Federal Reserve Bank of New York
Staff Reports

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Staff Report no. 181
April 2004

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JEL classification: G12, G15

Abstract

We examine the implications of time variation in the correlation between the equity premium and nondurable consumption growth for equity return dynamics in G-7 countries. Using a VAR-GARCH (1,1) model, we find that the correlation increases with recession indicators such as above-average unemployment growth and with proxies for stock market wealth. The *combined* effect is that the correlation increases during a recession. We find that the effect of a countercyclical correlation is that the equity premium, Sharpe ratio, and risk aversion are also generally countercyclical. These findings survive several robustness checks such as allowing the mean return to depend on its conditional variance and controlling for lower consumption volatility during the post-1990 period. The evidence is stronger for countries that have larger stock market capitalization relative to GDP. Our results show the importance of combining financial and macroeconomic indicators for explaining time variation in the consumption correlation and the equity premium.

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It is a challenge for economics to explain the time-series variation of the mean and volatility of the equity premium *EP*. The mean *EP* is predictable at long horizons (Fama and French, 1988) and increases during recessions, peaking near business cycle troughs (Fama and French, 1989; Ferson and Harvey, 1991). Explanations for the cyclical properties of *EP* include time-varying risk aversion (Constantinides, 1990; Campbell and Cochrane, 1999; Barberis et al. 2001), consumption commitments or transactions costs that must be paid to change consumption (Chetty and Szeidel, 2003), and time-varying correlation between durable consumption growth and returns (Yogo, 2003). It is harder to explain evidence of countercyclical variations in the Sharpe ratio *SR* (Brandt and Kang, 2001), where *SR* is the conditional mean return per unit of its conditional standard deviation. Lettau and Ludvigson (2003) show that leading asset-pricing models generate swings in the *SR* much smaller than what is visible in the data.

In this paper, using data for the G7 countries, we examine whether time-varying correlation between the *EP* and nondurable consumption growth (the consumption correlation) can account for cyclical properties of the *EP* and *SR*. While countercyclical variation in the correlation can potentially lead to similar variation in the *EP* and *SR*,[1] the empirical evidence remains unclear. Duffee (2004) shows that the correlation is high when stock market wealth is high relative to consumption (the "composition effect") and infers that the correlation is procyclical. However, Santos and Veronesi (2003) show that, if investors have dividend and labor income, then expected returns are negatively related to the ratio of labor income to consumption. Further, large and predictable income shocks imply countercyclical correlation when consumers infrequently update or monitor spending decisions, as discussed in section 1. Finally, the sample correlation is higher during recessions. For example, in U.S. quarterly data, the sample

[1] Harvey (1989) shows that the conditional covariance is high in January, but not enough to explain the January

correlation is 0.46 (0.24) after quarters with above (below) average unemployment growth.

We estimate a VAR-GARCH model that allows us to simultaneously characterize the correlation and obtain implications for the mean and variance of consumption growth and returns. The mean equations follow a Vector Auto Regression (VAR) process, augmented by exogenous prediction variables such as the term spread. We characterize the conditional correlation using a GARCH(1,1) model. The correlation varies *both* with changes in the unemployment rate *UG* and the composition effect *C* (proxied by the ratio of stock market wealth to consumption *MEC*, used by Duffee (2004), or the VAR return residual *RR*). Specifically, the correlation depends on whether, in the previous period, *UG* and *C* were above or below their sample averages. The means, variances and the correlation are estimated jointly, as a system.

We find that the constant correlation model is rejected for all countries except France and Italy.[2] During recessions, *C alone* causes lower correlation, consistent with Duffee (2004), while *UG alone* causes higher correlation, consistent with Santos and Veronesi (2003). However, plots of the estimates and regression analysis show that the *combined* effect of *UG* and *C* is for the correlation to increase during recessions. The time variation in correlation is large. For example, in U.S. quarterly data, the correlation is 0.60 (statistically zero) after quarters with above (below) average *UG* and *RR*.

Next, we plot the conditional equity premium implied by time-varying correlation, and show that it increases during recessions. Variations in the Sharpe ratio *SR* are also countercyclical and large in magnitude Finally, the countercyclical correlation tends to make risk-aversion

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premium in stock returns. In cross-sectional evidence, Lettau and Ludvigson (2001b) find that value stocks earn higher average returns than growth stocks because of higher consumption correlation during bad times.

[2] Previously, the hypothesis of constant conditional covariance was rejected in U.S. data by Schwert and Seguin (1989) and Harvey (1989), and for U.S., UK, and Japanese data by Cumby (1990).

(implied by the conditional Euler equation) procyclical, while the countercyclical *SR* has the opposite effect. Overall, the risk-aversion generally increases during recessions.

Comparing cross-country, we find that the evidence favoring countercyclical correlation, *EP*, *SR* and risk-aversion is stronger for countries with relatively large shares of stock market capitalization to GDP, such as the U.S. and Canada. In contrast, France and Italy have relatively small stock markets and small variation in the correlation, *EP* and *SR*.

Our results survive several robustness checks. We use different recession proxies such as real GDP growth *GG* or fluctuations in the aggregate consumption-wealth ratio *CAY* (Lettau and Ludvigson, 2001a). The correlation is greater when *GG* is below average or for high values of *CAY*. Since expected returns increase with *CAY*, this result again implies countercyclical correlation. We also implement a GARCH-M model where the mean return depends on the conditional return variance, and we control for the decline in consumption volatility in the post-1990 period. In all cases, our basic results continue to hold.

Of related papers, Duffee (2004) shows that the correlation is positively related to *MEC* and infers that it is procyclical. In contrast, Santos and Veronesi (2003) show that the ratio of labor income to consumption *LIC* is the main (negative) determinant of stock returns.[3] We resolve this confusion by showing that the correlation increases with *MEC* and unemployment growth *UG* but the latter effect dominates, so that the correlation is countercyclical. Similar to *LIC*, *UG* is a directly observable macro variable rather than an estimated or a price-scaled variable. Yogo (2003) finds that durable consumption growth is high relative to nondurable consumption growth during recessions and that stock returns decrease (increase) with durable (nondurable) consumption growth, implying countercyclical variation in the equity premium. In contrast, we

[3] In unreported results, the authors state that, in a previous version of their paper, they regress the conditional

obtain countercyclical variation in the equity premium through time varying correlation of returns with nondurable consumption growth. Unlike Yogo (2003), we relate the correlation to macro indicators such as unemployment, GDP and *CAY*.

Different from the above papers, we study implications of time-varying correlation for the Sharpe ratio and risk-aversion, and extend our analysis to the G7 countries. However, unlike us, Duffee (2004) tests different models of time-varying consumption risk, and Santos and Veronesi (2003) and Yogo (2003) study the cross-sectional variation in the equity premium. Finally, we are unable to explain the "equity premium puzzle" (Mehra and Prescott, 1985). Our estimates of the *level* of covariance imply unreasonably large risk aversion for all countries.

Lettau and Ludvigson (2003) find that *CAY* predicts the volatility of returns. We find that *CAY* is informative of the correlation even after conditioning on unemployment: both *UG* and *CAY* significantly determine the correlation and, further, time-variation in the correlation is amplified when *CAY* is included in the mean return equation. More generally, since we combine financial wealth and labor income shocks to explain the risk-return tradeoff, our approach is complementary to Lettau and Ludvigson's (2003) use of *CAY* for the same purpose.

The remainder of this paper is as follows. In section 1, we discuss why the correlation may vary over time. Sections 2 and 3 describe the VAR-GARCH framework and the data, respectively. Section 4 presents descriptive statistics of consumption growth and stock returns. Results for the U.S. are in sections 5 and 6. In section 7, we present results for the other G7 countries. In section 8, we plot estimates from our model and illustrate the dynamic properties of the equity premium, Sharpe ratio and risk-aversion. Section 9 concludes.

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covariance obtained from a GARCH(1,1) model on *LIC* and find a significant coefficient.

1. Time-varying Consumption Correlation: Discussion

Consumption-based asset pricing models predict that expected asset returns should be proportional to the covariance between returns and some function of real consumption, such as expected consumption growth (Hansen and Singleton, 1983). If the covariance is positive, then assets have high returns when consumption is high (i.e. marginal utility is low), and require a higher risk premium. However, the risk-aversion implied by the model is too high in all G7 countries (Table 1), varying between 50 and 162. An important reason for the model's failure is the low (and even negative) value of the unconditional correlation (Cochrane and Hansen, 1992).

Recent literature has focused on the conditional Euler equation. Given power utility and lognormally distributed consumption growth, the conditional equity premium is approximately:

$$E_t(EP_{t+1}) \approx \gamma\sigma_t(CGRO_{t+1})\sigma_t(EP_{t+1})\rho_t(CGRO_{t+1}, EP_{t+1}) \quad (1)$$

where *EP* is the equity premium, γ is the risk-aversion, ρ is the correlation, *CGRO* is the log consumption growth and E_t is an expectation conditional on information at time *t*. Thus, predictable variation in *EP* may arise from variations in γ, ρ or the conditional variances of *EP* and *CGRO*. Our approach is to incorporate time-variation in ρ and the variances. The conditional and unconditional correlation may differ, except in the special case of i.i.d. distribution. Further, the sample correlation varies substantially over different calendar periods and macro conditions for the G7 countries (Table 2).

Although time variation in correlation is present in the data, it may be difficult to interpret (Cochrane, 2001). Nevertheless, in section *A*, we argue that the observed behavior of consumers and investors is consistent with higher correlation during bad economic times. In section *B,* we discuss models implying, instead, that the correlation may be procyclical. We treat the overall cyclical property of the correlation as an empirical issue.

A. Models that may imply countercyclical correlation

Below, we discuss some recent models of consumer and investor behavior. Although some models do not address the correlation directly, their results have implications for the correlation.

Labor income shocks. In Santos and Veronesi (2003), investors have both dividend and labor income. When the share of labor income in consumption decreases, the covariance between consumption growth and dividend growth is higher, which translates to a higher covariance between returns and consumption growth.

Inattentive consumer. Gabaix and Laibson (2001) argue that slow updating of consumption (e.g. due to decision or attention allocation costs) leads to a downward bias in the measured covariance between consumption growth and returns. They show that the covariance increases with the frequency of updating. In addition, if households adjust consumption quicker after large stock return shocks, then the covariance is increasing in the size of return shocks. Reis (2003) models consumers' costs of information acquisition and finds that consumers adjust quicker in response to large and predictable shocks. If unemployment is predictable, then an implication is higher consumption correlation during times of high unemployment.

Absent-minded consumer. Ameriks et al. (2004) find that many consumers are highly uncertain of their spending behavior. Their model of the absent-minded consumer implies that, in a cyclical downturn, those with fewer resources and more time (such as the unemployed) may decide to monitor their spending more closely. This may exacerbate the decline in consumption, and cause the correlation to be higher during economic recessions.

Less consumption smoothing during recessions. Borrowing constraints imply that consumption smoothing is weaker during recessions than expansions. Zeldes (1989) finds that an inability to borrow against future labor income affects most consumption. Other methods of consumption smoothing may also be less effective during recessions. For example, Stephens (2001) reports that, following the head's unemployment, the reduction in family income is less than the reduction in the head's earnings, possibly due to increased spousal earnings and transfers from relatives. Such forms of consumption smoothing are less likely during recessions when spouses would find it harder to increase their labor supply.

B. Models that may imply procyclical correlation

In this section, we describe the composition effect and time-varying stock market participation, and their implications for the correlation.

Composition effect. When the share of stock market wealth (SMW) in total wealth is high, consumption will be low relative to SMW and more sensitive to changes in SMW. Thus, Duffee (2004) argues, the correlation is higher when the share of SMW in total wealth is above average.

Time-varying stock market participation. Shareholders' consumption is more closely correlated with stock returns than non-shareholder consumption (Mankiw and Zeldes, 1991). Further, there is large turnover in the set of stock market participants and, among participants, large changes in the portfolio shares of equity over time (Vissing-Jorgensen, 2002). Thus, if high stock returns attract increased participation, the correlation may increase with returns.[4] On the other hand, Polkovnichenko (2001) shows that, with fixed participation costs, the consumption correlation of shareholders endowed with labor income is lower compared to a model where they have no labor income. An implication is that the correlation increases after a negative labor income shock.

In the following section, we discuss the statistical model for estimating conditional moments of consumption growth and stock returns.

[4] Hong et al. (2004) illustrate that multiple participation equilibria can occur if equity investment is influenced by social interaction (i.e. an investor's cost of participation is decreasing in the number of his peers who also participate). Antunovich and Sarkar (2003) provide empirical evidence for participation externality.

2. Empirical Methodology

In the previous section, we argued that time-varying correlation is theoretically plausible. Sample evidence, for the G7 countries, also shows time variation in the mean and volatility of returns and consumption growth, as well as in the consumption correlation (Table 2). A natural way to model these features of the data is to combine a VAR model for means with a GARCH model for second moments. We first describe the VAR-GARCH process and then elaborate, based on our discussion in section 1, on economic factors driving the correlation.

Let R_t be a vector of consumption growth *CGRO* and the equity premium *EP*. We assume that the multivariate process governing R_t is:

$$R_t = m_{t-1} + e_t ,$$

$$m_{t-1} = E(R_t \mid \Omega_{t-1}) \qquad (2)$$

$$e_t \mid \Omega_{t-1} \sim N(0, H_t)$$

where Ω_{t-1} is the information set at time t-1. e_t is a vector of innovations, assumed conditionally normal with a conditional covariance matrix H_t. Elements of H_t are h_{ijt}, $i \neq j$, (off-diagonal terms, or conditional covariance) and h_{iit} (diagonal terms, or conditional variances).

We model the means of *CGRO* and *EP* as a VAR, augmented with one-period lagged values of exogenous prediction variables:

$$R_{it} = \alpha_{i0} + \sum_{j=1}^{2} \sum_{\tau=1}^{L} \alpha_{j\tau} R_{jt-\tau} + \sum_{j=1}^{P} \beta_{ij} z_{j.t-1} + e_{it} \qquad (3)$$

where i=1 (*CGRO*), or 2 (*EP*). L is the order of the VAR, chosen according to various information criteria. $z_{j.t-1}$, j=1,..,P is the j-th exogenous prediction variable.

The VAR model assumes that consumers can predict consumption growth and the equity premium. There is weak evidence that consumption growth is predictable. Campbell and Mankiw (1989) find that, for the G7 countries, consumption growth is predicted by its lags and by the term structure. Motivated by habit persistence models, Deaton (1987) estimates a regression of consumption growth on its lags.[5] Kandel and Stambaugh (1990) regress consumption growth on the dividend yield, the default and term spreads. Evidence in favor of return predictability is stronger. For U.S. quarterly returns, Fama and French (1989) document that the Baa-Aa corporate bond yield, the S&P 500 dividend yield and the term spread predict returns. Whitelaw (1994) uses similar variables to predict monthly and quarterly U.S. returns.

We use a GARCH(1,1) model for the conditional variances and covariance of the innovations. The conditional variance is assumed to be linear in its own lag and the squared past innovation. We do not include $z_{j,t\text{-}1}$ because high-dimensional GARCH models are difficult to estimate. Initially, the conditional correlation r_{ij} is assumed to be constant (Bollerslev, 1990):

$$h_{iit} = a_i + b_i\, e_{it-1} e_{it-1} + c_i\, h_{iit-1} \qquad i=1, 2 \tag{4}$$

$$h_{ijt} = r_{ij} \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j \tag{5}$$

where b_i represents the ARCH effect while c_i represents the GARCH effect.

Next, we test whether r_{ij} varies over time by introducing dummy variables in (5):

$$h_{ijt} = \left(\sum_{k=1}^{S} r_k D_{k,t-1}\right) \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j \tag{6}$$

Section 1 indicates that the correlation increases with large labor income shocks that occur during periods of high unemployment. Such periods may also witness reductions in aggregate output measures, such as GDP or industrial production. Thus, we hypothesize that the

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[5] Campbell and Mankiw (1989) omit the first lag of consumption growth, due to the time averaging of consumption (Breedon et al., 1989). Deaton (1987), however, includes the first lag of consumption growth.

correlation depends on one of the following macro factors *M*: growth in real industrial production (*IG*), the unemployment rate (*UG*) or real GDP (*GG*). Let E(*M*) be the sample mean of *M*. Then, for time *t*, we define dummy variables as follows:

$$D_{1,t} = 1 \, if \; M_t > E(M), \tag{7}$$

$$D_{2,t} = 1 \, if \; M_t \leq E(M), \tag{8}$$

and they are 0 otherwise. The correlation also varies with the composition effect *C*, where *C*={*MEC*, *RR*}. *MEC* is the ratio of stock market wealth to consumption and *RR* is the return residual $e_{2,t}$ from the VAR. Since consumption has low variation, most of the variation in *MEC* is likely to come from stock returns, so *RR* may be viewed as another proxy for the composition effect. Alternatively, if the stock market anticipates changes in the real economy, *RR* may pick up macro information not contained in *M*. Let E(*C*) be the sample mean of *C*. We define:

$$D_{3,t} = 1 \, if \; C_t > E(C), \tag{9}$$

$$D_{4,t} = 1 \, if \; C_t \leq E(C), \tag{10}$$

and they are 0 otherwise. Finally, Gabaix and Laibson (2001) imply that the correlation is higher for larger return shocks. Suppose a "large" return shock means that *RR* is greater in absolute value than its mean E(*RR*) plus standard deviation σ(*RR*). Then, we redefine D_3 and D_4 as:

$$D_{3,t} = 1 \, if \; |RR| > E(RR) + \sigma(RR), \tag{11}$$

$$D_{4,t} = 1 \, if \; |RR| \leq E(RR) + \sigma(RR), \tag{12}$$

and they are 0 otherwise. We combine information on macro and return conditions to define:

$D_{5,t}$=1 if $D_{1,t}$=1 and $D_{3,t}$=1, and $D_{5,t}$=0 otherwise.

$D_{6,t}$=1 if $D_{1,t}$=1 and $D_{4,t}$=1, and $D_{6,t}$=0 otherwise.

$D_{7,t}$=1 if $D_{2.t}$=1 and $D_{3,t}$=1, and $D_{7,t}$=0 otherwise. (13)

$D_{8,t}$=1 if $D_{2,t}$=1 and $D_{4,t}$=1, and $D_{8,t}$=0 otherwise.

As a robustness check, we also estimate a GARCH-in-means or GARCH-M(1,1) model by including the conditional return variance h_{22} in the mean return equation:[6]

$$R_{2t} = \alpha_{20} + \sum_{j=1}^{2} \sum_{\tau=1}^{L} \alpha_{j\tau} R_{jt-\tau} + \sum_{j=1}^{P} \beta_{2j} z_{j.t-1} + \gamma h_{22,t} + e_{2t} \quad (14)$$

In all cases, we estimate the VAR-GARCH system jointly. The conditional log-likelihood function for the GARCH(1,1) process can be expressed as:

$$Lik(x) = -\frac{1}{2} \sum_{t=1}^{T} [\ln(2\pi) + \ln | H_t \ | + e_t' (H_t)^{-1} \ e_t] \quad (15)$$

where x is the vector of all the parameters to be estimated and T is the sample size. $Lik(x)$ is maximized by the BFGS Quasi-Newton method with a mixed quadratic and cubic line search procedure. We initialize the conditional variances to their unconditional values, and use the Simplex method for a few iterations to "straighten out" the initial conditions. To test for coefficient restrictions, we use a likelihood ratio test LR:

$$LR = 2 * (ULOGL - RLOGL) \sim \chi^2 (k-1) \quad (16)$$

where $ULOGL$ ($RLOGL$) is the value of the unrestricted (restricted) likelihood function and k is the number of restrictions.

3. Data

A complete description of sources and sample dates is in the data appendix. The sample starts in the 1960s for the U.S., UK and Canada, in 1970 for others, and ends 2003 Q1 or Q2. We use monthly data for the U.S., and quarterly data for the non-U.S. G7 countries.

[6] We thank an anonymous referee for suggesting this to us.

Consumption is the sum of seasonally adjusted expenditures on nondurables and services if disaggregated data is available, and aggregate expenditures otherwise. We obtain per capita consumption expenditures after dividing by the population.[7] Consumption growth is the log difference in current and lagged consumption,[8] while the equity premium is the total return (capital gains plus dividend yield) minus the local 3-month Treasury bill rate. We mostly use the MSCI stock index except for the U.S., UK and Canada, where we use a local stock index to match the longer history of consumption data in those countries. All nominal data are converted to real terms using the local Consumer Price Index.

We use lagged values of *DEF*, the default spread, *DIVY*, the dividend yield, *TERM*, the 10-year note yield minus the 3-month bill rate[9] and *PE*, the price-earnings ratio, to predict the equity premium and consumption growth. For non-U.S. G7 countries, other than Canada, we define *DEF* as the corporate bond yield minus the long-term Treasury yield since separate data for high-risk and low-risk corporate bonds is unavailable.[10] For Canada, we use the corporate bond yield minus the 3-month prime corporate paper rate. For U.S. data, *DEF* is the Baa-Aa corporate bond yield, and *DIVY* is the S&P 500 dividend yield.

4. Descriptive Statistics for Consumption Growth and Stock Returns

Campbell (2002) reports a small or negative correlation in the quarterly data for most countries. He notes that variation in the ratio of stock market capitalization to GDP may imply

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[7] For Germany, we use West Germany's population before 1991 Q1 and use Unified Germany's population after that. This is consistent with standard practice of the main data agencies.

[8] Since consumption data is time-averaged, a timing convention is needed. Our definition assumes that consumption is measured at the end of a period. Alternatively, consumption growth may be defined relative to *next* period's consumption, which results in higher contemporaneous correlation with returns, especially at quarterly horizons (Campbell, 2002).

[9] We use constant maturity Treasury rates to define *TERM* for U.S. data

[10] Kandel and Stambaugh (1990) use the difference between Aaa and the Treasury bill rates. We use long-term rather than short-term Treasury rates to match the corporate bond maturities more closely.

similar variation in the stock market's share of total wealth, and in the stock market claim to total consumption. In section *A*, we discuss the sample correlation of consumption growth and stock returns for the G7 countries, and relate it to the size of the stock market. The correlation may be high conditionally, even when its unconditional value is low. Thus, in section *B*, we compare the correlation for different calendar periods and macro conditions.

A. Sample distribution and correlation of consumption growth and stock returns

Table 1 shows the distribution and correlation (CORR) of consumption growth *CGRO* and the equity premium *EP*. The U.S. has the highest correlation (0.24 for monthly and 0.34 for quarterly data). Canada has double-digit correlation, but the other countries have small or negative correlation. The correlation is weakly associated with *Mcap* and *Mgdp*. Thus, while the U.S. and Canada have relatively large stock markets and moderate correlation, Japan and the U.K. have large stock markets and negative correlation.[11]

The mean annualized *CGRO* is around 2% for most countries but, compared to the U.S., the volatility of *CGRO* is higher for the G7 countries.[12] The mean equity premium is high in all countries relative to the consumption volatility, as indicated by the high risk-aversion implied by the Euler equation.

B. Correlation by decade and macroeconomic conditions

Earlier, we saw that the unconditional consumption correlation is low or negative for many countries. Now, we examine whether the correlation is high in particular calendar periods and

[11] Data issues may influence the correlation. For example, the consumption data for some countries do not separate out nondurables and services expenditures. Also, the summation bias in consumption data reduces the variance of consumption changes whereas asset returns data do not have this bias. Variation in the size of this bias across countries may affect the comparability of the correlations.

[12] In particular, the standard deviation of *CGRO* exceeds 13% for Germany. The high volatility of consumption growth in Germany is consistent with the high variability of its other real macro variables. For example, the

macro economic conditions. Specifically, we compute the correlation for time *t* conditional on the realizations of D_1 and D_2 at time *t*-1, where D_1 and D_2 are defined in (7) and (8).

Table 2 presents CORR and COV, the correlation and covariance between *CGRO* and *EP*. There is substantial calendar time variation in CORR, primarily reflecting similar variation in COV. For example, CORR and COV are relatively high in the 1960s for the UK, in the 1970s for France and the U.S., and in the 1980s for Canada and Germany. Variations in the volatility of *CGRO* and *EP* also lead to variation in CORR. In particular, CORR is relatively high for the U.S. and UK in the post-1990 period, a time of low consumption volatility in these countries. However, for other G7 countries, even with low consumption volatility in the post-1990 period, CORR is low or negative because COV is low or negative.

Turning to macro conditions, for all countries except France and Italy, the correlation is higher in bad times. For example, in U.S. quarterly data, CORR is 0.24 (0.46) following quarters when unemployment growth is high (low). Similarly, the correlation is relatively high following periods with low growth in GDP or industrial production. Mean returns are generally low when the economy is in a bad way. However, anticipating future results, in the U.S. and Canada the mean return is *not* lower during higher unemployment periods.

In summary, the correlation varies over time and macro conditions, and is typically higher when economic conditions are poor. The volatility of returns and consumption growth also varies over time. Next, we estimate conditional moments of consumption and returns, and examine how the correlation varies with macro and stock market conditions.

5. VAR-GARCH(1,1) Results for U.S. data

In this section, we estimate the VAR-GARCH(1,1) model for U.S. data. Consumers may

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variance of real industrial production for Germany is multiples of the U.S. variance.

form better forecasts of mean returns and consumption growth by conditioning on variables such as the dividend yield. Table 3 shows that *CGRO* and *EP* are most correlated with lagged values of *TERM*, while *EP* also shows moderate correlation with lagged *DIVY* and lagged *DEF*. To describe time variation in the mean *CGRO* and *EP*, we discuss the VAR results in section *A*. In section *B*, we discuss results from the GARCH(1,1) model, first when the correlation is constant, and then when it varies with return shocks and macro factors *UG, IG* and *GG.*

A. VAR Results for U.S. data

Table 4 presents results from estimating the VAR model for U.S. data. Of significant forecasting variables, *TERM* is positively related to *CGRO* and *EP*. Further, *EP* is positively associated with *DIVY* and the price-earnings ratio. Turning to the autoregressive part of the model, *CGRO* is negatively autocorrelated at lag 1 and positively autocorrelated at lag 3.[13] The F-Tests show that we can reject the hypothesis that lagged consumption growth does not explain variations in *CGRO*, consistent with Flavin (1981) and Reis (2003). Lagged consumption and lagged returns are not significant in predicting *EP* in U.S. quarterly data. Finally, in the monthly data, lagged returns are significant in explaining variations in *CGRO* and *EP*. In unreported results, we find that the mean innovations and autocorrelations are nearly zero. A chi-square test cannot reject the null hypothesis of zero autocorrelation of innovations for all lags up to eight.

B. VAR-GARCH(1,1) results for U.S. monthly and quarterly data

Table 5 presents estimates of the conditional variances and correlation from the VAR-GARCH(1,1). Panel A shows results when the conditional correlation (CCORR) is restricted to be constant. The ARCH coefficients for *CGRO* and *EP* are significant in both the monthly and

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[13] Time-averaging of consumption data biases the autocorrelation upward for U.S. data, and downward for countries

quarterly data. The GARCH coefficients are significant in U.S. quarterly but not monthly data. CCORR is 0.26 for U.S. monthly data and 0.34 for U.S. quarterly data and both estimates are statistically significant. These estimates are similar to the sample values (Table 1).

Next, we test for time-variation in the conditional correlation. In Panel B of Table 4, for U.S. monthly data, CCORR varies with *UG*, *IG* and return residuals *RR*. Column *UG* shows that the correlation is 0.33 following months when *UG* is above average (D_1=1) and 0.20 otherwise (D_2=1). Column *RR* shows that CCORR is 0.29 after months when *RR* is above average or positive (D_3=1) and 0.23 otherwise (D_4=1). In both cases, the *LR* test rejects the constant correlation model at the 5% level or less. In column *UG+RR*, we combine information on unemployment and returns. Conditioning on D_1=1, CORR is 0.35 when *RR* is positive (D_5=1) and 0.32 when *RR* is negative (D_6=1). Conditioning on D_2=1, CORR is 0.26 when *RR* is positive (D_7=1) and 0.15 when *RR* is negative (D_8=1). However, with an *LR* test (not shown), we cannot reject the hypotheses that D_5= D_6 or D_7= D_8. Finally, we find that the correlation is similar whether *IG* is above or below average, and the constant correlation model cannot be rejected.

In panel C of Table 4, we repeat the tests for U.S. quarterly data. CCORR is twice as high in high rather than low unemployment states (0.45 versus 0.22), and higher after positive return shocks (0.47 versus 0.25). Further, CCORR is 0.60 when D_5=1, 0.30 when D_6=1, 0.36 when D_7=1 and statistically zero when D_8=1. An *LR* test (not shown) confirms that we can reject equality of D_5 and D_6, or D_7 and D_8. Thus, given the unemployment growth, the correlation is higher with higher return shocks; and, given the return shock, the correlation is higher with higher unemployment. Turning to *GG*, we cannot reject the constant correlation model when conditioning on *GG* alone, but we can reject it when we combine return and GDP information

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where the data includes durable consumption.

(column *GG*+*RR*). Given below average *GG*, the correlation is 0.57 after quarters with positive *RR* and statistically zero otherwise, and these estimates are significantly different.

In summary, we find that the correlation varies substantially over time. The correlation is higher in bad times (i.e. when unemployment growth is high or GDP growth is low). The results are consistent with infrequent updating and monitoring of spending decisions by consumers, resulting in higher correlation during recessions (Ameriks et al, 2004 and Reis, 2003). The results also imply a negative relation between expected returns and labor income shocks, consistent with Santos and Veronesi (2003). Finally, the correlation is higher with positive return shocks, consistent with the composition effect or increased stock market participation.

In the next section, we perform several robustness checks, including using different proxies for the composition effect (such as *MEC*) and macro conditions (such as *CAY*).

6. Robustness Checks for U.S. Data

Previously, we found that the correlation is higher for above average unemployment growth and return shocks. In this section, we check the sensitivity of our results to alternative proxies for macro conditions and stock market wealth (section *A*). We also estimate a GARCH-M model, where the conditional mean return depends on the return variance (section *B*). Finally, we control for the decline in consumption volatility in the post-1990 period (section *C*).

A. Alternative specifications for the correlation

Duffee (2004) finds that the correlation increases with *MEC*, the ratio of stock market wealth to consumption. We replace *RR* with *MEC* in the correlation equation. The *MEC* series is only available until 2002 Q2, a year earlier than the *RR* series. The results are in Panel D of Table 5, column *MEC*. Consistent with Duffee (2004), CCORR is 0.49 when *MEC* is above average (D_3=1) and 0.29 when it is below average (D_4=1). Column *UG*+*MEC* shows that CCORR is 0.47 when D_5=1, 0.32 when D_6=1, 0.43 when D_7=1 and statistically zero when D_8=1. Thus, given the state of unemployment, the correlation is higher when *MEC* is above average rather than below average; and, given *MEC*, the correlation is higher with higher unemployment. These results are qualitatively similar to our previous results using *RR* and *UG*.

Gabaix and Laibson (2001) predict that the correlation should be higher when the return shock is large. We replace *RR* with *ARR*, the absolute value of the return residual, and redefine dummies D_3 and D_4 as specified in (11) and (12). The results are in Panel D of Table 5, column *ARR*. We find that CCORR is 0.46 for large shocks (D_3=1) and 0.31 for small shocks (D_4=1). Further, conditioning on high *UG*, CCORR is 0.55 with large shocks and 0.35 with small return shocks. Conditioning on low *UG*, CCORR is 0.39 with large return shocks and statistically zero when return shocks are small. These results are consistent with Gabaix and Laibson (2001).

Extending the basic *UG* model, we allow the mean return and consumption growth, the conditional return variance and correlation to depend on a one-quarter lag of *CAY*.[14] In the VAR, lagged *CAY* is significantly associated with *CGRO* and *EP*, negatively with the former and positively with the latter, consistent with Lettau and Ludvigson (2001a). The GARCH results are in Panel D of Table 5, column *UG*+*CAY*. We find that *CAY* is negatively related to the return variance, consistent with Lettau and Ludvigson (2003). *UG* and *CAY* are significant, and the correlation increases with *CAY*.[15] Since high *CAY* predicts high returns, the result implies that the correlation is countercyclical. Hence, *CAY* is informative of the correlation, even after conditioning on unemployment.

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[14] *CAY* is not significant when it is included in the consumption volatility equation.

[15] In contrast to our result, Duffee (2004) finds the correlation is negatively related to *CAY*. This may be because, in Duffee's analysis, the correlation depends on *MEC* and *CAY*, which have a high negative correlation of –0.6, making their relative significance hard to distinguish. In contrast, we use *UG* and *CAY*, which have a low

We try other specifications of the conditioning variables in the covariance equation. For example, we allow CCORR to vary with the level of unemployment in addition to its change; and with unemployment and GDP growth combined. We also try a continuous specification rather than one-zero dummy variables. For example, let U^{+}=max(0,*UG*) and U^{-}=min(0,*UG*). Then, we allow CCORR to vary with an intercept, U^{+} and U^{-}. In all cases, the earlier results remain valid.

In summary, we show that the correlation is higher with proxies for recessionary periods (*UG* or *CAY*) and higher with proxies for stock market wealth (*MEC* or *RR*). The correlation also increases with the size of return shocks, consistent with Gabaix and Laibson (2001).

B. GARCH-M results

While we expect returns and volatility to be positively related, the evidence so far is mixed. Some (e.g. French, Schwert and Stambaugh, 1987), find a positive correlation but others (e.g. Campbell, 1987; Glosten et. al., 1993), find a negative or no relation between returns and volatility. The VAR-GARCH-M(1,1) results, reported in Table 6, show that the mean return is negatively and significantly related to the return variance, consistent with recent evidence in Brandt and Kang (2001), Lettau and Ludvigson (2003), and Whitelaw (2000). This is true for the constant correlation model (not reported) and the time-varying correlation model. Unlike in the base model, we include *CAY* in the mean equations. While the qualitative results are unchanged, we find that the time-variation in the conditional correlation is enhanced. For example, in column *UG*+*RR*, the correlation ranges from 0.69 in the high *UG*, high *RR* state to statistically zero in the low *UG*, low *RR* state. This compares to a correlation range of 0.60 to (statistically) zero in the same states when using model *UG*+*RR* in Table 5 Panel C.

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correlation of 0.14.

C. Reduction in consumption volatility in the post-1990 period

Stock and Watson (2002) show that macro volatility, including the consumption growth variance, is lower in the 1990s. Lettau, Ludvigson and Wachter (2004) show that this shift is associated with higher stock prices. We include a dummy variable for the post-1990 period and find that the conditional variance of consumption growth is lower and the conditional correlation is higher in the 1990s. However, our results do not change qualitatively.

7. VAR-GARCH(1,1) Results for non-U.S. G7 Countries

For U.S. data, we have shown that the conditional correlation CCORR increases with proxies for recessions and stock market wealth. Do the results also hold for non-U.S. G7 countries? Cross-country variations in the duration of unemployment insurance (Tatsiramos, 2003) and the size of the equity market (Table 1) may lead to cross-country differences in how CCORR reacts to unemployment and stock market wealth. We present descriptive statistics and VAR results followed by the GARCH estimates. There are two specifications for the correlation. First, CCORR varies with unemployment growth *UG* or with GDP growth *GG*; second, CCORR varies with *UG* and return shocks *RR*, or with *GG* and *RR*. When CCORR varies with *RR* alone, the estimates are not significant, so we do not report these results. We do not condition on *MEC* and *CAY* for lack of data. Nor do we condition on the size of return shocks, partly for brevity and partly because the U.S. results are similar whether using the size or the sign of return shocks.

Table 7, Panel A shows the distribution of prediction variables for non-U.S. G7 countries. The mean values are broadly comparable across countries, and with those of the U.S. The mean default spread is around 1% for Canada and the U.K. and 0.51% or below for other countries (compared to 0.71% for the U.S.). The mean dividend yield is between 3% and 4.5% for most countries (compared to 3.34% for the U.S.) except Japan. The *PE* ratio is around 20 for most countries (compared to 18.68 for the U.S.), except Italy and Japan. The term spread is between 1.24% and 2% for most countries (compared to 1.39% for the U.S.), except Italy and the U.K. Panel B shows the correlation between *CGRO*, *EP* and the prediction variables. Lagged prediction variables have low correlation with consumption growth and equity premium with few exceptions, such as *DIVY* and *TERM* in Canada and *DIVY* and *PE* in the UK.

A. VAR Results for non-U.S. G7 data

Table 8 shows results from estimating the VAR model for non-U.S. G7 countries. The F-tests reject the hypotheses that lagged consumption and lagged returns do not explain variations in *CGRO* in all countries except France, for lagged *CGRO*, and UK, for lagged returns). Consistent with U.S. data, consumption growth is generally negatively autocorrelated at short lags and positively autocorrelated at longer lags. However, the autoregressive model does poorly in predicting returns. Of the prediction variables, *DIVY* is positively correlated with returns in Canada and the U.K. *PE* is positively correlated with returns in the U.K. and negatively correlated with *CGRO* in Japan and France. *TERM* is positively correlated with returns in Canada and France, and with *CGRO* in Germany. Overall, there is moderate-to-strong evidence of predictability for *CGRO* but little evidence of predictability for returns.

B. VAR-GARCH(1,1) results for non-U.S. G7 data

In Table 9, we estimate the conditional correlation CCORR for non-U.S. G7 countries. For the constant correlation model (panel A), the Arch and Garch effects for *EP* are positive and significant in all countries, except Japan, Italy and France. The Garch effect for *CGRO* is significant for 4 countries. CCORR is statistically zero for all countries.

In panel B of Table 9, CCORR varies with *UG* and *RR*. Italy is excluded as it has no unemployment data before 1980. Other countries also have missing data in the early years. The results show that, for Canada and Germany, CCORR is positive when *UG* is above average (D_1=1) and statistically zero otherwise (D_2=1). For Japan, *UG* does not predict CCORR by itself, but does so in combination with returns. Thus, in column *UG*+*RR* for Japan, CCORR is 0.33 after quarters with high *UG* and negative *RR* (D_6=1) and statistically zero in other states. For Germany, too, CCORR is positive when D_6=1, and statistically zero otherwise.

In panel C of Table 9, CCORR varies with *GG* and *RR*. For Canada and the UK, CCORR is positive following quarters with below average *GG* (D_2=1) and statistically zero otherwise. For Japan, *GG* does not predict CCORR by itself, but does so in combination with returns. Thus, in column *GG*+*RR* for Japan, CCORR is 0.43 after quarters with low *GG* and negative *RR* (D_8=1) and statistically zero in other states. For UK, too, CCORR is positive when D_8=1, and statistically zero otherwise. In contrast, for Canada, CCORR is positive during periods of low GDP growth and *positive* return shocks (D_7=1).

Summarizing, the constant correlation model is rejected for 4 of 6 non-U.S. G7 countries: Canada, the UK, Germany and Japan. Similar to U.S. data, the conditional correlation varies substantially over time. Whereas the unconditional correlation is mostly zero or negative, the conditional correlation is positive and moderate during economic contractions (i.e. when unemployment growth is high or GDP growth is low). However, unlike U.S. data, return shocks alone do not affect the correlation. Further, conditional on low GDP growth, the correlation is higher after negative return shocks in the U.K., Japan and Germany. These result may indicate that the composition effect is weak these countries; alternatively, outside the U.S, the return shock may be a poor proxy for the ratio of stock market wealth to consumption.

8. Cyclical Properties of the Correlation, Equity Premium, Sharpe Ratio and Risk Aversion

What are the implications of time-varying correlation for the equity premium *EP*, Sharpe ratio *SR*, and the risk-aversion *RA*? *EP* and *SR* are proportional to the correlation, so we expect that countries with countercyclical correlation may also have countercyclical *EP* and *SR*. Implications for *RA* are ambiguous, since it varies inversely with the correlation and directly with *SR*. In this section, we plot estimates of the covariance, correlation, *EP* and *SR* from our model using G7 quarterly data[16] and examine their behavior over business cycles dated by the NBER (for the U.S.) and OECD (for non-U.S. countries). We omit cycles denoted "minor" by the OECD, since the theory discussed in section 1 mostly applies to large income shocks. We also plot the risk-aversion implied by the conditional Euler equation:

$$\gamma_t = \frac{E_t(EP_{t+1})}{\sigma_t(CGRO_{t+1})\sigma_t(EP_{t+1})\rho_t(CGRO_{t+1}, EP_{t+1})} \tag{17}$$

For U.S. data, we plot estimates from 3 models that differ by the variables determining the correlation: *RR*, return shocks; *UG*+*RR*, unemployment growth *UG* and *RR*; and *UG*+ *CAY*. For the non-U.S. countries, we only use model *UG*+*RR*. For France and Italy, we use the constant correlation model since it cannot be statistically rejected. We first discuss how moments of the conditional *EP* and *SR* track sample moments, the range of *SR* and the mean of γ_t. Then, we discuss the plots. Section *A* reports results for U.S. data and section *B* for the other countries.

A. U.S. quarterly data

Table 10 shows annualized moments of the conditional and sample *EP* and *SR* for the G7 countries. For U.S. quarterly data (USQ), the mean conditional *EP* matches its sample counterpart more closely when the correlation varies than when it is constant. For example, in the *UG*+*RR* model, the mean *EP* is 4.55% compared to 4.08% in the sample. When the correlation is constant, the mean *EP* is 6.14%. Thus, time-varying correlation is important in matching the mean equity premium in the data. However, the standard deviation (SD) of the conditional *EP* underestimates the sample SD by a factor of about 2.5. We find large swings in the conditional *SR*, ranging from around –2.70 to 3.28, compared to sample range (derived from daily data) of –2.45 to 2.58. The average implied *RA* remains too high, even allowing for time-varying correlation. This is consistent with Campbell (2002), who found that the implied *RA* is too high for most countries, varying between 9 and 50, even when the correlation is assumed 1.

We next turn to the business cycle properties of the covariance and correlation. Figure 1 plots these variables, averaged over each cycle of contraction (i.e. post peak to trough quarters) and expansion (i.e. post trough to peak quarters), with shaded areas indicating NBER-dated contractions or recessions. For model *SR*, the correlation mostly decreases in recessions, consistent with Duffee (2004). In some recessions, the covariance increases but it is offset by increases in the volatility, so that the correlation decreases. In contrast, for model *UG*+*RR*, the covariance and correlation always increases during recessions, consistent with Santos and Veronesi (2003). Table 11 confirms this result by regressing the correlation on a recession dummy, and obtaining a positive and significant coefficient. The correlation is also countercyclical for model *UG*+*CAY*. The *EP* is countercyclical for all models, increasing just before recessions and reaching a maximum at or near the trough, consistent with Whitelaw (1994). For model *SR*, the *EP* increases even in recessions where the covariance decreases as risk-aversion increases sufficiently to offset the decline in the covariance (see Figure 2).

Figure 2 plots the *SR* and *RA*, the latter averaged over each expansion and contraction. Like

[16] Results for U.S. monthly data are similar to quarterly data, and are not reported (they are available upon request).

the equity premium, the *SR* increases during recessions and peaks just before a trough. Fluctuations in the *SR* are greatest for model *UG+RR*, and least for model *SR*. The *RA* generally increases during recessions, suggesting that the higher correlation during recessions is more than offset by the increase in the *SR*. Exceptions are the short recession of 1980 Q2-Q3 and the most recession. Campbell and Cochrane (1999)'s model also did worst for the most recent recession.

B. Non-U.S. G7 quarterly data

Table 10 shows that, similar to USQ data, the model tracks the mean *EP* while underestimating volatility. For example, in UK data, the mean *EP* and SD for model *UG+RR* are 8.18% and 7.64%, respectively, compared to 8.15% and 20.49% in the data. Figure 3 clearly shows the countercyclical property of the correlation for all countries, and this result is confirmed by regression analysis in Table 11. Figures 4 and 5 show that the *EP* and *SR* generally increase during recessions for Canada, UK and Japan, while showing no discernible pattern for the others. Figure 6 plots the implied risk-aversion averaged over expansions and contractions and shows a clear pattern of higher risk-aversion during recessions for Canada, UK and Japan.

Summarizing, the correlation is countercyclical for all 4 countries where the constant correlation model is rejected. In Canada, UK and Japan---countries with large stock markets relative to GDP---the *EP*, *SR* and *RA* are all generally countercyclical. For the other countries, notably France and Italy, there is little evidence of any cyclical pattern in these variables.

9. Conclusion

We examine the implications of time-variation in the correlation between equity premium and nondurable consumption growth for equity return dynamics for the G7 countries. Using a

VAR-GARCH(1,1) model, we find that the correlation is higher with recession proxies, such as above average unemployment growth. This result is consistent with asset pricing models with labor income (Santos and Veronesi, 2003) and models where consumers infrequently update and monitor their spending decisions. The correlation also increases with proxies for stock market wealth, consistent with the composition effect (Duffee, 2004). Graphs and regression analysis show that the correlation is countercyclical when these two effects are combined. Plots of the equity premium and Sharpe ratio also show a countercyclical pattern. During recessions, the increase in the Sharpe ratio offsets the increase in the correlation, so that the risk-aversion generally increases. We try different recession proxies, allow the mean return to depend on its conditional variance, and control for lower consumption volatility during the post-1990 period, to find our results qualitatively unchanged in all cases. The evidence is stronger (weaker) for countries with larger (smaller) stock market capitalization relative to GDP.

The low unconditional correlation in the data has prompted some authors to find alternatives to aggregate consumption risk for explaining risk and returns. Our results, however, show that time-varying consumption correlation retains an important role for understanding the cyclical properties of a wide range of variables of interest: the equity premium, Sharpe ratio and risk aversion. Echoing Jagannathan and Wang (1996) and others, we show the important role of labor income for understanding the risk-return tradeoff. In particular, we stress that combining financial and macro indicators is a fruitful approach. However, our approach cannot explain the level of the covariance between consumption and returns and, hence, the equity premium puzzle. Incorporating realistic features of consumer behavior, like habit-formation and adjustment costs, may be necessary to explain both the level and variation in the covariance and the equity premium.

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Data Appendix

U.S.

1. Sample dates: January 1959 Q1 to June 2003.
2. Monthly and quarterly consumption expenditures (seasonally adjusted) on nondurables and services, and population figures, from USECON.
3. CPI, unemployment rates, GDP and Treasury bill/bond yields from the FRED II database of the Federal Reserve Bank of St. Louis.
4. The S&P 500 index returns, from Bloomberg.
5. The S&P 500 dividend yield and Moody's BAA corporate bond yields from DFDATA.
6. Moody's AA corporate bond yields from DRI.
7. The consumption-wealth ratio *CAY*, from Martin Lettau's web site http://pages.stern.nyu.edu/~mlettau/research.htm.
8. The price-earnings ratio, from Robert Shiller's web site http://aida.econ.yale.edu/~shiller/.
9. The ratio of stock market wealth to consumption, from Gregory R. Duffee's web site http://faculty.haas.berkeley.edu/duffee/

U.K.

1. Sample dates: 1963 Q1 to 2003 Q1 except unemployment data, which starts from 1965 Q1.
2. Quarterly nondurable and services (seasonally adjusted) and GDP, at current prices, from the U.K. Office of National Statistics.
3. Midyear population statistics, from www.census.gov/ipc/www/idbprint.html. The mid-year statistics were used to interpolate quarterly population figures.
4. Consumer Price Index, from quarterly OECD economic indicators.
5. Monthly FT-Actuaries All-share total return stock index, corporate and Treasury bond rates, the dividend yield and price-earnings ratio from Global Financial Data.
6. Unemployment rates from DRI International.

Canada

1. Sample dates: 1961 Q1 to 2003 Q2 except unemployment data, which starts from 1966 Q1.
2. Quarterly private final consumption expenditure (seasonally adjusted), at current prices, from OECD Quarterly National Accounts.
3. Midyear population, from the U.S. Census Bureau www.census.gov/ipc/www/idbprint.html. The mid-year statistics were used to interpolate quarterly population figures.
4. Consumer Price Index, from quarterly OECD economic indicators.
5. Monthly S&P/Toronto Stock Exchange Composite Index, corporate and Treasury bond rates, from Statistics Canada Online.
6. The dividend yield and price-earnings ratio from Global Financial Data.
7. Unemployment rates from DRI International.

Japan

1. Sample dates: 1970 Q1 to 2003 Q1.
2. Quarterly Household Consumption Expenditure (seasonally adjusted), at current prices, from IMF's International Financial Statistics.
3. Midyear population, from the U.S. Census Bureau www.census.gov/ipc/www/idbprint.html. The mid-year statistics were used to interpolate quarterly population figures.

4. Consumer Price Index, from quarterly OECD economic indicators.
5. Monthly MSCI stock index, from Morgan Stanley Capital International.
6. Corporate and Treasury bond rates, the dividend yield and price-earnings ratio from Global Financial Data.
7. Unemployment rates from DRI International.

France

1. Sample dates: 1970 Q1 to 2003 Q2 except unemployment data, which starts from 1970 Q4.
2. Quarterly Private Final Consumption Expenditure (seasonally adjusted), at current prices, from OECD Quarterly National Accounts.
3. Midyear population, from the U.S. Census Bureau www.census.gov/ipc/www/idbprint.html. The mid-year statistics were used to interpolate quarterly population figures.
4. Consumer Price Index, from quarterly OECD economic indicators.
5. Monthly MSCI stock index, from Morgan Stanley Capital International.
6. Corporate and Treasury bond rates, the dividend yield and price-earnings ratio from Global Financial Data.
7. Unemployment rates from DRI International.

Germany

1. Sample dates: 1970 Q1 to 2003 Q2.
2. Western Germany Private Final Consumption Expenditure until 1990, and United Germany Private Final Consumption Expenditure from 1991. Both series are quarterly, at current prices, seasonally adjusted, and from the OECD Quarterly National Accounts.
3. Midyear population, from the U.S. Census Bureau www.census.gov/ipc/www/idbprint.html. The mid-year statistics were used to interpolate quarterly population figures.
4. Consumer Price Index, from quarterly OECD economic indicators.
5. Monthly MSCI stock index, from Morgan Stanley Capital International.
6. Corporate and Treasury bond rates, the dividend yield and price-earnings ratio from Global Financial Data.
7. Unemployment rates from DRI International.

Italy

1. Sample dates: 1970 Q1 to 2003 Q1 except unemployment data, which starts from 1980 Q1.
2. Quarterly Private Final Consumption Expenditure (seasonally adjusted), at current prices, from OECD Quarterly National Accounts.
3. Midyear population, from the U.S. Census Bureau www.census.gov/ipc/www/idbprint.html. The mid-year statistics were used to interpolate quarterly population figures.
4. Consumer Price Index, from quarterly OECD economic indicators.
5. Monthly MSCI stock index, from Morgan Stanley Capital International.
6. Corporate and Treasury bond rates, the dividend yield and price-earnings ratio from Global Financial Data.
7. Unemployment rates from DRI International.

TABLE 1. Descriptive Statistics for U.S. Monthly and G7 Quarterly Data

The table shows statistics for U.S. monthly and G7 countries (the U.S., Canada, the UK, Germany, France, Italy and Japan) quarterly data. All data are converted to real terms using the local Consumer Price Index, and annualized. The equity market capitalization (*Mcap*) is in trillions of U.S. dollars for end-2002, *Mgdp* is the ratio of *Mcap* to GDP, and CORR is the sample correlation between per capita log consumption growth (*CGRO*) and the equity premium (*EP*). *EP* is the difference between stock returns (in local currencies) and the local short-term Treasury rate. The implied risk-aversion γ is given by:

$$\gamma = \frac{E(EP)}{\sigma(CGRO)\sigma(EP)\rho(CGRO,EP)}$$

where ρ is the correlation CORR. Data sources and sample dates are in the data appendix.

Country	Mcap	Mgdp	CORR	Implied risk-aversion		OBS	Mean	Median	Max	Min	SD
U.S.	11.06	1.04									
Monthly			0.24	90.86	*CGRO*	533	1.97	2.24	21.79	-21.61	1.55
					EP		4.13	6.45	130.02	-162.35	12.19
Quarterly			0.34	60.70	*CGRO*	178	1.97	2.06	8.51	-7.44	1.33
					EP		4.12	8.24	87.42	-113.81	14.98
Canada	0.57	0.76	0.12	51.84	*CGRO*	169	2.07	2.13	12.16	-13.05	1.88
					EP		1.93	3.88	74.05	-111.59	16.52
U.K.	1.80	4.21	-0.01	<0	*CGRO*	160	2.14	2.59	11.66	-15.69	2.20
					EP		7.51	14.13	219.79	-130.82	20.06
Italy	0.48	0.36	0.04	162.05	*CGRO*	132	2.58	2.69	10.59	-5.94	1.48
					EP		1.00	0.43	205.64	-124.33	26.83
Japan	2.10	0.50	-0.04	<0	*CGRO*	133	2.16	2.44	15.23	-31.45	3.11
					EP		7.27	8.05	130.33	-157.73	24.95
France	0.97	0.61	-0.01	<0	*CGRO*	133	2.07	1.90	28.08	-8.10	1.86
					EP		7.07	8.78	132.81	-181.51	25.04
Germany	0.69	1.24	-0.08	<0	*CGRO*	133	1.97	1.12	49.05	-63.43	13.12
					EP		7.74	7.83	132.10	-181.34	23.22

TABLE 2. Sample Correlation for Different Time Periods and Macro Economic Conditions

The table shows the correlation (CORR) and covariance (COV) between per capita log consumption growth (*CGRO*) and the equity premium (*EP*), and the mean and standard deviation (SD) of *CGRO* and *EP* for different decades of U.S. monthly and G7 quarterly data. Let *M* be the growth in real industrial production (*IG*), or the unemployment rate (*UG*) or real GDP (*GG*). Let E(*M*) be the sample mean of *M*. Define dummy variables D_1 and D_2 as follows:

$$D_{1,t} = 1\, if\ M_t > E(M),$$

$$D_{2,t} = 1\, if\ M_t \leq E(M),$$

and they are 0 otherwise. We show CORR conditional on $D_{1,t\text{-}1}$ and $D_{2,t\text{-}1}$. All data are converted to real terms using the local Consumer Price Index, and annualized. Data sources and sample dates are in the data appendix. *Start* and *End* indicate the sample start and end dates, respectively. *P-values* for CORR are in parentheses. Estimates significant at the 5 (10) percent level or less are marked by ** (*).

Panel A: U.S. monthly data

	Start to 1969	1970 to 1979	1980 to 1989	1990 to end	D_1 (*IG*)	D_2 (*IG*)	D_1 (*UG*)	D_2 (*UG*)
OBS	131	120	120	162	275	257	188	345
CORR	0.21**	0.20**	0.32**	0.25**	0.17**	0.29**	0.33**	0.19**
	(0.02)	(0.03)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
COV	3.67	4.44	6.49	3.97	2.73	6.52	6.68	3.36
SD *EP*	10.22	13.19	13.16	12.17	10.52	13.74	13.42	11.43
SD *CGRO*	1.70	1.72	1.53	1.29	1.49	1.62	1.52	1.57
Mean *EP*	3.80	-0.48	7.25	5.49	7.02	1.11	8.54	1.72
Mean *CGRO*	2.74	1.76	2.07	1.45	2.03	1.90	2.11	1.90

Panel B: G7 quarterly data

	Start to 1969	1970 to 1979	1980 to 1989	1990 to end	D_1 (*GG*)	D_2 (*GG*)	D_1 (*UG*)	D_2 (*UG*)
U.S.								
OBS	44	40	40	54	83	93	59	117
CORR	0.21	0.38**	0.31**	0.46**	0.27**	0.36**	0.46**	0.24**
	(0.16)	(0.02)	(0.05)	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)
COV	2.99	9.41	8.12	7.29	3.17	9.55	13.70	3.49
SD *EP*	12.43	17.22	16.27	14.31	11.32	17.74	17.84	13.53
SD *CGRO*	1.13	1.44	1.63	1.12	1.05	1.50	1.67	1.06
Mean *EP*	3.79	-0.48	7.25	5.49	6.55	1.89	4.22	4.02
Mean *CGRO*	2.72	1.76	2.07	1.45	2.54	1.41	1.00	2.42
Canada								
OBS	35	40	40	54	88	80	63	85
CORR	0.04	0.06	0.25	0.06	0.00	0.21*	0.18	0.02
	(0.84)	(0.71)	(0.12)	(0.68)	(0.97)	(0.06)	(0.16)	(0.82)
COV	0.88	2.05	8.42	1.56	-0.12	7.22	6.63	0.62
SD *EP*	12.53	15.94	19.26	17.38	15.41	17.79	16.23	17.81
SD *CGRO*	2.01	2.13	1.73	1.57	1.82	1.95	2.29	1.43
Mean *EP*	4.67	2.74	0.26	0.81	1.28	2.32	3.42	-0.20
Mean *CGRO*	3.18	3.00	1.40	1.14	2.22	1.84	1.29	2.32

TABLE 2 (continued). Sample Correlation for Different Time Periods and Macro Economic Conditions

	Start to 1969	1970 to 1979	1980 to 1989	1990 to end	D_1 (*GG*)	D_2 (*GG*)	D_1 (*UG*)	D_2 (*UG*)
U.K.								
OBS	27	40	40	53	88	71	59	92
CORR	0.24	-0.22	0.01	0.12	-0.06	0.03	-0.03	-0.01
	(0.22)	(0.17)	(0.95)	(0.38)	(0.56)	(0.78)	(0.80)	(0.94)
COV	9.26	-14.36	0.49	3.03	-2.42	1.69	-1.66	-0.32
SD *EP*	14.42	28.46	17.57	16.48	17.43	23.02	19.66	20.28
SD *CGRO*	2.64	2.30	2.59	1.49	2.21	2.20	2.45	2.01
Mean *EP*	8.72	5.55	14.58	3.05	10.32	4.28	19.12	0.71
Mean *CGRO*	2.02	1.75	2.64	2.13	2.23	1.96	2.08	2.24
Italy								
OBS	---	39	40	53	57	74	47	44
CORR	---	0.08	0.07	0.00	0.07	-0.02	0.03	0.05
		(0.64)	(0.66)	(0.99)	(0.59)	(0.88)	(0.83)	(0.75)
COV		3.73	2.96	-0.07	2.61	-0.74	1.09	1.85
SD *EP*	---	27.44	30.14	23.44	26.36	27.15	27.09	26.53
SD *CGRO*	---	1.77	1.35	1.26	1.36	1.51	1.23	1.41
Mean *EP*	---	-12.68	8.12	-2.61	4.93	-7.13	0.71	2.61
Mean *CGRO*	---	3.08	3.22	1.74	3.34	2.05	2.50	2.10
Japan								
OBS	---	39	40	53	65	66	72	59
CORR	---	0.10	0.14	-0.35*	-0.05	0.00	0.08	-0.11
		(0.54)	(0.40)	(0.01)	(0.70)	(0.98)	(0.51)	(0.39)
COV		8.40	8.41	-25.92	-4.79	-0.20	3.96	-11.99
SD *EP*	---	22.54	23.22	26.26	26.15	23.76	23.88	25.98
SD *CGRO*	---	3.72	2.66	2.84	3.71	2.42	2.13	4.02
Mean *EP*	---	12.92	21.69	-7.77	9.37	6.16	12.57	1.87
Mean *CGRO*	---	3.68	2.28	0.94	1.97	2.31	2.59	1.60
France								
OBS	---	39	40	54	69	62	57	72
CORR	---	0.18	-0.23	-0.14	0.09	-0.20	-0.17	0.10
		(0.26)	(0.16)	(0.31)	(0.45)	(0.11)	(0.22)	(0.40)
COV		12.64	-9.98	-3.47	4.82	-7.63	-7.13	4.93
SD *EP*	---	27.55	27.18	21.65	24.53	25.97	26.72	24.55
SD *CGRO*	---	2.49	1.62	1.14	2.13	1.45	1.60	2.01
Mean *EP*	---	8.45	10.34	3.66	11.61	2.08	6.51	7.51
Mean *CGRO*	---	3.95	1.54	1.11	2.63	1.33	1.15	2.68
Germany								
OBS	---	39	40	54	81	51	86	46
CORR	---	-0.43**	0.18	0.05	-0.05	0.07	0.02	-0.19
		(0.01)	(0.27)	(0.72)	(0.68)	(0.60)	(0.86)	(0.20)
COV		-160.32	59.81	6.55	-15.86	10.29	5.37	-63.65
SD *EP*	---	20.32	22.92	25.42	21.79	24.07	22.11	24.80
SD *CGRO*	---	18.29	14.69	5.24	15.62	5.76	13.01	13.30
Mean *EP*	---	9.30	13.49	2.36	15.26	-2.58	10.25	4.85
Mean *CGRO*	---	5.13	1.43	0.09	-3.10	9.30	1.03	2.92

TABLE 3. Statistics of Prediction Variables for U.S. Monthly and Quarterly Data

The table shows statistics of prediction variables for U.S. monthly and quarterly data. All data are converted to real terms using the local Consumer Price Index, and annualized. Panel A shows the distribution of the default spread *DEF* (Moody's BAA minus AA corporate bond yields), the S&P 500 dividend yield *DIVY*, the price-earnings ratio *PE*, and the term structure *TERM* (the constant maturity 10-year Treasury note minus the 3-month Treasury bill yields). Panel B shows the sample correlation of lagged values of these variables with each other and with the per capita log consumption growth (*CGRO*) and equity premium (*EP*). *EP* is the difference between stock returns and the 3-month Treasury bill rate. The prefix "L" before the variable name denotes a one period lag. Data sources and sample dates are in the data appendix.

Panel A. Distribution of prediction variables

	OBS	Mean	Median	Max	Min	SD
U.S. monthly data						
DEF	534	0.71	0.63	1.91	0.10	0.09
PE	534	18.68	17.90	44.20	6.64	2.39
DIVY	534	3.34	3.23	6.32	1.09	0.33
TERM	534	1.39	1.34	4.42	-2.63	0.35
U.S. quarterly data						
DEF	178	0.71	0.64	1.79	0.24	0.15
PE	178	18.68	17.87	43.06	6.89	4.14
DIVY	178	3.34	3.22	6.09	1.09	0.57
TERM	178	1.39	1.38	3.79	-1.42	0.59

Panel B: Sample correlation of prediction variables

	CGRO	*EP*	L*DEF*	L*PE*	L*DIVY*	L*TERM*
U.S. monthly data						
L*DEF*	-0.02	0.10	1.00			
L*PE*	0.04	-0.03	-0.57	1.00		
L*DIVY*	-0.07	0.05	0.57	-0.91	1.00	
L*TERM*	0.16	0.12	0.25	-0.13	-0.04	1.00
U.S. quarterly data						
L*DEF*	0.04	0.10	1.00			
L*PE*	0.06	-0.07	-0.58	1.00		
L*DIVY*	-0.09	0.10	0.58	-0.92	1.00	
L*TERM*	0.32	0.14	0.26	-0.14	-0.03	1.00

TABLE 4. VAR Results for U.S. Monthly and Quarterly Data

For U.S. monthly and quarterly data, the table presents results from a Vector Autoregression (VAR) with endogenous variables *CGRO* and *EP*, and exogenous variables L*DIVY*, L*TERM*, L*PE*, and L*DEF*. The prefix "L" refers to one period lag values. *DIVY* is the S&P 500 dividend yield, *TERM* is the constant maturity 10-year Treasury note yield minus the 3-month Treasury bill rate, *PE* is the price-earnings ratio, and *DEF* is the default spread (the difference between Moody's BAA and AA corporate bond yields). All data are converted to real terms by using the local Consumer Price Index. Data sources and sample dates are in the data appendix. Estimates significant at the 5 (10) percent level or less are marked by ** (*).

		U.S. monthly data				U.S. quarterly data			
		Estimate	t-stats	Estimate	t-stats	Estimate	t-stats	Estimate	t-stats
		CGRO		*EP*		*CGRO*		*EP*	
Intercept		-0.01	-0.06	-4.53**	-2.18	-0.83	-1.24	-15.58*	-1.90
CGRO	Lag 1	-0.28**	-6.34	-0.08	-0.24	0.14*	1.81	-0.67	-0.70
	Lag 2	0.01	0.22	-0.35	-0.97	-0.00	-0.06	-0.37	-0.40
	Lag 3	0.17**	3.96	0.26	0.75	0.24**	3.17	0.82	0.88
EP	Lag 1	0.01	0.94	0.27**	6.03	0.01	0.74	0.08	0.95
	Lag 2	0.01**	2.15	-0.08*	-1.67	-0.00	-0.31	-0.05	-0.61
	Lag 3	0.00	0.46	0.02	0.53	0.01	0.97	0.01	0.13
Exogenous variables									
L*DIVY*		0.20	0.39	8.36**	1.99	0.41	0.91	10.78**	1.97
L*TERM*		0.84**	4.06	4.39**	2.61	0.63**	3.48	5.23**	2.33
L*PE*		0.05	0.73	1.07*	1.88	0.09	1.46	1.23*	1.67
L*DEF*		-0.77	-0.84	5.52	0.75	0.88	1.11	0.59	0.06
Adjusted R-square		0.13		0.08		0.22		0.07	
F-Test, *CGRO*		18.85		0.67		4.95		0.45	
		(p=0.00)		(p=0.57)		(p=0.00)		(p=0.72)	
F-Test, *EP*		2.54		11.90		0.49		0.40	
		(p=0.06)		(p=0.00)		(p=0.69)		(p=0.75)	

Table 5. VAR-GARCH(1,1) Results: U.S. Monthly and Quarterly Data

The table presents results for the VAR-GARCH(1,1) model using U.S. monthly (USM) and quarterly (USQ) data. Panel A presents the GARCH estimates when the conditional correlation CCORR is restricted to be constant:

$$R_{it} = \alpha_{i0} + \sum_{j=1}^{2} \sum_{\tau=1}^{3} \alpha_{j\tau} R_{jt-\tau} + \sum_{j=1}^{4} \beta_{ij} z_{j,t-1} + e_{it}$$

$$h_{iit} = a_i + b_i\, e_{it-1} e_{it-1} + c_i\, h_{iit-1} \qquad i=1,2$$

$$h_{ijt} = r_{ij} \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j$$

where i=1 (log per capita log consumption growth *CGRO*) or 2 (equity premium *EP*), h_{iit} is the conditional variance, and h_{ijt} is the conditional covariance for $i \neq j$. a_i is the intercept term (*Intercept*), b_i is the *Arch* coefficient, and c_i is the *Garch* coefficient. $z_{j,t}$ is the j-th exogenous prediction variable where j={*DIVY*, *TERM*, *DEF*, *PE*}. *DIVY* is the S&P 500 dividend yield, *TERM* is the constant maturity 10-year Treasury note yield minus the 3-month Treasury bill rate, *PE* is the price-earnings ratio, *DEF* is Moody's BAA minus AA corporate bond yields.

In Panels B, C and D of the table, CCORR varies with dummy variables as follows:

$$h_{ijt} = \left(\sum_{k=1}^{n} r_k D_{k,t-1}\right) \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j$$

where $D_{k,,t-1}$ is a dummy variable evaluated at time t-1 and n is the number of dummy variables. Let M be the growth in real industrial production (*IG*), the unemployment rate (*UG*) or real GDP (*GG*). Let C be *RR*, the return residual e_2 from the VAR, or *MEC*, the ratio of stock market wealth to consumption. Note that the *MEC* series ends 2002 Q2, one year earlier than the remaining data. Let E(M) and E(C) be the sample means of M and C. The column heading identifies the appropriate combination of variables. The dummies are:

$$D_{1,t} = 1\, if\ M_t > E(M),$$

$$D_{2,t} = 1\, if\ M_t \leq E(M),$$

$$D_{3,t} = 1\, if\ C_t > E(C),$$

$$D_{4,t} = 1\, if\ C_t \leq E(C),$$

and they are 0 otherwise. Finally, macro and return information are combined to define four more dummies:

$D_{5,t}$=1 if $D_{1,t}$=1 and $D_{3,t}$=1, and 0 otherwise.
$D_{6,t}$=1 if $D_{1,t}$=1 and $D_{4,t}$=1, and 0 otherwise.
$D_{7,t}$=1 if $D_{2,t}$=1 and $D_{3,t}$=1, and 0 otherwise.
$D_{8,t}$=1 if $D_{2,t}$=1 and $D_{4,t}$=1, and 0 otherwise.

In Panel D, columns *ARR* and *UG*+*ARR*, D_3 and D_4 are based on *ARR*, the absolute value of *RR*, as follows:

$$D_{3,t} = 1\, if\ |RR| > E(RR) + \sigma(RR),$$

$$D_{4,t} = 1\, if\ |RR| \leq E(RR) + \sigma(RR),$$

and 0 otherwise. E(*RR*) and σ(*RR*) are the sample mean and standard deviation of *RR*.

Finally, in column *UG*+*CAY*, we include *CAY*, the aggregate consumption-wealth ratio, in the mean equations. We also include *CAY* in the return variance h_{22} and covariance equations as follows:

$$h_{22t} = a_2 + b_2 e_{22t-1} e_{22t-1} + c_2 h_{22t-1} + s_2 CAY_{t-1}$$

$$h_{ijt} = \left(r_0 CAY_{t-1} + \sum_{k=1}^{2} r_k D_{k,t-1}\right) \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j$$

We test the restriction that the dummy coefficients are equal with the Likelihood Ratio test *LR*: $LR = 2 * (ULOGL - RLOGL) \sim \chi^2 (k-1)$

where *ULOGL* (*RLOGL*) is the value of the unrestricted (restricted) log-likelihood function, and k is the number of restrictions. Estimates significant at the 5 (10) percent level or less are marked by ** (*). Data sources and sample dates are in the data appendix.

Table 5(continued): VAR-GARCH(1,1) Results: US monthly and Quarterly Data

Panel A: Constant correlation model

	USM		USQ	
	CGRO	*EP*	*CGRO*	*EP*
Intercept (a_i)	0.18**	9.67**	0.31**	82.77**
	(3.18)	(2.27)	(4.91)	(15.15)
Arch (b_i)	0.13**	0.18**	0.39**	-0.05**
	(2.31)	(2.90)	(3.01)	(-2.45)
Garch (c_i)	-0.21	-0.03	-0.19**	-0.46**
	(-0.69)	(-0.08)	(-3.18)	(-5.28)
CCORR		0.26**		0.34**
		(6.70)		(6.08)

Panel B: USM: Correlation varying with *IG*, *UG* and *RR*

	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
	UG		*RR*		*UG+RR*		*IG*		*IG+RR*	
D_1	0.33**	5.71	---	---	---	---	0.27**	4.01	---	---
D_2	0.20**	3.72	---	---	---	---	0.26**	5.19	---	---
D_3	---	---	0.29**	4.74	---	---	---	---	---	---
D_4	---	---	0.23**	4.45	---	---	---	---	---	---
D_5	---	---	---	---	0.35**	3.58	---	---	0.28**	3.10
D_6	---	---	---	---	0.32**	4.94	---	---	0.24**	3.73
D_7	---	---	---	---	0.26**	3.40	---	---	0.30**	3.34
D_8	---	---	---	---	0.15**	2.00	---	---	0.23**	2.64
Tests of coefficient restrictions										
LR	10.94**		8.92**		11.98**		0.04		0.48	

Panel C: USQ: Correlation varying with *GG*, *UG* and *RR*

	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
	UG		*RR*		*UG+RR*		*GG*		*GG+RR*	
D_1	0.45**	5.05	---	---	---	---	0.33**	2.45	---	---
D_2	0.22**	3.44	---	---	---	---	0.36**	5.24	---	---
D_3	---	---	0.47**	6.76	---	---	---	---	---	---
D_4	---	---	0.25**	2.92	---	---	---	---	---	---
D_5	---	---	---	---	0.60**	5.08	---	---	0.45**	5.37
D_6	---	---	---	---	0.30**	2.57	---	---	0.19*	1.90
D_7	---	---	---	---	0.36**	3.58	---	---	0.57**	4.85
D_8	---	---	---	---	0.18	1.33	---	---	0.16	0.89
Tests of coefficient restrictions										
LR	8.08**		5.12**		10.54**		0.96		7.40*	

Table 5(continued): VAR-GARCH(1,1) Results: US monthly and Quarterly Data

Panel D: USQ: Correlation varying with *UG*, *MEC*, *ARR* and *CAY*

	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat	Estimate	t-stat
	MEC		*UG+MEC*		*ARR*		*UG+ARR*		*UG+CAY*	
s_2	---	---	---	---	---	---	---	---	-6.88**	-1.77
r_0	---	---	---	---	---	---	---	---	0.11**	2.05
D_1	---	---	---	---	---	---	---	---	0.48**	8.54
D_2	---	---	---	---	---	---	---	---	0.23**	1.98
D_3	0.49**	7.15	---	---	0.46**	3.89	---	---	---	---
D_4	0.29**	3.88	---	---	0.31**	4.87	---	---	---	---
D_5	---	---	0.47**	2.51	---	---	0.55**	4.69	---	---
D_6	---	---	0.32**	2.48	---	---	0.35**	2.26	---	---
D_7	---	---	0.43**	5.66	---	---	0.39**	7.21	---	---
D_8	---	---	0.19	1.16	---	---	0.22	1.62	---	---
Tests of coefficient restrictions										
LR	3.22*		6.42*		3.46*		8.44**		5.60*	

Table 6. VAR-GARCH-M(1,1) Estimation Results: U.S. Monthly and Quarterly Data

The table presents results from a VAR-GARCH-M(1,1):

$$R_{1t} = \alpha_{10} + \sum_{j=1}^{2} \sum_{\tau=1}^{3} \alpha_{j\tau} R_{jt-\tau} \sum_{j=1}^{P} \beta_{1j} z_{j,t-1} + e_{1t}$$

$$R_{2t} = \alpha_{20} + \sum_{j=1}^{2} \sum_{\tau=1}^{3} \alpha_{j\tau} R_{jt-\tau} + \sum_{j=1}^{4} \beta_{2j} z_{j,t-1} + \gamma h_{22t} + e_{2t}$$

$$h_{iit} = a_i + b_i\, e_{it-1} e_{it-1} + c_i\, h_{iit-1} \qquad i=1,2$$

where i=1 (per capita log consumption growth *CGRO*) or 2 (equity premium *EP*), and h_{iit} is the conditional variance. R_{2t} also depends on the return variance h_{22t}. $z_{j,t}$ is the j-th exogenous prediction variable where j={*DIVY*, *TERM*, *DEF*, *PE* and *CAY* (for USQ only)}. *DIVY* is the S&P 500 dividend yield; *TERM* is the constant maturity 10-year Treasury note minus the 3-month Treasury bill yields; *PE* is the price-earnings ratio; *DEF* is Moody's BAA minus AA corporate bond yields and *CAY* is the consumption-wealth ratio. The correlation r_k varies as follows:

$$h_{ijt} = (\sum_{k=1}^{n} r_k D_{k,t-1})\sqrt{h_{iit}}\sqrt{h_{jjt}} \qquad i \neq j$$

where $D_{k,,t-1}$ is a dummy variable evaluated at time t-1 and n is the number of dummy variables. Let M be the growth in real industrial production *IG*, unemployment rate *UG* or real GDP *GG*. Let E(M) be the sample mean of M. Then:

$$D_{1,t} = 1\, if\ M_t > E(M),$$

$$D_{2,t} = 1\, if\ M_t \leq E(M),$$

and 0 otherwise. Next, let *RR* be the return residual e_2 from the VAR, and E(*RR*) the sample mean of *RR*. Define:

$$D_{3,t} = 1\, if\ RR > E(RR),$$

$$D_{4,t} = 1\, if\ RR \leq E(RR),$$

$D_{5,t}$=1 if $D_{1,t}$=1 and $D_{3,t}$=1, and 0 otherwise.
$D_{6,t}$=1 if $D_{1,t}$=1 and $D_{4,t}$=1, and 0 otherwise.
$D_{7,t}$=1 if $D_{2,t}$=1 and $D_{3,t}$=1, and 0 otherwise.
$D_{8,t}$=1 if $D_{2,t}$=1 and $D_{4,t}$=1, and 0 otherwise.
We test the restriction that the dummy coefficients are equal with the Likelihood Ratio test *LR*:

$$LR = 2*(ULOGL - RLOGL) \sim \chi^2(k-1)$$

where *ULOGL* (*RLOGL*) is the value of the unrestricted (restricted) log-likelihood function, and k is the number of coefficient restrictions. Estimates significant at the 5 (10) percent level or less are marked by ** (*). Data sources and sample dates are in the data appendix.

	USM				USQ			
	UG	*UG+RR*	*IG*	*IG+RR*	*UG*	*UG+RR*	*GG*	*GG+RR*
γ	-0.05	-0.05	-0.04	-0.04	-0.16**	-0.11**	-0.17**	-0.10**
	(-0.80)	(-0.81)	(-0.76)	(-0.80)	(-2.33)	(-2.95)	(-4.19)	(-2.48)
D_1	0.33**	---	0.26**	---	0.53**	---	0.33**	---
	(6.08)		(4.13)		(8.02)		(2.49)	
D_2	0.21**	---	0.26	---	0.24**	---	0.41**	---
	(3.68)		(5.19)		(2.46)		(8.20)	
D_5	---	0.32**	---	0.28**	---	0.69**	---	0.64**
		(3.22)		(3.44)		(6.89)		(6.61)
D_6	---	0.33**	---	0.24**	---	0.45**	---	0.11
		(5.04)		(3.84)		(4.98)		(0.44)
D_7	---	0.27**	---	0.30**	---	0.41**	---	0.35**
		(3.42)		(3.51)		(4.22)		(3.80)
D_8	---	0.15*	---	0.23**	---	0.12	---	0.45**
		(1.90)		(2.54)		(0.68)		(4.63)
Test of coefficient restrictions								
LR	2.84*	6.38*	0.24	2.48	6.70**	8.02**	1.58	7.36*

TABLE 7. Statistics of prediction variables for non-U.S. G7 Quarterly Data

The table shows statistics for non-U.S. G7 quarterly data. All data are converted to real terms using the local Consumer Price Index, and annualized. Panel A shows the distribution of the default spread *DEF* (the corporate bond yield minus the long-term Treasury yield), the dividend yield *DIVY*, the price-earnings ratio *PE*, and the term structure *TERM* (the 10-year Treasury note minus the 3-month Treasury bill). Panel B shows the sample correlation of one-period lagged values of these variables with each other and with the per capita log consumption growth (*CGRO*) and equity premium (*EP*). The prefix "L" before the variable denotes the lag. *EP* is the difference between stock returns and the 3-month Treasury bill rate. Data sources and sample dates are in the data appendix.

Panel A. Distribution of prediction variables

	OBS	Mean	Median	Max	Min	SD
Canada						
DEF	170	0.94	0.93	2.61	0.17	0.21
DIVY	170	3.17	3.25	6.31	1.06	0.49
PE	170	21.69	16.73	156.50	6.58	9.98
TERM	170	1.24	1.37	4.03	-3.33	0.76
U.K.						
DEF	161	1.05	0.98	4.18	0.00	0.31
DIVY	161	4.49	4.36	12.04	2.11	0.66
PE	161	14.43	13.78	28.64	4.02	2.57
TERM	161	0.79	0.96	6.33	-4.11	1.00
Italy						
DEF	133	0.08	0.14	2.80	-4.97	0.81
DIVY	133	2.85	2.59	5.64	1.25	0.53
PE	76	37.50	20.80	368.30	10.20	29.21
TERM	133	0.25	0.73	2.96	-4.58	0.86
Japan						
DEF	133	0.24	0.27	2.39	-1.43	0.37
DIVY	133	1.30	1.14	4.03	0.33	0.38
PE	133	108.29	34.94	1000.00	9.59	115.51
TERM	133	1.93	1.83	3.59	0.59	0.33
France						
DEF	134	0.33	0.34	1.42	-0.64	0.15
DIVY	134	4.30	3.73	9.42	1.32	0.97
PE	134	19.48	15.20	101.90	4.40	6.91
TERM	134	1.24	1.47	4.69	-3.12	0.75
Germany						
DEF	134	0.51	0.43	2.99	-0.21	0.23
DIVY	134	3.50	3.47	6.01	1.50	0.51
PE	134	17.25	14.30	63.40	7.40	4.87
TERM	134	1.71	1.81	5.08	-0.94	0.57

TABLE 7 (continued). Statistics of prediction variables for non-U.S. G7 Quarterly Data

Panel B: Sample correlation of prediction variables

	CGRO	*EP*	L*DEF*	L*DIVY*	L*PE*	L*TERM*
Canada						
L*DEF*	-0.13	-0.08	1.00			
L*DIVY*	-0.11	0.10	0.25	1.00		
L*PE*	0.01	0.03	0.03	-0.37	1.00	
L*TERM*	0.35	0.13	-0.07	-0.37	0.32	1.00
U.K.						
L*DEF*	-0.03	-0.04	1.00			
L*DIVY*	-0.11	0.30	0.01	1.00		
L*PE*	0.08	-0.18	0.01	-0.87	1.00	
L*TERM*	0.05	0.10	-0.12	0.22	-0.13	1.00
Italy						
L*DEF*	0.16	0.04	1.00			
L*DIVY*	0.01	-0.01	-0.01	1.00		
L*PE*	-0.04	-0.01	0.02	-0.28	1.00	
L*TERM*	0.08	0.07	0.90	-0.03	0.32	1.00
Japan						
L*DEF*	0.03	0.03	1.00			
L*DIVY*	0.07	0.12	-0.07	1.00		
L*PE*	-0.10	-0.07	-0.14	-0.15	1.00	
L*TERM*	-0.01	0.11	-0.43	0.23	-0.26	1.00
France						
L*DEF*	0.08	-0.04	1.00			
L*DIVY*	0.11	0.01	0.36	1.00		
L*PE*	-0.15	-0.01	-0.15	-0.27	1.00	
L*TERM*	0.09	0.28	-0.28	0.06	0.15	1.00
Germany						
L*DEF*	0.00	-0.07	1.00			
L*DIVY*	-0.04	0.05	-0.06	1.00		
L*PE*	-0.00	-0.08	0.01	-0.58	1.00	
L*TERM*	0.03	0.11	-0.15	-0.14	-0.03	1.00

Table 8. VAR Results for non-U.S. G7 Quarterly Data

For non-U.S. G7 quarterly data, the table presents results from a Vector Autoregression (VAR) with endogenous variables *CGRO* and *EP*, and exogenous variables L*DIVY*, L*TERM*, L*PE*, and L*DEF*. The prefix "L" refers to one period lag values. *DIVY* is the dividend yield, *TERM* is the 10-year Treasury note minus the 3-month Treasury bill rates, *PE* is the price-earnings ratio, and *DEF* is the corporate bond minus long-term Treasury yields.. All data are converted to real terms through deflating by the local Consumer Price Index (CPI). Data sources and sample dates are in the data appendix. Estimates significant at the 5 (10) percent level or less are marked by ** (*).

		Estimate	t-stats	Estimate	t-stats	Estimate	t-stats	Estimate	t-stats
		CGRO		***EP***		***CGRO***		***EP***	
			Canada				**UK**		
Intercept		-0.15	-0.46	-3.33	-1.00	1.17	1.11	-34.72**	-3.46
CGRO	Lag 1	-0.27**	-3.28	0.69	0.83	-0.18**	-2.27	0.90	1.22
	Lag 2	-0.02	-0.20	-0.09	-0.11	-0.02	-0.24	0.06	0.08
	Lag 3	0.24**	3.32	-0.65	-0.87	-0.22**	-2.85	-0.09	-0.13
	Lag 4	0.17**	2.41	0.21	0.29	0.24**	3.13	1.04	1.41
EP	Lag 1	0.04**	4.31	0.06	0.76	-0.01	-1.50	0.17**	2.13
	Lag 2	0.01	1.16	-0.08	-0.92	0.00	0.40	0.06	0.81
	Lag 3	0.01	1.32	-0.01	-0.10	0.00	0.57	0.14*	1.86
	Lag 4	0.00	-0.10	-0.12	-1.36	0.01	1.33	-0.04	-0.53
Exogenous variables									
L*DEF*		0.32	0.46	-10.93	-1.55	-0.34	-0.66	-0.72	-0.15
L*DIVY*		0.32	1.06	6.11*	1.97	-0.45	-0.85	21.59**	4.25
L*PE*		-0.01	-0.94	0.09	0.62	0.00	-0.02	3.02**	2.50
L*TERM*		0.97**	4.68	3.27	1.54	0.18	1.09	-0.40	-0.25
Adjusted R-square		0.26		0.02		0.17		0.11	
F-Test, *CGRO*		5.77		0.44		9.01		0.68	
		(p=0.00)		(p=0.78)		(p=0.00)		(p=0.61)	
F-Test, *EP*		5.28		0.80		1.07		1.98	
		(p=0.00)		(p=0.53)		(p=0.37)		(p=0.10)	
			Italy				**Japan**		
Intercept		0.25	1.24	-2.86	-0.74	1.06*	1.87	-4.76	-1.04
CGRO	Lag 1	0.19**	2.10	1.19	0.70	-0.29**	-3.11	0.57	0.76
	Lag 2	0.13	1.50	0.15	0.09	-0.01	-0.15	1.42*	1.79
	Lag 3	---	---	---	---	0.18*	1.83	-0.22	-0.28
	Lag 4	---	---	---	---	0.07	0.78	-1.31*	-1.72
	Lag 5					-0.13	-1.36	0.51	0.68
EP	Lag 1	0.01	1.62	0.02	0.21	0.01	1.13	0.08	0.87
	Lag 2	0.01*	1.93	0.19**	2.07	0.03**	2.28	0.14	1.61
	Lag 3	---	---	---	---	0.03**	2.29	0.15	1.58
	Lag 4	---	---	---	---	0.00	0.31	0.03	0.35
	Lag 5					-0.01	-0.65	-0.22**	-2.41
Exogenous variables									
L*DEF*		0.63*	1.78	-1.46	-0.21	-0.52	-0.52	8.53	1.03
L*DIVY*		0.32	1.28	2.03	0.42	0.40	0.40	10.52	1.31
L*PE*		---	---	---	---	-0.01**	-2.16	-0.01	-0.35
L*TERM*		-0.42	-1.26	4.02	0.62	-1.07	-1.07	4.65	0.57
Adjusted R-square		0.13		0.00		0.11		0.10	
F-Test, *CGRO*		4.43		0.28		3.15		1.65	
		(p=0.01)		(p=0.76)		(p=0.01)		(p=0.15)	
F-Test, *EP*		3.01		2.15		2.74		2.26	
		(p=0.05)		(p=0.12)		(p=0.02)		(p=0.05)	

Table 8 (continued). VAR Results for non-U.S. G7 Quarterly Data

		Estimate	t-stats	Estimate	t-stats	Estimate	t-stats	Estimate	t-stats
		CGRO		***EP***		***CGRO***		***EP***	
			France				**Germany**		
Intercept		0.36	1.39	-1.05	-0.30	-0.59	-0.63	3.58	0.50
CGRO	Lag 1	0.00	-0.02	1.01	0.85	-0.66**	-7.34	1.03	1.48
	Lag 2	---	---	---	---	-0.46**	-5.05	-0.16	-0.23
	Lag 3	---	---	---	---	-0.47**	-5.35	-0.35	-0.51
	Lag 4	---	---	---	---	0.47**	5.43	-0.16	-0.24
	Lag 5	---	---	---	---	0.19**	2.23	-0.99	-1.54
EP	Lag 1	0.02**	2.70	-0.02	-0.23	0.02	1.27	0.03	0.35
	Lag 2	---	---	---	---	0.04**	3.27	0.01	0.11
	Lag 3	---	---	---	---	0.02*	1.88	-0.14	-1.40
	Lag 4	---	---	---	---	0.03**	2.00	0.17	1.56
	Lag 5	---	---	---	---	0.02	1.61	-0.19*	-1.78
<u>Exogenous variables</u>									
L*DEF*		1.34	1.04	7.48	0.43	1.84	1.45	-6.53	-0.66
L*DIVY*		0.13	0.71	-0.41	-0.16	0.35	0.51	-0.34	-0.06
L*PE*		-0.04*	-1.67	-0.18	-0.56	-0.03	-0.51	-0.38	-0.72
L*TERM*		0.19	0.79	10.02**	3.11	1.59**	2.78	4.15	0.94
Adjusted R-square		0.05		0.05		0.95		0.01	
F-Test, *CGRO*		0.00		0.72		425.28		0.94	
		(p=0.99)		(p=0.40)		(p=0.00)		(p=0.46)	
F-Test, *EP*		7.27		0.06		3.70		1.54	
		(p=0.01)		(p=0.82)		(p=0.00)		(p=0.19)	

Table 9. VAR-GARCH(1,1) Estimation Results: G7 (non-US) Quarterly Data

The table presents results for the VAR-GARCH(1,1) model using non-U.S. G7 quarterly data. Panel A presents the GARCH estimates when the conditional correlation CCORR is restricted to be constant:

$$R_{it} = \alpha_{i0} + \sum_{j=1}^{2} \sum_{\tau=1}^{S} \alpha_{j\tau} R_{jt-\tau} + \sum_{j=1}^{4} \beta_{ij} z_{j,t-1} + e_{it}$$

$$h_{iit} = a_i + b_i\, e_{it-1} e_{it-1} + c_i\, h_{iit-1}$$

$$h_{ijt} = r_{ij} \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j$$

where i=1 (log per capita log consumption growth *CGRO*) or 2 (equity premium *EP*), S is the number of lags, h_{iit} is the conditional variance, and h_{ijt} is the conditional covariance. a_i is the intercept term (*Intercept)*, b_i is the *Arch* coefficient, and c_i is the *Garch* coefficient. $z_{j,t}$ is the j-th exogenous prediction variable where j={*DIVY*, *TERM*, *DEF*, *PE*}. *DIVY* is the dividend yield, *TERM* is the 10-year Treasury note yield minus the 3-month Treasury bill rate, *PE* is the price-earnings ratio, and *DEF* is the corporate bond yield minus the long-term Treasury yield.
In Panels B and C of the table, CCORR varies with dummy variables as follows:

$$h_{ijt} = (\sum_{k=1}^{n} r_k D_{k,t-1}) \sqrt{h_{iit}} \sqrt{h_{jjt}} \qquad i \neq j$$

where $D_{k,,t-1}$ is a dummy variable evaluated at time t-1 and n is the number of dummy variables. Let M be the growth in unemployment (*UG*) or real GDP (*GG*), and E(M) be the sample mean of M. The dummies are:

$$D_{1,t} = 1\, if\ M_t > E(M),$$

$$D_{2,t} = 1\, if\ M_t \leq E(M),$$

and they are 0 otherwise. In Panel B, M is *UG* and in Panel C, M is *GG*.
Next, let *RR* be the return residual e_2 from the VAR, and E(*RR*) the sample mean of *RR*. Define:

$$D_{3,t} = 1\, if\ RR > E(RR),$$

$$D_{4,t} = 1\, if\ RR \leq E(RR),$$

and 0 otherwise. Then, four additional dummies combine macro and return information as follows:
$D_{5,t}$=1 if $D_{1,t}$=1 and $D_{3,t}$=1, and 0 otherwise.
$D_{6,t}$=1 if $D_{1,t}$=1 and $D_{4,t}$=1, and 0 otherwise.
$D_{7,t}$=1 if $D_{2,t}$=1 and $D_{3,t}$=1, and 0 otherwise.
$D_{8,t}$=1 if $D_{2,t}$=1 and $D_{4,t}$=1, and 0 otherwise.
We test the restriction that the dummy coefficients are equal with the Likelihood Ratio test *LR*:

$$LR = 2 * (ULOGL - RLOGL) \sim \chi^2 (k-1)$$

where *ULOGL* (*RLOGL*) is the value of the unrestricted (restricted) log-likelihood function, and k is the number of restrictions. Estimates significant at the 5 (10) percent level or less are marked by ** (*). Data sources and sample dates are in the data appendix.

Panel A: Constant correlation model

	Canada		UK		Italy		Japan		France		Germany	
	CGRO	*EP*	*CGRO*	*EP*	*CGRO*	*EP*	*CGRO*	*EP*	*CGRO*	*EP*	*CGRO*	*EP*
Inter.	0.55*	33.09*	-0.01	18.12	0.12	194.38	0.57**	97.46**	0.98**	127.16	0.41**	107.00
	(5.73)	(1.85)	(-0.92)	(1.39)	(0.88)	(1.08)	(8.74)	(15.08)	(6.10)	(0.83)	(4.99)	(1.16)
Arch	-0.14**	0.11	0.02*	0.17**	0.07	-0.02	1.31**	-0.20**	0.06**	0.06	0.52**	0.26**
	(-3.05)	(0.95)	(1.95)	(2.00)	(0.89)	(-0.25)	(9.65)	(-7.51)	(7.98)	(0.81)	(3.58)	(2.15)
Garch	0.20	0.38**	0.34	0.62**	0.64*	-0.13	-0.04**	0.16**	-0.39**	0.07	0.31**	0.76**
	(0.73)	(6.71)	(0.88)	(3.22)	(1.74)	(-0.12)	(-7.14)	(2.35)	(-7.23)	(0.69)	(4.18)	(10.14)
Ccorr		0.04		0.07		-0.01		-0.10		-0.04		-0.00
		(0.44)		(0.96)		(-0.04)		(-1.12)		(-0.66)		(-0.01)

Table 9 (continued): VAR-GARCH(1,1) Estimation Results: G7 (non-US) Quarterly Data

Panel B: Correlation varying with *UG* and *RR*

	Canada		UK		Japan		France		Germany	
	UG	*UG+RR*	*UG*	*UG+RR*	*UG*	*UG+RR*	*UG*	*UG+RR*	*UG*	*UG+RR*
D_1	0.19*	---	0.03	---	-0.18	---	-0.23	---	0.27*	---
	(1.74)		(0.22)		(-1.53)		(-1.14)		(1.67)	
D_2	-0.08	---	0.05	---	0.06	---	-0.12	---	-0.13	---
	(-0.69)		(0.65)		(0.34)		(0.16)		(-1.13)	
D_5	---	0.16	---	0.22	---	-0.05	---	-0.16	---	0.10
		(1.12)		(1.14)		(-0.27)		(-0.38)		(0.18)
D_6	---	0.22	---	-0.10	---	0.33**	---	-0.28	---	0.30*
		(1.30)		(-0.44)		(2.45)		(-1.53)		(1.89)
D_7	---	-0.03	---	-0.07	---	-0.12	---	-0.25	---	-0.01
		(-0.18)		(-0.54)		(-0.17)		(-1.10)		(-0.01)
D_8	---	-0.09	---	0.22	---	-0.16	---	0.12	---	-0.31
		(-0.54)		(1.41)		(-1.12)		(0.86)		(-1.16)
Test of coefficient restrictions										
LR	2.36	6.00	1.52	2.78	9.80**	11.02**	1.70	2.96	3.48*	6.94*

Panel C: Correlation varying with *GG* and *RR*

	Canada		UK		Italy		Japan		France		Germany	
	GG	*GG+RR*	*GG*	*GG+RR*	*GG*	*GG+RR*	*GG*	*GG+RR*	*GG*	*GG+RR*	*GG*	*GG+RR*
D_1	0.07	---	-0.12	---	0.05	---	-0.16	---	0.01	---	0.03	---
	(0.49)		(-1.12)		(0.22)		(-1.34)		(0.05)		(0.21)	
D_2	0.16*	---	0.18*	---	-0.04	---	0.10	---	-0.21	---	-0.03	---
	(1.76)		(1.83)		(-0.18)		(0.57)		(-1.55)		(-0.20)	
D_5	---	-0.29	---	-0.01	---	0.01	---	-0.15	---	-0.12	---	-0.03
		(-0.89)		(-0.06)		(0.05)		(-0.53)		(-0.34)		(-0.11)
D_6	---	0.03	---	-0.33	---	0.17	---	-0.14	---	0.07	---	0.06
		(0.19)		(-1.09)		(0.60)		(-0.96)		(0.67)		(0.48)
D_7	---	0.23**	---	0.11	---	-0.19	---	-0.19	---	-0.38	---	0.01
		(2.04)		(0.61)		(-1.29)		(-0.75)		(-1.49)		(0.06)
D_8	---	0.08	---	0.27**	---	0.17	---	0.43**	---	-0.21	---	-0.05
		(0.16)		(2.42)		(1.11)		(2.81)		(-0.92)		(-0.24)
Test of coefficient restrictions												
LR	3.18*	6.38*	4.08**	9.82**	1.44	3.42	3.24*	6.58*	2.42	3.64	0.70	1.10

Table 10. Moments of the Conditional Equity Premium, Sharpe Ratio, and Implied Risk Aversion: G7 Quarterly Data

The table shows the mean and standard deviation (SD) of the conditional equity premium (*EP*) for quarterly data of the G7 countries. *EP* is the difference between stock returns (in local currency) and the local short-term Treasury bill rate. Also shown are the mean, the minimum *Min* and the maximum *Max* of the Sharpe ratio (*SR*) (i.e. the ratio of the conditional mean *EP* to its conditional SD). For the sample, *SR* is calculated by taking quarterly mean and σ of daily excess returns. Models with time-varying correlation are as follows. *GG+RR*: the correlation varies with growth in real GDP *GG* and return residuals *RR*; and *UG+RR*: the correlation varies with growth in unemployment *UG* and return shocks *RR*. Since the unemployment data is shorter than the GDP series for some countries, sample moments are shown separately for the *UG+RR* model. The implied risk-aversion (RA) is the mean of γ_t:

$$\gamma_t = \frac{E_t(EP_{t+1})}{\sigma_t(CGRO_{t+1})\sigma_t(EP_{t+1})\rho_t(CGRO_{t+1}, EP_{t+1})}$$

where *CGRO* is the log consumption growth and ρ is the correlation. All data are converted to real terms using the local Consumer Price Index, and annualized. Data sources and sample dates are in the data appendix.

Country		**Sample** *GG*	**Conditional** Constant	**Conditional** *GG+RR*	**Sample** *UG*	**Conditional** *UG+RR*
USQ	Mean *EP*	4.08	6.14	4.87	4.08	3.45
	SD of *EP*	15.14	6.16	6.28	15.14	7.28
	Mean *SR*	0.05	0.23	0.36	0.05	0.30
	(Min, Max) *SR*	(-2.45,2.58)	(-1.33,1.56)	(-2.70, 3.06)	(-2.45,2.58)	(-2.46,3.28)
	Mean Implied RA	58.92	24.62	113.23	58.92	20.45
Canada	Mean *EP*	2.13	0.74	1.97	1.34	1.63
	SD of *EP*	16.46	5.56	5.77	17.12	5.14
	Mean *SR*	0.13	0.06	0.14	0.08	0.10
	(Min, Max) *SR*	---	(-1.90,1.45)	(-1.99,1.84)	---	(-1.68,1.82)
	Mean Implied RA	68.80	49.77	81.41	45.94	<0
U.K.	Mean *EP*	7.57	8.58	8.91	8.15	8.18
	SD of *EP*	20.33	7.87	7.76	20.49	7.64
	Mean *SR*	0.37	0.45	0.46	0.40	0.42
	(Min, Max) *SR*	---	(-1.27,3.33)	(-1.10,3.13)	---	(-1.13,2.51)
	Mean Implied RA	<0	302.84	<0	<0	<0
Italy	Mean *EP*	1.85	-0.88	2.56	---	---
	SD of *EP*	26.93	4.96	6.71	---	---
	Mean *SR*	0.07	-0.04	0.09	---	---
	(Min, Max) *SR*	---	(-0.84,1.11)	(1.51,-1.14)	---	---
	Mean Implied RA	170.43	<0	146.37	---	---
Japan	Mean *EP*	7.31	7.41	10.56	7.31	7.42
	SD of *EP*	25.13	10.66	11.39	25.13	11.93
	Mean *SR*	0.29	0.34	0.46	0.29	0.30
	(Min, Max) *SR*	---	(-3.03,3.47)	(-3.42,3.23)	---	(-3.22,3.11)
	Mean Implied RA	<0	<0	99.03	<0	<0
France	Mean *EP*	7.10	6.73	6.20	7.07	5.89
	SD of *EP*	25.24	7.24	7.71	25.43	8.08
	Mean *SR*	0.28	0.28	0.26	0.28	0.24
	(Min, Max) *SR*	---	(-1.51,1.72)	(-1.62,2.02)	---	(-1.68,2.01)
	Mean Implied RA	<0	<0	44.51	<0	<0
Germany	Mean *EP*	8.20	10.64	9.67	8.20	7.62
	SD of *EP*	23.22	9.10	9.89	23.22	8.59
	Mean *SR*	0.35	0.53	0.47	0.35	0.37
	(Min, Max) *SR*	---	(-2.70,2.89)	(-2.19,3.10)	---	(-1.43,2.48)
	Mean Implied RA	<0	<0	<0	<0	<0

Table 11. Cyclical Properties of the Conditional Correlation: G7 Quarterly Data

The table shows, for G7 quarterly data, results from a regression of CCORR on an intercept and RECESSION. CCORR is the conditional correlation. Estimates for CCORR are obtained from the model where CCORR varies with unemployment growth and the stock return residual. France and Italy are excluded, since we cannot reject the hypothesis of constant correlation for these countries. RECESSION equals 1 from the post-peak to the trough quarters of business cycles. U.S. business cycle dates are from NBER and non-U.S. dates are from OECD. Cycles designated "minor" by OECD are excluded. *T*-statistics are corrected for heteroskedasticity and autocorrelation using the Newey-West procedure.

	US	CANADA	UK	JAPAN	GERMANY
Intercept	0.38**	0.03*	-0.02	-0.01	-0.10
	(22.67)	(1.89)	(-0.93)	(-0.67)	(-4.00)
RECESSION	0.13**	0.05**	0.05*	0.10**	0.08*
	(4.75)	(2.16)	(1.82)	(2.69)	(1.72)
Adjusted R^2	0.06	0.04	0.02	0.05	0.03

Figure 1: U.S. Quarterly Data: Conditional Correlation, Covariance and Equity Premium

For U.S. quarterly data, we plot results from 3 versions of the VAR-GARCH(1,1) model: SR, where the conditional correlation CCORR varies with stock return shocks; UG+SR, where CCORR varies with SR and changes in the unemployment rate UG; and UG+CAY, where CCORR varies with UG and the aggregate consumption-wealth ratio CAY. Shaded areas indicate NBER-dated recessions (post-peak to trough quarters). The affix "BC" indicates that CCORR and the conditional covariance (CCOV) are averaged over expansion (post-trough to peak quarters) and recession periods.

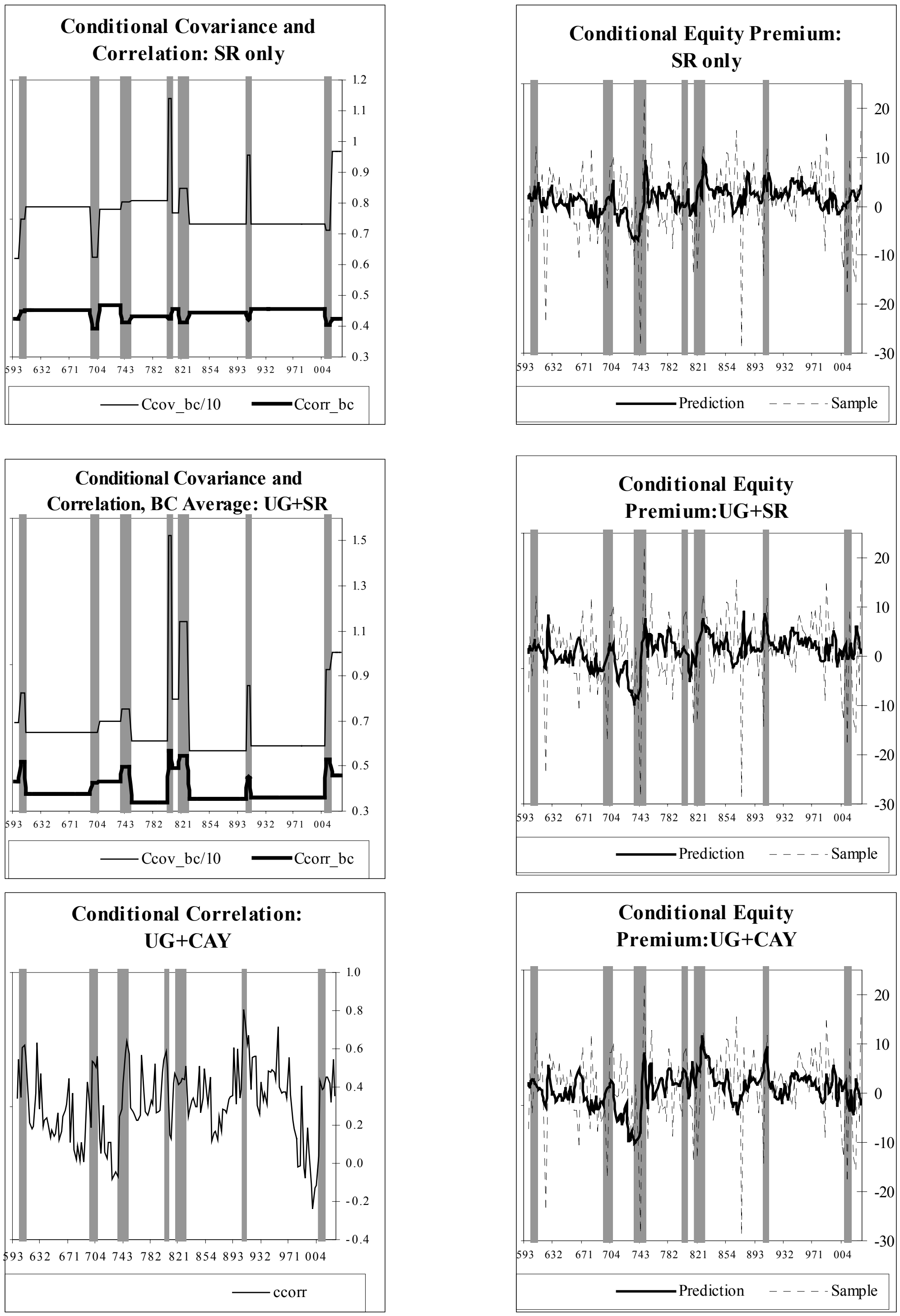

Figure 2: U.S. Quarterly Data: Conditional Sharpe Ratio and Risk Aversion

For U.S. quarterly data, we plot results from 3 versions of the VAR-GARCH(1,1) model: SR, where the conditional correlation CCORR varies with stock return shocks; UG+SR, where CCORR varies with SR and changes in the unemployment rate UG; and UG+CAY, where CCORR varies with UG and the aggregate consumption-wealth ratio CAY. SR is the Sharpe ratio, the conditional mean equity premium divided by its conditional standard deviation. Shaded areas indicate NBER-dated recessions (post-peak to trough quarters). The risk-aversion (RA) implied by the conditional Euler equation is:

$$\gamma_t = \frac{E_t(EP_{t+1})}{\sigma_t(CGRO_{t+1})\sigma_t(EP_{t+1})\rho_t(CGRO_{t+1}, EP_{t+1})}$$

where CGRO is the log consumption growth and EP is the equity premium. The affix "BC" indicates that RA is averaged over expansion (post-trough to peak quarters) and recession periods.

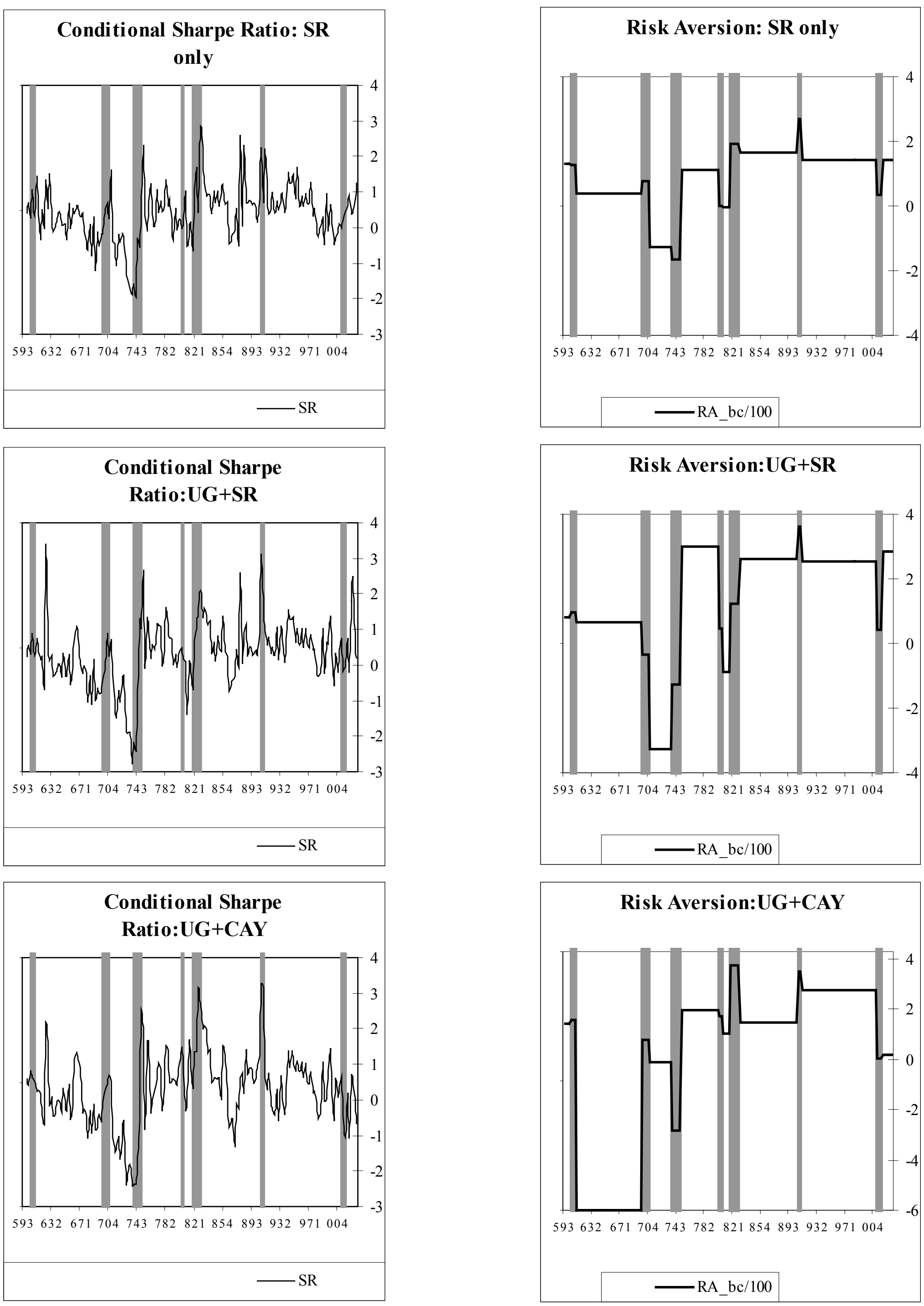

Figure 3: Conditional Covariance and Correlation for non-U.S. G7 Countries

For non-U.S. G7 quarterly data, we plot the conditional correlation obtained from the VAR-GARCH(1,1) model with the correlation varying with stock return shocks and changes in the unemployment rate. France and Italy are excluded since we cannot reject the constant correlation model for these countries. Shaded areas indicate OECD-dated major recessions (post-peak to trough quarters). The affix "BC" indicates that the conditional correlation is averaged over expansion (post-trough to peak) and recession quarters.

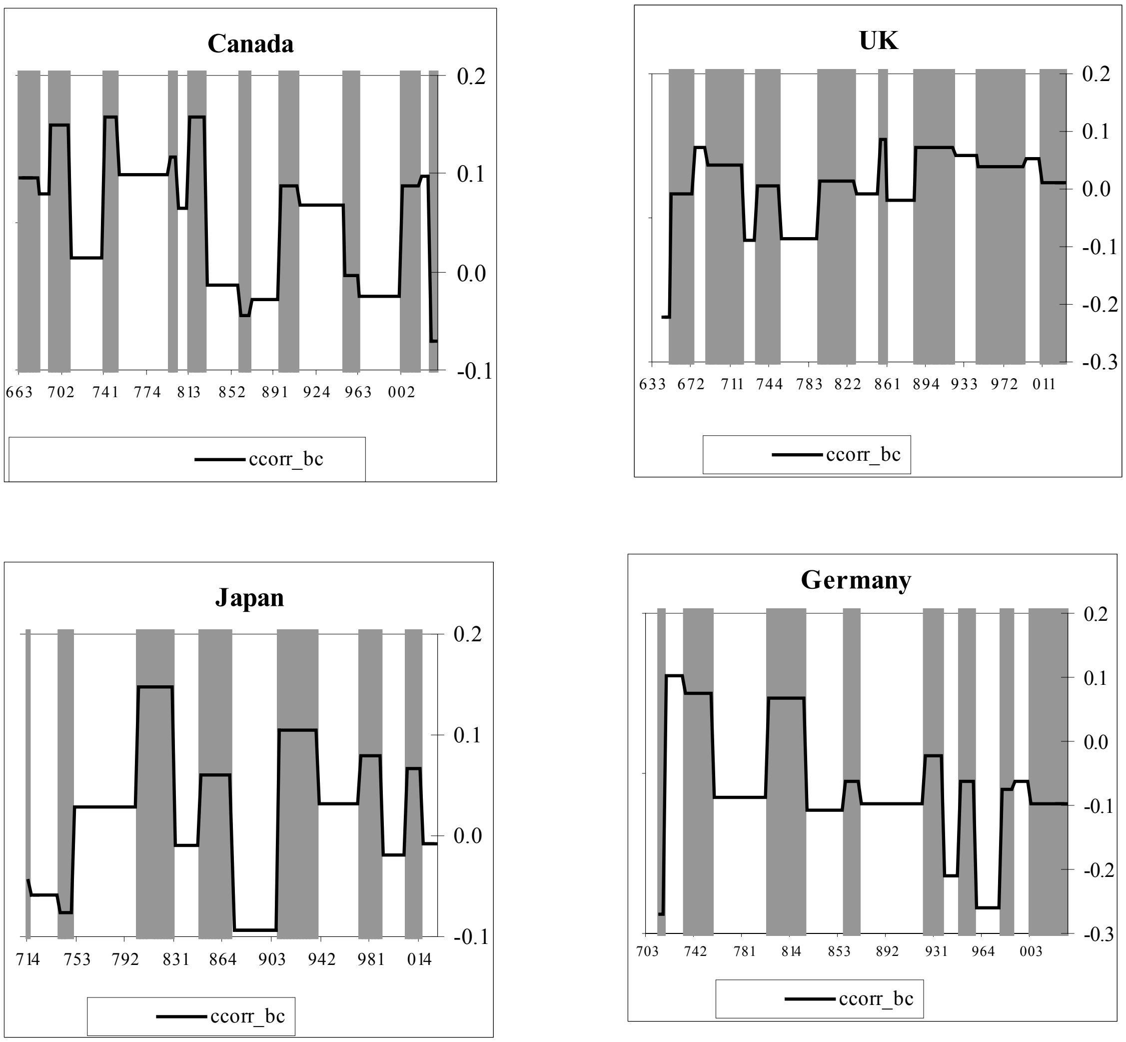

Figure 4: Conditional Equity Premium for non-U.S. G7 Countries

For non-U.S. G7 quarterly data, we plot the sample and conditional equity premium obtained from the VAR-GARCH(1,1) model with the correlation varying with stock return shocks and changes in the unemployment rate. For France and Italy, the correlation is assumed constant. Shaded areas indicate OECD-dated major recessions (post-trough to peak quarters).

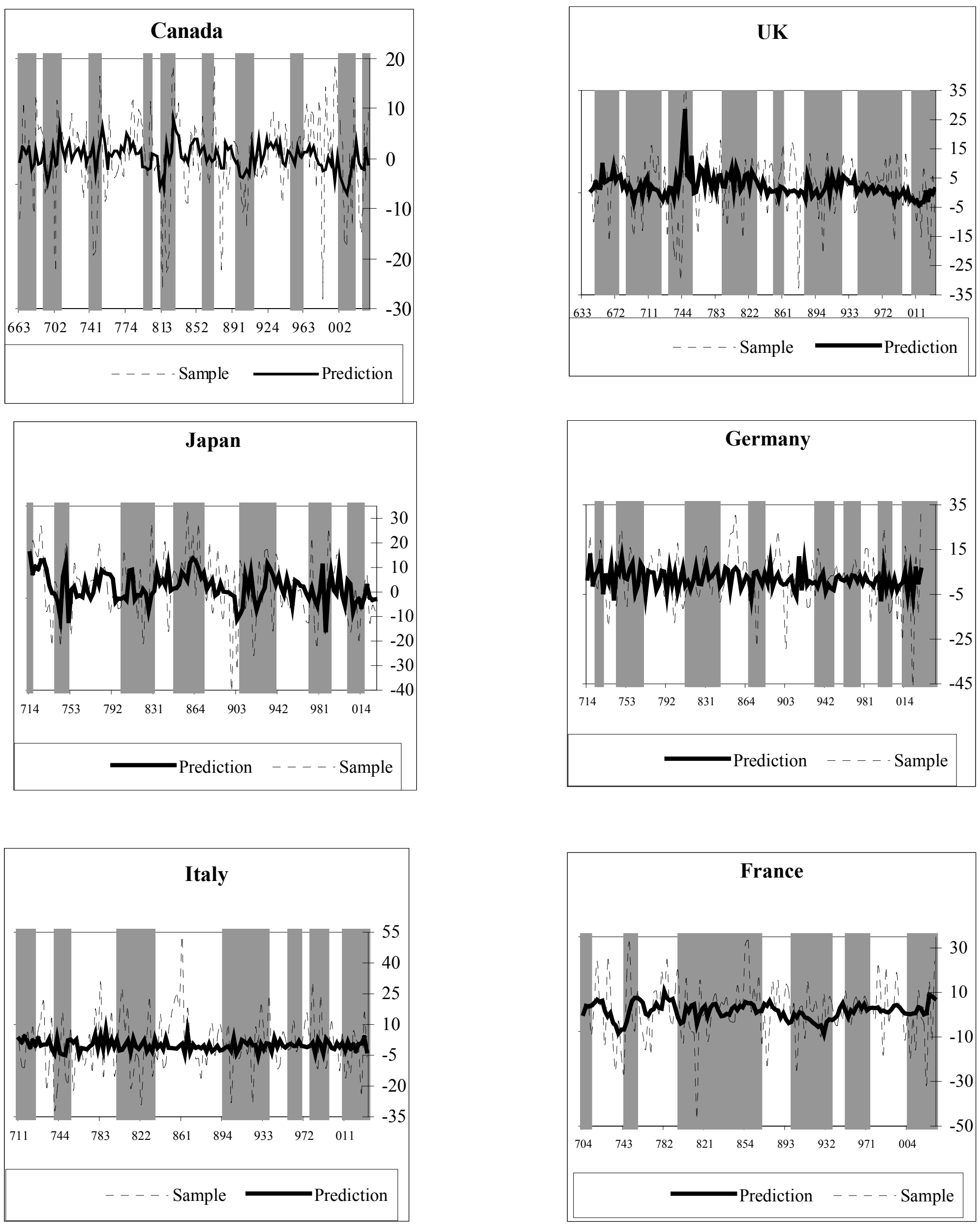

Figure 5: Conditional Sharpe Ratio for non-U.S. G7 Countries

For non-U.S. G7 quarterly data, we plot the conditional Sharpe ratio SR (i.e. the mean equity premium divided by its conditional standard deviation) obtained from the VAR-GARCH(1,1) model with the correlation varying with stock return shocks and changes in the unemployment rate. For France and Italy, the correlation is assumed constant. Shaded areas indicate OECD-dated major recessions (post-trough to peak quarters).

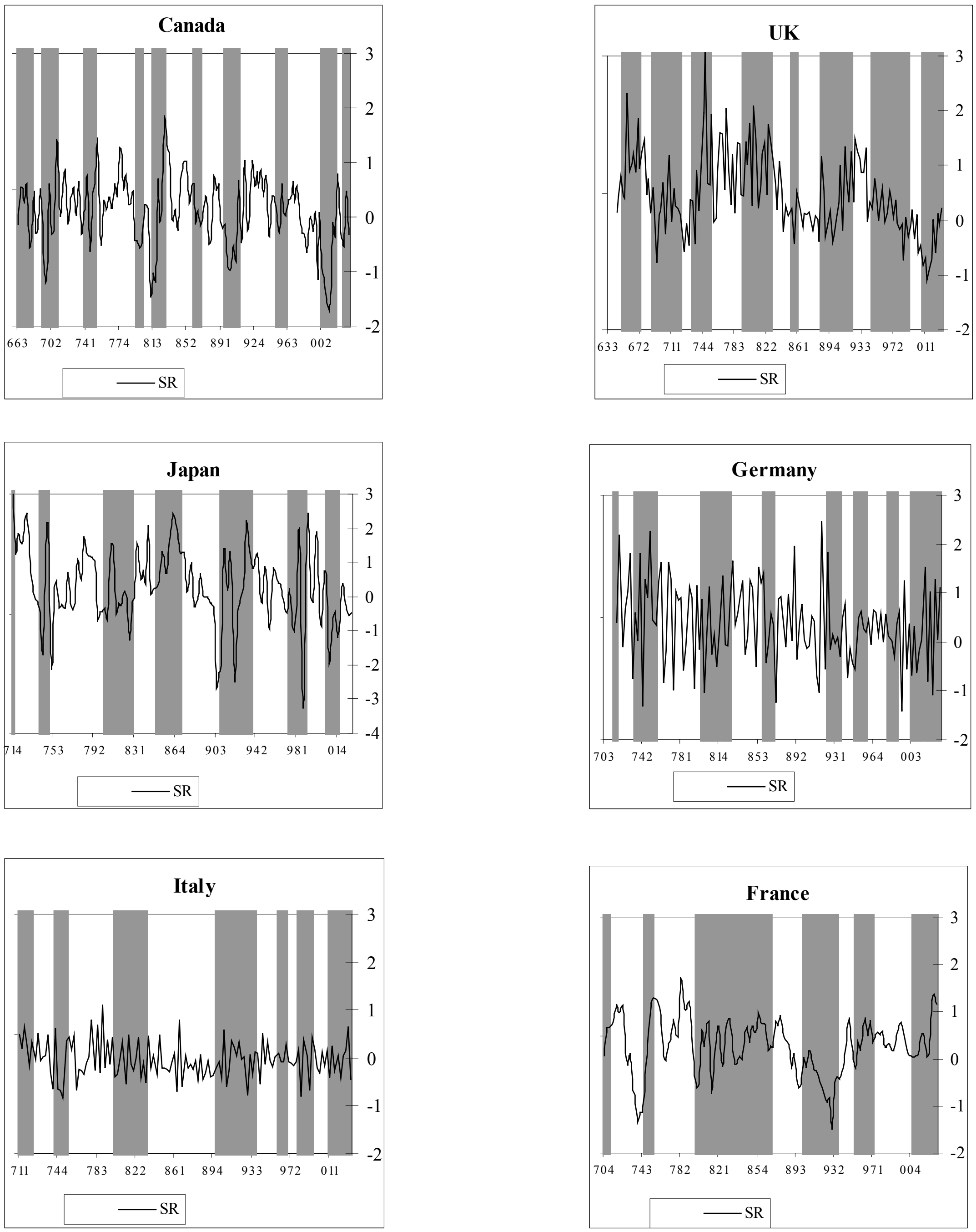

Figure 6: Implied Risk-Aversion for Non-U.S. G7 Countries

For non-U.S. G7 quarterly data, we plot the risk aversion implied by the conditional Euler equation:

$$\gamma_t = \frac{E_t(EP_{t+1})}{\sigma_t(CGRO_{t+1})\sigma_t(EP_{t+1})\rho_t(CGRO_{t+1}, EP_{t+1})}$$

where CGRO is the log consumption growth and EP is the equity premium. Estimates for conditional moments are from the VAR-GARCH(1,1) model with the correlation varying with stock return shocks and changes in the unemployment rate. For France and Italy, the correlation is assumed constant. Shaded areas indicate OECD-dated major recessions (post-trough to peak quarters). The affix "BC" indicates that RA is averaged over expansion (post-peak to trough quarters) and recession periods.