The Economic Value of Fundamental and Technical Information in Emerging Currency Markets*

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Abstract

We measure the economic value of information derived from macroeconomic variables and from technical trading rules for emerging markets currency investments. Using a sample of 23 emerging markets with a floating exchange rate regime over the period 1995-2007, we document that both types of information can be exploited to implement profitable trading strategies. In line with evidence from surveys of foreign exchange professionals concerning the use of fundamental and technical analysis, we find that combining the two types of information improves the risk-adjusted performance of the investment strategies.

Keywords: Emerging markets, Foreign exchange rates, Structural exchange rate models, Technical trading, Heterogeneous agents
JEL Classification: C53, F31, G15

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1 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 as used in technical trading rules. Meese and Rogoff's (1983) finding that structural models cannot outperform a naive random walk forecast at short horizons still stands after 25 years of intense research, see Cheung *et al.* (2005) for a recent assessment. There is somewhat more supportive evidence for the usefulness of macroeconomic information for forecasting exchange rates at longer horizons, see Mark (1995), Kilian (2001) and Berkowitz and Giorgianni (2001), among others. In general, the performance of technical trading rules at short horizons has been found to be considerably better, see Sweeney (1986), Levich and Thomas (1993) and Neely and Weller (1999), with Menkhoff and Taylor (2007) providing a recent comprehensive survey. Nevertheless, Olson (2004), Pukthuanthong-Le *et al.* (2007) and Neely *et al.* (in press) report that the profitability of technical trading rules has weakened substantially in recent years, at least for developed currencies.

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), Menkhoff (1997), Lui and Mole (1998), Cheung and Chinn (2001), and Gehrig and Menkhoff (2004). 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 the forecasting (or trading) horizon becomes longer.

The weights assigned to fundamental and technical information for a given horizon may also vary over time. For example, Frankel and Froot (1990) provide empirical evidence for the switch of many professional forecasters from being "fundamentalists" (using structural models and macro data) to acting as "chartists" (using technical trading rules) during the second half of the 1980s. They motivate this changing behavior by the fact that fundamentalists experienced large negative

returns in the mid-1980s, when currency prices deviated from their fundamental values. The concept of switching behavior has been formalized in so-called heterogeneous agents models. Brock and Hommes (1997, 1998) develop equilibrium models in which agents update their beliefs about the profitability of investment strategies based on their past performance. These 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 leads them to switch back to simple and costless strategies that might again result in prices moving away from their fundamental value. These heterogeneous agents models have recently been applied to currency markets, explicitly allowing for the presence of both chartists and fundamentalists, see Chiarella *et al.* (2006), and De Grauwe and Grimaldi (2005, 2006). The relative importance of these two types of traders (and, hence, the two types of information) 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, with weights varying over time as a function of past profitability.

Most research on exchange rate forecasting has focused on developed markets. Scarcely any attention has been paid to emerging market currencies, possibly due to the fact that many emerging countries maintained a fixed or pegged exchange rate regime until fairly recently.[1] Since the mid-1990s, approximately, more and more countries have switched to a floating exchange rate regime, such that by now the time series length as well as the cross-sectional breadth are sufficient to warrant a meaningful investigation of exchange rate predictability in emerging markets. To the best of our knowledge we are the first to conduct such an analysis. Previous empirical research on heterogeneous agents models has also been limited to developed currency

[1] One aspect of exchange rate forecasting in emerging markets that did receive ample attention in the past is prediction of currency crises, in particular by means of so-called early warning systems, see Kaminsky (2006) for a detailed overview.

markets, such as Vigfusson (1997) and De Jong *et al.* (2006), which report only limited evidence supporting the switching behavior that is assumed in the theoretical models. Our study contributes to this literature by examining the profitability of trading strategies that switch between fundamentalist and chartist strategies based on past performance in emerging currency markets.

In this paper we conduct a comprehensive analysis of the economic value of technical and fundamental information in emerging currency markets. Specifically, we assess the performance of currency trading strategies based on monthly fundamental information derived from the real interest rate differential, GDP growth, and the ratio of money supply to foreign exchange reserves, as well as a set of daily moving average technical trading rules. We implement these strategies for all freely floating emerging market currencies relative to the US dollar over the period 1995-2007. We also consider combined strategies in which both chartist and fundamentalist information are used, in line with the actual behavior of market participants, as discussed above. In particular, we examine a dynamic combination scheme with time-varying weights according to the relative profitability of the fundamental and technical strategies. As a benchmark we employ a naive strategy that assigns constant and equal weights to the two types of information. Throughout the empirical analysis, we also consider nine developed currencies as a control sample.

Our results can be summarized as follows. First, both fundamentalist and chartist strategies generate economically and statistically significant Sharpe ratios for emerging currency markets. This finding is consistent with McNown and Wallace (1989), who document that fundamentalist trading strategies perform well in four emerging markets over the period 1972-1986. Our positive results for technical trading rules provide out-of-sample evidence for the profits described by Martin (2001) and Lee *et al.* (2001a) for the early 1990s.

Second, we document that naively combining chartist and fundamentalist strategies generates positive risk-adjusted returns that are both economically and statistically significant. Moreover, the performance of the combined strategy is much more consistent and stable across currencies than the individual fundamentalist and chartist strategies. This provides convincing evidence for the complementary value of technical and fundamental information as suggested by questionnaires among currency traders. The dynamic combined strategies, where the weights assigned to

fundamentalist and chartist strategies vary according to their past performance, do not increase the profitability of the trading strategy relative to the naive combination. Thus, we find only limited empirical support for the enhanced profitability of the investment strategies based on the heterogeneous agents models of Chiarella *et al.* (2006) and De Grauwe and Grimaldi (2005, 2006).

Third, for developed currency markets we find that fundamental trading strategies render statistically and economically significant Sharpe ratios, but this is not the case for the chartist strategies. This result is in line with Abhyankar *et al.* (2005), who conclude that investors may benefit from fundamental exchange rate models trading the US dollar against the Canadian dollar, Japanese Yen, and British Pound over the period 1977-2000. It also corroborates the findings of Olson (2004), Pukthuanthong-Le *et al.* (2007) and Neely *et al.* (in press), who document that returns to technical trading strategies in developed markets have declined over time.

The remainder of this paper is organized as follows. In Section 2 we describe the data. We examine the performance of the fundamentalist and chartist strategies individually in Sections 3 and 4, respectively. In Section 5 we integrate the chartist and fundamentalist information into combined strategies. Finally, we conclude in Section 6.

2 Data description

Our analysis is most relevant for exchange rates under a free float, as currency prices in this system are determined in principle by demand and supply, although intervention activities of central banks cannot be ruled out completely.[2] Data before 1995 is thus not considered, as most of the countries in our sample adopted a floating exchange rate regime around that time or later.[3] In total we examine the currencies

[2]We refer to the conference notes of the IMF 'High-Level seminar on exchange rate regimes: Hard peg or free floating?' for an overview of central bank intervention activity in the emerging currency markets, see `http://www.imf.org/external/pubs/ft/seminar/2001/err/eng/`.

[3]In the late 1980s 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 rate. A side effect of the emerging markets currency crises during the 1990s has been that most emerging markets changed their exchange rate system from a pegged to a floating regime. Currently, only a small number of emerging market countries still maintain a (crawling) peg regime: China (pegged to the US dollar), Russia (pegged to a basket of the US dollar and euro), Vietnam (US dollar) and Pakistan

of 23 emerging markets which currently have a (managed) floating exchange rate system: the Argentine peso, Brazilian real, Chilean peso, Colombian peso, Mexican peso and Peruvian sol from Latin-America; the Indian rupee, Indonesian rupiah, Kazakhstan tenge, Korean won, Malaysian ringitt, Phillipine peso, Sri Lanka rupee, Taiwanese dollar and Thai bath from Asia; and the Czech koruna, Hungarian forint, Israeli shekel, Polish zloty, Romanian leu, Slovak koruna, South African rand, and Turkish lira from Europe, Middle-East, and Africa (EMEA). All of these currencies became floating at some point between January 1995 and June 2007. Figure 1 shows the historical development of the number of emerging market countries with a floating exchange rate regime in our sample. The exact dates of the the currencies' floats are given in Table 1.

- insert Figure 1 about here -

We employ daily and monthly exchange rates for the technical trading rules and the fundamental models, respectively. The exchange rates correspond to Reuters 07:00 GMT middle rate fixings against the US dollar.[4] All exchange rates are expressed in the standard way, that is, as the price of one US dollar in the emerging market currency. The sample period runs from January 1, 1995 to June 30, 2007 (3260 daily and 150 monthly observations), where it is to be understood that each currency is included in the analysis only six months after the start of its floating exchange rate regime. In practice, most investors will hold off investing in a currency for some time to avoid the often dramatic exchange rate movements immediately following the float of a currency. The market has sufficiently 'cooled down' after about half a year for most currencies.

A common instrument that can be used for *sec* investments in the currency market is the currency forward contract. These instruments enable us to invest in a currency without owning any underlying assets, for example bonds or stocks, in the country. With the help of the forward contract we lock in a specific foreign exchange rate in the future. The investment return on a currency is then defined as

(US dollar).

[4]Results for the Eastern European currencies (CZK, SKK, PLN, HUF and RON) relative to the EUR are similar and available upon request.

the difference between this forward rate and the future spot rate:

$$r_t = s_t - f_{t-1,t} \tag{1}$$

where s_t is the log spot rate at time t and $f_{t-1,t}$ is the log forward rate at time $t-1$ maturing at time t. In the absence of arbitrage opportunities, the forward rate is given by:

$$F_{t-1,t} = S_{t-1} \exp(i_{t-1}^{EM} - i_{t-1}^{US}) \tag{2}$$

where i_{t-1}^{EM} and i_{t-1}^{US} are the cash interest rates in the emerging country and the US, respectively. The cash rate is generally the offshore deposit rate for money deposited in the currency and maturity that matches the maturity of the forward contract, for example the London Interbank Offered Rate (LIBOR) for US dollars.[5] Substitution of (2) in (1) leads to the return on a foreign exchange investment:

$$r_t = s_t - s_{t-1} + i_{t-1}^{US} - i_{t-1}^{EM} \tag{3}$$

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 for a fair judgement of the investment returns. We obtain interest rates 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 time period, while the Bloomberg data is updated on a daily basis. As daily data entails more information, Bloomberg three-month interbank interest rates are used from the moment they are available; otherwise IFS three-month deposit rates are used.[6]

- insert Table 1 about here -

[5]The cash rates are quoted on an annualized basis. For our return calculations the cash rates are scaled to the a daily or monthly basis by dividing the rate by 360 days and multiplying by the number of days that a position will be held.

[6]We use the three-month deposit rates because our final trading strategy (see Section 5) holds its positions for three months on average.

Summary statistics for the monthly returns of the emerging markets currencies are reported in Table 1.[7] The Turkish lira has the best performance with an annualized mean return of 25.6 percent per year, relative to the US dollar. Note that the Turkish lira hardly moved during its floating period (February 2001 - June 2007), but an investor was more than compensated by the interest rate differential of 25.4 percent per year. The Taiwanese dollar has the worst performance with an average return of –2.45 percent per year. The annualized standard deviations of the monthly returns range between a low of 3.4 percent for the Malaysian ringitt (July 2005 - June 2007) and a high of 26.5 percent for the Indonesian Rupiah (August 1997 - June 2007). For 12 of the 23 currencies the 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 unreported Jarque-Bera test shows that almost none of the currency returns are Gaussian, due to the high kurtosis and the nonzero skewness. The example of the Turkish lira mentioned above already suggests that we should not disregard the interest rate differential when computing the investment return on the emerging market currencies. This is confirmed by the last two columns of Table 1, showing that the average interest rate differential is even larger than the spot rate return for 11 out of 23 currencies.

Table 1 also includes summary statistics of our developed markets control sample. This sample holds the G10 currencies: Australian dollar, Canadian dollar, UK pound, Japanese yen, Euro, Swiss franc, Norwegian krone, Swedish krona, and the New Zealand dollar, all relative to the US dollar. We use the German Deutschmark for the history of the euro prior to 1999. The New Zealand dollar performs best with an annualized return of 3.7 percent. The Japanese yen shows the worst performance with an average return of -7.1 percent per year. The average volatility is 9.4 percent, with much less variation across currencies than for the emerging markets.

Finally, we compute the cross-correlations of the monthly returns. The average correlation between all possible pairs of emerging markets exchange rates is 0.18. Most correlations are in fact close to zero, although some currencies within the

[7]The (unreported) descriptive statistics for the daily returns show similar patterns, although the kurtosis is higher. This corresponds quite well with the stylized fact of asset returns that non-normality (in particular peakedness and fat tails) becomes more pronounced at higher frequencies

same region have a correlation of up to 0.50 for Asia and 0.75 for Europe. These small correlations are advantageous for our empirical analysis, as it means that the trading strategies can benefit from diversification if we combine the currencies in a portfolio. The cross-correlations among emerging market currencies are considerably smaller than those for the developed exchange rates, which generally exceed 0.75. For example, the correlation between the euro and Swiss Franc is equal to 0.94. The main exception is the correlation of the Japanese yen with the other developed currencies, which is substantially lower and equals 0.32 on average.

3 Fundamentalist trading strategies

Fundamentalists believe that the exchange rate is intimately linked to macroeconomic variables such as output, inflation, and the trade balance, among others. Hence, news in these economic "fundamentals" is responsible for exchange rate movements. A wide variety of structural exchange rate models is available that might be used for forecasting the future exchange rate. Cheung *et al.* (2005) conclude that "old-fashioned", basic structural models, such as the real interest rate differential (see Frankel (1979), for example) perform at least as good as more recent, elaborate models. This motivates us to use relatively simple structural models in our empirical analysis. In particular, we assume that fundamentalists derive their exchange rate forecasts from information on the real interest rate differential, the growth rate of GDP, and the growth rate of the ratio of the money supply (M2) to foreign exchange reserves.[8] Furthermore, we do not explicitly estimate regression models that include these variables as regressors, but instead we simply use them to generate buy and sell signals for the different currencies based on a prediction of the sign of the exchange rate return in the next month, as explained in detail below. On the one hand, this is motivated by the fact that the time period during which the emerging market currencies are floating generally is already rather short. Using part of the available sample for model estimation would leave only a very limited number of observations for out-of-sample forecasting. On the other hand, as pointed out by Leitch and Tanner (1991), among others, correctly forecasting the *sign* of asset returns is perhaps

[8]Data on inflation, GDP, M2 and Reserves are taken from the IFS database. The Taiwan data comes from the website of the Taiwanese Central Bank.

more crucial than forecasting their magnitude when it comes to economic forecast evaluation measures such as the performance of trading strategies.

The three macroeconomic variables are used to generate buy and sell signals as follows. First, we consider the real interest rate differential (RID) as an example. Given the high inflation in emerging markets we do not consider the nominal differential but the real interest differential, see Isaac and de Mel (2001) for discussion of the real interest rates differential literature. The RID forecasting rule can be thought of in terms of the variable RID_t, defined as

$$RID_t = \begin{cases} 1 & \text{if } i_{t-1}^{EM} - \pi_{t-1}^{EM} < i_{t-1}^{US} - \pi_{t-1}^{US}, \\ -1 & \text{otherwise,} \end{cases} \tag{4}$$

where i_{t-1}^{X} is the short-term interest in country X and π_{t-1}^{X} is the corresponding inflation rate. The values 1 and -1 for RID_t correspond to a long position in the US dollar and in the emerging market currency, respectively. In other words, in month t we take a long (short) position in the emerging market currency if its real interest rate in month $t-1$ is above (below) the US one.

The levels of GDP in the countries under consideration differ substantially, therefore we consider the relative GDP growth rates as more appropriate for forecasting the direction of the future exchange rate movement. As higher GDP growth leads to higher income, we expect an increased demand for money and therefore a stronger currency. Hence, we take a long position in the emerging market currency if its GDP growth over the past 12 months was higher than the US GDP growth, and a short position when GDP growth was lower. The GDP buy-sell indicator may thus be defined as

$$GDP_t = \begin{cases} 1 & \text{if } \Delta GDP_{t-1}^{EM} < \Delta GDP_{t-1}^{US}, \\ -1 & \text{otherwise,} \end{cases} \tag{5}$$

where ΔGDP_{t-1}^{X} is the GDP growth rate in country X.

Our third and final fundamental variable, the growth rate of the ratio of M2 money supply ($M2$) to foreign exchange reserves (RES), influences exchange rates through the rules of demand and supply. A loss of international reserves or a large rise in the domestic money supply can lead to less confidence in a currency and therefore less demand and more supply. Let $\Delta\left(\frac{M2_{t-1}^{X}}{RES_{t-1}^{X}}\right)$ denote the 12-month growth rate of the money-reserves ratio in country X in period $t-1$. The investment decision

is based on the buy-sell indicator

$$M2R_t = \begin{cases} 1 & \text{if } \Delta\left(\frac{M2^{EM}_{t-1}}{RES^{EM}_{t-1}}\right) > \Delta\left(\frac{M2^{US}_{t-1}}{RES^{US}_{t-1}}\right) \\ -1 & \text{otherwise,} \end{cases} \tag{6}$$

that is, we take a long position in the currency with the lowest growth of the money-reserves ratio.

Although in the following we also consider the strategies based on the *RID*, *GDP* and *M2R* signals individually, we mainly focus on an investor who combines the different fundamental signals for making her ultimate decision. Of course, there are infinitely many ways to combine the three pieces of information. Here we take the simple average of the three signals, that is

$$F_t = \frac{RID_t + GDP_t + M2R_t}{3}. \tag{7}$$

Note that the combined fundamentalist signal will be +1 if all three strategies are negative on the non-US currency, and vice versa.

The fundamental buy-sell indicators RID_t, GDP_t, $M2R_t$, and F_t are used to implement trading strategies with monthly rebalancing. The return of the fundamental strategy based on signal Y_t for currency i, $r^Y_{i,t}$, is computed as $r^Y_{i,t} = Y_t \cdot r_{t,i}$, where $r_{i,t}$ is the return on a short position in the non-US currency (and thus a long position in the US dollar) for month t. This is a long-short investment strategy, because we will be long in one currency and short in the other currency. The risk free rate is therefore an appropriate benchmark. For this reason we use the Sharpe Ratio as the main criterion to judge the performance of the strategies, because our returns are self financed (excess) returns.

The strategies are implemented for all the emerging and developed currencies individually. In addition, we consider the performance of equally-weighted (EW) and volatility-weighted (VW) portfolios. The weights in the latter portfolio are set proportional to the inverse of the ex post volatility of the spot rates, as measured by the standard deviation over the whole sample period. This is based on the idea that in that case each currency contributes an approximately equal amount to the total portfolio risk. The return of the equal-weighted and volatility weighted portfolios are computed as

$$r^{Y,EW}_t = \frac{1}{n_t}\sum_{i\epsilon\Omega_t} r^Y_{i,t} \qquad \text{and} \qquad r^{Y,VW}_t = \frac{1}{\sum_{i\epsilon\Omega_t}\frac{1}{\sigma_i}}\sum_{i\epsilon\Omega_t}\frac{1}{\sigma_i} r^Y_{i,t} \tag{8}$$

where Ω_t is the set of available currencies at time t, n_t the number of currencies in Ω_t at t, and σ_i is the volatility of the spot rate for country i. We acknowledge that the use of the full-sample standard deviation to weight the currencies entails some form of data-snooping and also avoids the fact that, especially for the emerging markets, the volatilities vary over time. More advanced weighting schemes using an ex ante volatility measure would, however, put serious limitations on the sample period available for forecast evaluation. Hence, these are left for future research.

- insert Table 2 about here -

The results for the fundamental strategies based on the individual *RID*, *GDP* and $M2R$ signals are summarized in Table 2. Several interesting conclusions emerge. First, the performance of the strategies for individual currencies based on *RID* or *GDP* is on average positive, while the performance of the $M2R$ strategy is mostly negative. Especially for the *GDP* strategy the average return is also significantly different from zero (in terms of t-values at a 5 percent significance level) for quite a large number of currencies, while no significantly negative average returns occur. The $M2R$ strategy renders a significantly negative average return for two individual countries, compared to only one significantly positive return. Thus, the *RID* and *GDP* strategies seem to provide considerably more accurate forecasts of future exchange rate movements than the $M2R$ strategy. Within the strategies the results vary dramatically across countries. For example, the average returns on the *RID* strategy range between 14.3 and –5.1 percent for Turkey and Kazakhstan, respectively. For the other strategies the variation is even more pronounced. This also shows up in the volatilities of the individual strategies, see India and Slovakia, for example.

For the developed currencies, we also find that the $M2R$ strategy performs relatively worse for most countries. A difference with the emerging markets is, however, that the real interest rate differential seems to be more informative for the exchange rate movements than the relative GDP growth rates. Except for the Swedish krona, the RID strategy results in positive average returns for all developed currencies, which furthermore are statistically significant for four of the eight countries.

The results in Table 2 do not take into account transaction costs. To investigate the influence of such costs, we record the number of transactions in each strategy

and compute break-even transaction costs. The average number of transactions per year is equal to approximately 1, 0.5 and 1.5 for the *RID*, *GDP* and $M2R$ strategies, respectively. Compared to trend strategies these numbers are rather low (as shown in the next section), which also results in relatively high levels of break-even transaction costs. For most countries and strategies having a positive performance, break-even transaction costs exceed 2 percent, which for most currencies is clearly above the level of transactions costs encountered in practice by a large institutional investor. More detailed results on the *RID*, *GDP* and $M2R$ strategies are not shown here to save space, but are available upon request.

Combining the individual currencies in a portfolio results in significantly positive returns for the *RID*- and *GDP*-based strategies, except for the equally-weighted emerging market portfolio based on the real interest rate differential. The benefits of diversification across currencies become clear by noting the low volatilities of the portfolio returns. For the emerging markets, we also observe a substantial difference in returns for the equally-weighted and volatility-weighted portfolios, especially for the *GDP* strategy. This is due to the fact that the countries generating the highest average returns for this strategy, including Turkey, Argentina, Indonesia and Brazil, also have the highest exchange rate volatility (see Table 1) and thus receive a relatively small weight in the volatility-weighted portfolio. The reduction in average return from 4.32 to 2.49 percent when going from equal weighting to volatility weighting is, however, more than compensated for by the reduction in volatility, from 4.2 to 1.9, such that the Sharpe ratio in fact increases. For the $M2R$ strategy the portfolio performances are negative, albeit insignificant, as expected from the poor performance of this strategy for the individual currencies.

- insert Table 3 about here -

Our next step is to combine the individual fundamental signals, as in (7). Table 3 reports results of this combined strategy. The most pronounced effect of combining the three fundamental signals is a substantial reduction in volatility. For almost all currencies, the volatility of the combined strategy is about 50% lower compared to the individual strategies. The same applies to the volatility at the portfolio level. At the same time, the average portfolio returns for the combined strategy are also lower than those for the individual *RID* and *GDP* strategies, due to the inclusion

of the negative performing $M2R$ strategy. The reduction in returns is relatively small though for the emerging market RID strategy, such that the resulting Sharpe ratio is considerably higher. For the volatility-weighted portfolio, for example, the Sharpe ratio reaches 0.96, compared to 0.80 for the corresponding portfolio in the RID strategy. Due to the larger return difference, the combined strategy performs worse than the GDP-based strategy, which achieves a Sharpe of 1.30. The decline in average returns is also much larger for the developed portfolios, such that both the individual RID and GDP strategies outperform the combined strategy.

Returning to the results for individual emerging market currencies, we observe that the performance differences across countries of the combined strategy are much less extreme than for the individual strategies in Table 2. We find positive average returns for 18 of the 23 currencies, while none of the five negative average returns are significant. In sum, combining the fundamental signals results in an attractive and fairly robust fundamentalist trading strategy.

4 Chartist trading strategies

Among the different types of technical trading rules employed by chartists moving average rules are by far the most popular. The general idea of these rules is to give a buy signal when a fast moving average of the spot rate over the previous K days is above a slow moving average taken over the previous L days, that is

$$MA_t(K,L) = \begin{cases} 1 & \text{if } \frac{1}{K}\sum_{k=1}^{K} S_{t-k} \geq \frac{1}{L}\sum_{l=1}^{L} S_{t-l}, \\ -1 & \text{otherwise,} \end{cases} \tag{9}$$

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). We compute the returns of the moving average strategy as before, with the difference that the signal in (9) is updated daily.

In order to prevent data-snooping, as discussed in the context of technical trading rules by Sullivan *et al.* (1999), we decide to combine a range of moving average rules instead of testing one particular rule. To determine a reasonable range for the lengths of the fast and slow moving averages, we vary K between 1 – 20 days in steps of one day and L between 25 – 200 days in steps of 5 days. Figure 2 shows the empirical results for the individual moving average strategies based on (9) for each

of the resulting 720 different combinations of K and L. Panels (a) and (b) of Figure 2 show the average t-values for the 23 emerging markets currencies and for the nine developed currencies, respectively. For the emerging markets we observe that the average t-value of these strategies is positive for all settings. The average t-values are high for the models with a relatively short slow moving average ($L < 100$), independent of the length of the fast moving average.

The results for the developed markets are disappointing. For all settings the t-value is between –0.5 and 1. Closer inspection of these results reveals that they actually are poor for each of the individual developed currencies. This finding is in line with Olson (2004), Pukthuanthong-Le *et al.* (2007) and Neely *et al.* (in press), who report that profit opportunities for the moving average rules in the developed currency markets disappeared by the mid-1990s.

Based on these results we decide to select all rules with a fast moving average between 5 and 20 days and a slow moving average between 25 and 65 days, resulting in 144 combinations of K and L. The simple average of the resulting buy-sell signals $MA_t(K, L)$ obtained from (9) is defined as the buy-sell indicator C_t, which is employed in the chartist trading strategy.

- insert Figure 2 and Table 4 about here -

Table 4 reports the performance statistics of the chartist strategy. The trend strategy renders a positive return for 21 of the 23 currencies, where 10 are significant at a 5% level. One of the best risk-adjusted results is obtained for Taiwan, with a Sharpe ratio of 1.23 and t-statistic of 4.26. This is in line with Lee *et al.* (2001b), who find that moving average technical trading rules work well for Taiwan over the period 1988-1995. The high Sharpe ratios for Colombia, Romania and Kazakhstan are also worth mentioning (1.23, 1.22 and 2.02 respectively), although their floating regime history is shorter than for Taiwan. Negative returns, albeit not significant, are found for the Mexican peso and the Sri Lanka rupee. Our findings for Mexico are in contrast with the positive results reported by Lee *et al.* (2001a) for the period 1992-99. Apart from the different sample period, this discrepancy can be explained by the fact that Lee *et al.* (2001a) do not take into account the interest rate differential in the calculation of the exchange rate returns. As seen in Table 1, with an average

of 12.7 percent per year the interest rate differential is far from 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 rules has a highly economically and statistically significant Sharpe ratio of 1.24. The Sharpe ratio further increases to 1.52 for the volatility-weighted portfolio, as the moving average strategy performs well for the relatively less volatile currencies (Taiwan, Peru, India, Israel and Philippines), while it performs worse for some of the more volatile currencies (Mexico and Czech Republic).

Trend models with daily rebalancing as considered here may lead to high turnover. For that reason we now also consider the effects of transactions costs. Columns 6 and 7 in Table 4 show the number of transactions and the break-even transaction costs, respectively. Averaged across individual currencies, the number of transactions equals approximately 6.7 per year, which means that the chartist investor trades about once every two months in each currency. Compared to the fundamental strategies these numbers are rather high. For most countries and strategies having a positive performance, break-even transaction costs exceed 0.4 percent, which for most currencies is still above the level of transactions costs encountered in practice by a large institutional investor.

Thus, based on our empirical analysis, we conclude that chartists may benefit from applying a moving average trading rule in emerging markets currencies. Note that this is not the case for the developed markets in our control sample. Although the average return is positive for eight of the nine currencies, none of these are significantly different from zero. Even combining the currencies into a portfolio does not render significantly positive risk-adjusted returns, possibly as a result of the limited diversification potential due to the high cross-correlations among these currencies.

5 Combining fundamentalist and chartist trading rules

In the previous two sections we analyzed the profitability of fundamentalist and chartist investment strategies for emerging currency markets. Our empirical results

indicate that both types of strategies generate significantly positive risk-adjusted returns over the period 1995-2007. In this section, we investigate whether the performance can be improved further by combining fundamental and chartist information. We start by examining a naive equally-weighted combination of both types of information. Subsequently, this is extended to a combined strategy where the relative weight given to fundamental and chartist signals is based on their past performance.

Table 5 shows the performance statistics of the strategy that is based on an equally-weighted combination of the fundamental signal F_t and the chartist signal C_t. This strategy mimics the behavior of a currency trader who puts equal value on fundamentalist and chartist information. The benefits of combining both sources of information is clearly borne out by the results for the individual emerging markets. The 'naive' combination yields positive risk-adjusted returns for all 23 currencies, with no less than 12 being significant at the 5 percent level. We also note that turnover is reduced compared to the chartist strategy in Table 4, such that for most currencies the break-even transaction costs are considerably higher than transaction cost levels encountered in practice.

At the portfolio level, the highly significant Sharpe ratios equal 1.39 and 1.63 for the equally-weighted and volatility-weighted portfolios, respectively, which also are higher than the Sharpe ratios for the fundamental and chartist strategies individually. The Sharpe ratio of the combined strategy is significantly higher than the fundamental strategy according to the Jobson and Korkie (1981) test (and Memmel's (2003) adjustment). Although the Sharpe ratio of the chartist strategy is not significantly different from the combined strategy at the 5% level, the Jobson-Korkie t-values of 1.80 and 1.44 for the equal and volatility weighted portfolios, respectively, are quite high.[9] This indicates that over the past 12 years an emerging markets currency trader would have earned higher risk-adjusted returns from combining fundamentalist and chartist trading rules, even with a naive equally-weighted combination.

- insert Table 5 about here -

This result for emerging markets is in line with the questionnaire results obtained by Taylor and Allen (1992), Lui and Mole (1998), Cheung and Chinn (2001), and

[9]Details are not reported here to save space, but are available upon request.

Gehrig and Menkhoff (2004), which indicate that foreign exchange dealers, based in the major foreign exchange trading centers, view technical and fundamental analysis as complementary sources of information. In contrast, a naive combination does not seem to add sufficient value for an investor in the developed markets. We observe that none of the individual developed currencies has a risk-adjusted return which is statistically significant at the 5% level. Sharpe ratios are even negative (albeit insignificant) for Canada and Norway. The equally-weighted and volatility-weighted portfolios of developed currencies yield t-values of 1.72 and 1.60, respectively, indicating that the risk-adjusted returns (0.50 and 0.46) are not significantly different from zero.

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

$$W_t^F = \frac{\exp\left(\gamma \sum_{j=1}^{J} r_{t-j}^F\right)}{\exp\left(\gamma \sum_{j=1}^{J} r_{t-j}^F\right) + \exp\left(\gamma \sum_{k=1}^{K} r_{t-k}^C\right)}, \tag{10}$$

$$W_t^C = \frac{\exp\left(\gamma \sum_{j=1}^{J} r_{t-j}^C\right)}{\exp\left(\gamma \sum_{j=1}^{J} r_{t-j}^F\right) + \exp\left(\gamma \sum_{j=1}^{J} r_{t-j}^C\right)} = 1 - W_t^F, \tag{11}$$

where W_t^F and W_t^C are the weights on the fundamentalist and chartist signals, respectively, r_t^F and r_t^C are the returns on the fundamentalist and chartist trading strategies in month t, and J is the length of the look-back period of the investor. The parameter $\gamma \geq 0$ determines the strength of the deviation from the equally weighted average and thus measures the 'aggressiveness' of the dynamic weighting scheme. Note that the limiting case $\gamma = 0$ implies equal weighting, as this reduces W_t^F and W_t^C to 0.5. Figure 3 shows an example of the sensitivity of the dynamic weights for the choice of γ for Indonesia over the period 2004-2007.

- insert Figure 3 about here -

In Table 6 we display the results from the dynamic weighting scheme in (10) and (11) with $J = 12$ months and $\gamma = 30$, as well as the results of our equally-weighted strategy for the period 1997-2007.[10] The results from this dynamic approach are mixed for the individual countries, as about 2/3 of the Sharpe ratios (and their t-values) decrease relative to the equally-weighted strategy. Nevertheless, we observe a small increase in the level of risk-adjusted returns for both emerging market portfolios from 1.26 and 1.53 to 1.31 and 1.59 for the equally-weighted and volatility-weighted portfolios, respectively. This result does not depend on the particular configuration of the parameters J and γ, as can be seen in Figure 4. This figure shows the Sharpe ratios of the portfolio based on the combined strategy with dynamic weights for different look-back periods J ranging from 1 to 24 months and for different levels of 'aggressiveness' as measured by γ. Panel (a) of Figure 4 contains the results for the emerging markets portfolio. The Sharpe ratios are comparable for all parameter settings, although we do observe a modest increase in the Sharpe ratio when the look-back period gets longer and the strategy becomes more aggressive. The difference in Sharpe ratios between the best performing dynamic strategy (with $J = 24$ and $\gamma = 50$) and the equally-weighted strategy is not significant, however.[11] In panel (b) of Figure 4, where we rotate the graph by 90 degrees, it can be seen that for developed currency markets the naive equally-weighted combination seems to be best within the range of parameters considered. The Sharpe ratio declines along both dimensions with J or γ. This leads us to the conclusion that a dynamic weighting scheme between chartists and fundamentalists does not yield additional returns relative to a naive combination.

- insert Table 6 and Figure 4 about here -

6 Conclusions

Empirical research on exchange rate forecasting 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

[10] We reduce the sample period to 1997-2007 such that the performance evaluation covers the same period for all values of the look-back period J, which we vary between 1 and 24 months.

[11] More detailed results are available upon request.

heterogeneous agents models indicate that both types of information are relevant for assessing future 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 analyze the economic value of combining chartist and fundamentalist information for 23 emerging currency markets with a floating exchange rate regime over the period 1995-2007. We document that an equally-weighted combined chartist/fundamentalist investment strategy renders economically and statistically significant positive risk-adjusted returns. Although both fundamentalist and chartist trading rules individually also generate positive risk-adjusted returns on average, the performance of the combined strategy is far superior and, in particular, much more stable across countries. Notably, the dynamic strategy, in which the weights assigned to chartist and fundamental information are adjusted dynamically based on relative past performance, does not outperform a naive equally-weighted combination.

Further research can be done on the inclusion of other types of information in the emerging currency market. More specifically, it may be of interest to expand our information set with information on (proprietary) customer order flows of investment banks, which have been studied, as far as our knowledge, only for developed markets, see Evans and Lyons (1999), among others. 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 this additional source of information may further increase the economic value of emerging markets currency investments.

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Table 1: Summary statistics currency returns

Currency	Float	Mean	Stdev	Skew.	Kurt.	FX	IRD
Emerging							
Taiwanese dollar (TWD)	Dec-94	2.45	5.52	0.06	5.43	1.9	0.6
Peruvian sol (PEN)	Dec-94	−3.17	4.00	−0.12	4.12	2.7	−5.8
Indian rupee (INR)	Dec-94	0.04	5.05	0.74	5.13	2.0	−1.9
Mexican peso (MXN)	Dec-94	−8.23	9.06	0.53	1.68	4.4	−12.7
S. African rand (ZAR)	Jan-95	−2.07	15.37	0.20	1.21	5.5	−7.6
Czech koruna (CZK)	May-97	−5.45	11.57	−0.27	−0.20	−4.5	−1.0
Israeli shekel (ILS)	Jun-97	−1.82	7.41	1.45	5.46	1.9	−3.8
Thai bath (THB)	Jul-97	−3.55	11.97	−2.43	18.33	−3.3	−0.3
Phillipine peso (PHP)	Jul-97	−4.70	8.43	−0.05	4.43	1.4	−6.1
Indonesian rupiah (IDR)	Aug-97	−11.97	26.49	−0.64	8.83	0.4	−12.3
Korean won (KRW)	Dec-97	−5.47	9.60	−0.14	4.58	−4.6	−0.8
Slovak koruna (SKK)	Oct-98	−8.92	10.26	−0.24	−0.29	−6.2	−2.7
Brazilian real (BRL)	Feb-99	−13.31	17.61	1.10	5.24	0.9	−14.2
Chilean peso (CLP)	Sep-99	0.19	9.27	−0.14	−0.34	0.7	−0.5
Colombian peso (COP)	Sep-99	−5.05	9.14	−0.12	3.30	0.1	−5.1
Polish zloty (PLN)	Apr-00	−11.80	11.01	0.08	−0.30	−7.1	−4.7
Turkish lira (TRY)	Feb-01	−25.64	16.68	0.34	1.93	−0.2	−25.4
Hungarian forint (HUF)	May-01	−13.45	12.02	0.59	1.16	−7.7	−5.7
Sri Lanka rupee (LKR)	Dec-01	−4.59	3.92	−1.39	9.41	2.9	−7.5
Argentine peso (ARS)	Jan-02	−13.77	9.28	−1.38	2.40	−4.1	−9.6
Romanian leu (RON)	Oct-04	−9.85	8.93	0.17	−0.90	−8.0	−1.9
Kazakhstan tenge (KZT)	Dec-04	−5.09	6.40	1.21	3.65	−4.1	−1.0
Malaysian ringitt (MYR)	Jul-05	−4.41	3.44	0.43	0.19	−6.0	1.6
Developed							
Australian dollar (AUD)	Dec-94	−2.59	9.88	0.21	−0.04	−1.3	−1.2
Canadian dollar (CAD)	Dec-94	−1.84	6.33	−0.09	0.01	−2.1	0.3
UK sterling (GBP)	Dec-94	−3.04	7.26	0.03	−0.14	−1.9	−1.1
Japanese yen (JPY)	Dec-94	7.13	11.02	−0.88	4.72	3.1	4.0
Euro (EUR/DEM)	Dec-94	1.31	9.37	−0.25	0.06	0.2	1.1
Swiss franc (CHF)	Dec-94	3.14	9.87	−0.28	−0.39	0.5	2.7
Norwegian krone (NOK)	Dec-94	−0.99	9.99	−0.12	0.58	−0.5	−0.5
Swedish krona (SEK)	Dec-94	−0.14	10.13	−0.31	−0.01	−0.5	0.4
N. Zealand dollar (NZD)	Dec-94	−3.70	10.58	0.28	0.43	−1.3	−2.4

Note: The table shows annualized statistics (mean, standard deviation, skewness and kurtosis) of monthly returns on 23 emerging markets and 9 developed market foreign exchange rates (based on a long US dollar position and a short position in the emerging market) for the period January 1995 - June 2007. The returns include the spot rate change as well as the interest rate differential between the US and the specific country. Columns 7-8 report the average, annualized return on the foreign exchange rate (FX) and the average, annualized interest rate differential (IRD), respectively.

Table 2: Performance of fundamental trading strategies

	Average return			Standard deviation		
	RID	*GDP*	*M2R*	*RID*	*GDP*	*M2R*
Emerging						
TWD	−0.21	−0.87	−1.37	5.6	5.6	5.5
PEN	3.20∗	2.38∗	−1.02	4.0	4.0	4.1
INR	2.66∗∗	−0.04	0.75	5.0	5.0	5.0
MXN	4.01	9.59∗	−1.33	9.3	8.9	9.4
ZAR	1.02	2.11	−7.70∗∗	15.4	15.4	15.2
CZK	0.20	7.48∗	1.45	11.7	11.5	11.7
ILS	1.82	0.97	−1.98	7.4	7.4	7.4
THB	1.57	−1.15	−3.35	12.0	12.0	12.2
PHP	2.66	4.70∗∗	−3.06	8.5	8.4	8.5
IDR	−4.72	11.64	−4.68	26.7	26.5	26.7
KRW	3.15	−2.33	5.14	9.7	9.7	9.6
SKK	1.31	8.64∗	6.02∗∗	10.6	10.3	10.4
BRL	13.31∗	11.48∗∗	2.67	17.6	17.7	18.0
CLP	5.39	−0.19	−4.65	9.1	9.3	9.2
COP	1.20	6.33∗∗	0.88	9.3	9.1	9.3
PLN	8.73∗	4.90	5.04	11.2	11.4	11.4
TRY	14.30∗	25.64∗	−19.64∗	17.8	16.7	17.4
HUF	7.09	14.20∗	−8.96∗∗	12.5	11.9	12.4
LKR	0.41	4.59∗	2.14	4.1	3.9	4.1
ARS	−0.69	13.77∗	−11.83∗	10.1	9.3	9.5
RON	−0.81	9.85	14.07∗∗	9.4	8.9	8.4
KZT	−5.09	5.09	−2.86	6.4	6.4	6.5
MYR	−4.41	4.41	−1.58	3.4	3.4	3.6
Developed						
AUD	5.61∗	5.95∗	−0.10	9.8	9.8	9.9
CAD	0.93	−2.63	−2.91	6.3	6.3	6.3
GBP	1.58	3.23	−0.25	7.3	7.3	7.3
JPY	5.85∗∗	7.13∗	−7.84∗	11.1	11.0	11.0
EUR	5.42∗	1.39	0.16	9.3	9.4	9.4
CHF	7.26∗	3.03	0.20	9.7	9.9	9.9
NOK	3.79	−4.45	−2.10	9.9	9.9	10.0
SEK	−0.76	−2.26	5.86∗	10.1	10.1	10.0
NZD	1.00	11.57∗	0.02	10.6	10.1	10.6
Portfolios						
EM-EW	2.21∗∗	4.32∗	−1.63	4.1	4.2	4.2
EM-VW	1.49∗	2.49∗	−0.64	1.9	1.9	1.6
DEV-EW	3.41∗	2.55∗	−0.77	5.3	3.9	4.3
DEV-VW	3.23∗	2.18∗	−0.79	5.1	3.8	4.0

Note: The table shows average return, in annualized percentage points, and standard deviations for the fundamental strategies based on the real interest differential (*RID*), relative GDP growth (*GDP*) and relative growth in the M2 to reserves ratio (*M2R*) applied to all exchange rates over their floating currency regime periods (see Table 1). * and ** indicate that the average return is significantly different from zero at the 5% and 10% level, respectively.

Table 3: Performance of combined fundamentalist trading strategy

	Mean	Stdev	Sharpe	t-value	#TR	BETC
Emerging						
TWD	−0.81	3.6	−0.23	−0.79	1.02	−0.4
PEN	1.52	2.2	0.70	2.42	1.13	0.7
INR	1.12	2.7	0.42	1.45	0.52	1.1
MXN	4.09	5.6	0.73	2.53	0.88	2.3
ZAR	−1.52	10.1	−0.15	−0.52	0.58	−1.3
CZK	3.04	7.0	0.43	1.35	1.31	1.2
ILS	0.27	3.9	0.07	0.21	0.87	0.2
THB	−0.97	5.0	−0.19	−0.58	1.39	−0.4
PHP	1.43	5.2	0.28	0.85	0.88	0.8
IDR	0.75	11.4	0.07	0.20	0.86	0.4
KRW	1.99	5.4	0.37	1.11	1.03	1.0
SKK	5.32	5.7	0.94	2.69	0.89	3.0
BRL	9.16	10.0	0.92	2.59	0.80	5.7
CLP	0.18	5.4	0.03	0.09	1.45	0.1
COP	2.80	4.5	0.62	1.68	0.50	2.8
PLN	6.22	7.2	0.86	2.23	1.09	2.9
TRY	6.77	10.5	0.64	1.56	0.62	5.5
HUF	4.11	7.1	0.58	1.39	0.88	2.3
LKR	2.38	2.4	1.00	2.23	0.67	1.8
ARS	0.42	3.4	0.12	0.27	0.67	0.3
RON	9.30	4.0	2.32	2.76	1.71	2.7
KZT	−0.95	2.2	−0.44	−0.63	0.32	−1.5
MYR	−0.53	1.2	−0.43	−0.53	0.44	−0.6
Developed						
AUD	3.82	7.0	0.55	1.90	1.19	1.6
CAD	−1.54	2.8	−0.56	−1.94	1.24	−0.6
GBP	1.52	3.6	0.43	1.48	0.99	0.8
JPY	1.71	6.8	0.25	0.88	0.39	2.2
EUR	2.32	4.9	0.48	1.66	0.47	2.5
CHF	3.50	5.2	0.67	2.32	0.74	2.3
NOK	−0.92	5.8	−0.16	−0.55	1.32	−0.3
SEK	0.95	4.7	0.20	0.70	1.93	0.2
NZD	4.20	6.2	0.67	2.35	0.86	2.5
Portfolios						
EM-EW	1.65	2.41	0.68	2.37	1.28	0.6
EM-VW	1.11	1.15	0.96	3.35	0.90	0.6
DEV-EW	1.73	2.52	0.69	2.39	1.46	0.6
DEV-VW	1.51	2.32	0.65	2.27	1.03	0.7

Note: The table shows mean return (in annualized percentage points), standard deviation, the Sharpe ratio and its t-value, the average number of transactions per year (#TR) and the breakeven transaction costs (BETC) for the fundamental strategy combining signals from the real interest differential (RID), relative GDP growth (GDP) and relative growth in the M2 to reserves ratio ($M2R$), applied to all exchange rates over their floating currency regime periods (see Table 1). Transactions are reported as the single counted average number of transactions per year; therefore turnover is twice the number of transactions. The four bottom lines report the same statistics for equally-weighted (EW) and volatility-weighted (VW) portfolios for emerging (EM) and developed (DEV) markets.

Table 4: Performance of combined chartist trading strategy

	Mean	Stdev	Sharpe	t-value	#TR	BETC
Emerging						
TWD	5.00	4.1	1.23	4.26	5.86	0.43
PEN	2.14	3.5	0.62	2.15	6.21	0.17
INR	4.84	4.4	1.09	3.79	5.55	0.44
MXN	−2.94	9.8	−0.30	−1.04	8.25	−0.18
ZAR	5.96	13.1	0.46	1.58	6.84	0.44
CZK	1.13	11.0	0.10	0.32	7.80	0.07
ILS	4.88	5.9	0.83	2.56	6.48	0.38
THB	6.22	7.8	0.80	2.46	6.45	0.48
PHP	4.63	6.3	0.73	2.26	5.91	0.39
IDR	14.53	21.4	0.68	2.08	6.87	1.06
KRW	4.53	7.8	0.58	1.75	7.29	0.31
SKK	3.52	8.7	0.41	1.16	7.22	0.24
BRL	10.92	16.4	0.67	1.88	6.39	0.85
CLP	6.14	8.3	0.74	2.01	6.41	0.48
COP	9.98	8.1	1.23	3.33	5.72	0.87
PLN	3.47	9.4	0.37	0.96	7.25	0.24
TRY	8.56	13.0	0.66	1.60	7.14	0.60
HUF	1.19	9.3	0.13	0.30	8.43	0.07
LKR	−0.97	3.2	−0.30	−0.67	5.01	−0.10
ARS	3.72	7.8	0.48	1.07	7.07	0.26
RON	10.05	7.8	1.30	1.94	6.07	0.83
KZT	7.81	3.9	2.02	2.91	4.43	0.88
MYR	1.84	3.4	0.54	0.66	6.39	0.14
Developed						
AUD	0.13	9.1	0.01	0.05	8.08	0.01
CAD	0.44	5.7	0.08	0.27	7.96	0.03
GBP	−1.26	6.1	−0.21	−0.72	8.43	−0.07
JPY	2.94	9.1	0.32	1.12	7.71	0.19
EUR	3.43	7.8	0.44	1.53	7.50	0.23
CHF	1.10	7.8	0.14	0.49	7.92	0.07
NOK	0.04	7.8	0.00	0.02	8.24	0.00
SEK	2.25	8.5	0.26	0.91	7.67	0.15
NZD	2.10	10.1	0.21	0.72	7.98	0.13
Portfolios						
EM-EW	4.52	3.63	1.24	4.32	6.65	0.34
EM-VW	2.58	1.70	1.52	5.25	6.42	0.20
DEV-EW	1.24	4.77	0.26	0.90	7.94	0.08
DEV-VW	1.07	4.60	0.23	0.80	7.96	0.07

Note: The table shows performance statistics for the technical trading strategy combining signals from moving average rules with different lengths of the fast and slow moving averages applied to all exchange rates over their floating currency regime periods (see Table 1). See Table 3 for further details.

Table 5: Performance of equally-weighted fundamentalist-chartist trading strategy

	Mean	Stdev	Sharpe	t-value	#TR	BETC
Emerging						
TWD	2.09	2.63	0.80	2.77	3.44	0.30
PEN	1.83	2.12	0.87	3.01	3.67	0.25
INR	2.98	2.83	1.06	3.67	3.04	0.49
MXN	0.57	5.35	0.11	0.37	4.57	0.06
ZAR	2.22	7.75	0.29	0.99	3.71	0.30
CZK	2.09	7.07	0.30	0.92	4.55	0.23
ILS	2.57	3.13	0.82	2.54	3.67	0.35
THB	2.72	4.38	0.62	1.87	3.92	0.35
PHP	3.03	3.34	0.91	2.79	3.39	0.45
IDR	7.70	11.11	0.69	2.12	3.86	1.00
KRW	3.26	5.29	0.62	1.86	4.16	0.39
SKK	4.42	5.46	0.81	2.33	4.06	0.54
BRL	10.04	9.10	1.10	3.10	3.59	1.40
CLP	3.16	5.05	0.63	1.69	3.93	0.40
COP	6.39	4.67	1.37	3.70	3.11	1.03
PLN	4.85	6.83	0.71	1.84	4.17	0.58
TRY	7.67	8.47	0.91	2.20	3.88	0.99
HUF	2.65	6.65	0.40	0.95	4.66	0.28
LKR	0.70	1.99	0.35	0.79	2.84	0.12
ARS	2.07	3.08	0.67	1.51	3.87	0.27
RON	10.48	5.83	1.80	2.14	3.89	1.35
KZT	3.43	2.36	1.45	2.10	2.38	0.72
MYR	0.66	1.65	0.40	0.48	3.41	0.10
Developed						
AUD	1.98	6.20	0.32	1.11	4.63	0.21
CAD	−0.55	2.80	−0.20	−0.68	4.60	−0.06
GBP	0.13	4.06	0.03	0.11	4.71	0.01
JPY	2.33	5.32	0.44	1.52	4.05	0.29
EUR	2.88	5.14	0.56	1.95	3.98	0.36
CHF	2.30	5.10	0.45	1.57	4.33	0.27
NOK	−0.44	5.00	−0.09	−0.31	4.78	−0.05
SEK	1.60	5.04	0.32	1.10	4.80	0.17
NZD	3.15	6.48	0.49	1.69	4.42	0.36
Portfolios						
EM-EW	3.08	2.22	1.39	4.81	3.97	0.39
EM-VW	1.83	1.12	1.63	5.65	3.66	0.25
DEV-EW	1.48	2.98	0.50	1.72	4.70	0.16
DEV-VW	1.30	2.83	0.46	1.60	4.50	0.15

Note: The table shows performance statistics for the equally-weighted fundamentalist-chartist strategy applied to all exchange rates over their floating currency regime periods (see Table 1). See Table 3 for further details.

Table 6: Performance of dynamic combined fundamentalist-chartist trading strategy

	Dynamic weights				Equally-weighted			
	Mean	Stdev	Sharpe	t-value	Mean	Stdev	Sharpe	t-value
Emerging								
TWD	4.49	3.78	1.19	3.78	2.37	2.69	0.88	2.80
PEN	2.51	2.68	0.94	2.98	2.38	2.22	1.07	3.41
INR	3.78	3.17	1.19	3.79	3.12	2.60	1.20	3.81
MXN	0.05	8.19	0.01	0.02	−0.41	5.35	−0.08	−0.24
ZAR	5.29	13.81	0.38	1.21	2.18	8.40	0.26	0.82
CZK	1.83	7.00	0.26	0.72	3.12	6.72	0.46	1.29
ILS	1.99	3.91	0.51	1.40	2.62	3.16	0.83	2.29
THB	4.97	4.79	1.04	2.76	3.38	3.18	1.06	2.83
PHP	4.37	5.17	0.85	2.32	2.80	2.48	1.13	3.09
IDR	6.72	9.32	0.72	1.96	4.39	6.74	0.65	1.77
KRW	1.91	4.80	0.40	1.06	3.12	4.37	0.71	1.90
SKK	6.28	6.60	0.95	2.38	4.98	5.65	0.88	2.20
BRL	13.58	16.72	0.81	1.98	11.35	9.87	1.15	2.80
CLP	3.91	7.05	0.55	1.28	2.79	5.24	0.53	1.23
COP	7.62	6.51	1.17	2.70	6.98	5.18	1.35	3.11
PLN	1.58	6.77	0.23	0.51	4.42	6.82	0.65	1.41
TRY	4.88	10.93	0.45	0.88	7.37	7.13	1.03	2.05
HUF	1.13	5.28	0.21	0.41	1.00	5.75	0.17	0.33
LKR	−0.80	1.32	−0.60	−1.05	−0.60	1.59	−0.38	−0.65
ARS	0.27	1.43	0.19	0.33	0.53	1.48	0.35	0.61
RON	22.60	5.74	3.94	1.97	23.24	5.78	4.02	2.01
KZT	NA	NA	NA	NA	NA	NA	NA	NA
MYR	NA	NA	NA	NA	NA	NA	NA	NA
Developed								
AUD	3.21	7.98	0.40	1.28	2.44	6.67	0.37	1.16
CAD	−0.72	4.47	−0.16	−0.51	−0.48	2.92	−0.17	−0.52
GBP	0.02	3.85	0.00	0.01	0.11	3.87	0.03	0.09
JPY	0.56	5.86	0.10	0.30	0.96	4.79	0.20	0.64
EUR	2.20	5.56	0.39	1.25	2.98	5.22	0.57	1.81
CHF	0.58	5.63	0.10	0.33	1.47	4.62	0.32	1.01
NOK	0.43	6.48	0.07	0.21	−0.29	5.12	−0.06	−0.18
SEK	0.46	6.08	0.08	0.24	1.01	4.79	0.21	0.67
NZD	2.78	8.18	0.34	1.08	3.32	7.01	0.47	1.50
Portfolios								
EM-EW	3.83	2.91	1.31	4.17	2.78	2.21	1.26	3.99
EM-VW	1.93	1.21	1.59	5.06	1.61	1.05	1.53	4.86
DEV-EW	1.06	3.54	0.30	0.95	1.28	3.12	0.41	1.30
DEV-VW	0.92	3.39	0.27	0.86	1.14	2.97	0.38	1.21

Note: The table shows performance statistics for the combined fundamentalist-chartist strategy with weights determined by the relative performance during the past 12 months, applied to all exchange rates over their floating currency regime periods in the period 1997-2007 (see Table 1). See Table 3 for further details.

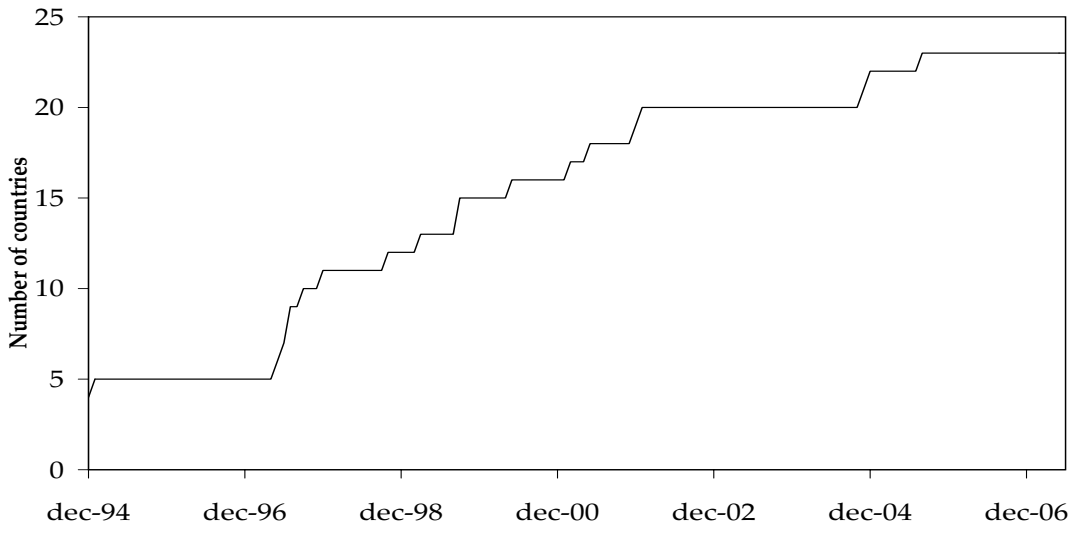
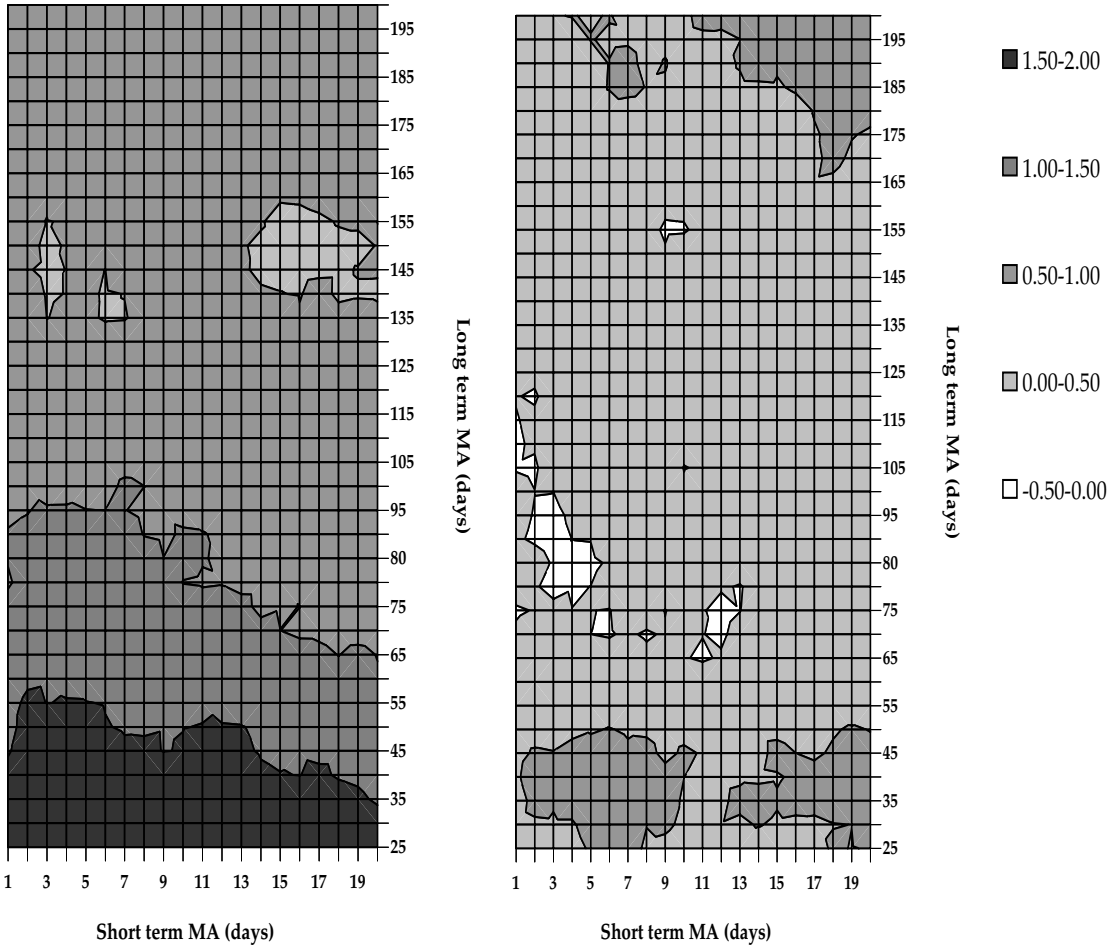


Figure 1: Number of emerging market countries with floating exchange rate regime, December 1994 – June 2007.



(a) Emerging Markets

(b) Developed Markets

Figure 2: Heat-map of the average t-values for moving average strategies with the short term moving average ranging between 1 – 20 days and the long term moving average between 25 – 200 days. The average t-value of the emerging markets in panel a) is based the average of 23 emerging market currencies. The developed market average in panel b) is based on nine developed market currencies. See Section 2 for details

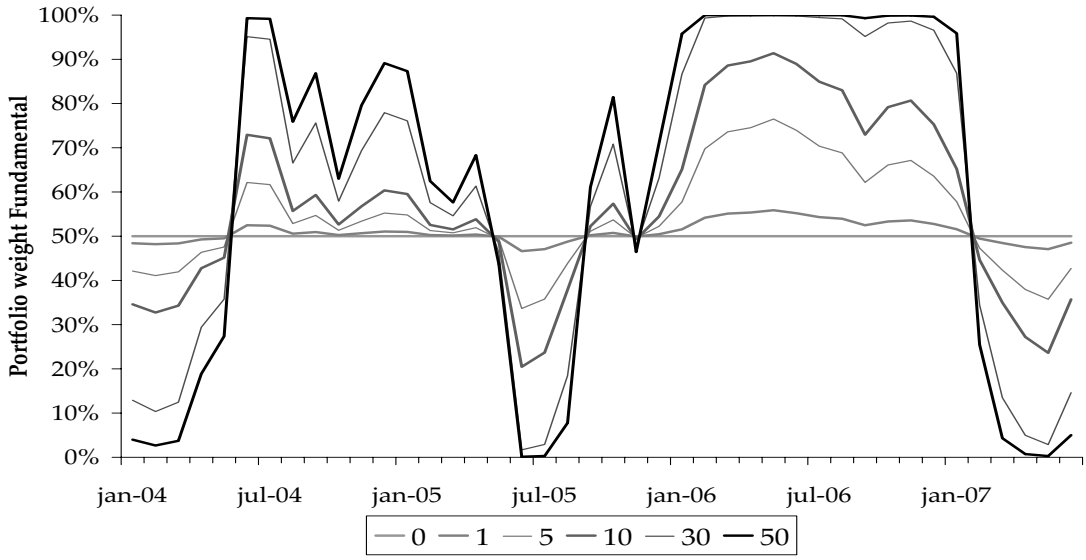
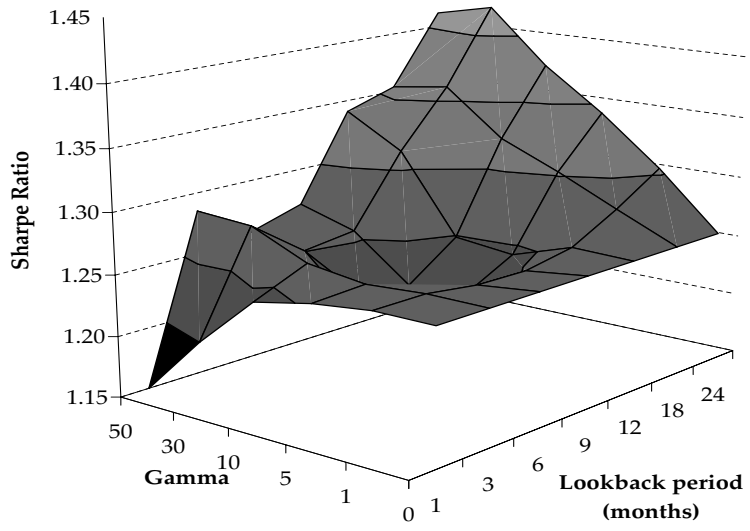
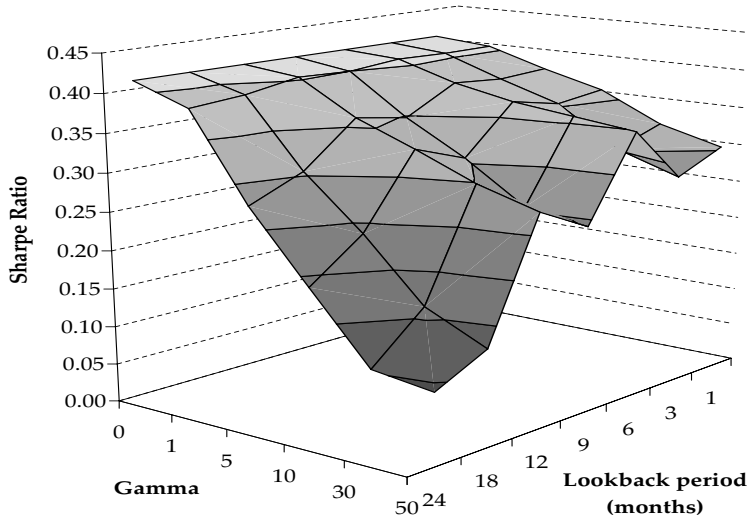


Figure 3: Sensitivity of the dynamic weights in the combined fundamental-technical trading strategy to the choice of γ in (10) for the Indonesian rupee.



(a) Emerging Markets



(b) Developed Markets

Figure 4: Dynamic weighting between fundamentalist and chartist rules. The figure shows the Sharpe ratio of the equally weighted portfolio for different lookback periods J ranging from 1 to 24 months and for different 'aggressiveness' of the dynamic strategy as measured by γ. Here $\gamma = 0$ corresponds to the naive equally-weighted strategy, while $\gamma = 50$ corresponds to the most aggressive strategy, with weights changes the fastest.