer HHI is meaningful. The HHI coefficient of 0.266 implies that moving from a market structure of four equal-share firms to two equal-share firms is associated with an RPM-associated price increase of 6.9 percent.[44] This fits with the idea that RPM policies are easier to implement when a manufacturer has fewer distributors, as the manufacturer can better monitor the distribution network. A positive relationship between price increases and concentration alone is not evidence of anticompetitive behavior. It does support the idea that a more concentrated market is able to more effectively implement an RPM policy, but this policy may be used for either procompetitive or anticompetitive ends. Though the quantity point estimates for retailer concentration are all negative, none of them are significant, giving weak support for the downstream collusion theory.

On the manufacturer side, the price coefficients on C5 and HHI are smaller than their retailer counterparts, though the the price coefficient on C5 is also sig-

[43] We use these measures due to their ubiquitousness in the industrial organization literature.
[44] This change in market structure increases HHI by 0.25.

nificant. Greater concentration among manufacturers is associated with greater price increases. This supports the idea that it is easier to implement an effective RPM policy as a manufacturer when you have fewer competitors. The coefficients on quantities are small and not significant. As the relationship between manufacturer C5 and quantity change is positive, the data do not support the theory of upstream collusion.

Neither the share of the largest retailer nor the share of largest manufacturer is strongly related (in a statistical or economic sense) to price or quantity changes, giving little support to dominant firm theories such as forestalled innovation.

Given the magnitude on price coefficients on the manufacturer and retailer measures of C5 and HHI, it appears that retailer concentration is a more important determinant of the effectiveness of an RPM policy than manufacturer concentration. This finding is in line with anecdotal evidence we heard in interviews with retailers and manufacturers.

4.3. Increased Distribution

If demand increases with the distribution of the product, then we would expect RPM contracts to allow retail outlets to carry the product that could not profitably do so otherwise. We use two measures of distribution to test this theory. The first measure is the number of unique store IDs that sell a UPC-level product in a month in a given state. Unfortunately, we only have store IDs for 46 percent of the data, thus this measure comes with a large amount of error. Missing store IDs are given the same code, so observations with missing stores are treated as coming from the same store in a given state-month period. The second measure is the number of unique household zip codes that purchase an individual product in a month in a given state. One advantage of this measure is that we have it for every observation. We create these measures for qualifying RPM modules, then run separate regressions by department to calculate the change due to *Leegin* according to the following model:

$$\begin{aligned} Outlets\, measure_{jst} = \alpha + \beta_1 ror_s + \beta_2 L_t + \psi(ror_s \times L_t) + \phi \cdot macro_{st} \\ + \sum_{j'} \delta_{j'} prod_{j'} + \sum_{s'} \xi_{s'} st_{s'} + \sum_{t'} \lambda_{t'} month_{t'} + \varepsilon_{jst}. \end{aligned}$$

As shown in the equation above, we control for fixed effects at the product, state, and month levels, as well as macroeconomic variables.

Table 9 presents the results for both measures. There is little evidence that increased distribution occurs across a broad variety of products, as the point es-

timates are near zero in most of the departments. Only in Fresh Produce is the increase meaningful, and it is not significant. This department sees an increase of approximately 8 percent in households and 13 percent in zip codes. The coefficient of 0.504 implies that, on average, half of the Fresh Produce products are carried in a new store across the Rule of Reason states. As this department contains the most perishable products, the higher margins due to RPM may encourage stocking items that are bought too infrequently to be profitable otherwise. An increase in retail outlets suggests distributional welfare effects that will be ignored in our welfare analysis in Section 5.

4.4. Adequate Inventories

As noted by Carlton and Dana (2008), firms will respond to demand uncertainty "by stocking low cost, low quality products as an alternative to high cost, high quality products that are occasionally stocked out." This is one explanation of the existence of private label products, which have historically been considered lower-quality substitutes of branded products.[45] Therefore, in the event of a shortage on a branded product, we expect to see some consumers substituting towards the private label alternative. Under the theory of adequate inventories discussed above, retailers reduce the frequency of shortages on branded products by holding greater inventories of goods subject to minimum RPM. This results in an increase in expected quantity sold across demand states.[46] If manufacturers are using minimum RPM to ensure adequate inventories are held by retailers, we would expect the share of branded products sold to increase relative to private-label substitutes.

To test this prediction, we implement a difference-in-differences model by department to determine the change in the share of branded products sold after *Leegin:*

$$\begin{aligned} Branded\_share_{ist} = \alpha + \beta_1 ror_s + \beta_2 L_t + \psi(ror_s \times L_t) + \phi \cdot macro_{st} \\ + \sum_{i'} \zeta_{i'} mod_{i'} + \sum_{s'} \xi_{s'} st_{s'} + \sum_{t'} \lambda_{t'} month_{t'} + \varepsilon_{ist} \end{aligned}$$

where $Branded\_share_{ist}$ is the quantity sold of branded products in module i divided by the total quantity sold in module i in state s during month t. We control for product module, state, retailer, and month fixed effects, as well as

[45] Perceptions of private label product quality has improved among consumers in recent years, as discussed on Nielsen's website: http://www.nielsen.com/us/en/insights/press-room/2008/nearly_three-quarters.html (accessed October 2012).

[46] See Deneckere et al. (1996), Section II.C

the macroeconomic variables described in Section 2.4. To create our individual observations, we aggregate separately all branded and private label product quantities by retailer-module-state-month. We include only product modules for which the aggregated branded share is between 0.05 and 0.95 in the pre period. This allows us to ignore modules for which there is no relevant mix of private and branded labels, and hence no substitution to private label due to stock outs of branded products.[47] We restrict our analysis to qualifying RPM modules, recognizing that the use of RPM to increase inventories could theoretically reduce the average price of goods sold.

The results of our regression can be found in Table 10. Overall, there is no indication that this mechanism is an important aspect of RPM, as the average estimated change is near zero.

4.5. MAP Policies and In-Store Discounts

For a manufacturer, enforcing a minimum advertised price while simultaneously allowing in-store discounts is one way to prevent free riding between retailers but increase interbrand competition once the customer is inside the store. From our discussions with manufacturers, we understand that the use of MAP policies increased greatly after the *Leegin* decision, which gave much more legal freedom to implement these agreements. While some of these policies were de facto RPM policies, many resulted in a increase in advertised prices only.[48] If MAP policies were indeed encouraged by the *Leegin* decision, then we would expect to see greater increases in list prices in Rule of Reason states. To test this, we repeat our main price regressions from Equation 1 with list prices used in place of the actual transaction price. We obtained similar results to our main transaction price regressions, with 8.6 percent or the 986 products seeing significant price increases and 5.4 percent seeing significant price decreases.

Though the percent of significant price increases is not substantially different from the results of the transaction price regressions, the products that had a significant and positive coefficient changed. There were 26 products that had a significant price increase for the list price but not for the transaction price. We call these products "MAP products," as they are candidates for the procompet-

[47] This removes roughly 31 percent of state-retailer-module-month observations, prior to further restricting the data to qualifying RPM modules.

[48] Innovation in discounting, often against the wishes of the manufacturer, is one way that MAP policies intended as RPM policies were in effect MAP policies. In online markets, innovations included a) presenting a new price at checkout and b) presenting an item-specific coupon next to the purchase button. For in-person sales, the tried-and-true method of price negotiation is still in use.

itive story of firms using in-store discounts to promote intrabrand competition. Conversely, there were 24 products that had a significant price increase for the transaction price but not for the list price. One explanation for this finding is that these products experienced discounting prior to the *Leegin* decision. Afterward, firms used retail price maintenance to enforce prices closer to the list price. We label these products "restricted discount products." Table 11 provides a list of products for each type.

Both MAP products and restricted discount products had an overall increase in transaction price of 1.7 percent.[49] Though the average price increases were the same for both types of products, the average quantity changes were quite different: -1.7 percent for restricted discount products, compared to -3.6 percent for MAP products. Though differences across product markets need to be accounted for, this difference in quantity changes may indicate that consumers are sensitive to the advertised price and not entirely informed about the true transaction price. MAP products had an average list price increase of 2.4 percent, whereas restricted discount products only had a list price increase of 1.0 percent. The implied elasticity with respect to the advertised price, holding the transaction price fixed, is -1.4. Our findings suggest that RPM policies used to limit discounting may be more procompetitive than MAP policies, as an increase in advertised prices outweighs the potential demand-enhancing effects of MAP policies.

5. Welfare Effects

In this section, we estimate the impact of a rule-of-reason regime on consumer welfare in the twenty-four states in our analysis. While we find more price increases and quantity decreases than other price-quantity combinations in Section 3, our methods above do not compare the magnitudes of these changes across products. In order to capture the aggregate effects of these price and quantity changes, we use our regression results and a simple demand system to evaluate the effect on consumer welfare.

For each module, we simulate counterfactual price and quantity changes, where the mean and standard deviation of these changes are determined by the point estimates ($\hat{\gamma}$, $\hat{\mu}$) and standard errors ($\hat{\sigma}_\gamma$, $\hat{\sigma}_\mu$) from regressions (1) and (2). We calibrate two heuristic demand systems (constant elasticity and linear) to the observed and counterfactual equilibria. In effect, we construct demand curves for each product module at the state-retailer-week level. We make the simplify-

[49] The average is calculated here using inverse variance weights.

ing assumptions that demand for products are independent across modules and that the elasticity does not change between the counterfactual states. The latter is akin to choosing the same markup for both equilibria. While we ignore potentially meaningful substitution patterns, our methodology can be thought of as a weighted aggregation of the changes in prices and quantities, where the weights are based on a demand approximation. The difference in consumer surplus between these two demand systems is our estimate of the impact of a rule-of-reason regime. Appendix D details our methodology and calculations.

In either demand system, the assumption of unchanging equilibrium elasticity implies that the change in consumer surplus is proportional to the change in revenue from the observed equilibrium to the counterfactual equilibrium.[50] Consumer surplus can be calculated for each product, using a different elasticity for each product. If we assume identical elasticities across the aggregated products, the percent change in consumer surplus is identical to the percent change in aggregate revenue from those products.

Our simulations estimate a range of consumer welfare loss by department of -7.6 percent to 0.8 percent, with a total of -3.1 percent across departments.[51] Table 13 shows further details by department. In these table, we show the counterfactual change in revenue due to a rule-of-reason regime, and we provide the standard deviation to account for the randomness in our estimates. We also provide state-by-state estimates of the change in revenue. State-by-state welfare effects fall between -3.6 percent and -2.2 percent.

The value in revenue in Table 13 is equivalent to the consumer welfare loss under the assumption of constant elasticity demand and 50 percent margins. It is straightforward to use the multipliers provided in Table 12 to calculate the welfare loss for different demand and elasticity combinations. The multiplier ranges from 2 to 1/20 under plausible demand elasticity assumptions. These multipliers give a range in total welfare loss of $571 million to $22.8 billion.

Our results show that across both states and departments, minimum RPM was generally welfare-reducing. As our results aggregate varying welfare effects across a broad variety of goods, the use of minimum RPM may be welfare-enhancing for some individual products. The only department that shows an increase in revenue and consumer surplus is Fresh Produce. This estimate should be treated with caution, as the standard deviation is approximately equal to the point estimate. One reason for increased revenues for Fresh Produce is increased

[50] A proof of this is provided in Appendix D.

[51] Different elasticity assumptions will result in different weightings by product or by department.

distribution, as shown in Section 4.3.

As shown in Table 14, consumer surplus impacts are directionally consistent across states. Differences in state-level impacts occur due to variation in the bundle of goods consumed across states. Notably, the counterfactual welfare impacts are greater in the Rule of Reason states compared to the Per Se states. This reflects the fact that our methodology does not incorporate all of the behavioral responses to a policy change. The Rule of Reason states show a larger change because consumers are more likely to substitute to lower-price products, thus lowering revenues even further. This difference further supports the broad impact of RPM policy and indicates that the magnitudes of our estimates of the impact on welfare are likely upper bounds.

6. Conclusion

Our analysis shows that a legal environment friendly to minimum RPM contracts results in price increases across a broad variety of consumer goods. The price increases are generally accompanied by decreases in output and net harm to consumers. We find that a more favorable legal environment for RPM results in a loss in consumer welfare. To be clear, we do not claim these results necessarily stem from the execution and enforcement of explicit minimum RPM agreements between manufacturers and retailers, but rather from a more permissive legal environment where allegations of anticompetitive uses of minimum RPM are examined on a case-by-case basis.

Though we capture a significant portion of household expenditures across a broad variety of goods, future research that includes nearly all household spending would be valuable in evaluating the overall impact of the change in RPM policy. More comprehensive data may also be able to answer the question of which consumer goods demonstrate welfare-enhancing effects empirically, a result that has so far eluded the literature.

We test implications from several of the prevailing theories about RPM, and we find little evidence for the broad applicability of any particular theory. However, we find evidence that retailer concentration is more relevant than manufacturer concentration for implementing an effective RPM policy, regardless of the intention of the agreement. As there is heterogeneity in effects across different goods, there is an opportunity for future research to more precisely determine which theory applies best to each good. Such research would allow for a more nuanced estimate of the welfare impact of the policy change and would help inform antitrust enforcement authorities as to which particular RPM agreements

are anticompetitive.

We find some evidence that firms use RPM policies to enforce minimum advertised prices while allowing in-store discounts. Our work suggests future research that combines estimates of consumer response to advertised prices with RPM theory to evaluate the welfare impacts of MAP policies and understand optimal in-store discounting.

There are reasons to believe that the effects of *Leegin* would be less pronounced than if minimum RPM received a rule-of-reason treatment with certainty across the U.S. The lack of uniformity of laws across states increases the risk of litigation and complicates contract negotiations between large manufacturers and national retailers, increasing the cost of implementing minimum RPM agreements. If these costs are different for firms intending to increase retailer services than they are for firms seeking to exert market power, then our results may not extend to a national rule-of-reason treatment.

Firms may be still be held liable for anticompetitive behavior resulting from RPM contracts. Because of this, they may not be not acting as anticompetitively as they might if RPM were per se legal. Still, whether through undetected anticompetitive behavior or unsuccessful retailer service strategies, a simple welfare analysis of the rule-of-reason environment shows that the harm to consumers outweighs the benefits.

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Table 1: Summary Statistics of Nielsen Consumer Panel Data

				Percent	Products per Module		
Dept Code	Dept. Description	Modules	Products	Private Label	25th Percentile	Median	75th Percentile
0	Health & Beauty Aids	173	242,564	26.4	163	463	1,455
1	Dry Grocery	416	499,943	34.0	140	419	1,130
2	Frozen Foods	85	83,209	39.3	94	443	1,171
3	Dairy	45	63,782	40.2	463	879	1,756
4	Deli	16	23,667	37.8	349	646	2,106
5	Packaged Meat	13	23,981	25.8	229	1,725	2,108
6	Fresh Produce	21	18,378	16.8	214	406	1,068
7	Non-Food Grocery	136	172,308	28.8	97	403	1,285
8	Alcoholic Beverages	30	40,303	2.4	250	566	922
9	General Merchandise	147	256,283	19.2	62	287	1,493
	Total	1,082	1,424,418	28.8	125	441	1,301

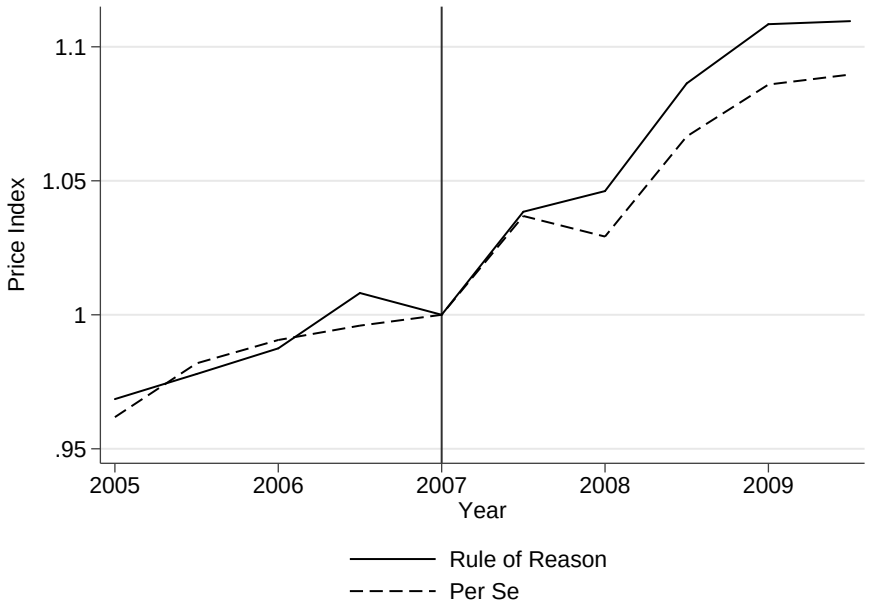
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 2: Mean Percent Price Changes of Modules in Rule of Reason vs. Per Se States (2007-2009)

Dept Code	Dept. Description	Per Se	Rule of Reason	Difference
0	Health & Beauty Aids	2.9	4.9	2.0
1	Dry Grocery	11.1	13.2	2.2
2	Frozen Foods	9.1	15.6	6.5
3	Dairy	6.7	8.8	2.0
4	Deli	7.9	12.2	4.4
5	Packaged Meat	9.2	11.4	2.2
6	Fresh Produce	0.6	-0.4	-1.0
7	Non-Food Grocery	10.7	8.5	-2.1
8	Alcoholic Beverages	5.2	7.8	2.6
9	General Merchandise	11.1	13.9	2.8
	All Modules	8.9	11.0	1.1
			t-statistic	1.798
			p-value	0.036

Notes: The price change for each module is calculated as the change in a Laspeyres quantity-weighted price index from first half of 2007 to the second half of 2009. Included are branded products that had at least one observation in both periods for both Per Se and Rule of Reason States. The mean price change within a department is a simple average of price changes across modules. The p-value is for a one-sided test.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Figure 1: Price Index by Legal Treatment



Notes: The price index displayed is a simple average across Laspeyres quantity-weighted price indices for each product module. Each Laspereyes price index is benchmarked to the first half of 2007, and includes only branded UPCs that have positive quantities in the first half of 2007 and the second half of 2009.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 3: Price Regressions by Module

Department Description	Number of Regressions	Significant $\gamma > 0$			Significant $\gamma < 0$			Percent Positive
		Count	Percent	Median[a]	Count	Percent	Median[a]	
Health & Beauty Aids	158	11	7.0	5.6	11	7.0	-7.5	51.9
Dry Grocery	402	40	10.0	5.6	28	7.0	-4.5	60.7
Frozen Foods	79	8	10.1	3.6	1	1.3	-6.1	72.2
Dairy	41	0	0.0		0	0.0		73.2
Deli	16	0	0.0		0	0.0		62.5
Packaged Meat	13	3	23.1	2.1	2	15.4	-13.6	76.9
Fresh Produce	21	2	9.5	10.2	0	0.0		61.9
Non-Food Grocery	118	9	7.6	1.9	3	2.5	-1.8	52.5
Alcoholic Beverages	30	2	6.7	6.4	3	10.0	-5.8	43.3
General Merchandise	108	8	7.4	7.5	4	3.7	-6.3	52.8
All Departments	986	83	8.4	5.3	52	5.3	-4.8	58.6

Notes: Significance is determined by one-sided tests at a significance level of 0.05. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed.

Source: Calculated based on data from The Nielsen Company (US), LLC.

a. The column "Median" gives the median coefficient as a percent change.

Table 4: Quantity Regressions by Module

Dept.	Number of	Significant $\mu > 0$			Significant $\mu < 0$			Percent
Description	Regressions	Count	Percent	Median[a]	Count	Percent	Median[a]	Positive
Health & Beauty Aids	158	3	1.9	45.1	15	9.5	-19.3	29.7
Dry Grocery	402	9	2.2	30.2	39	9.7	-15.1	32.8
Frozen Foods	79	1	1.3	54.1	5	6.3	-13.3	35.4
Dairy	41	1	2.4	37.5	1	2.4	-6.8	31.7
Deli	16	0	0.0		1	6.2	-27.6	43.8
Packaged Meat	13	0	0.0		0	0.0		46.2
Fresh Produce	21	0	0.0		0	0.0		57.1
Non-Food Grocery	118	2	1.7	56.8	12	10.2	-21.3	24.6
Alcoholic Beverages	30	1	3.3	10.6	4	13.3	-19.0	20.0
General Merchandise	108	0	0.0		16	14.8	-20.6	27.8
All Departments	986	17	1.7	37.5	93	9.4	-16.2	31.4

Notes: Significance is determined by one-sided tests at a significance level of 0.05. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed.

Source: Calculated based on data from The Nielsen Company (US), LLC.

a. The column "Median" gives the median coefficient as a percent change.

Table 5: Aggregate Indicators: Coefficient Counts

Included Coefficients	Percent of Main Results	p-value
Price		
Positive	58.6	0.065
Significant & Positive	8.4	0.090
Significant & Negative	5.3	0.490
Quantity		
Negative	68.6	0.220
Significant & Negative	9.4	0.170
Significant & Positive	1.7	0.770
Coefficient Pairs		
Quadrant 1 ($P\uparrow, Q\uparrow$)	18.6	0.690
Quadrant 2 ($P\uparrow, Q\downarrow$)	40.0	0.105
Quadrant 3 ($P\downarrow, Q\downarrow$)	28.5	0.365
Quadrant 4 ($P\downarrow, Q\uparrow$)	12.9	0.845

Notes: The p-values in this table correspond to seeing if the relevant percentage of coefficients increased. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed. Quadrants refer locations on the price-quantity plane, with price on the y-axis and quantity on the x-axis.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 6: Pooled Percent Changes for Prices and Quantities

	Price		Quantity	
Department	Coefficient	p-value	Coefficient	p-value
Health & Beauty Aids	0.00	0.480	-5.04	0.150
Dry Grocery	0.47	0.150	-3.37	0.195
Frozen Foods	1.00	0.060	-2.27	0.290
Dairy	0.52	0.235	-2.75	0.265
Deli	0.11	0.400	-3.14	0.235
Packaged Meat	0.81	0.025	-2.24	0.225
Fresh Produce	0.35	0.180	0.05	0.500
Non-Food Grocery	0.20	0.145	-4.38	0.140
Alcoholic Beverages	-0.03	0.540	-7.76	0.075
General Merchandise	0.10	0.300	-5.97	0.105
All Departments	0.33	0.095	-3.80	0.170

Notes: Coefficients are reported as percent changes and are pooled according to a standard meta-analysis approach, which weighs each coefficient by the inverse of the variance of the estimator. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed. The relevant tests for this table correspond to seeing if prices increased and quantities decreased. The total number of observations is 41,799,260 for the price regressions and 41,984,540 for the quantity regressions.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 7: Pooled Percent Changes for Candidate RPM Modules

	Price		Quantity	
Department	Coefficient	p-value	Coefficient	p-value
Health & Beauty Aids	4.19	0.000	-1.68	0.350
Dry Grocery	2.56	0.000	-3.85	0.190
Frozen Foods	2.70	0.005	-1.09	0.395
Dairy				
Deli				
Packaged Meat	1.57	0.010	-2.15	0.250
Fresh Produce	4.75	0.020	2.52	0.665
Non-Food Grocery	1.45	0.005	-0.65	0.420
Alcoholic Beverages	4.01	0.035	1.29	0.515
General Merchandise	2.87	0.000	-4.82	0.165
All Departments	2.32	0.000	-2.50	0.245

Notes: This table shows pooled coefficients for modules with significant and positive price coefficients. Coefficients are reported as percent changes and are pooled according to a standard meta-analysis approach, which weighs each coefficient by the inverse of the variance of the estimator. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed. The relevant tests for this table correspond to seeing if prices increased and quantities decreased. The total number of observations is 4,248,135 for the price regressions and 4,265,566 for the quantity regressions.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 8: Regressions of Estimated Coefficients on Concentration Measures

	Price		Quantity	
	Coefficient	p-value	Coefficient	p-value
Retailer HHI	0.266	0.122	-0.012	0.967
Retailer C5	0.223	0.002	-0.113	0.361
Retailer C1	0.034	0.760	-0.055	0.763
Manufacturer HHI	0.063	0.216	-0.039	0.646
Manufacturer C5	0.150	0.004	0.032	0.722
Manufacturer C1	0.041	0.367	-0.015	0.846

Notes: The coefficients are calculated by regressing the estimated difference-in-difference coefficients on measures of retailer and manufacturer concentration for products with price coefficients that are significant and positive. The concentration measures use revenue shares in the year prior to the *Leegin* decision (i.e., the pre-period). The relevant tests for this table use standard OLS t-statistics for two-sided tests.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 9: Outlets Test: Change in Number of Retailers for Candidate RPM Modules

	Store IDs			Household Zip Codes			
Dept. Description	Coefficient	Baseline	p-value	Coefficient	Baseline	p-value	Observations
Health & Beauty Aids	-0.013	1.504	0.555	0.007	1.653	0.485	52,501
Dry Grocery	-0.001	2.753	0.505	0.011	3.229	0.450	705,637
Frozen Foods	0.001	2.331	0.505	0.040	2.740	0.370	186,357
Dairy							
Deli							
Packaged Meat	-0.017	2.990	0.565	0.034	3.743	0.395	180,684
Fresh Produce	0.504	6.112	0.345	1.533	11.120	0.240	14,438
Non-Food Grocery	-0.018	2.315	0.625	0.013	2.835	0.440	272,882
Alcoholic Beverages	-0.077	1.339	0.710	-0.144	1.534	0.705	5,316
General Merchandise	0.010	1.209	0.260	0.027	1.385	0.245	133,366
Weighted Average	0.005	1.382	0.425	0.019	1.623	0.345	1,551,181

Notes: We use two measures of retailer outlets in this analysis: unique store IDs and unique household zip codes for each product-state-month observation. Observations with missing store IDs are counted as a single store for a given retailer. Store IDs are present in 46 percent of the product-level observations. We have household zip codes for every observation. The baseline is the average value of the measure in the pre-period. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed. There are no results for Deli nor Dairy as there are no candidate RPM modules in either department.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 10: Inventory Test: Change in Branded Share for Candidate RPM Modules

Dept. Description	Percent Change	p-value	Observations
Health & Beauty Aids	0.40	0.325	34,969
Dry Grocery	-0.15	0.730	275,174
Frozen Foods	-0.33	0.660	54,037
Dairy			
Deli			
Packaged Meat	0.02	0.515	61,378
Fresh Produce	-0.30	0.630	21,575
Non-Food Grocery	0.13	0.435	79,350
Alcoholic Beverages			
General Merchandise	0.02	0.500	25,693
Average	-0.03	0.620	552,176

Notes: p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed. There are no results for Deli nor Dairy as there are no candidate RPM modules in either department. There are no results for Alcoholic Beverages as there are no candidate RPM modules that had a mix of private label and branded products in period before *Leegin*.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 11: MAP Products and Restricted Discount Products

MAP Products	**Restricted Discount Products**
Cosmetics-Foundation-Cream And Powder	Baby Accessory
Depilatories - Women's	Hair Preparations-Men's
Minerals	Nasal Product Internal
Shave Creams - Women's	Sleeping Aids
Skin Cream-Special Purpose	Sunburn Aids
Unclassified Baby Needs	Cereal - Hot
Baby Food - Strained	Chili-Shelf Stable
Honey	Cooking Sprays
Oriental Foods-Ramen Noodles	Corn/Potato Starch
Relishes	Mexican Sauce
Snacks - Remaining	Rice - Mixes
Syrup-Chocolate	Seafood - Shrimp - Canned
Vegetables-Beans-Green-Canned	Entrees - Mexican - 1 Food - Frozen
Vegetables-Onions-Canned	Entrees - Remaining - 2 Food - Frozen
Bakery-Breakfast Cakes & Sweet Rolls-Frozen	Frozen Hors d'Oeuvres & Snacks
Dinners-Frozen	Lunchmeat-Sliced-Refrigerated
Pasta-Plain-Frozen	Bags - Freezer
Vegetables - Broccoli - Frozen	Cigarettes
Whipping Cream	Fabric Softeners-Liquid
Fruit Salads-Refrigerated	Pre-Moistened Towelettes
Pasta - Refrigerated	Water Conditioners Filters And Units
Pet Treatments External	Tequila
Soap - Liquid	Automotive Combinations
Water Filtration Storage Container	Hairstyling Appliance And Accessory
Wine-Sweet Dessert-Domestic	
Mouse & Rat & Mole Traps	

Notes: MAP products are those that have a significant positive coefficient when the dependent variable is the list price, but not for the transaction price. Restricted discount products are those that have a significant positive coefficient for the transaction price, but not for the list price. p-values are calculated using 200 iterations of a Wild bootstrap with clustering at the state level and the null hypothesis imposed. Products are sorted by department.

Table 12: Consumer Surplus as a Fraction of Revenue

Demand System	$\|\varepsilon\| = 1.5$	$\|\varepsilon\| = 2$	$\|\varepsilon\| = 4$	$\|\varepsilon\| = 10$
Constant Elasticity	2	1	$1/3$	$1/9$
Linear	$2/3$	$1/4$	$1/8$	$1/20$

Notes: For Constant Elasticity and Linear demand systems, consumer surplus is calculated as $CS = \frac{1}{|\varepsilon|-1}PQ$ and $CS = \frac{1}{2|\varepsilon|}PQ$, respectively, where PQ are revenues.

Table 13: Change in Revenue by Department for Per Se and Rule of Reason States (in millions of dollars)

Dept. Description	Percent Change	Mean	SD
Health & Beauty Aids	-5.1	-1,834	91
Dry Grocery	-3.1	-4,558	288
Frozen Foods	-1.9	-608	111
Dairy	-0.8	-182	86
Deli	-3.2	-254	56
Packaged Meat	-0.9	-118	64
Fresh Produce	0.8	89	60
Non-Food Grocery	-1.0	-521	220
Alcoholic Beverages	-7.6	-1,423	149
General Merchandise	-6.9	-2,022	132
All Departments	-3.1	-11,432	475

Notes: We simulate change in revenue by drawing 500 price and quantity changes from a normal distribution for each product module, with the mean equal to the point estimate from our main regressions and the standard deviation given by the standard deviation of coefficient estimates in 200 bootstrap simulations.
Source: Calculated based on data from The Nielsen Company (US), LLC.

Table 14: Change in Revenue by State (in millions of dollars)

State	Mean Percent Change	Mean	Std. Dev
Per Se			
CA	-2.7	-2,034	302
OH	-2.6	-667	108
SC	-2.5	-234	38
CT	-2.2	-214	38
NV	-2.3	-165	32
MS	-2.9	-130	18
WV	-2.5	-116	21
NH	-2.4	-90	16
MT	-2.6	-72	11
Rule of Reason			
TX	-3.6	-1,766	192
FL	-3.4	-1,560	182
PA	-3.2	-979	129
VA	-3.5	-592	68
WI	-3.4	-460	59
MO	-3.2	-455	60
MA	-3.1	-420	55
AL	-3.4	-373	47
OK	-3.3	-266	36
IA	-3.5	-264	35
NM	-3.5	-145	19
NE	-3.5	-145	17
ID	-3.4	-126	17
RI	-3.2	-90	12
DE	-3.0	-69	10

Notes: We simulate change in revenue by drawing 500 price and quantity changes from a normal distribution for each product module, with the mean equal to the point estimate from our main regressions and the standard deviation given by the standard deviation of coefficient estimates in 200 bootstrap simulations.
Source: Calculated based on data from The Nielsen Company (US), LLC.

A. Assignment to Treatment and Control

The figure below shows the geographic distribution of treatment and control states. Table 15 provides the legal justification for the categorization of the states.

Figure 2: Map of Grouped States

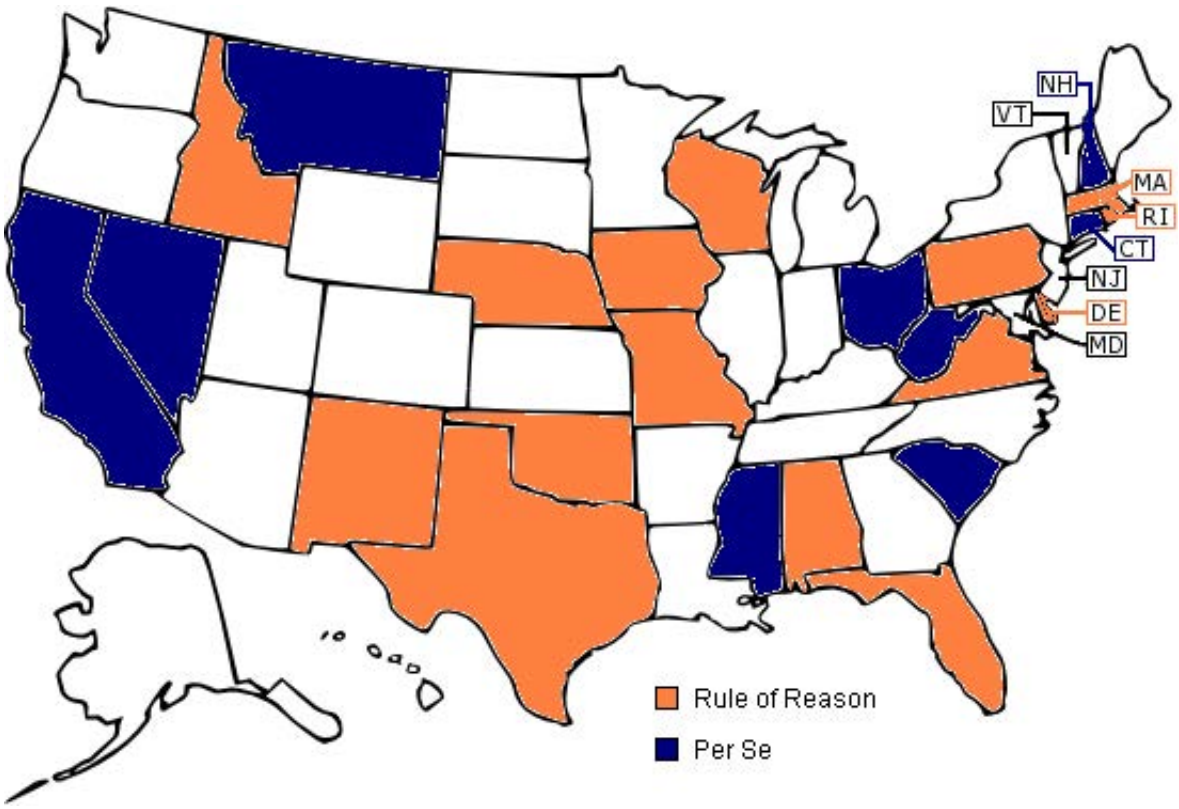


Table 15: State Law and Actions of State Attorneys General Regarding *Leegin* and Minimum RPM

State	Strongly Adheres	State Law Restricting RPM	Documents Supported by State AG				State	Strongly Adheres	State Law Restricting RPM	Documents Supported by State AG			
			Leegin Amicus	S.2261	S.148	HR.3190				*Leegin Amicus*	S.2261	S.148	HR.3190
AL	•						MT		•	•	•	•	•
AK	•						NE	•		•			
AZ				•	•	•	NV	•	•		•	•	•
AR				•	•	•	NH		•	•	•	•	•
CA		•		•	•	•	NJ	•	•	•	•	•	•
CO							NM	•		•	•	•	•
CT	•	•	•	•	•	•	NY		•		•	•	•
DE	•		•	•	•	•	NC			•		•	•
FL	•		•		•	•	ND				•	•	•
GA							OH		•	•	•	•	•
HI	•		•	•	•	•	OK	•		•	•	•	•
ID	•		•	•	•	•	OR			•	•	•	•
IL				•	•	•	PA	•		•	•	•	•
IN							RI	•			•	•	•
IA	•		•	•	•	•	SC	•	•	•	•	•	•
KS		•	•	•	•	•	SD			•			
KY			•	•			TN		•				
LA			•		•	•	TX	•					
ME			•	•	•	•	UT			•	•	•	•
MD		•	•	•	•	•	VT			•	•	•	•
MA	•		•	•	•	•	VA	•				•	•
MI	•		•				WA			•		•	•
MN			•	•	•	•	WV	•	•	•	•	•	•
MS		•	•	•	•	•	WI	•					
MO	•		•	•	•	•	WY			•	•	•	•

Notes: States that "Strongly Adhere" give strong deference to federal decisional law when interpreting state antitrust statutes. Bullets under "Supported by State Attorney General" indicate that the relevant state attorney general has signed the document indicated in the header line. Documents include a brief *amicus curiae* in support of the respondents in *Leegin* and letters to senators and congressmen in support of relevant legislative bills. Bills refer to: Discount Pricing Consumer Protection Act, S. 2261, 110th Cong. (2007); Discount Pricing Consumer Protection Act, S. 148, 111th Cong. (2009); Discount Pricing Consumer Protection Act of 2009, H.R. 3190, 111th Cong. (2009).

Sources: Brief for States of New York et al. as *Amici Curiae* Supporting Respondents, *Leegin Creative Leather Products v. PSKS*, 551 U.S. 877 (2007); Letters of the States; Duncan and Guernsey (2008).

B. Distribution of Coefficients by Department

Table 16: Joint Distribution of Price and Quantity Coefficient Point Estimates

All Departments

Price \ Quantity	-	+
+	0.40	0.19
-	0.28	0.13

Health & Beauty

Price \ Quantity	-	+
+	0.37	0.15
-	0.33	0.15

Dry Grocery

Price \ Quantity	-	+
+	0.42	0.18
-	0.25	0.15

(a) All, Departments 0 and 1

Frozen Foods

Price \ Quantity	-	+
+	0.43	0.29
-	0.22	0.06

Dairy

Price \ Quantity	-	+
+	0.56	0.17
-	0.12	0.15

Deli

Price \ Quantity	-	+
+	0.38	0.24
-	0.19	0.19

Meat

Price \ Quantity	-	+
+	0.46	0.31
-	0.08	0.15

(b) Departments 2-5

Fresh Produce

Price \ Quantity	-	+
+	0.24	0.38
-	0.19	0.19

Non-Food Grocery

Price \ Quantity	-	+
+	0.36	0.17
-	0.40	0.08

Alcohol

Price \ Quantity	-	+
+	0.30	0.13
-	0.50	0.07

General Merch.

Price \ Quantity	-	+
+	0.37	0.16
-	0.35	0.12

(c) Departments 6-9

Source: Calculated based on data from The Nielsen Company (US), LLC.

C. Modules with Significant Price or Quantity Changes

The following tables provide the descriptions of modules that experienced a significant price or quantity change, as determined by regressions (1) and (2).

Table 17: Modules with Significant Price or Quantity Changes

Module Description	$\gamma > 0$	$\gamma < 0$	$\mu > 0$	$\mu < 0$
Department 0: Health & Beauty Aids				
Adhesive Bandages - Liquid - Powder - Paste		•		
Baby Accessory	•			
Baby Bib And Burp Cloth				•
Baby Bottles & Nipples			•	
Baby Care Products-Bath				•
Baby Care Products-Lotions				•
Contact Lens Solution				•
Cosmetics-Foundation-Liquid				•
Cosmetics-Halloween/Costume Make-Up		•		
Cough Drops	•			
Denture Adhesives				•
Deodorants - Cologne Type				•
Depilatories - Men's				•
Diuretic Remedies	•			
Feminine Hygiene-Douches				•
First Aid - Thermometers		•		
Hair Preparations-Men's	•			
Insoles		•		
Insulin Syringes			•	
Jock Itch Products		•	•	
Lip Remedies - Remaining				•
Medical Accessory-Remaining		•		•
Men's Gift Sets & Travel Kits				•
Nasal Product Internal	•			
Pain Remedies - Alkalizing Effervescents	•			
Pain Remedies - Back & Leg				•
Pain Remedies - Children's Liquid	•			
Pain Remedies - Headache				•
Petroleum Jelly	•			
Pregnancy Test Kits	•			
Sleeping Aids	•			
Sunburn Aids	•			
Toothbrushes		•		
Unclassified Cosmetics		•		
Unclassified Hair Care		•		
Unclassified Sanitary Protection		•		
Vaporizing Products		•		
Vitamins/Tonics-Liquid & Powder				•
Department 1: Dry Grocery				
Baby Cereal & Biscuits		•		
Baby Food - Junior	•			
Baby Juice				•
Bakery-Rolls-Fresh	•			
Baking Chips - Milk Chocolate			•	
Baking Chips Other Than Chocolate		•		
Barbecue Sauces				•
Breading Products	•			
Breath Sweeteners		•		
Butter-Fruit & Honey	•			•
Candy-Chocolate	•			
Candy-Dietetic - Non-Chocolate		•		
Candy-Lollipops				•
Candy-Non-Chocolate-Miniatures				•
Canned Fruit - Berries		•		
Canned Fruit - Oranges	•			
Canned Fruit - Peaches - Freestone	•			
Canned Fruit - Prunes		•		
Canned Fruit - Remaining	•			
Canned Fruit-Grapefruit	•			
Capers	•			
Cereal - Granola & Natural Types		•		
Cereal - Hot	•			
Cherries-Maraschino	•			
Chili Sauce				•
Chili-Shelf Stable	•			
Cocktail Onions		•		
Cocoa	•			
Cooking Sprays	•			
Corn/Potato Starch	•			
Corned Beef - Canned				•
Crackers - Flavored Snack		•		
Creamers - Powdered		•		
Dip - Canned				•
Dog Food - Dry Type		•		
Dog Food - Moist Type		•		
Fruit Drinks & Juices-Cranberry	•			
Fruit Juice - Pineapple		•		
Fruit Juice-Orange-Canned			•	
Fruit Pectins				•
Fruit Spreads	•			
Garlic Spreads	•			
Gravy Aids & Beef Extract			•	
Gum-Chewing				•
Home Canning Seasonings				•
Hot Sauce		•		
Ice Pops - Unfrozen				•
Instant Meals		•		
Lard	•			
Marmalade	•			
Mayonnaise				•
Meat Sauce		•		
Mexican Sauce	•			
Mexican Shells				•
Milk - Canned	•			
Milk - Powdered	•			
Milk-Shelf Stable		•		
Mixes - Cake/Layer - 10 Oz & Under				•
Mixes-Frosting			•	
Mixes-Muffin		•		
Monosodium Glutamate & Flavor Enhancers				•
Olives - Green				•
Oriental Canned Vegetables				•
Peas & Lentils & Corn - Dry	•			
Pet Care - Pet Food				•
Pickled Vegetables & Fruit		•		•
Pickles - Sweet	•			
Pimentos - Canned				•
Pizza Pie And Crust Mixes		•		
Popcorn - Popped	•			
Potato Salad-Canned		•		
Remaining Drinks & Shakes Non-Refrigerated		•	•	
Rice - Canned	•			
Rice - Mixes	•			
Roast Beef - Canned		•		
Salad And Cooking Oil				•
Salt - Cooking/Edible/Seasoned	•			
Salt - Table				•
Salt Substitutes			•	
Sauce Mix - Cheese	•			
Scrapple & Mush		•		
Seafood - Sardines - Canned	•			
Seafood - Shrimp - Canned	•			

Table 18: Modules with Significant Price or Quantity Changes

Module Description	$\gamma > 0$	$\gamma < 0$	$\mu > 0$	$\mu < 0$
Department 1: Dry Grocery (continued)				
Seafood-Clams-Canned				•
Seasoning Mix - Chili			•	
Snacks - Corn Chips	•			•
Snacks - Meat				•
Snacks - Potato Sticks	•			
Snacks - Puffed Cheese				•
Soft Drinks - Low Calorie		•		
Soft Drinks - Powdered	•			
Soup Mixes - Dry & Bases				•
Syrup - Sorghum & Sugar				•
Tapioca - Pure			•	
Tea - Instant		•		•
Vegetable Juice - Tomato				•
Vegetables - Potatoes - Specialty - Dehydrated				•
Vegetables - Red Cabbage - Canned		•	•	
Vegetables-Asparagus-Shelf Stable	•			•
Vegetables-Beans-Garbanzo - Canned	•			
Vegetables-Beans-Lima-Canned				•
Vegetables-Beans-Pinto-Canned				•
Vegetables-Onions-Canned				•
Vegetables-Peas & Carrots-Canned	•			
Vegetables-Peas-Canned				•
Vegetables-Spinach-Canned		•		
Vegetables-Succotash-Canned				•
Vienna Sausage - Canned	•			
Worcestershire Sauce				•
Department 2: Frozen Food				
Entrees - Italian - 1 Food - Frozen				•
Entrees - Meat - 1 Food - Frozen	•			
Entrees - Mexican - 1 Food - Frozen	•			
Entrees - Remaining - 1 Food - Frozen	•			
Entrees - Remaining - 2 Food - Frozen	•			
Frozen Hors D' Oeuvres & Snacks	•			
Frozen Poultry				•
Fruit Juice - Apple - Frozen			•	
Meal Starters		•		
Pizza Crust-Frozen				•
Sauces & Gravies-Frozen/Refrigerated	•			
Seafood-Fish-Unbreaded-Frozen				•
Vegetables - Carrots - Frozen	•			
Vegetables - Mixed - Frozen	•			
Vegetables - Mushrooms - Breaded - Frozen				•
Department 3: Dairy				
Cheese - Natural - Variety Pack			•	
Margarine And Spreads				•
Department 4: Deli				
Pizza-Refrigerated				•
Department 5: Packaged Meat				
Bacon-Beef & Canned		•		
Bratwurst & Knockwurst		•		
Lunchmeat-Deli Pouches-Refrigerated	•			
Lunchmeat-Sliced-Refrigerated	•			
Sausage-Breakfast	•			
Department 6: Fresh Produce				
Fresh Cranberries	•			
Fresh Lettuce	•			

Module Description	$\gamma > 0$	$\gamma < 0$	$\mu > 0$	$\mu < 0$
Department 7: Non-Food Grocery				
Bags - Freezer	•			
Bags - Trash/Trash Compactor		•		•
Bags - Waste				•
Brushes - Miscellaneous				•
Cigarettes	•			
Cleaners - Powders				•
Cloth-Polishing/Cleaning		•		
Drain Pipe Openers				•
Fabric Softeners-Dry				•
Fabric Softeners-Liquid	•			
Facial Tissue	•			
Laundry Bar Soap				•
Lighter Fluid & Flints				•
Pet Care - Flea & Tick Products		•		
Pet Care - Flea Collars				•
Pet Incontinence Product			•	
Polishes				•
Pre-Moistened Towelettes	•			
Spot & Stain Removers	•			
Thermometers-Household/Outdoor				•
Toilet Bowl - Deodorizers	•			
Unclassified Pet Care			•	
Water Conditioners Filters And Units	•			
Water Softeners & Conditioners				•
Wood Chips-Cooking	•			
Department 8: Alcohol				
Bourbon-Straight/Bonded				•
Gin			•	
Light Beer (Low Calorie/Alcohol)		•		
Tequila	•			
Wine - Non Alcoholic		•		
Wine-Domestic Dry Table				•
Wine-Flavored/Refreshment		•		•
Wine-Sake	•			
Wine-Vermouth				•
Department 9: General Merchandise				
Air Purifier And Cleaner Appliances	•			
Artist And Hobby Paint And Supply	•			
Automotive Combinations	•			
Drinkware Container Set				•
Flashlights				•
Food Processor And Grinder Appliance				•
Garden, Lawn & Plant Chemicals & Additives	•			
Hairstyling Appliance And Accessory	•			
Insect Repellents		•		
Insecticide - House & Garden - Aerosol				•
Insecticide - Remaining Miscellaneous Products				•
Insecticide-Flying Insect-Aerosol				•
Insecticide-Wasp & Hornet				•
Lawn And Soil Fertilizer And Treatment	•			
Markers	•			
Mixer Appliance				•
Motor Oil Fluid And Lube		•		•
Motorized Vehicle Cleaner And Protectant				•
Oil-Lubricants-Remaining		•		•
Popcorn Popper Appliance	•			
School And Office Storage And Dispensers				•
Unclassified Cookware		•		
Unclassified Kitchen Gadgets				•
Unclassified Photographic Supplies				•
Unclassified Stationary, School Supplies				•
Vacume And Carpet Cleaner Appliance				•

D. Welfare Simulation Methodology

D.1. Constant Elasticity Demand (log-linear)

We aggregate our data to prices and quantities at the module level for each state, week, and retailer. A module price is simply the quantity-weighted average price of UPCs within that module. We then keep all modules for which we were able to estimate coefficients on both price and quantity, and we leave out 24 modules for which the standard errors on the coefficients of interest are greater than 0.1 for price or 0.35 for quantity. We leave out coefficients that were imprecisely estimated as these could have large effects on our estimates of consumer surplus despite their lack of precision.

With constant elasticity demand, the demand function is of the form:

$$Q = AP^{\varepsilon}$$

where $\varepsilon < -1$. With equilibrium price and quantities (P_0, Q_0), consumer surplus is equal to

$$\begin{aligned} CS_0 &= \int_0^{Q_0} (A^{-\frac{1}{\varepsilon}} Q^{\frac{1}{\varepsilon}} - P_0) dQ \\ &= A^{-\frac{1}{\varepsilon}} \frac{\varepsilon}{1+\varepsilon} Q_0^{\frac{1+\varepsilon}{\varepsilon}} - P_0 Q_0 \end{aligned} \tag{3}$$

In order to calculate the counterfactual *CS*, we calculate counterfactual prices and quantities, assuming unchanging equilibrium elasticities (from the Lerner Equation, $\frac{1}{|\varepsilon|} = \frac{P-C}{P} \equiv m$, unchanging equilibrium elasticity implies a constant margin). We then calibrate the model by solving for the residual demand component, A. For example, we calculate the change in *CS* for the Per Se states as follows:

1. Aggregate the data in the post-*Leegin* period to the state-retailer-module-week level. For each state-retailer-module-week, we calibrate the demand curve by solving $A_0 = Q_0 P_0^{-\varepsilon}$.

2. Use the regression coefficients $\hat{\gamma}$, $\hat{\mu}$,and the standard errors $\hat{\sigma}_\gamma$,$\hat{\sigma}_\mu$ to draw 100 log changes from a normal distribution, $x \sim N(\hat{\beta}, \hat{\sigma}^2)$

3. Estimate the counterfactual prices and quantities using the observed values:
$$\left.\begin{aligned} P_1 &= P_0 exp(x_p) \\ Q_1 &= Q_0 exp(x_q) \end{aligned}\right\} \longrightarrow (P_0, Q_0, x_p, x_q).$$

4. Calculate the residual $A_1 = Q_1 P_1^{-\varepsilon}$ for counterfactual equilibria.

5. Use (A_0, P_0, Q_0) and (A_1, P_1, Q_1) to calculate observed and counterfactual CS with equation (3), then take the difference.

6. Take the sum of $CS_1 - CS_0$ across retailers, weeks, and modules to arrive at a total change in consumer surplus per state in the post-*Leegin* period.

For the Rule of Reason states, we instead use observed price and quantity for (P_1, Q_1), and calculate the counterfactual by using $P_0 = P_1 exp(\text{-}x_p)$. We calculate the change in revenue, relating it to the change in consumer welfare using Table 12. The elasticities of -1.5, -2, -4, and -10 in the table imply margins of 67 percent, 50 percent, 25 percent, and 10 percent, respectively.

D.2. Linear Demand

We specify a differentiated product demand system of the form

$$Q = a - bP$$

for each product. For equilibrium price and quantities (P_0, Q_0), consumer surplus is given by

$$\begin{aligned} CS_0 &= \int_0^{Q_0} (\frac{a}{b} - \frac{1}{b}Q - P_0)dQ \\ &= (\frac{a}{b} - P_0)Q_0 - \frac{1}{2b}Q_0^2 \end{aligned}$$

In order to calculate counterfactual CS, we calculate counterfactual prices and quantities. We assume Bertrand pricing and unchanging equilibrium elasticities. From the Lerner equation, $\frac{1}{|\varepsilon|} = \frac{P-C}{P} \equiv m$, unchanging equilibrium elasticity implies a constant margin. The equilibrium elasticity of demand for this system is

$$\varepsilon = \frac{dQ}{dP}\frac{P_0}{Q_0} = \text{-}b\frac{P_0}{Q_0}$$

Thus, given ε, we can solve for $b = -\varepsilon\frac{Q_0}{P_0}$. Using the demand function, we can then solve for a.

$$\begin{aligned} a &= Q_0 + bP_0 \\ &= Q_0 - \varepsilon Q_0 \\ &= (1-\varepsilon)Q_0 \\ &= \frac{m+1}{m}Q_0 \end{aligned}$$

To calculate the change in CS, we follow a similar method that we specify above with constant elasticity demand.

D.3. Relating Changes in Consumer Surplus to Revenues

The relationship of consumer surplus to revenue is a mathematical result that makes our welfare calculations convenient is a mathematical result. Under assumptions of constant elasticity of demand, we can rewrite equilibrium consumer surplus by plugging for A using our formula for demand:

$$\begin{aligned} CS_0 &= A^{\text{-}\frac{1}{\varepsilon}} \frac{\varepsilon}{1+\varepsilon} Q_0^{\frac{1+\varepsilon}{\varepsilon}} - P_0 Q_0 \\ &= Q_0^{\text{-}\frac{1}{\varepsilon}} P_0 \frac{\varepsilon}{1+\varepsilon} Q_0^{\frac{1+\varepsilon}{\varepsilon}} - P_0 Q_0 \\ &= P_0 Q_0 (\frac{\varepsilon}{1+\varepsilon} - 1) \\ &= \frac{1}{|\varepsilon| - 1} P_0 Q_0 \\ &= \frac{m}{1-m} P_0 Q_0 \end{aligned}$$

Thus, holding elasticity (and therefore margins) fixed, a percent change in consumer surplus is equal to the percent change in revenues.

For linear demand, we can similarly plug in for a and b in equilibrium:

$$\begin{aligned} CS_0 &= (\frac{a}{b} - P_0) Q_0 - \frac{1}{2b} Q_0^2 \\ &= \left(\frac{(1-\varepsilon) Q_0}{\text{-}\varepsilon Q_0 / P_0} - P_0 \right) Q_0 - \frac{1}{2} \frac{P_0}{Q_0} \frac{\text{-}1}{\varepsilon} Q_0^2 \\ &= (\frac{\varepsilon - 1}{\varepsilon} - 1) P_0 Q_0 - \frac{1}{2} \frac{\text{-}1}{\varepsilon} P_0 Q_0 \\ &= \frac{1}{2|\varepsilon|} P_0 Q_0 \\ &= \frac{1}{2} m P_0 Q_0 \end{aligned}$$

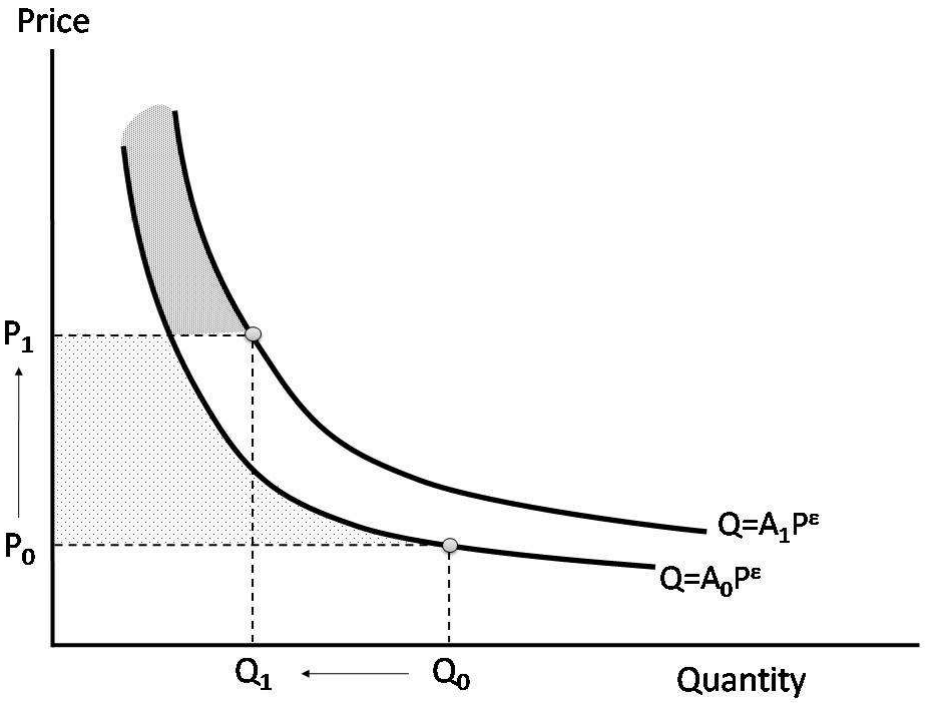
We see that consumer surplus for linear demand is also a linear function of revenues, and that percent change in consumer surplus is equal to the percent change in revenues. Thus, while elasticities (and margins) are unchanging, any change prices and quantities will result in an identical percent change in consumer surplus for both linear and constant elasticity demand. With the same equilibrium price, quantity, and elasticity, the consumer surplus from a linear demand system is smaller than a constant elasticity demand system by a factor of $\frac{|\varepsilon|-1}{2|\varepsilon|}$ or $\frac{1}{2}(1-m)$. Table 12 compares consumer surplus (as a fraction of

revenues) for the two demand systems for the elasticities used in our simulations.

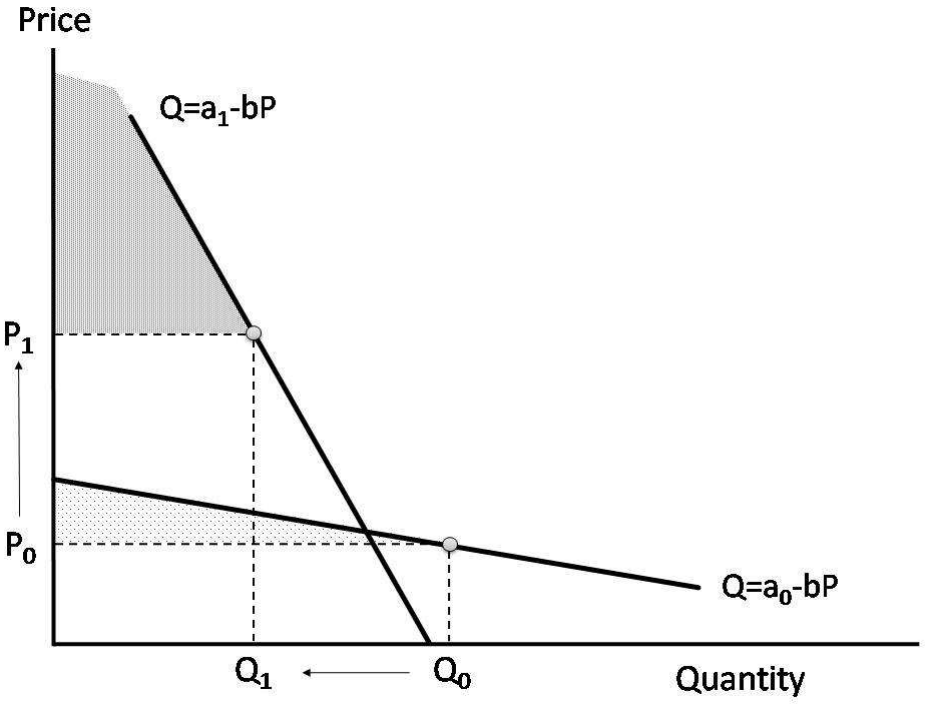
D.4. Graphs

Figures 4a and 4b show a graphical representation of a hypothetical observed equilibrium (P_0, Q_0) and a counterfactual equilibrium (P_1, Q_1). The lightly-shaded regions indicate consumer surplus lost as a result of the rule-of-reason regime, and the darkly-shaded regions represent consumer surplus gained.

Figure 3: Demand Calibration



(a) Constant Elasticity Demand



(b) Linear Demand