DISCUSSION PAPER SERIES

No. 6583

**FIDDLING WITH VALUE:
VIOLINS AS AN INVESTMENT?**

Kathryn Graddy and Philip Margolis

INDUSTRIAL ORGANIZATION

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP6583.asp**

ISSN 0265-8003

FIDDLING WITH VALUE: VIOLINS AS AN INVESTMENT?

Kathryn Graddy, Brandeis University and CEPR
Philip Margolis, Cozio Publishing

Discussion Paper No. 6583
November 2007

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 6583

November 2007

ABSTRACT

Fiddling with Value: Violins as an Investment?*

This paper measures the returns to investing in violins using two different datasets. One dataset includes 75 observations on repeat sales of the same violins at auction starting in the mid-19th century and another dataset includes over 2000 observations on individual violin sales at auction since 1980. Overall real returns for the dataset on repeat sales for the period 1850-2006 have been approximately 3.5%. Real returns to the overall portfolio of individual sales since 1980 have been nearly 4%. While this return is lower than other standard investments, the price path has been stable with a slight negative correlation to stocks and bonds.

JEL Classification: D44, G11 and L82
Keywords: auctions, investment, repeat sales and violins

Kathryn Graddy
Brandeis University
Department of Economics MS 0221
415 South Street
Waltham, MA 02454
USA
Email: kgraddy@brandeis.edu

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=135475

Philip Margolis
Cozio Publishing
Hanflaenderstr.
41 8640 Rapperswil
SWITZERLAND
Email: pmargolis@cozio.com

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=167539

* The authors would like to thank Tim Engles, Jonathan Hamilton, Ben Hebbert, Blake Lebaron, and Bill Taylor for their comments.

Submitted 19 November 2007

In this paper, we analyze the prices of violins using two different datasets: one dataset includes 75 observations on repeat sales of the same violins at auction starting in the mid-19th century and the other dataset includes over 2000 observations on individual violin sales at auction since 1980. The purpose of this paper is to give some indication as to whether violins are a viable alternative investment that might be part of a diversified portfolio and to determine if some types of violins have had higher returns than other types of violins.

Despite the growing discussion of alternative investments in the economics and finance literature, the growing number of wealthy individuals, funds and syndicates that invest in violins, and the interest in violins as a collateralizable asset, the only previous study of violin prices published in an academic journal was a study by Ross and Zondervan of repeat sales of 17 Stradivaris (1989). This dearth of academic analysis is most likely due to the difficulty in gathering information on the sale prices of violins. Compared to real estate and even art, the market for high-end violins is "thin" and many violins are sold through dealers rather than auctions, with the result that repeat sales at auction are few and far between.

To preview our results, overall real returns for the dataset on repeat sales for the period 1850-2006 have been approximately 3.3%. Real returns to the overall portfolio of individual sales since 1980 have been nearly 4%. While this return is lower than other standard investments, the price path has been stable with a slightly negative correlation to stocks and bonds. Violins made by Stradivari and Guarneri (del Gesù) have had higher returns than other instruments, though still less than art. In the period since 1980,

Modern Italian instruments have increased steadily in price relative to Old Italian instruments, with the exception of instruments made by Stradivari or del Gesù.

This paper proceeds as follows. In Section 2 we discuss the violin market and in section 3 we discuss the data and our estimation methodology. In section 4 we present our regression results, and in section 5 we discuss issues with sample selection. We conclude in section 6.

2.0 The Market for Violins

2.1 How the Market Works

Fiddles – the term used by dealers and collectors to refer to even the finest violins -- are sold through both auction houses and dealers and also directly from one musician or collector to another. The main sellers and buyers of these instruments, other than dealers, are musicians, collectors (often foundations), and investors.

For the musician, a fiddle is a tool of the trade that also has investment value. In the words of Jacqueline Du Pré's godmother, after purchasing a $90,000 Stradivari cello (The Davidov) for her in 1964,

'You know, dear child, this instrument is extremely valuable, very expensive. You must hang on to it as it's the only thing you've got. If anything should happen to you you've got this to sell'

p. 218, Faber

Some musicians are assembling syndicates to help them purchase the instrument they want.[1]

For a collector, the decision to invest in a violin is complex. Ownership of violins is similar to ownership of art, in that dividends in the form of enjoyment from ownership are received, thus likely allowing a lower return. As in art, the purchaser is often only secondarily interested in the capital appreciation of the investment. Investing in violins or artwork can provide the investor with prestige and a ticket into a social world of musicians or artists and other investors. However, the ownership of fine instruments has different benefits than other types of art ownership because most collectors loan out their instruments to talented musicians. The borrower of the violin typically pays all insurance and maintenance costs (but not a rental fee); insurance costs range from about ½% to about 2% of the value of an instrument. Institutions including the Austrian National Bank, Nippon Corporation, Chi Mei Foundation of Taiwan, L-Bank of Baden-Wurttemburg, Suntory Ltd., and the Samsung Foundation have also been important purchasers of violins. Again, these foundations generally loan their instruments to musicians.

There are also buyers who are interested in purchasing violins primarily as an investment, as part of a diversified portfolio. Firms such as Stradivari Invest® and The Stradivari Society® specialize in helping investors purchase instruments made by Stradivari, Guarneri (del Gesù) and a few other top makers. These instruments are then also loaned out to musicians, who pay insurance and maintenance.

[1] For example, the *Economist* magazine (December 23, 2006, p. 111) reported that Jamie Walton, a rising young musician, was putting together a syndicate to help him purchase a 1712 Guarneri filius Andreae cello for $1.7 miillion.

Violins are sold through both auction houses and dealers. One advantage of transacting through a dealer is that it is easier to borrow and try out the instrument (though auction houses also accommodate a small number of potential buyers in this manner). Furthermore, dealers will often accept "trade-ins" as long as the fiddle is traded for one of a similar or higher value. Advantages of buying (and selling) through auction include transparent pricing and a greater selection.

We have chosen to analyze auction prices because these prices are verifiable. However, the very, very top instruments are usually not sold through auction, but through dealers. For example, most of Menuhin's instruments were sold at auction at Sotheby's in 1999, but the most important, the Lord Wilton del Gesù, was sold at a separate private sale. We discuss the possible effects on our estimates of excluding the very top instruments from our dataset in Section 5 below.

2.2 Previous Work on Violin Prices

The one academic study that we know of is by Ross and Zondervan (1989). In this study, they examine a repeat sales dataset of 17 Stradivaris that were bought and sold a total of 29 times between 1803 and 1982. They find an average real return over this period of approximately 2 percent, equal to the long-run real rate of interest. There have been several other attempts to measure returns to violins, but these studies have not used auction data nor have they been published in refereed journals.[2]

3.0 Data and Methodology

3.1 Data on Repeat Sales

[2] One study, published by "Orchestrated Investment, Inc." in 1999 used price estimates listed in Fuchs Taxe der Streichinstrumente, a German publication that estimates prices for the violin market. This study concludes that from 1960-1996, Italian violins had increased on average 11.7% per year in price. The Economist magazine, also published an article which showed a price index from one dealer, Florian Leonhard Fine Violins, which we discuss in more detail below.

The data on repeat sales was gathered from both the original auction catalogues and price sheets from the main auction houses that sell, or have sold, violins and from the secondary sources, *"Violin Iconography of Antonio Stradivari"* (Herbert K. Goodkind, 1981) and *"Antonio Stradivari: His Life and Work"* (W.E. Hill & Sons, 1901). A good deal of time was spent both in The British Library and in the archives of Bonhams looking through old Puttick and Simpson catalogues!

For our repeat sales database we have 68 instruments comprising 75 observations – some of the violins in our dataset were sold more than twice. We originally had more instruments, but a closer look at the list revealed some anomalies. Several of the instruments appeared to have been sold twice in the same year by the same auction house. As we were not certain as to whether these were actual sales, we removed these instruments from the list. The minimum time between sales of the same violin in the dataset is 3 years and the maximum is 135 years, with an average time between sales of 33 years. A complete list of the fiddles included in the repeat sales dataset is included in Table 1 below, and descriptive details, photos, and provenance information about these violins can be found using the Cozio ID, as listed in the table, on the website www.cozio.com. These are typical high quality instruments by top Old Italian makers, including 22 instruments by Stradivari and 3 by del Gesù.

Table 1: Instruments included in Repeat Sales Dataset

ID	Maker	Built	Type	ID	Maker	Built	Type
5475	Amati, Antonio & Girolamo	1623	violin	6348	Pressenda, Giovanni F	1833	violin
4730	Amati, Nicolo	1662	violin	6352	Rocca, Giuseppe	1845	violin
209	Amati, Nicolo	1676	violin	6428	Rocca, Giuseppe	1857	violin
4032	Balestrieri, Tomasso	1760	violin	6793	Rogeri, Giovanni Battista	1671	violin
5690	Gabbrielli, Giovanni Battista	1770	violin	5415	Rogeri, Giovanni Battista	1695	violin
165	Gagliano, Ferdinando	1775	viola	224	Rogeri, Giovanni Battista	1705	violin
5370	Gagliano, Ferdinando	1790	violin	5052	Ruggieri, Francesco	1690	violin
6014	Gagliano, Giovanni	1806	violin	215	Ruggieri, Francesco	1694	violin
4765	Gagliano, Giuseppe	1785	child's violin	6171	Stainer, Jakob	1660	violin
817	Gagliano, Nicola	1760	violin	742	Stradivari, Antonio	1684	violin
4685	Grancino, Giovanni	1695	cello	756	Stradivari, Antonio	1685	violin
2189	Grancino, Giovanni	1706	cello	205	Stradivari, Antonio	1688	violin
2584	Guadagnini, Giovanni Battista	1765	violin	8507	Stradivari, Antonio	1690	violin
883	Guadagnini, Giovanni Battista	1769	cello	2274	Stradivari, Antonio	1692	violin
4722	Guadagnini, Giovanni Battista	1772	violin	775	Stradivari, Antonio	1694	violin
3469	Guadagnini, Giovanni Battista	1776	violin	771	Stradivari, Antonio	1694	violin
857	Guarneri, Andrea	1674	violin	438	Stradivari, Antonio	1696	cello
4399	Guarneri, Andrea	1679	violin	1277	Stradivari, Antonio	1699	violin
395	Guarneri, Giuseppe 'del Gesu'	1734	violin	713	Stradivari, Antonio	1703	violin
255	Guarneri, Giuseppe 'del Gesu'	1741	violin	1348	Stradivari, Antonio	1709	violin
453	Guarneri, Giuseppe 'del Gesu'	1744	violin	486	Stradivari, Antonio	1710	violin
2496	Guarneri, Giuseppe 'filius Andrea'	1703	violin	728	Stradivari, Antonio	1711	violin
4362	Guarneri, Giuseppe 'filius Andrea'	1703	violin	288	Stradivari, Antonio	1712	violin
4573	Guarneri, Pietro 'of Mantua'	1686	violin	1381	Stradivari, Antonio	1714	violin
181	Guarneri, Pietro 'of Mantua'	1699	violin	3952	Stradivari, Antonio	1716	violin
3424	Guarneri, Pietro 'of Mantua'	1715	violin	1489	Stradivari, Antonio	1720	violin
4621	Guarneri, Pietro 'of Mantua'	1715	violin	1418	Stradivari, Antonio	1720	violin
6788	Guidante, Floreno	1731	violin	1516	Stradivari, Antonio	1724	violin
4689	Maggini, Giovani Paolo	1610	violin	135	Stradivari, Antonio	1726	violin
3471	Maggini, Giovani Paolo	1620	violin	1533	Stradivari, Antonio	1727	violin
4477	Panormo, Vincenzo	1780	violin	1552	Stradivari, Antonio	1729	violin
5674	Panormo, Vincenzo	1800	viola	3246	Testore, Paolo Antonio	1750	violin
6349	Pressenda, Giovanni Francisco	1832	violin	5437	Tononi, Giovanni	1700	violin
6350	Pressenda, Giovanni Francisco	1832	violin	186	Tononi, Giovanni	1750	violin

For the regressions, we use prices including buyers' commissions. Other studies such as the Mei and Moses (2002) study on art prices include commissions, and we would like this study to be comparable. Auction houses usually report prices including buyers' commissions. Sellers' commissions are negotiable and unknown to us. We consider buyer's commissions when interpreting our regression results below. We estimate the index in GBP as all purchases, and all but a few sales, were recorded in GBP.

3.2 Data on Individual Sales

We began putting together the dataset on individual sales from 1980 to 2006 by merging data on violin sales published by Donald M. Cohen in "The Red Book: Auction Price Guide of Authentic Stringed Instruments and Bows" and sales published by Holfter GmbH in Stolberg, Germany in "Database: Sales of string instruments 1984-2006."[3] Neither dataset included all auction houses, so we went back to the original catalogues to fill in the missing sales. We included instruments sold by the major auction houses: Sotheby's, Christie's, Bonhams, Phillips, Tarisio, Bongartz and Skinner as well as other auction venues: Ader Tajan in Paris, Babuino in Rome, Da Salo on the Internet, Dorotheum in Vienna, Etude Tajan in Paris, Gardiner-Houlgate in London, and Vichy in Paris. In addition, we checked the catalogues to ensure that we included only full-size instruments listed as "by" a particular maker and represented in good physical condition. The characteristic that we focus on and include in our regressions and that is recognized to have a huge influence on price is maker. Altogether, the database consists of violins

[3] Previous editions of "The Red Book" were published by Samuel W. Eden.

by more than 100 different makers spanning four centuries and representing virtually all of the important schools of violin making.[4]

The schools represented in our data are the Old Italian School, comprising 899 violins made in Italy between 1574 and 1850, the Modern Italian School, comprising 833 violins made in Italy between 1820 and 1979 (makers are grouped as to whether they are Old Italian or Modern Italian), and the French school, comprising 349 violins made between 1783 and 1948. We also have 173 Old non-Italian makers, and 8 makers representing the modern American school. Table 2 below provides summary statistics on these instruments.

[4] There were 52 instruments included in the auction catalogues of Bongartz and Skinner for which we could not find sale prices.

Table 2: Summary Statistics for Individual Sales Dataset

	Mean	Min	Max
		All	
Sale Price	£50,087	£1,155	£1,818,878
Sale Date	1994	2000	2006
Year Built	1822	1574	1986
No. of makers	108		
No. of Observations	2316		
		Stradivari-del Gesu	
Sale Price	£572,756	£195,822	£1,818,878
Sale Date	1991	1980	2006
Year Built	1710	1667	1743
No. of makers	2		
No. of Observations	49		
		Old Italian	
Sale Price	£58,684	£7,848	£568,000
Sale Date	1993	1980	2006
Year Built	1741	1574	1850
No. of makers	55		
No. of Observations	899		
		Modern Italian	
Sale Price	£28,122	£1,155	£214,475
Sale Date	1994	1980	2006
Year Built	1909	1820	1979
No. of makers	33		
No. of Observations	833		
		French	
Sale Price	£28,017	£3,238	£130,376
Sale Date	1994	1980	2006
Year Built	1856	1783	1948
No. of makers	9		
No. of Observations	349		

Prices are in 2005 GBP and include buyers' commissions.

One interesting fact to note about the summary statistics is that the mean price of Stradivaris and del Gesùs in the individual sales dataset is nearly 10 times the mean price of other Old Italian instruments. Furthermore, Old Italian instruments are on average over double the price of Modern Italian and French instruments. Again, we report prices and estimate the indices in GBP.

3.3 Methodology

Each violin is a unique instrument, and the problems incurred in measuring returns to violins are similar to the problems incurred when measuring the returns to art. The result is that there will be some ambiguity in the construction of a single index of the movement of prices over time. One concern about simply using average prices is that price rises may be exacerbated during booms as "better" instruments may come up for sale—which has generally happened with art. In general average prices indicate variability over time in violin prices that is better described as movements in the heterogeneity of the quality of the objects offered, rather than movements in prices for the same objects.

The two primary types of indices used for heterogeneous objects are based on regressions known as "hedonic models" and "repeat sales models." In hedonic models, differences in items are controlled for by including a small number of "hedonic" characteristics. Repeat sales models, in effect, include a dummy variable for each item (see Ashenfelter and Graddy (2003, 2006) for a full discussion of the two types of indices and their use in estimating returns to art. A repeat sales model is better able to control for differences in items across time, but these models usually rely on only a small proportion of those items that have come to market. It is often argued that items that are

sold twice are "different" than other items that come to market and thus sample selection issues are present. With hedonic indices, all items that are sold can be used, but the controls for differences in quality are incomplete.

Our strategy in this paper is to estimate both types of models with different datasets. We then compare estimates from both models for an overlapping time period and in this manner gain some confidence that our indices reflect true market movements.

3.2.1 The Repeat Sales Model

Our repeat sales model is based on the regression,

$$\ln(\frac{P_{is}}{P_{ib}}) = \sum_{t=1}^{T} \beta_t \delta_t + \varepsilon_{it}$$

β_t is the average return in period t of violins in the portfolio, the δ_t are dummy variables for each of the periods in the dataset, and $\varepsilon_{i,t}$ is an error term. The observed data consist of purchase and sales of auction price pairs, P_{ib} and P_{is} of the individual violins that comprise the index, as well as the dates of purchase and sale, which are designated b_i and s_i. Please see Appendix A for a thorough discussion of the repeat sales model.

3.2.2 The Hedonic Model

Our regressions are based on the model

$$\ln P_{it} = \alpha X_i + \sum_{t=1}^{T} \gamma_t \tau_t + \eta_{it}$$

where P_{it} is the price of violin i at time t, X_i are hedonic characteristics which consist of 107 dummy variables representing maker and τ_t are 25 dummy variables representing years from 1981 to 2006. η_{it} is an error term. We estimate this model for the entire

sample and separately for Stradivaris and del Gesùs, for other Old Italian stringed instruments, for Modern Italian stringed instruments and for French instruments.

4.0 Results

We first analyze and present the results for the repeat sales model. We then estimate the hedonic model using the full dataset on individual sales. We compare the results with the purpose of establishing consistency between the two datasets. We then split the dataset on individual sales into the various schools and look at the relative returns of the various schools.

4.1 **Repeat Sales Regression Results**

The estimation results for the repeat sales model are presented in Table 3 below. As fully described in the appendix, we present OLS estimates and estimates using the standard Case and Shiller correction. Intuitively, β in Table 3 is the average of the natural logarithm of the return of each instrument held during the 10 year period.[5] The annual returns for the OLS regressions are then calculated as $e^{\frac{\beta}{10}} - 1$ (for the period 2000-2006, $e^{\frac{\beta}{7}} - 1$ is used). The annual returns for the Case Shiller regressions are calculated as $e^{\frac{\beta+\sigma^2/2}{10}} - 1$, where σ^2 is defined as the cross-sectional variance of assets held in any 10 year period. We adjust the estimate by $\sigma^2/2$ because of the well-known problem that the regressions estimate the geometric mean *across* assets, but we are interested in the arithmetic mean *across* assets (but the geometric mean over time). The cross-sectional

[5] A hypothetical example of how the return would be calculated for one instrument is as follows: if a violin were purchased at the beginning of 1860 and sold at the end of 1869, its return for the period 1860 to 1869 would be calculated as P_{1869}/P_{1860}.

variance is estimated as the coefficient on the number of periods held (estimated as .109 with a t-statistics of 2.54) in the second stage of the Case and Shiller regression.[6,7]

Table 3: Repeat Sales Regressions

	OLS (1st Stage)			Case Shiller (linear)		
period	β	t-stat	annual return	β	t-stat	annual return
1850-1859	-0.25	-0.45	-2.44%	-0.14	-0.29	-1.33%
1860-1869	-2.10	-0.65	-18.97%	-1.53	-0.38	-14.06%
1870-1879	11.40	0.76	212.56%	9.00	0.47	146.18%
1880-1889	-7.90	-0.66	-54.63%	-6.13	-0.4	-45.77%
1890-1899	-0.23	-0.29	-2.25%	-0.09	-0.12	-0.80%
1900-1909	0.34	0.97	3.47%	0.35	1.14	3.71%
1910-1919	0.68	1.62	6.99%	0.66	1.7	6.88%
1920-1929	0.20	0.31	2.06%	0.22	0.34	2.36%
1930-1939	0.37	0.46	3.76%	0.32	0.4	3.32%
1940-1949	-0.85	-1.09	-8.15%	-0.48	-0.59	-4.55%
1950-1959	1.83	1.93	20.14%	1.25	1.23	13.42%
1960-1969	1.18	2.54	12.49%	1.53	3.11	16.64%
1970-1979	1.75	8.25	19.10%	1.63	8.3	17.85%
1980-1989	0.97	5.4	10.19%	1.05	6.59	11.19%
1990-1999	0.47	2.5	4.76%	0.42	2.51	4.38%
2000-2006	0.08	0.39	1.21%	0.10	0.53	1.62%
adj -R2			0.9725			0.9648
obs.			75			75
Mean Return			105.18%			105.45%
Mean Return: 1980:2006			105.79%			106.11%

[6] The constant is interpreted as a transaction-specific error and is estimated as .021 with a t-statistics of 2.13. The adjusted R-squared in the regression is .046.

[7] The negative autocorrelation in period returns that is present during the very early periods is a known problem with repeat sales indices. Goetzmann (1992) proposed a Beysian correction that puts additional restrictions on the return path. As we are primarily interested in the returns in later periods and in averages over the entire time period we note the problem, rather than put additional assumptions and structure on the returns.

The mean return is then calculated as $(\prod_{1}^{T} \alpha)^{1/T}$, where α is the annual return and T is the number of years over which the mean is being calculated. Thus, our indices indicate that the mean nominal return for the period 1850-2006 is 5.45%, and the mean nominal return for the period 1980-2006 is 6.11%.[8]

4.2 Hedonic Model Regression Results

The full sample results for the hedonic model are presented in Table 4 below. Intuitively, γ in Table 4 for a particular period is the average of the natural logarithm of price, conditioning on the maker of the instrument. The index year in year t is then calculated as e^{γ_t}, and the return is calculated as $\frac{e^{\gamma_t} - e^{\gamma_{t-1}}}{e^{\gamma_{t-1}}}$. The mean nominal return for the portfolio of violins included in the dataset for the entire time period is approximately 7.51% (before commissions) and the standard deviation in estimated returns over the period is approximately 9%.[9] Note that when the regression is run only with time dummies, the R-squared is about .15, indicating that that the maker dummy variables explain about 60% of the variation in log price. Hence, the time dummies and the maker characteristics explain the series well.

The mean for the equivalent period in the repeat sales dataset is 6.11%. as compared to 7.51% for this dataset. The difference in means probably exists for a number of reasons. Firstly, the period returns are only estimates of the actual returns -- it is reassuring that the geometric averages of these estimates are still relatively close.

[8] This is the geometric mean over the time period for the portfolio of violins included in the dataset. The geometric mean return is usually calculated for financial assets because of compounding.
[9] This is again the geometric mean and the geometric standard deviation of the annual returns over the time period of the portfolio.

Secondly, the composition of the two datasets is slightly different. The individual sales dataset contains a large number of modern instruments – as we will see below, they seem to have performed well in the period since 1980. Thirdly, it could be that the correction for taking the average of the logarithms in the repeat sales model could be underestimated, skewing the repeat sales mean slightly downwards.[10] Finally, this may be resulting from unobservable time-invariant effects that drop out in the repeat sales regressions, but are biasing the results in the hedonic regressions (see Hausman and Taylor *Econometrica* (1981)).

Figure 1 below plots the nominal hedonic index over time, both in GBP and in US dollars. The figure and also plots nominal indices of total returns of the S&P, U.S. 10 year bonds[11], and the Mei and Moses art index. The Mei and Moses art index is a US dollar index. As the figure demonstrates, the rise in violin prices has been steady, but well below that of other assets.

[10] In the Case and Shiller correction, the transaction-specific error is not used in calculating the cross-sectional variance of asset returns; furthermore the individual asset returns in a particular period are assumed to be i.i.d, which may not be an appropriate assumption for an infrequently traded asset.
[11] The source for total returns on the S&P and US 10 year bonds is Global Financial Data.

Table 4
Hedonic Regression Results: Full Sample

year	γ	t-stat	Index	Return
1980			1.00	
1981	0.128	1.41	1.14	13.60%
1982	0.191	2.17	1.21	6.51%
1983	0.513	6.19	1.67	38.10%
1984	0.597	7.90	1.82	8.73%
1985	0.758	10.08	2.13	17.50%
1986	0.714	9.49	2.04	-4.28%
1987	0.924	12.74	2.52	23.34%
1988	1.105	15.30	3.02	19.82%
1989	1.163	15.93	3.20	6.00%
1990	1.294	17.46	3.65	13.91%
1991	1.318	17.55	3.74	2.49%
1992	1.430	18.76	4.18	11.86%
1993	1.487	19.74	4.42	5.84%
1994	1.563	19.97	4.77	7.86%
1995	1.609	20.89	5.00	4.73%
1996	1.642	20.88	5.16	3.34%
1997	1.581	20.39	4.86	-5.86%
1998	1.696	22.66	5.45	12.10%
1999	1.664	21.70	5.28	-3.09%
2000	1.693	22.68	5.44	2.92%
2001	1.791	23.98	6.00	10.29%
2002	1.779	23.62	5.93	-1.17%
2003	1.803	22.96	6.07	2.44%
2004	1.779	23.29	5.92	-2.41%
2005	1.780	24.27	5.93	0.13%
2006	1.882	25.12	6.57	10.74%

Years	26	F-statistic: 105.82	
Makers	107	F-statistic: 65.39	
Constant	8.843	(0.069)	
R-squared	0.832		
Obs	2316		
Mean Return			7.51%
Standard Deviation of Return			8.99%

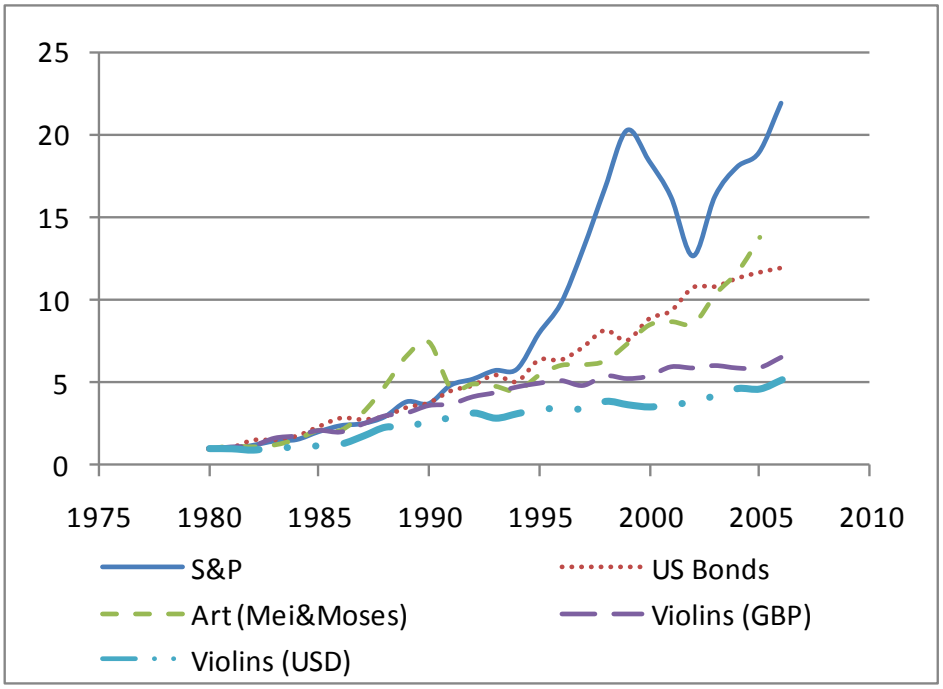

Figure 1

The end result that our hedonic indices are similar for the period to the repeat sales indices gives us confidence in our results, as neither dataset nor method is ideal. We can say that for one dataset containing 2,316 observations on different violins we are getting similar returns to a smaller repeat sales dataset of 75 observations, and that this nominal return (in GBP) averages between 6% and 7.5% for 1980-2006, not including commissions. If commissions are taken into account, the return should decrease by about .5% per year (based on violins changing hands on average of every 33 years and an average commission rate of 15%). Furthermore, the repeat sales model and the hedonic model track each other well for the decades since 1980.

It does not seem surprising that the overall returns to violins are lower than other assets. These instruments are primarily tools of trade and usually only

secondarily considered to be an investment. Both to musicians and to most collectors and investors they provide non-monetary dividends in the form of enjoyment.

Investors or institutions usually purchase or invest in only the very top violins – Stradivaris or Guarneris (del Gesùs), whereas the other instruments are most often purchased by musicians. It is therefore interesting to break the dataset up into subsamples and compare returns between these samples.

4.2 Results for the Various Schools

Table 4 below breaks up the individual dataset into a sample of violins made by Stradivari and del Gesù, a sample containing the Old Italian school of violin making, excluding those made by Stradivari or del Gesù, a sample containing violins made by the Modern Italian school, and a sample made by the French school. [12] The price indices are plotted in Figure 2. Stradivaris and del Gesùs have outperformed all of the other violin samples, though they have still underperformed art for the same period.[13] It is very likely that the high estimated standard deviation for Stradivaris and del Gesùs reflects the small sample size, rather than true variability in the index, though the high standard deviation is also consistent with higher risk and lower liquidity in this submarket. Modern Italian instruments have steadily outperformed Old Italian and French instruments.

[12] We included 4 dummy variables for Stradivari to represent his different periods. These dummy variables are not jointly significant; nor are they significantly different from one another.
[13] The real return for Stradivari's and del Gesùs for the period 1980-2006 is 6.92%, vs 7.74% for art.

Table 4
Hedonic Regression Results: Indices and Returns

	Stradivari-del Gesu		Old Italian (ex Stradivari and del Gesu)		Modern Italian		French	
	Index	Return	Index	Return	Index	Return	Index	Return
1980	1		1		1		1	
1981			1.07	7.01%	0.99	-1.03%	1.34	34.48%
1982	1.07	6.68%	1.07	-0.31%	1.13	13.97%	1.60	18.97%
1983	1.66	55.85%	1.34	25.93%	2.19	94.38%	2.12	32.29%
1984	2.40	44.45%	1.49	10.93%	2.46	12.12%	2.08	-1.62%
1985	3.61	50.12%	2.07	39.09%	2.40	-2.23%	2.63	26.13%
1986	2.41	-33.06%	2.05	-0.91%	2.59	7.79%	1.63	-37.93%
1987	3.25	34.56%	2.28	11.02%	3.22	24.44%	2.86	75.20%
1988	4.21	29.77%	2.61	14.63%	3.77	17.04%	3.16	10.71%
1989	2.60	-38.20%	2.84	8.62%	4.19	11.05%	3.25	2.66%
1990	11.37	336.54%	3.26	14.73%	4.60	9.66%	3.48	7.09%
1991			3.04	-6.61%	5.30	15.24%	4.31	23.98%
1992	4.44	-60.98%	3.43	12.78%	6.35	19.88%	4.03	-6.47%
1993	6.46	45.53%	3.40	-0.75%	6.84	7.73%	4.53	12.42%
1994	4.16	-35.61%	4.24	24.60%	6.97	1.94%	5.04	11.28%
1995	5.70	37.21%	4.43	4.44%	6.58	-5.59%	5.78	14.56%
1996			4.62	4.16%	7.77	18.11%	5.83	0.91%
1997	6.97	22.14%	3.69	-20.11%	7.11	-8.53%	4.58	-21.36%
1998	8.21	17.83%	4.48	21.45%	7.84	10.20%	5.19	13.24%
1999			4.64	3.68%	8.10	3.32%	4.24	-18.42%
2000	6.75	-17.82%	4.01	-13.71%	8.69	7.36%	5.52	30.23%
2001	8.32	23.39%	4.56	13.78%	10.02	15.23%	4.93	-10.58%
2002	6.80	-18.37%	5.02	10.18%	9.65	-3.64%	4.77	-3.29%
2003	10.22	50.46%	4.90	-2.42%	9.11	-5.61%	5.10	7.02%
2004			5.37	9.62%	8.82	-3.14%	5.42	6.13%
2005	14.25	39.40%	4.69	-12.80%	9.86	11.74%	4.51	-16.85%
2006	15.21	6.70%	5.35	14.18%	10.37	5.17%	5.25	16.62%
mean		11.04%		6.66%		9.41%		6.59%
std. dev.		54.49%		13.09%		15.42%		
Years	21	(5.440)	26	(39.660)	26	(69.830)	26	(14.440)
(F-stat)								
Makers	4	(0.850)	55	(26.190)	32	(69.810)	7	(94.810)
(F-stat)								
Cons.	11.279	(0.423)	9.272	(0.102)	7.480	(0.117)	8.8538	(0.160)
R^2	0.841		0.751		0.829		0.763	
Obs	49		899		833		349	

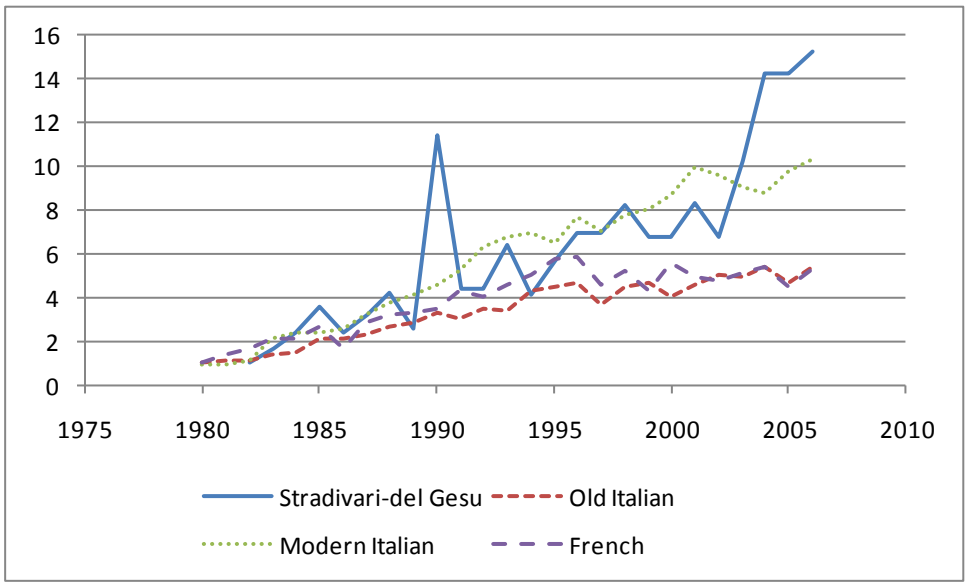

Figure 2

It is interesting to look at the relative prices of the various makers in our dataset. In Appendix Tables 1-3 we present the regression coefficients on each of the makers in the Old Italian school (leaving out Stradivari and del Gesùs), the Modern Italian School, and the French School. One point to note from these tables is that the range in prices for different makers is greater for the Old Italian School than it is for the French School or for the Modern Italian School. Furthermore, in this dataset of prices, Pietro Guarneri (of Venice) and Carlo Bergonzi appear to be the most valued Old Italian makers (after Stradivari and del Gesù (Guarneri), and Pressenda and Rocca are the most valued Modern Italian makers.

The results from the hedonic dataset are so consistently greater year by year for the Modern Italian school that it is interesting to speculate why the differences in returns may be occurring. There is a large absolute price difference between Modern Italian and Old Italian instruments, and due to the run-up in the past couple of decades in violin prices relative to inflation, Old Italian instruments have become unaffordable to many musicians. Many participants in the trade believe that there is a growing realization that Modern Italian violins are very good instruments and are now purchasing these instruments. Hence, there may be a shift in demand or tastes toward Modern Italian instruments.

Given the difference in returns to instruments belonging to the Old Italian School and instruments belonging to the Modern Italian School, it is interesting to look for differences in returns between 19th and 20th century Modern Italian instruments. These regression results are available on request, but the primary conclusion is that there is virtually no difference in returns to Modern Italian violins constructed in the different decades. Furthermore, one can look if there are differences in returns between Old Italian instruments (excluding Stradivari and del Gesù) constructed prior to 1750 and those constructed after 1750. Again, there are no differences in returns.

5.0 Auction Sample Selection

Many dealers believe that fewer of the "big name" makers are appearing at auction, and furthermore, it is widely believed that even among violins made by Stradivari and del Gesù, the "better" instruments are being sold through dealers rather than through auction.

As shown in Figure 3 below, the first claim appears to have merit.[14]

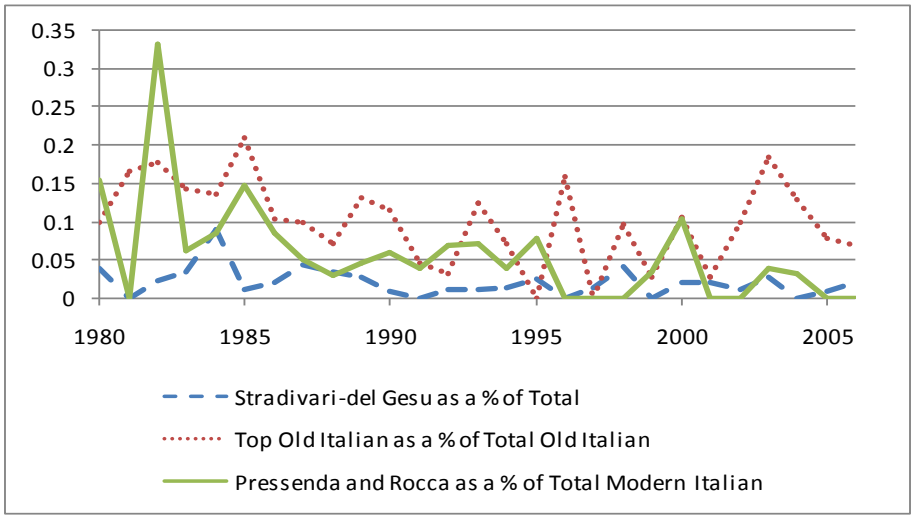

Figure 3

Although the percentages have bounced around, it does appear that since the early 1980s, the number of Stradivaris and del Gesùs appearing at auction as a percentage of all makers appearing at auction (and in the dataset) have decreased as have the total top Old Italian makers as a percentage of all Old Italian makers (these were defined, somewhat arbitrarily, as the top 10 makers by price as estimated for the hedonic model and presented in Appendix Table 2),as have the top modern Italian's (Pressenda and Rocca) as a percentage of all Modern Italian makers However, in all three categories, the numbers appear to have been fairly stable since 1990.

Although this change in composition of makers could be affecting the overall indices as Stradivaris and del Gesùs appear to outperform other makers, these changes

[14] In Figures 3 and 4 we have included the 52 instruments from Bongartz and Skinner for which we could not find prices.

should not be affecting the returns to the sub-indices.[15] Furthermore, it is unclear that the result of fewer appearances by Stradivari and del Gesù violins at auction necessarily translate into higher returns for dealers overall, for two reasons. Firstly, it may be that the decline in big names at auction houses could be because of the increase in purchases by institutions – these instruments are generally purchased and then taken off the market.[16] Secondly, any change in composition of Stradivaris and del Gesùs since 1980 could be offset by a change in composition of Modern Italian instruments and Old Italian instruments sold at auction. As shown by Figure 4 below, during the same period in which the numbers of Stradivaris and del Gesùs being sold at auction were decreasing, the number of Modern Italian instruments being sold at auction were increasing. Speculatively, these changes could possibly be increasing auction returns relative to dealer returns.

[15] We attempted to estimate returns to a subsample of top Old Italian makers and to a subsample containing only Rocca and Pressenda. These subsamples were admittedly small. However, the estimated returns were very similar to the estimated returns for the entire dataset of Old Italians and Modern Italians, respectively. Hence, we do not believe that the top Old Italian makers (excluding Stradivari and del Gesù) or the top Modern Italian makers return more than other makers in these respective categories.

[16] Many believe that Impressionist and modern art has recently underperformed other types of art because museums have purchased and kept the "best" pieces.

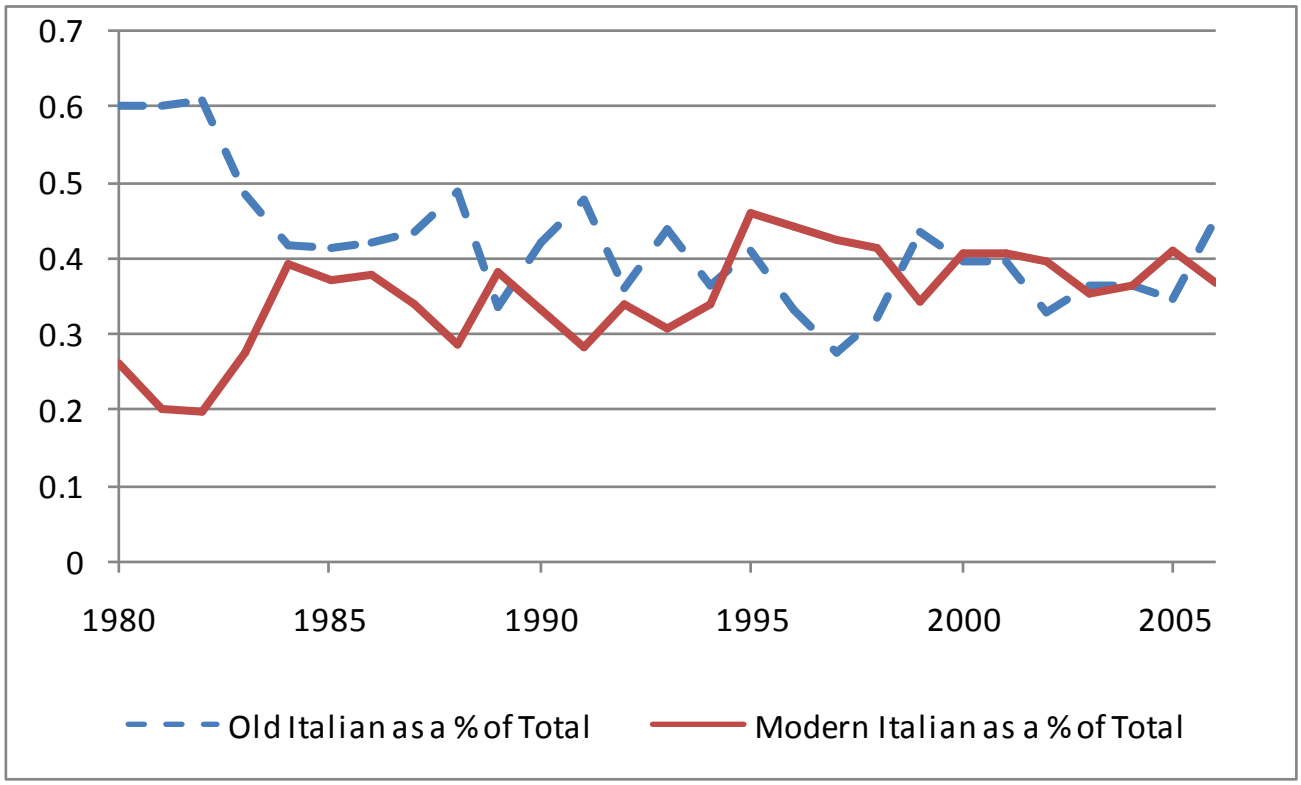

Figure 4

It is likely that the very best violins– such as Menuhin's Lord Wilton del Gesù -- are being sold through dealers rather than through auction houses. However, for this to change the returns in the repeat sales data, it must be shown that these instruments not only have higher prices, but also that their returns are different from those of other instruments, which would be difficult to justify in any long-run situation. Furthermore, the very top specimens of violins comprise a small proportion of all violin transactions and -- even if the returns were different -- would have a small effect on the overall index. Finally, many of the instruments included in the repeat-sales data set are considered excellent examples of the work of their makers.

We can compare our indices to an index published by *The Economist* supplied by the dealer Florian Leonhard. His index shows high-quality violins increasing approximately 7.6 times since 1980. Our hedonic index increases 6.5 times since 1980 and our repeat sales index increases approximately 5 times since 1980. Note that the Mei and Moses art index has increased approximately 14 times since 1980 and the S&P total return index -- i.e. the index including dividends -- has increased approximately 22 times since 1980. Hence, the violin indices are surprisingly similar to each other, given the potential difference in composition of instruments.[17]

Conclusion

Table 5 below converts the nominal returns into real returns by subtracting the inflation rate as calculated from long-term price indices on Global Financial data and then compares these real returns with various assets. As one can see from the table, the overall return to violins is lower than other assets. [18] However, the standard deviation in returns is lower, and over the period 1980-2006 there appears to be a slight negative correlation with the return to stocks and bonds.[19]

[17] His plotted index in the *Economist* article compared very favorably to the S&P for two reasons. Firstly, his S&P index was not a total return index – i.e. it did not include dividends. Secondly, his index starts in 1970. Both the 1960's and 1970s were bad periods for stocks and were very inflationary leading to high nominal increases in violin prices.

[18] The returns above do not take into account the effect of commissions for any of the assets, though as noted above, the effect of commissions would decrease returns for violins by about .5% per year if violins are held an average of 33 years.

[19] The reported standard deviation for art is undoubtedly high because the series was estimated from a repeat sales dataset, in which the known problem of negative correlation of the estimated index takes place in the early years of the series because of sparse data. A standard deviation for violins is not reported for the entire period because we do not have yearly returns, but only estimate returns for 10 year periods. As this is an illiquid market, it is unclear how the 10 year variance should relate to the yearly variance. Furthermore, because the returns are also estimated, the same upward bias would undoubtedly be present as is present in the art series.

Table 5
Comparison of Real Returns

Return	mean	standard deviation	Correlations S&P 500	U.S. Bonds	Ftse All-Share	Art	Violins (all)
1980-2006:							
S&P 500	9.18%	16.60%	1				
US Treasury Bonds	6.63%	11.70%	0.329	1			
Ftse-All Share	11.42%	15.70%	0.651	0.1762	1		
Art (Mei and Moses)	7.74%	19.56%	0.0376	-0.1867	0.1215	1	
violins(All)	3.97%	8.55%	-0.0557	-0.2243	-0.1071	0.3801	1
1850-2006							
S&P 500	6.48%	20.87%					
US Treasury Bonds	2.19%	8.55%					
Ftse-All Share	4.51%	16.52%					
Art (Mei and Moses)	4.72%	89.44%					
Violins (All)	3.30%						

Notes: We report geometric means and standard deviations. The total return series for stocks and bonds and the price index used for inflation were taken from Global Financial Data.
Returns for violins and the FTSE were deflated using the UK price index, and returns for other assets were deflated using the US price index.

In conclusion, the real returns to a portfolio of all violins over the past twenty-five years and over the long run have averaged between 3.3% and 4%. Furthermore, they have a slightly negative correlation to stocks and bonds, making them a candidate for inclusion in a diversified portfolio based on past performance, and they have had a relatively low variance in returns. Some violin categories have higher returns than other violin categories: the returns to Stradivaris and del Gesùs in the past 25 years appear to have been nearly as high as the returns to art (6.92% vs. 7.74% real returns), and Modern Italian violins have also performed above the average of all violins.

It is interesting to speculate why different categories of violins appear to have different returns. Based on reviews of literature in the field, and on conversations with experts and musicians, there appears to be an emerging consensus that 19, 20th, and now 21st-century, instruments are often just as good tonally as more expensive instruments from the 18th and 19th centuries. Professional musicians, the main purchasers of antique instruments, may be resisting paying high prices for old instruments if they feel they can get the same acoustic results from less expensive newer instruments. The fact that Strads and del Gesus continue to out-perform instruments by other makers may be explained by the fact that instruments by these makers really comprise a different market, the buyers being dominated by collectors and wealthy amateurs rather than working musicians.

References

Abraham, J., and W. Schauman, 1991, New Evidence on Home Prices from Freddie Mac Repeat Sales, *AREUEA Journal* 19: 333-352.

Ashenfelter, O. and K. Graddy (2003), "Auctions and the Price of Art", *Journal of Economic Literature* 41: 763-787.

Ashenfelter, O. and K. Graddy (2006), "Art Auctions," *Handbook on the Economics of Art and Culture,* V. Ginsburgh and D. Throsby, (eds.). Elsevier, pp. 909-945.

Baily, M. J., Muth, R. F. and Nourse, H. O. 1963. "A Regression Method for Real Estate Price Index Construction," *Journal of the American Statistical Association*, 58, 933-42.

Calhoun, C., 1996, OFHEO House Price Indexes: HPI Technical Description, mimeo, Office of Federal Housing Enterprise Oversight

Case, K. E. and Shiller, R. J. 1987. "Prices of Single-Family Homes Since 1970: New Indexes for Four Cities," *New England Economic Review*, September-October, 45-56.

Database Sales of String Instuments 1984-2006, published by Holfter GmbH: Stolberg, Germany.

The Economist, "Fiddling Expenses" December 23rd, 2006, p. 111.

Faber, T., (2004) *Stradivarius.* Macmilan: London.

Goetzmann, W.N. 1992. "The Accuracy of Real Estate Indices: Repeat Sale Estimators," *Journal of Real Estate Finance and Economics*, 5, 5-53.

Goetzmann, W.N. 1993. Accounting for Taste: Art and Financial Markets over Three Centuries. *American Economic Review*, 83, 1370-1376.

Goodkind, H. K. 1981. *Violin Iconography of Antonio Stradivari*.

Hausman, J. A. and Taylor W.E. 1981. "Panel Data and Unobservable Individual Effects." *Econometrica*, 49, 1377-1398.

Hill, W.E. and Sons. 1901. *Antonio Stradivari: His Life and Work.*

Hosios, A. and J. Pesando. 1991. "Measuring Prices in Resale Housing Markets in Canada: Evidence and Implications," *Journal of Housing Economics*, 1, 303-17.

Mei, J. and M. Moses (2002), "Art as an Investment and the Underperformance of Masterpieces", *American Economic Review* 92: 1656-1668.

Mei, J and M. Moses (2005), "Vested Interest and Biased Price Estimates: Evidence from an Auction Market", *Journal of Finance* 60: 2409-2435.

Pesando, J.E. 1993. Art as an Investment. "The Market for Modern Prints." *American Economic Review*, 83, 1075-1089.

The Red Book: Auction Price Guide of Authentic Stringed Instruments and Bows, various editions, formerly published by Samuel W. Eden, currently published by Donald M. Cohen: Alexandria, VA.

Ross, M. H. and S. Zondervan (1989), "Capital Gains and the Rate of Return on a Stradivarius", *Economic Inquiry* 27: 529-540.

Appendix A: Repeat Sales Estimation Method

Our regression equation begins with a standard repeat sales model used to estimate real estate and art indices where it is assumed the return for asset *i* in period *t* can be broken up into the return for a price index of the portfolio of assets and an individual error term,

$$r_{i,t}=\omega_t+\pi_{i,t}$$

where $r_{,it}$ is the continuously compounded return for a particular art asset i in period t, ω_t is the average return in period t of paintings in the portfolio, and $\pi_{i,t}$ is an error term.[20]

The observed data consist of purchase and sales of auction price pairs, $p_{i,b}$ and $p_{i,s}$ of the individual violins that comprise the index, as well as the dates of purchase and sale. Thus, the logged price relative for violin *i* held between its purchase date and its sale date may be expressed as

$$r_i=\ln\left(\frac{P_{i,s}}{P_{i,b}}\right)=\sum_{t=b_i+1}^{s_i} r_{i,t}$$
$$=\sum_{t=b_i+1}^{s_i}\omega_t+\sum_{t=b_i+1}^{s_i}\pi_{i,t}$$

This summation suggests that the log of the difference in sale prices should be regressed on a number of dummy variables that span the period over which the asset is held. The coefficient on the dummy variable for a particular period will represent the

[20] This methodology was developed by Bailey, et. al. (1963) and used by Case and Shiller (1987) and Hosios and Pesando (1991) for the real estate market, and subsequently used by Goetzmann (1993) Pesando (1993) and Mei and Moses (2002) for the art market. In these papers $\pi_{i,t}$ is assumed to be uncorrelated over time and across paintings.

average of the natural logarithm of the returns of all of the assets held in that specific period. Because of the summation, the t in effect drops out of the regression: each observation is the return for a particular asset. However, the errors will be heteroskadastic because of the summation: they will depend upon the number of time periods held.

Theory (by first differencing a hedonic model with fixed effects) suggests that the dummy variables for each pair should equal 1 at the time of sale, -1 at the time of purchase, and 0 in all other periods. Pesando (1993) uses this methodology. Goetzmann (1992) shows it is more efficient to allow the dummy variables to equal 1 during the periods between purchase and sale, zero otherwise, and then do GLS using weights suggested by Case and Shiller (1987). Goetzmann, and Mei and Moses, actually let the dummy variable equal 1 for an entire period if the painting was held before the current period and for any part of the current period. Otherwise it equals zero. We modify the construction of the dummy variables first by letting the dummy variable equal 1 if the violin was held for the entire period, letting it equal the proportion of the period held if it was held for less than an entire period (note that our periods are ten years in length), and letting it equal zero otherwise. This allows us to use data on violins that were held within a ten year period, and also more accurately describes the holding periods.

In the first stage of Case and Shiller's (1987) method, the log of the ratio of the sale price to purchase price is regressed on time dummy variables. In Case and Shiller in the second stage, a regression of the squared residuals from the first stage is run on a constant term and the number of periods held between sales. The linear specification for the second stage of Case and Shiller results partially from the iid assumption on the errors

in the return of the underlying asset i in period t (this is where the term for number of periods held appears) and partly because Case and Shiller put in a constant term to describe the transaction-specific error. The slope coefficient can be directly interpreted as an estimate of the cross-sectional variance in a period and therefore is used to correct for the known bias in the repeat sales estimates as described below. Some papers in the real estate literature have used a quadratic specification because the fit is better, but without theoretical justification (see Abaraham and Schaumann (1991) and Calhoun (1996)).

In the third stage, a generalized least squares (weighted) regressions is run that repeats the stage-one regression after dividing each observation by the square root of the fitted value in the second stage.

The regressions present estimates of the average of the log of the one period return of the portfolio of assets (the geometric mean). However, for the single period returns, we are interested in the arithmetic means across assets (Geotzmann 1992). Thus, resulting from Jenson's inequality, the estimates are downward biased by one-half of the cross-sectional variance. In the Case and Shiller results, we correct for this downward bias by adding 1/2 of the coefficient on the number of periods held terms in the second stage regressions to the estimated μ_t. Thus for a ten year period, our yearly returns are calculated as $(\exp(\mu_t+\sigma^2/2)^{1/10}$.

Appendix Table 1
Old Italian Makers

	Observations	Coefficient	Standard Error	Multiples of Nicola Gagliano
Guarneri, Pietro (of Venice)	3	1.64	0.26	5.14
Bergonzi, Carlo	4	1.49	0.23	4.45
Montagnana, Domenico	10	1.16	0.15	3.19
Guadagnini, Joannes Baptista	50	1.11	0.08	3.04
Guarneri, Joseph (fil. Andreae)	13	1.08	0.13	2.95
Guarneri, Pietro (of Mantua)	13	0.98	0.13	2.66
Amati, Nicolo	21	0.75	0.11	2.12
Ruggieri, Francesco	18	0.51	0.12	1.66
Guarneri, Andrea	20	0.50	0.11	1.65
Bergonzi, Nicola	3	0.48	0.26	1.61
Goffriller, Matteo	9	0.42	0.16	1.51
Bergonzi, Michele Angelo	1	0.41	0.45	1.51
Balestrieri, Tommaso	24	0.40	0.11	1.50
Serafin, Santo	14	0.26	0.13	1.29
Storioni, Lorenzo	19	0.19	0.12	1.21
Gagliano, Alessandro	8	0.11	0.17	1.12
Gobetti, Francesco	6	0.10	0.19	1.11
Camilli, Camillo	17	0.09	0.12	1.09
Amati, Antonio & Girolamo	20	0.07	0.11	1.07
Mantegazza, Pietro	5	0.07	0.21	1.07
Amati, Girolamo (II.)	6	0.01	0.19	1.01
Tononi, Carlo	10	0.01	0.15	1.01
Emiliani, Francesco	6	0.01	0.19	1.01
Gagliano, Nicola	63	0.00		1.00
Rogeri, Giovanni Batista	15	-0.02	0.13	0.98
Cappa, Gioffredo	21	-0.04	0.11	0.97
Gagliano, Gennaro	17	-0.04	0.12	0.96
Landolfi, Pietro Antonio	8	-0.09	0.17	0.91
Gagliano, Ferdinando	29	-0.10	0.10	0.90
Grancino, Giovanni	31	-0.15	0.10	0.86
Ceruti, Giovanni Battista	10	-0.15	0.15	0.86

Appendix Table 1 (continued)
Old Italian Makers

	Observations	Coefficient	Standard Error	Multiples of Nicola Gagliano
Amati, Andrea	1	-0.16	0.44	0.85
Landolfi, Carlo Ferdinando	23	-0.23	0.11	0.79
Deconet, Michele	12	-0.24	0.14	0.79
Maggini, Giovanni Paolo	13	-0.24	0.14	0.79
Sorsana, Spirito	10	-0.33	0.15	0.72
Goffriller, Francesco	3	-0.35	0.26	0.70
Gagliano, Giuseppe	34	-0.37	0.09	0.69
Testore, Carlo Giuseppe	13	-0.42	0.14	0.65
Costa, Pietro Antonio Dalla	6	-0.43	0.19	0.65
Calcagni, Bernardo	14	-0.44	0.13	0.64
Testore, Carlo Antonio	40	-0.44	0.09	0.64
Tecchler, David	11	-0.45	0.15	0.64
Tononi, Giovanni	12	-0.48	0.14	0.62
Gagliano, Giovanni	7	-0.51	0.18	0.60
Gragnani, Antonio	24	-0.54	0.11	0.58
Gabrielli, Giovanni Battista	25	-0.58	0.10	0.56
Gagliano, Giuseppe & Antonio	15	-0.61	0.13	0.55
Celoniatus, Giovanni Francesco	7	-0.67	0.18	0.51
Ventapane, Lorenzo	26	-0.76	0.10	0.47
Testore, Paolo Antonio	6	-0.78	0.19	0.46
Carcassi, Lorenzo & Tommaso	45	-0.81	0.09	0.45
Eberle, Tomaso	20	-0.81	0.11	0.44
Castello, Paolo	22	-0.81	0.11	0.44
Dall'Aglio, Giuseppe	7	-0.83	0.18	0.43
Amati, Dom Nicolò	9	-0.88	0.16	0.42

Appendix Table 2
Modern Italian Makers

	Observations	Coefficient	Standard Error	Multiples of Eugenio Degani
Pressenda, Joannes F.	35	2.00	0.08	7.36
Rocca, Giuseppe	40	1.92	0.08	6.84
D'Espine, Alexander	9	1.08	0.14	2.93
Ceruti, Enrico	10	0.84	0.13	2.31
Fagnola, Hannibal	53	0.83	0.07	2.30
Rocca, Enrico	8	0.83	0.14	2.29
Scarampella, Stefano	32	0.45	0.08	1.57
Poggi, Ansaldo	9	0.44	0.14	1.55
Fiorini, Giuseppe	21	0.40	0.10	1.49
Oddone, Carlo Giuseppe	27	0.36	0.09	1.43
Bisiach, Leandro	53	0.27	0.07	1.31
Guadagnini, Francesco	9	0.23	0.14	1.26
Bisiach, Carlo	11	0.20	0.13	1.22
Pedrazzini, Giuseppe	65	0.19	0.07	1.21
Ornati, Giuseppe	15	0.17	0.11	1.18
Sgarabotto, Gaetano	16	0.15	0.11	1.17
Postiglione, Vincenzo	31	0.11	0.08	1.12
Genovese, Riccardo	5	0.07	0.18	1.07
Degani, Eugenio	68	0.00		1.00
Farotti, Celeste	13	-0.01	0.12	0.99
Candi, Cesare	14	-0.04	0.11	0.96
Soffritti, Ettore	13	-0.05	0.12	0.95
Antoniazzi, Romeo	27	-0.06	0.09	0.95
Sannino, Vincenzo	25	-0.06	0.09	0.94
Pollastri, Gaetano	15	-0.06	0.11	0.94
Garimberti, Ferdinando	12	-0.07	0.12	0.94
Antoniazzi, Riccardo	21	-0.10	0.10	0.91
Degani, Giulio	52	-0.12	0.07	0.89
Capicchioni, Marino	23	-0.18	0.09	0.83
Pistucci, Giovanni	11	-0.24	0.13	0.79
Gadda, Gaetano	44	-0.39	0.07	0.68
Contino, Alfredo	31	-0.50	0.08	0.61
Marchetti, Enrico	15	-0.52	0.11	0.60

Appendix Table 3
French Makers

Maker	Observations	Coefficient	Standard Error	Multiples of a Vuillaume
Lupot, Nicolas	22	0.23	0.09	1.25
Vuillaume, Jean Baptiste	154	0.00		1.00
Pique, François	12	-0.45	0.12	0.64
Pacherele, Pierre	7	-0.57	0.15	0.57
Bernadel, Auguste Sebastien	35	-0.98	0.08	0.38
Chanot, Georges	31	-1.00	0.08	0.37
Gand, Gand & Bernardel	58	-1.20	0.06	0.30
Bernardel, Gustave	30	-1.28	0.08	0.28