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PRODUCTION-BASED ASSET PRICING IN A MONETARY ECONOMY: THEORY AND EVIDENCE.

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Abstract

This paper considers capital asset pricing based on the production side of a monetary economy. Relying on a general version of the traditional Real Business Cycle model with cash and credit goods, we find that the variables determining the mean excess returns of all financial assets are i) capital growth, ii) the nominal rate and iii) the share of capital in aggregate wealth. Our model is parsimonious in that the results do not lean on any particular specification of the production function nor capital adjustment costs. Empirical evidence gives strong support to the presence of the elicited factors in the cross section of excess returns on portfolios sorted i) by firm characteristics or ii) by industry. Both unconditional and conditional versions of the model are shown to perform as well as the Fama-French (1993) three-factor model when the universe of 25 portfolios sorted by size and book to market ratio is considered. On an extended portfolio universe, our model is shown to perform slightly better than the Fama-French model. We also show that our macro-related risk variables have some predicting power for the aggregate dividend yield and equity market premium.

1. INTRODUCTION

The equity premium and value premium puzzles question the usefulness of the standard capital asset pricing (CAPM) and consumption-based capital asset pricing (CCAPM) models. According to Mehra and Prescott (1985), the equity premium puts forward the inability of the smooth consumption process that characterizes the real world to explain the cross section of asset returns. As to the CAPM, its failure stems from its inability to explain the cross section of excess returns of portfolios sorted by firm characteristics (size and book-to-market ratio). In a series of very influential papers, Fama and French (1992, 1993, 1996 and 2006) have shown that the CAPM, even in the long run, is unable to explain the anomaly that high book-to-market firms have high expected excess returns in spite of having low market betas.

Among all tentative solutions to these puzzles, the Fama-French three-factor model (FF3 hereafter) is beyond doubt the most successful and popular. It adds to the market portfolio factor of the standard CAPM two portfolio factors, one aimed at capturing the size effect (SMB) and the other the value effect (HML). While these factors have been based on pure empirical considerations, Fama and French (1996) suggested that HML is probably related to corporate distress and therefore reflects the risk premium required by economic agents to invest into distressed firms.

The literature on asset pricing followed two main directions to cope with the failure of the standard asset pricing models. One direction was to try and find some interpretation to the Fama-French (FF hereafter) factors. Liew and Vassalou (2000) for example showed that HML has some predictive ability for the GNP growth rate, and that SMB and HML convey significant information about future GDP growth. This information is essentially independent from information about the equity market. Recently, Petkova (2006) showed that the HML may approximate for innovations in some state variables in an inter-temporal CAPM framework. Finally, Xing (2008) recently showed that HML may approximate for the growth rate of capital investment: an investment growth factor, defined as the difference in returns between low investment stocks and high investment stocks, contains an information similar to HML. Campbell et al. (2007) however question the original FF interpretation of HML and show that HML does not capture corporate distress. They suggest a way to measure distress by a probability of failure. Firms with a high probability of failure (thus in deep distress) display *lower equity returns* than firms exhibiting a low risk of failure, although the loadings of the former on the market, SMB and HML factors are higher than the latter. Campbell et al. (2007) conclude that this finding is inconsistent with the conjecture that size and value capture compensation for distress risk.

The second direction followed by the literature was to build new general equilibrium models that extend the basic framework of the CAPM/CCAPM. Some authors tried alternative preference specifications mainly implying time non-additivity. For instance, Epstein and Zin (1991) introduced a recursive utility approach that allows for the distinction between risk aversion and inter-temporal elasticity of substitution, and Campbell and Cochrane (1999) applied the external habit approach to asset pricing. Others relaxed the key assumption of market completeness underlying the standard CAPMs. For example, Constantinides and Duffie (1996) derived explicitly the pricing kernel when idiosyncratic risks are not hedgeable, Brav et al. (2002) tested a stochastic discount factor (SDF) that is an average of the implicit SDFs from individual Euler equations, and Jacobs and Wang (2004) showed that the cross section variation in consumption growth is a priced factor. Finally, Yogo (2006) showed that disaggregating consumption by splitting durable from non durable goods leads to a model that performs much better that the standard CCAPM. Several of the papers quoted above and some followers insisted that the proposed extensions do solve the aforementioned puzzles and even sometimes other anomalies such as the negative relationship between level of investment and stock return.

A particular strand of research providing new equilibrium asset pricing models, which has been initiated by Cochrane (1991, 1996), is variously called Productivity- or Production- or Investment-based asset pricing theory. The basic idea underlying this literature is to abstract totally from the consumption side of the economy and to rely on the production side to derive asset pricing predictions. Its main empirical implication is that under the assumption of constant returns to scale, investment returns and stock returns should be equal. This theory has been tested at the aggregate level by Cochrane (1991), and across individual stocks by Cochrane (1996) and Liu et al. (2007).

A recent series of papers showed that this theory is able to explain well known financial puzzles or anomalies. According to Zhang (2005) and Cooper (2006) for example, it can explain the value premium puzzle. Zhang (2005) argues that costly reversibility of investment and countercyclical price of risk cause assets in place harder to reduce in bad times, which makes value stocks riskier than growth stocks.. He uses a standard “AK” model where A is stochastic and driven by both systematic and idiosyncratic risks, K exhibits decreasing returns to scale and the SDF is given exogenously. The adjustment cost function is quadratic and asymmetric to account for partial irreversibility. Cooper’s (2006) findings are similar: as real investment is much irreversible, (value) firms who have idle capital benefit when the shock on its demand is positive (since they do not have to increase their capital level) but suffer when the shock is negative due to capital investment irreversibility. Li et al. (2007) explain the negative investment/stock return relationship by the fact that the investment to capital ratio affects adversely the return on equity (or, equivalently, investment) since it increases adjustment costs. Finally, in a recent contribution, Balvers and Huang (2008) develop a productivity-based asset pricing model and show that a conditional version of this model performs as well as FF3 in explaining the cross section returns on 25 FF portfolios sorted by size and BM ratio.

This strand of literature is affected by two main drawbacks that this paper intends to improve on. The first is related to the main empirical prediction of the theory, namely that returns on capital investment are equal to returns on equities. The main motivation for the production approach was to avoid the difficult identification of the representative investor’s preferences. However, empirical testing of the theory requires very strong assumptions as to the structure of the production and the adjustment cost functions. Moreover, additional assumptions have to be made so that productivity shocks can be identified. These are the crucial ingredients needed to compute the capital investment returns. We know from the macroeconomic literature how difficult these variables are to identify. And there is no apparent consensus among researchers as to which type of functions should be used. Zhang (2005) for example invokes decreasing returns to scale to explain the value premium while most production-based models use constant returns to scale to obtain testable implications. Overall, the specification burden has been shifted from preferences and consumption to production function, adjustment costs and technological shocks. This so far does not make the production route much better than the consumption approach.

The second drawback is that the SDF is left unidentified. Therefore, the theory is vacuous when it comes to pricing derivatives for instance. When the SDF is specified, it is in a very “ad hoc” manner. For example, Cochrane (1996) assumes that it is a linear function of returns on investment, Xing (2008) builds an investment growth portfolio (as seen above) and shows that it captures the information embedded in the HML factor, and Chen and Zhang (2007) replace the SMB and HML factors by two new ones: the return on a portfolio which is long stocks having low investment to assets ratios and short stocks with high investment to assets ratios; the return on a portfolio which is long stocks having high earning to assets ratios and short stocks with low earnings to assets ratios. Two recent papers by Balvers and Huang (2007) and Belo (2007) do overcome this criticism by deriving the SDF explicitly from the optimal behavior of either the consumer or the firm. Balvers and Huang (2007) show that the marginal utility of consumption is affected by technological shocks. Belo (2007) makes the firm optimize its productivity level instead of its investment level, which leads to an exact identification of the SDF without recourse to preferences. Yet, Belo's (2007) approach is not immune from the identification issue mentioned above.

The main purpose of this paper is twofold. First, we propose a production-based macro model of expected asset returns where an explicit role is given to money and thereby to monetary policy. All the above mentioned papers are indeed cast in a purely real production economy. Our second objective is to overcome the dichotomy between consumption and production asset pricing and to build a model where the central planer (the representative agent) is both a consumer and a producer.

Since our analysis is explicitly tied to the consumption and the production sides of the economy, the SDF characterization is immediate and draws on the CCAPM framework. The main advantage of our approach, in addition to featuring explicitly the monetary sector of the economy, is its parsimony. We need not specify the production and adjustment cost functions, nor the nature of productivity shocks. As far as empirical investigation is concerned, this parsimony of our theory is very valuable.

We introduce money in our economy using the Lucas and Stokey (1983, 1987) distinction between cash and credit goods. This choice presents several advantages as compared to the transaction approach, the pure cash-in-advance approach involving total consumption, or the money in-the-utility-function approach. First, the cash-in-advance binds only a fraction of total consumption, which is more realistic than assuming its binds total consumption. Second, it has been shown recently (see Yogo (2006)) that using a wider definition of consumption (i.e. durables and non durables) improves the quality of CCAPMs where consumption involves non durables and services only.

To identify the SDF, which is but the marginal utility of aggregate consumption, we proceed in two steps.. First, we find the relationship at the representative agent's optimum between cash goods and credit goods consumption. As the ratio of marginal utilities is equal to the ratio of prices, we can show that the consumption of cash goods can be written as a function of credit goods consumption and the nominal interest rate. In the second step, we express aggregate consumption as a function of credit goods consumption and thus show that the pricing kernel is simply the marginal utility of credit goods consumption.

Finally, we make explicit use of the fact that the representative agent's wealth is the sum of real capital and real money balances. Since the cash-in-advance constraint is assumed to be binding, real balances are equal to cash goods consumption, which depends upon the level of real capital and the capital to wealth ratio. Given the relationship between the consumption of credit goods and that of cash goods, the marginal utility of credit goods can be written as a function of real capital, the nominal interest rate and the capital to wealth ratio. The previous analysis is obtained in a fairly general setting and needs no specification of the production side of the economy beyond the AK capital accumulation process.

Our main theoretical finding is that the cross section of expected asset returns can be explained by a three-factor pricing model where the factors are innovations in the growth rates of real capital, the nominal interest rate and the capital to wealth ratio. The last two terms stem from the presence of money and would vanish in a purely real production economy. The nominal rate reflects the tradeoff between cash and credit goods consumption, while the capital to wealth ratio takes into account the tradeoff between capital and money balances.

Considering explicitly the production side of the economy is our main innovation vis-à-vis the extant literature that incorporates money in asset valuation modeling. The main finding in this literature is that the growth rate of real money is an additional factor to non monetary models. This result has been obtained whether money reduces transaction costs (see Marshal (1992) and Balvers and Huang (2008)), belongs in the utility function (see Bakshi and Chen (1996), Basak and Gallemeyer (1999) and Lioui and Poncet (2004)), or is due to a cash-in-advance constraint (see Chan et al. (1996) and Balduzzi (2007)). Considering the production side of the economy brings about a new original factor, namely the capital to wealth ratio. In addition, the fact that the nominal interest rate can be substituted for the growth rate of real balances may help overcome the potential problem of accurately defining and thus measuring what are in practice real money holdings.

Our empirical results can be summarized as follows. Based on US data, we show that an unconditional version of our three-factor model performs as well as the FF3 model on the universe of the 25 FF portfolios sorted by size and BM ratio and on an extended universe where 17 industry portfolios have been added. A conditional version of the model, where the factor loadings have been allowed to be time-varying as functions of the nominal interest rate, a term spread, a default spread and the aggregate dividend yield, performs extremely well as compared to the hard-to-beat FF3 model on both universes. The two money-related factors are systematically priced and the strong cross variation in the loadings for portfolios leads to a natural explanation of the value premium puzzle and an alternative explanation of the negative investment/stock return relationship documented in the literature.

The rest of the paper is organized as follows. Section 2 describes the economic environment and derives our pricing kernel and theoretical asset pricing equations. Section 3 reports the empirical results obtained from various competing models, including the FF3, several consumption-based and production-based non-monetary models, for the US equity market during most of the post-war period. Section 4 concludes.

2. THEORETICAL FRAMEWORK

This section describes the production economy in which are cast the pricing kernel and the pricing equation for the equity market portfolio at equilibrium. We will focus on the crucial difference between a real economy and a monetary economy. Finally, we provide a multi-factor CAPM-like representation for the excess returns on individual financial assets, on which will be grounded our empirical analysis.

2.1. Economic setting and pricing kernel

This section briefly describes our production monetary economy and provides the derivation of the pricing kernel. Although it is well-known that the latter is linked to the marginal utility of credit good consumption, we re-derive it to fix the notation and the model's main assumptions and to ensure that our presentation is self-contained.

Following Lucas and Stokey (1987), we consider an economy where credit goods can be acquired in exchange for any asset but cash goods must be paid by previously accumulated money balances[1]. The representative agent has an infinite horizon and maximizes the expected utility of her consumption stream of cash goods $\left(c_{1,t}\right)$ and credit goods $\left(c_{2,t}\right)$ under her budget constraint. Her consumption and portfolio decisions thus maximize:

$$E_t\left[\int_t^{\infty} e^{-\rho s} U\left(c_{1,t}, c_{2,t}\right) ds\right] \tag{1}$$

[1] To gain space, we start directly in continuous time, instead of setting the framework in discrete time and then take the limit as the period length shrinks to zero. The cash-in-advance constraint is assumed to be binding for "cash goods", and credit goods can be transformed into cash goods one-for-one. The timing of events then is as follows. At time t, consumers-producers hold the real money balances (m) they need to buy cash goods to be consumed between t and t + dt. They will also consume credit goods during that period but will pay for them only at time t + dt. To ensure that the two kinds of goods will sell at the same price, at each instant t, the sellers of the cash goods, who cannot consume the cash goods they produce, are assumed to accumulate the cash receipts during the period so that the resulting cash is available for investing only at time t + dt, like in the case of credit goods.

where ρ is the rate of time preference, U is assumed to be a thrice continuously differentiable, increasing and strictly concave utility function[2], c_1 and c_2 denote consumption of cash goods and credit goods, respectively, E_t is the expectation operator conditional on current endowments and the state of the economy. When maximizing (1), the representative consumer respects a wealth constraint and limits her attention to admissible controls only.

Various assets are available in this economy. First, there are financial assets (in number N) which pay no intermediate dividends, are in zero net supply and whose prices are assumed to follow diffusion processes, the parameters of which are endogenous to the model. There also exist nominal bonds, also in zero net supply, which earn an instantaneous yield equal to the nominal interest rate R_t.

Lastly, money is issued by a central banker, who arbitrarily sets its nominal rate of return to zero. On a priori grounds, money thus would be strictly dominated by the nominal bonds yielding R_t. However, as the cash-in-advance (CIA) constraint binds cash good consumption, the representative agent will hold money balances in equilibrium. The nominal money supply, denoted by M, follows a diffusion process exogenous to the model.

Finally, there is real capital, denoted by k, which accumulates, depreciates, and yields an output according to the diffusion process:

$$dk_t = \left[f(k_t; x_t) - \delta k_t - c_{1,t} - c_{2,t} \right] dt + k_t \sigma_{k,t} dZ_{k,t} \tag{2}$$

where f(.), the production function, depends on k and an arbitrary number of state variables stacked in the vector x, δ is the capital depreciation rate, σ_k is the volatility of the capital growth rate and Z_k is a one-dimensional Brownian motion, defined on the appropriate filtered probability space, reflecting real (technological) shocks.

[2] This implies the following conditions, where subscripts on U denote partial derivatives: $U_{c_1} > 0, U_{c_2} > 0, U_{c_1c_1} < 0, U_{c_2c_2} < 0, U_{c_1c_1} U_{c_2c_2} - (U_{c_1c_2})^2 > 0$. Also, the Inada conditions are satisfied: $\lim_{c_1 \to 0} U_{c_1} = \lim_{c_2 \to 0} U_{c_2} = \infty$.

Note that f(.) can be considered as the output net of adjustment costs but before depreciation. Note further that our formalization is very general as, unlike what is customary in production-based asset pricing theory, no assumption is needed as to the structure of the function f(.), beyond the neo-classical restrictions on the influence of capital k[3], or that of the implicit adjustment costs. This feature will prove crucial in the empirical analysis. Finally, the possible influence of non-neutral money will be exerted through the consumption stream of cash and credit goods.

Since financial assets and nominal bonds are in zero net supply, the representative agent's wealth dynamics writes:

$$w_t = k_t + m_t \tag{3}$$

i.e. total real wealth, w, is equal to real money holdings, m ≡ M/P where P denotes the general price level, plus real capital k.

The pricing kernel relates directly to the marginal utility of consumption[4]. The real pricing kernel is defined by $\Lambda_t = e^{-\rho t} U_c(c_t)$, where c stands for total consumption and $U_c(c_t) = \frac{\partial U(c_1(c_t), c_2(c_t))}{\partial c_t}$ is the marginal utility of total consumption.

From the first order conditions of the representative agent's optimization program, the marginal utilities of consumption of the two goods are known to be related by:

$$1 + R_t = \frac{U_{c_1,t}}{U_{c_2,t}} \tag{4}$$

The cost of consuming one-dollar amount of the cash good is one plus the opportunity cost R_t, while the cost of consuming one-dollar worth of the credit good is one. Eq. (4) states that the cost ratio $(1+R_t)/1$ must at the optimum be equal to the ratio of marginal utilities[5].

Differentiating $U(c_1(c_t), c_2(c_t))$ with respect to c_t yields:

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[3] We impose the neo-classical restrictions: $f_k > 0$, $f_{kk} > 0$, $f(0)=0$, $\lim_{k\to 0} f_k = +\infty$, $\lim_{k\to\infty} f_k = 0$. The representative agent starts at date t=0 with a positive k_0.

[4] See for instance Cochrane (2001).

[5] Note that in a discrete time setting, the cost of one unit of the cash good - the l.h.s. of Eq. (4) - would be $1 + R_t/(1+R_t)$, i.e. R_t would be discounted. In continuous time, this discounting vanishes.

$$U_c = \frac{\partial c_1(c_t)}{\partial c_t} U_{c_1} + \frac{\partial c_2(c_t)}{\partial c_t} U_{c_2}$$

Substituting into the preceding expression yields:

$$U_c(c_t) = \frac{\partial}{\partial c_t}((1+R)c_1(c_t) + c_2(c_t))U_{c_2}$$

Following for instance Lucas and Stokey (1987) and Bohn (1991), we define total consumption as $c_t = (1+R_t)c_1(c_t) + c_2(c_t)$, $R.c_1(.)$ being the opportunity cost induced by paying cash the cash good. It then follows that the pricing kernel Λ_t is also equal to:

$$\Lambda_t = e^{-\rho t} U_{c_2}(c_{1,t}, c_{2,t}) \qquad (5)$$

Since the CIA constraint is assumed to be binding, Eq. (5) can equally be written as: $\Lambda_t = e^{-\rho t} U_{c_2}(m_t, c_{2,t})$, which incidentally is what one would get from models with a single consumption good and money included in the utility function[6], or from models where money is introduced to reduce transaction costs[7].

In addition, since we have from Eq. (4) : $c_{1,t} = \varphi(c_{2,t}, R_t)$, one can also write Eq. (5) as: $\Lambda_t = \vartheta(R_t, c_{2,t})$. Consequently, our modeling of a monetary economy leads so far to two-factor asset pricing models, the factors being the consumption of credit goods and either real money holdings or the nominal interest rate. It is worth noting that in a pure exchange (or "tree") monetary economy, we would still have two-factor models with credit good consumption replaced by aggregate income since then $c_{1,t} + c_{2,t} = y_t$.

As we want to derive production-based pricing models, and therefore eliminate credit good consumption as a factor, we introduce the capital to wealth ratio $\omega_t \equiv k_t/w_t$. It then follows from the CIA constraint and Eq. (3):

$$c_{1,t} = m_t = (1-\omega_t)w_t = \frac{1-\omega_t}{\omega_t} k_t \qquad (6)$$

Since then $c_{1,t}$ is a function of ω_t and k_t, and, from Eq. (4), $c_{2,t}$ is a function of $c_{1,t}$ and R_t, the pricing kernel given by Eq. (5) rewrites, for a given impatience rate ρ:

$$\Lambda_t = \Phi(k_t, R_t, \omega_t) \qquad (7)$$

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6 See, for example, Bakshi and Chen (1996), Basak and Gallemeyer (1999) and Lioui and Poncet (2004).

7 See, for instance, Marshall (1992) and Balvers and Huang (2007).

Therefore, the pricing kernel is driven by three endogenous key variables: the level of real capital, the nominal interest rate and the capital/wealth ratio. These variables are of course affected by the state variables (x) and the technological shocks Z_k. The latter are notoriously very hard to identify as they depend on specific assumptions regarding the production function and the adjustment costs. Therefore, it is a relative advantage of our framework that k_t itself, and not technological shocks, appears as an argument of the pricing kernel.

In the same vein, another advantage of our approach is that we need not specify the capital adjustment cost function. The latter plays an important role as to the ability of production-based models to explain various anomalies (e.g. Zhang (2005) and Cooper (2006) for the value premium puzzle). However, it is unfortunately difficult to specify as many structural forms are conceivable on theoretical grounds. As a result, empirical tests may lead to very different conclusions.

Obviously, in a real economy, the last two factors on the r.h.s. of Eq. (7) vanish and only the amount of capital k_t matters [see for instance Balvers and Huang (2007)[8]]. The introduction of money thus brings about the nominal rate, which controls the trade-off between cash and credit goods, and the capital/wealth ratio as a control for the trade-off between real capital and real balances. The presence of R and ω will in fact prove crucial in empirical tests regarding the equity market premium and the aggregate dividend yield.

2.2. Production Economies: Real vs. Monetary

This section is intended to highlight the difference between real and monetary economies. While our empirical analysis will mainly focus on the cross-sectional behavior of asset returns, we show here why a monetary version of our production economy is very likely also to fare better empirically than a real version on various other issues, such as the time variation and the predictability of the equity market excess return or of the dividend yield.

[8] Note that they use k as a conditioning variable, not as a direct factor like we do here. This has a bearing on empirical testing since the estimation procedure is not the same.

Let p_t denote the real price at date t of a financial asset (say, the equity market portfolio) that is a claim on an infinite stream of cash and credit goods. By definition of the (real) pricing kernel, we thus have:

$$\Lambda_t \, p_t = E_t\left[\int_t^{\infty} \Lambda_s \left(c_{1,s} + c_{2,s}\right) ds\right] \tag{8}$$

Let us assume, as is standard in the literature, a separable log utility function:

$$U\left(c_{1,t}, c_{2,t}\right) = \phi \ln c_{1,t} + (1-\phi) \ln c_{2,t}, \qquad \text{with } 0 < \phi < 1. \tag{9}$$

Then Eq. (5) becomes:

$$\Lambda_t = e^{-\rho t} \frac{1-\phi}{c_{2,t}} \tag{10}$$

and Eq. (4) yields:

$$1 + R_t = \frac{\phi}{1-\phi} \frac{c_{2,t}}{c_{1,t}} \Leftrightarrow c_{1,t} = \frac{\phi}{1-\phi} \frac{1}{1+R_t} c_{2,t}$$

Therefore, one has:

$$c_{1,t} + c_{2,t} = \left(1 + \frac{\phi}{1-\phi} \frac{1}{1+R_t}\right) c_{2,t} \tag{11}$$

Using Eqs. (10) and (11) for t = s, the integrand present in Eq. (8) is equal to:

$$\Lambda_s \left(c_{1,s} + c_{2,s}\right) = e^{-\rho s} \left(1 - \phi \frac{R_s}{1+R_s}\right)$$

It then follows from Eq. (8) that:

$$p_t = \frac{1}{1-\phi} \left\{ \frac{1}{\rho} - \phi E_t\left[\int_t^{\infty} e^{-\rho(s-t)} \frac{R_s}{1+R_s} ds\right] \right\} c_{2,t} \tag{12}$$

which, using Eq. (11), yields the pricing equation:

$$\frac{p_t}{c_{1,t} + c_{2,t}} = \frac{\left\{ \frac{1}{\rho} - \phi E_t\left[\int_t^{\infty} e^{-\rho(s-t)} \frac{R_s}{1+R_s} ds\right] \right\}}{1 - \phi \frac{R_t}{1+R_t}} \tag{13}$$

In a real economy, c_1 and ϕ are equal to zero and the classical pricing equation $p_t = c_t/\rho$ is recovered. In a monetary economy, the conditional expectation present in the r.h.s. of Eq. (13) makes the price p_t lower than in the comparable real economy. This result is very intuitive as this expectation is nothing but the sum of the discounted opportunity costs of holding money. This is reminiscent of the opportunity cost present in an individual agent's balance sheet equation written at date t for all future sources and uses of funds. As real balances are needed to buy the stream of cash goods, non-interest-bearing money is required whose opportunity cost is the nominal rate. Consequently, all other things being equal, an increase in the latter rate decreases the current value p_t of the equity share.

The inverse of the l.h.s. of Eq. (13) is the instantaneous dividend yield. Our result implies that the latter depends on the nominal interest rate and the vector (x) of state variables. The influence of the state variables is exerted through the conditional nature of the expectation $E_t[.]$. Consequently, monetary policy will impinge more than is usually acknowledged on the behavior of financial asset prices. Also, in a real economy (with $c_1 = \phi = 0$), the dividend yield (c_t/p_t) is the constant ρ. As the empirical evidence hints at a rather volatile dividend yield (see panel B of Table I), introducing money is likely to generate an empirically more convincing model.

Finally, it is readily shown, using Eq. (6) to bring forward the capital/wealth ratio ω, that Eq. (12) rewrites:

$$p_t = \left\{ \frac{1}{\phi\rho} - E_t\left[\int_t^{\infty} e^{-\rho(s-t)} \frac{R_s}{1+R_s} ds \right] \right\} (1+R_t) \frac{1-\omega_t}{\omega_t} k_t$$

which implies by a standard application of Itô's lemma that the expected return on equity is given by:

$$E_t\left[\frac{1}{dt} \frac{dp_t + (c_{1,t} + c_{2,t})dt}{p_t} \right] = \mu(\omega_t, k_t, R_t, x_t) \qquad (14)$$

and is therefore both time-varying and (partially) predictable as it depends on current values of observable variables. This is in accordance with a now huge empirical literature on the predictability of asset returns. By contrast, in a real economy, expected equity returns would depend on k_t and x_t only.

2.3. The cross section of expected returns

Let $S_{j,t}$ denote the real price at date t of the j[th] financial asset[9], j = 1, …, N, $\mu_{j,t}$ its instantaneous expected return, and r(t) the real rate of interest. From standard financial theory, the expected excess return on asset j is such that:

$$\mu_{j,t} - r_t = -\frac{1}{dt}\mathrm{Cov}\left(\frac{dS_{j,t}}{S_{j,t}};\frac{d\Lambda_t}{\Lambda_t}\right) \tag{15}$$

Therefore, the dynamics of the real pricing kernel obeys the following stochastic differential equation:

$$\frac{d\Lambda_t}{\Lambda_t} = \mu_{\Lambda,t}dt + \sigma_{\Lambda,t}{}'dZ_t \tag{16}$$

where:

$$\mu_{\Lambda,t} = -\rho + \frac{c_2 U_{c_2c_2}}{U_{c_2}}\mu_{c_2,t} + \frac{c_1 U_{c_2c_1}}{U_{c_2}}\mu_{c_1,t}$$
$$+\frac{1}{2}\frac{c_2{}^2 U_{c_2c_2c_2}}{U_{c_2}}\sigma_{c_2,t}{}'\sigma_{c_2,t} + \frac{1}{2}\frac{c_1{}^2 U_{c_2c_1c_1}}{U_{c_2}}\sigma_{c_1,t}{}'\sigma_{c_1,t} + \frac{c_1 c_2 U_{c_2c_2c_1}}{U_{c_2}}\sigma_{c_2,t}{}'\sigma_{c_1,t}$$

$$\sigma_{\Lambda,t} = \frac{c_2 U_{c_2c_2}}{U_{c_2}}\sigma_{c_2,t} + \frac{c_1 U_{c_2c_1}}{U_{c_2}}\sigma_{c_1,t}$$

and Z_t is a multi-dimensional Brownian motion, ’ denotes a transpose, and $\mu_{c_i,t}$ and $\sigma_{c_i,t}$ (i = 1, 2) stand for the drifts and diffusion vectors of the two consumption processes, respectively. Note that the technological and monetary shocks are embedded in Z.

Eqs. (15) and (16) together imply that the expected excess return on asset j is equal to:

$$\mu_{j,t} - r_t = \left(-\frac{c_1 U_{c_2c_1}}{U_{c_2}}\sigma^2_{c_1,t}\right)\frac{\sigma_{j,t}{}'\sigma_{c_1,t}}{\sigma^2_{c_1,t}} + \left(-\frac{c_2 U_{c_2c_2}}{U_{c_2}}\sigma^2_{c_2,t}\right)\frac{\sigma_{j,t}{}'\sigma_{c_2,t}}{\sigma^2_{c_2,t}} \tag{17}$$

or else:

$$\mu_{j,t} - r_t = \left(-\frac{m U_{c_2m}}{U_{c_2}}\sigma^2_{m,t}\right)\frac{\sigma_{j,t}{}'\sigma_{m,t}}{\sigma^2_{m,t}} + \left(-\frac{c_2 U_{c_2c_2}}{U_{c_2}}\sigma^2_{c_2,t}\right)\frac{\sigma_{j,t}{}'\sigma_{c_2,t}}{\sigma^2_{c_2,t}} \tag{18}$$

where $\sigma_{j,t}$ and $\sigma_{j,t}$ are the diffusion vectors for the j[th] asset return and the real balances processes, respectively.

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[9] In section 2.2 above, p_t was interpreted as the price of the market portfolio, not a single asset, hence the change of notation.

Eq. (18) shows that real balances risk, such as previously investigated for instance by Marshall (1992) and Balvers and Huang (2007), is priced. Note that a representation similar to ours has been obtained by the latter authors under the assumption of a constant opportunity set (there are no predictors in their economy). The derivation of Eq. (18) is known not to require such a restrictive assumption.

Another representation of result (18) grounded on the FOC for the representative agent's optimal decisions writes:

$$\mu_{j,t} - r_t = \left(-\eta_{R_t} \frac{c_1 U_{c_2 c_1}}{U_{c_2}} \sigma^2_{R_t,t} \right) \frac{\sigma_{j,t}' \sigma_{R_t,t}}{\sigma^2_{R_t,t}} + \left[-\frac{c_2 U_{c_2 c_2}}{U_{c_2}} \sigma^2_{c_2,t} + \eta_{c_{2,t}} \frac{c_1 U_{c_2 c_1}}{U_{c_2}} \sigma^2_{c_2,t} \right] \frac{\sigma_{j,t}' \sigma_{c_2,t}}{\sigma^2_{c_2,t}} \quad (19)$$

where the nominal interest rate is substituted for real balances, η_{R_t} denotes the interest rate elasticity of the demand for money, and $\eta_{c_{2,t}}$ its elasticity to credit good consumption. Since the appropriate definition of money holdings is in practice debatable (M1 vs. M2 for instance) and might lead to measurement errors, this representation may perform empirically better than that of Eq. (18). We therefore will test both.

It is important to stress that the representation (17) - (18) - (19) is very general, and holds in particular for general utility functions. It also holds for instance in a pure exchange ("tree") economy. In the latter economy, the corresponding equations are obtained by substituting output for consumption.

Given the characterization (7) for the pricing kernel in a production monetary economy, a three-factor (ω_t, k_t, R_t) CAPM is easily derived. Applying Ito's lemma to Eq. (7), Eq. (15) can be written as:

$$\mu_{j,t} - r_t = -\xi_{k_t} \frac{\sigma_{j,t}' \sigma_{k_t,t}}{\sigma^2_{k_t,t}} - \xi_{R_t} \frac{\sigma_{j,t}' \sigma_{R,t}}{\sigma^2_{R,t}} - \xi_{\omega_t} \frac{\sigma_{j,t}' \sigma_{\omega,t}}{\sigma^2_{\omega,t}} \quad (20)$$

where ξ_i denotes the elasticity of the marginal utility of consumption to the variable i, and reflects the market price of the corresponding risk. The sign of these market prices of risk depend on the representative agent's preferences and cannot be determined without imposing additional structure on the model. Our empirical investigation will shed light on this issue.

To summarize, we will test, in both unconditional and conditional versions, the model encapsulated in Eq. (20) against three sets of alternatives:

(i) a real, non-monetary version where the last two terms on the r.h.s. of Eq. (20) disappear and where the first term involves either real capital, as in Eq. (20), or aggregate consumption or total output; the first version will be called K-CAPM, the second C-CAPM, and the last Y-CAPM:

(C-CAPM) $$\mu_{j,t} - r_t = -\xi_{c_t} \frac{\sigma_{j,t}'\sigma_{c_t,t}}{\sigma^2_{c_t,t}} \quad (21)$$

(Y-CAPM) $$\mu_{j,t} - r_t = -\xi_{y_t} \frac{\sigma_{j,t}'\sigma_{y_t,t}}{\sigma^2_{y_t,t}} \quad (22)$$

(K-CAPM) $$\mu_{j,t} - r_t = -\xi_{k_t} \frac{\sigma_{j,t}'\sigma_{k_t,t}}{\sigma^2_{k_t,t}} \quad (23)$$

(ii) a monetary pure exchange economy where capital and the capital to wealth ratio vanish and the three-factor (ω_t, k_t, R_t) CAPM (20) is replaced by a two-factor (c_t, R_t) or (y_t, R_t) CAPM:

$$\mu_{j,t} - r_t = -\xi_{c_t} \frac{\sigma_{j,t}'\sigma_{c_t,t}}{\sigma^2_{c_t,t}} - \xi_{R_t} \frac{\sigma_{j,t}'\sigma_{R,t}}{\sigma^2_{R,t}} \quad (24)$$

or

$$\mu_{j,t} - r_t = -\xi_{y_t} \frac{\sigma_{j,t}'\sigma_{y_t,t}}{\sigma^2_{y_t,t}} - \xi_{R_t} \frac{\sigma_{j,t}'\sigma_{R,t}}{\sigma^2_{R,t}} \quad (25)$$

(iii) the standard CAPM and its 3-factor extension by Fama and French (1993).

3. EMPIRICAL EVIDENCE ON EXCESS RETURNS

This section provides empirical tests of the various inter-temporal capital asset pricing models (ICAPM) grounded on the analysis conducted in this paper, i.e. various versions of Eq. (20) or its alternatives. We will perform our tests on U.S. stock portfolios for most of the post-war period. We intend to estimate which macroeconomic sources of risk are priced, and thus assess whether a production-based CAPM performs better than a consumption-based one or the "ad hoc" Fama-French model, and whether explicitly introducing money in the economy adds something empirically important regarding equity excess returns.

3.1. Data

We have obtained data from several sources. However, all our data are quarterly, as monthly data for real capital are not available. Our sample covers the period from 1959-I to 2004-II, i.e. 182 observations. When the theoretical equations to be tested involve growth rates, not levels, of variables, we will be left with 181 observations. Data for M1, GDP (output), CPI and the three-month Treasury bill rate have been downloaded from FRED at the Federal Bank of Saint Louis. Aggregate consumption (of cash and credit goods) is measured by "Personal Consumption Expenditures of Non-Durable Goods and Services", as compiled by the Bureau of Economic Analysis. The series on Credit Goods is obtained by subtracting real balances (which proxy cash goods) from aggregate consumption. Data on real capital data has been obtained from Paul Gomme [see Gomme and Rupert (2007)]. The definition of capital we have used is constructed from depreciation rate and investment data, and initial capital stocks given by chain-type index converted to year-2000 dollars. The capital/wealth ratio, ω, has been computed by dividing real capital by real wealth, the latter defined as real capital plus real money balances computed from M1 and the CPI. Data on excess returns on the market portfolio has been downloaded from Prof. Kenneth French's website. The market risk premium is computed as the value-weighted returns on all NYSE, AMEX, and NASDAQ stocks (obtained from the CRSP files) minus the one-month Treasury bill rate. Monthly data have been converted into quarterly data by discrete compounding.

The benchmark in testing alternative asset pricing models is the celebrated three-factor model pioneered by Fama and French (1993, 1995, and 1996). We will use it as the reference model explaining the cross-sectional variation in portfolio excess returns. The first factor is the excess return on the market portfolio ("Market"), the second is the return on a portfolio invested in small stocks and short in big stocks ("SMB" for "Small Minus Big"), and the third is the return on a portfolio long in high book-to-market stocks and short in low book-to-market stocks ("HML" for "High Minus Low")[10]. We have downloaded from K. French's website these factors, as well as the 25 Fama-French (FF hereafter) portfolios sorted by size and book-to-market equity which will constitute our first universe of portfolios[11]. Some authors, e.g. Lewellen, Nagel and Shanken (2006) have argued that excess return tests using these portfolios are biased favorably due to the factorial structure inherent to their construction. Consequently, to reduce this bias, we enlarge our second universe to comprise, in addition to the 25 FF portfolios, the 17 industry portfolios also compiled by Fama and French.

Actually, the theoretical equations to be tested make use of growth rates, not levels, of variables. Although most level series are not stationary, change rate series are stationary. Accordingly, Table I reports the rates of change of all aggregate variables, but reports levels for all variables having the dimension of a rate of return, such as the Treasury bill rate or the portfolio returns. More precisely, Table 1 presents the summary statistics for all the relevant variables, except for the 25 Fama-French portfolios to save space.

Insert Table I about here

[10] The SMB return is the average return difference between three small and three big stock portfolios (size measured by market value of equity, breakpoint at the median) and the HML return is the average return difference between two high and two low book-to-market stock portfolios (breakpoints at the 30^{th} and the 70^{th} percentiles), where book-to-market is the ratio of the accounting value of equity to its market value.

[11] The FF portfolios are obtained from an independent sort of all NYSE, AMEX and Nasdaq stocks into *quintiles* based on size and book-to-market ratio (hence there are 5x5=25 portfolios). See Fama and French (1993) for more details.

Panel A reports the statistics relative to the growth rates of aggregate consumption ("c"), consumption of credit goods ("c_2"), real output ("y"), real capital ("k"), the capital to wealth ratio ("ω"), and to the level of the latter ratio ("ω–level").

Panel B exhibits the levels of four predictive, return-related macro-variables: the three-month Treasury bill rate ("T-bill"), the term spread measured as the difference between the ten-year (constant maturity) Treasury bond yield and the three-month Treasury bill rate ("Term"), the default spread measured as the difference between the yield of a Baa-rated bond and that of an Aaa-rated bond both having a constant 10 year maturity ("Def"), and the dividend yield measured as the total dividends paid off during the last 12 months divided by the actual price of the market portfolio ("Div").

Panel C exhibits the excess return on the market portfolio over the T-bill rate ("Market") and the returns on the Fama-French "small minus big" size-related ("SMB") and "high minus low" book-to-market-related ("HML") portfolios. The average equity market premium is in line with what is reported in the extant literature (4.5% annualized).

Panel D reports the correlation matrix for the growth rates of six variables: aggregate consumption, credit goods, real output, real capital, the capital to wealth ratio and the three-month Treasury bill ("R"). Of particular relevance to this study, the capital-to-wealth ratio ω is not correlated with real capital k, which will allow the insertion of both variables in the regressions.

Panel E shows the correlation matrix for the levels of the four predictive variables "T-bill", "Term", "Def" and "Div". As intuition suggests, there is a rather strong correlation between the level of the T-bill rate and that of the other three variables.

Panel F exhibits the first-order auto-regression coefficients for the growth rates of the six following variables: aggregate consumption, credit goods, real output, real capital, the capital to wealth ratio, and the three-month Treasury bill. It also reports the Phillips-Peron test of stationarity for each variable, and its critical values. The large persistence of the capital growth rate ("k") is worth noting. Although theoretically very attractive, in particular because it avoids the notoriously difficult measurement of productivity shocks, this variable will thus probably have a hard time to be empirically a significant variable explaining cross sectional portfolio returns.

Panel G reports the average excess returns (over the 3-month Treasury bill) on the 25 Fama-French portfolios. As frequently reported in the literature on the value premium [e.g. in Fama-French (2006)], it is readily seen that (i) except for big size portfolios, there is a clear positive relationship between risk premium and book-to-market ratio, implying that "value" stocks command a higher excess return than "growth" stocks, and (ii) except for low book-to-market portfolios, there is a clear inverse relationship between excess return and size.

3.2 Estimation procedure

3.2.1. Unconditional models

According to an ICAPM [see Merton (1973)], the excess return (over the risk-free rate) on a risky asset (or portfolio) depends on its market beta and its exposure to random changes in the investment opportunity set. Of course, the econometrician has to decide, from a theoretical model such as the one presented in the previous section, what state variables, if any, may affect the investment opportunity set, and is led in general to test various empirical versions of the model.

To estimate an unconditional ICAPM, two kinds of regressions must be run, following the Fama and MacBeth (1973) standard procedure. In a first pass, the time-series of excess returns (over the risk-free rate) on a risky asset or portfolio ($r_{j,t}$) is typically regressed on the excess return on the market portfolio or the change rate of an aggregate such as consumption, output or capital, and possibly on the growth rate of other explanatory variables such as the nominal rate and the capital/wealth ratio, all generically denoted below by $Y_{i,t}$. We thus have:

$$R_{j,t} - R_t \equiv r_{j,t} = \alpha_j + \sum_{i=1}^{F} \beta_{j,Y_i} Y_{i,t} + \varepsilon_{j,t} \qquad j = 1,2,..,N \qquad (25)$$

where F is the number of factors and N the number of assets. In the second pass, we test in cross-section the hypothesis that the unconditional expected excess returns on assets or portfolios obey:

$$\mu_j - R \equiv E(r_j) = \lambda_j + \sum_{i=1}^{F} \gamma_{Y_i} \hat{\beta}_{j,Y_i} \qquad (26)$$

where the λ_j should be zero and the independent variables $\hat{\beta}_{j,.}$ are estimates obtained from regression (25). For example, the standard CAPM (with *Y* being the excess return on the market portfolio) leads to γ_{Y_M} significantly positive and all other γ_{Y_i} equal to zero, while the FF three-factor model leads to γ_{Y_M} and two other γ_{Y_i} (Y_1 the SMB portfolio and Y_2 the HML portfolio) significantly positive, and all other γ_{Y_i} equal to zero.

As an other example, our model represented by Eq. (20) states that the Y_i are the growth rates of real capital, of the nominal interest rate, and of the capital/wealth ratio (i.e. i = 3):

$$\mu_j - R \equiv E(r_j) = \gamma_k \hat{\beta}_{j,k} + \gamma_R \hat{\beta}_{j,R} + \gamma_\omega \hat{\beta}_{j,\omega} \qquad (27)$$

Alternative models represented by (various versions of) Eqs. (21)-(24) give rise to equations similar to Eq. (27) but with i = 1 or 2 only.

3.2.2. Conditional models

In view of the general failure of unconditional CAPMs or CCAPMs to explain cross-sectional asset returns, researchers have investigated conditional versions where various predictive macro-variables are used in the first-pass time-series regressions. The procedure is the one described for the unconditional models except that the time-series of excess returns on a risky portfolio ($r_{j,t}$) is regressed not only on the variables $Y_{i,t}$ as above, but also on the level of state variables, generically denoted below by $X_{k,t}$. The latter are deemed to represent changes in the investment opportunity set or proxies for the latter, and to ensure a degree of predictability in asset expected returns[12].

In principle, both the "constant" α_j and the $\hat{\beta}_{j,.}$ in Eq. (25) thus are time-varying. To avoid undue complexity, however, we choose to let α_j constant. In addition, the time-

[12] The literature is abundant. See for instance Fama and Schwert (1977), Campbell (1987), Campbell and Shiller (1988), Fama and French (1989), and recently Yogo (2006) or Petkova (2006).

varying $\hat{\beta}_{j,.}$ are assumed to depend linearly on the following four predictive variables ($X_{k,t}$) defined in Panel B of Table I: the short term interest rate “T-bill”, the term spread “Term”, the default spread “Def”, and the dividend yield “Div”. This choice is dictated by previous results available in the extant literature, e.g. in Petkova (2006) or Yogo (2006). We thus have:

$$R_{j,t} - R_t \equiv r_{j,t} = \alpha_j + \sum_{i=1}^{F}\left(\beta_{j,i,0} + \sum_{l=1}^{K}\beta_{j,i,l}X_{l,t}\right)Y_{i,t} + \varepsilon_{j,t} \qquad \forall j \qquad (28)$$

so that ultimately, developing the double sum, we have to estimate, for each portfolio j, (1+K)F = 5F betas where F is the number of variables Y_i. For instance, for our production-based monetary model, we will have 15 betas.

In the second pass, we conduct cross-section regressions to test the hypothesis that the conditional expected risk premia on portfolios obey:

$$\mu_j - R \equiv E(r_j) = \lambda_j + \sum_{i=1}^{F}\gamma_{Y_i}\hat{\beta}_{j,Y_i} + \sum_{i=1}^{F}\sum_{l=1}^{K}\gamma_{Y_{i,l}}\hat{\beta}_{j,Y_i,X_l} \qquad (29)$$

where the independent variables $\hat{\beta}_{j,.}$ are estimates obtained from regression (28).

3.3. Results

3.3.1. Preliminaries: predictive regressions

Before testing competing versions of the ICAPM, we briefly investigate whether various combinations of macro-variables help explain the aggregate dividend yield, the excess return on the equity market portfolio and the 25 FF portfolios. We ran predictive regressions in which the explanatory variables are the one-period lagged values of the 3-month Treasury bill rate (“T-bill”), the term spread (“Term”), the default spread (“Def”), the level of real capital (“k-level”) and the innovation of the capital to wealth ratio (“ω–innov”). The latter innovation is computed in view of the high correlation between the *levels* of capital and this ratio, and is obtained from the regression of the capital to wealth ratio on real capital, both expressed in levels. The corresponding t-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags. Results are reported in Table II.

Insert Table II about here

Generally speaking, the level of R^2s for the portfolios is very low, which vindicates the claim in the literature that excess or total returns on these are very hard to predict. Results for the aggregate dividend yield however are surprisingly encouraging, for a variable also deemed to be difficult to predict, with all variables but the default spread highly significant.

Note that the nominal rate has a positive impact on the dividend yield and a negative one on the equity market premium. One possible explanation for the first relationship is that the nominal rate increases with inflation as do dividend yields. As to the second relationship, when the level of interest rates increases because of inflation, the risk premium (which is expressed in real terms) decreases *ex post* as the inflation tax reduces the real profitability of firms[13].

The level of real capital has a negative impact on the dividend yield. The likely explanation is that dividend policy, as implied by Modigliani-Miller's irrelevance proposition, is a residual decision so that, other things being equal, a firm that faces profitable investment projects funds them (at least partly) by parting with cash that would otherwise be devoted to paying dividends.

The impact of our key variable, the capital to wealth ratio, is positive on both the dividend yield and the market premium. First, when that part of a technological skock that is captured by ω is positive, expected profits and dividends increase. This obtains for the 25 FF portfolios as well as the market as a whole. Second, the first order expansion of ω is (1-(m/k)). When its innovation is positive, the relative weight of real balances decreases, which implies less expected opportunity costs and then more expected returns and dividends.

3.3.2. Unconditional CAPMs

[13] Inflation, in addition to being a tax on real money holdings (particularly important for firms), increases the real tax burden on firms as, for instance, the latter cannot correctly depreciate their existing physical capital as replacement cost accounting is fiscally forbidden.

We report first tests of alternative unconditional CAPMs [Eq. (26)]. Table III reports (second pass) cross-sectional regressions using the excess returns on the 25 FF portfolios sorted by size and book-to-market.

This table presents cross-sectional regressions using the excess returns (over the three-month T-bill rate) on 25 Fama-French portfolios sorted by size and book-to-market. The full-sample factor loadings, which are the independent variables in the cross-sectional regressions and are not shown to save space, have been computed in time-series simple regressions (for each of the 25 portfolios) in which the dependent variable is the excess return on a given portfolio [Eq. (25)]. The cross-section regression (Fama-Macbeth) coefficients are obtained by Ordinary Least Squares (OLS) and displayed on the first rows of Table III. The t-statistics ("t(NW)") are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags to assess the statistical significance of the independent variables. Since the latter are estimates from a time series regression, we have also reported the t-statistics ("t(S)") adjusted for errors-in-variables according to the procedure established by Shanken (1992), a more difficult test to pass. Note however that when the homoskedasticity assumption made by Shanken (1992) is relaxed, Jagannathan and Wang (1996) and more recently Shanken and Wang (2007) have shown that the bias may be relatively small if it exists at all. This is why we report both t-statistics. To assess the overall fit of each competing model, we have computed the adjusted R^2 used by Jagannathan and Wang (1996), ("R^2(JW)"), which measures the proportion of cross-sectional variation in expected returns explained by the model.

Panel A of Table III reports the cross-sectional results for the standard CAPM and the Fama-French 3-factor model (FF3). Panel B refers to a non-monetary economy and shows results for the C-CAPM, the Y-CAPM, and the K-CAPM derived from Eqs (21), (22) and (23), respectively. Panel C exhibits results for a pure exchange monetary economy where the independent variables are various combinations of credit goods, output, total consumption, real money holdings and 3-month T-bill rate, all expressed in growth rates. Panel D reports results for a production monetary economy where the independent variables are various combinations of the growth rates of real capital, 3-month T-bill rate, and capital to wealth ratio. When all three variables are present, we have our model [Eq. (27)]. Panel E is the same as Panel D with the excess return on the market portfolio substituted for the growth rate of real capital.

Insert Table III about here

Panel A confirms the plain failure of the standard unconditional CAPM, where the R^2(JW) is only 0.31 and the both the constant and the excess return on the market portfolio are strongly significant, with the wrong negative sign on the latter variable. By contrast, the 3-factor FF model is much more successful, like in the literature where the reported adjusted R^2 lies roughly in the range 0.70 – 0.80 depending on the studies[14]. Here the R^2(JW) is 0.81 and the return on the HML is positive and very significant, and the return on the SMB portfolio is positive and border-line significant. Overall, this model performs rather well and remains the hard-to-beat reference model, but still has the puzzling wrong sign (hardly significant however) on the market portfolio.

Panel B shows the complete failure of both the Y-CAPM and the K-CAPM for which the independent variable has no explanatory power. This was expected since these models have no theoretical grounding. The C-CAPM fares better, with a high R^2(JW) of 0.49. However, the strongly significant and negative sign obtained for aggregate consumption is less expected but confirms the well established failure of the unconditional C-CAPM to explain the returns on the 25 FF portfolios[15].

Results on more complex versions of a pure exchange monetary economy where money is present are reported in Panel C. The introduction of money, either through real balances or the nominal interest rate, that show up everywhere as very significant, slightly improves the C-CAPM although consumption retains the wrong sign. In accordance with Yogo's (2006) result that disaggregating consumption between durable and non-durable goods, the former being significant, we find that when credit goods c_2 is substituted for total consumption c, results improve since the sign of c_2 is positive and almost significant when the nominal rate is used. The models based upon output

[14] See for instance Fama and French (1992), Jagannathan and Wang (1996), Lettau and Ludvigson (2001) or Petkova (2006). These studies differ by the period considered and/or the frequency of data.
[15] For a recent discussion on this failure, see Yogo (2006).

improve considerably with a monetary factor attached to them although output itself remains insignificant.

Panel D provides very encouraging results on various versions of our production monetary model. The best result is achieved by the full version (last model) where all k, R and ω enter the picture. Eq. (27) thus explains rather well the cross-sectional variation in expected excess returns and is a definite improvement over the analogous model derived in a pure exchange economy. Although real capital is not significant, which was predictable due to the afore-mentioned relative lack of variation of this variable, this model encapsulated in Eq. (27) fares almost as well as the hard-to-beat FF model, with an R^2(JW) of 0.76, and even better if we consider the wrong sign on the market portfolio that affects the latter model. Furthermore, the HML and SMB factors lack theoretical underpinnings and have no straightforward economic interpretation. Our theoretical model for a monetary production economy seems a sound alternative.

The nominal interest rate risk is priced and very significantly so. The risk premium is negative for the following reason. The nominal interest rate is negatively correlated with economic conditions since it increases with inflationary pressure. Therefore, when a portfolio is positively correlated with the nominal rate, it performs well under dire economic conditions, and thus commands a negative premium since this behavior is desirable from an investor's standpoint. A preference-based explanation for the sign of this premium could be as follows: when the nominal rate increases, the opportunity cost of savings increases, other things being equal, so that capital investment increases, consumption decreases and thus the marginal utility of credit goods increases (the income effect wins). Since the market price of risk is minus the elasticity of the pricing kernel (i.e. marginal utility of credit good consumption) with respect to the interest rate (see Eq. (20)), the sign of the premium is negative.

The risk associated with the randomness of the capital/wealth ratio is also priced and very significantly so. In the same way the nominal interest rate reflects the tradeoff between cash and credit goods, ω reflects the tradeoff between real money and capital. However, the risk premium is here positive. First, since real capital is not priced per se, technological shocks may be captured by ω, and this production risk must command a positive premium. Second, when a portfolio is positively correlated with ω, it yields high returns when real balances are weak (m and ω vary inversely) and thus their associated opportunity cost is low. This makes the portfolio relatively unattractive and it then commands a positive premium. The third, preference-based reason is that when omega increases, the relative increase in capital and related relative decrease in cash goods consumption induces a relative increase in the consumption of credit goods (the substitution effect wins). Therefore, the marginal utility of the latter decreases and the elasticity of the pricing kernel with respect to omega is negative, so that the risk premium is positive (see Eq. (20)).

Our measure of wealth is the sum of real capital and real money balances. Because our definition of real capital may be subject to measurement errors, and also to ease the comparison with results from for instance Yogo (2006) or Petkova (2006), we have adopted as an alternative to (the growth rate of) real capital the standard (excess return on the) market portfolio. Results are reported in Panel E. The R^2(JW) are essentially unaffected vis-à-vis those in Panel D, the significance of the interest rate and of the capital/wealth ratio is essentially identical, and the market retains its puzzling negative sign. We therefore retain our theoretical formulation Eq. (27) and conclude that our production-economy-based asset pricing model is a serious challenge to the unfounded FF model.

Note finally that in Table III, the size and significance of the constants have no straightforward interpretation. This is because the independent variables are not portfolios or mimicking portfolios, so that we do not really expect them to be zero.

Insert Table IV about here

One question arises as to the time-series regressions performed in the first pass of the Fama-Macbeth procedure which have led to the cross-sectional regressions reported in Table III. In theory, the constant in each and every regression (the 25 of them) should be equal to zero. Table IV reports the results of the Gibbons-Ross-Shanken (1989) test that checks the hypothesis that the constants in the time-series regressions are jointly null. It also provides the probability (p-value) that the constants are jointly equal to zero. We stress that we can not here interpret this test as a test of market efficiency as the authors did in their 1989 paper. The reason is that our factors in the time-series regressions are macro-variables, not portfolios as they had. That being said, the presence of a significant constant implies that there is something left to be desired in the model. In this respect, we note that the highest p-values are attained by our production-based monetary models, in particular our model Eq. (27).

Another gauge of the success of competing models in explaining cross-sectional excess returns is pricing error. We define the latter as the absolute value of the difference (in percentage points) between the realized excess return on a portfolio and the excess return as predicted by the model. Results are reported in Table V and illustrate in Figure 2. For most models including the standard CAPM the (quarterly) pricing error amounts to roughly 0.5% in absolute value, which is quite sizeable. It is only 0.27% for the FF model and 0.29% for our production-based model, which thus fares nearly as well on this account. The alternative model using the market portfolio instead of real capital fares as well too, with a 0.28% error.

Insert Table V about here

Insert Figure 2 about here

Due to the way the 25 FF portfolios are constructed, it is instructive to check whether the results above are robust to the composition of the universe of portfolios. We thus include 17 additional industry portfolios in our sample. Results relative to these 42 portfolios are reported in Tables VI and VII. As far as the cross-sectional regressions are concerned, three main conclusions emerge. First, Table VI evidences that all models fare more poorly than with the sub-sample of 25 portfolios. This is particularly true of the standard CAPM and the 3-factor FF model the respective R^2(JW) of which falls from 0.31 and 0.81 to 0.09 and 0.50. This was rather expected considering the structure imposed on the 25 portfolios, structure which is not imposed on the extra 17. Second, the ranking of the respective merits of all considered models is preserved, with the 3-factor FF model and our production-based model performing best. Third, the decrease in model performance is much less pronounced for our model than for the 3-factor FF, which is heartening due to the nature of the 25 portfolio universe which is biased towards FF and against us. Indeed, the R^2(JW) declines less, from 0.76 to 0.52 only, and becomes even slightly better than that of the FF model (0.50).

Insert Tables VI and VII about here

As to the pricing errors reported in Table VII, they confirm the above results, with a slight deterioration vis-à-vis the 25 portfolio sub-sample. With a 0.36% error, our model now fares slightly better than the FF model (0.39%).

Finally, the left part, part (*A*), of Table VIII reports the loadings on the capital (β_k), the 3-month T-bill rate (β_R) and the capital to wealth ratio (β_ω) factors, all expressed in growth rates, computed in the time-series regressions for the 25 FF portfolios. These loadings led to the last cross-sectional model reported in Panel D of Table III ("KRω-CAPM"). The last rows report the standard adjusted R^2. The right part (*B*) is the same as part (*A*) except that real capital ("k") has been replaced by the excess return on the market portfolio ("Market") expressed in level, so that β_{Mkt} is substituted for β_k. These loadings led to the last cross-sectional model reported in Panel E of Table III ("MRω-CAPM").

Insert Table VIII about here

The adjusted R^2 in part (*A*) are rather small, contrary to those in part (*B*), but this was expected from the literature where they are notoriously small when the market portfolio is not included in the independent variable list.

Results for the MRω-CAPM are extremely good. They provide a very strong support for the view that this model solves the value premium puzzle, at least in good part. This puzzle has been recently revisited by a number of researchers, for instance Liu, Whited and Zhang (2007). According to the latter, the value premium is du to the negative relationship between investment levels and rates of return (diminishing returns to scale). Firms enjoying a low B/M ratio are those who invest a lot and therefore earn relatively small profits. Also, the reason why the 3-factor FF model is said to explain the value premium is because the FF 25 portfolios display strong variations in the loading on

HML in the direction consistent with their average returns variations. Fama and French (1996) conjecture that the average return of HML is likely to be a risk premium for distressed firms. In words, stocks of distressed firm tend to move in the same direction and therefore their risk cannot be diversified away and thus command a premium. Here, the market beta exhibits the expected pattern: high B/M portfolios have a smaller beta than have low B/M ones (except for the big capitalizations). As to the interest rate betas, low B/M portfolios have positive loadings and high B/M portfolios negative ones. Since the money risk premium is negative, this tends to increase the expected returns on high B/M portfolios, as desired. This effect is increased by the impact of the capital/wealth ratio: overall, high B/M portfolios tend to have larger loadings on β_ω than low B/M portfolios and the premium associated with ω risk is positive.

3.3.3. Conditional CAPMs

We then proceed to test and compare the conditional versions of the CAPMs above. The procedure is changed in that the first-pass time-series regressions now obey Eq. (28) instead of Eq. (25) and the second-pass cross-section regressions follow Eq. (29) rather than Eq. (26). Results for the 25 FF portfolios are reported in Table IX. Recall that in the time-series regressions, the time-varying betas depend linearly on the short term interest rate, the term spread, the default spread, and the dividend yield. The cross-section regression (Fama-Macbeth) coefficients are obtained by OLS and then multiplied by 100 for readibility. The t-statistics denoted by "t(NW)" are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags, as usually done. The t-statistics denoted by "t(S)" are adjusted for errors-in-variables following Shanken's (1992) procedure. The adjusted R^2 are those proposed by Jagannathan and Wang (1996). Panel A reports the cross-sectional results for the standard conditional CAPM (model #1) and the conditional 3-factor FF model (models #2 and #3). In models #1 and #2, only the loading on the market portfolio is time-varying and thus depends on the four predictors. In model #3, all three loadings (on the Market, the SMB and the HML portfolios) are time-varying. Panel B reports results for a production monetary economy where the independent variables are various combinations of the growth rates of real capital, 3-month T-bill rate, and capital to wealth ratio. For the four models reported (models #4 to #7), all betas are time-varying and depend on the four predictors. Panel C is similar to Panel B with the market portfolio substituted for real capital. In the three models reported (models #8 to #10), all betas are time-varying and thus depend on the four predictors. To save space we do not report the results obtained for the non-monetary and the pure exchange economy models since, as with unconditional models, they are markedly inferior to those obtained for the production monetary economy.

Insert Table IX about here

As expected, the overall fit for all the cross-sectional regressions is greatly enhanced as compared with those obtained for the unconditional CAPMs, as the R^2(JW) generally soar. For instance, for the CAPM, the FF model and our production-based model, they increase from 0.31, 0.81 and 0.76, respectively, to 0.79, 0.96 (with all betas time-varying) and 0.97 (with all betas time-varying), respectively. This confirms the general tendency in the extant empirical literature to exhibit some predictability in asset or portfolio returns, and the correctness of choosing the four predictive variables mentioned above. The coefficients on the various betas are generally significant for the FF model (models #2 and #3). This is in accordance with e.g. Avramov and Chordia (2006) who show that, for individual equity stocks, a conditional version of this model performs much better than its standard CAPM counterpart.

The coefficients on the various betas are also generally significant for the production-based monetary models (#6 and #7). In particular, our theoretical model, numbered #7, performs remarkably well and even (slightly) surpasses the FF model in terms of R^2(JW). The risks associated with R and ω remain priced with the same signs which are also (with one exception only) the signs of the betas issued from the predictive variables. A novelty with respect to the unconditional version of the model is that capital risk tends now to be priced, and negatively so. One plausible interpretation is that when, other things being equal, capital (hence investment) is relatively high, consumption is relatively low and its marginal utility is high. Therefore portfolios offering a high return when consumption is valuable will command a negative risk premium.

Rather unsurprisingly perhaps, results for conditional models numbered #8 to #10, where the market portfolio replaces real capital, do not improve as much and are inferior to those obtained with real capital (in particular model #7), probably because the market portfolio already captures some of the effects produced by the predictive variables.

Turning to the question of the significance of the constants in the first-pass time-series regressions which have led to the cross-sectional regressions reported in Table IX, we report in Table X the results of the Gibbons-Ross-Shanken (1989) tests and their associated probabilities that the constants are jointly equal to zero. Again, as with unconditional models but in an even more pronounced manner, the highest p-values are attained by our production-based monetary models, in particular our choice model #7 for which the p-value reaches almost 21%.

Insert Table X about here

As to the level of the pricing error regarding cross-sectional excess returns implied by the competing models, Figure 3 shows that conditional models keep essentially the same ranking as unconditional models earned. The pricing error is somewhat reduced by the conditioning.

Insert Figure 3 about here

Results relative to the extended universe of 42 portfolios are reported in Table XI. Two main conclusions emerge. First, the overall goodness-of-fit of all models deteriorates markedly vis-à-vis that obtained with the 25 FF portfolios, with the ranking of the competing models preserved, as was the case for unconditional models. For instance, the respective R^2(JW) of the standard CAPM (#1), the 3-factor FF model (#3) and our choice model (#7) fall from 0.79, 0.96 and 0.97 respectively, to 0.36, 0.76 and 0.76, respectively. Second, our model (#7) continues to fare at least as well as the 3-factor FF model (#3), and the negative premium on real capital risk becomes larger and more significant.

Insert Table XI about here

Incidentally, Panel A of table XI is consistent with a finding by Fama and French (1997) according to which, when it comes to the conditional version of their model tested on a universe that include industry portfolios, it is important to make the loadings on the HML and SMB factors time-varying. Comparing model #2 (where only the market beta is time-varying) with model #3 clearly vindicates this finding, as the overall goodness-of-fit is seen to increase from 0.61 to 0.76 when all three betas are allowed to be time-varying.

Finally, Table XII reports the (average) loadings on the growth rates of capital (β_k), the 3-month T-bill rate (β_R) and the capital to wealth ratio (β_ω) factors computed in the first-pass time-series conditional regressions for the 25 FF portfolios. Since each beta is an affine function of the four predictive variable ("T-bill", "Term", "Def", and "Div"), we have computed the "aggregate" beta for each date t as $\hat{\beta}_{j,Y,0} + \sum_{k=1}^{4} \hat{\beta}_{j,Y,k} X_{k,t}$, where j is a portfolio, Y is either the real capital, the T-bill rate or the capital to wealth ratio, and X_k is one of the four predictors, and then have computed its average over time (181 observations). The loadings appearing in part (*A*) of the table led to the last cross-sectional model reported in Panel B of Table IX (model #7). The loadings appearing in part (*B*) of the table led to the last cross-sectional model reported in Panel C of Table IX (model #10), where the excess return on the market portfolio has been substituted for real capital.

Insert Table XII about here

As compared to the results obtained with unconditional models (see Table VIII), the adjusted R^2 for model #7 are significantly higher, as expected, while those for model #10 are left essentially unchanged for reasons explained when commenting on results exhibited in Table IX. This vindicates the superiority, at least when the market portfolio does not appear as an explanatory variable, to design conditional as opposed to unconditional models.

4. CONCLUDING REMARKS

Factor-based asset pricing models are useful models for *describing* the variation in the cross section of financial asset average returns. They can hardly however *explain* this cross section. This paper intended to share the effort devoted during the last decades to ground asset pricing on a firm theoretical macroeconomic basis. Our newly identified macro factors may be used in several applications such as measuring mutual funds/hedge funds performance, evaluating the firm's cost of capital, and many others.

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Table I: Summary Statistics

All data are quarterly (and non-annualized, except for the variables "Term", "Def", and "Div" defined below which are annualized) and cover the period 1959:II to 2004:II (182 observations for levels and 181 for growth rates). Panel A reports the growth rates of aggregate consumption ("c"), credit goods ("c_2"), real output ("y"), real capital ("k") and the capital to wealth ratio ("ω"). The last column also reports the level of the latter variable. Panel B shows the levels of four predictive macro-variables: the three-month Treasury bill rate ("T-bill"), the term spread measured as the difference between the ten-year (constant maturity) Treasury bond yield and the three-month Treasury bill rate ("Term"), the default spread measured as the difference between the yield of a Baa-rated bond and that of an Aaa-rated bond both having a constant 10 year maturity ("Def"), and the dividend yield measured as the total dividends paid off during the last 12 months divided by the actual price of the market portfolio ("Div"). Panel C exhibits the excess return on the market portfolio over the T-bill rate ("Market") and the returns on the Fama-French "small minus big" size-related ("SMB") and "high minus low" book-to-market-related ("HML") portfolios. Panel D reports the correlation matrix for the growth rates of six variables: aggregate consumption ("c"), credit goods ("c_2"), real output ("y"), real capital ("k"), the capital to wealth ratio ("ω") and the three-month Treasury bill ("R"). Panel E shows the correlation matrix for the levels of the four predictive variables defined for Panel B: "T-bill", "Term", "Def" and "Div". Panel F exhibits the first-order auto-regression coefficients for the six variables of Panel D: aggregate consumption ("c"), credit goods ("c_2"), real output ("y"), real capital ("k"), the capital to wealth ratio ("ω") and the three-month Treasury bill ("R"). It also reports the Phillips-Peron test of stationarity for each variable, and its critical values. Panel G reports the average excess returns (over the 3-month Treasury bill) on the 25 Fama-French portfolios.

Panel A: growth rates

	c	c_2	y	k	ω	ω (level)
mean	0.34%	0.47%	0.36%	0.27%	0.04%	80.33%
std. dev.	0.30%	0.50%	0.38%	0.08%	0.18%	3.90%
median	0.35%	0.43%	0.35%	0.27%	0.05%	81.57%
skewness	-0.733	0.786	-0.155	-0.219	-0.017	-0.471
kurtosis	5.658	4.691	3.987	2.391	2.593	1.757

Panel B: levels

	T-bill	Term	Def	Div
mean	1.35%	1.48%	0.98%	3.29%
std. dev.	0.64%	1.32%	0.43%	1.02%
median	1.26%	1.42%	0.84%	3.12%
skewness	0.944	-0.100	1.262	0.223
kurtosis	4.215	3.552	4.506	2.628

Panel C: returns

	Market	SMB	HML
mean	1.10%	0.54%	1.16%
std. dev.	8.70%	5.68%	5.64%
median	0.026	0.0001	0.0111
skewness	-0.8411	0.0299	0.1629
kurtosis	4.3648	2.6766	4.7121

Panel D: correlation matrix (for growth rates)

	c	c_2	y	k	ω	R
c	1					
c_2	0.51	1				
y	0.40	0.19	1			
k	0.04	0.03	-0.07	1		
ω	-0.04	-0.01	0.21	0.02	1	
R	-0.46	0.49	-0.20	0.05	0.06	1

Panel E: correlation matrix (for levels)

	T-bill	Term	Def	Div
T-bill	1.00			
Term	-0.31	1.00		
Def	0.56	0.21	1.00	
Div	0.71	0.00	0.58	1.00

Panel F: first-order auto-regressions and tests of stationarity

	Coefficient	Philipps-Peron
c	0.17	-11.38
c_2	0.07	-13.51
y	0.25	-10.47
k	0.93	-2.38
ω	0.10	-12.21
R	0.18	-11.30

Critical Values	
1%	-4.01
5%	-3.44
10%	-3.14

Panel G: average excess returns on the 25 Fama-French portfolios

	L(ow)	2	3	4	H(igh)
S(mall)	-0.15%	1.64%	1.98%	2.78%	2.92%
2	0.37%	1.40%	2.14%	2.46%	2.58%
3	0.59%	1.74%	1.70%	2.26%	2.48%
4	0.98%	1.15%	1.87%	2.20%	2.06%
B(ig)	0.91%	1.11%	1.33%	1.38%	0.59%

Table II: Predictive Regressions for the Dividend Yield, the Market Excess Return and the Fama-French Portfolios

This table reports time-series predictive regressions where the dependent variable is either the Dividend yield ("Div") as defined in panel B of Table I, the excess return on the market portfolio ("Market") as defined in panel C of Table I, or the 25 Fama-French portfolios as defined also in panel C of Table I. The explanatory variables are the one-period lagged values of the 3-month Treasury bill rate ("T-bill"), the term spread ("Term"), the default spread ("Def"), the level of real capital ("k-level") and the innovation of the capital to wealth ratio ("ω–innov"). The latter innovation is obtained from the regression of the capital to wealth ratio on real capital, both expressed in levels. The corresponding t-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags. The last columns report the standard adjusted R^2. All data are quarterly (and non annualized) and cover the period 1959:I to 2004:II (181 observations).

		Constant	T-bill	Term	Def	k-level	ω-innov	Adj. R^2
A. **Div**	Coefficient	0.01	1.16	0.16	0.20			0.55
	t Stat. (NW)	4.38	6.35	2.45	0.83			
	Coefficient	0.04	0.55			0.00	0.28	0.72
	t Stat. (NW)	11.49	3.73			-4.49	4.35	
	Coefficient	0.03	0.91	0.25	-0.14	0.00	0.20	0.79
	t Stat. (NW)	8.44	6.56	4.69	-0.48	-6.38	2.19	
B. **Market**	Coefficient	0.00	-3.64	-0.02	5.68			0.05
	t Stat. (NW)	0.25	-2.04	-0.04	2.26			
	Coefficient	0.06	-3.95			0.00	1.18	0.02
	t Stat. (NW)	2.04	-2.17			0.33	1.80	
	Coefficient	0.00	-3.48	0.00	5.90	0.00	-0.11	0.04
	t Stat. (NW)	0.08	-1.65	0.00	2.08	-0.11	-0.16	

C. **Portfolios**

		Constant	T-bill	k-level	ω-innov	t_{Cst}	t_{TB}	t_k	t_ω	Adj. R^2
	L	-1.74	-8.76	-0.08	2.72	-2.35	-3.01	-2.66	2.47	0.03
	2	-1.43	-6.82	-0.05	2.20	-2.34	-2.91	-2.31	2.42	0.02
S	3	-1.46	-6.66	-0.05	2.24	-2.73	-3.43	-2.60	2.81	0.04
	4	-1.23	-6.40	-0.05	1.92	-2.49	-3.46	-2.36	2.60	0.04
	H	-1.30	-6.89	-0.05	2.04	-2.47	-3.34	-2.45	2.58	0.03
	L	-1.32	-6.46	-0.05	2.04	-1.99	-2.46	-2.06	2.06	0.01
	2	-1.26	-5.46	-0.05	1.95	-2.42	-2.62	-2.49	2.50	0.02
2	3	-1.16	-5.44	-0.04	1.80	-2.53	-3.03	-2.51	2.62	0.03
	4	-1.17	-5.00	-0.05	1.82	-2.73	-2.88	-2.68	2.82	0.02
	H	-1.07	-5.04	-0.04	1.68	-2.39	-2.56	-2.58	2.51	0.02
	L	-1.25	-6.03	-0.05	1.94	-2.07	-2.58	-2.06	2.13	0.02
	2	-1.33	-5.88	-0.05	2.06	-2.91	-3.24	-3.03	3.02	0.03
3	3	-1.12	-5.03	-0.04	1.74	-2.60	-2.87	-2.52	2.67	0.03
	4	-0.97	-4.71	-0.04	1.52	-2.36	-2.66	-2.39	2.46	0.02
	H	-1.00	-4.35	-0.04	1.54	-2.40	-2.41	-2.22	2.47	0.02
	L	-0.95	-4.61	-0.03	1.46	-1.81	-2.15	-1.65	1.84	0.01
	2	-1.12	-5.40	-0.04	1.71	-2.42	-2.86	-2.22	2.47	0.03
4	3	-0.96	-4.69	-0.04	1.50	-2.35	-2.74	-2.24	2.42	0.03
	4	-0.83	-4.50	-0.03	1.31	-1.99	-2.44	-2.02	2.09	0.02
	H	-0.92	-3.80	-0.04	1.43	-2.08	-1.95	-2.02	2.13	0.01
	L	-0.49	-3.06	-0.02	0.76	-0.99	-1.54	-0.85	1.02	0.00
	2	-0.78	-3.66	-0.03	1.19	-1.80	-1.99	-1.46	1.80	0.02
B	3	-0.65	-3.79	-0.02	1.03	-1.74	-2.18	-1.67	1.81	0.03
	4	-0.58	-2.56	-0.02	0.89	-1.40	-1.50	-1.23	1.42	0.00
	H	-1.25	-6.03	-0.05	1.94	-2.07	-2.58	-2.06	2.13	0.02

Table III : Cross-Sectional Regressions for Unconditional Models (25 Portfolios)

This table presents cross-sectional regressions using the excess returns (over the three-month T-bill rate) on 25 Fama-French portfolios sorted by size and book-to-market. The full-sample factor loadings, which are the independent variables in the cross-sectional regressions, have been computed in time-series simple regressions (for each of the 25 portfolios) in which the dependent variable is the excess return on a given portfolio. The cross-section regression (Fama-Macbeth) coefficients (1^{st} rows, "Coeff.") are obtained by OLS. The t-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags and appear on 2^{nd} rows ("t(NW)"). t-statistics adjusted for errors-in-variables following Shanken (1992) are shown on 3^{rd} rows ("t(S)"). The last column reports the adjusted R^2 as computed by Jagannathan and Wang (1996). All data are quarterly. The sample period is 1959:II - 2004:II. Panel A reports the cross-sectional results for the standard CAPM and the Fama-French 3-factor model (FF3). Panel B refers to a non-monetary economy and shows results for the Consumption-CAPM, the Production-CAPM, and the Real Capital-CAPM. Panel C exhibits results for a pure exchange monetary economy where the independent variables are various combinations of credit goods ("c_2"), output ("y"), total consumption ("c"), real money holdings ("m") and 3-month T-bill rate ("R"), all expressed in growth rates. Panel D reports results for a production monetary economy where the independent variables are various combinations of real capital ("k"), 3-month T-bill rate ("R"), and capital to wealth ratio ("ω"), all expressed in growth rates. Panel E is the same as Panel D with "Market" substituted for real capital "k".

Panel A: CAPM and FF3

		Constant	Market	SMB	HML	R^2 (JW)
CAPM	Coeff.	0.04	-0.02			0.31
	t (NW)	3.79	-2.62			
	t (S)	5.28	-3.15			
FF3	Coeff.	0.03	-0.02	0.00	0.02	0.81
	t (NW)	2.48	-1.74	1.41	8.85	
	t (S)	2.19	-1.49	1.65	8.31	

Panel B: Non-monetary economy

		Constant	c	y	k	R^2 (JW)
C-CAPM	Coeff.	0.05	0.00			0.49
	t (NW)	4.03	-2.99			
	t (S)	4.56	-3.06			
Y-CAPM	Coeff.	0.02		0.00		0.00
	t (NW)	1.92		-0.10		
	t (S)	2.21		-0.12		
K-CAPM	Coeff.	0.02			0.00	0.04
	t (NW)	4.50			0.79	
	t (S)	4.23			0.80	

Panel C: Pure exchange economy

		Constant	c_2	y	c	m	R	R^2 (JW)
CGm-CAPM	Coeff.	0.04	0.00			-0.01		0.54
	t (NW)	4.65	0.63			-6.66		
	t (S)	5.05	0.68			-3.03		
CGR-CAPM	Coeff.	0.01	0.00				-0.09	0.58
	t (NW)	2.70	2.38				-5.80	
	t (S)	1.46	1.29				-2.82	
Ym-CAPM	Coeff.	0.04		0.00		-0.01		0.53
	t (NW)	3.11		-0.45		-4.48		
	t (S)	3.82		-0.59		-3.29		
YR-CAPM	Coeff.	0.00		0.00			-0.08	0.57
	t (NW)	-0.59		1.33			-5.31	
	t (S)	-0.30		0.62			-2.98	
Cm-CAPM	Coeff.	0.05			0.00	-0.01		0.55
	t (NW)	4.11			-1.57	-5.06		
	t (S)	5.00			-2.02	-2.56		
CR-CAPM	Coeff.	0.03			0.00		-0.04	0.61
	t (NW)	2.29			-1.56		-1.90	
	t (S)	2.91			-1.84		-1.65	

Panel D: Production economy

		Constant	k	R	ω	R^2 (JW)
KR-CAPM	Coeff.	0.01	0.00	-0.07		0.47
	t (NW)	5.00	0.35	-5.46		
	t (S)	2.50	0.28	-2.66		
Kω-CAPM	Coeff.	0.04	0.00		0.00	0.52
	t (NW)	10.96	0.45		7.03	
	t (S)	4.95	0.38		3.15	
Rω-CAPM	Coeff.	0.03		-0.05	0.00	0.76
	t (NW)	7.21		-5.51	5.02	
	t (S)	4.80		-2.81	3.02	
KRω-CAPM	Coeff.	0.03	0.00	-0.05	0.00	0.76
	t (NW)	8.17	0.02	-5.35	4.99	
	t (S)	4.60	0.02	-2.77	3.02	

Panel E: Production economy with Market substituted for Capital

		Constant	Market	R	ω	R^2 (JW)
MR-CAPM	Coeff.	0.02	-0.004	-0.06		0.48
	t (NW)	1.90	-0.55	-2.99		
	t (S)	1.33	-0.35	-1.87		
Mω-CAPM	Coeff.	0.05	-0.03		0.002	0.57
	t (NW)	4.98	-4.25		5.03	
	t (S)	5.55	-3.90		2.83	
MRω-CAPM	Coeff.	0.03	-0.02	-0.06	0.002	0.78
	t (NW)	4.13	-2.91	-5.07	6.42	
	t (S)	2.30	-1.55	-2.46	2.92	

Table IV: GRS Tests for Unconditional Models (25 Portfolios)

This table reports the results of the Gibbons-Ross-Shanken (GRS, 1989) test applied to the time-series regressions performed in the first pass of the Fama-Macbeth procedure having led to the cross-sectional regressions reported in Table III. This test checks the hypothesis that the constants in the time-series regressions are jointly null. The last column gives the probability that the constants are jointly equal to zero.

		GRS	p value
Factor Models	**CAPM**	3.70	0.00%
	FF3	2.99	0.00%
Non-Monetary Economy	**C-CAPM**	2.83	0.00%
	Y-CAPM	2.35	0.08%
	K-CAPM	1.86	1.22%
Pure Exchange Economy	**CGm-CAPM**	1.87	1.17%
	CGR-CAPM	2.84	0.00%
	Ym-CAPM	2.42	0.06%
	YR-CAPM	2.04	0.47%
	Cm-CAPM	2.38	0.07%
	CR-CAPM	3.51	0.00%
Production Economy	**KR-CAPM**	1.70	2.71%
	Kω-CAPM	1.64	**3.79%**
	Rω-CAPM	3.82	0.00%
	KRω-CAPM	1.65	**3.51%**
	MR-CAPM	3.25	0.00%
	Mω-CAPM	3.41	0.00%
	MRω-CAPM	3.07	0.00%

Table V: Pricing Errors from Cross-Sectional Regressions for Unconditional Models (25 Portfolios)

This table reports the pricing errors for the models having led to the cross-sectional regressions reported in Table III. The pricing error is computed as the difference (in percent and absolute terms) between the realized excess return on a portfolio and the excess return as predicted by the model.

		Mean	Std. Dev	Min	Max
Factor Models	**CAPM**	0.55%	0.36%	0.05%	1.34%
	FF3	**0.27%**	0.23%	0.00%	0.96%
Non-Monetary Economy	**C-CAPM**	0.44%	0.34%	0.07%	1.17%
	Y-CAPM	0.66%	0.43%	0.04%	1.72%
	K-CAPM	0.59%	0.49%	0.02%	1.99%
Pure Exchange Economy	**CGm-CAPM**	0.42%	0.34%	0.03%	1.33%
	CGR-CAPM	0.38%	0.33%	0.00%	1.30%
	Ym-CAPM	0.41%	0.34%	0.01%	1.52%
	YR-CAPM	0.41%	0.30%	0.01%	1.03%
	Cm-CAPM	0.41%	0.32%	0.04%	1.14%
	CR-CAPM	0.39%	0.29%	0.05%	1.07%
Production Economy	**KR-CAPM**	0.46%	0.33%	0.02%	1.30%
	Kω-CAPM	0.41%	0.37%	0.05%	1.88%
	Rω-CAPM	**0.29%**	0.25%	0.04%	0.90%
	KRω-CAPM	**0.29%**	0.25%	0.03%	0.90%
	MR-CAPM	0.47%	0.32%	0.05%	1.27%
	Mω-CAPM	0.40%	0.33%	0.02%	1.31%
	MRω-CAPM	**0.28%**	0.25%	0.01%	0.93%

Table VI : Cross-Sectional Regressions for Unconditional Models (42 Portfolios)

This table is similar to Table III and presents cross-sectional regressions using the excess returns (over the three-month T-bill rate) on 42 portfolios, namely the 25 Fama-French portfolios sorted by size and book-to-market plus the 17 industry portfolios compiled also by Fama and French. The full-sample factor loadings, which are the independent variables in the cross-sectional regressions, have been computed in time-series simple regressions (for each of the 42 portfolios) in which the dependent variable is the excess return on a given portfolio. The cross-section regression (Fama-Macbeth) coefficients (1st rows, "Coeff.") are obtained by OLS. t-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags and appear on 2nd rows ("t(NW)"). t-statistics adjusted for errors-in-variables following Shanken (1992) are shown on 3rd rows ("t(S)"). The last column reports the adjusted R^2 as computed by Jagannathan and Wang (1996). All data are quarterly. The sample period is 1959:II - 2004:II. Panel A reports the cross-sectional results for the standard CAPM and the Fama-French 3-factor model (FF3). Panel B refers to a non-monetary economy and shows results for the Consumption-CAPM, the Production-CAPM, and the Real Capital-CAPM. Panel C exhibits results for a pure exchange monetary economy where the independent variables are various combinations of credit goods ("c_2"), output ("y"), total consumption ("c"), real money holdings ("m") and 3-month T-bill rate ("R"), all expressed in growth rates. Panel D reports results for a production monetary economy where the independent variables are various combinations of real capital ("k"), 3-month T-bill rate ("R"), and capital to wealth ratio ("ω"), all expressed in growth rates. Panel E is the same as Panel D with "Market" substituted for real capital "k".

Panel A: CAPM and FF3

		Constant	Market	SBM	HML	R^2 (JW)
CAPM	Coeff.	0.02	-0.01			0.09
	t (NW)	4.60	-2.39			
	t (S)	4.55	-1.97			
FF3	Coeff.	0.02	-0.01	0.00	0.01	0.50
	t (NW)	2.35	-1.26	1.92	4.74	
	t (S)	2.31	-1.26	1.71	5.61	

Panel B: Non-monetary economy

		Constant	c	y	k	R^2 (JW)
C-CAPM	Coeff.	0.03	0.00			0.13
	t (NW)	3.43	-1.78			
	t (S)	4.81	-2.20			
Y-CAPM	Coeff.	0.01		0.00		0.00
	t (NW)	3.12		0.27		
	t (S)	2.78		0.27		
K-CAPM	Coeff.	0.01			0.00	0.00
	t (NW)	7.21			0.45	
	t (S)	7.97			0.42	

Panel C: Pure exchange economy

		Constant	c_2	y	c	m	R	R^2 (JW)
CGm-CAPM	Coeff.	0.03	0.00			-0.01		0.19
	t (NW)	3.82	1.05			-1.92		
	t (S)	4.82	1.21			-2.34		
CGR-CAPM	Coeff.	0.01	0.00				-0.03	0.23
	t (NW)	7.84	0.73				-2.62	
	t (S)	6.56	0.83				-3.03	
Ym-CAPM	Coeff.	0.03		0.00		-0.01		0.19
	t (NW)	3.30		0.12		-2.15		
	t (S)	3.72		0.12		-2.53		
YR-CAPM	Coeff.	0.01		0.00			-0.03	0.27
	t (NW)	1.05		0.90			-2.79	
	t (S)	1.00		0.87			-3.07	
Cm-CAPM	Coeff.	0.03			0.00	0.00		0.18
	t (NW)	3.67			-1.34	-1.64		
	t (S)	4.89			-1.46	-2.11		
CR-CAPM	Coeff.	0.02			0.00		-0.03	0.32
	t (NW)	4.23			-2.12		-2.79	
	t (S)	4.37			-1.93		-2.74	

Panel D: Production economy

		Constant	k	R	ω	R^2 (JW)
KR-CAPM	Coeff.	0.01	0.00	-0.03		0.22
	t (NW)	7.43	-0.31	-2.92		
	t (S)	5.65	-0.29	-2.92		
Kω-CAPM	Coeff.	0.03	0.00		0.00	0.19
	t (NW)	3.74	-0.02		2.19	
	t (S)	4.87	-0.02		2.58	
Rω-CAPM	Coeff.	0.03		-0.03	0.00	0.49
	t (NW)	5.78		-3.03	3.81	
	t (S)	5.47		-3.24	3.21	
KRω-CAPM	Coeff.	0.03	0.00	-0.03	0.00	0.52
	t (NW)	6.73	-1.37	-3.10	4.49	
	t (S)	5.14	-0.97	-3.27	3.19	

Panel E: Production economy with Market substituted for Capital

		Constant	Market	R	ω	R^2 (JW)
MR-CAPM	Coeff.	0.02	0.00	-0.02		0.24
	t (NW)	4.54	-1.39	-3.05		
	t (S)	3.06	-0.85	-2.57		
Mω-CAPM	Coeff.	0.03	-0.02		0.00	0.21
	t (NW)	3.93	-2.47		1.71	
	t (S)	4.70	-2.71		2.19	
MRω-CAPM	Coeff.	0.03	-0.02	-0.04	0.00	0.52
	t (NW)	5.27	-3.29	-3.74	4.64	
	t (S)	3.76	-2.28	-3.18	3.12	

Table VII: Pricing Errors from Cross-Sectional Regressions for Unconditional Models (42 Portfolios)

This table reports the pricing errors for the models having led to the cross-sectional regressions reported in Table VI. The pricing error is computed as the difference (in percent and absolute terms) between the realized excess return on a portfolio and the excess return as predicted by the model.

		Mean	**Std. Dev**	**Min**	**Max**
Factor Models	**CAPM**	0.55%	0.38%	0.02%	1.57%
	FF3	**0.39%**	0.30%	0.01%	1.46%
Non-Monetary Economy	**C-CAPM**	0.54%	0.37%	0.03%	1.61%
	Y-CAPM	0.56%	0.43%	0.01%	1.66%
	K-CAPM	0.56%	0.43%	0.03%	1.61%
Pure Exchange Economy	**CGm-CAPM**	0.50%	0.38%	0.05%	2.01%
	CGR-CAPM	0.49%	0.36%	0.01%	1.33%
	Ym-CAPM	0.50%	0.38%	0.01%	1.95%
	YR-CAPM	0.48%	0.35%	0.01%	1.36%
	Cm-CAPM	0.51%	0.38%	0.01%	1.95%
	CR-CAPM	0.47%	0.33%	0.01%	1.43%
Production Economy	**KR-CAPM**	0.51%	0.36%	0.00%	1.46%
	Kω-CAPM	0.49%	0.39%	0.04%	2.02%
	Rω-CAPM	**0.38%**	0.32%	0.01%	1.46%
	KRω-CAPM	**0.36%**	0.32%	0.01%	1.55%
	MR-CAPM	0.50%	0.35%	0.05%	1.52%
	Mω-CAPM	0.50%	0.38%	0.04%	1.95%
	MRω-CAPM	**0.37%**	0.31%	0.00%	1.29%

Table VIII: Loadings on the Capital (or Market), T-bill Rate, and Omega Factors from Time-Series Regressions

The left part (*A*) of this table reports the loadings on the capital (β_k), the 3-month T-bill rate (β_R) and the capital to wealth ratio (β_ω) factors, all expressed in growth rates, computed in time-series regressions for 25 Fama-French portfolios sorted by size (from Small (S) to Big (B)) and book-to-market (from Low (L) to High (H)) for the period 1959:II to 2004:II. These loadings led to the last cross-sectional model reported in Panel D of Table III ("KRω-CAPM"). The last rows report the standard adjusted R^2. The right part (*B*) is the same as part (*A*) except that real capital ("k") has been replaced by the excess return on the market portfolio ("Market") expressed in level, so that β_{Mkt} is substituted for β_k. These loadings led to the last cross-sectional model reported in Panel E of Table III ("MRω-CAPM").

(A)

	L	2	3	4	H
			α		
S	0.01	0.04	0.04	0.05	0.05
2	0.02	0.02	0.03	0.03	0.03
3	0.02	0.03	0.03	0.03	0.04
4	0.03	0.04	0.04	0.03	0.03
B	0.03	0.04	0.04	0.03	0.02
			β_k		
S	-0.55	-6.55	-5.18	-7.04	-6.66
2	-4.10	-0.03	-2.20	-1.77	-0.44
3	-4.53	-2.12	-3.31	-0.56	-3.25
4	-5.59	-9.44	-4.72	-2.01	-0.25
B	-6.18	-8.94	-8.33	-3.73	-4.53
			β_R		
S	0.17	0.10	-0.05	-0.05	-0.06
2	0.06	-0.03	-0.09	-0.12	-0.08
3	0.02	-0.04	-0.09	-0.13	-0.10
4	-0.03	-0.10	-0.12	-0.15	-0.17
B	0.03	-0.04	0.00	-0.07	0.02
			β_ω		
S	-13.05	-13.55	-9.37	-8.47	-8.19
2	-15.99	-13.51	-13.90	-10.60	-8.10
3	-17.51	-15.03	-13.94	-12.48	-9.64
4	-17.12	-14.75	-12.82	-11.99	-11.81
B	-15.12	-13.08	-10.65	-10.15	-17.51
			Adj. R^2		
S	0.00	0.02	0.00	0.00	0.00
2	0.02	0.02	0.04	0.02	0.00
3	0.04	0.05	0.05	0.04	0.01
4	0.05	0.06	0.05	0.05	0.04
B	0.07	0.07	0.06	0.05	0.04

(B)

	L	2	3	4	H
			α		
S	-0.02	0.00	0.00	0.01	0.01
2	-0.02	0.00	0.01	0.01	0.01
3	-0.01	0.00	0.01	0.01	0.01
4	0.00	0.00	0.01	0.01	0.01
B	0.00	0.00	0.00	0.01	-0.01
			β_{Mkt}		
S	1.66	1.37	1.19	1.12	1.18
2	1.57	1.27	1.11	1.05	1.11
3	1.43	1.13	1.01	0.96	1.01
4	1.30	1.08	0.96	0.93	1.00
B	1.03	0.90	0.77	0.75	1.43
			β_R		
S	0.17	0.11	-0.05	-0.05	-0.05
2	0.07	-0.03	-0.08	-0.12	-0.08
3	0.03	-0.03	-0.08	-0.13	-0.10
4	-0.02	-0.09	-0.12	-0.15	-0.16
B	0.03	-0.04	0.00	-0.07	0.03
			β_ω		
S	10.10	5.49	7.09	6.98	8.14
2	5.85	4.21	1.51	3.96	7.46
3	2.34	0.73	0.06	0.85	4.36
4	0.93	0.05	0.50	0.97	2.16
B	-0.87	-0.66	-0.14	0.21	2.34
			Adj. R^2		
S	0.72	0.72	0.69	0.68	0.64
2	0.81	0.79	0.78	0.74	0.70
3	0.84	0.84	0.79	0.75	0.66
4	0.88	0.85	0.83	0.79	0.71
B	0.90	0.88	0.77	0.74	0.84

Table IX: Cross-Sectional Regressions for Conditional Models (25 Portfolios)

This table presents cross-sectional regressions using the excess returns (over the three-month T-bill rate) on 25 Fama-French portfolios sorted by size and book-to-market. The full-sample factor loadings, which are the independent variables in the cross-sectional regressions, have been computed in time-series simple regressions (for each of the 25 portfolios) in which the dependent variable is the excess return on a given portfolio. In these time-series regressions, betas which are time-varying depend linearly on the following four predictive variables defined for Panel B of Table I: the short term interest rate "T-bill", the term spread "Term", the default spread "Def", and the dividend yield "Div". The cross-section regression (Fama-Macbeth) coefficients are obtained by OLS and then multiplied by 100 (column "Coeff."). t-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags and appear on column "t(NW)". t-statistics adjusted for errors-in-variables following Shanken (1992) are shown on column "t(S)". The last row reports the adjusted R^2 as computed by Jagannathan and Wang (1996). All data are quarterly. The sample period is 1959:II - 2004:II. Panel A reports the cross-sectional results for the standard conditional CAPM (model #1) and the conditional Fama-French 3-factor model (models #2 and #3). In models #1 and #2, only the loading on the Market is time-varying and thus depends on the four predictors. In model #3, all three loadings (on the Market, the SMB and the HML portfolios) are time-varying. Panel B reports results for a production monetary economy where the independent variables are various combinations of real capital ("k"), 3-month T-bill rate ("R"), and capital to wealth ratio ("ω"), all expressed in growth rates. For the four models reported (models #4 to #7), all betas are time-varying and depend on the four predictors. Panel C is similar to Panel B with "Market" substituted for real capital "k". In the three models reported (models #8 to #10), all betas are time-varying and thus depend on the four predictors.

Panel A: CAPM and FF3

	Coeff. (#1)	t (NW) (#1)	t (S) (#1)	Coeff. (#2)	t (NW) (#2)	t (S) (#2)	Coeff. (#3)	t (NW) (#3)	t (S) (#3)
Constant	0.64	1.19	0.58	5.42	9.49	2.80	3.47	2.58	1.16
Market	0.61	1.27	0.65	-4.27	-7.36	-2.23	-2.20	-1.50	-0.72
Mkt*Tbill	0.00	0.23	0.12	-0.10	-6.79	-2.45	-0.06	-1.95	-0.86
Mkt*Term	-0.02	-0.49	-0.38	-0.08	-2.32	-1.75	-0.04	-1.06	-0.62
Mkt*Def	0.02	1.48	0.86	-0.08	-5.90	-2.44	-0.06	-2.94	-1.08
Mkt*Div	0.07	2.36	1.28	-0.16	-6.46	-2.01	-0.10	-1.47	-0.68
SBM				0.23	2.91	1.29	0.23	1.69	0.79
SBM*Tbill							-0.02	-3.03	-1.79
SBM*Term							0.04	1.15	0.67
SBM*Def							-0.01	-0.94	-0.39
SBM*Div							-0.04	-4.42	-1.97
							0.00	0.00	0.00
HML				1.67	8.21	6.46	1.68	5.05	3.63
HML*Tbill							0.04	6.85	3.83
HML*Term							0.04	1.32	0.97
HML*Def							0.03	5.09	2.43
HML*Div							0.07	5.36	2.81
R^2 (JW)	0.79			0.92			0.96		

Panel B: Production economy

	(#4)			(#5)			(#6)			(#7)		
	Coeff.	**t (NW)**	**t (S)**	**Coeff.**	**t (NW)**	**t (S)**	**Coeff.**	**t (NW)**	**t (S)**	**Coeff.**	**t (NW)**	**t (S)**
Constant	1.40	4.01	1.19	2.55	6.35	2.18	2.65	8.74	2.36	1.79	7.11	1.90
k	0.03	0.70	0.41	0.03	0.92	0.50				-0.02	-1.06	-0.37
k*Tbill	0.00	-0.94	-0.55	0.00	0.36	0.19				0.00	-3.15	-0.92
k*Term	0.00	8.15	1.19	0.00	0.88	0.41				0.00	-0.62	-0.20
k*Def	0.00	0.04	0.03	0.00	0.78	0.42				0.00	-1.83	-0.57
k*Div	0.00	-0.69	-0.36	0.00	-0.43	-0.21				0.00	-3.80	-1.29
R	-1.44	-0.84	-0.27				-4.11	-2.88	-0.73	0.44	0.27	0.10
R*Tbill	-0.02	-1.71	-0.38				-0.07	-4.12	-1.16	-0.04	-4.87	-1.14
R*Term	0.00	-0.05	-0.02				-0.04	-1.03	-0.29	0.11	1.80	0.75
R*Def	0.00	-0.35	-0.10				-0.05	-3.17	-0.81	-0.01	-0.76	-0.21
R*Div	-0.02	-0.58	-0.17				-0.17	-3.80	-0.99	-0.06	-1.99	-0.55
ω				0.06	1.90	0.89	0.16	4.33	1.47	0.14	3.40	1.60
ω*Tbill				0.00	1.42	0.50	0.00	3.86	1.40	0.00	3.77	1.33
ω*Term				0.00	1.78	0.72	0.00	1.09	0.28	0.00	3.22	1.25
ω*Def				0.00	2.81	1.53	0.00	5.06	1.45	0.00	4.71	1.77
ω*Div				0.00	1.59	0.73	0.01	4.12	1.41	0.00	3.41	1.48
R^2 (JW)	0.90			0.89			0.87			0.97		

Panel C: Production economy with Market substituted for Capital

	(#8)			(#9)			(#10)		
	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)
Constant	2.42	2.07	1.28	2.99	4.08	1.84	2.68	3.80	1.15
Market	-1.28	-1.23	-0.69	-1.92	-2.81	-1.22	-1.68	-2.61	-0.72
Mkt*Tbill	-0.05	-2.00	-1.02	-0.05	-3.52	-1.42	-0.06	-2.75	-1.31
Mkt*Term	-0.10	-1.56	-1.15	-0.08	-1.67	-1.23	-0.06	-1.39	-0.61
Mkt*Def	-0.03	-1.07	-0.66	-0.04	-1.95	-1.05	-0.05	-2.43	-0.83
Mkt*Div	-0.04	-0.81	-0.41	-0.07	-2.51	-0.87	-0.08	-1.81	-0.69
R	-3.45	-1.53	-0.72				-5.63	-2.80	-0.92
R*Tbill	-0.03	-1.92	-0.59				-0.06	-3.18	-0.83
R*Term	-0.01	-0.17	-0.09				-0.11	-1.55	-0.58
R*Def	-0.02	-1.26	-0.47				-0.06	-2.67	-0.82
R*Div	-0.07	-1.24	-0.49				-0.18	-3.06	-0.88
ω				0.09	1.78	1.17	0.13	1.93	0.55
ω*Tbill				0.00	1.37	1.08	0.00	2.27	0.63
ω*Term				0.00	0.36	0.19	0.00	-0.01	0.00
ω*Def				0.00	1.54	1.14	0.00	2.00	0.60
ω*Div				0.00	1.51	1.06	0.00	2.04	0.56
R^2 (JW)	0.86			0.89			0.91		

Table X: GRS Tests for Conditional Models (25 Portfolios)

This table reports the results of the Gibbons-Ross-Shanken (GRS, 1989) test applied to the time-series regressions performed in the first pass of the Fama-Macbeth procedure having led to the cross-sectional regressions reported in Table IX. This test checks the hypothesis that the constants in the time-series regressions are jointly null. The last column gives the probability that the constants are jointly equal to zero.

		GRS	p value
Factor Models	**#1**	1.54	6.03%
	#2	2.94	0.00%
	#3	3.26	0.00%
Production Economy (with Capital)	**#4**	1.33	14.97%
	#5	1.35	13.67%
	#6	3.58	0.00%
	#7	**1.25**	**20.57%**
Production Economy (with Market)	**#8**	2.90	0.00%
	#9	3.09	0.00%
	#10	2.43	0.06%

Table XI : Cross-Sectional Regressions for Conditional Models (42 Portfolios)

This table is similar to Table VII and presents cross-sectional regressions using the excess returns (over the three-month T-bill rate) on 42 portfolios, namely the 25 Fama-French portfolios sorted by size and book-to-market plus the 17 industry portfolios compiled also by Fama and French. The full-sample factor loadings, which are the independent variables in the cross-sectional regressions, have been computed in time-series simple regressions (for each of the 42 portfolios) in which the dependent variable is the excess return on a given portfolio. In these time-series regressions, betas which are time-varying depend linearly on the following four predictive variables defined for Panel B of Table I: the short term interest rate " T-bill ", the term spread "Term", the default spread "Def", and the dividend yield "Div". The cross-section regression (Fama-Macbeth) coefficients are obtained by OLS and then multiplied by 100 (column "Coeff."). t-statistics are corrected for autocorrelation and heteroskedasticity using the Newey-West estimator with four lags and appear on column "t(NW)". t-statistics adjusted for errors-in-variables following Shanken (1992) are shown on column "t(S)". The last row reports the adjusted R^2 as computed by Jagannathan and Wang (1996). All data are quarterly. The sample period is 1959:II - 2004:II. Panel A reports the cross-sectional results for the standard conditional CAPM (model #1) and the conditional Fama-French 3-factor model (models #2 and #3). In models #1 and #2, only the loading on the Market is time-varying and thus depends on the four predictors. In model #3, all three loadings (on the Market, the SMB and the HML portfolios) are time-varying. Panel B reports results for a production monetary economy where the independent variables are various combinations of real capital ("k"), 3-month T-bill rate ("R"), and capital to wealth ratio ("ω"), all expressed in growth rates. For the four models reported (models #4 to #7), all betas are time-varying and depend on the four predictors. Panel C is similar to Panel B with "Market" substituted for real capital "k". In the three models reported (models #8 to #10), all betas are time-varying and thus depend on the four predictors..

Panel A: CAPM and FF3

	(#1)			(#2)			(#3)		
	Coeff.	**t (NW)**	**t (S)**	**Coeff.**	**t (NW)**	**t (S)**	**Coeff.**	**t (NW)**	**t (S)**
Constant	0.84	1.22	1.03	2.52	2.42	2.44	3.76	4.14	2.37
Market	0.28	0.46	0.40	-1.55	-1.50	-1.52	-2.44	-2.70	-1.56
Mkt*Tbill	0.00	0.04	0.04	-0.03	-1.96	-1.47	-0.05	-2.44	-1.30
Mkt*Term	-0.01	-0.23	-0.15	-0.05	-1.99	-1.55	-0.02	-0.99	-0.40
Mkt*Def	0.01	1.10	0.89	-0.03	-2.11	-1.68	-0.06	-3.28	-1.75
Mkt*Div	0.04	1.22	1.16	-0.06	-1.36	-1.26	-0.09	-1.96	-1.19
SBM				0.41	2.70	2.20	0.12	0.95	0.41
SBM*Tbill							-0.02	-3.22	-1.25
SBM*Term							0.04	3.57	1.17
SBM*Def							-0.01	-3.63	-1.14
SBM*Div							-0.02	-1.35	-0.70
HML				1.40	5.35	5.92	1.69	6.31	3.50
HML*Tbill							0.05	6.75	3.41
HML*Term							0.02	0.81	0.38
HML*Def							0.03	4.93	2.35
HML*Div							0.09	5.71	3.17
R^2 (JW)	0.36			0.61			0.76		

Panel B: Production economy

	(#4)			(#5)			(#6)			(#7)		
	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)
Constant	1.33	3.90	1.38	2.11	3.07	2.03	1.73	3.00	2.10	1.45	2.35	1.50
k	-0.06	-3.07	-1.33	-0.05	-2.19	-1.21				-0.06	-3.22	-1.58
k*Tbill	0.00	-2.37	-1.11	0.00	0.04	0.02				0.00	-2.48	-1.23
k*Term	0.00	0.30	0.11	0.00	-1.99	-0.62				0.00	-0.47	-0.22
k*Def	0.00	-3.04	-1.22	0.00	0.14	0.05				0.00	-2.25	-1.09
k*Div	0.00	-3.00	-1.59	0.00	-2.12	-0.90				0.00	-3.17	-1.65
R	-1.70	-1.77	-0.98				-2.78	-2.20	-1.94	-2.65	-2.29	-1.57
R*Tbill	-0.04	-3.20	-1.19				-0.07	-6.57	-2.67	-0.06	-5.07	-2.05
R*Term	0.07	1.96	1.02				0.04	1.00	0.67	0.06	1.60	0.89
R*Def	-0.03	-3.27	-1.21				-0.04	-4.75	-2.41	-0.04	-3.84	-1.93
R*Div	-0.05	-1.91	-0.78				-0.13	-4.06	-2.47	-0.11	-3.26	-1.70
ω				0.10	3.71	1.57	0.12	2.70	2.12	0.10	3.45	1.60
ω*Tbill				0.00	2.49	1.02	0.00	1.97	1.49	0.00	1.36	0.81
ω*Term				0.00	2.63	0.92	0.00	1.63	0.98	0.00	2.79	1.18
ω*Def				0.00	4.79	1.96	0.00	1.90	1.65	0.00	1.99	1.19
ω*Div				0.00	3.78	1.39	0.00	2.02	1.67	0.00	2.47	1.23
R^2 (JW)	0.63			0.61			0.63			0.76		

Panel C: Production economy with Market substituted for Capital

	(#8)			(#9)			(#10)		
	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)	Coeff.	t (NW)	t (S)
Constant	2.31	1.78	1.81	2.72	2.54	1.89	2.36	2.91	1.46
Market	-1.36	-1.07	-1.11	-1.77	-1.66	-1.29	-1.52	-1.90	-0.96
Mkt*Tbill	-0.05	-2.71	-1.43	-0.03	-1.33	-0.88	-0.03	-1.91	-0.79
Mkt*Term	-0.05	-1.14	-0.83	-0.05	-1.94	-1.11	-0.04	-2.02	-0.84
Mkt*Def	-0.03	-2.24	-1.07	-0.03	-1.45	-0.94	-0.03	-2.70	-1.03
Mkt*Div	-0.07	-1.29	-0.99	-0.05	-0.92	-0.69	-0.06	-1.83	-0.81
R	-2.05	-1.59	-1.23				-2.88	-2.13	-1.66
R*Tbill	-0.03	-2.09	-1.27				-0.06	-6.44	-2.12
R*Term	0.04	1.12	0.66				0.03	0.87	0.50
R*Def	-0.03	-2.20	-1.23				-0.04	-4.04	-1.87
R*Div	-0.05	-1.51	-0.95				-0.11	-3.54	-1.75
ω				0.12	2.53	1.82	0.14	2.95	1.77
ω*Tbill				0.00	2.50	1.38	0.00	2.77	1.38
ω*Term				0.00	0.90	0.52	0.00	1.84	0.88
ω*Def				0.00	2.95	1.64	0.00	2.45	1.42
ω*Div				0.00	2.48	1.59	0.00	2.58	1.49
R^2 (JW)	0.54			0.54			0.69		

Table XII: Loadings on the Capital (or Market), T-bill Rate, and Omega Factors from Time-Series Conditional Regressions

The left part (*A*) of this table reports the (average) loadings on the capital (β_k), the 3-month T-bill rate (β_R) and the capital to wealth ratio (β_ω) factors, all expressed in growth rates, computed in time-series regressions for 25 Fama-French portfolios sorted by size (from Small (S) to Big (B)) and book-to-market (from Low (L) to High (H)) for the period 1959:II to 2004:II. Since each beta is an affine function of the four predictive variable ("T-bill", "Term", "Def", and "Div"), we have computed the "aggregate" beta for each date t as $\hat{\beta}_{j,Y,0}+\sum_{k=1}^{4}\hat{\beta}_{j,Y,k}X_{k,t}$, where j is a portfolio, Y is either the real capital, the T-bill rate or the capital to wealth ratio, and X_k is one of the four predictors, and then have computed its average over time (181 observations). This table reports these averages. The loadings led to the last cross-sectional model reported in Panel B of Table IX (model #7). The last rows report the standard adjusted R^2.
The right part (*B*) is similar to part (*A*) except that real capital ("k") has been replaced by the excess return on the market portfolio ("Market") expressed in level, so that β_{Mkt} is substituted for β_k. The loadings led to the last cross-sectional model reported in Panel C of Table IX (model #10).

(A)	L	2	3	4	H	(B)	L	2	3	4	H
			β_k						β_{Mkt}		
S	-4.94	-6.41	-5.40	-5.14	-4.45	S	1.66	1.40	1.20	1.14	1.20
2	-10.82	-2.37	-3.24	-4.24	-0.31	2	1.59	1.29	1.14	1.06	1.14
3	-10.43	-5.71	-5.00	-1.92	-4.07	3	1.43	1.14	1.03	0.96	1.04
4	-11.05	-11.91	-7.23	-3.09	-1.55	4	1.29	1.09	0.99	0.94	1.04
B	-8.81	-13.24	-10.47	-5.66	-10.43	B	1.02	0.93	0.77	0.75	1.43
			β_R						β_R		
S	0.43	0.33	0.16	0.12	0.13	S	0.24	0.18	0.04	0.03	0.05
2	0.26	0.15	0.05	0.02	0.04	2	0.10	0.05	-0.03	-0.04	-0.02
3	0.19	0.11	0.05	0.00	0.01	3	0.04	0.02	-0.01	-0.05	-0.04
4	0.10	0.02	0.03	-0.06	-0.05	4	-0.05	-0.08	-0.05	-0.12	-0.11
B	0.12	0.05	0.05	0.03	0.19	B	0.03	-0.05	-0.03	-0.04	0.04
			β_ω						β_ω		
S	-15.55	-14.11	-8.18	-7.35	-6.62	S	5.04	3.41	6.32	5.62	6.91
2	-18.67	-13.51	-13.88	-9.17	-7.73	2	1.08	2.56	0.12	3.56	6.52
3	-18.35	-13.29	-12.75	-10.41	-9.39	3	-0.88	0.21	0.08	1.30	4.05
4	-18.67	-13.22	-10.97	-10.11	-9.82	4	-1.80	0.59	1.39	1.85	4.08
B	-14.54	-12.28	-8.96	-7.53	-18.35	B	-0.60	-0.25	1.19	2.18	-0.88
			Adj. R^2						Adj. R^2		
S	0.07	0.06	0.07	0.06	0.05	S	0.74	0.73	0.71	0.69	0.66
2	0.09	0.07	0.08	0.06	0.02	2	0.83	0.80	0.79	0.75	0.72
3	0.10	0.12	0.08	0.08	0.02	3	0.85	0.85	0.80	0.76	0.68
4	0.11	0.12	0.10	0.08	0.03	4	0.89	0.86	0.84	0.80	0.73
B	0.12	0.11	0.12	0.07	0.10	B	0.90	0.88	0.78	0.74	0.85

Figure 1: Macro Factors

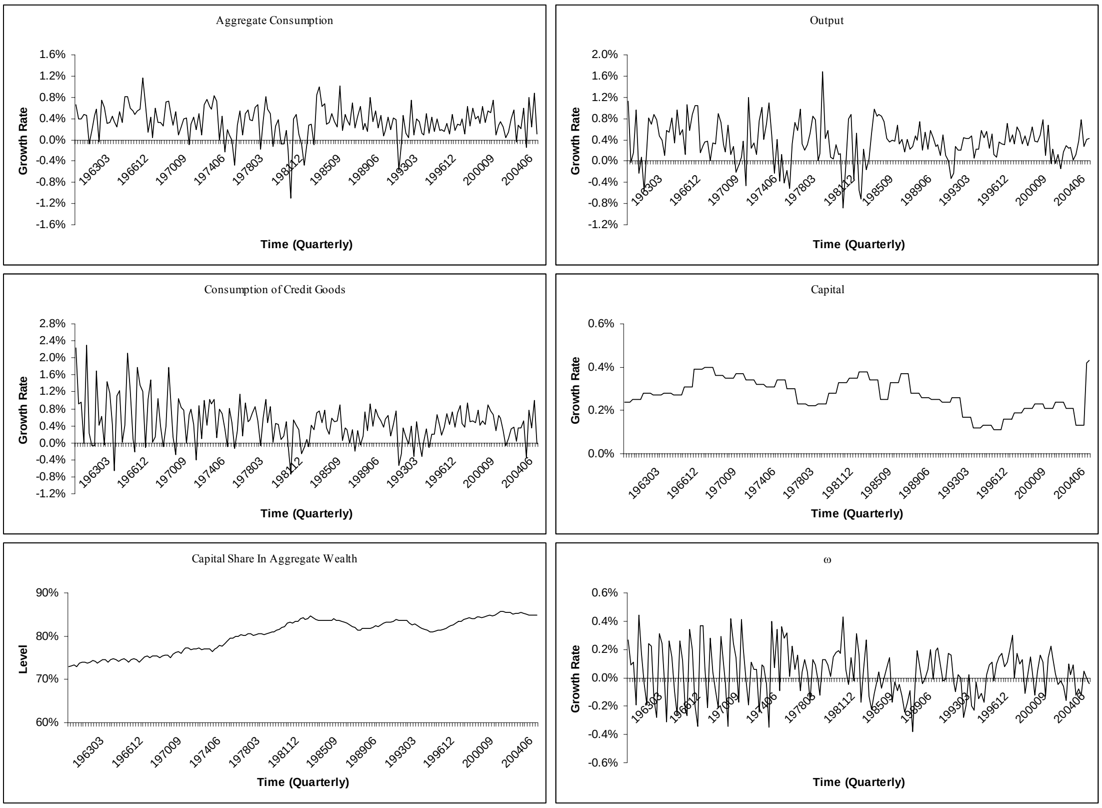
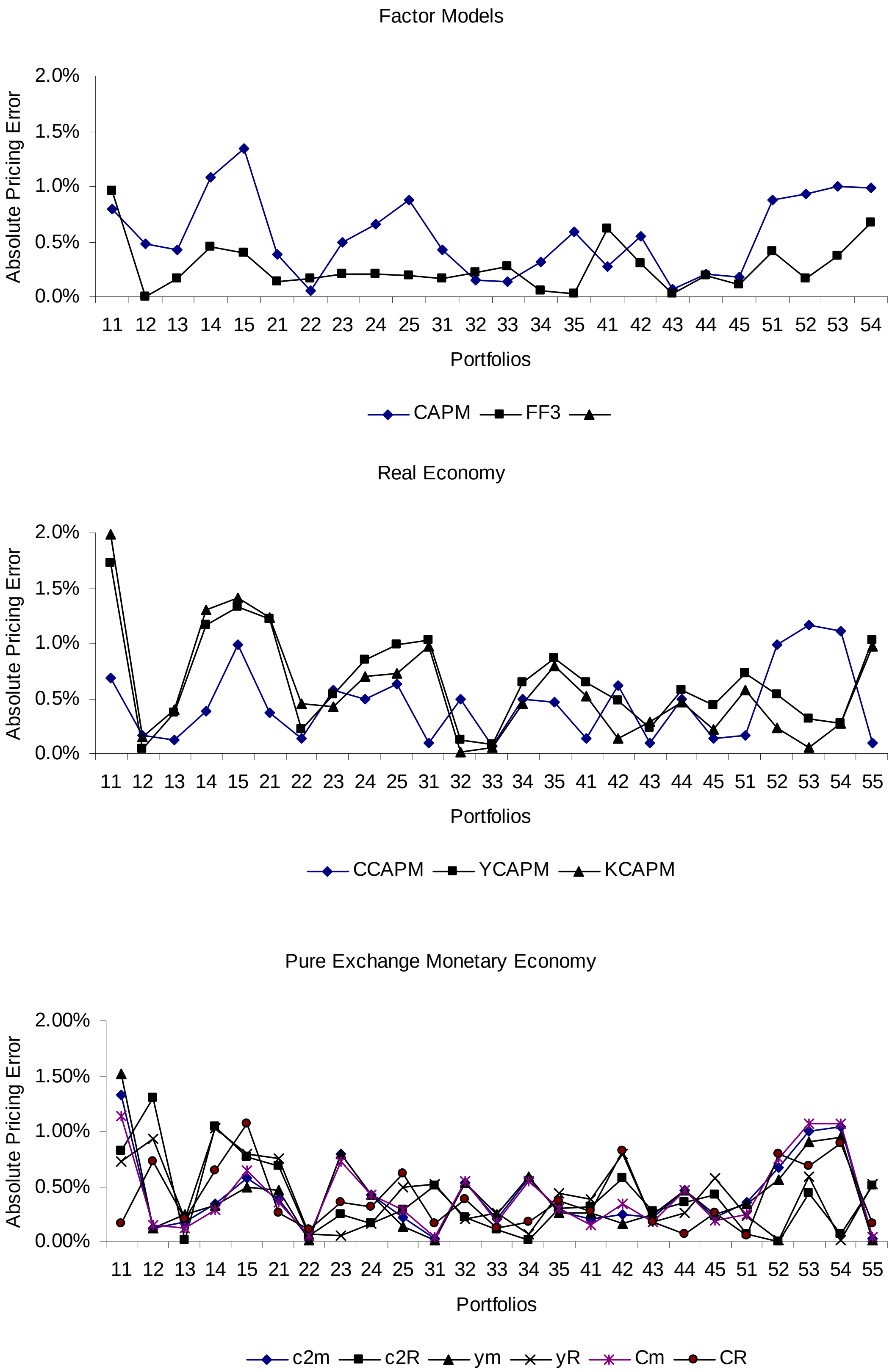
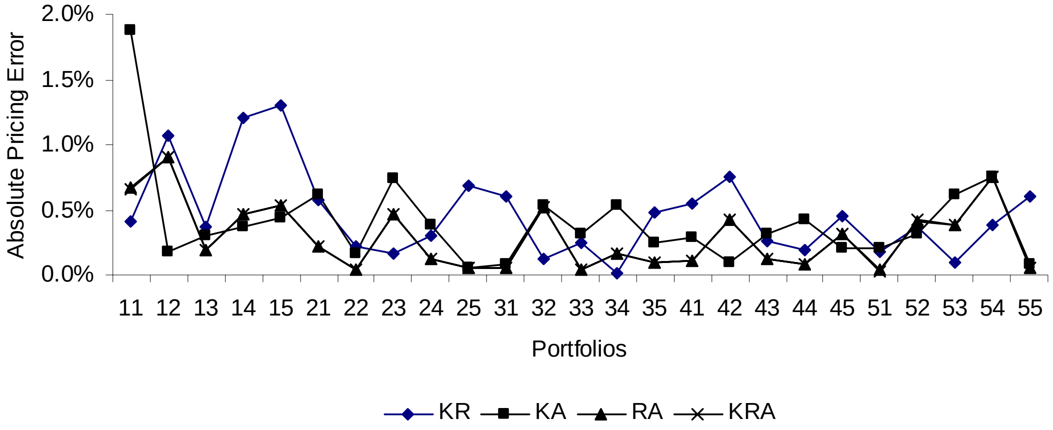


Figure 2: Pricing Errors for Unconditional Models



Production Monetary Economy



Production Monetary Economy

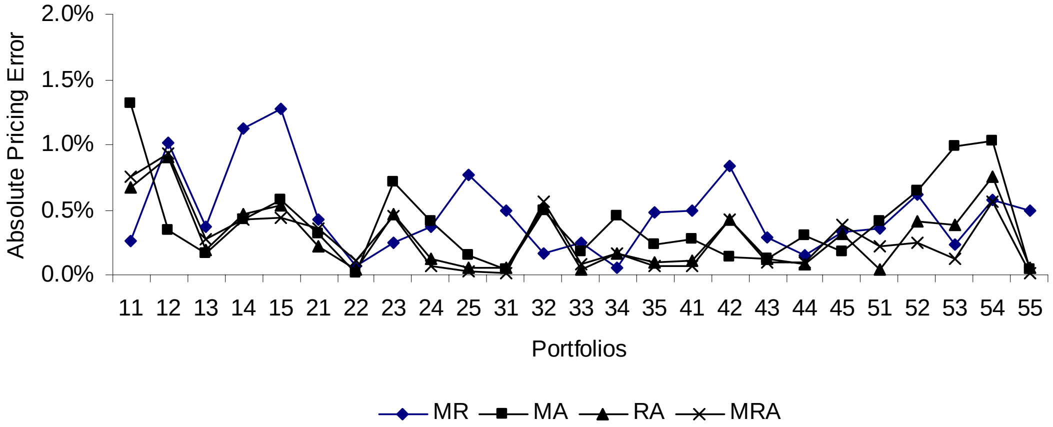
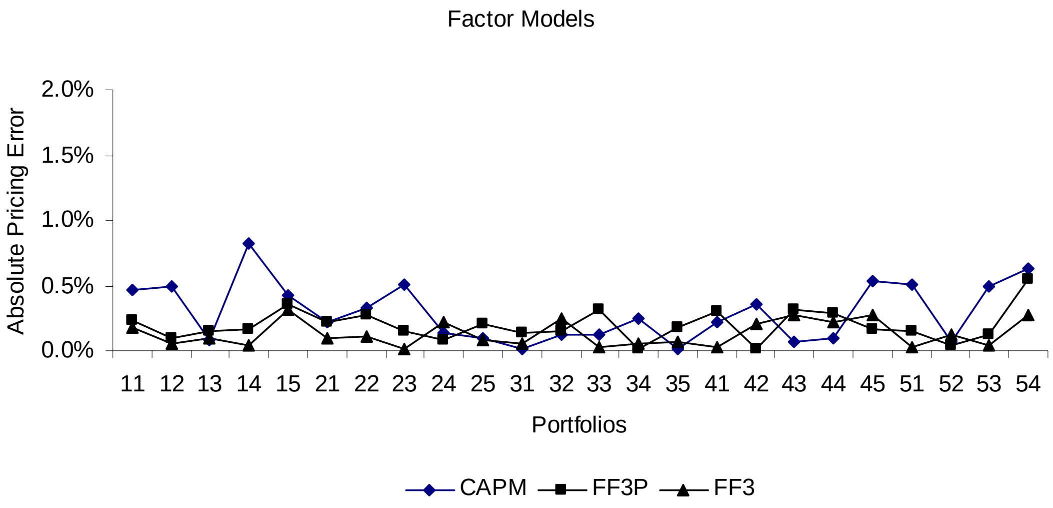
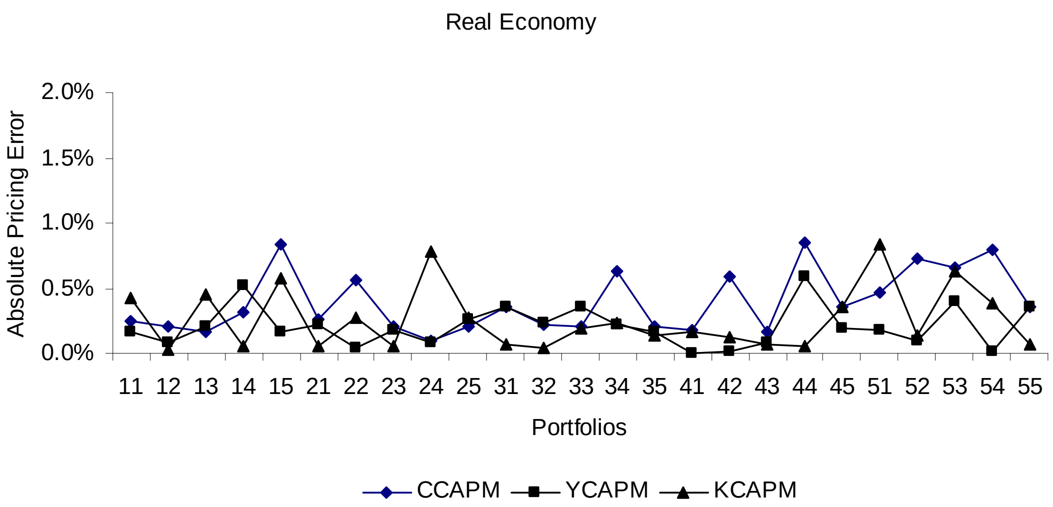
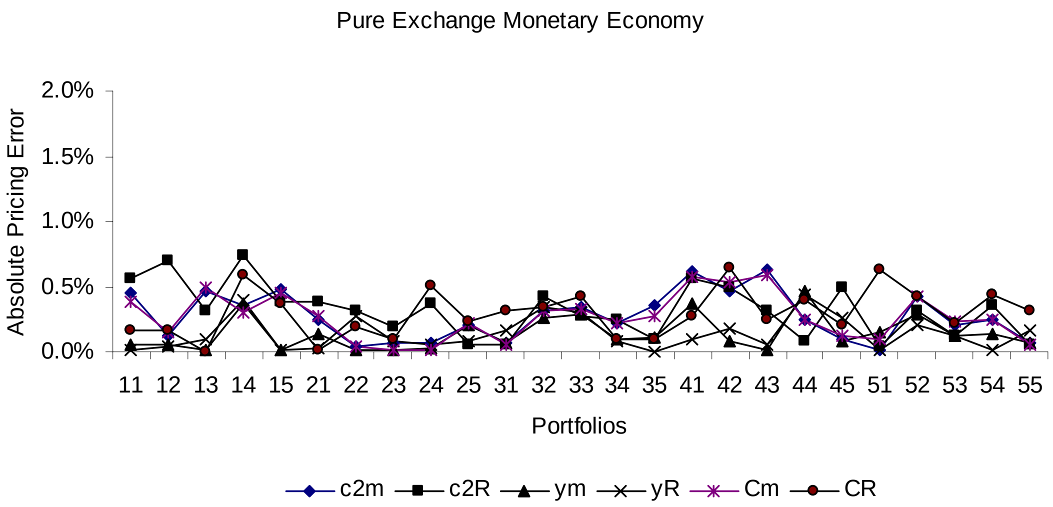


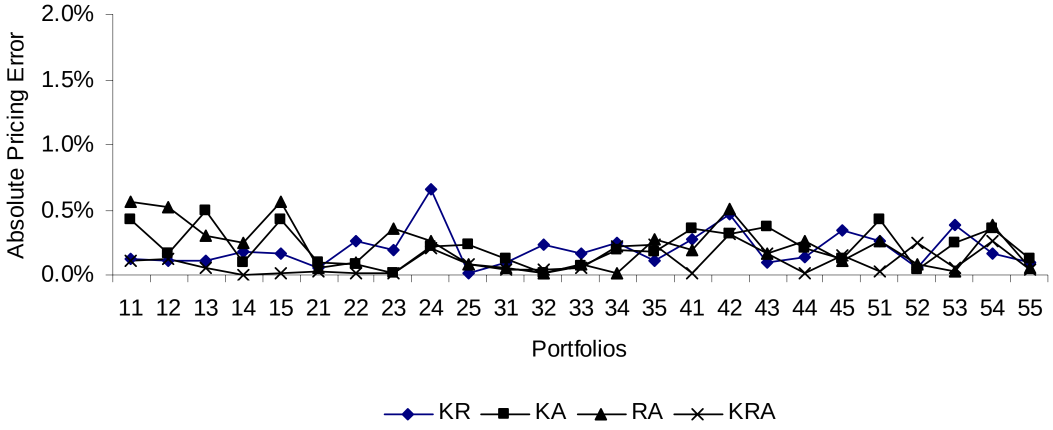
Figure 3: Pricing Errors for Conditional Models







Production Monetary Economy



Production Monetary Economy