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Hard assets: The returns on rare diamonds and gems

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A B S T R A C T

This note examines the investment performance of diamonds and other gems (sapphires, rubies, and emeralds) over the period 1999–2010, using a novel data set of auction transactions. Over our time frame, the annualized real USD returns for white and colored diamonds equaled 6.4% and 2.9%, respectively. Since 2003, the average returns have been 10.0%, 5.5%, and 6.8% for white diamonds, colored diamonds, and other gems, respectively. Both white and colored diamonds outperformed stocks between 1999 and 2010. Nevertheless, gem returns covary positively with stock returns, underlining the importance of wealth-induced demand for luxury consumption in collectibles markets.

1. Introduction

Diamonds are appreciated not only because of the (conspicuous) consumption utility they provide (Scott and Yelowitz, 2010), but also because they are a store of value. After the recent auction sale of a pink diamond for the record price of 45.75 million USD, a jewelry expert commented that "nobody knows what they are buying with stocks, but here they are buying something solid and tangible" (Reuters, 2010). Recent surveys by Capgemini (2010) and Barclays (2012) confirm that, in times of crisis, high-net-worth individuals are drawn to real assets that are perceived to have high intrinsic value. Nearly one third of the owners of precious jewelry interviewed by Barclays indicated to own the asset to provide security should other investments fail.

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Also in the uncertain economic climate of the late 1970s and the early 1980s, there was increased demand from investors for tangible but easily storable assets, such as gold (Ibbotson and Brinson, 1993), stamps (Dimson and Spaenjers, 2011), and gemstones. Diamond investor manuals (Sutton, 1979; Dohrmann, 1981) elaborated extensively on the advantages of investing in diamonds, claiming that diamonds have a track record of centuries of steady price appreciation.

In truth, however, very little is known about the historical investment performance of gems – or about the extent of their resilience to economic downturns. Our study constitutes an initial step towards filling this gap in the literature. We estimate the returns on diamonds and other gems in the auction market over the period 1999–2010, a period characterized by two financial crises, using a novel data set of auction transactions. We concentrate on the upper end of the market: high-quality white (i.e., colorless or near-colorless) and colored diamonds, and other types of precious gemstones (sapphires, rubies, and emeralds). We also compare and relate the price trends in the secondary market for investment-grade gems to the returns on more traditional asset categories.

We find that the average annual deflated USD returns for white and colored diamonds equaled 6.4% and 2.9%, respectively, between 1999 and 2010. Over the period 2003–2010, the annualized real returns were 10.0%, 5.5%, and 6.8% for white diamonds, colored diamonds, and other gems, respectively. Although the diamond returns since 1999 have been below those on gold, both white and colored diamonds have significantly outperformed the stock market over our time frame. The reward-to-volatility of white diamonds has been similar to that of government bonds. Diamond returns covary positively with stock market returns, confirming previous evidence on the importance of wealth effects on the demand for luxury goods consumption (e.g., Aït-Sahalia et al., 2004). Therefore, even if financial crises turn the attention towards luxury assets, the drops in buying power that they cause also adversely impact the market valuations of such goods.

2. Data and methodology

2.1. Data

The data used in this study were provided by Rocks International, a team of international diamond industry experts. The proprietary database covers the period 1999–2010 and includes information on 3952 auction sales of diamonds and other gems at offices of Sotheby's and Christie's worldwide. Table 1 shows the distribution of sales per half-year over the three types of stones included in the database: white diamonds, colored diamonds, and other gems. The different sorts of non-diamond gems considered are emeralds from Colombia, rubies from Burma (Myanmar), and sapphires from Burma, Ceylon (Sri Lanka), and Kashmir. (Ten transactions of stones from other regions were deleted.) Table 1 shows that a majority of the transacted gems are white diamonds (2034 sales). The number of observations for colored diamonds (1086) is slightly above that for other gems (832).

Table 1 also shows the average transaction price in USD, and the average price per carat, for each period for each type of gem. The results indicate that the average transaction value is highest for colored diamonds (530,349 USD), followed by white diamonds (440,583 USD) and other gems (272,921 USD). Also the average price paid per carat is highest for colored diamonds (78,306 USD). Yet, there is substantial time-series variation in average prices. For example, the average transaction value for white diamonds was 212,887 USD in the second half of 2002, but 817,855 USD in the first half of 2008. For both white and colored diamonds, the average price level per carat has roughly multiplied threefold over our time frame.

2.2. Methodology

Calculating average prices is only an initial step, since a price index should also take into account variation in the average quality of the items sold. Indeed, average prices can go up both because of an increase in the constant-quality price level, or because of a shift in the sales composition towards higher-quality objects. In this study, we estimate the returns on gems by applying a hedonic regression to our data. The hedonic methodology has previously been used to estimate the returns on other

Table 1
Numbers of observations and average price levels. This table displays the number of observed sales, the average price in nominal USD, and the average price per carat in nominal USD of white diamonds, colored diamonds, and other gems for each semester over the period 1999–2010. It also shows the total number of observations and the overall average prices for each type.

Semester	Number of observations			Average price in nominal USD			Average price/carat in nominal USD		
	White	Colored	Other	White	Colored	Other	White	Colored	Other
1999 (1)	42	23	10	247,046	259,096	248,738	18,290	38,311	20,302
1999 (2)	75	51	34	347,237	435,426	129,036	23,968	65,195	12,051
2000 (1)	87	38	49	376,442	358,030	200,715	23,135	56,965	14,632
2000 (2)	71	36	37	254,645	425,774	239,704	19,717	61,115	15,660
2001 (1)	89	43	28	321,323	228,779	220,736	21,787	46,633	11,638
2001 (2)	121	44	36	244,371	232,824	276,043	20,964	42,517	20,013
2002 (1)	72	49	27	267,138	228,782	156,929	19,666	38,609	14,622
2002 (2)	70	46	19	212,887	271,755	140,445	22,697	50,074	14,297
2003 (1)	49	27	18	308,444	237,116	145,530	20,519	20,402	12,935
2003 (2)	71	33	22	349,074	324,789	353,246	26,485	68,226	21,915
2004 (1)	88	57	30	375,120	434,952	220,680	27,891	64,022	20,484
2004 (2)	53	27	23	350,790	440,614	332,264	26,971	80,221	31,621
2005 (1)	113	42	48	370,545	404,504	320,667	25,588	79,268	27,256
2005 (2)	43	22	34	322,655	910,639	179,389	24,224	102,130	12,393
2006 (1)	101	65	71	371,682	547,782	291,371	32,889	64,549	24,211
2006 (2)	96	53	48	507,463	416,943	217,985	37,841	52,515	21,440
2007 (1)	92	60	42	415,626	683,877	344,331	36,585	76,489	22,288
2007 (2)	133	57	55	638,049	696,880	356,401	46,477	115,874	24,553
2008 (1)	86	51	41	817,855	778,011	316,885	58,728	86,682	25,316
2008 (2)	91	49	29	670,503	920,661	308,912	52,488	65,426	15,262
2009 (1)	111	36	37	465,515	676,261	175,948	40,659	92,984	16,103
2009 (2)	119	75	34	689,957	767,280	415,065	49,572	148,409	33,079
2010 (1)	118	75	49	653,831	775,850	434,993	53,040	145,689	38,489
2010 (2)	43	27	11	411,951	774,281	292,786	57,089	111,094	34,191
Total	2034	1086	832	440,583	530,349	272,921	34,226	78,306	21,430

heterogeneous and infrequently traded assets, such as real estate (e.g., Meese and Wallace, 1997) and art (e.g., Renneboog and Spaenjers, forthcoming). The idea is to relate the prices of individual sales to a number of price-determining characteristics (e.g., for a house: the number of rooms, the neighborhood, etc.) and a range of time dummies. Under the assumption that the hedonic characteristics capture the quality of the item, the regression coefficients on the time dummies will proxy for the price level in each period. Formally, a hedonic regression model can be represented as in the following equation:

$$\ln p_{kt} = \alpha + \sum_{m=1}^{M} \beta_m x_{mkt} + \sum_{t=1}^{T} \gamma_t d_{kt} + \varepsilon_{kt}, \tag{1}$$

where p_{kt} represents the price of good k at time t, x_{mkt} is the value of characteristic m of object k at time t, and d_{kt} is a time dummy variable which takes a value of one if good k is sold in period t (and zero otherwise). The coefficients β_m reflect the attribution of a shadow price to each of the M characteristics, while the changes in the antilogs of the coefficients γ_t can be used to calculate returns over T time periods.

2.3. Variables

Index construction through the use of hedonic regressions is particularly appropriate for diamonds, since a limited number of easily quantifiable characteristics capture a lot of the time-invariant appeal of each stone. Our database contains information on the attributes that can be expected to impact gem valuations. We first focus on 'the four Cs': carat, color, clarity, and cut. The variable *Ln*(*carat*) measures the natural log of the carat weight. We have different categories of color for each type of diamonds. For white diamonds, our dummy categories are based on the traditional scale which goes from D (colorless) to Z (light yellow). (If a diamond is indicated to belong to two adjacent categories, we use the second letter.) For colored diamonds, we include separate variables for blue, brown, green, pink, and yellow stones, which are the most frequently observed colors. With respect to the other gems, we create separate variables for emeralds, rubies, and for sapphires from Burma, Ceylon, and Kashmir. For the diamonds in our database, we also consider the clarity of each stone, going from flawless (*FL*), over internally flawless (*IF*), very very small inclusions (*VVS*), very small inclusions (*VS*), and small inclusions (*SI*), to inclusions or unspecified clarity (*Other/unknown*). Inclusions are scratches, minerals, or other imperfections that have an impact on the diamond's clarity. Diamonds that are completely free from internal flaws are extremely rare. (Only one colored diamond is of the "flawless" category; we pool it with the "internally flawless" stones.) While the color and clarity of a diamond are predetermined by nature, the cut, which affects the brilliance, is impacted by human intervention. Our database does not include detailed information on each object's proportions, polish, and symmetry, but we can include a dummy which equals one if the diamond has the classic round cut. (Common non-round shapes are princess, emerald, radiant, oval, pear, asscher, marquise, and heart.)

Next, in most cases, we observe the location of sale, which can be Geneva, Hong Kong, Los Angeles, London, St. Moritz, or New York. If there are less than 20 sales in a location, the relevant sales are pooled with the *Other/unknown* category. Finally, we include some additional information. *Christie's* equals one if the stone is sold at that auction house, and not at Sotheby's. *Brand* equals one if the jewel is from a premium brand, such as Bulgari, Cartier, Graff, or Tiffany. *Certificate* equals one when the database indicates that an authenticity certificate, often issued by one of the specialized laboratories, accompanies the stone. For white diamonds, a dummy variable *Potential* indicates whether the diamond could be upgraded by recutting or polishing. (We only use these additional variables if there are at least 20 observations that take the least frequent of the two possible values.)

2.4. Descriptive statistics

In our sample, the mean weight is highest in the category of non-diamond gems (2.63 carat vs. 2.19 for white diamonds). In the category of white diamonds, the colorless diamonds with color grading *D* are traded most often at the included auctions (with 42.6% of the trades). For colored diamonds, the most frequently observed color is yellow (57.0%), followed by pink (17.6%) and blue (11.5%). In both diamond categories, we observe variation with respect to clarity, but stones with very small inclusions are the largest category (36.1% and 42.5% of sales of white and colored diamonds, respectively). Truly flawless diamonds are very rare, even in the top segment of auctioned gems: they make up less than 5% of the white diamonds in our data set. About one in five of the white diamonds, and one in eight of the colored diamonds have a round shape. With respect to the other gems, sapphires are more frequently traded than both emeralds and rubies. For all three types of gems, a small majority of the sales included took place at Christie's. Only a small minority (between 8.1% and 22.2%) is from a renowned premium brand. The proportion of white diamonds that has the potential to be upgraded by means of recutting or polishing is small (7.8%). Finally, more than 90% of the diamonds' origin and quality are well-documented and certified.

3. The price determinants of gems

The shadow prices of the hedonic characteristics – represented by the vector of coefficients β in Eq. (1) – are assumed to stay constant over time. Given that our estimation time frame is relatively short, this is a reasonable assumption. We deflate all prices to real USD, using the U.S. Consumer Price Index. We then estimate Eq. (1) for each of the three types of stones, using ordinary least squares (OLS). Before examining the estimated returns, we focus on the estimation results for the hedonic variables. Panels A, B, and C of Table 2 show the results for white diamonds, colored diamonds, and other gems, respectively. For each dummy variable, we compute the percentage price impact as one minus the exponent of the coefficient.

Table 2 shows that many of our hedonic variables substantially affect prices. The impact of caratage differs between the different types of stones, but in general there is a very strong relationship between

Table 2

Regression results hedonic variables. This table shows the results of the OLS estimation of hedonic regression Eq. (1). All hedonic characteristics are defined in Section 2. For dummy variables, we also report the price impact, calculated as one minus the exponent of the coefficient. Panels A–C show the results for white diamonds, colored diamonds, and other gems, respectively. The results for the time dummies are shown in Table 3.

Variable	Coeff.	S.D.	*t*-stat.	Impact (%)
Panel A: White diamonds				
Carat				
Ln(carat)	1.8696	0.0578	32.33	
Ln(carat)^2	−0.0949	0.0115	−8.27	
Color				
D	[left out]			
E	−0.2076	0.0221	−9.38	−18.7
F	−0.3175	0.0211	−15.01	−27.2
G	−0.5202	0.0223	−23.35	−40.6
H	−0.6975	0.0228	−30.60	−50.2
I–J	−1.0083	0.0215	−46.84	−63.5
K–L	−1.4045	0.0314	−44.74	−75.5
M–Z	−1.7475	0.0302	−57.92	−82.6
Other/unknown	−1.8066	0.0730	−24.76	−83.6
Clarity				
FL	0.1649	0.0299	5.52	17.9
IF	[left out]			
VVS	−0.3177	0.0185	−17.16	−27.2
VS	−0.4320	0.0180	−24.02	−35.1
SI	−0.7521	0.0230	−32.69	−52.9
Other/unknown	−1.0507	0.0643	−16.34	−65.0
Cut				
Round	0.2013	0.0148	13.62	22.3
Location				
Geneva	[left out]			
Hong Kong	0.1343	0.0173	7.78	14.4
L.A.	0.0445	0.0573	0.78	4.6
London	0.1763	0.0465	3.80	19.3
St. Moritz	−0.0061	0.0244	−0.25	−0.6
New York	0.0012	0.0148	0.08	0.1
Other/unknown	−0.0789	0.0541	−1.46	−7.6
Additional information				
Christie's	0.0077	0.0121	0.63	0.8
Brand	0.0514	0.0174	2.95	5.3
Certificate	−0.0562	0.0271	−2.07	−5.5
Potential	0.2095	0.0232	9.04	23.3
N		2034		
R-squared		94.7		
Panel B: Colored diamonds				
Carat				
Ln(carat)	0.6547	0.1008	6.49	
Ln(carat)^2	0.0560	0.0220	2.55	
Color				
Blue	2.2244	0.0878	25.32	824.8
Brown	−0.6951	0.0968	−7.18	−50.1
Green	1.5177	0.1568	9.68	356.2
Pink	1.2405	0.0709	17.50	245.7
Yellow	[left out]			
Other/unknown	0.8323	0.1346	6.18	129.9
Clarity				
IF	[left out]			
VVS	−0.2773	0.0848	−3.27	−24.2

Table 2 (*continued*)

Variable	Coeff.	S.D.	*t*-stat.	Impact (%)
VS	−0.3099	0.0769	−4.03	−26.7
SI	−0.4905	0.0962	−5.10	−38.8
Other/unknown	−0.5898	0.1066	−5.53	−44.6
Cut				
Round	−0.0218	0.0783	−0.28	−2.2
Location				
Geneva	[left out]			
Hong Kong	−0.1036	0.0697	−1.49	−9.8
St. Moritz	−0.2580	0.1099	−2.35	−22.7
New York	−0.1575	0.0661	−2.38	−14.6
Other/unknown	0.3465	0.1243	2.79	41.4
Additional information				
Christie's	−0.0210	0.0518	−0.40	−2.1
Brand	0.0231	0.0895	0.26	2.3
Certificate	0.4578	0.1311	3.49	58.1
N		1086		
R-squared		59.2%		
Panel C: Other gems				
Carat				
Ln(carat)	1.2334	0.2058	5.99	
Ln(carat)^2	−0.0636	0.0353	−1.80	
Color				
Emerald	[left out]			
Ruby	0.7737	0.0819	9.45	116.8
Sapphire Burma	−0.7254	0.0751	−9.67	−51.6
Sapphire Ceylon	−1.3054	0.0886	−14.74	−72.9
Sapphire Kashmir	0.3226	0.0785	4.11	38.1
Location				
Geneva	[left out]			
Hong Kong	0.3564	0.0757	4.71	42.8
St. Moritz	−0.2236	0.0994	−2.25	−20.0
New York	0.0633	0.0618	1.02	6.5
Other/unknown	−0.2035	0.1510	−1.35	−18.4
Additional information				
Christie's	0.0439	0.0539	0.81	4.5
Brand	0.2152	0.0604	3.56	24.0
N		832		
R-squared		50.0%		

weight and price. (If we omit the squared term from the three models, the coefficients on *Ln*(*carat*) are all above one, indicating that in general prices increase more than proportionately with carat value.) For white diamonds, we see that prices move with the color and clarity scales. For example, a diamond of color category *E* sells on average at an 18.7% discount compared to an otherwise similar diamond of color category *D* (the left-out category); this discount increases to more than 80% for lower-quality stones. The average premium for a flawless diamond over an internally flawless (*FL*) diamond is 17.9%. Relative to an internally flawless white diamond, a white diamond with very very small inclusions (*VVS*) still incurs a discount of 27.2%. Also for colored diamonds, color and clarity play important roles. The most expensive colored diamonds are blue; blue diamonds cost in general more than sixteen times as much as brown ones. We also see that there is a significant premium of more than 20% for a round shape in the case of white diamonds, but not for colored diamonds. With respect to the other gem stone types, we observe that rubies are clearly more expensive than the other types of stones. There is a strong difference in price between the different types of sapphires: the ones coming from Kashmir are more expensive than the ones from Burma or Ceylon. White diamonds sell at slightly higher prices in London and Hong Kong than in Geneva, New York, or St. Moritz. Other types of gems are especially expensive in Hong Kong. However, the pricing differences between locations may reflect otherwise unobservable differences in average quality, rather than violations of the law of one price due to differences in clientele and taste. We do not find a significant discrepancy in prices between Christie's and Sotheby's. There are only relatively small premia for jewels created by renowned designer houses. Substantially lower prices are paid for the few colored stones that do not seem to have a certificate. Finally, we see a premium of more than 20% for white stones that have the potential to be recut and upgraded.

At the bottom of each panel, we show the R-squared of each model. We find that our time dummies and hedonic characteristics together explain almost 95% of the variation in prices of white diamonds. The explanatory power is somewhat lower for colored diamonds and for other gems, although still at least 50%. This difference in R-squared may not be surprising given that the qualitative hierarchy is more evident in the market for white diamonds, where everybody prefers a diamond of color category *D* over one of category E, than in the market for colored diamonds, where buyers' tastes may matter more. Also, our hedonic model for colored diamonds does not include a variable that captures differences in color intensity, which is known to be a price-determining factor.

4. The returns on gems

In Table 3, we show the returns for each type of gem, in deflated USD. These real returns are calculated as the exponent of the difference between the coefficients γ on the time dummy variables in two consecutive periods, minus one. For the non-diamond stones, we exclude the periods for which

Table 3
Real returns and index values. This table shows the returns in deflated USD, which follow from the OLS estimation of hedonic regression Eq. (1), for white diamonds, colored diamonds, and other gems for each semester over the period 1999–2010. It also shows index values, where the index is set equal to 100 in the first semester of 1999 for white and colored diamonds, and in the second half of 2003 for other gems.

Period	Returns in real USD			Index values		
	White (%)	Colored (%)	Other (%)	White	Colored	Other
1999 (1)				100.0	100.0	
1999 (2)	16.6	7.5		116.6	107.5	
2000 (1)	−1.2	−35.4	3.9	115.2	69.4	
2000 (2)	−8.9	43.8	−10.5	104.9	99.9	
2001 (1)	6.0	−8.3	5.1	111.3	91.6	
2001 (2)	−5.0	−22.9	−1.2	105.7	70.6	
2002 (1)	−1.1	10.1		104.6	77.7	
2002 (2)	−1.9	−4.8		102.6	74.0	
2003 (1)	−8.5	−4.7		93.9	70.5	
2003 (2)	12.2	35.4		105.3	95.4	100.0
2004 (1)	0.2	−4.6	1.3	105.5	91.0	101.3
2004 (2)	10.2	23.5	−3.5	116.3	112.4	97.7
2005 (1)	16.6	10.5	1.4	135.6	124.3	99.0
2005 (2)	2.7	2.3	−19.3	139.2	127.1	80.0
2006 (1)	10.8	−5.4	25.8	154.3	120.3	100.6
2006 (2)	7.8	−1.2	−15.3	166.3	118.8	85.2
2007 (1)	10.1	8.0	55.3	183.2	128.4	132.3
2007 (2)	9.0	14.5	−12.5	199.7	147.0	115.8
2008 (1)	36.0	−14.6	22.7	271.6	125.6	142.1
2008 (2)	−23.3	−15.9	−33.6	208.2	105.6	94.3
2009 (1)	−13.5	0.8	−7.1	180.0	106.4	87.7
2009 (2)	4.9	17.7	58.7	188.8	125.2	139.1
2010 (1)	10.4	0.6	10.4	208.5	125.9	153.6
2010 (2)	−1.6	10.0		205.0	138.4	
Geometric average return since 1999 (1)				6.4%	2.9%	N.A.
Geometric average return since 2003 (2)				10.0%	5.5%	6.8%

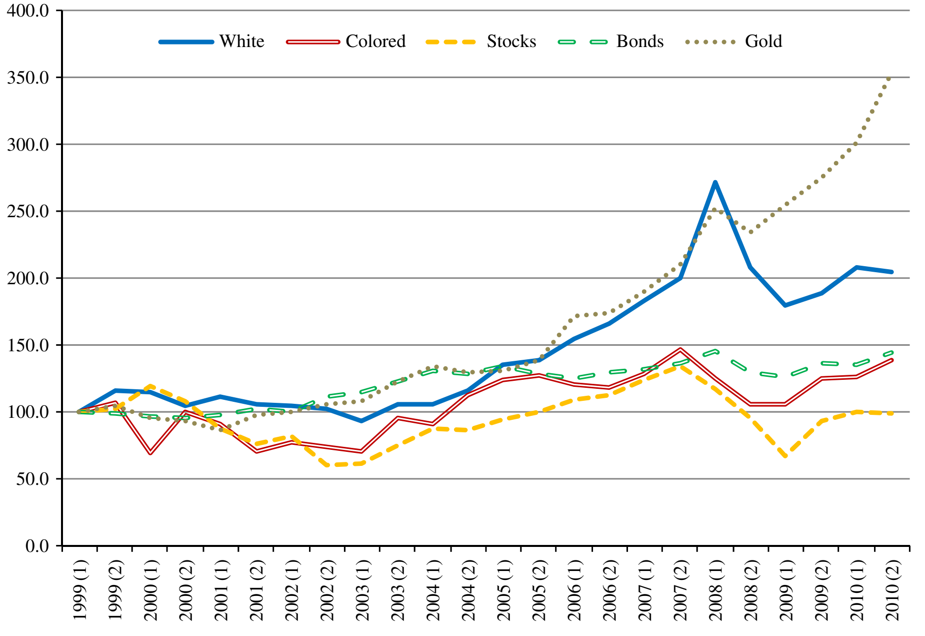

Fig. 1. The index values in deflated USD for white diamonds, colored diamonds, stocks, bonds, and gold, for each semester over the period 1999–2010. The returns for white and colored diamonds are shown in Table 3. Data on the returns of global stocks, global government bonds, and gold were downloaded from Global Financial data. In all cases, the index is set equal to 100 in the first semester of 1999.

there are less than 20 observations, because we want to avoid reporting non-representative returns. We also construct a price index for each category, with the relative deflated price level in the first semester of 1999 (or the second half of 2003, in the case of other gems) set equal to 100.

For white diamonds, we observe an annualized deflated USD return of 6.4% between the first half of 1999 and the end of 2010. Negative real returns were recorded in a number of time periods following the dot-com bust in early 2000 and during the middle of the recent financial crisis. These negative returns were more than compensated, however, by solid price rises in other periods, namely between end-2003 and early-2008 and since late-2009, when also equity markets performed reasonably well. The results suggest that changes in the equity market impact the funds available for investment in collectibles markets; we will examine the relationship between equities and diamond prices more thoroughly in the next section. Despite the financial crisis of 2007–2008, the annualized return after inflation on white diamonds since the second half of 2003 still equals 10.0%. The performance of colored diamonds is lower. The average deflated returns equal 2.9% since 1999 and 5.5% since 2003. The index for other gem stones is only available over a shorter time period, and is relatively volatile. Nevertheless, the returns beat inflation by an annualized 6.8% between end-2003 and end-2010. (The nominal USD equivalents of the reported deflated returns since the second half of 2003 are 12.6% for white diamonds, 8.0% for colored diamonds, and 9.5% for other gems.)

It is important to note that our price indices and returns are *estimated*, not directly observed. The standard errors on the time fixed effects in the white diamonds model are relatively small, with a 95% confidence interval of about 10% around most estimated index values. The other two indices, which are based on fewer data points, are somewhat less precisely estimated. The lower accuracy of the index for colored diamonds may lead to an overestimation of the volatility in this market (Bocart and Hafner, 2012). This caveat should be kept in mind when comparing volatilities and Sharpe ratios in the next section.

5. Comparison with other assets

Table 3 is instructive, but it is hard to evaluate the financial attractiveness of gems without a proper benchmark. Therefore, in Fig. 1 we compare the index values of white and colored diamonds to the investment performance of global stocks, global government bonds, and gold. All additional data come from Global Financial Data. (Since the diamond price indices aggregate information per half-year, the financial asset return series are based on the underlying index values in the middle of each semester.) As before, all index values capture returns in deflated USD, and each index is set equal to 100 for the first half of 1999. Fig. 1 shows that white diamonds outperformed financial assets between early-1999 and late-2010. Colored diamonds performed better than stocks and approximately as well as bonds. The figure also shows, however, that gold appreciated still faster than investment-grade gems. Of course, gold has increased its status of a safe haven since the deep financial crisis that started in 2007.

In Table 4, we more formally compare the performance of white and colored diamonds with that of financial assets and gold since the first half of 1999. We show the annualized returns, the annualized standard deviation, and an estimate of the Sharpe ratio (i.e., the return in excess of the risk free rate by unit of risk) for each asset. Table 4 also includes estimates of the equity market betas of white and colored diamonds. The betas are estimated by aggregating the slope coefficients on a lagged, a contemporaneous, and a leading market return, following Dimson (1979) and Dimson and Spaenjers (2011), to account for infrequent trading and non-synchroneity in the measurement of returns.

White diamonds appreciated by an annualized 6.4% in real USD between 1999 and 2010, whereas stocks and bonds recorded average returns of −0.1% and 3.3% over the same period. For gold, the average annual appreciation since the first half of 1999 is equal to 11.6%. The dismal performance of stocks is of course influenced by the bursting of the high-tech bubble in 2000 and by the financial crisis that commenced in 2007. At the same time, Table 4 indicates that diamond prices exhibit substantial volatility. When combining return and risk into a Sharpe ratio, we learn that the reward-to-variability of diamonds has been comparable to that of bonds.

One explanation for the finding that white diamonds so clearly outperform colored diamonds over our time frame, is that white diamonds are more likely to be used as a safe haven for investors. Several diamond investment funds only hold high-quality white diamonds. Moreover, unreported analysis shows that white diamonds are much more highly correlated with gold than colored diamonds, suggesting common factors driving the prices of both assets. Finally, also in the highly inflationary environment of the late 1970s, the prices of white diamonds seem to have been driven up much more by hedging demand than those of other gems (National Gemstone, 2012).

However, Table 4 also shows that the price changes of both types of diamonds are positively correlated with global equity market returns. (The beta of white diamonds is significantly positive at the 10 percent level.) Aït-Sahalia et al. (2004) argue that such a covariance between financial asset values and luxury goods prices may be due to the importance of investment income for wealthy households and to the discretionary nature of luxury consumption. Also the previous literature on art returns (e.g., Goetzmann et al., 2011) has found a significantly positive correlation with stock prices. The quantitative importance of the stock market wealth effects sheds doubt on the statement of an auction house

Table 4
Return distributions and correlations with stock returns. This table provides information on the distribution of returns in deflated USD for white diamonds, colored diamonds, stocks, bonds, and gold, based on half-yearly returns over the period 1999–2010. It also shows an aggregated coefficients estimate of the stock market betas for white and colored diamonds, following the methodology of Dimson (1979). The returns for white and colored diamonds are shown in Table 3. Data on the returns of global stocks, global government bonds, and gold were downloaded from Global Financial data.

	Annualized average return (%)	Annualized S.D. (%)	Sharpe ratio	β	*t*-Stat.
White	6.4	16.7	0.440	0.505	1.81
Colored	2.9	24.5	0.228	0.620	1.37
Stocks	−0.1	22.5	0.098		
Bonds	3.3	6.9	0.438		
Gold	11.6	11.9	0.979		

jewelry specialist in July 2008 that "when stock markets go down, it's always good for us" (Bloomberg, 2008). Table 4 already showed that white diamond prices dropped substantially in the midst of the recent financial crisis, during the second half of 2008 and the first half of 2009 – even if somewhat less than the overall equity market.

6. Discussion

It is important to acknowledge the exceptionally low performance and high volatility of financial markets in the period examined in this paper. This study should thus be considered as an account of the returns over the period 1999–2010, rather than as an attempt to accurately measure the historical performance of diamonds (or any other other class). Ideally, we would like to compare the price trends of diamonds with those of financial assets over a longer period. One can try to compute rates of price appreciation from the primary market prices of rough diamonds (Spar, 2006), or from average retail prices reported annually by the U.S. Geological Survey, or from the "benchmark" prices available from sources such as Rapaport (2012), but it is unclear whether such numbers would represent returns that can be realized by investors. Still, these alternative data sources suggest that the boom and bust in the price level of (high-quality) white diamonds in the late 1970s and early 1980s was followed by a long period of very moderate average price appreciation – with nominal returns close to inflation – that may only have ended during our time frame.

7. Conclusion

In this paper, we study the market for investment-grade gems between 1999 and 2010, a time frame that includes two financial crises, by applying a hedonic regression to a unique data set of auction transactions. Over our time frame, the annual USD returns for white and colored diamonds amount to 6.4% and 2.9%, above inflation. For the 2003–2010 period, the annualized real returns are 10.0%, 5.5%, and 6.8% for white diamonds, colored diamonds, and other gems, respectively. Although the diamond returns since 1999 have been below those on gold, both white and colored diamonds have outperformed the stock market. The strong performance over our time frame, in particular of white diamonds, may be related to increased demand for safe haven investments. Nonetheless, we find that diamonds have a substantial exposure to global stock returns, suggesting that diamond prices are affected by stock market wealth effects on luxury consumption.

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