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Stock return predictability and market integration: The role of global and local information

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Abstract: This paper examines the predictability of a range of international stock markets where we allow the presence of both local and global predictive factors. Recent research has argued that US returns have predictive power for international stock returns. We expand this line of research, following work on market integration, to include a more general definition of the global factor, based on principal components analysis. Results identify three global expected returns factors, one related to the major stock markets of the US, UK and Asia and one related to the other markets analysed. The third component is related to dividend growth. A single dominant realised returns factor is also noted. A forecasting exercise comparing the principal components based factors to a US return factor and local market only factors, as well as the historical mean benchmark finds supportive evidence for the former approach. It is hoped that the results from this paper will be informative on three counts. First, to academics interested in understanding the dynamics asset price movement. Second, to market participants who aim to time the market and engage in portfolio and risk management. Third, to those (policy makers and others) who are interested in linkages across international markets and the nature and degree of integration.

Subjects: Econometrics; Economic Forecasting; Finance; International Economics

Keywords: stock returns; predictability; global information; principal components; forecasting

JEL classifications: C22; G12

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PUBLIC INTEREST STATEMENT

This work reveals that information flows that affect stock market behaviour arise from both global and local sources. In contrast to much of the previous work, what defines global information is allowed to expand beyond just information from the USA. Indeed, using US-based global information misses several of the more interesting dynamics. The results reveal the importance of accounting for, and separating, both global and local information. In particular, they reveal how individual stock returns respond to changes in global risk premium (expected returns) as well as how movements in actual returns are transmitted across markets. The robustness of the results is supported by an out-of-sample forecast exercise. The results have implications for market participants in terms of portfolio and risk management, policy-makers and regulators in understanding how shocks can be transmitted and academics involved in modelling market behaviour.

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1. Introduction

This paper examines stock market predictability across a range of international markets and seeks to consider the role of global and local information in terms of any predictive power. Notably, we are interested in whether global information affects local markets to a greater extent than local information. There now exists a body of empirical evidence that supports the presence of stock return predictability arising from movements in financial ratios (particularly the dividend-price ratio) across a range of markets (e.g. Cochrane, 2008, 2011; Kellard, Nankervis, & Papadimitriou, 2010; McMillan & Wohar, 2010; 2013). The central argument behind this predictability is that movements in financial ratios proxy for movements in expected returns (risk premium). Most recently, that literature has been extended to consider to what extent movements in US stock returns contains predictive power for international stock returns. Rapach, Strauss, and Zhou (2013) demonstrate that lagged US stock returns have significant predictive power for non-US stock returns. However, non-US markets have limited predictive power for other markets (including the US). Therefore, the US stock market acts in a leading role, which may arise from the diffusion of news from the US. In a slightly different context, Goh, Jiang, and Tu (2013) considered the role of US economic variables in the predictability of the Chinese stock market. Again pointing to the view that the US acts as a leader and that such global information dominates over local market information.

Within the international finance literature, and related to the above work that seeks to link stock market behaviour, empirical evidence regarding the nature of integration has examined the extent to which movements in asset prices and valuations in one market (typically the US) are related to movements in asset prices and valuations in another market. Early research along this line goes back to, e.g. Bekaert and Hodrick (1992) and Bekaert (1995) who include US returns, dividend yield and interest rates in predictive regressions for a range of developed and emerging markets. Evidence of significant US-based variables in non-US markets would indicate the presence of global information. More recently, Cooper and Priestley (2013) argue that a measure of the world business cycle captures stock return predictability in seven developed markets. This, they argue, highlights two important findings. First, the business cycles of the markets considered in their research are integrated and second, that stock returns respond to global factors more than local factors.

The aim of this paper is to build upon these related lines of research and consider whether a predictability model that incorporates both global and local information on expected returns can provide additional information over a standard individual country predictability model. Thus, we reconsider the nature of stock market predictability for a range of international markets. We begin with regressions that contain single country information only in order to provide a baseline model. We then extend this following Bekaert (1995) and Rapach et al. (2013) through the inclusion of US variables which represent global information. However, as local market variables are likely to incorporate both local and global information we seek to orthogonalise local returns and dividend-price ratios. By doing so, we separate global information from local market information (i.e. local information about local market conditions).

Extending this further, it is our view that the nature of global information is greater than that captured only through US variables (a point equally made in Cooper & Priestley, 2013). Therefore, using principal components analysis, we identify those factors that account for the majority of the variations across international returns and dividend-price ratios. We then examine whether these global factors have predictive power for stock returns, while also incorporating local factors in the predictability model. An out-of-sample forecasting exercise aims to provide evidence regarding the ability of the separate global and local factors to predict stock returns in comparison to alternative models including the historical mean.

It is hoped the results in this paper would be of interest to those engaged in asset price modelling and international integration. In particular, for academics through understanding the role of global information and the need to adopt international-based asset pricing models. Furthermore, the results should be of interest to portfolio and risk managers in demonstrating the need to incorporate international information as inputs into their model building process, as well as in market-timing strategies. Finally, for policy makers and regulators who are interested in linkages across international markets and the nature and degree of integration.

2. Standard country predictability regressions

We begin the examination of predictability with the standard baseline model where individual country returns, r_t, are regressed on a lag of the individual country (log) dividend-price ratio, $d_t - p_t$, and a lag of the return.[1] We consider results for sixteen markets over the time period 1973 month 1 to 2012 month 12. The data on stock returns and dividend-price ratios are obtained from Datastream and the results from the following predictability regression are reported in Table 1:

Table 1. Benchmark predictive regression

Country	Div-price	Return	Adj R^2
Australia	0.034*	0.100*	0.018
	(2.48)	(2.59)	
Austria	0.006	0.286*	0.075
	(0.63)	(3.24)	
Belgium	0.003	0.200*	0.035
	(0.56)	(3.43)	
Canada	0.004	0.086***	0.004
	(0.58)	(1.68)	
Denmark	0.006	0.156*	0.022
	(0.89)	(2.78)	
France	0.014	0.11*	0.011
	(1.61)	(2.56)	
Germany	0.003	0.101**	0.006
	(0.36)	(2.08)	
Hong Kong	0.052*	0.119*	0.034
	(3.10)	(2.75)	
Ireland	0.008	0.184*	0.032
	(1.32)	(4.39)	
Italy	−0.003	0.108*	0.009
	(−0.28)	(2.43)	
Japan	0.004	0.117**	0.011
	(0.92)	(2.33)	
Netherlands	0.005	0.125***	0.012
	(0.81)	(1.90)	
Singapore	0.037*	0.150*	0.034
	(2.46)	(2.72)	
Switzerland	0.001	0.169*	0.024
	(0.15)	(3.77)	
UK	0.030**	0.119*	0.029
	(2.07)	(2.40)	
US	0.006	0.057	0.003
	(1.45)	(1.05)	

Note: Entries are coefficient values with Newey–West *t*-statistics from the predictive regression in Equation (1), given by $r_t = \alpha + \beta\left(d_{t-1} - p_{t-1}\right) + \rho r_{t-1} + \varepsilon_t$.

*Level of significance at 1%.

**Level of significance at 5%.

***Level of significance at 10%.

$$r_t = \alpha + \beta\left(d_{t-1} - p_{t-1}\right) + \rho r_{t-1} + \varepsilon_t. \tag{1}$$

Following, for example, Cochrane (2011) we would expect the parameter β to be statistically significant and positive. This would indicate that a higher dividend-price ratio is associated with a higher expected return and arises due to an increase in risk, which lowers current prices and increases the required risk premium. However, the reported results, which are consistent with those widely reported in the literature, are not supportive of such a relationship. Specifically, there is relatively little evidence of dividend-price ratio predictability, with only four of the sixteen markets demonstrating a positive and statistically significant coefficient. With regard to the lagged returns, there is more evidence of a statistical relationship, with lagged values significant across fifteen of the markets (albeit, at the marginal 10% significance level for two markets).

One explanation for the relative lack of significant results is the potential for confounding effects within the dividend-price ratio series, particularly as this ratio relates to both stock return and dividend growth predictability. For example, Menzly, Santos, and Veronesi (2004) demonstrate that the presence of dividend growth predictability can cause a negative relationship within the returns predictability equation. We consider the issue of confounding effects within the dividend-price ratio particularly as it relates to the presence of global and local information. In examining the effects of a global factor in predictability, we first consider the role of the US market as a lead market in terms of both stock returns and the dividend-price ratio (expected returns). Significant US effects would indicate a degree of international integration as noted by Bekaert and Hodrick (1992) and Bekaert (1995).

3. The role of US information in predictability

Following Rapach et al. (2013), it is argued that incorporating lagged US stock returns can improve predictive power for other market stock returns. Therefore, Table 2 reports the results of Equation (2) for each market where we now include lagged US returns, as such:

$$r_{i,t} = \alpha_i + \beta_i(d_{i,t-1} - p_{i,t-1}) + \rho_i r_{it,-1} + \rho_{\text{usa}} r_{\text{usa},t-1} + \varepsilon_{i,t} \tag{2}$$

where $r_{\text{usa},t}$ refers to the stock return of the USA and the subscript i references the other markets. In examining these results we can see that, amongst the predictor variables, the greatest amount of statistical significance occurs for the lagged US stock return. More specifically, the lagged dividend-price ratio is positive and significant for only five of the sixteen markets (albeit, one more than previously reported), own country lagged returns are significant for four markets, with a further two significant at the weaker 10% level, while all coefficients are positive. For the lagged US stock returns, there are eight markets that report a statistically significant effect, with a further one significant at the 10% level. Of interest, all the coefficients are positive, indicating that an increase in US stock returns last month leads to an increase in other market stock returns this month. This supports the information diffusion argument of Rapach et al. (2013) and that US stock returns act as a leader. Furthermore, for the vast majority of the markets the explanatory power (adjusted R^2) has increased, more than doubling in several cases (e.g. Germany, Italy and Japan amongst others). That said, for Singapore the adjusted R^2 value has remained constant, while for the UK it has decreased.

However, information regarding the movement of stock returns around the world may not only emanate from lagged US realised returns, but also from expected returns, as proxied by the dividend-price ratio. Indeed, as noted above, this was considered by Bekaert and Hodrick (1992). In particular, our belief is that the US dividend-price ratio may carry information about global (expected) returns and thus provide a predictive effect on global stock returns. We also contend that local market dividend-price ratios will in part reflect this global information as well as local, market-specific, information. Thus, the local dividend-price ratios may contain confounding effects from the behaviour of global and local expected returns, as well as any local dividend growth predictability, which appears more prevalent in non-US markets (Ang, 2012; Rangvid, Schmeling, & Schrimpf, 2013).

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Table 2. Predictive regression with lagged US returns

Country	Div-price	Return	US Return	Adj R^2
Australia	0.030**	0.007	0.198*	0.032
	(2.26)	(0.17)	(3.30)	
Austria	0.006	0.250*	0.106	0.079
	(0.66)	(2.38)	(1.52)	
Belgium	0.004	0.139**	0.108**	0.039
	(0.62)	(2.23)	(1.97)	
Canada	0.004	−0.054	0.179*	0.015
	(0.49)	(−0.68)	(2.40)	
Denmark	0.006	0.156*	0.037	0.025
	(0.93)	(2.43)	(0.45)	
France	0.013	0.045	0.132***	0.015
	(1.56)	(0.74)	(1.73)	
Germany	0.003	−0.005	0.195*	0.022
	(0.47)	(−0.09)	(3.34)	
Hong Kong	0.060*	0.079	0.097	0.044
	(3.01)	(1.28)	(0.76)	
Ireland	0.007	0.087***	0.233*	0.047
	(1.29)	(1.69)	(2.77)	
Italy	−0.002	0.052	0.188*	0.019
	(−0.26)	(1.01)	(2.46)	
Japan	0.005	0.049	0.180*	0.029
	(1.11)	(0.82)	(2.75)	
Netherlands	0.005	−0.023	0.234*	0.030
	(0.85)	(−0.28)	(3.42)	
Singapore	0.037*	0.119*	0.092	0.034
	(2.84)	(2.46)	(0.97)	
Switzerland	0.037*	0.119	0.092	0.034
	(2.46)	(1.53)	(0.80)	
UK	0.029**	0.115***	0.006	0.027
	(2.08)	(1.77)	(0.06)	

Note: Entries are coefficient values with Newey–West t-statistics from the predictive regression in Equation (2), given by: $r_{i,t} = \alpha_i + \beta_i\left(d_{i,t-1} - p_{i,t-1}\right) + \rho_i r_{it,-1} + \rho_{usa} r_{usa,t-1} + \varepsilon_{i,t}$.
*Level of significance at 1%.
**Level of significance at 5%.
***Level of significance at 10%.

Therefore, in order to separate the local and global expected return information (we return to the issue of dividend growth predictability below), we regress the local dividend-price ratio on the US dividend-price ratio. In addition, we also undertake the same procedure for stock returns, regressing local returns on the US stock return. From both sets of regressions we extract the residual term, which will represent the local dividend-price ratio and returns, respectively, which will now also be orthogonal to the equivalent US variables. Thus, our explanatory variables for local stock return predictability are given as the lagged US dividend-price ratio and the lagged US stock return, together with the residual from the local dividend-price ratio on the US dividend-price ratio and the residual from the local stock returns on the US stock returns. This allows us to separate global (US) information and local market information and prevents the likelihood of multicollinearity in the predictive regressions. For the sake of precision, first, we estimate the following regression:

$$x_{i,t} = \alpha_i + \beta_i x_{usa,t} + \varepsilon_{xi,t} \tag{3}$$

where *x* refers in turn to the stock return and dividend-price ratio series and the $\varepsilon_{xi,t}$ can be regarded as the orthogonalised local market return or dividend-price ratio. Using this separated local and global information our predictability regression now becomes:

$$r_{i,t} = \alpha_i + \beta_{usa}(d_{usa,t-1} - p_{usa,t-1}) + \beta_i \varepsilon_{dp,i,t-1} + \rho_{usa} r_{usa,t-1} + \rho_i \varepsilon_{r,i,t-1} + v_{i,t} \tag{4}$$

Table 3 presents the two separate regressions of the local dividend-price ratio on the US dividend-price ratio and the local stock return on the US stock return for our fifteen non-US markets based on Equation (3). Considering these results, two broad conclusions can be drawn. First, across the 15 markets there is a high degree of statistical significance within these regressions. For the local dividend-price ratio regressions, the US dividend-price ratio is significant for 13 markets, while for the local stock returns regressions, the US stock return is significant for all 15 markets. Furthermore, for both sets of regressions the coefficients are positive (except the insignificant Italy dividend-price ratio regression), hence the movement of the markets is in the same direction, indicting the presence of common information. Second, in terms of explanatory power, the US dividend-price ratio has greater power for local dividend-price ratios than in the corresponding returns regressions for ten of the markets, with the opposite therefore found for five markets. Overall, therefore, both sets of results support the idea of the presence of global information within returns and expected returns, which may aid in the predictive regressions.

Table 4 now presents the predictive regressions from Equation (4) where the explanatory variables are the US dividend-price ratio and stock returns and the local dividend-price ratio and stock returns given by the residuals from the respective market regressions in Equation (3). These results show that the dominant factor in determining local market stock returns is the US stock return (consistent with Rapach et al., 2013). Looking across the four explanatory variables, US stock returns have the greatest degree of statistical significance, including now being significant for markets that previously reported insignificance lagged US returns. This latter point suggests that the previous insignificance may have been due to collinearity between the two lagged returns series and hence, supportive of the orthogonalising procedure. More specifically, for the local market dividend-price ratio this is only significant for two markets (with a further one significant at the 10% level). Equally, the US dividend-price ratio is only significant for two markets (with a further one significant at the 10% level), while only three markets report a significant home market lagged returns (again, with a further market significant at the 10% level). However, for 14 of the 15 markets the lagged US return is significant and positive (while it is 10% significant for the remaining market). This result emphasises the view that US returns have predictive effect on returns around the rest of the world. In terms of the model fit, the adjusted R^2 is marginally lower for ten markets and marginally higher for five markets. This reflects the fact that adding the US dividend-price ratio does not improve the explanatory power and is largely insignificant.

4. Global information and principal components

The above results suggest that US stock returns have predictive power for stock returns in a range of international markets, although the US dividend-price ratio does not have similar global predictive power. However, this approach assumes that US returns and dividend-price ratio proxy fully for global information and ignores any global information content that may also exist in other markets. Moreover, we argue above that local market dividend-price ratios contain both global and local information, so the same should be true with the US variables. Thus, the above results really only inform us of predictive ability of US variables, with the belief that as the largest market it acts as a

Table 3. Regression of local market on the US market

Country	Div-price	Adj R^2	Returns	Adj R^2
Australia	0.233*	0.273	0.717*	0.335
	(6.12)		(8.59)	
Austria	0.041	0.002	0.542*	0.185
	(1.39)		(5.64)	
Belgium	0.598*	0.478	0.664*	0.364
	(10.98)		(8.96)	
Canada	0.664*	0.853	0.772*	0.597
	(25.94)		(20.26)	
Denmark	0.479*	0.373	0.642*	0.305
	(7.14)		(12.39)	
France	0.515*	0.561	0.818*	0.391
	(12.18)		(17.88)	
Germany	0.466*	0.439	0.715*	0.393
	(10.32)		(10.01)	
Hong Kong	0.386*	0.330	0.968*	0.216
	(6.36)		(7.60)	
Ireland	0.994*	0.755	0.853*	0.355
	(20.59)		(10.85)	
Italy	−0.048	0.001	0.683*	0.208
	(−0.55)		(11.20)	
Japan	0.368*	0.118	0.489*	0.183
	(4.97)		(8.79)	
Netherlands	0.680*	0.773	0.817*	0.515
	(18.85)		(12.89)	
Singapore	0.274*	0.176	0.983*	0.336
	(6.26)		(10.87)	
Switzerland	0.470*	0.487	0.684*	0.468
	(12.28)		(12.95)	
UK	0.503*	0.787	0.837*	0.495
	(20.08)		(13.20)	

Note: Entries are the coefficient values with Newey–West *t*-statistics from the regression on the country dividend-price ratio and stock return on the US dividend-price ratio and stock return, respectively, Equation (3), given by $x_{i,t} = \alpha_i + \beta_i x_{usa,t} + \varepsilon_{xi,t}$, where *x* refers to the dividend-price or returns series, respectively.
*Level of significance at 1%.

leader with information emanating from the US and diffusing towards other markets. However, global information will be present across all markets as it represents common information.

Therefore, in order to separate global and local information from market returns and the dividend-price ratio, we undertake principal components analysis. Principal component analysis allows us to extract common factors (components) from a group of data series. The components are ordered according to how much of the variation across the series they can account for and are orthogonal to each other, thus representing independent information. In order to report the output of the principal components analysis, we present in Figure 1 for the dividend-price ratio and Figure 2 for returns, the scree plot. This plot represents the ordered components from the highest to the lowest eigenvalue against the maximum number of components (equal to the number of series). A rule of thumb in choosing the number of principal components is to choose those whose eigenvalue is greater one.

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Table 4. Predictive regression with local and global (US) information

Country	Home DY	US DY	Home Ret	US Ret	Adj R^2
Australia	0.032***	0.006	0.009	0.204*	0.030
	(1.74)	(1.14)	(0.20)	(3.84)	
Austria	0.006	0.003	0.250*	0.243*	0.078
	(0.63)	(0.70)	(2.40)	(4.64)	
Belgium	0.001	0.004	0.137**	0.199*	0.038
	(0.08)	(0.96)	(2.24)	(3.79)	
Canada	0.003	0.003	−0.054	0.138*	0.012
	(0.15)	(0.51)	(−0.69)	(2.95)	
Denmark	0.005	0.003	0.155*	0.137***	0.023
	(0.62)	(0.69)	(2.44)	(1.89)	
France	0.013	0.007	0.045	0.169*	0.013
	(0.96)	(1.19)	(0.72)	(3.11)	
Germany	−0.002	0.005	−0.009	0.189*	0.021
	(−0.18)	(0.96)	(−0.17)	(3.77)	
Hong Kong	0.078*	0.010	0.093	0.168**	0.048
	(2.90)	(1.05)	(1.51)	(1.98)	
Ireland	0.009	0.007	0.088***	0.307*	0.045
	(0.59)	(1.21)	(1.69)	(4.58)	
Italy	−0.002	0.011***	0.048	0.228*	0.023
	(−0.17)	(1.71)	(0.96)	(3.49)	
Japan	0.002	0.010**	0.040	0.205*	0.034
	(0.37)	(2.22)	(0.68)	(3.17)	
Netherlands	−0.012	0.007	−0.040	0.209*	0.032
	(−0.62)	(1.54)	(−0.52)	(3.90)	
Singapore	0.039**	0.008	0.120	0.209*	0.032
	(2.29)	(1.17)	(1.54)	(2.74)	
Switzerland	−0.005	0.002	0.069	0.187*	0.031
	(−0.48)	(0.62)	(1.07)	(3.60)	
UK	0.062	0.011*	0.137	0.110**	0.031
	(1.43)	(2.31)	(1.42)	(2.23)	

Note: Entries are coefficient values with Newey–West *t*-statistics for the predictive regression, Equation (4), given by: $r_{i,t} = \alpha_i + \beta_{usa}(d_{usa,t-1} - p_{usa,t-1}) + \beta_i \varepsilon_{dp,i,t-1} + \rho_{usa} r_{usa,t-1} + \rho_i \varepsilon_{r,i,t-1} + v_{i,t}$, where home stock returns are regressed on lagged US stock returns and log dividend yield and the lagged home stock returns and dividend yield, with the latter defined as the residuals from the equations reported in Table 3.

*Level of significance at 1%.

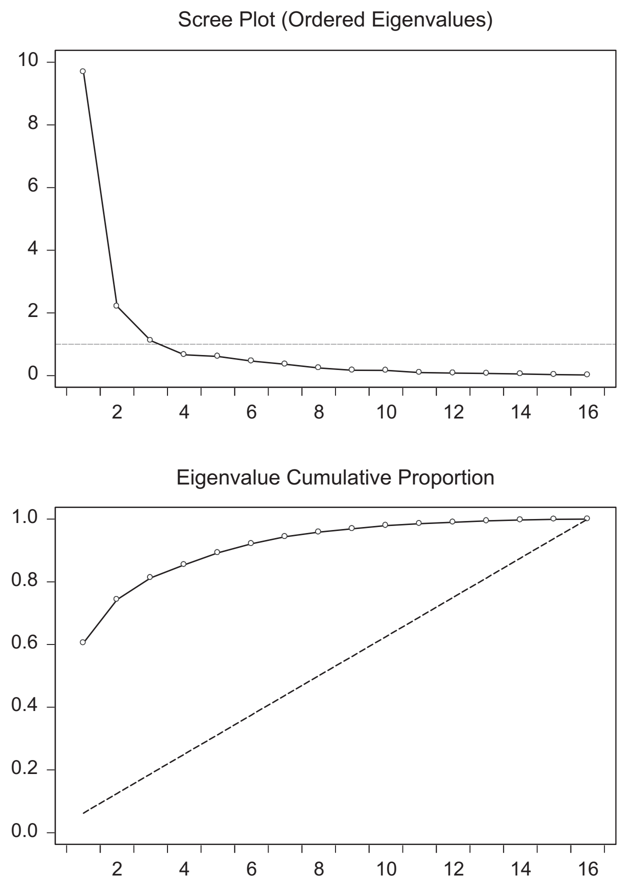
**Level of significance at 5%.

***Level of significance at 10%.

Alternatively, this is seen in the eigenvalue cumulative plot whose slope is steeper than the 45° line. Equally, the cut-off number of components is often regarded as the point where the plot hinges. For the dividend-price ratio it can be seen that the first three principal components account for over 80% of the variability in the sixteen series and is chosen as the preferred number of components. For stock returns we also chose three components for consistency with dividend-price ratio, however arguably we could chose only two or even one component.

To further examine the nature of the principal components analysis, Table 5 presents the factor loading for the first three factors for both the dividend-price ratio and stock returns. These loadings

Figure 1. Principal components analysis for the dividend yield.



will reveal if any particular component is dominated by one series, for example, following the general belief that the US market can proxy for the world then we would expect to see the first principal component loading heavily on the US market with little elsewhere. Given this therefore, these results present a contrasting view to this perception; for both the dividend-price ratio and stock returns the first principal component loads consistently across all markets (with perhaps the exception of Italy for the dividend-price ratio) supporting the view that the global factor emanates across all markets. With regard to the other principal components, it is noteworthy that the second component for stock return is negative for all European markets (except the UK) and positive elsewhere, while the second component for the dividend-price ratio is negative and of similar value for the UK and US. This indicates country differences, perhaps around Anglo-Saxon markets.

Table 6 presents the predictive regressions for our sixteen markets that include the three principal components identified as representing global information from the dividend-price ratio and stock return series. As with the previous analysis, in order to obtain local market information we again regress the home markets dividend-price ratio (return) on the three identified principal components for the dividend-price ratio (returns) series and use the resulting residual, which will be orthogonal to the principal component series. Again, for clarity, first we estimate:

$$x_{i,t} = \alpha_i + \sum_j \beta_{ij} pc_{xj,t} + \eta_{xi,t} \quad (5)$$

where x again refers to the dividend-price ratio and stock return series, respectively, pc refers to the principal component of which we include the first three ($j = 1, \ldots, 3$) and $\eta_{xi,t}$ is the orthogonalised local

Figure 2. Principal components analysis for returns.

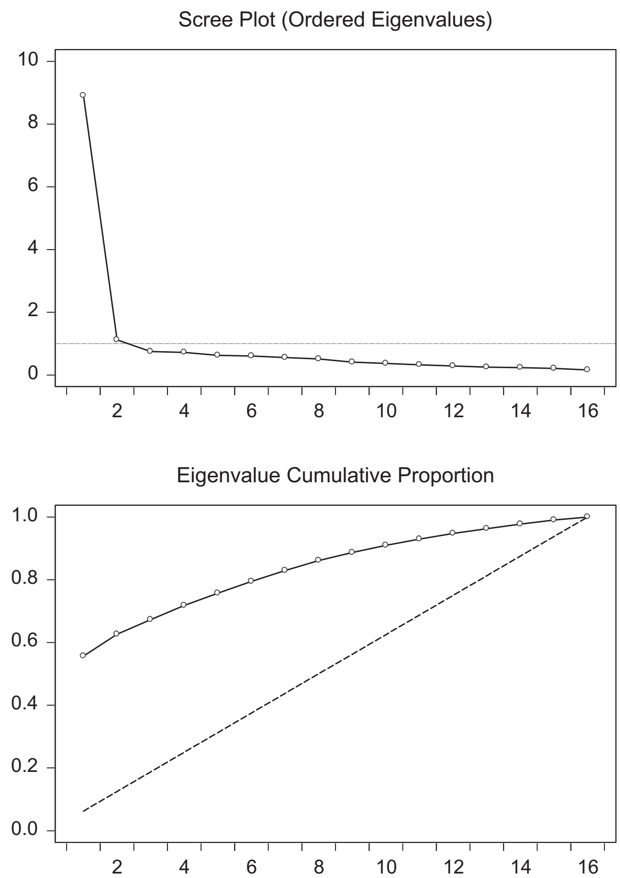


Table 5. Principal components factor loadings

	Dividend-price ratio principle comp.			Return principle components		
	PC1	**PC2**	**PC3**	**PC1**	**PC2**	**PC3**
Australia	0.2262	0.0718	0.5402	0.2324	0.2265	−0.3473
Austria	0.1268	0.4492	−0.0761	0.2091	−0.2096	0.4449
Belgium	0.2677	−0.0763	−0.0975	0.2657	−0.2369	−0.0593
Canada	0.2961	−0.1097	−0.0657	0.2647	0.1446	−0.2440
Denmark	0.2444	−0.0274	−0.2245	0.2265	−0.1332	0.0273
France	0.2912	0.0102	−0.0890	0.2671	−0.2301	−0.0762
Germany	0.2853	0.1861	−0.2050	0.2707	−0.2248	0.2452
Hong Kong	0.1885	−0.2062	0.6052	0.1963	0.5473	0.3760
Ireland	0.2694	−0.2942	−0.0881	0.2573	−0.0050	−0.2727
Italy	0.0880	0.4829	0.2955	0.2240	−0.2704	0.0846
Japan	0.2200	0.3649	−0.2295	0.1887	0.0446	0.4367
Netherlands	0.3016	−0.1393	−0.0833	0.2992	−0.1123	0.0164
Singapore	0.2350	0.2536	0.2299	0.2238	0.5181	0.1726
Switzerland	0.2813	0.1764	−0.0942	0.2834	−0.1365	−0.0134
UK	0.2885	−0.2229	0.0586	0.2768	0.1270	−0.2494
US	0.2733	−0.2825	−0.0470	0.2804	0.1268	−0.2134

Note: Entries are the factor loadings for each market for the first three principle components for the dividend-price ratio and stock returns, respectively.

Table 6. Predictive regression with local and global (principal components) information

Country	Dividend yield				Returns				Adj R^2
	Home	PC1	PC2	PC3	Home	PC1	PC2	PC3	
Australia	0.003	0.001	−0.001	0.007*	−0.060	0.003*	0.001	0.002	0.035
	(0.99)	(1.25)	(−0.23)	(2.95)	(−0.78)	(3.85)	(0.18)	(1.16)	
Austria	0.021	0.001	−0.002	0.007*	0.172*	0.005*	−0.001	0.008*	0.093
	(1.55)	(0.18)	(−0.14)	(2.69)	(2.50)	(5.92)	(0.39)	(2.57)	
Belgium	0.004	0.005	−0.001	0.006*	0.156***	0.003*	0.001	−0.002	0.044
	(0.42)	(0.62)	(−0.71)	(2.58)	(1.91)	(4.21)	(0.62)	(0.65)	
Canada	−0.001	0.001	0.001	0.004**	−0.101	0.002*	0.003***	0.004***	0.031
	(−0.03)	(0.75)	(0.01)	(1.98)	(−1.22)	(3.49)	(1.69)	(1.74)	
Denmark	0.011	0.002	−0.012	−0.001	0.122***	0.003*	−0.003	0.005***	0.024
	(0.99)	(0.33)	(−0.70)	(−0.46)	(1.92)	(3.13)	(−0.16)	(1.73)	
France	0.049*	0.001	−0.001	0.007*	−0.002	0.003*	0.001	0.002	0.034
	(2.37)	(0.96)	(−0.50)	(2.66)	(−0.02)	(3.17)	(0.32)	(0.62)	
Germany	0.032	0.001	−0.001	0.008*	−0.155***	0.003*	0.001	0.002	0.032
	(1.35)	(0.11)	(−0.38)	(3.39)	(−1.69)	(3.72)	(0.49)	(0.67)	
Hong Kong	0.091*	0.002***	−0.001	0.015*	−0.045	0.003**	0.008**	0.004	0.048
	(2.67)	(1.67)	(−1.47)	(3.78)	(−0.48)	(2.24)	(2.02)	(0.78)	
Ireland	0.018	0.001	−0.002	0.006**	0.016	0.005*	0.005***	0.001	0.059
	(0.99)	(0.82)	(−1.14)	(2.10)	(0.21)	(5.27)	(1.80)	(0.22)	
Italy	0.013	0.001	−0.003	−0.001	0.017	0.003*	−0.001	−0.002	0.013
	(0.89)	(0.96)	(−1.31)	(−0.41)	(0.25)	(3.15)	(−0.40)	(−0.50)	
Japan	0.010	0.003***	−0.002	0.001	0.029	0.003*	0.002	−0.002	0.032
	(0.87)	(1.88)	(−0.94)	(0.27)	(0.48)	(4.11)	(0.75)	(−0.63)	
Netherlands	−0.035	0.001	−0.002	0.005*	−0.186***	0.003*	0.004***	0.002	0.045
	(−1.38)	(1.07)	(−1.32)	(2.40)	(−1.77)	(3.74)	(1.69)	(0.87)	
Singapore	0.055*	0.002***	0.001	0.009*	0.118	0.004*	0.006***	−0.001	0.036
	(2.41)	(1.89)	(0.12)	(2.59)	(1.25)	(2.95)	(1.72)	(−0.20)	
Switzerland	0.008	0.002	−0.001	0.006*	0.060	0.003*	0.003	0.001	0.044
	(0.50)	(0.31)	(−0.97)	(3.02)	(0.68)	(4.02)	(1.58)	(0.49)	
UK	0.072**	0.002*	−0.001	0.006*	0.051	0.003*	0.003	−0.001	0.036
	(2.27)	(2.35)	(−0.79)	(2.66)	(0.55)	(2.95)	(1.05)	(−0.27)	
US	0.005	0.001**	−0.002	0.007*	−0.075	0.001****	0.002	0.003	0.027
	(0.32)	(2.01)	(−1.05)	(3.19)	(−0.82)	(1.94)	(1.13)	(1.29)	

Notes: Entries are coefficient values with Newey–West *t*-statistics for the predictive regression, Equation (6), given by: $r_{i,t} = \alpha_i + \sum_j \beta_{ij} pc_{dpj,t-1} + \beta_i \eta_{dpi,t-1} + \sum_j \rho_{ij} pc_{rj,t-1} + \rho_i \eta_{ri,t-1} + v_{i,t}$. Home stock returns are regressed on lagged stock return and log dividend yield principal components and the lagged home stock returns and dividend yield, which are defined as the residuals from a regression of stocks returns and log dividend yield on the principal components.

*Level of significance at 1%.

**Level of significance at 5%.

***Level of significance at 10%.

market dividend-price ratio or return. Using these separate local and global information our predictability regression now becomes:

$$r_{i,t} = \alpha_i + \sum_j \beta_{ij} pc_{dpj,t-1} + \beta_i \eta_{dpi,t-1} + \sum_j \rho_{ij} pc_{rj,t-1} + \rho_i \eta_{ri,t-1} + v_{i,t} \tag{6}$$

The results in Table 6 present an interesting pattern for both the dividend-price ratio and returns. Focusing on the dividend-price ratio, for the first principal component we can see that this is significant only in the regressions for the UK and US (and marginally for Hong Kong, Japan and Singapore). This accords with the view that a large part of the global information regarding expected returns emanates from the UK (as the dominant European market) and the US, while information from Asia appears dispersed across the three noted major markets. With regard to the second principal component, there are no significant markets for which this series has predictive power (discussed further below), while the third principal component is significant for thirteen markets and indicates it acts as a global factor. Turning to the principal components for returns, as perhaps expected from the plots in Figure 2, the first principal component is significant for all markets, with limited evidence of significance elsewhere. This indicates that a choice of one principal component would indeed be acceptable.

Regarding local dividend-price ratio and returns information there is limited evidence of significance across our markets, suggesting the dominance of global information. For the local dividend-price ratio, although this is positive for all bar two markets (consistent with our beliefs regarding the role of the ratio as a proxy for expected returns) but is only significant for four markets (France, Hong Kong, Singapore and the UK). With respect to the local stock returns, the coefficient sign are split between positive (nine markets) and negative (seven markets) however significance only occurs for a selection of the North European markets, Austria, Belgium, Denmark, Germany and the Netherlands (and only at the 10% level for the latter four).

The use of principal components analysis is designed to consider evidence for global information regarding expected returns (dividend-price ratio) and returns in contrast to using a US only proxy. Factor loadings on the dominant component for both the dividend-price ratio and returns support the view that they represent global information. Arising from this we report evidence of predictability for the major financial centres from the first dividend-price ratio principal component and for all markets from the first stock return principal component. The third dividend-price ratio principal component has predictive power for the majority of the series and suggests a secondary global factor with information content that is common to the majority of markets. Equally, it is also of key interest to note that the first and significant third dividend-price ratio principal coefficients are all positive and this is consistent with the view that a higher dividend-price ratio predicts higher returns, i.e. that the ratio proxies for expected returns and an increase in risk leads to lower prices, a higher ratio and higher expected future returns. Overall, these results demonstrate the role of global (and to a lesser extent local) information within stock return predictability for sixteen markets.

4.1. Dividend growth predictability

The above analysis leaves open the issue of how the second principal component relates to the information content within the dividend-price ratio. The returns predictability relation is only one side of the dividend-price ratio. The other side is the dividend growth predictability relationship. Table 7 presents the dividend growth predictability regression for each market with the three identified principal components and the local dividend yield component derived as above. We also include a lag of the dividend growth in each regression, but do not report it. These results present two interesting conclusions. First, looking at the local market dividend-price ratio parameter, we can see that this is statistically significant (and correctly, negatively, signed) for 13 markets (with a further market significant at the 10% level). Only for one market (the US) is the parameter significant and incorrectly signed. This significance can be contrasted with the returns equation, where the local market dividend-price ratio was only significant for four markets (France, Hong Kong, Singapore and the UK). This result suggests that while movement in returns is dominated by global information, movement in dividend growth rates is related to local information. Second, examining the second principal component, which was not significant in the returns regressions, we can see that it is significant and negative for 11 of the considered markets. Moreover, the negative reported relationship is consistent with the view that higher expected dividend growth is associated with a higher stock price and hence a lower ratio.

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Table 7. Dividend growth predictive regression with local and global (principal components) information

Country	Home DY	PC1	PC2	PC3	Adj R^2
Australia	−0.052*	−0.001	−0.002**	−0.002***	0.047
	(−4.26)	(−0.43)	(−2.33)	(−1.89)	
Austria	−0.046*	−0.001***	−0.003**	0.002	0.045
	(−3.75)	(−1.79)	(−2.07)	(0.85)	
Belgium	−0.052*	−0.001	−0.003	−0.004	0.050
	(−4.63)	(−1.39)	(−1.53)	(−1.54)	
Canada	−0.039*	−0.006	0.003	−0.001	0.035
	(−4.21)	(−1.52)	(0.38)	(−1.11)	
Denmark	−0.023**	−0.002***	−0.002	0.001	0.018
	(−2.05)	(−1.89)	(−1.16)	(0.19)	
France	−0.051*	−0.001	−0.002**	−0.0001	0.048
	(−3.09)	(−0.68)	(−2.29)	(0.04)	
Germany	−0.029**	−0.001	−0.002*	0.001	0.048
	(−2.29)	(−0.84)	(−2.66)	(1.40)	
Hong Kong	−0.044*	0.00	−0.003*	−0.006*	0.086
	(−5.13)	(1.17)	(−2.70)	(−4.71)	
Ireland	−0.052*	−0.001	−0.007*	−0.006*	0.081
	(−3.88)	(−1.60)	(−4.12)	(−2.80)	
Italy	−0.051*	−0.001	−0.005*	0.002	0.057
	(−4.85)	(−0.75)	(−3.03)	(0.09)	
Japan	0.002	−0.0001	−0.004	−0.0003	0.062
	(0.70)	(−0.57)	(−1.31)	(−0.41)	
Netherlands	−0.066*	−0.001**	−0.003*	−0.001	0.099
	(−4.12)	(−2.07)	(2.83)	(−1.26)	
Singapore	−0.054*	0.0002	−0.006**	−0.003***	0.041
	(−3.23)	(0.25)	(−2.22)	(1.84)	
Switzerland	−0.018***	−0.001	−0.001*	0.001	0.025
	(−1.64)	(−1.14)	(−2.73)	(0.92)	
UK	−0.033*	0.001***	−0.002*	−0.001	0.049
	(−3.10)	(1.81)	(−3.13)	(−1.12)	
US	0.009**	−0.0001	−0.0001	−0.0001	0.054
	(2.05)	(−0.05)	(−1.51)	(−0.13)	

Notes: Entries are coefficient values with Newey–West *t*-statistics for the predictive regression, Equation (6) but with dividend growth replacing stock returns as the dependent variable, of home dividend growth on lagged log dividend yield principal components and the lagged home dividend yield, which is defined as the residuals from a regression of the log dividend yield on the principal components. Home lagged dividend growth is also included in the regression but not reported.

*Level of significance at 1%.

**Level of significance at 5%.

***Level of significance at 10%.

The results presented here suggest important conclusions with respect to both asset pricing and international finance. With regard to international market co-movement, the principal components results demonstrate the presence of a global component in international expected and actual returns, which in turn have a greater influence on local market returns than movements in local market expected and actual returns. Moreover, over 80% of the variation in expected returns (dividend-price ratio) can be accounted for by just three principal components, while just under 70% of the variation in stock returns themselves can be accounted for by three principal components. Thus, these results confirm the integrated nature of international stock markets. Furthermore, as movement in expected returns is driven by considerations of risk and the risk premium, these results suggest risk and hence, economic conditions are equally linked.

With regard to asset pricing, these results suggest that contained within the dividend-price ratio is information that is useful for both stock return and dividend growth predictability. A debate has grown up surrounding whether movements in asset prices arise from changes to expected dividend growth or expected risk premium (see, e.g. Ang, 2012; Cochrane, 2011). This analysis, which considers the separate components within the dividend-price ratio, highlights the importance of both avenues. The results here demonstrate important differences between returns and dividend growth predictability and the potential confounding effects within the dividend-price ratio. By using the principal components analysis we are able to identify the separate global and local information that contain differing predictive power for stock returns and dividend growth. Noticeable in the results is that returns are driven almost solely by global information while dividend growth predictability arises from both global and local information. Furthermore, these results support the view of Menzly et al. (2004) that the analysis of the dividend-price ratio per se will include confounding effects which mask predictive power. Separating the components within the ratio is required to reveal that power.

5. Forecasting

Having established evidence above for the predictive power of global and local information components, this section proceeds to provide further evidence through out-of-sample forecasting. Following Rapach et al. (2013) as well as the earlier work of Campbell and Thompson (2008) and Welch and Goyal (2008) we utilise the out-of-sample R^2 approach as such:

$$R^2_{oos} = 1 - \left(\frac{\sum_{t=1}^{\tau} (r_t - \hat{r}_{t,alt})^2}{\sum_{t=1}^{\tau} (r_t - \hat{r}_{t,base})^2} \right) \quad (7)$$

where τ is the forecast sample size, r_t is the actual return, $\hat{r}_{t,alt}$ is the forecast value obtained from the alternate model of interest and $\hat{r}_{t,base}$ is the baseline forecast. When the R^2_{oos} value is positive then the alternative predictive model has greater forecasting power than the baseline forecast model. The baseline model chosen is the historical means model, i.e. the stock return regressed upon only a constant. The alternative models are given by the dividend-price ratio as in Equation (1), this ratio augmented by the US return as in Equation (2), the global and local model information model based on the US dividend-price ratio and returns and the global and local information model based on the principal components analysis, Equations (4) and (6) respectively. For ease of interpretations, these are referred to as Models 1 through 4 respectively in Tables 8 and 9. To supplement the out-of-sample R^2 analysis we also conduct the test of Clark and West (2007) which tests the null hypothesis of equal predictive accuracy between the baseline and alternative model against the alternative hypothesis that the competing model is preferred. We conduct the forecast exercise twice, first using a fixed rolling window of five years and second using an expanding recursive window that begins with the first five years. These two approaches allow us to mimic trader behaviour in real time. In conducting the forecasts we must be careful not to use any information that would not be available to a market participant. Thus, all estimations are conducted either in a rolling or recursive fashion, including the regressions of local information on global information and the principal components analysis. Although we maintain the number of principal components at three.

Table 8 reports the results of the five-year rolling forecast exercise, while Table 9 reports the recursive forecast results. In each table the results are reported for each alternative forecast models against the benchmark historical mean, which is also estimated in either a rolling or recursive fashion, respectively. The entry is the out-of-sample R^2 value, R^2_{oos}, for which a positive value indicates preference for the alternative model, while the number in parentheses represents the *p*-value from the Clark and West test.

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Table 8. Out-of-sample R^2 values—rolling forecasts

Country	Model 1	Model 2	Model 3	Model 4
Australia	0.063	0.078	0.115**	0.188**
	(0.60)	(0.12)	(0.04)	(0.03)
Austria	0.003**	0.014**	0.071**	0.157*
	(0.02)	(0.02)	(0.02)	(0.01)
Belgium	0.059	0.093	0.125	0.164**
	(0.30)	(0.43)	(0.20)	(0.05)
Canada	0.074	0.089	0.124	0.224***
	(0.68)	(0.24)	(0.16)	(0.06)
Denmark	0.024***	0.003*	0.128***	0.231**
	(0.06)	(0.01)	(0.09)	(0.03)
France	0.048	0.075	0.108	0.199***
	(0.88)	(0.56)	(0.34)	(0.10)
Germany	0.063	0.082	0.124	0.174***
	(0.79)	(0.66)	(0.34)	(0.08)
Hong Kong	0.071	0.087	0.117	0.235***
	(0.56)	(0.66)	(0.22)	(0.06)
Ireland	0.066	0.066***	0.099*	0.145*
	(0.23)	(0.09)	(0.01)	(0.01)
Italy	0.056	0.082	0.101	0.179***
	(0.48)	(0.52)	(0.34)	(0.07)
Japan	0.048	0.080	0.116	0.187***
	(0.27)	(0.17)	(0.15)	(0.08)
Netherlands	0.079	0.087	0.146***	0.189**
	(0.61)	(0.35)	(0.09)	(0.04)
Singapore	0.073	0.113	0.160	0.218**
	(0.76)	(0.50)	(0.34)	(0.05)
Switzerland	0.53	0.078	0.132	0.189***
	(0.52)	(0.75)	(0.27)	(0.07)
UK	0.089	0.136	0.158***	0.201**
	(0.42)	(0.12)	(0.08)	(0.04)
US	0.112	–	–	0.227**
	(0.46)			(0.05)

Notes: Entries are the out-of-sample R^2 values from Equation (7) with the *p*-values in parentheses from the Clark and West (2007) test of equal predictive accuracy. The models are given by: Model 1—the dividend-price ratio as in Equation (1); Model 2—this ratio augmented by the US return as in Equation (2); Model 3—the global and local model information model based on the US dividend-price ratio and returns; Model 4—the global and local information model based on the principal components analysis, Equations (4) and (6), respectively.
*Level of significance at 1%.
**Level of significance at 5%.
***Level of significance at 10%.

Examining the rolling forecasts, Table 8, we can see that for the usual single market dividend-price ratio (Model 1) regression then only once at the 5% level and once at the 10% level is the historical mean model significantly outperformed. Although, for all markets the R^2_{oos} values are positive indicating some reduction in the forecast error. For the two models that include US-based predictor variables (Models 2 and 3) the performance is slightly improved, but only marginally. Again, all the R^2_{oos} values are positive indicating an improved forecast performance over the historical mean, however, it is only

Table 9. Out-of-sample R^2 values—recursive forecasts

Country	Model 1	Model 2	Model 3	Model 4
Australia	0.014	0.009*	0.014**	0.048***
	(0.27)	(0.01)	(0.02)	(0.07)
Austria	0.035**	−0.009	0.030**	0.033*
	(0.03)	(0.13)	(0.02)	(0.01)
Belgium	0.053**	0.025**	0.023*	0.045*
	(0.03)	(0.03)	(0.01)	(0.00)
Canada	0.019	0.015	0.017	0.021
	(0.79)	(0.18)	(0.24)	(0.15)
Denmark	0.008**	0.003	0.037	0.049
	(0.04)	(0.50)	(0.15)	(0.34)
France	0.002	0.029	0.015	0.067**
	(0.25)	(0.11)	(0.24)	(0.03)
Germany	0.019	0.039	0.027	0.044***
	(0.77)	(0.16)	(0.39)	(0.07)
Hong Kong	0.005	0.036	0.039	0.052**
	(0.14)	(0.17)	(0.11)	(0.02)
Ireland	0.005	0.031**	0.023**	0.076**
	(0.12)	(0.05)	(0.04)	(0.03)
Italy	0.006	0.029***	0.017***	0.035**
	(0.36)	(0.06)	(0.09)	(0.03)
Japan	0.017	0.036***	0.019	0.023***
	(0.65)	(0.06)	(0.12)	(0.07)
Netherlands	0.012	0.023**	0.023***	0.014***
	(0.60)	(0.03)	(0.06)	(0.07)
Singapore	0.020	0.037	0.079	0.128**
	(0.14)	(0.21)	(0.28)	(0.02)
Switzerland	0.010	0.039***	0.009	0.026***
	(0.34)	(0.08)	(0.17)	(0.07)
UK	0.047***	0.054**	0.045	0.059
	(0.07)	(0.03)	(0.31)	(0.12)
US	0.020	–	–	0.027
	(0.45)			(0.28)

Notes: Entries are the out-of-sample R^2 values from Equation (7) with the *p*-values in parentheses from the Clark and West (2007) test of equal predictive accuracy. The models are given by: Model 1—the dividend-price ratio as in Equation (1); Model 2—this ratio augmented by the US return as in Equation (2); Model 3—the global and local model information model based on the US dividend-price ratio and returns; Model 4—the global and local information model based on the principal components analysis, Equations (4) and (6), respectively.
*Level of significance at 1%.
**Level of significance at 5%.
***Level of significance at 10%.

significantly for two (one) markets at the 5% (10%) level for model that includes US returns (Model 2) and for three (three) markets at the 5% (10%) level for the model that includes the US dividend-price ratio and returns (Model 3). In contrast, for the model that separates global and local information using the principal components analysis (Model 4), we see much greater evidence of superior forecast power. Again all the R^2_{oos} values are positive, supporting a lower forecast error over the historical mean. Moreover, for each market these values are at their highest level with this model in comparison to the previous three forecast models. For nine of the markets there is a statistically significant improvement at the 5% level, while the remaining seven markets are significant at the 10% level.

For the recursive forecasts the results are similar in nature, although there is, arguably, a lower degree of statistical significance overall. As with the rolling forecasts, all the R^2_{oos} values are positive, indicating that the competing forecast models provide a lower mean squared error than the historical mean approach. In terms of whether there is a statistical difference on the basis of the Clark and West (2007) test, for the dividend yield (Model 1) that occurs for three markets at the 5% level and a further market at the 1% level. For the two forecast models that incorporate US variables the number of markets with statistically significant forecast differences are five (three) and four (two) for the US returns (Model 2) and US dividend yield and returns (Model 3) respectively at the 5% level (additional markets at the 10% level). For the principal components based approach (Model 4), seven markets have a statistically lower forecast error at the 5% level (with a further five at the 10% level). Thus, for two markets there is no improvement, which contrasts to the rolling approach where all markets exhibited at least a 10% significance level forecast improvement.

Overall, these results support the following conclusions. First, as observed elsewhere, the dividend yield only model rarely provides a significant forecast improvement on the historical mean model with any gain in reducing the forecast error is minimal. Second, incorporating US-based variables improves the forecast power (as in Rapach et al., 2013). Although our results are relatively modest compared to theirs, our sample of markets differs. Third, when we utilise the principal components approach, which allows separation of both local and global information as well as information that relates to stock return and dividend growth predictability, then the forecast improvement is substantial. Finally, the results demonstrate some differences between the rolling and recursive approaches in terms of statistical significance, which is stronger under the rolling scheme.

6. Summary and conclusion

This paper has sought to examine the influence of global and local factors on stock return predictability for a range of international markets. Evidence of global factors within stock market predictability would speak to the literature on market integration, while evidence of predictability is important in asset pricing models. We consider three basic approaches in identifying predictability. First, as a baseline model, we estimated own country dividend-price ratio predictive regressions. Second, to capture global information we include US-based variables, stock returns and then returns with the dividend-price ratio. Third, we attempt to capture global information more widely (than just US variables) through a principal components approach. In addition to examining the in-sample predictive power of these different models, we consider an out-of-sample forecast exercise and compare the results with the historical mean model.

The results obtained suggest the following conclusions. First, with respect to the home market dividend-price ratio model only, there is very little evidence of predictive power. Second, adding US-based variables enhances the predictive power of the model, with US returns notably significant once we orthogonalise US and local market variables. Third, using principal components analysis we are able to identify a global component for both the dividend-price ratio and stock returns, for the former of which has predictive power for the major financial centres in the US, UK and Asia, while the latter has predictive power across all markets. Interestingly, a second component for the dividend-price ratio appears to relate to dividend growth predictability. Fourth and final, this latter principal components-based model provides the best fit both in-sample and out-of-sample, obtaining the highest in-sample adjusted R^2 for the majority of the markets and the highest out-of-sample R^2 for all markets.

The main implication and contribution of this paper can be stated as follows. The results presented here stress the need to separate different components in the dividend-price ratio to reveal the full predictive power of the ratio. Here, we have identified components that relate to global and local information and identified that different components relate separately to returns and dividend growth predictability. This is important in explaining the mixed nature of the literature. Furthermore,

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these results demonstrate that an examination of global information should extend beyond using only the US market as a proxy, as variables in all markets contain both local and global information. As an overarching result, this paper supports both returns and dividend growth predictability as well as market integration. It is hoped that the results from this paper will be informative on three counts. First, to academics interested in understanding the dynamics asset price movement, the results regarding the presence of different components and how they affect returns and dividend growth is important. Second, to market participants who aim to time the market and engage in portfolio and risk management, the forecast results will be helpful in devising such strategies. Third, to those (policy makers and others) who are interested in linkages across international markets and the nature and degree of integration, our results show the presence of global components across all market returns.

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Note

1. Returns are defined as the first-difference of the log price.

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