

What is hidden in the Fed's model? The second approximation

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Abstract

There are a lot of approaches for estimation of the equity market attractiveness. Fed's model has received a wide prevalence. However this model has a number of essential restrictions. In particular the Fed's model uses current earnings yield, which is based on analysts' estimates of earnings over the coming twelve months. However as it is shown in the article these estimations can play certain role only in the short-term prospect. In the long-term prospect they will reflect real changes in economy that makes their use as parameters for the long-term estimation doubtful enough. In the article the model of alternative investments is offered as one of the ways to evaluate the equity market.

1. Introduction

In 1997 in monetary policy report to Congress Fed Chairman Alan Greenspan [1] indicated that changes in the ratio of prices in the S&P 500 to consensus estimates of earnings over the coming twelve months have often been inversely related to changes in long-term Treasury yields.

So one of the generally accepted statement is that stock market fairly valued when

$$(1) \quad CEY = TBY$$

where

CEY is the current earnings yield and equals to the ratio of 12-month forward earnings (time weighted average of the current and next year's consensus estimates provided by Thomson Financial) to the S&P 500 price,

TBY is the 10-year Treasury bond yield.

In detail this model was described by Dr. Yardeni [2]. He has named it Fed's Stock Valuation Model (FSVM). However, Fed's model concept of the equity market attractiveness is disputable enough.

Firstly, it is necessary to note, that estimates of Wall Street's analysts reflect real changes in economy and do not the reverse (i.e. not the tail wags a dog, but a dog wags tail). Therefore analysts' estimates of earnings over the coming twelve months can play the certain role in the short-term prospect. In the long-term prospect they will reflect real changes in economy, that makes their use as parameter of a long-term estimation doubtful enough.

So, in Figure 1 dynamics of current real earnings yield CREY (where for calculation is taken real trailing 4-quarter earnings) and 10-year Treasury bond yield are shown. The high correlation between these two variables is evident. . Calculations show that correlation coefficient is $R=0.85$ (Adj R-sq 0.72). Therefore, the statement about existence of correlation between current real earnings yield and 10-year Treasury bond yield would be more correct. Thus it is necessary to write down

(2) $CREY \div TBY$

instead of (1).

Secondly, while description of Fed's model the correlation between CEY and TBY since the end of 70-th (the data of Thomson Financial on consensus estimates are available since September 1978) was investigated. However in the beginning of 80-th the "bull" trend at the equity market was started. It was extended up to 2000 i.e. practically during the whole period of Fed's model testing for growing market only.

2. Discussion

To estimate application of the model it is necessary to study its dynamics in various phases of the market. As it was already mentioned, the consensus estimates (and accordingly CEY) reflect real processes in economy.

To avoid confusion of the concept of earnings estimates used in Fed's model with real earnings let's refer to dependence of CREY from TBY as Treasury bond yield (TBY) model.

Therefore to evaluate Fed's model up to 1978 it is possible to use TBY model.

In Figure 2 the dependence of CREY from TBY is shown. It does not look so impressive, moreover, the correlation coefficient $R=0.32$ (Adj R-sq 0.09). Furthermore, 55 years ago in June of 53 10-year Treasury bond yield was 3.11 % (the same meaning was marked recently in June of 2003). At the same time the appropriate meaning of P/E ratio must be 32. However in spite of this real meaning of P/E ratio was equal to 9.54.

Therefore it is obvious, that the TBY model and, as consequence, the Fed's model, does not reflect connection with current real earnings yield adequately.

Dr. Yardeni also specified possible incompleteness of the Fed's model. He has tried to remove specified lack by entering a new improved model (FSVM-2) with new variables. Namely, according to the FSVM-2 model

$$(3) \quad CEY = a + b \cdot TBY + c \cdot RP - d \cdot LTEG$$

where

RP is the risk premium

LTEG is the long-term expected earnings growth, beyond the next 12 months.

Dr. Yardeni used the spread between the A-rated corporate composite yield and the Treasury bond yield to describe risk premium, i.e.

$$RP = CBY - TBY$$

Further Dr. Yardeni made presumption that $a = 0$ and $b = c = 1$. So,

$$(4) \quad CEY = TBY + RP - d \cdot LTEG = CBY - d \cdot LTEG$$

For calculation of "d" data available since 1985 was used ("d" has ranged between 0.33 and -0.27, and averaged 0.13). So Dr. Yardeni made conclusion that on average, investors assign a weight of 0.13 to LTEG.

In such a way it is possible to write down the similar expression for CREY:

$$(5) \quad CREY \div CBY - d \cdot LTG,$$

where the real Long-term earnings growth (LTG) is used instead of the long-term expected earnings growth (LTEG) .

But I suppose that another approach should be used for this problem solution. The question about attractiveness of the equity market valuation should be considered as a question about comparative attractiveness of the investments. Namely we should consider the equity market as a long-term business. Let's assume that nothing is known about this business except its yield, which is determined by the ratio of earnings (trailing four-quarter meaning's) to price. In other words the equity market could be considered as a black box with a single known parameter. The investor having a history about dynamics of the yield of some business could try to compare it with yields of other long-term investments.

Therefore task can be formulated in the following way

$$(6) \quad CREY = a + \sum_i b_i \cdot Yield_i + \varepsilon$$

The given expression shows nothing else than the task of multiple regression.

Where

a is the constant,

b_i is the coefficients of regression (for example b_1 includes how fast CREY changes when b_1 changes, holding all other b_i fixed),

$Yield_i$ is the yield of some business,

ε is the "error" of the model (supposed that ε is normally described with zero mean).

Let's name the expression (6) as the model of the alternative investments.

It is essential to make one important note here. One should not consider the decision of this task as a "math trick". The equity market is a complex system, which includes "the human factor". So as it was shown in [3] (see also [4]) the methods of analysis, which have recommended themselves well in natural sciences, cannot be directly used in financial market study.

However, it is well known [3], that in the long-term prospect a number of market parameters (for example P/E ratio) varies in certain ranges. Therefore, without pretending to universality of the laws of nature, nevertheless it is possible to reveal connections, which can steadily enough be shown during decades.

Let's try to establish these correlations in the second approximation. Considering Fed's model (or TBY model) as a first approximation one can establish correlation between CREY and TBY.

For an ordinary consumer the savings of funds and consumption of the goods (or services) are, obviously, the alternative of investment in any business. For an aggregate investor such an alternative for investments can be 10-year Treasury bond and commodities.

Given correlation can be expressed as:

$$(7) \quad CREY = a + b_i \cdot TBY + b_c \cdot ComY + \varepsilon,$$

where $ComY$ is the yield of investment in the commodities basket. It is possible to use the yield from investments in CRB Spot Index (basic components - Metals, Textiles and Fibers, Livestock and Products, Fats and Oils, Raw Industrials, Foodstuffs) as $ComY$. I have carried out a number of tests and found out that CREY has high correlation with 10-year average for CRB Index yield

(CRBY) (where CRB Index yield is the one-year change in the price of index). The results are shown in Figure 3. It appears, that the correlation coefficient for CREY and CRBY R=0.88 (Adj R-sq 0.78) even exceeds appropriate correlation coefficient for CREY and TBY R=0.71 (Adj R-sq 0.50).

Thus, one could say that market has long-term memory of dynamics of the prices on commodities.

However, it is necessary to take into account that dynamics of CRBY can depend (or correlate) from dynamics of TBY.

In order to eliminate the specified dependence it is necessary to rewrite the expression (7) in the following form

$$(8) \quad CREY = a + b_t \cdot TBY + b_c \cdot (CRBY - TBY) + \varepsilon \quad \text{or}$$

$$CREY = a + b_t \cdot TBY + b_c \cdot CRBY_p + \varepsilon,$$

where

a is a constant, as above,

b_t is the value of the response of CREY for TBY,

b_c is the value of the response of CREY for "pure" yield of CRB Index (i.e. its part which does not depend on TBY),

$$CRBY_p = CRBY - TBY$$

Strictly speaking, to remove completely the pair correlation between independent parameters, it is necessary to use residuals from regression CRB with TBY instead of the difference CRBY-TBY.

However, the coefficient of pair correlation TBY and $CRBY_p$ for the period since March 1958 till March 2003 (i.e. for 45 years) has very insignificant value R=0.083 (Adj R-sq 0.0013), and therefore, the specified correlation can be neglected.

For calculation of coefficients in expression (8) the statistical method of multiple regression is applied. The data for 181 quarters since March 1958 till March 2003 are used.

In result the following statistical results are received:

Table 1

Regression Summary for Dependent Variable: CREY

R= .88901427 R-sq = .79034637 Adj R-sq = .78799071

F(2,178)=335.51 p<0.0000 Std.Error of estimate: 1.2845

	BETA	St. Err. of BETA	B	St. Err. of B	t(178)	p-level
Intercept			4.185533	0.329811	12.69069	1.07E-26
TBY	0.662044	0.034437	0.717178	0.037305	19.22473	2.8E-45
$CRBY_p$	0.541178	0.034437	0.540395	0.034387	15.71494	1.81E-35

Evidently TBY and $CRBY_p$ adequately establish connection with current real earnings yield R=0.89 (Adj R-sq 0.79) (all variables have high Student's t-test value). Thus each of the model's parameters has a high level of the importance.

So it is possible to write down the following expression for the predicted CREY

$$(9) \quad CREY(pred) = 4.19 + 0.72 \cdot TBY + 0.54 \cdot CRBY_p$$

In Figure 4 the comparative dynamics of CREY, TBY and $CRBY_p$ is shown till June 2003. As it is evident that market was fairly valued by the TBY model at the end of the June. Nevertheless, current earnings yield predicted by the model of the alternative investments (9) is 5%, i.e. 50 % higher than market and 10-Year Treasury yield.

In Figure 5 the comparative dynamics of P/E, reciprocal 10-Year Treasury bond yield and value reciprocal to $CREY(pred)$ (i.e. predictable P/E) is shown. As it was mentioned above the TBY model supposes market fair valuation even when the meaning of P/E is equal to 30. Nevertheless, $CREY(pred)$ shows that at the end of June the market would be fairly valued if P/E equals to 20.

In Figure 6 the relative difference in the yields between the TBY model and CREY (as well as the model of the alternative investments and CREY) are shown. It is interesting, that if investors in 1953 were oriented for the TBY model they would find the 74% market's undervaluation. At the same time since 1953 up to middle of 60-th 10-Year Treasury bond yield was equal to today's yield. While CREY was almost 11% (P/E = 9) at the end of 1953 and about 6 % (P/E = 16.6) from the end of the 50-th to the beginning of the 70-th. The model of the alternative investments is applied from the end of 1958. In Tables 2,3 the periods within which the model points out on relative undervaluation or overvaluation of the market are shown.

In the first column of Table 2 the periods when the model indicates on undervaluation of the market are shown. In second, third and fourth columns are specified:

- the average meaning of P/E ratio for each period,
- the reciprocal 10-Year Treasury bond yield (TBY model),
- the average meaning of P/E predicted by the model of the alternative investments, respectively

Table 2

Periods of Market's Undervaluation	P/E Average	Reciprocal 10-Y Bonds Yield	Model Predict P/E
March 58 - Sept 59	16.5	27	21
Sept 60 - Sept 70	17.7	21.3	21.5
Sept 74 - Dec 74	7.5	13	9.3
Dec 76 - Jun 80	8.3	11.7	9.2
Sept 81 - Jun 82	7.76	7	8.1
March 84 - Sept 85	10.7	8.6	12.7
Dec 87	13.8	11.1	14.1
Jun 88 - Dec 90	13.9	11.7	15.7
Jun 94 - Jun 95	15.7	14.1	18

In Table 3 the appropriate meanings for the periods when the model of the alternative investments predict overvaluation conditions of the market are shown. It is necessary to note that since September 1995 according to the model the equity markets is overvalued.

Table 3

Periods of Market's Overvaluation	P/E Average	Reciprocal 10-Y Bonds Yield	Model Predict P/E
Dec 1959, Jun 60	17.5	22.7	17.2
Dec 70 - Jun 74	16.4	15.4	14.4
March 75 - Sept 76	11	12.7	10.2
Sept 80 - Jun 81	8.9	7.9	8.2
Sept 82 - Dec 83	11.6	8.9	9.7
Dec 1985 - Sept 87	17.6	12.5	15
March 88	14.3	12	14.1
March 91 - March 94	22.2	14.9	18.5
Sept 95 - Jun 2003	27.9	18.8	19.3

In Table 4 the average meanings for all periods, when the model of the alternative investments predicts undervaluation or overvaluation of the market, are shown.

Table 4

	P/E	Reciprocal 10-Y Bonds Yield	Model Predict P/E
Predict Market Undervaluation	14.3	16.8	17.1
Predict Market Overvaluation	20.4	15.4	15.9

It is interesting to note that the average meaning of P/E ratio for the predicted periods of the market undervaluation is 14.3. This value is close to the average meaning of P/E ratio for 25 years calculated up to 1995. The average meaning of P/E ratio predicted by the model for the periods of market undervaluation is 17.1, i.e. approximately 20 % higher than average market P/E ratio.

During the periods of predicted market overvaluation the average meaning of P/E ratio is 20.4. While model's predicted P/E is equal to 15.9, i.e. approximately 22 % lower.

Let's try to estimate the attractiveness of the equity market in accordance with the model of the alternative investments.

Bottoming in the middle of June at the level 3.1% 10-Year bond yield bounced back to 4.47% by the end of July. While 10-year average for CRB Index yield was 0.78% (thus CRBY-TBY difference was equal to -3.69%).

Then current earnings yield predicted by the model (9) CREY(pred) is 5.42% or P/E(pred) is 18.4. At the same time P/E ratio of the S&P 500 index is approximately equal to 27 (i.e. 47% higher than the same ratio predicted by the model).

In the long-term prospect the current earnings yield will depend on dynamic of TBY and CRB Spot Index yield. There are lots of various scenarios. For example, CRBY (Figure 3) began recover in the middle of 60-th when equity market topped. CRBY topped at the end of 70-th beginning of 80-th when new "bull" equity market was started. TBY showed the similar dynamics. The average meaning of CRBY since the 1969 up to 1991 was 5.3%. Since the December of 1999 CRBY started to recover again. Thus, now it is time for the equity market to adjust prices.

3. Conclusion

In the article the model of the alternative investments is considered. This model offers one more way to evaluate the market. As it is found, the current real earnings yield depends not only on 10-Y Treasury bond yield but also on 10-year average of CRB Index yield. Such dependence reveals the high importance of dynamics on the commodities prices in relation of all equity market. The model does not pretend to the whole completeness of the description. It should not also be considered as a "math trick", since the revealed parameters of correlation can change in time. So, for example, the role of 10-Y Treasury bond yield in the model has increased essentially from the end of 70-th - beginning of 80-th, i.e. in the new "bull" trend. However, the revealed parameters can remain steady enough during decades.

The model of alternative investments is applied to S&P 500 Index. It would be interesting to reveal similar connection for various sectors of the market, since the importance of model's parameters should vary for various sectors. It is possible, for example, that Financials will have the larger dependence from 10-Y Treasury bond yield while Energy and Materials from CRB Index Yield. It could appear that even during the model's predicted periods of market overvaluation there are undervalued sectors (or industries).

References

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Figure 1

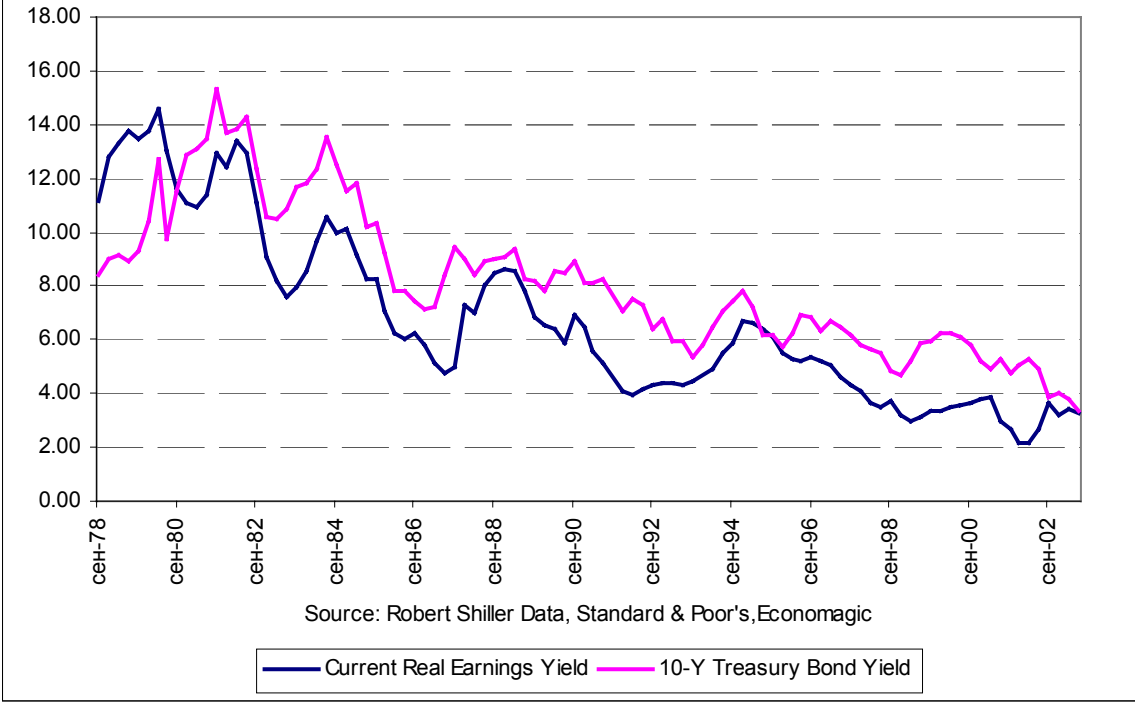


Figure 2

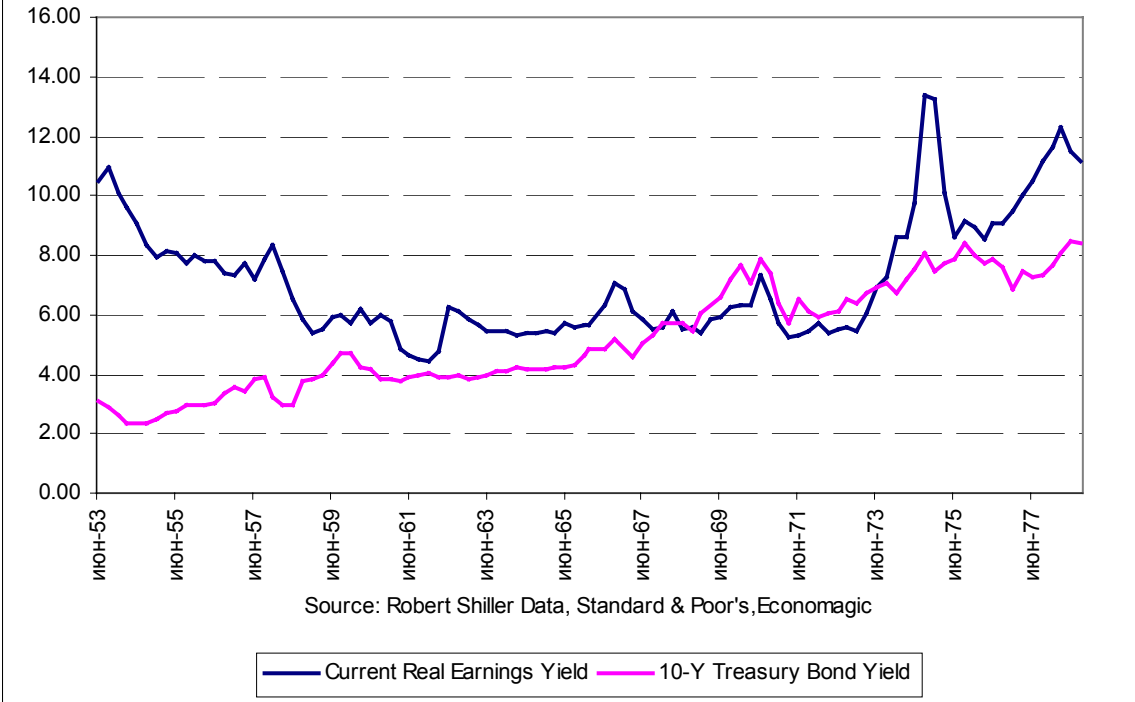
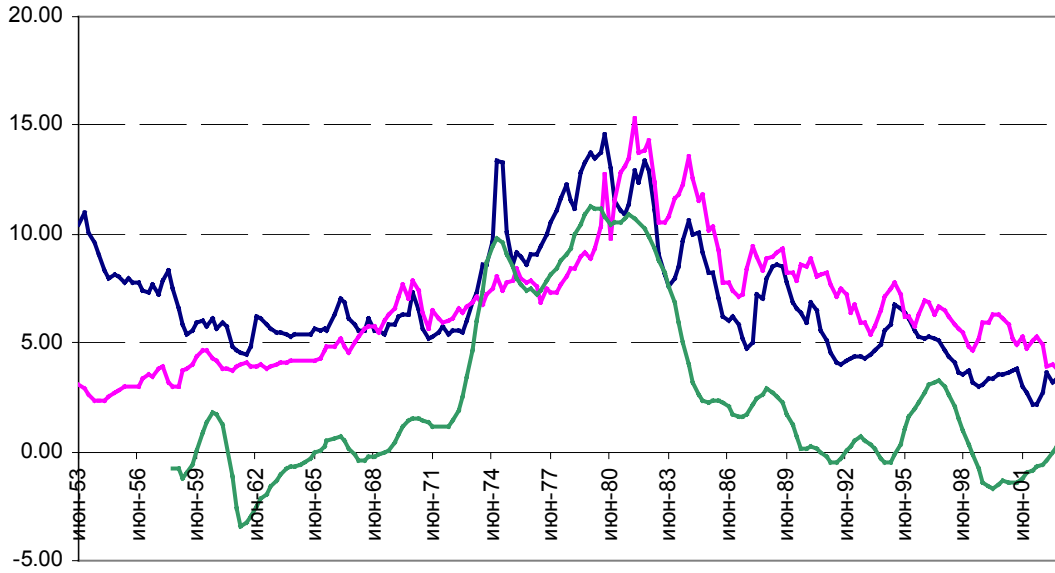


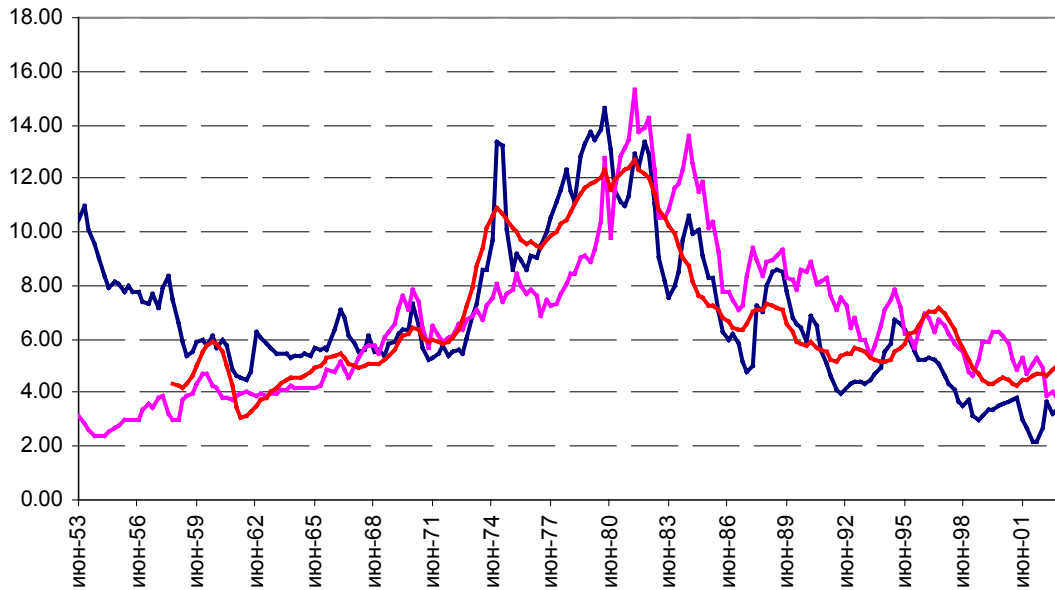
Figure 3



Source: Robert Shiller Data, Standard & Poor's, Economagic

— Current Real Earnings Yield — 10-Y Treasury Bond Yield — 10-Y Average CRB Spot Index Yield

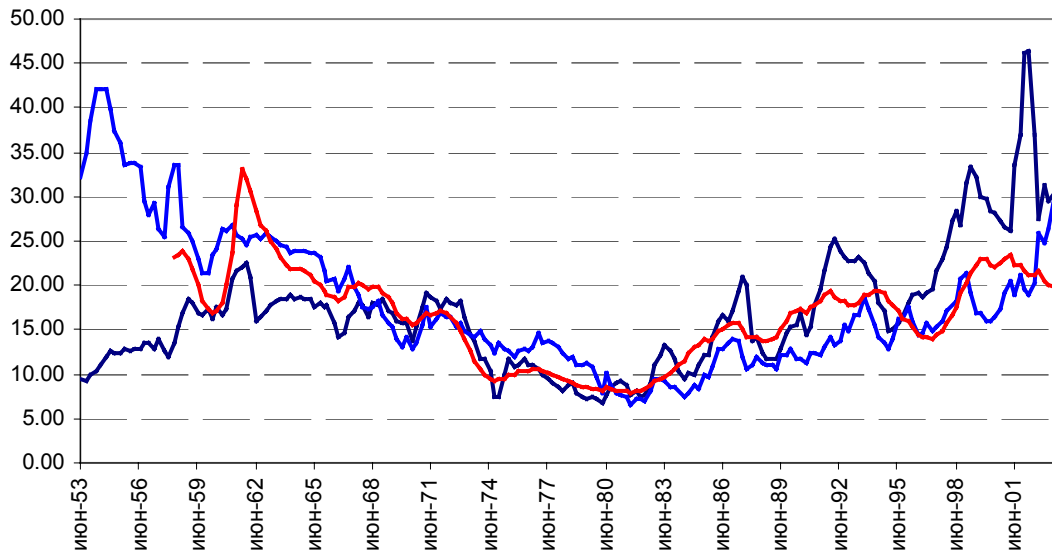
Figure 4



Source: Robert Shiller Data, Standard & Poor's, Economagic

— Current Real Earnings Yield — 10-Y Treasury Bond Yield — Predicted CREY

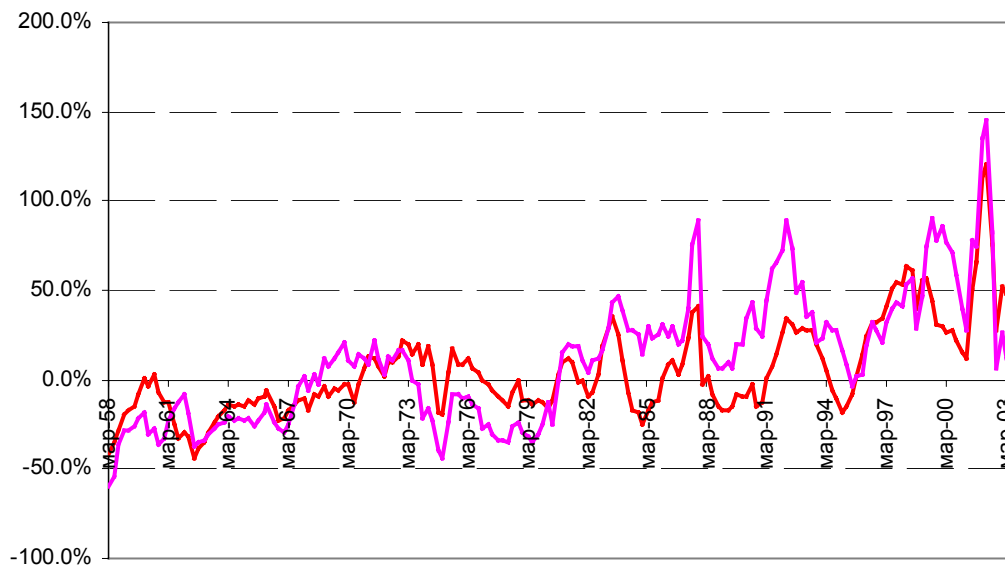
Figure 5



Source: Robert Shiller Data, Standard & Poor's, Economagic

— P/E — Reciprocal 10-Y Bond Yield — Predicted P/E

Figure 6



Source: Robert Shiller Data, Standard & Poor's, Economagic

— CREY(pred) vs CREY % — TBY vs CREY %

Figure 7

