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, Fama-French (FF) (1993), and Cochrane's (1996) model in explaining the 25 FF size-and book-to-market-sorted portfolios, as well as other sets of test assets. The proposed specification can explain the value and small-size premiums. In addition, it can explain the returns of small growth portfolios that are notoriously hard to price.

JEL Classification: G12

Keywords: Cochrane (1991, 1996), Fama-French (1993), size, book-to-market, equity returns, sector investment growth rates

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 Ludvingson (2001), which can explain equity returns relatively 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 four-factor sector investment growth model. Our results show that the proposed four-factor specification can explain very well the 25 book-to-market- and size-sorted FF portfolios, as well as other sets of test assets. It consistently outperforms by far the CAPM, Cochrane's model, and FF model in its ability to explain the cross-section. In the presence of the four investment-growth factors, HML and SMB lose completely their ability to explain the cross-section. Furthermore, the proposed model explains well the small-growth portfolio returns which are notoriously hard to price. To our knowledge, no other model can explain the returns of those portfolios well.

Why should one consider sector investment growth rates for explaining the cross-sectional variation in equity returns? And why does our proposed specification perform

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[2] Tests of the CCAPM include those of Breeden, Gibbons, and Litzenberger (1989), Campbell (1996), Cochrane (1996), and Lettau and Ludvingson (2001), among others. It should be noted that although the conditional version of consumption CAPM performs reasonably well, it still cannot explain well the book-to-market effect in the Fama-French (1993) portfolios.

so much better than Cochrane's (1996) empirical specification that focuses on residential and non-residential investments?

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

Cochrane's (1996) tests of his investment-based asset pricing model consider the ability of residential and non-residential investment returns (or growth rates) to explain equity returns. The model performs similarly to the Capital Asset Pricing Model (CAPM) and the consumption CAPM in its ability to explain size portfolios. However, as shown in Hodrick and Zhang (2002) and verified here, Cochrane's empirical specification fails to explain the cross-sectional variation in the 25 Fama-French (1993) portfolio returns, which are known for being hard to price.

We show that the sector-specific investment growth rates used in the current study are dramatically more successful in explaining the cross-section of equity returns. We argue that sector-specific investment growth rates can better capture differences in the productivity shocks received by different segments of the economy, which translate into different returns to capital, and therefore, equity returns for the firms examined. In contrast, residential and non-residential investment growth rates span several potential highly heterogeneous sectors that may receive very different productivity shocks and employ different shares of capital and labor in their production functions. As shown in the work of Horvath (1998, 2000) aggregation will result in a decrease of volatility in investment growth. It follows that this is likely to decrease the ability of this economic variable to explain the highly-variable equity returns.

While there may be many ways in which economy-wide investment-growth rates can be disaggregated, the contribution of this study is not in the particular disaggregation approach used. Rather, it is in demonstrating the degree of improvement that can be achieved in the performance of Cochrane's (1996) model by disaggregating investment data in a standard and plausible fashion. In other words, the nature of this paper is purely empirical, and it contributes to the empirical asset pricing literature. Whereas the factor model considered may be understood with reference to Cochrane's model, or generated within rather standard business cycle models, our aim here is not to derive and test a theoretical specification.

The sectors we consider are chosen to cover the entire economy but exclude the public sector. In particular, we consider Gross Private Investments (GPI) made by households (HHOLDS), non-financial corporate firms (NFINCO), non-corporate businesses (NONCOR), farms (FARM), and financials (FINAN). This classification is provided by the Board of Governors of the Federal Reserve System in the *Guide to the Flow of Funds Accounts.* The advantage of this classification is that it gives rise to a small number of sectors that exhibit very different investment growth rates. Keeping the number of investment growth rates small is vital for obtaining a parsimonious empirical asset pricing specification. Whereas it is desirable to disaggregate investment information, this disaggregation should not be at the expense of tractability and parsimony. 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 five sectors.

Our asset pricing tests show that the investment growth rates in all sectors except FINAN appear to be very important for 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

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 very 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

$$m = a + \sum_j b_j i_j = a + b' \cdot i \,, \tag{1}$$

where i_j is the investment growth rate of the *j*-th sector, $b = \left(b_1, ..., b_j\right)'$, and $i = \left(i_1, ..., i_j\right)'$.) 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 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]

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

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.

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

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

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 our tests. 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]

[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.

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:

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

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.

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 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:

$$R^2 = \frac{\text{var}_c(\overline{R_i}) - \text{var}_c(\overline{e_i})}{\text{var}_c(\overline{R_i})} \tag{10}$$

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

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) model, and Cochrane's (1996) 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 two different information variables, using the approach proposed in Cochrane (1996). These variables are the dividend yield of the market portfolio, and the default premium defined as the difference in yields between BAA and AAA corporate bonds.

Finally, we evaluate the extent to which the performance of our proposed model is driven by only a handful of influential observations.[7] Influential observations are defined as observations that occur in periods where a common factor of returns that can also explain the cross-section of average returns obtains high values. In such instances, a macroeconomic factor uncorrelated with returns could artificially explain a substantial part of the cross-sectional variation in average returns, if it has outliers in influential quarters. An obvious common factor is HML, which is known to be instrumental in explaining the returns of the 25 FF portfolios.

To account for this possibility, we perform a separate set of tests in which the most influential quarters for the Fama-French factors HML and SMB are excluded. The selected influential quarters are the following: 1974Q1, 1974Q4, 1976Q1, 1981Q1, 1992Q1, 1998Q4, 1999Q4, and 2000Q4. The results show that the exclusion of these

[7] For a discussion of the effect of influential observations in asset pricing tests, see Menzly (2001).

quarters has no material effect on the ability of the empirical sector-investment growth model to explain the cross-section.

In a separate test, we exclude those observations in which the five investment growth rates exhibit extreme values. The quarters excluded in this case are the following: 1952Q2, 1953Q1, 1958Q1, 1960Q4, 1964Q1, 1968Q1, 1974Q1, 1975Q1, 1980Q2, 1983Q3, 1987Q3, 1989Q1, 1997Q4, 1998Q1, 1998Q4, 1999Q2, and 1999Q3. The reason we perform those tests is in order to examine whether the performance of the empirical sector-investment-growth model is driven by a handful of observations. In such a case, the ability of the model to perform out-of-sample would be limited. Once again, our results show that the exclusion of the above observations do not significantly affect the ability of the proposed empirical model to explain the cross-section of equity returns.

3. Data

The investment data are from the Federal Reserve Board Statistical Releases. Our sample covers the period from 1952Q1 to 2000Q4 with a total of 195 quarterly observations.

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). Detailed definitions of the HHOLDS, NFINCO, NONCOR, and FARM 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.

As mentioned earlier, the test assets for our asset-pricing tests are the 25 Fama-French portfolios obtained from Kenneth French's website.[8] 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 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

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[8] 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/

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.

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.

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 deviations of CHGINV and FARM in Panel A. CHGINV is greatly affected by business cycles. Investment in FARM business also has a very volatile component in inventory changes which is responsible for its large standard deviation. In addition, FARM is a counter-cyclical component of GDP, as can be seen from its negative correlation with the GDP growth rate. The remaining 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 that the more aggregate investment growth rates used in his empirical specification result in a performance of the model which is significantly inferior to that of our proposed empirical specification. Graphs of the five 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.

4.1. GMM Estimation Results

Table 2 presents the results on the sector-investment growth model and the benchmark models used for comparison purposes. The estimations are performed using the GMM framework.

Panel A contains the results for the empirical specification that contains all five sector-investment growth rates as factors. The model performs well in explaining the 25 portfolios. The coefficients of HHOLDS, NFINCO, and NONCOR in the pricing kernel are statistically significant, which indicates that these investment growth rates can help explain the test assets. Furthermore, NFINCO, NONCOR, and FARM receive statistically significant risk premiums, suggesting that those factors are priced. The only factor which does not receive either a significant coefficient or risk premium is FINAN.

The interpretation we attach to the above results is that all investment growth rates in sectors that involve real investments are important for explaining the cross-section of the 25 portfolio returns. The only investment growth rate that is not important is that of the financial sector, possibly because investments in this sector are in response to changes in the investment growths of the other sectors, rather than being a primary source of economic growth. This argument may not apply to the case of emerging markets where the results may differ and developments in the financial sector are likely to have a central role in the economic growth of the country. They seem plausible, however, for a large developed economy such as that of the US.

The J-statistic has an associated p-value of 0.987, 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 are consistent with those of the J-test. The p-value is equal to 0.893, which suggests that the model can price the 25 assets correctly. In addition, stability tests based on the supLM statistic imply that the parameters of the model are stable over time. Finally, the p-value of the ΔJ statistic implies that the inclusion of HML and SMB in the pricing kernel does not improve the ability of the model to explain the 25 portfolios. In other words, it appears that in the presence of the five investment-growth factors, HML and SMB lose their incremental ability to explain the cross-section.

Notice that the risk premiums of NFINCO, NONCOR, and FARM are negative, while that of HHOLDS is positive. 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.

Since FINAN does not seem to be important for pricing the test assets, we drop it from the pricing kernel and estimate a four-factor investment growth model. The results on the four-factor model are reported in Panel B. The findings are consistent with those of Panel A, in the sense that the four- and five-factor models perform similarly. This confirms that FINAN is a redundant factor.

We perform further sensitivity tests on the ability of the model to explain the cross-section, by excluding sector-investment growth rates that appear to be of marginal significance given the results of Panels A and B. For instance, in Panel C1, we also exclude the investment growth rate of the farming sector, since its coefficient in the pricing kernel is not statistically significant. The model appears to perform similarly to those of Panels A and B, except that the ΔJ statistic has now a small p-value (0.009). This implies that this three-factor model does not absorb the priced information in HML and SMB.

We also consider an alternative three-factor model that includes NFINCO, NONCOR, and FARM as factors in Panel C2. The reason we consider this model is because HHOLDS does not receive a significant risk premium in Panels A and B but FARM does. In other words, we consider only the three investment growth rates that receive a statistically significant risk premium. Again, the performance of this model seems to be similar to that of Panel B, although the HJ-distance is larger.

Focusing exclusively on the statistics of Table 2 can be misleading however, since they do not clearly show the pricing errors resulting from each model. Figure 2 plots the pricing errors from the alternative investment-growth asset pricing specifications. The pricing errors of the five- and four-factor investment growth rates are generally small and very similar in magnitude. This is not the case with the pricing errors of the two three-factor models. In the absence of FARM from the pricing kernel, the pricing errors of the portfolios vary with BM, which means that the model cannot explain the BM effect in the test assets. However, when FARM is included but HHOLDS is excluded from the pricing kernel, as in the second three-factor model considered, all the test assets are greatly overpriced, despite the fact that the BM effect is now somewhat better explained than in the case of the first three-factor model. It appears that a four-factor investment growth model is needed in order to explain well the BM effect and the 25 test assets in general.

Although sectors such as the farming may initially appear irrelevant for the pricing of financial assets, the results of Table 2 show that it has some marginal role in explaining their cross-sectional difference. One reason for that may have to do with the fact that investments in farming are countercyclical, and farming maintains a significant level of inventory that varies greatly with the business cycle. Another reason may be that at occasion, farm-specific shocks have significant effects on aggregate productivity. An example from the nineties is the severe 1993 southern drought and the floods in the Midwest (see Horvath (2000)).

Panels D, E and F report the results from estimations of the CAPM, FF model and Cochrane's model respectively, that 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. However, 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.

[9] Page 211.

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

It terms of all the statistics reported, the proposed four-factor specification outperforms all three benchmark models. This can also be seen by comparing the pricing errors produced from the benchmark models with those of the four-factor model. The pricing errors of CAPM and Cochrane's model are often large and vary with the BM ratio of the portfolios. The four-factor model produces smaller pricing errors that are most similar to those of the FF model.

Notice that the two-standard error bands for the investment-growth models in Figure 2 are larger than those for the return-based models, such as the CAPM and the FF model. The reason is that the R-square in a factor regression of returns on investment growth rates is a lot lower than the R-square of returns on returns. The standard-error bands are also larger for Cochrane's model than they are for CAPM and the FF model, for exactly the same reason.

The proposed four-factor investment-growth model also outperforms the FF model in the sense that it prices better the small growth portfolios (11, and 21). These portfolios have been shown in previous studies to be the hardest to price (see, Davis, Fama, and French (2000), and Hodrick and Zhang (2001)), and no other model, to our knowledge, is able to explain their returns in a satisfactory manner. The ability of the model to explain the returns of small growth portfolios constitutes one of the contributions of the current study.

4.2. Fama-MacBeth Regressions

In this section we re-examine the performance of the competing models using Fama-MacBeth regressions.

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 results of the table reveal that the proposed model and its four-factor reduced form can explain a substantially larger proportion of the cross-sectional variation in the 25 portfolios than the CAPM, the FF, or Cochrane's model. In particular, the adjusted R-square for the four-factor model is 87.8%, versus 6.1% for the CAPM, 65.4% for the FF model and 0% for Cochrane's model. Even the three-factor investment-growth models explain substantially higher proportion of the cross-sectional variation in returns than the FF model. The striking difference in the adjusted R-square between the proposed models and Cochrane's model reveal the gains in performance obtained by disaggregating investment growth into sector-specific information. Reasons for this dramatic improvement are provided in the introductory section of the paper.

The signs of the risk premiums of the four-factor model in Table 3 are broadly consistent with those in Table 2. NFINCO and NONCOR receive negative and statistically significant risk premiums in both tables. FARM has a negative risk premium according to both estimation methods, but the risk premium is not statistically significant in the case of the Fama-MacBeth tests. This result underlines once more the marginal significance of the investment growth in the farming sector for explaining the cross-sectional variation in equity returns. Finally, HHOLDS does not receive a statistically significant risk premium in the Fama-MacBeth tests. In that sense, the fact that its estimated risk premium is negative here instead of positive as in the GMM tests is of no particular importance. As noted earlier, the two estimation methodologies are not nested, and the results from them are bound to differ slightly. This is exactly the reason why it is useful to present empirical evidence based on both of them. In the current study, the difference in the results produced by the two alternative methodologies is deemed to be minor, which reinforces the robustness of our general findings regarding the ability of sector-investment growth rates to explain the equity returns.

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 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. Put differently, the constant in the cross-sectional regressions acts as a misspecification test. The constants of the five- and four-factor models are only statistically significant at the 10% level, implying that most of the important factors for explaining the cross-sectional variation in equity returns are already included in the models. This is not the case for the benchmark models whose constants are significant at the 1% level.

Figure 3 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 results are consistent with those of Figure 2 that show the pricing errors from the GMM estimations.

The five- and four-factor investment-growth models produce almost identical fitted returns, supporting the earlier finding that FINAN is not important for the pricing of the 25 portfolios. The four-factor model performs better than the FF model in explaining the test assets, and particularly the small growth portfolios. This result is consistent with that obtained from examining the pricing errors from the GMM tests.

The plots of Figure 3 also confirm results in previous studies about the failure of CAPM to explain the cross-section of equity returns. Cochrane's model cannot explain the 25 portfolios either. The graph of fitted versus realized returns produced by the model is similar to that of the CAPM.

Tables 4A and 4B contain the results from specification tests that examine the ability of the models to explain the size and b/m effects. Table 4A refers to the specification tests for the size effect, whereas Table 4B reports the results from the BM specification tests.

In the presence of the sector investment-growth factors, the size and BM effects do not receive a statistically significant risk premium. This is not the case for the CAPM and Cochrane's model, where both size and BM effects are highly significant. Again these results render support to the argument that it is important to consider sector investment-growth rates, rather than investment growth rates that aggregate across several sectors of the economy, as it is the case with the residential and non-residential investment growth rates used in Cochrane's model.

6. Robustness Tests

In this section we present results from two types of robustness tests. The first set of tests aims 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. Two variables are considered: the dividend yield on the value-weighted equity market portfolio, and the default yield spread. The second set of tests examines the extent to which the performance of the proposed investment growth models depends on a handful of potentially influential observations. To test this hypothesis, we identify influential observations which we then exclude from our sample and repeat the tests.

6.1. 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 dividend yield and the default premium are known for their ability to predict equity returns.

Summary of GMM results on scaled returns are reported in Table 5. In Panel A, returns are scaled by dividend yield, whereas in Panel B they are scaled by the default premium.

A comparison of the results of Panel A, Table 5 with those in Table 2 reveals that the relative performance of the models remains largely the same when returns are scaled by the dividend yield. However, when returns are scaled by the default spread, the investment growth specifications lose some of their comparative advantages. For instance, whereas the four-factor model has a lower HJ-distance than the FF model, its p-value is now equal to 0.02. Furthermore, the ΔJ test has also a small p-value (0.001) implying that HML and SMB can now help explain the test assets even in the presence of the investment growth factors. In addition, Cochrane's model appears to have a lower HJ-distance than the four-factor investment growth model, although it is still larger than that of the five-factor investment growth specification.

The results of this section suggest that the proposed investment growth specifications can price scale returns reasonably well, although they can price them better when returns are scaled by the dividend yield rather than the default spread.

6.2. Robustness to the Exclusion of Influential Observations

It is conceivable that the performance of the proposed investment-growth models is driven by a handful of observations during which influential return factors such as SMB and HML receive particularly high values. If during those quarters the investment growth factors also obtained high values, then they may appear to be able to explain the test assets, even though they are otherwise unrelated to equity returns.

To account for this possibility, we exclude from our sample the observations during which SMB and HML had extreme values and we repeat our asset pricing tests. The observations excluded are the following: 1974Q1, 1974Q4, 1976Q1, 1981Q1, 1992Q1, 1998Q4, 1999Q4, and 2000Q4.

The results after excluding the above observations appear in Table 6A. The performance of the investment-growth models is not at all affected by the exclusion of those observations. It is qualitatively the same as that discussed in the context of Table 2.

Next we exclude observations during which the five investment-growth factors exhibit extreme positive or negative values. The reason we do these tests is in order to examine the extent to which the proposed model can be useful out-of-sample. If its performance is due to only a handful of observations, one should exercise caution in using it out-of-sample, as its performance will be conditional on the realization of an extreme observation during the out-of-sample period. The quarters excluded in this case are: 1952Q2, 1953Q1, 1958Q1, 1960Q4, 1964Q1, 1968Q1, 1974Q1, 1975Q1, 1980Q2, 1983Q3, 1987Q3, 1989Q1, 1997Q4, 1998Q1, 1998Q4, 1999Q2, and 1999Q3.

The results appear in Table 6B. Again, the four-factor investment growth model performs better than the benchmark models in terms of its ability to explain the cross-section of the 25 portfolios. The only difference that is observed now compared to the results of Table 2 is that the ΔJ statistic has smaller p-values than it has when the extreme observations are not excluded. In other words, in the absence of the above-mentioned observations, the investment-growth factors can absorb less well the priced information in HML and SMB. However, the model retains most of its superior ability to price equities, even when seventeen influential quarters are excluded from the sample. This result renders further support to the model, and implies that its performance as presented here is unlikely to be sample-specific.

7. Conclusions

This paper presents empirical results on an empirical asset pricing specification that includes as factors sector-specific investment growth rates. The ability of the model to explain equity returns is evaluated using both the Stochastic Discount Factor (SDF) approach and the classic beta method of Fama and MacBeth.

Our results show that the empirical sector investment-growth asset pricing model can explain the 25 Fama-French (FF) book-to-market and size-sorted portfolios better than the CAPM, Fama-French (1993) model and Cochrane's (1996) model. Furthermore, the model cannot be rejected on the basis of Hansen's J-test and the Hansen-Jagannathan distance measure. It absorbs the priced information in HML and SMB, and the pricing errors it produces are generally close to zero. The Fama-MacBeth tests conducted on the model show that it can explain 87% of the cross-sectional variation in the average returns of the 25 FF portfolios. In addition, it is very successful in explaining the average returns of small growth portfolios. Previous studies have found these portfolios to be particularly hard to price.

The performance of the empirical sector investment growth asset pricing model does not change substantially when it is called to price alternative sets of test assets, where the 25 Fama-French portfolios are scaled by information variables such as the dividend yield and the default yield spread. Furthermore, it is robust to the exclusion of potentially influential observations, suggesting that its performance is not dependent on the presence of a handful of observations with extreme values.

The success of the empirical sector-investment growth asset pricing model 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 render also support to multi-sector business cycle model, since their asset pricing implications are likely to be more in line with the pricing of equities than those of one-sector models.

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.

Farm Business

The farm business sector is made up of corporate and noncorporate farms. Like the firms in the nonfarm noncorporate business sector, noncorporate farms are owned by households. In the national income and product accounts (NIPA), produced by the Bureau of Economic Analysis (BEA), consumption by farm individuals is part of personal consumption expenditures, and farm proprietors' income is transferred to households as part of personal income and is thus an element of household saving. Similarly, in the flow of funds accounts, expenditures on farm residential structures are part of the fixed investment total for the households and nonprofit organizations sector, and proprietors' net investment in noncorporate farms (net additions to or subtractions from household ownership equity) is part of the net acquisition of financial assets by the sector. In the flow of funds accounts, however, corporate farms are included in the farm business sector; in the NIPA they are part of nonfinancial corporate business.
The major asset of farms, real estate, is a nonfiancial asset that does not appear on tables of either flows or outstandings; their other assets are small in comparison (farm real estate at the end of 1997 was about $850 billion, while financial assets totaled about $70 billion). Farms' major sources of funding are loans or credits from banks, government-sponsored enterprises, the federal government, and trade suppliers, along with equity investment by owners.
Data on farm income, investment, profits, and capital consumption allowances are from the Survey of Current Business and from other materials available from the BEA.

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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	0.017	0.010	0.390	
NONRES	0.020	0.026	0.365	67.63%
RESIDE	0.017	0.047	0.534	28.71%
CHGINV	0.279	6.170	-0.023	3.67%
HHOLDS	0.018	0.043	0.454	26.78%
NFINCO	0.022	0.083	-0.057	50.42%
NONCOR	0.021	0.079	-0.083	14.84%
FARM	-0.333	6.090	0.023	3.48%
FINAN	0.035	0.105	-0.118	4.40%

Panel B: Correlation with GDP Growth Rate

	GDP	NONRES	RESIDE	CHGINV		
GDP	1.000					
NONRES	0.565	1.000				
RESIDE	0.411	0.161	1.000			
CHGINV	0.062	-0.026	-0.025	1.000		
	GDP	HHOLD	NFINCO	NONCOR	FARM	FINAN
GDP	1.000					
HHOLD	0.407	1.000				
NFINCO	0.672	0.181	1.000			
NONCOR	0.320	0.286	0.310	1.000		
FARM	-0.058	-0.120	-0.099	-0.070	1.000	
FINAN	0.181	0.009	-0.030	-0.221	0.016	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 1952Q2 to 2000Q4.

Table 2. GMM Estimations Using FF 25 Portfolios

Panel A: Five-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FARM	FINAN
Coefficient	0.614	-22.076	17.302	18.885	0.131	2.490
(t-value)	(1.830)	(-2.568)	(2.569)	(2.057)	(1.156)	(0.629)
Premium		0.022	-0.146	-0.130	-6.419	-0.003
(t-value)		(1.551)	(-3.700)	(-2.906)	(-2.834)	(-0.074)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*	
statistic	8.657		0.512	16.959	1.616	
(p-value)	(0.987)	(0.008)	(0.893)		(0.446)	

Panel B: Four-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FARM
Coefficient	0.701	-23.109	18.809	18.680	0.131
(t-value)	(2.307)	(-2.601)	(2.857)	(2.224)	(1.150)
Premium		0.022	-0.151	-0.128	-6.047
(t-value)		(1.562)	(-3.783)	(-2.918)	(-2.711)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	8.697		0.541	16.214	1.822
(p-value)	(0.991)	(0.006)	(0.855)		(0.402)

Panel C1: Three-Factor Investment Growth Factor Model (1)

	Constant	HHOLDS	NFINCO	NONCOR	
Coefficient	0.897	-19.046	12.349	8.647	
(t-value)	(4.675)	(-2.966)	(2.822)	(1.737)	
Premium		0.025	-0.112	-0.073	
(t-value)		(2.466)	(-4.020)	(-2.569)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	20.388		0.567	14.133	9.465
(p-value)	(0.559)	(0.003)	(0.569)		(0.009)

Panel C2: Three Factor Investment Growth Factor Model (2)

	Constant	NFINCO	NONCOR	FARM	
Coefficient	0.380	15.342	19.018	0.180	
(t-value)	(1.422)	(2.502)	(2.228)	(1.389)	
Premium		-0.139	-0.135	-5.797	
(t-value)		(-3.670)	(-3.336)	(-2.610)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	15.716		0.615	16.214	1.158
(p-value)	(0.830)	(0.019)	(0.415)		(0.561)

Panel D: CAPM

	Constant	RMRF			
Coefficient	1.136	-3.775			
(t-value)	(23.592)	(-4.064)			
Premium		0.020			
(t-value)		(26.286)			
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	33.401		0.657	7.061	21.058
(p-value)	(0.096)	(0.000)	(0.000)		(0.000)

Panel E: The Fama-French Model

	Constant	RMRF	SMB	HML
Coefficient	1.191	-4.333	1.138	-6.647
(t-value)	(19.122)	(-3.921)	(0.885)	(-4.587)
Premium		0.020	0.004	0.009
(t-value)		(27.438)	(9.755)	(10.626)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*
statistic	28.575		0.601	11.489
(p-value)	(0.157)	(0.000)	(0.002)	

Panel F: Cochrane's Model

	Constant	NONRES	RESIDE		
Coefficient	0.580	33.603	-9.817		
(t-value)	(3.145)	(3.713)	(-2.375)		
Premium		-0.016	0.022		
(t-value)		(-2.605)	(2.795)		
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	28.960		0.648	9.445	10.498
(p-value)	(0.182)	(0.000)	(0.003)		(0.005)

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 1952Q2 to 2000Q4.

Table 3: Fama-MacBeth Regressions

	Constant	HHOLDS	NFINCO	NONCOR	FARM	FINAN	Adj R^2	Joint Sig
Premium	0.023	-0.009	-0.100	-0.117	-3.979	0.021	0.873	0.000
(t-value)	(3.676)	(-0.860)	(-4.024)	(-4.395)	(-1.813)	(0.850)		
[t-value(adj)]	[1.715]	[-0.388]	[-1.999]	[-2.396]	[-0.906]	[0.390]		
	Constant	HHOLDS	NFINCO	NONCOR	FARM		Adj R^2	Joint Sig
Premium	0.024	-0.009	-0.098	-0.112	-3.805		0.878	0.000
(t-value)	(3.800)	(-0.862)	(-3.869)	(-4.403)	(-1.875)			
[t-value(adj)]	[1.832]	[-0.402]	[-1.996]	[-2.471]	[-0.965]			
	Constant	HHOLDS	NFINCO	NONCOR			Adj R^2	Joint Sig
Premium	0.030	-0.025	-0.112	-0.164			0.737	0.000
(t-value)	(4.070)	(-1.898)	(-4.175)	(-4.095)				
[t-value(adj)]	[1.674]	[-0.745]	[-1.727]	[-2.257]				
	Constant	NFINCO	NONCOR	FARM			Adj R^2	Joint Sig
Premium	0.028	-0.120	-0.139	-2.530			0.837	0.000
(t-value)	(5.039)	(-2.879)	(-3.610)	(-0.981)				
[t-value(adj)]	[2.162]	[-1.325]	[-1.885]	[-0.434]				
	Constant	RMRF					Adj R^2	Joint Sig
Premium	0.035	-0.010					0.061	0.369
(t-value)	(3.641)	(-0.899)						
[t-value(adj)]	[3.613]	[-0.803]						
	Constant	RMRF	SMB	HML			Adj R^2	Joint Sig
Premium	0.031	-0.012	0.003	0.012			0.654	0.015
(t-value)	(2.343)	(-0.829)	(0.822)	(2.923)				
[t-value(adj)]	[2.265]	[-0.753]	[0.566]	[2.034]				
	Constant	NONRES	RESIDE				Adj R^2	Joint Sig
Premium	0.026	0.012	0.018				-0.001	0.269
(t-value)	(3.098)	(0.966)	(1.379)					
[t-value(adj)]	[2.706]	[0.889]	[1.178]					

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 1952Q2 to 2000Q4.

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

	Constant	HHOLDS	NFINCO	NONCOR	FARM	FINAN	SIZE	Adj R^2
Premium	0.045	-0.021	-0.068	-0.111	-4.436	0.006	-0.002	0.880
(t-value)	(2.781)	(-1.585)	(-2.179)	(-4.039)	(-2.141)	(0.246)	(-1.408)	
[t-value(adj)]	[1.394]	[-0.771]	[-1.092]	[-2.449]	[-1.182]	[0.122]	[-0.705]	
	Constant	HHOLDS	NFINCO	NONCOR	FARM		SIZE	Adj R^2
Premium	0.043	-0.019	-0.070	-0.102	-4.031		-0.002	0.882
(t-value)	(2.584)	(-1.394)	(-2.218)	(-3.903)	(-2.070)		(-1.102)	
[t-value(adj)]	[1.372]	[-0.719]	[-1.193]	[-2.428]	[-1.202]		[-0.585]	
	Constant	HHOLDS	NFINCO	NONCOR			SIZE	Adj R^2
Premium	0.036	-0.029	-0.104	-0.162			-0.001	0.725
(t-value)	(2.018)	(-2.097)	(-2.640)	(-3.709)			(-0.293)	
[t-value(adj)]	[0.849]	[-0.842]	[-1.104]	[-2.112]			[-0.123]	
	Constant	NFINCO	NONCOR	FARM			SIZE	Adj R^2
Premium	0.037	-0.078	-0.104	-4.009			-0.001	0.886
(t-value)	(3.047)	(-2.981)	(-3.949)	(-2.039)			(-0.930)	
[t-value(adj)]	[1.582]	[-1.594]	[-2.456]	[-1.152]			[-0.483]	
	Constant	RMRF					SIZE	Adj R^2
Premium	0.081	-0.033					-0.004	0.662
(t-value)	(4.656)	(-2.734)					(-3.101)	
[t-value(adj)]	[4.306]	[-2.482]					[-2.867]	
	Constant	NONRES	RESIDE				SIZE	Adj R^2
Premium	0.071	0.024	-0.017				-0.004	0.134
(t-value)	(5.271)	(1.984)	(-1.368)				(-3.219)	
[t-value(adj)]	[3.605]	[1.827]	[-0.959]				[-2.202]	

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	FARM	FINAN	BM	Adj R^2
Premium	0.022	-0.010	-0.100	-0.113	-3.494	0.024	0.001	0.867
(t-value)	(3.541)	(-0.970)	(-3.961)	(-4.017)	(-1.618)	(1.015)	(0.391)	
[t-value(adj)]	[1.710]	[-0.452]	[-2.049]	[-2.230]	[-0.827]	[0.481]	[0.189]	
	Constant	HHOLDS	NFINCO	NONCOR	FARM		BM	Adj R^2
Premium	0.023	-0.010	-0.098	-0.109	-3.300		0.001	0.874
(t-value)	(3.618)	(-0.986)	(-3.895)	(-4.096)	(-1.703)		(0.475)	
[t-value(adj)]	[1.790]	[-0.470]	[-2.074]	[-2.337]	[-0.887]		[0.235]	
	Constant	HHOLDS	NFINCO	NONCOR			BM	Adj R^2
Premium	0.022	-0.023	-0.106	-0.123			0.004	0.814
(t-value)	(3.476)	(-1.791)	(-4.029)	(-4.080)			(1.933)	
[t-value(adj)]	[1.708]	[-0.839]	[-2.081]	[-2.338]			[0.950]	
	Constant	NFINCO	NONCOR	FARM			BM	Adj R^2
Premium	0.023	-0.111	-0.118	-1.592			0.003	0.857
(t-value)	(3.720)	(-3.116)	(-4.102)	(-0.504)			(0.937)	
[t-value(adj)]	[1.796]	[-1.642]	[-2.302]	[-0.248]			[0.453]	
	Constant	RMRF					BM	Adj R^2
Premium	0.016	0.001					0.008	0.541
(t-value)	(1.455)	(0.058)					(3.136)	
[t-value(adj)]	[1.455]	[0.052]					[3.136]	
	Constant	NONRES	RESIDE				BM	Adj R^2
Premium	0.009	-0.011	-0.005				0.008	0.547
(t-value)	(1.272)	(-1.206)	(-0.342)				(3.142)	
[t-value(adj)]	[1.165]	[-1.159]	[-0.297]				[2.877]	

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: 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*
Five-Factor Investment Growth Model	statistic	9.684		0.449	19.571	1.916
	(p-value)	(0.974)	(0.001)	(0.932)		(0.384)
Four-Factor Investment Growth Model	statistic	9.905		0.478	17.190	1.255
	(p-value)	(0.980)	(0.000)	(0.870)		(0.534)
Three-Factor Investment Growth Model (1)	statistic	16.149		0.509	17.887	5.382
	(p-value)	(0.808)	(0.000)	(0.672)		(0.068)
Three-Factor Investment Growth Model (2)	statistic	19.199		0.564	17.569	1.181
	(p-value)	(0.633)	(0.003)	(0.281)		(0.554)
CAPM	statistic	32.727		0.603	2.835	18.203
	(p-value)	(0.110)	(0.000)	(0.000)		(0.000)
The Fama-French Model	statistic	28.823		0.553	12.257	
	(p-value)	0.150	0.000	0.003		
Cochrane's Model	statistic	25.109		0.587	11.739	6.314
	(p-value)	(0.345)	(0.000)	(0.035)		(0.043)

Panel B: Scaled Returns by Default Premium

	Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
Five-Factor Investment Growth Model	statistic	14.027		0.545	16.549	13.800
	(p-value)	(0.829)	(0.000)	(0.152)		(0.001)
Four-Factor Investment Growth Model	statistic	13.769		0.590	16.673	13.889
	(p-value)	(0.879)	(0.000)	(0.020)		(0.001)
Three-Factor Investment Growth Model (1)	statistic	20.193		0.600	11.908	14.373
	(p-value)	(0.571)	(0.000)	(0.013)		(0.001)
Three-Factor Investment Growth Model (2)	statistic	15.176		0.628	15.962	1.456
	(p-value)	(0.855)	(0.000)	(0.004)		(0.483)
CAPM	statistic	30.970		0.612	2.647	13.128
	(p-value)	(0.155)	(0.000)	(0.000)		(0.001)
The Fama-French Model	statistic	29.003		0.578	8.523	
	(p-value)	(0.145)	(0.000)	(0.001)		
Cochrane's Model	statistic	24.551		0.566	10.866	7.878
	(p-value)	(0.374)	(0.000)	(0.035)		(0.019)

Note: The returns on the test assets are scaled by the information variables noted in the panels. Same comments as in Table 2 apply.

Table 6A: GMM Estimations after Excluding Observations with Extreme HML and SMB Values

Panel A: Five-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FARM	FINAN
Coefficient	0.949	-20.333	13.030	12.054	0.076	-1.093
(t-value)	(4.136)	(-2.882)	(2.549)	(1.982)	(1.199)	(-0.309)
Premium		0.025	-0.101	-0.084	-3.607	0.026
(t-value)		(2.445)	(-3.994)	(-3.573)	(-2.072)	(0.778)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*	
statistic	14.766		0.565	16.245	2.259	
(p-value)	(0.790)	(0.002)	(0.365)		(0.323)	

Panel B: Four-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FARM
Coefficient	0.911	-19.799	12.623	12.036	0.077
(t-value)	(5.254)	(-3.073)	(3.050)	(2.191)	(1.226)
Premium		0.025	-0.100	-0.084	-3.744
(t-value)		(2.580)	(-4.432)	(-3.740)	(-2.306)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	15.216		0.566	14.918	2.285
(p-value)	(0.812)	(0.001)	(0.436)		(0.319)

Panel C1: Three-Factor Investment Growth Factor Model (1)

	Constant	HHOLDS	NFINCO	NONCOR	
Coefficient	0.876	-16.527	11.592	9.651	
(t-value)	(5.662)	(-2.861)	(3.082)	(2.032)	
Premium		0.019	-0.098	-0.071	
(t-value)		(2.233)	(-4.787)	(-3.579)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	19.348		0.589	11.949	8.060
(p-value)	(0.624)	(0.001)	(0.254)		(0.018)

Panel C2: Three-Factor Investment Growth Factor Model (2)

	Constant	NFINCO	NONCOR	FARM	
Coefficient	0.787	6.302	5.230	0.033	
(t-value)	(8.551)	(2.515)	(1.369)	(0.949)	
Premium		-0.059	-0.058	-0.451	
(t-value)		(-3.806)	(-3.256)	(-0.359)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	26.141		0.617	10.718	3.699
(p-value)	(0.246)	(0.034)	(0.099)		(0.157)

Panel D: CAPM

	Constant	RMRF			
Coefficient	1.088	-3.017			
(t-value)	(24.618)	(-3.134)			
Premium		0.018			
(t-value)		(23.953)			
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	31.889		0.651	8.373	21.565
(p-value)	(0.130)	(0.002)	(0.000)		(0.000)

Panel E: The Fama-French Model

	Constant	RMRF	SMB	HML
Coefficient	1.203	-4.258	1.550	-7.549
(t-value)	(18.141)	(-3.574)	(1.046)	(-4.413)
Premium		0.018	0.003	0.008
(t-value)		(25.269)	(7.120)	(10.590)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*
statistic	27.877		0.599	12.563
(p-value)	(0.180)	(0.000)	(0.002)	

Panel F: Cochrane's Model

	Constant	NONRES	RESIDE		
Coefficient	0.663	27.758	-7.592		
(t-value)	(4.428)	(3.941)	(-1.736)		
Premium		-0.014	0.016		
(t-value)		(-2.740)	(2.136)		
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	26.895		0.665	10.363	8.960
(p-value)	(0.260)	(0.000)	(0.001)		(0.011)

Note: The observations excluded are 1974Q1, 1974Q4, 1976Q1, 1981Q1, 1992Q1, 1998Q4, 1999Q4, and 2000Q4. All other comments of Table 2 apply.

Table 6B: GMM Estimations after Excluding Observations Investment Growth Rates Exhibit Extreme Values.

Panel A: Five-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FARM	FINAN
Coefficient	0.552	-17.461	12.436	29.338	-0.887	-2.832
(t-value)	(1.564)	(-2.037)	(1.409)	(3.065)	(-1.721)	(-0.501)
Premium		0.008	-0.099	-0.074	0.316	0.009
(t-value)		(0.641)	(-2.004)	(-2.266)	(1.712)	(0.309)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*	
statistic	16.146		0.577	22.653	5.709	
(p-value)	(0.708)	(0.035)	(0.603)		(0.058)	

Panel B: Four-Factor Investment Growth Factor Model

	Constant	HHOLDS	NFINCO	NONCOR	FARM
Coefficient	0.585	-17.332	11.200	24.372	-0.838
(t-value)	(1.923)	(-2.253)	(1.561)	(2.854)	(-1.793)
Premium		0.013	-0.090	-0.061	0.275
(t-value)		(1.175)	(-2.205)	(-2.207)	(1.713)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	17.970		0.577	18.370	7.688
(p-value)	(0.651)	(0.017)	(0.650)		(0.021)

Panel C1: Three-Factor Investment Growth Factor Model (1)

	Constant	HHOLDS	NFINCO	NONCOR	
Coefficient	0.729	-13.381	8.432	12.960	
(t-value)	(3.264)	(-2.457)	(1.685)	(2.165)	
Premium		0.016	-0.073	-0.037	
(t-value)		(1.904)	(-2.490)	(-1.890)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	24.236		0.649	11.142	14.237
(p-value)	(0.335)	(0.010)	(0.025)		(0.001)

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

	Constant	NFINCO	NONCOR	FARM	
Coefficient	0.430	8.383	16.098	-0.357	
(t-value)	(1.809)	(1.485)	(2.321)	(-1.125)	
Premium		-0.067	-0.056	0.045	
(t-value)		(-2.020)	(-2.500)	(0.361)	
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	23.177		0.637	14.575	5.737
(p-value)	(0.392)	(0.113)	(0.067)		(0.057)

Panel D: CAPM

	Constant	RMRF			
Coefficient	1.065	-2.601			
(t-value)	(26.670)	(-2.822)			
Premium		0.017			
(t-value)		(23.361)			
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	30.638		0.645	6.834	19.674
(p-value)	(0.165)	(0.005)	(0.000)		(0.000)

Panel E: The Fama-French Model

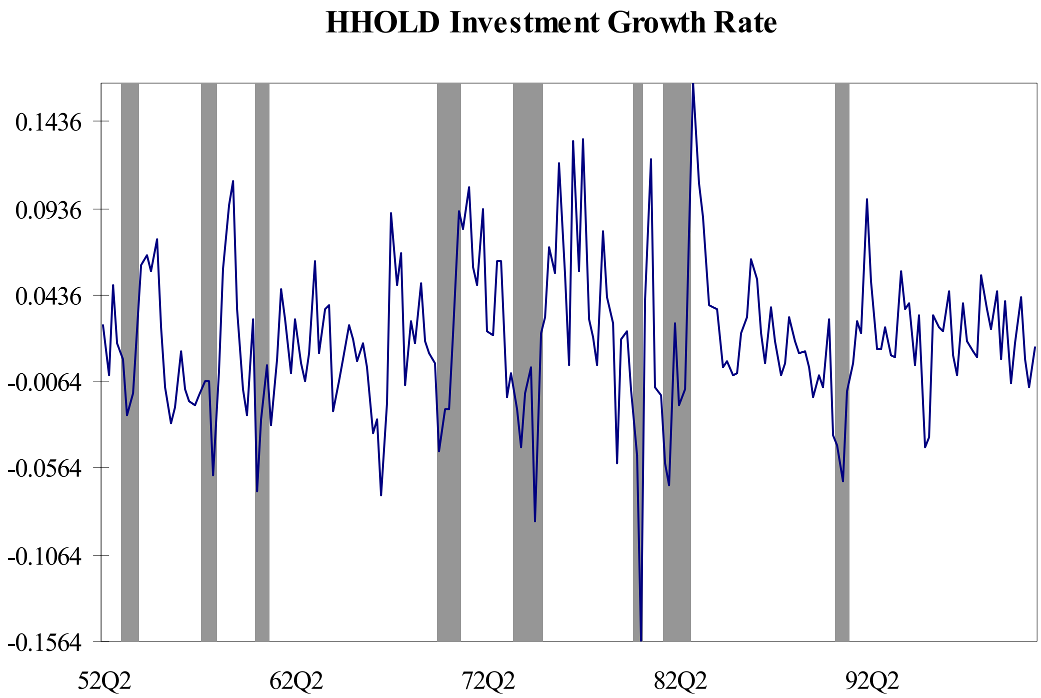
	Constant	RMRF	SMB	HML
Coefficient	1.151	-3.593	0.969	-6.375
(t-value)	(20.081)	(-3.333)	(0.732)	(-4.431)
Premium		0.017	0.002	0.008
(t-value)		(24.238)	(4.239)	(9.122)
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*
statistic	27.091		0.606	13.435
(p-value)	(0.208)	(0.000)	(0.003)	

Panel F: Cochrane's Model

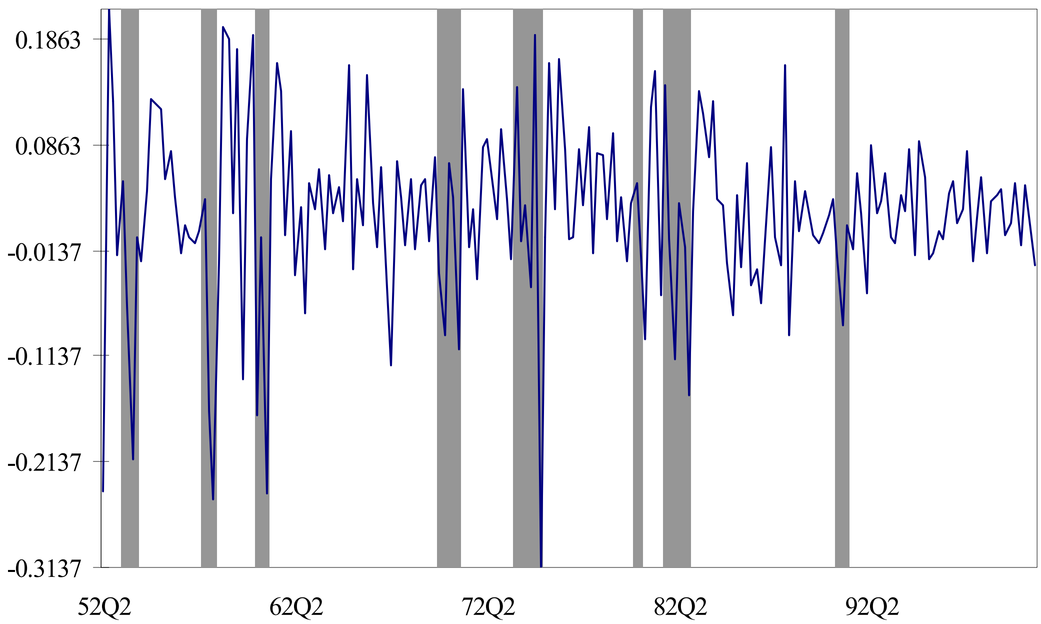
	Constant	NONRES	RESIDE		
Coefficient	0.887	14.806	-9.672		
(t-value)	(4.857)	(1.643)	(-2.853)		
Premium		-0.008	0.027		
(t-value)		(-1.548)	(4.792)		
Tests:	*J*	*Wald(b)*	*HJ Dist*	*sup LM*	*Δ J*
statistic	29.353		0.660	9.340	6.021
(p-value)	(0.169)	(0.007)	(0.001)		(0.049)

Note: The observations excluded are 1952Q2, 1953Q1, 1958Q1, 1960Q4, 1964Q1, 1968Q1, 1974Q1, 1975Q1, 1980Q2, 1983Q3, 1987Q3, 1989Q1, 1997Q4, 1998Q1, 1998Q4, 1999Q2, and 1999Q3. All other comments of Table 2 apply.

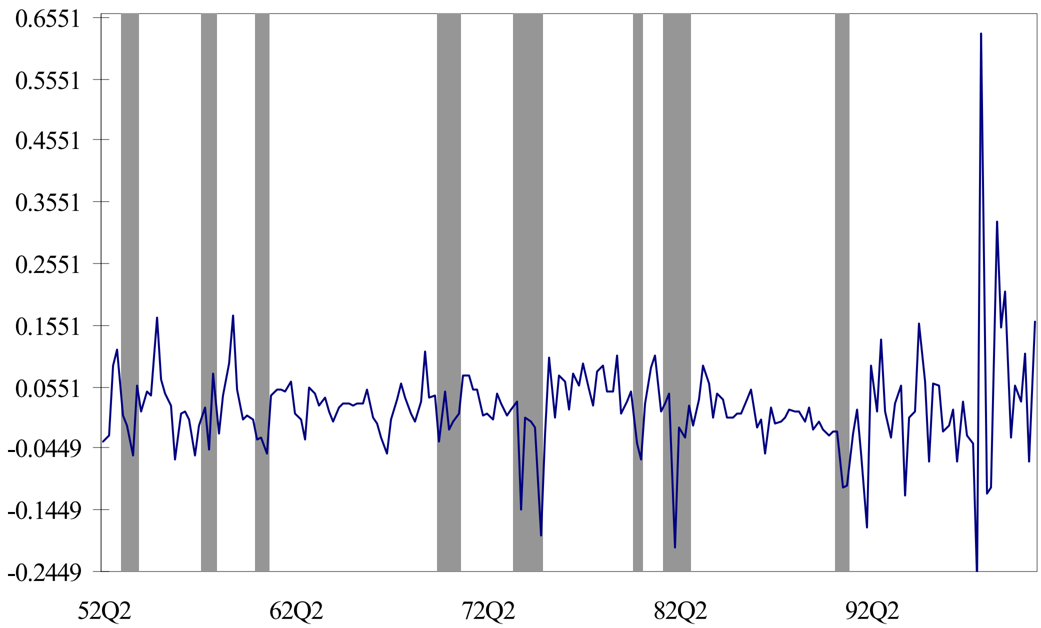
Figure 1: Investment Growth Rates



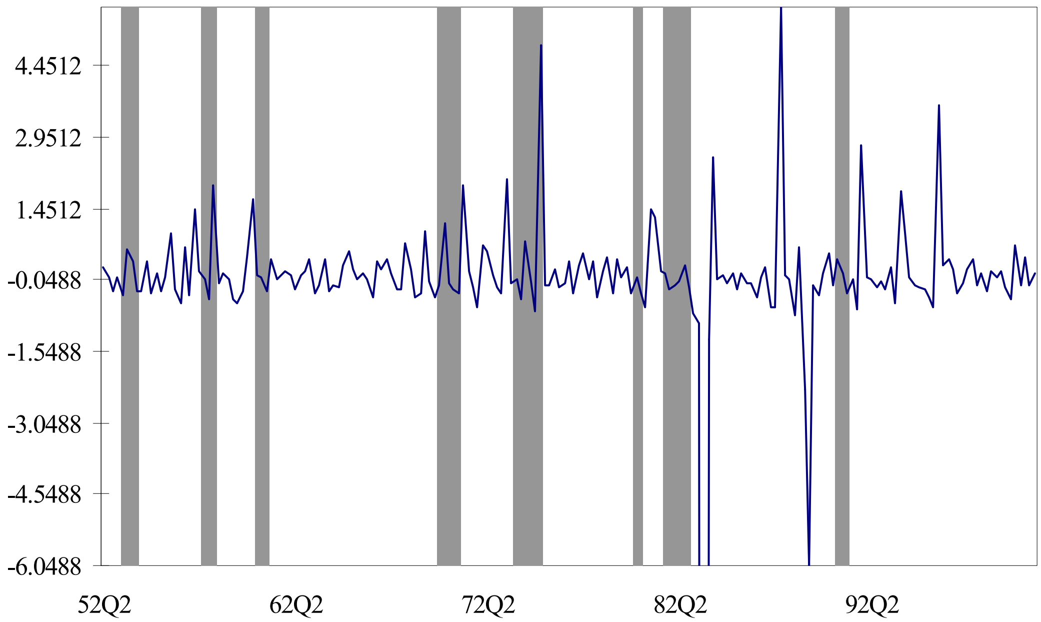
NFINCO Investment Growth Rate



NONCOR Investment Growth Rate



FARM Investment Growth Rate



FINAN Investment Growth Rate

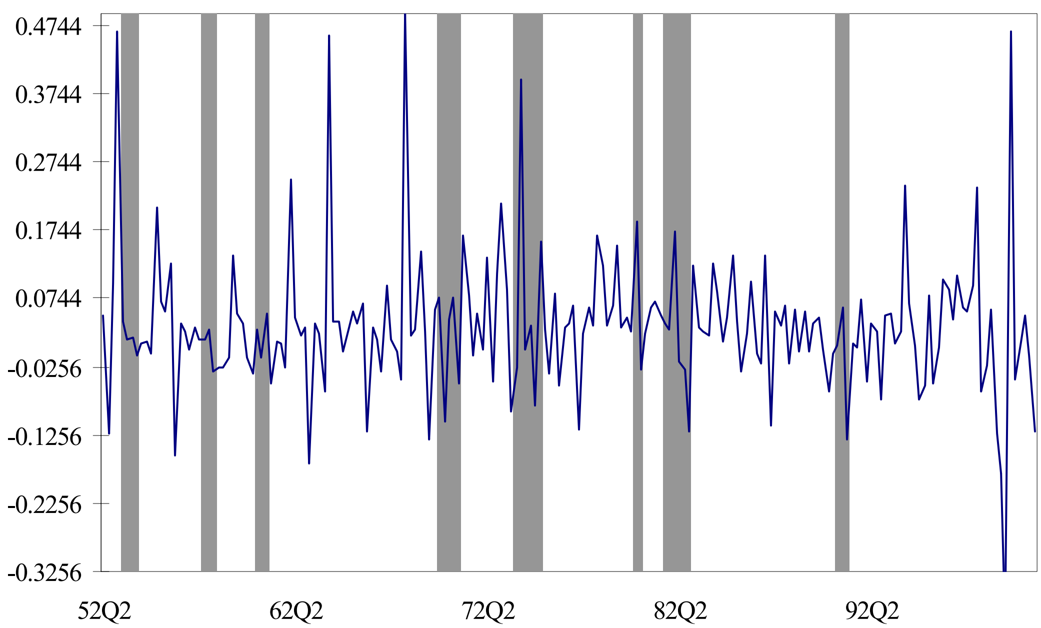
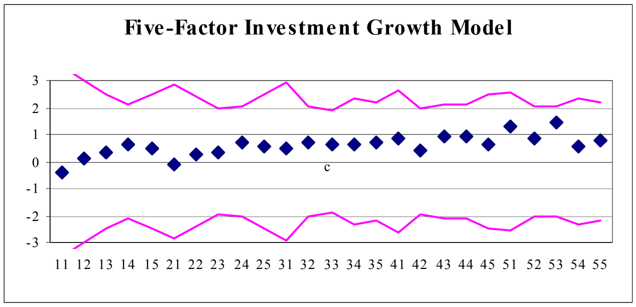
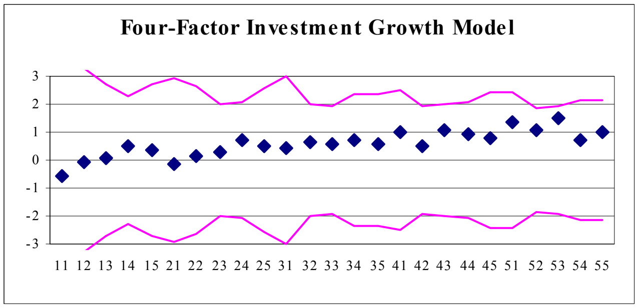
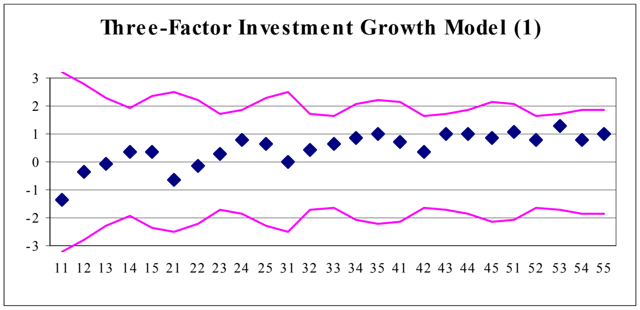
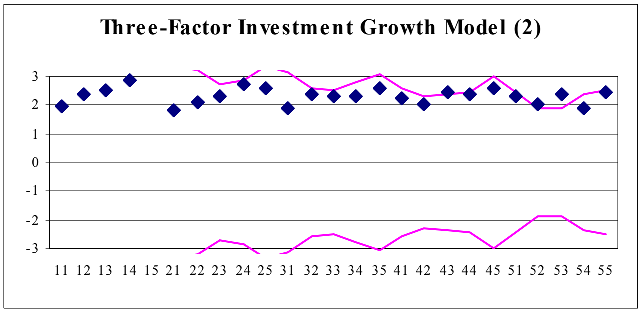


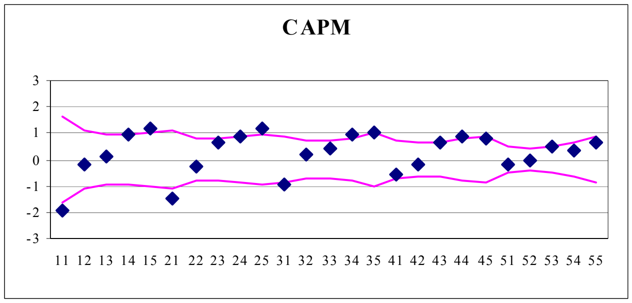
Figure 2: Pricing Errors of Unscaled Returns: GMM Estimations

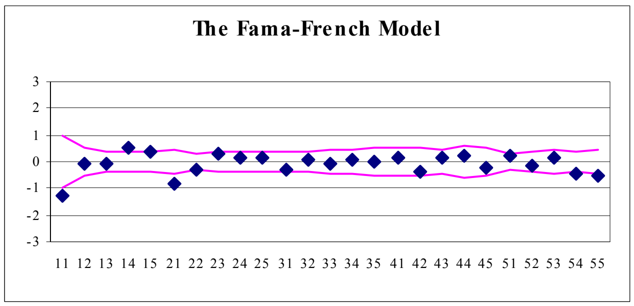


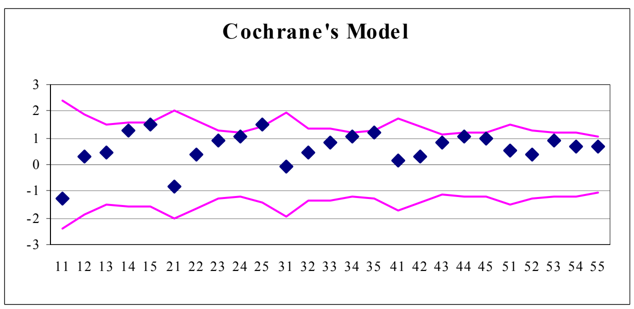






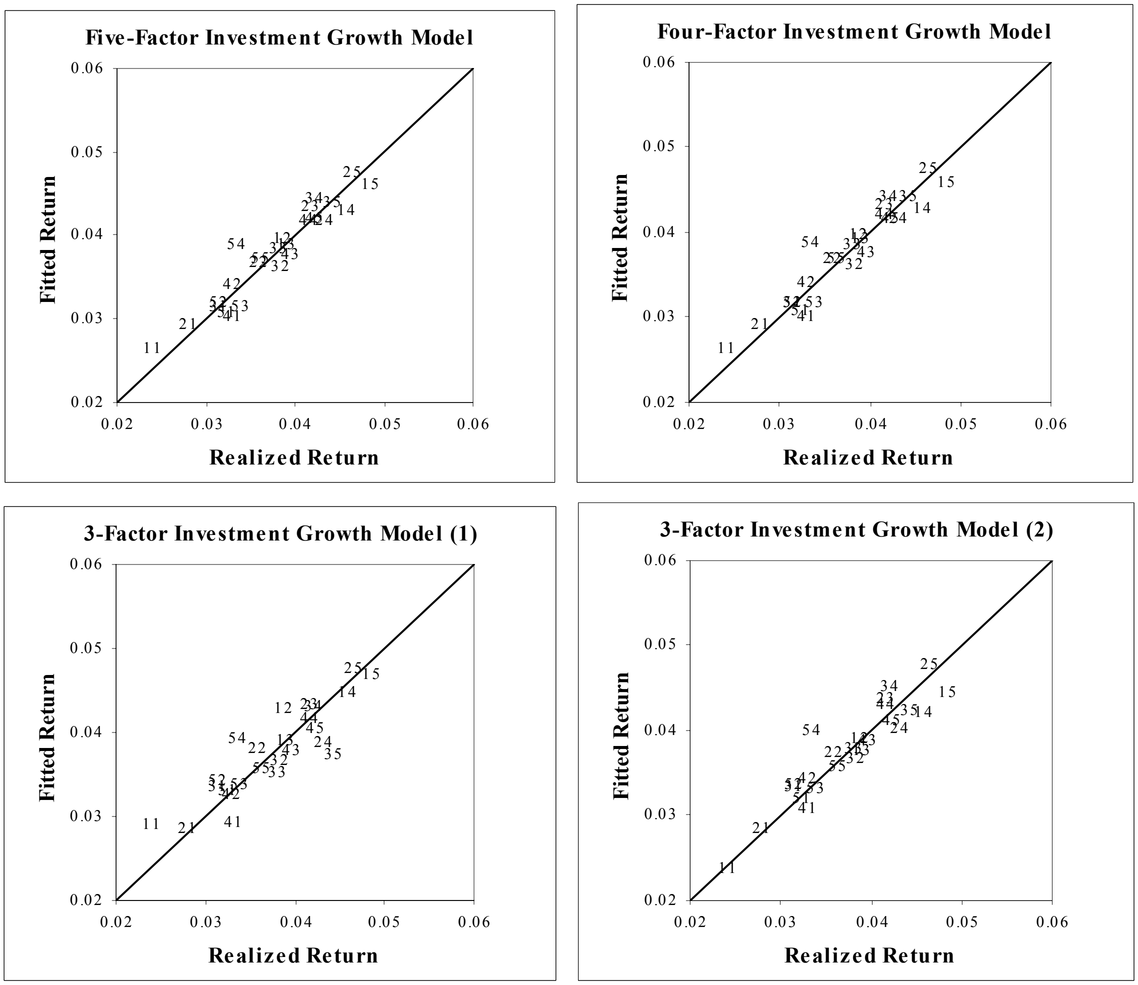


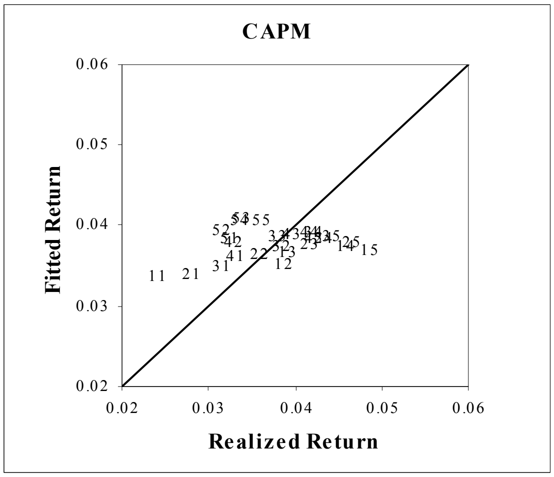


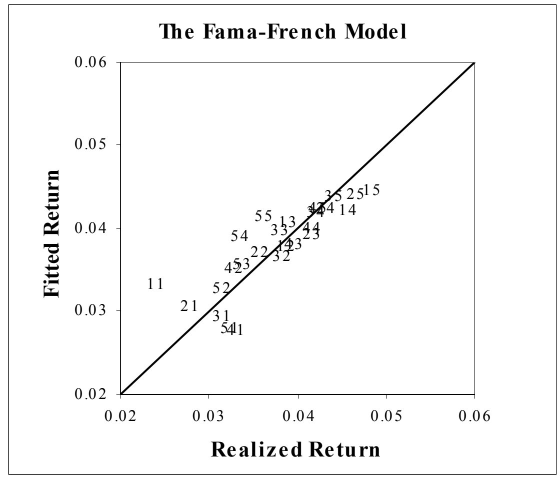


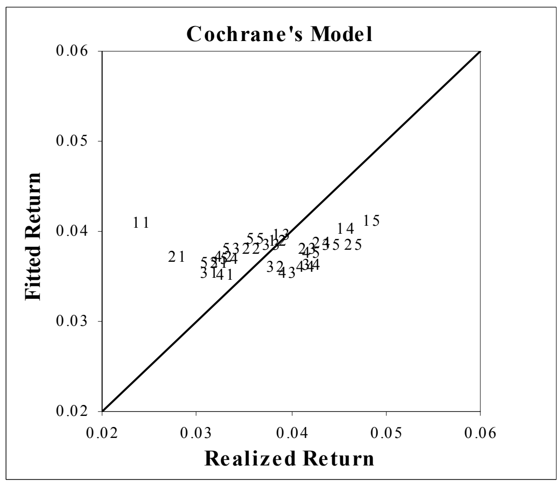
Note: The labels on the x-axis indicate the portfolio number. The first digit refers to the size quintile and the second digit to the book-to-market quintile. The scale on y-axis is in percentage points. The two lines denote the two standard-error band. The three-factor investment growth model (1) refers 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 NFINCO, NONCOR, and FARM in the pricing kernel.

Figure 3: Realized vs Fitted Returns from the Fama-MacBeth Regressions: 25 Portfolios









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 the investment growth rates of HHOLDS, NFINCO, and NONCOR as factors. Similarly, the three-factor investment growth model (2) is the one whose factors are the NFINCO, NONCOR, and FARM investment growth rates.