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THEORETICAL TESTABLE MODEL OF THE UIP BASED ON THE ICAPM MODEL.

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Introduction

The increasing phenomenon of globalisation has stressed the importance of international finance and the key role of uncovered interest parity (UIP) hypothesis in assessing the degree of financial integration between nations. The hypothesis prescribes the rules of engagement between two trading countries. It postulates that if two assets denominated in different currencies are similar, then the return in the domestic country should be equal to the foreign return plus the expected depreciation. In other words, the change in the exchange rate should be equal to the interest differentials between the two countries and can be expressed as follows:

$$S_{t+k}^{e} - S_t = (r_d - r_f) \qquad (1)$$

Where r_d= the natural log of the domestic risk-free rate

r_f= the natural log of the foreign risk-free rate

S_{t+k}^{e}= the natural log of the expected spot rate in period t+k

S_t = the natural log of the current spot exchange rate.

Thus, the hypothesis suggests that there needs to be a one-to-one relationship between the change in the exchange rate and the interest differentials (Alper et al, 2009). Econometrically, this can be tested with the following regression:

$$(S_{t+k}^{e} - S_t) = \alpha + \beta(r_d - r_f) + \varepsilon_t$$

Where α and β are parameters to be estimated, and according to the hypothesis, are expected to be 0 and 1, respectively, and$\{\varepsilon_t\}$ is a series of independently and identically distributed (i.i.d) residuals, with a mean of zero and standard deviation of one.

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Unfortunately, to date, vast empirical tests find evidence against the UIP hypothesis and this makes the UIP to be among the puzzles in international finance. These rejections are documented in the surveys by Hodrick (1987) and Engel (1996). Nevertheless, rejection of the hypothesis is well expected as there are many market frictions that would otherwise disable the relationship to work as theoretically expected. These frictions may be in the form of capital controls, asymmetric information, noise traders, home bias, speculation, interventions by central banks and the imperfect substitutability of assets. Moreover, the failure of the evidence for the UIP hypothesis is also attributed to the fact that the relationship, as it stands, assumes the presence of risk neutrality in the foreign exchange market, of which the assumption is not always realistic, especially with the flexible exchange rate regime.

It is with the abovementioned reason that a number of authors suggest the relaxation of the assumption of risk-neutrality and include a risk premium when testing the UIP hypothesis. For example, Poghosyan et al (2008) use GARCH-in-mean models to capture the risk premium and Francis et al (2002) use a multifactor conditional asset pricing model to examine the extent to which emerging market currency excess returns are explained by systematic risk factors and thus attributed to time-varying risk premia. Further, Engel (1996) surveys different methods of estimating the risk premium and draws the conclusion that the presence of a time-varying risk premium is the culprit for the phenomenon known as the forward premium puzzle. More interesting, Morley and Pentecost (1998) adopt the theoretical framework of Chiang (1991) which relates the foreign exchange market risk premium to stock market excess returns. Unfortunately, none of the studies suggest a systematic way to include risk premium in the UIP framework. Moreover, none of the studies offer a systematic way for using the UIP to test hypothesis such a financial integration conditions in the UIP framework that includes risk premium components. Thus, the contribution of this paper is to propose a novel and systematic way to test the UIP hypothesis in the presence of risk premium based on the ICAPM framework. Moreover, the paper proposes an econometric approach to test the hypothesis of financial and economic integration within the framework of the proposed

UIP. The paper applies the proposed new framework to test the degree of financial integration between South Africa and each of the BRICS countries, namely Brazil, Russia, India and China. The paper finds a long-term relationship in the context of UIP relationship as well as evidence of risk sharing specification between South Africa and countries such as Brazil, India and Russia, which specification guarantees full financial integration. There is no such evidence between South Africa and China during the sample period used.

This paper is divided as follows: section 2 presents the proposed methodology, section 3 discusses the data, section 4 presents and discusses the results of the empirical analysis and section 5 concludes the paper.

Methodology

The paper proposes a theoretical testable UIP model for the degree of financial integration. The model is based on ICAPM model. The paper shows that any long-run econometric technique can be used to assess the degree of integration between countries based on the proposed model.

It is important to note that the International CAPM is an extension of the classical CAPM originally developed by Sharpe (1964) and Linter (1965) and then extended by Black (1972). It stipulates that the expected excess return on all risky assets is proportional to the world market portfolio and beta is the measure of proportion. Such that,

$$r_i = r_f + \beta_{i,M}(r_M - r_f)$$

Or alternatively,

$$(r_i - r_f) = \beta_{i,M}(r_M - r_f),$$

where $(r_i - r_f)$ is the expected return on asset *i* in excess of the risk-free rate of return, $(r_M - r_f)$ is the risk premium of the world market portfolio and $\beta_{i,M}$ is asset *i*'s sensitivity to the world market portfolio.

Adler and Dumas (1983) show that using a world market portfolio as the only factor is appropriate if and only if global capital markets are integrated and there are no deviations in purchasing power parity (PPP). However, Dalquist and Sallstrom (2002) make the assertion that investors in different countries calculate real returns using different price deflators, and when PPP does not hold then a

change in a given deflator is not necessarily perfectly correlated to the change in the exchange rate. Hence, investors require a premium for the exchange rate risk. Thus, the reformulation of the CAPM model, which includes exchange rate risk as a relaxation to the assumption of PPP in a two country situation, is as follows:

$$(r_i - r_f) = \beta_{i,Md}(r_{Md} - r_f) + \beta_{i,M*}(r_{M*} - r_{f*}) + \beta_{i,E}(\Delta S_t - (rf - rf*)$$

where $(r_{Md} - r_f)$ is the market risk premium in the domestic country, $(r_{M*} - r_f)$ is the market risk premium of the foreign country, ΔS_t is the change in the exchange rate between the two countries, and the β's are the sensitivity measures for the different factors. Equation…is a well-known ICAPM model.

In their paper, Dahlquist and Sallstrom (2002) attempt two answer two key questions: (1) Does the international CAPM perform better than an international version of the empirical three-factor model in explaining the cross-sectional variation of returns? And (2) Does adding foreign exchange rate risk improve the model? They assessed the ability of various international asset pricing models (namely, the international CAPM, the international CAPM with foreign exchange risk and an international three-factor model) to explain the cross-sectional variation in asset returns. They found that all their models were seemingly able to capture national market returns with a reasonable amount of reliability; however, the international CAPM with foreign exchange risk had at least the same explanatory ability as the three-factor model, whereas the international CAPM without cannot explain the variation in average returns of the characteristic-sorted industry portfolios. Those results were a confirmation of the theoretical justification behind the international CAPM with exchange rate risk and hence we also adopt the theory for the purpose of our analysis.

By making the exchange rate risk of the excess exchange rate return the subject of the equation we can thus introduce an alternative approach to test the uncovered interest parity hypothesis within the framework of the international CAPM. Such that,

$$\Delta S_t - (rf - rf*) = \beta_{i,E}(r_i - r_f) - [\beta_{i,Md}(r_{Md} - r_f) + \beta_{i,M*}(r_{M*} - r_{f*})].$$

In their paper, Arouri, Nguyen and Pukthuanthong (2012) propose a theoretical testable capital asset pricing model for partially integrated markets. This was driven by the awareness brought by Bekaert and Harvey (1995) that emerging markets are partially segmented and that the process of financial

integration is gradual. They postulate that markets are integrated if assets require the same return, regardless of where their trading locations are and are segmented if the converse is true.

Given that at macro level $r_i = r_{Md}$, thus, the above equation is expressed as;

$$(\Delta S_t - (r_d - r_f))_t = \beta_d (r_{Md} - r_d)_t - \beta_f (r_{M*} - r_f)_t + \varepsilon_t$$

Which is the stochastic expression or the UIP.

Given that the UIP hypothesis hold if there is long-term relationship between variables that constitute the UIP expression, the same way, the existence of the long-run relation from the above equation should justify the existence of the UIP hypothesis. In addition, the existence of the long-run relationship should also confirm the hypothesis of financial integration between two countries. Any econometrics technique used to measure the long-term relationship of variables should be used to analyses the existence of the long-term relationship from the above equation.

The proposed theoretical model is tested by assessing the existence of the UIP hypothesis between South Africa and each of the BRICS countries. The paper makes use of the ARDL cointegration proposed by Pesaran. Pesaran shows that long-term relationship can exist between variables with different levels of integration, thus I(0) and I(1).

DATA AND EMPIRICAL ANALYSIS

The paper used exchange rate, equity return and risk free data of South Africa, India, Russia, china and Brazil to test the existence of the long-run relation of the above equation to infer the existence of the UIP hypothesis and to test the degree of their financial integration. Referring to the F-statistics to assess the long-run relation in the context of the proposed UIP hypothesis, it is found that the long-run relationship exists between South Africa and Brazil, South Africa and India as well as South Africa and Russia. Nonetheless, there is no proof of the existence of the long-run relationship between South Africa and china.

The following tables report the long-term coefficient obtained from the estimation of the above equation for the case of South Africa and each of the BRICS countries.

South Africa and Brazil

F-test confirms long term relationship between exchange rate risk, domestic and foreign risk premium. The two risk premiums are forcing variables. The long-term relationship is expressed as:

ARDL(0,0,0) selected based on Schwarz Bayesian Criterion

Dependent variable is ERBRA2

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Regressor	Coefficient	Standard Error	T-Ratio[Prob]
RPBRA2	-.11281	.079815	-1.4134[.160]
RPSA2	.40741	.11367	3.5840[.000]

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The restriction $\beta_d = -\beta_f$ is rejected given the CHSQ(1)= 11.5912[.001] (Wald statistics)

South Africa and India

ARDL(0,0,0) selected based on Schwarz Bayesian Criterion

Dependent variable is ERIND2

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Regressor	Coefficient	Standard Error	T-Ratio[Prob]
RPIND2	-.22227	.056777	-3.9148[.000]
RPSA2	.22309	.080416	2.7741[.006]

The restriction $\beta_d = -\beta_f$ is not rejected given the CHSQ(1)= .1508E-3[.990]

South Africa and Russia

ARDL(0,0,0) selected based on Schwarz Bayesian Criterion

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Dependent variable is ERRUS2

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Regressor	Coefficient	Standard Error	T-Ratio[Prob]
RPRUS2	-.11302	.042341	-2.6692[.008]
RPSA2	.18565	.087863	2.1129[.036]

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The restriction $\beta_d = -\beta_f$ is not rejected given the CHSQ(1)= .99696[.318]

South Africa and China

The F-statistics reject long-term relationship and premiums are not forcing variables for exchange rate risk.

No evidence of financial integration

CONCLUSION

The paper proposes a Theoretical testable model for UIP to assess the level of financial integration between two different countries. The model proposed is based on International CAPM. The paper shows that any econometric technique that aims at unravelling the long-term relationship between variables can be used to test whether UIP hypothesis holds, thus, the confirmation of financial integration between the two countries. Also, the paper proposes, through the restriction applied to the coefficient to indicate the degree of financial integration. When applies to the BRICS countries, the results of the empirical analysis show different level of financial integration between South Africa and other BRICS countries.