行政院國家科學委員會補助專題研究計畫成果報告

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外匯風險下的國際資產配置:計量模擬分析

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計畫主持人：朱家祥

共同主持人：無

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一、中文摘要

在國際資產配置的考慮下，投資人購買遠期外匯來規避匯率風險的行為是否為匯率的決定因素之一是研究的主題．運用模擬分析計算出的金融資產權重的變動來定義避險指數，然後進一步考慮避險指數是否能解釋匯率的變動．實証資料顯示，引入避險指數的匯率變動模型在樣本內或樣本外的預測能力均优於匯率遵循隨机漫步的模型．

關鍵詞：國際資產配置，遠期外匯，匯率風險，避險指數，隨机漫步．

Abstract

This article considers the impact of hedging in international portfolio adjustment on the foreign exchange market. Using the data from Taiwan and US bilateral model, the simulated hedging intensity index is shown to have significant explanatory power on the exchange rate determination. Specifically, a foreign exchange model with hedging intensity as additional explanatory variable outperforms the widely-believed random walk hypothesis.

Keywords: Hedging intensity, International portfolio, foreign exchange, Random walk.

二、緣由與目的

In the context of late twentieth century global capital markets, all financial markets have some international element. In the case of hedge funds, massive does of computer technology are combined with finance theory and online, real-time global information gathering to exploit perceived anomalies in the prices of related financial instruments. However, financial outcomes always have an element of uncertainty. As long as there is uncertainty about market relationships, surprises are capable of inflicting big losses. The resulting losses can be multiplied many fold to the extent such funds are leveraged. The International Monetary Fund estimated that the recent worldwide economic turmoil had cost millions of jobs and more than US $600 billion in output - the equivalent of a country with the size of Canada shutting down for a year.

Diversification is the heart of managing international portfolio, and profit motive is what drives the asset re-allocation over time. We consider an international tactical asset allocation model between domestic and foreign equity markets to mimic the behavior of international hedge fund. Specifically, we use Taiwan stock index and US Standard and Poor 500 index data to generate simulated portfolio investment path, from which an international hedging intensity measure is constructed.

For simplicity, we will consider a dynamic asset allocation strategy between the US equity market and Taiwan market. At the end of period t, investor is endowed with wealth W_t (in US dollar) with m_t proportion of W_t invested in the US market and $(1-m_t)$ proportion invested in Taiwan market. Let the observed exchange rate of New Taiwan dollar in terms of US dollar at the end of period t be x_t. Suppose that investor applies the mean-variance portfolio analysis to adjust his investment weight from m_t to m^*_{t+1} for the next time period $t+1$.

If $m^*_{t+1}>m_t$, investor would like to increase the US investment, and the magnitude of increment is $(m^*_{t+1}-m_t)W_t$. Taking into account the transaction cost in the foreign exchange market, he needs to move $[(m^*_{t+1}-m_t)W_t(1+\alpha)]$ investment fund out of Taiwan market. Thus, in the beginning of $(t+1)$ period, his total investment in the US and Taiwan market are $m^*_{t+1}W_t$, and $(1-m^*_{t+1})W_t-(m^*_{t+1}-m_t)W_t\alpha$, respectively. On the other hand, If $m^*_{t+1}<m_t$, the investor would like to decrease the US investment by $(m_t-m^*_{t+1})W_t$. Hence his investment in Taiwan market increases by $(m_t-m^*_{t+1})W_t(1-\alpha)$. As a result, his total investment in the US reduces to $m^*_{t+1}W_t$, and the investment in Taiwan increases to $(1-m^*_{t+1})W_t-(m_t-m^*_{t+1})W_t\alpha$. In short, the ex-ante total investment in the US and

Taiwan are:

$K_{t+1}^{US}=m_{t+1}^{*}W_t$

$K_{t+1}^{TW}=(1-m_{t+1}^{*})W_t-|m_{t+1}^{*}-m_t|W_t\alpha$.

二 結果與討論

While $m_{t+1}^{*}\neq m_t$ is the necessary condition for asset re-allocation at the end of period t, whether or not to adjust investment weight depends on the expected wealth. Let $E(W_{t+1}^{0}|\Psi_t)$ be the end-of-period expected wealth if investor chooses not to re-allocate the portfolio weights, where Ψ_t is the information set known to the investor at time t. It follows that investor will implement asset re-allocation only if the end-of-period expected wealth at (t+1), $E(W_{t+1}|\Psi_t)$, is greater than $E(W_{t+1}^{0}|\Psi_t)$.

In short, the conditions for adjusting portfolio weights are:

$m_{t+1}^{*}>m_t$, and

$$\frac{[1+E(R_{t+1}^{US}|\Psi_t)]}{[1+E(R_{t+1}^{TW}|\Psi_t)]}>[E(x_{t+1}|\Psi_t)/x_t](1+\alpha) \qquad (1)$$

$m_{t+1}^{*}<m_t$, and

$$\frac{[1+E(R_{t+1}^{US}|\Psi_t)]}{[1+E(R_{t+1}^{TW}|\Psi_t)]}<[E(x_{t+1}|\Psi_t)/x_t](1-\alpha) \qquad (2)$$

If (1) holds, capital investment in Taiwan will be moved to the US market. If, instead, (2) holds, then US investment will be moved to Taiwan market. If neither (1) nor (2) holds, there is no incentive for portfolio adjustment. The hedging intensity measure is defined as

$$h_t=(m_{t+1}^{*}-m_t) \qquad (3)$$

Equations (1) and (2) indicated that to implement portfolio adjustment strategy, forecasts on the domestic, foreign equity markets, and the foreign exchange market are necessary. If the investor decides and hedge the exchange rate risk, he can buy forward. If this is the case, the right hand side of equation (1) and (2) will become a constant to the investor, suggesting that he need to focus on the equity markets only.

The simulated hedging intensity measure generated from investor's portfolio choice is a complex function of financial and macroeconomic variables. Presumably, factors that have significant impact on the US and Taiwan equity market can change investor's behavior, and hence the hedging intensity measure. We use the monthly data to estimate the foreign exchange prediction equation. The explanatory variables under consideration include the difference between Taiwan and US returns on thirty-day commercial paper, Taiwan GDP growth rate, Taiwan-US inflation rate differnetial. The best prediction model for exchange rate based on Akaiki's (1969) final prediction error is set as the benchmark (the t ratio is included in parenthesis):

Benchmark model:

$\Delta x_t=-0.030+0.355\Delta x_{t-1}+e_t$,

$R^2=0.126, RMSE=0.757, t$=1985.04-1999.07

When the hedging intensity measure is used as an additional explanatory variable in the benchmark model, the within-sample goodness of fit is improved substantially. The hedging intensity as an explanatory variable improves the in-sample R-square from the benchmarked 0.126 to as 0.365. Moreover, all of the t statistic is highly significant at the one percent level.

Good within sample fit does not necessarily imply good post-sample prediction. The ultimate test for a model is its ability to predict. For this, we spilt the sample into two periods, 1980.01-1997.02, and 1997.03-1999.03. We use the first sub-sample to estimate the model parameters, from which we generated predicted values for the second sub-sample. As sample information becomes available sequentially, we recursively update the coefficient estimates to generate the next period's forecast. The relative forecast efficiency is calculated relative to the step ahead root mean square prediction error (RMSPE) of the benchmark. Since the random walk model for nominal exchange rate has gained wide acceptance, we also calculated the forecast efficiency relative to random walk as well. Results indicate that our model has the lowest RMSPE. The relative efficiency to the benchmark is 108.74%, and 111.11% to the random walk model. Our model also passed the formal predictive accuracy test such as Henriksson and Merton's tests at the 5% level.

三 計畫成果自評

It is generally believed that there is no stable empirical short-term relationship between the exchange rates and economic variables (Frankel and Rose (1995)). In terms of forecasting performance, it is difficult to beat the widely accepted random walk hypothesis. In this paper we have constructed hedge intensity measures based on some asset allocation rules. The hedging intensity coefficient is highly significant and improves the with-sample fit of the change of exchange rate equation substantially, from R^2 of 0.126 of the best time series model to 0.365 with the addition of hedge intensity measure. It also leads to a significant improvement in the post sample forecast accuracy. The one period ahead root mean squares prediction error using a hedge intensity index is about 8% smaller than the best time series model without the hedge intensity index; and is about 11% smaller than the random walk model.

Our results are indeed remarkable. It is interesting to explore the predictive power of hedging intensity index in other Asian countries. If we can find similar results, then our findings here are probably not spurious.

四 參考文獻

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