Chartists and Fundamentalists in Emerging Currency Markets

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ABSTRACT

The mainstream of literature on emerging currency markets focuses on the crisis early warning signals models. The rise of floating exchange rate regimes in the emerging markets since the late nineties warrants a different study. For six different floating emerging market currencies we provide new evidence on the economic and statistical significance of foreign exchange rate prediction by using purchasing power parity and real interest rate strategies, over the 1995-2006 period. We also document that technical trading strategies generate economically and statistically significant returns, even after the inclusion of the costs entailing the bid-ask spread as well as the, non-negligible, interest rate differential. The most important contribution of this paper is that we find empirical evidence that investment weights based on 12 month past performance of fundamentalist and chartist strategies economically and statistically improve the risk-adjusted performance over naive combinations of fundamentalists and chartists. Hence, these results provide empirical evidence supporting heterogeneous agents models that assume that not all traders are acting the same all the time. All these results are robust over an additional, but shorter, sample of nine floating emerging markets currencies.

Keywords: Emerging markets, Exchange rates, Heterogeneous agents, Purchasing power parity, Technical trading

JEL-classification: C53, F31, G15

I. Introduction

The literature on exchange rate forecasting has extensively analyzed the predictive content of two types of information: news on macroeconomic fundamentals as used in structural exchange rate models, and information from historical prices and/or trading volumes as used in technical trading rules. Meese and Rogoff's (1983) finding that structural models could not outperform a naïve random walk forecast at short horizons still stands after 25 years of extensive research, see Chinn, Cheung and Pascual (2005) for a recent analysis. There is somewhat more evidence for the usefulness of macroeconomic information for forecasting exchange rates at longer horizons, see Mark (1995), Kilian (2001) and Berkowitz and Giorgianni (2001). In general, the performance of technical trading rules at short horizons has been found to be considerably better, see Taylor and Menkhoff (2006) for a recent survey.

The predictive ability of structural exchange rate models and technical trading rules has generally been considered in isolation. This is quite remarkable, in the sense that surveys among foreign exchange market participants invariably indicate that they regard both types of information to be important factors for determining future exchange rate movements, see Taylor and Allen (1992), Lui and Mole (1998), Cheung and Chinn (2001), and Gehrig and Menkhoff (2004), among others. Not surprisingly then, most foreign exchange professionals use some combination of fundamental analysis and technical analysis for their own decision making, with the relative weight given to technical analysis becoming smaller as forecasting or trading horizon becomes longer.

In addition, recently a new literature on heterogeneous agents models has emerged, which allow for the presence of both chartists and fundamentalists in the foreign exchange market, see Chiarella, He and Hommes (2006), and De Grauwe and Grimaldi (2005, 2006). The relative importance of these two types of traders varies over time as investors are assumed to switch between strategies according to their relative past performance. De Grauwe and Markiewicz (2006) offer an alternative interpretation of these models, in which market participants combine technical analysis and fundamental information in order to forecast future foreign exchange rates.

In this paper we examine the empirical evidence for the relevance of technical and fundamental information in currency markets from emerging countries. Specifically, we examine the performance of fundamental trading strategies based on the deviation from purchasing power parity and the real interest rate differential and a moving average technical trading rule for six emerging market currencies over the period 1995-2006. In addition, a combined fundamentalist-chartist strategy is considered, with time-varying weights determined by the relative performance of the individual trading strategies over the past year.

Our results can be summarized as follows. First, fundamentalist strategies generate portfolios with economically and statistically significant Sharpe ratios that are well above one. Hence, these results provide out-of-sample evidence for the results in McNown and Wallace (1989), who claim that fundamentalist strategies perform better in four emerging markets over the period 1972-1986. Second, technical trading strategies in emerging currency markets generate Sharpe ratios near one. Due to the low turnover in the strategies we investigate, the influence of transaction costs on our results is limited. Our results are out-of-sample evidence for the profits in emerging currency markets described by Martin (2001) for the period 1992-1995. Third, we document that this combined investment strategy renders economically and statistically significant risk-adjusted returns, after accounting for transactions costs. The dynamic combination strategy significantly outperforms the fundamental and technical trading strategies, as well as a naïve equally weighted combination. These results provide empirical evidence supporting the complementary value of technical and fundamental information as suggested by questionnaires as well as the implications of theoretical heterogeneous agents models of Chiarella et al. (2006) and De Grauwe and Grimaldi (2005, 2006).

The remainder of this paper is organized as follows. In Section II we review the relevant literature on emerging currency markets and the models that we investigate. In Section III we describe the data in more detail. We examine the performance of the fundamentalist and chartist strategies in Sections IV and V, respectively. In Section VI we then combine the chartist and fundamentalist information in order to empirically evaluate the relevance of the heterogeneous agents model. Finally, we conclude in Section VII.

II. Related literature

In their seminal work, Meese and Rogoff (1983) concluded that there is hardly any empirical evidence that macro economic models can be used to beat predictions from a random walk model. Cheung, Chinn, and Pascual (2005) repeat and extend their analysis and indicate that the original conclusion from Meese and Rogoff (1983) still holds out-of-sample. Moreover, they conclude that "old-fashioned" structural models, such as purchasing power parity and real interest rate differentials (see, e.g., Frankel 1979) perform at least as good as more recent models for five developed markets versus the U.S. over the period 1973 to 2000. Their conclusion motivates our use of these "old fashioned" structural models in our empirical analysis.

Most of the research claiming that structural models perform poorly is based on developed currency markets that experienced relatively similar inflationary patterns. Conclusions might be different for currency markets with different characteristics. For example, McNown and Wallace (1989) find empirical evidence in favor of PPP in four emerging countries with high inflation rates over the period 1972 to 1985. This finding is corroborated by Salehizaeh and Taylor (1999), who investigate PPP for 27 emerging markets over the period 1975 to 1997. In our study we do not focus on formal statistical testing of cointegration relationships as both previous studies did, but focus on the economic value of predictability using the PPP relationship and real interest rate strategies as in, e.g., Hazuka and Huberts (1994). Our approach is consistent with Leitch and Tanner (1991), who indicate that the evaluation of forecasting performance by statistical and economic measures can be different and that for studies on the behavior of agents an economic criterion is often more relevant.

Several papers document that professional currency traders do not only look at fundamental currency values, but also put weight on short-term price movements and trading volume; see Taylor and Allen (1992), Menkhoff (1997), Lui and Mole (1998), and Cheung and Chinn (2001) for survey studies among foreign exchange traders based in the U.K., Germany, Hong Kong, and the U.S. respectively. This survey research leads us to believe that technical trading strategies should be able to generate profits for some currencies for some time horizons.

Sweeny (1986) finds empirical evidence supporting the profitability of technical trading rules in six foreign exchange markets over the period 1975-1980. Since then, a large body of literature emerged on technical currency trading; see, e.g. Levich and Thomas (1993) and Neely and Weller (1999). However, Olson (2004) indicates that profits from technical trading in developed currency markets have declined over time. Currently, we know relatively little about technical trading rules for emerging currency markets. Exceptions are Martin (2001) and Lee, Gleason, and Mathur (2001), who investigate simple technical trading strategies on spot exchange rates of emerging markets. Martin (2001) investigates moving average trading rules for 12 emerging markets over the period 1992-95, while Lee et al. (2001) examine the profitability of moving average and channel rules in 13 Latin American countries over the period 1992-99. Both papers conclude that for several currencies technical trading is profitable, also for out-of-sample periods, after inclusion of transactions costs. In this paper, we would like to extend this research and investigate whether moving average trading rules have been profitable in emerging currency markets over the past decade. Contrary to the previously mentioned studies, the currencies we investigate are freely floating. Hence, there must be a different explanation than that central bank interventions are the driving force behind the profitability of technical trading strategies as suggested by, e.g., Czakmary and Mathur (1997).

Frankel and Froot (1990) provide empirical evidence for the switch of many professional forecasters from fundamentalist (using structural models and macro data) to chartist (using technical trading rules). They motivate this changing behavior because fundamentalists experienced negative returns in the mid-80’s, when currency prices deviated from their fundamental values. These concepts have thereafter been formalized in so-called heterogeneous agents models. Brock and Hommes (1997, 1998) developed equilibrium models in which agents update their beliefs about the profitability of investment strategies on past performance. These theoretical models show that rational investors can switch between simple (costless) strategies and sophisticated (costly) strategies. When all investors follow the simple strategy prices may diverge from their fundamental value, making it worthwhile for investors to engage in sophisticated strategies, because expected profits increase. Prices are then pushed back to their fundamental value and the expected net profits for sophisticated investors are negative, which forces them to switch back to simple and costless strategies that might again lead to prices that move away from their fundamental value. De Grauwe and Grimaldi (2005, 2006) have applied these heterogeneous agents models to currency markets and have shown that several previously puzzling characteristics of foreign exchange returns can be generated by these type of models using simulation analysis. Basically, heterogeneous agents models assume that the fundamental value (which can be based on for example PPP) of the exchange rate is a random walk:

(1) $$S_t^* = S_{t-1}^* + \varepsilon_t$$

where S_t^* is the fundamental exchange rate at time *t* and ε_t a stochastic innovation based on new information that became available during period *t*.

The fundamentalists basically assume that the actual exchange rate will revert towards its fundamental value. The expected change in the exchange rate according to these fundamentalists is then

(2) $$E_{f,t}\{\Delta S_{t+1}\} = \theta_f \cdot \left(S_t - S_t^*\right)$$

with $\theta_f < 0$ the speed of adjustment to the fundamental value, and S_t the actual exchange rate at time *t*. Chartists, on the other hand, are assumed to ignore the fundamental value of the currency and only focus on past price movements in the currency and extrapolate these in their expectations:

(3) $$E_{c,t}\{\Delta S_{t+1}\} = \theta_c \sum_{k=0}^{K} \alpha_k \Delta S_{t-k}$$

with α_k the weights to the price at time *t–k* and $\theta_c > 0$ the degree of extrapolation that the chartists use. Based on the realized profits of both fundamentalists and chartists, they decide to either stick with their strategy or switch to the other strategy. The number of agents following the fundamentalist and chartist strategy can then for example be denoted as

$$
(4) \qquad
\begin{aligned}
N_{f,t} &= \frac{\exp\left\{\gamma \cdot \sum_{k=1}^{K} \phi_{f,k} \pi_{f,t-k}\right\}}{\exp\left\{\gamma \cdot \sum_{k=1}^{K} \phi_{c,k} \pi_{c,t-k}\right\} + \exp\left\{\gamma \cdot \sum_{k=1}^{K} \phi_{f,k} \pi_{f,t-k}\right\}} \\
N_{c,t} &= \frac{\exp\left\{\gamma \cdot \sum_{k=1}^{K} \phi_{c,k} \pi_{f,t-k}\right\}}{\exp\left\{\gamma \cdot \sum_{k=1}^{K} \phi_{c,k} \pi_{c,t-k}\right\} + \exp\left\{\gamma \cdot \sum_{k=1}^{K} \phi_{f,k} \pi_{f,t-k}\right\}}
\end{aligned}
$$

where γ is a parameter that denotes the switching intensity, π_t the profits in period *t*, and ϕ_k the weight assigned by agents to profits in period *t-k*. From Equation (4) it follows that the number of chartists N_c increases when profits on the technical trading strategy have been higher in the past. This is in line with the survey evidence from Frankel and Froot (1990) as discussed before.

This line of literature has generally been lacking empirical analyses to validate the predictions made by these heterogeneous agents models. Several attempts, e.g. Vigfusson (1997), Ahrens and Reitz (2005), and De Jong, Verschoor, and Zwinkels (2006) find only limited evidence in favor of these heterogeneous agents models. Vigfusson (1997) uses a Markov-switching approach to estimate the changing number of fundamentalists and chartists for the U.S. – Canada daily exchange rate over the period 1982-93. Ahrens and Reitz (2005) build on the work of Vigfusson (1997) and find empirical evidence of the chartist and fundamentalist model using a regime switching approach on the U.S. – German daily exchange rate over the period 1982-98. De Jong et al. (2006) find evidence of the presence of fundamentalists and chartists in a sample of European currencies from 1979-1998, but fail to find significant switching behavior between these groups measured by the switching intensity. Our study aims to extend this empirical literature on heterogeneous agents and shed more light on the interaction between chartists and fundamentalists in emerging currency markets.

Given the plethora of currency crises[1] that plagued the emerging markets, most studies on emerging markets currencies focus on early warning system models that predict financial crisis. Early research was conducted by the International Monetary Fund (IMF) and resulted in two seminal papers by Kaminsky et al. (1998) and Berg and Pattillo (1999). These two studies predict currency crisis with the help of a signal approach based on macro economic variables. Later on logit and probit models were used to estimate the probability of a crisis. We refer to Kaminsky (2006) for a recent overview of the early warning system models literature.

Late eighties many emerging market countries pegged their currency to the US dollar or a basket of developed currencies to achieve price stability after a period of (hyper) inflation. Some countries used a crawling peg, where the currency was allowed to depreciate at a steady rate such that the local inflation rate could be higher than the pegged country's rate. Late nineties, a side effect of all the emerging markets currency crises in the past decade is that most emerging markets changed their exchange rate system from a pegged to a floating regime. If we limit ourselves to the open emerging market countries, represented by the S&P/IFC composite investable index, only two countries still have a (crawling) peg regime (China and Malaysia). All other countries have the (managed) floating currency system, as becomes clear in Figure 1. This figure shows the relative number of countries per currency regime of the S&P/IFC investable index[2], where four different regimes are identified: peg, crawling peg, managed float and float.

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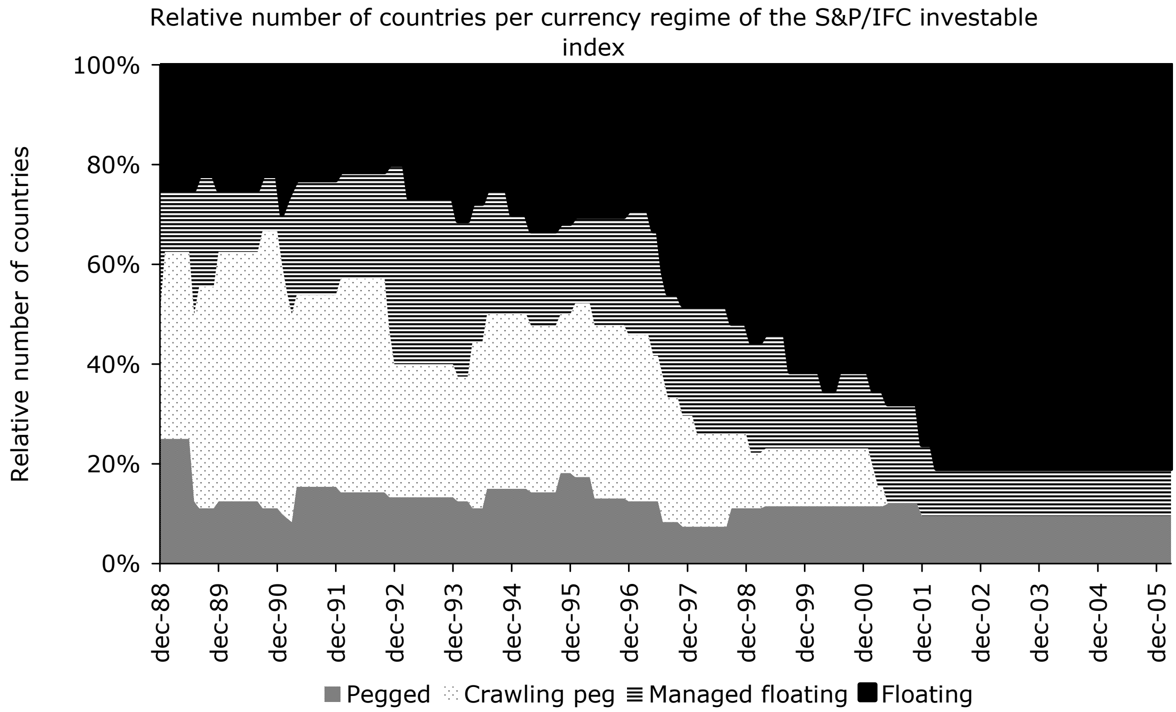
[1] Since 1990 several severe crises took place in the emerging markets. During the Tequila crisis in 1994, the Mexcian Peso was attacked, devaluated and changed to a floating currency. Later on attacks on other Latin American countries occurred in Argentina, Brazil, Peru and Venuzuela. The Asian crisis started in July 1997 with a floatation of the Thai bath. Attacks on other emerging market countries occurred after that in Malaysia, the Phillipines, Indonesia, Hong Kong, Korea and even on Brazil and Chile. More recently the crises in Turkey in 2001 and Argentina in 2001 did not affect other countries. We refer to Kaminsky (2006) for a more detailed overview of currency crisis.

[2] The S&P/IFC Investable Composite Index consists of stocks from the following countries, with the first month of inclusion in parenthesis. In case two months are provided, the second indicates the last month of inclusion. Latin America: Argentina (Dec 1988), Brazil (Dec 1988), Chile (Dec 1988), Colombia (Feb 1991 - Nov 2001), Mexico (Dec 1988), Peru (Jan 1994), Venezuela (Jan 1990 - Nov 2001); Asia: China (Oct 1995), India (Nov 1992), Indonesia (Sep 1990), Korea (Jan 1992), Malaysia (Dec 1988), Pakistan (Mar 1991 - Nov 2001), Philippines (Dec 1988), Sri Lanka (Jan 1994 - Nov

Figure 1: Exchange rate regime classification S&P/IFC investable countries



All countries in the S&P/IFC composite investable index are classified in four different currency regimes. The classification is based on Calvo and Reinhart (2001) and IMF information. Under a pegged regime the exchange rate is pegged at a fixed of another country's currency. Under a crawling peg the exchange rate is fixed but also allowed to steadily depreciate. Under a managed float the exchange rate floats within relatively wide bands and the currency is practically floating. Under a floating regime the exchange rate is set by demand and supply.

When price stability is under control the advantages of a floating regime are enormous: the exchange rate movements will be smaller, more gradual and less non-linear than under a pegged regime. The daily fluctuations make clear to all market participants how much risk is involved and a depreciation of the exchange rate may provide an early warning signal to the central bank and other policy makers. At this moment the large number of floating regimes warrants a different study to the emerging market currencies than the early warning signals studies, although a currency crisis can not be ruled out in the future.

III. Data description

2001), Taiwan (Jan 1991), Thailand (Dec 1988); Europe: Czech Republic (Jan 1996), Greece (Dec 1988 – Apr 2001), Hungary (Apr 1994), Poland (Apr 1994), Portugal (Dec 1988 - Mar 1999), Russia (Nov 1997), Slovakia (Nov 1997 - Nov 2001), Turkey (Aug 1989); Africa & Middle East: Egypt (Nov 1997), Israel (Dec 1996), Jordan (Dec 1988 - Nov 2001), Morocco (Nov 1997), South Africa (Apr 1995), and Zimbabwe (Apr 1994 – Nov 2001). Currency regime data is not available for Jordan and Zimbabwe.

We examine the exchange rates of six emerging market currencies versus the US dollar: the Mexican peso and Peruvian sol from Latin-America, the New Taiwanese dollar and the Indian rupee from Asia, and the South African rand and the Israeli shekel from Europe, Middle-East, and Africa (EMEA). The reason to use these specific currencies is that they have the longest history of being floating, although the central banks sometimes intervene to dampen volatility.[3] Furthermore, we want to include two currencies from each emerging market region to avoid any regional bias in our results. We employ both daily and monthly rates, for the technical trading rules and the fundamental models, respectively. The exchange rates correspond to Reuters 07:00 middle rate fixings, collected and provided by Robeco. The sample period runs from March 31st 1995 to March 31st 2006 (2871 daily and 133 monthly observations). In Section VI, we consider an additional nine emerging market exchange rates with a shorter history of a floating regime.

We feel that our analysis is most relevant for the free floating exchange rate regimes as prices in these systems are purely set by supply and demand. Data before 1995 is thus not considered, as most of the countries in our sample adopted a floating exchange rate system around that time or just before. The Mexican peso was allowed to float in December 1994, causing the Peso crisis with a depreciation from about 4 to 11 peso per dollar[4]. The Israeli shekel was introduced in 1980. In 1986 the link with the US dollar was broken, but the shekel was subsequently linked to a basket of major currencies. The band in which the shekel was allowed to fluctuate was widened each year. Since 1995 the shekel is practically floating, while the Bank of Israel has not intervened since June 1997[5]. The other currencies became floating earlier in respectively 1989 (Taiwan dollar and South African rand), 1990 (Peruvian sol[6]) and 1993 (Indian rupee). All currencies are tradable in the forward market, although the

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[3] Central bank intervention has been considered as one of the possible explanations for the profitability of technical analysis, see LeBaron (1999) and Neely (1998, 2002). We do not explore this further in this paper.

[4] Sidaoui (2005) discusses the Banco de Mexico floating regime experience in more detail.

[5] Sokoler (2005) discusses the Bank of Israel intervention in more detail.

[6] Armas (2005) discusses the Central Bank of Peru interventions and its motivations for the period 2002-2004.

Peruvian sol, Taiwan dollar and Indian rupee are traded as non-deliverable forwards. This means that the profit or loss on the forward contract is settled in US dollars instead of the emerging currency.

The investment return on a currency is defined as:

(5) $r_t = s_t - f_{t-1,T}$,

where s_t is the log spot rate at time *t* and and $f_{t,T}$ is the log forward rate at time *t* on a contract maturing at time *T*. In the absence of arbitrage opportunities, the forward rate is given by:

(6) $F_{t,T} = S_t \exp\left(i_t^{EM} - i_t^{US}\right)$,

where i_t^{EM} and i_t^{US} are the risk free interest rate in the emerging country and the US, respectively. Substitution of (6) in (5) leads to the return on a foreign exchange investment:

(7) $r_t = s_t - s_{t-1} + i_{t-1}^{US} - i_{t-1}^{EM}$.

Many studies on trading strategies for developed exchange rate markets disregard the interest rate differential as the influence on profitability is found to be negligible see Sweeney (1986) and LeBaron (1999), among others. For emerging markets the interest rate differentials can be substantial, as shown below, and therefore should be taken into account.

The interest rates are taken from two different sources: Bloomberg and the IMF *International Financial Statistics (*IFS*)* database. The monthly IFS data has the advantage that it is available for a longer period while the Bloomberg data is daily updated. As daily data entails more information, Bloomberg 3 month interbank interest rates are used from the moment they are available; otherwise the IFS three month deposit rates are used.[7] Data on inflation (based on the Consumer Price Index (CPI)) also is taken from the IFS database and is four months delayed to avoid any look-ahead bias in our analysis due to publication lags in the CPI data.

[7] The daily data are available as of March 1995 (Peru), October 1995 (South Africa), November 1995 (India), November 1996 (Israel), November 1999 (Mexico) and November 2005 (Taiwan).

Sample statistics for the monthly returns of the six emerging foreign exchange markets are reported in Table 1.

Table 1 : Summary statistics

	Mexico	Peru	Taiwan	India	S-Africa	Israel
Mean	-9.2	-3.1	2.2	0.8	-3.6	-1.4
Standard deviation	9.4	4.2	5.7	4.8	15.5	7.3
Skew	1.89	-0.16	0.03	1.06	0.18	1.20
Kurtosis	18.6	6.0	7.8	7.9	4.4	7.68
Jarque-Bera	116.6	203.0	348.7	396.4	99.0	364.8
Mean spot rate return	5.1	3.5	2.0	3.0	4.7	3.9
Mean IRD	-14.3	-6.6	0.2	-2.2	-8.3	-5.3

Note: The table shows annualized statistics of monthly returns on six emerging markets foreign exchange rates (based on a long US dollar position and a short position in the emerging market) for the period March 1995- March 2006. The returns include the spot rate change as well as the interest rate differential between the US and the specific emerging market country. Rows 7-8 report respectively the average return on the foreign exchange rate only and the average interest rate differential.

The Mexican peso has the best performance with an annualized mean return of -9.2% per year, meaning that a long Mexican peso position and a short US dollar position resulted in a yearly profit of 9.2 percent on average. Note that the Mexican peso actually depreciated with 5.1 percent per year over the sample period, but this depreciation is more than compensated by the interest rate differential of -14.3 percent. The Taiwanese dollar has the worst performance with an average return of -2.2 percent per year. The annualized standard deviations of returns range between a low of 4.2 percent for the Peruvian sol and a high of 15.5 percent for the South African rand. Kurtosis is much higher than three, indicating a high peak and fat tails in the empirical distribution of the returns relative to a normal distribution. The tail behavior of emerging market currencies is studied in detail by Candelon and Straetmans (2006). The Jarque-Bera test shows that none of the currency returns are Gaussian which is due to the high kurtosis and the nonzero skewness. From the last two lines we conclude that we cannot disregard the interest rate differential in our return calculations. The average interest rate differential is even larger than the spot rate return for four out six markets. The (unreported) descriptive statistics for the daily data show a similar pattern, although the kurtosis is higher.

Table 2 shows the correlations of the monthly returns. All correlations are close to zero and only five out of the 15 correlations are significant. These small correlations are advantageous for our study, as it means that the models have to cover different types of markets.

Table 2 : Correlation matrix of monthly emerging markets exchange rate returns, March 1995-March 2006

	Peru	Taiwan	India	S-Africa	Israel
Mexico	0.30*	0.13	-0.04	0.04	0.19*
Peru		0.17	0.20*	0.15	0.05
Taiwan			0.25*	0.22*	-0.02
India				0.13	0.01
S-Africa					0.10

Note: An asterisk indicates significant at a 5% level.

Transaction cost estimates, defined as the bid-offer spread, for our emerging currencies are taken from 2001, the middle year of our sample, and vary per currency. We use the JP Morgan Guide to Emerging Market Currency Options (2001) as a source and are shown in Table 3.

Table 3 : Transaction cost estimates

	Mexico	Peru	Taiwan	India	S. Africa	Israel
Bid	9.5070	3.4800	34.50	47.00	9.1650	4.3550
Offer	9.5170	3.4950	34.55	47.2	9.1700	4.3580
B/O spread (BP)	5	22	7	21	3	3
Average daily volume	4.0	0.15	1.8	0.75	1.0	1.3

Note: The table shows the bid and offer price in USD, and the B/O spread in basis points as of 2001. The average daily volume is estimated by JP Morgan (2001) and is in billions of USD per day.

Transaction costs are highest for India and Peru, which can be explained by the fact that these foreign exchange markets are less developed than the other countries. They are also less liquid, as shown by the average daily volumes. Transaction costs will only be considered for the strategies that allow trading on a daily basis.

IV. Fundamentalist trading strategies

Fundamentalists believe that news in economic fundamentals is responsible for exchange rates movements. A fundamentalist takes into account all fundamental variables that are deemed to be important for determining the exchange rate. In this study the available information for the fundamentalists is approximated by the deviation from the PPP exchange rate and the real interest rate differential.

In its simplest form PPP states that the nominal exchange rate is determined by the relative price levels of the two countries involved, as identical goods should have the same price when expressed in the same currency. Taylor and Taylor

(2004) provide a recent comprehensive overview of the PPP literature. We obtain the PPP exchange rate S_t^{PPP} using the recursive relationship

$$(8) \qquad S_t^{PPP} = S_{t-1}^{PPP} \frac{1+\pi_{t-1,t}^{EM}}{1+\pi_{t-1,t}^{US}} \qquad \text{with} \quad S_0^{PPP} = S_0,$$

where $\pi_{t-1,t}^{EM}$ and $\pi_{t-1,t}^{US}$ are the monthly consumer price inflation rates in the emerging market and the US, respectively. Note that we assume that PPP holds at the start of the sample period ($S_0^{PPP} = S_0$). In addition, for Taiwan we rebalance three months after the Asian crisis, based on the assumption that the reason for a currency crisis is to regain equilibrium. This is in accordance with the Peso crisis, because around the start of our sample, March 1995, the Peso crisis is said to be ended. The PPP-based trading strategy boils down to taking a long position in the emerging market currency when the actual spot rate is below the PPP-rate and a short position when it is above. We denote this forecasting rule or signal as

$$(9) \qquad \begin{array}{l} PPP_t = 1 \quad if \quad S_t^{PPP} > S_t \\ PPP_t = -1 \quad otherwise \end{array}$$

Monthly series of signals were constructed using the monthly CPI.

The interest rates differential strategy uses the interest differential to generate buy and sell signals. Given the high inflation in emerging markets we do not consider the nominal differential but at the real interest differential (RID), see Isaac and De Mel (2001) for a recent discussion of the real interest rates differential literature. The RID forecasting rule is defined as:

$$(10) \qquad \begin{array}{l} RID_t = 1 \quad if \quad i_t^{US} - \pi_t^{US} > i_t^{EM} - \pi_t^{EM} \\ RID_t = -1 \quad otherwise \end{array}$$

That is, we take a long (short) position in the emerging market currency if its real interest rate is above (below) the US one.

We assume that our fundamentalist investor combines the signals given by PPP and RID for making her ultimate decision. Of course, there are infinitely many ways to combine the two pieces of information. Here we simply take the average of the two signals, that is

(11) $Fundamentalist_t = \frac{PPP_t + RID_t}{2}$

The combined fundamentalist signal will be +1 if both PPP and the real interest rate differential are negative on the emerging market currency. The signal will be neutral if the signals are the opposite of each other and the signal will be -1 if both signals are positive on the emerging market currency. Given the definition of both indicators other signals are not possible.

The fundamentalist signal is used to implement a trading strategy. The return of the strategy, $r_{t,i}^{strat}$, is computed as $r_{t,i}^{strat} = Fundamentalist_t \times r_{t+1}$. In addition, we consider strategies based on the individual PPP and RID signals. The Sharpe Ratio is used as the main criterion to judge the performance of the strategies.

The strategies are implemented for each of the six currencies individually. In addition, we consider the performance of equal-weighted (EW) and volatility-weighted (VW) portfolios. The weights in the latter portfolio are based on the ex post volatility of the spot rates, based on the idea behind that each currency contributes an approximately equal amount to the total portfolio risk. The return of the equal-weighted portfolio is computed as

(12) $r_t^{EW} = \frac{1}{6}\sum_{i \in \Omega} r_{t,i}^{strat}$

where Ω is the set of currencies used in this study. The return of the volatility-weighted portfolio is computed as

(13) $r_t^{VW} = \frac{1}{\sum_{i \in \Omega} \frac{1}{\sigma_i}} \sum_{i \in \Omega} \frac{r_{t,i}^{strat}}{\sigma_i}$

where σ_i is the volatility of the spot rate for country *i*. The results are summarized in Table 4.

Table 4 : Investment returns to fundamental trading strategies, 1995-2006.

	Mexico	Peru	Taiwan	India	S.Africa	Israel	EW	VW
Return								
PPP	3.3	3.1	3.1	0.7	3.8	3.9	3.0	2.8
RID	2.8	3.7	1.5	3.1	2.6	0.8	2.4	2.6
Fundamental	3.1	3.4	2.3	1.9	3.2	2.4	2.7	2.7
Volatility								
PPP	9.7	4.2	5.7	4.8	15.5	7.2	3.9	2.8
RID	9.7	4.2	5.7	4.8	15.5	7.3	3.7	2.7
Fundamental	4.8	4.0	3.6	3.0	15.4	5.4	3.2	2.1
Sharpe								
PPP	0.34	0.75	0.55	0.15	0.25	0.54	0.78	0.98
RID	0.29	0.89	0.26	0.66	0.17	0.12	0.66	0.93
Fundamental	0.64	0.85	0.64	0.64	0.21	0.44	0.85	1.25
t-statistic								
PPP	1.12	2.46	1.80	0.50	0.82	1.79	2.56	3.22
RID	0.96	2.91	0.85	2.16	0.55	0.38	2.18	3.06
Fundamental	2.12	2.79	2.12	2.09	0.69	1.46	2.80	4.11

Note: The table shows mean and standard deviation of returns, in annualized percentage points, for fundamental strategies applied to emerging markets exchange rates over the period 1995-2006. PPP is the purchasing power parity strategy, RID is the real interest rate differential strategy and "Fundamental" denotes the combined PPP and RID strategy. Columns 2-7 report the statistics for the individual currencies. Columns 8-9 report respectively the equal-weighted and volatility-weighted portfolio statistics. Transaction costs are not taken into account.

Several interesting conclusions emerge. First, the performance of the strategies for individual currencies based on PPP or RID only are fragile. Although all average returns for these strategies are positive, they only are significant (at a 5% level) for one or two currencies. In addition, the performance of the PPP and RID strategies may differ considerably, see e.g. Israel and India. Second, combining the PPP and RID signals pays off in terms of stabilizing the return and reducing risk. For most currencies the volatility of the fundamental strategy is substantially lower than the volatilities of the PPP and RID strategies for all currencies, see Mexico in particular. The performance of the combined fundamental model is significant for four of the six markets at the 5% level, with South-Africa and Israel being the exceptions. Third, combining currencies in a portfolio is an even more effective means for improving the strategies' performance through risk reduction. This holds in particular for the volatility-weighted portfolio, where the standard deviation of the returns on the combined strategy is only 2.1 percent. The importance of volatility weighting is also suggested by the substantial differences in the volatility of returns across the individual currencies. At the aggregated volatility-weighted portfolio level we observe that both the PPP and RID strategy have a similar performance with

Sharpe Ratios close to 1. Combining the two signals still enhances the performance, with the Sharpe Ratio increasing to 1.25.

V. Chartist trading strategies

Among the different types of technical trading rules employed by chartists moving average rules are one of the most popular types. Moving average rules generate a long signal when a short moving average of *K* days is above a long-term moving average of *L* days, that is

$$(14) \quad \begin{aligned} &Chartist_t = 1 \quad if \quad \tfrac{1}{K}\sum_{k=1}^{K} S_{t-k} \geq \tfrac{1}{L}\sum_{l=1}^{L} S_{t-l} \\ &Chartist_t = -1 \quad otherwise \end{aligned}$$

where $K < L$. Moving average rules are sometimes referred to as trend-following rules, as they generate long (short) signals when the exchange rate has recently been rising (falling). In order to prevent data-snooping, as discussed in the context of technical trading rules by Sullivan, Timmermann and White (1999), we decide to only test one particular rule with K=20 and L=65, corresponding to one and three months, respectively. This type of chartist strategy fits well with the moving average rules that are often assumed in heterogeneous agents models, see Chiarella et al. (2006). We compute the returns of the moving average strategy as before, with the difference that the signal in (14) is updated daily. Given that this may lead to high turnover, we now also consider the effects of transactions costs.

Table 5 contains the empirical results from the moving average strategy based on Equation (14) for the six emerging markets in our sample. We observe that the average returns of these strategies are positive for all six currencies, and significant at the 5% level for four exchange rates.

Table 5 : Investment returns to technical trading strategy, 1995-2006

	Mexico	Peru	Taiwan	India	S.Africa	Israel	EW	VW
Return	0.0	1.0	6.5	3.8	8.0	5.5	4.1	3.7
Volatility	9.7	4.5	5.3	5.1	13.4	6.2	4.0	3.4
Sharpe Ratio	0.00	0.22	1.23	0.74	0.60	0.88	1.05	1.10
t-statistic	0.01	0.74	4.06	2.45	1.97	2.90	3.44	3.62

Note: The table shows mean and standard deviation of returns, in annualized percentage points, for the moving average strategy applied to emerging markets exchange rates over the period 1995-2006. Columns 2-7 report the statistics for the individual currencies. Columns 8-9 report respectively the equal-weighted and volatility-weighted portfolio statistics. Transaction costs are not taken into account.

The best risk-adjusted results are obtained for the Taiwan dollar, with a Sharpe ratio of 1.23 and t-statistic of 4.06. This is in line with Lee, Pan, and Liu (2001), who find that moving average technical trading rules work well for the Taiwan dollar over the period 1988-1995. The Mexican peso has an average return of almost zero, which is in contrast with the positive results reported by Lee, Gleason, and Mathur (2001) for the period 1992-99. Apart from the different sample period, this discrepancy can also be explained by the fact that Lee et al. (2001) do not take into account the interest rate differential in the calculation of the returns. As we have seen in Table 1. the interest rate differential is not negligible for the Mexican peso.

Combining the individual currencies again achieves a large reduction in risk. The equal-weighted portfolio based on the moving average trading rule has a highly economically and statistically significant Sharpe ratio of 1.05. The Sharpe ratio further increases to 1.10 for the volatility-weighted portfolio, as the moving average rule performs worst for the highly volatile Mexican peso and South-African rand on an individual basis.

The results including transactions costs are displayed in Table *6*. As the moving average rule tested in this research is rather slow, turnover is relatively low, and hence transactions costs only play a minor role. The number of changes in position ranges between 6 and 8 per year, which means that the chartist trades about once every two months. The portfolio Sharpe ratios decline from 1.05 to 0.92 for equal-weighting and 1.10 to 0.91 for volatility-weighting, respectively. The statistical significance remains.

Table 6: Investment returns to technical trading strategies 1995-2006, including transactions costs.

	Mexico	Peru	Taiwan	India	S.Africa	Israel	EW	VW
Return	-0.3	0.1	6.1	2.7	7.9	5.3	3.6	3.1
Volatility	9.7	4.5	5.3	5.1	13.4	6.2	4.0	3.4
Sharpe Ratio	-0.03	0.03	1.15	0.52	0.58	0.85	0.92	0.91
t-statistic	-0.10	0.10	3.80	1.72	1.92	2.79	3.01	3.00
Turnover	8	6	7	6	8	8	-	-

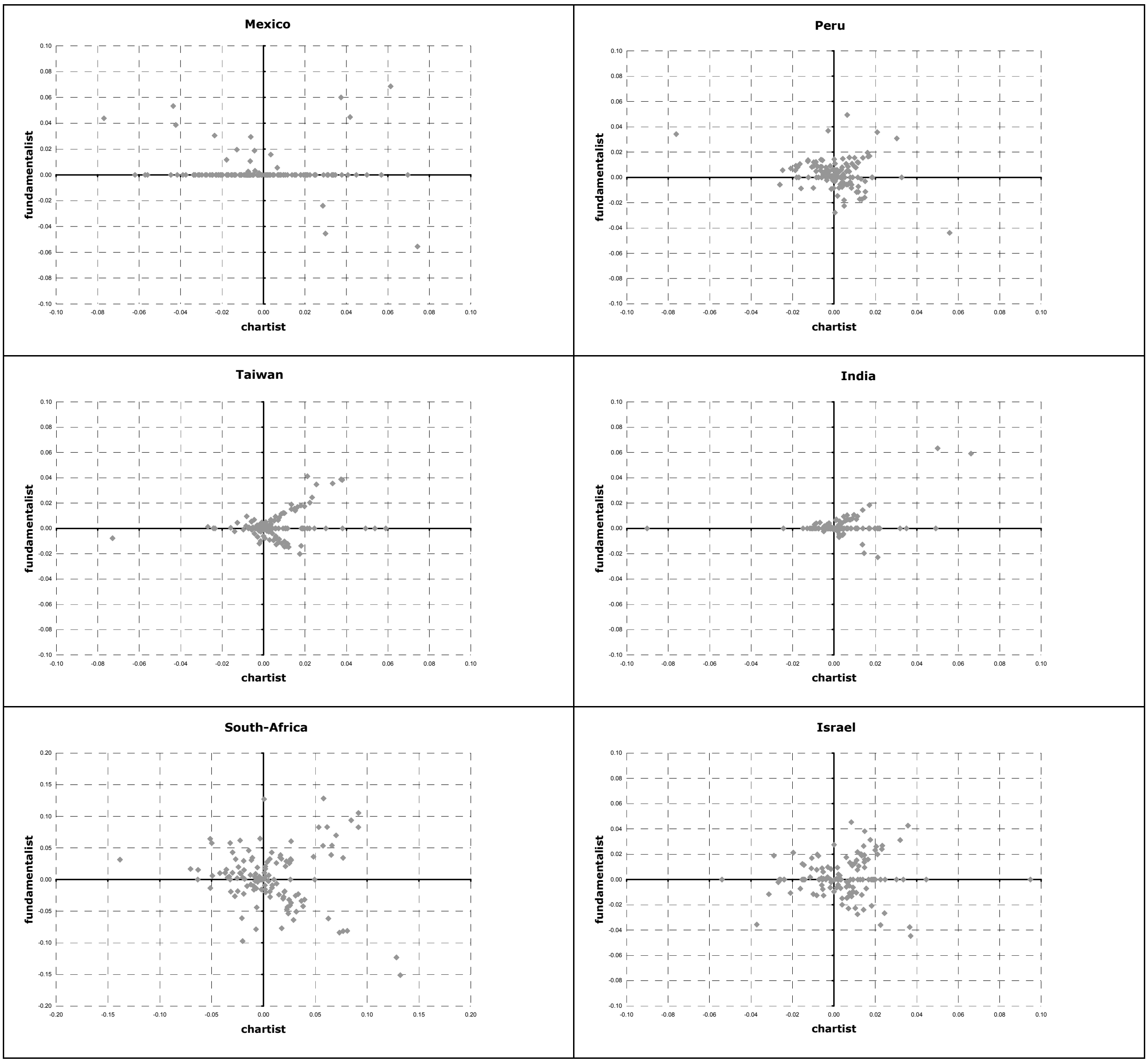
Note: The table shows mean and standard deviation of returns, in annualized percentage points, for the moving average strategy applied to emerging markets exchange rates over the period 1995-2006. Columns 2-7 report the statistics for the individual currencies. Columns 8-9 report respectively the equal-weighted and volatility-weighted portfolio statistics. Transaction costs are taken into account and taken from Table 3. The portfolio turnover is defined as the average number of sign changes per year.

Thus, based on our empirical analyses, we conclude that chartists may benefit from applying technical trading rules in emerging markets currencies.

VI. Heterogeneous agents' strategies

In the previous two sections we analyzed the profitability of fundamentalist and chartist investment strategies for emerging currency markets. The empirical results indicate that both types of strategies generated – on average – significantly positive results over the period 1995-2006. In this section, we investigate whether it is worthwhile to combine fundamental and technical analysis, with the weight given to the two types of signals depends on their relative past performance. As discussed before, this empirical question relates to the theoretical research on heterogeneous agents models of Chiarella et al. (2006), De Grauwe and Grimaldi (2005, 2006) and De Grauwe and Markiewicz (2006), in which agents may switch investment strategies based on past performance. Basically, what we try to do is empirically validate Equation (4). Previous empirical research on heterogeneous agents models, such as Vigfusson (1997) and De Jong et al. (2006), found only limited evidence supporting the switching behavior that follows from the theoretical models. Our study contributes to this line of literature by examining the profitability of strategies that switch between fundamentalist and chartist strategies based on past performance in emerging currency markets.

Figure 2: Scatter plots of monthly returns on the fundamentalist and chartist strategies



Before turning to the combined investment strategies in detail, their potential benefits are illustrated by means of the scatter plots of monthly returns on the fundamentalist and chartist strategy for each of the countries, as shown in Figure 2. For observations in quadrants I and III, both strategies generate positive and negative returns, respectively. Combining the strategies for these months is not worthwhile. The percentage of observations in these quadrants ranges between 25 percent for Mexico to 56 percent for India, see Table 7. Conversely, this means that between 44 and 75 percent of the observations are in quadrants II and IV, representing months in which one type of investor incurs a loss while the other incurs a gain. This suggests that the investor could benefit from switching between fundamentalist and chartist investment strategies or combining the two strategies.

Table 7 : Contemporaneous returns of chartist and fundamental strategies

Quadrant	Mexico	Peru	Taiwan	India	S.Africa	Israel
I	25	31	34	48	27	35
II	60	34	26	21	29	20
III	0	11	14	8	14	13
IV	15	25	26	23	29	31
Axis	85	12	31	63	8	28

Note: The numbers in rows 2-5 denote the percentage of the total observations that are in a certain quadrant and not on an axis. The row labeled "Axis" indicates the number of observations that are on an axis (because the fundamental signal can be zero).

The most crucial decision to make when combining the fundamental and chartist strategies is the weight attached to both strategies. Here we examine two possibilities. First, as a naive benchmark we consider a combined investment strategy that puts equal weight on the signals of the fundamental and chartist strategies:

(15) $$Naive_t = \frac{Fundamentalist_t + Chartist_t}{2}$$

where the two individual trading signals are defined in Equation (11) and (14). The performance of this strategy is displayed in Table 8. The weights on the strategies are updated monthly, but within the chartist strategy positions can be opened or closed each day as before.

Table 8 : Performance of the naive 50/50 strategy 1995-2006, including transactions costs.

Naive 50/50	Mexico	Peru	Taiwan	India	S-Africa	Israel	EW	VW
Average	1.4%	1.7%	4.1%	2.2%	5.5%	3.8%	3.1%	2.9%
Volatility	5.1%	2.6%	3.6%	3.5%	9.5%	4.2%	2.4%	2.0%
Sharpe	0.27	0.66	1.13	0.63	0.58	0.90	1.29	1.44
T-statistic	0.88	2.16	3.71	2.08	1.91	2.97	4.24	4.75

All statistics are annualized. Columns 2-7 report the statistics for the individual currencies. Columns 8-9 report respectively the equal-weighted and volatility-weighted portfolio statistics. The transactions costs are included and taken from Table 3.

We observe that the risk-adjusted performance, as measured by the Sharpe ratio, is higher than the maximum of the fundamental and chartist strategy for two individual currency pairs, and for four currency pairs is in between. The equal-weighted portfolio improves to a Sharpe ratio of 1.29 and the volatility-weighted strategy to 1.44. Hence, combining the fundamentalist and chartist information results in higher risk-adjusted investment returns. This result is in line with the questionnaire results obtained by Taylor and Allen (1992), Lui and Mole (1998), Cheung and Chinn (2001), and Gehrig and Menkhoff (2004), which indicate that foreign exchange dealers based in the major foreign exchange trading centres view technical and fundamental analysis as complementary sources of information.

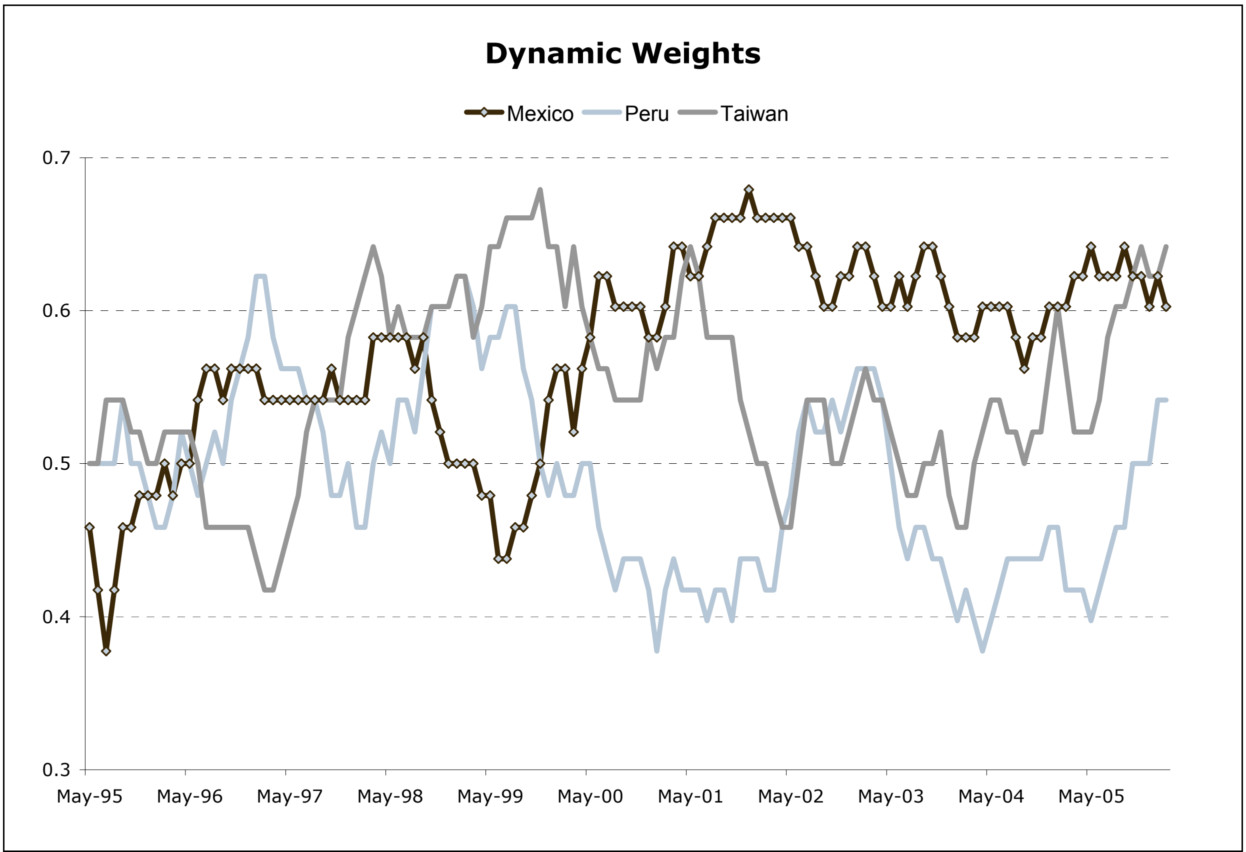
In the heterogeneous agents models developed in De Grauwe and Grimaldi (2005, 2006), Chiarella et al. (2006), and De Grauwe and Markiewicz (2006), agents determine the weight assigned to the different available investment strategies based on their relative past performance. In order to test whether this delivers superior returns we test a second combined investment strategy with dynamic weights placed on fundamental and chartist signals as follows:

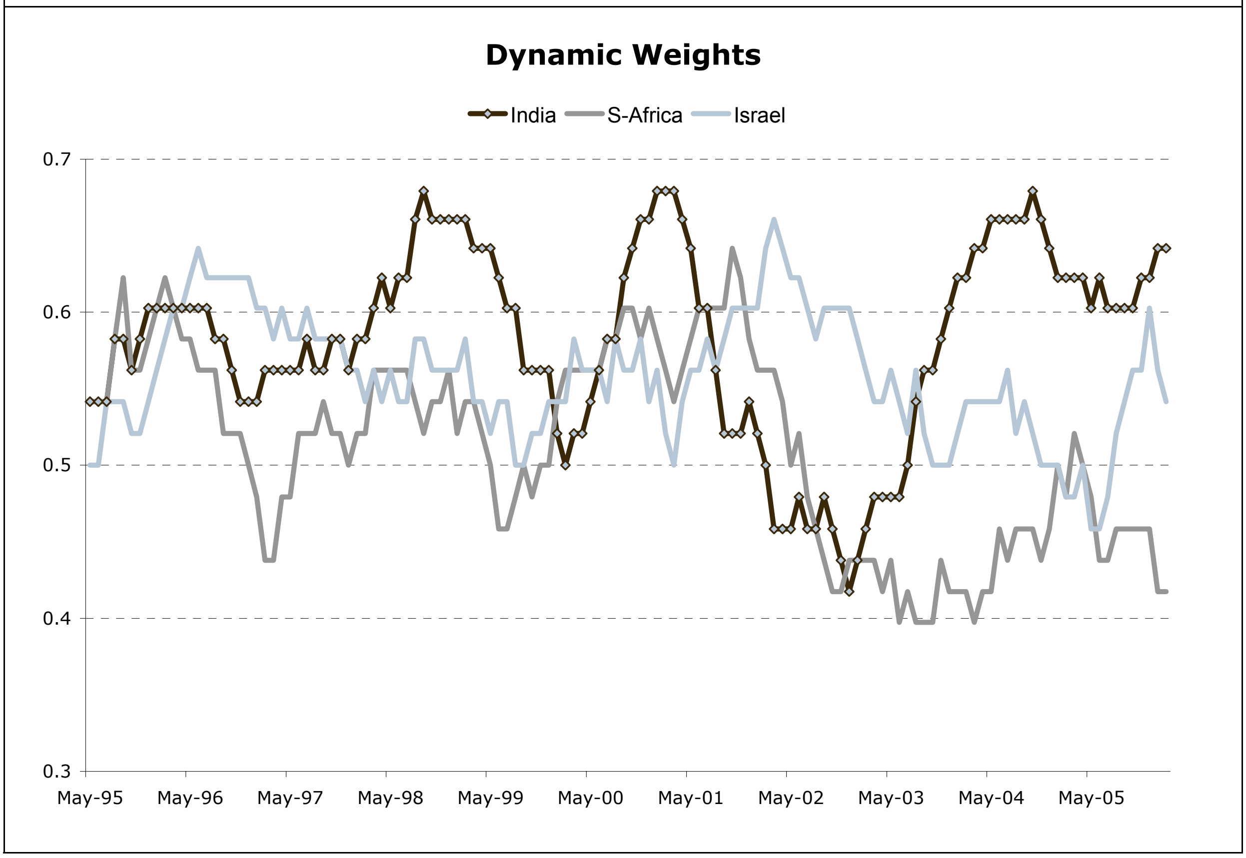
(16) $$Dynamic_t = \frac{\exp\{F_t\}}{\exp\{F_t\} + \exp\{C_t\}} \times Fundamentalist_t + \frac{\exp\{C_t\}}{\exp\{F_t\} + \exp\{C_t\}} \times Chartist_t$$

where F_t and C_t are the average number of months during the past year with positive returns for the fundamental and chartist strategies, respectively.

In Panels A and B of Figure 3 we show how the weights of Equation (16) change over time for the six currencies. We observe that the weight attached to the technical trading rules ranges between 0.4 and 0.7, with the average weight being slightly larger than 0.5. This corresponds with the finding that most foreign exchange dealers attach relatively more weight to technical analysis at short horizons.

Figure 3: Dynamic weights for the chartist strategy.





The performance statistics of this dynamic strategy are summarized in Table 9. We observe that for five out of six currencies the Sharpe ratio increases relative to the naive equal-weighted combination strategy discussed before, with Mexico being the only exception. Moreover, the Sharpe ratios of both the equally- and volatility-weighted portfolio significantly increase, with the Jobson-Korkie *t*-statistic taking values of 2.83 and 3.05, respectively.

Table 9 : Investment returns for the dynamic strategy 1995-2006, after inclusion of transactions costs.

Dynamic trading	Mexico	Peru	Taiwan	India	S-Africa	Israel	EW	VW
Average	1.3%	2.0%	4.5%	2.4%	7.2%	4.1%	3.6%	3.2%
Volatility	5.7%	2.6%	3.8%	3.6%	9.7%	4.4%	2.5%	2.1%
Sharpe	0.23	0.76	1.21	0.66	0.74	0.95	1.43	1.58
Sharpe (naive)	0.27	0.66	1.13	0.63	0.58	0.90	1.29	1.44
Diff. SR (t-stat)	-1.17	1.78	2.40	1.03	2.99	1.02	2.83	3.05

All statistics are annualized. Columns 2-7 report the statistics for the individual currencies. Columns 8-9 report respectively the equal-weighted and volatility-weighted portfolio statistics. The statistical significance of the difference in the Sharpe ratios between the naïve (constant 50/50) and dynamic (time-varying) strategy is tested using the Jobson and Korkie (1989) method. The transactions costs are included and taken from Table 3.

These results suggest that we can discriminate periods in which the chartists and fundamentalists are driving the exchange rate movements based on the historical performance of these strategies, as indicated by Equation (4). In other words, our analysis suggests that investors may use heterogeneous agents models in order to benefit from predicting exchange rate movements in emerging markets.

As a robustness check, we test whether our conclusions regarding the combination of fundamentalist and chartist information hold for nine other emerging currency markets. In Table 10 we display the descriptive statistics of these currencies, including the date as of which these currencies became floating. We only use the currency returns after that date in our analysis below.

Table 10 : Descriptive statistics for the currencies in the robustness check

	Hungary	Poland	Turkey	Brasil	Chile	Columbia	Korea	Thailand	Philippines
Float date	Jun-01	Apr-00	Feb-01	Jan-99	Sep-99	Sep-99	Nov-97	Jul-97	Mar-92
Transactions costs	6	2	32	7	3	42	4	11	19
Trading volume	0.6	1.3	1	3	1	0.08	3.5	0.5	0.15
Mean	-4.6%	-6.8%	-27.8%	-14.7%	-1.8%	-3.1%	-4.2%	-0.5%	-1.5%
Standard deviation	6.4%	10.1%	16.2%	19.3%	9.7%	8.4%	18.5%	14.1%	9.6%
Skew	0.82	0.73	-0.35	0.53	-0.12	0.91	3.19	-1.45	1.37
Kurtosis	4.6	3.2	3.1	7.3	2.2	4.9	29.0	15.1	9.9
Jarque-Bera	56.5	36.1	25.1	192.9	16.5	90.0	3683.6	1029.8	574.5
Mean spot rate return	1.9%	-0.3%	5.4%	1.8%	-0.1%	2.0%	-2.1%	2.3%	6.3%
Mean interest rate differential	-6.5%	-6.5%	-33.2%	-16.4%	-1.7%	-5.1%	-2.1%	-2.9%	-7.8%

The returns must be interpreted as the return on a long US dollar position and a short position in the emerging market. Rows 2-4 report the date that the currency became floating, the transactions costs (in bp), and the average daily trading volume (in billions of USD). The transactions costs and trading volume are from JP Morgan (2001). Rows 5-9 report the annualized statistics of monthly returns on six emerging markets foreign exchange rates from the floating date to March 2006. The returns include the spot rate change as well as the interest rate differential between the US and the specific emerging market country. Rows 10-11 report respectively the average return on the foreign exchange rate only and the average interest rate differential.

The robustness check is most powerful if these new currencies are only weakly correlated with the ones considered so far in the analysis. For that reason, we calculate the pairwise correlations between the six currencies analyze before and the nine new currencies in Table 11.

Table 11 : Correlation matrix of the monthly emerging markets exchange rate returns

	Hungary	Poland	Turkey	Brasil	Chile	Columbia	Korea	Thailand	Philippines
S-Africa	0.03	-0.02	0.08	0.04	0.16	0.01	0.11	0.15	0.11
Israel	-0.11	-0.04	0.08	0.15	0.22	0.01	0.03	0.02	-0.04
Mexico	0.27*	0.40*	0.22	0.32*	0.23*	0.21	0.02	0.05	0.06
Peru	0.25	0.17	0.11	0.34*	0.03	0.23*	0.07	0.07	0.02
Taiwan	0.08	-0.12	0.12	0.13	0.22	0.09	0.17	0.59*	0.31*
India	0.16	-0.03	0.26	0.18	0.16	0.16	0.27*	0.08	0.04

*The pairwise correlations are calculated over the period that the currency became floating until March 2006. * Correlation significant on a 5% significance level*

From Table 11 we learn that in general the correlation between old and new exchange rates is close to zero, especially across regions. Within regions we observe higher and sometimes statistically significant correlations.

The performance of the strategies based on fundamental, chartist, and combined information is shown in Table 12. We observe that for all but one of the countries both the fundamental and chartist strategies have positive Sharpe ratios. The fundamental strategy for Hungary is the only exception with a negative Sharpe ratio of -0.07. For the fundamental strategies the Sharpe ratio is highest for Thailand with 0.71. The highest Sharpe ratio for a chartist strategy is found for Colombia with 1.21, while Korea has the lowest (0.04). The observation that most Sharpe ratios are positive, and many significant, indicates the value of both chartists and fundamentalist information in our extended set of currencies.

Table 12 : Robustness analysis: Investment returns for different emerging currency pairs.

Model	Statistic	Hungary	Poland	Turkey	Brazil	Chile	Colombia	Korea	Thailand	Philipines	EW	VW
Fundamental	Sharpe Ratio	-0.07	0.58	0.32	0.54	0.59	0.15	0.53	0.71	0.33	0.92	1.10
Technical	Sharpe Ratio	0.39	0.82	0.18	0.51	0.42	1.21	0.04	0.24	0.02	0.92	0.85
Constant 50/50	Average	0.2%	4.6%	5.2%	12.1%	4.5%	3.6%	5.0%	6.7%	1.5%	4.0%	3.4%
	Volatility	4.0%	5.4%	14.6%	16.8%	5.6%	5.5%	11.7%	8.4%	5.9%	2.9%	2.4%
	Sharpe Ratio	0.06	0.85	0.36	0.72	0.80	0.66	0.43	0.80	0.25	1.37	1.41
Time-varying	Average	0.4%	5.1%	6.5%	13.4%	5.4%	3.8%	6.3%	7.0%	1.3%	4.6%	4.0%
	Volatility	4.4%	6.2%	16.2%	15.2%	5.9%	5.6%	11.9%	8.4%	6.1%	3.1%	2.6%
	Sharpe Ratio	0.08	0.81	0.40	0.88	0.91	0.68	0.53	0.84	0.22	1.51	1.54
Difference Sharpe Ratio (t-stat)		0.32	-0.66	1.07	1.56	1.63	0.44	1.40	0.69	-0.67	2.32	2.28

All statistics are annualized. Columns 3-8 report the statistics for the individual currencies. Columns 9-10 report respectively the equal-weighted and volatility-weighted portfolio statistics. The statistical significance of the difference in the Sharpe ratios between the constant 50/50 and time-varying strategy is tested using the Jobson and Korkie (1989) method. The transactions costs are included and taken from Table 3. The EW and VW portfolios start in September 1999, when 6 currency pairs are available; the three other pairs are added to the portfolio when they become floating.

In addition, we find for 7 out of 9 of these additional currency pairs that the Sharpe ratio increases when the dynamic weights of Equation (16) are employed, compared to the equal-weighted combination. For both the equal-weighted and value-weighted portfolio we find that the difference is significantly positive at the 5% level. Thus, this robustness check confirms our conclusions from the six currency pairs investigated above that there is empirical evidence in favour of the heterogeneous agents models developed by De Grauwe and Grimaldi (2005, 2006).

VII. Conclusions

Empirical research on forecasting exchange rates has tended to focus on the usefulness of either technical analysis or of structural exchange rate models. Both questionnaires among foreign exchange market participants as well as recently developed heterogeneous agents models indicate that both types of information are relevant for assessing exchange rate movements. In addition, the heterogeneous agents models suggest that the relative importance of chartism and fundamentalism varies over time according to the past performance of the corresponding trading strategies. In this paper we provide empirical support for this conjecture, based on an analysis of 15 emerging market currencies from different regions over the period 1995-2006.

We combine fundamental information on the deviation from purchasing power parity and the real interest rate differential with chartist information from a simple moving average technical trading rule, with time-varying weights determined by the relative performance of the individual trading strategies over the past year. We document that this combined investment strategy renders economically and statistically significant risk-adjusted returns, after accounting for transactions costs. The dynamic combination strategy significantly outperforms the fundamental and technical trading strategies, as well as a naïve equally weighted combination.

Further research can be done on the inclusion of other types of agents in the currency market. More specifically, we suggest the inclusion of flowtists and high frequentists, who look at (proprietary) customer order flows of investment banks and at trends in high frequency data, respectively. Gehrig and Menkhoff (2004), for example, document that many foreign exchange market participants consider flow analysis as an independent third type of information, next to technical analysis and fundamental information. The inclusion of these two additional agents may provide more empirical evidence for heterogeneous agents in (emerging) currency markets.

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