



# **South African Capital Markets: An Overview**

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# South African Capital Markets: An Overview\*

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## Abstract

This paper presents a overview and discussion of facts and research findings on South African equity, currency, bond and derivatives markets. It is not a comprehensive literature review, but rather an assessment of where we stand - how the markets have developed, how the main markets compare internationally, what do we have a firm understanding of, and what are (some of) the areas in most evident need for further research.

Keywords: bonds, derivatives, emerging markets, equities, foreign exchange, market value, turnover.

JEL Classifications: G10, F31.

## 1 Introduction

The significance of South Africa's capital markets in the economy is substantial. The stock market is worth almost twice the country's output, and is larger than the bourses of, for example, Mexico, Indonesia and Turkey – significantly larger economies. The currency, bond and derivatives markets are all among the world's twenty largest by turnover.

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Capital market variables are volatile and largely unpredictable, but influence the outcomes and effectiveness of economic policy, especially of monetary and fiscal decisions – in addition to the evident interest to financial market participants. The currency is a common speculative target, which can affect exchange rate dynamics. Arbitrage in the fixed income market influences the yield curve, which affects the monetary transmission mechanism, and long-term investment. Commodities speculation may magnify food and industrial input price movements. The weight of the stock market in the economy increases macro-economic sensitivity to asset price bubbles, and crashes. Derivatives permit managing exposure to volatility, e.g., in exchange and interest rates, and the engineering required to, e.g., replicating payoffs otherwise distorted by capital controls, should these be imposed.

The openness of debt and equity markets, to international portfolio investment, facilitates domestic currency funding of a persistent current account deficit, though at the cost of greater vulnerability to large reversals in capital flows (and hence to changes in global liquidity and risk aversion), and exchange rate volatility.

I present the basic facts, place the local markets within the global context, and discuss some research-based micro and macro aspects of each of the main capital markets.

## 2 Equities

The Johannesburg Stock Exchange (JSE, henceforth) was founded in 1887, one year after the discovery of gold on the Witwatersrand area, in response to the need for capital to fund burgeoning investments in the mining sector. It grew rapidly. The open outcry trading floor - different from the rough of the miner's tent where the bourse started primarily in scale - was closed in 1996, and replaced by an automated trading system. It is consistently one of the world's twenty largest stock markets; the sixth largest among emerging economies (after China, Brazil, India, Taiwan and South Korea); and by far the largest in Africa, with over 400 firms listed, and market capitalization in excess of 900 billion US dollars in early 2013.<sup>1</sup> It has a non-negligible weight in world stock indexes (e.g., eight percent of the benchmark MSCI Emerging

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<sup>1</sup>The number of firms listed declined steadily between the late 1990s, when it exceeded six hundred listings, and 2005. Most of the largest stocks have dual listings abroad, mainly in London and New York. See Kock (2009).

Markets index, the fifth largest country weight), and its aggregate value is therefore rapidly affected by the global flow of funds, to and from, emerging markets.

Mining is both at the origin of the bourse, and a reason for the growth and development of South Africa's financial sector. In contrast to countries where initial economic development was based on agriculture or trade, mining required raising capital for large scale projects – especially for deep-level gold. (See Bell, Farrell and Cassim (1999).)

The JSE's significance in the national economy, measured, admittedly crudely, by the ratio of market capitalization to Gross Domestic Product, is close to 190%.<sup>2</sup> This is unusually large, and only exceeded by Hong Kong, where the ratio is a staggering 914%, and Singapore, at 224%, and suggests that sustained movements in the aggregate valuation of the stock market can have significant effects on aggregate spending and the share of consumption in domestic output.<sup>3</sup>

Table 1 shows stock market capitalization, the markets' significance in the respective economy, capital raised, and average daily turnover, using 2011 figures from the World Federation of Exchanges, for a selection of advanced and emerging economies.

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<sup>2</sup>A listed company's capitalization is the market price of its shares multiplied by the number of shares issued. Summing this number over all companies listed in a given exchange gives that exchange's market capitalization. South Africa has the world's third most highly capitalized economy. Other emerging economies with high ratios of stock market capitalization to GDP include Malaysia (160%), Taiwan (126%), and Chile. The same ratio for the New York stock exchange, by far the world's largest stock market, is 78% (plus 25% from Nasdaq).

<sup>3</sup>The allocation of domestic institutional investors' funds is unusually heavy on equities, rather than bonds.

Table 1  
Stock Markets in Selected Advanced and Emerging Economies <sup>4</sup>

<i>Bourse</i>	<i>Value</i>	<i>% GDP</i>	<i>Capital</i>	<i>Turnover</i>
Tokyo SE, Japan	3325	57	18.360	16.270
London SE, UK	3266	69	41.224	11.081
Bovespa & BM, Brazil	1228	49	37.619	3.716
Deutsche Börse, Germany	1184	33	3.313	6.812
Korea Exchange	996	86	3.849	8.155
Johannesburg SE	789	187	12.115	1.487
Mexican Exchange	408	35	6.431	0.469
Indonesia SE	390	47	6.946	0.442
Santiago SE, Chile	270	111	3.594	0.219
Colombia SE	201	63	3.798	0.150
Istanbul IMKB, Turkey	197	26	2.366	1.601
Egyptian Exchange	48	21	1.036	0.077

Existing research documents similar findings regarding efficiency, risk-return trade-off, and pricing behaviour, to stock markets in advanced economies. The long-term average equity premium, defined as the return on the aggregate stock market in excess of a proxy for the risk-free interest rate, is approximately six percent – among the highest when compared to advanced economies, but in the same order of magnitude, despite higher perceived risk (Hassan and Van Biljon (2010)). The equity risk premium largely determines the cost of equity capital. That is, the return that investors expect from holding JSE stocks, determines the cost to listed firms from raising equity capital in the domestic market. Combined with the levels of interest rates and other sources of risk, it is an important determinant of the overall cost of capital in South Africa – which in turn determines investment, and hence growth and employment.

Research on the cross-section of individual stocks on the JSE documents the ex-post predictive power of market capitalisation, scaled-price ratios, and one-year lagged returns.<sup>5</sup> Portfolios with long positions on low-capitalization stocks and short positions on large-capitalization stocks; long on stocks with

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<sup>4</sup>‘Value’ is market capitalization; ‘% GDP’ is market capitalization as percentage of GDP; ‘Capital’ is capital raised; turnover is daily average. All absolute figures in billions of US dollars. Data source: World Federation of Exchanges, all figures: 2011. An obvious omission here is the Nigerian stock market, which is not included in the WFE database.

<sup>5</sup>See Bartens and Hassan (2010) on this literature and its limitations.

high earnings-to-price ratios (high earnings yield) and short on stocks with low earnings-to-price ratios; long on stocks that performed best over the previous 12 months, short on the worst performers, outperform passive investment benchmarks.

The outperformance is not easily explained by measures of covariance risk given by portfolio-based asset pricing models. Since there is no theoretic basis for the identified factors to represent sources of systematic risk, evidence that portfolios based on such ad-hoc characteristics earn abnormal returns implies violations of market efficiency, in the sense that “prices are not right”. That is, shares are not consistently priced as discounted expected future cash flows, where the expectations take into account all available information and discounting uses rates consistent with risk as determined by an equilibrium asset pricing model (Fama (1970)).

Such violations of pricing efficiency do not imply the existence of abnormally profitable (riskless) trading opportunities (i.e. that “prices are not right” need not imply “free lunches” in the market). The anomalies may be due to any of the factors that impose limits and risks to (quasi-) arbitrage trades, which would otherwise correct mispricing of non-replicable securities, including common stocks (e.g., horizon risk, positive-feedback trading, costs and risks of short selling).<sup>6</sup> Bartens and Hassan (2010) show that the documented evidence of in-sample predictability in the cross section of JSE stocks does not guarantee predictability which can be mechanically exploited in real time, and suggest that this may be due to some degree of data snooping in the identification of the anomalies, or to an unstable relationship between cross-sectional excess returns and the anomalous variables, limiting the predictive content of patterns identified in-sample. This is consistent with similar evidence from advanced economies, and indicative of a level of informational efficiency (“no free lunches”) – though not necessarily fundamental efficiency.

In sum, JSE prices can deviate from fundamentals, but profiting from such deviations requires facing the risk that the mispricing might persist and/or increase over the trading horizon. From an economic and welfare viewpoint, that prices can deviate substantially from fundamentals is more important than whether there are no free lunches. Such deviations imply inefficiency in the allocation of capital to the most productive investment projects.

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<sup>6</sup>See for example Abreu and Brunnermeier (2002), Barberis and Thaler (2003).

## 3 Bonds and foreign exchange

### 3.1 Bonds

The bond market is worth (amount outstanding) approximately 181 billion US dollars, as of 2012. Government bonds account for the bulk of the market (currently approximately 116 billion), and are highly liquid, with total turnover exceeding two trillion US dollars in 2011 (approximately two-thirds of which through repo trades) - recently assessed as the world's sixth most liquid by turnover. (See BIS (2007), RMB (2008), Citi (2012), SARB (2013)). Primary auctions of government debt are held by the South African Reserve Bank, on behalf of the National Treasury, with direct participation limited to authorized primary dealers. Secondary trading is through the JSE, after its acquisition of the Bond Exchange of South Africa in 2009. (The market began in 1989, was formalized as the Bond Exchange of South Africa in 1996, and had over a thousand instruments listed by 2008.) The corporate portion of the market remains smaller and less liquid, with issuance dominated by a few large firms – mainly banks and financial firms, which have replaced state-owned enterprises as the main ‘corporate’ issuers. It grew rapidly between 2003 and 2008, when South Africa experienced rapid economic growth and moderating interest rates, and careful fiscal management allowed a reduction in government bond financing needs.

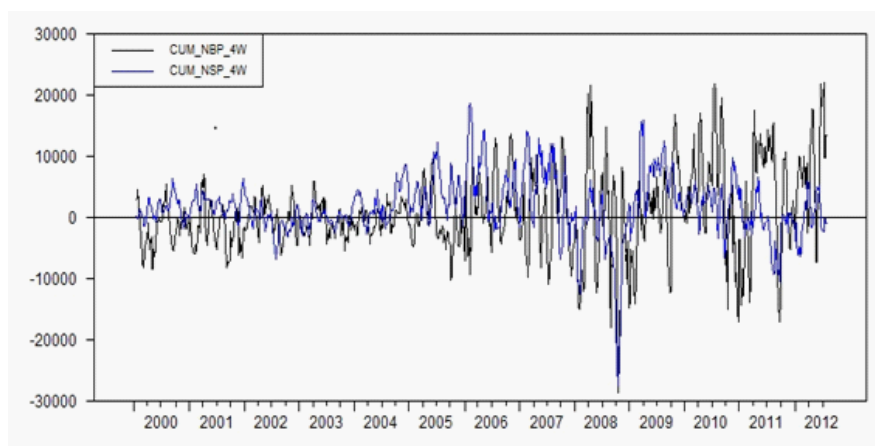
Non-government issuance as a percentage of total increasing from 13% in 2002 to 48% in 2008, when corporate bonds reached close to a third of the domestic bond market's value – its current weight. Relatively low leverage ratios in the domestic corporate sector allow scope for further growth in the market, which recorded record issuance in 2012, supported by low interest rates, but despite low economic growth. (RMB (2001, 2008, 2013), SARB (2013).)

Non-resident trading in domestic securities has risen substantially, especially in the fixed income market, where foreign ownership of government bonds (included in the Citi World Government Bond Index in September 2012) exceeded 30% during 2012.<sup>7</sup> The figure below illustrates the extent of the increase in non-resident activity in the domestic securities market. The increase in bond trading is particularly noteworthy.

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<sup>7</sup>Non-resident participation in the equities market was approximately 15 percent. (See SARB (2013).)

Figure 1: Net Purchases of Domestic Securities by Non-Residents<sup>8</sup>



International evidence indicates that increased foreign ownership of debt is associated with lower but more volatile bond yields (Andritzky (2012)). South African debt (corporate and public) is predominantly denominated in domestic currency, which is widely traded under a flexible exchange rate regime. The threat to financial stability from sudden stops and reversals in inflows, though increasingly non-negligible, remains therefore comparatively limited (compared to South East Asia in the late 1990s, and Latin America in the 1980s).<sup>9</sup> The rand’s volatility (discussed below), reduces the incentive for South African borrowers to raise foreign currency liabilities.

Interest rates and risk determine securities prices in the fixed income market (bonds and interest rate derivatives). The South African Reserve Bank directly influences short-term rates by setting the reference policy rate – the repo or repurchase rate, which is determined in response to forecasted deviations of inflation from an inflation target. The term structure of interest rates describes how these in turn relate to yields on longer maturities. The relationship between short and long-term interest rates is not constant – the shape of the yield curve changes. The effectiveness of monetary policy is limited when or if changes in the policy rate have little or no effect on

<sup>8</sup>CUM\_NBP is cumulative net bond purchases by by non-residents, in rand 1000s, over four weeks; CUM\_NSP is cumulative net stock purchases, in rand 1000s, over four weeks. Data: JSE and SARB.

<sup>9</sup>The threat to economic growth may be strong, despite the low threat to financial stability, depending on the inflationary impact of the loss in external value of the currency, and the monetary authority’s interest rate response.



long-term rates, because the latter determine productive investment. The interaction between arbitrage, risk, and demand and supply forces in the South African fixed income market, which in turn influence the term structure of interest rates, are hitherto insufficiently well understood.<sup>10</sup>

## 3.2 Foreign Exchange

Average daily rand turnover is estimated at 60 billion US dollars for 2013, of which 19 billion represents spot transactions. Table 2 shows market turnover for a selection of low (funding) and high (target) interest rate, and/or commodity currencies. The ‘total’ column includes spot and derivative turnover, across trading locations (i.e. domestic and internationally). A breakdown by type of foreign exchange derivative is provided in the next section, on the derivatives market (see Table 6). The rand is consistently among the world’s twenty most heavily traded currencies. Average daily foreign exchange turnover in South Africa is however 21 billion US dollars. Local trade accounts approximately for 34 percent of spot, 48 percent of forward, and 35 percent of swap transactions. The rest is cross-border trade – 65 percent of combined rand spot, forward and swap turnover. The main currency pairs are formed with the US dollar and Japanese yen, accounting for, respectively, 51 and 4 billion US dollars of average daily turnover.

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<sup>10</sup>For standard macroeconomic approaches to the yield curve, see Bonga-Bonga (2009), Marinkov, Amod and Kock (2013), and Du Plessis, Smit and Steinbach (2013). Fedderke and Pillay (2010) extract the risk premium implicit from deviations from an expectations hypothesis, but side step the issue of the validity of the classic expectations hypothesis to the term structure. Aling and Hassan (2011) use a no-arbitrage approach to the modelling of South African interest rates, but focus on stochastic short-rate dynamics, with no connection to macro variables.

Table 2  
Foreign Exchange Turnover, 2013<sup>11</sup>

<i>Rank</i>	<i>Currency</i>	<i>Total</i>	<i>Spot</i>	<i>Domestic</i>	<i>Offshore %</i> <sup>12</sup>
3	Japanese	1231	612	374	70
5	Australian	462	196	182	61
6	Swiss	275	84	216	21
7	Canadian	244	93	65	73
8	Mexican	135	57	32	76
10	New Zealand	105	39	12	89
16	Turkish	70	16	27	61
17	South Korean	64	19	48	25
18	<b>South African</b>	<b>60</b>	<b>19</b>	<b>21</b>	<b>65</b>
19	Brazilian	59	11	17	71
20	Indian	53	15	31	42

For the period from 2000 to 2009, the standard deviation of the rand-dollar rate is approximately 16 percent – exceeded, among the substantially traded emerging market currencies, with comparable average turnover, over the same period, only by the Turkish lira (27 percent) and the Brazilian real (20 percent).<sup>13</sup>

High currency volatility is typically matched by large interest rate differentials, and indirect evidence suggests the rand is a common currency speculation target. Average cumulative returns from Japanese yen-funded rand-targeting speculation through the forward market are volatile but high, though highly sensitive to trade initiation date, with a particularly attractive risk-return profile (same volatility but higher mean return and lower probability of rare but large losses than buy-and-hold in the stock market) after crashes in the rand. The table below compares the returns from a forward market version of the carry trade, which is a commonly used speculation strategy, between the rand and the Australian and New Zealand dollars as

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<sup>11</sup>Daily averages in April 2013, billions of US dollars (adjusted for double-counting). Data source: BIS (2013).

<sup>12</sup>These are estimates, based on the difference, for each currency, between global foreign exchange turnover for that currency, and turnover in the respective country's foreign exchange market.

<sup>13</sup>The currencies of 28 other countries with comparatively smaller economies, as well as the US dollar-euro exchange rate, were more volatile than the rand over the same period. The standard deviation of the Angolan kwanza, the most volatile, was 72 percent. See Gagnon and Hinterschweiger (2011).

targets, using the Japanese yen as funding currency.<sup>14</sup>

Table 3  
Currency Speculation (Forward Carry) Returns <sup>15</sup>

<i>Target</i>	<i>Mean Return</i>	<i>Standard Deviation</i>	<i>Sharpe Ratio</i>
Australian dollar	0.40	2.44	0.164
New Zealand dollar	0.41	2.51	0.164
South African rand	1.18	3.72	0.316

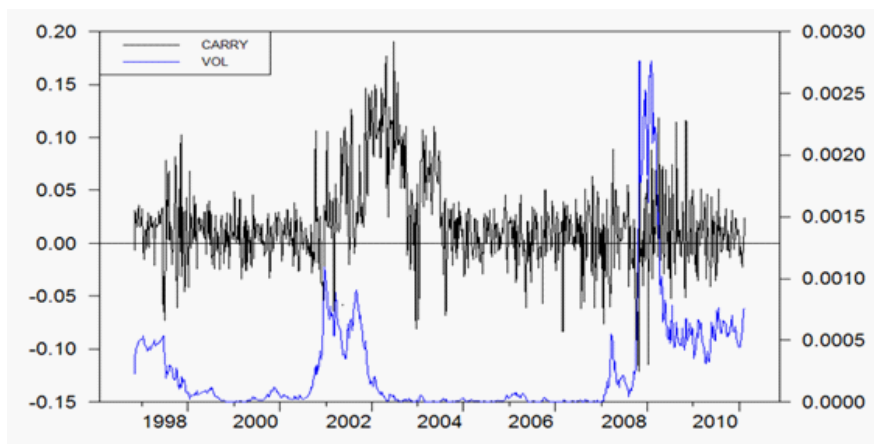
Prior to the 2008 subprime crisis, the currency experienced crashes in 1996, 1998, and 2001 (see Duncan and Liu (2009), SARB (2013).) The cumulative returns from rand-targeting speculation initiated after such crashes can be very large, and partly explain the attractive risk-return profile for carry strategies documented in Hassan and Smith (2011). Subsequent periods of high volatility can quickly erode these gains. The figure below plots weekly returns from yen-rand forward market speculation against rand-yen exchange rate conditional volatility. It shows how peaks in exchange rate volatility accompany large carry trade losses; and how large and persistent returns coincide with the sustained period of low volatility (and appreciation) after the 2001 crash.

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<sup>14</sup>Note that the reported average returns are affected by sub-samples of exceptional gains and losses. For example, returns from targeting the rand after it crashes, especially when the monetary authority raises interest rates to defend the currency, increases the reported average returns very substantially.

<sup>15</sup>Weekly percentage returns after transaction costs; sample period 03/11/1997-21/02/2011. Source: Hassan and Smith (2011).

Figure 2: Rand-Targeting Speculative Returns and Exchange Rate Volatility



Source: Hassan and Smith (2011)

## 4 Derivatives<sup>16</sup>

The derivatives market is the most innovative and, over the recent past, fastest growing segment of the capital markets – locally and globally.<sup>17</sup> It is also by far the largest, and potentially a rich source of information for policy-makers (e.g. on interest-rate expectations, volatility). Measured by notional outstanding amount (a function of the principal amounts underlying the contracts or the value of the underlying securities, not the value of the

<sup>16</sup>This section is particularly descriptive: surprisingly little has been published in peer-reviewed outlets on the non-trivial South African derivatives market.

<sup>17</sup>The main classes of derivative contracts are forwards, futures, swaps and options. Forward and futures contracts fix the date and price for an exchange in the future (of securities, rates, commodities, freight rates, etc). Futures are standardized products, traded in exchanges, so require daily re-settling through margin transactions; forwards are over-the-counter and hence do not. Swaps are OTC agreements for the exchange of one stream of cash flows for another (or the equivalent net payment(s)), at pre-determined points in time between inception and expiry, normally dependent on future realizations of an interest or exchange rate or another variable. Options give the right to buy or sell the underlying asset either at the contract's maturity, or at a point in time between inception and maturity, for a pre-determined price. Options provide a form of insurance to the buyer, and permit immense scope for customized contracts (e.g., to buy protection against default, extreme weather and other natural events, and on the definition of contingency that triggers the right to exercise). Options are traded in exchanges and OTC. See for example Hull (2012) for more detail.

derivative), the size of the global market was approximately 457 trillion US dollars in 2007. The combined market capitalization of global equity and bond markets, in contrast, was approximately 98 trillion US dollars (Deutsche Börse (2008), based on BIS and WFE data).

Derivatives are traded in exchanges (in South Africa all under the umbrella of the JSE), and over-the-counter (OTC). Exchange-traded products are standardized, and free of counterparty risk. The JSE permits trading in equity, commodity (mainly agricultural), currency, and interest rate derivatives. It seems to have the largest number of product lines per exchange than any other derivatives exchange worldwide – arguably more an indication of the degree of concentration in the domestic financial exchange market than of breadth. (See BIS (2010) and WFE (2013).) By annual number of contracts traded from 2010 (about 170 million), it was among the world’s 20 largest, but far smaller than the main derivatives exchanges, including those of emerging markets such as Korea, India, Brazil and Russia, which normally trade between one and four billion contracts annually, and match advanced economies in exchange traded turnover (based on Futures Industry Association data).<sup>18</sup>

The OTC market consists of bilateral deals between market participants, and permits virtually any level of contract customization. It is less transparent and transactions are subject to counterparty risk. Globally, it is estimated to be more than five times larger than the exchange-traded market (notional amounts). (Hull (2012) and Deutsche Börse (2008), based on BIS and WFE data.)

The South African market, like the spot markets for the main underlying securities, although naturally small compared to the world’s major financial centers, is one of the more significant among emerging economies. OTC turnover in rand-denominated interest rate derivatives is the eight largest worldwide (at par with Brazilian real denominated instruments). (See BIS (2013).)<sup>19</sup> It increased by approximately 60 percent between 2007 and 2010;

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<sup>18</sup>According to SARB (2013), exchange-traded derivatives turnover in the JSE for 2012 is approximately 504 billion US dollars (4,284 billion rand). Equity derivatives account for 81 percent of this; commodity, interest rate and currency derivatives account for, respectively, ten, seven, and two percent. Some sub-segments are globally significant: volume of trading in single stock futures was the sixth largest worldwide.

<sup>19</sup>Turnover in derivatives is the value of new deals, measured by the notional amounts underlying the contracts. It is a measure of market activity, and often used as a proxy for liquidity. Notional amounts are better indicators of market size and of the extent of risk

and more than thre-fold between 2010 and 2013 (see Table 4).<sup>20</sup> Turnover in forward rate agreements (world's sixth largest, at par with Australia) accounts for 70 percent of total rand interest rate derivatives turnover, and for most of the exponential recent growth in the market. Swaps and options explain the bulk of the remainder. Seventy percent of OTC rand interest rate derivatives trading is based in South Africa, in contrast to turnover in rand foreign exchange contracts, two-thirds of which is offshore. Considering only domestic trade, OTC turnover in interest rate derivatives in South Africa (eleven of the sixteen billion US dollars per day) is far larger than, e.g., in Brazil (4 billion), India and New Zealand (3 billion), or Mexico (2 billion); in interest rate options, which can be very complex instruments to value, it was larger than in Australia or Canada in 2010. (BIS, 2010, 2013.)

Table 4  
Interest Rate Derivatives Turnover, OTC <sup>21</sup>

<i>Rank</i>	<i>Currency</i>	<i>2004</i>	<i>2007</i>	<i>2010</i>	<i>2013</i>
4	Australian	12	19	37	76
5	Japanese	46	137	124	70
7	Canadian	8	15	48	30
8	<b>South African</b>	<b>2</b>	<b>3</b>	<b>5</b>	<b>16</b>
8	Brazilian	1	2	3	16
10	Swiss	10	19	20	14
11	South Korean	0	5	16	12
12	Mexican	2	5	5	10
15	Indian	0	3	2	6
16	New Zealand	2	7	4	5

Current estimates equate the notional value of the total South African OTC market to approximately 3.2 trillion US dollars (27 trillion rand). The bulk of the OTC market (87 percent of notional value) consists of interest rate derivatives; foreign exchange contracts account for 12 percent, and equities, credit and commodities represent the balance. Approximately 40 percent of transactions (accounting for more than half of turnover) involve foreign dealer counterparties.

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transfer in the market.

<sup>20</sup>The currencies in Tables 3 – 5 consist of low-interest (funding), and high-interest and/or commodity (target) currencies.

<sup>21</sup>Daily averages in April, in billions of US dollars, net-net basis (adjusted for double counting). Source: BIS (2013).

The predominance of interest rate derivatives in the OTC market is on the basis of notional amounts, consistent with world data, and due to the large amounts typically involved in interest rate swaps. However, average daily turnover in rand foreign exchange derivatives, OTC, domestic and offshore trade combined, is 40 billion US dollars as of April 2013 – far larger than turnover in rand interest rate derivatives (16 billion, domestic and offshore). (See Table 5, and BIS (2013).)

Table 5  
Foreign Exchange Derivatives Turnover, 2013<sup>22</sup>

<i>Rank</i>	<i>Currency</i>	<i>Forwards</i>	<i>FX Swaps</i>	<i>Options</i>	<i>Total</i> <sup>23</sup>
3	Japanese	123	332	153	619
5	Australian	50	183	27	266
6	Swiss	27	149	14	191
7	Canadian	36	101	12	151
8	Mexican	14	58	6	79
10	New Zealand	11	50	3	66
16	Turkish	10	39	3	54
17	Brazilian	34	1	11	48
18	South Korean	24	16	4	45
19	<b>South African</b>	<b>7</b>	<b>31</b>	<b>2</b>	<b>40</b>
20	Indian	24	10	3	38

This split, with heavier foreign exchange than interest rate turnover, is consistent with other emerging economies, naturally due to greater exchange rate volatility, which increases both the need to hedge exposure, and the attractiveness of speculating (e.g., trading straddles and strangles, as simple examples). In advanced economies in contrast, with deeper bond markets and more stable currencies, turnover (and notional amounts) in interest rate derivatives markets far exceeds that in foreign exchange derivatives. (See Deutsche Börse (2008), Mihaljek and Packer (2010).) That is, although underlying amounts in the South African interest rate derivatives market far outweigh those in foreign exchange, there is more issuance and trading activity in rand foreign exchange derivatives (largely abroad), suggesting significant and possibly under-utilized scope for the management of foreign

<sup>22</sup>Daily averages in April 2013, billions of US dollars, net-net basis (adjusted for double-counting). Source: BIS (2013).

<sup>23</sup>Including ‘currency swap’ as a separate category to ‘foreign exchange’ swaps.

exchange risk in the country.

At time of writing, there is an active discussion in policy and academic circles regarding the desirability of capital controls under certain circumstances, and on how to design and implement such controls appropriately.<sup>24</sup> The facts reported here suggest that any such measures would have to carefully consider the scope for evasion through the foreign exchange and interest rate derivatives markets – it is ample.

Little is known about the extent of high-frequency algorithmic trading in South African markets. (It accounts for 60% of trading volume in US options markets.)

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<sup>24</sup>See for example Gallagher, Griffith-Jones and Ocampo (2012), and Rey (2013).



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