The Differential Impact of Tariffs by Quality
Estimates from Scotch Whisky

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Abstract

I investigate the distributional consequences of tariffs on consumer goods, with a focus on the heterogeneity by product quality of the pass-through and variety-loss effects. Using product level data from Pennsylvania during the United States' 25% tariffs on single malt Scotch from 2019 to 2021, I find that the tariffs led to higher price increases for lower-quality products but higher exit of higher-quality products. I show that the heterogeneous pass-through rates can be explained by markup adjustments due to changes in demand curvature driven by consumer substitution patterns. Welfare estimates from a discrete choice demand model with heterogeneous consumer preferences suggest that, compared to a baseline scenario of uniform tariff-effects, tariffs have a more regressive effect once accounting for the heterogeneous tariff effects. This study contributes to the understanding of the distributional impact of tariffs, highlighting the role of heterogeneity in tariff effects and consumers.

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†Researcher(s)' own analyses calculated (or derived) based in part on data from Nielsen Consumer LLC and marketing databases provided through the NielsenIQ Datasets at the Kilts Center for Marketing Data Center at The University of Chicago Booth School of Business. The conclusions drawn from the NielsenIQ data are those of the researcher(s) and do not reflect the views of NielsenIQ. NielsenIQ is not responsible for, had no role in, and was not involved in analyzing and preparing the results reported herein.

1 Introduction

Tariffs may impact consumers through several channels, such as a pass-through of the tariff cost to retail prices and a decrease of imported varieties. Furthermore, individual product quality may substantially affect each product's degree of pass-through or availability. On the one hand, less vertically differentiated products of "lower quality" often have lower markups, which in the face of a tariff may lead to less room for tariff absorption and thus higher pass-through. On the other hand, due to the lower sales volume of high-quality products, the demand may shift inwards to the point that the product becomes unprofitable to export and consequently drops out. These varying effects of tariffs based on product quality can have significant distributional consequences, as low-income consumers tend to purchase cheaper lower-quality goods which may see higher price increases, while the high-income consumers may have been more likely to purchase the expensive products that drop out. Ex-ante, however, whether pass-through and availability varies significantly by product quality is an open empirical question, with potential distributional implications and relevance for evaluating the costs of tariff policy.

In this paper, I utilize detailed product-level data to answer the question of whether product quality significantly modulates the impacts of tariffs and its implications for consumers of differing incomes. I then estimate a consumer demand model with heterogeneous consumers and apply the descriptive findings to quantify the welfare loss from the tariffs by income levels. I find that the price increases are higher for low-quality products, which disproportionately hurts the welfare of the lower-income consumers. Conversely, I find that the tariffs led to a disproportionate decrease in the availability of higher-quality goods; as higher-income consumers were more likely to purchase these higher-quality goods, this loss of variety led to a disproportionate welfare loss for higher-income consumers. Overall, the tariffs pose a larger loss for low-income consumers, but high-income consumers lose substantially as well.

I study the 25% ad valorem tariffs, which were in effect from October 2019 to March 2021, on single malt Scotch imposed by the United States on the European Union as part of a package of tariffs approved by the World Trade Organization (WTO) relating to the Boeing-Airbus subsidies dispute. These specific tariffs are an ideal setting to study the quality bias of tariffs for several reasons. First, the tariffs were born out of a dispute on airliner subsidies, unrelated to the Scotch industry. This alleviates concerns over whether single malt Scotches were targeted for reasons related to demand or domestic industry protection. Second, Scotch has several observable features of quality, such as branding and spirit age, that vary widely across products and provide ample variation to study how tariff impact differs by quality. Third, single malt Scotch has an ideal control group to study the tariffs, blended Scotch, which shares most production processes with single malt Scotch. A detailed discussion of the tariffs and Scotch industry is provided in Section 2 of this paper.

My main data comes from Pennsylvania, where the Pennsylvania Liquor Control Board (PLCB) maintains a monopoly on the distribution and sales of liquor and wine within the state. With the weekly sales data from January 2019 to August 2021, I observe how prices and variety changed before, during, and after the tariffs. Furthermore, the PLCB also pueblishes a quarterly catalog of products along with the retail prices and a monthly sales list, and also maintains constant prices throughout most of the state[1]. The combination of these data sources allow me to track the changes in prices and availability throughout the state.

I start with a difference-in-differences design to measure the policy impact of the tariffs on single malt Scotch prices and variety. To account for confounding cost shocks from COVID-19 and Brexit, I use the prices and variety of blended Scotch as a control group for single malt Scotch. I find that relative to blended Scotch, single malt Scotch prices in Pennsylvania increased by 11% on average. Broken down by quality, however, there is a wide heterogeneity of the tariff effect: the price increases range from 16% for lower quality goods to 2% for higher quality goods. For the variety effect, I find that there is a 24% overall decrease in the availability of products, but once again, large heterogeneities by quality from 4% for the lower quality products to 37% for the higher quality products.

There are a few potential explanations from theory for why the tariff effect may vary so substantially by product quality. On the pass-through side, since firms create market power via product differentiation, more vertically differentiated ("higher quality") products may face a less elastic demand that corresponds to higher markups via the inverse elasticity pricing rule. Thus when hit with a cost shock such as a tariff, the firms have larger margins to adjust and may absorb more of the tariffs in the form of lower markups, unlike the less differentiated products that are setting prices closer to costs and cannot absorb the tariffs. However, whether such markup adjustment actually occurs is dependent on the curvature of the demand - if the residual demand for a product becomes more elastic as prices increase[2], markups will decrease, and vice versa. The curvature of the residual demand for each product depends on the heterogeneity of consumers demanding the good, and on the substitution of consumers to and away from the products in the

[1] There is an exception for certain stores at the state border

[2] i.e., Marshall's Second Law of Demand, which states that holding all else fixed, a price increase will lead to demand becoming more elastic

market. The substitution by less price-sensitive consumers to low-quality goods in the face of increased prices may induce convexity in the demand for low-quality goods and explain the markup adjustments that we observe. Using my demand model, I find this to be the case: there is substantial heterogeneity in the demand curvature across products of different prices, in particular, more concave for high-quality products and convex for low-quality, explained by the substitution of high-income consumers to cheaper products.

On the variety side, the fixed cost of exporting may suggest why we observe high-quality products drop out of the market more often. Romer (1994) emphasizes the role of fixed cost on the extensive margin of trade (i.e., introduction and exit of products), which Hummels and Klenow (2005) builds on with a quality dimension to argue that only the varieties with sufficiently low marginal cost relative to quality will be profitable to export. Thus, while the higher quality goods can absorb more of the tariffs by downward markup adjustments, the decrease in the demand may still make the fixed cost of exporting unrecoverable. Further, as Arkolakis et al. (2008) notes, the first products to exit in the face of higher trade costs are the low-volume varieties, which in this case tend to be the high-quality goods as fewer people may afford these products. Lower-quality goods on the other hand, while they pass through more of the tariffs, may be able to cover the fixed costs of exporting with their higher sales volumes. Several qualitative sources from industry insiders also indicate that many high-quality varieties ceased to be imported after the imposition of the tariffs.

The differential effect of the tariffs on pass-through and variety may have important distributional implications for consumer welfare. While tariffs and other taxes are often understood to be regressive due to the higher income-share of consumption of low-income consumers, the higher pass-through for the lower quality products may exacerbate this regressiveness due to the low-income consumers predominantly purchasing lower quality products. Conversely, high-income consumers will most feel the impact on variety: a low-income consumer may not care that a $300 limited-release bottle of Scotch is no longer available to purchase, but high-income consumers would, creating a progressive effect.

Thus, to quantify the welfare impact of the tariffs, I estimate a random coefficients nested logit (RCNL) model of demand (Berry 1994 and Berry et al. 1995) that flexibly models substitution behavior. Consumers choose each pricing period, which roughly corresponds to a month, to purchase one bottle of Scotch or Irish whisk(e)y[3], with utility determined by the price, alcohol content, bottle size, and brand. Substitution is driven by consumer heterogeneity in prices and proof, and a nesting structure further captures

[3]I introduce Irish whiskey to broaden the definition of the inside good market, as the normalization of utility to the outside good has important implications for substitution.

the preference for bottles of the same category (single malt Scotch, blended Scotch, single malt Irish, blended Irish, outside good). To estimate how consumers of different incomes are impacted differently by the tariffs, consumers are modeled to be one of four income groups ($<$ \$45K, \$45K - \$70K, \$70K - \$100K, $>$ \$100K) with distinct price sensitivities for each group. Prices are instrumented using the tariff and wholesale prices in New York state as exogenous cost shifters, along with an indicator for product sales promotion status, which induces exogenous shifts in prices. The consumer heterogeneity is estimated by matching consumer substitution patterns with model predictions.

With the demand model, I can calculate the welfare from single malt Scotch consumption, and the subsequent changes under different scenarios. First I calculate the welfare loss from increased prices, with and without the quality bias by taking the product choice set in October 2019 (at the beginning of the tariffs) and imposing reduced-form estimated price increases by March 2021 (at the end of the tariffs). I find that under a uniform pass-through assumption, the lowest income consumers (yearly income of less than \$45K) see a 53% decrease in consumer surplus from Scotch consumption, while the highest income consumers (yearly income of more than \$100K) see a 12% decline. However, by incorporating the heterogeneous pass-through rates by quality into the pass-through estimates, I find that the lowest income consumers' surplus decreased by 66%, and 17% for the high-income consumers.

I next calculate the welfare loss due to a decrease in variety, following a similar procedure to the pass-through estimates. I estimate a logit model of the exit probability of each product, with and without allowing for differing effects by quality, between October 2019 to March 2021. I then run Monte Carlo simulations of randomly dropping different products according to an estimated probability of being dropped and calculate the loss in consumer surplus in each case. This approach has the caveat of ignoring new product introduction, so the interpretation of the results is limited to "how does the loss of products due to the tariffs decrease consumer surplus?". I find that when simulating the exit of products independent of quality, lowest-income consumers' welfare decreases by 15% and 7% for high-income consumers. Once quality is accounted for, the welfare decrease is lessened and the order is flipped, to 0.18% for low-income consumers and 1.25% for high-income consumers. I find that these results are driven by the fact that once accounting for quality, the low-quality goods (which had higher market shares) are less likely to drop out. This result was discussed in Arkolakis et al. (2008), in that the gains (loss) from product introduction (exit) tend to be muted because of the low market shares of the marginal products. The novel result here is that because low market share products tend to be high-quality products, the welfare loss from variety loss is higher for high-income consumers than low-income consumers.

My final welfare calculation involves comparing (1) uniform price increases and uniform product exit and (2) heterogeneous price increases and heterogeneous product exit. That is, I compare the estimated welfare loss with no quality differential effects and with quality differential effects. I find that the lowest income consumers see a decrease in welfare by 60% compared to 18% for the highest income, but once the quality bias (in both prices and variety) is accounted for, the numbers become 66% and 18%, respectively. These findings suggest import distributional implications for evaluating the welfare consequences of tariffs. Assuming a uniform pass-through underestimates the welfare loss and assuming uniform product exit overestimates the welfare loss, as the majority of purchases across all income groups are generally the cheaper products which saw the highest pass-through rates and lower product exit. Combining the two effects, however, low-income consumers lose the most due to the dominating price effect while high-income consumers actually see a decrease in their welfare loss. Absent complete tariff absorption and no change in product variety by the suppliers, these findings suggest that the tariffs for differentiated consumer products disproportionately hurt low-income consumers, more so than previously estimated with uniform effects.

There are a few potential concerns and qualifications to this study. The first is whether unit price is an appropriate measure of quality. While unit price is often used as a proxy for quality, there may be cases of high-quality goods that are priced lower due to, say, the productivity of the exporting firm. However, as I show later in Section 2, observable quality measures such as branding and age statement are highly correlated with prices and thus suggest that price acts as a good proxy for quality[4]. Second, as a partial equilibrium analysis, my study ignores any strategic responses by domestic firms in response to the tariffs or any income effects due to the tariffs. For example, as in Flaaen et al. (2020), upon observing the price increase of single malt Scotch due to tariffs, domestic Bourbon producers may have raised their prices in response. Whether this effect is relevant depends on how much Scotch consumers perceive Scotch and Bourbon to be substitutes. However, by ignoring such strategic responses outside the Scotch market, my analysis may underestimate the harm of the tariffs on consumers. Finally, there may be concerns that the results are driven entirely by the business decisions of the Pennsylvania Liquor Control Board and not by the suppliers. Thus, I also present an analysis quantifying the impact of the tariffs using wholesale price data from New York, i.e., prices charged by manufacturers to

[4]There is another often used measure of quality in trade from Khandelwal (2010) that defines quality as shares conditional on prices. Defining quality as shares conditional on prices may lead to an expensive bottle and a cheap bottle, by having similar relative shares conditional on price, to have similar levels of "quality," which is contrary to common notions of Scotch "quality."

wholesalers, and find that these results hold as well.

My analysis first contributes to the empirical literature on the passthrough of tariffs. Examples of previous industry-level studies include Feenstra (1989), Irwin (2019), and Flaaen et al. (2020). These papers find a wide range of estimates of pass-through, suggesting that tariffs have idiosyncratic effects by industry and market structure. Fajgelbaum et al. (2019), Amiti et al. (2019b, 2020), and Cavallo et al. (2021) offer more macroeconomic analyses of the recent US trade wars and find complete pass-through in most cases. Nakamura and Zerom (2010), Ludema and Yu (2016), and Amiti et al. (2019a) study the role of markup adjustments in explaining incomplete pass-through. This paper is the first to study the heterogeneity of pass-through by quality at the individual product-level and to calculate the distributional effects of tariffs accounting for markups adjustment, using a demand model that accommodates consumers of different incomes and precisely measures consumer purchases.

My paper also contributes to the literature on consumer welfare from increased variety via trade. Krugman (1979), Feenstra (1994), and Broda and Weinstein (2006) model the consumer gains from additional variety, while Bernard et al. (2011), Mayer et al. (2014, 2021) approach the relationship between trade costs and variety from the firm side. Hummels and Klenow (2005) in particular studies the quality of exports, while Kehoe and Ruhl (2013) and Arkolakis et al. (2008) study the types of products that are introduced in the extensive margin. On the welfare loss from tariffs, Amiti et al. (2019b) calculates the impact of tariffs on variety and show that tariffs led to a decrease in the variety of imports. In contrast to many of these studies where variety is often defined as a country-product pair, my analysis considers variety within a "product," such as a \$30 vs \$300 bottle of Scotch. I link the changes in the extensive margins of trade to quality, and show that the bias towards high quality goods exiting the market affects high-income consumers the most.

Finally, estimation of cost pass-through has long been an interest in the industrial organization literature, with a recent resurgence of interest in the role of demand curvature. Weyl and Fabinger (2013) studies the relation between curvature of the log demand and pass-through in the presence of market power, and several recent papers study the role of functional form restrictions on demand curvature, such as Griffith et al. (2018), Birchall et al. (2023), and Miravete et al. (2023a,b). On the empirical side, Kim and Cotterill (2008), Chatterjee et al. (2013), and Allcott et al. (2019) examine pass-through in specific industries, and Miravete et al. (2020) analyze the effects of taxation in Pennsylvania. I complement the findings in the literature by showing that an industry-wide cost shock can lead to a wide range of pass-through rates for different products, and analyze the role of consumer substitution in determining the demand curvature that drives this heterogeneity.

The rest of this paper is organized as follows: Section 2 presents the institutional context of the Scotch industry, the tariffs, and discusses the data sources. Section 3 estimates the policy impact of the tariffs on prices and variety using difference-in-differences, and Section 4 presents the consumer demand model, the estimation strategy, and the results of estimation. Section 5 discusses the mechanisms behind the differential pass-through and analyzes the consumer welfare loss under different scenarios. Section 6 concludes.

2 Institutional Context and Data

Scotch Whisky Industry

Due to the distinctive brand and image associated with Scotch, the Scotch industry is tightly regulated by the government of the United Kingdom. In 2009, the UK Parliament passed a statute (*The Scotch Whisky Regulations 2009*) that lays out nine different conditions for a distilled spirit to be defined as Scotch, from the minimum years of maturation to the capacity of the casks. As a protected brand name under EU law, Scotch must be distilled and aged in Scotland, and single malt Scotch in particular must be bottled before it is exported. These regulations ensure that Scotch is produced in the UK, and thus production relocation of Scotch in response to the tariffs is limited. Single malt Scotch and blended Scotch constitute the majority of the market, accounting for 32% and 60% of Scotch exports by value in 2022, respectively. Single malt Scotch is a scotch whisky produced from only water and malted barley at a single distillery by batch distillation in pot stills, with popular brands such as Glenlivet, Glenfiddich, and Macallan. Blended Scotch is defined as a combination of one or more single malt Scotch whiskies with one or more single grain Scotch whiskies, with popular brands such as Johnnie Walker, Ballantine's, Chivas Regal, and Dewar's. The US is the largest export market for Scotch, at around 1 billion GBP in exports in 2022, constituting around one-sixth of total exports by volume.

The largest players in the industry are Diageo, Pernod Ricard, William Grant & Sons, with around 41%, 22%, and 8% of the Scotch market by sales. These firms often produce both single malt Scotch whiskies and blended Scotch whiskies. Diageo, for example, produces a line of single malt Scotch whiskies from its Talisker Distillery but also uses whisky from Talisker to blend with whiskies from its other distilleries to produce the Johnnie Walker Green Label. Distilling, maturing, bottling, storing, and transportation costs are shared between single malt and blended Scotch, which suggests that any potential cost shock to single malt Scotch arising from Brexit or the COVID-19 pandemic that propagates to retail prices would also be shared with blended Scotch as well. Thus, blended Scotch serves as a natural control group for studying the impact of the tariffs on single malt Scotch.

Single malt Scotch whiskies are known for each product's idiosyncratic taste and aroma coming from the particular distillery, aging, cask, and use of peat, amongst many other factors used in production. On the other hand, blended Scotches are made from whiskies from different sources and often "average out" these idiosyncrasies to create a consistent flavor. Scotch, but single malt Scotch, in particular, is differentiated in two main dimensions. The age of a bottle is the main method for vertical differentiation. Age statements are generally found on single malt Scotch whiskies, and is determined by the youngest spirit in the blend[5]. Age is often associated with higher quality due to the complex flavors drawn out of the spirit due to the longer maturation time in the oak casks (although there is a point of decreasing returns at the extreme upper end). Thus, an older age bottle is generally considered a higher quality bottle, both within a brand and across brands (e.g., a Glenlivet 18 would generally be considered higher quality than a Glenlivet 12 *and* a Macallan 12).

Branding is another method for product differentiation, as a mix of both horizontal and vertical. For single malt Scotches, the brand is simply the distillery from which the Scotch was produced, e.g., Macallan branded Scotches are distilled at the Macallan distillery in the Speyside region of Scotland. Distilleries are known for their distinctive characteristics; for example, the Laphroaig, Lagavulin, and Ardbeg distilleries are known for their smokey tastes coming from the peat used in the production process. Preference for this smokey taste, also known as "peatiness", is highly idiosyncratic, and thus creates horizontal differentiation. On the other hand, some brands, such as Macallan, are generally considered higher quality than others and act as a form of vertical differentiation. As the Scotch Whisky Association, an industry group notes, "many consumers buy these products because of their provenance and are unlikely to shift to products produced elsewhere," suggesting that the branding is a strong form of product differentiation.

These two dimensions of differentiation (age and brand) determine the overall (idiosyncratic or common) perceived "quality" of a bottle. A simple hedonic regression of log prices on age and brand of 750 ML bottles with an age statement returns an R-squared of 0.96, or an adjusted R-squared of 0.91, indicating that price is highly correlated with age and brand and strengthening the case for using prices as a proxy for quality. Select output for the hedonic regression is presented in Table 1.

[5] Single malt Scotch is technically a blend as well, just that the component spirits are from the same distillery

	Dependent variable:
	log(prices)
12 YEAR	0.371***
	(0.122)
15 YEAR	0.777***
	(0.130)
25 YEAR	2.235***
	(0.230)
MACALLAN BRAND	0.534***
	(0.188)
TALISKER BRAND	0.648**
	(0.271)
Observations	78
R^2	0.964
Adjusted R^2	0.909
Residual Std. Error	0.171 (df = 31)
F Statistic	17.793*** (df = 46; 31)
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 1: Select Output From Hedonic Regression

Using Pennsylvania data, Table 2 shows that the number of products in each age statement is generally decreasing while the median price is increasing , suggesting that more vertically differentiated products do enjoy less immediate competition, which may lead to higher markups.

United States Section 301 Tariffs on the European Union

The Section 301 tariffs were imposed by the United States on the European Union (EU) in response to what the U.S. considered illegal subsidies for Airbus. The dispute dates back to 2004 when the U.S. first filed a complaint with the World Trade Organization (WTO) alleging that the EU provided prohibited subsidies to Airbus, negatively impacting Boeing's competitiveness. After years of lawsuits and counterclaims, in April 2019, the U.S. announced a list of products to be tariff-ed pending WTO approval, which was authorized in October 2019. This led to the U.S. imposing a series of tariffs on various European imports.

In March 2021, the U.S. and the E.U. decided to suspend tariffs for four months, and in June 2021, both sides reached an agreement to suspend tariffs for five years, putting an

Age Statement	# Products	Median Price
12	46	$49.99
15	14	$67.49
18	23	$114.99
21	10	$209.99
25	10	$599.99

Table 2: Product Space by Age Statement

end to this long-standing trade dispute over aircraft subsidies.

The selection of the products to apply the tariff may be relevant for identification of the tariff effect. In particular, there may be concerns about whether the tariffs are not exogenous to demand or cost shocks, or perhaps single malt Scotch was chosen to protect the domestic whiskey industry. While no smoking gun suggests that the US did choose single malt Scotch as-good-as randomly, several pieces of evidence point to that fact. First, the tariff product list suggests that the administration was targeting "national icon" products, rather than taking into account demand shocks in particular industries. In addition to single malt Scotch whisky, the tariff list included Irish butter, Irish cream, French and Italian cheese, Spanish olive oil, and English wool coats. On the EU side, tariffs were already in place on product categories containing Harley Davidson motorcycles, Bourbon whiskey, and Levi's jeans. This tit-for-tat of tariffs between the US and EU appears to be focusing on inflicting political harm rather than economic, thus giving support to the exogeneity argument. Further, if the US was indeed interested in protecting the domestic whiskey industry from a burgeoning Scotch industry, placing the tariffs on blended Scotch would have been more sensible as they are closer in price and character to domestic whiskies. Thus, I argue that the selection of single malt Scotch for tariffs was unrelated to demand or other economic reasons, and that the tariff provides a natural experiment.

There is a concern about the potential spillover effect of the tariffs from single malt Scotches to blended Scotches. For instance, blended Scotch producers may increase their prices in response to the tariffs on single malt Scotch due to the strategic complementarity of prices in an oligopoly. Or, as Berry et al. (1999) noted, a multiproduct producer producing both blended and single malt Scotches may lower blended Scotch prices to attract the most price-sensitive consumers who will substitute away from single malt Scotch. To see if blended Scotch prices did respond to the tariffs, in Figure 1 I plot the change in average blended Scotch prices relative to changes in average Irish whiskey prices for each

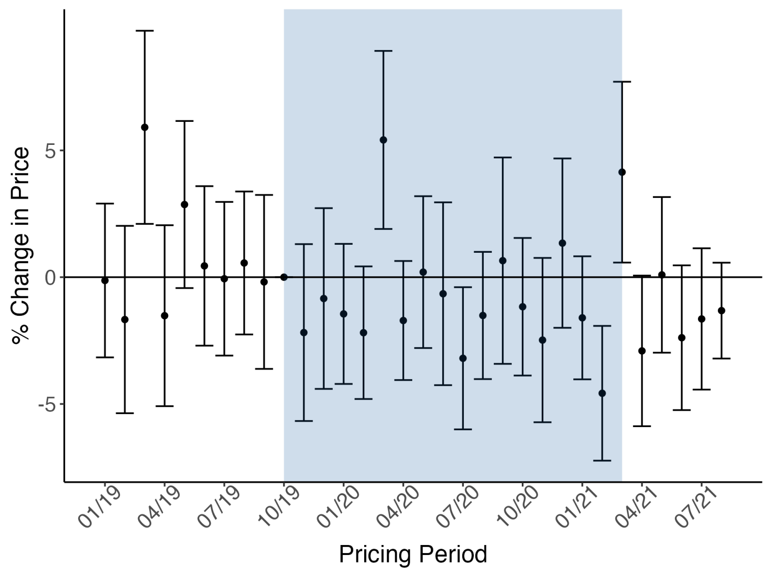


Figure 1: Blended Scotch vs Irish Prices

period, with the tariff period shaded in blue. The assumption here is that Irish whiskey is sufficiently removed from single malt Scotch and should not have any spillover effects of the tariffs, but would capture any other common demand and supply shocks affecting both blended Scotch and Irish. As seen in the figure, there does not appear to be any significant changes in prices of blended Scotch relative to Irish, suggesting that the tariffs did not have any spillover effects to blended Scotch.

Data Sources

The main data source used for both evaluating the impact of the tariffs and for estimating the demand model comes from the Pennsylvania Liquor Control Board (PLCB), acquired under a Right to Know Law request. The data contains the sales amount in dollars and sales quantity in units for every product sold at each liquor store in Pennsylvania, for each week from January 2019 to August 2021. I use a combination of a catalogue spreadsheet file from the PLCB archives and the quarterly product listing published by the PLCB to identify the Scotch products in the sales data. I aggregate each weekly sales data to the pricing period level (which roughly corresponds to each month), and aggregate each store to the state level.

Up until 2016, the PLCB adhered to a fixed pricing formula that made transparent the product acquisition costs that the PLCB pays to suppliers. Since the period that the data covers is no longer under the formulaic pricing, the PLCB may adjust markups accordingly to the demand for each product. As Cole and Eckel (2018) noted, retail markups may be a relevant factor when considering the incidence of tariffs. However, in response to the COVID-19 pandemic, PLCB elected to not initiate any price increase of their own during 2020 and 2021 and only elected to pass through cost increases from the suppliers. In 2020 for example, PLCB notes that "the PLCB did not pursue any retail price increases in 2020, some suppliers did request retail price increases or raise product acquisition costs ... there were 373 items with supplier-initiated retail price increases ... there were 372 cost increases," indicating that PLCB mostly did not choose to absorb any supplier price increases nor add-on to any price increases initiated by the suppliers besides according to its existing markup strategy. Thus, the evidence suggests that the retail prices observed in Pennsylvania are mostly the results of the decisions of the supplier.

However, to directly look at wholesale prices and supplier markups, I also collect wholesale price data from New York state. While not a state monopoly as in Pennsylvania, New York regulates the liquor and wine market and requires suppliers and wholesalers to publicly post their prices. This feature allows me to directly observe the prices that suppliers are charging to wholesalers, and thus better analyze the tariff effect without the influence of retail markups. The wholesale prices are also used to identify exogenous price shifts in my demand model.

For data on consumer demographics and purchases, I use the NielsenIQ Consumer Panel, which contains information on household characteristics and their purchases. I identify the households residing in Pennsylvania, categorize them into household income bins, and calculate the average purchase prices of products. By using this data I can correlate household incomes to purchases, which will be used in identification of the price sensitivities.

3 Policy Impact

Tariff Impact on Prices

I start by documenting the change in prices of Scotch whiskies in Pennsylvania. Figure 2 shows the evolution of the *quarterly* average prices of single malt Scotch and blended Scotch whiskies from January 2019 to August 2021, with the shaded areas indicating the periods in which tariffs were in effect. I calculate the average prices using a balanced panel to ignore the effects of product entry and exit.

Single malt Scotches show a notable increase in prices with a short lag after the imposition of the tariffs. While the tariff period also overlapped with many other cost shocks, such as Brexit and the COVID-19 pandemic, as discussed in the previous section, blended

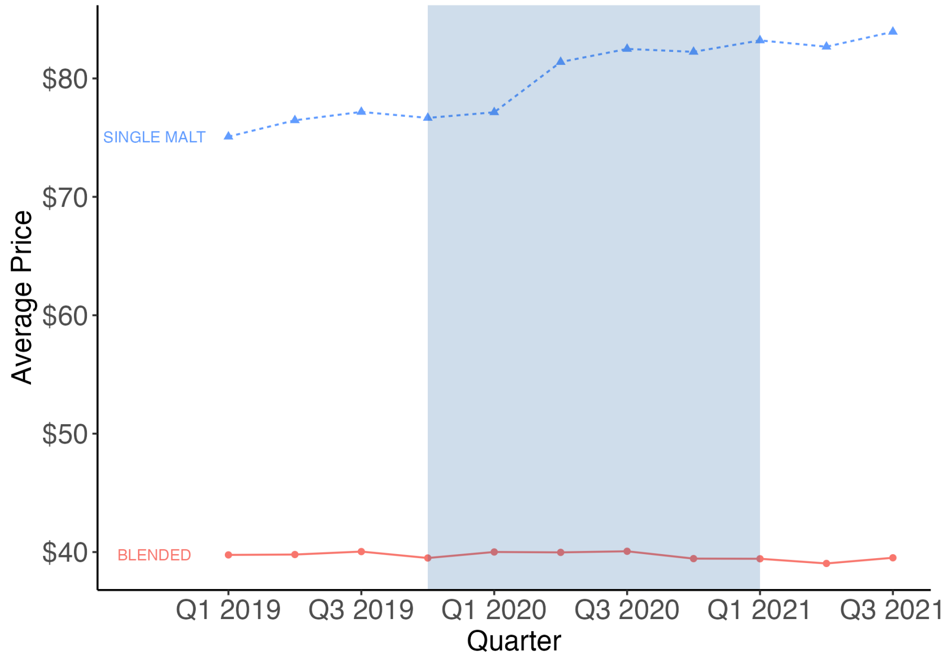


Figure 2: Average Price of Single Malt and Blended Scotches in Pennsylvania

Scotches act as a natural control group for assessing the impact of tariffs. The plot shows that blended Scotch did not exhibit any noticeable change in prices during the tariff period and beyond, suggesting that the leap in single malt prices seen in April 2020 can be attributed as the effect of the tariffs (but with a lag, perhaps due to contracts that predetermined the prices several quarters in advance).

To quantify the causal effect of the tariffs on prices, I estimate the following two-way fixed effects model,

$$ln(p_{it}) = \gamma_i + \lambda_t + \sum_{t=1}^{3} \beta_t D_{it} + \sum_{t=5}^{11} \beta_t D_{it} + \varepsilon_{it} \tag{1}$$

where p_{it} is the price of product i in quarter t, γ_i is a product fixed effect, λ_t is a quarter fixed effect, and D_{it} is an interaction of the quarter fixed effect with a dummy variable indicating that product i is a single malt Scotch. I normalize to the fourth quarter of 2019 (the tariffs were in effect from October 2019). While standard practice is to exclude the period before the policy, the lag in the policy effect observed in Figure 2 suggests this normalization is innocuous, and has the benefit of adding an additional period to study the pre-trends. The coefficients of the interaction terms (β_t's) estimate the dynamic treatment effects of the tariffs, and estimate the average price difference between single malt Scotch and blended Scotch relative to the average price difference in the fourth quarter of 2019.

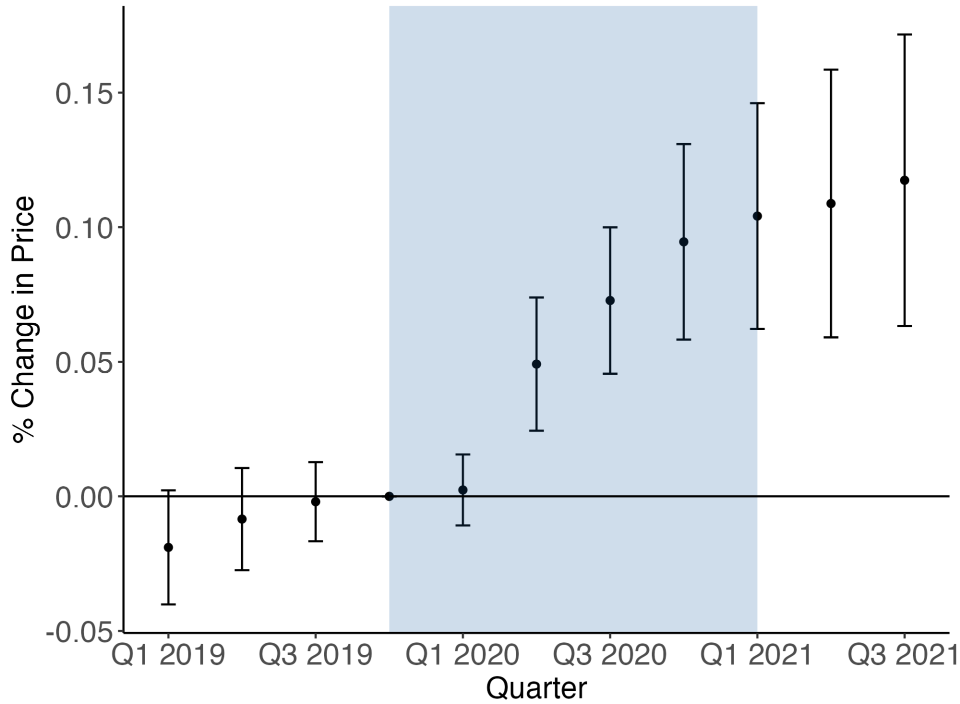


Figure 3: Single Malt vs Blended Price Difference

As the data ranges from January 2019 to August 2021, the coefficients on the first three time periods test for pre-trends, and the coefficients on the last seven quarters estimate the dynamic treatment effect.

The output of the regression is presented in the first column of Table 3, with the corresponding event study plots in Figure 3. While we fail to reject the null of zero effect at the 0.05 significance level in the three quarters prior to the tariffs, there may be some concerns for pre-trends as there appears to be a slight upward trend in prices before the policy. However, the same event study but estimated at the monthly level (presented in the appendix) indicates no discernible trends, suggesting that the slight upward trend seen here may be an artifact of the aggregation to the quarterly level. The dynamic nature of the tariffs is clear from the plot, as the prices gradually increase before tapering off around 11%. The increased prices are sustained even after the tariffs are repealed (March 2021), likely attributable to the uncertainty at the time on whether the tariff repeal would be permanent, or perhaps the "rockets and feathers" phenomenon of prices.

While the blended Scotch credibly controls for supply shocks, there may be demand shocks that may lead to violations of the parallel trends assumption. Namely, during the same period as the tariffs, the U.S. government issued three rounds of stimulus checks in response to the COVID-19 pandemic ($1200 in March 2020, $600 in December 2020, and

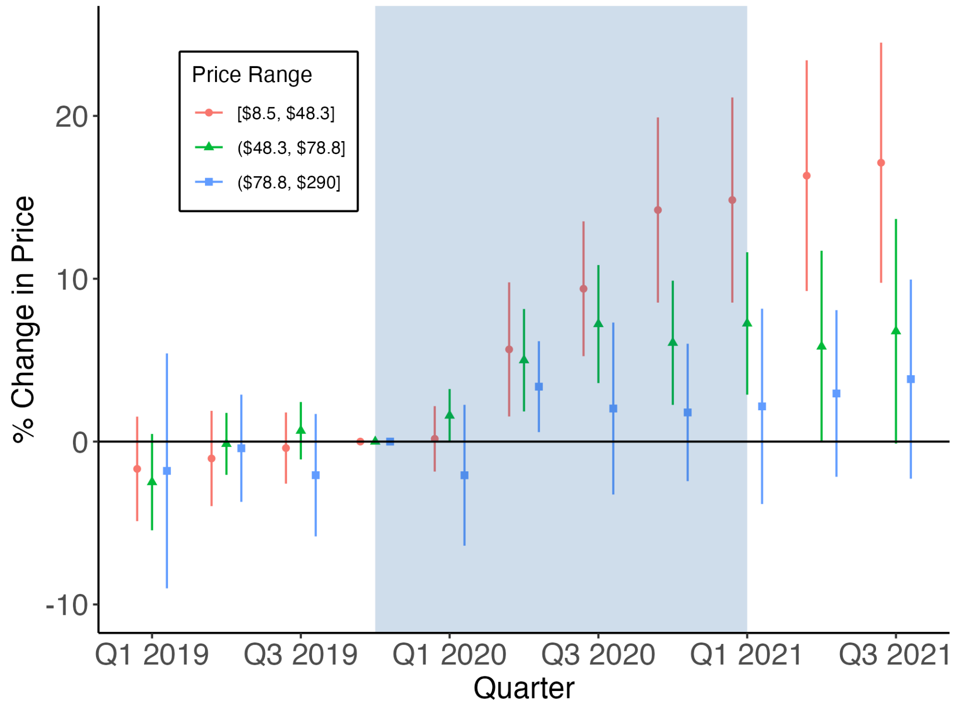


Figure 4: Percentage Change in Prices by Price Bin

$1400 in March 2021). As single malt Scotch products are generally more expensive than blended Scotch, the stimulus checks may have led to an increased demand for single malt Scotch but not blended, which could lead to price increases by suppliers independent of the tariffs and would confound the identification of the tariff effect. To address this concern, and also to determine whether the pass-through differs by quality, I split the single malt Scotches into three bins by price using the average pre-tariff price of each product. I calculate the average pre-tariff price of each blended Scotch product as well, and use the blended Scotch products in the same price ranges of the single malt Scotch price bins as the control group for each bin. I estimate Equation 1 three times, for each price bin, and plot the results in Figure 4, with the regression output in the last three columns of Table 3.

The output shows that there are no significant differences between the products in different price bins before the tariffs. Once the tariffs were in effect however, prices for the cheapest third of products increased significantly relative to the price increases for the more expensive two-thirds of products. For instance, by the first quarter of 2021 (Q9), which was the last quarter during which the tariffs were in effect, the average price increase estimated in the entire sample is 10.96%. But this number masks significant heterogeneity by quality, as the estimated price increase is 15.95% for the cheapest third of products, 7.57% for the middle third, and 2.22% for the most expensive third of products. In fact, for

	Dependent variable:			
	log(price)			
	Pooled	First Tertile	Second Tertile	Third Tertile
Single Malt x Q1	-0.019* (0.011)	-0.018 (0.037)	-0.025* (0.015)	-0.017 (0.016)
Single Malt x Q2	-0.008 (0.010)	-0.004 (0.017)	-0.001 (0.010)	-0.010 (0.015
Single Malt x Q3	-0.002 (0.007)	-0.021 (0.019)	-0.007 (0.009)	-0.004 (0.011)
Single Malt x Q4	-	-	-	-
Single Malt x Q5	0.002 (0.007)	0.002 (0.010)	0.016* (0.008)	-0.021 (0.019)
Single Malt x Q6	0.049*** (0.013)	0.057*** (0.021)	0.050*** (0.016)	0.034** (0.014)
Single Malt x Q7	0.073*** (0.014)	0.094*** (0.021)	0.072*** (0.018)	0.020 (0.027)
Single Malt x Q8	0.095*** (0.019)	0.142** (0.029)	0.061*** (0.019)	0.018 (0.021)
Single Malt x Q9	0.104*** (0.021)	0.148*** (0.032)	0.073*** (0.022)	0.022 (0.030)
Single Malt x Q10	0.109** (0.028)	0.163*** (0.036)	0.058* (0.030)	0.030 (0.026)
Single Malt x Q11	0.117*** (0.028)	0.171*** (0.038)	0.068* (0.035)	0.038 (0.031)
Observations	1,364	297	363	704
R^2	0.993	0.988	0.890	0.975
Adjusted R^2	0.992	0.986	0.872	0.971

*p<0.1; **p<0.05; ***p<0.01

Table 3: Single Malt Scotch Price Changes Relative to Blended Scotch

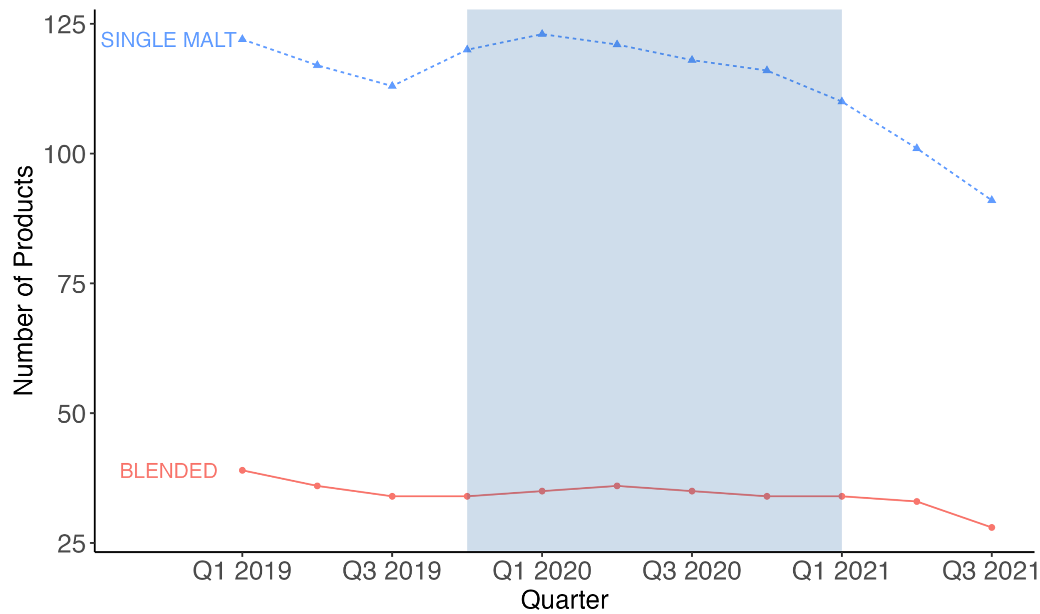


Figure 5: Pennsylvania Product Listings by Category

most time periods, the most expensive third of projects exhibit no statistically significant price increases relative to blended Scotches in the same price range.

Due to the large price differences between single malt and blended Scotch however, the blended Scotch products are not evenly distributed across the three single malt Scotch price bins (there are many more products in the cheapest price bin vs most expensive price bin). Thus, in the appendix I also estimate Equation 1 but with splitting the blended Scotch into thirds by price to form the control group. I also estimate the model using wholesale data from the State of New York instead of PLCB retail prices. As the wholesale data provides information on the prices at which the suppliers are selling to wholesalers, it addresses concerns over retail markup adjustments. I find that the results are robust in both specifications, with the same finding of higher price increases for the cheaper products.

Tariff Impact on Variety

Tariffs not only impact prices but also may have an impact on the scope of products that are imported. Figure 5 plots the unique number of products listed in the quarterly price catalogue published by the PLCB from Q1 2019 to Q3 2021.

There is a significant decrease in the number of single malt Scotch products listed in the catalog associated with the tariffs, while blended Scotch shows a slight decline in variety only near the end of the data period. But there is an additional threat to the parallel trends assumption here compared to the price effects: the confounding cost shocks may have impacted exports of single malt variety more than blended Scotch. For example, in response to the challenges posed by the pandemic, firms may have decided to cut back on the marginal products in their portfolio and focus on their core products. Since there are significantly more single malt Scotch varieties each with lower market shares than blended Scotches, the confounding cost shock may have prompted firms to cut down on their single malt portfolios more. However, export data published by the UK does not exhibit any significant changes in the export volume or value of single malt Scotches relative to blended Scotches, suggesting no differential response to the cost shocks (unless there was substantial reallocation of production in single malt Scotch towards their core products, which seems unlikely given the long production time-frame of single malt Scotch).

The main question of interest is whether the products that were discontinued were of higher quality than the products that continued to be sold. To study this question, I take the products that were sold in all four quarters of 2019, group each product category into thirds by pre-tariff price (P1 to P3 in increasing order of prices), and plot the availability of the products over time, in Figure 6.

Here, we can see that for single malt Scotch, the top third of products by price exhibit the steepest decline in variety, although the remaining two-thirds also exhibit a significant decline in variety. Blended Scotch, on the other hand, exhibits very few products dropping out of the sales data. This suggests that while the tariffs led to a decrease in the variety of all single malt Scotch products, it particularly affected the most expensive products. While this analysis ignores any potential introduction of new products, it provides evidence that the overall decrease in products seen in Figure 5 (which does account for new products) may be more biased towards high quality goods.

Because of the use the sales data, there may be concerns that zero sales are misconstrued for product unavailability. However since the data is aggregated to the quarter level, zero sales would imply that not one single bottle of the product was sold across three months across the entire state of Pennsylvania, although it had been sold in every quarter of 2019. Thus, the observed decline in the variety of products sold is more likely to be attributable to the discontinuation of products rather than zero sales.

To quantify the average drop-out rate by price bins, I estimate a similar model to Equation 1, with product availability as the dependent variable,

$$I_{it} = \gamma_i + \lambda_t + \sum_{t=1}^{3} \beta_t D_{it} + \sum_{t=5}^{11} \beta_t D_{it} + \varepsilon_{it} \tag{2}$$

where $I_{i,t}$ is whether product i was available in quarter t, $\gamma_{(i)}$ is a fixed effect for the cate-

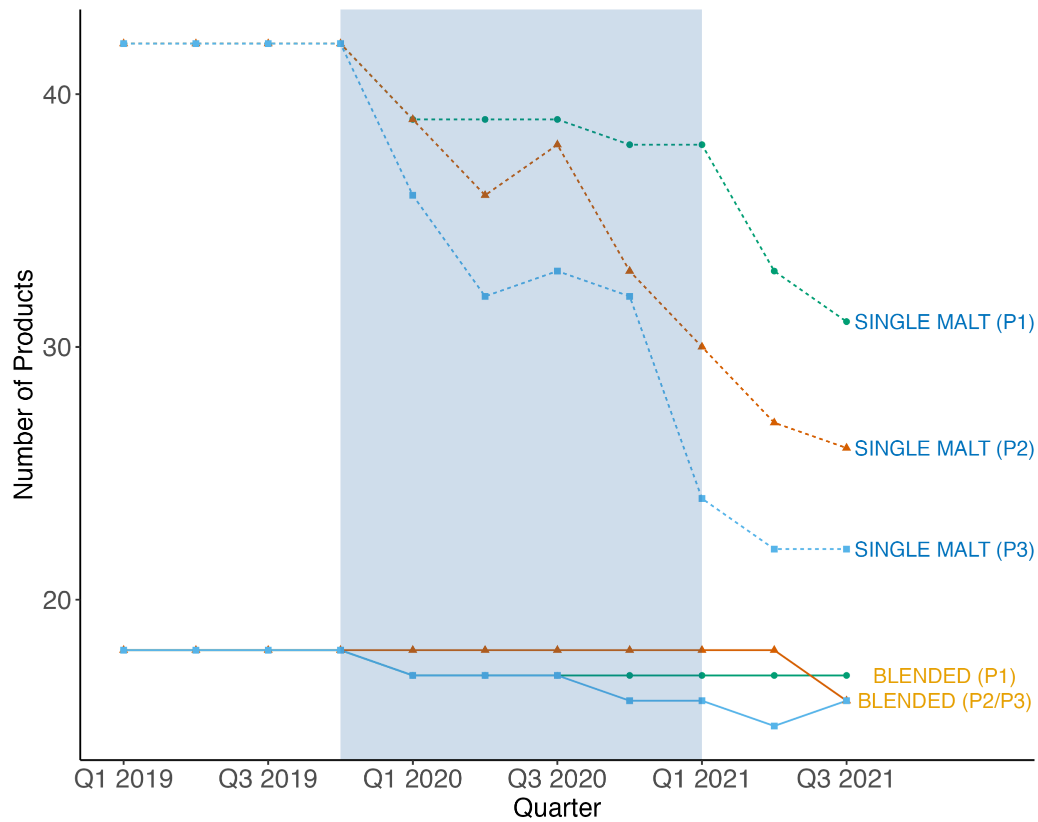


Figure 6: Products with Non-Zero Sales by Price Bins

(P1 to P3 in increasing order of prices)

gory of product i, λ_t is a quarter fixed effect, and D_{it} is an interaction of the quarter fixed effect and a dummy variable indicating that product i is single malt. As before, the fourth quarter of 2019 is excluded for normalization. The coefficients of the interaction terms (β_t's) are the main parameters of interest. Here, these coefficients estimate the differences in mean availability of single malt Scotch and blended Scotch, relative to the difference in the fourth quarter of 2019 (which is zero, as products that were available in all of 2019 were chosen); this model resembles less of a linear probability model and more of two-sample t-test for difference in means across time. Similar to the price effect, I estimate the model with the products pooled together, and also by splitting the products into thirds by prices, with the output presented in Table 4. By the first quarter of 2021 (Q9), the number of products overall that became unavailable is 23.86%. But this number masks significant heterogeneity by quality, as only 4.08% of the bottom third of products are unavailable in contrast to 33.1% and 37.3% for the next two third of products.

Qualitative evidence from the industry also suggests that the tariffs had a more significant impact on the variety of higher-end products. In response to an email inquiry

	Dependent variable:			
	Availability			
	Pooled	First Tertile	Second Tertile	Third Tertile
Single Malt x Q1	0.000 (0.066)	0.000 (0.096)	0.000 (0.110)	0.000 (0.131)
Single Malt x Q2	0.000 (0.066)	0.000 (0.096)	0.000 (0.110)	0.000 (0.131)
Single Malt x Q3	0.000 (0.066)	0.000 (0.096)	0.000 (0.110)	0.000 (0.131)
Single Malt x Q4	-	-	-	-
Single Malt x Q5	-0.058 (0.066)	-0.016 (0.096)	-0.071 (0.110)	-0.087 (0.131)
Single Malt x Q6	-0.114* (0.066)	-0.016 (0.096)	-0.143 (0.110)	-0.183 (0.131)
Single Malt x Q7	-0.090 (0.066)	-0.016 (0.096)	-0.095 (0.110)	-0.159 (0.131)
Single Malt x Q8	-0.127* (0.066)	-0.040 (0.096)	-0.214* (0.110)	-0.127 (0.131)
Single Malt x Q9	-0.214*** (0.066)	-0.040 (0.096)	-0.286*** (0.110)	-0.317** (0.131)
Single Malt x Q10	-0.275*** (0.066)	-0.159 (0.096)	-0.357*** (0.110)	-0.310** (0.131)
Single Malt x Q11	-0.280*** (0.066)	-0.206** (0.096)	-0.270** (0.110)	-0.365*** (0.131)
Observations	1980	660	660	660
R^2	0.156	0.089	0.194	0.214
Adjusted R^2	0.147	0.059	0.168	0.189

Table 4: Availability Relative to 2019

on the impact of tariffs, the Scotch Whisky Association, an industry trade group, stated that "for some companies, the tariff meant they had to cease exporting to the US for the time the tariffs were in place – to focus on other markets." Other interviews of importers, such as one by *Whisky Advocate*, a trade magazine, cite importers who explicitly stated that the tariffs led to a decrease in imports of higher-end single malt varieties. For example, one importer stated when the tariffs were lifted they were "once more gearing up to bring older, more exclusive single malts stateside, after sidelining them in the face of dramatic price surges." Another importer states: "Last year we deferred [importing] some of our portfolio because of the impact the tariff would have on them, so we can certainly bring those whiskies over now." Thus, the qualitative evidence, along with the data, suggests that the tariffs have led to a more marked decrease in the variety of high-end single malt products relative to lower-end products. This heterogeneous impact is likely to have been driven by the theoretical prediction that higher trade costs lead to the exit of the products on the margin, which high-end products (with their low-volume of sales) tend to be.

4 Model of Differentiated Products Market

Investigating the mechanisms behind the heterogeneous effects on prices and to quantify the welfare changes of the tariffs require a model of consumer substitution patterns and purchasing behavior. I estimate a random coefficients nested logit demand model[6] for Scotch and Irish whiskey in Pennsylvania, which can accommodate flexible substitution patterns and consumer heterogeneity in incomes.

Model of Demand

Each pricing period, a consumer decides to purchase a bottle of Scotch/Irish whiskey (inside good), or some other whiskey (outside good), of sizes 375ml, 750ml, 1000ml, or 1750ml. Consumer i's indirect utility of purchasing product j in pricing period (market) t is given as:

$$U_{ijt} = x_j \beta_i - \alpha_i p_{jt} + \xi_{jt} + \tilde{\varepsilon}_{ijt} \tag{3}$$

x_j is a vector of product characteristics, which includes bottle size and proof, and p_{jt} is the price of product j. The unobserved mean valuation for product j in time t is defined as

$$\xi_{jt} = \xi_{\tilde{j}} + \xi_t + \Delta\xi_{jt}, \tag{4}$$

[6]Previous studies have used the random coefficients nested logit (RCNL) model in estimating demand for alcohol, such as Miller and Weinberg (2017), Miravete et al. (2018), and Conlon and Rao (2023).

where $\xi_{\tilde{j}}$ is a fixed effect for the brand of a bottle (e.g., Johnnie Walker) and ξ_t is a fixed effect for the pricing period. Including the pricing period fixed effects will account for market-wide trends; for example, the online alcohol retailer Drizly has reported that Scotch market shares increase in the holiday season as consumers look to buy more expensive bottles. Finally, $\Delta\xi_{jt}$ represents product-specific unobserved mean valuation that is not explained by brand and pricing period effects and will be the structural error that will form the moment conditions for estimation.

The $\tilde{\varepsilon}_{ijt}$ forms the stochastic term, and can be further decomposed into

$$\tilde{\varepsilon}_{ijt} = \zeta_{ijt} + (1-\rho)\varepsilon_{ijt} \tag{5}$$

ε_{ijt} is the independent and identically distributed extreme value error term and ζ_{ijt} is drawn from the distribution such that $\tilde{\varepsilon}_{ijt}$ follows the extreme value distribution. The parameter ρ governs the nesting structure, bounded between zero and one, with values closer to one indicating a higher degree of substitutability within nests. Nests are defined as single malt Scotch, blended Scotch, single malt Irish, blended Irish, and the outside good. At $\rho = 1$, consumers will substitute only to products within the same nest, while at $\rho = 0$, consumer's substitution will be determined by the other parameters in the indirect utility function, i.e., the model collapses to the mixed logit model.

Finally, the parameters α_i and β_i can be decomposed into a mean value, observed heterogeneity by demographics, and unobserved heterogeneity:

$$\begin{pmatrix} \log(\alpha_i) \\ \beta_i \end{pmatrix} = \begin{pmatrix} \alpha \\ \beta \end{pmatrix} + \Pi D_i + \Sigma\nu_i, \quad \nu_i \sim N(0, I_{K+1})$$

I make the common assumption that the price coefficients α_i follow the lognormal distribution, which bounds the price coefficients to be negative. For the demographic component D_i, individuals are split into four bins of household income smaller than \$45,000, between \$45,000 and \$70,000, between \$70,000 and \$100,000, and greater than \$100,000. The demographics will interact with Π to allow the (dis)utility from price to vary by income bin. The ν_i term is drawn from the standard normal distribution with variance to be estimated and interacts with price and proof. This will induce heterogeneity in preferences for prices and the proof of a product, but not in the preference for a particular bottle size or other characteristics.

I define the potential outside market as the market of whiskey and calculate market shares as liters of ethanol equivalent. For example, an 80 proof 750ml bottle of scotch will contain 300ml of ethanol. Defining the potential market as the market of whiskey has the drawback in that it makes the prices of non-Scotch and non-Irish whiskies to be non-strategic. For example, if high-end Bourbon prices fell drastically, the model would not capture the substitution of Scotch drinkers to Bourbon. But the benefit of this definition of the market is that through the PLCB data, I can calculate the market size without additional assumptions.

I decompose the indirect utility term into

$$U_{ijt} = \delta_{jt}(x_j, \xi_{\tilde{j}}, \xi_t, \Delta\xi_{jt}; \beta) + \mu_{ijt}(x_j, p_{jt}, D_i, \nu_i; \Pi, \Sigma) + \tilde{\varepsilon}_{ijt} \tag{6}$$

where

$$\delta_{jt} = x_j\beta + \xi_{\tilde{j}} + \xi_t + \Delta\xi_{jt} \tag{7}$$

$$\mu_{ijt} = [p_{jt}, x_j] * (-\exp(\Pi D_i + \Sigma\nu_i)) \tag{8}$$

The conditional probability that consumer i chooses product j in market t is then

$$s_{ijt} = \frac{\exp((\delta_{jt} + \mu_{ijt})/(1-\rho))}{\exp(I_{ig}/(1-\rho))} \frac{\exp(I_{ig})}{\exp(I_i)}$$

with the McFadden (1978) inclusive values defined as

$$I_{ig} = (1-\rho)\ln\sum_{j=1}^{J_g}\exp((\delta_{jt} + \mu_{ijt})/(1-\rho))$$

$$I_i = \ln\left(1 + \sum_{g=1}^{G}\exp(I_{ig})\right)$$

for product set J_g of each nest. Thus product j's shares in market i are then simulated as

$$\hat{s}_{jt} = \frac{1}{N_t}\sum_{i=1}^{N_t}\frac{\exp((\delta_{jt} + \mu_{ijt})/(1-\rho))}{\exp(I_{ig}/(1-\rho))} \frac{\exp(I_{ig})}{\exp(I_i)} \tag{9}$$

Model of Supply

There are F firms each producing a subset J_{ft} of products in each period t. Firm f's profit function in market t (ignoring t subscripts), assuming constant marginal costs, and normalizing the market size to one, is

$$\Pi_f = \sum_{j\in\mathcal{J}_f}(p_j - mc_j)s_j(\mathbf{p}) - FC_f \tag{10}$$

where $\mathcal{J}_f$ is the firm's product set, mc_j is product j's marginal costs, $s_j(\mathbf{p})$ is the market share of product j as a function of market prices $\mathbf{p}$, and finally FC_f is the fixed cost of firm f. I then define the ownership elasticity matrix Ω as in Nevo (2001), where

$$\Omega_{jr} = \begin{cases} -\partial s_r/\partial p_j & \text{if } \exists f : r, j \subset \mathcal{J}_f \\ 0 & \text{otherwise} \end{cases} \tag{11}$$

Thus, the markup equation results,

$$p - mc = \Omega^{-1} s(\mathbf{p}) \tag{12}$$

I do not separately specify and estimate a model of marginal costs, but use the estimates from the demand model and the supply model specification to back out marginal costs.

Identification and Estimation

The arguments for identification and the estimation procedure are based on the procedure outlined in Berry (1994) and Berry et al. (1995). I utilize the NielsenIQ Consumer Panel Data as micro moments to identify the demographic interactions with prices (Conlon and Rao 2023). I draw the income distribution from the NielsenIQ Consumer Panel Data, where I assign panelists into one of four income bins {$<$ \$45,000, \$45,000 - \$70,000, \$70,000 - \$100,000, \$100,000 $<$}. I then calculate the average purchase price of Scotch by each income bin and add these micro moments to match with the model predictions (Petrin 2002). I exclude the coefficient on the lowest income bin for normalization.

The unobserved heterogeneity in price sensitivities is identified through the exogenous shifts in prices and the corresponding changes in shares, which the distribution of consumer heterogeneity must rationalize. To identify the exogenous changes in prices, I instrument price with three instruments: the first is an indicator variable for the tariff, which is credibly uncorrelated with the structural error term $\Delta\xi_{jt}$ due to the nature of the tariffs, but correlated with the price. The tariff serves as an ideal cost shock for "tracing out" the demand curve. For my second instrument, I match each product to the data of wholesale liquor prices in New York state and use the corresponding wholesale price in New York (the prices that suppliers charge to wholesalers in New York) as an instrument for retail prices in Pennsylvania. The identifying assumption behind this instrument is that wholesale prices in New York would reflect cost shocks that affect Pennsylvania as well, while being uncorrelated with any demand shocks in Pennsylvania. This is similar to the argument for "Hausman instruments," and as such, is susceptible to the same threats to identification as discussed in Nevo (2001). For example, if there is an unobserved cross-state demand shock that leads manufacturers to charge higher prices to both Pennsylvania and neighboring New York, retail prices in Pennsylvania and wholesale prices in New York would be correlated. However the inclusion of period fixed effects and brand fixed effects mitigates such concerns as identification now relies on wholesale prices in New York being uncorrelated with $\Delta\xi_{jt}$, the product-specific deviation from brand and period fixed effects. Unless the correlated demand shocks in both markets are brand-period specific, these instruments would satisfy the exclusion restriction. Finally, the third instrument is a dummy variable indicating whether a product is offered on sale or not. The PLCB does adjust prices according to an unknown method to maximize profits on most of their products, but for many products (absent some cost shock) PLCB's listed prices stay constant throughout the entire period. Most of the price variation is due to temporary price reductions and promotions, which are scheduled by the manufacturer or PLCB several months in advance, and thus, the identification holds as long as the sales are not correlated with $\Delta\xi_{jt}$, the product specific deviation from brand and period fixed effects. Using promotions as an instrument does risk attributing stock-piling behavior for elastic demand, but Seim and Waldfogel (2013) also study the Pennsylvania liquor market and find no correlation between consumers' distances to store and changes in sales, suggesting that stock-piling behavior is less of a concern.

The consumer heterogeneity for bottle-proof and the outside good is identified by the exogenous changes in the product choice sets across markets and the correlation between the shares and characteristics of the remaining products. The nesting parameter ρ is identified by the change in each nest's shares of the total inside market as products are added and dropped from the choice set. Thus, the number of products in each nest will be added as instruments to identify the nesting parameter.

I also utilize differentiation instruments from Gandhi and Houde (2019). Namely, I utilize the local and interacted form of the differentiation IVs, using exogenously predicted prices, proof, and bottle categories. These IVs capture the crowdedness of the product space for each product, for example, "how many similarly priced own-firm and rival-firm bottles are there to mine?".

Defining the set of instruments as $Z = [z_1, \ldots, z_M]$, I define the population moment conditions as $E[Z'\omega(\theta)]$ where $\theta = [\beta, \Pi, \Sigma, \rho]$ are the parameters to be estimated and $\omega(\theta)$ is an error term defined as the unobserved mean valuation $\Delta\xi_{jt}$. Specifically, using Equation 7, I derive

$$\omega(\theta) = \delta_{jt} - x_j\beta - \xi_{\tilde{j}} - \xi_t$$

The δ_{jt} comes from matching the predicted shares to the market shares, $\hat{s}_{jt}(\delta_{jt}, \theta) = s_{jt}$, and can be inverted numerically with the dampening term from Grigolon and Verboven (2014). Then, the GMM estimate is

$$\hat{\theta} = \arg\min \omega(\theta)' Z A^{-1} Z \omega(\theta)$$

for the appropriate weighting matrix A.

I simulate my consumers with 1000 Halton draws from the standard normal distribution, with income bins randomly assigned according to the distribution from the NielsenIQ Consumer Panel Data for 2019 and 2020 in Pennsylvania, and estimate the feasible efficient two-step GMM using a non-linear search over the parameters.

Estimation Results

The results of the estimation are presented in Table 5. For the price variable, as stated previously, the mean coefficient ($\bar{\alpha}$) is not separately identified from the demographic price coefficients. The demographic coefficients by income bin are in the expected order (for the lognormal distribution), becoming more and more negative as income increases. There is significant heterogeneity within each income bin as well, as indicated by the random coefficient on prices, and suggests a large overlaps in price sensitivities between the income bins. The consumers seem to prefer larger bottle sizes, and have little heterogeneity in preference for bottle-proof and the outside good (captured by the coefficient on the constant term). The nesting parameter is estimated to be 0.76, indicating that consumers generally prefer to substitute to other products in the same category in response to a price change. The nesting parameter may be particularly relevant later when considering the welfare impact of the tariffs as it indicates that consumers may not be inclined to substitute to other categories. Table 6 presents the micro moments to be matched and their model predicted values. Overall the model predictions tend to be higher than the NielsenIQ survey results, perhaps due to the sales of high priced products in the Pennsylvania data but not observed in the smaller survey sample.

The elasticities from the model are plotted for all products in Figure 8. All of the own price elasticities are negative and elastic, and there is a positive relation between prices and elasticity. Higher priced products are purchased more by price insensitive consumers, and since elasticity is calculated as a weighted mean of individual consumer purchase probabilities, the elasticities decrease as prices increase. These elasticities also imply higher markups for the high-priced products, in line with the theory of vertical and horizontal product differentiation.

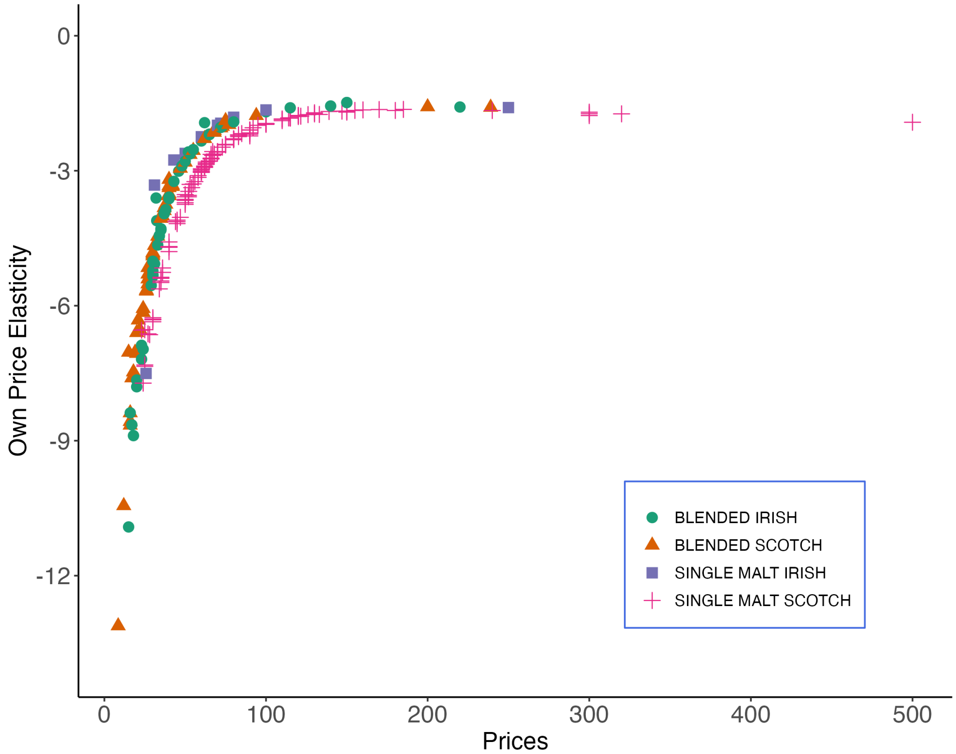


Figure 8: Own Price Elasticity

5 Markup Adjustments and Welfare

Markups Adjustment

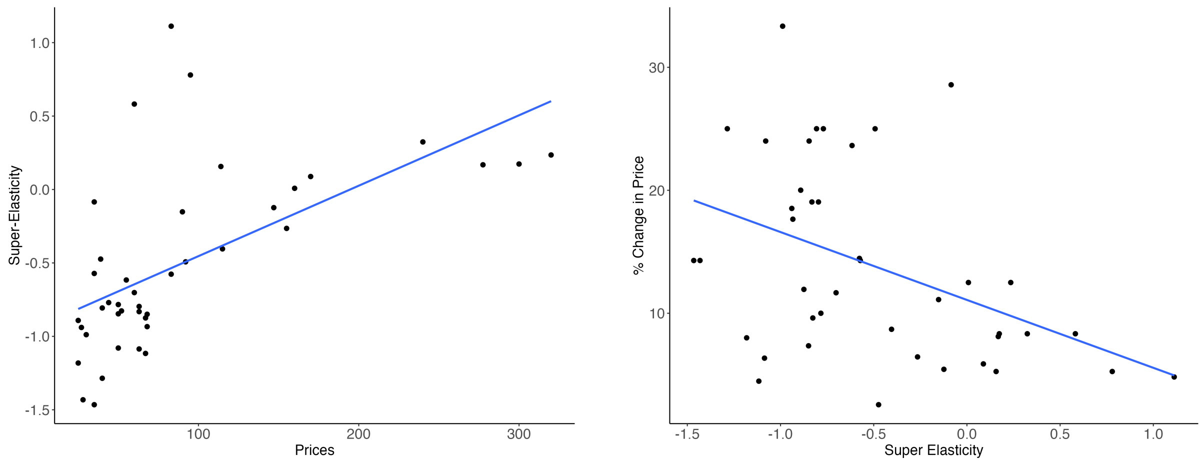
Now with the demand estimates, I can estimate the super-elasticity of demand for each product by taking the percentage change in the elasticity divided by the percentage change in prices. The super-elasticity serves as a measure of the demand curvature, as it is the elasticity of elasticity with respect to prices. Using the *observed* prices in October 2019 and March 2021, I calculate each product's respective price elasticities in each period and calculate the super-elasticities. Figure 9a plots the prices of products in October 2019 against the calculated super-elasticities and the accompanying Figure 9b plots the super-elasticities against observed percentage increase in prices, for a subset of products sold in both October 2019 and March 2021. The scatter plot and the fitted regression line in Figure 9a indicate a positive correlation between prices and super-elasticities, suggesting that for a percentage price increase, the demand elasticities increased (in magnitude) more for higher priced goods. Many of the lower priced products in fact have negative super-elasticities, indicating that the demand became *less* elastic by March 2021. Figure 9b shows that, as theory predicts, products for which demand became less elastic exhibit

	Mean Utility	Random Coeff	Demographic Interactions (Π)			
	(β)	(Σ)	<$45K	$45K - $75K	$75K - $100K	>$100K
Price	2.423 (2.758)	2.508 (0.897)	-	-0.825 (2.941)	-3.955 (1.279)	-4.926 (1.201)
Proof	-0.020 (0.032)	0.013 (0.018)				
Constant	-0.159 (3.197)	3.069 (2.341)				
375 ML	-1.266 (0.174)					
750 ML	-					
1000 ML	0.015 (0.044)					
1750 ML	0.813 (0.108)					
Nesting Parameter (ρ)						
0.764 (0.022)						

Table 5: Demand Model Estimates

Micro Moments		
Moment	Value	Estimated Value
$E[p_j \| inc1]$	$26.79	$25.60
$E[p_j \| inc2]$	$28.18	$32.42
$E[p_j \| inc3]$	$31.85	$38.08
$E[p_j \| inc4]$	$37.47	$41.08

Table 6: Micro Moments



(a) Prices vs Super-Elasticity (b) Super-Elasticity vs Price Changes

Figure 9: Passthrough and Super-Elasticity (October 2019 - March 2021)

higher changes in prices compared to those products for which demand became more elastic. These plots show that the patterns of pass-through observed in the data can be explained by the curvature of the demand, namely, more convex for lower-priced products and concave for higher-priced products.

The previous calculations is subject to the caveat that the other changes in the markets were occurring between October 2019 and March 2021, such as the introduction and exit of products, price changes in blended Scotch and Irish whiskies, changes in the outside good shares, and so on. Thus, to further isolate the effect of the tariffs on markups, I use the model to *simulate* the effects of a cost increase. Using the elasticity estimates, I recover the costs for each product in October 2019 through the markups equation in Equation 12. I then impose a 25% cost increase to single malt Scotch products only and re-compute the equilibrium prices and elasticities. Table 7 shows for a sample of best-selling single malt Scotch products the equilibrium prices and elasticities in October 2019, the newly estimated prices and elasticities, and the super-elasticities. Figure 10 plots the prices and super-elasticities for all single malt Scotch products. Once again, positive super-elasticities imply a (magnitude-wise) increase in elasticities for a percentage increase in price while negative super-elasticities imply the converse.

The plot shows a positive relationship between prices and super-elasticities. Thus, at the new equilibrium prices, holding all else fixed, elasticities increase for high-priced goods. This suggests downwards markups adjustment and consequently more absorption of the cost increase. On the other hand, demand for low-priced goods became *less* elastic at the new equilibrium prices, suggesting an upwards adjustment of the markups and more pass-through of the cost shock.

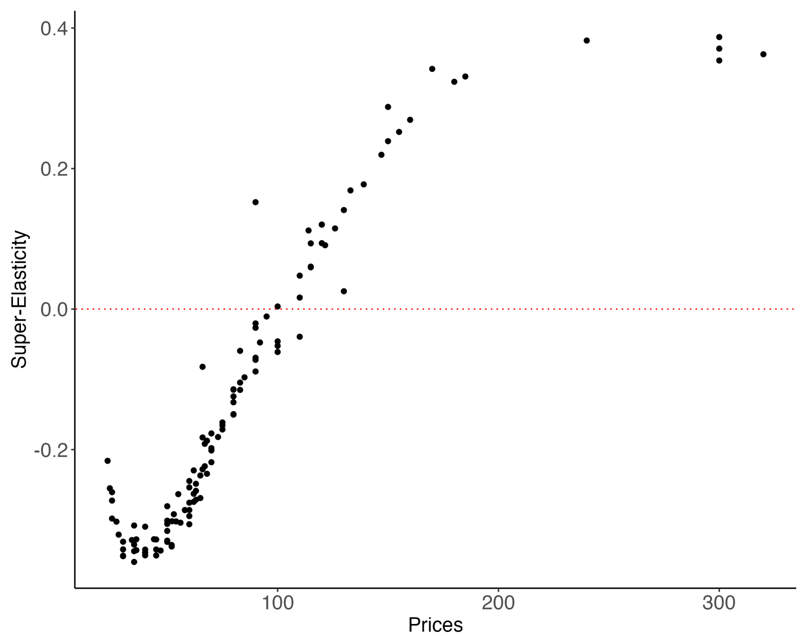


Figure 10: Model Simulated Super-Elasticities vs Original Prices

Product	Prices	New Prices	Elasticity	New Elasticity	Super-Elasticity
McClelland's Highland Single Malt Scotch	$22.99	$29.11	-6.54	-6.17	0.22
Loch Lomond Single Malt Scotch	$24.99	$31.67	-6.53	-6.08	0.26
The Glenlivet Speyside Single Malt Scotch Founders Reserve	$39.99	$52.21	-4.58	-4.09	0.35
Laphroaig Islay Single Malt Scotch 10 Year	$49.99	$65.30	-3.58	-3.23	0.32
Glenfiddich Single Malt Scotch 12 Year	$49.99	$65.37	-3.53	-3.20	0.30
The Glenlivet Speyside Single Malt Scotch 12 Year	$52.99	$69.89	-3.30	-3.00	0.29
The Macallan Highland Single Malt Scotch Double Cask 12 Year	$59.99	$79.45	-2.96	-2.69	0.28
The Balvenie Single Malt Scotch Doublewood 12 Year	$62.99	$83.00	-2.81	-2.59	0.25
The Macallan Highland Single Malt Scotch 12 Year	$66.99	$88.44	-2.57	-2.39	0.22
Oban Single Malt Scotch 14 Year	$82.99	$106.45	-2.20	-2.14	0.10
The Glenlivet Speyside Single Malt Scotch 18 Year	$113.99	$137.22	-1.83	-1.87	-0.11
Glenmorangie Highland Single Malt Scotch 18 Year	$114.99	$141.58	-1.82	-1.85	-0.06
Glenfiddich Single Malt Scotch 18 Year	$114.99	$141.66	-1.83	-1.85	-0.06
The Macallan Highland Single Malt Scotch Fine Oak 15 Year	$125.99	$153.02	-1.75	-1.80	-0.11
The Macallan Highland Single Malt Scotch 18 Year	$319.99	$372.12	-1.74	-1.84	-0.36

Table 7: Estimated Prices and Elasticities

The advantage of looking at the model-estimated prices and elasticities is that I can isolate out the effects that are driving the patterns in the data. The shifting demographic composition of buyers for low-price and high-price goods appears to be driving this pattern. In Table 8, I examine the proportion of buyers in each income bin before and after the cost increases for two products from Table 7, Glenfiddich Single Malt Scotch 12 Year and Glenfiddich Single Malt Scotch 18 Year.

		Original Share	Post Cost Increase Share	Change
Glenfiddich 12 Year	Income 1	1.05%	1.09%	0.04%
	Income 2	0.97%	0.88%	-0.09%
	Income 3	14.34%	11.06%	-3.28%
	Income 4	83.64%	86.67%	3.03%
Glenfiddich 18 Year	Income 1	0.3%	0.16%	-0.14%
	Income 2	0.05%	0.02%	-0.03%
	Income 3	3.34%	2.68%	-0.66%
	Income 4	96.31%	97.15%	0.84%

Table 8: Buyer Share by Income Bin

As these two products are from the same distillery and product line, with the only difference being the age, comparing these two products allows me to identify how the consumer composition differs initially and how it changes after a cost increase for products of different qualities. Income 1 through Income 4 represent the income bins {< \$45,000, \$45,000 - \$70,000, \$70,000 - \$100,000, \$100,000 <}, respectively. The first column shows the proportion of buyers in each income bin at the original equilibrium price, and the second column for the new equilibrium price after the 25% cost increases. We can see that initially the Glenfiddich 18 has a higher share of high-income consumers, as expected for a premium product (\$114.99 vs \$49.99). But post cost increase, the buyer composition shifts substantially for the Glenfiddich 12 compared to the Glenfiddich 18; in particular, the proportion of highest-income consumers purchasing the Glenfiddich 12 increase by 3.03%, a combination of lower income consumers substituting out and higher income consumers substituting in. This increase in high-income buyers will shape the demand to be less elastic, despite the increase in price. On the other hand, for Glenfiddich 18, due to the higher proportion of Income 1 through Income 3 buyers substituting out compared to Income 4 buyers, the proportion of buyers shift towards Income 4 and shapes the demand for this product to be less elastic. However, in this case, the increase in price appears to outweighs the change in the curvature, i.e., the demand shifts inwards more than the curvature becomes less elastic, and on net, the price elasticity increases.

Welfare Analysis

I can estimate the welfare impact of the tariffs, both through the impact on variety and on prices. Following McFadden (1981) and Small and Rosen (1981), I estimate individual i's expected welfare in market t for single malt Scotch products $\boldsymbol{J}_t$ as

$$CW_i(\boldsymbol{p}_t, \boldsymbol{J}_t) = \frac{\log(1 + \sum_{j \in J_t}[V_{ijt}(\boldsymbol{p_t})])}{\alpha_i}$$

where $V_{ijt} = U_{ijt} - \tilde{\varepsilon}_{ijt}$. The compensating variation for a counterfactual product choice set and prices $(\boldsymbol{J}'_t, \boldsymbol{p}'_t)$ is then calculated as

$$CV_i = \frac{1}{\alpha_i} \times \frac{\log(1 + \sum_{j \in J'_t}[V_{ijt}(\boldsymbol{p'_t})])}{\log(1 + \sum_{j \in J_t}[V_{ijt}(\boldsymbol{p_t})])}$$

The welfare effects are calculated for a subset of the consumers, specifically consumers who have a non-zero purchase probability of single malt Scotch products. As there are several lower-income consumers who derive zero consumer surplus from single malt Scotch due to their extremely high price sensitivity, including these consumers into the welfare calculations would find zero effect of the tariffs on welfare for many lower-income consumers. Thus, these results are interpreted as the welfare effect of the tariffs on single malt Scotch buyers.

Price Effect

I first calculate the welfare change accounting for the differential tariff pass-through by quality and compare it to the baseline of uniform tariff pass-through. I start with the products and prices in October 2019 (the baseline from the difference in differences model) and impose changes in equilibrium prices due to the tariffs by March 2021 (the final month of the tariffs), as estimated in the reduced-form model. I calculate welfare under two pass-through schemes, holding the products fixed. First, I impose a uniform price increase of 10.96% across all products regardless of price range. Second, I impose a heterogeneous price increase of 15.95%, 7.57%, and 2.22% for each product in each price bin of thirds, in increasing order of prices. The welfare effects of the first scheme is presented in the first column of Figure 9 and the second scheme in the second column. First, both results show that the low-income consumers lose more relatively to high-income consumers, which is expected as the low-income single malt Scotch consumers are the most price-sensitive.

But going from uniform to the heterogeneous price effect exacerbates the welfare loss for all consumers. The increase in the welfare loss for the high-income consumers can be explained by examining the micro moments, which matched the average purchase price of high-income consumers to be $41.08; that is, even high-income consumers purchase the cheaper goods often. Thus, the change in price-increases from 10.96% to 15.95% for the cheaper products hurt all consumers more than they gain from the change in price-increases from 10.96% to 2.22% for the more expensive products.

Variety Effect

For the product choice set, I simulate product exits using Monte Carlo simulations. First, I use a logit model to estimate the exit probability of each product, under two specifications: one with just category dummy variables (uniform effect) and one with category-price bin dummy variables (quality differential effect). The uniform effect predicts an exit probability of 26.6% for all single malt Scotches while accounting for quality, the exit probabilities become 8%, 20%, 41.2%, in increasing order of price bins. I then take Bernoulli draws for each product, according to its exit probabilities, 5000 times, for both schemes (uniform and heterogeneous).

The results are in Figure 10. The first column shows that assuming uniform exit probability across all products leads to the highest welfare loss for low-income consumers, as the uniform exit leads to largest decline in the range of products these consumers would substitute to, as compared to high income consumers who purchase a wider range of products. But once I simulate product exit with heterogeneous probabilities by quality, the magnitude of the welfare loss decreases for everybody and the order is reversed. The magnitude of the variety welfare effect is small because the low quality goods also tend to have the highest market shares, so when their exit probability decrease from 26.6% to 8%, all consumers' welfare losses decrease. However, the order of the welfare loss is flipped, so that the high-income consumers see the higher welfare loss than the low-income consumers. This is the "progressiveness" of the tariffs, in that the high quality products that the high-income consumers purchasing are more likely to drop out of the market, predominantly hurting the high-income consumers more than the low-income consumers.

Net Effect

Finally, I estimate the welfare changes with both increased prices and decreased variety, with and without the quality differential effect. The results are presented in Figure 11. As summarized in the two previous subsections, once accounting for the quality differ-

Median Consumer Surplus Change (Price)		
	Uniform	Heterogeneous
<$45K	-52.56%	-66.09%
$45K - $70K	-41.33%	-53.84%
$70K - $100K	-16.21%	-22.60%
$100K <	-12.04%	-16.73%

Table 9: Consumer Surplus Change from Price Increase

Median Consumer Surplus Change (Variety)		
	Uniform	Heterogeneous
<$45K	-14.85%	-0.18%
$45K - $70K	-11.78%	-0.52%
$70K - $100K	-7.28%	-1.18%
$100K <	-6.95%	-1.25%

Table 10: Consumer Surplus Change from Variety Loss

Median Consumer Surplus Change (Price and Variety)		
	Uniform	Heterogeneous
<$45K	-59.94%	-66.13%
$45K - $70K	-48.56%	-54.03%
$70K - $100K	-22.55%	-23.90%
$100K <	-18.01%	-17.87%

Table 11: Net Consumer Surplus Change

ential effect, the price effect "decreases" everybody's welfare while the variety effect "increases" everybody's welfare, creating two opposing forces. On net, I observe that the three lower-income consumers welfare decreases even more relative to the uniform effects case, while the highest income consumers actually see an increase in their welfare relative to the uniform effects case. When going from the uniform to the heterogeneous effects, higher-income consumers see more of their purchased high-quality goods disappear from the market, but they are not as sensitive to the increase in pass-through for the low-quality goods (which are less likely to exit now) and thus see a decrease in the welfare loss. On the other hand, for lower-income consumers, they see more of their low-quality goods surviving but the increase in pass-through effect dominates as they are more price sensitive, and thus see an increase in the welfare loss.

These results suggest that accounting for the quality-differential effect of the tariffs is consequential as otherwise we might underestimate the welfare loss on low-income consumers and overestimate for high-income consumers, implying that the tariffs have a much more regressive effect than previously understood.

6 Conclusion

This paper studies the impact of tariffs on consumer goods, but with a novel focus on the differential effects by quality. Tariffs have many potential impacts on consumers and producers, and this paper explores whether product quality significantly modulates these impacts and how they affect consumers of varying income levels. My findings find heterogeneity in tariff pass-through by product quality, which disproportionately impacts lower-income consumers. However, tariffs resulted in a disproportionate reduction in the importing of higher quality goods, leading to higher welfare losses on higher-income consumers compared to low-income consumers. Overall, the low price sensitivity of high-income consumers led to an overall muted impact of the tariffs for them and it was the low-income consumers who lost the most under the tariffs. Furthermore, since single malt Scotch is a premium product compared to other liquors, and thus the impact on low income consumers may be understated in this industry than others.

This paper suggests that assessing the welfare impacts of tariffs should consider all the multiple aspects in which tariffs affect consumers, mainly in prices and variety, but also the importance of matching consumer characteristics and purchases. That is, assuming a uniform impact of tariffs is innocuous as long as consumers are homogeneous, but once considering how different consumers purchase different quality goods at different volumes, the tariff impacts may be much more regressive than previously understood.

The mechanisms behind the markups adjustment are general and should extend to other differentiated products industries. However, future extensions to this study would include incorporating a supply model of endogenous product choice, which can be used to study the firm decisions in ceasing to import some products over others.

In conclusion, this study's findings encourage a more thorough consideration of the quality dimension when assessing the welfare impacts of tariffs, as trade policy impacts differ across consumers of different incomes due to heterogeneity in preferences.

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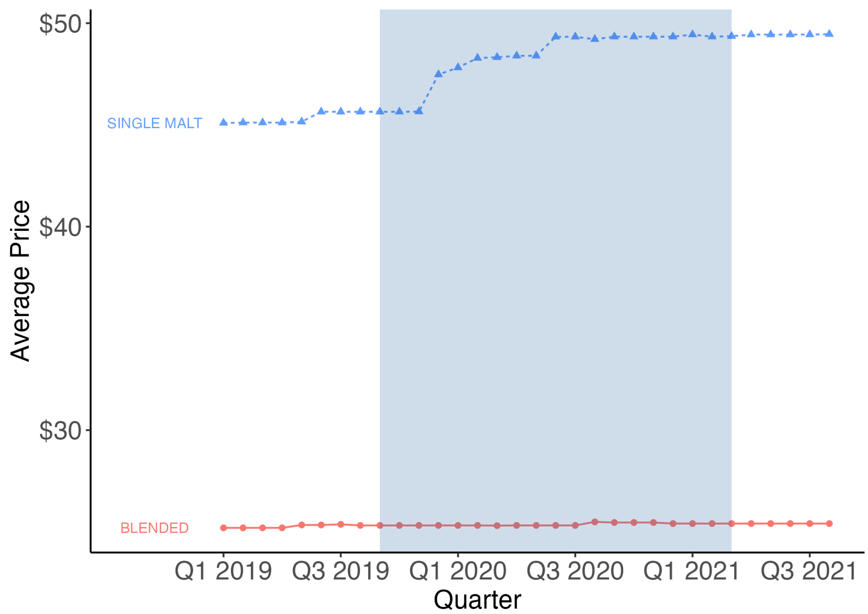


Figure 11: Monthly Wholesale Price Changes in New York

Appendix

A Robustness

New York Wholesale Prices

In order to disentangle the effect of potential markup adjustments made by the retailer (the PLCB), I replicate the difference-in-differences models using wholesale prices posted in the New York State Liquor Authority(NYSLA) system. These prices are the prices that suppliers and manufacturers sell to wholesalers in New York state, and are public and uniform for all wholesalers. The advantage of using this data is several-fold. First, these are the prices that the manufacturers are setting, and thus should provide a more accurate representation of the markup adjustments done by the suppliers and not the retailers. The prices are also updated monthly (in contrast to quarterly for the PLCB), and set two months in advance and but can be adjusted downwards up to one month before the sale month[7]. These prices are also not as constrained with contracts as they might be in the PLCB case, and also exhibit fewer nominal rigidities at price points compared to retail prices, alleviating the concern that the higher pass-through rates for cheaper products are due to nominal rigidities in pricing.

Figure 11 first plots the time series of the average prices, and shows a jump in average

[7]This is a post-and-hold system, as discussed in Conlon and Rao (2023)

prices during the tariff period, with a shorter lag than was the case with the retail prices. I estimate the following two-way fixed effects equation to quantify the difference in prices

$$ln(p_{it}^w) = \gamma_i + \lambda_t + \sum_{t=1}^{8} \beta_t D_{it} + \sum_{t=10}^{32} \beta_t D_{it} + \varepsilon_{it} \tag{13}$$

where p_{it}^w is the wholesale price of product i in month t, γ_i is a product fixed effect, λ_t is a month fixed effect, and D_{it} is an interaction of the month fixed effect with a dummy variable indicating that product i is a single malt Scotch. September 2019 (the tariffs were enacted on October 2019) is excluded for normalization. The coefficients of the interaction terms (β_t's) estimate the dynamic treatment effects of the tariffs, and estimate the average price difference between single malt Scotch and blended Scotch, relative to the price difference in September 2019. As the data ranges from January 2019 to August 2021, the coefficients on the first eight time periods test for pre-trends, and the remaining coefficients estimate the dynamic treatment effect. The values and the 95% confidence bounds are plotted below in Figure 12

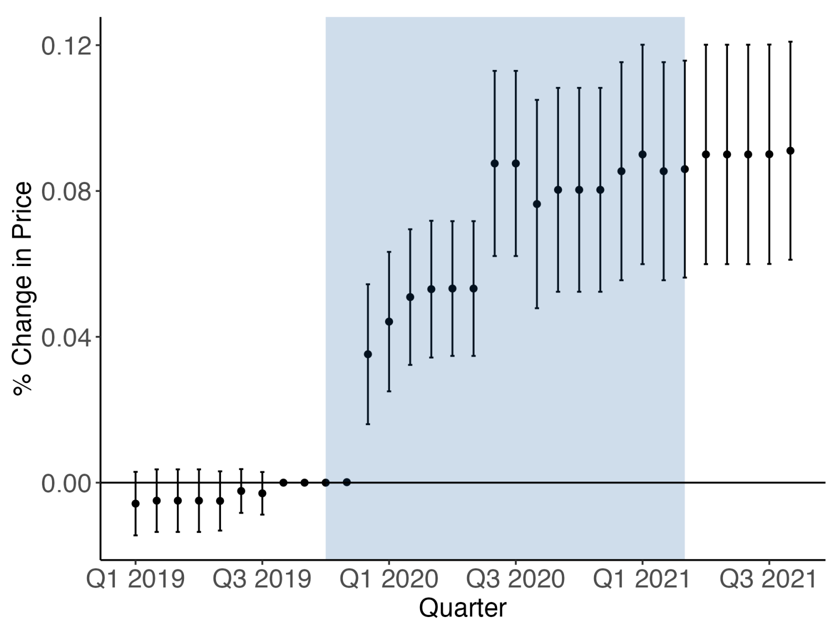


Figure 12: Dynamic Treatment Effects of Tariffs on Wholesale Prices

The plot shows a very similar pattern to the retail prices, although with a significantly shorter lag, reflecting the wholesale price posting system's pricing flexibility. The prices are sustained after the tariffs as well, suggesting that the high sustained retail prices observed in Pennsylvania may be driven by the manufacturers' pricing decisions. I next split the single malt products into thirds, a estimate the model, with the output plotted below:

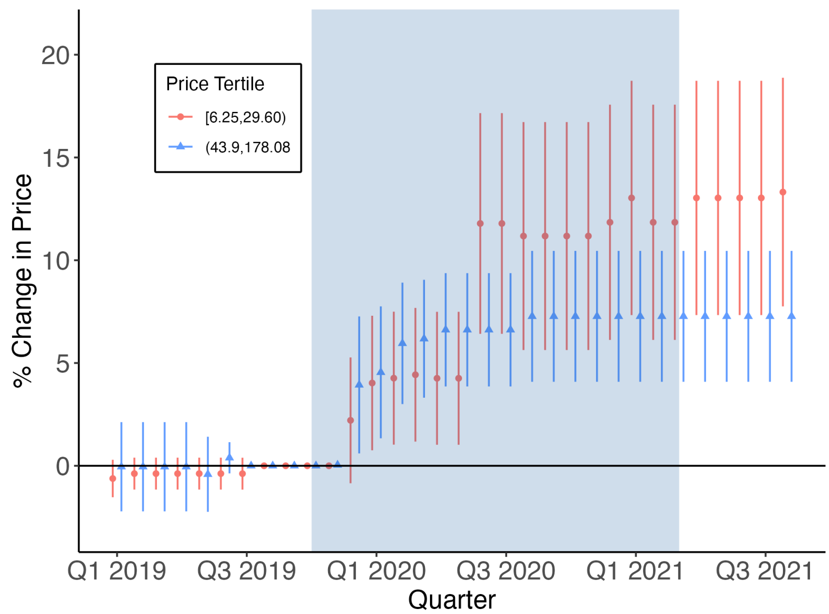


Figure 13: Dynamic Treatment Effects of Tariffs, by Price Range

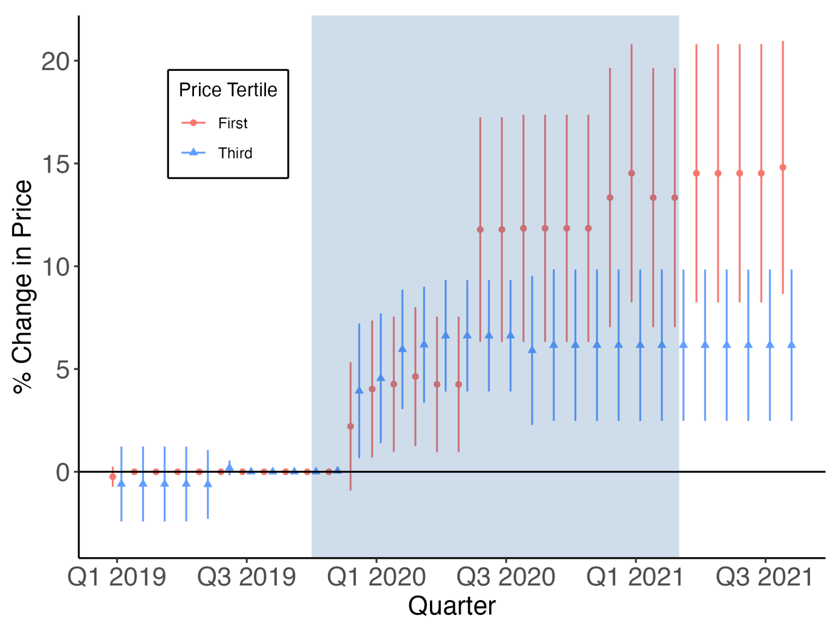


Figure 14: Dynamic Treatment Effects of Tariffs, by Price Bins

In both cases, I divide the single malt products into thirds, but in Figure 13, I match the blended Scotch products in the same prices ranges as the control group. On the other hand, in Figure 14 uses the blended Scotch products of the same tertile as the control group. In both plots, the middle price bins are excluded (the point values and confidence bands are similar to the most expensive bins) to present the heterogeneous effects more

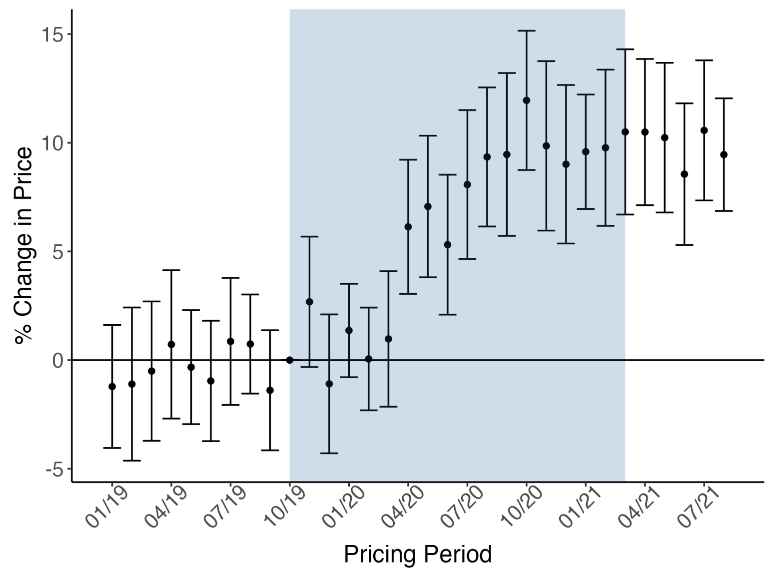


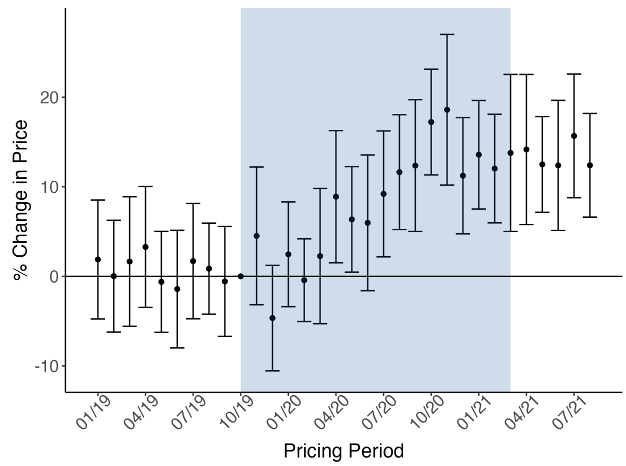
Figure 15: Dynamic Treatment Effects of Tariffs on Retail Prices in Pennsylvania

clearly. Similar to the main specification with Pennsylvania retail pricing data, the tariffs on the most expensive and most cheap products vary widely, from around 15% price increase for the cheaper products compared to 6-7% for the expensive products. These values once again suggest that the price changes observed in the Pennsylvania retail prices are likely to have been driven by changes initiated by the suppliers and manufacturers.

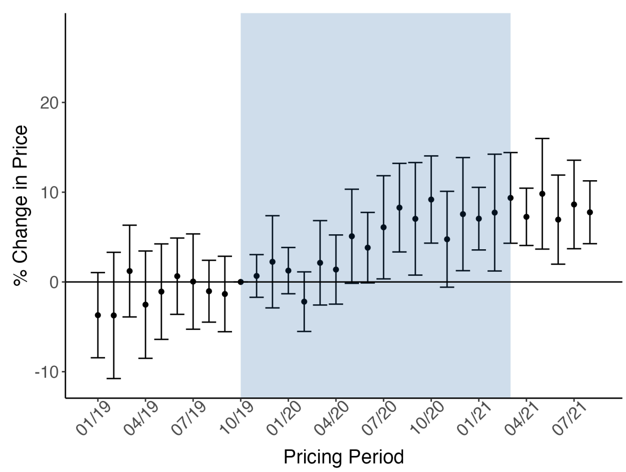
Monthly Level

The main analysis aggregated the weekly pricing data to the quarterly level, using the modal prices in each quarter. However, as the PLCB runs promotions roughly each month, the aggregation to the quarterly level may mask any promotions or pre-trends. For example, if single malt Scotch products were going on promotions more often in order to compensate for the increase in prices due to the tariffs, this would show up in the monthly data but not in the quarterly data; ignoring such effects would then overstate the impact of the tariffs.

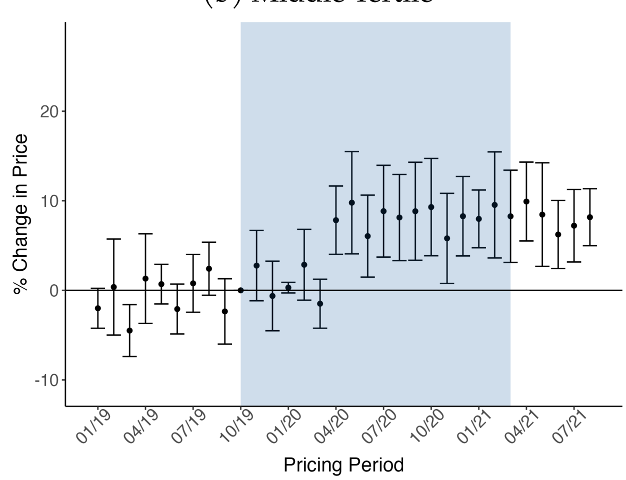
Figure 15 plots the output of the pooled model, where all the observations as combined, and Figure 16 plots the output from the regression where products are placed into thirds by price (the three price bins are separately presented, for tidiness). The slight pre-trend observed when the data was aggregated to the quarterly level disappears once the data is dis-aggregated to the monthly level, suggesting that the slight pre-trends may have been attributable to the aggregation. As for the heterogeneity in the price increases, we can see that the pass-through rate is decreasing in prices as in the main specification.



(a) Bottom Tertile



(b) Middle Tertile



(c) Top Tertile

Figure 16: Percentage Change in Prices by Tertile (Monthly)

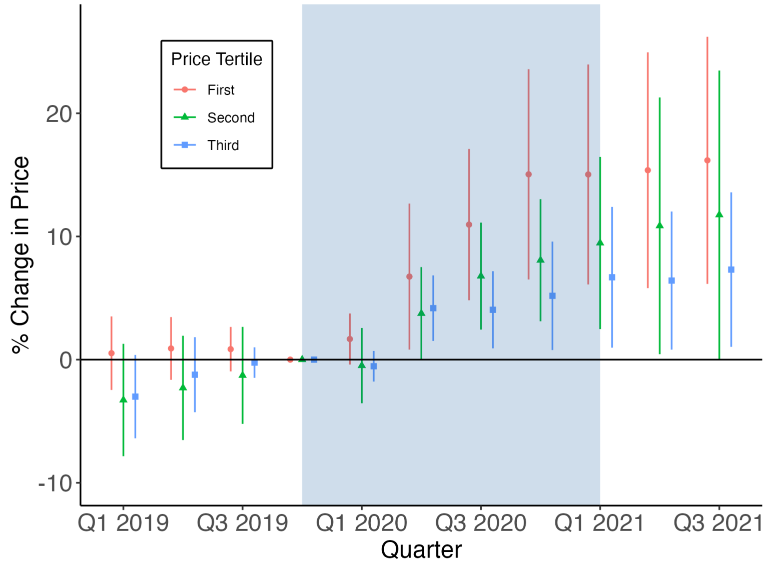


Figure 17: Monthly Price Changes in Pennsylvania

Price Bins

For the difference-in-differences models where the single malt products are split into thirds by price, and matched with blended scotch products in the same price bin, there was a potential issue of small sample size in the upper end of products for blended Scotch. Therefore, I estimate the difference-in-differences model but split both the single malt and blended Scotch products into thirds by price, and use the blended Scotch products in the same *tertile* as the controls for single malt products in each tertile. I return to aggregating to the quarterly level. The results are presented in Figure 17, and the point estimates follow the same pattern as in the main specification. The error bounds are larger and overlap more often however, due to the higher variance in the price changes of the control group (as the current specification now splits products equally into thirds, which leads to large variances in the prices compared to before where products of the same price ranges were pooled together). The regression output is in Table 12

	Dependent variable:			
	log(price)			
	Pooled	First Tertile	Second Tertile	Third Tertile
Single Malt x Q1	-0.019*	0.005	-0.033	-0.030*
	(0.011)	(0.015)	(0.023)	(0.017)
Single Malt x Q2	-0.008	0.009	-0.023	-0.012
	(0.010)	(0.013)	(0.022)	(0.015
Single Malt x Q3	-0.002	0.008	-0.013	-0.002
	(0.007)	(0.009)	(0.020)	(0.006)
Single Malt x Q4	-	-	-	-
Single Malt x Q5	0.002	0.017	-0.005	-0.005
	(0.007)	(0.011)	(0.016)	(0.006)
Single Malt x Q6	0.049***	0.067**	0.037*	0.042***
	(0.013)	(0.030)	(0.019)	(0.014)
Single Malt x Q7	0.073***	0.110***	0.068***	0.040**
	(0.014)	(0.031)	(0.022)	(0.016)
Single Malt x Q8	0.095***	0.150***	0.081***	0.052**
	(0.019)	(0.043)	(0.025)	(0.022)
Single Malt x Q9	0.104***	0.150***	0.095**	0.067**
	(0.021)	(0.045)	(0.036)	(0.029)
Single Malt x Q10	0.109**	0.154**	0.109**	0.064**
	(0.028)	(0.049)	(0.053)	(0.029)
Single Malt x Q11	0.117***	0.162***	0.118**	0.073**
	(0.028)	(0.051)	(0.060)	(0.032)
Observations	1,364	462	440	462
R^2	0.993	0.982	0.968	0.994
Adjusted R^2	0.992	0.979	0.936	0.993

Table 12: Single Malt Scotch Price Changes Relative to Blended Scotch