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Financial Asset Returns and the Macroeconomy: An Elaboration of the Consumption CAPM (*)

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Abstract

We develop a two-agents and two-sectors equilibrium model to explain the behavior of asset returns. We follow Shawky & Peng (1995) and Campbell (1996) who derive a consumption-CAPM and substitute out consumption. Our derivation is different and incorporates the market return, return on labor income, time-varying price mark-ups and the relative growth of employment as determinants of individual asset returns. When calibrated on US and Japanese quarterly data, we find that our model is able to resolve both the equity premium puzzle and the term premium puzzle for the unconditional asset returns. An unrestricted estimation with GMM, however, fails to deliver acceptable parameter estimates in a time-series context.

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1. Introduction

In the macroeconomic finance literature, there has been a continued interest in questions like what drives asset prices and whether asset prices provide a reliable signal about the macroeconomic outlook. Empirical evidence regarding the first question shows that various macroeconomic factors systematically affect stock returns. Amongst others, Fama (1981) demonstrated the existence of a link between stock returns and expected inflation and future output growth. Chen, Roll and Ross (1986) found that the yield spread, unexpected inflation, industrial production and the default spread were significantly priced risk factors affecting a cross-section of stock returns. Hardouvelis (1987) found the money supply to significantly influence stocks and bonds. Ferson and Harvey (1993) compared the relative importance of valuation ratios (size, price-to-book-value, P/E, dividend yield), economic performance measures and industry-specific returns and found the price-to-book, dividend-price and several macroeconomic factors to be significant for a cross-section of returns. Concerning the second question, Bernard and Gerlach (1996) and Estrella and Mishkin (1998) find that financial variables, especially the yield spread and stock returns signal recessions well in advance.

A number of formal models have been developed to justify the connection between financial asset prices and the macroeconomy. We mention three directions that have been explored. (1) Breeden (1981), Cox, Ingersoll and Ross (1985a,b) used a consumption-based capital asset pricing model (CCAPM) – extensions such as generalized preferences, habit formation, transaction costs, market incompleteness were introduced in a later stage (see Kocherlata (1996) for a survey). (2) Cochrane (1991), Balvers, Cosimano and McDonald (1990) pioneered the production-based CAPM (PCAPM). (3a) Fuhrer and Moore (1992) and Estrella (1998) considered a system of macroeconomic behavioral equations from which they derived equilibrium values of inflation, output and asset returns, interest rates, resp. (3b) Multifactor (VAR) models in which risk and return are related via several common factors, see e.g. Chen et al. (1986), Lee (1992). Across these models, the empirical performance yielded mixed results. Fama (1991) notes that there is often a danger of factor dredging. Also the empirical results for base CCAPM and PCAPM models were not very convincing, see e.g. Ferson (1995), Black et al. (1997).

In this paper, we elaborate a model that explains the movements of financial asset prices in terms of both consumption and production-based elements. We follow Shawky and Peng (1995) and Campbell (1996) who derived an equilibrium model by substituting out consumption from the CCAPM formula. As we shall see below, in our model, this implies that financial asset returns are correlated with the market return, returns on labor income (human capital), a time-varying labor elasticity and mark-ups. This appears to give a solid theoretical foundation for the study of Jagannathan and Wang (1996) and Jagannathan, Kubota and Takehara (1998) who studied the relationship between labor income and average returns. They found, for the US and Japanese market respectively, that returns on labor income tended to drive out the size effect that is documented in the literature. Our study considers whether the elements we add helps to explain the residual variation in a time-series of US financial asset returns.

To anticipate our (preliminary) results, a calibration on US and Japanese data shows that there exists an acceptable range of risk aversion and intertemporal substitution parameters that fit the unconditional first moments of stock returns and interest rates. Using GMM, however, we obtain implausible point estimates of the intertemporal substitution and risk aversion coefficients. In addition, the implied share of financial wealth in total wealth is estimated much too small (only 1 per cent).

The structure of the paper is as follows. In section 2, the model is developed and two reduced forms are derived for asset returns as a function of macroeconomic variables. In section 3, the data are described and empirical evidence is presented. The last section concludes and offers perspectives for further research.

2. The model

Our model is built along the lines of Shawky and Peng (1995) and Campbell (1996). Shawky and Peng constructed a two-sector and two-agents model, consisting of a representative firm and consumer-worker-investor[1]. The link between the two agents followed from the first order conditions. This yielded a type of consumption CAPM relation for the consumer, in which consumption was substituted out using the producer's first order conditions. This resulted in an asset pricing equation with changes in capital and labor inputs, and a constant term (the discount rate plus a labor elasticity times the risk aversion) as explanatory variables[2]. Campbell starts from the CCAPM formula and substitutes out consumption growth in a rather ad hoc manner, assuming (1) that it has a market-related return and a constant variance, and (2) that the market return is a weighted average of financial and non-financial returns.

In this paper, we also work with a two-sector and a two-agents model, but we use a more general specification than Shawkey and Peng. The consumer optimization problem follows from a general CCAPM representation, as in Epstein and Zin (1991) and Kocherlata (1996), allowing for a

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[1] In their model, the firm produced investment goods and consumer goods with the same Cobb-Douglas technology and it was treated as a price-taker. The firm maximized its net present value of consumer goods sales, taking into account the total labor costs and investment costs, subject to the CD-production function, by choosing the amount of labor and capital. The representative consumer was assumed to maximize his net present value of utility derived from consumption, by choosing the amount of per period consumption and asset holdings. His budget restriction included the current asset holdings, asset income and wages, which were assigned to consumption and the residual being invested in financial assets.

[2] When recalculated and corrected, technological progress disappears from their final equation.

separation between risk aversion and intertemporal substitution. The representative firm is modeled under imperfect (monopolistic) competition, in contrast to Shawky and Peng who assumed perfect competition. This yields a more general fundamental asset pricing equation, with real return on labor income, time-varying mark-ups and a labor elasticity as explanatory factors, besides the market return. Below, we will present the main equations that lead to our equilibrium asset return equation.

2.1. The representative consumer

Depending upon the specification of the utility function of the representative consumer-investor-worker, we obtain different formulas for asset prices. We follow Campbell (1996) and Epstein and Zin (1991) in representing the typical consumer who recieves utility at time t from a consumption stream that is described by the following formula :

$$U_t = \left\{ (1-\beta)c_t^{\rho} + \beta\left(E_t U_{t+1}^{\alpha}\right)^{\rho/\alpha} \right\}^{1/\rho} \tag{1}$$

Thus, utility today is a constant elasticity function of current consumption and future utility, with β=1/(1+δ) the subjective discount factor and δ the rate of time preference. The degree of risk aversion is α while the intertemporal substitution σ is reflected in ρ as $\sigma = 1/[1-\rho]$ [3]. Consumption is defined in per capita terms, as total consumption expenditures divided by the population (or work force, a distinction that we neglect in further derivations).

This formulation may help to disentangle aspects of asset pricing behavior that appeared anomalous in the existing literature. For instance, in a standard power utility function, risk aversion and intertemporal substitution are reciprocals, meaning that they cannot be high simultaneously. Kocherlata (1996) shows that with generalized expected utility preferences as in equation (1), it is possible to solve the risk free rate puzzle, with both a high risk aversion and a high intertemporal substitution which generates a high savings demand[4].

The consumer-investor-worker's optimal investment profile in this case leads to :

$$E_t\left[\beta^{\gamma}\left(\tfrac{c_{t+1}}{c_t}\right)^{\gamma(\rho-1)} R_{M,t+1}^{\gamma-1} R_{i,t+1}\right] = 1 \tag{2}$$

$$E_t\left[\beta\left(\tfrac{c_{t+1}}{c_t}\right)^{\rho-1} R_{M,t+1}\right]^{\gamma} = 1 \tag{3}$$

where $R_{M,t+1}$ is the discrete gross real market portfolio return, $R_{i,t+1}$ asset i's discrete gross real return, $\gamma = \alpha/\rho$. Equation (3) follows from (2) by setting $i=M$.

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[3] Risk aversion refers to the consumer's attitude toward variation across states of the world at one point in time whereas intertemporal substitution refers to variation in consumption over time, possibly in the absence of risk (Ferson, 1995).

[4] Kocherlata in his 1996 survey in the JEP also considers habit formation and "keeping up with the Joneses" specifications for the utility function and the effects of trading costs and incomplete markets. Our aim is just to specify a more general utility function than a power function which does not distinguish between risk aversion and intertemporal substitution.

The return on the market portfolio $R_{M,t+1}$ is not observable as such. For a cross-section study of the stock market, in the lines of Fama and French (1993), one can take the representative stock market index return to proxy the market portfolio return. However, in our empirical exercise, we will investigate time-series data of stocks, government bills and bonds, and gold, as in Campbell (1996). By considering a limited number of asset classes to invest in, we can circumvent this problem and obtain empirical estimates of portfolio weights along with the fundamental parameters[5]. As in Campbell (1996), we include human wealth in the analysis. Equation (4) expresses the total gross portfolio return as a weighted average of returns on financial wealth and human wealth[6].

$$R_{Mt} = v_t R_{at} + (1-v_t) R_{Wt} \tag{4}$$

Here, R_{at} denotes the discrete gross real return on financial wealth (a refers to financial assets) and R_{Wt} is the discrete gross real return on human wealth (W refers to labor income). We take aggregate labor income as an observable variable that can be thought of as the dividend on human wealth[7]. The aggregate financial asset return is obtained as a value-weighted average of the individual asset returns, with the value of outstanding claims per asset category as weighting elements. The fraction v is taken to be two-thirds, as is argued by Campbell (1996). The empirical results are robust to changes in this value.

2.2. The firm

Consider now the representative firm, producing two goods, viz. a consumption good and a capital good. These can be thought of as a single physical good that may be allocated to either consumption or investment purposes. Suppose that the firm operates in an environment of imperfect competition and maximizes its profits as described by the following equations, cf. Carlin and Soskice (1997, 140-143 and 418-422):

$$max_{p_{it}} \quad E_t \Sigma_t \; \rho^{it} \left(p_{it} Y_t - w_t L_t - F\right) \tag{5}$$

$$Y_t = C_t + I_t \tag{6}$$

$$Y_t^s = A_t L_t^{\alpha'} K_t^{\beta'} \tag{7}$$

$$Y_t^d = \left(\tfrac{p_{it}}{P_t}\right)^{-\varepsilon} \theta_t Y_t^* \tag{8}$$

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[5] Kocherlata (1996) suggests the following reduced-form equations which do not include the market return, for an environment with only stocks and bonds

$$\beta E\left[\left(\tfrac{c_{t+1}}{c_t}\right)^{-\alpha}\left(R_t^s - R_t^b\right)\right] = 0 \text{ and } \beta\left[E\left(\tfrac{c_{t+1}}{c_t}\right)^{1-\alpha}\right]^{(\alpha-\rho)/(1-\alpha)} E\left[\left(\tfrac{c_{t+1}}{c_t}\right)^{-\alpha} R_t^b\right] = 1$$

[6] Another representation is in terms of net returns. Following Campbell (1996), the analogous equation of (4) then becomes: $r_{Mt} = v r_{at} + (1-v) r_{W_t}$ + constant, using the fact that $r \approx R-1$ and after linearizing around the mean of v_t.

[7] The rationale is taken from Jagannathan and Wang (1996). Suppose labor income follows an autoregressive process $w_t = (1+g) w_{t-1} + \varepsilon_t$. Then the realized capital-gain part of the return on human capital will be the realized growth rate of labor income. To see this, wealth due to human capital is $w_t/(r-g)$ as from the Gordon-Shapiro model, and the rate of change in wealth is then given by $r_{W_t} = (w_t - w_{t-1})/w_{t-1}$.

where Y is real output, L labor input, K real capital, I real investment, C aggregate real consumption, ρ' is the discount rate factor, p is the general price of produced goods, w is the labor cost per worker, F denotes fixed costs and subscript t is a time index. Equation (5) measures the present value of the future net profits. Equation (6) says that output consists of consumer and investment goods, as mentioned above. The supply is described by a Cobb-Douglas production function as in equation (7). The firm is informed of stochastic productivity shocks A_t at the beginning of each period t. Demand for the firm's products is given in equation (8) and varies positively with trend output Y_t^*, the business cycle θ (larger than one in a boom and smaller than one during recessions), and negatively with relative prices p_{it}/p_t with ε measuring the elasticity of demand.

The optimization for the firms result in the following first order condition[8] :

$$p_t = \frac{w_t / (\partial Y_t / \partial L_t)}{1 - 1/\varepsilon} = (1 + m_t) \frac{w_t}{\alpha' Y_t / L_t} \tag{9}$$

where $1+m_t = \frac{1}{1-1/\varepsilon_t}$ is a time-varying mark-up factor and other variables are as defined above.

Because we assumed that a single physical good with two alternative ends is produced, the consumer goods sector and the investment goods sector have identical production functions. This leads to the condition that labor productivity is equal in the consumption goods sector, the capital goods sector and in the economy as a whole:

$$Y_t / L_t = C_t / L_{ct} = I_t / L_{kt} \tag{10}$$

with L_{ct} (L_{kt}) denoting employment in the consumption (capital) goods sector.

2.3. Substituting out consumption

Recall that consumption in equations (2)-(3) was defined as aggregate consumption divided by the number of consumers-investors-workers in the economy, or $c_t = C_t/L_t$ (assuming that the population coincides with the number of consumers, investors and workers). Using conditions (9) and (10), the term c_{t+1}/c_t can be rewritten as:

$$\frac{c_{t+1}}{c_t} = \frac{C_{t+1}/L_{t+1}}{C_t/L_t} = \frac{\frac{Y_{t+1}}{L_{t+1}} \frac{L_{ct+1}}{L_{t+1}}}{\frac{Y_t}{L_t} \frac{L_{ct}}{L_t}} = \frac{w_{t+1}/p_{t+1}}{w_t/p_t} \frac{1+m_{t+1}}{1+m_t} e^{a_{t+1}} \tag{11}$$

where $a_{t+1} = \mathrm{dln}(L_{ct+1}) - \mathrm{dln}(L_{t+1})$ is a labor elasticity, viz. the percentage change of the labor force in the consumption sector minus the change in total employment. The substitution of (11) in the asset pricing equations (2)-(3) results in the following equations:

$$E_t \left[\beta^{\gamma} \left(\frac{w_{t+1}/p_{t+1}}{w_t/p_t} \frac{1+m_{t+1}}{1+m_t} e^{a_{t+1}} \right)^{\gamma(\rho-1)} R_{M,t+1}^{\gamma-1} R_{i,t+1} \right] = 1 \tag{12}$$

$$E_t \left[\beta \left(\frac{w_{t+1}/p_{t+1}}{w_t/p_t} \frac{1+m_{t+1}}{1+m_t} e^{a_{t+1}} \right)^{\rho-1} R_{M,t+1} \right]^{\gamma} = 1 \tag{13}$$

where equation (13) follows from (12) by setting $i{=}M$.

Equations (12) and (13) are transformed following standard practice. First, we loglinearize the equations and obtain the following equations (see Hansen and Singleton, 1983)[9]:

$$E[r_{at} \mid z_{t-1}] = (1-\tfrac{\rho}{v})\, E[r_{W_t} \mid z_{t-1}] + \tfrac{1-\rho}{v}\, E[\Delta m_t + (g_{Lc_t} - g_{L_t}) \mid z_{t-1}] + \text{constant} \tag{14}$$

$$E[r_{it} \mid z_{t-1}] - r_{ft} + \tfrac{1}{2} V_{ii,t} = v(1-\tfrac{\alpha}{\rho}) V_{ia,t} + [1 - v - \alpha + \tfrac{\alpha v}{\rho}] V_{ir_W,t} + \alpha\left(\tfrac{1}{\rho} - 1\right)[V_{i\Delta m,t} + V_{ig_{Lc}-g_L,t}] \tag{15}$$

where $V_{ii,t} \equiv \text{var}(r_{it} \mid z_{t-1})$, $V_{ia,t} \equiv \text{cov}(r_{it}, r_{at} \mid z_{t-1})$, $V_{ir_W,t} \equiv \text{cov}(r_{it}, r_{Wt} \mid z_{t-1})$,

$V_{i\Delta m,t} \equiv \text{cov}(r_{it}, \Delta m_t \mid z_{t-1})$, $V_{i,g_{Lc}-g_L,t} \equiv \text{cov}(r_{it}, g_{Lct}\text{-}g_{Lt} \mid z_{t-1})$, r_{it} (and respectively, r_{at} and r_{Wt}) denote continuously compounded net returns on individual assets (respectively, the aggregate financial portfolio and labor income), r_{ft} is the riskfree interest rate, z_{t-1} denotes a vector of predetermined variables that belong to the information set Ω_{t-1}. With data of asset returns, returns on labor income, mark-ups and changes in employment, one can use equations (14) and (15) to assess the explanatory power of the model in a cross section and time series context. In the next section, we present the results of a calibration on US and Japanese data and GMM estimation results.

The conditional variance term in the left-hand side of (15) disappears, by substituting the expected discrete excess return (i.e., the expected gross excess asset return) for the left-hand side (i.e., the expected continuously compounded return)[10].

$$E[r_{it} \mid z_{t-1}] + \tfrac{1}{2} V_{ii,t} - r_{ft} \approx E[R_{it} \mid z_{t-1}] - R_{ft} \tag{16}$$

The treatment of the time-varying covariances is a remaining technical problem. The measurement method will be described in the following section.

To sum up, we find that in a two-agent, two-sector model, a cross-section of individual financial asset returns might be determined by three to four driving forces. One is the market portfolio return, the other elements are the real return on labor income (or wages), the sensitivity of employment in the consumption goods sector vis-à-vis total employment, and time variation in the mark-up pricing of the firms. The appearance of returns on real labor income in the asset pricing equation can be explained intuitively, since (1) labor income is an important factor in the budget constraint of a typical consumer and thus affects the demand for and the pricing of financial assets, and (2) real wages are correlated with the business cycle, via the CD-production function (which -in equilibrium- can be rewritten in input factor prices). Mark-up price variations reflect the firm's profit perspectives. The relative

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[8] We used the fact that the aggregation eliminated firm specific prices, wages and mark ups (viz. the i's).

[9] We allowed for heteroskedasticity in the variance-covariance structure. The simpler case of homoskedasticity ensures that the unconditional variances and covariances of innovations are the same as the constant conditional variances and covariances of these innovations. This need not be the case if heteroskedasticity is present.

[10] See Hardouvelis et al. (1995, footnote 7) for a further discussion.

employment fluctuations in the consumption goods sector may reveal additional supply-side and business cycle effects, and since this sector is largest in terms of employment and output, it has major macroeconomic consequences, which here are reflected in the pricing of the firm's assets.

Our model might make up for a missing element in the Jagannathan-Wang (1996) conditional CAPM or Premium-Labor model. They find that this model with the market return, a premium between low and high-grade bonds and returns on labor income, supports the US data very well, and is robust to adding the Chen et al. (1986) macroeconomic factors or the Fama-French (1993) size and book-to-market variables. Nonetheless, they mention that the magnitude of the intercept term suggest that it is missing some aspect of reality. This might be the relative fluctuations of employment in the consumption goods sector, which appears in our asset pricing equations. On the other hand, our model does not incorporate the premium term, but it may perhaps be proxied by the cyclical variation in the mark-up pricing.

The next session describes the details of the estimation procedure and presents empirical results for the US[11].

3. Empirical results

3.1. Estimation methodology using GMM

Equations (12)-(13) and (14)-(16) represent a long-run equilibrium determination of financial asset returns. We follow the mainstream literature [see e.g., Campbell (1993, 1996) and Hardouvelis et al. (1995)] to estimate the model by GMM. First, we describe how the conditional covariances are determined. Then, we continue describing the specific system approach to estimate equations (15)-(16). A short description of GMM is provided in the appendix.

3.1.1. Conditional covariances

We adopt the approach of Harvey (1989) to estimate time-varying covariances. For this exercise, a set of regression equations is estimated. Equation (17) shows the general formula for the covariance between x and y, conditional on the information set z_{t-1} at time t-1. The conditional expected values of x and y can be derived seperately from regressions of x, resp. y, on z_{t-1}. Then, the residuals of these estimations μ_i are used to construct the covariances, conditional on the information at t-1.

$$\begin{aligned} V_{xy,t} &= \text{cov}(x_t, y_t \mid z_{t-1}) = E\{(x_t - E[x_t \mid z_{t-1}])(y_t - E[y_t \mid z_{t-1}]) \mid z_{t-1}\} \\ &= E\{(x_t - z_{t-1}\delta_x)(y_t - z_{t-1}\delta_y) \mid z_{t-1}\} \\ &= E[\mu_{x|z}\, \mu_{y|z} \mid z_{t-1}] \qquad (17) \end{aligned}$$

where the δ_i's represent regression coefficients and μ_i's represent regression residuals.

In the second step, generalized method of moments (GMM) of Hansen (1982) is used to estimate equations (14)-(16), for stocks returns, yields on government bonds, returns on gold and on real

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[11] In a later stage, we will also investigate whether the model works for Germany and Japan.

estate[12] –where the right-hand side conditional covariances are replaced using the outcomes of equation (17). As we shall see, there is a one-step approach that combines the estimation of the conditional expected values, conditional covariances and the asset pricing equations.

3.1.2. System estimation

A general approach is to estimate the full system, including the conditional covariances and the asset return equations (14)-(16) in one step using GMM. In line with Harvey (1989), we can write our system (14)-(16) as a k-factor pricing relation:

$$E[R_{it} \mid z_{t-1}] - R_{ft} = \lambda \operatorname{cov}[R_{it} - R_{ft}, f_t \mid z_{t-1}] \tag{18}$$

where $R_{it}-R_{ft}$ represents the discrete excess asset returns, λ is a k-dimensional row vector of coefficients and f are the k factors relevant for asset pricing. Then, all the disturbances can be stacked in one large system:

$$\eta_t = (\mu_t' \; v_t' \; w_t') = \begin{pmatrix} R_{it} - R_{ft} - \delta_i z_{t-1} \\ f_t - \delta_f z_{t-1} \\ R_{it} - R_{ft} - \left(\left(f_t - \delta_f z_{t-1}\right)\lambda'\right)\left(R_{it} - R_{ft} - \delta_i z_{t-1}\right) \end{pmatrix} \tag{19}$$

The implied restrictions are $E[\eta_t \mid z_{t-1}] = \mathbf{0}$ [13], and are estimated by GMM. Hamori (1997) suggests a more parsimonious system as follows[14]:

$$\xi_t = (v_t' \; w_t') = \begin{pmatrix} f_t - \delta_f z_{t-1} \\ R_{it} - R_{ft} - \lambda\left(f_t - \delta_f z_{t-1}\right)\left(R_{it} - R_{ft}\right) \end{pmatrix} \tag{20}$$

An advantage of system (20) is that the forecast error u_t need not be calculated. If there are l instrumental variables, n assets and k factors, then instead of $(2n+k)\text{x}l$ orthogonality conditions and $[k+(n+k)\text{x}l]$ parameters to be estimated in (19), there are only $(n+k)\text{x}l$ orthogonality conditions and $(k + k\text{x}l)$ parameters to be estimated in (20). In both cases, the number of overidentifying restrictions is $n\text{x}l - k$, but the dimension of the weighting matrix is smaller in (20), and thus, it is computationally more manageable (Hamori, 1997).

3.2. Data and descriptive statistics

The model is tested for the US and Japan. We opt for a time-series analysis[15]. Most of our current data are obtained from the OECD Statistical Compendium CD-ROM, version 98/1, sectoral database. Stock prices and long-term government bond yields are from IMF, International Financial Statistics. The financial asset portfolio thus consists of stocks, bills and bonds. Weightings of the respective asset categories were derived from flow of funds balance sheet tables, taken from the Board of Governors of the Federal Reserve System's Coded Tables Z1 for the US and from Bank of Japan for Japan. Our

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[12] Excellent surveys of GMM are provided by Hall (1993) and Hamilton (1994).

[13] See Harvey (1989, p. 294, equation 14).

[14] This follows from $E[(R_{it}-R_{ft}-\delta_i z_{t-1})(f_t-\delta_f z_{t-1})|z_{t-1}] = E[(R_{it}-R_{ft})(f_t-\delta_f z_{t-1})|z_{t-1}] - E[\delta_i z_{t-1}(f_t-\delta_f z_{t-1})|z_{t-1}]$
$= E[(R_{it}-R_{ft})(f_t-\delta_f z_{t-1})|z_{t-1}] - \delta_i z_{t-1}E[f_t-\delta_f z_{t-1}|z_{t-1}] = E[(R_{it}-R_{ft})(f_t-\delta_f z_{t-1})|z_{t-1}]$

[15] In a sequel, we will investigate the ability of our model to account for the pricing of cross-sectional data on

approach of constructing an aggregate asset price index is in line with Stambaugh (1982) and Borio et al. (1994)[16]. All data are quarterly, 1960Q1-1997Q4 (1970Q1-1997Q1 for Japan), which is the highest possible frequency for some real series (labour, output). Table 1 gives an overview of the variables, sources, codes and a short description. Calculated variables are represented in the second part of the table.

We considered the output of the business sector, viz. production of consumption goods and business investments. The overall deflator of output and the accompanying inflation rate are derived from the consumption and investment components. We have estimated mark-ups from pricing data. As described in table 1, we derived the mark-ups from an equilibrium inflation model that had wages corrected for productivity gains, and two mark-up terms as explanatory variables, besides a lagged inflation term (designed to pick up adjustment lags). The two mark-up terms are from Bils (1989), viz. the output gap and a foreign price competition effect –which are documented in the literature to positively covary with the mark-up pricing factor.

Table 1: Description of the data

Symbol	Source	Code	Description
C	OECD	CPV	Private consumption, volume
I	"	IBBV	Investment by the business sector, volume
L	"	ETB	Employment, business sector
w	"	WSSE	Compensation per employee, private sector
P_k	"	PIB	Business sector fixed investment deflator
P_c	"	PCP	Deflator for private consumption expenditure
s	"	62	S&P500 stock price index
i	OECD/IMF	60/61	T-bill rate / Government bond yield
			Calculated series
P	$\frac{P_c C+P_k I}{C+I}$		Deflator of business sector output
L_c ; L_k	$C/(C+I)L;I/(C+I)L$		Employment in the consumption, resp. capital goods sector
$g_{L_C}-g_L$	$\mathrm{dln}(L_c)-\mathrm{dln}(L)$		Elasticity of employment in the consumption goods sector w.r.t. total employment
R_s	$(s_t/s_{t-1})/(P_t/P_{t-1})$		Gross real stock return
R_f ; R_b	$(1+¼\, i_t)/(P_t/P_{t-1})$		Gross real interest rate (yield) on short-term bills (assumed risk-free) and long-term government bonds, resp.
R_a	$\Sigma_j\, \omega_j R_j$		Real financial portfolio return, with weights ω_i (j= stocks, ST bills, LT bonds) weights are derived from flow of funds balance sheet statistics of the Board of Governors Publication of Coded Tables *Z.1* (cf. appendix)
Mark-up $= \frac{1+m_{t+1}}{1+m_t}$	The mark-up is estimated from the following model of prices (cf. Bils, 1989): $\Delta \mathrm{p} = \lambda[\Delta w-\Delta q+m_1\Delta\theta+m_2\Delta(\mathrm{p}-\mathrm{p}^*)]+(1-\lambda)\Delta \mathrm{p}_{-1}$, hence $m_t = m_1\theta + m_2(\mathrm{p}-\mathrm{p}^*)$ where w denotes wages, q productivity, $\theta=Y-Y^*$ business cycle indicator (Y^* trend output), p (p*) domestic (import) prices – variables in logs		
Δm_t	$= m_t - m_{t-1}$		

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stocks and bonds using the Fama-McBeth (1973) procedure.

[16] Stambaugh also included investments in corporate bonds, residential real estate, housefurnishings and automobiles in his analysis. Borio et al. ignored bills and bonds, but included residential and commercial real estate as investments. We chose to limit ourselves to purely financial assets, in part because of data limitations. In appendix, we give detailed references of the flow of funds tables weightings we used.

Descriptive statistics are provided in tables 2 to 4. Table 2 provides a first glance of the distribution of financial wealth in the US and Japan, as invested in equities, short-term interest rate instruments and long term fixed-income (government) bonds. Table 2 shows that on average, equities with 40 per cent were the main net financial asset category in the US, while short-term and long-term interest rate instruments averaged 30 per cent of financial wealth. Over time, there is a large variation in these asset shares, as is demonstrated by the large range between maximum and minimum and a standard deviation of 5 to 7 per cent up and down (cf. graph in appendix). Note also that over time, financial wealth invested in these assets has grown by a factor 10. For Japan, we find that the bulk of financial wealth is invested in short-term interest rate securities, well beyond 60 per cent. Long-term bonds represent a lower but steadily increasing percentage of financial wealth, and arrived at 20 per cent near the end of our sample. Equity investments fluctuated cyclically and reached a maximum of 30 per cent around 1990, but declined toward its historical average afterwards (around 20 per cent of total financial wealth).

Table 2: Characteristics of relative importance and total market value of equities and fixed-income assets (short and long term)

US

	Equities	Short-term fixed-income	Long-term fixed-income	Total market value (billion USD)
Mean	40.9%	30.1%	29.0%	
Median	40.3%	29.3%	29.2%	1965 Q4
Maximum	54.3%	39.8%	36.3%	1446.19
Minimum	29.3%	18.4%	20.8%	1975 Q4
Std. Dev.	0.072	0.056	0.041	2361.66
Skewness	0.090	0.064	-0.186	1985 Q4
Kurtosis	1.617	1.992	1.845	7066.78
Jarque-Bera	11.99	6.36	9.08	1995 Q4
Probability	0.002	0.041	0.011	16328.1

Japan

	Equities	Short-term fixed-income	Long-term fixed-income	Total market value (100 million Yen)
Mean	20.9%	63.1%	16.1%	
Median	20.0%	65.0%	16.0%	1965 Q4
Maximum	31.5%	70.0%	21.2%	500 412
Minimum	16.1%	52.9%	11.6%	1975 Q4
Std. Dev.	0.040	0.051	0.026	2 754 165
Skewness	0.990	-0.340	0.213	1985 Q4
Kurtosis	3.103	1.553	2.136	8 642 972
Jarque-Bera	17.84	11.61	4.22	1995 Q4
Probability	0.000	0.003	0.121	17 510 381

Note: Financial wealth is specified as equities plus fixed-income assets, as derived from the flow of funds accounts (cf. table 1 and appendix).

We deliberately chose to confine ourselves to these three asset types as opposed to Stambaugh (1982), who also considered corporate bonds, automobiles, housing and housefurnishing. However, the problem is that returns on these assets are difficult to calculate and are largely based on the evolution of consumer price indices (except for corporate bonds, for which only recent data are publicly available).

Table 3: Descriptive statistics – US (1960Q1-1997Q4)

	r_f	r_b	r_s	r_a	r_w	Δm	$g_{L_c} - g_L$
Mean	0.489%	0.841%	0.836%	0.737%	0.290%	0.005%	-0.037%
Median	0.454%	0.784%	0.827%	0.826%	0.309%	0.040%	-0.056%
Maximum	2.382%	2.752%	17.347%	6.653%	1.503%	1.062%	0.884%
Minimum	-0.840%	-1.016%	-25.026%	-9.187%	-1.071%	-1.401%	-0.702%
Std. Dev.	0.006	0.007	0.062	0.027	0.005	0.004	0.003
Skewness	0.406	0.256	-0.643	-0.786	-0.134	-0.243	0.484
Kurtosis	3.566	3.690	4.878	4.439	3.312	3.663	3.666
Jarque-Bera	6.09 ^{b}	4.58	32.15 ^{a}	28.21 ^{a}	1.05	4.19	8.56 ^{b}
acf 1	0.848 ^{a}	0.897 ^{a}	0.302 ^{a}	0.376 ^{a}	0.374 ^{a}	0.217 ^{b}	0.463 ^{a}
acf 4	0.64 ^{a}	0.685 ^{a}	0.005	0.073	0.106	0.057	0.034
acf 8	0.44 ^{a}	0.458 ^{a}	-0.026	-0.006	0.03	-0.099	-0.267 ^{a}
acf 16	0.108	0.201 ^{a}	0.242 ^{a}	0.282 ^{a}	0.156 ^{c}	0.143 ^{c}	0.046
pacf 1	0.848 ^{a}	0.897 ^{a}	0.302 ^{a}	0.376 ^{a}	0.374 ^{a}	0.217 ^{b}	0.463 ^{a}
pacf 4	-0.042	-0.134	0.048	0.093	-0.074	-0.015	-0.088
pacf 8	-0.003	-0.072	0.017	0.038	0.081	-0.096	-0.174 ^{b}
pacf 16	-0.051	-0.051	0.218 ^{a}	0.198 ^{b}	0.033	0.146 ^{c}	0.012
Correlations * and covariances	r_f	r_b	r_s	r_a	r_w	Δm	$g_{L_c} - g_L$
r_f	3.466	**0.896** ^{a}	**0.227** ^{a}	**0.365** ^{a}	**0.136** ^{c}	**-0.350** ^{a}	**0.198** ^{b}
r_b	3.611	4.681	**0.298** ^{a}	**0.429** ^{a}	**0.197** ^{b}	**-0.261** ^{a}	**0.159** ^{b}
r_s	8.338	12.709	387.835	**0.977** ^{a}	**0.243** ^{a}	**0.021**	**0.172** ^{b}
r_a	5.679	7.762	161.047	69.989	**0.265** ^{a}	**-0.034**	**0.173** ^{b}
r_w	0.397	0.664	7.477	3.462	2.439	**0.191** ^{b}	**0.055**
Δm	-0.895	-0.775	0.567	-0.387	0.411	1.888	**-0.456** ^{a}
$g_{Lc}-g_L$	0.297	0.277	2.730	1.165	0.068	-0.503	0.646

Notes.

Variables are r_f : short-term fixed-income (risk-free); r_b : long-term fixed income (government bond yield); r_s : S&P500 equity index return ; r_a : composite financial asset return ; r_w : return on labor income ; Δm : changes in the price mark-up; $g_{L_c} - g_L$: changes in employment in the consumer goods sector vis-a-vis total employment.

(p)acf z : (partial) autocorrelation coefficient of order z.

* : unconditional/instantaneous correlations are bold-typed above the diagonal numbers, on/below the diagonal numbers are the unconditional/instantaneous (co)variances multiplied by 10 000.

Statistically significant at ^{a} : 1 %, ^{b} : 5%, ^{c} : 10 %.

The top panels of table 3 and 4 cover US and Japanese descriptive statistics, respectively, for the variables as specified in (15)-(16) and table 1, viz. the mean and median, minimum and maximum, standard deviation, skewness and kurtosis and (partial) autocorrelations. The bottom panels of table 3 and 4 provide the unconditional variances, covariances and (instantaneous) correlations between these variables. From the tables, it is clear that real returns on stocks show the largest variation, while short-term and long-term government bond variation falls in a much smaller range. The interest rates (and in Japan also the returns on labor) have a clearer autoregressive character. Except for the first order effect, no systematic moving average behaviour seems present. The Jarque-Bera test statistic shows that most series are not quite normally distributed. The composite asset return closely follows the behavior of the stock market return, as can be seen from the correlations of 0.98 and 0.94, for the US and Japan, respectively, though the peaks and troughs are more smooth, due to the presence of interest rate components. Another large correlation is that between the short-term, risk-free and long-term interest rates, which follows from the expectations theory of interest rate determination. Other correlations appear to be below 0.50 for the US, while in Japan, returns on labor income are quite highly correlated with asset returns. There is no sign of multicollinearity from a Belsey test. Perhaps he most striking is the observation that price mark-ups and employment appear to covary negatively with a coefficient of 0.46, which might create difficulties for the empirical application under consideration, since they appear with the same coefficient.

Table 4: Descriptive statistics – Japan (1970Q1-1997Q1)

	r_f	r_b	r_s	r_a	r_w	Δm	$g_{L_c}-g_L$
Mean	0.605%	0.681%	1.007%	0.690%	-0.597%	0.065%	0.007%
Median	0.837%	0.927%	1.591%	0.831%	-0.312%	-0.025%	0.006%
Maximum	2.705%	1.873%	19.521%	5.675%	1.058%	1.672%	1.148%
Minimum	-4.805%	-5.912%	-17.331%	-5.896%	-7.553%	-1.596%	-0.926%
Std. Dev.	0.010	0.011	0.080	0.021	0.011	0.007	0.004
Skewness	-2.242	-3.093	-0.067	-0.493	-2.865	0.181	0.187
Kurtosis	11.923	16.449	2.920	3.808	15.870	2.608	2.617
Jarque-Bera	452.9	995.2	0.11	7.38	901.4	1.29	1.30
acf 1	0.652 ^{a}	0.747 ^{a}	0.389 ^{a}	0.459 ^{a}	0.71 ^{a}	0.14	0.35 ^{a}
acf 4	0.242 ^{a}	0.414 ^{a}	-0.008	0.021	0.466 ^{a}	0.057	0.148
acf 8	0.071	0.194 ^{c}	0.004	0.031	0.276 ^{a}	-0.152	-0.04
acf 16	0.192 ^{c}	0.219 ^{b}	-0.019	0.459 ^{a}	0.281 ^{a}	-0.171 ^{c}	-0.091
pacf 1	0.652 ^{a}	0.747 ^{a}	0.389 ^{a}	-0.051	0.71 ^{a}	0.14	0.35 ^{a}
pacf 4	-0.345 ^{a}	-0.326 ^{a}	-0.158 ^{c}	0.016	-0.196 ^{b}	-0.015	-0.064
pacf 8	-0.064	-0.057	0.146	-0.041	0.098	-0.175 ^{c}	-0.007
pacf 16	0.028	0.023	0.161 ^{a}		0.121	-0.128	-0.053
Correlations * and covariances	r_f	r_b	r_s	r_a	r_w	Δm	$g_{L_c}-g_L$
r_f	0.921	**0.894** ^{a}	**0.230** ^{b}	**0.535** ^{a}	**0.810** ^{a}	**-0.110**	**-0.008**
r_b	0.906	1.114	**0.277** ^{a}	**0.550** ^{a}	**0.937** ^{a}	**-0.034**	**-0.092**
r_s	1.758	2.331	63.553	**0.935** ^{a}	**0.268** ^{a}	**0.025**	**-0.083**
r_a	1.066	1.205	15.471	4.308	**0.521** ^{a}	**-0.018**	**-0.075**
r_w	0.865	1.099	2.372	1.203	1.237	**0.010**	**-0.069**
Δm	-0.070	-0.024	0.130	-0.024	0.008	0.438	**-0.209** ^{b}
$g_{Lc}-g_L$	-0.003	-0.043	-0.291	-0.069	-0.034	-0.060	0.192

Notes : see previous table.

3.3. Calibration

In line with Kandel and Stambaugh (1991), in table 5 we first examine the implied unconditional moments of quarterly stock and bond returns for different combinations of the unknown parameters α, σ and v. We assume a value of 0.33 for v, the share of financial wealth in total wealth, in line with the value assumed by Campbell (1996). In appendix, we present analogous results for v-values of 0.1, 0.2 and 0.5. We consider four values for the intertemporal substitution elasticity ($\sigma = 0.1, 0.5, 0.99$ and 1.5). The degree of relative risk aversion is allowed to take on eight different values ($\alpha = 0.5$, 1, 1.5, 3, 10, 30, 100 and 900). In general, the results in table 5 indicate that the sample values of the asset returns can be obtained for several combinations of α and σ, both for Japan and the US, if one considers one asset category at a time. A first set combines a high substitution elasticity (0.99) with a very low risk aversion (around 0.25). A second set of outcomes that reproduces the sample counterparts of the stock returns consists of a medium substitution elasticity (between 0.5 and 0.99) and a low risk aversion (between 1 and 10). Finally, a combination of low substitution elasticities (between 0.10 and 0.50) and very high risk aversion (from 30 to 900) also matches the unconditional data. The results also show that intertemporal substitution elasticities higher than 1 cannot reproduce the sample mean asset returns.

Table 5: Implied first moments of quarterly returns

US

Unconditional mean stock return
sample value = 0.836 %

	σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33
α	0.5	0.545%	0.566%	2.913%	0.470%
	1	0.542%	0.585%	5%	0.393%
	1.5	0.539%	0.603%	8%	0.316%
	3	0.531%	0.659%	15%	0.084%
	10	0.493%	0.919%	48%	-0.997%
	30	0.384%	1.661%	142%	-4%
	100	0.002%	4%	474%	-15%
	900	-4.4%	34%	4258%	-138%

Unconditional mean interest rate
sample value = 0.841 %

	σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33
α	0.5	0.492%	0.493%	0.634%	0.488%
	1	0.492%	0.495%	0.775%	0.483%
	1.5	0.492%	0.496%	0.917%	0.479%
	3	0.492%	0.500%	1.342%	0.466%
	10	0.493%	0.519%	3.3%	0.404%
	30	0.496%	0.573%	9.0%	0.229%
	100	0.507%	0.762%	28.8%	-0.384%
	900	0.629%	2.920%	255.5%	-7.390%

Japan

Unconditional mean stock return
sample value = 1.007 %

	σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33
α	0.5	0.663%	0.683%	2.9%	0.593%
	1	0.655%	0.695%	5.1%	0.514%
	1.5	0.646%	0.707%	7.4%	0.435%
	3	0.621%	0.741%	14%	0.198%
	10	0.501%	0.904%	45%	-0.9%
	30	0.160%	1.37%	134.5%	-4.1%
	100	-1.036%	2.99%	447%	-15.1%
	900	-14.7%	22%	4015%	-141%

Unconditional mean interest rate
sample value = 0.681 %

	σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33
α	0.5	0.611%	0.611%	0.661%	0.609%
	1	0.606%	0.607%	0.706%	0.602%
	1.5	0.601%	0.602%	0.751%	0.596%
	3	0.585%	0.588%	0.886%	0.576%
	10	0.514%	0.523%	1.52%	0.482%
	30	0.309%	0.336%	3.32%	0.215%
	100	-0.406%	-0.316%	9.61%	-0.721%
	900	-9%	-8%	82%	-11.4%

Notes.

The optimization follows from equations (14)-(16). The covariances were set equal to their unconditional sample counterparts. A value of 0.33 was assumed for v (the share of financial wealth in total wealth). Several values for α (degree of relative risk aversion) and σ (intertemporal substitution elasticity) were generated. In appendix, we present similar cases for v = 0.10, 0.20 and 0.50.

The optimum values of α and σ across the two asset categories that we considered (viz. stocks and bonds) can be calculated from equation (15), taking the unconditional returns and unconditional covariances as given.

This yields

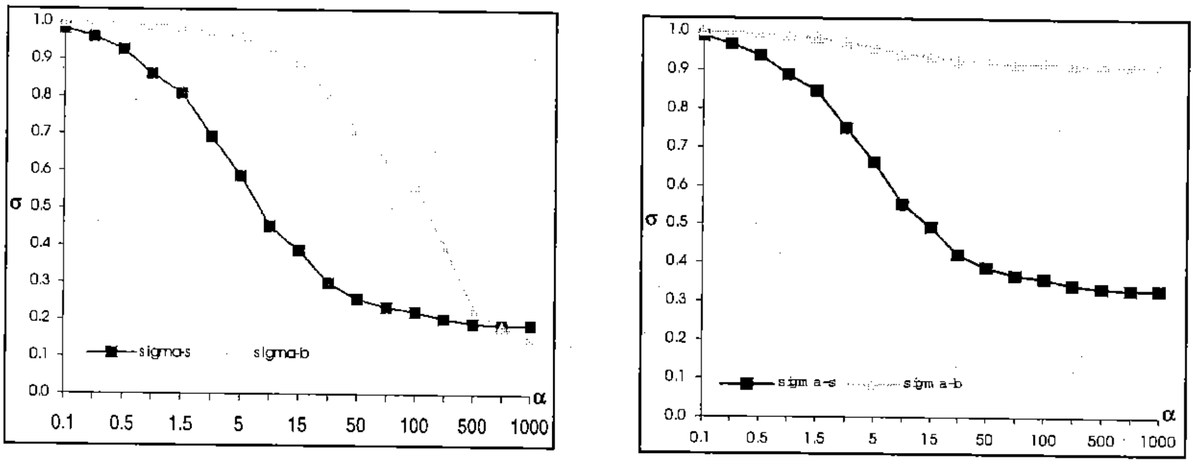
$$\rho = \frac{\alpha v V_{ir_w} + \alpha\left(V_{i\Delta m} + V_{ig_L - g_L}\right) - \alpha v V_{ia}}{R_i - R_f - vV_{ia} - (1 - v - \alpha)V_{ir_w} + \alpha\left(V_{i\Delta m} + V_{ig_L - g_L}\right)} \qquad (21)$$

and recalling that $\sigma = 1/[1-\rho]$.

The results are depicted in the figures below for $v = 0.33$. In appendix, we present similar results for $v = 0.10$, 0.20 and 0.50. The risk aversion varies from 0.1 to 1000 on the horizontal axis and the corresponding value of σ (substitution elasticity) is plotted on the vertical axis. For the US, we see two optimal (α, σ) combinations were the stock and bond lines cross, one is the very low risk aversion-high substitution, the other is the high risk aversion-low substitution. For Japan there is only one optimum at the very low risk aversion-high substitution.

Figures 1 and 2: Optimal (α, σ) combinations for stocks (s) and bonds (b) ($v = 0.33$)

US **Japan**



3.4. GMM estimation

We test the model using time series of stocks, short-term Treasury bills and long-term government bonds (yields actually). The market portfolio is taken to be a weighted average of these three classes, as expressed in (4)-(5). Using the GMM procedure documented in appendix, we have a set of two equations of excess returns (15), with i = stocks, long term bonds. The short term T-bills are conceived as risk free investments.

Table 6 contains the results of equation (15) estimated by iterated GMM –without restricting the coefficients. For the US, one column is the standard GMM, the other column is the GMM output after prewhitening the series. For Japan, we only obtained convergence when no prewhitening was utilized. We used a constant and one lagged value of the state variables (including the market return, labor income, mark-ups and employment) as instruments. To evaluate the goodness-of-fit, we report the average J-value (the average minimized weighted sum of squares that is used as optimization criterion in GMM). A test for overidentifying restrictions and mispricing is the statistic TJ, which is χ^2 distributed with 7 degrees of freedom (viz. the number of moment conditions, 6x5, minus the number of coefficients to be estimated, 23).

Table 6 : GMM estimation results

Coefficients	US GMM No Prewhitening	 GMM Prewhitening	Japan GMM No Prewhitening
λ_1	-29.34	-45.89	-2.19
	(-0.77)	(-1.19)	(-0.20)
λ_2	-897.5	-701.1	-53.50
	(-1.67)	(-1.21)	(-1.22)
λ_3	2065.0	2375.3	244.6
	(3.10)	(2.85)	(3.24)
Parameters α	927.85	747.97	56.69
ρ / σ	0.31 / 1.45	0.2395 / 1.32	0.1882 / 1.23
ν	0.981 %	1.47 %	0.731 %
***J*-test value**	6.116	5.524	9.803
	[0.526]	[0.596]	[0.200]

Notes:

Estimation was based on iterated GMM, using a Bartlett kernel and fixed bandwith (optimally chosen using the Newey-West criterion) for the US, while using the Andrews bandwith selection for Japan. Instruments were a constant and lagged dependent variables. Coefficient t-statistics are between brackets; the probability value of the *J*-test is placed between square brackets.

The detailed estimation results are presented in appendix. The results in table 6 show the main results which suggest moderately significant but large point estimates for two out of three covariance coefficients –we imposed an equality constraint for the third and fourth covariance term, in line with equation (15). The *J* statistics show the model is not rejected by the overidentifying restrictions test. From the coefficients, we can calculate the three underlying structural parameters, viz. the share of financial wealth in total wealth, the risk aversion and the substitution coefficient [17]. This yields US parameter values of between 750 and 930 for the risk aversion, around 1.30 for the intertemporal substitution, and a mere 1-1.5 percentage share of financial wealth in total wealth. The Japanese data imply a lower risk aversion, about 50, but equally produce an intertemporal substitution elasticity above 1 and financial wealth share below 1%. Clearly, this is not an adequate description of the data, finding such huge risk aversion and substitution elasticity and such a small financial wealth share. As might be inferred from section 3.3, this outcome might not be an optimal result, since there exists no combination of high risk aversion and substitution elasticity larger than one that reproduce the (unconditional) sample first moments.

Some reasons for this poor fit can be suggested. First, the time-varying covariances may be so low that extremely high coefficients are needed to match the time pattern of returns. Second, the coefficients of interest may yield a myriad of optimal combinations from which the GMM technique cannot infer the economically most logical ones, especially when ν, ρ and α vary. Third, our model abstracts from reality and some elements might be missing. E.g., we abstracted from some types of

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[17] From equation (15) and (20), $\lambda_1 = \nu(1-\alpha/\rho)$; $\lambda_2 = 1-\nu-\alpha-\alpha\nu/\rho$; $\lambda_3 = \lambda_4 = \alpha(1/\rho-1)$.
From this, $\alpha = 1-\lambda_1-\lambda_2$; $\rho = (1-\lambda_1-\lambda_2)/(1-\lambda_1-\lambda_2+\lambda_3)$; $\nu = \lambda_1/[\lambda_1-\lambda_2+\lambda_3]$.

asset holdings, such as international assets, residential and commercial real estate, which might augment the financial wealth share for this GMM estimation. At the same time, a reduction in the risk aversion/substitution coefficients might be expected. This off course requires adequate data, which are either unavailable or unreliable since they have to be collected from many different sources.

4. Conclusions - further research

We have developed a model of asset returns based on an underlying microeconomic structure, in the lines of Shawky and Peng (1995) and also Campbell (1996). We arrive at a simple expression for gross real asset returns which contains the market return, returns on real labor income, a time-varying price mark-up and a labor/employment term. Empirically, we found evidence in favor of this form when calibrated on US and Japanese data. The US results showed that there exists a combination of low risk aversion and high substitution elasticity that explains the implied unconditional moments well. Further analysis is required though, e.g., applying a time-series technique that fits the data well.

The model itself is a simplification of reality. A neglected issue so far is the fact that asset returns in different countries are not independent processes, given the empirical literature about the international co-movements of asset prices. It might be introduced by considering exports as part of production and imports as an intermediate input and cost element. Another critical point is the specification of the utility function. In the spirit of Ferson and Constantinides (1991), we might consider some form of habit persistence in preferences or durability of consumer goods. Another problem might arise from the aggregation of individual consumers-workers-investors, which we overlooked. Finally, our model could be tested on a cross-section of individual stocks or stock portfolios ranked by size and market beta, in the way Fama and French (1993) or Jagannthan et al. (1998) did.

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Appendix

Quarterly Flow of founds balance sheet data: US

Amounts outstanding end of period, not seasonally adusted (Billions of US dollars).

- Short-term assets =

+ Checkable Deposits and Currency (L.204)
+ Time and Savings Deposits (L.205)
+ Federal Funds and Security Repurchase agreements (L.207)
  - – Bank Loans Not Elsewhere Classified (L.215: FL763068005)
  - – Consumer Credit (L.215: FL723066000)

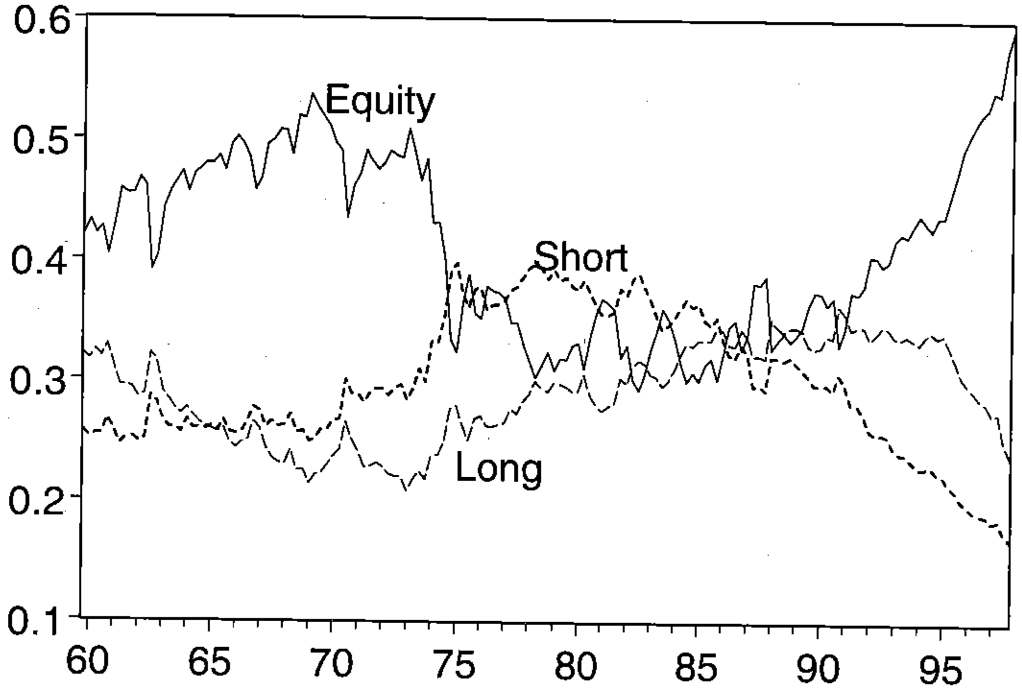
- Long-term assets =

+ Treasury Securities (L.209)
+ Municipal Securities and Loans (L.211)
– Short-term Municipal Securities and Loans (L.211: FL213162400)

- Equities =

  + Corporate Equities Issues at market value (L.213)
  – Bank Loans / Security Credit (L.215: FL763067005)

Figure A1 : Relative importance of equity and fixed-income assets (short and long) – US



Quarterly Flow of founds balance sheet data: Japan

Financial Assets Outstanding of the Domestic Nonfinancial Sector (By Source) (100 million Yen)

- Short-term assets =

  Total of All Deposits + Deposits with Trust Fund Bureau + Government Current Deposits
- Long-term assets =

  Bonds + Insurance
- Equities =

  Stocks + Trusts + Securities Investment Trust

Figure A2 : Relative importance of short-term fixed-income assets (left-hand scale), resp. equities and long-term fixed-income assets (right-hand scale) – Japan

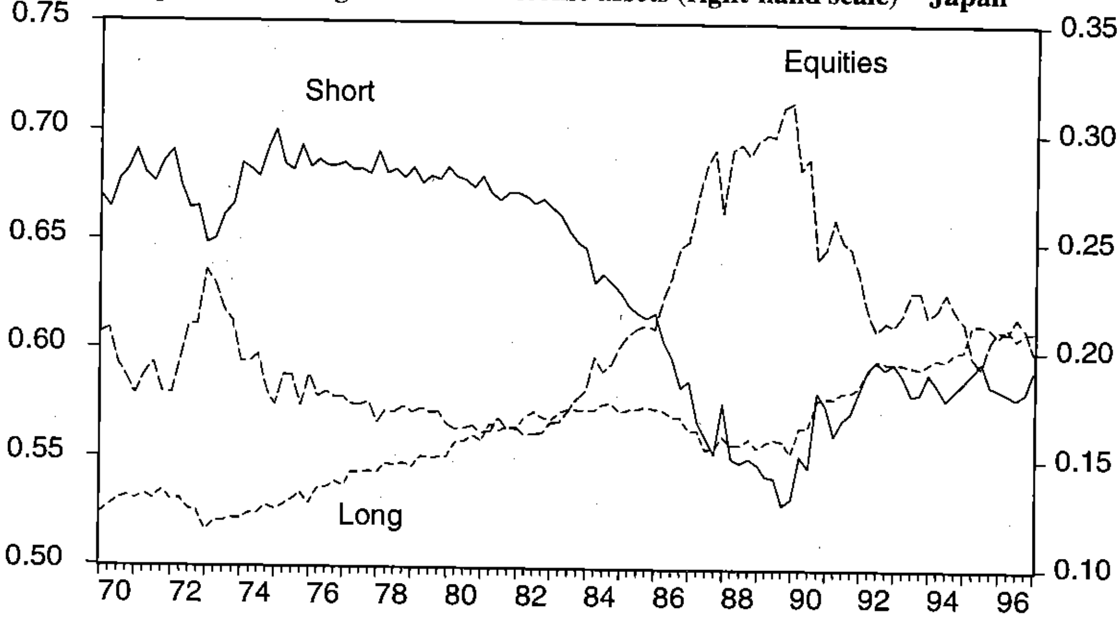


Table A1. Mark-up price equations

Coefficient	US 1960Q1 – 97Q4	Japan 1969Q1 – 97Q4
m_0	0.227 (7.85) [a]	0.097 (2.71) [a]
m_1	0.487 (4.23) [a]	-1.73 (-1.54) [c]
m_2	-0.122 (-2.91) [a]	-0.124 (-0.78)
Adj. R^2	0.876	0.651
D.W.	2.51	2.26

Note:

Mark-up equation: $\Delta p = m_0 [\Delta w - \Delta q + m_1 \Delta\theta + m_2 \Delta(p-p^*)] + (1 - m_0)\Delta p_{-1}$, hence $m_t = m_1\theta + m_2(p-p^*)$, where w denotes wages, q productivity, $\theta = Y - Y^*$ business cycle indicator (Y^* Hodrick-Prescott trended output), p (p*) domestic (import) prices – variables are entered in logs.

t-stats are placed between brackets, [a] statistically significant at 1 %, [c] at 10 %

Table A2: Implied first moments of quarterly unconditional mean stock return

	US						Japan				
	$\nu = 10$ %						$\nu = 10$ %				
	σ	0.1	0.5	0.99	1.5		σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33		ρ	-9	-1	-0.01	0.33
α	0.5	0.507%	0.512%	1.103%	0.488%	α	0.5	0.631%	0.638%	1.358%	0.608%
	1	0.502%	0.513%	1.695%	0.465%		1	0.621%	0.634%	2.075%	0.575%
	1.5	0.498%	0.514%	2.286%	0.441%		1.5	0.611%	0.630%	2.793%	0.542%
	3	0.483%	0.516%	4.061%	0.371%		3	0.580%	0.619%	4.9%	0.443%
	10	0.417%	0.525%	12.3%	0.042%		10	0.437%	0.567%	15.0%	-0.02%
	30	0.229%	0.550%	36.0%	-0.897%		30	0.027%	0.419%	44%	-1.3%
	100	-0.432%	0.640%	118.8%	-4.2%		100	-1.41%	-0.10%	144%	-6.0%
	900	-8.0%	1.669%	1065.4%	-41.7%		900	-18%	-6.0%	1291%	-59%
	$\nu = 20$ %						$\nu = 20$ %				
	σ	0.1	0.5	0.99	1.5		σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33		ρ	-9	-1	-0.01	0.33
α	0.5	0.523%	0.535%	1.879%	0.481%	α	0.5	0.645%	0.657%	2.020%	0.602%
	1	0.519%	0.544%	3.2%	0.434%		1	0.635%	0.660%	3.385%	0.549%
	1.5	0.515%	0.552%	4.6%	0.388%		1.5	0.626%	0.663%	4.8%	0.496%
	3	0.504%	0.577%	8.6%	0.248%		3	0.597%	0.672%	8.8%	0.338%
	10	0.450%	0.694%	27.6%	-0.403%		10	0.464%	0.711%	28%	-0.401%
	30	0.295%	1.026%	81.6%	-2.264%		30	0.084%	0.825%	83%	-2.5%
	100	-0.246%	2.191%	270.9%	-8.8%		100	-1.25%	1.225%	274%	-9.9%
	900	-6.4%	15.5%	2433.7%	-83.2%		900	-16.5%	5.8%	2459%	-94%
	$\nu = 50$ %						$\nu = 50$ %				
	σ	0.1	0.5	0.99	1.5		σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33		ρ	-9	-1	-0.01	0.33
α	0.5	0.572%	0.605%	4.2%	0.458%	α	0.5	0.686%	0.716%	4.00%	0.582%
	1	0.571%	0.636%	7.8%	0.342%		1	0.679%	0.739%	7.32%	0.470%
	1.5	0.569%	0.667%	11.5%	0.226%		1.5	0.672%	0.761%	10.6%	0.359%
	3	0.565%	0.761%	22.4%	-0.121%		3	0.650%	0.829%	20.6%	0.023%
	10	0.547%	1.200%	73.2%	-1.739%		10	0.547%	1.144%	67%	-1.541%
	30	0.495%	2.5%	218.5%	-6.4%		30	0.254%	2.04%	199%	-6.0%
	100	0.312%	6.8%	727.0%	-22.6%		100	-0.771%	5.19%	663%	-21.6%
	900	-1.774%	57.0%	6538.7%	-207.5%		900	-12.5%	41%	5960%	-200%

Notes. see table 5.

Table A3: Implied first moments of quarterly unconditional interest rate

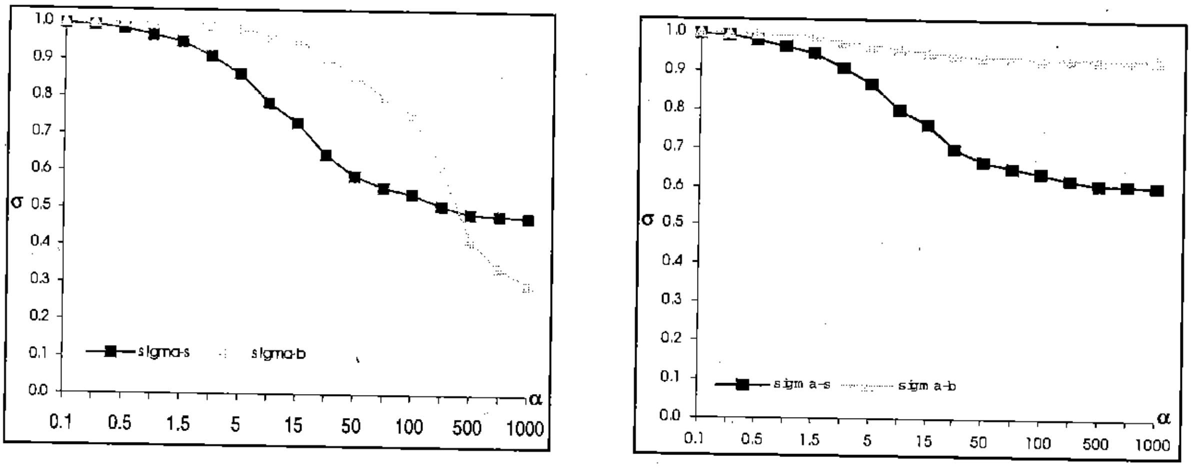
		US						Japan			
		v = 10 %						v = 10 %			
	σ	0.1	0.5	0.99	1.5		σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33		ρ	-9	-1	-0.01	0.33
α	0.5	0.490%	0.491%	0.550%	0.488%	α	0.5	0.610%	0.611%	0.648%	0.609%
	1	0.490%	0.491%	0.610%	0.486%		1	0.605%	0.606%	0.681%	0.603%
	1.5	0.490%	0.492%	0.669%	0.485%		1.5	0.600%	0.601%	0.714%	0.597%
	3	0.490%	0.493%	0.848%	0.479%		3	0.585%	0.587%	0.812%	0.578%
	10	0.490%	0.501%	1.684%	0.452%		10	0.513%	0.520%	1.272%	0.489%
	30	0.489%	0.522%	4.1%	0.377%		30	0.308%	0.329%	2.58%	0.237%
	100	0.487%	0.594%	12.4%	0.111%		100	-0.409%	-0.341%	7.2%	-0.65%
	900	0.461%	1.427%	107.9%	-2.9%		900	-9%	-8%	60%	-11%
		v = 20 %						v = 20 %			
	σ	0.1	0.5	0.99	1.5		σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33		ρ	-9	-1	-0.01	0.33
α	0.5	0.491%	0.492%	0.586%	0.488%	α	0.5	0.611%	0.611%	0.654%	0.609%
	1	0.491%	0.493%	0.681%	0.485%		1	0.605%	0.606%	0.692%	0.603%
	1.5	0.491%	0.494%	0.775%	0.482%		1.5	0.600%	0.602%	0.730%	0.596%
	3	0.491%	0.496%	1.060%	0.473%		3	0.585%	0.587%	0.844%	0.577%
	10	0.491%	0.508%	2.4%	0.432%		10	0.513%	0.521%	1.38%	0.486%
	30	0.492%	0.544%	6.2%	0.313%		30	0.309%	0.332%	2.90%	0.227%
	100	0.496%	0.666%	19.5%	-0.101%		100	-0.408%	-0.330%	8.22%	-0.68%
	900	0.533%	2.1%	171.2%	-4.8%		900	-8.6%	-7.9%	69%	-11.0%
		v = 50 %						v = 50 %			
	σ	0.1	0.5	0.99	1.5		σ	0.1	0.5	0.99	1.5
	ρ	-9	-1	-0.01	0.33		ρ	-9	-1	-0.01	0.33
α	0.5	0.493%	0.495%	0.693%	0.487%	α	0.5	0.611%	0.611%	0.661%	0.609%
	1	0.493%	0.497%	0.894%	0.481%		1	0.606%	0.607%	0.706%	0.602%
	1.5	0.494%	0.499%	1.094%	0.475%		1.5	0.601%	0.602%	0.751%	0.596%
	3	0.494%	0.505%	1.695%	0.456%		3	0.585%	0.588%	0.886%	0.576%
	10	0.496%	0.532%	4.5%	0.370%		10	0.514%	0.523%	1.52%	0.482%
	30	0.502%	0.610%	12.5%	0.124%		30	0.309%	0.336%	3.32%	0.215%
	100	0.521%	0.881%	40.5%	-0.738%		100	-0.406%	-0.316%	9.61%	-0.721%
	900	0.748%	3.986%	360.9%	-10.6%		900	-9%	-8%	82%	-11.4%

Notes. see table 5.

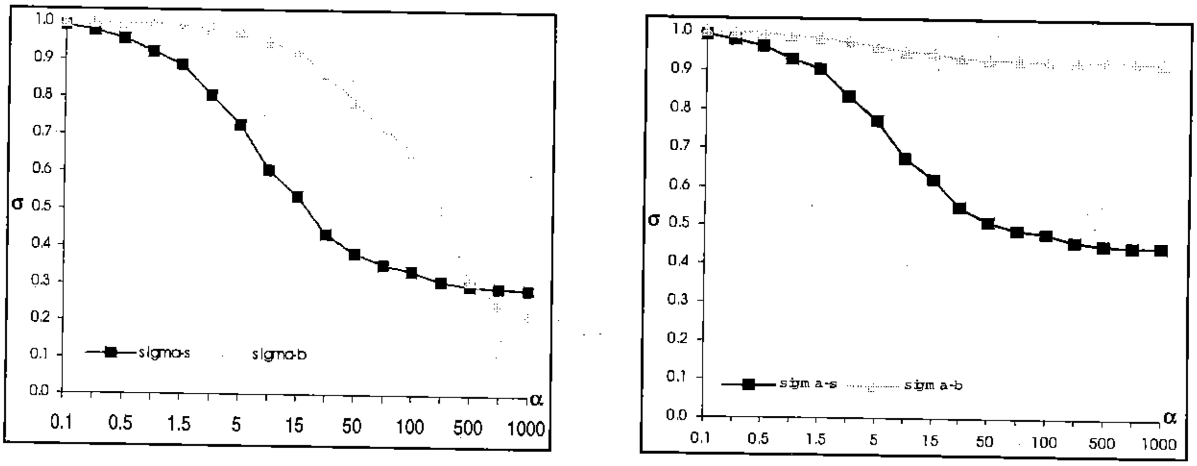
Figure A1 – A6

Optimal (α ,σ) combinations for stocks (s) and bonds (b)

US **(v = 0.10)** **Japan**



US **(v = 0.20)** **Japan**



US **(v = 0.30)** **Japan**

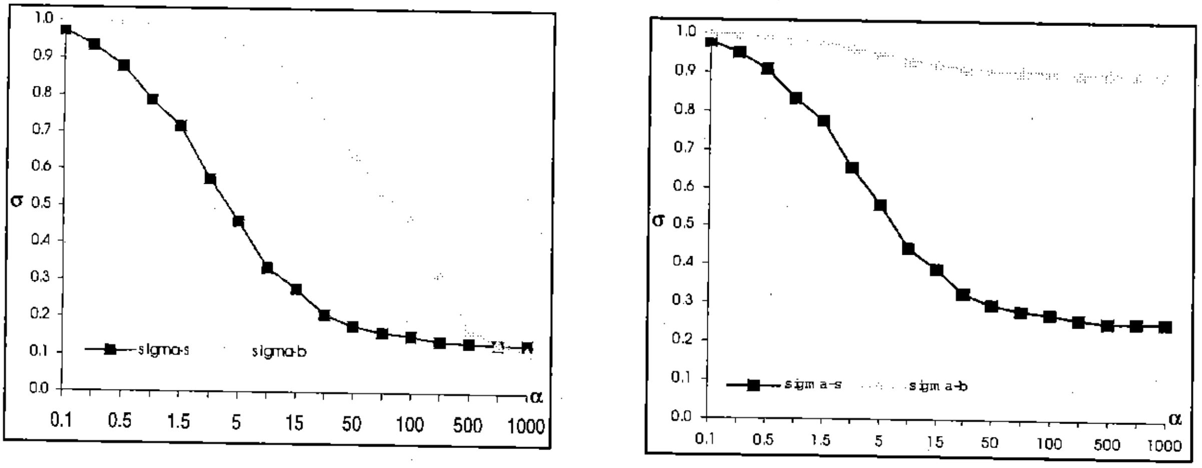


Table A4 : Complete GMM estimation results

Coefficients		**USA**		**Japan**
		GMM **no prewhitening**	**GMM** **prewhitening**	**GMM** **no prewhitening**
eq. (1)	r_a			
	constant	0.00947 (4.18)	0.00879 (3.92)	0.0068 (2.79)
	c2	0.347 (4.11)	0.354 (3.91)	0.369 (4.14)
	c3	-0.614 (-1.38)	-0.531 (-1.19)	0.443 (1.85)
	c4	-0.192 (-0.28)	-0.492 (-0.74)	-0.577 (-2.63)
	c5	1.736 (1.73)	1.413 (1.51)	0.144 (0.48)
eq. (2)	r_w			
	constant	0.0021 (5.53)	0.0019 (5.13)	-0.00164 (-2.11)
	c7	0.0151 (1.38)	0.0186 (1.88)	0.0255 (0.79)
	c8	0.412 (6.00)	0.418 (6.34)	0.748 (5.20)
	c9	-0.258 (-2.84)	-0.278 (-3.11)	-0.324 (-2.71)
	c10	-0.245 (-2.46)	-0.280 (-3.03)	-0.1135 (-0.83)
eq. (3)	Δm			
	constant	-0.00046 (-1.15)	-0.00039 (-0.94)	0.00136 (1.78)
	c12	0.0029 (0.22)	0.00056 (-0.04)	-0.0868 (-2.68)
	c13	0.115 (1.50)	0.124 (1.57)	0.0116 (0.20)
	c14	0.083 (0.90)	0.072 (0.73)	0.0695 (0.74)
	c15	-0.276 (-2.57)	-0.253 (-2.26)	-0.357 (-2.60)
eq. (4)	$g_{Lc}-g_L$			
	constant	-0.00022 (-1.19)	-0.00020 (-1.06)	-0.00089 (-1.78)
	c17	-0.0119 (-1.90)	-0.0119 (-1.92)	0.03036 (1.55)
	c18	-0.0228 (-0.65)	-0.0318 (-0.93)	-0.0988 (-2.66)
	c19	-0.067 (-1.50)	-0.0576 (-1.32)	-0.0536 (-0.88)
	c20	0.438 (6,51)	0.435 (6.17)	0.3137 (3.67)
λ_1		-29.34 (-0.77)	-45.89 (-1.19)	-4.459 (-0.41)
λ_2		-897.5 (-1.67)	-701.1 (-1.21)	-49.36 (-1.09)
λ_3		2065.0 (3.10)	2375.3 (2.85)	261.8 (3.32)
***J*-test value**		6.116 [0.526]	5.524 [0.596]	9.464 [0.221]

Notes : Estimation was based on iterated GMM, using a Bartlett kernel and fixed bandwith (optimally chosen using the Newey-West criterion) for the US, while using Andrews bandwith for Japan. Instruments were a constant and lagged dependent variables (r_a, r_w, Δm, $g_{Lc}-g_L$). Instrumental equations are eq. (1)-(4). Coefficient t-statistics are between parantheses; the probability value of the *J*-test is placed between square brackets.

GMM : Technical note.

Generalised Method of Moments (GMM) is an increasingly popular research method in financial econometrics. In response to the Lucas policy critique, models are now being formulated in terms of taste and technology parameters which are believed to be constant over time (Hall, 1993). GMM provides a way to easily estimate these parameters. Suppose you have a first order condition (Euler equation) of the following kind:

$$E_t\,[m_t(\theta)\,R_t\,] = 1 \qquad (1)$$

equivalently,

$$E_t\,[m_t(\theta)\,R_t - 1] = 0 \qquad (1a)$$

or,

$$E_t\,[\varepsilon_t(\theta)] = 0 \qquad (1b)$$

with m denoting the intertemporal marginal rate of substitution (IMRS), R gross asset returns and ε disturbances. The θ parameter vector is to be estimated. In most asset pricing applications, the consumer discount rate and relative risk aversion appear as parameters to be estimated. This expression is called a moment condition since it shows that the statistic $m_t\,R_t$ will converge in probability to some constant, here one, in equation (1).

GMM exploits the idea that disturbances in the equation (1b) are derived from a rational expectations model, and uncorrelated with any information available at time t. Denote z_t as a vector of variables that represents the information set at time t. Then, this implies that any information of z_t is uncorrelated with, or orthogonal to, disturbances ε_t:

$$\mathrm{E}[\varepsilon_t \otimes z_t] = 0 \qquad (2)$$

where $\otimes$ denotes the Kronecker product. These z_t are called instrumental variables.

Intuitively speaking, GMM finds the parameters θ which make the corresponding sample means of (2) as close to zero as possible (Hamilton, 1994).

When there are q parameters to be estimated, in order to use GMM, one needs at least q moment conditions, or equivalently, q instruments which create orthogonality constraints. Suppose there are r moment conditions/instruments. In case r=q, the system is exactly identified. Then, there will be a single solution to the moment equations. In case r>q, the system is overidentified. There are in effect $\binom{r}{q}$ sets of estimates that can be produced.

In GMM, a criterion function J_T is minimized, as the weighted sum of squares of the disturbances times instruments, with W^{-1} the weighting matrix (in which the weights are inversely proportional to the variances of the moments):

$$J_T = g_T'\,W^{-1}\,g_T \qquad (3)$$

where $g_T = (1/T)\,\Sigma\; e_t \otimes z_t$ is the sample analogue of the unconditional expectation of equation (2) and W is the asymptotic covariance matrix of the moment conditions, *viz.* $\mathrm{W} = (1/T^2)\mathbf{Z}'\boldsymbol{\Omega}\mathbf{Z}$, with $\mathbf{Z}$ the matrix of instruments and $\boldsymbol{\Omega}$ the covariance matrix of the fitted disturbances e. The estimators θ that minimize J_T are called minimum distance estimators. If W_T is a positive definite matrix and plim $g_T = 0$, then these estimators are consistent (Greene, 1993).

In full matrix notation, the criterion for the GMM estimator is

$$J_T = (1/T)e'\mathrm{Z}\,[(1/T^2)\mathbf{Z}'\boldsymbol{\Omega}\mathbf{Z}]^{-1}\,(1/T)Z'e \qquad (4)$$

Note that there is some circularity in this description. Before the parameters can be derived, one needs an estimate for W and Ω, and before Ω can be estimated, one needs an estimate of the parameters. The convention in GMM is as follows (Greene, 1993; Hamilton, 1994). The initial parameter estimates are obtained using an arbitrary weighting matrix, **I**, and the resulting estimates are used to produce a first W.

$$\mathrm{Min}_{\theta}\; J^0 = \frac{1}{T^2}\,e'ZZ'e \qquad (5)$$

and given the estimated $\hat{\theta}$, the weighting matrix W^0 is obtained, either as White (if observations are independent, hence there are no cross terms in Ω) or Newey-West (if disturbances are autocorrelated)

$$W^{0,\mathrm{White}} = (1/T)\mathrm{S}_0 = (1/T)[1/\mathrm{T}\;\Sigma_i\; z_i z_i'\,e^2] \qquad (6)$$

or

$$W^{0,\mathrm{N.W.}} = (1/T)\mathrm{S} = (1/T)\{\mathrm{S}_0 + 1/\mathrm{T}\;\Sigma_l\;\omega(l)\;\Sigma_i\;\; e_i e_{i-l}\,[z_i z_{i-l}' + z_{i-l} z_i']\} \qquad (7)$$

where $\omega(l) = 1 - l\,/(L+1)$ and L the maximum lag length of the autocorrelations in e.

The procedure can be iterated until there is satisfactory parameter convergence. Hamilton notes that single iterated estimates have the same asymptotic properties as estimates with many iterations, but that iterating has the advantage that the resulting estimates are invariant with respect to the scale of the data and to the initial weighting matrix W.

The choice of instruments to include in z_t is to a certain degree arbitrary. It may cause a problem because the parameter estimates will vary with the choice of z_t, esp. in finite samples. In general, lagged values of m and R are taken as instruments. The number of lags is usually chosen relatively small, following Tauchen (1986) who found an increase in bias when the number of lags were increased.

Hansen (1982) provides a J-test to examine the goodness of fit (overidentifying restrictions) of the model. The test statistic TJ_T is asymptotically chi-square distributed with degrees of freedom equal to the number of orthogonality conditions (moments) minus the number of parameters to be estimated. This test tells whether the given model can statistically be rejected against a nonspecific alternative. Another test is to compare the minimized objective of a restricted system to the objective of an unrestricted system. If the excluded factors are not important, the J_T should not rise much: TJ_T(restricted)$-TJ_T$(unrestricted) ~ χ^2 (# of restrictions).

Hall (1993) points out two advantages of GMM. First, it is computationally convenient, and second, it avoids potential bias due to misspecification of the distribution of m and R.

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