

# Determinants of Stock Prices: *New International Evidence*

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Insight into the determination of stock prices is of great importance for forecasting future stock price movements and therefore widely analyzed. This article presents new empirical evidence on the determinants of stock prices at the total market index level in a dozen countries. In line with the present-value pricing relationship for stock prices, not only are earnings and a risk-free interest rate considered as fundamental determinants, but also as a proxy for the time-varying equity risk premium. Inspired by Mills [1991], and Harasty and Roulet [2000], I estimate, in two steps, error-correction models of stock prices.

The first step is to estimate a long-run equilibrium “fair” fundamental value of stock prices on the basis of earnings, a risk-free interest rate, and a structural or long-run equity risk premium. The last is approximated by the one-period lagged five-year rolling earnings yield premium. The earnings yield premium refers to the spread between the reported earnings yields and the ex post real 10-year government bond yield. A five-year moving average of the earnings yield premium is long enough to eliminate the possibility that speculative movements in the risk premium determine the equilibrium value of the risk premium and, therefore, the fair value of stock prices. At the same time, it is short enough to capture a possible structural break in its long-term equilibrium value. Developments in this proxy for the risk premium show that the risk premium

cannot be assumed to be constant over time, as is the case in other studies. The regression results indicate that the long-run equity risk premium is an important determinant of stock prices.

The second step models short-run stock price movements around their estimated long-run fair value and the changes in the fundamental factors. In the short run, stock prices can and do diverge, sometimes for quite long periods of time (on average, for as long as four years) from their long-run fair value. In addition, nonfundamental factors might play a role in the short-run determination of stock prices. In principle, any variables that do not enter the present value theory, but are supposed to determine stock prices, can be evaluated. I consider the exchange rate, commodity prices, momentum, and seasonality as potential short-run stock price determinants.

The validity of the stock price model is further tested by examining its forecasting properties and its potential use of exploiting profitable trading strategies. Its forecasting errors are found to be substantially lower than applying a *no-change* model. In other words, the model presented clearly beats a random walk model. Admittedly, this is due in large part to the contemporaneous change in the earnings yield premium as a proxy for the change in the short-run equity risk premium.

By contrast, two types of investment strategies illustrate the real-time capacity of the long-run stock price model to generate

excess returns. The first investment strategy shows that for the dot-com bubble the model is able to select ex ante countries to over- and underweight in a global equity portfolio. The second investment strategy helps in the asset allocation between cash and equity and is applied over the last decade of the sample period in the U.K., U.S., Japan, and Germany. In all four major economies, a buy and sell trading rule, based solely on a consistent significant stock market under- or overvaluation according to the long-run fair stock price model, clearly outperforms a buy and hold strategy.

## STOCK PRICE MODEL

According to the dividend discount model, stock prices,  $P$ , should equal the net present value of dividends distributed to shareholders. The discount rate at which shareholders value future dividend streams consists of the interest rate on safe government bonds,  $rf$ , and a risk premium,  $rp$ , that shareholders require for accepting uncertain equity returns. Corporations typically divide their profits, paying a portion as dividends to shareholders, while retaining the remainder for investment. Given an annual dividend of  $D$ , which shareholders expect to grow annually at rate  $g$ , the steady-state price of an equity should be the following:<sup>1</sup>

$$P_t = D_t (1 + g) / (rf_t + rp_t - g) \quad (1)$$

As seen in Equation (1), stock prices, in the long run, depend upon unobservable variables, such as the expected future growth in dividends and the equity risk premium. Nevertheless, the present value approach suggests that stock prices might be empirically modeled by linking them to 1) observed dividends, 2) the long-term interest rate as a proxy for the risk-free interest rate, and 3) a proxy for the equity risk premium. In line with previous studies, dividends are replaced by earnings,  $E$ , because earnings eventually underlie dividends. MacDonald and Power [1995], among others, argued that dividends alone may not provide investors with a sufficient signal about a firm's future growth prospects. Dividend payments might be distorted by dividend pay-out, share buyback, and tax policies. The long-run risk premium is approximated by the one-period lagged five-year rolling earnings yield premium. The constant captures the unobservable variables and measurement errors in the observable variables,

$$\log P_t = \alpha_1 + \beta_1 \log E_t + \gamma_1 rf_t + \delta_1 rp_t + \varepsilon_{1,t} \quad (2)$$

The residual,  $\varepsilon$ , denotes the deviation from the long-run equilibrium relation between stock prices and their fundamental determinants. The subscript 1 refers to the coefficients and residual estimated in the first step.

In this model, if an equilibrium relationship does hold, any deviation from the long-run equilibrium should trigger appropriate adjustment in some or all of the variables to correct this "error" over time. For instance, if stock prices do the adjusting after a deviation emerges from long-run equilibrium, then the coefficient  $\lambda$  in Equation (3) should be statistically significant with a negative sign:

$$\Delta \log(P_t) = \alpha_2 + \beta_2 \Delta \log(E_t) + \gamma_2 \Delta rf_t + \delta_2 \Delta rp_t + \lambda_2 \varepsilon_{1,t-1} + \mu_{2,t} \quad (3)$$

The subscript 2 refers to the coefficients and the residual,  $\mu$ , estimated in the second step.

In the short-run, the change in the risk premium is approximated by the contemporaneous change in the earnings yield premium. Besides the changes in the fundamentals, other variables can be included in the short-run dynamics. I consider the exchange rate,  $er$ , a commodity price index,  $comm$ .; momentum effects,  $momentum$ ; and seasonality,  $bad\ season$ . In addition, the lagged monthly change in stock prices captures a very simple momentum rule which states that the previous monthly stock market return helps to predict the current one. For instance, Harasty and Roulet [2000] showed that stock markets might be influenced by the U.S. dollar. In the same vein, commodity prices might affect stock markets beyond their impact on corporate earnings. Momentum investors try to exploit "the trend is your friend" phenomenon. They buy stocks that were past winners while selling the losers (Rouwenhorst [1998]; Jegadeesh and Titman [2001], and Kwon and Kish [2002]). Seasonality might play a role as known by the market saying "sell in May and go away, but remember to come back in September" (De Bondt and Thaler [1987]; Bouman and Jakobsen [2002], and Keppler and Hong Xue [2003]).

The previously described research ends in the following fully fledged stock price model:

$$\begin{aligned} \Delta \log P_t = & \alpha_2 + \beta_2 \Delta \log E_t + \gamma_2 \Delta rf_t + \delta_2 \Delta rp_t \\ & + \lambda_2 \varepsilon_{1,t-1} + \phi_1^1 \Delta \log er_t + \phi_2^2 \Delta \log comm_t \\ & + \phi_3^3 momentum_t / 100 + \phi_4^4 \Delta \log P_{t-1} \\ & + \phi_5^5 bad\ season_t / 100 + \mu_{2,t} \end{aligned} \quad (4)$$

## DATA SPECIFICATION

The stock price model determinants are specified as follows.

Earnings refer to reported, rather than expected, earnings because the former are unbiased and available long backward. The risk-free interest rate is defined as the 10-year government bond yield. The earnings yield (i.e., the reciprocal of the price-to-earnings (PE) ratio) is commonly viewed as a reasonable proxy for the real expected return to equity (European Central Bank [2005], and Siegel [2005]). As earlier described, the long- and short-run equity risk premia are approximated by the one-period lagged five-year rolling and contemporaneous earnings yield premium, respectively. The earnings yield premium is defined as the spread between the earnings yield and the ex post real interest rate. The latter is calculated as the nominal 10-year government bond yield minus the annual consumer price index (CPI) inflation.

The exchange rate is the U.S. dollar per the respective national currency. For the U.S., it is the trade-weighted exchange rate. Commodity prices are measured by the Commodity Research Bureau (CRB) commodity index. Momentum effects are captured by a dummy, which takes the value one when the one-period lagged stock price is higher than both the three- and five-month moving averages of the stock price, and zero otherwise. This dummy reflects moving average lines for two different horizons as typically shown in technical analyses. The bad season dummy variable takes the value one from June to September, and zero otherwise.

The end-of-month stock price index and earnings data are from Thomson Financial Datastream. The data source for the other variables is Global Financial Data.<sup>2</sup> The effective sample period begins in January 1978 and ends in September 2005 for twelve major countries: Australia (AU), Belgium (BG), Canada (CN), Germany (DE), Denmark (DK), France (FR), Japan (JP), Netherlands (NL), Austria (OE), Switzerland (SW), the United Kingdom (UK), and the United States (US).

Exhibit 1 plots the long-run equity risk premium. It illustrates the importance of considering a time-varying risk premium as a fundamental determinant of stock prices and suggests there is little reason to smooth the earnings yield premium beyond a five-year moving average. The charts show double-digit structural equity risk premia in the early part of the sample period in many countries and much lower levels in the second part (Siegel [1999], and

Lettau, Ludvigson, and Wachter [2004]). In the most recent two decades, however, the levels of the country-average structural equity risk premia have varied between 1% and 3%, with a significantly higher average earnings yield premium in the U.K. (5%) and a lower one in Japan (-1%). The latter is mainly related to the prolonged low earnings yield and deflation in Japan.

## ESTIMATION RESULTS

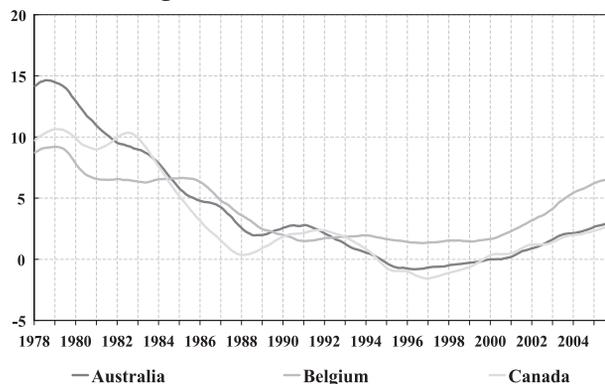
The results are based on a conventional univariate two-step estimation approach (Engle and Granger, [1987]).<sup>3</sup> First, I estimate the long-run relation by ordinary least squares (OLS) and, second, the short-run dynamics by maximum likelihood estimates using the Marquardt optimization algorithm and assuming first-order ARCH and GARCH terms. The main finding is that the risk premium is indeed an important determinant of stock prices.

Exhibit 2 presents the estimates of Equations (2) and (3). Four observations emerge from the exhibit.

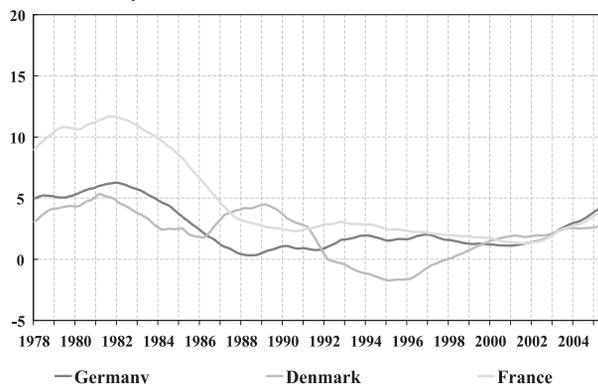
1. In all cases, the proxy for the equity risk premium is a significant short- and long-run determinant of stock prices. The estimated long-run risk premium semi-elasticities vary between around -2.5 in Denmark and France to around -12 in Japan and Switzerland. A 100-basis point (bp) rise in the long-run risk premium ultimately results in up to 12% lower stock prices. The estimated levels of the long-run interest rate semi-elasticities, excluding the insignificant result for Austria, vary in a similar range (-3 to -11) and are somewhat lower than the range between -4 and -17 as reported by Harasty and Roulet [2000]. In the long run, a 100 bp increase in both risk-free interest rates and the equity risk premium results in 8% to 18% lower stock prices, Austria excluded. In the short run, the risk premium coefficient in all countries is found to be similar or lower than the risk-free interest rate coefficient.
2. The earnings elasticity is estimated to be close to unity in the long run in all countries except Japan, where it is much lower in the short run. In the long run, a 1% rise in earnings results more or less in a 1% increase in the fair stock price value. This implies that the PE ratio is broadly stable in the long run, controlling for the interest rate and risk premium. It

## EXHIBIT 1 Long-Run Equity Risk Premium

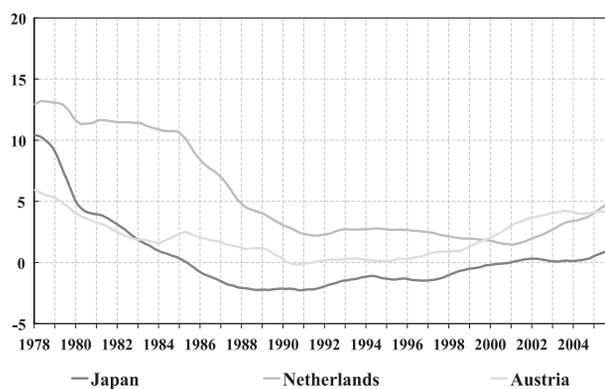
*Australia, Belgium, and Canada*



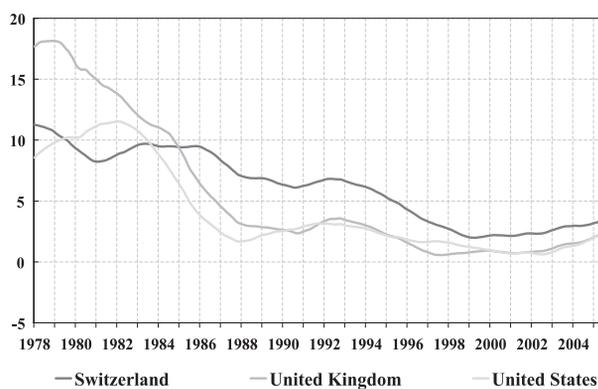
*Germany, Denmark, and France*



*Japan, Netherlands, and Austria*



*Switzerland, U.K., and U.S.*



Note: The long-run equity risk premium is calculated as the 1-month lagged 5-year rolling average of the spread between the reported earnings yield and the nominal 10-year government bond yield minus annual CPI inflation.

also suggests that reported earnings are an appropriate proxy for expected earnings, at least in the long run. The estimated short-run earnings elasticities are in all cases below the long-run levels. This finding can be viewed as supporting the underreaction of stock prices to earnings news. Stock prices tend to underreact to news over horizons of 1 to 12 months (Barberis, Shleifer, and Vishny [1998]).

3. The coefficient of the reversion force, albeit low, differs significantly from zero in most countries. In those countries, the stock market corrects each month between 2% and 10% of the previous month's valuation gap. This implies roughly an average time span of between one and four years for a reversion to the long-run fair fundamental stock price value. This time span is in line with evidence that, over horizons of three to five years, stock prices

tend to overreact to consistent patterns of news which point in the same direction (Barberis, Shleifer, and Vishny [1998]). That is, stock prices with a long record of good news receive (extremely) high valuations and return to the mean afterwards. The estimated reversion forces are overall slower than those reported by Harasty and Roulet [2000]. This difference is most likely related to a different sample period. Estimates for a similar sample period, from January 1990 to April 1998, show a reversion force coefficient for Australia, Japan, and the U.K. of as much as about  $-0.2$ , and for all countries, on average, a seven percentage point quicker correction.

4. The explanatory power of the estimated model, despite its simplicity, is quite satisfactory. Between 35% and 70% of the variance in the monthly stock market return is explained by earnings, the risk-free

## EXHIBIT 2

### Fundamental Stock Price Determinants

Country	Equation (2): Long-run determinants			Equation (3): Short-run determinants					
	Earnings	Risk-free rate	Risk premium	Reversion force	Earnings	Risk-free rate	Risk premium	R <sup>2</sup>	R <sup>2</sup> with no premium
AU	0.82***	-6.04***	-5.52***	-0.10***	0.34***	-5.53***	-3.32***	0.37	0.09
BG	0.62***	-10.5***	-7.72***	-0.02	0.47***	-7.10***	-5.83***	0.54	0.06
CN	0.68***	-8.02***	-4.60***	-0.03***	0.36***	-6.67***	-4.41***	0.41	0.09
DE	0.82***	-4.33***	-9.22***	-0.02**	0.48***	-6.72***	-6.39***	0.42	0.00
DK	0.70***	-8.93***	-2.94***	-0.01	0.30***	-6.05***	-3.70***	0.35	0.12
FR	0.96***	-5.75***	-2.19***	-0.02	0.71***	-7.73***	-7.45***	0.69	0.05
JP	0.36***	-4.50***	-12.8***	-0.01	0.13*	-2.51***	-2.39***	0.08	0.00
NL	0.84***	-9.39***	-7.60***	-0.02*	0.65***	-6.39***	-5.37***	0.47	0.00
OE	0.96***	1.42	-5.08***	0.01	0.36***	-5.68***	-5.17***	0.38	0.00
SW	0.87***	-3.25**	-11.5***	-0.02***	0.55***	-6.71***	-5.54***	0.43	0.01
UK	0.56***	-8.35***	-5.85***	-0.06***	0.36***	-6.73***	-3.95***	0.41	0.10
US	1.29***	-3.44***	-4.37***	-0.03***	0.63***	-6.41***	-5.37***	0.43	0.05

\*, \*\*, and \*\*\* denote significance at the 1%, 5%, and 10% levels, respectively.

Note: Estimates of Equation (2) with the log of the stock price index as dependent variable. Estimates of Equation (3) with the change in the log of the stock price index as dependent variable. The sample period is January 1978–September 2005. R<sup>2</sup> refers to the adjusted R<sup>2</sup>. The exhibit does not report the constant and first-order (G)ARCH terms.

interest rate, and the risk premium. The only exception is Japan with an adjusted R<sup>2</sup> of only 0.08. This country is likely difficult to model given that it experienced a prolonged period of a negative risk premium and an exceptional stock market bubble. The last column in Exhibit 2 shows that the adjusted R<sup>2</sup> of a stock price model without a risk premium, as previously calculated, rarely explains monthly stock market returns. The equity risk premium appears to have high value added. Bear in mind, however, that the high explanatory power is largely due to the contemporaneous change in the short-run equity risk premium which, in turn, largely depends on the contemporaneous change in stock prices.

It could therefore be wise to focus on the long-run fair value of the stock market. Exhibit 3 plots the stock market valuation gap, defined as the percentage deviation of the actual outcome of the stock price from the estimated long-run fair stock price value. The charts show that actual stock prices may deviate strongly, by more than plus or minus 20%, from their long-run fair value for

longer periods. Strong percentage deviations from the fair value, if they are protracted, could reflect the detachment of stock prices from underlying fundamentals. A caveat is that these deviations could either simply reflect temporary deviations of earnings growth or the discount factor from their long-run equilibrium levels or structural changes in the relation between stock prices and their long-run fundamentals. Moreover, it is important to bear in mind that any sign of under- or overvaluation is based on the sample average.

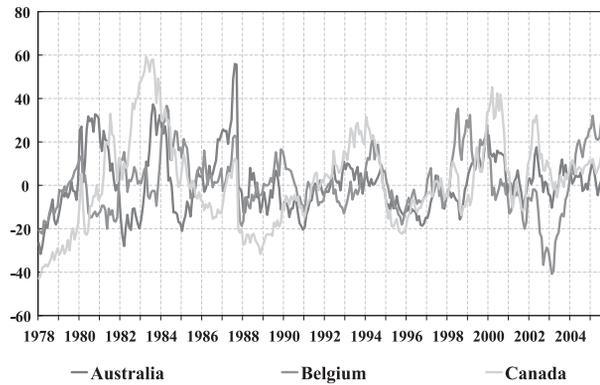
Exhibit 4 presents the estimates of Equation (4). The main finding is that in addition to earnings and the discount rate other factors also determine stock prices in the short run.

In more detail, the exchange rate is a significant short-run stock price determinant in all countries except the U.S. A 10% appreciation of the U.S. dollar vis-à-vis the national currency causes, ceteris paribus, a rise in stock prices in continental Europe by 1% to 4%. It causes a decline of about 2% in Japan and the U.K., and 6% in Canada. In all countries except Austria, the short-run commodity price elasticity is significantly different from

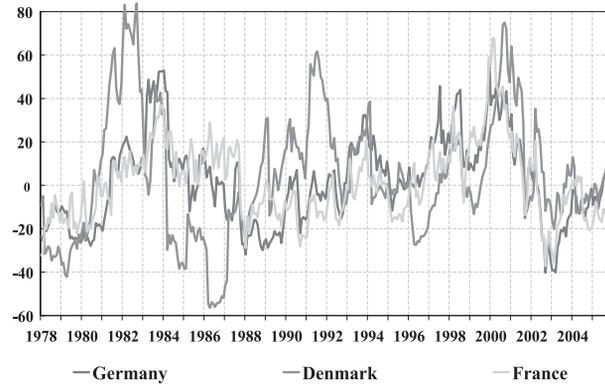
## EXHIBIT 3

### Long-Run Fair Stock Market Valuation Gap (%)

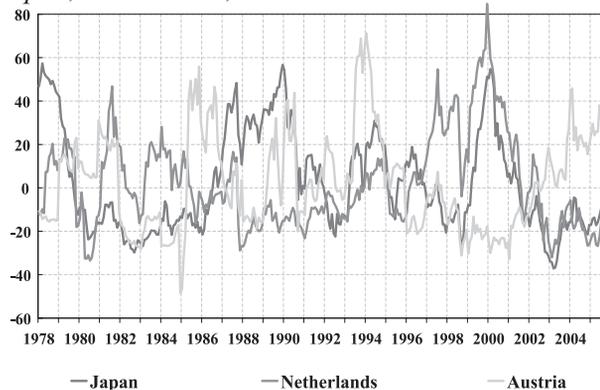
#### *Australia, Belgium, and Canada*



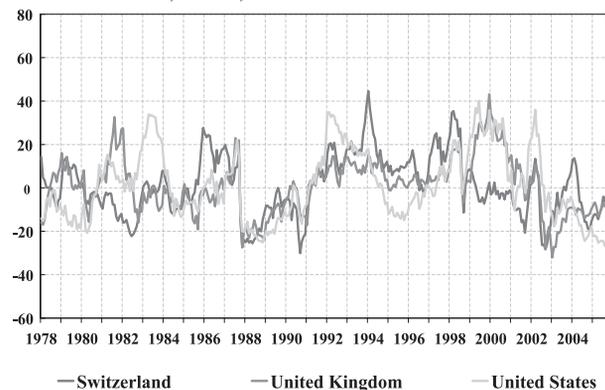
#### *Germany, Denmark, and France*



#### *Japan, Netherlands, and Austria*



#### *Switzerland, U.K., and U.S.*



Note: The long-run fair stock market valuation gap is calculated as the percentage deviation of the actual stock price index from its fair value according to Equation (2) estimated over the period January 1978–September 2005.

zero. A 10% increase in commodity prices results in 3% higher stock prices in Canada and up to 2% in the other countries. Significant momentum effects are found for five countries. In these five countries, a stock price index which was in the preceding month above its three- and five-month moving averages causes an additional stock market return of about 1%. The lagged monthly stock market return is statistically significant in Canada and Austria. In both countries, the stock market return of the previous month explains the current one by about 10%. In all countries, the monthly stock market return is 0.1% to 1% lower in the bad season (June to September). These seasonal effects are significantly different from zero in the Netherlands, U.K., U.S., Switzerland, and Canada. The addition of the variables not related to the dividend discount model increases the adjusted  $R^2$  by up to nine percentage points.

## FORECASTING

An out-of-sample exercise shows that the model, despite its simplicity, beats a random walk model. This finding, however, extensively attributes to the inclusion of the contemporaneous change in the earnings yield premium as a proxy for the short-run risk premium.

Exhibit 5 presents forecast statistics of a sequence of one-month-ahead dynamically forecasted monthly stock market returns from January 2003 to September 2005 according to Equation (4) estimated up to December 2002. The statistics are calculated on the basis of the actual outcomes of the stock price determinants. Three observations emerge from the exhibit.

1. The root mean squared forecast error (MSE) varies between 2.3% and 3.0%, with higher forecast errors

## EXHIBIT 4

### Short-Run Stock Price Determinants

Country	Reversion force	Earnings	Risk-free rate	Risk premium	Exchange rate	Commodities	Momentum	Lagged return	Bad season	R <sup>2</sup>
AU	-0.09***	0.30***	-5.25***	-3.10***	0.13*	0.13**	1.02**	-0.06	-0.50	0.37
BG	-0.01	0.44***	-7.21***	-5.74***	0.18***	0.22***	0.25	0.00	-0.40	0.56
CN	-0.03***	0.32***	-6.09***	-4.03***	-0.58***	0.29***	0.62*	0.07*	-0.60*	0.50
DE	-0.03**	0.48***	-7.49***	-6.41***	0.23***	0.12*	0.01	0.02	-0.15	0.44
DK	-0.01*	0.26***	-5.91***	-3.33***	0.37***	0.17**	1.05**	-0.02	-0.14	0.41
FR	-0.02**	0.68***	-7.81***	-7.27***	0.10**	0.17***	0.80**	-0.02	-0.52	0.70
JP	-0.02**	0.12**	-1.77**	-2.07***	-0.13**	0.21***	0.58	0.07	-0.52	0.11
NL	-0.01	0.58***	-6.64***	-4.87***	0.19***	0.16***	-0.48	0.03	-0.69**	0.50
OE	0.00	0.34***	-6.08***	-4.97***	0.14**	0.06	0.35	0.13**	-0.58	0.41
SW	-0.02	0.47***	-6.86***	-4.93***	0.17***	0.19***	0.77*	-0.05	-1.00***	0.46
UK	-0.06***	0.32***	-6.95***	-3.72***	-0.21***	0.12*	0.14	-0.07	-0.66*	0.42
US	-0.03***	0.64***	-6.61***	-5.29***	0.04	0.13**	-0.44	0.02	-0.57*	0.44

\*, \*\*, and \*\*\*, denote significance at the 1%, 5%, and 10% levels, respectively.

Note: Estimates of Equation (4) with the change in the log of the stock price index as dependent variable. The sample period is January 1978–September 2005. R<sup>2</sup> refers to the adjusted R<sup>2</sup>. The exhibit does not report the constant and first-order (G)ARCH terms.

of around 3.7% for Denmark and Japan. This is very satisfactory, especially compared to the root MSE of between 3% and 4% for monthly stock market returns as reported by Harasty and Roulet [2000].

2. Theil's inequality coefficient (U) compares the out-of-sample forecasting accuracy of the presented stock price model with a no-change model which can be interpreted as a random walk model. This statistic is the ratio between the root MSE of the full model and a no-change model. Theil's U will have a value of one if the full model performs as well as the no-change model in terms of the MSE and lower than one if it performs better. Studies have shown that, in practice, values of around 0.55 or less are very good. In all countries except Japan, Theil's U is found to be lower than 0.55. The lowest value of 0.31 is found for France, the country with the highest in-sample R<sup>2</sup>.
3. As developed by Theil [1966], the MSE can be decomposed into three components, each addressing a different aspect of forecast accuracy. The bias or mean proportion (U<sub>M</sub>) describes how far the mean of the forecast is from the mean of the actual series. The variance or regression proportion (U<sub>R</sub>) shows

how far the variation of the forecast is from the variation of the actual series. The covariance or disturbance proportion (U<sub>D</sub>) measures the remaining unsystematic forecasting errors. The most desirable decomposition is U<sub>M</sub> = 0%, U<sub>R</sub> = 0%, and U<sub>D</sub> = 1%. In practice, we expect U<sub>M</sub> and U<sub>R</sub> to be close to 0% and U<sub>D</sub> to be close to 1%. For six countries the covariance proportions range between 84% and 99%, which is very satisfactory. For the other countries, the variance proportion is high or, in the case of Austria, the bias proportion is alarming. The comparatively very poor forecasting performance of Austria does not necessarily reflect poor model performance. It could be that the Austrian stock market was overvalued, according to the considered fundamentals, in the forecast period, as suggested by the very high in-sample long-run stock market valuation gap shown in Exhibit 3.

Other than potential distortions from misaligned stock prices, bear in mind that exploiting forecasting accuracy in practice is rather difficult. The values for the stock price determinants are hard to predict, particularly the change in the short-run equity risk premium, given

## EXHIBIT 5

### Out-of-Sample Forecast Statistics of Monthly Stock Market Returns

Country	Root MSE	Theil's U	Proportion of MSE in %		
			Bias	Variance	Covariance
Australia	2.3	0.54	4.2	12.0	83.8
Belgium	2.9	0.36	8.6	0.1	91.3
Canada	2.7	0.42	1.3	7.4	91.3
Germany	2.7	0.37	3.0	32.2	64.8
Denmark	3.6	0.49	4.8	45.6	49.6
France	2.3	0.31	0.7	0.1	99.2
Japan	3.8	0.65	0.5	51.7	47.8
Netherlands	2.8	0.42	3.2	30.3	66.5
Austria	3.0	0.52	49.7	7.7	42.6
Switzerland	2.6	0.42	0.0	10.8	89.2
United Kingdom	2.8	0.53	3.4	35.1	61.5
United States	2.8	0.46	2.2	0.5	97.3

*Note:* The results are based on 33 one-month ahead dynamically forecasted monthly stock market returns over the period January 2003–September 2005 according to Equation (4) estimated over January 1978–December 2002, using the actual outcomes of the stock price determinants. MSE refers to mean squared forecast error.

that it depends on the change in the stock price itself. It is possible, however, to design different macroeconomic scenarios, such as earnings growth that follows the short- and long-term earnings per share growth forecasts by brokers, a 10-year government bond yield in line with consensus forecasts, and the structural equity risk premium going to its historical average or another plausible value.

#### INVESTMENT STRATEGIES

A useful real-time application of the stock price model is closely monitoring the long-run fair stock market value in order to detect misaligned stock prices which will, sooner or later, correct. Two investment strategies illustrate that the long-run stock price model can generate excess returns. The first investment strategy examines the dot-com bubble and shows that the long-run stock price model is indeed able to detect, on an ex ante basis, comparatively overvalued stock markets across countries. The second investment strategy analyzes when to be in or out of stocks in the four major economies considered for the most recent decade of the sample period. In all four cases, a buy and sell trading rule—solely based on a consistent significant stock market under- or overvaluation according

to the long-run fair stock price model—clearly outperforms a buy and hold strategy.

#### Strategy One: Country Selection

The evaluation date for assessing the stock price misalignment is March 2000, the peak in the U.S. and euro-area equity markets. The long-run fair stock market valuation gap, as plotted in Exhibit 3 for the total sample period, is first calculated for a sample up to February 2000. This is done because of a reporting lag in CPI of up to two months and the fact that the one-month lagged CPI is used for the long-run equity risk premium. To ensure stock market overvaluation is captured and not an outlier, the long-run fair stock market valuation gap is also calculated for a sample to January 2000 and another to December 1999. The latest observation of the fair stock market valuation gap (in percent) for the three sample periods is then averaged. On the basis of these three-month averages, the 12 countries are split into three groups: 3 countries with fairly valued stock markets, 6 countries with overvalued stock markets, and 3 countries with strongly overvalued stock markets.

Exhibit 6 plots the realized stock market return of the three groups of countries in March 2000 for 3 to 48

months ahead using an equal weight of one-third or one-sixth for all countries within the groups.<sup>4</sup> It shows that the group of countries with fairly valued stock markets significantly outperformed countries with strongly overvalued stock markets for an investment horizon of six months or longer. This finding suggests that a potentially useful application of the long-run stock price model would be to help in the investment decision of which countries to over- and underweight in a global equity portfolio or in a long/short equity (market neutral) investment strategy across a group of countries.

### Strategy Two: Asset Allocation

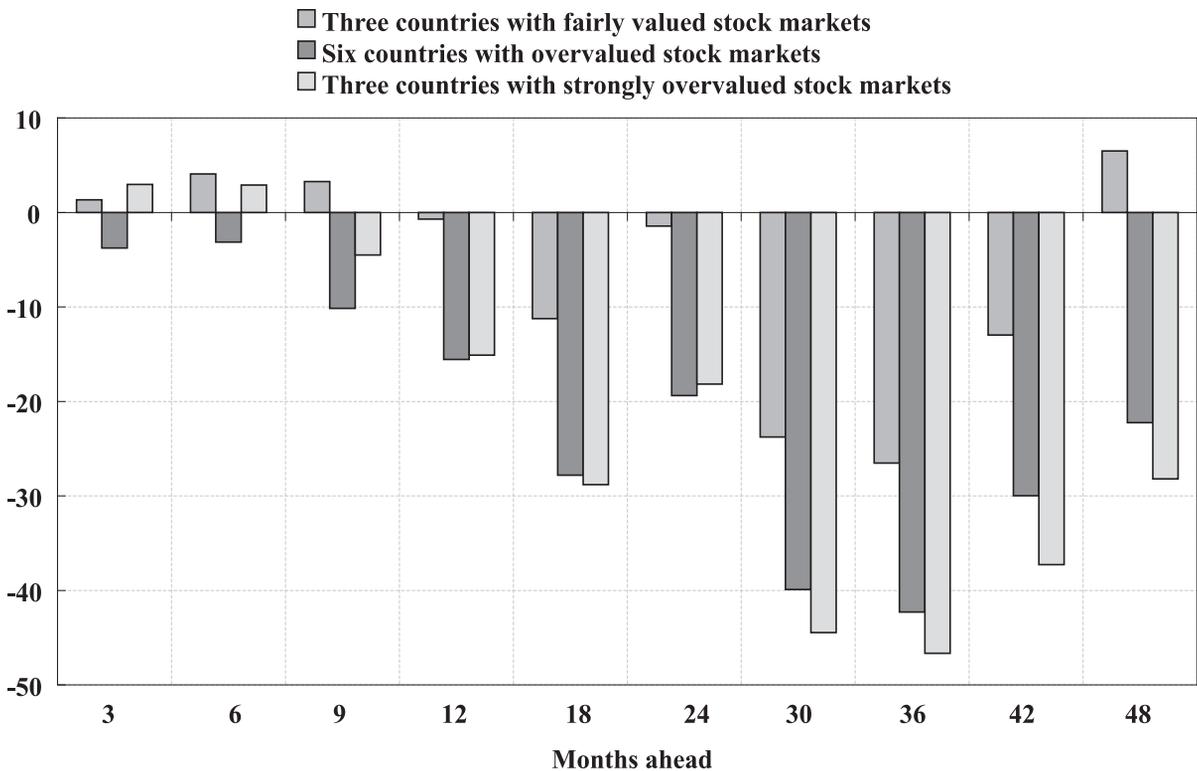
This investment strategy buys or sells the stock price index when the long-run stock price model indicates out of sample a significant stock market under- or overvaluation for three consecutive months. A significant fair stock price misalignment is defined as the latest (i.e., the

endpoint of the period considered) realized stock price outside the estimated standard errors of regression bounds of Equation (2). The buy and sell signals are based on a significant long-run stock price misalignment three times in a row to ensure that the level of the stock price is misaligned from its long-run fair value and not a one-off misalignment. They also take into account the CPI reporting lag (i.e., the buying or selling takes place one month later than discovered).

Exhibit 7 compares this buy and sell strategy with a buy and hold strategy (defined as fully invested at all times in the stock price index) for the four largest countries considered over the last decade. The beginning of the periods examined is always January 1978 and the ending rolls from September 1995 to September 2005. The exhibit also plots the buy and sell strategy as being reinvested in money market instruments when not invested in stocks. It is assumed that the investment in the money market earns the total return of Treasury bills. In all cases,

## EXHIBIT 6

**Future Stock Market Returns (March 2000) of Fairly Valued, Overvalued, and Strongly Overvalued Country Groups (%)**



*Note: The grouping of countries is based on the ranking of the three-month average fair stock market overvaluation gap in percent at the latest sample observation according to estimates of Equation (2) with a sample starting in January 1978 and ending in December 1999, January 2000, or February 2000. The future stock market returns are unweighted cross-country averages.*

the charts show a clear outperformance of the buy and sell strategy. For Japan, the difference between the returns with or without a reinvestment in the money market is minimal, given the very low money market returns. Taking into account the possibility of a reinvestment in the money market, the cumulative returns above the stock price index over the last decade of the sample period were 66% for Japan and between 102% and 185% for the other three countries.

Noteworthy is that a trading rule based on selling stocks when PE ratios go above a certain critical value does not reliably time the stock market in the same four countries (Fisher and Statman [2006]). Trading rules based on PE ratios have been successful in one market, but not always in others. The potential strength of the second

investment strategy, therefore, is that it has been successful in all major developed stock markets. This success most likely relates to the fact that the investment strategy is based on three consecutive months of a statistically significant long-run stock market under- or overvaluation. In the case of such a consistent statistically significant stock price misalignment, the likelihood of a future price correction is expected to be rather high.

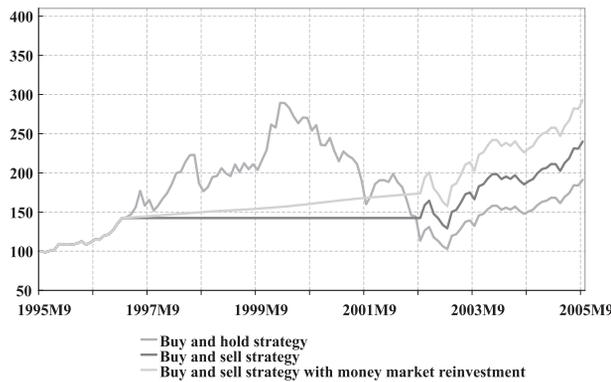
## CONCLUSION

The stock price model is easy to understand and to apply and, therefore, appealing to investors. The concept of a long-run fair stock market value and short-run deviations from it matches many investors' intuition that in

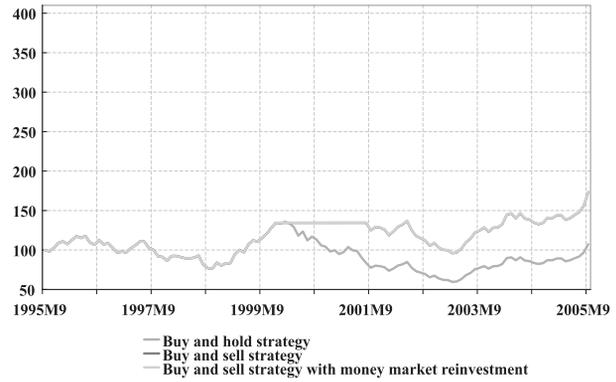
## EXHIBIT 7

### Buy and Sell Strategy Based on Significant Long-Run Fair Stock Market Under- and Overvaluation vs. Buy and Hold Strategy

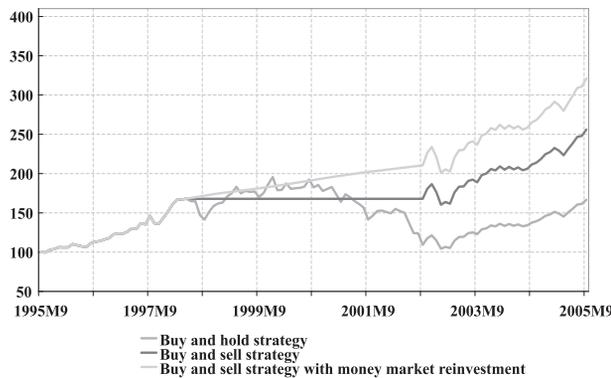
Germany



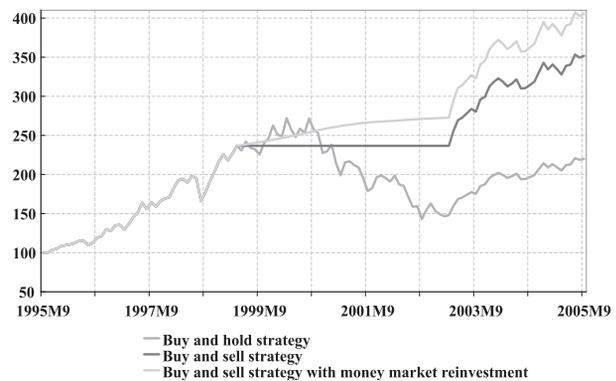
Japan



United Kingdom



United States



Note: Stock price index in September 1995 is 100. The buy and sell strategy is based on buying/selling the index three times in a row with a significant long-run fair stock market under/overvaluation for the latest observation of the period examined. That is, the latest realized stock price index is outside the lower (for buying) and upper (for selling) standard error of the regression bounds of Equation (2).

the long run only fundamentals matter, whereas in the short run other factors—such as the exchange rate, commodities, momentum, and seasonality—might also determine stock prices. In principle, however, any short-run factor can be considered. The model provides investors with an estimate of the degree of over- or undervaluation of stock markets versus their long-run fair fundamental levels and thus can help in selecting countries to over- and underweight in a global equity portfolio. The long-run fair stock price model also detects periods when stock prices are too expensive compared to their long-run fair value, pinpointing stocks that should be sold, and vice versa.

All in all, the performance of the stock price model is promising, especially compared to error correction models that totally ignore the risk premium. An important recommendation is that stock market investors should not simply look at the PE ratio, but correct it for risk-free interest rate and equity risk premium movements. This study approximates the long-run equity risk premium by the preceding five-year average of the spread between the reported earnings yield and the ex post real 10-year government bond yield. Although this measure may have shortcomings like any other proxy for this unobservable variable, it provides a good starting point for further research. This follows in the spirit that it is better to be *approximately* right by including a proxy for the equity risk premium than to be *precisely* wrong by ignoring the risk premium.

## ENDNOTES

The usual disclaimer applies. I thank an anonymous referee for valuable comments.

<sup>1</sup>In this highly simplified, long-run representation of the value of a stock, shareholders expect the price of the corporation's stock as well as its dividends, earnings, and assets to grow at the same rate each year. It is also important to emphasize that the shareholders' discount rate exceeds the corporation's rate of growth in the long run. Otherwise, this approach would not fix a price for equity.

<sup>2</sup>The variable codes are put in square brackets, where "C" denotes the respective country or currency code: total market stock price index in local currency [TOTMKCC(PI)]; PE ratio [TOTMKCC(PE)]; 10-year government bond yield [IGCCC10]; consumer price index [CPCCC]; U.S. dollar exchange rate [\_\_CCC]; trade-weighted exchange rate of the U.S. [\_DXY]; CRB total return commodity index [\_CRBTRD]; and total return bills index [TRCCCBIM].

<sup>3</sup>Some may argue that I should apply a multivariate error correction approach. This framework is, in my view, unnecessarily sensitive to slight misspecifications, whereas the simplicity of the applied univariate two-step approach makes it easy to understand and to apply. The two stages nicely formalize the intuitive notions of a long-run fair stock price value and short-run deviations from it. Also note that similar results are obtained by 1) adding or deleting a few years in the calculation of the long-run equity risk premium, 2) applying the \$/EUR, \$/YEN, or \$/GBP exchange rates instead of the U.S. trade-weighted exchange rate, 3) using nearby months in constructing the momentum dummy variable, and 4) adding May and/or October in the seasonal dummy variable.

<sup>4</sup>Underlying country-specific results are available upon request. The same country grouping results when looking at 6- and 12-month averages instead of 3-month averages of long-run fair stock market valuation gaps. For the 6-month averages, the 6 sample periods end between September 1999 and February 2000, and for the 12-month averages, the 12 sample periods end between March 1999 and February 2000.

## REFERENCES

- Barberis, N., A. Shleifer, and R. Vishny. "A Model of Investor Sentiment." *Journal of Financial Economics*, Vol. 49, No. 3 (1998), pp. 307–343.
- Bouman, S., and B. Jacobsen. "The Halloween Indicator, "Sell in May and Go Away": Another Puzzle." *American Economic Review*, Vol. 92, No. 5 (2002), pp. 1618–1635.
- De Bondt, W.F.M., and R. Thaler. "Further Evidence on Investor Overreaction and Stock Market Seasonality." *Journal of Finance*, Vol. 42, No. 3 (1987), pp. 557–581.
- Engle, R.F., and C.W.J. Granger. "Co-integration and Error Correction: Representation, Estimation and Testing." *Econometrica*, Vol. 55, No. 2 (1987), pp. 251–276.
- European Central Bank. "The Cost of Equity in the Euro Area and in the United States." *Monthly Bulletin*, Box 4 (September 2005), pp. 38–40.
- Fama, E. "Efficient Capital Markets: A Review of Theory and Empirical Work." *Journal of Finance*, Vol. 25, No. 2 (1970), pp. 383–417.
- Fisher, K.L., and M. Statman. "Market Timing at Home and Abroad." *Journal of Investing* (Summer 2006), pp. 19–27.
- Harasty, H., and J. Roulet. "Modelling Stock Market Returns: An Error Correction Model." *Journal of Portfolio Management* (Winter 2000), pp. 33–46.

- Jegadeesh, N., and S. Titman. "Profitability of Momentum Strategies: An Evaluation of Alternative Explanations." *Journal of Finance*, Vol. 56, No. 2 (2001), pp. 699–720.
- Kepler, M., and X. Hong Xue. "The Seasonal Price Behavior of Global Equity Markets." *Journal of Investing* (Winter 2003), pp. 49–53.
- Kwon, K.Y., and R.J. Kish. "Technical Trading Strategies and Return Predictability: NYSE." *Applied Financial Economics*, Vol. 12, No. 9 (2002), pp. 639–653.
- Lettau, M., S.C. Ludvigson, and J.A. Wachter. "The Declining Equity Premium: What Role Does Macroeconomic Risk Play?" NBER Working paper No. 10270, 2004.
- MacDonald, R., and D. Power. "Stock Prices, Dividends and Retention: Long-Run Relationships and Short-Run Dynamics." *Journal of Empirical Finance*, Vol. 2, No. 2 (1995), pp. 135–151.
- Mills, T.C. "Equity Prices, Dividends and Gilt Yields in the UK: Cointegration, Error Correction and 'Confidence'." *Scottish Journal of Political Economy*, Vol. 38, No. 3 (1991), pp. 242–255.
- Rouwenhorst, K.G. "International Momentum Strategies." *Journal of Finance*, Vol. 53, No. 1 (1998), pp. 267–284.
- Siegel, J.J. "The Shrinking Equity Premium: Historical Facts and Future Forecasts." *Journal of Portfolio Management*, Vol. 26, No. 1 (1999), pp. 10–17.
- . "Perspectives on the Equity Risk Premium." *Financial Analysts Journal*, Vol. 61, No. 6 (2005), pp. 61–73.
- Theil, H. *Applied Economic Forecasting*. Amsterdam: North-Holland, 1966.

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