**Feedback Trading in Retail-dominated Assets:**

**Evidence from the Gold Bullion Coin Market**

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**Abstract**

Although investors’ behaviour in gold investments has been widely researched, no study to date has investigated it in the gold bullion coin market, despite the fact that the latter is dominated by retail investors, who are traditionally prone to noise trading. We present seminal empirical evidence on this issue by examining feedback trading in the Krugerrand’s secondary market on the Johannesburg Stock Exchange for the March 1996 – August 2019 period. We also assess whether feedback trading interacts with variables relevant to the coin’s valuation and the impact of the global financial crisis over those interactions. Positive feedback trading is present for the full sample period, before and during the crisis, interacting significantly with a variety of factors related to Krugerrand’s pricing, yet dissipates post crisis, likely due to enhanced foreign demand that catapulted the coin’s value, rendering it less easy to trade for South African retail investors. The above imply that Krugerrand-investors should be focusing less on historical price trends and devote more attention to the coin’s global demand instead.

**JEL classification:** G01; G40; G41

**Keywords:** feedback trading; Krugerrand; gold bullion coins; global financial crisis

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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**1. Introduction**

Research has demonstrated that investors in gold and gold-related assets (e.g. gold mining shares, gold futures and forward contracts) are particularly prone to over/underreaction (Caporale et al., 2018; 2019) and pursuing speculative strategies based on historical prices (Baker and van Tassel, 1985; Baur and Glover, 2014; 2015; Cutler et al., 1990; Frank and Stengos, 1989; Ogum, 2013; Siegel et al., 2000). Although this suggests that feedback trading is widespread in gold investments, no study to date has investigated its presence – indeed, any facet of investors’ behaviour - in gold bullion coins. This is interesting, considering that the latter have traditionally been dominated by retail investors (Baur and Löffler, 2015), whose propensity towards noise trading is well-established in the literature (Barber and Odean, 2013; Barber et al., 2009a; 2009b; Burghardt, 2011; Dorn et al., 2008; Jame and Tong, 2014; Kumar, 2009; Kumar and Lee, 2006; Li et al., 2017). In addition, the fact that feedback trading has been often documented in currencies (Aguirre and Saidi, 1999; Daníelsson and Love, 2006; Laopodis, 2005; Osler, 2005; Tayeh and Kallinterakis, forthcoming) further warrants its investigation in gold coins, since several of them constitute legal tender internationally.

We provide the first empirical study on investors’ behaviour in the gold bullion coin market, by investigating the presence of feedback trading in the Krugerrand (world’s first-ever gold-bullion coin, launched in South Africa) during the March 1996 – August 2019 period, how it varies with a series of factors related to its pricing and whether it manifests itself differently before, during and after the global financial crisis. Drawing on daily data from Krugerrand’s secondary market (Johannesburg Stock Exchange; JSE, hereafter) we report results from the full sample period, before and during the 2007-2009 global financial crisis showing that the Krugerrand-market accommodated significant positive feedback trading, characterised by directional asymmetry (it grows stronger during Krugerrand’s price-slumps) and significant interactions with a variety of factors (Krugerrand volume; gold returns; South African Rand exchange rate with the US Dollar; JSE All Share index returns; and geopolitical risk) associated with Krugerrand’s pricing. However, the post crisis’ years witness the dissipation of its presence as well as a marked reduction in the number (and significance) of its interactions with the aforementioned factors. We believe this dissipation to be associated with the enhanced foreign investors’ interest in the coin in the aftermath of the global financial crisis that led to a meteoric rise in its value and rendered it expensive to trade for South African retail investors (who dominate Krugerrand-trades on the JSE).

Our study contributes significantly to the behavioural finance literature, first, by providing seminal evidence on the behaviour of investors in the gold bullion coin market. Second, with positive feedback traders having been active in the Krugerrand over time, this denotes that gold bullion coins are as likely to attract feedback traders as ordinary currencies.[[1]](#footnote-1) Third, to the extent that these coins involve a predominantly retail clientele, our findings confirm research evidence (Barber and Odean, 2013; Barber et al., 2009a; 2009b; Burghardt, 2011; Dorn et al., 2008; Jame and Tong, 2014; Kumar, 2009; Kumar and Lee, 2006; Li et al., 2017) on the propensity of retail investors towards noise trading. Fourth, the fact that the feedback trading documented here is found to interact differently with various factors over time suggests that feedback trading need not be based exclusively on past returns but can also involve more complex dynamics, in line with earlier evidence (Charteris et al., 2014; Chau et al., 2011).

The rest of this paper is organised as follows: section 2 offers an overview of feedback trading (section 2.1), presents evidence on behavioural trading dynamics in gold-related investments (section 2.2) and introduces the Krugerrand (section 2.3). Section 3 presents the data with descriptive statistics (section 3.1) and describes the empirical design employed alongside the hypotheses tested for (section 3.2). Section 4 discusses the results and section 5 summarises our findings and highlights their implications.

**2. Theoretical background**

***2.1 Feedback trading***

The term “feedback trading” refers to any investment strategy relying on historical aggregate market statistics (normally, prices and volume) to identify past trends, with the purpose of predicting – and profitably exploiting – their recurrence in the future (Koutmos, 2014). Contingent on whether their intention is to track or trade against trends, feedback traders are defined as positive (they buy when prices rise; sell when they fall) or negative (they buy when prices fall; sell when they rise), respectively. In view of its reliance on historical trading information and its documented ability to exacerbate existing trends (De Long et al., 1990), feedback trading runs counter to the weak-form of market efficiency and, as such, can lead to deviations of securities’ prices from their fundamental values.[[2]](#footnote-2) From a behavioural perspective, feedback trading may be motivated by a series of psychological factors prompting pattern-recognition, including representativeness heuristic, conservatism bias, disposition effect, availability bias and anchoring (see the discussion in Kallinterakis et al., 2020). However, feedback trading may also be the result of more rational considerations, including rational speculation[[3]](#footnote-3) (De Long et al., 1990), risk-aversion[[4]](#footnote-4) (Holmes and Kallinterakis, 2014) and window-dressing[[5]](#footnote-5) (Lakonishok et al., 1992), with a large array of popular trading strategies[[6]](#footnote-6) being essentially feedback in nature.

Empirically, feedback trading has been found to be widely practiced by institutional investors internationally (Choi and Skiba, 2015); post-2000 studies (Celiker et al., 2015; Choi and Sias, 2009; Frijns et al., 2016; Froot and Teo, 2008; Sias, 2004;) report stronger momentum trading on behalf of fund managers in the US compared to pre-2000 ones (Grinblatt et al., 1995; Lakonishok et al., 1992; Wermers, 1999). Several studies support the presence of feedback trading of either sign among institutional investors in various countries, including Germany (Kremer and Nautz, 2013; Walter and Weber, 2006), South Korea (Choe et al., 1999), Taiwan (Hsieh, 2013; Hung et al., 2010) and the UK (Wylie, 2005), with plenty of evidence (Colwell et al., 2008; Dorn et al., 2008; Grinblatt and Keloharju, 2000; Kaniel et al., 2008; Nofsinger and Sias, 1999) suggesting the popularity of (negative, in most cases) feedback trading among retail investors internationally. At the market level, there exists ample evidence denoting the presence of feedback traders in a series of asset classes, including equities (Chau and Deesomsak, 2015; Koutmos, 1997; Koutmos and Saidi, 2001; Schuppli and Bohl, 2010; Sentana and Wadhwani, 1992; Watanabe, 2002), fixed-income (Cohen and Shin, 2013), currencies (Aguirre and Saidi, 1999; Daníelsson and Love, 2006; Laopodis, 2005; Osler, 2005; Tayeh and Kallinterakis, forthcoming), American Depositary Receipts (Li and Yung, 2004) and exchange-traded funds (Charteris et al., 2014; Chau et al., 2011; Kallinterakis et al., 2020), with the findings from futures markets being more mixed (Antoniou et al., 2005; Antoniou et al., 2011; Chau et al., 2008).

***2.2 Investors’ behaviour in gold-related assets***

Gold is one of the most widely studied assets, with research (Baker and van Tassel, 1985; Baur and Glover, 2014; 2015; Cutler et al., 1990; Frank and Stengos, 1989; Siegel et al., 2000) denoting that investors in this asset class are speculators with a focus on short-term price-trends. Aside from gold *per se*, the latter has been confirmed for several gold-related investment assets (e.g. gold-mining companies’ stocks or gold futures contracts) and has been argued (Akinsomi et al., 2017; Baur and Glover, 2014; O’Conner et al., 2015; Shafiee and Topal, 2010) to be largely motivated by gold’s safe-haven and hedging properties, particularly around crisis-episodes (Akinsomi et al., 2017). Much of this speculative conduct, has given rise – perhaps unsurprisingly, given its trend-based nature – to feedback trading among gold investors, with evidence (Baur and Glover, 2014; 2015; Ogum, 2013) denoting the presence of strong positive feedback trading in the gold market, primarily during the bull-period for gold prices of the first decade of this century, with this behaviour largely ascribed (Aggarwal and Lucey, 2007; Aggarwal et al., 2014; Caporale et al., 2018, 2019) to investors’ over- and under-reaction to news.

Of key importance in the gold market is sentiment, with a number of studies demonstrating how several sentiment proxies interact significantly with the first and second moments of gold assets’ returns. To begin with, news’ sentiment has been found to have a substantial impact on gold futures’ returns and volatility (more so, during bearish sentiment periods; Smales, 2014; 2015).[[7]](#footnote-7) Web-based sentiment measures have also been found to be relevant to gold prices; Rao and Srivastava (2013) identified a significant correlation between gold prices and a series of online sentiment indicators (internet search volumes for gold; volume of Twitter messages about gold; ratio of positive to negative tweets about gold), while Balcilar et al. (2017) documented significant causal effects of internet search volumes on gold volatility (but not gold returns), with extreme sentiment (excitement/fear) contributing to (negative/positive) jumps in that volatility. In addition, a series of studies (Balcilar et al., 2016; Beckmann et al., 2019) showed that economic policy uncertainty affects gold volatility and is significantly related to gold prices.[[8]](#footnote-8) Finally, several studies demonstrated a direct relationship between gold prices and ‘fear’, the latter measured by volatility/stress indices (Boscaljon and Clark, 2013; Cohen and Qadan, 2010; Malliaris and Malliaris, 2015), more so during the post global financial crisis period.

With regards to gold coins – the focus of this paper – specifically, research has been rather limited; gold coins have occasionally been included in some studies’ samples alongside other forms of gold investment, with very few of those studies, however, entailing behavioural aspects. Affleck-Graves and Barr (1986) found that the Krugerrand earned lower risk-adjusted returns than gold mining shares for the period between 1980 and 1983; Pule (2013), however, found directly contrasting results for the period between 2004 and 2012, during which the Krugerrand earned higher risk-adjusted returns than gold mining shares, on average. Pule’s (2013) study also revealed that the Krugerrand earned similar returns to gold bullion but exhibited less volatility. In a study of the volatility of gold bullion and Krugerrands, Baur (2012) found that both forms of gold investment exhibited highly persistent volatility; gold volatility responded more to positive news than negative news, a fact attributed to the safe-haven property of gold, whereby investors view positive gold price changes as a signal of future adverse conditions and uncertainty in other markets. More recently, Ghazali et al. (2020) demonstrated that Malaysian gold bullion coins (*Kijang Emas*) contributed only to a minor extent as a safe haven, hedge or diversifier to a portfolio for Malaysian investors compared to gold bullion investments in the US, UK, India and China.

***2.3 The Krugerrand***

The Krugerrand, first struck by the South African Mint[[9]](#footnote-9) on the 3rd July 1967, is the world’s first gold bullion coin, denominated in one troy ounce of gold and produced every year since (Moncur and Jones, 1999; Rand Refinery, 2017).[[10]](#footnote-10),[[11]](#footnote-11) The unique feature of the Krugerrand is that (unlike other gold coins minted by governments for hundreds of years prior to its launch) it was earmarked as an investment asset, rather than as a medium of exchange (hence, the importance on its designated weight of gold). Krugerrands are legal tender in South Africa (although they have no face value) with the South African Reserve Bank (SARB) guaranteeing to purchase the coins at their market value as determined by the US dollar-denominated gold price (Brooks, 1985; Pretorius, 2004).[[12]](#footnote-12)

Accordingly, upon its launch, the Krugerrand represented the first internationally standardised investment aimed to increase the private ownership of gold[[13]](#footnote-13) and, as a result, met with considerable initial success, both in South Africa and overseas, accounting for over 90% of the international gold bullion coin market in 1980.[[14]](#footnote-14) It was especially popular in the US (after 1975, it became legal for US citizens to hold gold bullion coins following the collapse of the Bretton Woods Accord) which, between 1975 and 1984, accounted for 30%-50% of global Krugerrand-sales (Brooks, 1985; Rothmeyr and Pitterman, 1977; Watts and Snyder, 2015). Revenue from the latter represented a substantial portion of South Africa’s foreign exchange earnings (facilitating payments for the import of critical goods) and formed an important source of revenue for the South African government through taxes and profit shares (Brooks, 1985).[[15]](#footnote-15) As such, Krugerrands were seen as providing financial and economic stability for the Apartheid regime (Brooks, 1985; Fentin, 1985; Rothmeyr and Pitterman, 1977), a fact which led to bans on imports[[16]](#footnote-16) of the coin in the US and several members of the then European Community (Belgium, Germany, Netherlands, France, Italy and Luxembourg) (Holland, 1989; Johnson, 1999; Robbins, 1991) and campaigns launched against its sale in Canada (Pratt, 1983) in the 1980s. This led the Krugerrand’s popularity to wane, effectively creating a void in the global gold bullion coin market that was soon filled via other gold bullion coins launched in the 1980s[[17]](#footnote-17) and gold rounds of private mints[[18]](#footnote-18) (Rodgers, 2017).

The Krugerrand was unbanned in the early 1990s following the abolition of Apartheid (Fioramonti, 2013), yet despite a peaceful transition to democracy in the country and South Africa’s reintegration into the global economy, the coin’s popularity remained low.[[19]](#footnote-19) In 2000, sales equalled only 10,000 ounces of gold compared to 7 million ounces in 1977, with many beginning to question the Krugerrand’s longevity (Thomas, 2017). The 2007-2009 global financial crisis, however, witnessed a fourfold-surge in demand for gold coins (Reade, 2019) – and a twelvefold-one for the Krugerrand - with US investors alone purchasing around 670,000 ounces of official gold coins in the final quarter of 2009, as investors searched for safe-haven investments away from falling equity markets (Rodgers, 2017). Demand remained high in the years thereafter, despite the introduction of other channels through which gold can easily be purchased such as exchange traded products (such as ABSA’s NewGold exchange traded fund (ETF) and Standard Bank’s 1nvest Gold ETF and Gold-Linker exchange traded note). In 2016 and 2017, sales amounted to 1.1 and 1.4 million ounces of gold respectively, with the Krugerrand returning to the global top seller position among gold bullion coins in 2016, with 32% of the market-share as of 2017, followed by the Canadian Maple Leaf and the American Eagle (Thomas, 2017). Since 1967, over 60 million coins (of all weights) have been sold, which is more than the Canadian Maple Leaf and the American Eagle combined (Rand Refinery, 2017).

South Africa remains the biggest market for Krugerrands (accounting for between 40% and 60% of total sales), with gold constituting a popular investment choice due to political tensions, years of low economic growth, as well as the contribution of the sector to the economy. However, sales of Krugerrands internationally have grown, especially in Germany (the biggest offshore buyer), whose demand in 2016 equalled 400,000 ounces (Christianson, 2017). This demand was fuelled by uncertainty over the future of the European Union and the sub-zero returns on German government bonds. Overall, investors from Europe and the US form the bulk of Krugerrand’s clientele outside South Africa (Christianson, 2017), with demand by China documenting a rise during the last decade (World Gold Council, 2020 October).

The primary market for Krugerrands comprises the Rand Refinery issuing new coins by way of tender, with only banks being able to tender (Rand Refinery, 2017). Investors are then able to buy and sell Krugerrands with authorised traders at a price commensurate with the Krugerrand’s fine weight in gold according to the US dollar-denominated gold price (JSE, 2014). In addition, Krugerrands are traded as common stock on the JSE, which thus provides a secondary market for the Krugerrand, allowing for a daily updated price for the coin to be determined in the market. Krugerrand-trades on the JSE are subject to an *ad hoc* regulatory framework entailing various rules regarding the coins’ delivery following their sale and purchase, both of which are not paper based but involve physical delivery of the coins to the counterparty (JSE, 2014).

Historically, the Krugerrand has been the only gold coin providing its investors with a secondary market venue for their trades for decades, compared to other gold coins whose trading activity in secondary markets has been much more recent.[[20]](#footnote-20) Krugerrand-trades on the JSE are overwhelmingly dominated by South African retail investors; the coin’s price-formation process, demand and supply aside, is further influenced by the US dollar-denominated gold price, the Rand/US dollar exchange rate and South Africa’s market/political risk (JSE, 2014; RMB, 2014). Evidence on Krugerrand’s dominance by retail investors over time is provided by the business press[[21]](#footnote-21) as well as online gold bullion coin dealers’ websites.[[22]](#footnote-22) This is in line with evidence from the global gold bullion coin market, as attested by several sources for various gold coins both at the global level (World Gold Council, 2020 October) as well as for several individual countries, including China (World Gold Council, 2020 March), India and Vietnam (Truitt, 2018) and has further been confirmed time and again via a series of financial media releases.[[23]](#footnote-23) The evidence there suggests that retail investors opt for gold bullion coins motivated either by cultural reasons as well as the lack of trust in/underdevelopment of their countries’ financial system (particularly during times of crises/uncertainty), with their trades tending to rely on price-trends.[[24]](#footnote-24)

**3. Data and Methodology**

***3.1 Data***

Daily data on closing prices and trading value (both denominated in South African Rand) for the Krugerrand have been obtained from iRESS for the period between March 1st, 1996[[25]](#footnote-25) and August 30th, 2019; the data pertains to Krugerrand’s trading activity on the secondary market in South Africa (JSE). We further collected daily data from Thomson-Reuters Datastream for the same period on the following variables[[26]](#footnote-26) upon which we condition feedback trading in our paper, namely: Gold Bullion (LBMA)[[27]](#footnote-27); South African Rand – US Dollar (ZAR/USD) rate (this is the direct quote of the US dollar (USD) in South African Rand (ZAR) terms, i.e., its value in Rand); and JSE All Share Index values. We also obtained the monthly series of the Geopolitical Risk index for South Africa from the <https://www.matteoiacoviello.com/gpr.htm> website. As the summary statistics from Panel A in Table 1 demonstrate, Krugerrand’s average performance during our sample period has been positive (0.073%), with its percentage log-differenced returns’ distribution exhibiting notable departures from normality, appearing significantly positively skewed and leptokurtic; in addition, the absence of normality is further denoted via the significant Jarque-Bera test-statistic value. To ascertain whether this lack of normality is due to temporal dependencies in the return-structure, we employ the Ljung-Box portmanteau test for Krugerrand’s returns; the test-statistic obtained is significant, suggesting the presence of significant first-order autocorrelation. However, the latter need not necessarily be motivated via feedback trading (autocorrelations in returns can also be driven by market frictions, such as thin trading); in view of the established (e.g. Koutmos, 2014) association of feedback trading with high volatility, we perform the Ljung-Box test for the second moment of returns. The test-statistic obtained is significant (and larger than that of the first-moment test), thus confirming that Krugerrand’s volatility exhibits time-varying properties. We also observe that Krugerrand’s logarithmic trading value series also accommodates significant departures from normality. Panel B in Table 1 presents a series of summary statistics for the daily percentage log-differenced returns of the Gold Bullion (LBMA), ZAR/USD exchange rate and JSE All Share index, alongside the monthly percentage changes in the Geopolitical Risk index for South Africa. As the figures there suggest, both gold prices and South African equities exhibit a positive average performance (approximately 0.03% and 0.02%, respectively), while the ZAR/USD rate’s positive average return suggests that, on average, the South African Rand tends to trade at a depreciated value versus the US dollar. The Geopolitical Risk index exhibits a positive mean percentage change month-on-month, indicating that the country’s monthly geopolitical riskiness rises, on average, throughout our sample window. Similar to Panel A, all of these control variables exhibit leptokurtosis and (with the exception of the JSE All Share index) positive skewness.

Figure 1 presents the evolution of Krugerrand’s daily prices over time, with the coin’s annualised trading values (constructed by aggregating the daily trading values of each year) depicted in Figure 2. As the figures suggest, Krugerrand has been exhibiting a consistent rise in value throughout the years, which gained an accelerated momentum after 2005. As per its annual trading value, it has been hovering around lower levels post-2003 (compared to earlier years), yet exhibits clear volatility in its year-on-year fluctuations.

***3.2 Methodology***

We assess the presence of feedback trading in the Krugerrand market drawing on the empirical design proposed by Sentana and Wadhwani (1992), which relies on the interaction between rational speculators and feedback traders. The demand function of the former is given as follows:

(1)

where: represents the expectation of Krugerrand’s return in period as of period ; reflects the risk-free rate of return; *θ* is the time-invariant coefficient of risk-aversion; and represents Krugerrand’s conditional variance (i.e. risk) at period .

The demand function of feedback traders is the following:

(2)

As a result, feedback traders rely on the immediately previous period’s return, exhibiting either positive () or negative () feedback trading. With all Krugerrands being held in equilibrium, we have:

(3)

Expanding the two demand functions, Equation (3) becomes:

(4)

Utilising the returns’ rational expectation (, where is an *i.i.d.* error term), we convert the expected return, , into a realised one:

(5)

The - term suggests that the first-order return-autocorrelation rises with volatility and is positive if there exists negative feedback trading () and negative if positive feedback trading dominates (). To enable ourselves to decipher the part of autocorrelation due to market frictions (e.g. thin trading) and that due to feedback trading, we employ the following *ad hoc* empirical specification of Equation (5) proposed by Sentana and Wadhwani (1992):

(6)

In Equation (6), reflects the part of autocorrelation due to market inefficiencies and the part due to feedback trading[[28]](#footnote-28); the latter will be positive (negative) if is significantly negative (positive), in view of .[[29]](#footnote-29) In the specific context of the Krugerrand, its overwhelmingly retail ownership suggests – in view of the wealth of evidence associating retail investors with noise trading patterns[[30]](#footnote-30) – that it would be expected to entail significant feedback trading; as a result, we propose our first hypothesis:

**Hypothesis 1:** Feedback traders are active in the Krugerrand market.

Retail traders are prone (Barber et al., 2009a; 2009b) to extrapolating from historical prices motivated by psychological forces, which are capable of fomenting feedback trading in the presence of different directional price-trends. A series of price-rises, for example, could prompt investors to enter positions in an asset, believing it to be a good investment (the case of representativeness heuristic motivating positive feedback trading).[[31]](#footnote-31) If they hold the asset for some time and it retains its upward price-momentum, they may consider it prudent to sell in order to avoid any potential price-reversal (the case of disposition effect[[32]](#footnote-32) motivating negative feedback trading). On the other hand, a series of recent price-falls may lead investors to sell an asset, in order to curtail their losses, if they believe the asset to have ceased being a good pick (representativeness heuristic motivating positive feedback trading). The above, therefore, denote that both up- and down-markets can incite feedback trading, with plenty of empirical evidence (see e.g. Koutmos, 2014 for a review) denoting that positive feedback trading is more pronounced during market slumps versus market upswings. This frequently observed regularity has been dubbed “directional asymmetry” and has been attributed to the fact that down-markets increase the probability of realised losses; as this enhances investors’ risk-aversion, it prompts them to unload their positions in order to curtail their losses, thus amplifying the price-downtrend in the process. We test empirically for directional asymmetry via the following extension of Equation (6) proposed by Sentana and Wadhwani (1992):

(7)

where the coefficient of is equal to:

+

-

As a result, if assumes significantly positive values, this would denote that positive feedback trading grows stronger when the Krugerrand’s value declines. Whether Krugerrand investors would be more willing to feedback trade amid rising or declining Krugerrand-prices is impossible to assert; as a result, we propose the following two hypotheses:

**Hypothesis 2a:** Feedback trading in the Krugerrand grows stronger on days of positive Krugerrand-returns.

**Hypothesis 2b:** Feedback trading in the Krugerrand grows stronger on days of negative Krugerrand-returns.

To gauge whether feedback trading in the Krugerrand varies across different states of a variety of factors related to its pricing, we employ the following empirical extension proposed by Chau et al. (2011):

(8)

Drawing on Equation (8), we examine the variations of feedback trading with respect to the following factors:

*Krugerrand volume[[33]](#footnote-33)*: we first test whether feedback trading varies between days with *rising* and days with *declining* volume, in which case, D = 1, if today’s volume is higher than the previous day’s, zero otherwise. Additionally, we examine whether feedback trading exhibits variations between *high* and *low* volume days, with high (low) volume days defined as those whose volume is above (below) its previous 30-days’ moving average. In this case, D is set equal to unity for high volume days, zero otherwise. The choice of volume as a control variable here is motivated both by the fact that high volume is an established attribute of noise trading (Baur and Dimpfl, 2018; Black, 1986; Kodres, 1994; Miwa and Ueda, 2011)[[34]](#footnote-34) and because it helps render feedback trading (indeed, any trading strategy) more feasible (Andrikopoulos et al., 2020); as a result, we propose the following hypotheses:

**Hypothesis 3a:** Feedback trading in the Krugerrand grows stronger on days of rising volume.

**Hypothesis 3b:** Feedback trading in the Krugerrand grows stronger on days of high volume.

*Gold prices*: we condition feedback trading on the performance of Gold Bullion in the London market, again using two dummy-specifications. First, we test whether feedback trading differs in presence between days of *positive* and *negative* gold bullion returns (i.e. between days when gold bullion prices have risen and days when they have fallen compared to the previous day’s). Here, D = 1 for positive return days, zero otherwise. Second, we assess whether feedback trading is more pronounced on days with *high* gold bullion returns (defined as those days when gold bullion returns are in excess of their previous 30-days’ moving average) or *low* ones (defined as those days when gold bullion returns are below their previous 30-days’ moving average). In this case, D equals one for high return days, zero otherwise. The choice of gold prices as a control variable here is driven by the fact that gold is Krugerrand’s key benchmark and, as such would be expected to impact its pricing (JSE, 2014; RMB, 2014). Whether rising or falling gold prices would be more conducive to Krugerrand-investors’ feedback trading is hard to assert (either would bear the potential of being so, similar to hypotheses 2a/2b above), so we propose the following hypotheses:

**Hypothesis 4a:** Feedback trading in the Krugerrand grows stronger on days of positive gold returns.

**Hypothesis 4b:** Feedback trading in the Krugerrand grows stronger on days of high gold returns.

**Hypothesis 4c:** Feedback trading in the Krugerrand grows stronger on days of negative gold returns.

**Hypothesis 4d:** Feedback trading in the Krugerrand grows stronger on days of low gold returns.

*ZAR/USD rate*: we condition feedback trading on the direct quote of the US dollar (USD) in South African Rand (ZAR) terms, i.e., its value in Rand. We first estimate feedback trading contingent on days when the ZAR/USD return is positive (i.e., when the Rand has depreciated versus the dollar day-on-day) and on days when it is negative (reflective of Rand-appreciation versus the dollar). Here, we set D equal to one for positive ZAR/USD return days, zero otherwise. We then re-estimate feedback trading, this time contingent on whether the ZAR/USD return on a day is above (i.e. the Rand exhibits *deep depreciation*) or below (i.e. the Rand exhibits *deep appreciation*) its previous 30-days’ moving average, in which case, D = 1 for deep depreciation days, zero otherwise. The choice of this control variable is motivated here by two reasons. On the one hand, the fact that international gold prices are US dollar-denominated suggests that any change in the ZAR/USD exchange rate would be expected to confer an impact over the pricing of the Krugerrand, whose value, as mentioned above, is benchmarked against gold. On the other hand, evidence (Arezki et al., 2014; Capie et al., 2004, 2005; Kiohos and Sariannidis, 2010; Nair et al., 2015; Reboredo and Rivera-Castro, 2014a, b; Sjaastad, 2008; Tulley and Lucey, 2007) indicates that gold prices tend to be significantly related to the valuations of currencies, without however the sign of this relationship appearing uniform internationally. In the specific context of our study, appreciations (depreciations) of the US dollar would lead the South African Rand to depreciate (appreciate) in value, thus weakening (strengthening) the purchasing power of South African investors and rendering it more difficult (easier) for them to divert a larger part of their disposable income to Krugerrand-investments. Whether feedback trading among Krugerrand investors is more strongly motivated via an appreciated (a stronger Rand may encourage them to engage in more aggressive Krugerrand-purchases) or a depreciated (a weaker Rand may encourage them to sell Krugerrands in order to boost their consumption) Rand is impossible to assert. To that end, we propose the following hypotheses:

**Hypothesis 5a:** Feedback trading in the Krugerrand is stronger when the Rand depreciates in value.

**Hypothesis 5b:** Feedback trading in the Krugerrand is stronger when the Rand appreciates in value.

*Geopolitical risk*: we condition feedback trading on South Africa’s geopolitical risk (as a proxy for political risk) by drawing on Caldara and Iacoviello (2019)’s Geopolitical Risk index for South Africa (see Figure 3) and we calculate the percentage month-on-month changes of the index (see Figure 4). We first estimate feedback trading contingent on whether a day belongs to a month whose index value is greater than that of the previous month (i.e. a month of *rising country risk*) or to a month when the index value fell compared to the previous month (i.e. a month of *declining country risk*). In this case, D is set equal to one for days belonging to rising country risk months, zero otherwise. Second, we estimate feedback trading conditional on various bands of monthly absolute percentage changes of the index, in order to identify whether feedback trading is stronger on days falling within months of *moderate* or *extreme* monthly changes. As Figure 4 illustrates, the majority (74%, or 236 out of the 319) months of our sample entail a percentage monthly change of +/-20%. To gauge whether feedback trading is stronger for moderate-versus-extreme monthly changes, we proxy moderate-change months via different bands (+/-5%, +/-10% and +/-20%); in this case, D = 1 when the day falls within a month whose monthly change is |5%|/|10%|/|20%|, zero otherwise. The choice of the geopolitical risk index as a control variable here was driven by gold’s “safe haven” properties, which prompt investors to increase their exposure to it under conditions of uncertainty (Baur and Lucey, 2010; Baur and McDermott, 2010). Considering the enhanced country risk levels of South Africa (AM Best, 2019; Goldberg and Veitch, 2010; Hassan et al., 2003), this suggests that any rise in those levels or their volatility[[35]](#footnote-35) would be expected to prompt domestic investors to buy Krugerrands; to that end, we propose the following hypotheses:

**Hypothesis 6a:** Feedback trading in the Krugerrand grows stronger when South Africa’s geopolitical risk rises.

**Hypothesis 6b:** Feedback trading in the Krugerrand grows stronger when South Africa’s geopolitical risk exhibits extreme changes.

*Equity market performance*: we condition feedback trading on the daily performance of the JSE All Share index, first by assessing whether it manifests itself differently between days of positive (i.e. *rising* market days) and days of negative (i.e. *falling* market days) index-returns. In this case, D is set equal to one for rising market days, zero otherwise. Next, we estimate feedback trading contingent on whether the JSE All Share index return on a day is *high* (defined here as being above its previous 30-days’ moving average) or *low* (defined here as being below its previous 30-days’ moving average); here, D = 1 for high return days, zero otherwise. We condition feedback trading on South Africa’s equity market performance in view of evidence (Baur and Lucey, 2010; Baur and McDermott, 2010; Chua et al., 1990; Ciner et al., 2013; Gürgün and Ünalmis, 2014; He et al., 2018; Hillier et al., 2006; O’Connor et al., 2015) stipulating an inverse relationship between gold and equity returns (based on gold’s “safe haven” properties) internationally; as a result, adverse market conditions would be likely to witness a greater propensity of investors towards buying Krugerrands. However, rising/high equity market performance accommodates optimistic sentiment and it is possible that this can promote positive mood among Krugerrand-investors.[[36]](#footnote-36) Since positive mood has been found (Schwarz, 1990; Forgas, 1998) to foster the employment of heuristics in decision-making, it can encourage heuristics-based behavioural trading patterns, such as feedback trading. This possibility is far from unlikely for the Krugerrand, considering the retail-dominance of the Krugerrand-market in the JSE and the established susceptibility of retail traders (Barber et al., 2009a; 2009b) to extrapolating from historical prices. In view of the above, we propose the following hypotheses:

**Hypothesis 7a:** Feedback trading in the Krugerrand grows stronger when equity market returns are negative.

**Hypothesis 7b:** Feedback trading in the Krugerrand grows stronger when equity market returns are low.

**Hypothesis 7c:** Feedback trading in the Krugerrand grows stronger when equity market returns are positive.

**Hypothesis 7d:** Feedback trading in the Krugerrand grows stronger when equity market returns are high.

Equation (8) is estimated incorporating each of the above factors in turn, for the full sample period (01/03/1996 – 30/08/2019). However, this window includes the global financial crisis and, it is possible that the latter can introduce biases in our results. To that end, we first estimate Equation (8), setting the dummy D equal to one for the 10/10/2007 - 06/03/2009 period (corresponding to the crisis’ period – see Guney et al., 2017), zero otherwise, in order to assess whether a crisis-effect exists in feedback trading. We then repeat each of the estimations from Equations (6), (7) and (8) for the pre- (01/03/1996 – 09/10/2007) and post- (07/03/2009 – 30/08/2019) crisis periods, in order to gauge whether Krugerrand’s feedback trading dynamics vary before and after the crisis’ outbreak.[[37]](#footnote-37)

Equations (6), (7) and (8) are estimated employing the asymmetric GARCH (1,1) framework (Glosten et al., 1993) to model the conditional variance (), as follows:

(9)

This GARCH-specification allows us to assess whether volatility is asymmetric via , which is a dummy variable equal to one, if the lagged shockis negative, zero otherwise. In this framework, if ’s value is positive and significant, this indicates that volatility is more pronounced following negative vis-à-vis positive shocks.

**4. Results – Discussion**

***4.1 Full-sample period results***

***4.1.1 Are feedback traders present in the Krugerrand market? (Hypothesis 1)***

We begin the discussion of our results by assessing whether feedback traders are active in the Krugerrand market during our sample period, as per our first hypothesis. As the estimates in Table 2 suggest, volatility is highly persistent (as the significant[[38]](#footnote-38) -value indicates) and responds significantly to news ( is significant), yet not asymmetrically so, given the insignificantly negative value of . The Krugerrand market incorporates inefficiencies, as the significantly negative value of indicates; this suggests the presence of negative first-order autocorrelation, something not unusual for financial time series across long horizons (see e.g. Antoniou et al., 2005, Cutler et al., 1990), which denotes that Krugerrand-returns bear predictability in their structure. What is more, is negative and significant, thus confirming that positive feedback traders are active in Krugerrand’s trading process.

This leads us to accept hypothesis 1 and – given the retail dominance of Krugerrand’s secondary market in the JSE - supports earlier evidence (Barber et al., 2009a; 2009b; Barber and Odean, 2013; Burghardt, 2011; Dorn et al., 2008; Jame and Tong, 2014; Kumar, 2009; Kumar and Lee, 2006; Li et al., 2017) on the propensity of retail investors toward noise trading. In addition, by showcasing that the Krugerrand entails feedback trading patterns, these results are in line with extant evidence on investors extrapolating from historical price-trends in gold-related assets (Baker and van Tassel, 1985; Baur and Glover, 2014; 2015; Cutler et al., 1990; Frank and Stengos, 1989; Ogum, 2013; Siegel et al., 2000), while demonstrating that gold coins (most of which, Krugerrand included, are legal tender) are also prone to feedback trading, similar to currencies (Aguirre and Saidi, 1999; Daníelsson and Love, 2006; Laopodis, 2005; Osler, 2005; Tayeh and Kallinterakis, forthcoming).

***4.1.2 Is feedback trading directionally asymmetric? (Hypotheses 2a/2b)***

Hypothesis 2a (2b) stated that feedback trading in the Krugerrand would grow stronger on days of positive (negative) Krugerrand-returns. Table 3 presents the results from the estimation of Equations (7) and (9), with which we test whether feedback trading is directionally asymmetric in the Krugerrand (hypotheses 2a and 2b). Similar to the results presented previously, Krugerrand-returns entail significantly negative first-order autocorrelation and significant positive feedback trading (as the coefficients and , respectively, suggest). assumes a significantly positive value, thus denoting that positive feedback traders appear more active when the Krugerrand declines in value; this leads us to accept (reject) hypothesis 2b (2a) and suggests the existence of directional asymmetry in feedback trading for the Krugerrand (similar to evidence from other asset classes; see e.g. Koutmos, 2014). It is possible that Krugerrand-investors trend-chase more strongly when the coin loses value due to risk-aversion, which prompts them to sell in order to avoid seeing the value of their investment subside even further in the event of the slump growing prolonged.

***4.1.3 Does trading activity impact feedback trading? (Hypotheses 3a/3b)***

Hypothesis 3a (3b) predicted that feedback trading in the Krugerrand would grow stronger on days of rising (high) volume. Table 4, column 1, presents the estimates from Equations (8) and (9) when feedback trading is conditioned on rising/falling volume days. The results reported there suggest that positive feedback traders are active during both rising and falling volume days, more strongly so during the latter ( is larger in absolute terms than and more strongly significant, considering its much lower p-value), thus leading us to reject hypothesis 3a. Column 2 of Table 4 outlines the results from conditioning feedback trading on high/low volume days, from where we can surmise that positive feedback traders are again active on days when Krugerrand’s volume is both high and low (as per the definition offered in the previous section). With being larger in absolute terms than , these results indicate that positive feedback trading is stronger for high volume days (in support of hypothesis 3b).

These results suggest that positive feedback traders are active irrespective of Krugerrand’s volume, yet grow in presence more when its volume decreases day-on-day or becomes high. Although the latter results may appear contradictory, it is possible that they each reflect different horizon-effects. The stronger positive feedback trading detected for decreasing volume days is likely associated with feedback traders of very short-term focus and may well be due to informational reasons (decreasing volume may render the market less informative, thus encouraging investors to focus on historical prices as a source of information). On the other hand, high volume days involve clear rises in volume versus longer-term benchmarks (in view of the 30-day moving average volume-benchmark); the stronger positive feedback trading associated with them, therefore, is likely driven by feasibility reasons (high volume renders it easier for feedback traders to execute their strategy) as well as noise trading (considering both the role of noise traders in boosting volume and the retail-dominance of Krugerrand’s JSE secondary market).

***4.1.4 Do gold prices impact feedback trading? (Hypotheses 4a-4d)***

Hypothesis 4a (4b) postulated that feedback trading in the Krugerrand would grow stronger on days of positive (high) gold returns, with hypothesis 4c (4d) stipulating that feedback trading in the Krugerrand would grow stronger on days of negative (low) gold returns. Column 3 (4) in Table 4 presents the results from conditioning feedback trading on positive/negative (high/low) gold returns. The estimates outlined there reveal that positive feedback traders are again active, irrespective of the sign/magnitude of gold returns, with their presence appearing more pronounced for days of negative/low gold returns, thus leading us to accept (reject) hypotheses 4c and 4d (4a and 4b). It is reasonable to assume that decreasing/low gold prices are associated with lower Krugerrand-valuations and this renders these findings relevant to those from Table 3, where positive feedback trading was found to be stronger during price-slumps for the Krugerrand.

***4.1.5 Do South Africa’s currency valuations impact feedback trading? (Hypotheses 5a/5b)***

Hypothesis 5a (5b) predicted that feedback trading in the Krugerrand would be stronger when the Rand depreciates (appreciates) in value versus the US Dollar. We now turn to discuss the results depicted in Table 4 from our estimations of feedback trading conditional on the Rand-US dollar exchange rate returns, depending on whether these are positive/negative (column 5) or high/low (column 6). Overall, positive feedback trading is present ( and are both significantly negative) regardless of the sign/magnitude of those returns. With assuming larger absolute values than for both estimations, this shows that positive feedback trading grows more pronounced on days corresponding to appreciations (reflected through negative ZAR/USD rate returns) and deep appreciations (reflected through low ZAR/USD rate returns) of the South African currency, thus leading us to accept (reject) hypothesis 5b (5a). Underlying this set of results may be the fact that Rand-appreciations strengthen the purchasing power of South African investors and this can encourage them to divert a larger part of their income toward safe investments (more so given the high political and economic volatility typifying South Africa; Kumo, 2006; Redl, 2018). If so, this would translate into increased buy-interest for the Krugerrand, potentially fostering up-trends in its prices – and, thus enhance feedback trading in the process.

***4.1.6 Does South Africa’s geopolitical risk impact feedback trading? (Hypotheses 6a/6b)***

Hypothesis 6a (6b) postulated that feedback trading in the Krugerrand would grow stronger when South Africa’s geopolitical risk rises (exhibits extreme changes). Conditioning feedback trading on the monthly changes of South Africa’s geopolitical risk index reveals (Table 4, column 7) stronger positive feedback trading for days falling in months of rising (compared to months of decreasing) geopolitical risk, thus allowing us to accept hypothesis 6a. Estimates from the tests conditioning feedback trading on days falling in months of moderate versus months of extreme monthly changes of geopolitical risk (Table 4, columns 8-10) reveal that positive feedback traders are active across all three extreme monthly changes’ specifications, yet for only one moderate specification (|5%|)[[39]](#footnote-39), thus leading us to accept hypothesis 6b. Overall, these results suggest that increases and extreme changes in South Africa’s geopolitical risk foster stronger positive feedback trading in the Krugerrand, possibly due to such changes enhancing uncertainty – and, as a result, prompting investors to increase their exposure to “safe haven” assets (Baur and Lucey, 2010; Baur and McDermott, 2010).[[40]](#footnote-40)

***4.1.7 Does South Africa’s equity market performance impact feedback trading? (Hypotheses 7a-7d)***

Hypothesis 7a (7b) stipulated that feedback trading in the Krugerrand would grow stronger when equity market returns are negative (low), with hypothesis 7c (7d) predicting that feedback trading in the Krugerrand would grow stronger when equity market returns are positive (high). Results from estimations on the impact of positive/negative and high/low returns of the JSE All Share index over feedback trading are presented in columns 11 and 12 of Table 4 and denote that positive feedback trading is exclusively identified with positive and high returns of the index, in effect leading us to accept (reject) hypotheses 7c and 7d (7a and 7b). The exclusive presence of positive feedback trading on days of positive and high equity market performance is possibly due to the positive mood associated with outperforming market periods. Given the potential for positive mood to motivate the use of heuristics in decision-making (Forgas, 1998; Schwarz, 1990), it is possible that Krugerrand-investors feel more tempted to extrapolate from historical prices and feedback trade on days of positive/high equity market returns.

***4.2 Sub period analysis***

The 2007-2009 global financial crisis constituted a milestone in financial history that led to the revelation of ground-breaking fundamentals for global economies and affected investors’ behaviour, as several studies have shown (Andrikopoulos et al., 2020; Charteris et al., 2014; Economou et al., 2015; Guney et al., 2017). As no prior research has investigated the behaviour of investors in gold bullion coins, it is impossible to assert what the crisis’ effect over it may have been. A priori, one might argue that gold grows more valuable as a safe haven investment during crisis-periods, as literature evidence suggests (Akinsomi et al., 2017; Baur and Glover, 2014; O’Conner et al., 2015; Shafiee and Topal, 2010). To that end, and considering the rise in risk associated with financial crises, it would be reasonable to anticipate investors flocking more aggressively into the Krugerrand in-crisis (as a response to the uncertainty emitted from the latter), potentially leading to a rise in feedback trading[[41]](#footnote-41). Although the above constitutes a theoretical possibility, asserting the behaviour of Krugerrand-investors prior to compared to the aftermath of the crisis is far less straightforward. To obtain an initial view of the crisis’ effect over feedback trading in the Krugerrand, we re-estimate Equation (8), setting D equal to 1 for the crisis-period (10/10/2007 - 06/03/2009; see Guney et al., 2017 for more on its definition), zero otherwise and present the results in Table 5. The estimates obtained indicate that positive feedback traders were active both within and outside the global financial crisis, with their presence growing in magnitude during the crisis’ years ( is almost three times the size of in absolute terms). This confirms an enhanced surge in trend-chasing for the Krugerrand in-crisis, quite possibly reflective of the higher demand for the coin during that period (Rodgers, 2017), which witnessed a sharp rise in the coin’s price.

Table 6 presents the pre- (01/03/1996 – 09/10/2007) and post- (07/03/2009 – 30/08/2019) crisis’ estimates from Equations (6) and (7), which showcase the presence (absence) of positive feedback trading before (after) the crisis’ years. Tables 7 and 8 present the pre- and post-crisis’ results for all estimations of Equation (8) based on our control variables and, overall, the picture emanating is one of widespread (very limited) evidence of positive feedback trading pre- (post) crisis. The pre-crisis period sees positive feedback traders being active on days of decreasing/low volume, positive/high gold returns, appreciations/deep appreciations of the Rand, decreasing/extreme geopolitical risk months and positive/high equity market returns. Although not all of these results necessarily tally with those from the full sample period, they do, nevertheless, demonstrate that feedback trading in the Krugerrand interacts significantly pre-crisis with a multitude of factors relevant to its pricing. These interactions largely dissipate during the post-crisis years, where positive feedback trading appears significant (mostly at the 10 percent significance level) on days of negative gold returns, decreasing/extreme[[42]](#footnote-42) geopolitical risk months and positive equity market returns.

The dissipation of feedback trading in the years following the crisis needs to be viewed in the context of the enhanced uncertainty surfacing during those years globally. To begin with, the Krugerrand rallied from 10,450 Rand on the 9/3/2009 (the first day of the post crisis’ period) to 25,100 Rand on the 14/8/2019 (a few days before the end of our sample period). Such an unprecedented surge in value (largely the result of the progressively growing demand of foreign investors for the Krugerrand, in view of the heightened global financial uncertainty post crisis; Christianson, 2017; Reade, 2019) would be expected to render the coin less accessible to retail investors in South Africa. As the Krugerrand, therefore, grew more expensive, these investors would be less likely to trade on it as aggressively as in earlier years on their country’s stock exchange[[43]](#footnote-43) (something further confirmed via Figure 2, where Krugerrand’s value of trading is depicted) and this is likely to have contributed[[44]](#footnote-44) to the dissipation of feedback trading[[45]](#footnote-45) in the post crisis’ years.

**5. Conclusion**

We provide the first empirical study on investors’ behaviour in the gold bullion coin market, by investigating whether feedback traders are active in the Krugerrand’s secondary market on the JSE during the March 1996 – August 2019 period, whether their presence varies across different states of a series of factors related to its pricing and whether it exhibits differences before, during and after the global financial crisis. Our results from the full sample period, before and during the crisis show that the Krugerrand entailed significant positive feedback trading, which was directionally asymmetric (it grew stronger during Krugerrand’s price-slumps) and interacted significantly with a variety of factors (Krugerrand volume; gold returns; South African Rand exchange rate with the US dollar; JSE All Share index returns; and geopolitical risk). However, the post crisis’ years witnessed the dissipation of its presence, coupled with a sharp reduction in the number (and significance) of its interactions with the aforementioned factors. This dissipation appears to be largely associated with the enhanced foreign investors’ interest in the coin in the aftermath of the global financial crisis that led to a meteoric rise in its value, rendering it less easy to trade for South African retail investors.

Our results bear important implications for researchers, as they denote the potential for a wider cross section of behavioural trading facets being present in the gold bullion coin market. In view, for example, of the evidence presented in this study on feedback trading in the Krugerrand, future research in this asset class could investigate the existence of other well-documented behavioural facets based on price-patterns’ recognition (such as anchoring, disposition effect and gambler’s fallacy). Also, in the event that data on investors’ transactions becomes available in the future for gold bullion coins, it would be interesting to investigate whether cross-country effects exist in their demand. Moreover, our findings are relevant to investors (in particular, those already investing or contemplating investing in gold coins) from two aspects. On the one hand, the fact that feedback trading has largely dissipated in the post-crisis years suggests that investors should consider devoting more focus on fundamental factors when trading Krugerrands; to the extent that overseas investors have been setting the pace for the coin’s prices since the global financial crisis’ years, it would be beneficial for Krugerrand-investors to place greater weight over global factors (e.g. global demand both for the Krugerrand as well as for other gold investment assets) in their analysis. On the other hand, for those investors wishing to rely on historical prices, our post-crisis findings could offer them the possibility of incorporating some behavioural elements in their strategies. The fact, for example, that the Krugerrand was found to accommodate some limited evidence of feedback trading for specific states of some factors in recent years could motivate a Krugerrand-trader to consider varying his strategy contingent on those factors’ states. As an example of a possible strategy here, assume the significant positive feedback trading observed during days with negative gold bullion returns during the post-crisis years (Table 8, column 3). To the extent that lower gold bullion prices are likely to imply lower valuations for the Krugerrand, this suggests that Krugerrand investors will trend-chase during those days, i.e. sell Krugerrands. Armed with this knowledge, an investor might then choose to enter the Krugerrand market on days of falling gold prices, in order to buy cheap (in anticipation of this trend-chasing leading to depressed Krugerrand prices).

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| **Table 1: Descriptive statistics** | | | | | |
| **Panel A: Summary statistics** | | | | | |
|  | | Krugerrand returns | | Krugerrand logarithmic trading value (Rand) | |
| Mean | | 0.0734 | | 12.0766 | |
| Standard deviation | | 2.1110 | | 1.3319 | |
| Skewness | | 0.2029\* | | -0.4954\* | |
| Excess kurtosis | | 3.4318\* | | 0.3564\* | |
| Jarque-Bera | | 1842.5373\* | | 171.1367\* | |
| LB(10) | | 309.279\* | | 1516.293\* | |
| LB²(10) | | 1007.867\* | | 1582.163\* | |
| **Panel B: Summary statistics (other control variables)** | | | | | |
|  | Gold bullion (LBMA) - returns | | ZAR/USD - returns | JSE All Share - returns | Geopolitical Risk index - % change month-on-month |
| Mean | 0.0325 | | 0.0429 | 0.0194 | 5.3668 |
| Standard deviation | 1.0633 | | 1.0953 | 1.2744 | 37.6355 |
| Skewness | 0.6950\* | | 0.1743\* | -0.5169\* | 2.4967\* |
| Excess kurtosis | 11.2491\* | | 7.7361\* | 6.4617\* | 16.5548\* |
| Panel A presents a series of summary statistics (mean; standard deviation; skewness; excess kurtosis; Jarque-Bera test statistic; Ljung-Box test statistics for ten lags for returns (LB(10)) and squared returns (LB²(10))) for Krugerrand’s daily percentage log-differenced returns, alongside Krugerrand’s logarithmic trading value for the full sample period (01/03/1996 – 30/08/2019). Panel B presents summary statistics (mean; standard deviation; skewness; excess kurtosis) for the daily percentage log-differenced returns of the Gold Bullion (LBMA), South African Rand/US Dollar rate and the JSE All Share index, alongside the percentage month-on-month change of the Geopolitical Risk index of South Africa. \* indicates significance at the 1% level. | | | | | |

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| **Table 2: Maximum likelihood estimates for feedback trading for the full sample period** | | | | | | | | |
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|  | -0.0094  (0.8036) | 0.0196  (0.0874) | -0.1435  (0.0000) | -0.0142  (0.0004) | 0.0551  (0.0000) | 0.8675  (0.0000) | 0.1313  (0.0000) | -0.0011  (0.9380) |
| The table presents the maximum likelihood estimates from the following set of equations:  for the full sample period (01/03/1996 – 30/08/2019). Parentheses include the p-values of the estimates. | | | | | | | | |

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| **Table 3: Maximum likelihood estimates for feedback trading for the full sample period – testing for directional asymmetry** | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |
|  | -0.0357  (0.3539) | 0.0014  (0.9222) | -0.1462  (0.0000) | -0.0144  (0.0002) | 0.0752  (0.0069) | 0.0521  (0.0000) | 0.8709  (0.0000) | 0.1332  (0.0000) | -0.0110  (0.4455) |
| The table presents the maximum likelihood estimates from the following set of equations:  for the full sample period (01/03/1996 – 30/08/2019). Parentheses include the p-values of the estimates. | | | | | | | | | |

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| **Table 4: Maximum likelihood estimates for feedback trading controlling for various factors for the full sample period** | | | | | | | | | | | | |
|  | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Parameter |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.0184  (0.6974) | 0.1331  (0.0340) | 0.1902  (0.0002) | 0.1631  (0.0014) | 0.0834  (0.0954) | 0.0479  (0.3491) | -0.0650  (0.2541) | -0.0249  (0.7912) | -0.0641  (0.3919) | -0.0319  (0.5947) | 0.0189  (0.7040) | 0.0381  (0.4627) |
|  | -0.0382  (0.5053) | -0.0954  (0.0327) | -0.1766  (0.0010) | -0.1865  (0.0005) | -0.1038  (0.0646) | -0.0698  (0.1928) | 0.0294  (0.5621) | -0.0057  (0.8875) | 0.0096  (0.8237) | 0.0019  (0.9686) | -0.0500  (0.3498) | -0.0763  (0.1502) |
|  | 0.0226  (0.1696) | 0.0121  (0.5651) | 0.0361  (0.0199) | 0.0409  (0.0084) | 0.0347  (0.0335) | 0.0391  (0.0188) | 0.0380  (0.0292) | 0.0298  (0.2703) | 0.0409  (0.0631) | 0.0328  (0.0741) | 0.0201  (0.1994) | 0.0153  (0.3318) |
|  | 0.0189  (0.2800) | 0.0258  (0.0579) | -0.0024  (0.8887) | 0.0000  (0.9991) | 0.0060  (0.7258) | 0.0013  (0.9373) | 0.0060  (0.7036) | 0.0164  (0.2061) | 0.0113  (0.4087) | 0.0114  (0.4476) | 0.0229  (0.1649) | 0.0281  (0.0930) |
|  | -0.1056  (0.0023) | -0.0807  (0.0725) | -0.1264  (0.0005) | -0.1586  (0.0000) | -0.1195  (0.0007) | -0.1601  (0.0000) | -0.1221  (0.0023) | -0.2191  (0.0006) | -0.1917  (0.0002) | -0.1052  (0.0152) | -0.0706  (0.0550) | -0.0763  (0.0467) |
|  | -0.0101  (0.0505) | -0.0153  (0.0355) | -0.0145  (0.0041) | -0.0115  (0.0229) | -0.0131  (0.0147) | -0.0103  (0.0568) | -0.0147  (0.0347) | -0.0049  (0.6182) | -0.0096  (0.2688) | -0.0163  (0.0264) | -0.0255  (0.0000) | -0.0226  (0.0001) |
|  | -0.1757  (0.0000) | -0.1805  (0.0000) | -0.1406  (0.0002) | -0.1208  (0.0012) | -0.1532  (0.0001) | -0.1256  (0.0010) | -0.1625  (0.0000) | -0.1287  (0.0000) | -0.1242  (0.0000) | -0.1655  (0.0000) | -0.2084  (0.0000) | -0.2116  (0.0000) |
|  | -0.0186  (0.0026) | -0.0130  (0.0050) | -0.0179  (0.0055) | -0.0196  (0.0013) | -0.0177  (0.0019) | -0.0187  (0.0010) | -0.0139  (0.0047) | -0.0159  (0.0003) | -0.0158  (0.0005) | -0.0135  (0.0042) | -0.0042  (0.4626) | -0.0060  (0.2912) |
|  | 0.0547  (0.0000) | 0.0503  (0.0000) | 0.0498  (0.0000) | 0.0525  (0.0000) | 0.0512  (0.0000) | 0.0540  (0.0000) | 0.0531  (0.0000) | 0.0562  (0.0000) | 0.0552  (0.0000) | 0.0529  (0.0000) | 0.0580  (0.0000) | 0.0612  (0.0000) |
|  | 0.8689  (0.0000) | 0.8718  (0.0000) | 0.8726  (0.0000) | 0.8691  (0.0000) | 0.8741  (0.0000) | 0.8695  (0.0000) | 0.8684  (0.0000) | 0.8657  (0.0000) | 0.8671  (0.0000) | 0.8691  (0.0000) | 0.8645  (0.0000) | 0.8612  (0.0000) |
|  | 0.1293  (0.0000) | 0.1295  (0.0000) | 0.1290  (0.0000) | 0.1324  (0.0000) | 0.1243  (0.0000) | 0.1284  (0.0000) | 0.1305  (0.0000) | 0.1326  (0.0000) | 0.1312  (0.0000) | 0.1295  (0.0000) | 0.1317  (0.0000) | 0.1350  (0.0000) |
|  | -0.0007  (0.9587) | -0.0041  (0.7757) | -0.0059  (0.6845) | -0.0055  (0.7078) | -0.0003  (0.9825) | 0.0012  (0.9340) | -0.0000  (0.9978) | -0.0002  (0.9875) | -0.0002  (0.9913) | 0.0003  (0.9842) | 0.0029  (0.8411) | 0.0023  (0.8767) |
| The table presents the maximum likelihood estimates from the following set of equations for the full sample period (01/03/1996 – 30/08/2019):  is a dummy variable assuming the value of unity if the condition for each variable specified immediately beneath its column-number holds, zero otherwise. The variables are as follows: Krugerrand trading value (Vol); Gold Bullion (LBMA) returns (GR); ZAR/USD exchange rate (R/$) returns; percentage month-on-month change in South Africa’s geopolitical risk index (GEO); and the returns on the JSE All Share Index (ALSI). MA30 represents the 30-day moving average of a variable. Parentheses include the p-values of the estimates. | | | | | | | | | | | | |

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| **Table 5: Maximum likelihood estimates for feedback trading for the full sample period – testing for the crisis’ effect** | | | | | | | | | | | | |
|  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 0.0534  (0.8867) | 0.0073  (0.8505) | 0.0165  (0.7381) | 0.0180  (0.1476) | 0.1732  (0.3402) | -0.0371  (0.0337) | -0.1505  (0.0000) | -0.0138  (0.0013) | 0.0553  (0.0000) | 0.8677  (0.0000) | 0.1311  (0.0000) | -0.0014  (0.9230) |
| The table presents the maximum likelihood estimates from the following set of equations for the full sample period (01/03/1996 – 30/08/2019):  is a dummy variable assuming the value of unity for the crisis’ period (10/10/2007 - 06/03/2009), zero otherwise. Parentheses include the p-values of the estimates. | | | | | | | | | | | | |

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| **Table 6: Maximum likelihood estimates for feedback trading and controlling for its directional asymmetry, pre- versus post- crisis** | | | | |
|  | Original feedback trading model | | Feedback trading model controlling for directional asymmetry | |
| Parameters | Pre-crisis | Post-crisis | Pre-crisis | Post-crisis |
|  | -0.0344  (0.4053) | -0.5619  (0.0577) | -0.0602  (0.1544) | -0.9030  (0.0287) |
|  | 0.0272  (0.1280) | 0.1201  (0.0413) | 0.0063  (0.7840) | 0.2129  (0.0251) |
|  | -0.1042  (0.0007) | -0.1649  (0.0709) | -0.1055  (0.0005) | -0.1481  (0.1193) |
|  | -0.0120  (0.0199) | -0.0206  (0.1180) | -0.0121  (0.0171) | -0.0203  (0.1592) |
|  |  |  | 0.0793  (0.0495) | -0.0864  (0.2122) |
|  | 0.0909  (0.0000) | 2.6250  (0.0000) | 0.0849  (0.0000) | 3.0019  (0.0000) |
|  | 0.8102  (0.0000) | 0.3458  (0.0018) | 0.8159  (0.0000) | 0.2751  (0.0175) |
|  | 0.1769  (0.0000) | 0.1228  (0.0000) | 0.1793  (0.0000) | 0.1069  (0.0001) |
|  | -0.0140  (0.5451) | 0.0872  (0.1390) | -0.0259  (0.2647) | 0.1166  (0.0559) |
| The table presents the maximum likelihood estimates from the following sets of equations:  and  pre-crisis (01/03/1996 – 09/10/2007) and post-crisis (07/03/2009 – 30/08/2019). Parentheses include the p-values of the estimates. | | | | |

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| **Table 7: Maximum likelihood estimates for feedback trading controlling for various factors for the pre-crisis period** | | | | | | | | | | | | | | | | | | | | | | | | |
|  | (1) | | (2) | | (3) | | (4) | | (5) | | (6) | | (7) | | (8) | | | (9) | | (10) | | (11) | | (12) |
| Parameter |  | |  | |  | |  | |  | |  | |  | |  | | |  | |  | |  | |  |
|  | -0.0180  (0.7376) | | 0.1304  (0.0667) | | 0.1687  (0.0020) | | 0.1450  (0.0068) | | 0.0033  (0.9536) | | -0.0048  (0.9312) | | -0.0874  (0.1656) | | -0.0083  (0.9463) | | | -0.0788  (0.3616) | | -0.0416  (0.5342) | | -0.0579  (0.2669) | | -0.0308  (0.5710) |
|  | -0.0849  (0.1945) | | -0.1360  (0.0057) | | -0.2038  (0.0008) | | -0.2093  (0.0007) | | -0.0936  (0.1411) | | -0.0827  (0.1784) | | -0.0020  (0.9724) | | -0.0391  (0.3700) | | | -0.0245  (0.5998) | | -0.0321  (0.5480) | | -0.0006  (0.9924) | | -0.0419  (0.4989) |
|  | 0.0382  (0.1562) | | 0.0285  (0.4198) | | 0.0395  (0.0966) | | 0.0493  (0.0375) | | 0.0731  (0.0075) | | 0.0631  (0.0131) | | 0.0598  (0.0286) | | 0.0149  (0.8035) | | | 0.0545  (0.1699) | | 0.0442  (0.1347) | | 0.0654  (0.0043) | | 0.0548  (0.0169) |
|  | 0.0341  (0.2115) | | 0.0289  (0.1824) | | 0.0058  (0.8460) | | -0.0016  (0.9572) | | -0.0053  (0.8494) | | -0.0015  (0.9565) | | 0.0063  (0.8035) | | 0.0288  (0.1268) | | | 0.0206  (0.3133) | | 0.0184  (0.4351) | | -0.0180  (0.5295) | | -0.0048  (0.8691) |
|  | -0.0719  (0.0785) | | -0.0496  (0.3415) | | -0.0797  (0.0548) | | -0.1138  (0.0067) | | -0.0975  (0.0225) | | -0.1318  (0.0017) | | -0.0423  (0.3945) | | -0.1760  (0.0684) | | | -0.1237  (0.0818) | | -0.0122  (0.8223) | | -0.0603  (0.1319) | | -0.0645  (0.1171) |
|  | -0.0012  (0.8651) | | -0.0095  (0.3242) | | -0.0145  (0.0149) | | -0.0134  (0.0275) | | -0.0058  (0.4368) | | -0.0045  (0.4987) | | -0.0146  (0.2035) | | -0.0017  (0.9459) | | | -0.0117  (0.5346) | | -0.0153  (0.2132) | | -0.0216  (0.0014) | | -0.0198  (0.0035) |
|  | -0.1340  (0.0049) | | -0.1500  (0.0000) | | -0.1198  (0.0106) | | -0.1057  (0.0173) | | -0.1039  (0.0183) | | -0.0780  (0.0797) | | -0.1501  (0.0003) | | -0.0959  (0.0037) | | | -0.0953  (0.0078) | | -0.1526  (0.0001) | | -0.1408  (0.0017) | | -0.1453  (0.0013) |
|  | -0.0230  (0.0149) | | -0.0114  (0.0581) | | -0.0132  (0.1992) | | -0.0124  (0.1633) | | -0.0197  (0.0181) | | -0.0201  (0.0198) | | -0.0110  (0.0668) | | -0.0128  (0.0161) | | | -0.0125  (0.0225) | | -0.0109  (0.0578) | | -0.0026  (0.7362) | | -0.0035  (0.6575) |
|  | 0.0924  (0.0000) | | 0.0826  (0.0000) | | 0.0865  (0.0000) | | 0.0896  (0.0000) | | 0.0875  (0.0000) | | 0.0905  (0.0000) | | 0.0836  (0.0000) | | 0.0930  (0.0000) | | | 0.0916  (0.0000) | | 0.0821  (0.0000) | | 0.0855  (0.0000) | | 0.0882  (0.0000) |
|  | 0.8122  (0.0000) | | 0.8169  (0.0000) | | 0.8119  (0.0000) | | 0.8085  (0.0000) | | 0.8171  (0.0000) | | 0.8126  (0.0000) | | 0.8165  (0.0000) | | 0.8075  (0.0000) | | | 0.8096  (0.0000) | | 0.8178  (0.0000) | | 0.8177  (0.0000) | | 0.8152  (0.0000) |
|  | 0.1665  (0.0000) | | 0.1763  (0.0000) | | 0.1801  (0.0000) | | 0.1822  (0.0000) | | 0.1678  (0.0000) | | 0.1686  (0.0000) | | 0.1700  (0.0000) | | 0.1786  (0.0000) | | | 0.1760  (0.0000) | | 0.1702  (0.0000) | | 0.1705  (0.0000) | | 0.1710  (0.0000) |
|  | -0.0018  (0.9375) | | -0.0208  (0.3593) | | -0.0226  (0.3161) | | -0.0220  (0.3370) | | -0.0096  (0.6696) | | -0.0025  (0.9130) | | -0.0072  (0.7491) | | -0.0132  (0.5748) | | | -0.0117  (0.6155) | | -0.0092  (0.6845) | | -0.0141  (0.5279) | | -0.0113  (0.6178) |
| The table presents the maximum likelihood estimates from the following set of equations for the pre-crisis period (01/03/1996 – 09/10/2007):  is a dummy variable assuming the value of unity if the condition for each variable specified immediately beneath its column-number holds, zero otherwise. The variables are as follows: Krugerrand trading value (Vol); Gold Bullion (LBMA) returns (GR); ZAR/USD exchange rate (R/$) returns; percentage month-on-month change in South Africa’s geopolitical risk index (GEO); and the returns on the JSE All Share Index (ALSI). MA30 represents the 30-day moving average of a variable. Parentheses include the p-values of the estimates. | | | | | | | | | | | | | | | | | | | | | | | | |
| **Table 8: Maximum likelihood estimates for feedback trading controlling for various factors for the post-crisis period** | | | | | | | | | | | | | | | | | | | | | | | | |
|  | | (1) | | (2) | | (3) | | (4) | | (5) | | (6) | | (7) | | (8) | (9) | | (10) | | (11) | | (12) | |
| Parameter | |  | |  | |  | |  | |  | |  | |  | |  |  | |  | |  | |  | |
|  | | -0.4159  (0.2851) | | -0.8655  (0.0965) | | -0.6665  (0.1379) | | -0.8630  (0.0682) | | -0.5058  (0.2184) | | -0.7089  (0.1095) | | -1.1993  (0.0066) | | -1.2572  (0.0204) | -1.3610  (0.0115) | | -1.0656  (0.0177) | | -0.1738  (0.6843) | | -0.1870  (0.6536) | |
|  | | -0.6608  (0.1036) | | -0.4112  (0.2323) | | -0.7773  (0.0736) | | -0.7292  (0.0910) | | -0.6475  (0.1205) | | -0.5388  (0.1903) | | -0.1046  (0.7934) | | -0.3484  (0.3320) | -0.2515  (0.5010) | | -0.1943  (0.6009) | | -1.2352  (0.0089) | | -1.1380  (0.0127) | |
|  | | 0.0982  (0.1934) | | 0.1553  (0.1331) | | 0.1942  (0.0270) | | 0.2253  (0.0156) | | 0.1409  (0.0871) | | 0.1757  (0.0494) | | 0.2469  (0.0058) | | 0.2752  (0.0107) | 0.2920  (0.0069) | | 0.2273  (0.0121) | | 0.0251  (0.7665) | | 0.0320  (0.6952) | |
|  | | 0.1340  (0.1022) | | 0.1035  (0.1272) | | 0.1122  (0.2036) | | 0.1094  (0.2022) | | 0.1068  (0.1917) | | 0.0899  (0.2639) | | 0.0271  (0.7252) | | 0.0688  (0.3278) | 0.0507  (0.4854) | | 0.0432  (0.5443) | | 0.2748  (0.0034) | | 0.2491  (0.0060) | |
|  | | -0.1345  (0.2288) | | -0.1323  (0.3141) | | -0.2592  (0.0782) | | -0.1906  (0.1790) | | -0.0992  (0.4835) | | -0.1301  (0.3510) | | -0.2943  (0.0378) | | -0.2484  (0.1574) | -0.2692  (0.1163) | | -0.2748  (0.0571) | | -0.0577  (0.6992) | | -0.0429  (0.7781) | |
|  | | -0.0213  (0.1724) | | -0.0200  (0.2832) | | -0.0061  (0.7819) | | -0.0151  (0.4815) | | -0.0249  (0.2423) | | -0.0239  (0.2528) | | -0.0016  (0.9415) | | -0.0070  (0.7892) | -0.0057  (0.8263) | | -0.0063  (0.7666) | | -0.0379  (0.0988) | | -0.0367  (0.1094) | |
|  | | -0.2164  (0.1527) | | -0.1748  (0.1865) | | -0.0532  (0.7223) | | -0.0774  (0.6084) | | -0.2167  (0.0671) | | -0.1746  (0.1292) | | 0.0575  (0.7302) | | -0.0915  (0.5016) | -0.0724  (0.6142) | | -0.0466  (0.7471) | | -0.2488  (0.0991) | | -0.2724  (0.0578) | |
|  | | -0.0161  (0.4670) | | -0.0229  (0.2323) | | -0.0383  (0.0930) | | -0.0345  (0.1344) | | -0.0176  (0.2816) | | -0.0202  (0.1996) | | -0.0535  (0.0327) | | -0.0332  (0.1044) | -0.0351  (0.1035) | | -0.0365  (0.0836) | | -0.0038  (0.8639) | | -0.0048  (0.8210) | |
|  | | 2.4457  (0.0000) | | 2.7564  (0.0000) | | 2.7204  (0.0000) | | 2.8798  (0.0000) | | 2.6485  (0.0000) | | 2.8420  (0.0000) | | 2.7661  (0.0000) | | 2.7926  (0.0000) | 2.7696  (0.0000) | | 2.6549  (0.0000) | | 2.7342  (0.0000) | | 2.6228  (0.0000) | |
|  | | 0.3839  (0.0003) | | 0.3168  (0.0072) | | 0.3288  (0.0049) | | 0.3023  (0.0138) | | 0.3436  (0.0025) | | 0.3057  (0.0096) | | 0.3197  (0.0022) | | 0.3189  (0.0030) | 0.3259  (0.0020) | | 0.3420  (0.0010) | | 0.3308  (0.0020) | | 0.3537  (0.0010) | |
|  | | 0.1123  (0.0001) | | 0.1298  (0.0000) | | 0.1085  (0.0005) | | 0.1028  (0.0005) | | 0.1123  (0.0001) | | 0.1147  (0.0002) | | 0.1075  (0.0004) | | 0.1133  (0.0005) | 0.1098  (0.0006) | | 0.1193  (0.0002) | | 0.1058  (0.0002) | | 0.1064  (0.0001) | |
|  | | 0.0991  (0.0922) | | 0.0786  (0.1970) | | 0.0933  (0.1032) | | 0.0996  (0.0858) | | 0.0949  (0.1070) | | 0.0942  (0.1157) | | 0.1087  (0.0604) | | 0.0886  (0.1283) | 0.0882  (0.1202) | | 0.0844  (0.1393) | | 0.0967  (0.0796) | | 0.0948  (0.0898) | |
| The table presents the maximum likelihood estimates from the following set of equations for the post-crisis period (06/03/2009 –30/08/2019):  is a dummy variable assuming the value of unity if the condition for each variable specified immediately beneath its column-number holds, zero otherwise. The variables are as follows: Krugerrand trading value (Vol); Gold Bullion (LBMA) returns (GR); ZAR/USD exchange rate (R/$) returns; percentage month-on-month change in South Africa’s geopolitical risk index (GEO); and the returns on the JSE All Share Index (ALSI). MA30 represents the 30-day moving average of a variable. Parentheses include the p-values of the estimates. | | | | | | | | | | | | | | | | | | | | | | | | |

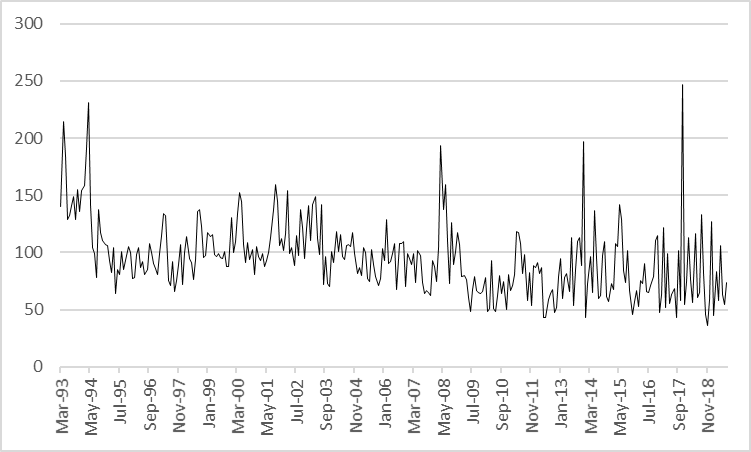
**Figure 1: Krugerrand prices (01/03/1996 – 30/08/2019)**

Source: iRESS

**Figure 2: Krugerrand total annual trading value in Rand (01/03/1996 – 30/08/2019)**

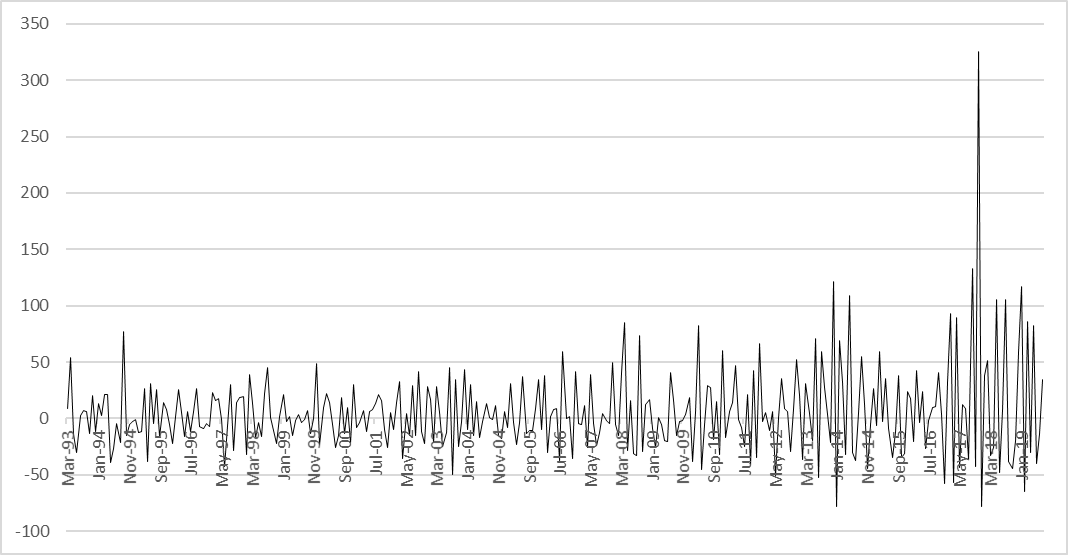
Source: iRESS

**Figure 3: South African Geopolitical Risk Index (March 1993 – August 2019)**



Source: <https://www.matteoiacoviello.com/gpr.htm>

**Figure 4: South African Geopolitical Risk Index (March 1993 – August 2019) - monthly percentage changes**



Source: <https://www.matteoiacoviello.com/gpr.htm> and authors’ calculations

1. Evidence suggests that currency investors rely on historical trends (Allen and Taylor, 1990; Frankel and Froot, 1987) and feedback trading (Aguirre and Saidi, 1999; Daníelsson and Love, 2006; Laopodis, 2005; Osler, 2005; Tayeh and Kallinterakis, forthcoming). [↑](#footnote-ref-1)
2. For more on this, see De Long et al. (1990); for more on the role of feedback trading in amplifying serial correlation and volatility in returns, see Cutler et al. (1990), Farmer (2002) and Farmer and Joshi (2002). [↑](#footnote-ref-2)
3. Rational speculators can exploit their noise counterparts by launching trends in the market in anticipation of noise investors following them (De Long et al., 1990). [↑](#footnote-ref-3)
4. Evidence suggests that investors feedback trade strongly when trading small (Lakonishok et al., 1992; Sias, 2004; Voronkova and Bohl, 2005; Wermers, 1999;) and foreign stocks (Bekaert et al., 2002; Bohn and Tesar, 1996; Brennan and Cao, 1997; Choe et al., 1999; Dahlquist and Robertson, 2001; Froot et al., 2001; Griffin et al., 2004; Kalev et al., 2008; Kang and Stulz, 1997; Karolyi, 2002; Kim and Wei, 2002a, b; Lin and Swanson, 2008; Porras and Ülkü, 2015; Richards, 2005; Ülkü, 2015); this has been attributed to the fact that in both cases, they are faced with enhanced information risk (small stocks enjoy limited analyst-coverage; trading in foreign markets implies the potential for an informational disadvantage vis-à-vis domestic investors). In either case, feedback trading can help reduce this informational uncertainty by allowing investors to infer information from past prices. [↑](#footnote-ref-4)
5. Window-dressing refers to the case whereby a fund manager buys (sells) recently winning (losing) stocks in order to generate a positive impression as per his skills, a practice culminating in positive feedback trading. [↑](#footnote-ref-5)
6. Many investment styles are price-based, such as momentum and contrarian trading (Galariotis, 2014); technical analysis (Nazario et al., 2017), by definition (it relies on past prices/volume), falls under the umbrella of feedback trading, while portfolio insurance, margin trading and stop-loss orders have also been found to amplify price-trends (Grossman and Zhou, 1996; Hirose et al., 2009; Kodres, 1994; Osler, 2005). [↑](#footnote-ref-6)
7. Smales and Yang (2015) found that gold futures responded positively to unexpected macroeconomic news, both good and bad, with their response to good news found to be greater than their response to bad news. [↑](#footnote-ref-7)
8. Beckmann et al. (2019) showed that economic (macroeconomic and inflation) policy uncertainty among analysts is (are) positively (negatively) correlated to the price of gold. In a similar vein, Baur and McDermott (2012) demonstrated that investors resort to gold as a safe haven asset during periods of extreme financial and economic uncertainty. [↑](#footnote-ref-8)
9. The South African Mint is a subsidiary of the South African Reserve Bank (SARB). The production and minting of Krugerrands are undertaken via a partnership between the South African Mint and Rand Refinery (which provides the gold for the production of the Krugerrands; Rand Refinery, 2017). [↑](#footnote-ref-9)
10. The Krugerrand is 22-carat-gold meaning that it comprises 91.7% gold and 8.3% copper, with the copper included to increase the resilience of the coin (Rand Refinery, 2017). [↑](#footnote-ref-10)
11. The coin’s name represents a combination of former South African president Paul Kruger’s name, and the currency of the country, the Rand (Christiansen, 2017). The obverse of the coin contains an image of Paul Kruger, while the reverse features a springbok. This initial design has remained unchanged, although proof coins with varying images are regularly minted; these are numismatic coins created by the South African Mint with unique designs meant as collectors’ items. [↑](#footnote-ref-11)
12. The South African Mintage and Coin Act 78 of 1964 provided for any South African gold coin (including the Krugerrand) to be regarded as legal tender. This Act was repealed by the SARB Act of 1989, which explicitly allows for Krugerrands as legal tender, although they have no nominal value (Pretorius, 2004). [↑](#footnote-ref-12)
13. Several other gold-producing countries minted their own gold bullion coins thereafter, such as the Canadian Maple Leaf (1979), Chinese Gold Panda (1982), Australian Gold Nugget (1986), American Eagle (1986), American Buffalo (2006), British Sovereign (initially minted in 1817; struck for the gold bullion coin market since 1979), the Britannia (1987) and the Austrian Philharmonic (1989) (Muradyan, 2013; Watts and Snyder, 2015). The American Eagle, similar to the Krugerrand, comprises 91.7% gold, with the remaining 8.3% comprised of silver and copper. This contrasts with the other gold bullion coins listed which contain only gold (Thomas, 2017). These gold bullion coins are legal tender in their countries of origin but, unlike the Krugerrand, they have a nominal value; for example, the one troy ounce Canadian Maple Leaf, American Eagle and British Britannia coins have nominal values of 50 Canadian dollars, 50 US dollars and 2 British pounds respectively. This means that the issuing governments only guarantee the (largely symbolic) face value of the coin, which is much lower than the gold value of the coin (which is a function of the coin’s gold-content and the daily price of gold). The designs of the Chinese and Australian gold bullion coins change annually; as such, their limited annual mintage makes them more numismatic in nature and raises their value in contrast to the other ‘investment’ coins. [↑](#footnote-ref-13)
14. Due to the rise in the gold price since the launch of the Krugerrand, smaller coins in fractions of troy ounces (½ troy ounce, ¼ troy ounce and 1/10 troy ounce) were issued from 1980 onwards so as to ensure that the gold coins were affordable for the ‘man in the street’ (Moncur and Jones, 1999). [↑](#footnote-ref-14)
15. Mining companies paid taxes to the government on profits and paid mining leases (Robbins, 1991). The South African Chamber of Mines, the industry organisation to which all mines belonged, sold the gold bullion to the government for export. However, Krugerrands were minted by the government and then sold by the Chamber of Mines internationally through its subsidiary, the International Gold Corporation (Intergold). The government and mine owners thus shared in the earnings from the coin sales (Brooks, 1985; Rothmeyr and Pitterman, 1977). [↑](#footnote-ref-15)
16. The prohibition applied only to imports and not to possession or trade. However, there were very few purchasers, and in many instances, the Krugerrands were melted down for their gold value (Kampmann, 2010). Shortly after the introduction of the ban, the Krugerrand actually traded below its gold price value on the gold bullion markets but this was quickly corrected as investors realised that it could be melted down for gold (Giedroyc, 1999). [↑](#footnote-ref-16)
17. By 1984, the Canadian Maple Leaf (launched in 1979) had already attained 25% of the global gold bullion coin market (particularly among Japanese investors; Langan, 1984) as a result of the growing intolerance toward Apartheid internationally and its purer nature (the Maple Leaf coin was 99% gold). [↑](#footnote-ref-17)
18. Gold rounds are not legal tender in a country (Rodgers, 2017). [↑](#footnote-ref-18)
19. No changes were made to the name of the coin or the images of the springbok or Paul Kruger after the abolishment of Apartheid, with Nelson Mandela, the country’s first post-Apartheid elected president, supporting the continued use of these images (Rodgers, 2017). [↑](#footnote-ref-19)
20. Chinese Panda gold coins minted post-2015 began trading on the Shanghai Gold Exchange in September 2018 (Manly, 2018); in addition, Royal Canada Mint’s two exchange traded receipts (ETRs; launched in November 2011) - one denominated in US dollars and the other in Canadian dollars - are a hybrid between the trading of gold (coins and bullion) directly on an exchange and exchange traded funds (investors can trade the ETRs on the Toronto Stock Exchange, but can also redeem a minimum of 10,000 ETRs for physical gold - Maple Leaf coins or bars - on the 15th of each month, or cash; Royal Canadian Mint, 2011). [↑](#footnote-ref-20)
21. See, for example, Creamer Media Reporter (2009), Holman (2009) and Money Week (2020). [↑](#footnote-ref-21)
22. See, for, example, Suisse Gold (2020) and Swiss Bullion (2020). [↑](#footnote-ref-22)
23. Examples include: Clark (2017), Hoyle (2012), Richter and Li (2020) and Young and Harvey (2018). [↑](#footnote-ref-23)
24. In the same vein, using the demand for gold coins as a proxy for retail investors’ demand, Baur and Löffler (2015) tested whether it can predict the equity risk premium and showed that the demand for American Eagle gold coins can forecast future stock returns alongside traditional variables (such as the dividend yield). [↑](#footnote-ref-24)
25. No data on Krugerrand prices/volume was available pre-March 1996. [↑](#footnote-ref-25)
26. The choice of these variables was motivated by the discussion in JSE (2014) and RMB (2014). [↑](#footnote-ref-26)
27. Denotes the London Bullion Market AM fixing for US dollar-denominated gold prices. [↑](#footnote-ref-27)
28. The transformation of Equation (5) into Equation (6) hinges essentially on the fact that autocorrelation may or may not be volatility-dependent. Non-synchronous trading, for instance, can motivate autocorrelation over time, without this autocorrelation depending on volatility; on the other hand, feedback traders can boost volatility in the market – and autocorrelation as well, since they trade based on trends. To disentangle those possibilities, Sentana and Wadhwani (1992) recommend linearization of the autocorrelation, i.e., to express the autocorrelation coefficient as a linear function of volatility, hence - became . Here, is added to capture any autocorrelation constant over time (and, hence, not interacting with volatility, due e.g., to non-synchronous trading; Koutmos, 1997). The volatility-driven component of the autocorrelation, represented in Equation (5) via “-” is now captured in the theoretical model proposed by Sentana and Wadhwani (1992) by 1 in Equation (6) (with the empirical quantity being equal to , where is the original feedback coefficient), hence implying that positive (negative) estimates of will denote the presence of negative (positive) feedback trading. [↑](#footnote-ref-28)
29. The demand function of feedback traders (Equation (2)) entails a single feedback coefficient (); as such, it does not allow us to disentangle between the demand of positive and the demand of negative feedback traders. This suggests that significant positive and negative feedback trading may both be simultaneously present, yet the estimation may generate a) a significantly negative , if there is more pronounced positive than negative feedback trading or b) a significantly positive , if there is more pronounced negative than positive feedback trading or c) an insignificant value for , if positive and negative feedback traders cancel each other out. The above need to be taken into account when discussing estimates from the Sentana and Wadhwani (1992) model. [↑](#footnote-ref-29)
30. An established (Barber et al., 2009a; 2009b; Barber and Odean, 2013; Burghardt, 2011; Dorn et al., 2008; Jame and Tong, 2014; Kumar, 2009; Kumar and Lee, 2006; Li et al., 2017) trait of retail investors is that they tend to exhibit herding and feedback trading, motivated by a confluence of behavioural biases and heuristics. [↑](#footnote-ref-30)
31. Representativeness heuristic is manifest when people extract inferences about a population by relying on a very limited sample of evidence (Barberis and Thaler, 2003). [↑](#footnote-ref-31)
32. Disposition effect is the tendency of investors to sell their winners too early and hold onto their losers for long (in anticipation of a reversal in their performance); see Barberis and Thaler (2003). Reasons proposed for it include regret aversion (not selling losers prevents experiencing the regret associated with the realisation of losses) and gambler’s fallacy (people predicting regularities in mean-reversion of otherwise completely random phenomena). [↑](#footnote-ref-32)
33. Krugerrand volume is reflected here via its value-traded (denominated in Rand). [↑](#footnote-ref-33)
34. High volume can further attract noise traders as it functions as an attention-grabbing signal (Barber et al., 2009a; 2009b) facilitating stock-selection (choosing stocks from among the universe of listed stocks can be an onerous task in the presence of investors’ limited attention; Hirshleifer et al., 2011). [↑](#footnote-ref-34)
35. Extreme positive month-on-month changes in geopolitical risk are associated with severe exacerbation of uncertainty and (similar to monthly increases in geopolitical risk) would, indeed, be capable of motivating Krugerrand-purchases (such conditions would encourage investors to opt for safe-haven assets); this, in turn could give rise to uptrends in Krugerrand-valuations, encouraging investors to trend-chase by buying more Krugerrands. For clarity purposes, we note here that a similar rise in feedback trading would be possible for extreme negative month-on-month changes of that variable – yet for different reasons. Extreme negative changes in geopolitical risk would imply severe dampening of uncertainty and would be expected to prompt investors to exit (enter) safe-haven (higher-yield) assets, thus potentially motivating Krugerrand-sales; the latter could give rise to downtrends in Krugerrand-prices and encourage more investors to sell their Krugerrands (i.e. positive feedback trade) in order to avoid witnessing a further dissipation of their holdings’ value. [↑](#footnote-ref-35)
36. Equity market sentiment has been empirically shown to impact non-equity asset classes, including bonds (Beber et al., 2009; Nayak, 2010), the housing market (Zheng and Osmer, 2019) and metals’ futures (Zheng, 2015). [↑](#footnote-ref-36)
37. This is motivated here via evidence (Charteris et al, 2014; Cho et al., 1999; Kim and Wei, 2002a, b) suggesting that feedback trading dynamics exhibit changes prior to versus following the outbreak of a crisis. [↑](#footnote-ref-37)
38. For the purposes of our paper, statistical significance is identified with the 10 percent significance level, i.e. for those estimates whose p-value is less than 0.1. [↑](#footnote-ref-38)
39. Specifically for the moderate specification of +/-5% monthly changes in the geopolitical risk index, is larger in absolute terms than , thus denoting that positive feedback trading for that specification is stronger for moderate monthly changes (+/-5%) of that index than extreme ones. [↑](#footnote-ref-39)
40. Although extreme changes in geopolitical risk are found to foster positive feedback trading, the latter may be motivated via different considerations for months of extreme positive versus months of extreme negative changes. Whereas months of extreme positive changes in geopolitical risk would, indeed, be expected to motivate Krugerrand-purchases (being associated with severe exacerbation of uncertainty, they would encourage investors to opt for safe-haven assets), months of extreme negative changes could well prompt investors to exit safe-haven assets (e.g. sell Krugerrands) and enter higher-yield ones (e.g. equities). Both extreme changes of geopolitical risk would be expected to foster trends in Krugerrand-prices (buy-induced ones in the former case; sell-induced ones in the latter case) and give rise to positive feedback trading. [↑](#footnote-ref-40)
41. The rise in Krugerrand-demand during the global financial crisis (confirmed by Rodgers, 2017) led to an almost 100%-surge in its value (from around 5,100 Rand to just under 10,500 Rand; see also Figure 1). [↑](#footnote-ref-41)
42. Only for the moderate specification of +/-5% monthly changes in the geopolitical risk index. [↑](#footnote-ref-42)
43. The Krugerrand’s price first crossed 4,000 Rand in May 2006 and reached 5,000 Rand shortly before the start of the crisis (see Figure 1). Authors’ communications with JSE officials revealed that South African investors heavily bought Krugerrands in the 1990s either to use the coin as currency or to move money out of the country. [↑](#footnote-ref-43)
44. Authors’ communications with JSE officials indicated two additional reasons that motivated – albeit to a lesser extent - this decline in trading activity. First, whereas authorised Krugerrand dealers had to tender for Krugerrands until the early 2000s (suggesting that, if the Rand Refinery had excess supply, the latter would be sold on the JSE), new regulations introduced permitted them to buy Krugerrands directly from the Rand Refinery (in effect taking over any excess supply and leading to fewer Krugerrands being sold on the JSE). Second, the rapidly rising value of the coin since the mid-2000s rendered the risk/insurance costs of keeping/transporting it prohibitive for many brokers, thus leading to fewer brokers offering brokerage services for Krugerrands. [↑](#footnote-ref-44)
45. An issue with the original Sentana and Wadhwani (1992) model (Equation 6) is that of proper interpretation of . As noted, earlier, , and as the results from Table 2 and Table 6 (first two columns: pre and post crisis) corresponding to estimations based on Equation (6) indicate, varies in its significance, thus raising the question whether the significance of is related to significant (insignificant) -estimates (i.e. whether the significance of is due to feedback trading). To do this, we follow the procedure outlined in Kmenta (1986, pp. 485-490) and proposed by Koutmos (2012), according to which we generate standard errors for and then assess the significance of (which, by definition, equals -/). We find that any time is significant (insignificant) in Table 2 and Table 6 (first two columns), is also significant (insignificant); results are not presented here in the interest of brevity and are available from the authors on request. [↑](#footnote-ref-45)