REVIEW OF THE EMPIRICAL EVIDENCE ON THE EFFICIENT MARKET HYPOTHESIS IN THE FOREIGN EXCHANGE MARKETS

Róisín Donnelly

Senior Sophister

The efficient markets hypothesis is an often-criticised theory whose practical value is questionable. Roisin Donnelly provides an extremely well researched account of the EMH and the empirical evidence for its applicability to the foreign exchange markets, ultimately arguing that it seems to have taken hold over time in more mature markets.

Introduction

An old economics joke has been employed to demonstrate the efficient markets hypothesis (EMH): An economist is walking down the street with a companion when they see a $100 bill on the ground. As the companion attempts to reach down and pick it up, the companion stops him and says 'Don't bother – if it were a genuine $100 bill, someone would have already picked it up' (Lo and MacKinlay, 1999, p.6).

The EMH has been a subject of debate since its inception in the 1960s, dividing academics and professionals. In general, academics have believed that the EMH holds, but have been proven wrong in applied finance (LeBaron, 1999). This essay will first discuss the EMH and apply its theory to the foreign exchange market. The second section will then examine evidence of efficiency in the market, in terms of forward and spot rates and the profitability of technical rules. This section will track the evolution of research on the EMH, particularly noting recent evidence of the EMH. The final section will consider the implications of the EMH in the current market, given unprecedented central bank interventions, emerging markets and the aftermath of the global financial crisis.

The Efficient Market Hypothesis

Fama (1970) stated that an efficient market is where prices fully reflect all available information. If this is true, no profit opportunities can be left unexploited. The market is therefore considered to be a 'sensitive process of all new information', and responds with price fluctuations instantaneously. (Baillie and McMahon, 1989, p.40)

Fama (1970, p.383) further developed the EMH into three forms indicating different levels of available information: weak form efficiency reflects past historical prices; semi-strong form efficiency reflects both historical prices and information that is 'obviously publicly available'; strong form efficiency questions whether some information is private and therefore, if some investors have 'monopolistic access' to price relevant information. If all public and private information is available to all investors then strong form efficiency holds.

Interestingly, for the EMH to hold, there must also be belief that the market can be in disequilibrium, which is an incentive to gather information to uncover arbitrage. Therefore arbitrageurs play a key role in the existence of the EMH (Grossman and Stiglitz, 1980). It has been suggested that the degree of efficiency can also vary across markets (e.g. markets in emerging countries may be less efficient than the US market due to a less intensive analysis) (Bodie, Kane, and Marcus, 2008).

Simple EMH assumes that investors are both 'endowed with rational expectations' and risk neutral (although the model can be modified to adjust for risk) (Sarno and Taylor, 2002, p.5).

Specifically for the foreign exchange market, semi-strong efficiency can be divided into two categories: single market efficiency and multimarket efficiency (Geweke and Feige, 1979). Single market efficiency implies that all public information about a single exchange rate is part of available information. Multimarket efficiency implies that information on all exchange rates is part of available information (Sarno and Taylor, 2002).

Under the EMH, forward prices follow a martingale, which is 'a statistical process in which the expected value of successive changes are independent of previous changes' (Dooley and Shafer, 1984, p.50). This suggests that the spot rate today is the best indicator of the spot rate in the future and therefore changes in the spot rate are serially uncorrelated, appearing random, with equal probabilities of both appreciation and depreciation (Baillie and McMahon, 1989).

A key insider in terms of private information in the foreign exchange market is the central bank. Baillie and McMahon (1989) suggest that strong form efficiency is unlikely to hold, due to non random interventions by central banks. If a central bank makes zero expected profit on intervention, then the market is strong form efficient (Sweeney, 2000).

Empirical Evidence on the EMH

Generally, tests for market efficiency involve determining whether the current spot and forward rates have a long term relationship with information available (Levich, 1978). There are several tests for spot market efficiency. One method is to test the null hypothesis that changes in spot rates are serially uncorrelated. Another method is to test technical trading rules; whether profit can be made from technical analysis such as filter rules[1] (Levich, 1978) and moving-average rules[2].

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[1]   A filter rule can be defined as generating 'buy and sell signals by the following: buy a

Tests of forward market efficiency include regression models to determine whether the forward rate is an unbiased predictor for the future spot rate. If this is true, then the market is weakly efficient (Longworth, 1981). Furthermore, a semi-strong form test is whether the spot rate change is on average equal to the lagged forward premium (Longworth, 1981).

It is suggested that if investors' expectations are part of available information, then they are reflected in market prices, and hence the forward rate is an unbiased predictor of the future spot rate (Levich, 1979). Many multinational companies would use this as a forecast because it reflects the 'collective wisdom of many well informed, profit seeking traders' (Levich, 1979, p.50). Furthermore, it is useful as it can be revised rapidly to reflect new information and is inexpensive to use as a method of forecasting.

Theoretically, the merits of the current forward rate predicting the spot rate are obvious. However is it actually that accurate in practice? Levich (1979, p.54) found that, across a wide range of currencies, the forward rate is an unbiased predictor of the level of the future spot rate: the 'level of the forward rate will explain a high percentage of the variation in the level of the future spot rate'. However the forward rate premium is not very accurate in predicting exchange rate changes and hence Levich (1979) concludes that while the forward rate is an unbiased indicator of the future spot rate, it is a poor one.

Kohlhagen (1979) found that, in the long run, the forward rate is an unbiased predictor of the future spot rate. However, he identified short run periods in which the current forward rate was considerably different to its related subsequent spot rate. Furthermore, Geweke and Feige (1979) found inconclusive evidence for single market efficiency but firmly rejected multimarket efficiency using econometric testing of the correlation between the spot and forward rate. They found inefficiencies varied over time, due to both risk aversion (predominantly in the 1970s) and transaction costs (predominantly in the 1960s).

Longworth (1981) also rejected both weak and semi-strong form tests of the forward rate as a predictor of the future spot rate in the US Dollar (USD)-Canadian Dollar (CAD) currency pairing. Moreover, it was found that the current spot rate is a better predictor of the future spot rate, echoing earlier findings by Fama (1984). Later research indicated that spot and forward rate are non-stationary with unit roots and are therefore biased and inconsistent (Bakshi and Naka, 1997). What became clear was that spot and forward rates were cointegrated[3]. It was found that the seven largest exchange rates were tied together in a long term relationship (Baillie and Bollerslev, 1989). Therefore exchange rate determination is not based on individual currency fundamentals as previously thought. Furthermore,

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currency whenever it rises x percent above its most recent trough; sell the currency and take a short position whenever the currency falls x percent below its most recent peak' (Nguyen, 2004, p. 3).

[2]   A moving-average rule can be defined as 'when the short-term moving average penetrates the long-term moving-average from below (above) a buy (sell) signal is generated' (Nguyen, 2004, p. 3).

[3]   Cointegration violates efficiency as if 'exchange rates are cointegrated, then it is possible to predict one on the basis of another' (Wua and& Chen, 1998, p. 831).

as these relationships determine future prices, there is evidence of a time varying risk premium, which is a violation of weak-form efficiency.

Testing for Profits

Under the EMH, there should be no trading rule found that can beat the market (Copeland, 2008). Invariably, examining whether the efficient market hypothesis holds often tests if technical analysis holds, which would disprove the EMH. Therefore a review of the profitability of technical trading is necessary in this discussion of efficiency. These rules are usually tested against a simple buy and hold strategy (Copeland, 2008). This is the primary technique used for testing efficiency in the foreign exchange market (Nguyen, 2004).

Dooley and Shafer (1984) found that using filter rules of 1%, 3% and 5% for nine currencies from 1973 to 1981 was profitable for the sample period. However, they also found elements of risk in the trading rules, as there was sub-periods of losses in each currency (Nguyen, 2004).

Sweeney (1986) examined the profitability of filter rules against a benchmark of a buy and hold strategy for nine currencies from 1973 to 1990. It was found that all except the 10% filter beat buy and hold, and that the 0.5% and 1% filters were statistically significant, suggesting inefficiency in the market. However, taking into account transaction costs, they found that only the 1% filter was still statistically significant. Nevertheless, this suggests that profits can be made using a 1% filter after transaction costs, which is a blatant contradiction of efficiency.

Schulmeister (1988) tested the weak form efficiency of the USD versus the Deutsch Mark (DM) between 1973 and 1986. Testing both the moving-average and momentum rule, it was found that the average annual return over the entire period was 15%. As such strategies exploit previous information to make profit Schulmeister (1988) concluded that foreign exchange markets are not even weak form efficient.

However, more recent evidence suggests that profits have been on the decline. Levich and Thomas (1991) analysed both the filter rule and the moving-average rule over the 15 year period from 1976 to 1990 for the British Pound (GBP), CAD, DM, Japanese Yen (JPY) and Swiss Franc (CHF). They tested the filter rule from 0.5% to 5% and three moving average rules. Significantly, although they found profitability in these trading results and therefore market inefficiency, when they divided the sample period into three, the period from 1986 to 1990 showed declining (albeit positive on average) profitability.

Interestingly, Curcio et al. (1997), using filter rules on the intra-daily foreign exchange market, found evidence against profitability of trading strategies; therefore in favour of market efficiency. Studying two periods - April to June in 1989 and January to June in 1999 - they tested the DM, JPY and GBP against the USD. In the first period, one third of strategies generated significant profit. However, once trading costs were accounted for, most cases of profits were eliminated. In the later period there were only a very small number of significant profits found, which were matched by

the same number of significant losses, suggesting market efficiency. Incorporating transaction costs into the later test sample eliminates all significant returns and therefore endorses market efficiency.

Rubio (2004) further developed evidence of market efficiency from the period 1975 to 2004. 48 strategies for each currency pairing were tested; that of the USD versus the Austrialian Dollar (AUS), CAD, JPY, CHF and GBP. These pairings represented significant percentages of the foreign exchange market turnover (4%, 4%, 20%, 5% and 11% respectively). The strategies tested were based on rules such as the moving-average rule and filter rules. Out of 48 strategies for each of the currencies, they found only one or two were profitable after taxation and commissions. Therefore, in general, they found the market did not produce excess profits and was efficient.

Pukthuanthong-Le and Thomas III (2008) examined weak form efficiency for the period from 1975 to 2006, testing the moving-average and momentum rules for the GBP, CHF, JPY, and CAD based on the USD. It was found that trading rules had worked in the past but have been worthless since 2000, signifying that the market has become weak form efficient. They suggest that reasons for prior inefficiency could be due to immature markets. Consequently, they tested emerging market currencies for inefficiency using the Brazilian Real (BRL), Mexican Peso (MXN), Russian Rouble (RUB), New Zealand Dollar (NZD), and the South African Rand (ZAR). The results mirror the early inefficiencies in the major currency markets. From the period between 2000 and 2006 trading rules were profitable (except for the MXN). If these emerging currencies follow the path of the major currencies, it should be expected that they become more efficient (Pukthanthong-Le and Thomas III, 2008). Oh, Kim and Eom (2007) found that, on average, markets with large liquidity and trading volumes (such as in Europe and North America) showed higher market efficiency than those with smaller liquidity (such as in the Asian and African markets). Overall, it appears that mature markets have become efficient over the last 10-15 years, following decades of inefficiency. However, emerging markets remain inefficient.

LeBaron (1999) found that exchange rate predictability is dramatically reduced in periods in which there is no central bank intervention. He found that, by examining the period from 1979 to 1992 and testing the moving-average rule of the USD with the JPY and DM there was significant forecast ability, generated by large Sharpe ratios (0.6 to 0.9). This is compared with buy and hold strategy Sharpe ratios of 0.3-0.4. However, removing periods of intervention by the Federal Reserve and repeating the tests produced results that were not statistically significant (LeBaron, 1999). This supports Dooley and Shafer's (1984, p.48) notion that 'at worst, central bank intervention would introduce noticeable trends into the evolution of exchange rates and create opportunities for alert private market participants to profit from speculating against the central bank'.

The Current Situation

As has been described, central bank intervention can often disturb market efficiency. Therefore, the recent trend in intervention should prove interesting in terms of measuring efficiency.

Japan recently intervened in the Yen for the first time since 2004, selling the Yen against the Dollar to stem gains and protect its exports (Bloomberg, 2010a). The use of Quantitative Easing (QE) by the Federal Reserve has been criticised as being ineffective due to information uncertainty (Fell, 2010). Furthermore, Fell (2010) reports that the Federal Reserve has not made specific pledges about accommodative monetary policy and inflation (unlike when Japan used QE). Therefore, investors 'have no clear-cut policy target upon which to anchor the likely path of forward rates' (Fell, 2010, p.1). This suggests that the actions of the Federal Reserve are futile; although they want their currency to remain weak, they have not given enough signals to investors to make informed decisions based on new information such as inflation.

A possible impact of the Fed's latest round of quantitaitve easing (QE2) is that the excess liquidity in the US market will flow to emerging markets, resulting in inflation and bubbles(Saunders, 2010; The Economist, 2010). This could lead to quantitative tightening, where emerging market governments introduce capital controls to reduce inflows into their countries. Both Brazil and Thailand have already imposed high taxes on bonds, with Indonesia and South Korea possibly following suit. Such measures by emerging markets would inhibit efficiency due to greater transaction costs (Pilling, 2010).

A recent report has highlighted the changing nature of currency traders' behaviour as a result of the financial crisis. Recent developments suggest that the risks of currency trading are greater; traders are more likely to be fired if they make big losses and may not be paid the traditional large bonuses for big gains (Melvin and Taylor, 2009). Moreover, a recent survey of foreign exchange professionals showed that 80% were worried about the impact of recent regulations on profitability (Bloomberg, 2010b). One possible effect of both increased regulation and decreased bonuses could be a disincentive to seek arbitrage opportunities. As arbitrage is vital to the EMH, this could hinder the future efficiency of the market.

Conclusion

Similarly to the foreign exchange market, recent research on the stock market by Sullivan, Timmermann and White (1999) suggests that it has become more efficient, thanks to cheaper computing power, lower transaction costs and increased liquidity. These can also be applied to foreign exchange markets. Aggarwal, Lucey and Mohanty suggest that the foreign exchange market boasts high liquidity and low trading costs (2006).

Malkiel (2003) argues that although inefficiencies exist in the stock market, such as persistent predictability of prices, they always eventually disappear. This essay has shown that this appears true in the foreign exchange market; trading strategies that once were profitable have been deemed redundant in the last 10 years. The focus will now shift to inefficient emerging markets and how globalisation will assist the rapid growth in liquidity and efficiency.

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