New Return Anomalies and new-Keynesian ICAPM [1]

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Abstract

I propose a new multi-factor asset pricing model with new-Keynesian factors to explain stock return anomalies from 1972Q1 to 2009Q2. This new model explains the average returns across testing portfolios formed on financial distress, momentum, and standardized unexpected earnings with misspecification-robust statistics. Test portfolios formed on net stock issues and total accruals are also partly explained by new-Keynesian factors. Two monetary policy factors play an important role in explaining these new anomalies. The credit aspect of these new anomalies suggests an economic rational for the model through capital market imperfections and the credit channel of monetary policy mechanism.

Keywords: new-Keynesian ICAPM, Return Anomalies, Capital Market Imperfections, Misspecification-Robust Inference

JEL Classification: E32, E52, G12

1 Introduction

Fama and French (1996) demonstrate that their three-factor model with the market excess return (RMRF) and two mimicking portfolios based on market capitalization (SMB) and book-to-market (HML) can explain the average return variations across portfolios formed on many different characteristics. They interpret their two mimicking portfolios as risk factors capturing risk premia for the relative distress of firms in the context of the ICAPM.

However, there are patterns in average stock returns that are considered new anomalies because they are not explained by the Fama-French three-factor model. Fama and French (2008) find that the anomalous returns associated with net stock issues, accruals, and momentum are pervasive in all size groups in cross-section regressions. Furthermore, Campbell, Hilscher, and Szilagyi (2008) report that more distressed firms have lower average returns despite their high loadings on HML than less distressed firms. They conclude that their results indicate a significant challenge to the Fama-French model. Finally, the post-earnings-announcement drift anomaly or earnings momentum exists, first documented by Ball and Brown (1968), which describes the outperformance of good-news firms with high standardized-unexpected earnings (SUE) relative to bad-news (low-SUE) firms.

Recently, several papers propose commonalities in these asset pricing anomalies. For example, Avramov, Chordia, Jostova, and Philipov (2012) find that strategies based on price momentum, earnings momentum, credit risk, and other anomalies derive their profitability from taking short positions in high credit risk firms during the deteriorating credit conditions. While Avramov, Chordia, Jostova, and Philipov (2012) do not find risk-based explanations for the commonalities, other researchers find connections between these anomalies and aggregate risk factors. For example, Mahajan, Petkevich, and Petkova (2012) claim that momentum is a compensation for the systemic default risk because momentum profits are concentrated in periods of high default shocks. Liu and Zhang (2008) find that the growth rate of industrial production is a priced risk factor for the momentum. Finally, Chen, Novy-Marx, and Zhang (2010) demonstrate that neoclassical factors based on the q-theory can explain these return anomalies. These results suggest that an asset pricing model with macroeconomic factors is a good candidate to describing these return anomalies. Particularly asset pricing models with neoclassical factors have a clear interpretation because the motivation of the selected factors are from equilibrium macroeconomic models.

In this paper, I add a new dimension to this literature. I argue that an Intertemporal CAPM with new-Keynesian factors motivated from new-Keynesian dynamic stochastic general equilibrium models (DSGE) is important to understand these anomalies. Like the neoclassical approach, new-Keynesian macroeconomic analysis has micro-foundations with rational expectations. However, new-Keynesian analysis assumes a variety of market failures and emphasizes the importance of monetary policy actions. Surprisingly, these factors have not been received deserved attention in explaining the cross-sectional asset pricing puzzles. For example, it is well known that the stock market investors continuously watches and forms expectations about the Federal Reserve Board (Fed) decisions. It seems natural to investigate the role of these monetary factors because the actions of the Fed seem to have a considerable impact on stock market returns.

However, I do not impose tight restrictions of the new-Keynesian DSGE in driving the asset pricing model with new-Keynesian factors. This reduced-form approach would induce misspecification biases naturally. To ensure robust and valid inference under the potential misspecification, I use misspecification-robust standard errors in the second pass cross-sectional regression for estimates of the risk premia or the prices of covariance risk proposed by Kan, Robotti, and Shanken (2012). They demonstrate that the statistical inference in asset pricing models particularly with macroeconomic factors should be conducted allowing for the possibility of potential misspecification to avoid spurious results. For the better comparison with the literature, I also report the standard errors based on Fama and MacBeth (1973), Shanken (1992), and Jagannathan and Wang (1998) under correctly specified models. As expected, the use of misspecification-robust standard errors often makes a qualitative difference in determining whether estimates of the risk premia or the prices of covariance risk are statistically significant, confirming the usefulness of this robust statistics. Finally, I also report standard errors of adjusted R^2 following Kan, Robotti, and Shanken (2012).

The results with these robust statistical tools show that the new-Keynesian ICAPM explains the average returns of portfolios formed on financial distress, price and earnings momentums with statistically significant adjusted R^2. Furthermore, I find that other anomalies can be at least partially explained by these new-Keynesian factors. Particularly, I find that the temporary monetary policy factor explains the distress and momentum premia, and the permanent monetary policy factor captures the anomalous returns on portfolios formed on SUE and total accruals. These two monetary factors also have theoretically-consistent negative risk prices because higher interest rates from monetary tightening forecast negative changes in investment opportunities.[1] Other factors have limited success in explaining the anomalies with misspecification-robust standard errors. While the proposed new multi-factors model has a limited success in driving out some of the anomalies, the results with new-Keynesian factors looks sufficiently encouraging to warrant further empirical investigation. At a minimum, the evidence shows that the new-Keynesian factor model is possible to shed new light on understanding the puzzling risk premia in stock markets.

One economic interpretation of the results is the capital market imperfections story. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) predict that changing

[1] As described carefully by Maio and Santa-Clara (2012), any ICAPM should produce theoretically consistent risk prices.

credit market conditions can have very different effects on firms'risks and expected returns. Interestingly, Avramov, Chordia, Jostova, and Philipov (2012) show that return anomalies such as momentum profits are restricted to high credit risk firms and are nonexistent for firms of high credit quality. Mahajan, Petkevich, and Petkova (2012) claim that this credit risk is a systematic risk factor. The credit channel mechanism of monetary policy describes the theory that a central bank's policy changes affect the amount of credit that banks issue to firms and consumers for purchases, which in turn affects the real economy and return-risk characteristics of firms. Particularly, during a flight-to-quality episode (deteriorating credit conditions) external financing becomes harder for lower quality borrowers. Investors or banks faced with tightened balance sheet and uncertainty aversion shift their portfolio only towards high quality borrowers. During this uncertain period, however, easier monetary policy (arguably temporary monetary policy shock) can generate much needed liquidity within the financial system, correspondingly changing the credit conditions.

The rest of the paper is organized as follows. Section 2 presents briefly the structural new-Keynesian model employed in this study. Section 3 outlines the empirical methods. Section 4 presents the data and discusses the cross-sectional results of the new-Keynesian factor models for portfolios formed on various anomalies. Section 5 summarizes the main findings and concludes.

2 Empirical asset pricing models

This section motivates the new-Keynesian ICAPM; the first subsection briefly discusses a multi-factor asset pricing model implied by new-Keynesian equilibrium models and the second subsection explains the Keynesian DSGE model employed to identify new-Keynesian factors.

2.1 The pricing kernel of the new-Keynesian models

Without imposing any theoretical structure, the fundamental existence theorem of Harrison and Kreps (1979) states that, in the absence of arbitrage, there exists a positive stochastic discount factor, or pricing kernel, M_{t+1}, such that, for any traded asset with a gross return at time t of $R_{i,t+1}$, the following equation holds:

$$1 = E_t[M_{t+1}(R_{i,t+1})] \tag{2.1}$$

where E_t denotes the expectation operator conditional on information available at time t.

Standard new-Keynesian macro models employ the following external habit specification in utility function built on Fuhrer (2000).[2]

$$E_t \sum_{s=t}^{\infty} \psi^{s-t} U(C_s; F_s) = E_t \sum_{s=t}^{\infty} \psi^{s-t} \left[\frac{F_s C_s^{1-\sigma} - 1}{1-\sigma} \right]$$

where C_s is the composite index of consumption, F_s represents an aggregate demand shifting factor and usually denotes as $H_s G_s$ where H_s is an external habit level and $G_s$is a preference shock.;ψ denotes the subject discount factor and σ is the inverse of the intertemporal elasticity of consumption.

Bekaert, Cho, and Moreno (2005) derive the pricing kernel implied by Fuhrer (2000) assuming standard log-normality and simple three-equation new-Keynesian model:

$$m_{t+1} = \ln \psi - \sigma y_{t+1} + (\sigma + \eta) y_t - (g_{t+1} - g_t) - \pi_{t+1} \tag{2.2}$$

where $m_{t+1} = \ln(M_{t+1})$, y_{t+1} is detrended log output, $g_{t+1} = \ln(G_{t+1})$ and π_{t+1} is the

[2] I closely follow the representation given in Bekaert, Cho, and Moreno (2005). Refer to the first nine chapters in Woodford (2003) for more detailed explanations.

inflation rate.

They express (2.2) in terms of the structural shocks in the economy.

$$m_{t+1} = -i_t - \frac{1}{2}\Lambda' D \Lambda - \Lambda' \varepsilon_{t+1} \tag{2.3}$$

where Λ' is a vector of prices of risks entirely restricted by the structural parameters of new-Keynesian models and D is the covariance matrix of structural shocks.

The pricing kernel (2.3) is a linear combination of structural shocks to the overall economy. In this way, any new-Keynesian model can be expressed as an asset pricing model. However, strictly speaking, this pricing kernel assumes constant risk premium. Bekaert, Cho, and Moreno (2005) articulate that without either heteroscedasticity of structural shocks or time-varying market price of risk, their model essentially imposes that expectation hypothesis holds in the bond market.

One possible remedy is to adapt the external habit specification of Fuhrer (2000) to that of Campbell and Cochrane (1999) and develop a pricing kernel with time-varying risk aversion. Since time-varying risk aversion is emphasized in the finance literature, this extension would be beneficial for explaining asset pricing facts. Another suggestion would be introducing heteroscedasticity in the pricing kernel and structural shocks. While some steps in this direction have begun to be taken only recently,[3] the common practice is to estimate the log-linearized economy and plug the estimates into the second-order approximation.

The easiest but perhaps ad-hoc solution is often implemented (e.g. Rudebusch and Wu (2004) and Hordahl, Tristani, and Vestin (2006)). These researchers simply ignore pricing kernel implications of their models and set the pricing kernel exogenously. Similar approaches are often employed in the empirical finance literature, too. For example,

[3]Refer to An (2006) for Bayesian estimation of this type of models.

researchers employ a version of the Campbell (1996)'s ICAPM with the homoskedastic volatility even though it might not have mechanisms to generate time-varying risk premium. Petkova (2006) estimates this version of the model with homoskedastic VAR to extract state variables and uses her five factor "ICAPM" model to explain the value premium. Even though theoretically it is possible to modify the pricing framework in (2.3) using time-varying price of risk or heteroscedasticity, I defer these attempts to future studies.

Instead, I focus on other aspects of new-Keynesian models. Since Smets and Wouters (2003) developed a large-scale new-Keynesian DSGE model, these models are not only attractive from a theoretical point of view, but also are emerging as useful forecasting tools in macroeconomics because posterior odds favored these DSGE model relative to VARs estimated with a diffuse training sample prior. As explained in Del Negro, Schorfheide, Smets, and Wouters (2007), the structural VAR based on DSGE model can be used as forecasting tools.

The ICAPM intuition suggests that state variables should forecast the changing investment opportunity set in that economy. In this sense, reasonably identified state variables from the structural VAR of new-Keynesian models are natural candidates since impulse response analysis implied by these models show that each shock explains the future course of the economy consistent with the stylized facts in monetary economics. Furthermore, reassuringly, there are time series evidence to show that arguably the most important new-keynesian factor, the monetary policy factor affect the future risk premium (e.g. Bernanke and Kuttner (2005) and Jensen, Mercer, and Johnson (1996))[4]

Based on this intuition and empirical facts, I propose the following new-Keynesian

[4]As explained in Campbell (1996), state variables in the ICAPM could forecast the future movement of stock returns.

ICAPM.

$$E(R_i) = \gamma_0 + \gamma_M \beta_{i,M} + \sum \left(\gamma_{u(k)}\right) \beta_{i,u(k)}, \forall i \tag{2.4}$$

where $E(R_i)$ is the return of asset i, γ_0 is the zero beta rate, γ_M is the market risk premium, and $\gamma_{u(k)}$ is the price of risk for innovations in new-Keynesian factors k. The betas are the slope coefficients from the regression of returns on the innovations of new-Keynesian factors.

The model says that the expected excess return on a portfolio is described by the sensitivity of its return to the market portfolio(RMRF) and innovations in the new-Keynesian factors I extract from a new-Keynesian DSGE model.

However, there are concerns on the misspecification of these models. For example, Del Negro, Schorfheide, Smets, and Wouters (2007) find that while the predictions of the effects of unanticipated changes in monetary policy or technology shocks derived from the new Keynesian DSGE model are not contaminated by its dynamic misspecification, some of the other shocks would suffer from the misspecification. This misspecification problem would also affect statistical inference in the current study. To ensure robust and valid inference, I use misspecification-robust standard errors in the second pass cross-sectional regression for estimates of the risk premia and the prices of covariance risk proposed by Kan, Robotti, and Shanken (2012).[5] They demonstrate that the statistical inference in asset pricing models particularly with macroeconomic factors should be conducted allowing for the possibility of potential misspecification to avoid spurious results. For the better comparison with the literature, I also report the standard errors based on Fama and MacBeth (1973), Shanken (1992), and Jagannathan and Wang (1998) under correctly specified models. As expected, the use of misspecification-robust standard errors makes a qualitative difference in determining whether estimates of the

[5]Further details will be provided in the next section.

risk premia or the prices of covariance risk are statistically significant, confirming the usefulness of this robust statistics.

2.2 New-Keynesian factors

I use De Graeve (2008) as a baseline new-Keynesian DSGE model to extract new-Keynesian factors. A series of papers proposed by Smets and Wouters (e.g.Smets and Wouters (2003)) incorporate a number of real and nominal frictions to explain the persistence in the macro-economic data. Their new-Keynesian models have become a standard approach in monetary policy literature because of its superior fits and forecasting performance[6] However, they have an exogenous ad-hoc mechanism to impose capital market imperfections.

De Graeve (2008) extends the Smets and Wouter model with a plausible endogenous mechanism to generate capital market imperfections. In his model, entrepreneurs buy the capital stock K_{t+1} from capital goods producers at a given price Q_t with either internal funds(net worth, N_{t+1}) and bank loans. Entrepreneurs cannot borrow at the risk-less rate because of the asymmetric information between the financial intermediary and entrepreneurs. Therefore, the bank should pay a state verification cost for monitoring entrepreneurs. In equilibrium, entrepreneurs borrow up to the point where the expected return to capital equals the cost of external finance.

Following Bernanke, Gertler, and Gilchrist (1999), he assumes that the premium over the risk-free rate required by the financial intermediary is a negative function of the amount of collateralized net worth. De Graeve finds that his measure of the external finance premium is closely related to readily available qualitative proxies of the premium such as credit standards (Lown and Morgan (2006)), and his model performs better than the Smets and Wouters model from Bayesian hypothesis tests.

[6] Refer to Smets and Wouters (2006) to fully understand micro-foundations of this model.

From this model, I recover the following nine structural shocks; the total factor productivity shocks (GE_A), the preference shocks (GE_B), the government spending shocks (GE_G), the shocks to investment technology (GE_I), the labor demand shocks (GE_L), the permanent monetary policy shock (GE_PIE_BAR), the price mark-up shocks (GETA_P), the temporary monetary policy shocks (GETA_R), the wage mark-up shocks (GETA_W).[7]

However, to obtain reliable empirical results using their misspecification-robust t-statistics, Kan, Robotti, and Shanken (2012) suggest to use small number of test assets (e.g. 30 assets). Further, given this constraint and the desire for both parsimony and for reliable statistical inference, it is preferable to reduce the number of factors. Here I limit the model to five factors.[8]

I first choose three asset pricing factors based on the theoretical arguments to minimize data mining bias. Recently, Avramov, Chordia, Jostova, and Philipov (2012) show that return anomalies are restricted to high credit risk firms and are nonexistent for firms of high credit quality. Mahajan, Petkevich, and Petkova (2012) claim that this credit risk is a systematic risk factor. Under capital market imperfections hypothesis and the credit channel mechanism of monetary policy, the Fed's policy changes affect the amount of credit that banks issue to firms and consumers for purchases. If the credit risk is important in explaining new return anomalies, monetary policy shocks and a proxy of capital market imperfections should be also important.

From the estimation of the De Graeve (2008)'s model, I obtain two monetary policy shocks and the estimated investment technology shocks. The investment technology shocks can be interpreted as the primary proxy for capital market imperfections as De Graeve (2008) finds that the investment technology shocks explain 85% of the external

[7]Further details are provided in the Appendix A.

[8]Most of factor-based asset pricing models do not seem to have more than five factors. For example, Liu and Zhang (2008) use five factors based on Chen, Roll, and Ross (1986).

finance premia. Each of these three theoretically motivated factors is discussed in the next section.

Finally, in addition to the market excess returns, a fifth factor is identified via several preliminary specification analyses. More precisely, I add one shock from the remaining new-Keynesian shocks and examine the statistical significance of the price of covariance risk for that additional factor. Only the preference shock seems to have independent explanatory power for some of testing portfolios while other shocks never show independent explanatory power for any asset.[9] Therefore I choose the preference shock as the fifth asset pricing factor.[10]

2.3 Digesting three new-Keynesian factors

2.3.1 Investment technology shocks

De Graeve's model has the following capital (K_t) accumulation equation.[11]

$$K_{t+1} = K_t\,(1-\tau) + \left[1 + \varepsilon_t^I - S\,(I_t/I_{t-1})\right] I_t$$

where I_t is gross investment, τ is the depreciation rate and the adjustment cost function $S\,(I_t/I_{t-1})$ is a positive function of changes in investment. As explained in Smets and Wouters (2003), ε_t^I is equivalent to a shock in the relative price of investment versus consumption goods and takes up the investment specific technological shocks. The estimated results of the De Graeve (2008) model indicate that the investment technology shocks are an important determinant for the external finance premium.

Intuitively, new-Keynesian models such as De Graeve's model can be interpreted as an extension of production-based asset pricing models with short-term frictions and

[9]Results are available upon request.

[10]Because this empirically oriented approach to select a factor could induce more severe misspecification biases, it is essential to rely on misspecification-robust inference in asset pricing tests.

[11]The linearized version of this equation is provided as A.7 in the Appendix A.

monetary policy. Kogan and Papanikolaou introduce new production-based asset pricing models motivated from a standard real-business cycle model with investment technology shocks.[12] These models decompose the firm value into the value of assets in place and the present value of future growth opportunities. Kogan and Papanikolaou (2013a) show that the investment technology shocks can explain the value premium.

Investment technology shocks affect firms differentially depending on whether they derive most of their value from their growth opportunities or assets in place because investment technology shocks get implemented in the new vintages of capital. For example, a positive investment technology shock has a larger positive impact on the market value of firms that are relatively rich in growth opportunities. Intuitively, with capital market imperfections, investment shocks can affect the external finance premium as in De Graeve's model. For example, when entrepreneurs are subject to binding collateral constraints, a reduction in the value of existing assets (or installed capital) reduces the value of collateral (net-worth) and thus the amount an entrepreneur can borrow, thereby increasing the external finance premium.

2.3.2 Permanent and temporary monetary policy shocks

De Graeve's model has two monetary policy shocks. The permanent monetary policy shocks reflect changes in the inflation target while the transitory shocks represent temporary deviations from the interest rate reaction function. Simpler new-Keynesian models with a single type of monetary policy shocks (e.g. Cho and Moreno (2006)) can be used by assuming that the inflation target of monetary policy is constant, and all monetary policy actions are transient. However, recent studies such as Coibion and Gorodnichenko (2011) find that the inflation target has been drifting over the post-WWII U.S. economic history.

[12]These models also have similar capital accumulation equation with the investment technology shocks. Kogan and Papanikolaou (2012) provides an excellent survey on these models.

Changes in the inflation target or permanent monetary policy shocks determine the persistence of measured inflation. Since Friedman (1968) initiated this literature by arguing that inflation is always and everywhere a monetary phenomenon, many researchers (e.g., Ireland (2007) or De Graeve (2008)) have used a highly persistent trend inflation process, interpreted as the Federal Reserve's slowly-moving implicit inflation target, to model the sustained rise of inflation during the 1970s (the Great Inflation period) and its subsequent decline since the 1980s, and have studied its implications for various aspects of macroeconomic dynamics. Accommodative raises in the inflation target during the 1970s are often criticized as the main cause for undermining confidence in the economy and creating more volatility in the marketplace. Many researchers believe that the Volcker's rule with a priority for price stability in the early 1980s eventually brought both inflation and unemployment down.

Changes in the inflation target can be an important factor for longer-term planning such as firms' capital investment decisions. For example, if inflation expectations and actual inflation remain within a range consistent with price stability, raising the inflation target can induce more volatile and higher inflation, thereby undermining confidence and the ability of firms and households to make longer-term plans and squandering the Fed's inflation credibility. For this reason, the Fed has taken mostly temporary measures to ease monetary and financial conditions, through both interest rate and credit channels, during recession or crisis periods to stimulate aggregate demand and ease credit conditions. Temporary monetary easing has been the main instrument to reduce credit market imperfections and to stabilize economy.

2.3.3 Q theory and monetary policy shocks

Intuitively the neoclassical q-theory of investment (e.g. Cochrane (1991)) implies that firms invest more when their marginal q (the net present value of future cash flows generated from one additional unit of capital) is high. For example, given expected cash flows, low costs of capital mean high values of marginal q and high investment, whereas high costs of capital mean low values of marginal q and low investment. Because the marginal q is not observed, average q or Tobin's Q (the market value of a firm's assets relative to their replacement costs) is frequently used instead with constant returns to scale assumption.

Tobin (1969) argues that through the interest rate channel, the Fed's monetary policy can play a crucial role in altering Tobin's Q. For example, a tightening of monetary policy induced by an increase in inflation lowers the present value of future earnings flows, thereby decreasing investment. Under the credit market imperfections, monetary policy can affect Tobin's q through credit channels, too. Hubbard (1998) summarizes two stylized facts. First, investment is significantly correlated with proxies for changes in net worth or internal funds. Second, given investment opportunities, proxies for borrowers' net worth affect investment more for lower-net-worth (or financially constrained) borrowers. The extended q-theory suggests that, to the extent that monetary policy can affect borrowers' net worth, pure interest rate effects of the Fed's monetary policy will be magnified; the more constrained the access to capital markets, the greater the sensitivity of investment to financial variables. De Graeve's model utilized in this paper include the equivalent (linearized) version of q-theory.

3 Empirical analysis under potentially misspecified models

Following the notation of Kan, Robotti, and Shanken (2012), let's denote f_t be the vector of K proposed asset pricing factors and R_t is a vector of returns on N test assets at time t.[13]

Linear beta pricing models for asset i can be expressed as

$$E\left[R^i\right] = \gamma_0 + \gamma_1' \beta_i$$

where $\beta_i{}'$s are the multiple regression coefficients of R_i on the risk factors and a constant, γ_0 is the zero-beta rate and γ_1 is the vector of risk premia on the K risk factors (f). For N test assets, we can express the above equation using a compact matrix notation as

$$E\left[R\right] = X\gamma$$

where $X = [1_N, \beta], \beta = Cov[R, f]Var[f]^{-1}$ is an (N x K) matrix of factor loadings and $\gamma = (\gamma_0, \gamma_1')'$

A popular approach to estimate these beta pricing models is two-pass cross-sectional regression method. The usual two-pass cross-sectional regression method first estimates the betas of the N test assets by running the following multivariate regression for each time t.

$$R_t = \alpha + \beta f_t + \varepsilon_t, t = 1, \ldots, T$$

Let's denote Y_t as $[f_t', R_t']'$ and compute the sample mean and covariance matrix of Y_t as

$$\hat{\mu} = \begin{bmatrix} \hat{\mu}_1 \\ \hat{\mu}_2 \end{bmatrix} = \frac{1}{T} \sum\nolimits_{t=1}^{T} Y_t$$

[13] I only summarize misspecification-robust OLS t-ratios since I only compute OLS t-ratios to explain the cross-section of original portfolio returns (return anomalies) rather than the cross-section of transformed portfolio returns (GLS) in this study.

,

$$\hat{V} = \begin{bmatrix} \hat{V}_{11} & \hat{V}_{12} \\ \hat{V}_{21} & \hat{V}_{22} \end{bmatrix} = \frac{1}{T}\sum\nolimits_{T=1}^{T}(Y_t - \hat{\mu})(Y_t - \hat{\mu})'$$

The estimated betas from this first-pass regression are given as $\hat{\beta} = \hat{V}_{21}\hat{V}_{11}^{-1}$. These estimated $\hat{\beta}$s are used as regressors in the second-pass CSR, and the zero beta rate and risk premia are given by $\hat{\gamma} = \left(\hat{X}'\hat{X}\right)^{-1}\hat{X}'\mu_2$

where $\hat{X} = \left[1_N, \hat{\beta}\right]$ and $\hat{\gamma} = [\hat{\gamma}_0, \hat{\gamma}_1']'$ is a vector consisting of the zero-beta rate ($\hat{\gamma}_0$) and risk premia on the K factors ($\hat{\gamma}_1$).

Researchers have typically focused on the price of the beta risk to test whether a proposed factor is priced. However, Kan, Robotti, and Shanken (2012) provide numerical examples illustrating a potential issue exists in multi-factor asset pricing models because the beta of an asset with respect to a particular factor depends on what other factors are included in the first-pass time-series OLS regression. Their solution to this inference problem consists in running the second-pass CSR with covariances ($\hat{V}_{21}$) instead of betas. Kan, Robotti, and Shanken (2012) show that finding a statistically significant price of covariance risk is indeed evidence that the underlying factor is incrementally useful in explaining the cross-section of asset returns. If we let $\hat{C} = \left[1_N, \hat{V}_{21}\right]$, then the price of covariance risk in the OLS regression is computed as $\hat{\lambda} = \left(\hat{C}'\hat{C}\right)^{-1}\hat{C}'\hat{\mu}_2$.

Under the correctly specified model, the asymptotic standard errors of $\hat{\gamma}$ estimates are provided by Shanken (1992) and Jagannathan and Wang (1998). However, when the beta-pricing model is misspecified, the asymptotic standard errors proposed by these papers are incorrect and could be misleading. Kan, Robotti, and Shanken (2012) demonstrate that the statistical inference in asset pricing models should be conducted allowing for the possibility of potential misspecification to ensure robust and valid inference. Kan, Robotti, and Shanken (2012) provide general expressions for the asymptotic variances of both $\hat{\gamma}$ and $\hat{\lambda}$ under potential model misspecification as follows.

$$\sqrt{T}\left(\hat{\gamma}-\gamma\right)\sim N\left(0_{K+1},V\left(\hat{\gamma}\right)\right)$$

where $V\left(\hat{\gamma}\right)=\sum_{j=-\infty}^{\infty}E\left[h_t h'_{t+j}\right]$ with $h_t=\left(\hat{\gamma}_t-\hat{\gamma}\right)-\left(\hat{\phi}_t-\hat{\phi}\right)\hat{\gamma}_1'\hat{V}_{11}^{-1}\left(f_t-\hat{\mu}_1\right)+\left(\hat{X}'\hat{X}\right)^{-1}\hat{z}_t$, $\hat{\phi}_t=\left[\hat{\gamma}_{0t},\left(\hat{\gamma}_{1t}-f_t\right)'\right]'$, $\hat{\phi}=\left[\hat{\gamma}_0,\left(\hat{\gamma}_1-\hat{\mu}_1\right)'\right]'$, $\hat{z}_t=\left[0,u_t(f_t-\hat{\mu}_1)'\hat{V}_{11}^{-1}\right]'$, $u_t=\left(\hat{\mu}_2-\hat{X}\hat{\gamma}\right)'\left(R_t-\hat{\mu}_2\right)$

$$\sqrt{T}\left(\hat{\lambda}-\lambda\right)\sim N\left(0_{K+1},V\left(\hat{\lambda}\right)\right)$$

where $V\left(\hat{\lambda}\right)=\sum_{j=-\infty}^{\infty}E\left[\bar{h}_t\bar{h}_{t+j}'\right]$ with $\bar{h}_t=\left(\hat{\lambda}_t-\hat{\lambda}\right)-\left(\hat{C}'\hat{C}\right)^{-1}\hat{C}'\bar{G}_t\hat{\lambda}_1+\left(\hat{C}'\hat{C}\right)^{-1}\hat{z}_t$, $\bar{G}_t=\left(R_t-\hat{\mu}_1\right)\left(f_t-\hat{\mu}_2\right)'-V_{12}$

In this two-pass regression framework, Kan, Robotti, and Shanken (2012) use, as testing assets, portfolio returns in excess of the T-bill rate, while excluding the constant from the expected return relations. This restriction implies that the zero-beta rate is constrained to equal the risk-free rate. Without this restriction, they find that the two-pass method produce the high values of the zero-beta rate and the negative market risk premium. However, it is well known that the zero-beta rate may be higher than the risk-free interest rate if risk-free borrowing rates exceed lending rates in the economy. Therefore it would be too restrictive to exclude the constant and use excess returns as test assets.

Instead, I include the T-bill rate as a test asset in the regression with the constant. I have also included the Fama-French three factors as additional assets in the two-pass regressions.[14] This inclusion requires that the estimated price of risk should be consistent with the anomalies summarized in the Fama-French three-factor model. A popular goodness-of-fit measure is the cross-sectional R^2 from the second pass regression. This R^2 indicates the extent to which the model's risk measures account for the cross-sectional variation in average returns of test asset portfolios. It is defined as

[14] I use returns (risk factors + T-bill rates) in the asset pricing tests.

$$\hat{R}^2 = 1 - \frac{\hat{Q}}{\hat{Q}_0}$$

where $\hat{Q} = \hat{e}'\hat{e}$, $\hat{e} = \hat{\mu}_2 - B\hat{\gamma}$, $Q_0 = \hat{e}_0\prime\hat{e}_0$, $\hat{e}_0 = \left[I_N - 1_N(1'_N I_N 1_N)^{-1} 1'_N I_N\right]\hat{\mu}_2$ represents the deviations of mean returns from their cross-sectional average. Kan, Robotti, and Shanken (2012) derive the asymptotic distribution of under the misspecification ($0 < \hat{R}^2 < 1$).

$$\sqrt{T}\left(\hat{\rho}^2 - \rho^2\right) \sim N\left(0, \sum_{j=\infty}^{\infty} E\left[n_t n_{t+j}\right]\right)$$

where $n_t = 2\left[-u_t y_t + \left(1 - \hat{\rho}^2\right) v_t\right] \big/ \hat{Q}_0$ with $u_t = \hat{e}'\left(R_t - \hat{\mu}_2\right)$, $v_t = \hat{e}_0'\left(R_t - \hat{\mu}_2\right)$, and $y_t = 1 - \hat{\lambda}_1'\left(f_t - \hat{\mu}_1\right)$.

Finally, I conduct inference with a one-lag Newey and West (1987) adjustment.

4 Data and empirical results

4.1 Data

To estimate new-Keynesian factors, I use quarterly time-series of real GDP, consumption, investment, real wages, hours worked, price(GDP deflator), and the short-term interest rate of Smets and Wouters (2006) from the first quarter of 1954 to the first quarter of 2011.[15] Nominal variables are first deflated by the GDP-deflator and aggregate real variables are expressed in per capita terms. All variables except for hours, inflation and the interest rate are linearly detrended. I estimate De Graeve's model using the full

[15] I thank De Graeve for sharing his DYNARE programs and data set. I closely follow De Graeve (2008) to construct the data and verify it for the common sample period. Refer to the data appendix of Smets and Wouters (2006) and De Graeve (2008) for more details.

sample data.

Monthly value-weighted portfolio returns on 25 portfolios sorted by Campbell, Hilscher, and Szilagyi (2008)'s failure probability measure and size, 25 portfolios sorted by momentum and size, 25 portfolios sorted by standardized unexpected earnings (SUE) and size, 25 portfolios sorted by total accruals and size, and 25 portfolios sorted by net stock issues and size are obtained from Long Chen and transformed into quarterly series for the empirical asset pricing tests. This data span the period from 1972Q1 to 2009Q2.

The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website.[16]

4.2 Estimation of new-Keynesian factors

I estimate De Graeve (2008)'s model with his DYNARE program and updated data. I refer to his paper for the estimation details. Only the details on the prior selections and monitoring convergence deserve to be mentioned.

The Bayesian approach facilitates the incorporation of prior information from other macro as well as micro studies. This prior distribution describes the available information prior to observing the data used in the estimation. The observed data are then used to update the prior, via Bayes theorem, to the posterior distribution of the parameters. Bayesian analysis is often criticized for its subjectivity bias from prior selections.

For the estimation of new-Keynesian models, however, informative priors seem to be indispensable. several researchers (e.g.An and Schorfheide (2005)) criticize maximum likelihood estimation (MLE) with "dilemma of absurd parameter estimates" when applying the MLE to DSGE models and argue that Bayesian methods often produce more

[16]I thank French for making his data available on line
(*http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html*).

acceptable parameter estimates.

For the estimation of De Graeve (2008), I follow his selections of prior distributions. But I experiment with several choices of non-informative priors to minimize biases caused by the selection of prior distribution. For example, with DYNARE, I can check whether posterior modes are uniquely identifiable with given prior density and likelihood function. I set the variance of prior density as large as possible if unique mode is identified.

In the Bayesian analysis, monitoring the convergence of parameters is critical since without it, we are not sure whether estimated parameters can be considered as a valid sample from the posterior distribution. Therefore, to ensure convergence, I do several checks. First, I simulate samples from the new-Keynesian model at least 200,000 draws from five different chains and after discarding 50% of them in each chain as burn-in replications, I calculate the convergence diagnostics of Brooks and Gelman (1998) offered in DYNARE package. I find every parameter converged with this statistics. When I also draw one long chain of 1,000,000 draws from each model with 500,000 as burn-in periods, I obtain similar results.

After extensive checks, I find that most of the parameter estimates are qualitatively similar to those presented in De Graeve (2008),[17] Here I report the details on the estimated structural shocks (new-Keynesian factors) absent from the tables of De Graeve (2008). Table 1 and Figure 1 reports the sample statistics and patterns of estimated structural shocks from De Graeve's model with updated data.

4.3 Cross-sectional implications of new-Keynesian models

In this section, I examine the pricing performance of new-Keynesian models over the period from 1972Q1 to 2009:Q2. The empirical literature has uncovered several anomalous

[17] Results are available upon request.

patterns (e.g. Fama and French (2008)) in the relations between firm characteristics and stock returns that can't be explained by Fama and French (1993)'s three factors.

In this paper, I choose, as testing assets, the anomalous returns associated with net stock issues, accruals, and price momentum, the financial distress anomaly, and the post-earnings-announcement drift anomaly (earnings momentum). I briefly summarize the failure of the Fama-French model on these puzzles as follows.

Price and Earnings momentum: Chordia and Shivakumar (2006) examine the relation between price and earnings momentums. From time-series tests, they find that the Fama-French model produces a significant alpha for both momentums. Moreover the Fama-French model exacerbates momentum; losers load more on SMB and HML than winners.

Distress anomaly: Campbell, Hilscher, and Szilagyi (2008) find that more distressed firms earn lower average returns than less distressed firms. Controlling for risk with the Fama-French model exacerbates the anomaly because more distressed firms appear riskier with higher loadings on SMB and HML. The magnitude of the drift is particularly larger for small firms.

Net stock issues: Lyandres, Sun, and Zhang (2008) find that strong evidence of underperformance following initial public offerings, seasoned equity offerings, and convertible debt offerings. For example, from time-series asset pricing tests for the seasoned equity offereings portfolios, they find that the equal-weighted alpha from the Fama-French model is -0.39% per month (t = -3.52), and the value-weighted alpha is similar in magnitude.

Accruals: Wu, Zhang, and Zhang (2010) find that accruals are positively related to current returns and negatively related to future returns. From time-series asset pricing tests for the low-minus-high total accruals portfolio, they find the equal-weighted alpha from the Fama-French model is 0.8% per month (t = 5.8), and the value-weighted alpha is similar in magnitude.

To understand how these patterns arise and their link to the fundamental factors of the economy, several asset pricing models are proposed based on economics models with production or credit conditions. Particularly, many papers use the q-theory to explain the cross-sectional pattern in returns. For example, Chen, Novy-Marx, and Zhang (2010) motivate their empirical factors based on the first-order condition of firms, which relates three endogenous variables of firms: the optimal investment rate, the expected future firm profitability, and the expected future stock return. However, Kogan and Papanikolaou (2012) criticize this approach because this first-order condition has no causal content, and therefore offer no explanation about the economic causes of the return anomalies.

Kogan and Papanikolaou (2013b) also propose a unified explanation for several apparent anomalies in the cross-sectional relation between average stock returns and firm valuation ratios, past investment, profitability, market beta, or idiosyncratic volatility. Using a calibrated structural model, they argue that these characteristics are imperfect proxies for the share of growth opportunities to firm value and that return differences among firms sorted on these characteristics are largely driven by one factor related to investment technology shocks. However, this result is not without controversy. For example, Garlappi and Song (2012) find only weak support for the existence of a significant price of risk for investment-specific shocks for the value and momentum premiums.

In this paper, I add a new dimension to this literature. I argue that an Intertemporal CAPM with new-Keynesian factors motivated from new-Keynesian dynamic stochastic general equilibrium models (DSGE) is important to understand these anomalies. Intuitively, new-Keynesian models can be interpreted as an extension of these models with short-term frictions and monetary policy actions. Surprisingly, these factors have not been received deserved attention in explaining the cross-sectional asset pricing puzzles.

For example, it seems natural to investigate the role of these monetary factors because the actions of the Fed seem to have a considerable impact on stock market returns.

Finally, new-Keynesian models as an extension of reduced form asset pricing models based on real business cycle models (e.g. Chen, Novy-Marx, and Zhang (2010)) can provide more robust results with this general setting. In the next section, I present the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model in explaining each puzzle and demonstrate how much the new-Keynesian factors can improve on the Fama-French factors.

4.3.1 Financial distress

Table 2 presents the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model using quarterly value-weighted returns of the 25 portfolios sorted by Campbell, Hilscher, and Szilagyi (2008)'s failure probability measure and size. I also include the T-bill rate and the Fama-French three factors (in return forms by adding the T-bil rate to each factor) as additional test assets to obtain reasonable zero-beta rate and the risk premia.[18] I report estimates of the risk premia in Panel A and the prices of covariance risk in Panel B with Fama and MacBeth (1973) t-ratio under correctly specified models, the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem and Kan, Robotti, and Shanken (2012)'s model misspecification-robust t-ratios. To show the overall usefulness of the model, I report the adjusted R^2 with its standard error. Finally, I conduct every inference with a one-lag Newey and West (1987) adjustment.[19]

[18] If I don't include the T-bill rate and the Fama-French factors as additional assets, I often estimate 12% zero-beta rate in annual terms and negative market risk premia or even negative HML premia. In asset pricing tests with the T-bill rate and the Fama-French three factors, zero-beta rates becomes reasonable (annual 6%) and the estimated risk premia remain positive in most cases. I report the results with sensible zero-beta rate and risk premia.

[19] I thank Raymond Kan for sharing his matlab programs to compute misspecification-robust statistics.

The Panel B in Table 2 shows that the Fama-French three factors clearly fail to explain the returns of the 25 portfolios sorted by Campbell, Hilscher, and Szilagyi (2008)'s failure probability measure and size. The adjusted R^2 is practically zero and the estimated premium on the three factors are insignificant even with the Fama and MacBeth (1973) t-ratio under correctly specified models.

The new-Keynesian ICAPM factors improve dramatically on the Fama-French model. In the Panel A of Table 2, the adjusted R^2 is 74% and statistically significant at 1% level. The estimated premia on the preference shock and the temporary monetary shock, and the permanent monetary shock are statistically significant with Shanken, Jagannathan and Wang standard errors under correctly specified models. However, once I use misspecification-robust standard errors, only the preference shocks and temporary monetary policy shocks are statistically significant with t-ratio -2.95 and -2.91, respectively.

As discussed in Kan, Robotti, and Shanken (2012), only the price of covariance risk can identify factors that improve the explanatory power of the expected return. The price of covariance risk for preference shocks is not statistically significant with all t-statistics. However, the temporary monetary factor maintains its significance with misspecification-robust t-statistics -2.26. Results for the prices of covariance risk imply that the temporary monetary policy shocks have explanatory power for the cross-section of expected returns for the test assets beyond any factor included in the model. This indicates that the typical test results on whether a factor is priced or not can lead erroneous conclusions on the usefulness of a factor.

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 the portfolio. It can be seen from the graph that the multi-factor model with new-Keynesian factors explains the financial distress premium much better than the Fama-French three-factor model.

4.3.2 Momentum

Table 3 presents the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model using quarterly value-weighted returns of the 25 portfolios sorted by prior returns and size. As before I include the T-bill rate and the Fama-French three as additional test assets to obtain reasonable zero-beta rate and the risk premia. I report estimates of the risk premia in Panel A and the prices of covariance risk in Panel B with Fama and MacBeth (1973) t-ratio, the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio and Kan, Robotti, and Shanken (2012)'s model misspecification-robust t-ratios. Finally, I report the adjusted R^2 with its standard error. As before I conduct every inference with a one-lag Newey and West (1987) adjustment.

The results reported in Table 3 and plotted in Figure 3 are almost same with the results in Table 2 and Figure 2. The Panel B in Table 3 shows that the Fama-French three factors clearly fail to explain the returns of the 25 portfolios sorted by prior returns and size. The adjusted R^2 is practically zero and the estimated premium on the three factors are insignificant even with the wrong negative sign.

The new-Keynesian ICAPM factors improve dramatically on the Fama-French model. The adjusted R^2 is 72% and statistically significant at 1% level. The estimated premia and the price of covariance risk on the temporary monetary shock are statistically significant with misspecification-robust t-statistics -1.97 and -2.26 respectively. Figure 3 also indicates that the multi-factor model with new-Keynesian factors explains the momentum premium much better than the Fama-French three-factor model.

4.3.3 Earnings momentum

Table 4 presents the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model using quarterly value-weighted returns of the 25 portfolios sorted by standardized unexpected earnings and size. Again I include the T-bill rate and the Fama-French three as additional test assets and report estimates of the risk premia in Panel A and the prices of covariance risk in Panel B with Fama and MacBeth (1973) t-ratio, the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio and Kan, Robotti, and Shanken (2012)'s model misspecification-robust t-ratios. And I report the adjusted R^2 with its standard error as usual. Finally, I use a one-lag Newey and West (1987) adjustment.

The Panel B in Table 4 again shows that the Fama-French three factors clearly fail to explain the returns of the 25 portfolios sorted by SUE and size. The adjusted R^2 is again practically zero and the estimated premium on the three factors are insignificant with any t-statistics.

The new-Keynesian ICAPM factors seem to improve on the Fama-French model. In the Panel A of Table 4, the adjusted R^2 is 48% and statistically significant at 1% level while Figure 4 does not seem to show much difference between two models. The estimated premia on the permanent monetary shocks is statistically significant with Shanken, Jagannathan and Wang standard errors under correctly specified models. However, with misspecification-robust standard errors, the permanent monetary policy shocks lose its statistically significance. However, as explained before only the price of covariance risk can identify factors that improve the explanatory power of the expected return. The price of covariance risk for the permanent monetary policy shocks is at least marginally statistically significant with misspecification-robust t-statistics -1.89.

4.3.4 Total accruals

Table 5 presents the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model using quarterly value-weighted returns of the 25 portfolios sorted by total accruals and size. Again I include the T-bill rate and the Fama-

French three factors as additional test assets and report estimates of the risk premia in Panel A and the prices of covariance risk in Panel B with Fama and MacBeth (1973) t-ratio, the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio and Kan, Robotti, and Shanken (2012)'s model misspecification-robust t-ratios. And I report the adjusted R^2 with its standard error as usual. Finally, I use a one-lag Newey and West (1987) adjustment.

The results reported in Table 5 and plotted in Figure 5 show that the Fama-French three factors can capture the value-weighted returns of the 25 portfolios sorted by SUE and size comparable to the new-Keynesian model. The adjusted R^2s are 0.68 for the new-Keynesian model and 0.65 for the Fama-French model with statistical significance. In the Panel A of Table 5, the estimated premia on the permanent monetary shocks is statistically significant at 1% with Shanken, Jagannathan and Wang standard errors under correctly specified models, but it is marginally significant with misspecification-robust t-statistics -1.88. However, the price of covariance risk for the permanent monetary policy shocks is not statistically significant with misspecification-robust t-statistics -1.65. In the Panel B of Table 5, the estimated premia and the price of covariance risk on the HML factor are statistically significant with misspecification-robust t-statistics 2.3 and 2.45 respectively.

To further investigate the relative performance of asset pricing factors in these models, I combine all factors and re-estimate the risk premia and the price of covariance risk jointly. Table 6 presents the estimation results of the new-Keynesian ICAPM augmented with two Fama-French factors (the SMB and HML factors). In short, the risk premia and the price of covariance risk of the permanent monetary policy shocks are statistically significant with misspecification-robust t-statistics while the price of covariance risk for the HML factor loses its statistical significance. This evidence seem to indicate that only the permanent monetary shocks provide a independent explanatory power in the cross-section of expected return of portfolios sorted by total accruals and size.

4.3.5 Net stock issues

Table 7 presents the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model using quarterly value-weighted returns of the 25 portfolios sorted by net stock issues and size. As before I include the T-bill rate and the Fama-French three as additional test assets and report estimates of the risk premia in Panel A and the prices of covariance risk in Panel B with Fama and MacBeth (1973) t-ratio, the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio and Kan, Robotti, and Shanken (2012)'s model misspecification-robust t-ratios. And I report the adjusted R^2 with its standard error as usual. Finally, I use a one-lag Newey and West (1987) adjustment.

The results reported in Table 7 and plotted in Figure 6 are almost similar with the results in Table 5 and Figure 5. The Fama-French three factors can capture the value-weighted returns of the 25 portfolios sorted by net stock issues and size comparable to the new-Keynesian model. As before, the estimated premia and the price of covariance risk on the HML factor are statistically significant with misspecification-robust t-statistics while the price of covariance risk for the temporary monetary policy shocks shows weak statistical significance with misspecification-robust t-statistics -1.65. With the Shanken t-statistics, the price of covariance risk for investment technology shocks is statistically significant. This result is entirely spurious because it becomes insignificant with Jagannathan and Wang and misspecification-robust t-statistics. This evidence again issues a warning on the usual practice of reporting only the Shanken t-statistics in the empirical asset pricing literature.

As before, to further investigate the relative performance of asset pricing factors in these models, I combine all factors and re-estimate the risk premia and the price of covariance risk. Table 8 presents the estimation results of the new-Keynesian ICAPM augmented with two Fama-French factors (the SMB and HML factors). In short, the risk premia and the price of covariance risk of the temporary monetary policy shocks are statistically significant with misspecification-robust t-statistics while the price of covariance risk for the HML factor loses its statistical significance. Only the temporary monetary shocks seem to provide an independent explanatory power in the cross-section of expected return of portfolios sorted by net stock issues and size.

Finally, Maio and Santa-Clara (2012) argue that the ICAPM imposes two conditions; first if a state variable forecasts positive (negative) changes in investment opportunities in time-series regressions, its innovation should earn a positive (negative) risk price in the cross-sectional test of the respective multifactor model. Second, the market (covariance) price of risk estimated from the cross-sectional tests must be economically plausible as an estimate of the coefficient of relative risk aversion (RRA). In all of the tables, these two monetary factors seem to have theoretically-consistent negative risk prices because higher interest rates from monetary tightening forecast negative changes in investment opportunities as described carefully by Maio and Santa-Clara (2012). Moreover, by including the T-bill rate and the Fama-French factors as additional assets, the market prices of risk for the market portfolio remains positive in almost all cases. Therefore the ICAPM with new-Keynesian factors used in this study seems to satisfy Maio and Santa-Clara (2012)'s consistency conditions.

4.3.6 Robustness check

The great moderation, first documented by Kim and Nelson (1999) and McConnell and Perez-Quiros (2000), is characterized as a sharp reduction in the variance of output growth from the pre-84 period to the post-84 period in the US.[20] One prominent ex-

[20]Both papers estimate a break date of 1984 independently using different econometric methods.

planation for this phenomenon is that monetary policy became more "hawkish" with the ascent of Paul Volcker as Federal Reserve chairman (e.g. Clarida, Gali, and Gertler (2000)). This view emphasizes that U.S. monetary policy in the pre-Volcker years was highly accommodative to inflation, thereby leaving the U.S. economy subject to self-fulfilling expectations-driven fluctuations. However, since Volcker adopted a proactive stance toward controlling inflation, the Fed's rapid response to the sharp contraction in the growth rate of output and its commitment to low trend inflation has been able to stabilize inflationary expectations and remove the source of economic instability (e.g. Coibion and Gorodnichenko (2011)). Particularly, the Fed systematically raised real as well as nominal short term interest rates in response to higher expected inflation.[21]

The possible regime changes in macroeconomic volatility and monetary policy could be influential. For instance, the credibility of monetary policy is important because long-term inflation expectations are anchored by private sector perceptions of the central bank inflation target. If monetary policy becomes more credible and stabilizing after Volcker regime, the effect of monetary policy could be different across different monetary policy regimes. Contributing further to the literature, I examine whether the impact of new-Keynesian factors differs across monetary policy regimes. Following the literature, I choose a break date of 1984 and examine asset pricing implications of new-Keynesian models for two sub periods.[22]

Tables 9 and 10 show the estimation results for five return anomalies for pre-84 and post-84 periods. The results over the accommodative monetary policy regime, Q1/1972-Q4/1983 in Table 9 are much weaker than the results for the full sample. None of the prices or risk is statistically significant, whereas the results of Table 10 show that the signs and statistical significance of estimated prices of risks are largely consistent in the

[21]This conclusion is not without controversy. For example, Stock and Watson (2003) argue that improved monetary policy accounted for only a small fraction of the reduction in the variance of output growth in the post-Volcker period.

[22]I thank an anonymous referee for suggesting the analysis in the section.

post-Volcker period with the results for the full sample.

This empirical fact suggests that new-Keynesian factors are priced as systematic asset pricing factors only in the credible monetary policy regime while the exact nature of this phenomenon is not yet understood. Perhaps, new-Keynesian models are more useful tools to understand the economy and stock markets in post-Volcker period. Alternatively investors have been able to interpret the Fed's actions better and respond more systematically to unexpected monetary policy shocks only after the Fed's action became more credible and stabilizing. I defer the examination of this potentially important issue to future studies.

4.3.7 Economic interpretation

The results with robust statistical tools show that the new-Keynesian ICAPM explains the average returns of portfolios formed on financial distress, price and earnings momentums with statistically significant adjusted R^2. Particularly, the temporary monetary policy factor explains the distress and price momentum premia, and the permanent monetary policy factor captures the anomalous returns on portfolios formed on earnings momentum. However, new-Keynesian factors have a limited success in driving out the anomalies related to net stock issues and accruals.

To understand the empirical results more clearly, I explain commonalities across five return anomalies first based on investment based asset pricing models and then empirical results from other models with macroeconomic factors. Finally I interpret the empirical results and suggest possible extensions of the new-Keynesian models.

Investment-based models: Recently many papers use reduced form asset pricing models based on the q-theory to explain the cross-sectional pattern in returns. These models may have limited success in explaining the economic causes of the return anomalies (Kogan and Papanikolaou (2012)). Nonetheless, they provide an intuitive and convenient framework to classify anomalies. As explained in the previous section, monetary policy actions can have important effects on investment because of investment theory under capital market imperfections and the relation between Tobin's Q and monetary policy.[23]

Intuitively the q-theory of investment implies that firms will invest more when their profitability is high and the cost of capital is low. This intuition provides two hypotheses; (1) controlling for investment, profitability should be positively correlated with expected returns (e.g. Chen, Novy-Marx, and Zhang (2010)) and (2) controlling for profitability, investment should be negatively correlated with expected returns (e.g. Lyandres, Sun, and Zhang (2008) and Wu, Zhang, and Zhang (2010)).

First, the positive profitability-return relation (hypothesis 1) seems to drive the earnings and price momentums and the distress anomaly. Intuitively, firms that have recently experienced positive earnings surprises are more profitable than firms that have recently experienced negative earnings surprises (earnings momentum). Further, price momentum is highly correlated with earnings momentum (Chordia and Shivakumar (2006)). Firms that have experienced large, positive earnings surprises are likely to experience stock price increases, whereas firms that fall below earnings expectations are likely to experience stock price decreases. Finally, less distressed firms are more profitable and should earn higher average returns, even though they are less levered, whereas more distressed firms are less profitable and should earn lower average returns, even though they are more levered. Chen, Novy-Marx, and Zhang (2010) show that their profitability factor (returns-on-assets) substantially reduce the mispricing of these portfolios.

Second, the negative investment-return relation (hypothesis 2) drives the negative

[23]New-Keynesian models such as De Graeve's model also include the q-theory as one of equilibrium conditions.

relations of average returns with accruals and net stock issues.[24] Lyandres, Sun, and Zhang (2008) argue that the balance-sheet constraint of firms requires that the uses of funds must equal the sources of funds, meaning that issuers should invest more and earn lower average returns than matching non-issuers. Wu, Zhang, and Zhang (2010), interpreting accruals as working capital investment, argue that high accrual firms invest more given expected cash flows than low accrual firms. These papers show that adding the investment factor into the Fama-French model substantially reduces the magnitude of these anomalies.

Asset pricing models with macroeconomic risk: Several asset pricing models have been proposed to explain price and earnings momentums, and partly the distress anomaly. These models explain these anomalies based on short-term business cycle variations or disruptions in financial markets. Naturally, monetary policy actions have important effects on these variables through both interest rate and credit channels.

First, Liu and Zhang (2008) argue that a factor based on the growth rate of industrial production, as a priced risk, explains more than half of momentum profits. They find that the winners group appears riskier than the losers group because winners have temporarily higher loadings than losers on the growth rate of industrial production. Chordia and Shivakumar (2006) also show that the price momentum and the earnings momentum are significantly related to future macroeconomic activities, including growth in GDP, industrial production, consumption, labor income, inflation and T-bill returns even after controlling for the Fama-French factors.

Second, Tobias, Etula, and Muir (2013) propose an asset pricing model where a

[24] Behavioral finance models also provide a hypothesis on why these two anomalies are closely related. For example, large positive accruals tend to occur during periods of equity issuance. The typical hypothesis is that substantial earnings "management" via "discretionary" accruals occurs around equity issuance, because managers then have unusually strong incentives to influence their reported financial performance.

stochastic discount factor (SDF) is modeled as the marginal value of wealth of financial intermediaries (sophisticated frequent traders), proxied by the leverage of security broker-dealers, which they interpret as funding constraint. Intuitively, as funding constraints tighten (negative shocks to leverage or worsening credit conditions), balance sheet capacity falls and intermediaries are forced to deleverage by selling assets at fire sale prices. They find that this leverage or funding constraint factor explains the momentum profits.

Finally, Avramov, Chordia, Jostova, and Philipov (2012) find that strategies based on price momentum, earnings momentum, and credit risk derive their profitability from taking short positions in high credit risk firms that experience deteriorating credit conditions, without any formal cross-section tests. In a related study, Mahajan, Petkevich, and Petkova (2012) find that winners tend to have relatively higher risk and expected returns in worsening aggregate default conditions due to lower recovery.

Digesting empirical results: One economic rationale of the importance of new-Keynesian factors to price and earnings momentums, and distress anomaly can be offered with the capital market imperfections story. Under capital market imperfections, higher credit risk will be reflected as a higher external finance premia, when the asymmetric information problems becomes severe between lenders and borrowers. For example, during a flight-to-quality episode external financing becomes harder for lower quality borrowers. Banks faced with tightened balance sheets will ask bigger external finance premia.[25]

When credit markets are tight, unanticipated monetary easing reduces the exter-

[25] De Graeve (2008)'s new-Keynesian model is particularly successful in capturing this aspect of capital market imperfections. De Graeve finds that posterior odds analysis favor his model over a popular specification of Smets and Wouters (2003) because of the endogenous mechanism to estimate the external finance premia. And his measure of the external finance premium is closely related to readily available qualitative proxies of the premium such as credit standards (Lown and Morgan (2006)), and his model performs better than the Smets and Wouters model from Bayesian hypothesis tests.

nal finance premium. The credit channel mechanism of monetary policy describes the theory that a central bank's policy changes affect the amount of credit that banks issue to firms and consumers for purchases, which in turn affects the real economy and return-risk characteristics of firms. Moreover, as funding constraints tighten, financial intermediaries may be forced to deleverage by selling assets at fire sale prices. During this uncertain period (deteriorating credit conditions), however, easier monetary policy can generate much needed liquidity within the financial system, correspondingly changing the credit conditions. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) predict that changing credit market conditions can have very different effects on firms'risks and expected returns.[26]

In summary, new-Keynesian factors seem to explain the return anomalies closely related to short-term profitability and financial constraints. For example, momentum profitability seems to be large in the interaction between high levered and risky cash flow firms. Firms with high credit risk and risky cash flow are potentially more sensitive to monetary policy shocks through credit channels. However, new-Keynesian factors have a limited success in driving out the anomalies related to investment factors (hypothesis 2, related to net stock issues and accruals).

Recently, in a response to Garlappi and Song (2012)'s doubt on the validity for investment-specific shocks, Li (2012) argues that by including investment commitment (or investment irreversibility) into standard real business cycle models with the investment technology shocks, the value and momentum premiums can be simultaneously explained. Because the value premium is often related to investment factors, an extension of De Graeve's model with the investment commitment could be helpful to better identify the role of investment factors.

[26] Refer to Appendix B for more detailed explanations on credit channels of monetary policy actions.

5 Conclusion

While the Fama and French (1993)'s three factors can explain the average return variations across portfolios formed on many different characteristics, there are patterns in average stock returns that can't be explained by the model. Fama and French (2008) find that the anomalous returns associated with net stock issues, accruals, and momentum are pervasive in all size groups in cross-section regressions. The financial distress anomaly documented in Campbell, Hilscher, and Szilagyi (2008) and the post-earnings-announcement drift anomaly or earnings momentum, first documented by Ball and Brown (1968) pose as an additional challenge to the Fama-French model.

In this paper, I present the estimation results of the new-Keynesian ICAPM and the Fama and French (1993) three-factor model in explaining each puzzle and demonstrate how much the new-Keynesian factors can improve on the Fama-French factors. To ensure robust and valid inference under the misspecification, I use misspecification-robust standard errors in the second pass cross-sectional regression for estimates of the risk premia or the prices of covariance risk proposed by Kan, Robotti, and Shanken (2012).

The results with these robust statistical tools show that the new-Keynesian ICAPM explains the average returns of portfolios formed on financial distress, momentum, and SUE with statistically significant adjusted R^2. Furthermore, I find that other anomalies can be at least partially explained by these new-Keynesian factors. Particularly, I find that the temporary monetary policy factor explains the distress and momentum premia, and the permanent monetary policy factor captures the anomalous returns on portfolios formed on SUE and total accruals. Other factors have limited success in explaining the anomalies with misspecification-robust standard errors. While the proposed new multi-factors model has a limited success in driving out some of the anomalies, the results with new-Keynesian factors looks sufficiently encouraging to warrant further empirical investigation. At a minimum, the evidence shows that the new-Keynesian factor model is possible to shed new light on understanding the puzzling risk premia in stock markets.

The present study uses a reasonable approximation to the economy, but several refinements can be done in the future studies. First, the current study uses exogenous pricing kernel to investigate risk premia since it uses a new-Keynesian model mainly to obtain reasonable structural shocks. It would be interesting to see how more consistent pricing kernels using either Campbell and Cochrane (1999) type conditional models or heteroskedasticity based models could explain return anomalies. Second, to better understand net stock issue and accruals anomalies, it seems worthwhile to extend De Graeve's model with investment commitment (Li (2012)). Finally, Bekaert, Cho, and Moreno (2005) extend the simpler three-equation new-Keynesian model with latent factors from the term structure. This extension of new-Keynesian models could be valuable for appropriate inferences since term structure information links the long-term and short-term interest rates and that link is regarded as a crucial channel for gauging the real effects of monetary policy.

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Appendix A. New Keynesian DSGE models

A simple three-equation New-Keynesian model (e.g. Cho and Moreno (2006)) has been a working-horse model in monetary economics literature until recently. But this model assumes frictionless capital markets, and often cannot explain persistent macro data. The seminal paper by Bernanke and Gertler (1989) and a number of subsequent calibration studies document how relaxing this perfect capital market assumption can generate additional features observed in macroeconomic data.

A series of papers proposed by Smets and Wouters(e.g.Smets and Wouters (2003)) incorporate a number of additional frictions to capture this persistence in the macro-economic data and they also add an exogenous mechanism to impose capital market imperfections. Their New-Keynesian models have become a standard approach in monetary policy literature since they can explain many stylized facts in monetary economics. This model contains three agents; Households consume, work, set wages, and invest; firms hire labor and capital, produce goods and set the prices of those goods; and the central bank sets the short-term interest rate in response to the deviation of inflation from the inflation target and output gap. The model accommodates both real and nominal frictions such as monopolistic competition in goods and labor markets with sticky nominal prices and wages, partial indexation of prices and wages, costs of adjustment in capital accumulation, external habit formation and variable capital utilization and fixed costs.

First, households' maximization provides the aggregate consumption equation and wage equation.[27] In addition to the external habit specification as in Cho and Moreno (2006), households have differentiated labor characteristics and some monopoly power over wages, which introduce sticky nominal wages in the sense of Calvo (1983). Households act as price-setters in the labor market and partial indexation of the wages is allowed. "Hat" means the steady state value.

[27] Most of the equations are directly adapted from Smets and Wouters (2005) except for capital market imperfection mechanisms. For detailed review of microfoundation of these models, see De Graeve (2008)

The aggregate consumption($\hat{C}_t$) in this model is determined by:

$$\hat{C}_t = \frac{h}{1+h}\hat{C}_{t-1} + \frac{h}{1+h}E_t\hat{C}_{t+1} + \frac{\sigma_c - 1}{(1+\lambda_w)(1+h)\sigma_c}(\hat{L}_t - E_t\hat{L}_{t+1}) - \frac{(1-h)}{(1+h)\sigma_c}\hat{R}_t$$

$$+\frac{(1-h)}{(1+h)\sigma_c}(\hat{\varepsilon}_t^B - E_t\hat{\varepsilon}_{t+1}^B) \quad \text{(A1)}$$

where $\hat{\varepsilon}_t^B$ is interpreted as preference shock and follows a first-order autoregressive process with an i.i.d normal error term; $\hat{L}_t$ stands for the labor supply included as the non-separability of the utility function of labor and consumption; $\hat{R}_t(\hat{R}_t^n - E_t\hat{\pi}_{t+1})$ is the ex-ante real interest rate, where $\hat{R}_t^n$ is the nominal interest rate and $\hat{\pi}_{t+1}$) is the inflation rate; Finally, E_t indicates conditional expectation given information up to time t.

Households set their wages with the following Calvo (1983) type staggered wage-setting scheme proposed by Christopher, Henderson, and Levin (2000). In this model, the real wage $\hat{w}_t$ is a function of expected and past real wages and the expected, current and past inflation rates($\hat{\pi}_t$).

$$\hat{w}_t = \frac{\beta}{1+\beta}E_t\hat{w}_{t+1} + \frac{1}{1+\beta}\hat{w}_{t-1} + \frac{\beta}{1+\beta}(E_t\hat{\pi}_{t+1} - \bar{\pi}_t) - \frac{1+\beta\gamma_w}{1+\beta}(\hat{\pi}_t - \bar{\pi}_t) - \frac{\gamma_w}{1+\beta}(\hat{\pi}_{t-1} - \bar{\pi}_t)$$

$$-\frac{1}{1+\beta}\frac{(1-\beta\xi_w)(1-\xi_w)}{(1+\frac{(1+\lambda_w)\sigma_l}{\lambda_w})\xi_w}\left[\hat{w}_t - \sigma_l\hat{L}_t - \frac{\sigma_c}{1-h}(\hat{C}_t - h\hat{C}_{t-1}) - \hat{\varepsilon}_t^L\right] + \eta_t^W \quad \text{(A2)}$$

where η_t^W is interpreted as a wage-markup disturbance. And $\hat{\varepsilon}_t^L$ represents the shock to the labor supply and is assumed to follow a first-order autoregressive process with an i.i.d. normal error term.

New-Keynesian economists emphasize the role of nominal rigidities(price stickiness) based on microfoundations of imperfect competition. However, for these rigidities to have important implications, it is necessary that wages do not respond much to fluctuations in demand. The fall in output also results in a fall in labor demand which, in turn, would drive down the equilibrium wage in the labor market and the firm's marginal cost curves. This may increase the gain from price adjustment significantly. Thus, for the lack of price adjustment to be a macroeconomic equilibrium, we need real rigidity in the labor market. Staggered wage-setting equation is one of the mechanisms to generate this real rigidity in labor market. In fact, Smets and Wouters (2003) use partial or full indexation of this kind for both wages and prices, and find that this extension of the Calvo pricing model improves the empirical fit of their models.

Intermediate goods firms' optimizations in monopolistic competition markets yield the following equations. First, Cobb-Douglas production function augmented with fixed costs and variable capital utilization is given by:

$$\hat{Y}_t = \phi\hat{\varepsilon}_t^A + \phi\alpha\hat{K}_{t-1} + \frac{\phi\alpha}{\psi}\hat{r}_t^k + \phi(1-\alpha)\hat{L}_t \tag{A3}$$

where output($\hat{Y}_t$) is produced using capital ($\hat{K}_{t-1}$) and labor services ($\hat{L}_t$). Total factor productivity ($\hat{\varepsilon}_t^A$) is assumed to follow a first-order autoregressive process.

The firm's labor demand($\hat{L}_t$) depends negatively on the real wage($\hat{w}_t$) and positively on the rental rate of capital($\hat{r}_t^k$) by equalizing marginal cost:

$$\hat{L}_t = -\hat{w}_t + (1+\frac{1}{\psi})\hat{r}_t^k + \hat{K}_{t-1} \tag{A4}$$

Finally, price is determined following Calvo (1983) scheme.

$$\hat{\pi}_t - \bar{\pi}_t = \frac{\beta}{1+\beta}(E_t\hat{\pi}_{t+1} - \bar{\pi}_t) + \frac{\gamma_p}{1+\beta\gamma_p}(\hat{\pi}_{t-1} - \bar{\pi}_t)$$

$$+\frac{1}{1+\beta\gamma_p}\frac{(1-\beta\xi_p)(1-\xi_p)}{\xi_p}\left[\alpha\hat{r}_t^K + (1-\alpha)\hat{w}_t - \hat{\varepsilon}_t^A\right] + \eta_t^P \tag{A5}$$

where the deviation of inflation($\hat{\pi}_t$) from the target inflation rate ($\bar{\pi}_t$) depends on past and expected future inflation deviations and on the current marginal cost($\alpha\hat{r}_t^K + (1-\alpha)\hat{w}_t - \hat{\varepsilon}_t^A$).

The stochastic component $\hat{\varepsilon}_t^A$ is assumed to follow a first-order autoregressive process and η_t^P is an i.i.d. normal price mark-up shock.

Capital goods producers work in a perfectly competitive environment and their investment decision can be summarized as:

$$\hat{I}_t = \frac{1}{1+\beta}\hat{I}_{t-1} + \frac{\beta}{1+\beta}E_t\hat{I}_{t-1} + \frac{1/\varphi}{1+\beta}(\hat{Q}_t + \hat{\varepsilon}_t^I) \tag{A6}$$

where $\hat{Q}_t$ is the real value of installed capital and φ is the investment adjustment cost parameter. A positive shock to the investment-specific technology, $\hat{\varepsilon}_t^I$ increases investment in the same way as an increase in the value of the existing capital stock $\hat{Q}_t$. This investment shock is also assumed to follow a first-order autoregressive process with an i.i.d normal error term.

And the capital stock evolves as:

$$\hat{K}_{t+1} = (1-\tau)\hat{K}_t + \tau\hat{I}_t + \tau\hat{\varepsilon}_t^I \tag{A7}$$

where τ is the depreciation rate, $\hat{I}_t$ stands for investment and $\hat{\varepsilon}_t^I$ represents a shock to the investment technology.

Unlike the forward-looking monetary policy used in Cho and Moreno (2006), the monetary policy rule follows a generalized Taylor rule by gradually responding to deviations of lagged inflation from an inflation objective and the lagged output gap. This reaction mechanism contains two monetary policy shocks: a temporary i.i.d. normal interest rate shock(η_t^R) and a persistent shock for changes in the inflation target($\hat{\pi}_t - \bar{\pi}_t$).

$$\hat{R}_t^n = \rho\hat{R}_{t-1}^n + (1-\rho)\left\{\bar{\pi}_t + r_\pi\left(\hat{\pi}_t - \bar{\pi}_t\right) + r_Y\left(\hat{Y}_t - \hat{Y}_t^P\right)\right\} + r_{\Delta\pi}\left(\hat{\pi}_t - \bar{\pi}_{t-1}\right)$$

$$+ r_{\Delta Y}\left(\hat{Y}_t - \hat{Y}_t^P - \left(\hat{Y}_{t-1} - \hat{Y}_{t-1}^P\right)\right) + \eta_t^R \tag{A8}$$

where $\hat{R}_t^n$ is the federal funds rate, $\bar{\pi}_t$ is the inflation target set by the central bank and potential output($\hat{Y}_t^P$) is defined as the level of output that would prevail under flexible price and wages in the absence of cost-push shocks and in frictionless credit market equilibrium. Finally $\hat{Y}_t$ is the actual real GDP and $\hat{\pi}_t$ is the actual inflation rate.

The goods market equilibrium condition can be written as:

$$\hat{Y}_t = c_y \hat{C}_t + \tau k_y \hat{I}_t + \varepsilon_t^G + \frac{\left(\bar{R}^K - 1 + \tau\right)}{\psi k_y} \hat{r}_t^k + k_y \left(\bar{R}^K - \bar{R}\right)(1 - \frac{\bar{N}}{\bar{K}}) \left(\hat{R}_t^K + \hat{Q}_{t-1} + \hat{K}_t\right) \quad \text{(A9)}$$

where c_y and k_y denotes the steady-state ratio of consumption and capital to output respectively. And ε_t^G is interpreted as government spending shock, which follows a first-order autoregressive process with an i.i.d. normal error term.

Finally, in order to endogenize capital market imperfection mechanism into standard New-Keynesian models, De Graeve (2008) extends the role of entrepreneurs in Smets and Wouters's economy by explicitly accounting for the external finance premium equation in the sense of Bernanke, Gertler, and Gilchrist (1999). Entrepreneurs buy the capital stock K_{t+1} from capital goods producers at a given price Q_t with internal funds(net worth, N_{t+1}) and bank loans. And they choose capital utilization and rent out capitals to intermediate goods firms at a rate $\hat{r}_t^k$.[28]

The aggregate expected real return to capital is given by:

$$E_t \hat{R}_{t+1}^K = \frac{1-\tau}{\bar{R}^K} E_t \hat{Q}_{t+1}^K + \frac{\bar{r}^k}{\bar{R}^K} E_t \hat{r}_{t+1}^K - \hat{Q}_t \quad \text{(A10)}$$

where $\bar{R}^K$ denotes the steady state return to capital and $\bar{r}^k$ stands for the steady state rental rate. The first term in the equation states the value of remaining capital($\frac{1-\tau}{R^K} E_t \hat{Q}_{t+1}^K$), the second term indicates the return from renting out the capital($\frac{1-\tau}{R^K} E_t \hat{Q}_{t+1}^K$) and the last term indicates the paid price for the purchase of capital stock($\hat{Q}_t$).

While De Graeve (2008) uses set of equations adopted directly from Smets and Wouters

[28]This is modified equation (3) of Smets and Wouters (2005) without exogenous risk premium shock. From now on, I closely follows page 8 and 9 of De Graeve (2008)

(2005) for the equations described up to now, De Graeve (2008) extends the Smets-Wouters model by assuming that entrepreneurs cannot borrow at the risk-less rate because of capital market imperfections. In that case, because of the asymmetric information between the financial intermediary and entrepreneurs, the bank should pay a state verification cost for monitoring entrepreneurs. In equilibrium, entrepreneurs borrow up to the point where the expected return to capital equals the cost of external finance.

At equilibrium, De Graeve (2008) argues that the external finance premium is given by:

$$E_t \hat{R}^K_{t+1} = -\varepsilon E_t \left[\hat{N}_{t+1} - \hat{Q}_t - \hat{K}_{t+1} \right] + \bar{R}_t \tag{A11}$$

where ε measures the elasticity of the external finance premium to variations in entrepreneurial financial health($E_t \left[\hat{N}_{t+1} - \hat{Q}_t - \hat{K}_{t+1} \right]$), measured by net worth relative to capital expenditures. Following Bernanke, Gertler, and Gilchrist (1999), he assumes that the premium over the risk-free rate required by the financial intermediary is a negative function of the amount of collateralized net worth. When entrepreneurs have sufficient net worth to finance the entire capital stock, De Graeve (2008) explains that his model reduces to the Smets and Wouters model.

And De Graeve (2008) sets the net worth equation of entrepreneurs by:

$$\hat{N}_{t+1} = \gamma \bar{R}^K \left[\frac{\bar{K}}{\bar{N}} \left(\hat{R}^K_t - E_{t-1} \hat{R}^K_t \right) + E_{t-1} \hat{R}^K_t + \hat{N}_t \right] \tag{A12}$$

where γ is the entrepreneurial survival rate and $\frac{\bar{K}}{\bar{N}}$ is the steady state ratio of capital to net worth.

De Graeve (2008) concludes that his model with the financial accelerator(endogenous external finance premium) performs substantially better in matching the macro-dynamics relative to the Smets-Wouters model without that mechanism from examining the Bayes factor.

Appendix B. Credit Channels of Monetary Policy

New-Keynesian models typically assume the existence of financial market frictions because of an agency problem caused by asymmetric information between borrowers and lenders. The agency problem leads to the external finance premium, a wedge between the cost of external financing and internal financing. For instance, Gertler and Gilchrist (1994) argue that firms with relatively larger informational asymmetries are affected more from worsening credit market conditions because banks tend to reduce credit lines or request higher premium first to those customers about whom they have the least information. The external finance premium also varies inversely with the borrower's net worth (internal funds and collateralizable resources).

This credit market imperfection offers channels through which monetary policy can affect the external finance premium. Three such credit channels can be identified from literature: (1) financial constraints on non-financial borrowers, (2) funding constraints on financial intermediary, and (3) bank-dependent borrowers.

Financial constraints on non-financial borrowers

Most new-Keynesian models focus on credit constraints faced by non-financial borrowers. For example, a monetary tightening (or rising real interest rates) can increase these borrowers' debt-service burdens and reduce the value of the collaterals posted for their loans, thereby increasing the cost of external financing. This process known as the financial accelerator amplifies the initial contractionary shock and decreases ability of the borrowers to implement investment and employment. Particularly, small and credit-constrained firms are more vulnerable to increases in the information and agency costs of external finance from a monetary contraction.

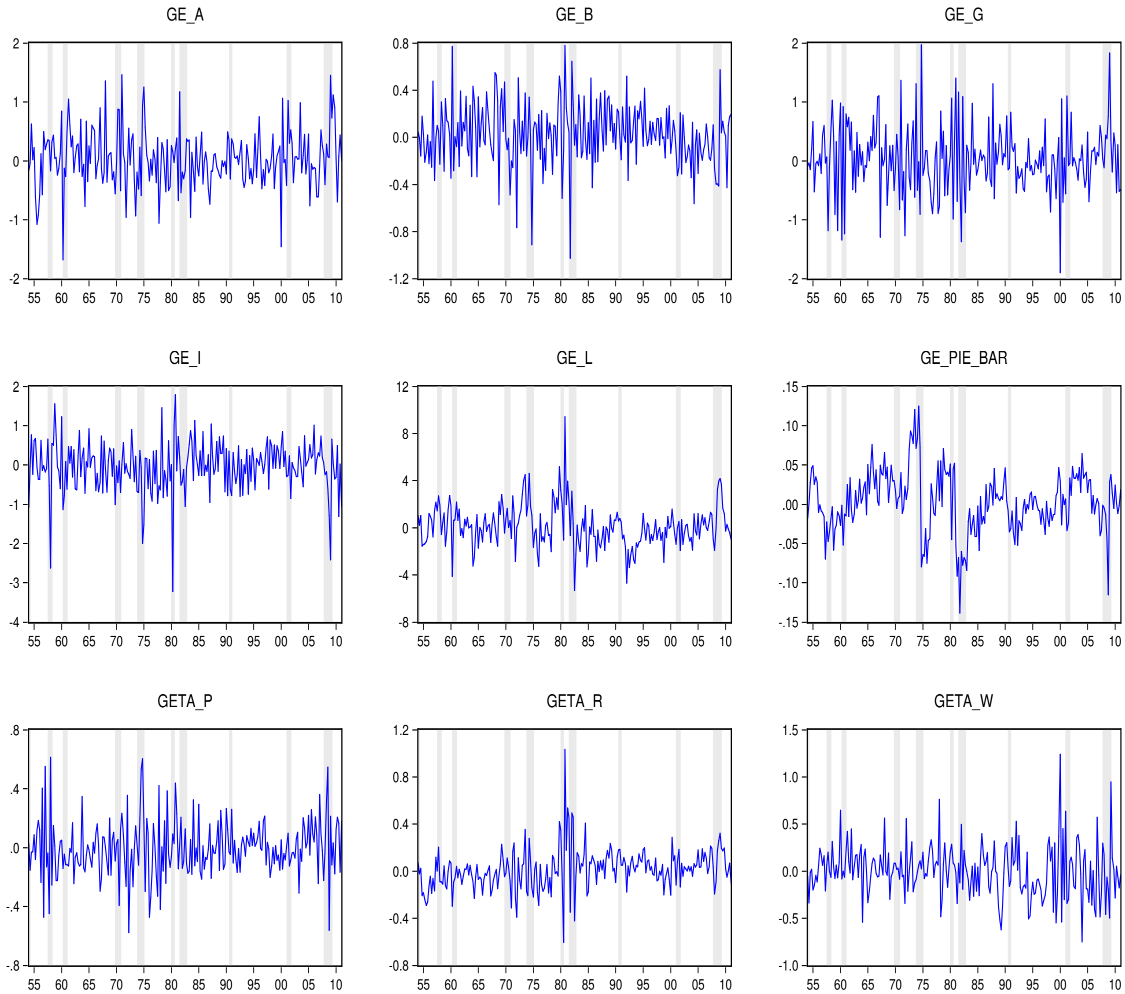
Funding constraints on financial intermediary

Disruption of financial intermediation is regarded as a key feature of turmoil in financial markets. Credit flows from lenders to non-financial borrowers through financial intermediaries.

If there is an agency problem between an intermediary (borrower) and depositors and other financial institutions (lenders), the intermediary's balance sheet can limit its ability to obtain deposits (funding liquidity), introducing a wedge between the loan and deposit rates. For example, disruptions of inter-bank markets can widen this spread substantially. In this case, intermediaries with deficit funds offer higher loan rates to nonfinancial firms than intermediaries with surplus funds. Sharpe increase in the cost of credit for non-financial borrowers and the reduced supply of credit can further depress aggregate activity. The Fed's monetary policy is expected to remove this instability of credit markets with lower interest rates or direct credit to financial institutions.

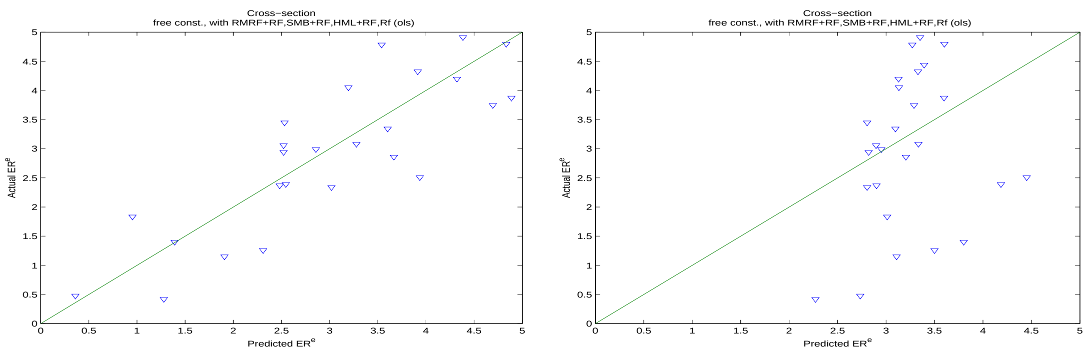
Bank-dependent borrowers

Banks have the expertise in extending credit to borrowers, especially those who do not have access to other types of credit. For example, small firms are highly bank-dependent borrowers because they have limited ability to issue commercial paper and raise capital. If banks reduce their loan supply significantly in a monetary tightening, small firms are more vulnerable to worsening credit conditions because they are typically the first to be cut off their credit lines from banks without alternative financing options.



This figure plots the quarterly time series of smoothed structural shocks estimated by the new-Keynesian DSGE Note: GE_A is the estimated technology shocks;GE_B is the estimated preference shocks;GE_G is the estimated government spending shocks;GE_I is the estimated shocks to investment technology; GE_L is the estimated labor demand shocks;GE_PIE_BAR is the estimated shocks to the inflation target set by the Federal reserve(permanent monetary policy shocks);GETA_P is the estimated price mark-up shocks;GETA_R is the estimated temporary monetary policy shocks;GETA_W is the estimated wage mark-up shocks. Shared areas indicate NBER business recessions.

Figure 1: Estimated Factor innovations from a new-Keynesian DSGE (1954:1-2011:1)

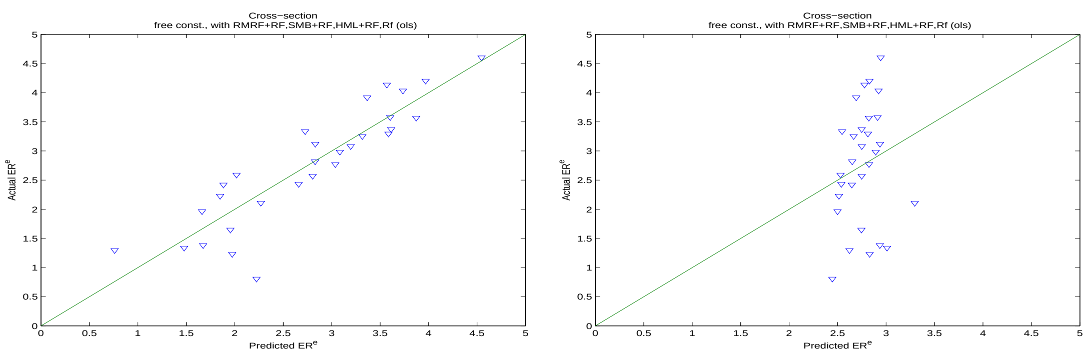


(a) The New Keynesian ICAPM

(b) The Fama-French three factor model

The plot shows realized average returns (in percent) on the vertical axis and fitted expected returns (in percent) on the horizontal axis. Two asset pricing models (the new-Keynesian ICAPM and the Fama-French three factor model) are estimated using the value-weighted returns on 25 portfolios sorted by Campbell, Hilscher, and Szilagyi (2008)'s failure probability measure and size. For each portfolio, the realized average return is the time-series average of the portfolio return and the fitted expected return is the fitted value for the expected return from the corresponding model. The straight line is the 45-degree line from the origin. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and failure probability measure portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

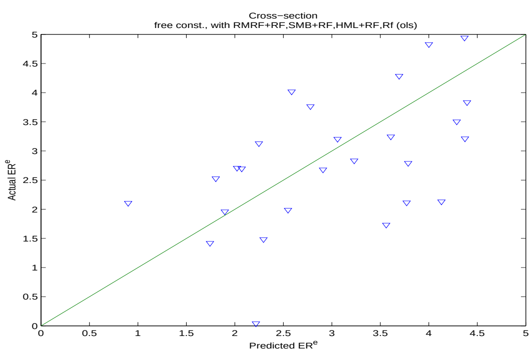
Figure 2: Fitted Expected Returns Versus Average Realized Returns for 25 portfolios sorted by failure probability measure and size, T-bill, Fama-French three factors (1976Q1-2009Q2)



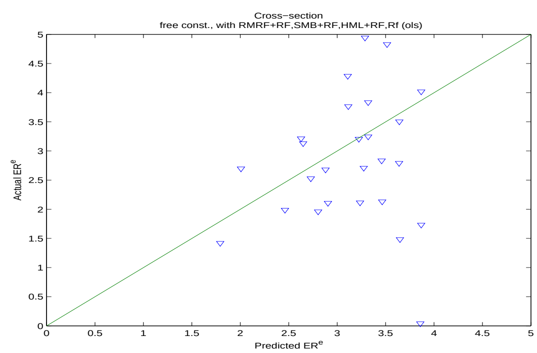
(a) The New Keynesian ICAPM (b) The Fama-French three factor model

The plot shows realized average returns (in percent) on the vertical axis and fitted expected returns (in percent) on the horizontal axis. Two asset pricing models (the new-Keynesian ICAPM and the Fama-French three factor model) are estimated using the value-weighted returns on 25 portfolios sorted by prior returns and size. For each portfolio, the realized average return is the time-series average of the portfolio return and the fitted expected return is the fitted value for the expected return from the corresponding model. The straight line is the 45-degree line from the origin. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and momentum portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Figure 3: Fitted Expected Returns Versus Average Realized Returns for 25 portfolios sorted by prior returns and size, T-bill, Fama-French three factors (1972Q1-2009Q2)



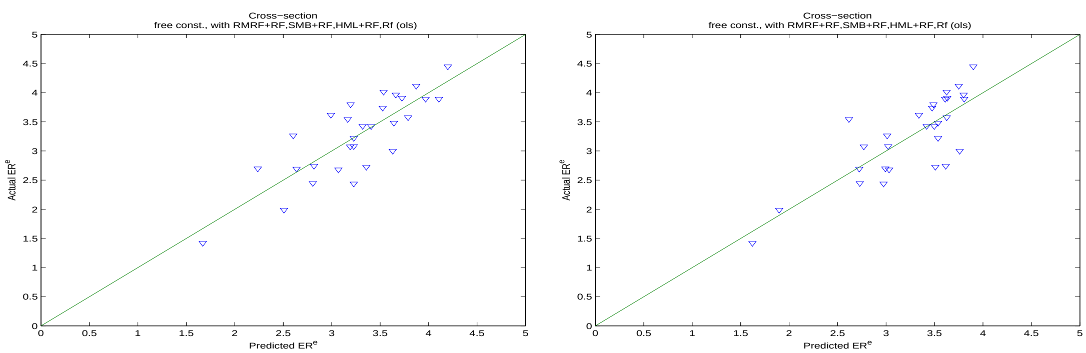
(a) The New Keynesian ICAPM



(b) The Fama-French three factor model

The plot shows realized average returns (in percent) on the vertical axis and fitted expected returns (in percent) on the horizontal axis. Two asset pricing models (the new-Keynesian ICAPM and the Fama-French three factor model) are estimated using the value-weighted returns on 25 portfolios sorted by standardized unexpected earnings (SUE) and size. For each portfolio, the realized average return is the time-series average of the portfolio return and the fitted expected return is the fitted value for the expected return from the corresponding model. The straight line is the 45-degree line from the origin. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and SUE portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

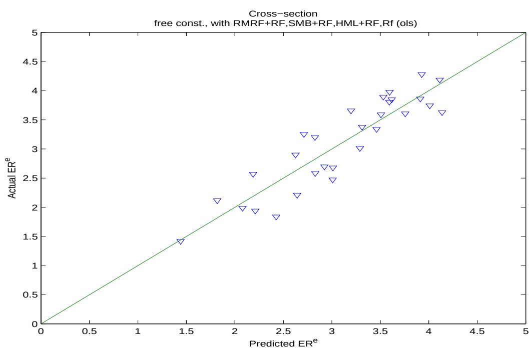
Figure 4: Fitted Expected Returns Versus Average Realized Returns for 25 portfolios sorted by SUE and size, T-bill, Fama-French three factors (1972Q1-2009Q2)



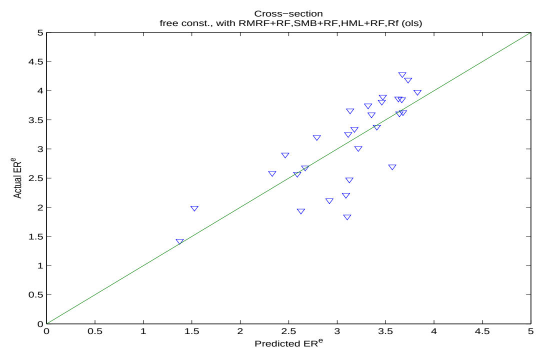
(a) The New Keynesian ICAPM (b) The Fama-French three factor model

The plot shows realized average returns (in percent) on the vertical axis and fitted expected returns (in percent) on the horizontal axis. Two asset pricing models (the new-Keynesian ICAPM and the Fama-French three factor model) are estimated using the value-weighted returns on 25 portfolios sorted by total accruals and size. For each portfolio, the realized average return is the time-series average of the portfolio return and the fitted expected return is the fitted value for the expected return from the corresponding model. The straight line is the 45-degree line from the origin. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and total accruals portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Figure 5: Fitted Expected Returns Versus Average Realized Returns for 25 portfolios sorted by total accruals and size, T-bill, Fama-French three factors (1972Q1-2009Q2)



(a) The New Keynesian ICAPM



(b) The Fama-French three factor model

The plot shows realized average returns (in percent) on the vertical axis and fitted expected returns (in percent) on the horizontal axis. Two asset pricing models (the new-Keynesian ICAPM and the Fama-French three factor model) are estimated using the value-weighted returns on 25 portfolios sorted by net stock issues and size. For each portfolio, the realized average return is the time-series average of the portfolio return and the fitted expected return is the fitted value for the expected return from the corresponding model. The straight line is the 45-degree line from the origin. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and net stock issues portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Figure 6: Fitted Expected Returns Versus Average Realized Returns for 25 portfolios sorted by net stock issues and size, T-bill, Fama-French three factors (1972Q1-2009Q2)

Table 1: Summary Statistics for New Keynesian Structural Shocks

Summary statistics for structural shocks from a new-Keynesian DSGE model from 1954:1 to 2011:1. The Auto(1) give the first autocorrelation. Note: GE_A is the estimated technology shocks; GE_B is the estimated preference shocks; GE_G is the estimated government spending shocks; GE_I is the estimated shocks to investment technology; GE_L is the estimated labor demand shocks; GE_PIE_BAR is the estimated shocks to the inflation target set by the Federal reserve(permanent monetary policy shocks); GETA_P is the estimated price mark-up shocks; GETA_R is the estimated temporary monetary policy shocks; GETA_W is the estimated wage mark-up shocks.

	GE_A	GE_B	GE_G	GE_I	GE_L	GE_PIE_BAR	GETA_P	GETA_R	GETA_W
Panel A: Correlation Matrix									
GE_A	1.0000								
GE_B	-0.0069	1.0000							
GE_G	0.5011	-0.1380	1.0000						
GE_I	-0.0165	0.0331	-0.1514	1.0000					
GE_L	0.1894	-0.1026	0.2474	-0.0022	1.0000				
GE_PIE_BAR	-0.0727	0.3175	-0.1219	0.1525	0.0959	1.0000			
GETA_P	-0.0572	-0.3269	0.1783	-0.1582	0.1806	0.0805	1.0000		
GETA_R	0.2019	0.2548	0.2065	0.1286	0.6432	-0.1233	-0.0280	1.0000	
GETA_W	0.0742	-0.0678	-0.1688	-0.0790	0.0717	0.0872	-0.0666	-0.1714	1.0000
Panel B:Univariate Summary Statistics									
Mean	0.0318	0.0237	0.0256	-0.0430	0.1281	0.0028	-0.0035	0.0154	0.0021
Std. Dev.	0.4799	0.2667	0.5746	0.6454	1.7758	0.0387	0.1924	0.1718	0.2723
Skewness	0.1235	-0.2996	0.1400	-0.9405	0.6763	-0.1548	0.3183	0.9010	0.5380
Kurtosis	4.1766	4.2986	3.9886	6.5736	6.2203	3.9786	4.2074	8.7104	4.9531
Auto(1)	0.0310	-0.1760	-0.2390	-0.0520	0.3990	0.6140	-0.1850	0.1120	0.0100

Table 2: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size-failure portfolios with T-bill rate and three Fama-French Factors (1976Q1-2009Q2)

The table presents the estimation results of two asset pricing models (Panel A: the new-Keynesian ICAPM and Panel B: the Fama-French three factor model). These models are estimated using the value-weighted returns on 25 portfolios sorted by Campbell, Hilscher, and Szilagyi (2008)'s failure probability measure and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1976Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and failure probability measure portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Panel A. The New Keynesian ICAPM

SF25	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2 (S.E.)
Beta risk	1.74	1.13	-0.58	0	-0.43	-0.05	0.74(0.27)
FM	10.94	1.45	-6.21	0	-6.43	-5.74	
Shanken	3.46	1.18	-2.02	0	-2.1	-1.97	
JW	3.86	1.3	-2.39	0	-2.54	-2.41	
Misspe	2.77	1.07	-2.95	0	-2.91	-1.26	
Covariance risk	1.74	-0.06	-4.75	0.96	-11.57	-30.07	
FM	10.94	-3.12	-3.57	1.53	-5.87	-4.89	
Shanken	3.46	-0.98	-1.12	0.48	-1.83	-1.53	
JW	3.86	-1.36	-1.16	0.63	-2.3	-1.6	
Misspe	2.77	-1.22	-1.23	0.3	-2.26	-1.14	

Panel B. The Fama-French three factor model

SF25	constant	RMRF	SMB	HML	R2 (S.E.)
Beta risk	3.81	-0.9	0.38	0.65	0.08(0.14)
FM	10.46	-1.05	0.8	1.02	
Shanken	10.3	-1.05	0.8	1.01	
JW	10.02	-1.06	0.76	0.92	
Misspe	7.49	-1.03	0.68	0.31	
Covariance risk	3.81	-0.02	0.03	0.01	
FM	10.46	-1.03	1.27	0.65	
Shanken	10.3	-1.01	1.24	0.64	
JW	10.02	-0.99	1.14	0.6	
Misspe	7.49	-0.71	0.98	0.2	

Table 3: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size-momentum portfolios with T-bill rate and three Fama-French Factors (1972Q1-2009Q2)

The table presents the estimation results of two asset pricing models (Panel A: the new-Keynesian ICAPM and Panel B: the Fama-French three factor model). These models are estimated using the value-weighted returns on 25 portfolios sorted by momentum and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1972Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and momentum portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Panel A. New Keynesian ICAPM

SM25	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2 (S.E.)
Beta risk	2.13	0.99	-0.5	0.21	-0.42	-0.02	0.72(0.28)
FM	10.35	1.25	-3.45	0.74	-4.45	-1.29	
Shanken	3.7	1.08	-1.25	0.27	-1.61	-0.48	
JW	2.44	1.01	-1.26	0.26	-1.68	-0.48	
Misspe	2.07	0.97	-1.21	0.18	-1.97	-0.42	
Covariance risk	2.13	-0.07	-3.87	1.46	-10.82	-8.61	
FM	10.35	-3.47	-1.96	2.02	-4.63	-1.06	
Shanken	3.7	-1.23	-0.7	0.72	-1.64	-0.38	
JW	2.44	-1.36	-0.73	0.65	-1.87	-0.41	
Misspe	2.07	-1.62	-0.67	0.53	-2.26	-0.43	

Panel B. Fama-French three factor model

SM25	constant	RMRF	SMB	HML	R2 (S.E.)
Beta risk	2.94	-0.4	0.36	-0.04	0.03(0.08)
FM	8.96	-0.46	0.68	-0.06	
Shanken	8.92	-0.46	0.68	-0.06	
JW	8.31	-0.47	0.69	-0.06	
Misspe	6.1	-0.48	0.56	-0.03	
Covariance risk	2.94	-0.01	0.02	0	
FM	8.96	-0.74	0.94	-0.23	
Shanken	8.92	-0.74	0.93	-0.23	
JW	8.31	-0.73	0.91	-0.21	
Misspe	6.1	-0.51	0.68	-0.11	

Table 4: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size and standardized unexpected earnings (SUE) with T-bill rate and three Fama-French Factors (1972Q1-2009Q2)

The table presents the estimation results of two asset pricing models (Panel A: the new-Keynesian ICAPM and Panel B: the Fama-French three factor model). These models are estimated using the value-weighted returns on 25 portfolios sorted by SUE and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1972Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and SUE portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Panel A. New Keynesian ICAPM

SSUE25	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2 (S.E.)
Beta risk	1.07	1.17	0.28	-0.91	0.08	-0.11	0.48(0.2)
FM	7.8	1.58	3.9	-4.88	1.18	-9.53	
Shanken	2.21	1.39	1.16	-1.44	0.34	-2.83	
JW	1.83	1.32	1.21	-1.25	0.35	-2.95	
Misspe	1.11	1.03	0.49	-0.78	0.26	-1.48	
Covariance risk	1.07	-0.02	8.53	-1.62	-2.54	-72.87	
FM	7.8	-1.25	9.27	-3.75	-1.24	-11.87	
Shanken	2.21	-0.35	2.57	-1.06	-0.35	-3.24	
JW	1.83	-0.37	2.32	-0.86	-0.35	-3.37	
Misspe	1.11	-0.26	1.34	-0.62	-0.32	-1.89	

Panel B. Fama-French three factor model

SSUE25	constant	RMRF	SMB	HML	R2 (S.E.)
Beta risk	1.8	1.09	0.67	0.21	0.12(0.11)
FM	17.34	1.48	1.4	0.42	
Shanken	17.1	1.48	1.39	0.42	
JW	15.55	1.46	1.49	0.4	
Misspe	5.61	1.36	1.32	0.18	
Covariance risk	1.8	0.01	0.01	0.02	
FM	17.34	1.27	0.84	1.02	
Shanken	17.1	1.24	0.82	1	
JW	15.55	1.07	0.84	0.92	
Misspe	5.61	0.68	0.65	0.39	

Table 5: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size and total accruals with T-bill rate and three Fama-French Factors (1972Q1-2009Q2)

The table presents the estimation results of two asset pricing models (Panel A: the new-Keynesian ICAPM and Panel B: the Fama-French three factor model). These models are estimated using the value-weighted returns on 25 portfolios sorted by total accruals and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1972Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and total accruals portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Panel A. New Keynesian ICAPM

SNSTA25	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2 (S.E.)
Beta risk	1.58	1.4	0	-0.04	-0.11	-0.03	0.68(0.28)
FM	8.35	1.87	0.02	-0.27	-1.52	-3.28	
Shanken	5.44	1.81	0.02	-0.19	-1.01	-2.22	
JW	4.58	1.81	0.01	-0.17	-1.15	-2.55	
Misspe	3.29	1.74	0.01	-0.15	-1.04	-1.88	
Covariance risk	1.58	-0.02	2.48	0.34	-5.16	-25.52	
FM	8.35	-1.34	1.86	1.01	-2.51	-3.91	
Shanken	5.44	-0.87	1.2	0.66	-1.62	-2.5	
JW	4.58	-0.92	0.94	0.59	-1.71	-2.23	
Misspe	3.29	-0.87	0.8	0.49	-1.71	-1.65	

Panel B. Fama-French three factor model

SNSTA25	constant	RMRF	SMB	HML	R2(S.E.)
Beta risk	1.62	1.41	0.28	1.37	0.65(0.24)
FM	15.05	1.89	0.57	2.58	
Shanken	14.22	1.88	0.56	2.57	
JW	13.1	1.9	0.6	2.4	
Misspe	12.11	1.84	0.6	2.3	
Covariance risk	1.62	0.03	-0.01	0.05	
FM	15.05	3	-0.36	3.53	
Shanken	14.22	2.76	-0.34	3.22	
JW	13.1	2.16	-0.34	2.68	
Misspe	12.11	2.02	-0.33	2.45	

Table 6: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size and total accruals with T-bill rate and three Fama-French Factors (1972Q1-2009Q2)

The table presents the estimation results of the new-Keynesian ICAPM augmented with two Fama-French factors (SMB and HML). These models are estimated using the value-weighted returns on 25 portfolios sorted by total accruals and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1972Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 Portfolios Formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and total accruals portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

SNSTA25	constant	RMRF	SMB	HML	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2
Beta risk	1.09	1.59	0.74	1.38	0.14	0.03	0.08	-0.03	0.79(0.15)
FM	7.41	2.14	1.52	2.62	1.92	0.2	1.53	-3.55	
Shanken	4.79	2.08	1.43	2.48	1.27	0.14	1.01	-2.4	
JW	4.69	2.15	1.46	2.25	1.35	0.11	0.84	-2.07	
Misspe	3.48	2.13	1.48	2.02	1.15	0.1	0.55	-2.13	
Covariance risk	1.09	0.03	0.02	0.05	2.92	0.1	0.89	-23.4	
FM	7.41	1.66	0.79	3.01	2.19	0.31	0.45	-4.02	
Shanken	4.79	1.07	0.51	1.92	1.41	0.2	0.29	-2.54	
JW	4.69	0.99	0.41	1.68	1.33	0.16	0.24	-2.14	
Misspe	3.48	0.74	0.39	1.31	1.33	0.15	0.16	-2.18	

Table 7: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size and net stock issues portfolios with T-bill rate and three Fama-French Factors (1972Q1-2009Q2)

The table presents the estimation results of two asset pricing models (Panel A: the new-Keynesian ICAPM and Panel B: the Fama-French three factor model). These models are estimated using the value-weighted returns on 25 portfolios sorted by net stock issues and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1972Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 portfolios formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and net stock issues portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

Panel A. New Keynesian ICAPM

SNSA25	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2 (S.E.)
Beta risk	1.71	1.57	-0.38	0.59	-0.3	-0.02	0.82(0.14)
FM	9.61	2.11	-3.49	3.46	-4.33	-2.8	
Shanken	3.77	1.9	-1.39	1.42	-1.73	-1.2	
JW	2.74	1.86	-1.18	1.59	-1.67	-1.23	
Misspe	2.79	1.86	-1.01	1.43	-1.45	-1.19	
Covariance risk	1.71	-0.05	-2.76	2.22	-9.41	-16.12	
FM	9.61	-3.28	-1.85	5.09	-4.53	-2.97	
Shanken	3.77	-1.28	-0.72	1.97	-1.76	-1.16	
JW	2.74	-1.35	-0.64	1.64	-1.75	-1.28	
Misspe	2.79	-1.29	-0.55	1.53	-1.65	-1.19	

Panel B. Fama-French three factor model

SNSA25	constant	RMRF	SMB	HML	R2 (S.E.)
Beta risk	1.36	1.29	0.15	2.19	0.6(0.17)
FM	13.72	1.74	0.31	3.84	
Shanken	12.4	1.73	0.31	3.75	
JW	10.69	1.75	0.34	3.8	
Misspe	9.55	1.73	0.34	3.2	
Covariance risk	1.36	0.04	-0.01	0.08	
FM	13.72	3.51	-0.64	4.74	
Shanken	12.4	3.07	-0.58	4.04	
JW	10.69	2.38	-0.58	3.47	
Misspe	9.55	2.27	-0.56	3.15	

Table 8: Estimates and t-ratios of Zero-Beta Rate and Risk Premia on 25 size and net stock issues portfolios with T-bill rate and three Fama-French Factors (1972Q1-2009Q2)

The table presents the estimation results of the new-Keynesian ICAPM augmented with two Fama-French factors (SMB and HML). These models are estimated using the value-weighted returns on 25 portfolios sorted by net stock issues and size, T-bill rate, and the Fama-French three factors in return forms (T-bill rates are added to each factor) from 1972Q1 to 2009Q2. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio under correctly specified models (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio under correctly specified models that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 Portfolios Formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on 25 size and net stock issues portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

SNSA25	constant	RMRF	SMB	HML	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2
Beta risk	1.67	1.68	0.4	1.68	-0.35	0.45	-0.33	-0.02	0.84(0.11)
FM	12.82	2.26	0.85	3.08	-3.56	3.47	-5.87	-2.55	
Shanken	5.15	2.11	0.74	2.32	-1.46	1.5	-2.43	-1.14	
JW	4.64	2.04	0.82	2.5	-1.57	1.47	-3.12	-1.15	
Misspe	4.18	2.05	0.8	2.19	-1.29	1.21	-2.81	-1.18	
Covariance risk	1.67	-0.04	-0.02	0.01	-2.01	1.88	-10.4	-14.89	
FM	12.82	-2.61	-1.14	0.48	-1.34	5.08	-5.29	-2.78	
Shanken	5.15	-1.04	-0.46	0.19	-0.54	2.01	-2.09	-1.11	
JW	4.64	-1.05	-0.49	0.17	-0.5	1.55	-2.05	-1.22	
Misspe	4.18	-1.1	-0.47	0.18	-0.43	1.39	-2.3	-1.2	

Table 9: Estimates and t-ratios of Zero-Beta Rate and the Price of Covariance Risk on Characteristic portfolios with T-bill rate and three Fama-French Factors (1972Q1 to 1983Q4)

The table presents the estimation results of the new-Keynesian ICAPM for characteristic based portfolios (size-failure (SF25), size-momentum (SM25), size and SUE (SSUE25), size and total accruals (SNSTA25), and size and net stock issues (SNSA25)). As recommended in Lettau and Ludvigson (2001), the estimated covariances, which are the independent variables in the second stage regressions, are computed using full-sample in the first step regression. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 Portfolios Formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on characteristic portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon
SF25	2.43	-0.07	0.35	-0.28	-19.24	-46.88
FM	7.89	-1.88	0.14	-0.23	-5.03	-3.94
Shanken	2.01	-0.48	0.03	-0.06	-1.25	-0.99
JW	2.39	-0.74	0.02	-0.06	-0.87	-0.67
Misspe	1.87	-0.73	0.02	-0.04	-0.92	-0.54
SM25	2.69	-0.08	-1.58	1.15	-14.57	-16.06
FM	7.81	-2.68	-0.48	0.95	-3.72	-1.18
Shanken	2.55	-0.87	-0.16	0.31	-1.2	-0.39
JW	1.94	-0.83	-0.17	0.21	-1.1	-0.32
Misspe	1.3	-1	-0.14	0.16	-1.31	-0.39
SSUE25	1.77	-0.04	11.57	-3.17	-7.55	-83.53
FM	7.32	-1.72	7.12	-4.15	-2.08	-7.7
Shanken	1.61	-0.38	1.53	-0.91	-0.46	-1.65
JW	1.32	-0.27	1.08	-0.58	-0.33	-1.37
Misspe	0.92	-0.22	0.67	-0.43	-0.31	-0.85
SNSTA25	2.45	-0.05	3.14	-0.18	-10.42	-21.51
FM	7.33	-1.8	1.33	-0.31	-2.87	-1.86
Shanken	3.54	-0.86	0.64	-0.15	-1.36	-0.89
JW	2.38	-0.66	0.33	-0.1	-0.99	-0.45
Misspe	1.46	-0.62	0.24	-0.09	-1.08	-0.32
SNSA25	2.34	-0.07	0.02	1.58	-13.86	-22.91
FM	7.46	-2.7	0.01	2.05	-3.77	-2.39
Shanken	2.72	-0.97	0	0.74	-1.35	-0.86
JW	2.04	-0.81	0	0.56	-1.04	-0.68
Misspe	1.98	-0.82	0	0.57	-1.12	-0.63

Table 10: Estimates and t-ratios of Zero-Beta Rate and the Price of Covariance Risk on Characteristic portfolios with T-bill rate and three Fama-French Factors (1984Q1 to 2009Q2)

The table presents the estimation results of the new-Keynesian ICAPM for characteristic based portfolios (size-failure (SF25), size-momentum (SM25), size and SUE (SSUE25), size and total accruals (SNSTA25), and size and net stock issues (SNSA25)). As recommended in Lettau and Ludvigson (2001), the estimated covariances, which are the independent variables in the second stage regressions, are computed using full-sample in the first step regression. Following Kan, Robotti, and Shanken (2012), I report the Fama and MacBeth (1973) t-ratio (FM), the Shanken (1992) and the Jagannathan and Wang (1998) t-ratio that account for the EIV problem (Shanken and JW, respectively), and their model misspecification-robust t-ratios (Misspe). As a model diagnostic, I also report Adjusted R2 and its standard errors computed as in Kan, Robotti, and Shanken (2012). I use Newey-West correction with one lag to compute all the statistics. The quarterly Fama-French factors (RMRF, SMB, HML) are computed using monthly returns of 6 Portfolios Formed on Size and Book-to-Market and market excess returns, T-bill rates from Kenneth French's website. Quarterly value-weighted returns on characteristic portfolios are computed using corresponding monthly returns obtained from Long Chen. Four structural shocks are estimated from a new-Keynesian DSGE model; Preference is the estimated preference shocks; Invest.Tech is the estimated shocks to investment technology; permanent monetary policy shock (Per.Mon) and temporary monetary policy shock (Tem.Mon).

	constant	RMRF	Preference	Invest. Tech	Tem.Mon	Per.Mon	R2 (S.E.)
SF25	1.49	-0.06	-6.6	1.41	-8.79	-23.98	0.72(0.26)
FM	8.01	-2.51	-4.25	1.92	-3.82	-3.34	
Shanken	2.58	-0.81	-1.36	0.62	-1.22	-1.07	
JW	3.03	-0.98	-1.87	0.7	-1.86	-1.1	
Misspe	3	-0.92	-1.95	0.35	-1.91	-0.99	
SM25	1.82	-0.05	-5.13	1.63	-8.74	-4.5	0.77(0.29)
FM	7.09	-2.34	-2.08	1.81	-3.01	-0.45	
Shanken	2.59	-0.85	-0.76	0.66	-1.09	-0.16	
JW	1.61	-1.1	-0.8	0.71	-1.45	-0.21	
Misspe	1.51	-1.29	-0.82	0.62	-1.83	-0.17	
SSUE25	0.74	-0.01	7.09	-0.89	-0.19	-67.85	0.44(0.21)
FM	4.44	-0.33	6.36	-1.7	-0.08	-9.11	
Shanken	1.4	-0.11	1.96	-0.53	-0.02	-2.76	
JW	1.62	-0.18	2.56	-0.6	-0.03	-3.25	
Misspe	0.84	-0.09	1.39	-0.37	-0.03	-1.74	
SNSTA25	1.17	-0.01	2.17	0.59	-2.69	-27.41	0.67(0.25)
FM	5.09	-0.39	1.34	1.44	-1.08	-3.46	
Shanken	3.43	-0.26	0.9	0.97	-0.73	-2.27	
JW	3.85	-0.29	0.98	1.18	-0.83	-3.1	
Misspe	3.56	-0.29	0.9	1.19	-0.84	-2.86	
SNSA25	1.41	-0.04	-4.08	2.52	-7.32	-12.93	0.73(0.28)
FM	6.54	-2.12	-2.25	4.77	-2.91	-1.97	
Shanken	2.53	-0.82	-0.87	1.82	-1.12	-0.76	
JW	1.76	-0.84	-0.71	1.37	-1.14	-0.75	
Misspe	1.83	-0.77	-0.58	1.15	-0.99	-0.69	