The Differential Effect of Tariffs by Quality

Estimates from Scotch Whisky

Minuk Kim

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Abstract

I investigate the distributional consequences of tariffs on consumer goods, with a novel focus on the role of product quality on pass-through and variety. In the context of the United States' 25% tariffs on single malt Scotch from 2019 to 2021, I use product level data from Pennsylvania and find that the tariffs caused more pronounced price increases for lower quality products, which disproportionately harms low-income consumers. On variety, the tariffs reduced the imports of higher-quality products, disproportionately harming high-income consumers. Compared to a baseline of uniform tariffs effect on pass-through and variety, I find that accounting for this quality differential effect increases the welfare loss for all consumers. My findings underscore that assuming a uniform pass-through underestimates the welfare loss of tariffs, particularly for low-income consumers. This study contributes to understanding the distributional effects of tariffs, emphasizing the importance of considering product quality in tariff policy assessments.

1 Introduction

Assessing the burden of tariffs on final consumer goods depends on a precise measure of the distributional impact on consumers. Tariffs may impact consumers through several channels, such as a pass-through of the tariff cost to retail prices and a decrease in imported varieties. Individual product quality, however, may substantially affect each product's degree of pass-through or availability. For instance, less vertically differentiated products of "lower quality" tend to have lower markups, which in the face of a tariff may lead to a little room for tariff absorption and so 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 the product becomes unprofitable to export and drops out. These quality differential effects of the tariffs may 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 individual product quality does significantly alter the pass-through and availability 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 whether the product quality significantly modulates the impacts of tariffs and its implications for consumers of differing incomes. I examine the effect of tariffs in both how prices respond (do lower quality products see a higher passthrough of tariffs?) and the variety of products imported (do higher quality products drop from the market?). I then estimate a consumer demand model with heterogeneous consumers, and apply the descriptive findings to quantify the welfare loss by income levels for both the price and variety effect. I find that the degree of passthrough of the tariffs differs with the quality of the product, and disproportionately hurts the welfare of the lower-income consumers. On the other hand, I find evidence indicating that the tariffs led to a disproportionate decrease in imports of the higher quality goods. As higher income consumers were more likely to purchase these higher quality goods, this loss of variety leads to an 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 due to the tariffs.

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 salient features of quality, such as branding and spirit age, that varies widely across products and provides ample variation to study how tariff impact differs by quality. Third, single malt Scotch has an ideal control group of blended Scotch, which shares most production processes with single malt Scotch. The tariffs overlap with several potential confounding factors like COVID-19 and Brexit, which the blended Scotch effectively controls for. A detailed discussion of the tariffs and Scotch industry is provided in Section 2 of this paper.

I study the Scotch whisky market in 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 am able to observe how prices and variety changed before, during, and after the tariffs. Furthermore, the PLCB also publishes a quarterly catalogue of products along with the retail prices, and also a monthly sales list, and maintains constant prices throughout most of the state[1], which all allow me to track the changes in prices and variety 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

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

COVID 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 10.4% on average. Broken down by quality however, there is a wide heterogeneity of the tariff effect: the price increases range from 15.0% for the low quality goods to 6.70% for the expensive goods. For the variety effect, I find that there is a 26% overall decrease in the availability of products, but once again, large heterogeneities by quality from 8% for the lower quality products to 41.2% 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 undifferentiated products that are operating at prices closer to costs and cannot absorb the tariffs. However, whether such markup adjustment occurs is dependent on the curvature of the demand - if the residual demand becomes more elastic as prices increase[2], markups will decrease, and vice versa. Thus, concavity in the demand for high quality goods and convexity for low quality goods may explain these results. The substitution of 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 rationalize the markup adjustments that we observe. As 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 market, whether the curvatures of demand for high and low quality goods differ is an empirical question.

On the variety side, the fixed cost of exporting may suggest why we observe the high quality products drop out of the market more. Romer (1994) emphasizes the role of fixed cost

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

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 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 few people may afford to purchase 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. These results show the importance of measuring what consumers actually purchase when estimating the tariff impacts.

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. On the other hand, the variety impact will be felt the most by the high-income consumers. While a low-income consumer may not care that a $300 limited release bottle of Scotch is no longer available to purchase, high-income consumers will be more likely to have been purchasing the high quality bottles - 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, Levinsohn, and Pakes (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 choice of the outside good is relevant for substitution

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

With the demand model, I can calculate the welfare loss of the tariffs 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 16% decrease in consumer surplus from Scotch consumption, while the highest income consumers (yearly income of more than \$100K) see a 10% decline. However, by incorporating the heterogeneous pass-through rates by quality into the pass-through estimates, I find that lowest income consumers consumer surplus decreased by 23%, suggesting an underestimation of the welfare loss by 28% under the uniform pass-through assumption. For the high income consumers, consumer surplus decreased by 13%, suggesting an underestimation of the welfare loss by 21% with a uniform pass-through assumption.

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 decrease in product choice set correlated with the tariffs decrease consumer surplus?". I find that when simulating the exit of products independent of quality, lowest income consumers welfare decreases by 1.59%, and 2.32% for high income consumers. Once quality is accounted for, the welfare decrease actually is lessened, to 1.05% for low income consumers and 1.82% for high income consumers. I find that these results are driven by the fact that once accounting for quality, the low quality goods are less likely to drop out, but the low quality goods also tend to have the higher market shares as well. This result was discussed in Arkolakis et al. (2008), in that the gains (loss) from products 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 the 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 (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 18% compared to 12% for the highest income, but once the quality bias (in both prices and variety) is accounted for, the numbers become 24% and 15%, respectively. These findings suggest import distributional implications for evaluating welfare consequences of tariffs. Assuming a uniform pass-through underestimates the welfare loss and assuming uniform product exit overestimate the welfare loss, as the majority of purchases across all income groups are the generally the cheaper products, which saw the highest pass-through rates and lower product exit. On net, however, the low-income consumers lose out the most due to the dominating price effect. Particularly, the baseline of uniform tariff effect underestimates welfare loss for low-income consumers more than for high-income consumers. 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 the 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 is 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, Hortaçsu, and Tintelnot (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. But by ignoring such strategic responses outside the Scotch market, my analysis may underestimate the harm of the tariffs on consumers. Further, single malt Scotch in general is a premium product compared to other liquors, and thus the impact on high (low) income consumers may be higher (lower) than for tariffs on other product categories. 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 analysis quantifying the impact of the tariffs using wholesale price data from New York, i.e., prices charged by manufacturers to 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, Hortaçsu, and Tintelnot (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, Redding, and Weinstein (2019), Amiti, Redding, and Weinstein (2020), and Cavallo et al. (2021) offer more macroeconomic analyses of the recent US trade

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 cheap bottle, by virtue of having similar relative shares conditional on price, to have similar levels of "quality," which is contrary to common notions of Scotch "quality."

wars and find complete pass-through in most cases. Nakamura and Zerom (2010), Ludema and Yu (2016), and Amiti, Itskhoki, and Konings (2019) 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, using a demand model that accommodates consumers of different incomes and precisely measures consumer purchases, to calculate the distributional effects of tariffs accounting for markups adjustment by quality.

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, Redding, and Schott (2011), Mayer, Melitz, and Ottaviano (2014), Mayer, Melitz, and Ottaviano (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, Redding, and Weinstein (2019) 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.

Finally, there is a rich literature in the industrial organization literature on pass-through of costs. 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 have studied the role of functional form restrictions on demand curvature, such as Griffith, Nesheim, and O'Connell (2018), Birchall, Mohapatra, and Verboven (2023), Eugenio J. Miravete, Seim, and Thurk (2023a), and Eugenio J. Miravete, Seim, and Thurk (2023b). Empirical papers studying the passthrough of costs include Kim and Cotterill (2008), Chatterjee, Rafael, and

Vichyanond (2013), and Allcott, Lockwood, and Taubinsky (2019). This paper utilizes an exogenous cost shock to observe the pass-through rates, and finds that the observed pass-through rate is surprisingly well-matched by the pass-through predicted in a mixed logit discrete choice demand model, at least when demand is log concave.

The rest of this paper is organized as follows: Section 2 presents institutional background of the Scotch industry and tariffs, as well as a discussion on the data sources. Section 3 estimates the policy impact of the tariffs on prices and variety. Section 4 discusses the consumer demand model, the estimation strategy, and the results. Section 5 estimates the welfare loss under different scenarios, and Section 6 concludes.

2 Institutional Background 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 euros 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%, 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 blended 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 avenue for vertical differentiation. The age of a Scotch is determined by the youngest spirit in the blend[5], and age statements are mostly found on single malt Scotch whiskies. 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 taste at the extreme ages of 50 years and above. Besides the extreme values, an older age bottle is almost always 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 avenue for product differentiation, as a mix of both horizontal and

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

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 individual characteristics, such as the Laphroaig, Lagavulin, and Ardbeg distilleries known for their smokey tastes coming from the peat used in 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 thus creates vertical differentiation.

These two dimensions of differentiation (age and brand) determine the overall (individual or shared) perceived "quality" of a bottle. Furthermore, 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.

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.

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 a four months, and

	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

in June 2021, both sides reached an agreement to suspend tariffs for five years, putting an 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 whether the tariffs are not in fact exogenous to demand or cost shocks, or perhaps single malt Scotch was chosen to product the domestic whiskey industry. While there is no smoking gun that suggests that the US did choose single malt Scotch as-good-as randomly, there are several evidences that point to the fact. The tariff product list suggests that the products to be targeted was based

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

on choosing "representative" goods, rather than in response to demand shocks in particular industries. In addition to single malt Scotch whisky, the tariff list included airplanes, 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 and Bourbon whiskey, also likely not for economic reasons. This tit-for-tat of tariffs between the US and EU appears to be focusing on inflicting political harm rather than economic, thus giving credence 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 thus the tariff provides a natural experiment for estimating the impact of tariffs.

There is a concern on 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, Levinsohn, and Pakes (1999) noted, a multiproduct producer producing both blended and single malt Scotches may lower blended Scotch prices in order 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

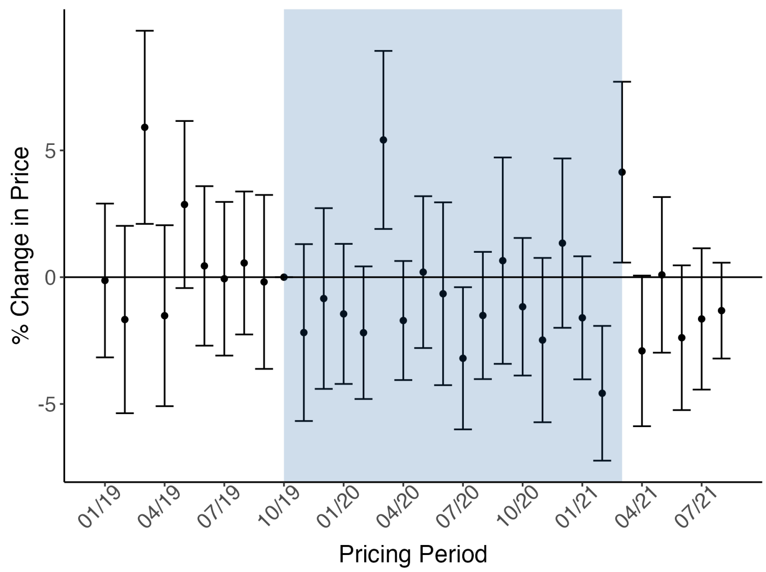


Figure 1: Blended Scotch vs Irish Prices

for each period, with the tariff period shaded in blue. The assumption here is that Irish whiskey prices did not respond to the tariffs, but would capture any other common cost shock affecting both blended Scotch and Irish. As seen in the figure, there does not appear to be any significant price movements in 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 via a Freedom of Information Act (FOIA) request. The data covers the sales amount in dollars and sales quantity in units for every product sold at each state owned liquor store in Pennsylvania, for each week from January 2019 to August 2021. I use a combination of a catalogue spreadsheet from the PLCB archives and the quarterly product listing published by the PLCB to identify all the Scotch and Irish products in the sales data, and aggregate each product across every store to the state level, and aggregate from the weekly level to the pricing period level (which roughly corresponds to each month).

Up until 2016, the PLCB adhered to a fixed pricing formula (see Eugenio J Miravete, Seim, and Thurk 2018) that made transparent the product acquisition costs that 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 passthrough 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 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 (see Conlon and Rao (2023)). 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. Furthermore, the wholesale prices are used in my identification strategy in my demand model as cost proxies.

I also use data from the Nielsen Consumer Panel, which contains information on household characteristics and their purchase. I identify the households residing in Pennsylvania, and categorize them into household income bins and calculate the average purchase prices of products, to be used as identifying moments later in my demand model.

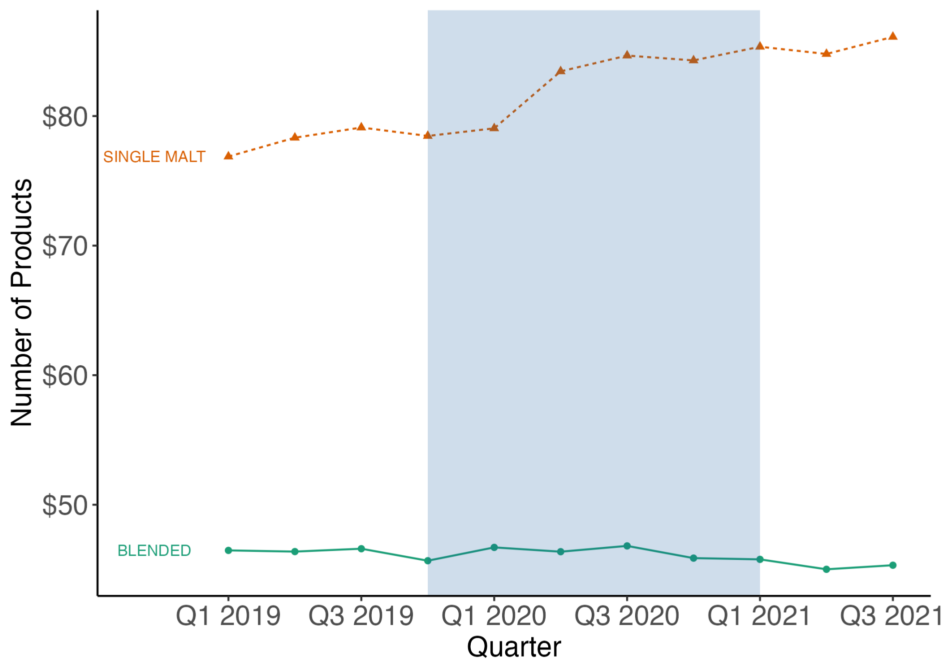


Figure 2: Average Price of 750ML Bottles in Pennsylvania

3 Policy Impact

Tariff Impact on Prices

I start by documenting the change in prices of Scotch and Irish whiskies in Pennsylvania. Figure 2 shows the evolution of the quarterly average prices of single malt Scotch, blended Scotch, and Irish whiskies from January 2019 to August 2021, where the shaded area indicates the periods in which tariffs were in effect. I filter for only 750ML sized bottles and use a balanced panel to ignore the effect of introduction or exit of products.

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 Scotches act as a natural control group for these cost shocks. Both parallel trends and potential spillovers were discussed in the previous section. As the data shows, blended scotch does not show any noticeable change in prices during the time period and beyond, suggesting that the leap in single malt prices seen in April 2020 is the effect of the tariffs, coming at a delay perhaps due to contracts that predetermined the prices up until then or front loading of imports in expectation of the tariffs[6].

To quantify the causal effect of the tariffs on prices, as seen in Figure 2, I estimate the following canonical two-way fixed effects model:

$$ln(p_{it}) = \gamma_i + \lambda_t + \sum_{t=1}^{11\backslash 4} \beta_t D_{it} + \varepsilon_{it} \tag{1}$$

where $p_{i,t}$ 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 and a dummy variable indicating that product i is single malt. As product characteristics of whisky (proof, age statement, etc.) are invariant, additional product characteristics are not included, and each time period is defined as a quarter. The coefficients of the interaction terms (β_t's) are the main parameters of interest. The fourth quarter of 2019 (the tariff was enacted on October 2019) is excluded for normalization, and the control group is blended scotch. Thus, the coefficients estimate the average price difference between single malt scotch and blended scotch, relative to the the average price difference in the fourth quarter of 2019. Since the data runs from January 2019 to August 2021, the coefficients on the first three quarters 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 Figure 5, with the corresponding event study plots in Figure 3. While we cannot reject the null of zero in the three quarters prior to the tariffs, there may be some concerns for pre-trends as there appears to be a slight upwards trend in prices pre-tariffs. However, the same event study but estimated at the monthly level (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

6. Front-loading may somewhat be limited with Scotch imports however, as firms cannot simply ramp up production of Scotch. Front-loading would have to come in form of diverting products from other destinations.

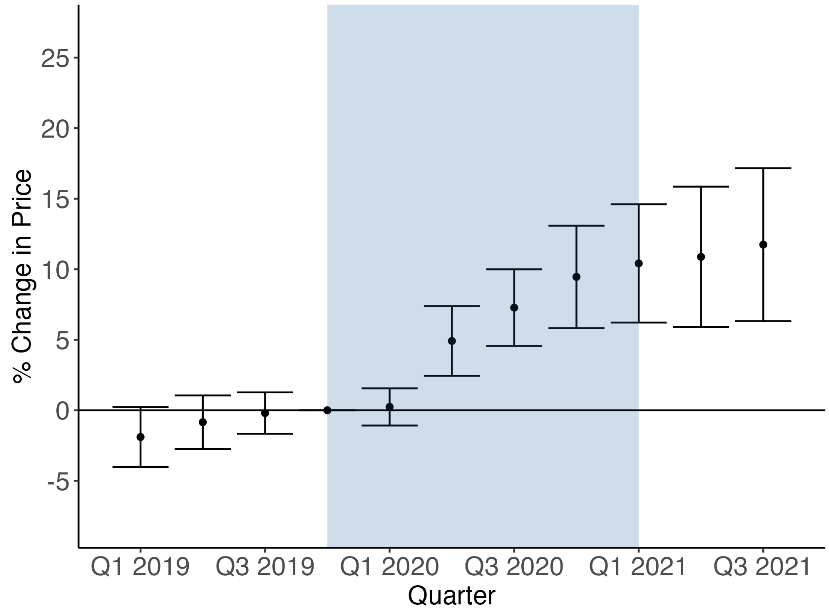


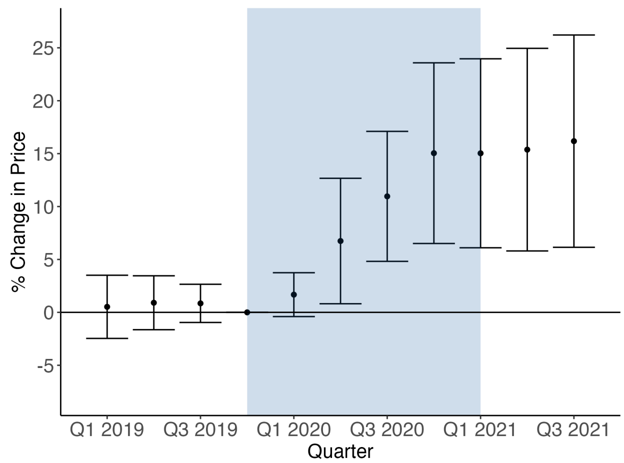
Figure 3: Single Malt vs Blended Price Difference

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.

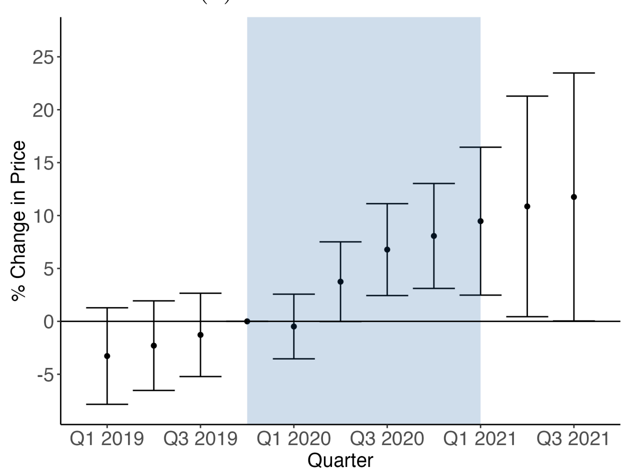
To determine whether the pass-through differs by quality, I split both the single malt and blended Scotch into three groups sorted by pre-tariff price, and estimate Equation 1 for each group. The event-study plots for each tertile are presented in Figure 4 and results of the regression in the last three columns of Figure 5.

At each quarter post-tariff, the pass-through rates are almost uniformly decreasing as the price bins increase. For instance, in the fourth quarter of 2020 (Q8), the pass-through rate from the pooled regression is 0.095. This number masks significant heterogeneity by quality however, as the pass-through is 0.150 for the cheapest third of products, 0.081 for the middle third, and 0.052 for the most expensive third of products.

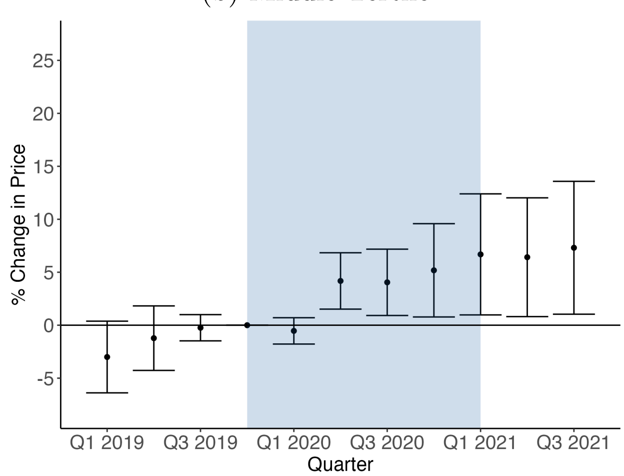
To see whether these results are robust to other settings, I also estimate Equation 1 using wholesale data from the State of New York. The event study plots are presented in



(a) Bottom Tertile



(b) Middle Tertile



(c) Top Tertile

Figure 4: Percentage Change in Prices by Tertile

	Dependent variable:			
	log(price)			
	Pooled	First Third	Middle Third	Top Third
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	0.963	0.993
		Note:	*p<0.1; **p<0.05; ***p<0.01	

Figure 5: Single Malt Scotch Price Changes Relative to Blended Scotch

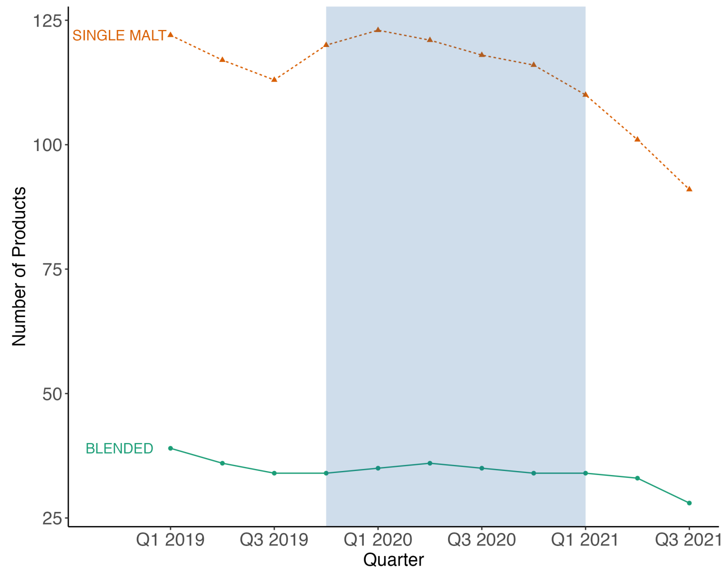


Figure 6: Pennsylvania Product Listings by Category

the appendix, along with the results of the regression. Similar to the pass-through patterns for Pennsylvania, here I find that the highest price increases are for the cheapest third products, while the middle third and top third expensive products tend to see similar lower price increases. Also, to see whether the results are robust to the classification by price bins (which is a sensible question to have, as the top third of single malt prices are much higher than the top third of blended prices), I reproduce the regression with price ranges instead of price bins. This regression would also address the potential confound from the COVID-19 stimulus checks, which may have encouraged consumers to purchase higher priced bottles and drive up demand and prices. The results are presented in the appendix.

Tariff Impact on Variety

Tariffs not only impact prices, but as discussed in the introduction, they may also have an impact on the variety of products imported. Figure 6 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 catalogue associated with the tariffs, while blended scotch shows a slight decline in variety

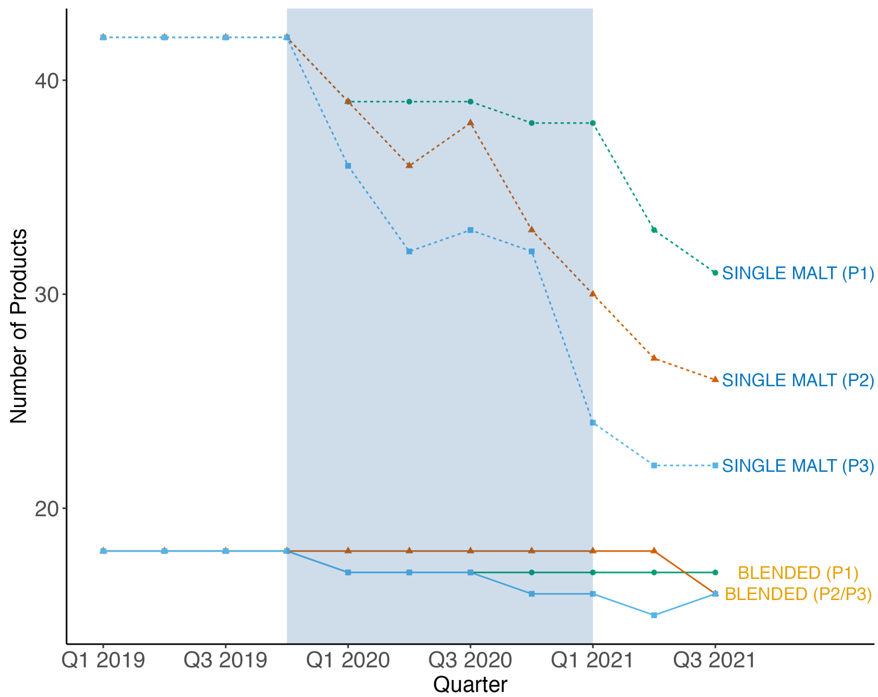


Figure 7: Variety by Price Bins in Increasing Order

only near the end of the data period. While the confounding cost shocks (COVID-19, Brexit) may have impacted single malt Scotch more than blended, if that were the case we would expect to see a decline worldwide in single malt Scotch exports. Detailed export data from the UK (presented in the appendix) does not indicate such a drop in units exported however, suggesting that the confounding cost shocks did not contribute to the observed decrease in single malt Scotch variety.

The main question is whether the products that were discontinued were of higher quality than the products that continued to be sold. To study this with the sales data, I take the products that were sold in all four quarters of 2019, and once again I divide each group into thirds by pre-tariff price (P1 to P3 in increasing order of prices). I track the changes over time[7] of whether the products show up in the sales data or not, and plot the results in Figure 7. Because this plot is from the sales data, there may be concerns that it may be capturing zero sales and not product unavailability. But since the data is aggregated to the

7. This analysis ignores new product introductions, which however should be captured in Figure 6, unless there is significant heterogeneity in product introductions by price bin.

quarter level, zero sales would mean that the product has not sold a single bottle across three months across all of Pennsylvania. Thus, the decline in variety of products sold is unlikely zero sales and more likely discontinuation of products.

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 significant decline in variety. Blended scotch, on the other hand, shows very few products dropping out of sales. If parallel trends holds, then this plot suggests that the tariffs impacted the variety of single malt scotch, but particularly the most expensive products. Further, this analysis acts as a lower-bound of sorts on the effect of tariffs on product variety, as it does not capture what scotch firms *would have* supplied to retailers in the United States were it not for the tariffs. For example, PLCB sold Laphroaig's annual special release product line Cairdeas for 2018, 2019, and 2021, but with a notable absence of the 2020 release.

Industry sources also indicate that the tariffs had a significant impact on variety, particularly in the higher end products. In response to an inquiry 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." Further, *Whisky Advocate*, a trade magazine, interviewed importers who explicitly state that the tariffs led to a decrease in product variety of higher-end single malt. 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."

4 Demand Estimation

Model of Demand

To estimate the welfare costs of the tariffs, I estimate a random coefficients nested logit demand model, as in Brenkers and Verboven (2006) and Grigolon and Verboven (2014)[8].

For my application, I estimate the demand for Scotch and Irish whisky in Pennsylvania. Consumer i's indirect utility of purchasing product j in pricing period (market) t is given as:

$$U_{ijt} = X_j \beta_i + \alpha_i p_{jt} + \xi_{\tilde{j}} + \xi_t + \Delta\xi_{jt} + \tilde{\varepsilon}_{ijt} \tag{2}$$

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

$$\xi_{jt} = \xi_{\tilde{j}} + \xi_t + \Delta\xi_{jt}, \tag{3}$$

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 errors, and can be further decomposed into

$$\tilde{\varepsilon}_{ijt} = \zeta_{ijt} + (1-\rho)\varepsilon_{ijt} \tag{4}$$

8. Previous studies have used the random coefficients nested logit (RCNL) model in estimating demand for alcohol, such as Miller and Weinberg (2017), Eugenio J Miravete, Seim, and Thurk (2018), and Conlon and Rao (2023).

ε_{ijt} is the independent and identically distributed extreme value error terms 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, and Irish. At $\rho = 1$, consumers will substitute only to products within the same nest, while at $\rho = 0$ consumer's substitution will be guided only 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:

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

Most relevant for my welfare analysis later is the demographic component D_i. Individuals are split into four household income bins of 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 by Π to allow the (dis)utility from price to vary by income bin. I do not model other demographics nor interactions with other product characteristics, as my main interest is in modeling how the tariff differentially impacted consumers of different income levels. The ν_i term is drawn from the standard normal distribution with variance to be estimated, and will be interacted with price and proof. This modeling assumption will induce heterogeneity in preferences for prices and the proof of a product, but not in the preference for a particular bottle size.

I define the potential outside market as the market of whiskey, and calculate market shares as litres of ethanol equivalent. For example, a 80 proof 750ml bottle of scotch will contain 300ml of ethanol. This definition of market shares is more sensible than volume or units, as often the "standard serving" associated with consumption alcohol is often defined in terms of alcohol consumed (one can of beer is equal to a glass of wine and a shot of liquor).

Defining the potential market as the market of whiskey has the drawback in that it makes the prices of other non-Scotch and non-Irish whiskies 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 there is data on the actual sales of all whiskey, and thus I do not have to make arbitrary assumptions about the size of the outside market.

Identification and Estimation

I will discuss the identifying variation and assumptions for each parameter and discuss the related instruments. As in Conlon and Rao (2023), I utilize the Nielsen Consumer Panel Data as micro moments to identify the demographic interactions with prices. I draw the income distribution from the Nielsen Consumer Panel Data, where I combine panelists into the 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 as in Petrin (2002). Note that the mean price coefficient $\bar{\alpha}$ will not be separately identified from the household valuation by income bin.

The variation in the data that identifies the unobserved heterogeneity in product characteristics is the exogenous shifts in the product characteristics 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 (specifically, the price 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 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. But the inclusion of period fixed effects and brand fixed effects somewhat ameliorates such concerns as identification 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 market 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 demand shock, PLCB 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.

The consumer heterogeneity for bottle-proof and the outside good is identified by the exogenous shifts in the product choice sets 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 (single malt Scotch, blended Scotch, and Irish) will be added as instruments to identify the nesting parameter.

I also add differentiation instruments from Gandhi and Houde (2019). Specifically, I introduce the local and interacted form of the differentiation IVs, using exogeneously predicted prices and bottle category. These IVs capture the crowdedness of product space, as in "how many similarly priced own-firm and rival-firm bottles are there to mine?".

Estimation follows the procedure in Nevo (2001) and Grigolon and Verboven 2014. My consumers are simulated with 1000 Halton draws, with income bins randomly assigned according to the distribution from the Nielsen hosuehold panel for 2019 and 2020. As product characteristics are invariant, I use product fixed effects in lieu of individual product characteristics, but later regress the estimated product fixed effects on product characteristics to recover the mean parameters. Further estimation details in the appendix.

Estimation Results

The results of the estimation are presented in Table 3. 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, becoming less and less negative as income increases. The preference for the outside good is captured by the coefficient on the constant term, and appears to have little heterogeneity between consumers.

The nesting parameter is estimated to be 0.80, 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 that the tariff that hit the single malt Scotch as a whole, and consumers may not be inclined to substitute to the blended Scotch, Irish, or the outside good. Table 4 presents the micro moments to be matched and their estimated values. The middle two income bins fairly precisely matched but the two other incomes are less so, suggesting that there is more heterogeneity modeled than the Nielsen Consumer Panel estimates.

The elasticities from the model are plotted for all products in Figure 8. All of the own price elasticities are negative and follow a characteristic U-shape of the mixed logit model. Initially, as prices increase, the own price elasticity becomes more elastic due to the higher

	Mean Utility	Random Coeff	Demographic Interactions (Π)			
	(β)	(Σ)	<\$45K	\$45K - \$75K	\$75K - \$100K	>\$100K
Price	-0.247	0.0492	-	0.0411	0.0824	0.121
	(0.121)	(0.0208)		(0.0771)	(0.267)	(0.103)
Proof	0.0345	0.0025				
	(0.0792)	(0.248)				
Constant	-4.28	0.0173				
	(2.99)	(0.648)				
375 ML	-0.630					
	(0.118)					
750 ML	0.124					
	(0.035)					
1000 ML	-					
1750 ML	0.569					
	(0.069)					
Nesting Parameter (ρ)						
0.80						
(0.015)						

Table 3: Demand Model Estimates

price dominating, but starting around the \$60 bottles, the buyer composition of less price sensitive consumers outweighs the higher prices and leads to the price elasticity becoming less elastic. At the highest prices however, the price effect outweighs the buyer composition effect and elasticities start to increase once more.

Another way to check whether the estimates are sensible is to plot the substitution patterns. First, Figure 9a plots the diversion ratio to the outside good (Conlon and Mortimer (2021)), and shows that the diversion ratio is decreasing in price. Thus, consumers of Scotch and Irish will tend to substitute to the inside good rather than the outside good, particularly for the less price sensitive consumers.

Micro Moments		
Moment	Value	Estimated Value
$E[p_j \| inc1]$	\$26.79	\$22.93
$E[p_j \| inc2]$	\$28.18	\$27.25
$E[p_j \| inc3]$	\$31.85	\$32.34
$E[p_j \| inc4]$	\$37.47	\$44.10

Table 4: Micro Moments

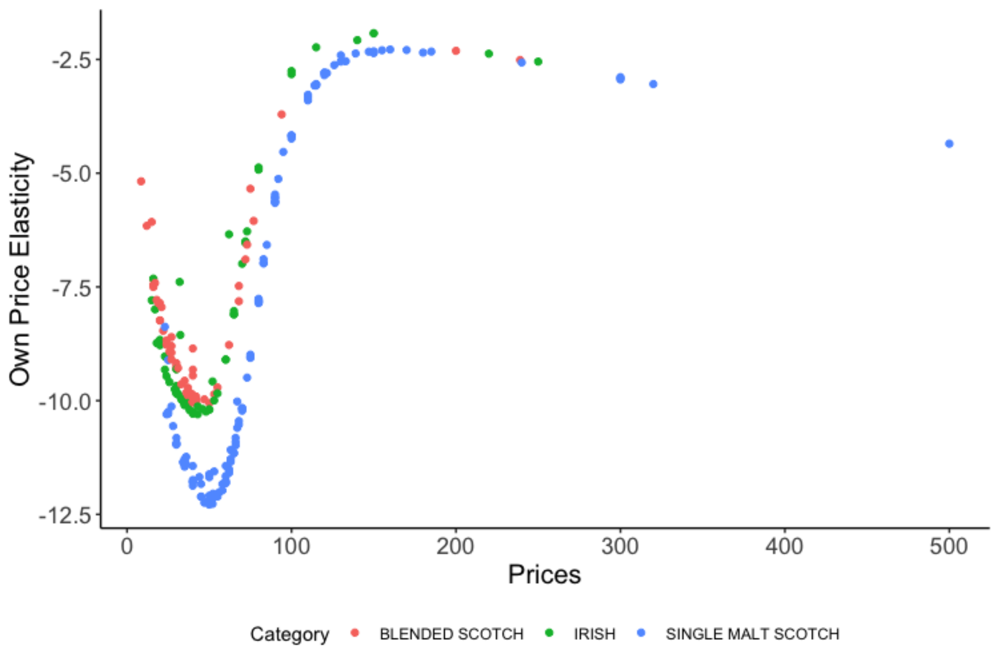
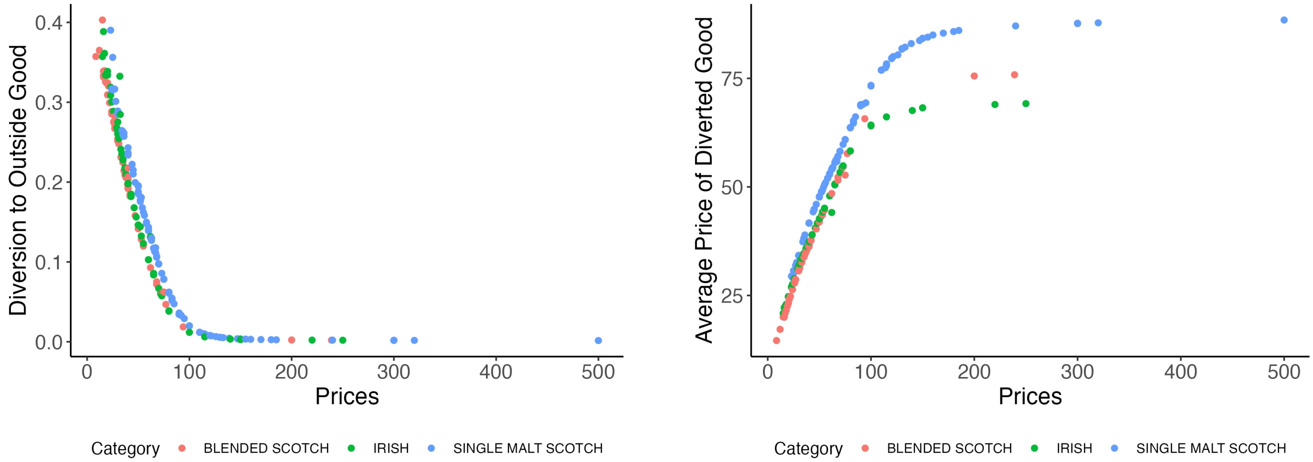


Figure 8: Own Price Elasticity

Further, Figure 9b plots the weighted average price of products that consumers of each product substitute to. As predicted by the decreasing price sensitivity of higher income consumers, consumers who purchased higher priced items will generally substitute to other higher priced items. The five products that consumers substitute to the most are Jameson Irish Whiskey 1.75L, Jameson Irish Whiskey 750ML, Jameson Irish Whiskey 1L, The Macallan Highland Single Malt Scotch 12 Year 750ML, and Dewar's White Label Scotch Whiskey 1.75L. The five 750ML products that consumers substitute the most are Jameson Irish Whiskey, The Macallan Highland Single Malt Scotch 12 Year, The Glenlivet Speyspide



(a) Diversion Ratio

(b) Diverted Prices

Figure 9: Diverted Products

Single Malt Scotch 12 Year, Glenfiddich Single Malt Scotch 12 Year, and Laphroaig Islay Single Malt Scotch 10 Year.

With the demand model, I can recover the marginal costs via the inverse elasticity equation, and model the impact of a 25% cost increase. Figure 10 plots the model predicted pass-through by price, and finds results that support the analysis in the reduced form estimates - lower priced goods see a higher pass-through than higher priced goods. While estimating markups adjustments relies on a precise analysis of the demand curvature, the preliminary evidence here suggests that the demand for higher quality and more expensive products are more concave than demand for lower quality and cheaper products.

5 Welfare Analysis

Using the demand estimation results, I can now estimate the welfare impact of the tariffs, in 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 as

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

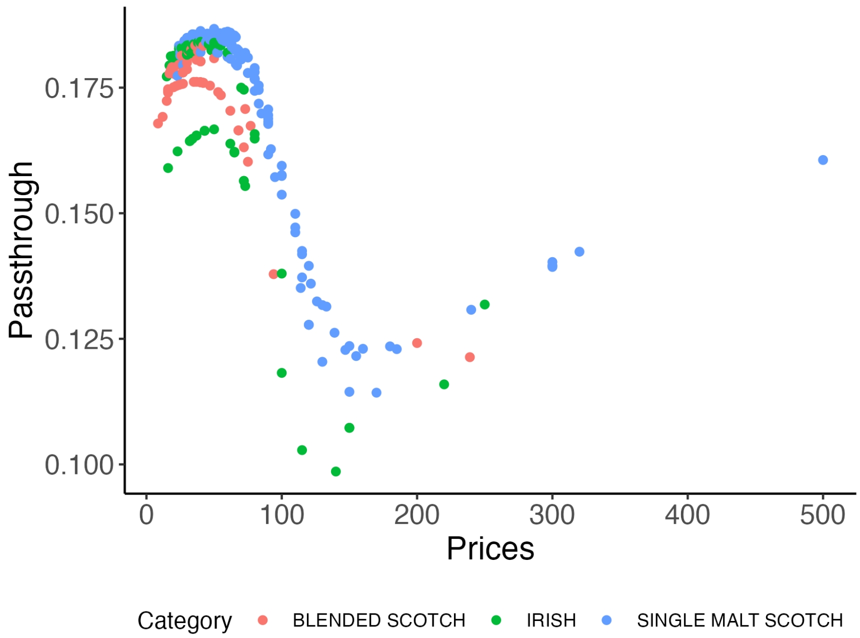


Figure 10: Estimated Passthrough

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

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

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 calculate the increase in prices due to the tariffs by March 2021 (the final month of the tariffs). I calculate welfare under two pass-through schemes, holding the products fixed. First, I impose a uniform price increase of 7.70% across all products regardless of price range. Second, I impose a heterogeneous price increase of 11.49%, 7.30%, and 4.19% for each product in each price bin of thirds, in increasing order of prices. The first scheme is presented in the first column of Figure 11, and the second scheme is in the second column. First, both results

Mean CS Change by Income		
	Uniform Passthrough	Heterogeneous Passthrough
<$45K	-16.58%	-23.01%
$45K - $70K	-15.48%	-21.39%
$70K - $100K	-14.50%	-19.77%
$100K<	-10.30%	-13.07%

Figure 11: CS Change in Prices

show that low-income consumers lose the most in terms of relative consumer surpluses, as low-income consumers are the most price sensitive and are impacted the most due to the higher prices. But going from uniform to the heterogeneous pass-through scheme hurts the low income consumers even more, increasing the estimated welfare loss by 39% compared to 26% for the high income consumers. I find that these results are driven by the fact that both high income and low income consumers purchase low quality (but high volume) goods, which see an increase in price increases from 7.70% to 11.49% when going from the uniform pass-through scheme to the differential effects one.

Variety Effect

For the product choice set, I first take the product choice set in October 2019 as the baseline, and then remove the products that were not in the March 2021 choice set. I find a 0.13% decrease in consumer surplus for low income consumers to a 1.49% decrease in consumer surplus for high income consumers. This observational analysis is informative of the magnitude of the welfare loss due to lower variety.

Now to compare a uniform tariff effect on variety against a differential one by quality, I simulate the product exit using a Monte Carlo simulation. First, I use a logit model to

Mean CS Change by Income		
	Uniform	Heterogeneous
<$45K	-1.59%	-1.05%
$45K - $70K	-1.60%	-0.92%
$70K - $100K	-1.85%	-0.87%
$100K<	-2.32%	-1.82%

Figure 12: CS Change in Variety

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 prices. I then take Bernoulli draws for each product, according to its exit probabilities, for 5000 times, for both schemes (uniform and quality differential).

The results are in Figure 12. The loss in variety, as expected, mostly hurts the high-income consumers as they would be the most likely to purchase the discontinued products. Overall, the magnitude of the variety effect is rather small, due to the smaller shares of the products that exit on the margin. The effect of accounting for the quality differential effect *decreases* the welfare loss for all consumers. This effect is driven by the exit probability of the low quality high market share products decreasing from 26.6% to 8%. Consumers of all incomes purchase the low quality products, and thus everybody's welfare loss decreases due the increased survival of the high share products. Nevertheless, the "progressivity" of the estimates stand, and we can see that the variety effect is around 13% of the price effect for the high-income consumers, compared to 4.5% for the low-income consumers, suggesting that loss in variety comprises a larger portion of the welfare loss for high-income consumers.

Net Mean CS Change by Income			
	Uniform	Heterogeneous	% Underestimation
<$45K	-17.93%	-23.85%	24.82%
$45K - $70K	-16.83%	-22.17%	24.08%
$70K - $100K	-16.03%	-20.50%	21.80%
$100K<	-12.36%	-14.71%	15.97%

Figure 13: CS Change in Variety

Net Effect

Finally, I combine both the price and variety effect, with and without the quality differential effect. The results are presented in Figure 13. The net effect is that the tariffs negatively impact low-income consumers more, due to the dominance of the price effect over the variety effect. Furthermore, compared to the baseline of uniform tariff effects, welfare decreases further for all consumers once quality differential effect is taken into account. This is once again due to the dominance of the price effect over variety, and within the price effect, the outsized effect of higher pass-through for low quality goods. The policy implication from these results are the rightmost column of Figure 13, which takes the quality differential effects as the reality and estimates how much the baseline uniform tariff effects underestimates welfare loss. Here, I can see that the underestimation is higher for lower income consumers than higher income consumers, suggesting that the negative welfare impact of tariffs may have been understated under uniform effect assumptions, but particularly more so for the low income consumers.

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 reveal the heterogeneity of tariff pass-through by product quality, disproportionately impacting lower-income consumers. Furthermore, tariffs resulted in a disproportionate reduction in the importation of higher quality goods, leading to higher welfare losses on higher-income consumers.

This paper implies 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 purchases and quality. 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, policy makers must make a more minute look into the impacts of the tariffs.

This study has the usual drawback of industry specific studies, in that the results may have little external validity. However, I aim to illuminate the mechanisms behind quality differential effect, which should be extendable to other situations as well.

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 are different across consumer preferences and income groups.

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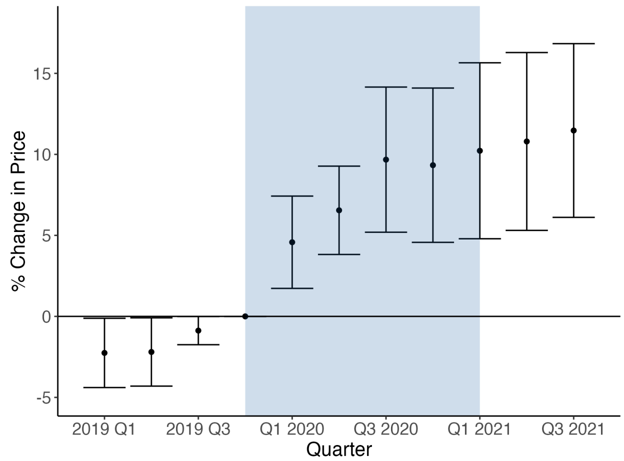
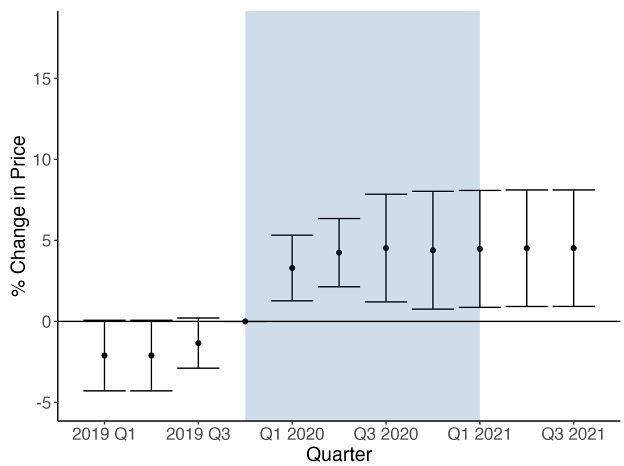
Appendix

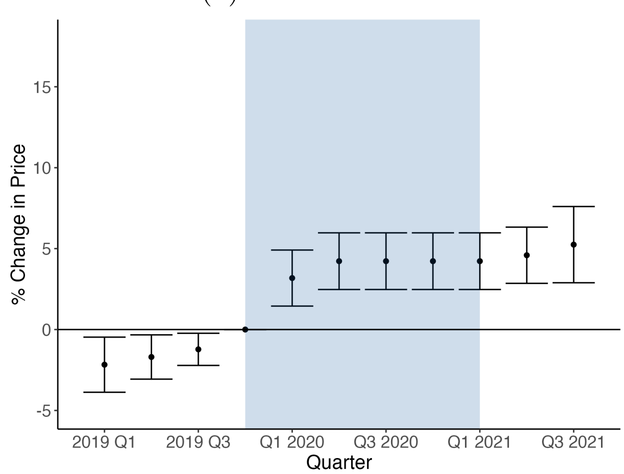
6.1 New York Wholesale Prices



(a) Bottom Tertile



(b) Middle Tertile



(c) Top Tertile

Figure 14: Percentage Change in Prices by Tertile New York Wholesale

6.2 Hedonic Regression

Table 5

	Dependent variable:
	log(prices)
c(AGE)12	0.371***
	(0.122)
c(AGE)13	0.466*
	(0.271)
c(AGE)14	0.696***
	(0.159)
c(AGE)15	0.777***
	(0.130)
c(AGE)16	0.025
	(0.271)
c(AGE)17	1.431***
	(0.172)
c(AGE)18	1.213***
	(0.129)
c(AGE)19	1.582***
	(0.223)
c(AGE)21	1.787***
	(0.148)
c(AGE)25	2.235***
	(0.230)
c(AGE)8	−0.323
	(0.271)
c(AGE)9	−0.323
	(0.271)
c(BRAND.x)ABERLOUR	0.219