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Habit Formation, Surplus Consumption and Return Predictability: International Evidence*

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Abstract

On an international post World War II dataset, we use an iterated GMM procedure to estimate and test the Campbell-Cochrane (1999) habit formation model. In addition, we analyze the predictive power of the surplus consumption ratio for future asset returns. We find that, although there are important cross-country differences, for the majority of countries in our sample the model gets empirical support in a variety of different dimensions, including reasonable estimates of risk-free rates, and the model dominates the time-separable power utility model in terms of pricing errors. Further, for the majority of countries the surplus consumption ratio captures time-variation in expected returns. Together with the price-dividend ratio, the surplus consumption ratio contains significant information about future stock returns, also during the 1990s. Finally, in most countries the surplus consumption ratio is also a powerful predictor of future bond returns.

JEL Classification: E21, G12, G15
Keywords: Habit formation, Campbell-Cochrane model, surplus consumption ratio, GMM estimation, pricing errors, return predictability.

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1 Introduction

Rumors of the death of the consumption based capital asset pricing model (C-CAPM) have been widely exaggerated.[1] Throughout the 1980s asset pricing tests of the time separable power utility model provided direct evidence against the ability of the consumption based asset pricing model being able to capture the behavior of asset returns (See Hansen and Singleton, 1982). Indeed, Mehra and Prescott (1985) note that the return on equity in excess of the risk-free rate is greater than that which can be explained by the standard consumption based asset pricing model with a reasonable degree of risk aversion. However, the development of alternative approaches which either relax the assumption of separation between states (Epstein and Zin, 1989, 1991) or abandon the time-separability constraint allowing habit formation (Abel, 1990; Constantinides, 1990; Campbell and Cochrane, 1999) breathed new life into the consumption based asset pricing model. Subsequent empirical tests have proved to be more supportive, resuscitating the C-CAPM, and leading Chen and Ludvigson (2006) to argue that within the equilibrium consumption based framework, habit formation models are the most promising and successful in describing aggregate stock market behavior.

In this paper we provide fresh international evidence on the pricing and predictability of asset returns.[2] First, in order to provide motivation for the surplus consumption ratio as a predictor variable, we investigate the performance of the Campbell and Cochrane (1999) habit formation specification compared to the benchmark time separable power utility model. By adding the surplus consumption ratio to the standard C-CAPM with power utility, Campbell and Cochrane show by calibration that their habit formation model accounts for a number of stylized facts on the US stock market, including time-varying expected returns. The model implies that individuals slowly develop habits for high or low consumption such that the price of risk (risk-aversion) becomes time-varying and counter-cyclical: when consumption is well above habit in cyclical upswings, the price of risk is low leading to low expected returns and high asset prices. In contrast, when consumption is close to habit, the price of risk is high leading to high expected returns and low asset prices. However, there is scant evidence using non-US data on the performance of the Campbell-Cochrane model.[3] Indeed, even with US data many studies employ the calibrated values from the original study rather than re-estimating and testing the model empirically.[4] We address this lack of international evidence by estimating the Campbell-Cochrane model using a post World War II sample of nine countries. We use an iterated

[1] With apologies to Mark Twain.

[2] Li and Zhong (2005) investigate the ability of consumption based asset pricing models with habit persistence to both predict and explain the cross section of international stock returns however their focus is whether the model holds in the context of world market integration.

[3] Engsted, Møller and Tuong (2007) estimate the Campbell-Cochrane model on Danish data. However, other international evidence (Hyde and Sherif, 2005; Hyde, Cuthbertson and Nitzsche, 2005; Li and Zhong, 2005) employs US calibrated values when applying the model to non-US samples.

[4] For example, Li (2001, 2005) employs the calibrated values rather than estimating the parameters of the model. Tallarini and Zhang (2005), Fillat and Garduño (2005), Garcia et al. (2005) estimate the model with limited success while Møller (2007) estimates and reports supportive evidence for the specification.

GMM approach where, in each iteration, a new time-series for the surplus consumption ratio is generated, which is then used to obtain the moment conditions of the model. We find that, although there are important cross-country differences, for the majority of countries in our sample the Campbell-Cochrane model is not rejected statistically, dominates the time-separable power utility model in terms of Hansen and Jagannathan (1997) pricing errors, and produces economically plausible parameter values, including reasonable values for the risk-free rate.

Next, using the same international sample, we provide evidence on the power of the surplus consumption ratio as a predicator variable for returns. It is a well established fact of empirical finance that stock returns are predictable. Evidence that aggregate valuation ratios such as the dividend yield, dividend-price ratio, and earnings-price ratio or financial/monetary variables such as the term premium or relative interest rate can account for the time variation in expected returns is provided by Fama and French (1988, 1989), Campbell and Shiller (1988a, 1988b), Campbell (1991) and Hodrick (1992). However, the documented inability of the dividend yield to capture time variation during the 1990s has resulted in the emergence of a number of new predictor variables. For instance, Boudoukh et al. (2007) argue that the net payout ratio is more appropriate than the dividend yield since it captures more accurately the extent of distributing cash to shareholders and show that it has greater ability to predict future returns.

Alternatively, many of these new predictors are linked to macroeconomic factors such as consumption, labor income, and output demonstrating the strong links between the financial and real sectors of the economy. From the representative consumer's budget constraint, Lettau and Ludvigson (2001a, 2001b) show that the consumption-wealth ratio, *cay*, contains information about future returns.[5] Further, Santos and Veronesi (2006) introduce a labor income-consumption ratio which predicts US returns well both independently and in addition to the price-dividend ratio. Julliard (2007) argues that the consumption-wealth ratio should be combined with expected future labor income growth to predict future US returns, demonstrating not only that expected changes in labor income have high predictive power for future returns but that together the consumption-wealth ratio and expected changes in labor income explain much of the variation in the cross-section of returns. Using the Campbell-Cochrane habit persistence model directly, Li (2001) examines the forecasting power of the surplus consumption ratio in addition to the consumption-wealth ratio for US stock returns, documenting that the surplus consumption ratio contains incremental information not incorporated in the consumption-wealth ratio. Additionally, Møller (2007) provides evidence for a cross-section of US returns suggesting the surplus consumption ratio has strong predictive abilities, demonstrating incremental power over both the dividend yield and the net payout ratio. Focusing on output rather than consumption, Rangvid (2006) advocates the adoption of a price-output variable and provides evidence that it explains more of the time variation in expected returns than either the price-earnings or price-dividend ratios and performs as well as *cay* for US returns. Rangvid (2006) also provides evidence

[5] The consumption-wealth ratio is measured as the residuals of the cointegrating relationship between log consumption, log asset wealth and log labor income.

on an international sample, showing that the ability of the price-output ratio to predict returns is robust outside the US.

Here we examine predictability using annual data over the post World War II period up to 2004. Given the debate regarding disappearing predictability in the 1990s we also report results for a shorter sample that ends in 1990. We demonstrate that the surplus consumption ratio significantly predicts future stock returns in the majority of countries. To check the robustness of this result we examine bivariate regressions with alternative predictors. We consider the traditional return predictors, price-dividend ratio and the term spread in addition to the price-output ratio. We show that the ability of the surplus consumption ratio to predict future returns is not diminished by including these additional predictors. In particular, the surplus consumption ratio together with the price-dividend ratio contains significant information about future stock returns in most countries and, interestingly, the predictive power remains statistically significant during the 1990s. Furthermore, the surplus consumption ratio is shown to be a powerful predictor of future bond returns in most countries. This is also robust to the inclusion of alternative predictor variables. In general, the countries in which the surplus consumption ratio is a useful return predictor are the same that get most empirical support in the GMM estimations. Thus, our analysis implies that, although there are clear cross-country differences, for many countries several of the implications of the Campbell-Cochrane model are supported empirically.

The remainder of the paper is set out as follows. Section 2 describes the consumption based asset pricing models. Section 3 provides details on the GMM estimation of the models while section 4 gives details of the data and section 5 reports the empirical results. Section 6 concludes.

2 The models

In the consumption based asset pricing framework the representative agent makes consumption and investment decisions to maximize expected lifetime utility. This maximization problem implies the following first order condition that all correctly priced assets must satisfy:

$$E_t \left[R_{i,t+1} M_{t+1} \right] = 1 \tag{1}$$

$R_{i,t+1}$ is the real gross return of investing in asset i at time t and selling it at time $t+1$, and M_{t+1} is the stochastic discount factor:

$$M_{t+1} = \delta \frac{U' \left(C_{t+1} \right)}{U' \left(C_t \right)} \tag{2}$$

where δ is the subjective time discount factor, C_t is real consumption, and $U'(\cdot)$ is marginal utility. To observe the stochastic discount factor the representative agent's utility function has to be specified. With standard CRRA utility,

$$U\left(C_t\right)=\frac{C_t^{1-\gamma}-1}{1-\gamma} \tag{3}$$

where γ is the coefficient of relative risk aversion, the stochastic discount factor equals:

$$M_{t+1}=\delta\left(\frac{C_{t+1}}{C_t}\right)^{-\gamma} \tag{4}$$

Inserting (4) in (1), the expected excess return can be approximated as:[6]

$$E_t\left[R_{i,t+1}\right]-R_{t+1}^f \approx \gamma cov_t\left[R_{i,t+1},\frac{C_{t+1}}{C_t}\right] \tag{5}$$

Empirically the consumption based CRRA model has run into trouble because the covariance between stock returns and consumption growth is too low to explain the historically high excess return on stocks, unless the degree of risk aversion γ is extremely high. In addition, even if an extremely high value of γ is accepted it would imply an implausibly high real risk-free rate. Assuming that consumption growth is *iid* and lognormally distributed, $\log\left(\frac{C_{t+1}}{C_t}\right)\sim N\left(g,\sigma^2\right)$, the log real risk-free rate is:

$$r_f=-\log\left(\delta\right)+\gamma g-\frac{1}{2}\gamma^2\sigma^2 \tag{6}$$

Thus, the real risk-free rate is very sensitive to the mean consumption growth for high values of γ. Consequently, the standard specification cannot solve the equity premium puzzle without running into a risk-free rate puzzle. Furthermore, the standard model also faces a return predictability puzzle. Expected returns vary counter-cyclically over the business cycle (Fama and French, 1989), but the consumption covariance with returns is too smooth to account for time-variation in expected returns (Ferson and Harvey, 1993; Li, 2001). New consumption based models have been developed to solve these puzzles. In what follows we present the habit persistence model of Campbell and Cochrane (1999).

The utility function in the Campbell-Cochrane model is specified as follows:

$$U(C_t,X_t)=\frac{\left(C_t-X_t\right)^{1-\gamma}-1}{1-\gamma},\quad C_t>X_t \tag{7}$$

where X_t is an external habit level of consumption. With this specification the surplus consumption ratio, $S_t=\frac{C_t-X_t}{C_t}$, becomes a business cycle variable that is high in cyclical upswings and low in cyclical downturns such that relative risk aversion, γ/S_t, moves counter-cyclically. Rather than specifying a process for the habit, X_t, Campbell and Cochrane specify a process for the log surplus consumption ratio, $s_t=\log\left(S_t\right)$, to ensure that consumption is above habit at all times. The log surplus consumption ratio is modeled as a stationary first-order autoregressive process:

[6] See Cochrane (2006) for derivations.

$$s_{t+1} = (1-\phi)\,\bar{s} + \phi s_t + \lambda\,(s_t)\,v_{t+1} \tag{8}$$

where $0 < \phi < 1$ is the habit persistence parameter, $\bar{s}$ is the steady state level of s_t, and $\lambda\,(s_t)$ is the sensitivity function that determines how innovations in consumption growth v_{t+1} influence s_{t+1}. The consumption growth process is given by:

$$\triangle c_{t+1} = g + v_{t+1}, \qquad v_{t+1} \sim niid\left(0, \sigma_c^2\right) \tag{9}$$

where $c_t = \log\,(C_t)$, and g is the mean consumption growth. The sensitivity function $\lambda(s_t)$ is specified as follows:

$$\lambda\,(s_t) = \left\{ \begin{array}{cc} \frac{1}{\overline{S}}\sqrt{1-2\,(s_t-\bar{s})} & \text{if} \quad s_t \leq s_{\max} \\ 0 & \text{otherwise} \end{array} \right\} \tag{10}$$

where

$$\overline{S} = \sigma_c\sqrt{\frac{\gamma}{1-\phi}}, \qquad s_{\max} \equiv \bar{s} + \frac{1}{2}(1-\overline{S}^2), \qquad \bar{s} = \log(\overline{S})$$

Specifying $\lambda\,(s_t)$ in this way implies a constant real risk-free rate. Using the stochastic discount factor,

$$M_{t+1} = \delta\left(\frac{S_{t+1}}{S_t}\frac{C_{t+1}}{C_t}\right)^{-\gamma}, \tag{11}$$

and assuming lognormality of consumption growth, the log real risk-free rate is:

$$r_f = -\log\,(\delta) + \gamma g - \frac{\gamma}{2}\,(1-\phi) \tag{12}$$

Since relative risk aversion is no longer measured by γ but as γ/S_t, the Campbell-Cochrane model avoids a sensitive relationship between the real risk-free rate and the mean consumption growth rate and allows high relative risk aversion without facing a risk-free rate puzzle.

The expected excess return can be approximated as:

$$E_t\left[R_{i,t+1}\right] - R_f \approx \gamma\left[1+\lambda\,(s_t)\right] cov_t\left[R_{i,t+1}, \frac{C_{t+1}}{C_t}\right] \tag{13}$$

which states that expected excess returns move counter-cyclically with s_t since $\lambda\,(s_t)$ is decreasing in s_t. Thus, in contrast to the CRRA model, the Campbell-Cochrane model accounts for counter-cyclical time-variation in expected returns despite smooth consumption covariance with returns.

Campbell and Cochrane (1999) calibrate their model to postwar US data from 1947 to 1995 and find that the model explains a number of stylized facts for the US stock market, including stock return predictability. Instead we use an iterated GMM approach to estimate the model, which we describe in the next section.

3 GMM estimation of the models

We estimate and test the CRRA model and the Campbell-Cochrane model using the GMM technique of Hansen (1982). From the first order condition (1), we obtain the following moment conditions:

$$E\left[\left(R_{t+1}M_{t+1}\left(\theta\right)-1\right)\otimes Z_t\right]=0 \tag{14}$$

where R_{t+1} is a vector of selected test assets, Z_t is a vector of instrument variables observable at time t, and θ is a vector of parameters to be estimated. When estimating the power utility model and the Campbell-Cochrane model, $M_{t+1}\left(\theta\right)$ is given by respectively (4) and (11), where $\theta=\left(\delta,\gamma\right)'$ in both cases. Using the sample counterpart of (14),

$$g_T\left(\theta\right)=\frac{1}{T}\sum_{t=1}^{T}\left[\left(R_{t+1}M_{t+1}\left(\theta\right)-1\right)\otimes Z_t\right]=0 \tag{15}$$

we estimate θ by minimizing the quadratic form:

$$g_T\left(\theta\right)'Wg_T\left(\theta\right) \tag{16}$$

As weighting matrix, W, we use the identity matrix, I, to give equal weight to all test assets, c.f. Cochrane (2005).

To estimate the Campbell-Cochrane model we need to take some initial steps to observe the S_t process. Following Campbell and Cochrane (1999) we estimate the persistence parameter, ϕ, as the first-order autocorrelation parameter for the log price-dividend ratio. This is feasible since in the model the surplus consumption ratio is the only state variable, whereby the log price-dividend ratio will inherit the dynamic properties from the surplus consumption ratio. The mean consumption growth rate, g, and the volatility, σ_c, are estimated from (9). We choose an initial value of γ to obtain $\overline{S}=\sigma_c\sqrt{\frac{\gamma}{1-\phi}}$ and set $s_t=\bar{s}=\log\left(\overline{S}\right)$ at $t=0$. From the chosen parameter values, we obtain the s_t process recursively. Given s_t, S_t is obtained as $\exp\left(s_t\right)$. Using this S_t process we minimize (16) to get estimates of δ and γ. The estimate of γ is used to generate a new S_t process and we repeat this procedure until convergence of δ and γ.

The asymptotic covariance-matrix of the GMM estimator $\widehat{\theta}$ is provided by Hansen (1982) as (for $W=I$):

$$Var(\widehat{\theta})=\frac{1}{T}(d'Id)^{-1}d'ISId(d'Id)^{-1} \tag{17}$$

where $d=\partial g_T(\theta)/\partial\theta'$, and the spectral density matrix $S=\sum_{j=-\infty}^{\infty}E[\ g_T(\theta)g_{T-j}(\theta)']$ is estimated using the Newey and West (1987) estimator with a Bartlett kernel. To evaluate the model fit we use Hansen's J-test of overidentifying restrictions:

$$J_T = T g_T(\widehat{\theta})' \left[Var(g_T(\widehat{\theta})) \right]^{-1} g_T(\widehat{\theta}) \tag{18}$$

where $Var(g_T(\widehat{\theta})) = \frac{1}{T}(I - d(d'Id)^{-1}d'I)S(I - d(d'Id)^{-1}d'I)'$ is singular and hence inverted using the Moore-Penrose pseudo-inversion. J_T has an asymptotic χ^2 distribution with degrees of freedom equal to the number of moment conditions minus the number of parameters.

The J-test provides a statistical test whether the moment conditions for a given model are significantly different from zero. As a supplement to the J-test we use Hansen and Jagannathan's (1997) distance measure that provides a useful *economic* measure of the model fit. The Hansen-Jagannathan distance is given by:

$$HJ = \left[E(M_{t+1}(\theta)R_{t+1} - 1)'(E(R_{t+1}R'_{t+1}))^{-1}E(M_{t+1}(\theta)R_{t+1} - 1) \right]^{\frac{1}{2}} \tag{19}$$

HJ gives the minimum distance from the stochastic discount factor of a given model to the set of true stochastic discount factors that price assets correctly. It is a measure of the maximum percentage pricing error associated with a given model and hence gives a comparable measure of model misspecification. To compute the asymptotic standard error of the estimate of (19), we follow the procedure in Hansen et al. (1995).

4 Data and summary statistics

We study the G7 countries (Canada, France, Germany, Italy, Japan, the UK and the US) and two smaller countries (Belgium and Sweden). We select these countries on the basis of data availability. Our samples of annual observations begin between 1948 and 1955, depending on the country, and end in 2004. We measure consumption as private total consumption from IMF International Financial Statistics and adopt the Campbell (2003) beginning of period timing assumption that consumption during year t takes place at the beginning of year t. Nominal consumption is converted to real units using the consumer prices indices from IMF International Financial Statistics. Real per capita consumption is obtained using the population numbers from Global Financial Data. We obtain returns on stocks, long-term (10 year) bonds, and short-term (3 month) bonds from Global Financial Data. The only exception is the US, where we use stock returns from the CRSP index including NYSE, AMEX and NASDAQ firms. All return series are deflated using consumer price indices from IMF International Financial Statistics. As instrument variables in GMM estimations, we use the price-dividend ratio (Global Financial Data), the price-output ratio (the output series are from IMF International Financial Statistics), and the term spread between long-term bonds and short-term bonds (from Global Financial Data).

Table 1 provides summary statistics for the real gross return on equity, long-term bonds and short-term bonds in each of the nine countries. The reported statistics are consistent with the stylized facts for international equity and bond markets over the past half century. Mean real stock returns range from 7.2% (Italy) to 11.1% (Sweden) with the return on short-term bonds between 1.0% (Japan) and 3.1% (Belgium) implying that the average equity premium ranges from 4.3% in Belgium to 9.7% in Sweden. The average long-term real bond returns are between 2.1% (Sweden) and 4.6% (Germany).

5 Empirical results

Table 2 reports the estimated mean consumption growth rate, g, the standard deviation of the consumption growth rate, σ_c, and the persistence parameter ϕ (based on the first-order autocorrelation coefficient for the log price-dividend ratio). These parameters are used to obtain an initial estimate of the S_t process to be used in the subsequent iterated GMM procedure. Annual real consumption growth ranges from 2.0% to 3.6%, with standard deviation from 2.0% to 2.9%. The estimates of ϕ indicate a high degree of persistence, consistent with previous studies.

The consumption based framework implies that returns are negatively correlated with the stochastic discount factor. Table 3 reports such correlations for the nine countries, where we have imposed various values for γ, and the parameter values from table 2, in generating the stochastic discount factors. As seen, almost all correlations are negative for both stock and bond returns and for both models. This implies that in a *qualitative* sense both the standard CRRA model and the Campbell-Cochrane model fit stock and bond returns across countries. In the rest of the paper we analyze in more detail whether the models also fit the data *quantitatively*, i.e. by formal estimation and testing of the models, by comparison of pricing errors, and by testing for return predictability.

5.1 GMM estimates and tests

Table 4 shows GMM results for the CRRA model and the Campbell-Cochrane model for each of the nine countries in our sample. The models are estimated on moment conditions of excess stock returns, excess long-term bond returns, and gross returns on short-term bonds. The instrument variables are a constant and the price-dividend ratio.

For the CRRA model, the estimates of the constant relative risk aversion, γ, have the correct sign, but the estimates tend to be quite imprecise. Consistent with other studies such as Hansen and Singleton (1982) and Mehra and Prescott (1985), the γ estimates are extremely high ranging from 16.94 (Belgium) to 85.01 (Sweden). Furthermore, the estimates of the subjective time discount factor, δ, are all greater than 1, which shows that the time-separable power utility model is unable to solve the equity premium puzzle without facing a risk-free rate puzzle. Although the estimates of δ and γ seem economically implausible, the J-test of overidentifying restrictions does not statistically reject the model at conventional significance levels. However, this may be due to low power of the test.[7]

For the Campbell-Cochrane model, the estimates of the utility curvature parameter, γ, vary considerably across countries from 3.01 in Belgium to 30.27 in France, implying an average value of risk aversion, γ/S, of 21.86 in Belgium and 77.66 in France. As with the CRRA model, the γ estimates are in most cases statistically insignificant. The estimates of the time discount factor, δ, are less than 1 (except for Japan) and statistically significant. For France, Germany and the UK, however, the δ estimates are somewhat low. Despite the cross-country differences, the J-test does not reject the Campbell-Cochrane model in any country. Again, this may be due to low power of the test.

The above findings are robust to a number of robustness checks. Table 5 shows that the use of an expanded set of instruments (a constant, the price-dividend ratio, the price-output ratio, and the term spread on bonds) gives similar results as in table 4. In general, different combinations of instrument variables do not change the main results. We have also tried different combinations of moment conditions of returns on stocks, short-term bonds, and long-term bonds, but it does not have any substantial effect on the main results. For some countries consumption growth is better described as an AR(1) process rather than a random walk, but specifying consumption growth as an AR(1) process does not change the main results either (details are available upon request).

Tables 4 and 5 show that the implied risk-free rates vary a lot across countries and models. Focusing on Table 5, for the CRRA model the implied r_f is reasonable for Belgium, Canada, Italy, and the US. For the Campbell-Cochrane model, reasonable r_f values are obtained for the same four countries and also for Japan and Sweden. However, for France, Germany and the UK, the r_f values are clearly not economically plausible. Thus, for six out of nine countries the Campbell-Cochrane model produces plausible time-discount factors together with low and positive risk-free rates despite of high average risk-aversion.

5.2 Hansen-Jagannathan distances

In this section, we estimate the Hansen and Jagannathan (1997) distance that provides a measure of the maximum percentage pricing error associated with a given model and hence is suitable for direct model comparisons.

Table 6 provides estimates of the Hansen-Jagannathan distance for the Campbell-Cochrane model and the CRRA model using the estimates of γ from table 4. The distances are estimated using excess stock returns, excess bond returns, and gross returns on

[7] The identity matrix is used as weighting matrix in the estimations. If instead the statistically optimal weighting matrix is used (the inverse of the covariance matrix of the sample orthogonality conditions), the results are qualitatively similar to the results for the CRRA model in table 4, except that the parameters are estimated more precisely, as expected. For the Campbell-Cochrane model, using the statistically optimal weighting matrix does not lead to convergence with positive values of γ in the GMM iterations, a problem also faced by Garcia et al. (2005). Thus, we restrict attention to the case with $W = I$.

short-term bonds. The table shows that the Campbell-Cochrane model yields somewhat lower pricing errors than the time-separable model in the majority of countries. The improvement in performance is most naturally associated with the Campbell-Cochrane model's ability to allow for time-varying risk aversion, and with the model's ability to generate reasonable risk-free rates with plausible values of the time discount factor, in contrast to the CRRA model. Indeed, for France and the UK, where the GMM results in the previous section did *not* support the Campbell-Cochrane model, Hansen-Jagannathan pricing errors are *larger* for the Campbell-Cochrane model than for the CRRA model. For the remaining countries the Campbell-Cochrane model dominates the CRRA model, although pricing errors in the magnitude of 20-30 percent, as seen from Table 6, are still economically significant.

The evidence in this and the previous subsection give mixed results regarding the consumption based framework's ability to explain international asset returns. The CRRA and Campbell-Cochrane models are not rejected statistically at conventional significance levels, and for the Campbell-Cochrane model parameter estimates are in most cases not economically implausible, although the estimates have high sampling uncertainty, and the Hansen-Jagannathan measure does indicate economically important pricing errors also for this model. In the remaining part of the paper we investigate the Campbell-Cochrane model in another dimension, by analyzing whether the surplus consumption ratio contains useful information about future returns.

5.3 Time-varying expected returns

The Campbell-Cochrane model implies that the surplus consumption ratio captures time-varying expected returns. When consumption is well above habit in cyclical upswings, relative risk aversion and expected returns on risky assets are low. In contrast, when consumption is close to habit in cyclical downturns, relative risk aversion and expected returns on risky assets are high. To test this feature of the Campbell-Cochrane model, we run predictability regressions of returns on stocks and bonds with the surplus consumption ratio as predictor. Moreover, since the Campbell-Cochrane model implies that the surplus consumption ratio is the only state variable in the economy, it should capture all relevant information about time-varying expected returns. We test this implication of the model using bivariate predictability regressions with the surplus consumption ratio and alternative return predictors. The benchmark stock return predictor is the log price-dividend ratio, pd_t (Campbell and Shiller, 1988; Fama and French, 1989; Hodrick, 1992). The price-dividend ratio is used as proxy variable for the surplus consumption ratio to estimate the persistence parameter ϕ and, hence, the Campbell-Cochrane model implies a one for one relationship between these two variables. We also include two alternative predictors, the price-output ratio (Rangvid, 2006), and the term spread, which is a traditional predictor of stock and bond returns (Fama and French, 1989; Campbell and Shiller, 1991).

Figure 1 plots the surplus consumption ratio, s_t (based on the g, σ_c and ϕ estimates from table 2, and the γ estimates from table 4), and the price-dividend ratio. Both series are in logs and standardized to have mean 0 and variance 1. The figure shows that the two series tend to move together, but in many countries they become less connected from the beginning of the 1990s and onwards. In fact, up to 1990 s_t and pd_t are positively correlated (except in Japan), but the correlations are reduced by including data up to 2004. As an example, for the US the correlation between s_t and pd_t up to 1990 is 0.54 which is reduced to -0.06 for the whole sample. This indicates a deteriorating performance of the Campbell-Cochrane model in recent years (as already anticipated by Campell and Cochrane (1999) themselves who note a poor fit for their model at the end of their sample period). Thus, it will be interesting to see whether the predictive ability of the surplus consumption ratio deteriorates by including data after 1990.[8]

5.3.1 Stock return predictability

To examine whether the surplus consumption ratio is able to track time-varying expected stock returns, table 7 reports results of predictability regressions of 1-year ahead log real stock returns, $r_{S,t+1}$, with the log surplus consumption ratio, s_{t-1}, as predictor: $r_{S,t+1} = c + \beta_S s_{t-1} + e_{t+1}$. The log surplus consumption ratio is lagged twice relative to returns because we use Campbell's (2003) beginning of period consumption timing convention. We report both the standard Newey and West (1987) corrected t-statistics and the Hodrick (1992) t-statistics, which Ang and Bekaert (2007) recommend due to better small sample properties. The upper panel reports the full sample results up to 2004, and the lower panel reports the sub sample results up to 1990. The table shows that the surplus consumption ratio is negatively related to future stock returns, such that low surplus consumption ratio's in cyclical downturns predict high future stock returns. However, the predictive power varies strongly across countries. Based on the t-statistics and adjusted R^2, the surplus consumption ratio has low predictive power in Canada, France, Germany, Japan, and the UK. On the other hand there is statistical evidence of stock return predictability in Belgium, Italy, Sweden, and the US (and also France if the sample is restricted to end in 1990).

Next, to compare the surplus consumption ratio's predictive power for future stock returns with alternative predictors, we use in turn the price-dividend ratio, the price-output ratio, and the term spread in bivariate predictability regressions together with the surplus consumption ratio. Throughout the predicted variable is the 1-year ahead log real stock return and the predictors are in logs and standardized to have mean 0 and variance 1.

Table 8 shows that the surplus consumption ratio does not drive out the price-dividend ratio in bivariate predictability regressions of future stock returns. Based on the Hodrick t-statistics for the full sample, the price-dividend ratio is a significant stock return predictor in Belgium, Canada, France, the UK, and the US at the 5% significance level, and in Germany, Italy, and Sweden at the 10% level. The price-dividend ratio is not a

[8] As a further check on the time-series movements of the surplus consumption ratio, we have correlated it with Hodrick-Prescott filtered GDP. In each of the nine countries the correlation is positive, and strongest for Belgium, Canada, Sweden, and the US (details are available upon request).

significant predictor of stock returns in Japan. The surplus consumption ratio remains a significant predictor in Belgium, Italy, Sweden, and the US. Furthermore, the predictive power of the surplus consumption ratio is strengthened in bivariate predictability regressions with the price-dividend ratio, such that the surplus consumption ratio significantly predicts stock returns also in Canada and France, which was not the case in the univariate predictability regressions. For the sub sample that ends in 1990, the surplus consumption ratio drives out the price-dividend ratio in Belgium and Italy, whereas the price-dividend ratio drives out the surplus consumption ratio in Canada, the UK, and the US. In France and Sweden both predictors are significant at the 10% level based on the Hodrick (1992) t-statistic. Neither the price-dividend ratio nor the surplus consumption ratio predict stock returns in Germany or Japan. The overall conclusion is that both predictors have significant forecasting ability for future stock returns in the majority of countries and, interestingly, they remain significant when including data from the 1990s, which is surprising in light of the findings in other recent studies.

Turning to bivariate predictability regressions of future stock returns with the surplus consumption ratio and the price-output ratio, py_t, as predictors, table 9 shows that the price-output ratio does not bring much additional information about future stock returns relative to the surplus consumption ratio. The exceptions are the UK and the US, but otherwise the price-output ratio is not significant in bivariate predictability regressions with the surplus consumption ratio. Similarly, the term spread, $TERM_t$, is generally not significant in bivariate predictability regressions with the surplus consumption ratio, cf. table 10.

The overall impression from the results so far is that the surplus consumption ratio significantly captures time-varying expected stock returns in Belgium, France, Italy, Sweden, the US, and to a lesser extent Canada, but not in Germany, Japan, and the UK. Furthermore, the surplus consumption ratio appears to be a stronger stock return predictor than the price-output ratio and the term spread. However, the surplus consumption ratio does not consistently drive out the price-dividend ratio in bivariate predictability regressions, which suggests that the surplus consumption ratio does not capture all relevant information about future stock returns.

5.3.2 Bond return predictability

The basic version of the Campbell-Cochrane model does not generate time-varying expected returns on bonds since bond returns at all maturities are equal to the constant risk-free rate. However, Wachter (2006) extends the model such that the surplus consumption ratio captures counter-cyclical time-variation in both stock and bond returns. We analyze this extended version of the model by running predictability regressions of 1-year ahead log real bond returns with the log surplus consumption ratio as predictor. Table 11 shows that, indeed, high surplus consumption ratios predict low future bond returns. As with stock returns, the ratio significantly predicts bond returns in Belgium, Canada, France, Italy, Sweden, and the US. Once again, the surplus consumption ratio does not have predictive power in Germany, Japan and the UK.

The most often used predictor for bond returns is the term spread. In table 12 we include this variable together with the surplus consumption ratio in bivariate predictability regressions. The table shows that the surplus consumption ratio is a better bond return predictor than the term spread for the majority of countries. The main exception is the US, where the term spread seems to drive out the surplus consumption ratio as a significant predictor.

There is growing body of literature about return predictability on both stocks and bonds. However, a common limitation to returns predictors is that they only contain information about either future stock returns or future bond returns. Interestingly, we find that the surplus consumption ratio captures predictive patterns in both stock and bond markets. Our findings therefore support the extended version of the Campbell-Cochrane model in which expected returns on stocks and bonds move counter-cyclically with the surplus consumption ratio.

6 Concluding remarks

Consumption based models with habit persistence, and in particular the Campbell and Cochrane (1999) model, is at present one of the leading frameworks within the equilibrium based paradigm to explain financial market returns and how they vary over time and across assets. The Campbell-Cochrane model has the intuitively appealing implication that risk-aversion moves counter-cyclically, and the model implies return predictability based on the surplus consumption ratio.

Most previous analyses using the Campbell-Cochrane model have been on US data, and in the few existing international studies using the model, the calibrated parameter values from the original US study are employed in the analyses. In the present paper we have analyzed the Campbell-Cochrane model on an international dataset in which, for each country, we have used an iterative GMM procedure to formally estimate and test the model. In addition, based on the parameter estimates, we have constructed time series for the surplus consumption ratio in each country, which we have used as a predictor variable in predictability regressions for stock and bond returns.

We find that there are large cross-country differences in the Campbell-Cochrane model's ability to explain financial market returns. Clearly the model does not give a perfect description of the data in any of the countries, which is of course not surprising given the highly stylized nature of the model. However, for the majority of countries (Belgium, Canada, Italy, Sweden and the US) the Campbell-Cochrane model gets empirical support in a variety of different dimensions: Economically plausible estimates of preference parameters and the risk-free rate, time-varying counter-cyclical risk-aversion, and statistically significant return predictability for both stocks and bonds based on the surplus consumption ratio (and in the 'right' direction, i.e. increasing (decreasing) consumption relative to habit during economic up(down)turns predicts lower (higher) future returns). For another group of countries (Germany and the UK), however, there is not much empirical support for the Campbell-Cochrane model. For a third group of countries (France and Japan), the results are mixed.

Thus, there seems to be important cross-country differences in how habit persistence affects equilibrium pricing in the financial markets. We leave a deeper investigation into the nature of these cross-country differences for future research.

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8 Tables and figures

	Sample	R_S	R_{LB}	R_{SB}
BEL	1953-2004	1.078	1.043	1.031
		(0.186)	(0.080)	(0.023)
CAN	1948-2004	1.075	1.035	1.020
		(0.159)	(0.086)	(0.029)
FRA	1952-2004	1.096	1.038	1.020
		(0.255)	(0.091)	(0.030)
GER	1952-2004	1.094	1.046	1.018
		(0.257)	(0.077)	(0.019)
ITA	1952-2004	1.072	1.042	1.020
		(0.281)	(0.140)	(0.032)
JAP	1955-2004	1.093	1.043	1.010
		(0.268)	(0.123)	(0.036)
SWE	1950-2004	1.111	1.021	1.014
		(0.249)	(0.069)	(0.035)
UK	1952-2004	1.099	1.030	1.018
		(0.240)	(0.070)	(0.032)
US	1948-2004	1.093	1.027	1.012
		(0.173)	(0.097)	(0.021)

Table 1. Summary statistics.

The table shows average real gross returns on stocks, R_S, long-term bonds, R_{LB}, and short-term bonds, R_{SB}. Standard deviations are in parentheses.

	g	σ_c	ϕ
BEL	0.021	0.025	0.900
	(0.004)		(0.069)
CAN	0.020	0.022	0.935
	(0.004)		(0.050)
FRA	0.023	0.024	0.878
	(0.004)		(0.070)
GER	0.030	0.029	0.741
	(0.005)		(0.109)
ITA	0.034	0.025	0.801
	(0.004)		(0.052)
JAP	0.036	0.027	0.941
	(0.008)		(0.038)
SWE	0.020	0.020	0.829
	(0.003)		(0.064)
UK	0.022	0.021	0.822
	(0.003)		(0.084)
US	0.020	0.020	0.944
	(0.003)		(0.053)

Table 2. Estimates of g, σ_c, and ϕ.

The table shows estimates of the mean log consumption growth rate, g, the standard deviation of the log consumption growth rate, σ_c, and the persistence parameter, ϕ, og the log price-dividend ratio. Standard errors are in parentheses.

γ		1	3	5	7	2	5	10	25
		Campbell-Cochrane				*CRRA*			
BEL	R^e_S	−0.08	−0.06	−0.05	−0.03	−0.07	−0.06	−0.05	−0.01
	R^e_{LB}	0.03	−0.19	−0.25	−0.28	−0.14	−0.17	−0.21	−0.28
CAN	R^{ex}_S	−0.34	−0.34	−0.34	−0.33	−0.31	−0.32	−0.32	−0.33
	R^e_{LB}	−0.39	−0.36	−0.35	−0.34	−0.31	−0.32	−0.33	−0.34
FRA	R^e_S	−0.28	−0.25	−0.26	−0.24	−0.10	−0.11	−0.11	−0.12
	R^e_{LB}	0.07	0.03	0.00	−0.02	0.03	0.03	0.03	0.02
GER	R^e_S	−0.38	−0.40	−0.38	−0.37	−0.46	−0.44	−0.42	−0.37
	R^e_{LB}	−0.11	−0.14	−0.15	−0.17	−0.01	−0.02	−0.03	−0.06
ITA	R^e_S	−0.24	−0.29	−0.28	−0.27	−0.29	−0.29	−0.28	−0.28
	R^e_{LB}	−0.12	−0.21	−0.22	−0.22	−0.19	−0.19	−0.20	−0.20
JAP	R^e_S	−0.42	−0.35	−0.33	−0.31	−0.34	−0.34	−0.34	−0.28
	R^e_{LB}	−0.03	−0.04	−0.06	−0.07	−0.17	−0.18	−0.20	−0.24
SWE	R^e_S	−0.15	−0.19	−0.18	−0.17	−0.25	−0.24	−0.23	−0.20
	R^e_{LB}	−0.24	−0.19	−0.17	−0.15	−0.20	−0.20	−0.20	−0.20
UK	R^e_S	−0.14	−0.17	−0.19	−0.20	−0.21	−0.21	−0.21	−0.20
	R^e_{LB}	−0.49	−0.45	−0.43	−0.43	−0.51	−0.51	−0.51	−0.49
US	R^e_S	−0.40	−0.39	−0.36	−0.33	−0.40	−0.36	−0.30	−0.18
	R^e_{LB}	−0.36	−0.33	−0.32	−0.32	−0.34	−0.32	−0.30	−0.26

Table 3. Correlations between the stochastic discount factor and excess returns. R^e_S is the excess stock return, $R_S - R_{SB}$, and R^e_{LB} is the excess bond return, $R_{LB} - R_{SB}$.

	δ	γ	J_T	γ/S	r_f (%)	δ	γ	J_T	r_f (%)
	Campbell-Cochrane					*CRRA*			
BEL	0.91	3.01	3.80	21.86	0.03	1.22	16.94	5.51	6.40
	(0.14)	(3.17)	(0.43)			(0.18)	(11.29)	(0.25)	
CAN	0.87	5.32	3.22	25.53	6.97	1.35	26.97	3.97	7.17
	(0.09)	(2.50)	(0.52)			(0.22)	(12.74)	(0.41)	
FRA	0.46	30.27	0.81	77.62	−36.90	1.30	78.36	4.34	−25.28
	(0.75)	(24.81)	(0.94)			(1.01)	(57.67)	(0.36)	
GER	0.72	6.30	3.49	48.23	−31.16	2.48	64.22	4.20	−60.35
	(0.28)	(4.36)	(0.48)			(0.97)	(59.67)	(0.36)	
ITA	0.81	2.53	2.11	26.72	4.47	1.88	26.63	1.52	1.87
	(0.24)	(2.20)	(0.72)			(0.78)	(20.68)	(0.82)	
JAP	1.16	17.17	4.10	36.34	−3.44	1.64	35.12	7.41	33.97
	(0.21)	(11.26)	(0.39)			(0.32)	(14.32)	(0.12)	
SWE	0.80	3.50	3.75	38.33	−1.06	1.42	85.01	3.25	8.56
	(0.75)	(6.42)	(0.44)			(1.26)	(83.72)	(0.52)	
UK	0.70	6.17	4.36	47.59	−5.45	1.95	67.10	6.26	−15.88
	(0.44)	(5.32)	(0.36)			(0.42)	(64.69)	(0.18)	
US	0.91	11.77	2.99	39.41	0.24	1.57	41.51	3.29	3.58
	(0.14)	(4.68)	(0.56)			(0.28)	(15.69)	(0.51)	

Table 4. GMM estimation of the Campbell-Cochrane model and the CRRA model.

The model parameters, $\theta = (\delta, \gamma)'$, are estimated using excess stock returns, $R_{S,t+1} - R_{SB,t+1}$, excess bond returns, $R_{LB,t+1} - R_{SB,t+1}$, and gross returns on short-term bonds, $R_{SB,t+1}$, as moment conditions:

$$g_T(\theta) = \frac{1}{T} \sum_{t=1}^{T} \begin{bmatrix} (R_{S,t+1} - R_{SB,t+1}) M_{t+1}(\theta) \\ (R_{LB,t+1} - R_{SB,t+1}) M_{t+1}(\theta) \\ (R_{SB,t+1} M_{t+1}(\theta) - 1) \end{bmatrix} \otimes Z_t = 0.$$

The instrument variable set is a constant and the price-dividend ratio, $Z_t = (1, PD_t)$. J_T is Hansen's (1982) test of overidentifying restrictions with p-values in parentheses. S in γ/S is the average value of the surplus consumption ratio over the sample. r_f is the implied risk free rate.

	δ	γ	J_T	γ/S	r_f (%)	δ	γ	J_T	r_f (%)
	Campbell-Cochrane					*CRRA*			
BEL	0.92	2.92	7.97	21.56	0.27	1.22	16.91	14.89	6.61
	(0.14)	(3.21)	(0.63)			(0.19)	(11.36)	(0.14)	
CAN	0.87	5.41	14.09	25.76	7.00	1.36	27.16	17.86	7.13
	(0.09)	(2.53)	(0.17)			(0.22)	(12.78)	(0.06)	
FRA	0.44	31.96	14.10	79.81	−38.24	1.27	79.99	13.70	−27.00
	(0.76)	(26.25)	(0.17)			(1.04)	(58.35)	(0.19)	
GER	0.72	5.97	7.55	47.02	−27.94	2.44	63.04	22.85	−56.58
	(0.29)	(4.26)	(0.67)			(0.95)	(60.19)	(0.01)	
ITA	0.81	2.62	3.71	27.19	4.14	1.90	25.88	6.55	1.50
	(0.24)	(2.22)	(0.96)			(0.78)	(20.52)	(0.77)	
JAP	1.13	21.53	13.94	41.07	1.79	1.55	32.63	14.08	36.35
	(0.23)	(12.14)	(0.18)			(0.30)	(13.92)	(0.17)	
SWE	0.80	3.14	5.86	36.01	2.17	1.39	78.38	5.68	16.34
	(0.61)	(4.91)	(0.83)			(0.98)	(72.89)	(0.84)	
UK	0.70	6.06	7.34	42.13	−5.18	1.94	69.46	13.60	−17.29
	(0.43)	(5.14)	(0.69)			(0.43)	(66.40)	(0.19)	
US	0.91	11.64	15.44	39.17	0.60	1.56	42.04	17.44	4.12
	(0.14)	(4.65)	(0.12)			(0.28)	(15.89)	(0.07)	

Table 5. GMM estimation of the Campbell-Cochrane model and the CRRA model.

The instrument variable set is a constant, the price-dividend ratio, the price-output ratio, and the term spread on bonds together, $Z_t = (1, PD_t, PY_t, TERM_t)$. Otherwise see notes to table 4.

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
					Campbell-Cochrane				
HJ	0.24	0.22	1.20	0.46	0.23	0.25	0.34	0.69	0.27
$s.e.$	(0.15)	(0.25)	(0.98)	(0.18)	(0.12)	(0.19)	(0.17)	(0.25)	(0.26)
					CRRA				
HJ	0.31	0.28	0.31	0.68	0.48	0.43	0.38	0.58	0.45
$s.e.$	(0.14)	(0.15)	(0.27)	(0.13)	(0.07)	(0.17)	(0.25)	(0.09)	(0.14)

Table 6. Hansen Jagannathan distances.

The table shows Hansen and Jagannathan (1997) distances for the Campbell-Cochrane model and the CRRA model with Hansen, Heaton and Luttmer (1995) standard errors in parentheses. The utility curvature parameter, γ, is set equal to the estimated value in table 4, and the subjective discount factor, δ, is set equal to 1.

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
				Full sample period, ends in 2004					
β_s	−0.06	−0.02	−0.04	−0.02	−0.07	0.02	−0.10	−0.05	−0.05
t_{NW}	−3.32	−1.22	−1.37	−0.53	−1.88	0.55	−3.73	−1.85	−2.54
t_H	−2.29	−1.02	−1.39	−0.57	−2.10	0.44	−2.95	−1.88	−2.00
$\bar{R}^2$	11.33	0.09	1.59	−1.42	6.00	−1.69	15.44	2.99	8.99
				Sub-sample period, ends in 1990					
β_s	−0.08	−0.03	−0.09	−0.05	−0.13	−0.04	−0.08	−0.06	−0.06
t_{NW}	−4.19	−1.15	−3.36	−1.55	−3.51	−1.13	−2.25	−1.52	−2.23
t_H	−2.05	−1.09	−1.88	−1.27	−2.44	−0.93	−1.83	−1.50	−1.93
$\bar{R}^2$	15.72	0.79	10.57	1.90	19.16	−0.15	11.23	1.90	10.86

Table 7. Predicting stock returns with the surplus consumption ratio.

The table shows results of predictability regressions, $r_{S,t+1} = c + \beta_s s_{t-1} + e_{t+1}$, where $r_{S,t+1}$ is the log real stock return, and s_{t-1} is the log surplus consumption ratio, which is standardized to have mean 0 and variance 1. t_{NW} is the Newey and West (1987) corrected t-statistic, t_H is the Hodrick (1992) corrected t-statistic, and $\bar{R}^2$ denotes adjusted R^2 value (in %).

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
				Full sample period, ends in 2004					
β_s	−0.08	−0.07	−0.07	−0.04	−0.10	−0.02	−0.12	−0.01	−0.06
t_{NW}	−4.86	−2.87	−2.27	−1.19	−2.20	−0.60	−4.92	−0.35	−2.59
t_H	−2.74	−2.25	−2.09	−1.07	−2.58	−0.48	−3.00	−0.24	−2.21
β_{pd}	−0.06	−0.08	−0.07	−0.06	−0.07	−0.07	−0.08	−0.10	−0.05
t_{NW}	−2.59	−3.36	−2.65	−1.87	−2.87	−1.88	−2.89	−3.00	−2.58
t_H	−2.29	−2.46	−2.24	−1.92	−1.94	−1.60	−1.92	−2.21	−2.06
$\bar{R}^2$	19.25	13.12	8.65	3.17	11.31	2.66	24.29	16.65	17.86
				Sub-sample period, ends in 1990					
β_s	−0.07	−0.02	−0.09	−0.03	−0.12	−0.07	−0.08	−0.01	−0.03
t_{NW}	−4.64	−0.92	−3.85	−0.76	−2.74	−1.98	−2.84	−0.34	−1.38
t_H	−2.03	−0.87	−1.87	−0.65	−2.19	−1.46	−1.76	−0.31	−1.04
β_{pd}	−0.04	−0.06	−0.06	−0.06	−0.06	−0.06	−0.08	−0.14	−0.06
t_{NW}	−1.67	−3.49	−2.34	−1.10	−2.04	−1.50	−2.12	−2.96	−3.41
t_H	−1.37	−2.74	−1.70	−1.17	−1.16	−1.15	−1.68	−2.11	−2.35
$\bar{R}^2$	18.11	14.99	14.40	4.42	20.99	1.86	21.73	26.45	19.93

Table 8. Predicting stock returns with the surplus consumption ratio and the price-dividend ratio.

The table shows results of predictability regressions, $r_{S,t+1} = c + \beta_s s_{t-1} + \beta_{pd} pd_t + e_{t+1}$, where $r_{S,t+1}$ is log real stock return, s_{t-1} is the log surplus consumption ratio, and pd_t is the log price-dividend ratio. Both predictors are standardized to have mean 0 and variance 1. Otherwise see the notes to table 7.

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
				Full sample period, ends in 2004					
β_s	−0.06	−0.02	−0.04	−0.00	−0.08	0.02	−0.10	−0.03	−0.05
t_{NW}	−2.85	−1.01	−1.30	−0.05	−1.66	0.66	−4.02	−1.11	−2.28
t_H	−2.03	−0.91	−1.29	−0.05	−1.87	0.55	−2.95	−0.85	−1.99
β_{py}	−0.02	−0.01	−0.04	−0.05	0.01	−0.05	−0.04	−0.06	−0.04
t_{NW}	−1.34	−0.40	−1.29	−1.25	0.19	−1.44	−1.43	−2.08	−2.10
t_H	−1.06	−0.34	−1.18	−1.44	0.21	−1.32	−1.07	−1.17	−1.83
$\bar{R}^2$	10.92	−1.67	1.96	−0.26	4.14	1.25	16.99	6.57	12.31
				Sub-sample period, ends in 1990					
β_s	−0.07	−0.03	−0.09	−0.05	−0.13	−0.07	−0.07	−0.03	−0.06
t_{NW}	−3.87	−1.30	−3.05	−1.20	−3.17	−1.86	−2.18	−0.93	−2.04
t_H	−1.94	−1.11	−1.79	−1.00	−2.41	−1.55	−1.71	−0.69	−1.81
β_{py}	−0.01	−0.01	−0.01	−0.01	0.01	−0.08	−0.04	−0.06	−0.02
t_{NW}	−0.79	−0.57	−0.56	−0.23	0.24	−1.79	−1.40	−1.75	−1.59
t_H	−0.50	−0.45	−0.40	−0.25	0.25	−1.58	−1.14	−1.00	−1.01
$\bar{R}^2$	13.63	−1.40	8.29	−0.86	16.97	6.23	12.99	4.17	10.24

Table 9. Predicting stock returns with the surplus consumption ratio and the price-output ratio.

The table shows results of predictability regressions, $r_{S,t+1} = c + \beta_s s_{t-1} + \beta_{py} py_t + e_{t+1}$, where $r_{S,t+1}$ is the log real stock return, s_{t-1} is the log surplus consumption ratio, and py_t is the log price-output ratio. Both predictors are standardized to have mean 0 and variance 1. Otherwise see the notes to table 7.

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
				Full sample period, ends in 2004					
β_s	−0.05	−0.01	−0.05	−0.03	−0.07	0.03	−0.10	−0.05	−0.05
t_{NW}	−2.78	−0.60	−1.37	−0.95	−1.85	0.84	−3.66	−1.45	−2.31
t_H	−1.86	−0.52	−1.39	−0.96	−2.09	0.62	−2.86	−1.06	−1.83
β_T	0.03	0.02	0.00	0.03	0.02	−0.01	−0.01	0.01	0.01
t_{NW}	1.11	1.31	0.11	1.05	0.51	−0.47	−0.66	0.26	0.76
t_H	0.95	0.80	0.10	0.95	0.43	−0.47	−0.51	0.18	0.52
$\bar{R}^2$	11.60	0.37	−0.45	−2.31	4.60	−3.75	14.35	1.11	7.74
				Sub-sample period, ends in 1990					
β_s	−0.06	−0.02	−0.09	−0.07	−0.12	−0.02	−0.08	−0.05	−0.05
t_{NW}	−2.91	−0.69	−3.35	−2.51	−3.35	−0.43	−2.16	−1.12	−1.89
t_H	−1.74	−0.68	−1.87	−1.72	−2.39	−0.34	−1.73	−0.79	−1.66
β_T	0.05	0.03	−0.01	0.04	0.03	−0.03	−0.01	0.02	0.03
t_{NW}	1.26	1.55	−0.40	1.23	0.83	−0.90	−0.52	0.33	1.76
t_H	1.09	0.92	−0.30	1.15	0.62	−0.71	−0.39	0.23	1.11
$\bar{R}^2$	19.74	2.28	8.07	1.23	18.40	−5.28	9.25	−0.68	11.38

Table 10. Predicting stock returns with the surplus consumption ratio and the term spread.

The table shows results of predictability regressions, $r_{S,t+1} = c + \beta_s s_{t-1} + \beta_T TERM_t + e_{t+1}$, where $r_{S,t+1}$ is the log real stock return, s_{t-1} is the log surplus consumption ratio, and $TERM_t$ is the term spread on bonds. Both predictors are standardized to have mean 0 and variance 1. Otherwise see the notes to table 7.

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
				Full sample period, ends in 2004					
β_s	−0.04	−0.04	−0.04	−0.02	−0.04	−0.00	−0.03	−0.10	−0.03
t_{NW}	−3.91	−4.45	−3.79	−1.91	−2.29	−0.34	−4.44	−0.73	−3.51
t_H	−2.97	−2.89	−3.29	−1.57	−2.49	−0.35	−2.60	−0.67	−2.27
$\bar{R}^2$	20.67	16.55	17.28	2.42	8.41	−2.02	23.30	−0.49	10.13
				Sub-sample period, ends in 1990					
β_s	−0.04	−0.03	−0.05	−0.02	−0.06	−0.00	−0.02	−0.02	−0.03
t_{NW}	−3.28	−2.55	−4.82	−1.50	−2.29	−0.16	−3.99	−1.09	−3.01
t_H	−2.26	−2.68	−3.13	−1.37	−2.30	−0.15	−2.05	−1.08	−1.88
$\bar{R}^2$	26.99	11.80	32.68	2.72	18.92	−3.06	18.06	2.49	11.24

Table 11. Predicting bond returns using the surplus consumption ratio.

The table shows results of predictability regressions, $r_{LB,t+1} = c + \beta_s s_{t-1} + e_{t+1}$, where $r_{LB,t+1}$ is the log real bond return, and s_{t-1} is the log surplus consumption ratio, which is standardized to have mean 0 and variance 1. Otherwise see the notes to table 7.

	BEL	CAN	FRA	GER	ITA	JAP	SWE	UK	US
				Full sample period, ends in 2004					
β_s	−0.03	−0.03	−0.04	−0.02	−0.04	−0.02	−0.03	−0.02	−0.02
t_{NW}	−2.84	−3.45	−3.94	−1.89	−2.32	−1.65	−4.16	−1.66	−2.03
t_H	−2.38	−2.50	−3.38	−1.61	−2.53	−1.63	−2.50	−1.33	−1.41
β_T	0.01	0.01	−0.00	0.00	0.00	0.04	−0.01	−0.02	0.04
t_{NW}	0.76	0.55	−0.10	0.33	0.53	1.72	−1.20	−2.39	3.46
t_H	0.67	0.49	−0.08	0.30	0.40	0.88	−0.77	−2.15	2.40
$\bar{R}^2$	20.23	15.68	15.58	0.66	6.85	5.88	23.08	5.13	23.36
				Sub-sample period, ends in 1990					
β_s	−0.04	−0.03	−0.05	−0.02	−0.06	−0.03	−0.02	−0.03	−0.02
t_{NW}	−3.09	−2.38	−5.08	−1.96	−2.19	−1.82	−3.96	−2.07	−1.84
t_H	−2.27	−2.35	−3.13	−1.68	−2.27	−1.76	−1.97	−1.63	−1.29
β_T	0.01	0.01	−0.01	0.01	0.02	0.05	−0.01	−0.03	0.04
t_{NW}	0.66	0.86	−0.98	0.77	1.02	2.67	−1.58	−2.41	3.88
t_H	0.63	0.66	−0.55	0.71	0.76	1.02	−1.04	−2.31	2.18
$\bar{R}^2$	25.46	11.20	31.68	1.98	18.09	12.98	18.78	10.38	32.09

Table 12. Predicting bond returns with the surplus consumption ratio and the term spread.

The table shows results of predictability regressions, $r_{LB,t+1} = c + \beta_s s_{t-1} + \beta_T TERM_t + e_{t+1}$, where $r_{LB,t+1}$ is the log real bond return, s_{t-1} is the log surplus consumption ratio, and $TERM_t$ is the term spread on bonds. Both predictors are standardized to have mean 0 and variance 1. Otherwise see the notes to table 7.

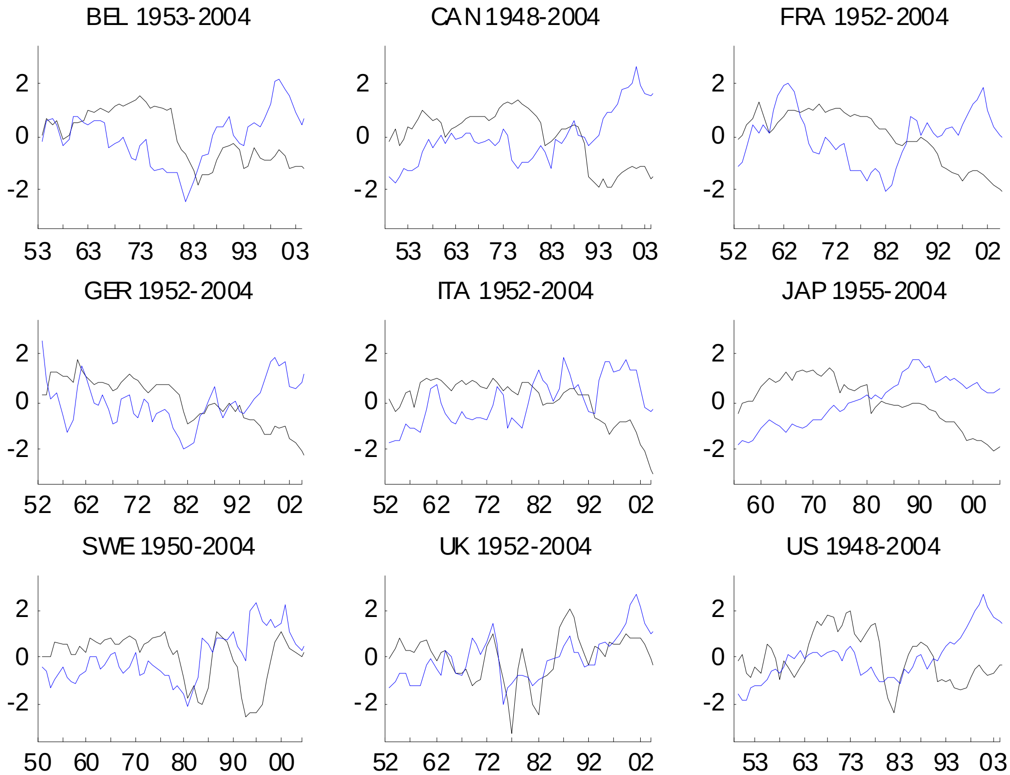

Figure 1. The surplus consumption ratio and the price-dividend ratio.

The figure shows the log surplus consumption ratio (black line) and the log price-dividend ratio (blue line). Both series are standardized to have mean 0 and variance 1.

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