Sector Investments Growth Rates and the Cross-Section of Equity Returns

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Abstract

We examine the importance of the information contained in sector investment growth rates for explaining the cross-section of equity returns. We propose an empirical specification that outperforms the CAPM, and Cochrane's (1996) model, and performs at least as well as the Fama-French (FF) (1993), Lettau and Ludvingson (2001), models in explaining the 25 FF size-and book-to-market-sorted portfolios, as well as other sets of test assets.

JEL Classification: G12

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1. Introduction

Portfolio-based models have dominated the field of asset pricing in the 20th century. The Capital Asset Pricing Model (CAPM) of Sharpe (1964) and Lintner (1965) has been the model on which most of finance theory and practice was built. Unfortunately, tests of the CAPM by Fama and French (1992) revealed that the model cannot explain the cross-section of asset returns. Fama and French (1992, 1993) proposed an alternative empirical model whose factors are also portfolio returns. This model includes in addition to the market portfolio, a factor related to the book-to-market (B/M) of stocks (HML) and a factor related to size (SMB). Fama and French (1992, 1993, 1996) and Davis, Fama and French (2000) show that the model performs well in explaining a cross-section of B/M and size portfolios. The Fama-French (FF) model has by now largely replaced the CAPM in all finance applications that require the use of an asset pricing model.

Nevertheless, there are two outstanding issues with the FF model. First, the model is empirically motivated, and it is not a priori clear whether HML and SMB are related to fundamental economic risk.[1] Second, as Cochrane (1996, and 2001) argues, asset pricing models that use portfolio returns as factors may be successful in describing asset returns, but they will never be able to explain them. The reason is that these models leave unanswered the question of what explains the return-based factors.

Ideally, one would want to explain asset returns using macroeconomic factors. A central paradigm in this literature is the Consumption CAPM (CCAPM) of Breeden

[1] Liew and Vassalou (2000) provide evidence that HML and SMB can help predict future economic growth and their ability to do so is largely independent of that of the market factor. In addition, Vassalou (2003) shows that much of the ability of HML and SMB to explain asset returns is due to news related to future Gross Domestic Product (GDP) growth. These studies provide a risk-based explanation for the ability of the FF model to explain the cross-section of equity returns.

(1979). The empirical success of the CCAPM has been however limited, with the exception of a conditional version of the model developed by Lettau and Ludvigson (LL) (2001), which can explain equity returns reasonably well.[2]

Cochrane (1991, and 1996) propose an investment-based CAPM, where the factors are investment returns, or investment growth rates. Cochrane (1996) shows that his model performs significantly better than the CCAPM and about as well as the CAPM and the Chen, Roll, and Ross (1986) model in explaining size-sorted portfolio returns.

In this paper, we extend Cochrane's (1991, 1996) work. Instead of focusing on residential and non-residential investment growth, as Cochrane (1996) does, we propose a three-factor sector investment growth model. Our results show that the proposed three-factor specification can explain well the 25 book-to-market- and size-sorted FF portfolios, as well as other sets of test assets. It consistently outperforms the CAPM, and Cochrane's model, and performs similarly, or marginally better than the FF and LL models in its ability to explain the cross-section and subsume the priced information in the size and b/m factors.

Why should one consider sector investment growth rates for explaining the cross-sectional variation in equity returns, rather than residential and non-residential investments as Cochrane's (1996) model does?

The underlying idea is that the various sectors of the economy may receive different productivity shocks that will in turn result into different returns on capital for the firms of those sectors. The return on capital is directly related to equity returns, and in

[2] Previous tests of the CCAPM include those of Breeden, Gibbons, and Litzenberger (1989), Campbell (1996), and Cochrane (1996), among others.

the context of business cycle models, the two notions are identical. But the return on capital also determines investments, and as a result, the investment growth of the sector. Since the return on capital is harder to measure than investment growth, this paper focuses on the relation between investment growth rates in broad sectors of the economy and their implications for the cross-section of equity returns.

There is an expanding literature of business cycle models that aim to explain aggregate economic fluctuations. Whereas the common wisdom of one-sector models is that heterogeneous economic agents vary their consumption and investment decisions in response to some economy-wide shock, economists have difficulty in identifying exogenous aggregate shocks that can generate the observed volatility in GDP growth. Recently, Horvarth (2000) proposed a multi-sector model, where variations in productivity across sectors do not cancel out at an aggregate level. Unlike Long and Plosser (1983), the sector-level shocks in Horvath's model are not uncorrelated. Our specification uses insights from Horvath (1998) where it is shown that, while there are comovements across sectors, sector-specific economic variables exhibit higher volatilities than their economy-wide counterparts.

This observation is particularly useful for the asset pricing literature, where financial economists are called to explain the high levels of time-series and cross-sectional variations in equity returns using ideally macroeconomic variables which are typically aggregate ones. This study contributes to the asset pricing literature by showing that the performance of Cochrane's model can be dramatically improved if disaggregate investment data are used as factors to explain equity returns.

One may argue that since the importance of using sector investment growth rates instead of aggregate investments lies in their ability to capture different productivity shocks, a better specification would be one that directly includes productivity shocks, such as Total Factor Productivity (TFP). Although this is a valid argument, it is problematic in its implementation. The reason is that TFP is not observable, but needs to be estimated. Given that in our application it would need to be used as a factor in asset pricing tests, this will give rise to a "generated regressors" problem that may affect the interpretation of our results. Furthermore, TFP is defined with reference to a production function. There is a plethora of production functions used in the literature to determine TFP. Using any particular one may result in a specification error that will only augment the inference problems produced by the "generated regressors" problem. For these reasons, we choose to use sector investment growth rates as factors, which are observable and readily available.

The sector classification we consider is the one provided by the Board of Governors of the Federal Reserve System in the *Guide to the Flow of Funds Accounts.* Gross Private Investments (GPI) are classified into investments made by households (HHOLDS), non-financial corporate firms (NFINCO), non-corporate businesses (NONCOR), farms (FARM), and financials (FINAN). In our tests, however, we exclude FARM due to problems with missing observations in the data series. FARM represents only 3.5% of GDP, and therefore its omission does not affect substantially the ability of the sectors considered to cover the entirety of GPI in the economy. To compute the sector investment growth rates used as factors in our tests, we sum up the residential fixed investment, non-residential fixed investment and changes in private inventories in each of the four sectors.

Our asset pricing tests show that the investment growth rates considered are important in explaining the cross-section of equity returns. Our tests are conducted within the Stochastic Discount Factor (SDF) framework, as well as the classic beta method of Fama and MacBeth (1973).

The results of this paper imply that the production-side of the economy can provide useful information for the pricing of equities. They also imply that the asset pricing implications of multi-sector business cycle models may be more plausible than those of one-sector models. As noted in Cochrane and Hansen (1992), examining the asset pricing implications of business cycle models can be beneficial for both literatures, as it provides an alternative way to differentiate among competing business cycle model specifications.

The remainder of the paper is structured as follows. In Section 2 we discuss the empirical methodology. Section 3 gives details about the data. Section 4 presents our main asset pricing results, whereas Section 5 reports various robustness tests. We conclude with a summary of our findings in Section 6.

2. Estimation Methodology

As mentioned earlier, our asset pricing tests are performed using both the Stochastic Discount Factor (SDF) approach and the classic beta method of Fama and MacBeth (FM)

(1973). The two approaches are not nested within a general econometric model, and therefore, they cannot be directly compared.

Cochrane (2001) and Jagannathan and Wang (2002) demonstrate that the SDF approach and the classic beta method have the same finite sample performance. Their findings are in contrast to the Kan and Zhou (1999) conclusion that the SDF approach has markedly inferior small sample performance. They argue that the Kan and Zhou (1999) result stems from an erroneous assumption regarding the ex ante mean market return. Kan and Zhou (2001) counter the result in Cochrane (2001) and Jagannathan and Wang (2002) by arguing that the analyses of these authors rely on the assumption of joint normality for stock returns and factors.

Since the question of which methodology is more powerful remains contentious for at least part of the profession, we present results based on both testing approaches. What is important for the current study is that the conclusions that emerge from the two testing methodologies about the proposed empirical model are similar. Below, we provide a brief discussion of the two alternative methodologies, and the tests conducted in their contexts.

2.1 The SDF approach

The SDF approach is implemented using the Generalized Method of Moments (GMM), which is a very flexible estimation approach. The pricing kernel, *m*, in the SDF approach is given by

$$m = a + \sum_j b_j i_j = a + b' \cdot i \,, \qquad (1)$$

where i_j is the investment growth rate of the j-th sector, $b = (b_1, ..., b_j)'$, and $i = (i_1, ..., i_j)'$.) The GMM tests that estimate equation (1) use Hansen's (1982) optimal weighting matrix. This provides optimal estimates of the coefficients of the pricing kernel, but not the risk premiums. In previous studies, the risk premiums, λ, are estimated using the following relation:

$$\lambda = -r_f \cdot V \cdot b \tag{2}$$

where r_f is the risk-free rate, and V the covariance matrix of investment growth factors.[3] However, this estimator has two shortcomings. First, it is not an efficient estimator, since the estimation of the risk premiums is not incorporated in the GMM system. Second, and more importantly, V needs to be estimated, which gives rise to an error-in-variables problem in the calculation of the standard errors of λ's.

We remedy these shortcomings by incorporating the estimation of λ in the optimal GMM. As will be discussed below, our test assets are excess returns of portfolios and do not include the risk-free rate. In that case, the mean of the pricing kernel is unspecified, but following Cochrane (2001), we can set it to be equal to one. Under this assumption, it can be easily shown that[4]

$$E[m \cdot i - i + \lambda] = 0, \tag{3}$$

[3] See, for example, Cochrane (1996, 2001), and Hodrick and Zhang (2001) for a recent application.

[4] Mathematically, $E[m \cdot i - i + \lambda] = E[m \cdot i] - E[i] + \lambda = \text{cov}(a + i' \cdot b, i) + E[m]E[i] - E[i] + \lambda$ $= Vb + \lambda = 0$.

We can then incorporate equation (3) into our GMM system, and use the optimal weighting matrix to obtain an efficient estimator of the risk premiums λ.

The reason we do not include the risk-free rate in our test assets is the following. Stambaugh (1982) points out that the ability of a certain set of factors to price equities might be affected by the inclusion of both equities and bonds in the set of test assets. According to his findings, a factor that cannot price equities may receive a significant risk premium if the set of test assets includes also bonds.

Following Stambaugh's results, the inclusion of both equities and bonds in the set of test assets is warranted when the purpose of the model examined is to explain the size of the equity premium. However, the question we ask in this study is different. We focus on the ability of sector-investment growth rates to explain the cross-sectional variation in equity returns. To address this question while avoiding concerns regarding the interpretation of our results, we do not include the risk-free rate in our set of test assets. It is important however to note that our results *remain qualitatively the same* when the risk-free rate is included in the set of test assets. To conserve space, we do not report those results in this draft.

We perform several tests within the GMM framework in order to evaluate and compare the performance of the proposed empirical specification with that of standard asset pricing models. In particular we compute Hansen's (1982) J-statistic on the over-identifying restrictions of the models. Most importantly, we compare the performance of the models using the Hansen and Jagannathan (1997) distance measure, or HJ-distance as it is often termed. The weighting matrix in these estimations is the inverse of the covariance matrix of the second moments of asset returns. Unlike the optimal weighting matrix, it is invariant across models, which makes the HJ-distance suitable for model comparisons.[5]

We also examine explicitly the ability of the investment growth factors to absorb all the priced information in the Fama-French (1993) factors HML and SMB, using the Newey-West's (1987) ΔJ test. The test follows a χ^2 distribution. It involves first estimating a model that includes the sector-investment growth rates along with HML and SMB. We will call this specification the "unrestricted model". Subsequently, one can use the weighting matrix of this "unrestricted model" to estimate a model that includes only the sector-investment growth factors, but excludes HML and SMB. We will call this the "restricted model". The difference in the J functions from the two estimations is chi-square distributed:

$$TJ(restricted) - TJ(unrestricted) \sim \chi^2(\#of\ restriction) \qquad (4)$$

To examine the stability of the estimated parameters of the empirical model considered and compare its properties with those of the standard asset pricing models, we use Andrews (1993) supLM test. This test is a useful diagnostic because it reveals the suitability of a model to be used out-of-sample. If a model fails the supLM test, it means that its parameters are not stable, and therefore it should be used with caution in applications that require the model to hold out-of-sample.

[5] Jagannathan and Wang (1996) derive the asymptotic distribution of the HJ-distance, which turns out to be a weighted sum of n-k i.i.d. random variables of $\chi^2(1)$ distribution, where n denotes the number of assets and k the number of factors. To get the p-value for the HJ-distance, we simulate the weighted sum of n-k $\chi^2(1)$ random variables 100,000 times.

Suppose there is a change point at time $T\pi$. Using GMM, we can estimate the parameters for the sample between 0 and $T\pi$, and the sample between $T\pi$ and T. We can impose the restriction that the parameters of the two samples are equal by also estimating the parameters for the whole sample period. To test whether this restriction holds, we can apply standard Wald, LR (Likelihood Ratio) or LM (Lagrange Multiplier) tests. The LM test is especially easy to perform, because it only uses the restricted estimate, which is just the whole sample estimation that we already got from our previous GMM. To test whether there is a structural change in the time period between $T\pi_1$ and $T\pi_2$, Andrews suggests to use the $\sup_{\pi\in[\pi_1,\pi_2]} LM(\pi)$ statistic. Unfortunately, we cannot test whether there is a change point in the whole sample, because $\sup_{\pi\in[\pi_1,\pi_2]} LM(\pi)$ will go to infinity if the interval does not have a positive distance at both endpoints (see Andrews 1993). For that reason, we choose the interval of $\pi_1 = 15\%$ and $\pi_2 = 85\%$. This is the interval recommended by Andrews (1993) when the change point is unknown.

3*.2. The Fama-MacBeth (FM) method*

The FM procedure is widely used in asset pricing tests. By performing such tests, we make our results directly comparable with those of other studies.[6] The main drawback of the FM procedure is that it suffers from the well-known errors-in-variables problem. This problem arises because betas are estimated in the first-stage regressions and subsequently used as factors in the second-stage cross-sectional regression. To correct for

[6] See for instance, Fama and French (1992), Jagannathan and Wang (1996), and Lettau and Ludvingston (2002).

this problem, we adjust the standard errors from the second-stage regressions as proposed in Shanken (1992).

The cross-sectional R-square reported in the FM tests is defined below:

$$R^2 = \frac{\text{var}_c(\overline{R_i}) - \text{var}_c(\overline{e_i})}{\text{var}_c(\overline{R_i})} \quad (5)$$

where $\overline{R_i}$ is the time-series average of the return to portfolio *i,* $\text{var}_c(\cdot)$ is the cross-sectional average across the average returns to the *N* portfolios, and $\overline{e_i}$ is the time-series average of the pricing error for portfolio *i* in the cross-sectional regressions.

In the context of the FM regressions, we perform specification tests by including the average portfolio size and book-to-market ratio in the second-stage cross-sectional regressions. These specification tests are proposed in Jagannathan and Wang (1996) who show that useless factors cannot make firm characteristics such as size and book-to-market insignificant in the second stage regressions. The results from these specification tests confirm the findings of the Newey-West ΔJ tests performed within the GMM framework.

3.3. Benchmark models and test assets

To better evaluate the performance of the sector-investment growth specification and the reduced forms of it considered, we compare its ability to explain equity returns with those of the Capital Asset Pricing Model (CAPM), the Fama-French (FF) (1993), Cochrane's (1996) model, and the Lettau Ludvinson (LL) (2002) model.

Our empirical tests focus on the ability of the competing models to price the 25 Fama-French (1993) portfolios. The reason we choose the 25 FF portfolios as test assets has to do with the fact that much of the debate on asset pricing in the nineties is centered around the ability of alternative models to price those 25 portfolios, which have been proven harder to explain than previously used test assets. Furthermore, the success of the FF model is mainly cemented on its ability to price these 25 FF portfolios. Therefore, we deemed necessary to examine how a newly proposed empirical specification fairs in explaining the cross-sectional variation of those asset returns.

3.4. Robustness tests

We test the robustness of our results by examining the ability of the competing models to price alternative sets of test assets. To that end, we scale the returns on the 25 portfolios by four different information variables, using the approach proposed in Cochrane (1996). The variables we consider are the dividend yield of the market portfolio, the default premium defined as the difference in yields between BAA and AAA corporate bonds, Lettau and Ludvigson's (2001) CAY variable, and the short-term rate. Note that LL show that CAY can predict the market risk premium, and a similar result is obtained in Ang and Liu (2003) for the short-term rate.

3. Data

The investment data are from the Federal Reserve Board Statistical Releases. Our sample covers the period from 1963Q1 to 2000Q4. At the recommendation of the referee, we start our sample in 1963, to make our results more readily comparable to those in the literature.

As it is well-known, the biggest two components of the GDP are consumption and Gross Private Investment (GPI). Consumption accounts for 65.3% of GDP, and GPI for about 16.2% of the GDP. The GPI is divided into five sectors by the Federal Reserve Board, namely Household and Non-profit Organizations (HHOLDS), Non-farm Non-financial Corporate Business (NFINCO), Non-farm Non-corporate Business (NONCOR), Farm Business (FARM), and Financial Business (FINAN). However, we eliminate FARM from our tests due to problems with missing observations from the data series. Detailed definitions of the HHOLDS, NFINCO, and NONCOR sectors can be found in the Appendix.

Each investment sector is composed of non-residential fixed investment, residential fixed investment, and changes in private inventories. Cochrane (1996) uses the aggregate residential and non-residential investment growth rates as factors. In what follows, we denote nonresidential investment by NONRES, residential investment by RES, and inventory changes by CHGINV. The tests of Cochrane's model in this study use as factors the variables NONRES and RES.

The 25 Fama-French portfolios, used as test assets, are obtained from Kenneth French's website.[7] These portfolios are formed from the intersection of five size and five book-to-market (BM) portfolios. They are rebalanced every end of June, using end-of-June market capitalization and six-month prior BM information.

The returns on the 25 portfolios are monthly. Since investment growth rates are only available on a quarterly basis, we compute quarterly returns by compounding the

[7] We are thankful to Kenneth French for making the data available. The data, as well as details about the portfolio construction can be obtained from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/

three monthly returns of each quarter. We denote the 25 portfolios as 11, 12, 13 ..., 55, where the first digit indicates the portfolio's size group and the second digit the portfolio's BM ratio group. The number 1 refers to the smallest size (lowest BM ratio) whereas the number 5 to the biggest size (highest BM ratio).

Data on HML, SMB, average BM and size for the test portfolios, and the return on the market portfolio are also obtained from Kenneth French's website. Size is the portfolio's average market capitalization. The BM ratio of a portfolio is the sum of the book value of firms in the portfolio divided by the sum of their market value. Size is a monthly series whereas B/M is available on an annual basis. The return on the market portfolio is the value-weighted return of all stocks in the CRSP database.

The three-month T-bill rate, RF, is obtained from CRSP. In our estimations, we use the last observation of the previous quarter as the safe rate for the next quarter. Recall that RF is used only in the calculation of excess returns for the test assets, but not as a test asset.

The dividend yield is defined as the annualized dividend level divided by the price level, which is the definition used in Hodrick (1992). Dividends are imputed from the value-weighted CRSP return, by including and excluding dividends and then annualizing by summing up the previous 12-month observations. Once the monthly dividend yield series is computed, we use the end-of-quarter observation to construct the quarterly series.

The default premium is calculated as the difference between Moody's seasoned yields on Baa and Aaa corporate bonds. The data source is the Federal Reserve Economic Data. The CAY variable is downloaded from Martin Lettau's website.[8]

We present summary statistics of our investment growth factors and the decomposition of gross private domestic investment in Table 1. It is worth noting the large standard deviation of CHGINV in Panel A. CHGINV is greatly affected by business cycles. The investment growth variables are contemporaneously positively correlated with GDP growth. NFINCO has the highest correlation with the GDP growth and it is equal to 0.672. NFINCO also constitutes the largest component of gross private domestic investment with a share of 50.42%. The second largest component is HHOLDS with 26.78% .

Notice that the sector investment growth rates considered share correlations that are typically very small, while the volatilities of the series are similar in size. This implies that aggregating those growth rates into a single variable would produce a series with much smaller volatility than those estimated for the sector rates, with the likely implication that the aggregate series would be less able to explain equity returns. Indeed, the tests of Cochrane's model verify this hypothesis.

Graphs of the four sector investment growth rates are presented in Figure 1. The shaded areas represent NBER-defined recession periods.

4. Results

This section contains the main body of our empirical results based on GMM tests and Fama-MacBeth regressions.

[8] We are grateful to Martin Lettau for making his series publicly available.

4.1. GMM Estimation Results

Table 2 presents results from the estimation of the competing models within the GMM framework.

In Panel A we report the results for the proposed four factor sector investment growth model. The model performs well in explaining the 25 portfolios. The coefficients of HHOLDS, and FINAN in the pricing kernel are statistically significant, which suggests that these investment growth rates can help explain the test assets. Furthermore, HHOLDS, and NFINCO receive statistically significant risk premiums, implying that those factors are priced. The only factor which does not receive either a significant coefficient or risk premium is NONCOR.

The J-statistic has an associated p-value of 0.191, which indicates that the model cannot be rejected. Furthermore, the Wald test rejects the hypothesis that the *b* coefficients of the model are jointly equal to zero. The results from the HJ-distance measure show however that the model cannot price the 25 assets correctly. The associated p-value is 0.002. Note that all models considered are rejected on the basis of the HJ-distance.

The stability tests based on the supLM statistic imply that the parameters of the model are stable over time. This is also the case with all models examined. Finally, the p-value of the ΔJ statistic implies that the inclusion of HML and SMB in the pricing kernel can somewhat improve the ability of the model to explain the 25 portfolios. Again, this is also the case with all the other models considered.

Notice that the risk premiums of NFINCO, NONCOR, and FINAN are negative, while that of HHOLDS is positive. We know from Ferson (2003) that if the risk factor is positively correlated with the pricing kernel, there should be a negative risk premium associated with the factor. This is indeed the case. Note also that the signs of the risk premiums are consistent with those obtained for Cochrane's model in Cochrane (1996) and in Panel F of Table 2 of the current study. Residential investments are mainly HHOLDS investments and receive a positive risk premium in Cochrane's model, whereas non-residential investments are mainly investments in the remaining sectors which get a negative risk premium. We will return to the point of the signs of the risk premiums in Section 4.2.

In an effort to reduce the number of factors in our empirical specification and make it more readily comparable to the benchmark models, we consider two alternative three factor specifications.

The first one includes HHOLDS, NFINCO, and NONCOR as factors (Panel B), whereas the second one includes HHOLDS, NFINCO, and FINAN (Panel C). The performance of those models is not substantially different from the four factor model, and this is particularly true for the second three-factor specification considered. This implies that the proposed model can be easily reduced to a three factor model without much loss of information.

Panels D, E, F and G report the results from estimations of the CAPM, FF model Cochrane's model, and Lettau and Ludvigson's CCAPM respectively, which act here as benchmarks for comparisons purposes.

In estimating Cochrane's model, we use the growth rates of residential and non-residential investments, rather than calculate investment returns for those sectors, as Cochrane (1996) does. This difference is not of material importance for our purposes.

Cochrane (1991) notes that "the investment return calculated with an adjustment cost production function is approximately a monotone function of investment growth. As a result, relations between asset returns and investment *growth* drive the relations between asset returns and investment *returns* and the results are not sensitive to the particular form of the adjustment cost technology or, as it turns out, to the production function parameters."[9] Cochrane (1996) compares the use of investment returns with that of investment growth rates, and concludes that the performance of his model is slightly improved when the latter are used. Therefore, the use of investment growth rates here instead of investment returns does not adversely affect the performance of Cochrane's model, nor does it constitute a material misrepresentation of it.[10] Furthermore, although Cochrane (1996) uses investment returns as factors, his model is not the typical return-based model. The investment returns can be substituted by investment growth rates without much loss of generality.

Given that none of the models considered passes the HJ-distance test or the ΔJ test, and they all pass the supLM test, it is hard to compare them on the basis of those statistics. It appears that in our case, the results from the Fama-MacBeth tests are more illuminating, as we will see in the following section.

4.2. Fama-MacBeth Regressions

This section re-examines the performance of the competing models using Fama-MacBeth regressions.

[9] Page 211.

[10] Hodrick and Zhang (2001) also use investment growth rates in estimating Cochrane's model.

Table 3 reports the risk premium estimates for all models considered. The t-values in square brackets are computed from Shanken (1992) adjusted standard errors.

The proposed four factor model delivers a cross-sectional R-squared of 67%, whereas its two reduced three-factor versions have cross-sectional R-squared of 68% and 59% respectively. These performances are somewhat lower than the cross-sectional R-squared from the FF model, which in our sample is equal to 73%, and only marginally higher than the 55% of the LL model.

Note that in the case of the CAPM, the market factor receives a negative risk premium when estimated using the classic beta approach, but a positive risk premium in the GMM tests. The prevailing result in the literature since Fama and French (1992) is that the market factor in the CAPM receives a negative and statistically insignificant risk premium in Fama-MacBeth tests. The fact that the results from the GMM tests yield a positive and significant risk premium for the market factor does not reveal any inconsistency between the two estimation approaches. Rather, it is due to the presence of a constant in the cross-sectional Fama-MacBeth regressions and the absence of a constant in the GMM tests. If the Fama-MacBeth second-stage regressions are repeated in the absence of a constant, the market factor risk premium in the Fama-MacBeth tests becomes positive and statistically significant. In other words, the difference in the results between the two testing approaches depends on the presence of a constant in the empirical specification.

The constant in the Fama-MacBeth cross-sectional regressions however has an economic interpretation, and this is the reason why it is included. A statistically significant constant implies that there are factors which are not included in the model, and which are important for explaining the asset returns. In other words, the constant in the cross-sectional regressions acts as a misspecification test. Note that the constants for the four- and three-factor specifications are marginally statistically significant at the 5% level, whereas the constants for the CAPM, Cochrane's and LL models are statistically significant at that 1% level. The implication is that those benchmark models may omit more important information about the cross-section of equity returns than the proposed models do.

This point is verified through the specification tests of Table 4. Table 4A reports size specification tests. The proposed models and the LL model pass those specification tests, whereas the CAPM, FF and Cochrane's model fail them. In Table 4B, we report the results from book-to-market (BM) specification tests. Interestingly, the proposed models and the FF model are the only ones to pass these specification tests. The LL model fails the BM specification test, although it passes it in the original publication of the model. This has to do with two facts. First, our sample extends beyond 1998, the year that the data end in the LL paper. Second, the variable cay is not exactly the same as the one used in the original publication. The reason is that every time cay is updated by Lettau and Ludvigson, the whole series changes somewhat, because the cointegrating vector is reestimated.

Notice that several of the investment growth factors receive negative risk premia. This, however, does not imply that the total risk premia for the test assets are negative. Table 5 presents calculations of the total risk premia for the 25 Fama-French portfolios, based on the results from the Fama-MacBeth regression. Notice that for the cases where a particular risk premium is negative, the associated regression loadings are also predominately negative, resulting in a positive risk premium for the test assets. In other words, the negative risk premia estimated for some of the investment growth factors are consistent with the fact that the total risk premium on equities is positive.

Figure 2 plots the realized versus predicted returns of the models examined. The closer a portfolio lies on the 45 degree line, the better the model can explain the returns of that portfolio. The four- and three-factor reduced version models appear to perform better than all the benchmark models, including the FF and LL models, in explaining the test assets, and particularly the small growth portfolios. The plots of Figure 2 also confirm previous findings that the CAPM cannot explain well the cross-section of equity returns. The same applies to Cochrane's model when it is called to explain the 25 portfolios.

5. Robustness Tests

In this section we report results from robustness tests. These tests aim to evaluate whether the proposed investment-growth specifications retain their performance when they are called to price a different set of test assets. To that end, we use Cochrane's (1996) approach and scale returns by information variables. Four variables are considered: the dividend yield on the value-weighted equity market portfolio, the default yield spread, the variable CAY, and the short-term rate.

5.1. The Ability of the Models to Price Alternative Sets of Test Assets

According to Cochrane (1996), scaled returns by an information variable can be interpreted as managed portfolios where the fund manager adjusts his/her weights on the various assets according to the signal he/she receives from the conditioning variable. The variables considered are the dividend yield, the default premium, the short rate, and the variable cay. All of these variables are known in the literature for their ability to predict equity returns.

Table 6A reports results on scaled returns using the GMM estimator. A comparison of Table 6A with Table 2 reveals that the relative performance of the various models examined is not significantly affected when they are called to price alternative sets of test assets. The same conclusion is obtained when we compare the results of Table 6B with those of Table 3. Table 6B reports results from scaled returns estimations when the tests are performed using the Fama-MacBeth methodology. Much of the relative performance of the models is again preserved. These findings are encouraging, since they imply that the performance of the proposed models, as well as the benchmark models, is not specific to the use of the 25 FF portfolios as test assets.

6. Conclusions

This paper presents results on empirical asset pricing specifications that include as factors sector-specific investment growth rates.

Our results show that the empirical sector investment-growth asset pricing specifications examined can explain the 25 Fama-French (FF) book-to-market and size-sorted portfolios better than the CAPM, and Cochrane's (1996) model, and at least as well as the Fama-French (1993) and Lettau and Ludvingson (2001) models. This conclusion is based on a battery of tests performed using the GMM and Fama-MacBeth testing methodologies.

The success of the empirical sector-investment growth asset pricing models underlines the importance of disaggregating investment growth information when the scope is to explain the cross-sectional variation in equity returns. Indirectly, the findings of the current study also render support to multi-sector business cycle models, since their asset pricing implications appear to be consistent with equity returns data.

Appendix

The following definitions are from the "Guide to the Flow of Funds Accounts", Board of Governors of the Federal Reserve System.

Households and Nonprofit Organizations:

The households and nonprofit organizations sector consists of individual households (including farm households) and nonprofit organizations such as charitable organizations, private foundations, schools, churches, labor unions, and hospitals. Nonprofits account for about 6 percent of the sector's total financial assets, according to recent estimates, but they own a larger share of some of the individual financial instruments held by the sector. (The sector is often referred to as the "household" sector, but nonprofit organizations are included because data for them are not available separately except for the year of 1987 though 1996.)
For most categories of financial assets and liabilities, the values for the household sector are calculated as residuals. That is, amounts held or owed by the other sectors are subtracted from known totals, and the remainders are assumed to be the amounts held or owed by the household sector.
In contrast to the practice in some countries, the household sector statement in the U.S. flow of funds accounts does not include the transactions of unincorporated businesses; those are shown separately in the nonfarm noncorporate and farm business sectors.

Nonfarm Nonfinancial Corporate Business

The nonfarm nonfinancial corporate business sector comprises all private domestic corporations except corporate farms, which are part of the farm business sector, and financial institutions; it includes holding companies (through consolidated reporting), S-corporations, and real estate management corporations. The sector is the largest component of the total nonfincancial business sector, alone accounting for roughly half of all net private investment in the U.S. economy.
The data cover only the domestic activities of nonfarm nonfinancial corporations; they do not include the financial transactions of foreign subsidiaries of U.S. corporations.
Information on the nonfarm nonfinancial corporate business sector is obtained from a variety of sources. Data on investment and depreciation, as well as on corporate profits and other elements of cash flow, are taken from the national income and product accounts published in the *Survey of Current Business*.

Nonfarm Noncorporate Business

The nonfarm noncorporate business sector comprises partnerships and limited liability companies (business that file Internal Revenue Service Form 1065), sole proprietorships (businesses that file IRS Schedule C or Schedule C0EZ), and individual who receive rental income (income reported on IRS Schedule E). Limited liability companies combine the corporate characteristic of limited liability for all owners with the pass-through tax treatment of partnerships, and they offer more organizational flexibility than S-corporations (corporations having thirty-five or fewer stockholders that elect to be taxed as if they were partnerships under the provisions of subchapter S of the Internal Revenue Code; such corporations are included in the nonfarm nonfinancial corporate business sector). The nonfarm noncorporate business sector is often thought to be composed of small firms, but some of the partnerships included in the sector are large companies. Firms in the sector generally do not have access to capital markets and, to a great extent, rely for their funding on loans from commercial banks and other credit providers (including federal government) and on trade credit from other firms.

The investment data for the sector are estimates based on summary reports published in the IRS *Statistics of Income Bulletin* (SOI). Usually, figures from SOI are available with a lag of about two years.

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Table 1: Summary Statistics of the Data

Panel A: Mean, Standard Deviation, Autocorrelation, and % of GPI(Gross Private Investment)

Variable	mean	std	autocorrelation	% of GPI
GDP	0.019	0.009	0.298	
NONRES	0.022	0.022	0.455	69.21%
RESIDE	0.019	0.049	0.525	27.04%
CHGINV	0.438	6.810	-0.029	3.75%
HHOLDS	0.020	0.044	0.435	25.04%
NFINCO	0.024	0.068	-0.188	51.96%
NONCOR	0.020	0.085	-0.128	14.52%
FARM	-0.460	6.914	0.022	3.02%
FINAN	0.036	0.107	-0.154	5.35%

Panel B: Correlation with GDP Growth Rate

	GDP	NONRES	RESIDE	CHGINV		
GDP	1.000					
NONRES	0.580	1.000				
RESIDE	0.371	0.145	1.000			
CHGINV	0.078	-0.071	-0.014	1.000		
	GDP	HHOLD	NFINCO	NONCOR	FARM	FINAN
GDP	1.000					
HHOLD	0.353	1.000				
NFINCO	0.604	0.075	1.000			
NONCOR	0.299	0.243	0.314	1.000		
FARM	-0.057	-0.122	-0.133	-0.074	1.000	
FINAN	0.167	-0.034	-0.024	-0.339	0.022	1.000

Note: Panel A of Table 1 provides the means, standard deviations (std), first-order autocorrelations (ρ_1), and the percentage of Gross Private Investment (%GPI) that each investment growth rate accounts for. Panel B reports the correlation coefficients of the investment growth rates with the Gross Domestic Product (GDP) growth rate. We denote the investment growth rate of the household and nonprofit sector by HHOLDS, the non-financial, non-farm sector by NFINCO, the non-farm non-corporate sector by NONCOR, the farming sector by FARM, and the financial sector by FINAN. The time period is from 1963Q1 to 2000Q4.

Table 2. GMM Estimations Using FF 25 Portfolios

Panel A: Four-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FINAN
Coefficient	0.990	-13.327	4.605	3.001	4.455
(t-value)	(5.273)	(-2.655)	(1.390)	(0.958)	(2.001)
Premium		0.034	-0.029	-0.013	-0.030
(t-value)		(3.816)	(-2.267)	(-0.811)	(-1.732)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	26.420		0.738	10.747	7.462
(p-value)	(0.191)	(0.000)	(0.002)		(0.024)

Panel B: Three-Factor Investment Growth Factor Model (1)

	Constant	HHOLDS	NFINCO	NONCOR	
Coefficient	1.162	-13.493	3.931	2.223	
(t-value)	(9.927)	(-3.001)	(1.386)	(0.929)	
Premium		0.035	-0.029	-0.012	
(t-value)		(4.440)	(-2.449)	(-0.793)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	27.468		0.764	10.276	10.060
(p-value)	(0.194)	(0.006)	(0.000)		(0.007)

Panel C: Three-Factor Investment Growth Factor Model (2)

	Constant	HHOLDS	NFINCO	FINAN	
Coefficient	1.174	-15.493	5.204	2.085	
(t-value)	(6.908)	(-3.224)	(1.931)	(1.142)	
Premium		0.040	-0.028	-0.015	
(t-value)		(4.648)	(-2.214)	(-0.868)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	26.193		0.760	7.748	7.542
(p-value)	(0.244)	(0.000)	(0.000)		(0.023)

Panel D: CAPM

	Constant	RMRF			
Coefficient	1.193	-4.736			
(t-value)	(22.629)	(-4.948)			
Premium		0.017			
(t-value)		(24.007)			
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	27.648		0.752	5.700	10.414
(p-value)	(0.275)	(0.000)	(0.000)		(0.005)

Panel E: The Fama-French Model

	Constant	RMRF	SMB	HML
Coefficient	1.183	-4.134	0.278	-5.003
(t-value)	(18.343)	(-3.190)	(0.202)	(-3.114)
Premium		0.017	0.004	0.012
(t-value)		(24.050)	(12.974)	(11.159)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*Sup LM*
statistic	25.732		0.701	10.740
(p-value)	(0.263)	(0.000)	(0.003)	

Panel F: Cochrane's Model

	Constant	NONRES	RESIDE		
Coefficient	0.534	35.795	-11.737		
(t-value)	(2.850)	(4.340)	(-3.001)		
Premium		-0.017	0.028		
(t-value)		(-3.875)	(3.689)		
Tests:	*J*	*Wald(b)*	*HJ Dist*	*Sup LM*	*Δ J*
statistic	24.266		0.745	4.450	12.334
(p-value)	(0.389)	(0.000)	(0.001)		(0.002)

Panel G: Lettau-Ludvigson Model

	Constant	CONS	CAY	CAY*CONS	
Coefficient	1.038	0.015	0.176	0.075	
(t-value)	(6.854)	(0.053)	(1.042)	(0.330)	
Premium		0.190	-0.384	-0.120	
(t-value)		(3.070)	(-2.090)	(-1.037)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*Sup LM*	*Δ J*
statistic	30.948		0.783	11.009	16.085
(p-value)	(0.097)	(0.298)	(0.000)		(0.000)

Note: The GMM estimations of the models use the 25 Fama-French portfolios as test assets. We denote the investment growth rate of the household and nonprofit sector by HHOLDS, the non-financial, non-farm sector by NFINCO, the non-farm non-corporate sector by NONCOR, the farming sector by FARM, and the financial sector by FINAN. In the tests of Cochrane's model, the residential investment growth rate is denoted by RES and the nonresidential by NONRES. HML is a zero-investment portfolio which is long on high book-to-market (B/M) stocks and short on low B/M stocks. Similarly, SMB is a zero-investment portfolio which is long on small capitalization stocks and short on big capitalization stocks. EMKT refers to the excess return on the stock market portfolio. The J-test is Hansen's (1982) test on the overidentifying restrictions of the model. The ΔJ test is the Newey-West (1987) chi-square difference test. It examines the increase in the J function of a model when HML and SMB are added in the pricing kernel. The Wald(b) test is a joint significance test of the *b* coefficients in the pricing kernel. The J, ΔJ , and Wald(b) tests are computed in GMM estimations that use the optimal weighting matrix. We denote by "HJ Dist" the Hansen-Jagannathan (1997) distance measure. It refers to the least-square distance between the given pricing kernel and the closest point in the set of pricing kernels that price the assets correctly. The p-value of the measure is obtained from 10,000 simulations. The supLM test refers to Andrews (1993) stability test. It examines whether the parameters of the model are stable during the sample period. We indicate that a model does not pass the stability test at the 10%, 5%, and 1% level of significance with one, two, and three asterisks respectively. The critical values for the supLM test are obtained from Andrews (1993). The HJ-distance and the supLM tests are computed using the Hansen and Jagannathan weighting matrix of second moments of asset returns. The estimation period is from 1963Q1 to 2000Q4.

Table 3: Fama-MacBeth Regressions

Constant	HHOLDS	NFINCO	NONCOR	FINAN	Adj R^2	Joint Sig
0.027	-0.019	-0.050	-0.109	0.069	0.668	0.014
(3.379)	(-1.313)	(-2.651)	(-2.971)	2.249		
[1.994]	[-0.751]	[-1.541]	[-1.896]	[1.287]		
Constant	HHOLDS	NFINCO	NONCOR		Adj R^2	Joint Sig
0.026	-0.020	-0.051	-0.120		0.677	0.006
(3.343)	(-1.348)	(-2.675)	(-3.027)			
[1.892]	[-0.737]	[-1.473]	[-2.206]			
Constant	HHOLDS	NFINCO	FINAN		Adj R^2	Joint Sig
0.029	-0.012	-0.042	0.129		0.587	0.007
(3.476)	(-0.935)	(-2.266)	(2.848)			
[2.065]	[-0.546]	[-1.411]	[2.352]			
Constant	RMRF				Adj R^2	Joint Sig
0.031	-0.007				0.013	0.547
(3.239)	(-0.602)					
[3.228]	[-0.526]					
Constant	RMRF	SMB	HML		Adj R^2	Joint Sig
0.021	-0.005	0.006	0.014		0.727	0.018
(1.513)	(-0.294)	(1.136)	(2.790)			
[1.460]	[-0.264]	[0.776]	[1.951]			
Constant	NONRES	RESIDE			Adj R^2	Joint Sig
0.023	0.007	0.016			-0.027	0.366
(2.727)	(0.780)	(1.073)				
[2.492]	[0.715]	[0.956]				
Constant	CONS	CAY	CAY*CONS		Adj R^2	Joint Sig
0.035	0.020	-0.178	0.501		0.552	0.019
(4.587)	(0.119)	(-0.382)	(1.491)			
[3.218]	[0.082]	[-0.276]	[1.384]			

Note: The Fama-MacBeth regression tests are performed on the 25 Fama-French portfolios. The premiums are estimated in the second-stage cross-sectional regressions and they are the coefficients on the betas of the factors listed on the column headings. We denote the investment growth rate of the household and nonprofit sector by HHOLDS, the non-financial, non-farm sector by NFINCO, the non-farm non-corporate sector by NONCOR, the farming sector by FARM, and the financial sector by FINAN. In the tests of Cochrane's model, the residential investment growth rate is denoted by RES and the nonresidential by NONRES. HML is a zero-investment portfolio which is long on high book-to-market (b/m) stocks and short on low b/m stocks. Similarly, SMB is a zero-investment portfolio which is long on small capitalization stocks and short on big capitalization stocks. EMKT refers to the excess return on the value-weighted stock market portfolio. We report two t-values for each parameter. The first one is calculated using the uncorrected Fama-MacBeth standard errors. The second one is calculated using Shanken's (1992) adjusted standard errors. The last column of the table reports p-values from chi-square tests on the joint significance of the betas of each model. The estimation period is 1963Q1 to 2000Q4.

Table 4A: Size Specification Tests – Fama-MacBeth Regressions

	Constant	HHOLDS	NFINCO	NONCOR	FINAN	SIZE	Adj R^2
Premium	0.061	-0.036	-0.025	-0.103	0.062	-0.003	0.690
(t-value)	(3.752)	(-2.314)	(-1.234)	(-2.773)	2.032	-2.138	
[t-value(adj)]	[2.239]	[-1.409]	[-0.711]	[-1.803]	[1.174]	[-1.276]	
	Constant	HHOLDS	NFINCO	NONCOR		SIZE	Adj R^2
Premium	0.061	-0.037	-0.024	-0.111		-0.003	0.701
(t-value)	(3.751)	(-2.316)	(-1.227)	(-2.793)		-2.173	
[t-value(adj)]	[2.161]	[-1.354]	[-0.680]	[-2.015]		[-1.252]	
	Constant	HHOLDS	NFINCO	FINAN		SIZE	Adj R^2
Premium	0.066	-0.030	-0.015	0.120		-0.003	0.609
(t-value)	(4.024)	(-2.071)	(-0.776)	(2.637)		-2.317	
[t-value(adj)]	[2.450]	[-1.337]	[-0.468]	[2.133]		[-1.411]	
	Constant	RMRF				SIZE	Adj R^2
Premium	0.083	-0.031				-0.005	0.716
(t-value)	(4.185)	(-2.424)				-3.103	
[t-value(adj)]	[3.917]	[-2.172]				[-2.904]	
	Constant	RMRF	SMB	HML		SIZE	Adj R^2
Premium	0.050	0.012	-0.014	0.011		-0.006	0.770
(t-value)	(2.680)	(0.724)	(-1.516)	(2.061)		-2.652	
[t-value(adj)]	[2.413]	[0.641]	[-1.282]	[1.405]		[-2.387]	
	Constant	NONRES	RESIDE			SIZE	Adj R^2
Premium	0.093	0.009	-0.056			-0.007	0.466
(t-value)	(3.681)	(0.905)	(-2.605)			-3.332	
[t-value(adj)]	[2.270]	[0.581]	[-2.353]			[-2.055]	
	Constant	CONS	CAY	CAY*CONS		SIZE	Adj R^2
Premium	0.051	-0.173	0.245	0.634		-0.002	0.601
(t-value)	(3.624)	(-1.363)	(0.701)	(2.092)		-1.487	
[t-value(adj)]	[2.656]	[-0.969]	[0.438]	[1.796]		[-1.090]	

Note: Size is the log of the portfolio size. The same comments as in Table 3 apply.

Table 4B: Specification Test with Book-to-Market Ratio

	Constant	HHOLDS	NFINCO	NONCOR	FINAN	BM	Adj R^2
Premium	0.018	-0.013	-0.043	-0.062	0.056	0.005	0.732
(t-value)	(2.618)	(-1.036)	(-2.387)	(-2.526)	2.017	1.979	
[t-value(adj)]	[1.926]	[-0.734]	[-1.802]	[-1.778]	[1.481]	[1.455]	
	Constant	HHOLDS	NFINCO	NONCOR		BM	Adj R^2
Premium	0.016	-0.015	-0.044	-0.077		0.005	0.734
(t-value)	(2.463)	(-1.104)	(-2.438)	(-2.791)		1.940	
[t-value(adj)]	[1.740]	[-0.748]	[-1.719]	[-2.172]		[1.371]	
	Constant	HHOLDS	NFINCO	FINAN		BM	Adj R^2
Premium	0.016	-0.010	-0.039	0.070		0.006	0.734
(t-value)	(2.460)	(-0.805)	(-2.141)	(2.376)		2.373	
[t-value(adj)]	[1.850]	[-0.586]	[-1.727]	[1.983]		[1.785]	
	Constant	RMRF				BM	Adj R^2
Premium	0.008	0.005				0.010	0.589
(t-value)	(0.694)	(0.398)				3.232	
[t-value(adj)]	[0.693]	[0.354]				[3.226]	
	Constant	RMRF	SMB	HML		BM	Adj R^2
Premium	0.026	-0.011	0.005	0.010		0.003	0.729
(t-value)	(1.741)	(-0.644)	(1.007)	(1.530)		1.090	
[t-value(adj)]	[1.691]	[-0.594]	[0.688]	[1.188]		[1.059]	
	Constant	NONRES	RESIDE			BM	Adj R^2
Premium	-0.004	-0.021	-0.003			0.010	0.711
(t-value)	(-0.460)	(-3.144)	(-0.190)			3.147	
[t-value(adj)]	[-0.330]	[-2.927]	[-0.131]			[2.254]	
	Constant	CONS	CAY	CAY*CONS		BM	Adj R^2
Premium	0.024	-0.009	-0.477	0.116		0.006	0.640
(t-value)	(3.231)	(-0.052)	(-1.091)	(0.417)		2.522	
[t-value(adj)]	[2.646]	[-0.042]	[-0.979]	[0.344]		[2.065]	

Note: B/M stands for book-to-market and is the portfolio's average book-to-market ratio. Same comments as in Table 3 apply.

Table 5: Regression loadings and Sector Risk Premiums for the Individual Test Assets

	Regression loadings on Investment factors				Premium on Investment factors				
	HHOLDS	NFINCO	NONCOR	FINAN	HHOLDS	NFINCO	NONCOR	FINAN	Total Premium
					0.034	**-0.029**	**-0.013**	**-0.030**	
1	0.8720	-0.5278	0.0818	-0.1195	0.0296	0.0153	-0.0011	0.0036	0.0475
2	0.7836	-0.5131	0.0225	-0.0741	0.0266	0.0149	-0.0003	0.0022	0.0435
3	0.7417	-0.4219	0.0233	-0.0752	0.0252	0.0122	-0.0003	0.0023	0.0394
4	0.7822	-0.4234	-0.0167	-0.0959	0.0266	0.0123	0.0002	0.0029	0.0420
5	0.8844	-0.4301	-0.0535	-0.0720	0.0301	0.0125	0.0007	0.0022	0.0454
6	0.6147	-0.4924	0.1286	-0.1777	0.0209	0.0143	-0.0017	0.0053	0.0388
7	0.5796	-0.4824	0.1037	-0.0903	0.0197	0.0140	-0.0013	0.0027	0.0351
8	0.5816	-0.4390	0.0527	-0.0937	0.0198	0.0127	-0.0007	0.0028	0.0346
9	0.6156	-0.3998	0.0319	-0.0869	0.0209	0.0116	-0.0004	0.0026	0.0347
10	0.6488	-0.4475	-0.0110	-0.0683	0.0221	0.0130	0.0001	0.0020	0.0372
11	0.4669	-0.4695	0.1494	-0.1266	0.0159	0.0136	-0.0019	0.0038	0.0313
12	0.4824	-0.4310	0.1040	-0.1207	0.0164	0.0125	-0.0014	0.0036	0.0312
13	0.5190	-0.3618	0.0797	-0.0830	0.0176	0.0105	-0.0010	0.0025	0.0296
14	0.4209	-0.3987	0.0297	-0.0826	0.0143	0.0116	-0.0004	0.0025	0.0280
15	0.5452	-0.4187	0.0745	-0.0479	0.0185	0.0121	-0.0010	0.0014	0.0311
16	0.3237	-0.3887	0.1504	-0.1726	0.0110	0.0113	-0.0020	0.0052	0.0255
17	0.4230	-0.4227	0.1356	-0.1311	0.0144	0.0123	-0.0018	0.0039	0.0288
18	0.3215	-0.3613	0.0754	-0.1281	0.0109	0.0105	-0.0010	0.0038	0.0243
19	0.3828	-0.3720	0.0505	-0.0693	0.0130	0.0108	-0.0007	0.0021	0.0252
20	0.4980	-0.3813	0.0241	-0.1083	0.0169	0.0111	-0.0003	0.0032	0.0309
21	0.2814	-0.2236	0.0864	-0.0912	0.0096	0.0065	-0.0011	0.0027	0.0177
22	0.2701	-0.2790	0.0884	-0.1338	0.0092	0.0081	-0.0011	0.0040	0.0201
23	0.2485	-0.2036	0.0914	-0.0752	0.0084	0.0059	-0.0012	0.0023	0.0154
24	0.2501	-0.2840	0.0351	-0.0992	0.0085	0.0082	-0.0005	0.0030	0.0193
25	0.4361	-0.2219	-0.0067	-0.1079	0.0148	0.0064	0.0001	0.0032	0.0246

Note: This table reports the regression loadings of the 25 Fama French portfolio returns on the sector investment growth factors, as well as associated risk premiums. The numbers in bold are the estimated risk premiums for the individual investment growth factors, as in Table 3. The column labeled "Total Premium" reports the total risk premium for each of the test assets based on adding the products of the regression loadings with the sector investment growth risk premia.

Table 6A: GMM Estimations of Competing Models on Scaled Returns

Panel A: Scaled Returns by Dividend Yield

	Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
Four-Factor Investment Growth Model	statistic	24.672		0.634	9.036	7.218
	(p-value)	(0.262)	(0.001)	(0.057)		(0.027)
Three-Factor Investment Growth Model (1)	statistic	28.899		0.677	14.515	13.502
	(p-value)	(0.148)	(0.017)	(0.003)		(0.001)
Three-Factor Investment Growth Model (2)	statistic	25.783		0.674	9.420	17.107
	(p-value)	(0.261)	(0.000)	(0.004)		(0.000)
CAPM	statistic	27.132		0.668	2.963	10.985
	(p-value)	(0.298)	(0.000)	(0.001)		(0.004)
The Fama-French Model	statistic	26.175		0.620	9.825	
	(p-value)	(0.244)	(0.000)	(0.004)		
Cochrane's Model	statistic	21.268		0.650	6.482	14.062
	(p-value)	(0.565)	(0.000)	(0.017)		(0.001)
LL Model	statistic	30.542		0.676	14.591	31.136
	(p-value)	(0.106)	(0.001)	(0.012)		(0.000)

Panel B: Scaled Returns by Default Premium

	Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
Four-Factor Investment Growth Model	statistic	24.685		0.619	7.433	10.474
	(p-value)	(0.261)	(0.000)	(0.038)		(0.005)
Three-Factor Investment Growth Model (1)	statistic	23.865		0.662	7.829	8.335
	(p-value)	(0.354)	(0.000)	(0.003)		(0.015)
Three-Factor Investment Growth Model (2)	statistic	22.661		0.652	8.627	14.049
	(p-value)	(0.421)	(0.000)	(0.004)		(0.001)
CAPM	statistic	26.239		0.651	2.602	7.119
	(p-value)	(0.341)	(0.000)	(0.001)		(0.028)
The Fama-French Model	statistic	25.403		0.620	9.661	
	(p-value)	(0.278)	(0.000)	(0.004)		
Cochrane's Model	statistic	22.053		0.608	6.559	12.742
	(p-value)	(0.517)	(0.000)	(0.031)		(0.002)
LL Model	statistic	27.157		0.684	13.986	15.684
	(p-value)	(0.205)	(0.000)	(0.002)		(0.000)

Panel C: Scaled Returns by Short Rate

	Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
Four-Factor Investment Growth Model	statistic	22.118		0.656	9.144	7.952
	(p-value)	(0.393)	(0.002)	(0.016)		(0.019)
Three-Factor Investment Growth Model (1)	statistic	24.807		0.694	11.043	5.791
	(p-value)	(0.306)	(0.008)	(0.001)		(0.055)
Three-Factor Investment Growth Model (2)	statistic	20.238		0.673	10.852	6.507
	(p-value)	(0.568)	(0.000)	(0.002)		(0.039)
CAPM	statistic	25.146		0.670	4.966	9.372
	(p-value)	(0.398)	(0.000)	(0.001)		(0.009)
The Fama-French Model	statistic	25.238		0.638	12.003	
	(p-value)	(0.286)	(0.000)	(0.005)		
Cochrane's Model	statistic	24.945		0.689	8.275	15.976
	(p-value)	(0.353)	(0.001)	(0.001)		(0.000)
LL Model	statistic	27.736		0.700	10.751	20.193
	(p-value)	(0.185)	(0.180)	(0.002)		(0.000)

Panel D: Scaled Returns by CAY

	Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
Four-Factor Investment Growth Model	statistic	14.377		0.311	11.007	19.103
	(p-value)	(0.853)	(0.212)	(0.838)		(0.000)
Three-Factor Investment Growth Model (1)	statistic	14.081		0.314	10.095	1.165
	(p-value)	(0.899)	(0.141)	(0.854)		(0.559)
Three-Factor Investment Growth Model (2)	statistic	15.928		0.311	8.672	1.178
	(p-value)	(0.819)	(0.175)	(0.875)		(0.555)
CAPM	statistic	14.011		0.296	4.701	54.804
	(p-value)	(0.946)	(0.000)	(0.951)		(0.000)
The Fama-French Model	statistic	9.987		0.244	8.545	
	(p-value)	(0.986)	(0.000)	(0.990)		
Cochrane's Model	statistic	14.789		0.319	8.486	32.040
	(p-value)	(0.902)	(0.058)	(0.838)		(0.000)
LL Model	statistic	16.039		0.314	10.315	1.409
	(p-value)	(0.814)	(0.000)	(0.786)		(0.494)

Note: The returns on the test assets are scaled by the information variables noted in the panels. Same comments as in Table 2 apply. The three-factor investment growth model (1) refers to the model that includes in the pricing kernel the investment growth rates of HHOLDS, NFINCO, and NONCOR. Similarly, the three-factor investment growth model (2) is the one that includes HHOLDS, NFINCO, and FINAN in the pricing kernel.

Table 6B: Fama Macbeth Estimations of the Competing Models Using Scaled Returns:

Panel A: Scaled Returns by Dividend Yield

	Tests:	*constant*	*Adj R^2*	*Size*	*BM*
Four-Factor Investment Growth Model	Statistic	0.063	0.738	-0.010	0.015
	[t-value(adj)]	(1.602)		(-1.261)	(1.381)
Three-Factor Investment Growth Model (1)	Statistic	0.059	0.748	-0.010	0.015
	[t-value(adj)]	(0.550)		(-1.214)	(1.324)
Three-Factor Investment Growth Model (2)	Statistic	0.080	0.690	-0.010	0.018
	[t-value(adj)]	(2.058)		(-1.444)	(1.843)
CAPM	Statistic	0.077	-0.035	-0.018	0.035
	[t-value(adj)]	(2.645)		(-3.019)	(3.208)
The Fama-French Model	Statistic	0.014	0.820	-0.018	-0.002
	[t-value(adj)]	(0.357)		(-2.238)	(-0.223)
Cochrane's Model	Statistic	0.054	0.112	-0.028	0.035
	[t-value(adj)]	(1.940)		(-2.294)	(2.539)
LL Model	Statistic	0.125	0.605	-0.011	0.012
	[t-value(adj)]	(3.177)		(-1.540)	(1.192)

Panel B: Scaled Returns by Default Premium

	Tests:	*constant*	*Adj R^2*	*Size*	*BM*
Four-Factor Investment Growth Model	Statistic	0.020	0.662	-0.006	0.005
	[t-value(adj)]	(1.287)		(-1.705)	(1.152)
Three-Factor Investment Growth Model (1)	Statistic	0.025	0.661	-0.006	0.005
	[t-value(adj)]	(1.870)		(-1.966)	(1.446)
Three-Factor Investment Growth Model (2)	Statistic	0.032	0.487	-0.007	0.008
	[t-value(adj)]	(1.989)		(-2.233)	(2.102)
CAPM	Statistic	0.029	-0.043	-0.006	0.011
	[t-value(adj)]	(2.922)		(-2.978)	(3.009)
The Fama-French Model	Statistic	0.008	0.798	-0.006	-0.001
	[t-value(adj)]	(0.530)		(-2.115)	(-0.323)
Cochrane's Model	Statistic	0.012	0.075	-0.009	0.011
	[t-value(adj)]	(1.218)		(-1.992)	(2.214)
LL Model	Statistic	0.042	0.598	-0.003	0.003
	[t-value(adj)]	(2.964)		(-1.481)	(0.795)

Panel C: Scaled Returns by Short Rate

	Tests:	*constant*	*Adj R^2*	*Size*	*BM*
Four-Factor Investment Growth Model	statistic	0.039	0.640	-0.008	0.008
	[t-value(adj)]	(1.729)		(-1.966)	(1.571)
Three-Factor Investment Growth Model (1)	statistic	0.035	0.647	-0.008	0.008
	[t-value(adj)]	(1.647)		(-1.867)	(1.494)
Three-Factor Investment Growth Model (2)	statistic	0.045	0.626	-0.009	0.009
	[t-value(adj)]	(1.969)		(-2.012)	(1.814)
CAPM	statistic	0.050	0.082	-0.008	0.016
	[t-value(adj)]	(3.319)		(-2.685)	(2.932)
The Fama-French Model	statistic	0.014	0.771	-0.009	0.000
	[t-value(adj)]	(0.559)		(-2.028)	(0.004)
Cochrane's Model	statistic	0.030	-0.004	-0.011	0.017
	[t-value(adj)]	(2.215)		(-1.877)	(2.526)
LL Model	statistic	0.050	0.757	-0.003	0.005
	[t-value(adj)]	(2.811)		(-0.758)	(1.052)

Panel D: Scaled Returns by CAY

	Tests:	*constant*	*Adj R^2*	*Size*	*BM*
Four-Factor Investment Growth Model	statistic	0.004	0.138	0.003	0.003
	[t-value(adj)]	(0.201)		(0.941)	(0.510)
Three-Factor Investment Growth Model (1)	statistic	0.000	0.029	0.003	0.004
	[t-value(adj)]	(0.034)		(0.935)	(0.626)
Three-Factor Investment Growth Model (2)	statistic	0.006	0.169	0.003	0.003
	[t-value(adj)]	(0.313)		(0.960)	(0.493)
CAPM	statistic	-0.010	0.557	0.001	-0.003
	[t-value(adj)]	(-0.902)		(0.667)	(-0.647)
The Fama-French Model	statistic	0.000	0.908	0.000	0.001
	[t-value(adj)]	(0.024)		(-0.031)	(0.183)
Cochrane's Model	statistic	-0.010	0.372	0.003	-0.001
	[t-value(adj)]	(-0.690)		(0.976)	(-0.365)
LL Model	statistic	0.005	0.701	0.001	0.001
	[t-value(adj)]	(0.280)		(0.302)	(0.316)

Note: The returns on the test assets are scaled by the information variables noted in the panels. Same comments as in Table 3 apply. The three-factor investment growth model (1) refers to the model that includes in the pricing kernel the investment growth rates of HHOLDS, NFINCO, and NONCOR. Similarly, the three-factor investment growth model (2) is the one that includes HHOLDS, NFINCO, and FINAN in the pricing kernel. The adj. R-squared reported is the cross-sectional adj. R-squared from estimating the models on scaled returns.

Figure 1: Investment Growth Rates

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Figure 2: Realized vs Fitted Returns from the Fama-MacBeth Regressions: 25 Portfolios

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Note: The two-digit numbers denote the individual portfolios. The first digit refers to the size quintile and the second digit to the book-to-market quintile. The three-factor investment growth model (1) refers to the model that includes in the pricing kernel the investment growth rates of HHOLDS, NFINCO, and NONCOR. Similarly, the three-factor investment growth model (2) is the one that includes HHOLDS, NFINCO, and FINAN in the pricing kernel.