Behavioral approach to Arbitrage Pricing Theory

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Abstract

In this paper, I have examined the relation between expected returns and measures of systematic risk stemming from macroeconomic factors studied by Chen, Roll and Ross (1986, hereafter CRR) for a different time period (1978-2007) and different formation of portfolios (based on ME and BE/ME). Like CRR, I've used a version of Fama and MacBeth's (1973) two-pass cross-sectional regression (CSR) methodology. Apparently, changing the time period and formation of portfolio lead to noticeably different conclusions. Using the same macrofactors as CRR only factor related to the change in expected inflation (DEI) is significantly priced in the overall period. The sample mean of the Industrial production factor (MP), a highly significant factor in CRR, is insignificant, although positive, for this period. Adding a sixth factor that captures the investor's confidence in the market is quite insensitive to other marcofactors. However, both the five factor by CRR and proposed six factor model show evidence of joint significance, which is a new property entered in this paper.

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1. Introduction:

The major idea of this paper is macroeconomic developments exert important effects on equity returns. The general 'intuition' of this idea is that any variable that affects the future investment opportunity set or the level of consumption (given wealth) could be a priced factor in equilibrium Merton (1973). So, assets or securities those are influenced by such 'undiversifiable' risks should earn risk premium in a risk-averse economy, according to Ross (1976). Starting with Chen, Roll, and Ross (1986) to Shanken and Weinstein (2006), many famous articles have tried to show reliable associations between macroeconomic variables and security returns. The impact of real sector macro variables on equity returns has been much more difficult to establish. Indeed, the following dialogue regarding the asset pricing literature seems still relevant today as it was in 1986: "A rather embarrassing gap exists between the theoretically exclusive importance of systematic "state variables" and our complete ignorance of their identity" (Chen et al., 1986). My study in this paper is highly motivated by the approaches followed and explained by CRR (1986); Shanken and Weinstein (2006, hereafter SW).

There exist other challenging assets pricing models developed and criticized before the multifactor model. These include the Sharpe-Lintner (SL) capital asset pricing models (CAPM) and Black Version of CAPM[1], consumption based[2] (intertemporal models) CAPM and the arbitrage pricing theory (APT) of Ross (1976). CAPM is based on the idea that asset's systematic risk can be measured by a risk premium termed 'beta' with respect to a diversified stock index. Because true market portfolio is unobservable, later researches proposed a 'proxy' which is the value-weighted market portfolio of all assets in the market (Fama and MacBeth, 1973). These approaches are criticized[3] by several authors by stressing that CAPM will work for asset pricing only if the true market portfolio were used in the tests. This statement is the turning point of financial studies on more risk factors which gave rise to APT (Arbitrage pricing theory).

In this area of APT, Roll and Ross (1980) used 'factor-analytic' methods to find more than one measures of systematic risk. In this approach, different restrictions on the covariance matrix of returns are initiated to statistically spot 'betas'. Fundamental risk factors are not apparent in these studies. Under this method, first the factor sensitivity matrix and the disturbance covariance matrix are estimated. Then these estimates are used to construct measures of the factor realization (Campbell et.al., 1997).

The next idea was developed by Chan et al. (1985, hereafter CCH) and CRR, which is the primary focus of this paper. Here the risk factors or pricing factors are observable macroeconomic factors. Selection of these factors basically depends on economic 'intuition'. However, factors selection should be backed by some equilibrium models – as per the requirement of any econometrics study. Shanken and Weinstein (2006) says, "although the authors appeal to the APT in motivating their work, the strong intuition underlying their choice of factors is derived, in large part, from the intertemporal models…..". According to Shanken (1987) again, these macrofactors can be depicted as a "multivariate proxy for the unobservable equilibrium benchmark". So, the joint hypothesis is important in these studies.

[1] Check Sharpe (1964), Lintner (1965) and Black (1972) for more information

[2] Check Merton (1973), Long (1974) etc. for more information.

[3] Check Roll (1977) for more information.

CRR identify five potential factors: the growth rate of Industrial Production, Expected Inflation, Unexpected Inflation, a bond Default Risk Premium, and a Term Structure Spread. They conclude that the default and term premium are priced risk factors and that Industrial Production is a strong candidate for being a risk factor, and that weaker evidence supports Inflation's claim to that status. SW shows that CRR's main conclusions depend on the specific method used to form test portfolios. Correcting some of CRR's standard error estimates for errors in variables further reduces the statistical importance of macro factors for equity returns. Cutler, Poterba, and Summers (1989) find that Industrial Production growth is significantly positively correlated with real stock returns over the period 1926-1986, but not in the 1946-1985 subperiod, which substantially overlaps CRR's 1958-1984 sample period. Many researchers also tried to incorporate more variables in the CRR model. Even if the variables are not found significant, these variables should make economic sense and have some sort of theoretical background.

This paper tries to contribute somewhat to researches in this area. Here I retrace the pricing of the Chen, Roll, and Ross (CRR) macrofactors for a different time period (January 1978 to December 2007) and different 'formation of portfolios'. The results are startlingly sensitive to reasonable alternative formation of portfolios based on 'size' (ME = Market equity) and BE/ME (Book to market equity ratio) and change of time period. Surprisingly enough, I found Strong evidence of pricing for 'changes in expected inflation' in contrast to CRR and SW where they found 'Industrial Production' uncertainty to be significant risk factor. My study also depicts negative pricing for 'risk premium' and positive pricing for 'Term structure' – those are completely opposite signs compared to CRR. However, I get similar signs (negative) for the inflation related pricing. Finally I added a sixth factor to the CRR model capturing the behavioral aspect of agent proxied by 'consumer's confidence'. Although the factor is not priced - inclusion of this factor improve the joint significance of all the six factors in my proposed six factor model.

Following a brief literature review in Section 1, Section 2 describes the five factors of CRR those I'll be using in the model. The estimation technique and data formation are described in Section 3. The five factor results for a different time period (1978-2007) than CRR is presented and explained in Section 4, along with a robustness analysis for different sub-periods. Section 5 introduces a new factor (sixth one) pertaining to consumer confidence and explains rationale behind choosing this factor. In Section 6, I add the sixth factor to the five factor model and analyze the findings. The paper concludes with a summary and discussion of the implications for future research.

2. Discussing the Five Factors:

In the 1st empirical model, I use the same five factors[4] as depicted by CRR. I would first discuss the rationality behind choosing these factors. The current value of any financial asset can be expressed as the integral of the expected future cash flows (dividends, for example) those are discounted with a 'risk-adjusted' discount rate. So, return on that asset, which is a function of prices, thus depends on this 'expected future cash flows' and the 'discount rate'. On the basis of this 'economic intuition' the factors are chosen.

To capture the level of 'real activity', which is one of the indicators of the state of economy, I took monthly growth rate of industrial production ($MP = \log(IP_{t+1}/IP_t)$). To detain more effect of expected future evolution of the economy, I also consider the impact of the 'pricing operator' of the economy. If the cash flows and discount rate are not balanced for price rises, it will have an effect on asset returns. I have taken two factors to capture this impact of inflation. First one is unexpected inflation ($UI = I(t) - E[I(t)/t - 1]$) which is the difference between the realized inflation rate, $I(t)$, during period t and the expected inflation rate, $E[I(t)/t - 1]$[5], at the beginning of period t. The second inflation variable is the change in expected inflation ($DEI = E[I(t+1)/t] - E[I(t)/t - 1]$). There is always a chance that future inflation predictions can be influenced by economics factors. So, DEI may contain information not present in UI. Since the present value of any asset captures both the short run and long run phenomenon (discounted expected cash flows), I have used another factor named term structure ($UTS(t) = LGB(t) - TB(t-1)$), which is the difference between the long-term government bonds (LGB)[6] and the T-Bill rate (TB). We mentioned before that discount rate is 'risk adjusted' and adjustment for risk refers to 'risk premium' – which is a functions of 'cost of risk[7]' and 'risk' itself. So, it is reasonable to expect that economic fluctuations can affect the risk premium. Risk can capture both business risk and financial risk. So, the final factor we incorporate is the 'risk premium' (UPR(t) = "Baa and under" bond portfolio return (t) – LGB (t)). CRR hoped that UPR would reflect much of the unanticipated movement in the degree of risk aversion and in the level of risk implicit in the market's pricing of stocks". The data on these five factors are obtained from Liu and Lu (2008).

Table 1 gathers the correlation coefficients among the variables. Most of the correlations are not large except (a) between the two inflation variables, UI and DEI, because these contain the common expected inflation term in calculation; (b) between the UPR and UTS (in the 3 subsamples particularly) because these contain the long-term government bond returns. I have also included the sixth factor (in the 6th Column, GCCI) measuring the monthly change of the Consumer Confidence Index (CCI). This variable will be explained and used later to substantiate the interpretation of our empirical model.

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[4] They (Chen et.al., 1986) chose the five factor on the basis of 'intuition' and previous empirical studies (check Roll and Ross 1980; Brown and Weinstein 1983).

[5] The expected inflation data can be obtained from Fama and Gibbons (1984, eq. (15)). They derived this using the famous 'Fisher equation'. They extract the expected inflation from the time series of one-month T-Bill rates assuming that the expected real return is a random walk. The way they extracted the expected inflation from the T-Bills – it makes the unanticipated inflation (UI) perfectly negatively correlated with the change in the expected one-month real rate. So, we do not include a factor for capturing the effect of interest rate although it is important because it represents opportunity costs.

[6] from Ibbotson and Sinquefield (1982)

[7] Marginal trade-off between consumption and risky investment. It depends on the current state and expected future state of the economy.

Table 1: Correlation Matrices for the Independent Variable

Symbol	UI	DEI	UTS	UPR	GCCI
		A. January 1978 – December 2007			
MP	0.031	0.035	-0.003	-0.236	0.236
UI		0.655	0.132	-0.064	0.045
DEI			-0.008	-0.118	0.078
UTS				-0.129	0.014
UPR					-0.064
		B. January 1983 – December 1990			
MP	.212	0.181	0.199	0.097	0.194
UI		0.679	0.203	0.020	0.173
DEI			0.040	-0.003	0.069
UTS				0.517	0.089
UPR					0.174
		C. January 1991 – December 1998			
MP	-0.025	0.034	-0.153	-0.334	0.095
UI		0.656	0.133	0.066	-0.121
DEI			0.040	-0.010	-0.079
UTS				0.430	-0.009
UPR					0.016
		D. January 2000 – December 2007			
MP	0.007	0.024	-0.019	0.029	0.219
UI		0.901	0.108	0.066	0.057
DEI			0.067	0.012	0.084
UTS				0.497	-0.009
UPR					0.013

Note: MP = Monthly growth rate in industrial production; UI = Unanticipated Inflation; DEI = Change in expected inflation; UTS = Unanticipated change in the term structure; UPR = Unanticipated change in the risk premium; and GCCI = Monthly percentage change in Consumer Confidence Index (CCI).

3. The Methodology:

3.1 Constructing the portfolio:

In their famous paper, CRR grouped the securities in to 20 'equally weighted' sized portfolios to control for the EIV (Errors in variable) problem and to reduce the noise in individual asset returns. They formed the portfolios on the basis of firm size[8]. In this paper, I rather formed 25 value weighted sized portfolios based on size (ME) and book equity to market equity (BE/ME). This portfolio formation is highly motivated by the work of Fama and French (1995). They (Fama and French, 1992) found that not only size (ME), book to market ratio (BE/ME) can also explain much of the 'cross-section' of average stock returns. They also documented that these two variables must also proxy for sensitivity to common 'risk' factors in returns. Later they (Fama and French, 1993) confirmed that portfolios constructed to imitate 'risk' factors related to size and BE/ME explain considerably the variation in stock returns. I already explained before that expected price of an asset is a function of discounted future earnings or cash flows. Fama and French (1995) further explains that BE/ME is related to importunate properties of earnings - high BE/ME can be attributed to persistent low earnings on book equity. According to them, size too is related to earnings. Controlling for BE/ME, stocks with small market capitalization apt to have lower earnings on book equity[9].

As I'm interested in 'cross-section' of average stock returns here, to control the effects of ME and BE/ME on stock returns, I took data (timeline: 1983-2007) for 25 value weighted portfolios constructed on size (ME) and BE/ME from the personal website of Kenneth R. French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/index.html). These portfolios are the intersections of 5 portfolios formed on size (ME)[10] and 5 portfolios formed on BE/ME[11] those are constructed at the end of each June.

3.2 Fama-MacBeth Cross Sectional Regression (CSR):

After constructing the portfolios according to firm size and BE/ME, I have used the Fama-MacBeth (1973) CSR method to test the five factor model. CSR implies a linear relation between expected returns and market (factor) betas which completely explains the cross section of expected returns (Campbell et.al., 1997). I've first regressed each of the 25 portfolios on five marco-factors in the first five years (starting from January, 1978) to estimate the factor betas. Then I've performed cross-sectional regressions of the 25 portfolios' returns on the obtained portfolios' multiple betas month-by-month in the sixth year (Starting from 1983)[12]. Then I've gone down by the years by one from the beginning (starting from 1979) to estimate the time series betas and for the sixth year again (1984) I've calculated cross section estimates. This is

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[8] Chen et.al. (1986) says that firm size is strongly related to average returns as proposed by Banz (1981). They hoped that this would give the predicted dispersion without biasing the tests of economic variables.

[9] To learn more on these ME and BE/ME facts, look at Penman (1991), Lakonishok, Shleifer, and Vishny (LSV, 1994) etc.

[10] The 'size' breakpoints for year t are the NYSE market equity quintiles at the end of June of t.

[11] The BE/ME breakpoints are NYSE quintiles. BE/ME for June of year t = BE for the last fiscal year end in t-1 / ME for December of t-1.

[12] Along with several other studies, Chen et.al. (1986) made an implicit assumption that unconditional risky behavior of their equally weighted portfolios (formed on size) are constant over each six year timeline – 5 years of time-series regressions to estimate the betas and a 6th year for cross-section. For more information on this check Shanken and Weinstein (2006), Ball and Kothari (1989), Chan (1988) etc.

how the process goes on[13]. The estimation of betas are dependent on time-series tests of asset pricing models that focus on the intercept in excess-return factor model regression as exemplified by Gibbons et al. (1989). To calculate the excess return on portfolios, the data for risk-free rate in U.S. have been obtained from Kenneth R. French website.

I've used simple ordinary least squares (OLS) method, as in CRR, for 125 time-series regressions and 300 (360 months minus first 60 months) cross sectional regressions. CCH, SW etc. used weighted-least-squares (WLS) methods in their analysis. I've used 25 VW portfolios formed on size and BE/ME and CRR used 20 EW portfolios formed on size only. Given my limited knowledge about the small-sample properties, strong conclusions are not possible. However, the findings of Shanken and Weinstein (2006) suggest that "using OLS or WLS with a relatively large set of assets (in my case it is more than CRR) may be the preferred approach in work of this sort".

4. The Five Factor Model (as in CRR):

Here I've checked for the pricing of five factors as proposed by Chen et.al. (1986) for the period of January, 1978 – December, 2007. We start with the following time series model for excess returns on the portfolio[14] –

$$R_{pt} = \alpha_p + \beta_{1p}MP_t + \beta_{2p}UI_t + \beta_{3p}DEI_t + \beta_{4p}UTS_t + \beta_{4p}UPR_t + \varepsilon_{pt} \quad (1)$$

Here R_{pt} = the excess return on value weighted (based on ME and BE/ME) portfolio p for month t; MP_t = the percentage change in industrial production led by one month; UI_t = contemporaneous unanticipated inflation; DEI_t = the change in expected inflation; UTS_t = the return on long term government bonds over T-bills with one month to maturity; UPR_t = the return on low grade corporate bonds over long term government bonds and ε_{pt} is the error term with zero mean and constant covariance matrix conditional on independent variables. Returns and factors are assumed to be IID[15] over time.

Then the coefficients of gammas are estimated for each month t (starting from January 1983) by regressing[16] the cross-section portfolio excess returns and the estimates of betas from time-series regression above. In this step we have the following model –

$$R_{pt} = \gamma_0 + \gamma_1\beta_{1p} + \gamma_2\beta_{2p} + \gamma_3\beta_{3p} + \gamma_4\beta_{4p} + \gamma_5\beta_{5p} + \omega_{pt} \quad (2)$$

The estimated cross-sectional coefficients (γ_1 to γ_5) are estimated risk premiums associated with each of the macro-factors, from which I can test the null hypothesis that the risk premiums are zero. The cross-sectional regressions force the intercept term (γ_0) as well as the risk premiums to be the same across the 25 portfolios. So, if I can find any discrepancies or violation of the cross

[13] A graphical representation of the method is given in the appendix 8.4
[14] For each five year timeline we have 25 different time-series regressions for 25 different portfolios. These time series betas are then saved to conduct the cross-sectional regressions in the second step.
[15] Shanken and Weinstein (2006) referred to this assumption as adequate approximation for stock returns.
[16] Here we have 12 cross sectional regressions for each year for 25 portfolios.

sectional pricing equation occurs, it is coming from the disturbance term ω_{pt} - which is the unconditionally unexpected return.

A valid assumption, used in many other similar studies, that returns are normally distributed and temporally IID – then gammas will also be normally distributed and IID. According to Campbell et al. (1997), one can test the individual significance level of gammas from all the regression by usual t-statistics –

$$t_{\hat{\gamma}_1} = \frac{\hat{\gamma}_1}{\hat{\sigma}_{\gamma_1}} = \frac{T^{-1}\sum_{t=1}^{T}\hat{\gamma}_{1t}}{\left[\frac{1}{T(T-1)}\sum_{t=1}^{T}\left(\hat{\gamma}_{1t}-\bar{\gamma}_1\right)^2\right]^{1/2}}$$

Here, $\hat{\gamma}_1$ is the mean value of a gamma coefficient from all the cross section regressions and $\hat{\sigma}_{\gamma_1}$ is the adjusted standard deviation.

I already stated before referring to Shanken (1987) that the joint hypothesis (F-Test) is the important test statistics while discussing the significance level of these sort of multifactor studies. However, a problem related to degrees of freedom arises for F-test in CSR method. In most of the approximations to the F-distribution, with k and n degrees of freedom in the numerator and denominator, are based on the assumption that both k and n are large. This assumption, however, does not hold and F-distribution doesn't provide a good approximation when only either k or n are large (Li and Martin, 2000). This problematic situation can arise here because I have six coefficients in a five factor model, but a large number of gammas from large number of cross-sectional regressions (300 in this case). Li and Martin (2000) proposed a "shrinking factor approximation" (SFA), G (λkx; k) to approximate[17] F- distribution, F(x; k, n), for large n and fixed k, with a chi-square distribution, G(x; k) with degrees of freedom = k and λ=λ (kx; n) being the shrinking factor. I used this method in this paper.

The gamma coefficients through estimating (2) for the overall period (1983-2007) and three sub-periods (1983-1990, 1991-1998 and 2000-2007) are presented in the Table 2 below for comparison with overall period (1958 – 1984) by Chen et.al. (1986).

[17] $F(x; k, n) \approx G\left[kx\left\{\frac{2n+(k-2)}{2n+kx}\right\}; k\right]$ for large n and fixed k ($\approx$means approximately and $\lambda = \frac{2n+(k-2)}{2n+kx}$)

Table 2: Five factor model and Pricing (Exposure × 100), multivariate approach

A. Results for the overall period for comparison with Chen et.al. (1986)							
Years	MP	UI	DEI	UTS	UPR	Constant	F-Stat
1983-2007	0.062	-0.034	-0.030**	0.166	-0.037	0.959**	4491.8
(This Paper)	(0.462)	(-1.154)	(-2.193)	(0.935)	(-1.018)	(3.384)	
CRR Values*	1.398**	-0.067**	-0.011	-0.587*	0.794**	0.411	……
(1958-1984)	(3.727)	(-2.052)	(-1.499)	(-1.844)	(2.807)	(1.334)	
B. Results for the sub-periods							
Years	MP	UI	DEI	UTS	UPR	Constant	F-Stat
1983-1990	0.242	-0.113	-0.099**	-0.090	-0.114	1.094**	1381.6
(This Paper)	(1.298)	(-1.791)	(-3.043)	(-0.257)	(-1.185)	(1.969)	
1990-1998	0.344**	-0.015	-0.003	0.430	-0.005	1.190**	1451.1
(This Paper)	(1.960)	(-0.351)	(-0.163)	(1.266)	(-0.144)	(2.535)	
2000-2007	-0.316	0.010	0.019	0.119	-0.017	0.628	1450.4
(This Paper)	(-0.991)	(0.213)	(1.366)	(0.469)	(-0.354)	(1.309)	

*Exposures obtained by Chen et.al. (1986). I divide their exposures by 10 to make the values comparable to my result.

Note: MP = Monthly growth rate in industrial production; UI = Unanticipated Inflation; DEI = Change in expected inflation; UTS = Unanticipated change in the term structure; and UPR = Unanticipated change in the risk premium. T-test statistics are in the parenthesis. F-stat measures the joint significance of the factors.

From the table above, for the overall period, the risk premium (i.e., the estimated gammas) associated with MP is positive (also in the first two sub-periods), as expected. This positive sign on MP reflects the value of insuring against real organized production risks. The negative risk premium associated with UI and DEI are plausible. If people prefer stocks whose returns are positively correlated with inflation and if this is the determining factor, then the risk premium for the inflation risk variables would be negative. These negative signs on the premium mean that stocks can be perceived to be hedges against the adverse influence of inflation on other assets. These signs of MP, UI and DEI match with the signs predicted by CRR (true for the first two sub-periods too). However, a positive risk premium for UTS and negative risk premium for UPR oppose the findings of CRR. A positive UTS premium says that stocks or portfolios those we are working on provides hedge against stochastic shifts in the interest (after controlling for the effect of inflation) – which is not plausible. In contrast Long term government bonds should be the hedges against this unanticipated change in interest rates. We only find negative UTS premium for the sub-period (1983-1990) nearer to the estimation period of CRR (1958-1984). A negative UPR premium says that stocks can be hedge against unanticipated changes risk premium (differences between rates of baa rated bonds and long term government bonds) – which is kind of opposite what CRR says.

In terms of significance, over the entire sample period DEI is the only significant variable. The industrial production variable MP, which is found to be highly priced by CRR and SW, is significant only in the 1990-1998 period of my study and insignificant both earlier and later. These results in my study are very different from those obtained by CRR. CRR do not perform joint tests of significance, however. For my study, the F-test of the joint hypothesis[18] that all prices of risk equal zero, given in the last column of Table 2, is saying that variables are all jointly significant in all the models.

5. Adding a New factor – Consumer Confidence:

The unusual performance or a different results compared to CRR suggest that there can be some other risk factors which are affecting the stock prices in recent years. Investors in the market are getting more well-informed day by day. They make educated guesses about the stock returns. That's why my prime focus is now to look for a variable which will capture this behavioral aspect of the investors.

5.1 Number of factors allowed:

The fundamental multifactor model doesn't restrict the number of factors that are required. While some authors suggest using small number of factors, "the researcher still has significant latitude in the choice" (Campbell et al., 1997). In this literature, authors found minimal sensitivity when number of factors increases[19]. Connor and Korajczyk (1993) examined returns from NYSE stocks and American Stock Exchange and concluded that there are up to six pervasive factors – which strengthens my idea of adding one more variable because their study was conducted somewhat at the middle (early, late or middle 90's) of the time-period I'm working for.

5.2 Rationale behind choosing the factor:

A fundamental question of behavioral finance is that - What drives investor behavior? A famous theory in behavioral finance, related to over- or under-reaction, says that the consequence of investors putting too much weight on "recent news" at the expense of other data is market over- or under-reaction. This theory suggests that people rely on 'overconfidence'. They tend to become more optimistic when the economy is bullish and more pessimistic when the economy goes down. Investors do like to 'follow the crowd'. As a result, asset prices fall too much on bad news and rise too much on good news. This over-reaction and under-reaction hypothesis is one of the bases of my selection of 6^{th} factor.

According to Thaler (1993), behavioral biases that affect security pricing can be divided into two classes: non-economic behavior (agents not maximizing the expected value of their portfolio) and heuristic biases. Heuristics are 'mental shortcuts' or 'rules-of-thumb' which is related to confidence. Reliance on heuristics can result in mistaken decisions. Such biases can cause investors to make systematic mistakes in evaluating new information and investing. So, investor reacts to some of the market and economic related news. There are ample amount of literatures talking about this effect of economic or market related news on stock prices. McQueen and Roley (1993) suggest that a given announcement shock may have different insinuation at different points in the business cycle. For example, an increase in employment related data or market confidence related data might be a bullish sign as the economy emerges from recession, but a bearish sign near a cyclical peak.

[18] Using a Chi-square distribution as proposed by Li and Martin (2000)
[19] Check Lehmann and Modest (1988); Connor and Korajczyk (1988) for more information

5.3 Defining the factor:

To capture this 'over- & under-reaction hypothesis' and 'heuristics biases', I used a factor which is related to consumer's confidence on the overall economy. When people see confidence related indicators are going up, they may believe market goes well – thus they invest. They sell shares when they see that these lagging indicators are falling. This provides the background of my 6th variable.

There are several measures of consumer confidence[20], but the most common one is Consumer Confidence Index (CCI) which is defined as the 'degree of optimism' on the condition of the economy that retail consumers are expressing through their savings and expenditure decisions. First calculated in 1985 (base year = 100) and then tracked back, the monthly CCI is prepared by the 'Conference Board'[21]. The basis of the calculation is the household survey of consumers' opinions on 'current conditions' (40%) and 'future expectations' (60%) of the economy. The idea is that the more confident people think about the future fate of the economy (earnings, employment etc.), the more likely they are to make purchases. One of the primary determinants of consumer confidence index is 'strong consumer demand'.

One need to keep in mind that CCI is a 'lagging indicator' which comes out only after the economy has already performed. So, I propose to use the percentage change of the CCI (GCCI) as the 6th factor 'contemporaneously' with MP – which means other variables excluding MP will lead GCCI by one month (as CRR did for MP). It takes time for consumers to recover from and respond to business cycles. A less than 5% change of CCI are often taken as insignificant in literature. If it moves by 5% or more, it indicates a change in the path of the economy (McWhinney, 2010).

5.4 Survey and calculations:

Every month the Conference Board surveys 5,000 U.S. households asking five questions about (1) Present business conditions, (2) Business Conditions for the next six months. (3) Present employment conditions, (4) Employment conditions for the next six months, (4) Total family income for the next six months while putting options like 'positive', 'negative' or 'neutral'. After getting the responses a 'relative value[22]' is calculated for each question. This value is then compared against each relative value from the base year (=100) which results in an 'index value' for each question. Then they finds the average[23] of the 'index value' of all questions to put is as Consumer Confidence Index for U.S.

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[20] Some other indexes are defined in the appendix (8.1-8.3)

[21] The Conference Board, a global independent membership organization working in the public interest, has been preparing and disseminating information and analysis, economics-based forecasts and trends, knowledge about management and the marketplace to help businesses strengthen their performance. They define the CCI as "a monthly report detailing consumer attitudes and buying intentions, with data available by age, income and region". For additional information about The Conference Board, one can visit them through their website at www.conference-board.org

[22] Each question's 'positive' responses are divided by the sum of its 'positive' and 'negative' responses.

[23] Average of index values for questions (1) and (3) forms the 'Present Situation Index' (40%) and the average of index values for questions (2), (4) and (5) form the 'Expectations Index' (60%).

6. The Six Factor Model (proposed):

Table 3: Six factor model and Pricing (Exposure × 100), multivariate approach

A. Results for the overall period for comparison with Chen et.al. (1986)								
Years	MP	UI	DEI	UTS	UPR	GCCI	Constant	F-Stat
1983-2007 (6-factors)	0.008 (0.083)	-0.026 (-0.876)	-0.026** (-1.963)	0.090 (0.540)	-0.047 (-1.215)	-1.035 (-0.780)	0.990** (3.522)	5023.6
CRR Values* (1958-1984)	1.398** (3.727)	-0.067** (-2.052)	-0.011 (-1.499)	-0.587* (-1.844)	0.794** (2.807)	……..	0.411 (1.334)	……..
1983-2007 (5-factors)	0.062 (0.462)	-0.034 (-1.154)	-0.030** (-2.193)	0.166 (0.935)	-0.037 (-1.018)	……..	0.959** (3.384)	4491.8
B. Results for the sub-periods								
Years	MP	UI	DEI	UTS	UPR	GCCI	Constant	F-Stat
1983-1990 (6-factors)	0.145 (0.828)	-0.086 (-1.361)	-0.078** (-2.507)	-0.151 (-0.435)	-0.114 (-1.220)	-2.183* (-1.757)	1.169** (2.131)	1523.9
1983-1990 (5-factors)	0.242 (1.298)	-0.113 (-1.791)	-0.099** (-3.043)	-0.090 (-0.257)	-0.114 (-1.185)	……..	1.094** (1.969)	1381.6
1990-1998 (6-factors)	0.092 (0.618)	-0.018 (-0.457)	-0.012 (-0.654)	0.273 (0.996)	-0.020 (-0.563)	0.516 (0.230)	1.290** (2.871)	1667.3
1990-1998 (5-factors)	0.344** (1.960)	-0.015 (-0.351)	-0.003 (-0.163)	0.430 (1.266)	-0.005 (-0.144)	……..	1.190** (2.535)	1451.1
2000-2007 (6-factors)	-0.253 (-1.587)	0.036 (0.722)	0.025* (1.938)	0.074 (0.289)	-0.035 (-0.536)	-0.816 (-0.272)	0.576 (1.246)	1623.1
2000-2007 (5-factors)	-0.316 (-0.991)	0.010 (0.213)	0.019 (1.366)	0.119 (0.469)	-0.017 (-0.354)	……..	0.628 (1.309)	1450.4

*Exposures obtained by Chen et.al. (1986). We divide their exposures by 10 to make the values comparable to our result.

Note: MP = Monthly growth rate in industrial production; UI = Unanticipated Inflation; DEI = Change in expected inflation; UTS = Unanticipated change in the term structure; UPR = Unanticipated change in the risk premium; and GCCI = Monthly percentage change in Consumer Confidence Index (CCI). T-test statistics are in the parenthesis. F-stat measures the joint significance of the factors.

Table 3 reports the results of six factor model. I don't discuss the model here because it is the same linear model I described before, just I'm adding one more factor as 'change in CCI'. As with the MP, the GCCI series was led by 1 month to enhance its influence. The GCCI betas were insignificant for pricing in the overall period and in two of the subperiods. It is significant at 10% level only for the sub-period 1983-1990. As a comparison with five factor model shows, inclusion of GCCI does not changes the sensitivity that much for all the periods. It is negative in most of the periods, except for the sub-period from 1990-1998. This means that stocks traded in NYSE should be hedges against changes in consumer confidence – which is plausible. Consumer's fall in confidence about the economy can affect any assets in the market. To make the portfolio of assets more diversified consumer should insure with stocks. The joint significance is also saying that inclusion of this variable doesn't hurt the model; however it increases the joint significance. The magnitude and individual significance of other factors are almost the same. The tests on six factor model discussed above were "fair" in the sense that the time-series regressions that measured the betas and the subsequent cross-sectional regressions that estimated their pricing influence gave each variable a priori equal opportunity to be significant; that is variables are treated in a symmetric fashion. We wouldn't call if fair if it changes the significance of CRR factors.

7. Conclusion:

To summarize, I find some evidence that DEI has a positive price of risk over the period 1983–2007, inconsistent with the findings of CRR. Moreover, there is no indication that the other factors are priced. I can say that, the statistically significant evidence for MP is limited to the time-period of the study taken by CRR and SW and formation of portfolios. Boyd, Jagannathan, and Hu (2001) also find that macro news has distinctly time-varying effects on equity returns. They examine the impact of unemployment announcement surprises on the S&P 500 return over 1948-1995, and conclude that surprisingly high unemployment raises stock prices during an economic expansion but lowers stock value during a contraction. So, whether the differences in results, between CRR and this paper, are driven by the specific selection biases discussed earlier or have some other basis, will raise significant doubts about the 5-factor model – I hope. All the values of coefficients that I found for period 2000-2007 is interesting enough (I would rather say 'peculiar' for the time being) for further future studies. If future researches with more new data can prove the 'doubt', my proposed six factor model will have a ground to play. One simply cannot ignore this behavioral fact pertaining to 'consumer confidence' as it is always said in economic literatures that consumers are responsible for two-thirds of the nation's economic activity (McWhinney[24], 2010).

8. Appendix

There exist several other indicators than Consumer Confidence Index (CCI) those attempt to track and measure consumer confidence in the US[25]:

8.1 University of Michigan Consumer Sentiment Index

University of Michigan Consumer Sentiment Index (MCSI) is a monthly release produced by the University of Michigan. The MCSI is designed to gauge consumer attitudes toward the overall business climate, state of personal finances, and consumer spending. The University of Michigan releases three related figures each month: Index of Consumer Sentiment (ICS, or MCSI), Index of Current Economic Conditions (ICC), and Index of Consumer Expectations (ICE). The most recent data for ICS is published by Reuters here. The Index of Consumer Expectations is an official component of the U.S. Index of Leading Economic Indicators.

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[24] James McWhinney, specializes in financial services and travel, has been a professional writer for many for numerous magazines, websites and other publications for nearly two decades. He has worked for many of the top U.S. mutual fund providers and banks. He is currently the Managing Director of Global Investment Communications at SEI and Owner at J. McWhinney Communications.

[25] Source: http://en.wikipedia.org/wiki/Consumer_confidence

Methodology of the MCSI

The Index of Consumer Sentiment (ICS) is based on the monthly telephone survey of the US household data. The Index is aggregated from five questions on the following topics: i) personal financial situation now and a year ago, ii) personal financial situation one year from now, iii) overall financial condition of the business for the next twelve months, iv) overall financial condition of the business for the next five years, v) current attitude toward buying major household items. The ICS is calculated from computing the “relative scores” for each of the five index questions: the percent giving favorable replies minus the percent giving unfavorable replies, plus 100. Each relative score is then rounded to the nearest whole number. All five relative scores are then summed and the sum is divided by 6.7558 (the 1966 base period) and the result is added 2 (a constant to correct for sample design changes from the 1950s). ICC is calculated by dividing the sum of the rounded “relative scores” of the questions one and five by 2.6424 and adding 2. ICE is calculated by dividing the sum of the rounded “relative scores” of the questions two, three, and four by 4.1134 and adding 2.

8.2 Washington–ABC News Consumer Comfort Index

Washington–ABC News Consumer Comfort Index represents a rolling average based on telephone interviews with about 1,000 adults nationwide each month. The survey began in December 1985. The Index is based on consumers’ ratings of the economy, the buying climate, and personal finances.

Methodology of the Consumer Comfort Index

The Index aggregates consumer responses to three questions on the following topics: i) national economy ("would you describe the state of the nation’s economy these days as excellent, good, not so good, or poor?"), ii) on personal finances ("would you describe the state of your own personal finances these days as excellent, good, not so good, or poor?") and iii) buying climate (“considering the cost of things today and your own personal finances, would you say now is an excellent time, a good time, a not so good time, or a poor time to buy the things you want and need?"). The Index is derived by subtracting the negative response to each question from the positive response to that question. The three resulting numbers are then added and divided by three. The index can range from +100 (everyone positive on all three measures) to -100 (all negative on all three measures).

8.3 Consumer Confidence Average Index

Consumer Confidence Average Index (CCAI) is a monthly indicator that aggregates data from three major national polls on consumer confidence. It represents the rescaled average of Conference Board Consumer Confidence index, Reuters - University of Michigan Consumer Sentiment index and ABC News Consumer Comfort index. CCAI is produced and published by the StateOfEconomy.com.

Methodology of the CCAI

The CCAI takes into account historical values of three indexes starting from January 2002. The value 0 of the Consumer Confidence Average represents the average value of the weighted average of three indexes. The value +/-100 of the Consumer Confidence Average represents one standard deviation from the average value. The value +/-200 of the Consumer Confidence Average represents two standard deviations from the average value and so on.

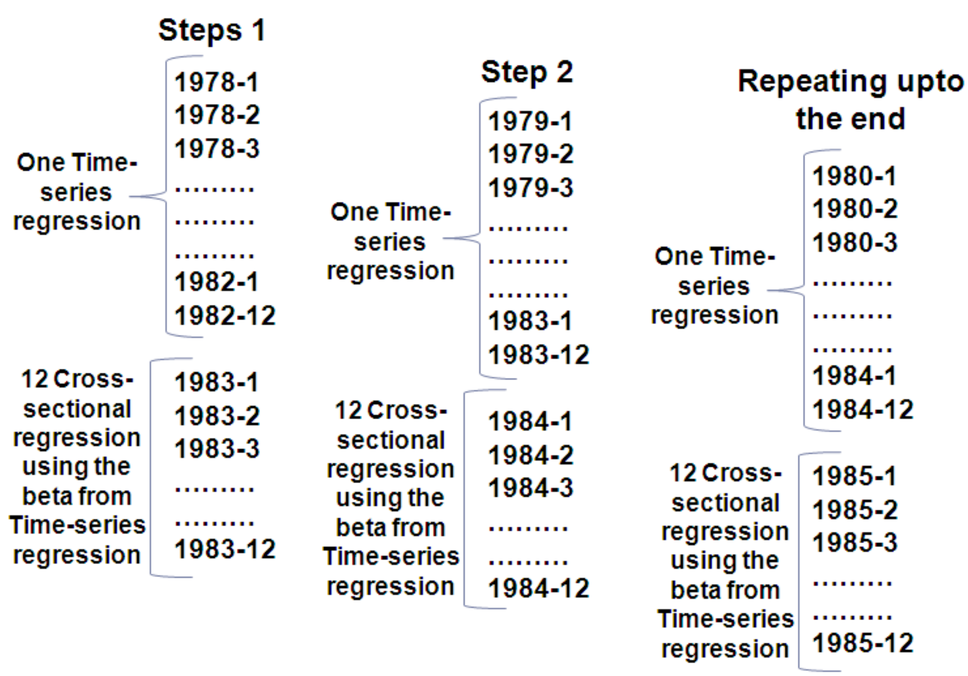
8.4 Explaining Fama-Macbeth CSR approach[26]

The procedure starts with choosing a sample of assets.

1. The assets' exposure to the economic state variables was estimated by regressing their returns on the unanticipated changes in the economic variables over some estimation period (we used the previous 5 years).

2. The resulting estimates of exposure (betas) were used as the independent variables in 12 cross-sectional regressions, one regression for each of the next 12 months, with asset returns for the month being the dependent variable. Each coefficient from a cross-sectional regression provides an estimate of the sum of the risk premium, if any, associated with the state variable and the unanticipated movement in the state variable for that month.

3. Steps 1 and 2 were then repeated for each year in the sample, yielding for each macro variable a time series of estimates of its associated risk premium. The time-series means of these estimates were then tested by a t-test for significant difference from zero.



[26] As in Chen et al. (1986)

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