AN ALTERNATIVE MEASURE OF THE "WORLD MARKET PORTFOLIO": DETERMINANTS, EFFICIENCY, AND INFORMATION CONTENT

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Key Words: Proxy market portfolio, traded assets, human capital, missing assets, market efficiency.
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1. INTRODUCTION

The "market portfolio" figures prominently in modern asset pricing.[1] Many, if not most, theoretical pricing models include the market portfolio as an explanatory variable.[2] By definition, the market portfolio is supposed to comprise all assets in the economy, both traded and non-traded, including human capital and capital owned by the government. The problem that we address and provide a solution for in this paper is that the "market portfolio" cannot be observed directly, thereby making it necessary to use proxy portfolios when conducting empirical studies. The problem is important for theory and practice. Empirical validation of the theoretical models, such as the CAPM (capital asset pricing model) or the Fama-French 3-factor model, depends crucially on the index or indices chosen to proxy for the true market portfolio.[3] In practice, the proxy portfolio is important for asset evaluation and portfolio construction on the one hand and for performance meausrement on the other, because performance measurement is extremely sensitive to the choice of the market proxy as shown in many studies, such as Roll (1978), Dybvig and Ross (1985) and Green (1986).

The most popular proxy for the market portfolio is typically a general stock market index. For example, many US studies use the CRSP equal weighted or value weighted index and most

[1] Campbell (2000) provides an extensive literature review of the development of asset pricing models.

[2] Some of the best known multivariate models are by King (1966), Rosenberg (1974), Chen et al. (1986), Burmeister and McElroy (1988) and Burmeister et al. (1994), Fama and French (1992) and Carhart (1997). At the international level, see: Adler and Dumas (1983) and Solnik (1974a).

[3] For example, in the context of the CAPM Roll (1977) has shown that the only testable hypothesis is the mean-variance efficiency of the proxy used for the market portfolio.

international studies use the MSCI global index (e.g. Vassalou, 2000). There are, however, many problems with indices such as these. First of all, they represent only one asset class and are typically inefficient. Shanken (1987), for example, shows that using the equally weighted CRSP index (alone, or together with a long-term US government bond portfolio) as the market portfolio, either invalidates the CAPM or the proxy is inefficient. Fama and French (1998) find that the MSCI global index is inefficient with respect to the value and growth portfolios they form. Secondly, irrespective of whether the proxy used is efficient or not, using a proxy market portfolio which consists of the individual assets used in the tests makes it likely that their returns will be correlated with the proxy used. In other words, the results will be tautological. To overcome this, some researchers exclude from the proxy they use the returns of the assets included in their tests. However, Fama and French (1998) have argued that while this may avoid inducing a spurious relation between assets' returns and the proxy, it can corrupt the estimates of the risk loading in the tests employed.

Attempts to improve the proxy quality follow two general routes. Some studies, such as Mayers (1972) and Stambaugh (1982), who used several definitions of the market portfolio, including corporate bonds, government bonds, Treasury bills, home furnishings, residential real estate, automobiles, and common stocks, have attempted to augment the market proxy with other marketable assets and/or non-marketable assets in order to include a bigger proportion of the economy's value. Others use a traditional proxy and add explanatory variables. For example, Jagannathan and Wang (1996) include a measure of human capital and Vassalou (2003) uses GDP forecast revisions as an additional risk factor.[4] Neither method overcomes the fact that a large part of the economy's value is excluded and both are vulnerable to the tautology weakness.

In this paper we take a completely different route to construct the "market portfolio". We build on the intuition that if the "market portfolio" of financial theory represents the value of all the assets in the economy, it, in fact, represents the total value of the economy. Thus, rather than adding up values of individual assets to determine a proxy for the national "market portfolio", we use the Hicks (1987) model of discounted macro-economic cash flows to calculate the value of the economy directly. In this

[4] Another extended version of the CAPM incorporates hedging against changes in future investment opportunities in a multi period setting (Merton (1973), Campbell (1996)).

way, all assets are represented in the country "market portfolio", but since no individual assets enter the portfolio directly, we avoid the tautology problem. We construct the international market proxy, which we call the world market portfolio (WMP), as the sum of the ninety national market portfolios in our sample. We then analyze this portfolio and test its empirical relevance for explaining the return generating process on individual assets and portfolios of assets. We do not, however, aim to test any particular asset pricing model.

This paper contributes to the literature on international macro asset pricing. It proposes a completely new proxy for the world market portfolio and shows that it has significant explanatory power for the return generating process of portfolios of a wide range of assets that include stock indexes, medium and long term government bonds, money markets and commodity and real estate indexes, including diversified portfolios generated by principal components analysis and by characteristic-sorting à la Fama and French. It is important to bear in mind that the paper does not attempt to construct an international asset pricing model. The proxy developed in this paper can be used in any international asset pricing model that uses a proxy for the "international market portfolio", such as the international single-beta CAPM, the Adler and Dumas (1983) CAPM with foreign exchange risk, the international Fama-French multifactor model (1998), etc. [5] To reflect this, the empirical analysis uses a wide range of model specifications to test the explanatory power of the world market proxy developed in this paper. We present strong evidence that the proxy is not efficient but that it does provide significant, incremental information for explaining asset returns that is contained neither in the other explanatory variables nor in the returns of the traded assets in our sample.

The rest of the paper is organized as follows. Section 2 develops the theoretical and practical construction of the world market portfolio. Section 3 presents the data, methodology and empirical analysis. Section 4 summarizes and concludes.

[5] To maintain the distinction between the performance of the model and the performance of the world market proxy, all the tests are unconditional. While we appreciate that conditional models (such as Lettau and Ludvigson, 2001) perform better than unconditional models, in this paper we are interested in the explanatory power of the proxy rather than the value of the model. Since the choice of conditioning variables is crucial for the success of a model, whether a conditional or unconditional version of the proxy can explain portfolios' returns better and which set of conditioning variables is most appropriate is left for future research.

2. CONSTRUCTING THE WORLD MARKET PORTFOLIO

2.1 The General Approach to Asset Inclusion

The problem of determining the true market portfolio is analogous to the problem encountered when calculating the value of any portfolio that includes assets whose value cannot be observed directly. Most proxy portfolios for the market portfolio, for example, are constructed as weighted sums of asset prices observed in the market. For example, a portfolio weighted by market value would be equal to

$$V_T^M = \sum_{i=1}^{m} V_T^i \tag{1}$$

where V_T^M is the value of the market portfolio at time *T* and the V_T^i are the market values at time *T* of the individual *m* assets that are included in the portfolio. The market values of the individual assets that comprise the market portfolio are the outcome of supply and demand based on investor analysis of the present values of the assets' expected cash flows.[6] Assuming that all transactions take place on the first day of each period, the well known present value formula for asset *i* with n_i periods to maturity gives:

$$V_T^i = E(B_T^i - A_T^i) + E(B_{T+1}^i - A_{T+1}^i)R_i^{-1} + ... + E(B_{n_i}^i - A_{n_i}^i)R_i^{-(n_i - T)} \tag{2}$$

where the B_t^i's represent cash income in period *t* for asset *i*, the A_t^i's represent expenditure in period *t* for asset *i*, *E* is the expectations operator, $R_i = 1 + r^i$ and r^i is the required rate of return on asset *i*. In practice, however, there is a problem because many assets are combinations of individual projects of various sizes and maturities, some correlated with others and some not. The value of assets such as these is equal to the sum of the value of the individual projects v_T^j,

$$V_T^i = \sum_{j=1}^{k} v_T^j \tag{3}$$

which, in turn, are determined by the present values of the expected cash flows

[6] The discounted cash flow methodology, including internal rate of return, net present value, adjusted net present value, real option adjusted net present value, etc., is widely accepted as the appropriate format for asset evaluation.

$$v_T^j = E(b_T^j - a_T^j) + E(b_{T+1}^j - a_{T+1}^j)R_j^{-1} + ... + E(b_{n_j}^j - a_{n_j}^j)R_j^{-(n_j - T)} \qquad (4)$$

where the b_t^j's and a_t^j's are the income and expenditure for project *j* at time *t*. Ideally, each project should be identified and evaluated individually at the appropriate required rate of return. The problem is that because of complexity, confidentiality or just plain lack of information it is often not possible to identify the individual projects and/or their cash flows and required rates of return. When this is the case, asset valuation has to be effected at a less complex level where information is readily available. This implies a certain amount of aggregation. For example, the cash flows of a complex asset at the aggregate level in equation 2 could be defined as the observable sum (reported in the accounts) of the unobservable cash flows of the individual projects: $B_t^i = \sum_{j=1}^{k} b_t^j$ and $A_t^i = \sum_{j=1}^{k} a_t^j$. In practice, the required level of aggregation will be determined by the company's organization, disclosure requirements, and the like.

As mentioned above, the true market portfolio should include all the assets of an economy, including traded assets as well as those that are not traded, like government owned assets (real estate, public hospitals, schools, postal service, etc.),[7] human capital, real estate, partnerships, farms, shops, vendors and one man shows. Clearly, there is an information problem at this level of detail and scope. For a whole country it is not feasible to identify all the individual assets and their expected cash flows, much less to measure their required rates of return. Up to now the problem in studies on international asset pricing has been addressed by taking a set of assets that have observable market values, then adding the values up in one way or another, as in equation 1, for example, to construct a proxy index. The drawback to this procedure is that a huge number of assets are excluded from the portfolio, which is akin to estimating the value of General Motors stock based only on the performance of its Cadillac division and ignoring the performance of the other divisions as well as its financial activities, pension liabilities, etc. An alternative method that we propose in this paper is to proceed at the aggregate level of the economy as a whole, rather than at the micro level of the value of individual assets. For a national economy, the relevant observable information is contained in the national accounts.

[7] Public assets can represent a significant amount of a country's total assets. The French government, for example, has extensive real estate holdings and employs between 20 and 25% of the workforce.

2.2 The Valuation Model at the Country and World Level of Aggregation

For an open national economy, the profile of individual project cash flows can be defined as [$b_t^j = x_t^j + c_t^j$, $a_t^j = m_t^j + w_t^j$], where x_t^j, c_t^j, m_t^j and w_t^j are respectively the local currency values of exports, receipts from expenditure on locally produced final goods and services, imports and wages for project j in period t. Thus, for the whole economy, $B_t = \sum_{j=1}^{k} b_t^j = X_t + C_t$ and $A_t = \sum_{j=1}^{k} a_t^j = M_t + W_t$, where X_t, M_t, C_t and W_t denote respectively the local currency value of total exports, total imports, total consumption expenditure and total wages for period *t*. Using this information in equation (2) and assuming that the capital markets are in equilibrium and that all transactions take place on the first day of the period, the value of the economy in local currency on the first day of the current period T is:

$$V_T = (B_T - A_T) + E(B_{T+1} - A_{T+1})R^{-1} + ... + E(B_n - A_n)R^{-(n-T)} \tag{5}$$

where the superscripts *i* have been eliminated to simplify the notation.

In the appendix, we show that the US dollar (USD) value of the economy is

$$V_T^* = S_T V_T \tag{6}$$

where the asterisk denotes USD and S_T denotes the spot exchange rate at time T expressed as the price of 1 unit of local currency in USD.

At the world level of aggregation the sum of imports equals the sum of exports so, in the calculation of world income and expenditure per period, X_t and M_t cancel out. The value of the world economy reduces to the value of the world capital stock.[8] Thus, by analogy with equation (1), the world market portfolio is simply the sum of the USD values of the individual i countries

$$V_T^{*M} = \sum_{i=1}^{m} V_T^{*i} \tag{7}$$

[8] Kraay et. Al. (2005) reach the same conclusion assuming a two-country world, one factor of production, capital and a single good that can be used for consumption or investment. Our methodology, developed in the appendix, uses the analytical framework of discounted cash flows.

where the superscript $*M$ denotes the world.[9]

2.3 Implementation of the World market Portfolio

For the individual countries, the capital stock is constructed with the standard perpetual inventory methodology (PIM) from time series data (see: OECD, Measuring Capital, 2001, for details of the PIM methodology). Briefly, starting with historical data on gross investment in local currency, including gross fixed capital formation and change in stocks, depreciation was subtracted to obtain net investment over the period. This net investment was then added to the value of the economy in local currency outstanding at the beginning of the period to obtain the value of the economy outstanding at the end of the period.[10] The value of the economy in current USD was obtained by implementing equation (6) and multiplying by the end of period exchange rate. We compute the initial capital stock from time 0 until the period preceding the first available data point in 1966 from the following regression:

$$\text{Profits}_t = c + \hat{r}V_t + u_t \tag{8}$$

where Profits are estimated from equation (4A*), c is a constant representing profits generated with the capital outstanding at the end of 1965, the period preceding the first year of the sample period, $\hat{r}$ represents the estimated return for the sample period and u_t is a random error.[11] If we capitalize the constant from equation 14, i.e. $c/\hat{r}$, we obtain the capital value of the country outstanding at the end of 1965.

By definition the world economy is a closed economy where the exports of one country are the imports of another. Thus, with $X_T^{*M} - M_T^{*M} = 0$, the return on the world market portfolio is given as:

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[9] The relationship between V_T^{*M} and world GDP is straightforward. Equation (7) can be written as $V_T^{*M} = (B_T^{*M} - A_T^{*M}) + E(B_{T+1}^{*M} - A_{T+1}^{*M})R^{*-1} + ... + E(B_n^{*M} - A_n^{*M})R_M^{*-(n-T)}$. Substituting for V_{T+1}^{*M}, multiplying by $1 + r_M^*$ and remembering that the world economy is a closed economy (exports = imports), gives the world GDP: $r_M^* V_T^{*M} + A_T^{*M} = B_T^{*M} + V_{T+1}^{*M} - V_T^{*M}$. Profits ($r_M^* V_T^{*M}$) plus Wages ($A_T^{*M}$) = Consumption ($B_T^{*M}$) plus Net Investment ($V_{T+1}^{*M} - V_T^{*M}$).

[10] This application of PIM is similar to that outlined in Kraay et al. (2005), Caselli and Feyrer (2007), in their estimation of the amount of the world capital stock, use an alternative application of PIM.

[11] As a practical matter, the effect of the capital outstanding in time on country returns disappears after a maximum of 10 years in all cases. For countries with very high inflation it can disappear in two or three years. The constants in this study were calculated for 1965, well before the test period. Thus, estimation errors have little or no effect on our results.

$$[V_{T+1}^{*M} / V_T^{*M}] - 1 \quad (9)$$

2.5 Construction of the World Market Portfolio

To construct the world market portfolio we collected the relevant macroeconomic and exchange rate data for 90 countries from Datastream over the period 1975-2007 and applied the procedures outlined above. Table 1 reports summary statistics for this index expressed in USD. All the figures in Table 1 refer to quarterly returns from 1975Q1 to 2007Q4, a period of 33 years.

The average quarterly return for the World market portfolio is 1.73% (6.92% annual) with a standard deviation of 3.35%. The mean excess return, calculated using the US T-bill rate as the risk free rate, is 0.25% (1% annual). The kurtosis and skewness statistics suggest that the quarterly world index returns have a distribution close to the normal. The Jarque-Bera test suggests that we cannot reject normality at any reasonable level of significance.

[INSERT TABLE 1 ABOUT HERE]

Figure 1 presents the value of the WMP and the global market capitalization of listed companies in trillions of US$.[12] In 1988, the value of all listed companies represents about 37% of the value of the WMP, while in 2003 the respective figure is 59%. This increase represents the fact that during the last 20 years an increasing number of companies have become listed on stock markets and that several developing and transitional economies have established a stock market. Figure 1 suggests that the WMP tracks the movement of global market capitalization, but with less volatility. The WMP should be less volatile than market capitalization because it is better diversified.

[INSERT FIGURE 1 ABOUT HERE]

Table 2 reports the average percentage of the market value of selected countries in relation to the total value of the WMP. To provide a reference for comparison, we also report the average percentage of GDP (in US$) of these countries in relation to the world GDP. Although the weights differ, as expected, the figures with respect to individual countries are quite reasonable. For example, the U.S. accounts on average for about 23.3% of the value of the WMP and 28.2% of world GDP

[12] The global market capitalisation was obtained from the World Development Indicators database, where data begin in 1988. We do not have data for this series prior to 1988.

during the 33 years of our sample, the UK 3.6% and 4.22%, Australia 1.57% and 1.46%, India 1.12% and 1.55%, the Netherlands 1.62% and 1.37%, etc. In fact, there are no “aberrations” where the figures are markedly different.

[INSERT TABLE 2 ABOUT HERE]

3. TESTING THE PORTFOLIO

In this section we investigate whether the WMP is a plausible proxy for the “market portfolio” of financial theory. In the absence of a formal test, we propose a series of tests that analyze the determinants of WMP, its efficiency and its significance as a relevant explanatory variable for the asset return generating process when it stands alone, when it is broken down into the Mayers (1972) “included” and “missing” components and when it is combined with the Fama-French (1992) model. To this end, we collect a sample of international assets that include stock indices, long and short term government bonds, money market instruments and varied commodity indices that we use to construct portfolios of assets according to their class (money markets, government bonds, equities, etc.) and according to a diversified portfolio of assets constructed with principal components analysis. We also check the robustness of the results in the Fama-French (1992) stock pricing model.

3.1 The Data

We use quarterly data for three types of assets: stocks, commodities and debt instruments, where debt instruments are broken down into long term (10-year government benchmark bond), medium term (5-year government benchmark bond) and short term (3-month money market rate). The sample period begins in 1975 quarter 1 for most stocks, money markets and some commodities. Due to data availability, it begins in 1985 quarter 2 for the remaining series.[13] The sample period ends in

[13] The beginning of the sample period for each series is reported in Table 3. It is important to mention that the period under consideration was very turbulent. It includes the effects of the oil shocks of the 70s, the debt crisis and currency turbulence of the 80s, including the 1987 stock market crisis. In the 1990s and early 2000s it includes the war with Iraq, the Mexican peso crisis, the Southeast Asian currency crisis, the Russian default, the currency crises in Turkey, Brazil and Argentina, as well as September 11 and its aftermath and the beginning of the current crisis in 2007.

2007, quarter 4 for all series.[14] Table 3 reports the data sample and summary statistics for each asset. All data are available on Datastream. Returns for all assets are in U.S. dollars and excess returns are computed using the 3 month U.S. Treasury bill rate.[15] All returns are calculated as simple arithmetic returns.

Stocks: a broad stock market index for each of 19 countries; Australia, Austria, Belgium, Canada, Denmark, France, Germany, Hong Kong, Ireland, Italy, Japan, Netherlands, Norway, Singapore, South Africa, Sweden, Switzerland, U.K. and U.S.

Long term debt: the total return series for the 10 year benchmark government bonds for Germany, Canada, France, Ireland, Japan, Austria, Switzerland, U.K. and U.S.

Medium term debt: the total return series for the 5 year benchmark government bond for Germany, Belgium, Canada, Denmark, France, Ireland, Japan, Austria, Sweden, Switzerland and U.K.

Short term debt: the return series on the local 3-month money market asset represented by the 3 month interbank interest rate for each respective currency.[16] Money market return series are calculated for Australia, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Switzerland and U.K.

Commodities: We include in our study total returns for five indices; Livestock, Precious Metals, Energy, Industrial Metals and Real Estate[17]. The first four indices are compiled by Goldman Sachs. To make them comparable to total return series on equities and bonds, Goldman Sachs compute the indices assuming that an investor takes a long position on a group of futures contracts which represent the constituent commodities of each index, while investing the face value of the futures contracts on a short term risk free asset. The indices represent the return from the investment in the risk free asset plus the return on the futures contracts. The real estate index (NAREIT) is compiled by

[14] In results not reported here but available on request, the Jarque-Bera test suggests that normality can be rejected for only 16 of the 55 assets in our universe. Based on the mixed distribution hypothesis (MDH) proposed by Clark (1973), returns should become more normal as the sampling period becomes longer and the arrival of information averages out. Thus, data sampled quarterly should be more normal than data sampled daily.

[15] Thus, asset returns reflect exchange rate fluctuations as well as returns in domestic currency.

[16] We considered using the 3 month T-bill rate for each country, but this was available for a small number of countries, so we used the interbank rate to allow us to use a larger sample. In any case, these rate series do not exhibit large differences for most of the sample period.

[17] We also considered including an index of agricultural production, but this is mainly affected by the weather and government policy rather than market forces.

the National Association of Real Estate Investment Trusts and tracks the prices of real estate in the U.S. No index for real estate prices of other countries is available to us.

[INSERT TABLE 3 ABOUT HERE]

3.2 The Determinants of WMP Excess Returns

The excess returns of the true market portfolio are simply the reflection of the excess returns of the individual assets in the economy. If the WMP is a good proxy for the market portfolio of financial theory, its returns should be reflected to a certain extent in the excess returns of the assets that are traded around the world. In this section we test whether and to what extent the excess returns of the WMP are determined by the excess returns of the three categories of assets in our sample, i.e. stocks, debt instruments and commodities. For stocks we use the returns on total returns of the MSCI global index. (MSCI).[18] For the debt instruments (DEBT) and commodities (COMM) we construct equally weighted and GDP weighted indices of returns of all the assets in each category. We then test these indices as explanatory variables for the excess returns of the WMP:

$$r_{WMP,t} = \alpha + \beta \ MSCI_t + cDEBT + dCOMM_t + e_t \tag{10}$$

Since none of the bond data is available before 1985 Q2, the tests cover the period 1985 Q2 to 2007 Q4. The results are reported in Table 4.[19]

[INSERT TABLE 4 ABOUT HERE]

The results suggest that traded assets composed of stocks, debt instruments and commodities are major determinants of WMP excess returns. The overall equation explains 79% of WMP excess returns and all three of the coefficients are significant. This result is interesting because none of the assets that compose the explanatory variables enters the WMP directly. In fact, we were surprised by how high the R-squared is, because, even though the explanatory variables do cover a wide range of assets, the included assets represent only a small proportion of all assets that exist in the world. This is reassuring because it suggests that the explanatory indices we used are good proxies for the returns of

[18] As a robustness test not reported here, we also use the total returns on French's global stock index. The results are qualitatively equivalent.

[19] There is very little difference in results using the equally weighted indexes or indexes weighted by GDP.

many other assets that are not directly included. The residuals of the equation can thus be considered a good approximation of the returns on what Mayers (1972) and Fama and Schwert (1977) have called "missing" assets, that is, assets that are omitted from the analysis due to oversight or lack of data. These assets include human capital, government owned assets like public hospitals, schools, administration buildings, etc., many agricultural producers and unlisted going concerns, etc. This information is specific to the WMP and we will use it in tests of the WMP contribution to explaining asset returns.

3.3 Regression Results for Portfolios of Asset Classes

We now investigate the role of the WMP as a determinant of asset returns. This section reports the results of testing the explanatory power of WMP on the return generating process of the portfolios of individual asset classes (stock indices, 10 year bonds, 5 year bonds, money markets and commodities) in our sample. For each asset class we create one equally weighted index which at any time includes the excess returns of all the assets available to us.[20] All indices begin in 1975 quarter 1, except the bond indices which begin in 1985 quarter 2. We then regress the excess returns of each index on the excess returns of the WMP. The risk free rate is the 3-month U.S. T-bill rate. The results are reported in Table 5.

The results suggest that WMP plays an important role in the return generating processes of the asset portfolios. WMP excess returns are highly significant in every case.[21] They explain17% of returns on the stock portfolio, 60% of returns on the portfolio of 10 year bonds, 73% of returns on the portfolio of 5 year bonds, and 84% of returns on the portfolio of money market instruments. The explanatory power is considerably lower for the portfolios of commodities but still explains 7%. The beta coefficient on the stock portfolio is interesting, because, although the stock portfolio gives much higher returns than the portfolios of bonds and money markets, the beta is considerably lower. The alpha is also significant, as it is for commodities, which suggests that the WMP is not efficient. We

[20] For example, the stock portfolio includes stock index returns from all the countries in our sample except Sweden from 1975 quarter 1 to 1985 quarter 1 and all countries in our sample (including Sweden) from 1985 quarter 2 to 2007 quarter 4. For availability by country and asset class, see Table 3.

[21] We also tested portfolios of stocks, bonds and foreign exchange weighted by GDP. The results, not reported here but available on request, are substantially unchanged.

will come back to these points in a later section where efficiency tests show that, in fact, the WMP is not efficient.

[INSERT TABLE 5 ABOUT HERE]

3.4 Regression Results for Diversified Portfolios Generated by Principal Components Analysis

This section reports the results of testing the explanatory power of WMP on the return generating process of diversified portfolios. Rather than establishing an arbitrary diversification rule, which could affect the results, we use principal components analysis on the excess returns of the assets in our sample to generate the diversified portfolios. The argument here is that the principal components are portfolios of the individual assets that best explain the variance of the original data. At least one principal component, and possibly several, should capture the variance due to market risk. Thus, the true market portfolio should be correlated with at least one of the statistically generated principal components of the sample. Correlation between one or more of these components and the WMP would be evidence that the WMP is a determinant of their return generating process.

We have a very diverse sample of assets so we expect that more than one principal component will be required to capture a significant proportion of common variation. We run the analysis for two samples. The first sample begins in 1975 and ends in 2007, and contains all the assets for which we have data for that period (18 stock return series, 7 money market return series and 3 commodity return series; a total of 28 series). The second sample contains all 55 assets in our sample and runs from 1985 to 2007. The analysis is carried out on excess returns.[22]

Panel A of Table 6 reports statistics for the first 8 components derived using the 1974-2007 sample. The first one explains about 35% of total variance, while the first two components explain more than 48%. The Spearman correlation coefficients between the WMP excess returns and the first two components (not reported in the table) are 51% and 72% respectively and are statistically significant. Panel A also reports the regression results of the principal components on WMP. It is a

[22] To deal with in-sample bias we also estimated the principal components using the Heston et. al. (1995) procedure, where the component matrix is estimated for odd (even) quarters and the loadings are used to obtain components for even (odd) quarters. The components are then zippered to obtain estimates for the whole period. The unbiased components are highly correlated with the full sample components and the results from both procedures are qualitatively the same.

significant explanatory variable for the first two components and the regressions explain 5% of excess returns in the first component and 72% of the second.

[INSERT TABLE 6 ABOUT HERE]

Panel B of Table 6 reports statistics for the first 8 components derived for the 1985-2007 sample. Clearly the first 2 components are the most important ones, explaining more than 62% of common variation. The Spearman correlation coefficients, not reported here, between the first 2 components and the WMP are 85% and 21% respectively and they are statistically significant. The regression results of the first two principal components on WMP show WMP is significant for the first component and the regression explains 68% of the excess returns.

The above analysis provides evidence that when the asset sample is broken down into diversified portfolios, which explain most of the common variation in the excess returns of the sample, the WMP has a statistically significant correlation with them. Thus, we conclude that the correlation between the diversified portfolios and the WMP is weak evidence that the WMP is a factor in the asset return generating process in our sample and that further investigation on the relationship between asset returns and the WMP is warranted.

3.5 Testing for Relevance in Returns of Individual Assets

In this section we test for a statistical relationship between the world market portfolio and the individual assets using regression analysis of the excess returns of each asset on the excess returns of the WMP. The argument here is that since the world market portfolio is composed of all assets, it should be correlated with a wide range of assets in the same way that a stock or bond index is likely to be correlated with many of the stocks or bonds that compose it. Table 7 reports the results for each asset in our sample.

The world market portfolio has significant explanatory power across all the asset classes. Betas for stocks estimated with the world market portfolio are significant for 12 out of 19 markets, 7 at the 1% level and 5 at the 5% level. For the 11 money markets included in our study, 10 betas are significant at the 1% level, while the beta for Canada is significant at the 10% level. For the government bond market, both 5 and 10 year, all betas are statistically significant at the 1% level except Canada's 10 year bond, which is significant at the 5% level. In the commodity markets two of the 5 betas are significant. Importantly, very few alphas are significant at conventional levels: eight for stocks, none for the money market, three for bonds and none for commodities.

[INSERT TABLE 7 ABOUT HERE]

The fact that the WMP is a significant explanatory variable for a large number of individual assets spread over a wide range of asset classes is impressive if we consider that not only are none of the individual assets directly included in the construction of the index, but also that the individual assets are not internationally well diversified portfolios. Except for certain commodities, they are restricted to individual countries, which means that they have large idiosyncratic components (e.g. Harvey (1991)). Therefore, as Fama and French (1998) note, "country portfolios leave plenty of room for asset pricing models to fail".

This having been said, these results do raise some questions. Many of the alphas on equity returns are significant and the equity betas are relatively small with respect to those in the money market and bond asset classes, in spite of the fact that equity returns are higher. Furthermore, the R-squares for stock returns are generally rather low. Some of the individual results are also surprising. For example, the US has the largest stock market and economy in the world so that we could reasonably expect a good fit with the WMP. In fact, the contrary is true. The beta is very small and not significant and the overall model has almost no explanatory power.[23] One possible explanation is that the WMP is not efficient. It could also be that a single factor model is inadequate to explain stock returns. In the next section we test whether or not the WMP is efficient. We then test for evidence that factors other than the WMP drive stock prices.

3.6 Efficiency Tests

Although we showed in section 2.2 that the WMP represents all assets in the economy, including human capital, etc., this does not guarantee its efficiency. Many assets, such as human capital and residential property are not practically fungible and cannot be diversified. In fact, for many

[23] There does, however, seem to be a relationship between the WMP and the US stock market. In results not reported here but available on request we find that WMP and the US stock market are co-integrated.

people human capital and their homestead are the only capital they possess. Therefore, many, if not most, people could be holding a portfolio of assets that is far from efficient and, if this is the case, the WMP would reflect this.

In the usual test for efficiency proposed by Gibbons et. al. (1989) we find that the WMP is marginally inefficient, which confirms the results in the preceding section. However, sample size is a problem. We use quarterly returns for 33 years which give us only 132 observations. For some of the assets in our sample, observations begin in 1985 quarter 2, which means that for these assets we have 87 observations. Considering that there are 55 assets in our sample, the power of the Gibbons et. al. test would be too low to be very reliable. To overcome this problem, we use the marginal conditional stochastic dominance (MCSD) test, developed by Shalit and Yitzhaki (1994). MCSD has several advantages over traditional efficiency tests: i) it is consistent with expected utility maximization, ii) it involves no restrictions on the class of investor utility functions, iii) it considers the entire joint distribution of assets' returns, rather than summary statistics such as mean and variance, iv) it makes no assumptions about the underlying probability distribution, and v) it makes no assumptions about the return generating process. The last point is probably the most important since traditional models require a specific linear return generating process. Chow (2001) shows how to apply the MCSD methodology for efficiency testing by letting the market index be the core portfolio against which other assets are tested for dominance. The idea behind MCSD is simple: if an asset dominates the market portfolio, then increasing the share of that asset in the market portfolio would improve portfolio returns.[24] In that case, the market portfolio is not efficient. In the results reported here the tests include all the assets for which we have observations from 1975, quarter 1; i.e. 28 assets.[25]

To implement the MCSD methodology for efficiency testing, we estimate the Absolute Concentration Curve for each asset.[26] The number of targets is chosen arbitrarily.[27] We set equally spaced sextiles, such that p_1=0.167, p_2=0.333, …, p_6=1 and we chose the target return levels to

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[24] Clark and Jokung (1999) develop a rule for asset percentages with respect to MCSD.

[25] For efficiency testing the length of the period is more important than the number of assets, since it takes only one dominating asset to prove inefficiency. The results using all assets over the shorter time period also indicate inefficiency.

[26] For a detailed discussion on implementing the MCSD methodology to test the efficiency of the market portfolio, see Chow (2001) and Shalit and Yitzaki (1994).

[27] Chow (2001) shows that the number of targets does not affect the power of the test.

correspond to the sample population sextiles of p in the WMP return distribution. We should note that Chow (2001) examines the power of the MCSD test and finds that the test has good power for samples of more than 300 observations, although the same study shows that the size of the test statistic is not really affected by sample size. For smaller samples, such as ours, there is a high probability of type II error; i.e. the test fails to reject the null when dominance exists. In other words, if we find that no asset dominates the WMP, the result could be attributed to the small sample size, while if we find that there is dominance, the low power of the test re-enforces this result.

The results for the MCSD tests are reported in Table 8. It is clear that the WMP is not efficient. The Z statistic suggests that the WMP is dominated by the Canadian and U.S. stock markets, the Canadian, French, German and Swiss money markets, as well as two commodity series (livestock and real estate). Considering the conservative nature of the test, we can be confident that dominance does indeed exist in our sample. So, while the WMP is a significant explanatory variable for the returns of individual assets over a wide range of asset classes, our efficiency tests confirm it is inefficient and cannot (at least unconditionally) fully explain asset returns. In sections 3.6 and 3.7 we explore this point in more detail.

[INSERT TABLE 8 ABOUT HERE]

3.6 Testing for Incremental Information

We now turn to a multi-index model and the question of whether the WMP provides any incremental information for explaining asset returns outside that contained in the tradable assets in our sample. In section 3.2, equation (20), we showed that 80% of the returns on the WMP can be explained by returns on a global stock index (MSCI), a global debt index and a commodities index. In this regression the random innovations and estimation errors along with the information specific to the WMP were isolated in the residuals e_t.[28] These residuals, which we note as NMK, should include returns on what Mayers (1972) and Fama and Schwert (1977) have called "missing" assets, that is,

[28] Estimation errors could arise due to coefficient estimates that are not population values or mis-specification.

assets that are omitted from the analysis due to oversight or lack of data. To test the relevance of NMK for explaining asset returns, we test the equation:

$$r_t = \alpha + \beta MSCI_t + cDEBT_t + hCOMM_t + dNMK_t + \varepsilon_t \tag{11}$$

for all the assets in our sample, where ε captures the random innovations and estimation errors. If NMK has explanatory value, the coefficient d should be significant and reflect the effect of the "missing" assets on the returns of the included assets. Given the wide range of assets represented in NMK, we have no prior about its sign.[29] We also note the tautological relationship between MSCI, DEBT and COMM and the assets in our sample. This problem does not exist for NMK because NMK represents the residuals of the regression of WMP on the other three indices. The results are reported in Table 9.

[INSERT TABLE 9 ABOUT HERE]

In Panel B we see that the coefficient on NMK is significant for all but four of the money markets, Australia, Canada, Italy and the UK. It is significant at the 1% level for the other 7 countries. For the bond market in Panel C, NMK is significant for 14 out of 20 bonds, all at the 1% level. For the commodities markets, NMK is significant for 4 of the 5 markets, at the 1% level for livestock, and industrial metals and at the 5% level for precious metals and real estate. Furthermore, the adjusted R-squares in all three panels are much higher than those of the single index model in table 7.

The results in Panels B, C, and D are strong evidence that the WMP does provide incremental information for explaining asset returns. The results for stock returns in Panel A are weaker, but supportive as well. NMK is significant for 3 of the 19 markets, all at 1%. The problem with equity betas and overall fit that came up in the single factor tests of table 7 has also disappeared. All the MSCI coefficients are significant at the 1% level and look reasonable and the overall fit is markedly improved for all countries.

[29] The different elements of NMK can have different correlations with market returns. Government owned assets are likely to be independent of the market and have zero correlation with asset returns. Fama and Schwert (1977) find a negative correlation between human capital and asset returns. Agriculture has a large weather element and other going concerns may be positively correlated.

Bundling all the information into one index to explain equity returns was clearly less effective than breaking it down into its component parts. In fact, the MSCI component of the WMP accounts for most of the explanatory power of the return generating process for stocks with NMK playing only a minor role. We speculate that the contrast with the other asset classes is due to the fact that stock returns are less sensitive to macroeconomic variables than interest bearing securities and commodities. We do find, however, in results not reported here but available on request, that the WMP is a better predictor of future, out-of-sample stock performance than the MSCI, thereby suggesting that the incremental information in the WMP does have some practical value. All this is circumstantial evidence that modeling stock returns requires more than a single index model.

We now pursue the idea of an unbundled WMP to see how it stands up in the context of the Fama-French (1992) model. To this end, we augment the regressions reported in Panel A of Table 9 with the returns of the high-minus-low (HML) book to market [30] portfolios for each country [31] because there is strong empirical evidence that this variable is significant in explaining stock returns. The results (not reported here but available upon request) suggest that HML generally improves the adjusted R-squares and it is significant for 9 of the 17 countries. Interestingly and importantly, it doesn't seem to have any effect on the statistical significance of NMK reported in table 9. Changes in the magnitude of the significant coefficients and their t-statistics in table 9 are very small. The overall results suggest that NMK is an important explanatory variable and that the NMK coefficients and t-ratios are robust to the inclusion of HML in the regressions.

3.7. Additional Tests on Stock Returns

In this section we look more closely at the relationship between stock returns and WMP. Up to now we have established that WMP does have significant explanatory value for returns of international stock indexes. In this section we examine how well it can explain

[30] A size factor was not included because the relevant data is not available to us. However, given the empirical evidence against the explanatory power of the size factor (e.g. Knez and Ready, 1997), we believe that not including it does not affect our results substantially. The size factor is available in French's website for the U.S. only and we used it for the U.S. regression. It is insignificant and including it in the regression does not affect the results at all.

[31] The quarterly HML portfolio returns were calculated from the monthly HML returns reported in French's website.

international stock portfolios sorted by specific characteristics such as book-to-market value, dividend yield, price-earnings ratio and cash earnings to price. We than compare the results with results calculated with an alternative market proxy linked to the consumption based CAPM (C-CAPM) literature, i.e. world GDP growth.[32] We conclude with an analysis of the information content of the WMP with respect to market integration.

Dahlquist and Sallstrom (2002) have underlined that characteristic-sorted portfolios pose a special challenge for international asset pricing models because they have a large dispersion in average returns. Thus, we examine if the WMP proxy is significant in explaining such portfolios. Statistical significance would be more evidence that the WMP is a significant factor in explaining the return generating process of international assets. To this end, we use the characteristic-sorted portfolios available in Kenneth French's website. These are international stock portfolios sorted by book-to-market value, dividend yield, price-earnings ratio and cash earnings to price. The portfolios consist of: high book-to-market stocks (HMB), low book-to-market stocks (LBM), high P/E stocks (HPE), low P/E stocks (LPE), high cash earnings to price stocks (HCEP), low cash earnings to price stocks (LCEP), high dividend yield stocks (HDY), low dividend yield stocks (LDY) and zero dividend yield stocks (ZDY). We use two model specifications to test WMP. The first is a single factor asset pricing model and the second is a three factor model where the two additional factors account for exchange rate (FX) risk. The FX risk indexes are constructed as in Vassalou (2000) where one factor captures common variation in changes in exchange rates and the other factor captures idiosyncratic changes in exchange rates against the U.S. dollar.[33]

[INSERT TABLE 10 ABOUT HERE]

Table 10 reports the results. Importantly, WMP is statistically significant in every regression in both specifications. This is further evidence that the WMP is relevant for international asset pricing. The idiosyncratic FX index is also statistically significant but a comparison between the adjusted R^2s in Panels A and B suggests that most of the explanatory power of the model comes from WMP. The intercepts of some regressions are statistically significant and the adjusted R^2s range between 7% for the zero dividend portfolio in the single

[32] We thank an anonymous referee for suggesting this.
[33] The indexes are constructed using the exchange rates of the countries whose stocks are included in the international portfolios.

factor specification and 22% for the low book-to-market portfolio in the three factor specification.

Given the relationship between WMP and world GDP, made explicit in footnote 9, and the outstanding literature on the consumption based CAPM, an obvious question is whether world GDP is a viable alternative to the WMP. For example, in a simple model that assumes a representative agent with logarithmic preferences, the market return is proportional to the growth rate of the economy, which, in the context of the world economy, is the growth rate of the world GDP. There are several reasons to believe that the growth rate of world GDP will not be a viable alternative. The first reason is that a stock concept such as the WMP that includes capital losses and gains is consistent with capital asset pricing theory, whereas a flow concept such as GDP is not. More importantly, GDP is a backward looking flow measure calculated with the average exchange rates over the period while WMP is a forward looking stock measure calculated with the end of period exchange rates that include expectations that are not present in an exchange rate average over a period. Furthermore, as a practical consideration, because of changes in productivity, consumer demand, export markets, etc., GDP can vary independently of the value of the economy. When this is the case, the dynamics of the evolution of GDP are far different from those of the value of the economy.

To examine whether the growth rate of the world GDP (in U.S. dollars) is a viable alternative to the WMP, we use it as an explanatory variable in the place of WMP in the regressions of Table 10. The results are reported in Table 11.[34] As expected, the world GDP growth is significant in only some of the regressions and the R^2s of all regressions are notably lower than those in Table 10. In other words, compared to the WMP, the global GDP growth rate does a much worse job at explaining stock portfolio returns.

[INSERT TABLE 11 ABOUT HERE]

According to financial theory, asset returns should be correlated to expected changes in future GDP and not contemporaneous changes. Given the foregoing discussion of the relationship between WMP and world GDP, we clearly show that the world market portfolio is the asset that generates this stream of future GDP. As a state factor, it should be able to predict future economic growth. For example, Liew and Vassalou (2000) argue that the Fama and French factors and the momentum factor are state variables because they can predict GDP

[34] We report only the single factor regressions for economy of space. The regressions including the two FX risk indices yield similar results. They are available upon request.

growth four quarters ahead. To test the predictive power of WMP with respect to world GDP, we run an OLS regression of world GDP growth on WMP lagged four quarters. The results in table 12 show that WMP can predict future growth in GDP. WMP lagged four quarters is significant at the 5% level and the overall equation explains 8% of changes in world GDP growth. We compare this result with the global MSCI, the usual proxy for the world market portfolio, lagged four quarters and see that the MSCI is clearly inferior. It is significant, but at the 10% level, and the overall equation explains only 2% of variations in world GDP growth. When we include both the global MSCI and WMP in a regression on future growth of world GDP, the global MSCI becomes insignificant.[35]

[INSERT TABLE 12 ABOUT HERE]

Finally, we ask what kind of information the WMP can provide on world market integration. Errunza and Losq (1985) and Stulz (1987) argue that if the proportion of a country's returns that can be explained by global factors is small, then this country is not integrated in the world economy. Solnik (1974b), Sercu (1980), and Adler and Dumas (1983) argue that if markets are fully integrated, then a single asset pricing model can apply to all. Most empirical studies find that markets are not fully integrated, but the results depend crucially on the methodology used. For example, Carrieri, Errunza and Hogan (2007) show that measuring integration by real activity indices shows increased integration compared to measuring integration using correlations of country index returns. Bekaert and Harvey (1995) use a time varying integration measure between countries' indices and a global factor and find that integration is not always increasing. In a more recent paper, Bekaert et. al. (2009) find that emerging markets are still segmented but their level of integration is increasing. Pukthuanthong and Roll (2009) follow a different approach to measure integration. They measure the power of a multifactor model to explain national return indices each year using daily returns. Their inference on market integration is based on the R^2 of the multifactor model each year. An increasing R^2 for a particular market implies increasing integration for that market.

To examine the evolution of market integration, we adopt a procedure similar to Pukthuanthong and Roll (2009). We estimate rolling regressions using 60 observations at a time, where the dependent variable is the returns of a country's stock market index and the

[35] The reverse relationship does not hold. GDP is not a significant predictor of WMP.

explanatory variables are the WMP and the two FX indices.[36] The first regression uses observations from 1975 quarter 1 to 1989 quarter 4; i.e. 15 years. Each subsequent regression drops one year from the beginning of the estimation period and adds one year at the end of the estimation period, keeping the number of observations at 60. Our results suggest that increasing integration is not the general case. In results not reported here, betas and (more importantly) the R^2s of the regressions increase for some countries while they drop for others.[37] Figure 2 shows the R^2s for a sample of four representative countries; Japan (JP), Hong Kong (HK), South Africa (SA) and Switzerland (SW). For all four countries, integration varies through time. However, Hong Kong and South Africa have a clear upward trend while Japan and Switzerland are decreasing. For Hong Kong, which has the lowest R^2 for the beginning of the period, there is an increase in the explanatory power of the model to 17%. Similarly, for South Africa, the explanatory power of the model increases from 22% to 43%. For Switzerland, the figure goes from 35% to 11%. For Japan, it drops from 52% to 25% during the 1990s, probably reflecting the deep recession that Japan experienced during that period, and then increases to 42%. Overall, our results support the findings of Bekaert and Harvey (1995) that not all national stock markets become more integrated. Also, considering that most R^2s are below 50%, it is evident that other factors are also important in explaining stock returns.

[INSERT FIGURE 2 ABOUT HERE]

4. SUMMARY AND CONCLUSION

In this paper, we build on the intuition that the “market portfolio” of financial theory represents the total value of a national economy to construct and test a portfolio that corresponds to the “market portfolio” of financial theory. Thus, rather than adding up values of individual assets to determine a proxy for the national “market portfolio”, we use the Hicks (1987) framework of discounted macro-economic cash flows to calculate the value of the economy directly. In this way, we avoid the shortcomings of the popular proxy indices currently in use that generally exclude many asset classes and are vulnerable to the tautology weakness. All assets are represented in the country “market

[36] The reason we include the two FX indices is because our tests suggest that FX risk is significant in explaining asset returns.
[37] We do not report the results on all countries for economy of space. They are available upon request.

portfolios” we construct and since no individual assets enter the portfolio directly, we also avoid the tautology weakness. Our international market portfolio proxy, the WMP, is calculated as the sum of the ninety national market portfolios in our sample. Its dynamics depend on the growth rates, volatilities and correlations of the exchange rates and the local currency values of the individual economies.

We find that the major determinants of the world market portfolio excess returns are the excess returns of assets that are traded publicly on international and local markets. We present strong evidence that the world market portfolio has significant explanatory power for the return generating process of portfolios of a wide range of assets that include stock indices, medium and long term government bonds, money markets and commodity and real estate indices, including well diversified portfolios generated by principal components analysis. It also has significant explanatory power for most of the individual assets across all the asset classes. We provide strong evidence based on individual asset betas, the Gibbons et al. (1989) F-test, and marginal conditional stochastic dominance, that the index is not efficient. We show that the index provides significant incremental information on the return generating process of a wide range of assets that is not contained in the prices of assets that are traded publicly on international and local markets. This incremental information retains its significance as a complement in the Fama-French (1992) model. We have shown that the explanatory information of the WMP is robust with respect to characteristic-sorted portfolios as well as to various model specifications, including the single index model, the Fama-French (1992) three factor model for stocks, and various specifications of multi-index models hedged and unhedged for foreign currency risk.

The shortcoming of the WMP is that due to data constraints, it is difficult to construct on less than a quarterly time scale. Further research includes generating the world market portfolio on a more frequent basis, extending the tests to include more countries and asset classes, and testing its out of sample predictive power.

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Appendix 1The World Model

The Valuation Model at the Country Level of Aggregation

John Hicks (1987) showed that the value of an economy can be presented in the present value format of equation 2 where the $B_t^i = \sum_{j=1}^{k} b_t^j$ represent the value of the economy's total output of final goods and services for period *t* and the $A_t^i = \sum_{j=1}^{k} a_t^j$ represent the value of the total input of final goods and services for period *t*.[38] Thus, the A_t^i's measure the cost of inputs in terms of the value of final goods and services. The idea behind this is that a national economy is one big firm devoted to producing final goods and services. Within the firm there is a range of projects with different temporal profiles of outputs and inputs [b_t^j, a_t^j], different durations n_j, and different required rates of return r^j. Although highly stylized, this insight provides a framework that can be used to construct the "world market portfolio".

The idea is this. Although all the transactions and prices within firms, between individuals and firms and between individuals or within families cannot be known with any reasonable degree of accuracy, the aggregate money value of consumption and investment goods produced in a period can be measured with a degree of accuracy high enough to make economic evaluation reasonable. Thus, for the world market portfolio, the level of aggregation we consider is the national economy. The national economies themselves are open and together they constitute the world economy.

Let $B_t = \sum_{j=1}^{k} b_t^j$ represent the value of the economy's total output and consumption of **final** goods and services for period *t* and the $A_t = \sum_{j=1}^{k} a_t^j$ represent **wages** (the value of the total input of **final** goods and services for period *t*). Let $R = 1 + r$, where *r* is a nominal rate that represents the

[38] The assumption here, which we will follow in our presentation, is that labor is the only original factor of production. If there are other original factors, such as land, for social accounting purposes the rents have to be treated as wages.

economy's required rate of return.[39] For expository convenience but no loss of generality, assume that the real rate of interest and the expected rate of inflation remain constant and that the capital markets are in equilibrium so that each country just earns its required rate of return.[40] Assuming that the capital markets are in equilibrium and that all transactions take place on the first day of the period, the value of the economy on the first day of the current period T is:

$$V_T = (B_T - A_T) + E(B_{T+1} - A_{T+1})R^{-1} + ... + E(B_n - A_n)R^{-(n-T)} \qquad (1A)$$

Substituting for V_{T+1} gives:

$$V_T = B_T - A_T + V_{T+1}R^{-1} \qquad (2A)$$

Multiplying by 1+r and ignoring interest on net consumption (which disappears in continuous time),[41] gives the outcome at the end of period T:

$$rV_T + A_T = B_T + V_{T+1} - V_T \qquad (3A)$$

Equation (3A) is the national accounting equation: Profits (rV_T) plus Wages (A_T) = Consumption (B_T) plus Net Investment ($V_{T+1} - V_T$). The right hand side (RHS) of (7) is the GDP of a closed economy. The difference between Consumption and Wages is the consumption out of profits, which includes consumption by entrepreneurs as well as the value of the final goods and services consumed by the activity of producing, maintaining and retiring human capital.[42] Thus, Wages plus consumption out of profits = Consumption, the total value of final goods and services produced and consumed by the economy from the beginning of T to the end of T (any final good or service that is

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[39] According to the Fisher hypothesis, the nominal rate is composed of the "real" rate and expected inflation in the relationship $1 + r = (1 + \rho)(1 + E(i))$, where ρ represents the "real" rate of interest and $E(i)$ is the expected rate of inflation.

[40] If the real rate of interest or the expected rate of inflation changes, the discounting and compounding become more complicated but the conclusions remain unchanged.

[41] For simplification we ignore interest on net exports which disappears in continuous time. The continuous time equivalent of equation 5 is $V(T) = \int_T^n (B(t) - A(t))e^{-r^*(t-T)}dt$, where r* is the instantaneous rate of interest and we assume that *V(T)* is a continuous function of T. Multiply both sides of the equation by e^{-r^*T} and differentiate with respect to T. This gives: $V'(T)e^{-r^*T} - r^*V(T)e^{-r^*T} = -[B(T) - A(T)]e^{-r^*T}$. Simplifying and rearranging gives $r^*V(T) + A(T) = B(T) + V'(T)$. This is the continuous time equivalent of equation 7.

[42] This includes, for example, the consumption of retirees and children, consumption by the sectors providing education and health care, etc.

not consumed is reinvested in the process and does not appear as consumption). Wages are associated with three activities: ongoing processes, replacement of processes that were terminated in T-1 (depreciation), and new processes over and above what existed at the beginning of T-1 (net investment $V_{T+1} - V_T$). Consider the following numerical example.

Numerical example:

Consider an economy with one simple process [b_t , a_t] such that:

[$b_0 = 0$, b_1 40.21, $b_2 = 40.21$, $b_3 = 40.21$][$a_0 = 100$, $a_1 = 0$, $a_2 = 0$, $a_3 = 0$] where the required rate of return = the internal rate of return = 10%.

At T there are 30 processes in operation. Ten were started 3 years ago, ten were started 2 years ago and ten were started 1 year ago (in T-1). The ten that were started 4 years ago were terminated in T-1 and have to be replaced in T to maintain the economy's level of output and consumption. Suppose that instead of 10 new processes, entrepreneurs reduce their consumption out of profits and start 12 new processes. The cash flows for T, T+1, T+2 and T+3 look like this

	T		**T+1**		**T+2**		**T+3**		
	402.1	From T-3							
	402.1	From T-2	**402.1**	From T-2					
	402.1	From T-1	**402.1**	From T-1	**402.1**				
	-1200	New starts	**482.52**	From T	**482.52**	From T	**482.52**	From T	
Total	**1206.3-1200**		**1286.72**		**884.62**		**482.52**		
PV	**1206.3 - 1200**		**1169.75**		**731.09**		**362.52**		

From equation (1A):

$$V_T = (B_T - A_T) + E(B_{T+1} - A_{T+1})R^{-1} + ... + E(B_n - A_n)R^{-(n-T)}$$

$$V_T = (1206.3 - 1200) + (1286.72 - 0)(1.1)^{-1} + (884.62 - 0)(1.1)^{-2} + (482.52 - 0)(1.1)^{-3} = 2269.69$$

$$V_{T+1} = (1286.72 - 0) + (884.62 - 0)(1.1)^{-1} + (482.52 - 0)(1.1)^{-2} = 2489.72$$

$$V_{T+1}R^{-1} = (2489.72)(1.1)^{-1} = 2263.38$$

From equation (2A)

$$V_T = B_T - A_T + V_{T+1}R^{-1}$$
$$2269.69 \approx 1206.3 - 1200 + 2263.38$$

Multiply by (1.10) and rearrange to get the outcome at the end of T to get equation (3A)

$$rV_T + A_T = B_T + V_{T+1} - V_T$$
$$0.1 \times 2269.69 + 1200 \approx 1206.3 + (2489.72 - 2269.69)$$

Profits (rV_T) 226.97 plus Wages (A_T) 1200 = Consumption (B_T) 1206.3 plus Net Investment ($V_{T+1} - V_T$) 220. The value of net investment at the end of T is equal to the 200 investment in the 2 extra processes at the beginning of T above the replacement of the ten that were terminated in T-1 plus the interest on this investment.

For an open economy, the only thing that changes is that exports and imports have to be added to the foregoing presentation. Define X_t and M_t respectively as total exports and imports for period t not including investment income.[43] The profile of outputs and inputs becomes [$b_t^j = x_t^j + c_t^j$, $a_t^j = m_t^j + w_t^j$], where x is exports, c is consumption of locally produced final goods and services, m is imports and w is the local wage. Thus, $B_t = \sum_{j=1}^{k} b_t^j = X_t + C_t$ and $A_t = \sum_{j=1}^{k} a_t^j = M_t + W_t$. Substituting this into equations (1A), (2A) and (3A) gives :

$$rV_T + W_T = X_T - M_T + C_T + V_{T+1} - V_T \qquad (4A)$$

[43] We do not include investment income in exports and imports because we are dealing with GDP.

The LHS of equation (4A) is Profits (rV_T) plus Wages (W_T) . The RHS of equation (4A) is the GDP of an open economy. The difference between C_T and W_T is consumption out of profits (the same as for a closed economy) and the difference between X_T and M_T is the current account balance before investment income (not counting investment income). Net investment is equal to $V_{T+1} - V_T$ and includes net investment in fixed and circulating capital. Using the analogy with the firm where all internal consumption of resources such as those due to internal transfer prices, cross subsidies, managerial perks, etc. are costs that reduce firm profits, all internal consumption of resources by a national economy is a cost and should be included in *W*. This definition means that $C_T = W_T$ and equation (4A) becomes

$$rV_T = X_T - M_T + V_{T+1} - V_T \qquad (4A^*)$$

Similarly, the value of the economy in US dollars (USD), where asterisks denote USD, is

$$V_T^* = (B_T^* - A_T^*) + E(B_{T+1}^* - A_{T+1}^*)R^{*-1} + \ldots + E(B_n^* - A_n^*)R^{*-(n-T)} \quad (5A)$$

Let S_t denote the spot exchange rate at time t expressed as the price of 1 unit of local currency in USD and $F_{T,t}$ the forward exchange rate (the price of 1unit of local currency in USD) at time *T* for delivery at time *t*. By definition $B_t^* = S_t B_t$ and $A_t^* = S_t A_t$. Make these substitutions into equation (9), take expectations and apply forward rate parity[44] $E(S_t) = F_{T,t}$ and interest rate parity $F_{T,t} = S_T \dfrac{R^{*t-T}}{R^{t-T}}$. Then, substituting V_T from equation (5) in the text gives

$$V_T^* = S_T V_T \qquad (6A)$$

[44] To avoid complicating the presentation unnecessarily, we assume there is no risk premium.

Table 1 Summary statistics for quarterly returns of the World market portfolio

Mean return	1.73%
Mean Excess Return	0.25%
St. Devn.	3.20%
Kurtosis	0.065
Skewness	0.96
Jarque-Bera	0.05 (p = 0.98)

The sample period is 1975 quarter 1 to 2007 quarter 4. The risk free rate used for the excess return is the U.S. 3-month T bill rate.

Table 2. Average shares of market value and GDP in relation to the total value of the WMP and global GDP for the period 1975-2007

	Market Value	GDP
Australia	1.567%	1.464%
Canada	2.560%	2.486%
France	5.337%	5.168%
Greece	0.278%	0.422%
India	1.115%	1.548%
Indonesia	0.446%	0.624%
Ireland	0.199%	0.250%
Luxembourg	0.063%	0.055%
Morocco	0.122%	0.128%
Malaysia	0.307%	0.253%
Netherlands	1.617%	1.372%
New Zealand	0.188%	0.209%
Paraguay	0.020%	0.028%
South Africa	0.390%	0.552%
Tunisia	0.068%	0.065%
UK	3.599%	4.224%
USA	23.314%	28.184%

The table reports the average percentage of the market value and GDP of selected countries in relation to the total value of the WMP and world GDP for the period 1975-2007.

Table 3. Summary statistics for asset excess quarterly returns

		Start of sample	Statistics for quarterly excess returns Mean	St. Devn.	Kurtosis	Skewness
STOCKS						
	Australia	1975 : Q1	2.66	11.15	1.21	-0.32
	Austria	1975 : Q1	2.69	13.43	9.55	2.01
	Belgium	1975 : Q1	2.41	10.79	0.56	0.00
	Canada	1975 : Q1	2.01	9.20	1.22	-0.21
	Denmark	1975 : Q1	2.53	9.45	0.33	-0.34
	France	1975 : Q1	3.00	11.98	1.67	0.06
	Germany	1975 : Q1	2.20	11.60	1.11	0.10
	Hong Kong	1975 : Q1	4.70	17.52	1.52	-0.01
	Ireland	1975 : Q1	3.69	14.06	8.43	1.50
	Italy	1975 : Q1	2.67	14.60	4.36	1.27
	Japan	1975 : Q1	1.60	12.39	0.39	-0.08
	Netherlands	1975 : Q1	2.87	9.24	1.08	-0.20
	Norway	1975 : Q1	3.52	16.28	2.94	0.71
	Singapore	1975 : Q1	2.76	15.31	7.84	1.15
	South Africa	1975 : Q1	3.21	15.72	0.60	0.20
	Sweden	1985 : Q2	3.82	13.69	0.60	-0.31
	Switzerland	1975 : Q1	2.54	10.15	0.68	-0.05
	UK	1975 : Q1	3.15	11.41	15.25	2.31
	US	1975 : Q1	2.15	7.97	1.26	-0.25
DEBT INSTRUMENTS						
Short Term (3-month money market)						
	Australia	1975 : Q1	0.48	5.00	0.29	-0.31
	Belgium	1985 : Q2	1.30	6.00	-0.45	0.20
	Canada	1975 : Q1	0.46	2.85	0.49	0.55
	Denmark	1985 : Q2	1.43	5.90	-0.35	0.26
	France	1975 : Q1	0.72	5.86	-0.23	0.12
	Germany	1975 : Q1	0.44	6.03	-0.29	0.11
	Italy	1975 : Q1	0.68	5.75	0.26	-0.23
	Japan	1985 : Q2	0.51	6.49	-0.11	0.45
	Netherlands	1985 : Q2	1.16	6.09	-0.36	0.21
	Switzerland	1975 : Q1	0.26	6.81	0.11	0.42
	UK	1975 : Q1	0.74	5.22	0.23	-0.04
Long Term (10 Year Benchmark Government Bonds)						
	Germany	1985 : Q2	1.68	7.20	0.00	0.55
	Canada	1985 : Q2	1.57	4.68	0.68	-0.23
	France	1985 : Q2	2.01	6.86	-0.13	0.63
	Ireland	1985 : Q2	2.19	7.29	0.57	0.29
	Japan	1985 : Q2	1.34	8.26	2.46	0.89
	Austria	1985 : Q2	1.80	6.71	-0.23	0.46
	Switzerland	1985 : Q2	1.26	7.28	0.67	0.60
	UK	1985 : Q2	1.92	6.97	0.59	0.45
	US	1985 : Q2	0.87	3.95	-0.27	0.43
Medium Term (5 Year Benchmark Government Bonds)						
	Germany	1985 : Q2	1.53	6.72	-0.06	0.47
	Belgium	1985 : Q2	1.84	6.29	-0.46	0.38
	Canada	1985 : Q2	1.28	3.98	0.78	-0.02
	Denmark	1985 : Q2	1.98	6.22	0.02	0.50
	France	1985 : Q2	1.70	6.23	-0.25	0.50

	Ireland	1985 : Q2	1.88	6.54	0.40	0.43
	Japan	1985 : Q2	1.15	7.59	1.60	0.85
	Austria	1985 : Q2	1.58	6.46	-0.06	0.51
	Sweden	1985 : Q2	1.63	6.05	0.34	-0.20
	Switzerland	1985 : Q2	1.12	6.95	0.54	0.56
	UK	1985 : Q2	1.62	6.11	0.96	0.54
COMMODITIES						
	Livestock	1975 : Q1	1.17	9.05	0.17	0.22
	Precious Metal	1975 : Q1	0.24	10.24	7.25	1.58
	Energy Index	1985 : Q2	3.24	18.95	10.15	1.90
	Industrial Metals	1985 : Q2	2.95	13.57	10.65	2.46
	NAREIT	1975 : Q1	2.11	7.96	1.41	0.50

Note: Mean excess return and standard deviation are in percentage terms. Quarterly excess returns are calculated using the 3-month U.S. T-bill rate as the risk free rate. The end of the sample period is 2007 quarter 4.

Table 4 Regression of the excess returns of the WMP on the excess returns of stocks, debt and commodities returns indexes 1985 Q2 – 2007 Q4

	Coefficient	t-ratio
Constant	-0.00087	-0.54
MSCI	0.0404**	1.99
DEBT	0.5516***	25.22
COMM	0.0777***	2.83
Adusted R^2: 0.79	Durbin-Watson stat. 1.96	

MSCI is the excess return of the value weighted MSCI stock market global index. DEBT and COMM refer to excess returns of a debt and commodity index respectively. DEBT and COMM are equally weighted portfolios of the debt instruments and commodities in our sample. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Table 5 Regression Results of $r_{it} = \alpha_i + \beta_i r_{pt} + e_{it}$ for the Individual Asset Classes

	a	t-ratio(a)	b	t-ratio(b)	R^2-adj.
Stocks	0.017**	2.39	1.113***	4.03	0.17
10-year bonds	0.004	1.07	1.333***	11.28	0.60
5-year bonds	0.003	0.77	1.444***	14.19	0.73
Money Market	0.002	0.78	1.235***	18.23	0.84
Commodities	0.017***	2.77	0.539***	2.63	0.07

The table reports results for equation $r_{it} = \alpha_i + \beta_i r_{pt} + e_{it}$, where r_{it} is the quarterly excess return of asset i during period t and r_{pt} is the quarterly excess return of the world market portfolio for period t. Each dependent variable is an equally weighted portfolio of the assets in our sample which belong in each respective asset class. The estimation period is 1975 quarter 1 to 2007 quarter 4 for Stocks, Money Market and Commodities, and 1985 quarter 2 to 2007 quarter 4 for 10 and 5 year bonds. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Table 6. Principal Component Analysis of Assets Excess Returns

Panel A: Results for the period 1975 - 2007

Component	Total	Eigenvalues % of Variance	Cumulative %
1	11.356	35.121	35.121
2	4.236	13.453	48.574
3	1.623	7.211	55.785
4	1.322	5.353	61.138
5	1.101	4.149	65.287
6	0.964	3.529	68.816
7	0.863	3.302	72.118
8	0.804	2.952	75.070

Regression Results of $C_i = a_i + b_i WMP + \varepsilon_i$ for the first 2 principal components

	a	t-ratio	B	t-ratio	R2 adj.
C 1	0.022	0.23	-6.828**	-2.11	0.05
C 2	-0.074	-1.44	23.22***	12.20	0.72

Panel B: Results for the period 1985 - 2007

Component	Total	Eigenvalues % of Variance	Cumulative %
1	21.724	40.011	40.011
2	12.985	22.580	62.591
3	2.991	6.141	68.732
4	2.740	4.082	72.814
5	1.985	3.755	76.569
6	1.616	3.197	79.766
7	1.155	2.641	82.407
8	1.040	2.131	84.538

Regression Results of $C_i = a_i + b_i WMP + \varepsilon_i$ for the first 4 principal components

	a	t-ratio	B	t-ratio	R2 adj.
C 1	0.234***	3.33	-25.57***	-14.74	0.68
C 2	0.003	0.30	-3.269	-0.73	0.00

We estimate the principal components of the assets in our sample to create diversified portfolios. The first set of principal component refers to all the assets in our sample which have available observations from 1975 quarter 1 to 2007 quarter 4 and the components are estimated for that period. The second set of principal components is estimated from 1985 quarter 2 to 2007 quarter 4 and includes all the assets in our sample. The second column of the top part of each panel reports the eigenvalue associated with each component. The third column reports the percentage of common variance explained by each component and the fourth reports the cumulative variance explained by the components. WMP is excess returns for the World Market Portfolio. C1 and C2 are the first and second principal components derived for each respective sample period. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Table 7. Betas for asset excess returns using the world market portfolio

	Start date	α	t-ratio	β	t-ratio	R^2
STOCKS						
Australia	1975 Q1	0.016	(1.53)	0.739	(1.57)	0.034
Austria	1975 Q1	0.017	(1.18)	0.950***	(2.72)	0.047
Belgium	1975 Q1	0.012	(1.22)	1.366***	(3.47)	0.166
Canada	1975 Q1	0.012	(1.37)	0.308	(1.12)	0.004
Denmark	1975 Q1	0.015	(1.47)	0.750***	(2.80)	0.057
France	1975 Q1	0.018*	(1.70)	1.220***	(3.02)	0.106
Germany	1975 Q1	0.015	(1.52)	0.961**	(2.46)	0.071
Hong Kong	1975 Q1	0.034**	(2.36)	0.353	(0.68)	0.000
Ireland	1975 Q1	0.020	(1.48)	0.997**	(2.22)	0.044
Italy	1975 Q1	0.015	(1.10)	1.130**	(2.48)	0.061
Japan	1975 Q1	0.001	(0.62)	1.534***	(4.95)	0.173
Netherlands	1975 Q1	0.017*	(1.90)	1.016***	(3.71)	0.113
Norway	1975 Q1	0.020	(1.17)	0.757	(1.37)	0.016
Singapore	1975 Q1	0.016	(1.32)	0.530	(1.12)	0.006
South Africa	1975 Q1	0.022*	(1.72)	1.066**	(2.19)	0.045
Sweden	1985 Q2	0.030*	(1.81)	0.083	(0.14)	0.000
Switzerland	1975 Q1	0.016**	(2.08)	1.261***	(3.58)	0.166
UK	1975 Q1	0.018*	(1.93)	0.578**	(2.03)	0.019
US	1975 Q1	0.014*	(1.91)	0.092	(0.33)	0.000
DEBT INSTRUMENTS						
Short Term (3-month money market)						
Australia	1975 Q1	0.001	(0.13)	0.623***	(4.41)	0.154
Belgium	1985 Q2	-0.003	(-0.71)	1.623***	(18.81)	0.772
Canada	1975 Q1	0.003	(0.92)	0.148*	(1.93)	0.020
Denmark	1985 Q2	-0.001	(-0.19)	1.580***	(18.39)	0.757
France	1975 Q1	0.003	(0.86)	1.455***	(15.92)	0.723
Germany	1975 Q1	-0.000	(-0.01)	1.560***	(17.32)	0.769
Italy	1975 Q1	0.002	(0.58)	1.277***	(10.58)	0.580
Japan	1985 Q2	-0.008	(-1.58)	1.712***	(13.37)	0.691
Netherlands	1985 Q2	-0.004	(-1.23)	1.654***	(19.80)	0.782
Switzerland	1975 Q1	-0.000	(-0.11)	1.689***	(17.95)	0.686
UK	1975 Q1	0.002	(0.52)	1.054***	(8.43)	0.440
Long Term (10 Year Benchmark Government Bonds)						
Germany	1985 Q2	0.001	(0.31)	1.713***	(13.31)	0.598
Canada	1985 Q2	0.011**	(2.56)	0.364**	(2.53)	0.054
France	1985 Q2	0.006	(1.05)	1.582***	(10.83)	0.558
Ireland	1985 Q2	0.008	(1.42)	1.436***	(8.18)	0.410
Japan	1985 Q2	-0.002	(-0.29)	1.944***	(8.12)	0.563
Austria	1985 Q2	0.003	(0.63)	1.627***	(14.98)	0.622
Switzerland	1985 Q2	-0.002	(-0.36)	1.735***	(11.87)	0.598
UK	1985 Q2	0.005	(0.96)	1.229***	(5.85)	0.321
US	1985 Q2	0.008*	(1.770)	0.293***	(2.70)	0.042
Medium Term (5 Year Benchmark Government Bonds)						
Germany	1985 Q2	-0.000	(-0.09)	1.711***	(17.08)	0.686
Belgium	1985 Q2	0.003	(0.83)	1.574***	(14.98)	0.661
Canada	1985 Q2	0.008**	(2.23)	0.340***	(2.71)	0.065
Denmark	1985 Q2	0.005	(1.19)	1.508***	(13.18)	0.621
France	1985 Q2	0.003	(0.61)	1.557***	(13.72)	0.659
Ireland	1985 Q2	0.005	(1.02)	1.448***	(9.53)	0.519
Japan	1985 Q2	-0.004	(-0.59)	1.894***	(10.25)	0.633

Austria	1985 Q2	0.000	(0.13)	1.648***	(17.64)	0.691
Sweden	1985 Q2	0.003	(0.48)	1.292***	(6.04)	0.464
Switzerland	1985 Q2	-0.004	(-0.74)	1.732***	(13.43)	0.649
UK	1985 Q2	0.002	(0.51)	1.196***	(6.57)	0.385
COMMODITIES						
Livestock	1975 Q1	0.007	(0.85)	-0.143	(-0.51)	0.000
Precious Metal	1975 Q1	0.001	(0.10)	1.091***	(4.07)	0.104
Energy Index	1985 Q2	0.021	(1.04)	0.624	(0.87)	0.000
Industrial Metals	1985 Q2	0.010	(0.66)	1.438**	(2.17)	0.095
NAREIT	1975 Q1	0.013	(1.63)	0.045	(0.19)	0.000

Results for equation $r_{it} = \alpha_i + \beta_i r_{pt} + e_{it}$, where r_{it} is the quarterly excess return of asset i during period t and r_{pt} is the quarterly excess return of the world index during period t. The end of the sample period is 2007 quarter 4. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Table 8. Marginal Conditional Stochastic Dominance tests for the WMP

Sextile (p)		0.167	0.333	0.5	0.667	0.833	1
T = $F_m^{-1}(p)$		-1.14%	0.36%	1.53%	3.23%	4.98%	11.9%
				$Z_{\iota-M}^{\tau_\tau^m}$			
Stocks	Australia	0.92	0.20	1.57	1.70	1.73	1.49
	Austria	-0.32	0.04	0.31	1.72	1.81	1.50
	Belgium	-1.14	-0.38	0.12	0.35	0.90	1.53
	Canada	1.75	1.57	2.43	2.70*	1.71	1.18
	Denmark	0.29	0.75	1.75	2.19	1.60	1.69
	France	-0.09	-0.25	0.32	1.25	1.50	1.91
	Germany	-0.25	0.08	0.62	1.63	1.55	1.54
	Hong Kong	1.18	0.61	1.65	2.46	2.42	2.05
	Ireland	0.48	0.28	0.56	1.80	1.43	1.62
	Italy	0.24	0.27	0.04	0.65	0.93	1.29
	Japan	-2.16	-2.07	-1.01	-0.22	0.35	0.87
	Netherlands	-0.48	0.03	0.82	1.86	1.82	2.14
	Norway	-0.23	-0.01	0.92	1.67	1.50	1.35
	Singapore	1.22	0.27	1.13	1.45	1.38	1.09
	South Africa	-0.12	-0.39	0.69	1.46	1.43	1.68
	Switzerland	0.02	-0.54	0.15	1.45	1.61	2.13
	UK	1.51	0.93	1.51	2.17	1.75	1.67
	US	3.35*	2.60	3.13*	3.47*	2.56	1.46
MM	Australia	1.72	0.72	2.03	0.96	0.64	-0.16
	Canada	6.45*	4.32*	4.89*	4.01*	2.18	-0.06
	France	-3.52*	-3.24*	-2.62	-2.01	-0.31	1.48
	Germany	-4.78*	-5.13*	-4.94*	-3.68*	-1.32	0.62
	Italy	-2.29	-1.08	-1.54	-1.27	-0.25	0.96
	Switzerland	-4.05*	-4.07*	-4.72*	-4.06*	-1.69	0.48
	UK	-0.52	0.02	-0.22	0.19	0.27	0.67
Commodities	Livestock	2.16	2.68*	3.48*	2.11	1.37	0.39
	Precious Metals	-1.37	-1.25	-0.19	-0.47	0.27	0.16
	NAREIT	3.62*	2.46	2.65	3.05*	2.23	1.21

We test the efficiency of the WMP for the period 1975 quarter 1 to 2007 quarter 4 using marginal conditional stochastic dominance. The assets used for the tests are those for which we have data from 1975 quarter 1, i.e. most stocks, short term debt (MM) and some commodities. The target return levels (τ) are chosen to correspond to the sample population sextiles of p in the WMP return distribution. The null hypothesis is no dominance which means that the WMP is efficient. The critical value at the 5% level for a joint studentised maximum modulus test is 2.673. * indicates significance at the 5% level.

Table 9. Testing for the Relevance of Incremental Information Contained in WMP

PANEL A: Stocks

	α	MSCI	DEBT	COMM	NMK	Adj. R2
Australia	0.014	0.854***	-0.191	0.197	-0.619	0.43
	(1.61)	(7.27)	(-0.76)	(1.19)	(-1.36)	
Austria	0.033	0.536***	0.110	-0.084	-0.166	0.04
	(1.63)	(2.66)	(0.37)	(-0.25)	(-0.16)	
Belgium	0.008	0.935***	0.588***	-0.056	-0.569	0.55
	(1.03)	(6.84)	(2.87)	(-0.44)	(-1.27)	
Canada	0.007	0.907***	-0.388***	0.281**	0.191	0.66
	(1.39)	(9.91)	(-3.08)	(2.30)	(0.43)	
Denmark	0.014	0.620***	0.187	0.228*	-0.265	0.33
	(1.43)	(5.18)	(1.44)	(1.81)	(-0.54)	
France	0.011	1.093***	0.188	-0.041	-0.106	0.63
	(1.60)	(9.45)	(1.51)	(-0.34)	(-0.19)	
Germany	0.007	1.062***	0.148	-0.057	-0.534	0.47
	(0.76)	(5.69)	(0.68)	(-0.40)	(-0.89)	
Hong Kong	0.024	1.088***	-0.496*	0.180	0.038	0.31
	(1.35)	(7.41)	(-1.81)	(0.61)	(0.03)	
Ireland	0.022**	1.069***	0.267	-0.330***	-1.388***	0.59
	(2.57)	(9.11)	(1.10)	(-3.06)	(-2.64)	
Italy	0.011	1.130***	0.398	-0.377	0.261	0.43
	(1.04)	(5.57)	(1.11)	(-1.64)	(0.366)	
Japan	-0.023**	1.210***	0.416**	0.303	2.030***	0.62
	(-2.46)	(8.18)	(2.17)	(1.59)	(2.75)	
Netherlands	0.007	0.923***	0.182*	0.160*	0.092	0.71
	(1.20)	(9.59)	(1.86)	(1.68)	(0.26)	
Norway	0.011	0.805***	-0.396	0.955***	0.039	0.39
	(1.02)	(4.44)	(-1.34)	(6.62)	(0.06)	
Singapore	0.013	0.953***	-0.503*	0.138	0.668	0.35
	(1.02)	(6.43)	(-1.88)	(0.89)	(0.94)	
S Africa	0.014	0.989***	-0.330	0.346	0.988	0.32
	(1.11)	(6.31)	(-1.20)	(1.54)	(1.25)	
Sweden	0.012	1.414***	-0.399**	0.212	-0.050	0.67
	(1.47)	(11.75)	(-2.07)	(1.57)	(-0.11)	
Switzerland	0.014*	0.868***	0.310	-0.090	-0.170	0.52
	(1.90)	(7.88)	(1.62)	(-0.77)	(-0.36)	
UK	0.004	0.906***	0.210**	0.090	-1.048***	0.72
	(1.06)	(13.53)	(2.28)	(1.08)	(-2.64)	
US	0.015***	0.879***	-0.372***	-0.196**	-0.267	0.82
	(3.39)	(12.40)	(-5.50)	(-2.19)	(-0.99)	

PANEL B: Money markets

	α	MSCI	DEBT	COMM	NMK	Adj. R2
Australia	-0.001	0.204***	0.242**	0.316***	-0.289	0.26
	(-0.09)	(4.17)	(2.14)	(4.37)	(-1.01)	
Belgium	-0.002	-0.048*	1.099***	0.037	0.528***	0.89
	(-0.93)	(-1.72)	(25.91)	(1.27)	(3.37)	
Canada	0.001	0.124***	0.101*	0.141***	-0.068	0.18
	(0.34)	(4.29)	(1.69)	(3.35)	(-0.40)	
Denmark	-0.001	-0.056**	1.082***	0.054	0.401***	0.89
	(-0.39)	(-2.19)	(27.54)	(1.58)	(3.05)	
France	-0.002	-0.049*	1.087***	0.048**	0.426***	0.90

	(-0.88)	(-1.78)	(24.70)	(1.99)	(2.84)	
Germany	-0.004	-0.052**	1.110***	0.042	0.599***	0.89
	(-1.95)	(-2.27)	(27.10)	(1.33)	(3.89)	
Italy	-0.001	-0.016	0.943***	0.060	0.424	0.69
	(-0.04)	(-0.64)	(12.49)	(1.47)	(1.23)	
Japan	-0.012***	0.131***	0.854***	0.143***	2.346***	0.78
	(-2.75)	(3.34)	(10.69)	(2.89)	(8.97)	
Netherlands	-0.004*	-0.048**	1.112***	0.049	0.578***	0.89
	(-1.86)	(-2.11)	(28.83)	(1.55)	(3.79)	
Switzerland	-0.006**	-0.126***	1.177***	0.022	0.804***	0.85
	(-2.12)	(-4.12)	(24.43)	(0.58)	(3.18)	
UK	0.0004	0.030	0.756***	0.131**	0.208	0.64
	(0.10)	(0.94)	(12.47)	(2.29)	(1.20)	

PANEL C: Government Bonds

	α	MSCI	DEBT	COMM	NMK	Adj. R2
Germany 10y	0.001	-0.077***	1.363***	-0.115***	-0.464***	0.92
	(0.78)	(-3.24)	(38.08)	(-3.71)	(-4.39)	
Canada 10y	0.007*	0.168***	0.399***	-0.041	-1.102***	0.37
	(1.73)	(3.78)	(4.36)	(-0.53)	(-3.58)	
France 10y	0.005***	-0.046	1.292***	-0.160***	-0.639***	0.92
	(2.71)	(-1.64)	(33.93)	(-5.15)	(-5.15)	
Ireland 10y	0.006**	0.011	1.248***	-0.157**	-1.193***	0.80
	(2.45)	(0.38)	(22.45)	(-2.32)	(-5.16)	
Japan 10y	-0.006	0.106	1.232***	-0.003	1.349***	0.63
	(-0.95)	(1.25)	(7.55)	(-0.03)	(2.80)	
Austria 10y	0.002	-0.059**	1.264***	-0.046	-0.408***	0.92
	(0.80)	(-2.09)	(27.28)	(-1.03)	(-3.69)	
Switzerland 10y	-0.003	-0.140***	1.314***	-0.051	-0.006	0.84
	(-0.76)	(-5.29)	(21.65)	(-1.08)	(-0.03)	
UK 10y	0.003	0.092**	1.068***	-0.078	-1.116***	0.66
	(0.85)	(2.22)	(11.39)	(-1.28)	(-3.72)	
US 10y	0.008**	-0.060	0.422***	-0.258***	-0.805***	0.46
	(2.43)	(-1.33)	(8.35)	(-5.08)	(-4.38)	
Germany 5y	-0.001	-0.072***	1.284***	-0.042	-0.074	0.94
	(-0.58)	(-4.18)	(36.70)	(-1.53)	(-0.74)	
Belgium 5y	0.003**	-0.058***	1.190***	-0.060**	-0.147	0.92
	(2.05)	(-2.73)	(29.13)	(-2.01)	(-1.55)	
Canada 5y	0.005	0.141***	0.320***	0.023	-0.744***	0.30
	(1.36)	(3.89)	(4.03)	(0.31)	(-2.73)	
Denmark 5y	0.005***	-0.060***	1.176***	-0.035	-0.409***	0.93
	(3.07)	(-2.89)	(36.61)	(-1.27)	(-5.14)	
France 5y	0.002	-0.064***	1.197***	-0.054**	-0.265***	0.95
	(1.45)	(-2.85)	(36.33)	(-2.60)	(-2.65)	
Ireland 5y	0.004*	-0.044*	1.170***	-0.047	-0.705***	0.84
	(1.72)	(-1.95)	(24.26)	(-1.31)	(-4.34)	
Japan 5y	-0.008	0.144**	1.107***	0.038	1.809***	0.70
	(-1.39)	(2.15)	(8.77)	(0.57)	(4.74)	
Austria 5y	-0.0001	-0.080***	1.229***	-0.004	-0.082	0.94
	(-0.08)	(-4.16)	(36.16)	(-0.11)	(-0.80)	
Sweden 5y	-0.001	0.124***	0.930***	0.067*	-0.459	0.66
	(-0.13)	(4.37)	(12.47)	(1.81)	(-1.11)	
Switzerland 5y	-0.003	-0.153***	1.267***	-0.018	0.192	0.87
	(-1.32)	(-7.82)	(28.46)	(-0.40)	(0.91)	
UK 5y	0.002	0.034	0.965***	-0.001	-0.688***	0.66

	(0.54)	(0.92)	(11.69)	(-0.03)	(-2.93)	

PANEL D: Commodities

	α	MSCI	DEBT	COMM	NMK	Adj. R2
Livestock	-0.004	0.129	-0.191*	0.588***	-1.155***	0.21
	(-0.67)	(1.50)	(-1.88)	(4.57)	(-2.72)	
Precious Metals	-0.010	0.083	0.274***	0.396***	0.877**	0.21
	(-1.58)	(1.26)	(2.96)	(3.68)	(2.09)	
Energy Index	0.003	-0.517**	-0.237	2.569***	-0.007	0.61
	(0.18)	(-2.17)	(-0.68)	(6.52)	(-0.01)	
Industrial Metals	0.003	-0.061	0.368	1.328***	1.455***	0.32
	(0.27)	(-0.24)	(0.96)	(4.38)	(2.65)	
NAREIT	0.008	0.366***	-0.213*	0.119	-1.169**	0.20
	(1.02)	(4.50)	(-1.70)	(0.75)	(-2.40)	

MSCI is the excess return of the MSCI global index. DEBT and COMM refer to excess returns of a debt and commodity index respectively. The indexes are equally weighted portfolios of the debt instruments and commodities in our sample. NMK is the residual from a regression of the excess return of the WMP on the excess returns of MSCI, DEBT and COMM. It represents information contained in the WMP which is not included in any of the three indexes of tradable assets. The estimation period is 1985 quarter 2 to 2007 quarter 4. Figures in parentheses are t-ratios. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ***, ** and * indicate significance at the 1%, 5% and 10% level respectively.

Table 10. Asset pricing regressions for international portfolios sorted on book-to-market, P/E, cash earning to price and dividend yield

Panel A	HBM	LBM	HPE	LPE	HCEP	LCEP	HDY	LDY	ZDY
C	0.028**	0.012	0.011	0.026**	0.027**	0.010	0.026**	0.012	0.021*
	(3.81)	(1.63)	(1.52)	(4.01)	(3.86)	(1.31)	(3.68)	(1.54)	(1.92)
WMP	0.988**	1.203**	1.139**	0.972**	1.063**	1.124**	1.205**	1.174**	0.987**
	(3.32)	(4.36)	(4.30)	(3.41)	(3.50)	(4.07)	(4.15)	(4.25)	(2.69)
R^2 adj	0.11	0.18	0.16	0.12	0.14	0.16	0.18	0.16	0.07

Panel B	HBM	LBM	HPE	LPE	HCEP	LCEP	HDY	LDY	ZDY
C	0.029**	0.013	0.011	0.027**	0.027**	0.010	0.026**	0.020*	0.012
	(3.68)	(1.55)	(1.45)	(3.80)	(3.72)	(1.25)	(3.49)	(1.78)	(1.49)
WMP	0.817*	1.07**	1.058**	0.830**	1.082**	1.066**	0.991**	1.349**	0.999*
	(1.80)	(2.10)	(2.00)	(2.05)	(2.49)	(1.99)	(2.31)	(1.99)	(1.86)
COM	-0.013	0.030	0.075	0.017	0.147	0.093	-0.077	0.488	0.013
	(-0.03)	(0.07)	(0.16)	(0.05)	(0.40)	(0.21)	(-0.21)	(0.84)	(0.027)
RES	-4.975**	-5.259**	-5.184**	-5.113**	-4.526**	-5.075**	-4.134**	-5.517**	-6.029**
	(-2.74)	(-3.07)	(-3.02)	(-3.05	(-2.57)	(-2.81)	(-2.27)	(-2.46)	(-3.44)
R^2 adj	0.14	0.22	0.20	0.16	0.17	0.20	0.20	0.10	0.21

The estimation period is 1975 quarter 1 to 2007 quarter 4 and we use quarterly returns. The dependent variables are excess returns of international portfolios which consist of high book-to-market stocks (HMB), low book-to-market stocks (LBM), high P/E stocks (HPE), low P/E/ stocks (LPE), high cash earnings to price stocks (HCEP), low cash earnings to price stocks (LCEP), high dividend yield stocks (HDY), low dividend yield stocks (LDY) and zero dividend yield stocks (ZDY). The portfolio returns and construction details are available in K. French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The risk free rate used is the rate on the 3-month U.S. Treasury bill. The independent variables are the excess return of the world market portfolio proxy (WMP), and two exchange rate indexes as proposed by Vassalou (2000). The indexes are constructed using the exchange rates of the countries whose stocks are included in the international portfolios. One index captures common changes in exchange rates (COM) and one captures individual changes in the exchange rates against the U.S. dollar (RES). c is a constant. Figures in parentheses are t-statistics. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ** and * indicate significance at the 5% and 10% level respectively.

Table 11. Asset pricing regressions for international portfolio sorted on book-to-market, P/E, cash earning to price and dividend yield

	HBM	LBM	HEP	LEP	HCEP	LCEP	HDY	LDY	ZDY
C	0.030**	0.013*	0.013	0.028**	0.029**	0.011	0.027**	0.013	0.022*
	(3.16)	(1.65)	(1.56)	(3.82)	(3.57)	(1.34)	(3.47)	(1.58)	(1.90)
World	0.542	0.852**	0.782**	0.548	0.581*	0.753**	0.665*	0.818**	0.731
GDP	(1.52)	(2.15)	(2.05)	(1.55)	(1.69)	(2.06)	(1.65)	(2.06)	(1.44)
growth									
R^2 adj.	0.01	0.05	0.04	0.02	0.02	0.04	0.03	0.04	0.02

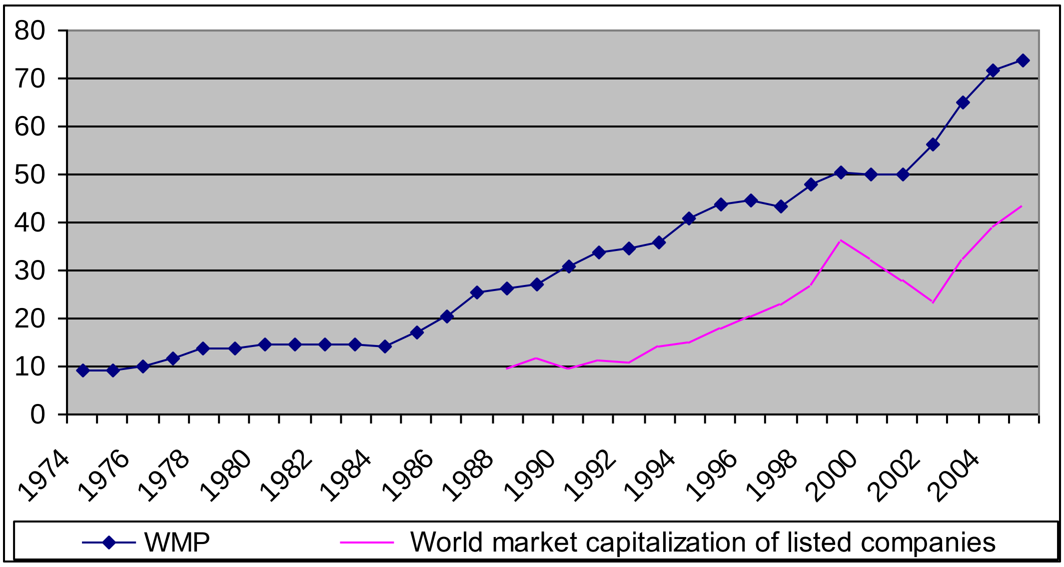
The estimation period is 1975 quarter 1 to 2007 quarter 4 and we use quarterly returns. The dependent variables are excess returns of international portfolios which consist of high book-to-market stocks (HMB), low book-to-market stocks (LBM), high P/E stocks (HPE), low P/E/ stocks (LPE), high cash earnings to price stocks (HCEP), low cash earnings to price stocks (LCEP), high dividend yield stocks (HDY), low dividend yield stocks (LDY) and zero dividend yield stocks (ZDY). The portfolio returns and construction details are available in K. French's website at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html. The independent variable is the change in GDP minus the risk free rate. The risk free rate used is the rate on the 3-month U.S. Treasury bill. c is a constant. Figures in parentheses are t-statistics. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ** and * indicate significance at the 5% and 10% level respectively.

Table 12. The world market portfolio and future economic growth.

	Dependent variable: World GDP growth rate$_{t+4}$		
C	0.0014	0.0009	0.0009
	(0.52)	(0.27)	(0.13)
WMP	0.220**		0.204**
	(3.17)		(2.98)
MSCI		0.050*	0.027
		(1.68)	(1.02)
R^2 adj	0.08	0.02	0.07

The estimation period is 1975 quarter 1 to 2007 quarter 4 and we use quarterly returns. The dependent variable is log changes of the world GDP four quarters ahead minus the U.S. risk free rate. The independent variables are the excess returns on the world market portfolio proxy (WMP) and the excess returns on the global MSCI. The risk free rate used is the rate on the 3-month U.S. Treasury bill. c is the constant. Figures in parentheses are t-statistics. Standard errors have been adjusted for heteroscedasticity and serial correlation using the Newey-West estimator. ** and * indicate significance at the 5% and 10% level respectively.

Figure 1. The WMP and world market capitalization of listed companies in trillions of US$.



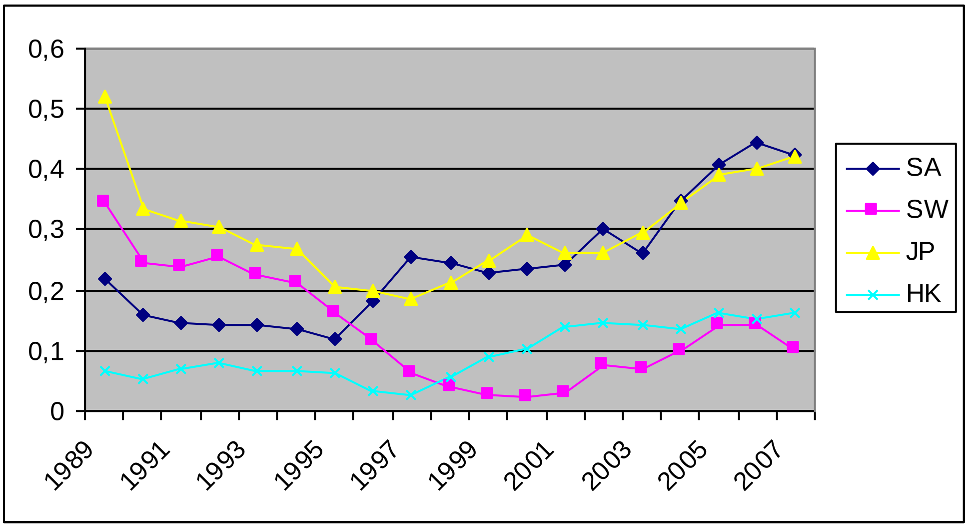


Figure 2. R^2s from rolling regressions each using 60 quarterly observations of excess stock index returns as the dependent variable and the excess return of WMP and two FX indices as the independent variables. The risk free rate used is the rate on the 3-month U.S. Treasury bill. The horizontal axis reports the end of each estimation period. The countries are Japan (JP), Hong Kong (HK), South Africa (SA) and Switzerland (SW)