SCHOOL OF ECONOMICS AND MANAGEMENT

Pricing power and time variation of global factor proxies

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Abstract: The marginal pricing power and individual impact of proxies used in international asset pricing and financial integration studies is not well researched. In this study I look at the most widely used proxies; i.e. World Index Return, change in Eurodollar rate, change in spread between 10-year U.S. T-bond and 3-month U.S. T-bill, and change in spread between Baa and Aaa rated bonds; and ascertain whether they have marginal pricing and time-variation and what their impact is on integration. For these purposes, I use the Generalized Method of Moments approach to estimate the pricing power and impact of these variables on the Stochastic Discount Factor/Pricing Kernel.

The results show that during periods of non-crisis, all four variables have pricing power, whereas during periods of major crisis change in the Eurodollar rate does not have pricing power. Moreover, the pricing power of the change in Eurodollar rate and change in spread between 10-year U.S. T-bond and 3-month U.S. T-bill rates is time-varying and shows an increasing trend.

Keywords: international asset pricing, financial integration, Stochastic Discount Factor, pricing power, time-variation.

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1. INTRODUCTION

Financial integration is the interdependence of financial markets around the world (Carrieri, et al., 2007). As integration increases; countries share more risk with one another and start to develop more rapidly, companies gain greater economies of scale and greater access to resources, and investors are exposed to lower risk and earn greater returns (Carrieri, et al., 2007; Bekaert & Harvey, 2003; Pungulescu, 2010). While treaties among countries, multilateral tax treaties and trade treaties, greatly facilitate integration and are required to achieve full integration, they are not essential for a high degree of integration (Pungulescu, 2010). In the absence of treaties, a high degree of integration is possible through the establishment of local branches of foreign companies (Kose, et al., 2009) and introduction of country funds and American Depositary Receipts (Arouri & Foulquier, 2012). These multitude of benefits and ways of integration have sparked an increased interest among researchers about the level of integration and its implications for asset pricing.

In order to measure the degree/level of integration and its impact on asset pricing, various methods have been presented over time[1]. The most widely used method, for both, uses regression analysis with proxies of global factors as independent variables. While the global factors used in these models are found to be priced in markets around the globe, there is no research on how many of them should be included as independent variables. According to Cochrane (2005); even if a risk factor (λ) is priced in the market, that does not mean that it is marginally useful in pricing assets/it has pricing power. He argues that in order for a model to give accurate and reliable results, it should only include those factors that have marginal pricing power.

Integration studies focus on the percentage of variance in returns explained by using proxies of global factors and international asset pricing studies focus on whether these global factors are priced in markets, by using these proxies. While various proxies have been presented by researcher over the years (details of which can be found in Billio, et al. (2017)), the most prominent and widely accepted ones are the World Index Return (WIR), spread between Moody's Aaa and Baa rated corporate bonds (USDP), spread between 10-year U.S. T-bond and 3-month U.S. T-bill (CUSTP), and change in monthly Eurodollar rate (CED). While international asset pricing has shown that the

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[1] A comparison of the various methods used to measure integration is presented by Billio, et al. (2017). And details of the various methods for international asset pricing can be found in Korajczyk & Viallet (1989) and Zaremba & Maydybura (2019).

factors proxied by these variables are priced in markets around the world, their individual impact and pricing power is not well researched. If any of these factors do not have marginal pricing power, and if Cochrane's (2005) argument is true, then international asset pricing and financial integration studies that use these factors may be reaching inaccurate conclusions. The percentage of explained variance found in integration studies will be distorted by the use of factors that are not marginally useful in pricing, leading to the estimated degree of integration being inaccurate. Furthermore, the conclusion that these factors (which do not have marginal pricing power) are helpful in determining global returns, based on them being priced, will also be inaccurate. In order to avoid inaccurate conclusions, the marginal pricing power of these factors needs to be assessed and only those factors that have significant pricing power should be used in these studies. Moreover, as these studies mostly look at the combined impact of these proxies, so assessing their individual impact and how/if this impact changes could provide useful insights for researchers and investors. For example, CED is a proxy for the change in sovereign credit risk, if this variables has no marginal pricing power then it would warrant researcher as to why investors do not price the possibility of a government defaulting when investing internationally.

The current study provides support for studies in international asset pricing and financial integration, by formally testing the most used global factor proxies for their marginal pricing power and the time variation in their impact. Formally, this study:

- Ask is if the most widely used global factors are all marginally useful in pricing asset and shows that they are not always needed/marginally useful.
- Asks if there time-variation in the impact of factors variables and shows that the impact of these factors changes with time and with global economic conditions.
- Asks if the increase in integration is due to the changing impact of these factors and shows that this is the case.
- Asks if variables related to a Hegemon are appropriate proxies of global variables and shows that during non-crisis periods the variables related to a Hegemon can be used to proxy global factors.

The rest of the thesis is structured as follows: in section 2, I review some of the literature related to international asset pricing and financial integration to show how these variables have been used and what competing variables have been presented. In section 3, I describe the methods used to ascertain the pricing power and impact of these variables and their time-variation. In section 4, I describe the data used in this study and what each variable means in an economic context. In section 5, I present the results and give some of the limitations of this study. Finally in section 6, I conclude the study.

2. LITERATURE REVIEW

The use of regression models in finance requires the use of independent variables that proxy factors. For international finance models this requirement is mostly fulfilled based on the economic implications of the Hegemonic Stability Theory. The theory implicitly assumes that “collective action in the international system is impossible in the absence of a dominant state” (Snidal, 1985). The economic implication of this theory is that cross-border economic impacts and financial integration are due to a dominant state (a Hegemon) (McKeen-Edwards, et al., 2004)

Harvey (1991) uses the conditional and unconditional International CAPM (ICAPM) to test if global risk can explain the time-variation in country returns, as measured by the returns on an equity index of that country. He uses the implications of the Hegemonic Stability Theory to suggest that U.S. related variable and the world index return can be used to proxy global factors. Under the assumption that countries are perfectly integrated, he concludes that, except for Japan, the ICAPM is able to explain the time-variation better than or almost as well as the Domestic CAPM (DCAPM). And for Japan he concludes that the time-variation cannot be explained due to the assumption of perfect integration. Moreover, the study concludes that there is time variation in the price of global risk (λ) and also provides evidence that the price of risk may be different for different countries, if there is segmentation (mild or complete). As the price of risk is dependent on the pricing power of the factor, so these conclusions provide some preliminary support that the pricing power of factors may be time varying.

Based on the conclusions of Harvey (1991), Ferson & Harvey (1993) build a conditional multifactor model that uses global risk premiums (λ) and a common numeraire to measure local returns to explain the cross-variation in local equity returns for 18 countries. In addition to using the global risk premiums used by Harvey (1991), they also include risk premiums for inflation expectations, average oil prices (in USD), and exchange rate risk. Under the assumption of complete integration, they conclude that much of the cross-variation in equity return premiums, even for Japan, can be predicted by global risk premiums (λ) when these additional risk premiums are used. This conclusion is suggested to be somewhat inaccurate by Dumas & Solnik (1995), who conclude that only the addition of exchange risk premium is sufficient to explain the cross-variation in returns.

Bekaert and Harvey (1995) use a conditional regime switching model to measure financial integration over time for 18 developed and 9 developing countries. Based on the results of Ferson & Harvey (1993), they include CED, WIR, USDP, and USTP as proxies of global variables. They conclude that while the overall degree of integration is increasing over time, this increase cannot be directly linked to ease in capital control policies, because some countries with relaxed policies were found to far more segmented than countries with extremely strict policies. Their model is one of the first that allows testing for partial integration, but it is simply a weighted combination of a domestic and international asset pricing model, with the weight being the measure of integration. Thus, is it susceptible to the use of mis-specified systematic factors and can easily give erroneous results.

Hardouvelis, et al. (2006) use a modified version of Bekaert and Harvey's (1995) model to assess the impact that the formation of the Economic and Monetary Union (EMU) of the European Union had on its member countries. They conclude that while there was no definite increasing trend in integration during the first half of the 1990s, but in the second half the countries began to converge towards full integration. Hanhardt & Ansotegui (2009) also look at the impact of the EMU on member countries, they conclude that while perfect integration has not been achieved, but there has been an increase in integration over time. Moreover, they conclude that Germany, France, and the United Kingdom and Italy and Spain are more integrated with one another than they are with the rest of the European Union.

Carrieri, et al. (2007) measure integration on a rolling basis from 1977 to 2000 for 8 developing countries. They conclude that while at times, especially during times of local crises, integration tends to show reversals i.e. decrease, but overall integration has increased. They attribute this increase in integration to greater financial liberalization and increased financial development of these countries. Akbari, et al. (2017) investigate reversals in financial integration and conclude that they can mainly be attributed to funding constraints which are exacerbated during periods of crisis.

Pukthuanthong & Roll (2009) suggest that the R-Squared from a regression analysis where only global factors are included as independent variable should be used as an integration measure. Moreover, they advocate the use of Principal Component Analysis to extract global factors instead of using the world index return and factors related to a Hegemon. They use the time of availability of indices on Datastream to form and analyze 4 cohorts; pre-1973 cohort, 1974-1983 cohort, 1984-

1993 cohort, and post-1994 cohort; and conclude that on average each cohort has shown a steady increase in integration. Moreover, they find that members of the Euporean Union have seen a rapid increase in integration and countries such as Nigeria, Pakistan, Bangladesh, Sri Lanka, and Zimbabwe, which face instability, have seen a decrease in integration. While their model has a simplistc appeal, the use of R-Sqaured can lead to biased (upward bias) estimations of integration during periods of high volatility (Bekaert, et al., 2005). Moreover, the use principal components can lead to difficulty in linking the change in integration to specific economic reasons.

As the Principal Components do not have an economic meaning and as the use of variables related to a Hegemon may be inappropriate, Bali & Cakici (2010) suggest the use of global counter-parts to the Fama-French variables. They measure the impact of global and country specific risk on the cross-section of country returns for 23 developed and 14 developing countries, under the assumption of partial integration, and conclude that most of the difference in returns among countries is explained by the difference in country specific risk and global factors are not very useful in explaining these differences. Zaremba & Maydybura (2019) test for the impact of the Fama-French global factors on 22 frontier countries and assess whether the cross-variation in their returns can be explained by the global factors. Similar to Bali & Cakici (2010), they also conclude that the cross-variation is mostly explained by the differences in country specific factors and global factors are not useful in explaining these variations.

Arouri & Foulquier (2012) develop a model for measuring integration over time which accomodates for the inability of investors to hold the complete world market portfolio. They use the same global varaibles as Bekaert and Harvey (1995) and their results corroborate previous conclusions of increased integration due to increased financial liberalization. While their model has more realistic assumptions than previous ones, it needs to be estimated in two steps, which makes it vulnerable to misspecifications in the first step i.e. the model is vulnerable to the use of variables with no pricing power. Moreover, the model provides very volatile point estimates of integraton, which necessitates the use of the Hodrick-Prescott Filter or other smoothing techniques.

The focus of most of previous research has mostly been on developing new models with fewer/more realistic assumptions, using the variables related to the Hegemon and the world index return as global foctors. Only a few researchers have focued on presenting or looking at alternative global factors. With the Fama-French variables not presenting consistent results in a global context and the Principal Componets not having an economic interpretation, the variables related to the Hegemon and the world index return have become the most widely accepted. But, even then there is no research, at least to my knowledge, into testing whether all these factors have pricing power and the results of research that finds these factors to be priced are accepted as giving support for their continuous use.

3. METHODOLOGY

3.1 Stochastic Discount Factor

The Stochastic Discount Factor (SDF) is a stochastic process that transforms future payoff(s) of any asset to today's price, based on the information available today. It combines both the risk-free rate and the risk premium for the asset. Formally, for excess returns, the SDF model can be stated as the following Euler equation:

$$0 = E_t[M_{t+1} R^e_{t+1}] \qquad (1)$$

Where M is the SDF/pricing kernel and R^e is the gross excess return on the asset. As I estimate "M" through a linear factor model, the above model can be stated as:

$$0 = E_t\left[\left(1 - \sum_{i=1}^{n} b_i R^f_{i,t+1}\right) R^e_{t+1}\right] \qquad (2)$$

Where: $1 - \sum_{i=1}^{n} b_i R^f_{i,t+1} \approx M_{t+1}$

In equation (2), R^f_i is the gross return on the i^{th} factor and b_i is its impact on the SDF. The impact "b_i" is different from the Beta estimate from a regression based asset pricing model, because it measures the impact of the factor return on the SDF instead of the direct impact of the factor return on the excess return of the asset. This difference can be seen more clearly by demeaning the factor return[2] (to generate covariances) and expanding the equation, which converts equation (2) into (I drop the time sub-script below to simplify notation):

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[2] The SDF obtained from using the demeaned factor return is only slightly different from the non-demeaned one. Moreover, the demeaning process doesn't impact the significance of the "b" estimate i.e. if "b" is insignificant for the non-demeaned SDF then it will be insignificant for the demeaned SDF.

$$R^e = \sum_{i=1}^{n} Cov\left(R_i^f, R^e\right) b_i$$

$\because E(\tilde{R}^f{}_i R^e) = Cov\left(R_i^f, R^e\right)$ (Where: $\tilde{R}^f$ is the demeaned factor return)

Multiplying and dividing the above equation with the variances of the factors.

$$R^e = \sum_{i=1}^{n} \frac{Cov\left(R_i^f, R^e\right)}{Var\left(R_i^f\right)} b_i Var(R^f{}_i)$$

$$R^e = \sum_{i=1}^{n} \beta_i b_i Var\left(R_i^f\right) \qquad (3)$$

$Where$: $b_i Var\left(R_i^f\right) = \lambda_i$ (the factor risk premium)

Equation (3) shows the difference between "β" and "b" more clearly. As "b" measures the impact of the factor on the SDF, so it estimates whether the factor has any marginal pricing power. The above equations also show that the impact of global variables on should be the same for all countries and the eventual differences in how much return is explained by them depends on the county's covariance with the global factor[3]. For this thesis, I use the non-demeaned factor returns to estimate the SDF, using the following linear model:

$$M_{t+1} \approx 1 - b_{WIR} R_t^{WIR} - b_{USTP} R_t^{USTP} - b_{USDP} R_t^{USDP} - b_{CED} R_t^{CED} \qquad (4)$$

WIR: Excess World index return
USTP: U.S. term premium spread
USDP: U.S. default premium
CED: Change in 1-month Eurodollar rate

3.2 Generalized Method of Moments

The b's (parameters) of the SDF will be calculated using the Generalized Method of Moments (GMM). The GMM approach avoids the need to specify an underlying distribution theory and is better suited for SDF models than the Maximum Likelihood Estimate (MLE) (Smith & Wickens, 2002). While there are multiple underlying assumptions necessary to apply the GMM approach,

[3] This is the reason why I do not look at difference in pricing power of global factors across countries.

the necessary and most important ones are stationarity and identification (Ogaki, 1993). The identification requirement is fulfilled as long as the Law of One Price and no arbitrage conditions hold (Cochrane, 2005). The stationarity condition requires that the excess returns and the factor returns are stationary. This can easily be tested by using the Phillips-Perron test[4] (which has null of unit root) and can be confirmed with a Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test (which has null of stationairty). The variables are considered stationary unless both tests conclude that they are non-stationary.

The GMM approach estimates parameters by trying to equate sample moments (first moments) to their population counterparts. It then works out the distribution theory of the moments, thus enabling us to perform significance tests (Cochrane, 2005). While this introduces the need to define the population moments, this is not a significant problem for asset pricing models (SDF model included) as the first moment of the pricing errors can be used. As in finance we expect the first moment of the pricing errors to be zero, the moment conditions that GMM must satisfy can be stated as:

$$\hat{g}(b) = \sum_{t=1}^{T} \frac{E\left[\left(1 - b_{WIR}{R^f}_{WIR,t} - b_{USTP}{R^f}_{USTP,t} - b_{USDP}{R^f}_{USDP,t} - b_{CED}{R^f}_{CED,t}\right)R_t^e\right]}{T} = 0 \quad (5)$$

Where $\hat{g}(b)$ is an N × 1 vector of first moments for a set of "b" estimates and "N" is the equal to the number of assets used for estimation. Using this vector, the parameter estimates can be obtained as:

$$b = (d'Wd)^{-1}d'WE(R^e)$$

$$Where: \qquad d = \frac{\partial \hat{g}(b)}{\partial b_i} = E(R^e R^{f\prime})$$

"b" is a K × 1 vector of parameter estimates and "W" is an N × N weighting matrix. "d" is an N × K matrix, where "K" is the number of parameters, of partial derivatives, with respect to b, of the moment conditions.

[4] The Phillips-Perron test and the Augmented-Dickey Fuller test have low power if the process is close to non-stationary (Brooks, 2014).

As I only use global variables in my estimation, it is possible that the parameter estimates may be influenced by omitted variables bias. In an attempt to avoid this, I use an identity weighting matrix to obtain estimates. The use of the identity matrix forces the model to give equal importance to each moment condition and as such the estimates should only explain the global impact. One drawback to the use of the identity matrix is that the estimates will not be efficient, thus requiring the use of a more lenient rejection criteria. Even with the use of the identity matrix, the estimates are efficient and asymptotically normally distributed with standard errors calculated as:

$$\sqrt{Var\ (b)} = \sqrt{\left(\frac{1}{T}(d'Wd)^{-1}d'W\hat{S}(d'W)'(d'Wd)^{-1}\right)}$$

$Var\ (b)$ is a K × K covariance matrix with the variance of each parameter on the principal diagonal. $\hat{S}$ is the estimate of the Spectral Density Matrix (SDM), calculated using a Bartlett estimate. The SDM is calculated as:

$$\hat{S} = \sum_{j=-k}^{k}\left(\frac{k-|j|}{k}\right)\frac{1}{T}\sum_{t=1}^{T}\left(\mu_t\mu'_{t-j}\right)$$

As a preliminary test for time-variation, I use the "D-test", which is similar to the likelihood ratio test. The test statistic is calculated as:

$$TJ_T(restricted) - TJ_T(unrestricted) \sim \chi^2_{Number\ of\ restrictions}$$

$Where$:

$$J_T = \hat{g}(b)'[Var(\hat{g}(b))]^{-1}\hat{g}(b)$$

$$Var(\hat{g}(b)) = (W - d(d'Wd)^{-1}d'W)\hat{S}(W - d(d'Wd)^{-1}d'W)'$$

The restricted J_T-Stat is calculated using the full sample estimate of the parameters and the unrestricted J_T-Stat is calculated using the partial sample estimate of the parameters. In accordance with the recommendation of Andrews (1993), the partial sample moment conditions and Spectral Density Matrix are used for calculating both the restricted and unrestricted J_T-Stat. One "hitch" in the above formula is that as I use an identity matrix, so the variance-covariance matrix of the errors will not be invertible. Thus in accordance with the recommendation of Cochrane (2005), I take a pseudo-inverse by performing an eigenvalue decomposition of the variance of errors and invert the non-zero eigenvalues.

The D-test provides evidence of whether at least one of the parameters change over time, and while it can also be used to test the individual parameters, but I opt to use tests of statistical significance instead. If there is time-variation then I estimate parameters for each of the sample sub-periods and test to see whether they are significantly different or not.

4. DATA

While the pricing power of factors can be determined by using portfolios or individual stocks, the use of portfolios is preferable, due to reduced researcher biases, as such I use index returns to determine pricing power and its time variation. Specifically, I use the Morgan Stanley Country Index (MSCI) for India, Malaysia, Singapore, Taiwan, South Korea, and Hong Kong, Australia, Canada, Denmark, Japan, New Zealand, Norway, Sweden, Switzerland, United Kingdom, Austria, Germany, Belgium, France, and Finland and the Stock Exchange of Thailand Index for Thailand[5].

All country excess returns are U.S. Dollar denominated and are calculated by converting the index level using the prevailing exchange rate and then subtracting the one-month Eurodollar (London) rate from the total return. The global factors include; the U.S. Dollar denominated Return on the World Index in excess of the one-month Eurodollar rate (WIR), the difference between Moody's Aaa and Baa rated corporate bonds (USDP), the difference between the 10-year U.S. T-bond and the 3-month U.S. T-bill (USTP), and change in the monthly Eurodollar rate (CED). The WIR and USTP represent global market risk (Arouri & Foulquier, 2012), USDP represent global default risk, and CED represents the change in sovereign default risk (Harvey, 1991).

All global factors are used with one month lag relative to the excess country returns. The return and factor data is obtained from the Wharton Research Data Service and spans the period from September, 1996 to September, 2016[6]. Summary statistics for excess USD denominated returns and results from the unit root/stationarity tests for all variables are presented in table 1.

[5] The MSCI index for Thailand was launched in 2001 and as such could not be used to for pre-2001 estimates.
[6] The end period is selected due to data restrictions.

Table 1 Descriptive statistics and tests for stationarity

Country	***Mean***	***Standard Deviation***	***Excess Kurtosis***	***Skewness***	***Phillips-Perron Test***	***KPSS Test***
Australia	0.28%	6.06%	-0.84164	1.939617	Do not reject null	Do not reject null
Canada	0.45%	5.18%	-0.82027	5.608207	Do not reject null	Do not reject null
Denmark	0.76%	5.94%	-0.86812	3.745647	Do not reject null	Do not reject null
Hong Kong	0.34%	6.82%	-0.36237	1.073822	Do not reject null	Do not reject null
India	0.65%	9.07%	-0.58205	4.749363	Do not reject null	Do not reject null
Japan	-0.11%	4.97%	-0.13324	0.196615	Do not reject null	Do not reject null
South Korea	0.50%	6.79%	-1.00774	5.731557	Do not reject null	Do not reject null
Malaysia	0.05%	4.68%	-0.44069	1.952775	Do not reject null	Do not reject null
New Zealand	-0.05%	3.98%	-0.32226	0.277642	Do not reject null	Do not reject null
Norway	0.30%	7.72%	-1.1532	3.652283	Do not reject null	Do not reject null
Singapore	0.17%	6.43%	-0.52121	4.409145	Do not reject null	Do not reject null
Sweden	0.52%	6.29%	-0.5307	3.82103	Do not reject null	Do not reject null
Switzerland	0.34%	4.39%	-0.63708	0.74851	Do not reject null	Do not reject null
Taiwan	0.16%	6.22%	-0.24462	1.314322	Do not reject null	Do not reject null
Thailand	0.20%	6.85%	-0.88807	3.118103	Do not reject null	Do not reject null
United Kingdom	0.04%	4.84%	-0.71015	1.859421	Do not reject null	Do not reject null
Austria	0.10%	8.55%	-0.90474	3.013486	Reject null	Do not reject null
Belgium	0.27%	6.61%	-1.88075	7.681404	Reject null	Do not reject null
Finland	0.65%	7.00%	-0.31498	1.866778	Reject null	Do not reject null
France	0.24%	5.81%	-0.60749	0.828192	Reject null	Do not reject null
Germany	0.30%	6.39%	-0.64019	1.138898	Do not reject null	Do not reject null

WIR	0.23%	4.75%	-0.76114	2.033468	Do not reject null	Do not reject null
USDP	-	-	-	-	Do not reject null	Reject null
USTP	-	-	-	-	Do not reject null	Reject null
CUSDP	-	-	-	-	Reject null	Do not reject null
CUSTP	-	-	-	-	Reject null	Do not reject null
CED	-	-	-	-	Do not reject null	Do not reject null

Notes: Rejection criteria for the KPSS and Phillips-Perron tests was set at 5% confidence.

All variables other than USDP and USTP are concluded to be stationary based on the Phillips-Perron and KPSS tests. I use first differencing to render the USDP and USTP variables stationary i.e. convert them into the change in U.S. Default Premium (CUSDP[7]) and change in U.S. Term Premium (CUSTP[8]). The choice of using first differences was made, because the use of change in level of variables instead of the level of the variables is common practice in finance. Moreover, the use of change in the premiums instead of the level of premiums should not significantly affect the conclusions that can be drawn about the pricing power of USDP and USTP, if the change in levels has pricing power then the levels should have pricing power as well and vice versa. With these changed variables, the equation for estimating the SDF (equation 4) and the equation for the moment conditions (equation 5) become:

$$M_{t+1} \approx 1 - b_{WIR} R_t^{WIR} - b_{USTP} R_t^{CUSTP} - b_{USDP} R_t^{CUSDP} - b_{CED} R_t^{CED} \qquad (6)$$

$$\hat{g}(b) = \sum_{t=1}^{T} \frac{E\left[\left(1 - b_{WIR} R^f{}_{WIR,t} - b_{CUSTP} R^f{}_{CUSTP,t} - b_{CUSDP} R^f{}_{CUSDP,t} - b_{CED} R^f{}_{CED,t}\right) R_t^e\right]}{T} = 0 \ (7)$$

5. EMPIRICAL RESULTS & ANALYSIS

As time variation in parameters could lead to inaccurate estimates, if the entire sample is used, I start by testing for structural breaks. In order to test for breaks, the entire sample was divided into sub-period, with each sub-period starting in September and ending in August. As these tests are

[7] The variable now proxies the change in global default risk.
[8] The variable now proxies the change in global market risk.

only meant to determine whether there is time-variation, the selection of break points was made to ensure that each unrestricted parameter estimate is obtained from five years of data. Thus three unrestricted estimates were obtained from the data from 1996-2001, 2001- 2006; and 2006- 2011 and were tested against three restricted estimates obtained from the data from 1996-2006, 2001-2011, and 2006-2016, respectively. The results from the D-test are present in table 2.

Table 2 D-test for structural breaks

Test point	**Restricted** TJ_T	**Unrestricted** TJ_T	**P-value**	**Reject null of no break**
2001	31.41	23.51	0.04813	✓
2006	32.1	23.26	0.03145	✓
2011	37.95	26.54	0.01107	✓

Notes: Spectral Density Matrix of three lags (k = 3) was used. The p-value is calculated from a Chi-Square distribution with 4 degrees of freedom and rejection criteria was set at 5% significance.

The results of the D-test (in table 2) show that at least one of the parameter estimates have time variation. In order to find out which parameters change over time, I estimate the parameters for each sub-period and test if the estimates from two consecutive sub-periods are significantly different. The parameter estimates for each sub-period, including estimates for 2011-2016 sub-period, and the results of significance tests are presented in table 3.

Table 3 Sub-period parameter estimates and tests for significant difference

Estimation date	**CED**	**CUSDP**	**CUSTP**	**WIR**
2001	0.1054** (0.0487)	0.8933* (0.0665)	0.0018 (0.059)	-0.0005* (0.0001)
2006	0.2787* (0.1038)	0.4638* (0.1635)	0.2584* (0.0738)	-0.0006* (0.0002)
2011	-0.0318 (0.0701)	0.7862* (0.0984)	0.2432** (0.1072)	0.0024* (0.0002)
2016	0.3729** (0.1894)	0.2201*** (0.1561)	0.4076* (0.1111)	-0.0005* (0.0002)
Reject Null of break at:				
2001	✓	✓	✓	✕
2006	✓	✓	✕	✓
2011	✓	✓	✓	✓

*, **, and *** denote statistical significance at 1%, 5%, and 10%.
Notes: Standard Errors are shown in parentheses. Spectral Density Matrix of three lags (k = 3) was used. Rejection criteria was set at 5% confidence.

Part two of table 3 shows that there is time variation in the parameters of each variable, but it hides multiple nuances of this conclusion, which can be seen more clearly from part 1 of the table. While a similar conclusion can be drawn about CED by looking at either part 1 or 2 of table 3, but this is not the case for the rest of the variables. The CUSDP variable does change over time, but this change seems to be due to the occurrence of crises. The parameter estimate of CUSDP in 1996-2001 is not significantly different from the estimate in 2006-2011 and the 2001-2006 estimate is not significantly different from the 2011-2016 estimate. This indicates that the estimate only changes in periods of crisis and is stable/non-time varying during non-crisis periods. The parameter of WIR shows a similar pattern, it does not change from sub-period 1996-2001 to 2002-2006, but it does show change from the sub-periods 2002-2006 to 2007-2011 and 2007-2011 to 2012-2016. Looking at part 1 of table 3, shows that if the 2007-2011 sub-period is excluded, then none of the estimates are significantly different for one another. Thus, it may be that the parameter estimate and as such the pricing power of WIR only shows variation during periods of major crisis[9]. Finally part 1 of table 3 shows that the parameter of CUSTP does show time-variation, but the change in the parameter occurs over a longer period of time, the estimate in 2006-2011 is not significantly different from 2001-2006, but the estimate in 2011-2016 is significantly different from all other estimates.

Shifting focus to the marginal pricing power/parameter significance of the variables. Part 1 of table 3 shows that the estimates of all variables in all sub-periods, except for USTP in 1996-2001 and CED in 2006-2011, are statistically significant. This indicates that the use of CUSDP and WIR is always necessary to price assets, whereas CED and CUSTP are not always needed for asset pricing and as such researchers and investors should perform a preliminary analysis before including or excluding them.

The finding that CED was not significant in pricing assets during 2006-2011 (as shown in table 3), the sub-period that included the 2007-2008 global crisis, is quite peculiar as one would expect that the change in sovereign default risk (as proxied by CED) would be even more important during such a major crisis. A possible reason for this may be that, during this period, change in the sovereign default risk was not significant enough to be considered i.e. the default risk was already so high that any increase/decrease was considered too miniscule to be considered. The

[9] The 2001 crisis was not as impactful as the 2007-2008 crisis.

insignificance of CUSTP in the 1996-2001 sub-period (as shown in table 3) leads to two possibilities, either it was just insignificant in this period or the Hegemon's market risk was not indicative of the global market risk until after 2001. The War on Terror launched by the U.S. after 2001, which led to its increased global influence; through multilateral treaties, increased presence in countries, increased aid to countries etc. (State, 2009); could be a possible explanation for the latter possibility. But this is unlikely, because if the CUSTP did not capture global market risk in 1996-2001 then the impact of WIR would be considerably higher, as it is a supplementary proxy for global market risk.

Part 1 of table 3 shows that the impact of CED and CUSTP has increased over the years. This trend confirms the findings of increased integration (see for example Pukthuanthong & Roll (2009), Arouri & Foulquier (2012)); as equity markets become more integrated, the difference between their returns are increasingly explained by the global risk of sovereign default and the global market risk. This increased impact of CED also corroborates the intuition that in a global context investors ask a higher premium from countries that have a higher sovereign default risk. The increased impact of CUSDP during crises is also intuitive and corroborates the finding that there is increased integration during periods of crisis (see for example Bekaert, et al (2005), Bekaert, et al. (2014)). Moreover, it shows that the increased integration during crises observed in previous research is due to the increased default risk and not due to increased sovereign default risk. Finally, the constant impact of WIR, during non-crisis periods, shows that most of the global market risk is determined by the Hegemon and as such it is appropriate to use variables related to the Hegemon as proxies of global factors.

5.1 Limitations & possible future research

This study has a number of limitations, the most prominent is the use of an identity matrix to ensure that only the impact of the used variables is estimated by the parameters. The use of a Spectral Density Matrix of 3 lags may also be inaccurate as there is no evidence that this is the appropriate number of lags. Furthermore, the use of monthly data and 5-year sub-periods seems to distort some of the information related to time-variation. Future research on this topic may wish to improve on these problems by separately estimating the impact of global variables for each country, obtaining multiple estimates through the use of several Spectral Density Matrices of differing lengths, or using daily or weekly data instead of monthly.

The peculiar finding that CED had no impact during a major crisis needs to be research more thoroughly and as such may be a fruitful topic for future research. Research into the impact of CUSTP over a longer period of time to see if it was priced before 1996 could be a supplementary objective to the CED research. Future research could also include the Fama-French variables and Principal Components along with the variables used in this study to see how they compare to one another.

6. CONCLUSION

The aims of this study were to find out whether the proxies of global factors; Return on World Index, change in spread between Moody's Aaa and Baa rated corporate bonds, change in spread between 10-year U.S. T-bond and 3-month U.S. T-bill, and change in monthly Eurodollar rate; are all needed to ascertain the global impact on a country's return, whether there is time-variation in these factors, how the impact of these factors has changed, and if the use of variables related to a Hegemon are appropriate proxies for global variables. In order to achieve these objectives, I estimate the impact of these variable on the SDF for four periods 1996-2001, 2001-2006, 2006-2011, and 2011-2016 by using the index returns of 21 countries.

The results show that the CED and CUSDP always have pricing power, whereas this is not the case for CED and CUSTP. As such researchers should use caution when including CED and CUSTP as proxies of global variables. In periods of major global crisis, the change in global sovereign default risk becomes irrelevant for pricing global equities, but the exact reason is not clear. During normal times, increased integration is due to the increased impact of the change in global sovereign default risk and change in global market risk, whereas during crises increased integration is attributable to the increased impact of the change in default risk. Moreover, the use of a Hegemon's variables to proxy global factors is an appropriate decision.

7. REFERENCES

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