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Raj Aggarwal
Firestone Chair and Professor of Finance, Kent State University

Brian M Lucey
School of Business Studies and Institute for International Integration Studies, University of Dublin

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Raj Aggarwal
Brian M Lucey

Department of Finance,
College of Business Administration,
Kent State University, Kent, Ohio

School of Business Studies,
University of Dublin, Trinity College,
Dublin

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Abstract

This paper examines for the first time the existence of psychological barriers in a variety of daily and intra-day gold price series. This paper uses a number of statistical procedures and presents evidence of psychological barriers in gold prices. We document that prices in round numbers act as barriers with important effects on the conditional mean and variance of the gold price series around psychological barriers.

Keywords: Gold, psychological barriers, M-Values, Market Psychology
JEL Categories: G14, G15

Raj Aggarwal, Firestone Chair and Professor of Finance, Kent State University, Kent, OH 44242 USA. raggarwa@bsa3.kent.edu 1-330-672-1219
Brian M Lucey, School of Business Studies and Institute for International Integration Studies, University of Dublin, Trinity College, Dublin 2, Ireland: Blucey@tcd.ie 353-1-6081552 (#Corresponding Author)

Psychological Barriers in Gold Prices?

I. Introduction & Motivation

This paper examines the issue of whether or not there exist detectable barriers at price levels that are perceived to be psychologically important (psychological barriers) in a set of gold prices. This issue has not been examined in prior research, either that on gold prices or on psychological barriers. If gold markets are rational and efficient, we should not expect to see any psychological price barriers. However, significant numbers of commentators attribute particular levels of the gold bullion price as being ‘barriers’ or ‘support levels’ or in some other manner as being intrinsically more ‘important’ than other price levels. In support of such contentions, research on equity prices has provided some evidence of the existence of such psychological barriers. Also, it has been argued that gold has a somewhat unique position as an asset that perhaps provides greater scope for such psychological effects than other asset price series.

Gold is traded 24 hours a day and has been an important metal for many millennia and almost all of the gold ever mined is still in existence. Demand for gold arises from consumers in the form of jewellery, dental fillings, and others uses; from industry as one of the most ductile metals and as an excellent conductor of heat and electricity; and from central banks, investors, and speculators as a store of value and as an investment. The supply of gold arises from mining and refining of re-cycled gold and from sales by central banks and investors. However, unlike other commodities, the gold market and gold prices are also influenced by possible supply related to the vast overhang of all of the gold ever mined and demand related to political uncertainty and inflationary prospects. Thus, gold prices are generally higher than the price if Gold was just another commodity with little or no monetary role. Unlike other commodities, a negative relationship between gold prices and mining output of the metal has been documented at least in the short run (Marsh, 1983). In addition, transactions in the gold market by central banks are generally not characterized by profit maximizing behaviour (Aggarwal & Soenen, 1988). Indeed, gold prices can suffer from much uncertainty and there is some evidence of short-term positive feedback cycles in gold prices - (Frank & Stengos, 1989). Thus, gold prices may be particularly subject to the effects of psychological barriers. That market participants perceive such barriers to exist is evident from perusal of the main commentators and financial newspapers. Consider some of the following quotations:

> *Gold is set to test the key $450 barrier in the coming weeks as concerns over the weak US dollar following last week's re-election of President Bush send investors rushing for the safe-haven metal. Analysts believe the psychological mark is well within reach (Financial Times (9/11/04))*
>
> *Gold breached the key psychological level of US$ 440/oz last week. (Financial Mail (South Africa) (26/11/04))*
>
> *The price of gold rallied again on Friday but tormented bulls with its third failed swipe at $400 an ounce.....Commodity trading advisers and other funds have been buying heavily, training their guns on what has been a huge psychological level for gold over the years. Many just want to see $400 flash on the board for the first time since March 1996."I guess it's a self-fulfilling prophesy," said David Rinehimer, head of commodities research at Citigroup Global Markets. Courier Mail (Australia) (17/11/03)*
>
> *Gold stormed past the psychological mark of US$ 300 an ounce yesterday as improving fundamentals, the Enron accounting scandal and Japan's economic woes sparked a buying frenzy in the safe-haven investment (South China Morning Post (9/2/02))*
>
> *IN a major display of weakness, gold slipped below the psychological $260 per ounce level during the week. A gradual fall saw the yellow metal officially close at $259.90/oz on Friday (London PM Fix) (Business Line (India) (12/2/01))*
>
> *After repeatedly flirting with the $280-an-ounce mark in the last month, the nearby gold future dipped below the key psychological level yesterday, touching an 18-year low. (Wall Street Journal (9/1/1998))*
>
> *Gold has been trading under the psychological level of $ 360 an once since late last week (Glasgow Herald (10/1/1997))*
>
> *..the psychological gold-price level of US$400 an ounce was also a target that many gold-share buyers had kept at the back of their minds. (Financial Post (Canada) (9/7/1993))*

In New York, February gold eased US90c to $US399.30 an ounce on Thursday. Analysts were divided on when gold would re-test the psychological barrier (The Australian (13/1/1996))

Nevertheless, there is no prior academic research on psychological barriers in gold prices. Using a number of statistical procedures to assess psychological barriers, this paper documents for four different gold price data series, including an intra-day series, that there are significant changes in means and variances associated with certain round number gold prices that are perceived to act as psychological barriers. The results presented here provide strong support for the presence of psychological barriers in gold prices and should be of much interest to investors.

This paper is structured as follows. The remainder of this section outlines why numerical psychological barriers may exist in asset prices, and in particular gold. The second section outlines the concept of m-values, pairs of digits that are used to examine the existence of such barriers. The third section outlines the data used, while the fourth section outlines the results from a variety of tests, including uniformity tests, regression barrier tests and tests of conditional returns and volatility conditioned on barriers.

II. Psychological Barriers in Asset Prices

Due to limited arbitrage (Shleifer & Vishny, 1997) and psychological aspects of human information processing and decision-making, a number of behavioural biases have been shown to persist in asset price series (Hirshleifer, 2001). For example, the concepts of anchoring and heuristic simplification in behavioural finance are closely related to the issue of psychological barriers. Anchoring ((Slovic & Lichtenstein, 1971) is the phenomenon whereby individuals fixate on a recent number or a number which they may be told by informed commentators is important. Drawing on the heuristics concept of (Kahneman, Slovic, & Tversky, 1982) and herding behaviour (Avery & Zemsky, 1998), (Welch, 2000), more recent research ((Westerhoff, 2003) develops formal models of how traders cluster expectations around round numbers. Other researchers (Sonnemans, 2003) note a number of issues relating to the competing hypotheses around why these barriers might *a priori* be expected, and suggests that in addition to the anchoring approach an element of the phenomenon of odd-ending pricing may be important.[1]

Recent research (Shiller, 2000) notes that in the absence of accurate agreement on fundamentals many traders focus on the nearest round number as a reasonable proxy for the fundamental value. One of the characteristics of gold is that unlike many financial instruments, there is much uncertainty in the price of gold above its commodity value (estimated at around 1/10 of the existing price[2]), thus the gold prices we see reflect a large dose of 'psychological' value.

Other research (Mitchell, 2001) draws a distinction between psychological barriers and clustering phenomena and distinguishes clustering, where particular digits and levels appear more often, from psychological barriers, where trades are infrequent at or around a particular cluster of prices. Thus it is clarified that the two aspects are related but not synonymous. Clustering is a necessary, but not a sufficient condition, for a psychological barrier to be present.

III. Testing For the Existence of Psychological Barriers

A number of different approaches have been advocated to examine the potential existence of psychological barriers in asset prices. These break into three broad categories: tests

[1] This concept is well known in marketing, and denotes the phenomenon whereby (due to anchoring and mis-attribution bias) consumers perceive a price such as 99.5 to be significantly different to 100 and not significantly different to 99, even though the percentage difference in both cases is (almost) equal.
[2] This relativity was suggested by a number of analysts in the London gold market to the authors

of the *distribution* of the digits, tests of the *behaviour* of returns around barriers and tests of the *frequency* of digits around presupposed barriers. Underlying all approaches is the examination of the significant digits of the returns series. Take the two price levels 329.97 and 399.97. If there are no barriers then the probability of any set of trailing digits will be equal to that of any other - the distribution of these will be uniform. It is popularly supposed (see the quotations above) that barriers exist in gold prices around exact hundreds, i.e., at levels such as 300, 400. If this is the case then we should expect to see relatively fewer 00 digit pairs than pairs such as 01, 74, 63 or 98. Thus to test for barriers at this level we examine the pair of digits preceding the decimal point. We refer to these as the "10's Digits". For an examination of barriers at levels such as 209.87 or 301.92 we are interested in whether the pair of digits *bracketing* the decimal point displays a frequency that is different from other pairs of digits. If there exist barriers at levels such as these then we would expect to see relatively fewer xx0.0x digits than otherwise.[3] Thus for a series 309.82, 301.09 and 298.87 we would extract 09, 01, 98 and 98, 10, 88 as the 10's and 1's digits respectively.

However, the assumption of uniformity of digit distribution runs counter to the implications of Benford's Law. In essence, Benford's law points out that as the various digits, 1, 2, 3 etc are not increasing at a constant percentage rate, the limit distribution of such digits need not be uniform. The larger the sample the closer the distribution would be to uniform. Countervailing this, the small sample sizes found in many applications implies that the return generating process, typically in assets involving significant autocorrelations, will have a major impact on the distributions. This point, and the implication that tests of uniformity are useful if the data are confined within relatively small ranges, as are gold prices, are discussed in

[3] More formally, the 10's digits are given as $[P_t]\text{mod}100$ and the 1's as $\left[1000 * \left(P_t^{(\log_{10} P_t)\text{mod}1}\right)\right]\text{mod}100$, where mod refers to the reduction modulo.. These are known formally as *M*-values. An extensive discussion is provided in (De Ceuster, Dhaene, & Schatteman, 1998)

previous research ((Ley & Varian, 1994) , (De Ceuster et al., 1998)). As we have a large sample here we do not expect this issue to be problematic.

Generally, two different statistical tests have been used in studies of the uniformity of digits, the chi-square test and a regression test. One paper (Koedijk & Stork, 1994) use a chi-squared test to reject uniformity in a number of equity indices[4]. Another (R. G. Donaldson & Kim, 1993) analyses uniformity using a regression approach. The regression is of the frequency of the DJIA's trailing digits as the dependent variable against a dummy variable, the dummy taking 1 when it is close[5] to the presupposed psychological barrier of 00. Under the null of no barriers the assumption is that each set of digits, each of the 100 pairs of digits, will be equally likely. Thus, the intercept term is expected to be .01 and the slope coefficient insignificantly different from zero. Generally however (see (R. G. Donaldson & Kim, 1993), (R. Glen Donaldson, 1990a, 1990b)) a variety of equity markets (not, however the Nikkei or the Wiltshire indices) are shown to deviate from this assumption, with negative coefficients on the intercept indicating fewer than hypothesized occurrences of the digits near the 00 pair. Other research (Burke, 2001) uses chi-squared analyses on US government bond indices, again finding that there is significant evidence for deviation from uniformity.

An earlier (Koedijk & Stork, 1994) study failed to find evidence supporting the significance of 00 barriers in predicting returns. However, this finding has been critiqued (Cyree, Domian, Louton, & Yobaccio, 1999) for not disaggregating the effects of upward and downward movement. Thus, a third approach followed in the literature uses regression or GARCH analysis to assess the differential impact of being above or below a barrier in the neighbourhood of such a barrier. The initial paper to use this approach (Cyree et al., 1999) suggests that volatility effects tend to accompany mean effects, and finds such differential

[4] They are able to reject the existence of psychological barriers for S&P 500, the Brussels Stock Exchange, the FAZ General, and the FTSE-100, but not for the Nikkei
[5] A variety of measures of closeness are used : within 25 of 00, within 5 etc. The results are qualitatively similar.

results. A GARCH approach to this problem has also been used (Burke, 2001), on the hypothesis that the mean effect depends on whether the series is above, below or in the barrier zone while variance effects are dependent merely on being in or out of the barrier area. Using this approach for US bonds he finds no barrier effects in a GARCH framework.

IV. Data

Four sets of data are examined: daily gold prices from the official London AM fix over the period 2/1/1980 – 31/12/2000, yielding 5478 datapoints; daily data from COMEX for cash and futures gold for the period 2/1/1982 – 28/11/2002, yielding 5255 datapoints; a high frequency dataset supplied by UBS London, consisting of 15 minute interval data over the period 28/8/2001 – 9/1/2003 yielding 12,938 datapoints[6]. All data are expressed in $/Troy Oz. Summary statistics on the series are presented in Table 1 where it is evident that the data are significantly non normal. In order to examine the issues of uniformity and barriers we also calculate the M-values discussed above and derive the frequency of occurrence of each value[7] As all data are less than 1000 in absolute value only tests of the 10's and 1's digits are carried out. Thus we are assessing the existence of barriers around 00 and 0, such as 300 or 330, for example. An interesting feature of the data is that for the high frequency gold the series leaps from 294 to 317 approx, on September 11 2001, reflecting the impact of the terrorist attacks in New York. However, as the series leaps directly between these two elements there are no 10's digits around supposed barrier of 300. Thus, we are unable to test this barrier at this data series.

(Please insert table 1 about here)

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[6] The data are from UBS's proprietary trading system for their own precious metal customers which operate continually. Thus we have a full series of data 24h per day.
[7] These tables are available on request.

V. Empirical Results

a. Uniformity Tests:

A variety of tests have been proposed in relation to the existence of barriers or otherwise. Table 2 provides a test of uniformity of the distribution of the frequency of appearance of the 10's and 1's digits derived from the data. The data clearly are not drawn from a uniform distribution. As earlier papers have shown (Ley & Varian, 1994) however such a rejection of uniformity is not in itself sufficient to demonstrate the existence of barriers. In addition, others (De Ceuster et al., 1998) caution that in series that grow without limit, as the series grows and thus the intervals between the barriers widen, the theoretical distribution of digits and frequencies of occurrence is no longer uniform. While the data examined here are clearly not uniformly distributed and are bounded within reasonably tight limits, the importance of these findings is limited as noted in prior research. Accordingly we next examine the frequency of the M-values at and near the pre-supposed barriers, as well as the overall shape of the distribution.

(Please insert table 2 about here)

b. Barrier Tests

Following others (Burke, 2001), we examine tests designed to measure whether or not yield observations on or near the barriers occur significantly less frequently than a uniform distribution would predict. In general, these tests examine the shape of the frequency distribution for the various decimal digit combinations. The first test focuses on the frequency of observations in close proximity to the barriers while the second test examines the shape of the frequency distribution. These are referred to as *barrier proximity* and *barrier hump* tests respectively.

We implement the barrier proximity test using Eq. (1) below. The dummy variable takes the value of 1 when the price of the relevant series is at the supposed barrier and 0 elsewhere. The test for barriers then resolves to a test of significance of the coefficient on the dummy variable. Under the null of no barriers β will be zero, whereas the presence of barriers will result in a lower frequency of M-values at the barrier and thus β will be negative and significant. Following others, (R. G. Donaldson & Kim, 1993) , (Burke, 2001) a number of specifications of the barrier are examined. The first is a strict barrier at the 0 frequency, the second and third are wider tests where the dummy takes the value 1 in the range 90-02 and 95-05 respectively.

$$f(M) = \alpha + \beta D + \varepsilon \tag{1.}$$

The *barrier hump* test on the other hand is implemented with Eq. (2) below, where the frequency of occurrence of each M value is regressed on the M value itself and its square.

$$f(M) = \alpha + \phi M + \gamma M^2 + \eta \tag{2.}$$

The null of no barriers should result in γ being zero, while under the alternative of barriers it will be expected to be negative and significant.

Results for these the *barrier proximity* test are show in Table 3, from which it is clear that we can reject the no barriers hypothesis for the 10's digits in all series, but not for the 1's digits. Barriers in the daily gold price series appear from this test to exist at levels such as 300, 200 etc but not at levels such as 310, 350 etc. Barriers in the high frequency data, however, also seem to exist at the latter digits. Table 4 shows the results of the barrier hump test but there is little evidence here of a persistent barrier.

(Please insert tables 3 and 4 about here)

c. Conditional effects

Psychological barriers are generally taken as offering 'support' or 'resistance' to series. The statistical interpretation of this is that the dynamics of the returns series around and in the vicinity of these barriers should differ from that elsewhere. Unlike others (Burke, 2001) we do not impose exogenous assumptions regarding the impact of being in the barrier region. Instead, what is of interest is the issue of the differential effect on the return from being in the region of the barrier, and whether the barrier is being approached from above (towards a hypothesised support barrier) or below (towards a presumed resistance barrier). We define four regimes around barriers, UB for the 5 days prior to the gold price reaching a barrier from below, but before it breaches the barrier, UA for the 5 days after the barrier from below, DB and DA for the 5 days before and after breaching the barrier in a downwards direction .

Shown in Table 5 are results of a simple autoregression model. We note that in general the sum of the coefficients around upward movements is greater than that of downward movements, providing some evidence of differential effects in returns depending on whether one is moving through a barrier from below or above. It is also clear however that, with the exception of the futures market, there is little statistical significance to these regions. The explanatory power is low, but of a similar magnitude to the results in (Cyree et al., 1999). While the residuals are relatively clean with no serial correlation, there is evidence of ARCH, to degree 4, still present.

(Please insert table 5 about here)

The residual ARCH tests indicate that variance is impacted by the regions of barriers. Shown in Table 6 are the results of Levene tests for the equality of variance of returns in the regions of the barriers. It is clear that we can reject the null of equality of variances across the barrier regions in all three cases. Thus, a full analysis of the effect of barriers requires an analysis of the variance and the mean. Shown in Table 7 are the results of a GARCH analysis of the returns shown in (3), with four lagged variance terms. We do not include an ARCH-in-Mean term based on the results of (Lucey & Tully, 2004). Again, we expect that in the absence of barriers the coefficients on the indicator variables would be insignificant from zero. As there is an absence of prior research in this area for the gold market, we have no a priori expectation on the sign of the indicator variables.

$$
\begin{aligned}
&Rt = \beta_0 + \beta_1 R_{t-1} + \beta_2 BD + \beta_3 AD + \beta_4 BU + \beta_5 AU + \beta_6 \varepsilon_{t-1} + \varepsilon_t \\
&\varepsilon_t \sim N(0, V_t) \\
&V_t = \alpha_0 + + \alpha_2 BD + \alpha_3 AD + \alpha_4 BU + \alpha_5 AU + \sum_{j=1}^{4} \alpha_j V_{t-1} + \eta_t
\end{aligned}
\qquad (3.)
$$

(Please insert tables 6 and 7 about here)

A number of points are evident from the results presented in these two tables. For a number of the barrier regions, the mean coefficients have changed in sign, magnitude and significance. We now see that four of the coefficients are significant. We also however see all the barrier region indicators as significant. Apart from Front futures gold, these indicators also allow for easy interpretations. We see that for all the 'after' indicators the coefficients are negative and the before coefficients, apart from front future gold, are positive. While there is evidence of some mean effects around barriers, there are clear, consistent, and strong indicators of significant variance effects around barriers.

Shown in Table 8 are a number of tests of parameter restrictions. Although for stock returns it is reasonably accepted that volatility is greater in bear conditions (see (Campbell & Hentschel, 1992)) and that there are leverage effects, no such comparable research exists in the gold market. Thus, we test a number of restrictions. If these barriers are real, then we should see that the constraints on the mean and variance are relaxed after the asset breaches the barrier. As in (Cyree et al., 1999), four possible hypotheses are examined:

H1o: there is no difference in the conditional mean return before and after an *upwards* crossing of a barrier

H2o: there is no difference in the difference in conditional mean return before and after an *downwards* crossing of a barrier

H3o: there is no difference in the difference in conditional variance before and after an *upwards* crossing of a barrier

H4o: there is no difference in the difference in conditional variance before and after an *downwards* crossing of a barrier

(Please insert table 8 about here)

With the exception of Cash gold, we find that in general there is no significant change in the conditional mean returns associated with breaching a barrier. However, we find that in all cases there is strong evidence that the conditional volatility of gold returns does change significantly after crossing barriers.

Conclusion

Prior literature documents psychological barriers, support and resistance levels and importance round numbers, in equity and foreign exchange markets. Despite the importance of psychological elements in the gold market, there is no prior research on these phenomena in the gold market. Using a number of statistical procedures, this paper finds evidence that psychological barriers at the 100's digits (price levels such as $200, $300 etc) do exist in daily gold prices. For high frequency gold the evidence is weaker, but this is perhaps a function of the time period under investigation. We find some significant evidence of changes in conditional means around psychological barriers. However, we document very strong evidence of changes in the variances of returns in the vicinity of and when crossing psychological price barriers in gold markets.

Table 1: Summary Statistics

		Return Series				Level Series	
	N	Mean	S.Deviation	Skewness	Kurtosis	Min	Max
Gold AM Fix	5478	-0.000119	0.013088	0.18378	19.042788	252.90	843.00
Cash Gold	5255	-0.000041	0.010035	0.07107	13.606823	252.80	509.20
Futures Gold	5255	-0.000048	0.010275	0.22393	9.122686	253.00	510.10
High Frequency Gold	12938	0.000020	0.001571	63.10	5,833.27	270.95	357.10

Table 2: K-S Z Test for Uniformity

	10's Digits		1's digits	
	Z-Stat	p-value	Z-Stat	p-value
Gold AM Fix	4.72	0.00	2.16	0.00
Cash Gold	4.77	0.00	2.12	0.00
Futures gold	4.38	0.00	3.20	0.00
High Frequency Gold	4.75	0.00	5.23	0.00

Table 3: Barrier Proximity Test

		10's Digits			1's Digits		
		β	p-value	R^2	β	p-value	R^2
Strict Barrier	Gold AM Fix	-21.000	0.000	0.865	29.505	0.000	0.885
	Cash Gold	-18.740	0.000	0.853	15.596	0.000	0.901
	Futures gold	-8.640	0.000	0.865	1.455	0.030	0.982
	High Frequency gold				255.162	0.000	0.599
9802 Barrier	Gold AM Fix	-15.779	0.000	0.867	-6.937	0.470	0.883
	Cash Gold	-14.063	0.000	0.855	-11.326	0.119	0.902
	Futures gold	-15.326	0.000	0.868	-2.274	0.303	0.983
	High Frequency gold				137.063	0.006	0.606
9505 barrier	Gold AM Fix	-13.960	0.000	0.869	-2.624	0.654	0.883
	Cash Gold	-16.564	0.000	0.861	-5.328	0.264	0.900
	Futures gold	-12.988	0.000	0.870	0.019	0.908	0.983
	High Frequency gold				51.860	0.132	0.586

Table 4 : Barrier Hump Test

	10's digits			1's digits		
	γ	p-value	R2	γ	p-value	R2
Gold AM Fix	0.003	0.306	0.912	-0.003	0.249	0.884
Cash Gold	0.002	0.463	0.914	-0.003	0.212	0.901
Futures gold	0.003	0.261	0.926	-0.002	0.027	0.989
High Frequency gold			0.431	0.046	0.002	0.624

Table 5: OLS Analysis

	GFXR		GCR		GFR	
Independent Variable	**Coefficient**	**Significance Level**	**Coefficient**	**Significance Level**	**Coefficient**	**Significance Level**
Constant	-0.0001	0.46	-0.0001	0.38	-0.0001	0.56
BD	-0.0006	0.45	0.0010	0.11	-0.0081	0.07
AD	0.0004	0.59	-0.0009	0.14	-0.0014	0.03
BU	0.0003	0.72	0.0004	0.60	0.0093	0.04
AU	-0.0002	0.81	0.0008	0.25	0.0009	0.17
AR(1)	-0.1047	0.00	-0.0604	0.00	-0.0466	0.00
Q(4)	2.9100	0.51	6.4400	0.18	3.9800	0.44
ARCH(4)		0.00		0.00		0.00
R2	0.0110		0.005		0.003	

Table 6: Variance Test

Gold Fix		Gold Cash		Gold Front	
Levene Statistic	Sig.	Levene Statistic	Sig.	Levene Statistic	Sig.
41.990	.000	43.822	.000	11.445	.000

Table 7: GARCH Analysis

	Gold Fix		Gold Cash		Gold Front	
	Coefficient	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
Means Equation						
Constant	-0.00007	0.60	- 0.00005	0.67	- 0.00007	0.57
Before Down	0.00170	0.04	0.00235	0.00	- 0.00696	0.94
After Down	-0.00096	0.22	- 0.00193	0.00	- 0.00064	0.35
Before Up	0.00040	0.68	0.00394	0.00	0.00832	0.93
After Up	-0.00066	0.32	- 0.00032	0.57	0.00077	0.15
AR(1)	-0.76799	0.00	- 0.57889	0.00	- 0.05097	0.87
MA(1)	0.71408	0.00	0.54657	0.00	0.01054	0.97
Variance Eq						
Constant	0.00000	0.00	0.00000	0.02	0.00000	0.00
GARCH(-1)	0.03165	0.70	0.82774	0.00	0.52122	0.00
GARCH(-2)	-0.15265	0.00	- 0.00525	0.40	- 0.22518	0.00
GARCH(-3)	0.96215	0.00	- 0.81095	0.00	1.04240	0.00
GARCH(-4)	0.14647	0.07	0.98505	0.00	- 0.35216	0.00
Before Down	0.00003	0.00	0.00004	0.00	0.00085	0.00
After Down	-0.00002	0.00	- 0.00003	0.00	- 0.00003	0.00
Before Up	0.00003	0.00	0.00001	0.00	- 0.00081	0.00
After Up	-0.00003	0.00	- 0.00001	0.00	- 0.00001	0.00

Table 8: Barrier Hypothesis Tests

	Gold Fix		Gold Cash		Gold Front	
Hypothesis/Test	χ^2	**p**	χ^2	**p**	χ^2	**p**
H1o : No difference in conditional mean return before and after an upwards crossing of a barrier	5.1440	0.02	23.4284	0.00	0.0046	0.95
H2o : No difference in conditional mean return before and after an downwards crossing of a barrier	0.7950	0.37	22.5612	0.00	0.0065	0.94
H3o : No difference in conditional mean variance before and after an upwards crossing of a barrier	44.9098	0.00	147.7135	0.00	60, 882.94	0.00
H4o : No difference in conditional mean variance before and after an downwards crossing of a barrier	74.8959	0.00	28.8436	0.00	35, 211.63	0.00

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Institute for International Integration Studies
The Sutherland Centre, Trinity College Dublin, Dublin 2, Ireland