

Bourbon Whiskey: Boring Collectible or Valuable Alternative Investment?

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Abstract

This paper examines secondary markets for bourbon. Specifically, the paper asks if bourbon should be considered as a collectible (such as sports memorabilia) or as a type of financial asset that can help diversify an investment portfolio? To answer this question, the paper employs a repeat sales regression empirical framework in combination with hand-collected auction and unique secondary market sales data on rare and vintage bourbons. Estimates suggest that bourbon has been appreciating somewhere between 30 and 40% per year since 2014.

1 Introduction

The bourbon industry is currently experiencing an unexpected renaissance.¹ In particular, bourbon's surging popularity over the past 10 to 15 years has become known as the "bourbon boom."² In that time, domestic and international consumption has increased significantly, major distilleries have invested millions of dollars into capacity expansion, and, after several decades of absence, craft whiskey distilleries have reappeared in the American market. Furthermore, the boom shows no signs of abating: the American Craft Spirits association reported that there were 1,589 craft distilleries as of August 2017, a 20.8% annual increase compared to August 2016.³

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¹For readers interested in the history of "America's Native Spirit" the authors recommend Reid Mitenbuler's 2015 book *Bourbon Empire*.

²See this *New York Times* article - <https://www.nytimes.com/2017/07/11/opinion/will-trump-kill-the-bourbon-boom.html>.

³For more information, see <http://www.americancraftspirits.org/2017/10/24/craft-spirits-producers-sold-nearly-6-million-cases-last-year-alone/>, <http://whiskyadvocate.com/why-bourbon-prices-got-higher/>, and <http://www.discus.org/us-bourbon-and-tn-whiskey-drive-export-records-in-2013/>.

As part of this bourbon boom, auctions for rare bourbon have become common at major auction houses. For example, 34 bottles of 24-Year-Old Blade and Bow bourbon sold for \$95,550 on December 9, 2016 at Christie's in New York City.⁴ At almost \$3,000 per bottle, the role of consumption in this transaction is questionable and bourbon's potential as an "alternative investment" becomes apparent.⁵ Secondary markets for lower-priced bourbons, including global auction websites and private groups hosted on major social networks, also appear to be thriving.

What is curious is that, despite increased demand for bourbon, few of the major distillers have resorted to significantly increasing the wholesale price of their standard products. The major bourbon distillers are a group of pre-boom industry incumbents: Heaven Hill, Jim Beam, Maker's Mark, Four Roses, Buffalo Trace, Brown-Forman/Woodford Reserve, and Wild Turkey. These distilleries produce several times more bourbon than all of the craft distilleries combined. Their aversion to increasing shelf prices has led to retail shortages which incentivize hoarding (known as "bunkering" among bourbon enthusiasts) and outright speculation. The fact that retail prices are below market-clearing levels creates an opportunity for arbitrage in (illegal) secondary markets. That means secondary markets for bourbon are not limited to vintage bottles. Instead, many of these secondary markets facilitate the exchange of recently-released bottles.

Two examples illustrate distillers' aversion to price increases to resolve shortages. The first is the case of Maker's Mark (now part of the Beam-Suntory group and situated in Loretto, KY). On February 9, 2013 Maker's Mark announced that in order to satisfy surging demand they would begin watering down their product from 90 proof to 84 proof. Essentially, they planned to stretch their existing bourbon stock in order to put more bottles on store shelves.⁶ Customers reacted so vehemently against the idea that Maker's Mark had to backtrack on the decision a week later.⁷

A second example is the annual release of the infamous *Pappy Van Winkle* line from Buffalo Trace distillery in Frankfort, KY (originally produced by the now-defunct Stitzel-Weller, one of many distilleries to disappear during bourbon's funk). The Van Winkle limited annual release

⁴<http://www.christies.com/lotfinder/Lot/one-barrel-of-blade-and-bow-single-6051424-details.aspx>

⁵The term "alternative investment" tends to be used as a catch-all for assets other than stocks and bonds. Some alternative investments, such as real estate, private equity, and derivatives contracts, are quite similar to traditional financial assets while others are perhaps better-described as "collectibles," such as wine, fine art, sports memorabilia, stamps, antique furniture, cigars, and so on.

⁶Maker's Mark could not simply ramp up production to meet present demand. Bourbon's aging process ensures the elasticity of supply is virtually zero (in the short run).

⁷See https://www.washingtonpost.com/lifestyle/food/makers-mark-debacle-the-proof-is-in-the-overreaction/2013/02/25/0aba8564-7c32-11e2-9a75-dab0201670da_story.html?utm_term=.ec5b9e4d5060 for more on this story.

includes several “expressions” of varying ages (15, 20, and 23 year-old bourbons along with three brand extensions: *Old Rip Van Winkle*, *Van Winkle Family Reserve Rye*, and *Van Winkle Family Reserve 12-Year* commonly known as “Lot B”). The annual number of bottles of each expression is extremely limited: most liquor stores around the United States do not receive Van Winkle of any type. Stores that do receive an allocation often hold lotteries or charity raffles to award someone the right to buy a bottle. The chosen customer typically pays close to the distiller’s/manufacturer’s suggested retail price (MSRP): ranging from \$60 to \$270 for the 2017 Van Winkles.⁸ For store owners, Van Winkle sales at MSRP are a marketing opportunity. Raffles, lotteries, or simply long lines - as opposed to market prices - are also used to ration limited releases such as the Buffalo Trace Antique Collection (an annual set of five whiskeys - George T. Stagg, Thomas H. Handy Rye, Eagle Rare 17, Sazerac 18 Year Rye, and William Larue Weller), Heaven Hill’s Parker’s Heritage Collection, and Four Roses’s Small Batch Limited Edition series.

Using these limited edition bourbons to generate publicity for a store may be individually rational for the store owner but their choice of allocation mechanism creates the opportunity for gains from trade in secondary markets. Of course, secondary markets for alcohol are not legal.⁹ Despite the legal barrier, evidence suggests secondary markets in bourbon are thriving: reallocating bottles from those who have them to those who want them. Specifically, as demand has increased, vintage and/or rare bottles have come to be traded in “informal” secondary markets and, for a short time, on websites such as ebay.¹⁰ These markets are especially interesting because their questionable legality ensures that market participants face unusual risk, there is no external enforcement of property rights, and social norms and trust likely play a significant role.

This paper will be the first to describe and examine the unique characteristics of the secondary market for bourbon. Specifically, the paper seeks to answer three related questions: (1) why do secondary markets exist for bourbon, (2) is the increased demand for bourbon reflected in secondary market prices, and (3) are secondary markets “efficient” despite their unusual institutional features.

To do so, the paper examines auction data hand-collected from whiskyauction.com and the publicly-available sales records of “Strong Water Trading” (SWT), a private social network group, which, at its peak, had about 6,000 members. The sales records include about 3,300 bourbon sales

⁸See <https://thewhiskeywash.com/whiskey-styles/bourbon/pappy-van-winkle-bourbon-2017-release-details-emerge/>.

⁹It is illegal to sell alcohol in the United States without a license. Major auction houses are licensed.

¹⁰See <http://www.drinkspirits.com/other/ebay-bans-alcohol-sales-whisky-auction-alternatives/>

or trades over a four-year period from early 2014 to late 2017. The group was shut down in mid-2016 because it facilitated illegal liquor sales. The fact that sales were logged to the spreadsheet long after the group was shut down suggests a successful replacement emerged quickly. Several similar groups exist on well-known social networks at the time of writing this paper. These groups operate on norms and trust. New members need referrals and sellers and buyers seek personal references from those they have not interacted with before. For members, their reputation is a hostage created by a history of successful and honest (albeit illegal) transactions.

The answers to the paper's research questions will provide some evidence about whether bourbon should be considered as a collectible item or as a viable "alternative investment." If it is a collectible, then secondary markets likely exist to move items from one person to another among those who value the product for non-pecuniary reasons. That is, they are buying because they want to display, gift, or consume the product. In that case, the secondary market is facilitating mutually-beneficial exchanges to resolve a mis-allocation of resources in the primary market. A key characteristic of such a market would be relatively mild price increases like those seen historically in the art market or baseball cards (aside from a few unique cases). As Burton and Jacobsen (1999) explain, the rate of return on investment in collectibles should be lower than returns to non-collectible assets (with comparable risk) because collectibles have non-pecuniary value.

On the other hand, if the secondary market shows rapidly increasing prices for virtually all bourbon expressions, bourbon might instead be considered as a potential alternative investment.¹¹ The rest of the paper proceeds as follows: Section 2 briefly examines the literature surrounding (and the methods used to examine) markets for collectibles and alternative investments, Section 3 describes the data and estimation framework employed in this paper, Section 4 presents the paper's main findings, and Section 5 concludes.

2 Alternative Investments and Collectibles

Burton and Jacobsen (1999) examined the state of the literature on collectibles in a review article for the *Journal of Economic Perspectives*. They explain that, because collectibles have non-pecuniary

¹¹Particularly if legislation further relaxes the rules on reselling small quantities of rare and vintage bourbons as has happened recently in Kentucky: <https://www.nbcnews.com/business/consumer/check-grandma-s-attic-vintage-bourbon-now-legal-sell-probably-n743066>

value, the rate of return on collectibles should be lower than the returns to non-collectible assets with similar risk. That is, because collectibles can be used for decoration or display the rate of return should be lower. Paraphrasing Burton and Jacobsen, if you own a Picasso painting you can hang it on your wall and show it off to your friends.

Burton and Jacobsen then examine the rate of return on a variety of collectibles including art, wine, antiques, ceramics, coins, stamps, and books.¹² Each paper they examine makes methodological choices given their data and the state of econometric knowledge at the time of their work. However, none of these papers examine the rate of return on whiskey, in general, and bourbon, in particular.

Burton and Jacobsen note that a key challenge the literature on collectibles has faced is the fact that sales of collectibles tend to be rare and are not always of an identical item. For what appear to be identical products, the sale price may depend on specifics including the identity and reputation of a seller (or buyer), difficult-to-observe differences in the item's condition, vintage, provenance, or the presence of a guarantee of authenticity.

Authors have tried to address these barriers to measurement using three primary methods. The first is to create composite indices by selecting sets of items whose prices will be measured and averaged over time. This method is subject to the same biases as indices such as the Consumer Price Index and therefore sensitive to the choice of items in the initial basket and changes in the "representative basket." Goetzmann (1996) harnessed some of the drawbacks of this method to examine the consequences of survivorship in the high-end art market.

A second potential approach is hedonic in nature. It attempts to control for objective features of collectibles such as their size or location. This approach is ideal for something like real estate where characteristics are easily observed (such as the number of bedrooms, bathrooms, neighborhood, and so on). Ashenfelter et al. (1995) used this kind of hedonic analysis to examine the relationship between the price of young Bordeaux wine and the weather during its growing season.

A third approach involves the creation of a repeat sales index that accounts for the price of similar but perhaps not identical items when there are a variety of types of a given collectible. This

¹²Somewhat humorously, their examination of the payoff from holding "Beanie Babies" will forever date their work. As Alan Krueger noted in his *New York Times* column in 2005, "[t]he resale price of Beanie Babies, for instance, grew at an astonishing rate of 140 percent a year from 1994 to 1999 and has since crashed." See <http://www.nytimes.com/2005/06/23/business/are-collectibles-the-new-real-estate.html>.

involves the use of sales data on many similar items over an extended period of time. As just one example, Baumol (1986) used repeated sales of many paintings from 1652 to 1961 and estimated that the rate of return on fine art was about eight percentage points below the rate of return on stocks. Goetzmann (1993) extended that analysis to 1987. The repeat sales approach is ideal for calculating a broad rate of return on a group of similar collectibles such as wine, stamps, and, in the case of this paper, bourbon.

Regardless of the approach taken, Burton and Jacobsen find that “[t]he majority of collectibles yield lower financial returns than stocks, and studies that include a measure of variability over time uniformly find that collectibles embody more risk than most other financial assets.” This implies that those who buy and hold collectibles are doing so for non-pecuniary reasons. The immediate implication is that they value ownership of the collectible (at least in addition to being interested in returns on investment). The fact that they buy and hold items that do not achieve the returns of (and are riskier than) traditional financial assets is evidence in favor of such a claim.

This paper will examine if bourbon whiskey suffers the same fate and how its rate of return compares to other investments and collectibles. Specifically, the paper explains the recent changes in the primary and secondary markets for bourbon and then examines the riskiness and the rate of return of bourbon using complementary data sources. If the rate of return is low and the risk is high, bourbon should be considered more like a collectible item, purchased and held mainly for its non-pecuniary benefits. If the rate of return on bourbon is high and the risk is low, then it could be considered an alternative investment. Of course, sale prices, and therefore both risk and return, are dependent upon the unique and evolving institutional details of the secondary market for bourbon. A market that is, strictly speaking, prohibited by state and federal law.

3 Data and Empirical Framework

3.1 Data

The paper relies on two complementary data sources.¹³ The first data source is hand-collected data from www.whiskyauction.com. This site is one of many similar auction websites. This auction data is valuable because the website has a global presence and prices should therefore reflect all

¹³The author is working to obtain a third data source with more observations from late 2017 and early 2018.

available information. The site operates as a typical auction house, listing only items actually in their (temporary) possession.¹⁴ The site appears to be headquartered in the United Kingdom, and claims that there are relatively few restrictions on where they can ship to. For the United States, they say they can ship to most states (those they could not ship to during the time period studied were Alabama, Arkansas, Iowa, Kentucky, Mississippi, New Hampshire, North Dakota, Pennsylvania, and Utah).¹⁵

Unlike artwork and sports memorabilia, secondary markets in bourbon are a relatively new phenomenon. For example, www.whiskyauction.com began hosting bourbon auctions in April of 2015. For that reason, there are only 72 bourbons that have been sold more than once. For these 72 different bourbons, there are 451 observed sales in total. Because there are so few observations, the paper also takes advantage of data on several thousand transactions from a decentralized secondary market operated by American bourbon aficionados on a major social network from 2014 to early 2018.

These transaction records exist only because members of the group were “required” to document all sales or trades that occurred. Of course, compliance may have been imperfect. Moreover, because the sales are among members of a closed and geographically-concentrated group the data is potentially not representative of the bourbon market as a whole. For these reasons, the findings from this data source might diverge from the www.whiskyauction.com data. On the other hand, the members of this group likely possess above-average knowledge of bourbon and the open nature of sales (in these groups, “private” deals are not allowed and are cause for a warning and subsequent expulsion from the group) might allow for efficient price discovery and preclude arbitrage opportunities between the secondary market and centralized auctions or other decentralized secondary markets.

The data from the auction website and the social network group are summarized in Table 1. The summary statistics in Table 1 highlight that sale prices are much higher for the auction site. However, this is likely due to selection. That is, the shipping and commission costs associated with

¹⁴Sellers send their products to the company and the company runs the auction, collects payment, and ships the product to the buyer. Sellers get paid a few days after the auction ends and the site makes money from commission on sales. More info at <https://whiskyauction.com/auction/vendor.e.html>.

¹⁵Importing a single bottle for personal use is legally possible but only if using a courier service. Shipping alcohol by mail is strictly prohibited. Rules and associated custom duties vary by state, see https://help.cbp.gov/app/answers/detail/a_id/212/~/requirements-for-importing-alcohol-for-personal-use.

Table 1: Summary Statistics

whiskyauction.com Data	
Total Number of Sales Recorded (Products sold > 1)	451
Earliest Sale	April 2015
Latest Sale	October 2017
# of Quarters	11
Mean Sales per Quarter	41
Mean Sales per Product	6.26
# of Products with Repeat Sales	72
Mean Sale Price (Standard Dev.)	\$545 (520)
Median Sale Price	\$392
Minimum Sale Price	\$19
Maximum Sale Price	\$2,871
# of Quarterly Log Price Relatives	161
Most Commonly Resold Product (# of Sales)	George T. Stagg 2004 (29)
Strong Water Trading Data	
Total Number of Sales Recorded (Products sold > 1)	2,693
Earliest Sale	October 2014
Latest Sale	November 2017
# of Months	44
Mean Sales per Month	61
Mean Sales per Product	11.71
# of Products with Repeat Sales	430
Mean Sale Price (Standard Dev.)	\$384 (365)
Median Sale Price	\$265
Minimum Sale Price	\$25
Maximum Sale Price	\$4,100
# of Monthly Log Price Relatives	1,246
Most Commonly Resold Product (# of Sales)	George T. Stagg 2014 (100)

Summary statistics come from hand-collected data from www.whiskyauction.com and a publicly-available spreadsheet of sales records maintained by the “Strong Water Trading” bourbon aficionado social network. There are a handful of sales prior to October of 2014 but not repeat sales.

the auction should lead to selection from the right tail of the bourbon distribution. Upon close examination, that is confirmed in the data. In particular, only 5.7% (154 out of 2,693) of the bottles sold in the SWT data sold for more than \$1,000 whereas 19.2% (87 of the 451) bourbons in the auction data sold for more than \$1,000. Absent this selection effect, the data sources align quite well. For example, for a bottle of 2014 George T. Stagg, the auction data reports a 2016 average sale price of \$403.96 and the SWT data reports a 2016 average sale price of \$390.83.

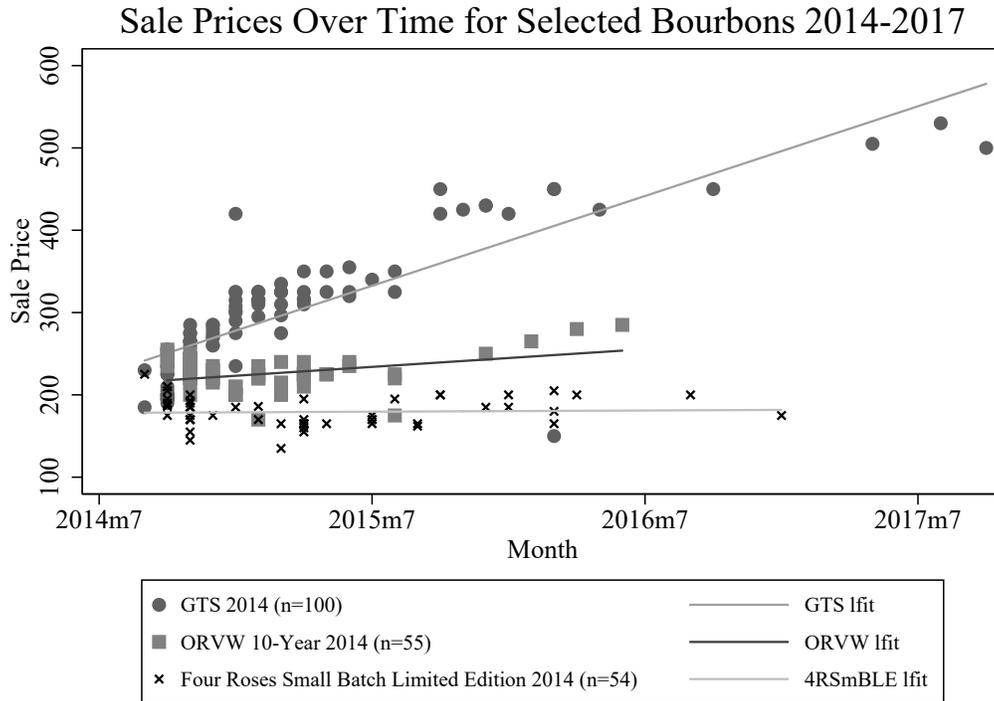
The empirical analysis uses the available data in a repeat sales regression framework. The framework is described in detail in the next subsection but the term “repeat sales” hints that the analysis is naturally going to be restricted to bourbons that are sold more than once in each available data set. For that reason, the data in Table 1 only refer to bottles that are observed more than once. This restriction is less binding in the case of bourbon relative to something like art. In order to be considered as a repeat sale a bottle needs to be only quasi-identical to a previously sold bottle. For the purposes of this paper, two bottles are quasi-identical if they are the same brand/expression, age, and bottled in the same year (essentially, perfect substitutes). For example, any given bottle of 2016 Pappy Van Winkle 23-Year-Old is, for all intents and purposes, a perfect substitute for any other Pappy Van Winkle 23-Year-Old from the same year. On the other hand, Pappy Van Winkle 23-Year-Old from 2017 is not a perfect substitute for the 2016 vintage and is considered as a different product in the data.¹⁶

The data from www.whiskyauction.com was intentionally collected and was therefore easy to organize into a usable format. On the other hand, the spreadsheet data from Strong Water Trading required manual examination of thousands of records to determine which records represent quasi-identical bourbons. This requires parsing the various different ways of referring to the similar items, considering the role bottling year (vintage) plays in being “identical,” and in-depth familiarity with colloquial and often-abbreviated bourbon, auction, and, indeed, bourbon-auction terms. For example, a one year difference, say 2015 versus 2016, matters a lot for George T. Stagg but not so much for Michter’s 10-Year. Of course, at some point, differences in release date will matter for every product and therefore bourbons in the data that were released prior to 2010 are considered to be different to today’s version (even for commonly available products such as Jim Beam, Evan Williams, and Maker’s Mark).

Additionally, about 1,200 of the SWT records had an associated note which explained the deal was part-trade, or that shipping cost was split between the buyer and seller, or that the price included a “taster” of some other bourbon, and so on. Other notes stated that the sale later fell through for a good reason or that the bottle (rather than its contents) was unique: it had some kind of celebrity or distiller signature or a quirky packaging error/ flaw that made this one actually quite

¹⁶The restriction to repeat sales does exclude a number of products sold only once in the time period studied. However, these items are typically unique/vintage products such as antique medicinal whiskey bottles from the prohibition era or bottles with one-off designs, unusual sizes, or that possess celebrity/distiller signatures.

Figure 1: Observed Sale Prices Over Time



Data Source: Strong Water Trading Sales Records 2014-2017

different to other similar bottles in the data set. For the estimation sample, notes which indicated that the bottle was not comparable to others were dropped and deals that ultimately fell through (for any reason) were also dropped.

The remaining data, after cleaning and organization, includes only “fifth” size bottles of bourbon (750ml).¹⁷ This restriction excludes 363 observations of bottles of varying sizes (handles, shoulders, and mini bottles) many appearing in that size only once in the data, in any case. Sale prices were also adjusted to exclude the cost of shipping whenever notes indicated that was necessary. In addition, all deals involving a trade (as opposed to a “cash-only” sales) are dropped from the analysis (this eliminated only 87 observations). Summary statistics for the remaining 2,693 records (from a starting sample of 3,305 transactions) are presented in Table 1.

In addition, to help the reader understand the data, Figure 1 illustrates how prices have changed over time for three bourbons released in the fall of 2014. These three bourbons are the

¹⁷The one exception to the size rule is Blanton’s, which is sold in 700ml bottles.

most frequently observed bourbons in the SWT data. For the three bourbons depicted in the graph - George T. Stagg, Old Rip Van Winkle, and Four Roses Small Batch Limited Edition - the retail prices at time of release were \$80, \$50, and \$100, respectively. The graph shows that the secondary market quickly established a different price for each bourbon: there is a flurry of activity with lots of observations. Over time, the frequency diminishes. This pattern characterizes all of the annual release bourbons observed repeatedly in the data (although the more recent releases have had less time for activity to diminish as markedly). This is likely to happen for a variety of reasons including that the bottles have ended up in the hands of the investors who plan to buy and hold for a long time, that many of the finite number of bottles have been consumed, and that new bourbons have been released deflecting attention from the 2014 releases. Most strikingly, it is clear that returns are variable even for frequently traded products: some bourbons appreciate considerably, some only a little, while others remain at or around their initial secondary market price.

3.2 Repeat Sales Methodology

The paper’s chief empirical goal is to use the available sales data to estimate a price index for bourbon as a product category. To do so, the analysis focuses on the information contained in product-specific “log-price relatives” (these are reported without explanation in Table 1). A log-price relative is the difference between the log of consecutive sale prices of the same product. These log-price relatives are employed in the same repeat-sales regression framework used to calculate the rate of return on wine (Burton and Jacobsen, 2001) and artwork (Baumol, 1986; Goetzmann, 1993; Mei and Moses, 2002).

The repeat-sales approach is built on the idea that the expected difference in prices for sales of the same product at different times is equal to the change in the price predicted by the overall category price index between those times plus an error term (Bailey et al., 1963 originally developed this method to estimate real estate price indices).¹⁸ Specifically, for sales in $0, 1, \dots, T$ of $T + 1$ time periods, for good i , prices and indices are related as follows

$$\frac{P_{it'}}{P_{it}} = \frac{B_{t'}}{B_t} U_{itt'}$$

¹⁸The description of the repeat sales methodology provided here borrows some nomenclature and notation from Nagaraja et al. (2014).

where P_{it} is the sale price of the bourbon i in time period $t \in T$. For any two consecutive sales, t is the time of the first sale and t' is the time of the subsequent sale ($t' > t$). The B_t term represents the general price index for bourbon as a category at time t and $U_{itt'}$ is the multiplicative error term for the sale pair and follows a log-normal distribution. Taking the natural logarithm of each side gives

$$r = b_{t'} - b_t + u_{itt'}$$

where $r = p_{it'} - p_{it}$ and p , b , and u refer to the logarithms of P , B , and U (therefore, $u_{itt'}$ is independent and identically distributed homoscedastic random error). Ordinary least squares can then be used to estimate log indices which can be converted into price indices using the exponential function. The empirical analog of the repeat-sales methodology is an estimating equation of the form;

$$r = X\beta + \mu.$$

In the estimating equation, r and μ are n -dimensional vectors where n is the number of log-price relatives that can be calculated. A log price relative r for sales that occur in periods t and t' is $r = \log(p_{t'}) - \log(p_t)$. The matrix X is $n \times T$ -dimensional where T refers to the number of time periods in which sale prices are observed for any item in the data set. Completing the equation, β is a T -dimensional column vector of logarithms of the price indices that are to be estimated. There is no constant term in the regression, so that first value of the index is normalized at zero ($\beta_0 = 0$). The β_t coefficients (from $t = 0, \dots, T$) can be converted into a price index with a base value equal to 1 by taking the inverse log of each coefficient.

For any bourbon sold in $k \leq T$ time periods there will be $k - 1$ log price relatives calculated. The log price relative then approximates the percent increase in price between the two time periods. The calculated log-price relatives are regressed on a set of T “dummy” variables. That is, there is a $T \times 1$ column vector created for each time period $t \in T$. Each row of the vector is set to zero except that the time of the later sale is set to +1 in the row corresponding to that t 's log price relative. In

Table 2: Sample of Data Structure

Product	Price	r	t	t=1	t=2	t=3	t=4	t=5	t=6	t=7	t=8
A	1	.	1	1	0	0	0	0	0	0	0
B	2	.	1	1	0	0	0	0	0	0	0
A	1.11	.	2	-1	1	0	0	0	0	0	0
B	2.69	.	2	-1	1	0	0	0	0	0	0
A	2.07	0.273	3	0	-1	1	0	0	0	0	0
B	3.67	0.135	3	0	-1	1	0	0	0	0	0
A	2.65	0.108	4	0	0	-1	1	0	0	0	0
B	4.19	0.058	4	0	0	-1	1	0	0	0	0
A	2.72	0.011	5	0	0	0	-1	1	0	0	0
B	4.96	0.073	5	0	0	0	-1	1	0	0	0
A	2.78	0.009	6	0	0	0	0	-1	1	0	0
B	5.22	0.022	6	0	0	0	0	-1	1	0	0
A	2.86	0.014	7	0	0	0	0	0	-1	1	0
B	5.73	0.041	7	0	0	0	0	0	-1	1	0
A	3.62	0.102	8	0	0	0	0	0	0	-1	1
B	6.52	0.056	8	0	0	0	0	0	0	-1	1

This data is a sample of the data structure required for a repeat sales regression analysis.

the same row, a -1 is entered in the vector corresponding to the time period of the earlier sale. Table 2 provides an example of the data structure required for a repeat sales analysis.

4 Main Findings

4.1 Auction Data

For the purposes of analysis the whiskyauction.com data is aggregated into quarters. That is, observed sale prices for each observed product were averaged *within* a calendar quarter. Therefore, each bourbon's log-price relative is based on differences in the log of the average sale price between two quarters in which sales are observed. This means that the exponent of the estimated coefficients can be considered as quarterly index values.¹⁹ With this data transformation, the analysis relies on 161 unique quarter-bourbon observations over 13 quarters (2Q 2015 to 4Q 2017). As described in Table 1, the 161 quarter-bourbon observations come from 451 observed sales collected for 72

¹⁹Robustness checks, yet to be completed, will repeat the analysis using the lowest and highest sale prices in each time period.

Table 3: Bourbon Price Index Based on Repeat Sales Regressions - April 2015 to October 2017

Period	Coefficient	Index	Quarterly Return	Period	Coefficient	Index	Quarterly Return
2015q3	-0.0520 (0.15)	.9493	-0.0520	2017q1	0.399 (0.18)	1.49	-0.071
2015q4	0.1600 (0.14)	1.17	0.2120	2017q2	0.597 (0.19)	1.82	0.198
2016q1	0.1390 (0.14)	1.14	-0.0210	2017q3	0.524 (0.19)	1.68	-0.073
2016q2	0.3820 (0.16)	1.46	0.2430	2017q4	0.353 (0.19)	1.42	-0.171
2016q3	0.3650 (0.17)	1.44	-0.0170	2018q1	TBD	TBD	TBD
2016q4	0.4700 (0.18)	1.60	0.1050				

Standard errors in parentheses (** p<0.01, * p<0.05, * p<0.1). Note: 2015q3 refers to the third quarter of 2015, and so on. The second quarter of 2015 is the base quarter (index value=1). The estimates presented are based on a hand-collected sample from www.whiskyauction.com from early 2015 to late 2017. The analysis will be updated with Q1 2018 data when the quarter ends.

unique bourbons. Using the repeat sales regression approach described in Section 3 gives the estimates seen in Table 3.

The first column of the table is the time period (where “2015q2” refers to April, May, and June of 2015). Then, the repeat sales regression coefficient is reported. Taking an inverse log of the coefficient returns the index value in the third column. The fourth column calculates the quarterly rate of return (% change in index value). The coefficients should be interpreted as the rate of return on a basket of bourbons purchased in early 2015 up to the date associated with that coefficient. As can be seen, the rate of return is large over the time period studied and is much larger than the rate of return on wine or art (at least during the short time period studied) implied by the analyses of Burton and Jacobsen (2001) and Mei and Moses (2002). Note that the estimate for 2017 Q4 is likely unreliable as it relies on only a handful of observations from one month (October 2017) in that quarter. Additional data from November 2017 to March 2018 will be added to the next iteration of the paper.

Table 4: Bourbon Index Based on Repeat Sales Regressions - October 2014 to 2017

Month	Index Value	Month	Index Value	Month	Index Value	Month	Index Value	Month	Index Value
2014m11	1.024 (0.0223)	2015m7	1.259*** (0.0483)	2016m3	1.654*** (0.0667)	2016m11	1.622*** (0.0746)	2017m7	1.659*** (0.128)
2014m12	1.081*** (0.0263)	2015m8	1.309*** (0.0477)	2016m4	1.735*** (0.0829)	2016m12	1.618*** (0.0862)	2017m8	2.096*** (0.154)
2015m1	1.130*** (0.0303)	2015m9	1.350*** (0.0483)	2016m5	1.691*** (0.0716)	2017m1	1.737*** (0.0843)	2017m9	2.022*** (0.171)
2015m2	1.149*** (0.0317)	2015m10	1.449*** (0.0528)	2016m6	1.579*** (0.0692)	2017m2	1.910*** (0.0986)	2017m10	1.841*** (0.135)
2015m3	1.194*** (0.0326)	2015m11	1.408*** (0.0559)	2016m7	1.654*** (0.0691)	2017m3	1.946*** (0.115)	2017m11	2.114*** (0.286)
2015m4	1.205*** (0.0348)	2015m12	1.394*** (0.0509)	2016m8	1.840*** (0.0796)	2017m4	1.887*** (0.122)		
2015m5	1.208*** (0.0381)	2016m1	1.445*** (0.0542)	2016m9	1.789*** (0.0901)	2017m5	1.843*** (0.120)		
2015m6	1.341*** (0.0442)	2016m2	1.497*** (0.0550)	2016m10	1.649*** (0.0755)	2017m6	1.999*** (0.150)		
Observations					1,246				

Standard errors in parentheses (**p<0.01, * p<0.05, * p<0.1). Note: 2014m11 refers to the November of 2014, and so on. October 2014 is the base month (index value=1). The estimates presented are based on records from a spreadsheet that was maintained by the members of a social network group that ran a secondary market for bourbon over the time period in the analysis. The data is publicly available.

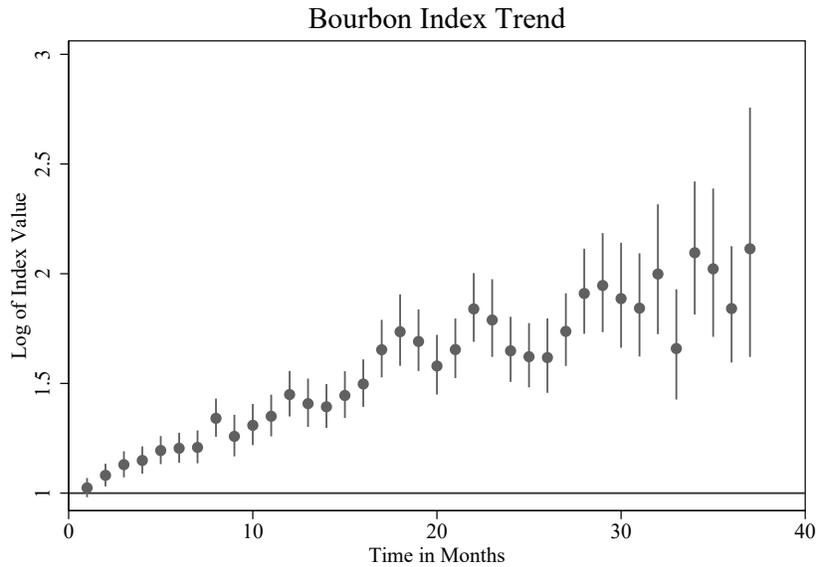
4.2 SWT Data

The second data source available to the authors comes from the SWT secondary market for bourbon as described in Section 3.²⁰ The data spans about three and a half years between 2014 and late 2017 and there are several thousand observations. For this reason, the data can be used to estimate a monthly - rather than quarterly - bourbon price index. That is, observed sale prices for each observed product were averaged *within* a calendar month. Therefore, each bourbon's log-price relative is based on differences in the log of the average sale price between two months in which sales are observed.

The findings from a repeat sales regression are presented in Table 4. The estimates are presented across four columns. The first estimate of 1.024 is the index value in November of 2014. By construction, the October 2014 index value is the base value and is equal to 1. An estimate of 1.024 implies that the bourbon index increased by 2.4% in that month although the increase was not statistically different from zero. However, the index rapidly increases throughout 2015 and 2016. By November of 2017, the index is sitting at 2.114, representing a 211.4% increase in bourbon

²⁰The aforementioned spreadsheet is publicly available at <https://docs.google.com/spreadsheets/d/1CAh7RLsi750ruEVNubV3Pghf78HcfbOqNhGjLP.lc/htmlview>

Figure 2: Monthly Price Index (SWT Data - 2014 to 2017)



Data Source: Strong Water Trading Sales Records 2014-2017

prices relative to late 2014. Due to the repeat sales regression methodology, where estimates are based only on changes in prices for a given product, the increase observed cannot be due only to changes over time in the underlying sample of bourbons used to construct the index.

These estimates align quite well with the quarterly index estimates estimated from the auction data. However, because they are likely based upon different underlying “types” of bourbon (the quarterly index covers only very high-end bourbon over the time period), it is difficult to draw direct comparisons. Future work will attempt to resolve the differences using only closely matched sub-samples.

Together, the estimated indices suggest that secondary markets for bourbon are caused by more than a desire to exchange boring collectibles. Anyone who bought a variety of limited edition bourbons several years ago (and held them) has probably experienced a significant gain in their “portfolio’s” value. The legality of realizing those gains is, of course, questionable, although the formal and legal auction house route will become more attractive if prices continue to follow the same trend (see Figure 2). Those who operate in these markets tend to suggest liquor law enforcement agencies are not concerned about high-end trading among “hobbyists.” In addition,

there are movements being made towards legal sale of vintage and rare bottles, one example is a recent law in Kentucky. It remains to be seen what effect these changes will have on the secondary market.

5 Discussion and Conclusion

Using two complementary sources of data, this paper has shown remarkable price increases since 2014 in the secondary market for bourbon. Future updates to the paper will examine the robustness of these estimates to alternative measures of prices (including minimum and median sale prices) and will examine a variety of relevant sub-samples (including by location, distillery, and “collection”). Following Mei and Moses (2002), the next version of the paper will also attempt to characterize and estimate the systematic risk of bourbon as an asset over this short time period.

Note that this paper provides absolutely no investment advice. It merely seeks to describe what is happening in the market for bourbon over recent years. The recent bourbon boom could easily be the next “beanie baby” phenomenon: here today and gone tomorrow. Suppliers might increase production enough to clear the market at MSRP, substitutes (rye whiskey, scotch, and so on) may become more attractive options, or regulators could crack down on secondary sales causing speculators to exit the market. That might be a welcome turn of events to many who bemoan that their favorite whiskey is missing from their local liquor store’s shelves.

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