

# The effect of health care reform: Testing the stability of systematic risk<sup>†</sup>

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Received 30 June 2010, revised 17 August 2010, accepted 25 August 2010

## Abstract

As the U.S. Congress has continued to debate over the health care reform pushed by President Obama, there is an ample reason to believe that the systematic risk of the health care industry, especially health care plan providers, is increasing. This study measures and compares the systematic risk of two health care industry indexes and one portfolio of health care plan providers from before and after the introduction of the health care legislation into Congress in September, 2009. The Capital Asset Pricing Model (CAPM) is used to measure the systematic risk, and a dummy variable approach and the Chow test are used to formally compare the systematic risk from before and after the introduction of the legislation.

*Keywords:* Capital asset pricing model (CAPM), Chow test, dummy variable, health reform.

## 1. Introduction

The purpose of this paper is to study the effect that the current health care reform debate is having on the health care industry. The issue became most relevant on 10 September 2009, when President Obama gave a televised speech to the joint sessions of Congress detailing his health care reform plan, and six days later when Senate Finance Committee Chair Max Baucus introduced the health care bill to Congress. It is of concern to determine whether the systematic risk of the health care industry is increasing as the health care reform debate continues, the legislation is altered, and Congressional votes are taken.

There is much evidence that the current American health care system needs reform. Americans pay over twice the Western average to maintain a health care system that is the worst in the developed world. In fact, the Centers for Medicaid and Medicare Services estimates

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<sup>†</sup> This research was partially supported by Arkansas Biosciences Institute (ABI).

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that this year Americans will spend over \$2.5 trillion solely on health care. Specifically looking at health insurance, the McKinsey Global Institute found that in 2006 health insurance cost the U.S. \$145 billion, which is \$91 billion more than what would be expected in a comparably wealthy country (Mitchell, 2009). On the individual level, employee benefits are going less into salary and more into health outlays. Unfortunately, employees are getting insufficient value for these outlays, effectively decreasing their compensation (Barrett and Lee, 2009). The American Medical Association states, here has been year to year growth in the largest health insurers' profitability even as consumers have been facing higher premiums, deductibles, copayments, and coinsurance, effectively reducing the scope of their coverage. In response to these facts, Obama made health care reform a major part of his presidential campaign, and announced his reform bill, which was introduced formally to Congress within a week.

The most controversial aspect of the reform bill is the public option, which is a government health insurance program (Waldman, 2008). This issue is especially significant to the sector of health care plan providers. The introduction of real competition by government would collapse the private insurance industry, and the Heritage Foundation states, the main argument for a public option is that it would increase competition. However, if the federal government creates a health care plan that it controls and also sets the rules for the private plans, there is little doubt that Washington would put its private sector competitors out of business sooner or later. In corroboration of this, if a government health care plan is created, it is estimated that 88.1 million people would see their employer-sponsored health plan eliminated (Heritage Foundation, 2009).

It is reasonable to think that the risk involved in a health care portfolio may have increased since the introduction of this health care legislation. To see if this is the case, the risk of three portfolios consisting of publicly traded health care stocks is assessed before and after the health care legislation was introduced to Congress in September 2009. Several methods have been investigated to estimate the value at risk of stock returns (Park and Yeo, 2004; Yeo and Jeong, 2005). Particularly, the returns of the market are regressed on the returns of the portfolio in the Capital Asset Pricing Model (CAPM), seeing if the regression coefficient, an indicator of risk, significantly increases,

$$E(R_p) = R_F + \beta[E(R_M) - R_F],$$

where  $E(R_p)$  is the expected return of the portfolio of interest,  $E(R_M)$  is the expected return on a market index of investments, and  $R_F$  is the return of a risk-free security (Lintner, 1965; Sharpe, 1964). The stochastic regression model based on the CAPM then is

$$R_{pt} - R_{Ft} = \alpha + \beta(R_{Mt} - R_{Ft}) + \epsilon_t, \quad (1.1)$$

where at time  $t$ ,  $R_{pt}$  is the return of the portfolio of interest,  $R_{Mt}$  is the return on a market index,  $R_{Ft}$  is the return on a risk-free security, and  $\epsilon_t$  is the random error component (Hertz and Thomas, 1983).

The parameter  $\alpha$  is a measure of performance, revealing whether the portfolio is earning more or less than the average risk premium (Jensen, 1968). However, the parameter  $\beta$  is the most revealing aspect of this model, and is of more interest in our context. Often called the beta-coefficient,  $\beta$  measures the systematic risk of the portfolio by measuring the sensitivity of the portfolio returns to market returns. A nice aspect of this model is that the

interpretation of the beta-coefficient is quite intuitive. If  $\beta$  is greater than one, then notice from the regression model that the security has greater risk, amplifying what the market is doing. That is, if the market increases, then the security will gain even more, but if the market drops, then the security will lose even more. If  $\beta$  is exactly one, then the security has the exact same risk as the market, mirroring the market movements. Finally, if  $\beta$  is less than one, it is dampening what the overall market is doing, making it a less risky investment.

The main objective in this paper is to measure and compare the systematic risk of health care industry, particularly health care plan providers, from before and after the introduction of the health care legislation into Congress in September, 2009 using the Chow test and a dummy variable approach in the CAPM (Allen *et al.*, 1990; Drakos, 2003).

## 2. Methodology

In this section, we will briefly address the two methods used in this paper.

### 2.1. Chow test

The Chow test compares two regression equations, using an  $F$  test to determine whether the regression coefficients are the same (Cho and Doh, 2008; Chow, 1960; Oh, 2004). The Chow test is applied on the system of equations

$$\begin{aligned} Y_1 &= X_1\beta^1 + \epsilon_1 \\ Y_2 &= X_2\beta^2 + \epsilon_2, \end{aligned} \quad (2.1)$$

where  $Y_i$  is a set of observations of size  $N_i$ ,  $X_i$  is an  $N_i \times p$  covariate matrix,  $\beta^i$  is a  $p \times 1$  vector of regression coefficients, and  $\epsilon_i$  is a vector of stochastic error terms of length  $N_i$ , where  $p$  is the number of covariates including the intercept, and  $i = 1, 2$ . For simple linear regression (as is the case for the CAPM),  $p = 2$ . It is assumed that  $\epsilon_i$  is from a normal distribution with mean 0 and constant variance  $\sigma^2$ . The null hypothesis for the Chow test is  $H_0 : \beta^1 = \beta^2 = \beta$  or

$$H_0 : \begin{bmatrix} Y_1 \\ Y_2 \end{bmatrix} = \begin{bmatrix} X_1 \\ X_2 \end{bmatrix} \beta + \begin{bmatrix} \epsilon_1 \\ \epsilon_2 \end{bmatrix} \quad (2.2)$$

and the test statistic under  $H_0$  is given by

$$F^* = \frac{||X_1b^1 - X_1b^0||^2 + ||X_2b^2 - X_2b^0||^2}{||Y_1 - X_1b^1||^2 + ||Y_2 - X_2b^2||^2} \cdot \frac{(N_1 + N_2 - 2p)}{p} \quad (2.3)$$

where  $F^*$  has an  $F$  distribution with  $p$  and  $N_1 + N_2 - 2p$  degrees of freedom. Thus for some significance level  $\alpha$  we reject the null hypothesis if  $F^* > F_{\alpha;p,N_1+N_2-2p}$ . In the CAPM, the null hypothesis for the Chow test then is  $H_0 : \beta^1 = \beta^2$  where  $\beta^j = [\alpha_j, \beta_j]^T$  and  $j = 1, 2$ .

### 2.2. A dummy variable approach

Suppose it is the case that observations can be logically split into two sets (in our case  $R_{Pt} = \{R_{Pt_1}, R_{Pt_2}\}$ ,  $t_1 = 1, 2, \dots, N_1$  and  $t_2 = N_1 + 1, N_1 + 2, \dots, N_1 + N_2$ ), where it is of interest in the context of a regression model to determine whether the regression coefficients

are the same for both sets of data (Gujarati, 1970). Let  $D \in \{0, 1\}$  be a dummy variable, such that

$$D = \begin{cases} 1 & \text{if } t \in t_1 \\ 0 & \text{if } t \in t_2 \end{cases}$$

Then (1.1) can be rewritten as

$$R_{Pt} - R_{Ft} = \alpha_1 + \alpha_2 D + \beta_1 (R_{Mt} - R_{Ft}) + \beta_2 D (R_{Mt} - R_{Ft}) + \epsilon_t \quad (2.4)$$

Notice that the dummy variable is incorporated in an additive and a multiplicative way. In this manner it is possible to determine which parameter, if any, changes over time. This is an important improvement on the Chow test, which can only conclude whether the two sets of data belong to the same regression model. If the parameter  $\alpha_2$  is significant, then its value will show how the portfolio's measure of performance is changing. If  $\alpha_2$  is not significant, then one can conclude that the measure of performance is not changing, and  $\alpha_1$  gives the portfolio's measure of performance. Similarly, but more relevantly, if  $\beta_2$  is significant, we can tell by its value how the systematic risk is changing, and if  $\beta_2$  is not significant, then one can conclude that the correct model is one of a stable Beta, and not a conditional Beta. If this is the case, then  $\beta_1$  is the portfolio's stable beta, indicating a constant slope for the two data sets, and hence implying a constant level of risk.

### 3. Analysis

The two methods addressed above were applied to a set of data collected before and after September 2009. Using the CAPM requires data for a market index and a risk free security in addition to the portfolio of interest. For a market index and a risk free security, the Dow Jones Industrial (DJI) and Federated US Government Bond (FEDBX) were used, respectively. For the portfolio of interest, four different selections were made and tested. The first two chosen were health care indexes, the S&P Health Care Index (HCX) and the Vanguard Health Care Index Fund Investor Shares (VGHGX), in order to investigate whether or not there was an overall risk change for the health care industry. The third was a portfolio consisting of the top 25 health care plan providers (denoted HCPP) publicly traded to examine the risk change on the health care plan providers sector. Fourth was a control portfolio chosen to be the Dow Jones U.S. Basic Materials index (IYM), which includes stocks in chemicals, metals and mining, and coal, and its purpose will be discussed shortly.

Data was gathered from 3 January 2005 to 19 January 2010. So as to avoid outliers that might arise from daily data, weekly data was used. A concern in using the data sets is that the recent recession may disrupt the analysis. To ensure that any significant results are not due solely to coming out of the recession, a control portfolio was analyzed, which is unrelated to the health care industry. If the recession is the main cause of increased systematic risk, we expect to see significant results across our three health care portfolios and the control portfolio.

An ordinary least squares (OLS) estimate of a constant Beta was computed for the four data sets, and the Chow test was applied to test if the data from before September 2009 belonged to the same regression as the data after. Table 3.1 gives the OLS estimates of constant Betas. The Betas corresponding to the three health care portfolios are below one,

indicating that these three health care portfolios are less risky relative to the market, not accounting for any change in risk over time. The last column in Table 3.1 provides p-values for the Chow test. All three indexes were insignificant at  $\alpha = 0.05$ , while the HCPP was significant. Table 3.2 shows the estimates of the parameters in (2.4), with statistical significance. The OLS estimates using dummy variables corroborates the Chow test results, in that  $\beta_2$  is insignificant for all three indexes, and significant for the HCPP. For the HCPP in Table 3.2,  $\beta_1$  indicates the current systematic risk of the portfolio, and  $\beta_1 + \beta_2$  indicates the systematic risk of the portfolio before September 2009.

**Table 3.1** OLS estimates of constant Betas and p-values for the Chow test.  
\* indicates significance at  $\alpha = 0.05$ .

Index	$\alpha$	$\beta$	p-value (Chow test)
S&P	0.0004	0.748*	0.500
Vanguard	<0.0001	0.656*	0.264
Basic Materials	<0.0001	1.279*	0.734
HCPP	0.0019	0.668*	0.048*

**Table 3.2** OLS estimates of time-varying Betas, using dummy variables.  
\* indicates significance at  $\alpha = 0.05$ .

Index	$\alpha_1$	$\alpha_2$	$\beta_1$	$\beta_2$
S&P	0.002	-0.002	0.794*	0.060
Vanguard	-0.004	0.004	0.666*	0.012
Basic Materials	0.001	0.007	1.365*	0.111
HCPP	0.003	-0.001	1.028*	-0.464

## 4. Conclusion

Two approaches, the Chow test and OLS using dummy variables, to testing the equality of regression coefficients have been applied to financial data in order to detect any change over time of systematic risk of a health care portfolio before and after health care legislation introduced to Congress in early September 2009. Both tests concluded that systematic risk of the health care industry as a whole has not increased, while the systematic risk of health care plan providers has significantly increased. In addition, it was confirmed that these significant results are not due to a general effect of the recession using a general portfolio acting as a control on the effects of the recession. Testing with dummy variables concludes that the measure of performance for all portfolios is constant over time and is zero.

The natural extension of this research is to evaluate the systematic risk of the health care industry, and that of health care plan providers especially, after the health care legislation has passed in final form, and regulatory measures begin to shape the industry.

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