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Stock Markets and Household Wealth: Can a Stock Market Crash Cause a Recession in The U.S. Economy?

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Abstract: Stock market wealth effects on the level of consumption in the United States economy have been constantly debated; there is evidence for arguments for and against its prominence and its symmetry. This paper seeks to investigate the strength of its negative effect by creating models to analyze unexpected shocks to the Standard and Poor's 500 index. First, a transmission mechanism between the stock market and GDP is established through the use of second-order vector autoregressive models. Following which, theory from the life cycle model and adaptations of previous researchers' models are used to create a structural model. This paper finds that stock market wealth effects are small, but important to consider, especially if markets are overpriced; this claim is corroborated by evidence from simulation of 'alternative scenarios' and the historical experiences of 1987 and 2001.

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1. Introduction

The "r-word" has been so frequently used in the past few months, that most economists and journalists are no longer hesitant to mention it in its full form. The actual phenomenon of a recession occurs every decade or so in U.S. history and all students of macroeconomics know, such is the nature of business cycles. Before proceeding, it is necessary that one understand what exactly a recession implies. The traditional definition of a recession is negative growth in real gross domestic product for two consecutive quarters.[1] Recessions are caused essentially due to erroneous policy decisions or negative shocks to some area of the economy. Typically, the effects of changes in policy are challenging to model, while shocks to a component of GDP can be incorporated into an econometric model. The latter will be the focus of this paper.

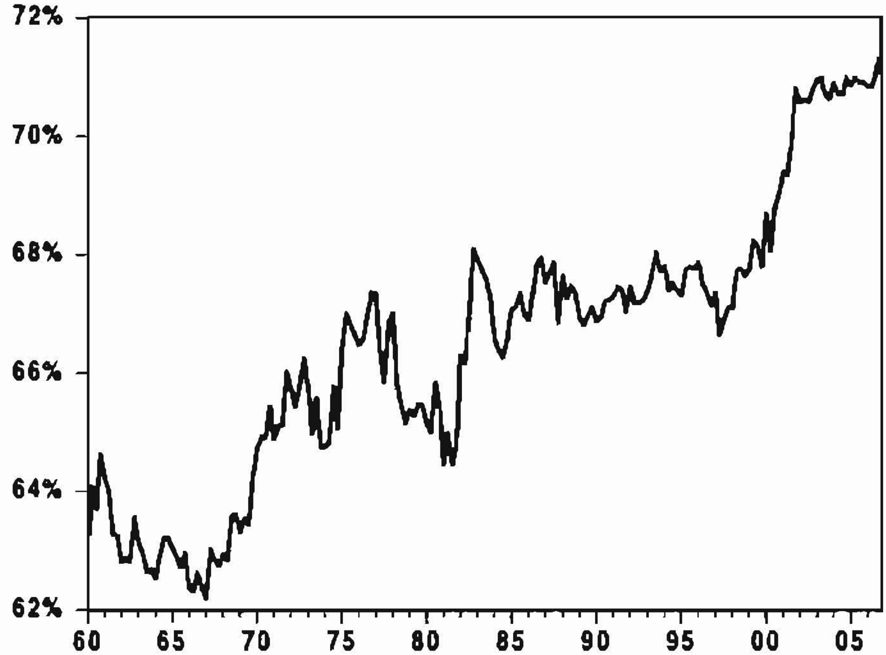
Despite the increasing size of corporations' investments, government spending and exports abroad, personal consumption is the primary driver of economic activity in the US. It represents the value of goods and services purchased by individual households, and, comprises almost seventy percent of the total spending in the economy[2]. As policymakers or business strategists, the ability to analyze changes in personal consumption in the economy is imperative to implementing policies and adjusting output and investment levels, while it also might provide insight in to what can lead the economy into a recession. For 2006, real consumption was approximately $9.22 trillion:[3] a significantly large number to estimate.

[1] For technical purposes, the National Bureau of Economic Research's business-cycle-dating committee decides on when the economy is actually in recession; however, this happens well after the recession has occurred and, therefore, is not as helpful. 'A prolonged downturn in economic activity' is the basic principle that will be required for the purposes of this paper.

[2] Since GDP does not include imports while consumption does, the latter is examined as a fraction of Imports and GDP together.

[3] Source: Table 1.1.5, <http://www.bea.gov/national/nipaweb/TableView.asp#Mid>

Figure 1: Real Household Consumption as a Percentage of Total Spending (1960:Q1 – 2007:Q4)



Source: Haver Analytics Database and author's own calculations.

In the graph above, depicting the ratio between nominal PCE and GDP between 1950 and 2006, it is evident that consumption's importance in the GDP mix is continually rising; it is currently 71.44% of GDP.[4] In light of its importance to GDP, personal consumption is very often used as a gauge of how an economy is performing. Thus, a significant decrease in consumption by households is likely to produce a noticeable decrease in GDP.

According to the basic Keynesian consumption function, changes in PCE consist of changes in disposable personal income or changes in personal wealth. Shocks to household incomes are rather unrealistic due to wages being sticky downwards, while a shock to wealth is more ordinary. Warren Buffet recently remarked that although the US had not passed the formal test of a recession, he was concerned that household wealth was "heading south" which would

[4] Source: Bureau of Economic Analysis

lead to a recession.[5] Household wealth is a major part of what policymakers scrutinize every quarter. Wealth can be further classified into stock market wealth [6], real estate wealth and other wealth. Appendix Figure 1\ graphically illustrates their trends in the late twentieth and early twenty-first century in aggregate real terms. Barring the general upward drift in all the variables, there are relationships that exist between the variables. The correlation between stock market wealth and consumption, for instance, is 0.73 for the entire period; however, causation cannot be deduced from this. Moreover, wealth from the stock market has been far more volatile that wealth from the housing market, and, its impact on GDP, through consumption, is unclear. For instance, between January 2000 and October 2002, the Dow Jones Industrial Average lost 38% of its value,[7] while shredding more than $8 trillion in stock market wealth.[8] GDP growth rates during this period of a 'stock-market crash,' barely fell below 0% for a full quarter. Whether this was technically a recession or not has been argued; regardless, the economy did suffer and this is what policymakers are concerned with.

So, if the stock market has an influence on household net worth, can it have a significant impact on the economy? Figure 2, on the following page, shows the value of the Standard and Poor's 500 Index since 1950 using a logarithmic scale. Shaded in are the quarters when the US economy experienced negative real GDP growth. Keeping in mind that the NBER dating techniques determine the recessionary periods only several months after it has occurred, the stock market has declined before almost every recessionary period. The market correctly predicted the recessions of 1954, 1957, 1970 and 1974, while the economic downturns of 1991 and 2001 occurred with negative equity shocks in a more contemporaneous manner. As any

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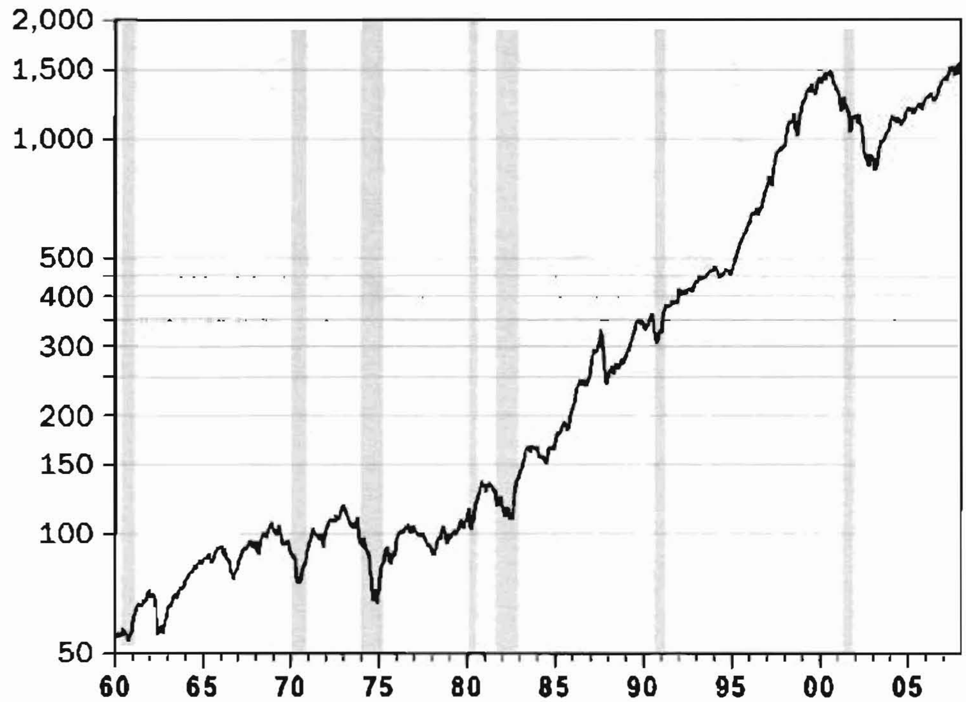
[5] Source: <http://www.ft.com/cms/s/0/f0b95a0c-e95e-11dc-8365-0000779fd2ac.html>
[6] Stock market wealth can be defined as the sum of equity held by households directly in the form of shares of companies and index-linked securities.
[7] Source: <http://mutualfunds.about.com/cs/history/p/crash10.htm>
[8] Bostic, Gabriele and Painter (2003, p. 3)

sensible statistician would deduce, correlation is not necessarily causation — and the latter is of interest to the investigation that follows.

Figure 2: S&P 500 Quarterly Performance (1960:Q1 – 2007Q4) (Logarithmic Scale)



Source: Haver Analytics and Author's Own Caluclations

Other things equal, if the 'wealth effect' exists, an increase in stock-market wealth should make people wealthier and thus purchase more goods. By the same logic, a decrease in stock market wealth should result in a downward adjustment to consumption and this would be followed by a fall in gross domestic product. This paper seeks to create mechanisms whereby the stock markets can be shocked negatively in a manner where the economy as a whole shrinks. A Lehman Brothers economist, Paul Sheard, recently wrote in a note to investors, "The equity market discounting a recession can actually be a self-fulfilling prophecy -- a kind of shock through consumer confidence and wealth effects that could push the economy over the edge."[9]

[9] Source: <http://www.reuters.com/article/businessNews/idUSSP39805200801 22>

This paper seeks to isolate and focus on, the direct wealth effect of the stock market, while ignoring the expectations effect for reasons discussed in Section 2.

What follows is a review of relevant research done linking the stock market to consumption and GDP. After which, there are two unique types of models are estimated; the first, a second order vector autoregressive model (VAR) which is followed by a structural model. The former successfully outlines a transmission mechanism that relates the stock markets to the wider economy, and more specifically, to gross domestic product. With knowledge from the VAR analysis, a structural model is created. The model confirms that the marginal propensity to consume out of stock market wealth is within the other researchers' range at 0.03 cents. This information is then compiled in EViews to illustrate the impact of a negative shock to the stock market in the United States. In accordance with theory, given that shocks are typically unpredictable, and that consumers respond contemporaneously, a downturn in the economy is caused, but of small magnitude. It is also hypothesized that the intensity of the impact depends on how overvalued or undervalued the market is at the time of impact. Ultimately, this paper finds that US economy is resilient to the stock market; the experiences of 1987:Q4 and 2001-2002 provide historical evidence to this claim.

2. Literature Review

Before one can attempt to build a model or examine the effect of a shock, it is necessary to review past research on the topic. There is a plethora of research and literature modeling consumption with financial and housing wealth.

The 'Random Walk' theory of stock prices, which argues that stock prices are unpredictable if markets are efficient, coupled with evidence from Hall (1978) confirming that

only surprises in income should affect current consumption, might imply that the randomness of the stock market leads to a greater ability to influence consumption relative to other types of wealth.[10] There is a range of research on the topic of wealth arising from the stock market. A paper by Mehra (2000), for instance, attempts at quantifying the impact of a stock market boom on consumption and finds that the equity wealth effect represents an increase to growth of real GDP of about 1 percentage point annually, and that the total effect may have added to the growth rate of real GDP about two percentage points a year.[11] Generally, an increase in stock markets makes people that hold these securities wealthier. By that logic, the wealthier people are, the more they spend.

Likewise, Meyer and Associates (1994) showed that a $1 increase in stock market wealth led to an increase in personal consumption by 2 cents in the following quarter and 4.2 cents in the long run.[12] Shirvani and Wilbratte (2000) have gauged this marginal propensity to consume at around 7.5 cents out of the dollar.[13] However, many have disputed this effect; Case, Quigley and Shiller (2005) for instance, found that the evidence for stock market wealth effect on consumption is at best 'weak.'[14] There is also primary research, revealed by Starr-McCluer (1998) that supports the non-existence of the relationship between stock market wealth and consumption. Their report uses the Michigan SRC Survey of Consumers, which asked individual households questions about consuming and saving immediately following stock market price increases. Eighty-five percent of those surveyed reported that the *upward* trend in the stock market had 'no effect on consumption expenditures.'[15]

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[10] Hall (1978, p. 971-987)
[11] Mehra (2000, p. 66)
[12] Meyer and Associates (1994, p. 481-502)
[13] Shirvani and Wilbratte (2000, p. 48)
[14] Case, Quigley and Shiller (2005, p. 26)
[15] Starr-McCluer (1998, p. 8)

Much of the previous research on the stock market wealth effect on consumer spending has been carried out in response to the build up of stock-market wealth in the 1990's and thus focuses on the positive impacts on consumption and consequently GDP. The downturn in stock prices in more recent times has led researchers to question whether a fall in stock markets in the United States has a larger impact on consumption spending, as opposed to a rising stock market. Shrivani and Wilbratte (2000) find that PCE in the short-term responds to equity price declines more in Japan, Germany and the United States. Bertaut (2002) uses basic reduced-form regressions to show identical results for Japan but contradictory results for the United States. Their results may differ because of differences in model specification, differences in measure of stock prices and incomes, or, differences in estimation samples.

Literature that disputes the existence of any stock market wealth effect need to be examined more closely. With regards to the Case, Quigley and Shiller article, it is also true that those respondents who reported holdings in excess of $250,000 were significantly more likely to say that they spent more as a result of the increase in stock prices.[16] Given the importance of this wealthy class of individuals to household consumption in our economy, it is appropriate to deem the effect 'modest,' at the least, as the authors later admit. According to Johnson (2006), in 2005, the top 20% of households by income contributed almost 40% of total PCE in the US economy.[17] Second, several research pieces find that the impact of the stock markets on individuals' spending is different, and in fact, of greater magnitude when one considers a fall in stock markets and a consequent fall in personal consumption. Donihue and Avramenko (2007) point out, "Consumers react more strongly to negative shocks to the value of their liquid stock market

[16] Case, Quigley and Shiller (2005, p. 6).

[17] Johnson (2006). Source: <http://adage.com/images/random/consumerchart011607.pdf>

assets than they do to shocks to any other component of total wealth,"[18] while this study also finds that the time taken for consumers to revert back to 'normal' spending after a shock is greater when the shock is negative.[19] In essence, the effects of a change in stock market wealth on consumption expenditure are non-symmetric.

Ludvigson and Steindel (1999) analyze the dynamic response of consumption growth to a wealth shock; however, this shock is a positive shock, and this is important to consider when analyzing the results, especially given the evidence highlighted in Donihue and Avramenko's research (above). The effect of a one-standard deviation (1.5%) move in wealth growth is modeled using a second-order, restricted vector autoregressive approach. The results from the study show that upward shocks in the stock markets in the current period appear to effect present consumption growth, as opposed to next quarter's growth. The fact that households respond contemporaneously might be evidence of simultaneity as confidence levels instantaneously change consumption with regard to negative or positive news about the stock market. This finding has relevance to the type of variables and lags used in a structural model.

There are also non-academic sources that provide explanations for a plausible link between a collapse of the stock markets and its implications on the wider economy. For instance, an Economist (1998) article, states that during the second quarter of 1998, the stock markets were overvalued;[20] an external source confirms that the price/earnings ratio of the Dow Jones Composite Index was at an unprecedented 28 times, while the dividend yield was only 1.3%.[21] In simpler words, investors paid a lot for a dollar's worth of ownership in a company, heavily overestimating the potential cash flows in the future. The author of the article proceeds to warn

[18] Donihue and Avramenko (2007, p. 22).
[19] Donihue and Avramenko (2007, p. 26).
[20] Paraphrased from Economist Article, "America's Bubble Economy." (1998, p. 15 – 16)
[21] Vronsky (1998). Source: <http://www.gold-eagle.com/editorials_98/vronsky060698.html>

its readers "the bubble might suddenly burst, causing financial instability, destroying wealth and bringing about a recession." Such a chain of causation was not only possible, but also likely, given the highly over-valued markets.

Thus far, only so-called direct effects have been discussed, with respect to how a change in the stock market index can affect spending. In addition to the above, there is a separate channel through which the stock markets can influence consumption: this effect is related to the level of consumer sentiment in the economy. Otoo (1999), for instance, investigates the relationship between consumer sentiment and stock prices. She uses micro data and finds a correlation between consumer sentiment and stock prices even for individuals that do not hold stocks. However, she also adds that the traditional wealth effect should not be ruled out. Unfortunately, the confidence channel is not necessarily constrained by the logic of the life cycle hypothesis and budget constraints, which causes obstacles in quantifying this effect, as Poterba (2000) asserts. In addition, wealth affects confidence (the richer you are the more confident you get, generally) and confidence affects wealth (by raising prices of assets owned), therefore making both effects difficult to quantify together. In an attempt to include this variable in the analysis, it was found that the sentiment index was highly correlated with consumption, and, to include the former as an explanatory variable when predicting the former introduced econometric difficulties.[22] Finding a suitable of instrument for confidence is equally challenging.

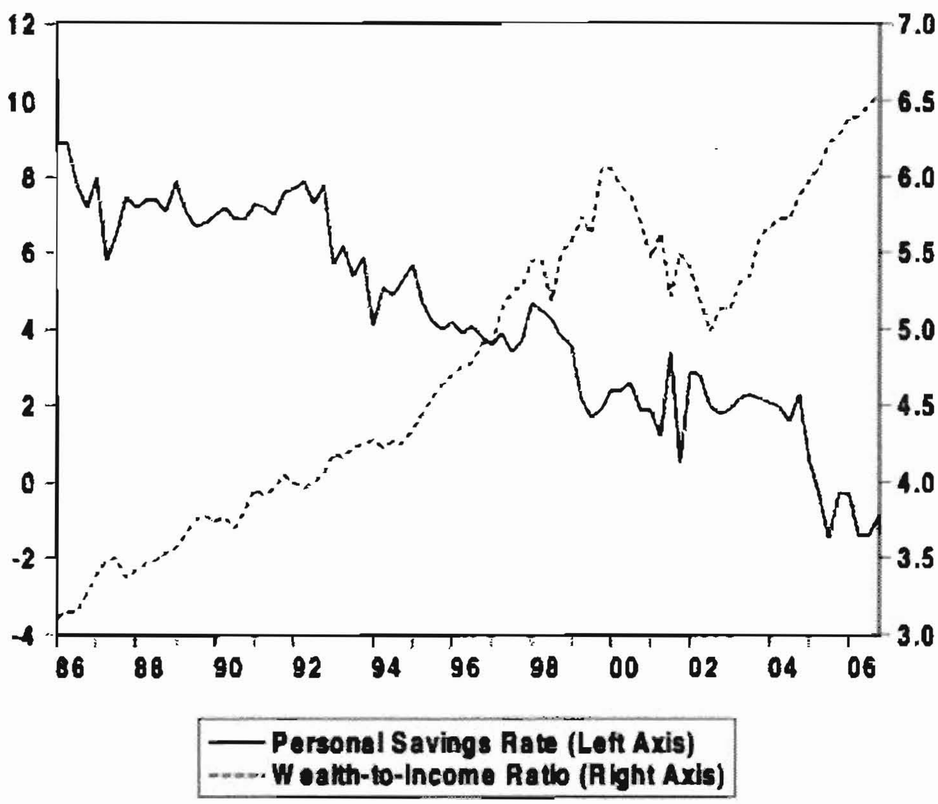
In summary, it is clear that some wealth effect exists from households' stock market assets, Much of the literature discussed above is based on the Life-Cycle Theory of Consumption. In the following section, this theory is examined more closely with the aim of providing a rationale for selecting the appropriate dependent and independent variables in the models.

[22] The t-statistics of all the other predictors of consumption failed to be significant.

3. Theoretical Background: The Life-Cycle Theory of Consumption

Figure 3, below, plots the ratio of wealth-to-disposable income and the personal savings rate. It is evident from a first look that the wealth-to-income ratio has been rising for many years (barring the 2000-2002 period); recently, the trend has been even stronger. In addition, the personal savings rate in the US has been falling steeply. Researchers have made the argument that a strong wealth effect must exist as the increase in the ratio of wealth-to-disposable income, due to stock market and non-stock market gains, has propelled consumer spending and this is depicted by a reduction in savings.

Figure 3: Wealth-to-Disposable Income Ratio and Personal Savings Rate



Source: Haver Analytics and author's own calculations.

Such a straightforward negative correlation is not sufficient to accept the existence of the wealth effect, or the fact that stock markets even contributed to that increase in wealth. The

model estimated below is based on well-accepted economic theory known as the life-cycle model of household spending, developed by Franco Modigliani, Richard Brumberg and later by Albert Ando in the 1950's and 1960's.[23] While initially wealth was not included in the model, economists like Deaton (1972) recommended that wealth be added.[24] It makes sense that adjustments in spending were made on the basis of changes in income and wealth. Perhaps such effects were not included until this point due to the fact that the real estate and stock markets were still developing. Davis and Palumbo (2001) illustrate the model above with a simple numerical example.[25] In a simplified situation where only income and consumption matter in three periods of an individual's life, the theory states that people adjust their saving and wealth over time to keep their planned spending levels steady in face of uneven income streams.[26] By this logic, if the aim of an individual household is to maintain a constant, smooth level of consumption, he or she will not modify spending patterns with predictable changes in wealth. It is thus only when changes in wealth are unanticipated that consumption change. This is an essential part of theory with respect to the shock mechanisms employed by this paper. Examples of unexpected changes include the sudden inheritance of a property under a will or, more applicable, a crash in stock markets.

Planned spending can thus be modeled in the following theoretical form[27]:

(1) $$C_t = m_y \cdot H_t + m_w \cdot W_{t-1}$$

In the equation above, m_y and m_w represent marginal propensities to consume of human wealth and financial wealth, respectively. Human wealth is depicted by H_t, measured by current income

[23] Source: <http://www.economics.strath.ac.uk/julia/teaching/mf/L8_JS.pdf>
[24] Deaton (1972, p. 443)
[25] Davis and Palumbo (2001, p. 7-14)
[26] Davis and Palumbo (2001, p. 9)
[27] Adpated equation from Davis and Palumbo (2001, p. 9)

plus expected future income, while W_{t-1} is the end-of-period financial wealth used to finance current spending[28]. Future income is, of course, a challenge to gauge accurately.

Case Quigley and Shiller (2001) among others, have argued that it makes sense to distinguish between financial asset wealth and non-financial market wealth as the properties of each may have differing effects on the MPC. The reason for the above is embedded in the theory that the response of consumption to an asset shock is of greater magnitude if the asset is more liquid:[29] moreover, it allows us to test our hypothesis in a more effective manner. The equation is modified below:

(2) $$C_t = m_y \cdot H_t + m_{smw} \cdot SMW_{t-1} + m_{nsmw} \cdot NSMW_{t-1}$$

where m_{smw} is the MPC out a $1 change in stock-market wealth *and* SMW_{t-1} is the level of stock market assets owned by households. Similarly, m_{nsmw} is the MPC out of non-stock market wealth, which is comprised mostly of real estate assets and is depicted by $NSMW_{t-1}$.

What follows is a brief description of the data used by this paper. The purpose of Section 5 is to establish the dynamics between the stock market and gross domestic product by using a vector autoregressive model. Once a causal relationship is established, information from the life-cycle theory is used to build a structural model in Section 6.

[28] Donihue and Avramenko (2007, p. 6)
[29] Donihue and Avramenko point this out. See literature review section for details.

4. Data Properties

All the data and variables used were obtained from Haver Analytics through their DLX software program. Where necessary, data were adjusted to chained 2000 dollars in order to reduce the inflationary bias. Gross domestic product, personal disposable income, personal consumption, government spending, investment by firms, export, import and savings rate data were obtained from the USNA (United States National Accounts) and the BEA (Bureau of Economic Analysis) database. The five-year treasury yield data and the 2000 chain price index were obtained from the USECON (United States Economic Indicators) database. Wealth variables including total wealth, stock-market wealth, real estate wealth and other wealth were extracted from the Federal Reserve Flow of Funds database. The Standard and Poor's 500 Index data was also extracted from the USECON database. Table 1 is a summary of all the variables and their code names.

Table 1: Variables Used, Including Descriptions and Coded Names

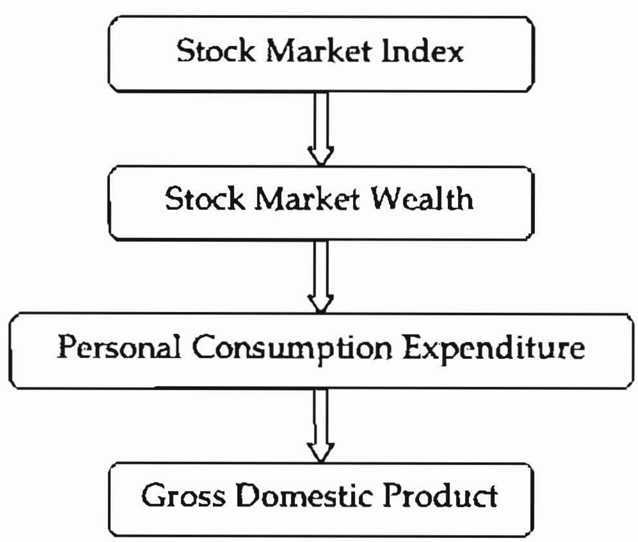
Variable	Description
GDPH	Real Gross Domestic Product (Ch. 2000$)
YPDH	Real Personal Disposable Income (Ch. 2000$)
CONS	Personal Consumption Expenditures (Ch. 2000$)
RSMW	Household's Equity Shares at Market Value, Directly Held (Ch. 2000$)
RNSMW	Real Total Wealth – Real Stock Market Wealth (Ch. 2000$)
RREW	Real Owner Occupied Real-Estate Wealth (Ch. 2000$)
ROTHERW	Real Non-Stock Market, Non-Real Estate Market Wealth
JC	Chain Price Index (SA, 2000=100) - Personal Consumption Expenditures
SP500	Standard & Poors' 500 Index
FH	Real Fixed Spending by Firms
GH	Real Government Spending
XH	Total US Export Values (Ch. 2000$)
MH	Total US Import Values (Ch. 2000$)
FCM5	5-Year Treasury Note Yield at Constant Maturity (% p.a.)

5. Vector Autoregressive Model

5.1 VAR Models and Impulse Response Functions

The VAR approach is commonly used to analyze shocks on equity markets or wealth arising from the equity markets. Ludvigson and Steindel (1999) and more recently Fry, Hocking and Martin (2008) utilize VAR models in their papers. The aim of this section is to determine whether historical relationships and trends between certain variables allow for the detection of a process of transmission between them. It is hoped that a VAR model that captures such a mechanism can lead us to answer the question in focus: can a stock market crash lead to a recession in the economy? It would also be useful to estimate the period of time the economy requires in order to return to original levels of spending and growth. It may be hypothesized that a reduction in stock market indices will lead to an immediate reduction in stock market wealth, which would reduce consumption in the same period or next, ultimately causing GDP to fall below trend in the next. The suspected mechanism is illustrated in Figure 4, below:

Figure 4: The Transmission Mechanism



In order to test the existence of such a process, a Vector Autoregressive approach is used to model the joint behavior of the stock market, consumer wealth and GDP. The vector autoregressive (VAR) framework of Sims (1980) has long been a standard part of the econometrician's toolkit. Technically, a VAR is a set of *k* time series regressions, in which the regressors are lagged values of all *k* dependent variables. As explained by Stock and Watson (2007), the coefficients in a VAR are estimated by the Ordinary Least Squares method and are proven to be consistent and to have a joint normal distribution in large samples.[30]

In determining the number of variables to include in the model and the variables themselves, one needs to be cautious to not have too many coefficients that need to be estimated as this increases the estimation error and decreases the accuracy of any analysis. The general idea is that the number of variables in such a model needs to be few and all need to be plausibly related to one another so that they can be effective in forecasting each other. In deciding what variables to include in the VAR framework proposed, Ludvigson and Steindel (1999) use consumption, income, stock market wealth and non-stock market wealth to create a system of equations for their model. Minor modifications have been made to their choice of variables. Since this paper attempts to link the stock markets in particular, to the rest of the economy (through GDP), the S&P 500 index variable along with gross domestic product has been added to the VAR system. In essence it is taking a model used by previous researchers (Ludvigson and Steindel (1999)) and adding two additional variables that are the start and end points in the points in the hypothesized chain of causation in Figure 4.

There are two principal reasons why the S&P 500 index was chosen for the purpose of the impulse response mechanism. First, the index is widely considered to be the 'definition' of

[30] Stock and Watson (2007, p. 640)

where U.S. equity markets stand at any time, mostly due to the number of influential companies it covers[31], as opposed to the Dow Jones Industrial Average Index, which only covers 30 stocks. Second, the index covers large-cap stocks and is market-cap weighted (i.e. movements in smaller companies' share prices are reflected less than the same for larger companies), the product of which is an effective gauge of the stocks commonly held by individual households.[32]

In light of the information and criteria above, the VAR model estimated has the following form with five equations that can be represented in a matrix form:

$$\begin{bmatrix} (1)CONS_t \\ (2)GDPH_t \\ (3)YPDH_t \\ (4)SMW_t \\ (5)REW_t \\ (6)SP500_t \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \end{bmatrix} + \begin{bmatrix} \beta_{1,1} & \beta_{1,2} & \beta_{1,3} & \beta_{1,4} & \beta_{1,5} & \beta_{1,6} \\ \beta_{2,1} & \beta_{2,2} & \beta_{2,3} & \beta_{2,4} & \beta_{2,5} & \beta_{2,6} \\ \beta_{3,1} & \beta_{3,2} & \beta_{3,3} & \beta_{3,4} & \beta_{3,5} & \beta_{3,6} \\ \beta_{4,1} & \beta_{4,2} & \beta_{4,3} & \beta_{4,4} & \beta_{4,5} & \beta_{4,6} \\ \beta_{5,1} & \beta_{5,2} & \beta_{5,3} & \beta_{5,4} & \beta_{5,5} & \beta_{5,6} \\ \beta_{6,1} & \beta_{6,2} & \beta_{6,3} & \beta_{6,4} & \beta_{6,5} & \beta_{6,6} \end{bmatrix} \begin{bmatrix} CONS_{t-1} \\ GDPH_{t-1} \\ YPDH_{t-1} \\ SMW_{t-1} \\ REW_{t-1} \\ SP500_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix}$$

Where $CONS_t$ is real personal consumption expenditure in the current period, GDP_t is real gross domestic product in the same period, $YPDH_t$ is personal disposable income[33]. EMW_t is real equity market wealth for the same period, $NEMW_t$ is the real non-equity market wealth in the same and $SP500_t$ is the Standard & Poor's 500 Index Value in the current period. ε_{nt} is the error term for that particular equation. Therefore, in total there will be six error terms, one for each equation. In the coefficient matrix, each variable is represented by a number; for instance, $\beta_{4,3}$ estimates the coefficient of personal disposable income, (3)YPDH, in the previous period for

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[31] Paraphrased from Investopedia.com

[32] Note that this process takes for granted the fact that owners of corporate equity are not permitted to 'short' stocks (this involves borrowing a stock from another entity and selling it in anticipation of a fall in future price). This is a mostly realistic view, and falsifying this assumption would imply that stock market wealth could rise when the indices drop. Margin accounts are required to carry out such hedging transactions, and, although today, such capabilities are essential to hedge funds and mutual funds, they are relatively uncommon and unavailable to households.

[33] C, YPDH, GDP, RSMW and RNSMW are adjusted to 2000 dollars.

equation where stock market wealth, (4)SMW, is the dependent variable. Notice that the system of equations above assumes the inclusion of only a one-period lag. The actual number of lagged periods required will depend on criteria described below.

Standard recommendations for the selection of the appropriate lag length is to choose the number of lags to be long enough to ensure that the residuals are white noise, but not too long since the estimates can become imprecise. From a review of other papers, it is a somewhat ambiguous process and it appears that the lag-length is set in a rather arbitrary manner. In order to determine the appropriate lag-length, The Akaike Information Criterion was used.[34] AIC methodology attempts to find the model that best explains the data with a minimum of free parameters. The Akaike Information Criterion is calculated by the following formula:

$$AIC = -2l/T + 2k/T$$

Where l is the log likelihood criterion and k is the number of parameters in the model. This figure can be calculated according to the formula and it was found that lagging over two time periods minimized the AIC criteria at 10.10. Coincidentally, Ludvigson and Steindel (1999) also use two lags in their study. This implies that the model now estimates double the number of coefficients described in the matrix system of equations i.e. 72 coefficients are estimated as a result.

There is an issue regarding whether variables in a VAR need to be stationary. Sims (1980), among others recommend against taking first differences even if the variables contain a unit root. The argument they propose is that the aim of a VAR analysis is to investigate the relationships among variables, not to determine the parameter estimates. As Enders (1996) states, differencing "throws away" information concerning the co-movements in the data and therefore

[34] EViews 5 – Users Guide (p. 437).

the form of the variables in a VAR should mimic the true data generating process.[35] However, Ludvigson and Steindel (1999) do use first differences in their study, and this information is useful for the supplementary VAR model that is estimated.

Finally, in order to observe the effects of a shock, a process known to econometricians as 'Impulse Response' is used. A research piece by Koop, Pesaran and Potter (1996) explores this area of econometric forecasting. An impulse response function measures the time profile of the effect of a shock on the behavior of a series. Basically, it allows users to observe the effect of a shock of size x affecting a system at a particular time, assuming that all other variables are endogenous and no other shocks hit the system.[36] It is a type of conceptual experiment. In the system defined in this paper, the S&P 500 index has been chosen as the variable to be shocked, given the desire to model a significant, one-time drop in the prices of equity-based securities.

[35] Enders (1996, p. 111)

[36] Koop, Pesaran and Potter (1996, p. 119)

5.2 Results from the VAR Models

Table 2 presents the results of a VAR model with a two-period lag, using the variables discussed previously. There are six equations, each with one dependent and ten explanatory variables.

Table 2: Estimated Correlation Coefficients from VAR Model[37]*:*

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	GDP	CONS	YPDH	RSMW	RNSMW	SP500
GDP_{t-1}	0.853***	0.013	0.101*	1.458**	1.293**	0.127**
GDP_{t-2}	-0.022	-0.097**	-0.082	-0.168	-0.685	-0.048
$CONS_{t-1}$	0.734***	0.948***	0.398***	0.842	1.267	-0.080
$CONS_{t-2}$	-0.484***	0.089	-0.355**	-1.221	-0.836	0.047
$YPDH_{t-1}$	0.141**	0.147***	0.631***	-0.605	-0.740	-0.066
$YPDH_{t-2}$	-0.154**	-0.075	0.299***	-0.364	-0.208	-0.014
$RSMW_{t-1}$	0.026	0.027***	0.030**	0.972***	-0.089	0.017
$RSMW_{t-2}$	-0.001	-0.019**	-0.020	-0.156	-0.014	-0.019*
$RNSMW_{t-1}$	-0.017	-0.008	0.030	-0.366**	1.011***	0.024**
$RNSMW_{t-2}$	0.021	0.010	-0.026	0.288	-0.052	-0.020
$SP500_{t-1}$	0.178	0.041	-0.319**	2.704**	0.016	1.066***
$SP500_{t-2}$	-0.372***	-0.047	0.233	-2.007*	0.223	-0.105
AIC Stat.	10.102	8.970	10.073	14.369	14.132	9.274
R-Square	0.999	0.999	0.999	0.974	0.999	0.997

In the VAR model, CONS is the annual rate of growth in consumption, while GDPH is the real level of GDP, both adjusted to 2000's prices. Similarly, RSMW and RNSMW are the variables for real stock market wealth and real non stock market wealth. The Standard & Poor's 500 Index for the last day of each quarter from 1951:Q1 until 2006:Q4 is defined by SP500. The statistically significant coefficients are asterixed (See footnote). Given that the model above is an atheoretical model, one would not expect all coefficients to be significant. In search of a

[37] For a full output from EViews see Table 1 in the Appendix.
*** implies that the coefficient is significant, using a two-tailed t-test, at the 1% level
** implies the same at the 5% level
* implies the same at the 1% level

transmission mechanism, there are a few important coefficients in the model that need to be considered.

Table 3: Two-sided t-test of VAR Results

Dependent Variable	Explanatory Variable	Significance Level of Coefficient
Real Stock Market Wealth$_{(t)}$	S&P 500$_{(t-1)}$	5%
Real Stock Market Wealth$_{(t)}$	S&P 500$_{(t-2)}$	10%
Consumption$_{(t)}$	Real Stock Market Wealth$_{(t-1)}$	1%
Consumption$_{(t)}$	Real Stock Market Wealth$_{(t-2)}$	5%
Gross Domestic Product$_{(t)}$	Consumption$_{(t-1)}$	1%
Gross Domestic Product$_{(t)}$	Consumption$_{(t-2)}$	1%

Table 3, above, confirms that relationships between lags of S&P 500 variables and real stock market wealth, lags of real stock market wealth and consumption, and, lags of consumption and real gross domestic product exist in a significant manner. In the VAR model we are concerned primarily with these relationships. In summary, a process of transmission between the S&P 500 index to real gross domestic product, through the wealth channel, can be hypothesized.

After establishing the basic VAR model and estimating significant coefficients, this paper seeks to ultimately shock the S&P500 variable, by using an impulse response function in order to observe the effects on consumption and gross domestic product. As discussed in the previous section, the stock market performance proxy is the S&P 500 Index and a shock of negative 38% amount is induced, similar to what was experienced in the 2000-2001 bear market. The results are illustrated diagrammatically in Appendix Figure 2.

Starting with the S&P500, a shock of 38% implies that the index falls by about 500 points (from 1400 the 2007:Q1 approximate value). This is depicted by the fact that in the last graph (S&P500) starts at 500 points below trend in the first quarter (Q1). The x-axis represents the number of quarters after the shock in all graphs. Given the strong relationships found in the

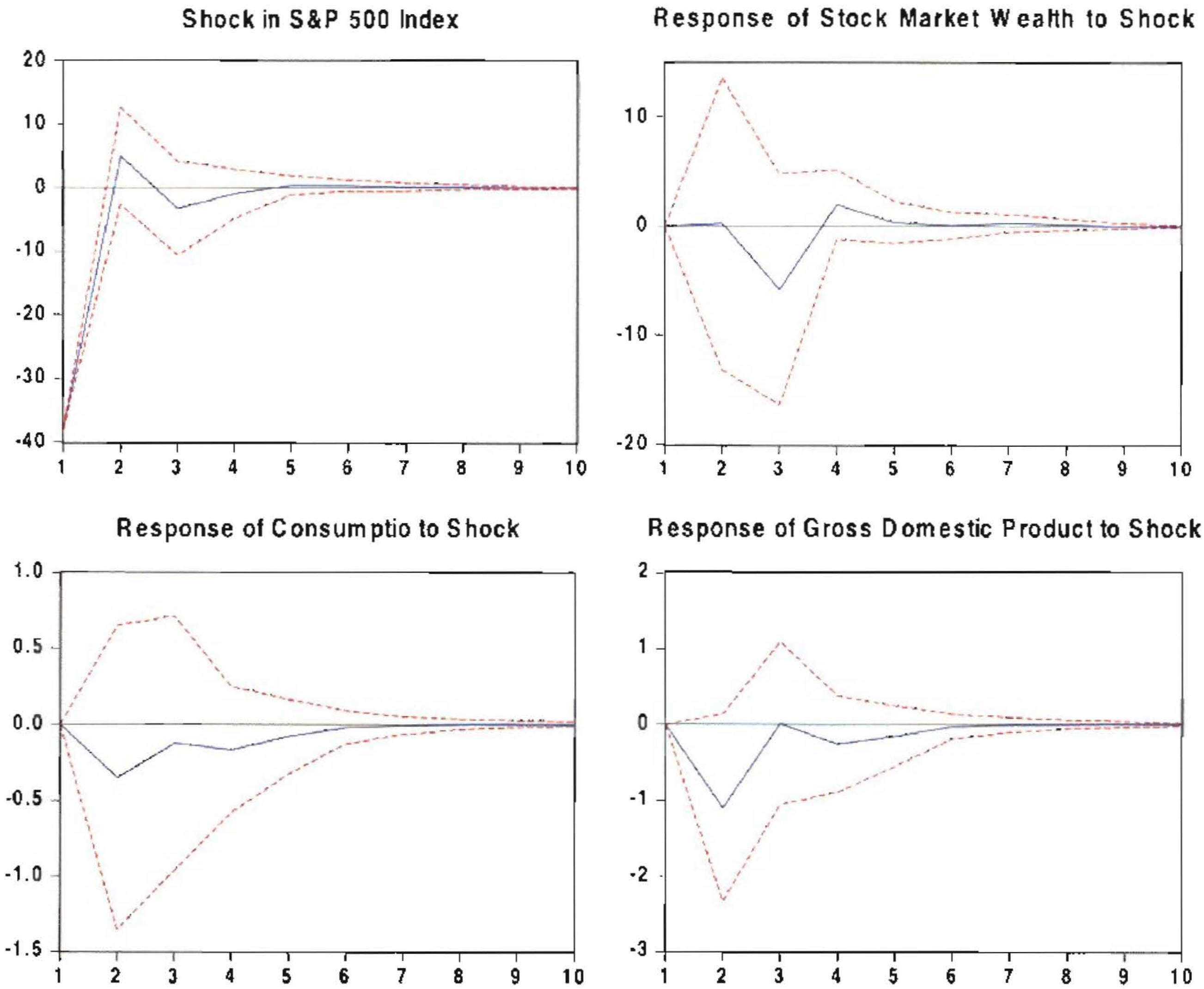
VAR, in the RSMW (real stock market wealth) graph, there is a one-period lagged effect and it falls by about $2,000 trillion below trend in a matter of two quarters after the shock has been induced. Since individual households now have less overall wealth, and given that the MPC out of stock market wealth is positive, we see that personal consumption expenditure (CONS) falls below trend in the second period as well. On increasing the response time to 100 quarters, it is visible that the negative impact on consumption lasts seventy-five quarters i.e. only after six years will consumption be able to return to trend levels. On a final note, some instability was recognized in the model given that GDP and personal disposable income (YPDH) fell initially, only to rise above trend levels after Q3 of imposing the shock. Luvdigson and Steindel (1999) encounter similar instabilities in their model.[38]

Although the model above successfully achieves the objective of using a VAR framework, namely to illustrate a transmission mechanism, in an effort to analyze the possibility of a recession and whether negative growth will linger in the economy, a second VAR has been estimated. This model uses quarter-to-quarter rate of growth values instead of absolute values for the same variables. Although, not necessary, and sometimes not recommended, this method allows for the alleviation of non-stationarity. The impulse response functions for the modified variables are illustrated in Figure 5, on the following page. The stability of the model is evidenced from the fact that all the variables ultimately return the normal trend within the 10 periods after the imposition of the shock.[39] The 0% line represents the variable's benchmark value, or, where the economy would have been had it not been subject to any shocks. Thus, for real stock market wealth (RSMW), personal consumption (CONS) and real gross domestic

[38] Ludvigson and Steindel (1999, p. 44)
[39] Morley, Bruce. Source: <people.bath.ac.uk/bm232/ EC50162/Financial%20Econ%202.doc>

product (GDP), the deviations need to be interpreted as are viewed as percentage-point deviations from trend rates.

Figure 5: Response of Variables to 38% Shock in S&P 500



Focusing on the response of CONS and GDP, the results are in line with the hypothesis of this paper i.e. both fell below trend and both continued to remain below trend growth for a considerable period of time. It is surprising however, that GDP reacted more strongly to the impulse. According to the theory, given that consumption expenditures constitute around 70% of total spending in the US economy, the former should always generate a larger impact. Real GDP

falls significantly below trend for a quarter (over 1%) and attempts to stabilize by the third quarter, only to fall negative again in the fourth quarter, to finally return to trend growth by the sixth quarter (almost two years later). It is interesting that when the size of the shock to the stock markets was altered, the responses of GDP and personal consumption followed similar patterns (of stabilizing and then falling below again), the only difference being the magnitude of the troughs. For instance, a similar experiment was carried out imposing on a 20% shock — the largest one quarter shock experienced by the S&P 500 since 1980.[40] The results are shown in Figure 3 in the Appendix. The direction of impact on each variable is identical to the previous shock, while the magnitudes are noticeably lower. Notice, however that in strictly definitional terms, no recession was caused in the economy despite the size of the shocks.

5.3 Conclusions from the VAR Models

Two VAR models were estimated, each for an individual purpose. The first model was built for the purpose of illustrating the workings of a transmission mechanism; it was evident that the coefficients between lagged SP500 and RSMW, lagged RSMW and CONS, and lagged CONS and GDP were all statistically significant at the 5% level. Upon inducement of a shock to the model, where the S&P 500 index is used as a proxy for equity prices, a visual representation of the transmission mechanism is observed. All variables react in the sequence that was hypothesized, the only issue being the fact that the model does take several quarters to stabilize to trend levels (75 quarters for personal consumption).

In the second VAR, annualized rates of growth are used for two reasons. First, to deal with the non-stationarity of the variables, and, second, for the purpose of creating more 'stable'

[40] Source: Flow of Funds Database.

impulse response functions. There is, however, a loss of significance with modification; not as many of the relationships had significant coefficients, when compared with the previous VAR. Results showed that consumption and GDP both fell a significant amount below trend, though never actually resulting in two or more quarters of negative growth. The preliminary results are historically consistent, especially when examined in light of the 2000-2001 stock market crash. The data for GDP percent change, based on 2000 dollars is given in Table 4.

Table 4: Actual GDP Growth Rates (2000:Q2 – 2001:Q4)

Year	Period	GDP (% change[41])
2000	Q2	6.4
2000	Q3	-0.5
2000	Q4	2.1
2001	Q1	-0.5
2001	Q2	1.2
2001	Q3	-1.4
2001	Q4	1.6

Source: Bureau of Economic Analysis

In the second VAR impulse response model, a similar result was predicted, i.e., GDP falls initially, and then reverberates around trend and below trend growth. The model predicted that the economy would normalize to trend rates after a timeframe of six consecutive quarters. Notice from the data above that GDP growth was positive after 2001:Q3, and fluctuated below trend for exactly six quarters. For an atheoretical model, the consistency of the results are impressive.

5.4 Shortcomings of a VAR approach

The shortcomings of a VAR based approach are apparent. In essence, such a model is a simple model that hypothesizes about historical relationships between variables. Moreover, vector autoregressions do not incorporate any form of economic theory in their estimations. Structural models on the other hand, are based entirely on economic theory and therefore might

[41] Annualized rate of growth figures were used to measure the changes in real GDP.

provide a more accurate representation of a shock. In addition, the interpretation of an impulse response function cannot be understood in terms of a specific point in time, i.e. the crash of 2001 cannot be examined. This has several drawbacks. Another problem is the potential for the model to be incomplete. When important variables are omitted from the system, this could have an impact on the results, since it makes the impulse responses less valuable for interpretations. A structural model, conversely, would signal the problem of omitted variable bias.

6. The Structural Model

From the literature review in Section 2, one sees that the majority of previous research concurs on a wealth effect of some magnitude. Section 3 provides a very comprehensive theory that supports the stock market wealth effect. Section 4 uses a second-order VAR estimation technique to illustrate a transmission mechanism in a stock market collapse. This section of the paper intends to use more sophisticated econometric techniques to research the effect of a declining stock market on the economy.

Ultimately, the aim of the model is to examine the possibilities of a recession and thus seeks to model changes in real Gross Domestic Product. Using the expenditure method of calculating GDP, it is composed of the following parts:

(1) $$GDPH = f\,[CONS, FH, GH, (XH\text{-}MH)]$$

The above is an essentially an identity equation i.e. it remains true regardless of what values are inserted into each side of the equation. The fact that we are using real terms might reduce the accuracy of this equation, but the effect is negligible.

6.1. Estimation of a Consumption Equation

Next, a consumption equation is estimated, using select variables in the following manner:

(2) *CONS = f [YPDH, RSMW, RREW, FCM5]*

The life-cycle theory of consumption, discussed earlier, states that consumption depends on wealth and lifetime income. Case, Quigley and Shiller (2005) use similar variables in their model for the independent variables that predict consumption. They find all variables to be significant at the 5% level. Five-year treasury rates (FCM5) were added to the right-hand-side of the equation, as it is believed to be a strong predictor of consumer spending. This variable represents the cost of borrowing for individual households, and is therefore hypothesized to be negative due to the fact that a higher interest rate increases the cost of borrowing causing households to spend less on goods and services in the economy. Simultaneously, individuals are more inclined to invest in higher yielding assets when yields rise, which also reduces spending. In addition, the inclusion of FCM5 to the equation increases the R-squared value marginally. Ludvigson and Steindel (1999) include other sources of wealth as a separate variable in their model, which this model specifically excludes due to the existence of a high degree of multicollinearity that was discovered. Appendix Table 4 shows a correlation matrix of the variables in the equation above, highlighting the fact that other forms of wealth variable is highly correlated with consumption and personal disposable income (0.99 and 0.99 respectively). In addition, the model does not include lagged effects of consumption or stock market wealth. Ludvigson and Steindel (1999) find that "movements in the stock market today appear to influence today's consumption and growth, not tomorrows." As discussed in Section 2, they use similar techniques, including a VAR and a structural model, over separate time intervals to arrive at this conclusion.

Equation (2) is estimated in the following manner:

(3) $$CONS_t = \beta_0 + \beta_1 YPDH_t + \beta_2 RSMW_t + \beta_3 RREW_t + \beta_4 FCM5_t + \varepsilon_t$$

The results are below:

Table 5: OLS Estimation of Equation 3 (1960:Q1 – 2006:Q4)

Variable	Coefficient	Std. Error	t-Statistic	Probability
Constant	9.628498	14.17400	0.679307	0.4978
Personal Disposable Income	0.810935	0.010689	75.86285	0.0000
Real Stock Market Wealth	0.032243	0.003277	9.840674	0.0000
Real Real Estate Wealth	0.064800	0.004682	13.83890	0.0000
5-Yr Treasury Yield	-16.40158	1.729054	-9.485869	0.0000
R-squared	0.999419			
Durbin-Watson stat	0.755375			

All the variables are statistically significant at the 5% significance level in a two-sided t-test. Consequently, the probabilities of a Type I error are 0.00 for all the independent variables[42]. For the purpose of interest, the marginal propensity to consume out of stock-market wealth is 3.2cents, while the marginal propensity to consume out of real-estate wealth is significantly higher at 6.5cents (for every dollar increase in wealth from the respective category.)

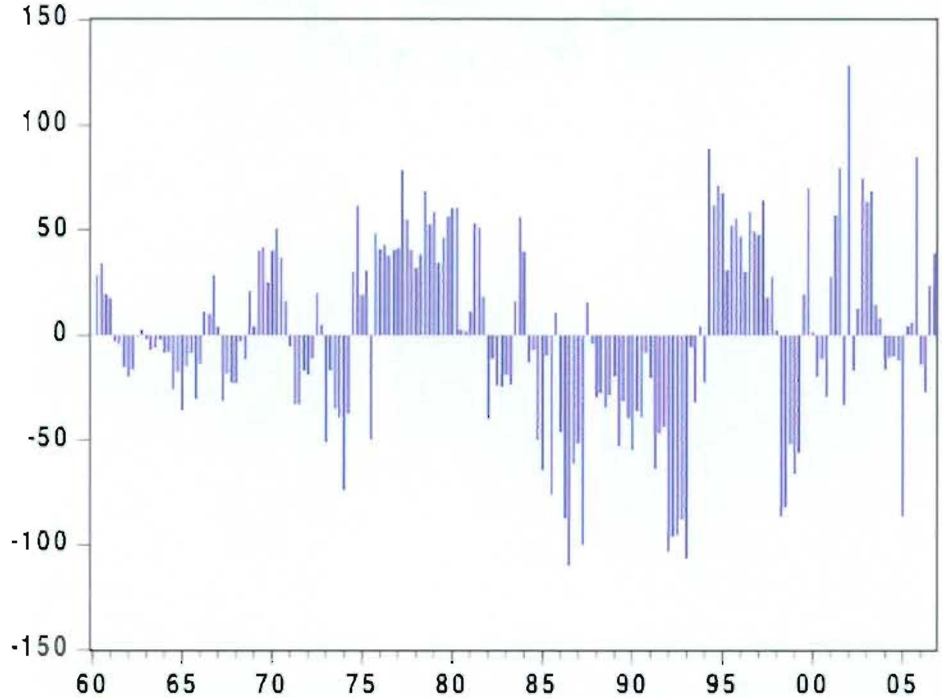
However, there is one issue with the regression above that needs to be tackled before proceeding. Due to the trending nature of consumption, income and wealth over the sample period that extends close to fifty years, the error-term in Equation 3 is non-stationary. Consequently, the marginal propensity values estimated, although consistent with previous estimates, are not reliable.

According to Studenmund (2000), pure serial correlation occurs when Classical Assumption IV, which assumes uncorrelated observations of the error term, is violated in a

[42] For a full regression output, see Appendix Table (2)

correctly specified equation. From observing the graph of the residuals in Figure 6, it is visually ascertained that there are statistically significant spikes at several lags.

Figure 6: Spike Graph of Residuals of Equation (5)



A more definitive method of determining serial correlation, however, is the Durbin Watson d-statistic. From the EViews output for Equation (3) it is evident that the statistic is 0.755375. Given this statistic we can perform a formal test. The null hypothesis is that no positive serial correlation exists. Given that there are 4 explanatory variables, according to the d-statistic tables, at a 5% level of significance (two-sided test), the lower limit is 1.53 and the upper limit is 1.70[43]. As 1.530>0.755, we are able to reject H_0 and confirm the results of the residual plot in Figure 6, that serial correlation is present. The implications of this cause reason for concern; the standard errors are underestimated and hence the t-statistics are overestimated, while the coefficients are unbiased and consistent[44].

[43] Studenmund (2006, p. 617-619)
[44] Studenmund (2000, p. 318-319)

In essence, our test results imply that the coefficient of last period's error term (ρ), when the current period's error term is regressed on it is positive – indicative of a relationship. The solution, according to Studenmund (2000), is to use Generalized Least Squares instead of OLS. For the purposes of this equation the AR(1) technique has been chosen as it is a one-step process where the standard errors have improved properties when compared with other methods[45]. The results in Table 6 are an estimation of Equation 3 with ρ included:

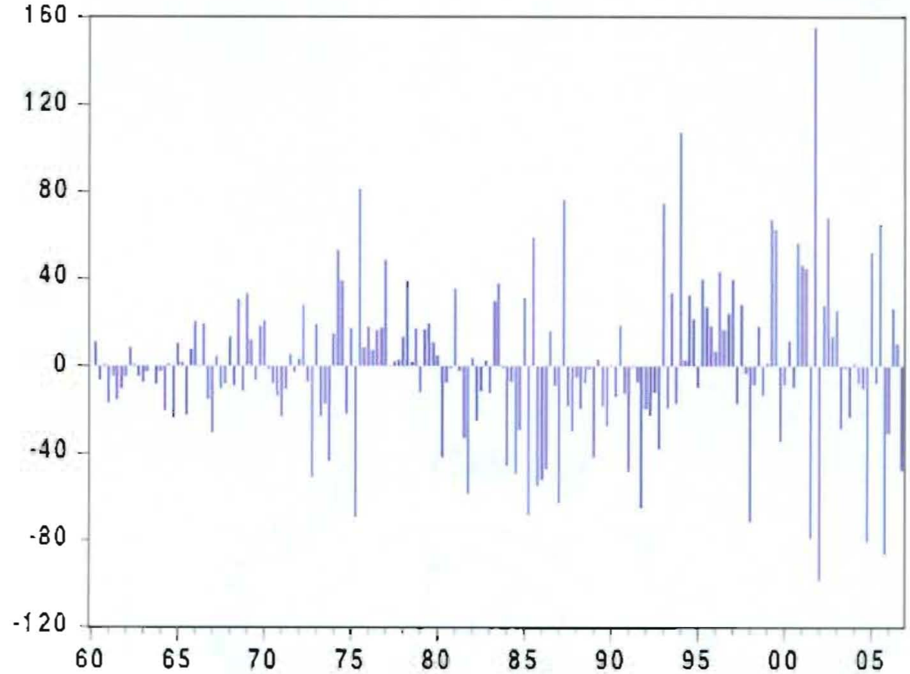
Table 6: Generalized Least Squares Estimation of Equation 3 (1960:Q1 – 2006:Q4)

Variable	Coefficient	Standard Error	t-statistic	Probability
Constant	31.14482	36.22239	0.859822	0.3910
Personal Disp. Income	0.773801	0.022709	34.07431	0.0000
Real Stock Market Wealth	0.030325	0.005996	5.057839	0.0000
Real Real Estate Wealth	0.082900	0.010124	8.188159	0.0000
5-Yr Treasury Yield	-11.98222	3.280437	-3.652630	0.0003
AR(1) or ρ	0.702967	0.057006	12.33156	0.0000
R-squared	0.999648			
Durbin-Watson stat	2.367040			

The R-squared value is 0.99, implying that almost all the movements in personal consumption are explained by the independent variables[46]. The autoregressive parameter, i.e. the coefficient of the AR(1) term is statistically significant at 1% significance level in a two-tailed t-test. Thus, the inclusion of this term in the regression successfully eliminates the problem of autocorrelation. This is evident from two ways; first, the Durbin-Watson d-statistic is 2.36, and second, from the graph of the residuals in Figure 7, the distribution is random and no spikes are present.

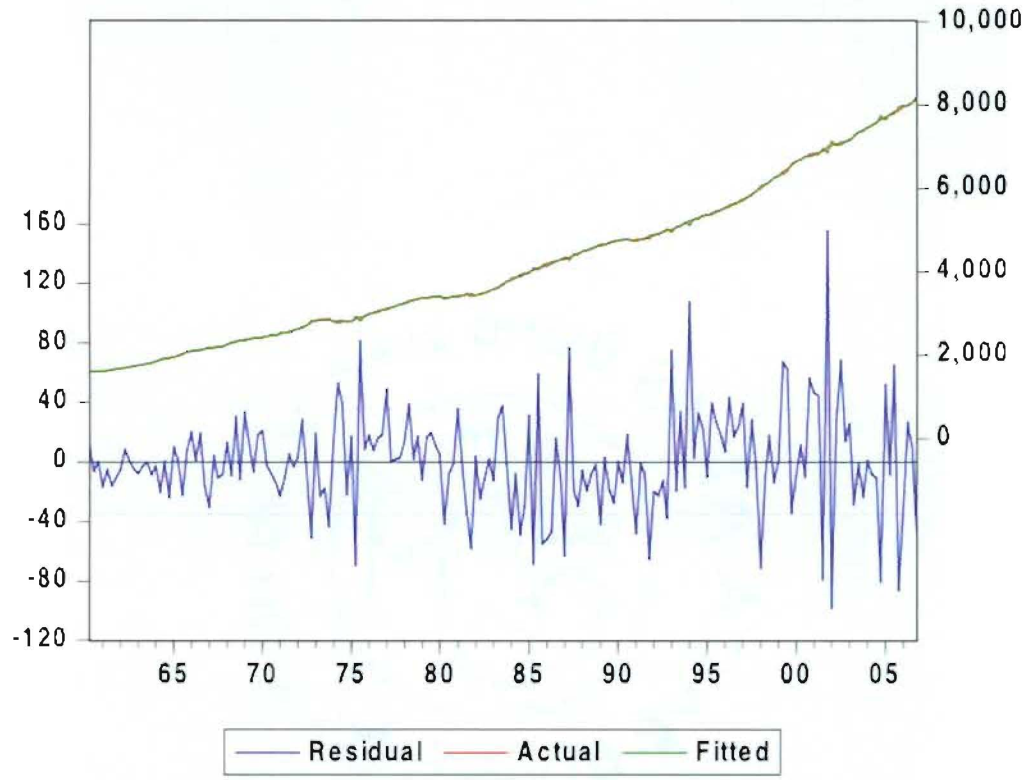
[45] Studenmund (2000, p. 333)
[46] For a full regression output, see Appendix Table 3.

Figure 7: Spike Graph of Residuals of Equation (5) Using GLS Techniques



In addition, YPDH, RSMW, RREW and FCM5 are all statistically significant using a 1%, two-tailed t-test. The marginal propensity to consume out of stock market wealth is 3 cents, while the same figure for real estate wealth is slightly higher than the OLS estimate at 8.3 cents. The former is broadly consistent with Ludvigson and Steindel's (1999) range of estimates of between 2 cents – 4 cents. The MPC out of stock market and housing market wealth are slightly below Donihue and Avramenko's (2007) estimates: approximately 1 cent lower in both. Figure 8 shows the GLS version of Equation (3), illustrating the actual and planned consumption levels, as well as the size of the residuals for each quarter.

Figure 8: Actual and Planned Levels of Consumption (1960:Q1 – 2006:Q4)



There are clearly some "spikes" at certain time periods, including the times around the following periods: 1975, 1984-86, 1993-94 and 2001-2. These periods in fact, coincide with the years when the US economy was in a state of recession. It is therefore understandable that the fitted values for consumption did not fit the actual values, and hence, large residuals.

6.2. Estimation of a Stock Market Wealth Equation

Moving forward, in order to implement an alternative scenario that involves shocking the Standard & Poor's 500 Index, another equation needs estimation – one that relates the stock market to consumption. The solution lies in stock market wealth's dependence on the SP500 variable. Stock market wealth can also increase from individuals transferring wealth from other sources to purchase stocks. Equation (4) represents what one is attempting to model:

(4) $RSMW = f\,[SP500]$

In econometric form, this simple equation can be re-written as:

(5) $RSMW_t = \beta_0 + \beta_1 SP500_t + \varepsilon_t$

Table 7: Ordinary Least Squares Estimation of Equation 5 (1960:Q1 – 2006:Q4)

Variable	Coefficient	Std. Error	t-statistic	Probability
Constant	1603.008	81.55893	19.65460	0.0000
S&P 500 Index	4.041884	0.140871	28.69210	0.0000
R-squared	0.815702			
Durbin-Watson stat	0.126607			

Before any interpretations are carried out, the non-stationarity of SP500 and RSMW need to be tackled. One can suspect this issue occurs from an examination of Appendix Figure 4. Non-stationarity in the data can lead to inflated r-squared values and t-statistics. Essentially, the OLS estimation above attributes changes in real stock market wealth to changes in the S&P 500 index that may have been the result of trends in the variables i.e. RSMW and SP500 moving together. Appendix Figure 4, which plots the S&P 500 with real stock market wealth on separate axes, shows that non-stationarity might be present.

The Dickey-Fuller test is the standard formal method for testing for non-stationarity. It examines the hypothesis that the variable in question has a unit root and, as a consequence, would benefit from being expressed in first-difference term.[47]

For the Dickey-Fuller Test, the following equations are estimated:

(6) $RSMW_t = \beta_1 + \beta_2 RSMW_{t-1} + \varepsilon_t$

(7) $SP500_t = \beta_1 + \beta_2 SP500_{t-1} + \beta_3 D(SP500_{t-1}) + \varepsilon_t$

[47] Studenmund (2006, p. 434)

The Null Hypothesis is, $H_0 : \beta_2 = 1$ i.e. the series is non-stationary. While the alternate Hypothesis is $H_1 : \beta_2 < 1$ i.e. the series is stationary[48].

Table 8: Augmented Dickey Fuller Test Statistic for RSMW and SP500

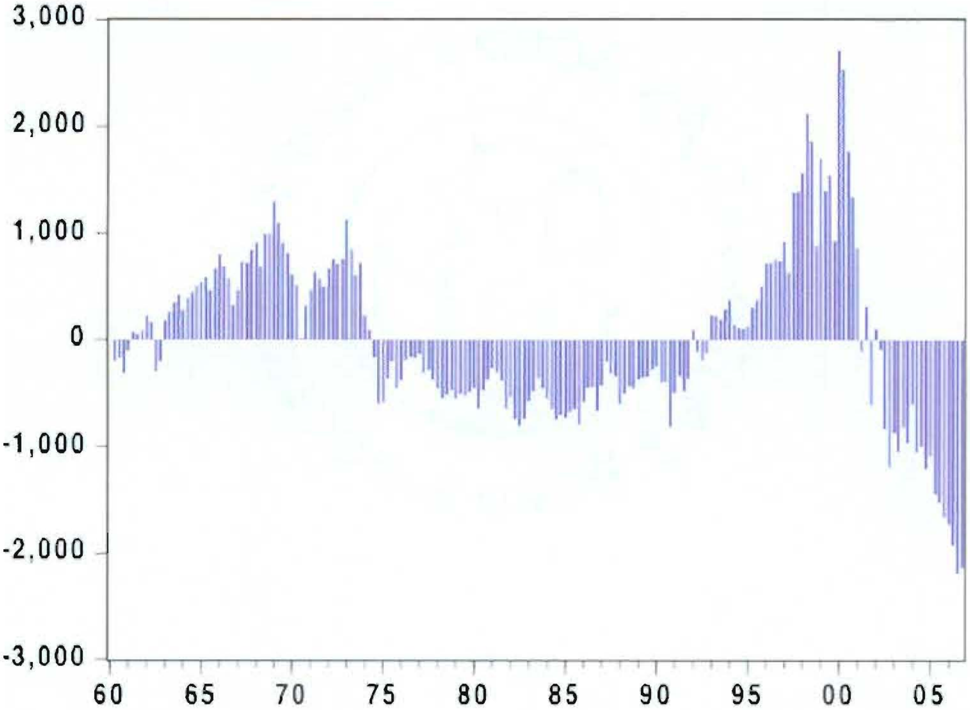
Variable	t-Statistic	Critical t-statistics	
		1% level	-3.465977
Real Stock Market Wealth	-1.235417	5% level	-2.877099
S&P 500 Index	0.969670	10% level	-2.575143

In both cases, the null hypothesis is not rejected, thus confirming non-stationarity in the series.

There is one more issue with the regression estimation of Equation 5. The Durbin-Watson statistic is a low figure of 0.126607. From an examination of the residuals in Figure 9, a pattern is apparent, however, a more formal test is carried out. Given that there is only one explanatory variable, the d-statistic tables tell us that at a 5% level in a two-tailed test, the lower limit is 1.65. Since 1.65>0.126607[49], we reject H_0 and confirm the presence of serial correlation.

48 Source: Dougherty (2000)
49 Studenmund (2006, p. 617-619)

Figure 9: Residuals Spike Graph of Equation 6 Using OLS



On solving for serial-correlation by performing a generalized-least squares estimation of Equation 5 – and adding an AR(1) term, a co-efficient of 1.01 was estimated for ρ, the co-efficient of the lagged error term. Thus implying that the residuals are positively related and that, by taking differences, both issues may be simultaneously solved. Below is the modified estimation of Equation 5. Note that a GLS transformation of with $\rho = 1$ is equivalent to the estimation below:

Table 9: Ordinary Least Squares of Equation 5 (1960:Q1 – 2006:Q4)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Probability**
Constant	-29.35323	21.12119	-1.389753	0.1663
D(S&P 500)	6.512585	0.656954	9.913303	0.0000
R-squared	0.346921			
Durbin-Watson stat	2.515397			

The interpretation of the co-efficient of SP500, given that first differences were used, is as follows: A one point change in the index, leads to a consequent change (in the same direction) in

real stock market wealth (RSMW) by approximately \$6.513 billion. The coefficient is significant using a 1% two-tailed t-test. In addition, the issue of positive serial correlation is solved, and this can be visually and statistically confirmed.

Figure 10: Residuals Spike Graph of Equation 6 Using OLS & Taking Differences

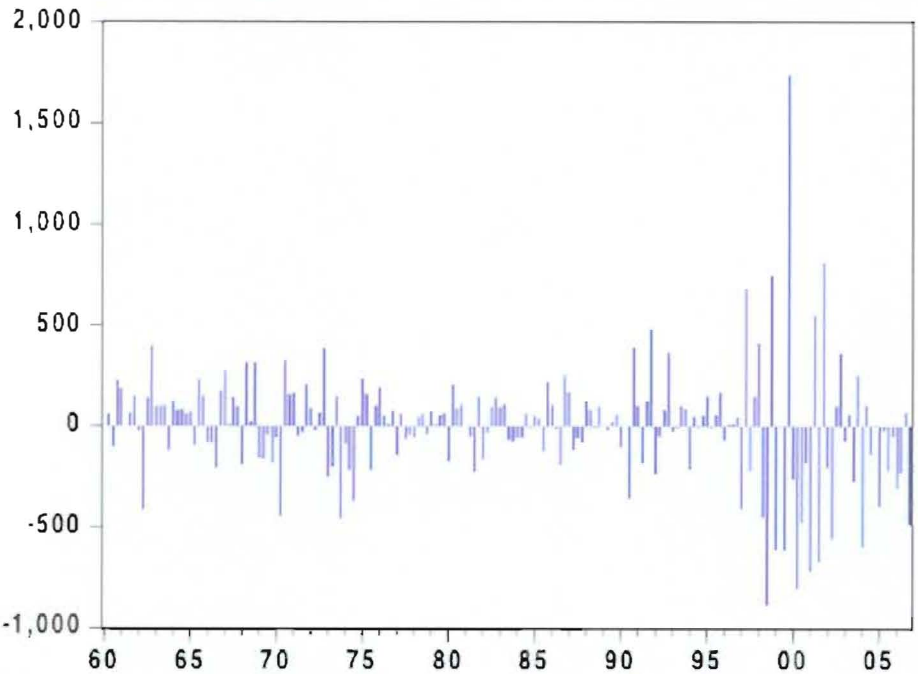


Figure 10, above, shows that the previous trends that existed in Figure 9, on the previous page, have now disappeared. From a statistical standpoint, the Durbin-Watson statistic confirms that 2.515 is in the acceptance region of H_0, implying that the estimation is free of positive serial correlation.

6.3. The Final Model

The three equations discussed in Section 5.2 can be summarized in a visual form. Figure 11 captures the transmission mechanism that will be used to create an alterative scenario.

Figure 11: A Flow Chart of the Structural Model

Identity Equation: $\underline{GDPH} = \underline{CONS} + FH + GH + (XH\text{-}MH)$

EQ (5): $\underline{CONS} = 31.14482 + 0.7738 \bullet YPDH + 0.0303 \bullet \underline{RSMW} + 0.0829 \bullet RREW - 11.982 \bullet FCM5$

EQ (8): $\underline{\Delta RSMW} = -29.35323 + 6.512585 \bullet \Delta SP500$

Consumption (CONS), real stock market wealth (RSMW) and real gross domestic product (GDPH) are underlined in order to highlight them as endogenous to the model: all of the above are determined inside the model's framework. Conversely, the Standard and Poor's 500 index (SP500), real housing market wealth (RREW), the yield on the 5-year Treasury note (FCM5) and personal disposable income (YPDH) are exogenous variables.

For the purposes of interpretation it is useful to carry out a ceteris paribus experiment. Suppose the Standard & Poor's 500 Index is shocked, in 2000:Q3, by a negative amount of 38%[50]. This corresponds to a drop of 560 points (38% of 1,475 index points). Using Equation (5), this translates into a reduction in wealth of \$3,650 billion. Given that our estimated marginal propensity to consume out of stock market wealth is 3.03 cents per dollar of additional wealth, the reduction in consumption from such a direct effect is approximately \$110 billion. Gross

[50] This was the identical magnitude of shock imposed on the VAR model.

domestic product at the end of the third quarter of 2003 was $9,836.6 billion; if the fall in consumption is subtracted, this roughly translates into a reduction in real GDP by 1.10%. These preliminary results are, in fact consistent with an article by Cecchetti (2000), a professor of global finance, who assumes a shock in the Dow Jones Industrial Average of 25% percent – which ultimately causes a fall in GDP by 1.5 to 2 percent. The relevance of his estimation lies in the fact that he focuses solely on wealth effects and uses stock market wealth to arrive at his conclusion.

The result above is in agreement with the results of the VAR model, where similar effects on the economy were observed. In fact, from Figure 5, in the VAR section, it is evident that a large-magnitude, 38% shock to the stock market corresponds to a one-quarter reduction in real gross domestic product of just a little over 1%.

6.4. Simulation of Alternative Scenarios

Although the results above are satisfactory and in agreement with previous literature and results from previous sections in this paper, it would be of interest to create a model using our regression software that can further validate our findings.

For the purposes of this section, the equation for real stock market wealth has been modified slightly to use rate-of-growth figures, in order that a shock can be more easily implemented.

The adapted estimation of Equation 5 is provided below:

Table 10: Ordinary Least Squares of Equation 5 (1960:Q1 – 2006:Q4)

Variable	Coefficient	Standard Error	t-Statistic	Probability
C	-43.99246	22.52958	-1.952653	0.0524
SP500 (% change)	32.14453	3.668587	8.762099	0.0000
R-squared	0.293285			
Durbin-Watson stat	2.462448			

The co-efficient of the S&P 500 variable (% change) is statistically significant at the 1% level using a two-sided t-test. Also, the equation is free of serial correlation as evident from the Durbin-Watson statistic. Moreover an SP500 variable that is in rate of growth terms is free of non-stationarity issues, as evidenced from the Dickey-Fuller Unit Root test; the co-efficient of its lagged term has t-statistic of -9.789, causing us to reject the null-hypothesis of non-stationarity.[51] Relating back to the full model, the interpretation is that a 1% change (positive or negative) in the S&P 500 index causes a $32.14billion decrease in household wealth, resulting in a fall in consumption of $969.6 million.

Now that the model is setup to transmit a shock in the S&P500 (rate of growth) variable to GDP, and that it is free of detectable econometric failings, alternative scenarios can be created. The objective of this section is to definitively answer the following question: Can a shock in the stock markets cause a significant downturn in the U.S. economy?

The creation up of an alternative scenario is a technique that allows researchers to examine how the model behaves under alternative assumptions with respect to exogenous variables. One possible method of carrying out such an exercise is by directly editing the exogenous series (SP500) so that it contains the new values, then re-solving the model, in effect overwriting any existing results. The issue with this method is that it makes it awkward to

[51] Appendix Table (6) provides the output from EViews for the formal ADF test.

manage the data and compare the several sets of outcomes; it is crucial for the purposes of this paper that one is capable of making direct comparison with baseline numbers. Fortunately, EViews 5.0, the program used through out this project, allows for a more efficient method for creating alternative situations through the use of model scenarios. Under this arrangement, the exogenous variables SP500 (rate of growth), RSMW and CONS, are overridden with new values, while the values for the remainder of the variables are stored in the actual series. Following which, a new scenario is created by manually editing the SP500 (rate of growth) variable at a certain time period, for a pre-specified negative amount. The program is then instructed to use the new SP500 (rate of growth) variable to solve the model.

It is important to maximize the use of reasoning and logic when planning the magnitude of the shock and time period when it is imposed; leaving no room for arbitrariness. Fair (2000), attempts a similar task of observing the effects of shocks on the economy using a stock market variable. In his piece, the level of stock prices is assumed to fall in the desired period to a value consistent with historical experience and then to grow at a historically average rate after that.[52] Looking over quarterly stock market performance[53] in our recent history, the worst one-period quarterly decline was in 1987:Q4, when the Standard and Poor's 500 Index dipped 20.04%[54]. According to literature already discussed, another slump of this magnitude is very much in the realm of possibility. Hence, negative shocks of 20% are imposed on one-period percentage change growth in the Standard and Poor's 500 Index in both time periods. In accordance with Fair's technique (2000), the market was allowed to grow at the historical trend - a 2.04% quarter-

[52] Fair (2000, p. 7)
[53] Source: Haver Analytics Database
[54] Source: Haver Analytics Database and author's own calculations.

to-quarter rate[55]. In addition, shocks of 30%, 40% and 50% were imposed in the same manner. As implemented by Fair (2000), the rates of growth return to trend rates after the shock is imposed.

In order to observe shocks in the economy, first, two unique periods have been selected; one is a relatively normal period, where the economy grows at a healthy pace. 1997:Q1 has been chosen for this purpose (See Figure 12). The closest periods of decline are 1991:Q1 and 2000:Q3. The period 2005:Q1 has been selected as the second period to impose the shock, for the purpose of creating a control, of sorts, for the experiment. During this period, the economy was still recovering from the dot-com crash and the 9/11 shocks and was therefore more vulnerable. The shocks imposed in 2005:Q1 are illustrated in Figure 13. For a full summary of the results, see Appendix Tables 5 and 6.

In 1997, real GDP growth was extremely robust; it required a 50% shock to the stock market[56] to cause a quarterly decline in the rest of the economy of 0.20% (negative annualized rate of growth). In scenarios where the shock was any value less, the economy did not shrink. Conversely, in 2005, a one-quarter downfall in the stock market of just 20% caused an annualized decline of negative 0.22%. As expected, the 50% shock caused a decline of 2.22% — a significantly large downfall. In fact the last time the US economy shrunk by such an amount was in 1990:Q4[57]. It is interesting that the economy recovered to baseline rates of growth after two quarters. This however, is due to the specifications of the model.

[55] This rate is the quarter-to-quarter rate of growth of the S&P 500 Index from 1987:Q1 - 2004:Q4 (20 years). Source: Haver Analytics Database.
[56] This implies that if the stock market at the end of the previous quarter was 1,000 index points, it was shocked to 500 index points at the end of the quarter in focus.
[57] Source: Bureau of Economic Analysis.

Figure 12: One-Period Shock to The S&P 500 in 1998:Q1

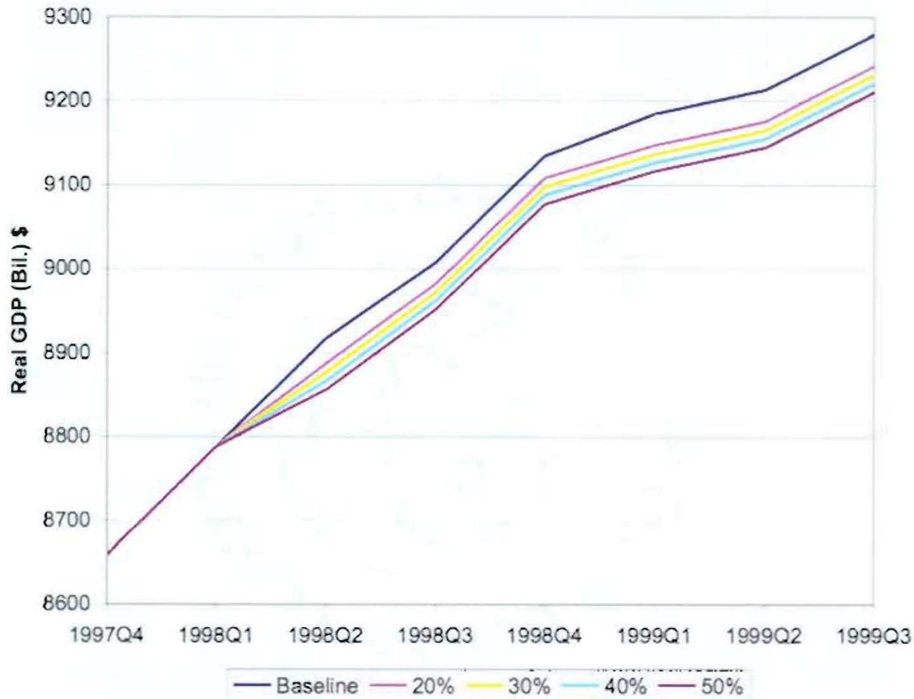
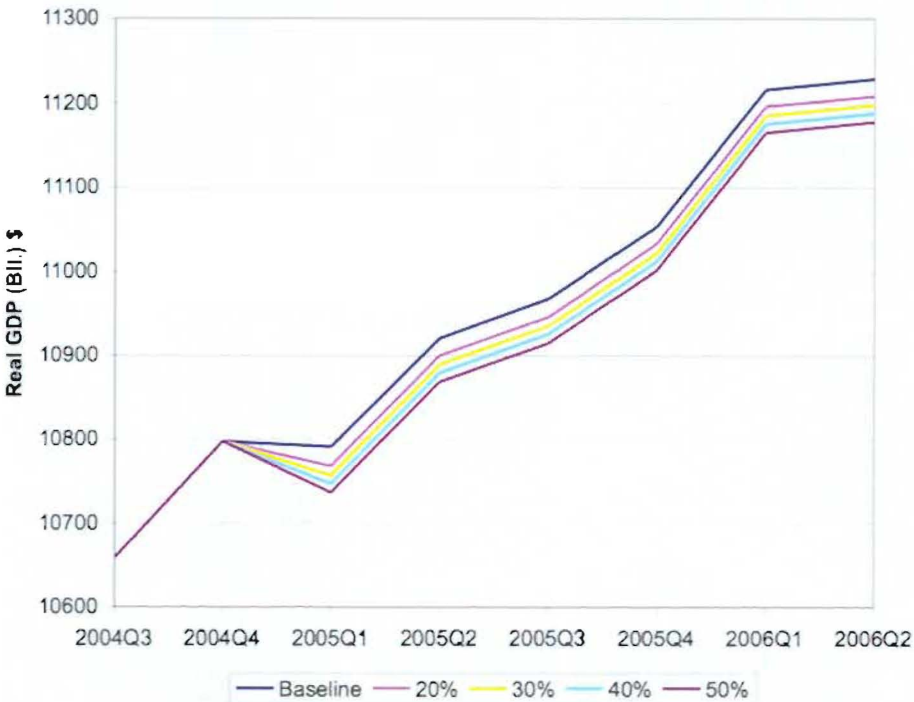


Figure 13: One-Period Shock to The S&P 500 in 2005:Q1



Source: Haver Analytics Database and author's own calculations

The results here too are consistent with the results from the VAR model in the fact that growth rates converge after a certain number of quarters. However, the time taken for this convergence to occur differs in both models. It takes approximately six quarters to return to trend levels of real GDP growth in the VAR model, while it takes the economy two quarters to accomplish the same in the structural model. Moreover, the output lost to the economy from the shock is a dead-weight loss, as it is never recovered. This is observable from the fact that real GDP projections in the alternative scenarios do not get progressively closer to the baseline level.

The muted response of real GDP in 1998 was not unique to that period; it was by far the most common response observed when the shocks were implemented in other periods. Table 11, on the following page, is a depiction of the response of real GDP to a 30% shock in the S&P 500 index, implemented in a manner described above. Note again that 30% is a historically abnormal shock, when considering the rise and fall of the S&P 500 index in the recent past. Nonetheless, the shock is implemented in the first quarter of every year since 1990. So, for instance, in 1990:Q1 the S&P 500 index rate of growth was reduced by 20%, following which, it was allowed to grow in the remaining quarters at a quarter-to-quarter rate of 2.04%. The result, as expected, was a lower level of GDP than would have been with out the shock; regardless, the new level was not lower than 1989:Q4. Hence, the annualized quarter-to-quarter rate of growth remained positive at 2.22%. This phenomenon was observed for most of the time periods between 1990 and 2006.

Table 11: Response of GDP to a 30% Shock in the S&P 500 Index (1990–2006)

Period	Change in GDP rate of growth[58]
1990:Q1	2.22%
1991:Q1	-0.96%
1992:Q1	4.11%
1993:Q1	-7.22%
1994:Q1	-4.77%
1995:Q1	1.61%
1996:Q1	5.81%
1997:Q1	2.72%
1998:Q1	4.23%
1999:Q1	0.05%
2000:Q1	3.84%
2001:Q1	0.50%
2002:Q1	4.56%
2003:Q1	0.13%
2004:Q1	0.95%
2005:Q1	-1.46%
2006:Q1	4.69%

Source: Author's Own Calculations

In summary, the overall resilience of the economy is depicted by the fact that negative growth occurred only in 1991:Q1, 1993:Q1, 1994:Q1 and 2005:Q1.

Another interesting finding was discovered when normal shocks of 20% were imposed on different time periods. The already discussed Economist article (1998)[59] is just one of many sources citing the possibility of a "bubble" bursting when stock markets have high price/earnings ratios (an indication of overpricing). The hypothesis that shocking the market during such periods causes a greater loss to output is tested below. Table 12, on the following page, offers some evidence to this theory.

[58] Annualized, quarter-to-quarter percentage change in GDP. (Measured relative to Q4 of previous period).
[59] Source: Economist Article, "America's Bubble Economy." (1998, p. 15 – 16)

Table 12: Response of real GDP (billions of dollars) to 20% shock during 1999:Q2, 2003:Q3 and 2005:Q2[60]:

Period	Baseline	20% shock	Decline in real GDP		Historical
	Level	*Level*	*Amount*	*As % of Baseline*	**Market P/E Ratio[61]**
1999:Q2	9223.502	9250.058	26.556	0.29%	32.6 (High)
2003:Q3	10332.12	10359.76	27.64	0.27%	25.8 (Med)
2005:Q2	10900.32	10920.16	19.84	0.18%	18.6 (Low)

Essentially, a 20% shock was imposed on three periods with highly contrasting market PE ratios. In 1992:Q2 when the PE ratio of the market was significantly above average market PE (which stands at 22.15[62]), the loss in gross domestic product through a reduction in consumption is $26.6 billion (0.29% of baseline for that quarter). Similarly, for 2005:Q2, when the PE ratio was significantly lower than average, the loss to real GDP, although it might have led to a negative growth, was only 0.18% lower than baseline real GDP. As one might expect, the results were in-between the former two for the 2003:Q3 period when the market PE ratio was slightly above average at 25.8. Given the small sample used, such results might not appear conclusive; however, evidence does point to consumers cutting back on spending by a greater percentage when markets are overpriced by historical standards.

The amount of negative economic growth caused by a shock in the stock market, as suggested by Cecchetti (2000), is highly dependent on how much consumers get used a certain level of spending prior to a crash; this is relevant for market boom periods when equities tend to be overvalued. If consumers do not increase consumption by a significant amount as stock market wealth rises in a boom period, then when the market crashes, the negative impact on total spending in the economy is smaller.

[60] Source: Haver Analytics and author's Own Calculations
[61] This is an index weighted Standard & Poor's 500 price/earnings ratio.
[62] 22.15 is the average market PE ratio from 1987:Q1 - 2006:Q4 (20 years).

6.5. Conclusions from the Structural Model

Overall, the additional insight from a theoretical model has led us to a very similar result as obtained from the VAR model. Although the stock market wealth effect does exist, the effect it has on aggregate consumption and gross domestic product is weak. The marginal propensity to consume out of stock market wealth has a contemporaneous effect of increasing spending in the same time period and has been found 3.03%. In dollar terms, an additional dollar of stock market wealth increases consumption by 3.03 cents. The implication is that an additional dollar of stock market wealth translates into an additional 3.03 cents in spending in the same period. The result is in between results found by Ludvigson and Steindel (1999) and Laurence H. Meyer and Associates (1994).

The addition of the alternative scenarios to the analysis has successfully corroborated the findings above. The economy is resilient to shocks from the stock market's direct wealth effect. It required over 50% of a shock to the stock market index in order to cause negative growth in the economy during a period of stable growth (1997Q1). When shocks of a historically abnormal amount were imposed on every year of the economy since 1990, only four out of the sixteen periods experienced any negative growth. Further analysis was carried out to illustrate the theory that an overpriced stock market causes the economy to be more vulnerable to shocks. The findings are consistent with the claims of the Economist article (1998) and Cecchetti's (2000) theory, "[when the market is 20% overvalued] If people have adjusted their consumption level to their new wealth, then a drop in the value of wealth could be catastrophic.[63]"

[63] Cecchetti (2000)

7. Final Conclusions

The foregoing analysis aimed to analyze the potential effect of a downturn in the stock market on the wider economy by the creation of two unique models. The major finding is that the economy is resilient to shocks from the stock market; therefore a recession is unlikely to occur from a normal-sized shock to the market through a wealth effect. The first model used to defend this claim is an atheoretical, vector autoregressive model that successfully illustrates the existence of a transmission mechanism between the stock market index and real gross domestic product; while it also hints at the resilience of the wider economy to shocks in the stock market. The results are consistent with previous research done by Ludvigson and Steindel (1999).

Next, theory from life cycle model of consumption was used to create a structural model that essentially related a stock market index (the Standard and Poor's 500 index) to real gross domestic product. Two equations were estimated, a consumption equation, and, a stock market wealth equation. The former was added to an identity equation for GDP. The results confirm that the stock market wealth effect in the short term is approximately 3.03 cents of additional consumption out of a dollar. A scenario where a specified one-period decline was fed through the model showed results that were consistent with previous research by Cecchetti (2000). Overall, the conclusions from both models are consistent with Ludvigson and Steindel (1999) and Case, Quigley and Shiller (2005) and Starr (1998), amongst others, who contend that the stock market effect is small but important to consider.

Methodically created alternative scenarios provided justification for the muted stock market effect observed. Even during less stable periods of growth, a shock of up to 50% to the stock markets was required to induce negative growth. These results are also compatible with the historical experience of the 1987:Q4 stock market crash when the U.S. economy grew at an

annualized rate of 7%[64]. This result was further corroborated by the fact that 30% shocks imposed on the first quarter of every year between 1990 and 2006 caused negative growth in only four of the sixteen periods. Additionally, it was found that GDP contracted by a larger amount, relative to baseline growth, when a historically overpriced stock market was shocked as compared to a fairly valued market.

There are several reasons why a muted stock market effect might be observed. While it must be remembered that the intention of this paper is to analyze direct stock market wealth effects, leaving the expectations effect aside,[65] Poterba (2000) along with Starr-McCluer (1998) provide most appealing reason for a muted direct wealth effect from the stock market. They claim that the distribution of wealth amongst households in the US is skewed greatly towards high-income individuals. The fact that these individuals account for majority of consumer expenditures makes for a good argument.[66] A recent article in the New York Times, titled "Despite Tough Times, Ultra Rich Keep Spending," evidences this claim.[67] Moreover, many foreign nationals own stocks listed on the NASDAQ and NYSE, thus causing a more international wealth effect.

The analysis above, employing shocks to the stock market in econometric models, is an area of wealth effects that have not been previously explored in great detail. At a time in US economic history when some economists are predicting negative consumer spending for the first time since 1990, the mechanisms and processes used can be put to further use by carrying out similar experiments on other forms of wealth, namely housing market wealth. Additionally, the

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64 Source: Haver Analytics Database.

65 As mentioned, simultaneity problems combined with econometric issues increase the difficulty of quantifying the indirect effects.

66 Source: <http://www.bls.gov/cex/csxann05.pdf>

67 The article discusses exuberant spending by America's rich during a time when the economy is believed to be in a recessionary phase.
Source: <http://www.nytimes.com/2008/04/14/nyregion/14partying.html?_r=3&pagewanted=2&hp&oref=slogin>

model can be used to replicate the stock market crash of 2000-2001 to investigate whether the economy contracted more due to a stock market wealth effect or for other reasons.

On a final note, it is important to think about how, from a policy perspective, the impact of a shock to equity markets can be minimized. Special provisions have already been put in place to prevent the severity of a shock. For instance, the market will halt trading for an hour if the Dow drops 10% before 2 pm and trading is paused for the entire day if the Dow-Jones Industrial Average falls over 30%.[68] Nonetheless, according to an interview with Richard Sylla, a professor of the history of financial institutions and markets, a drop like the one that occurred on the Black Monday "can happen again."[69] However, the intensity and severity of the crash depends who's running the central bank and how quick they are to react.

[68] Source: <http://stocks.about.com/od/whatmovesthemarket/a/crash102904.htm>
[69] Interview conducted by Lobb, Annelena.

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9.1. Appendix Tables

Table 1: VAR Model Using Levels

	GDPH	CONS	YPDH	EMW	NEMW	S&P500
GDPH(-1)	0.853337	0.013288	0.100573	1.457521	1.293408	0.127279
	(0.07959)	(0.04520)	(0.07846)	(0.67203)	(0.59721)	(0.05263)
	[10.7211]	[0.29395]	[1.28178]	[2.16883]	[2.16576]	[2.41859]
GDPH(-2)	-0.022017	-0.096984	-0.082326	-0.168230	-0.684689	-0.047961
	(0.07974)	(0.04529)	(0.07861)	(0.67328)	(0.59832)	(0.05272)
	[-0.27610]	[-2.14148]	[-1.04728]	[-0.24987]	[-1.14436]	[-0.90967]
CONS(-1)	0.734308	0.947977	0.398458	0.841931	1.266697	-0.080059
	(0.15073)	(0.08560)	(0.14859)	(1.27264)	(1.13094)	(0.09966)
	[4.87169]	[11.0739]	[2.68161]	[0.66156]	[1.12004]	[-0.80333]
CONS(-2)	-0.484552	0.088801	-0.355405	-1.221293	-0.835765	0.046732
	(0.15367)	(0.08727)	(0.15149)	(1.29746)	(1.15300)	(0.10160)
	[-3.15322]	[1.01750]	[-2.34612]	[-0.94130]	[-0.72488]	[0.45995]
YPDH(-1)	0.141364	0.146868	0.630687	-0.604903	-0.739784	-0.065896
	(0.07049)	(0.04003)	(0.06949)	(0.59518)	(0.52891)	(0.04661)
	[2.00539]	[3.66903]	[9.07582]	[-1.01634]	[-1.39870]	[-1.41386]
YPDH(-2)	-0.154458	-0.074800	0.298679	-0.364278	-0.208311	-0.014316
	(0.07303)	(0.04148)	(0.07200)	(0.61664)	(0.54798)	(0.04829)
	[-2.11486]	[-1.80335]	[4.14848]	[-0.59074]	[-0.38014]	[-0.29646]
EMW(-1)	0.025783	0.027022	0.030183	0.971505	-0.088538	0.017363
	(0.01458)	(0.00828)	(0.01437)	(0.12308)	(0.10937)	(0.00964)
	[1.76877]	[3.26399]	[2.10044]	[7.89346]	[-0.80950]	[1.80152]
EMW(-2)	-0.001385	-0.018768	-0.019583	-0.155769	-0.014252	-0.018841
	(0.01454)	(0.00826)	(0.01433)	(0.12273)	(0.10907)	(0.00961)
	[-0.09529]	[-2.27340]	[-1.36658]	[-1.26916]	[-0.13067]	[-1.96031]
NEMW(-1)	-0.016538	-0.008160	0.029561	-0.365868	1.011448	0.023869
	(0.01761)	(0.01000)	(0.01736)	(0.14873)	(0.13217)	(0.01165)
	[-0.93887]	[-0.81564]	[1.70237]	[-2.46001]	[7.65283]	[2.04947]
NEMW(-2)	0.020865	0.009446	-0.025975	0.287194	-0.052085	-0.020496
	(0.01742)	(0.00990)	(0.01718)	(0.14712)	(0.13074)	(0.01152)
	[1.19746]	[0.95439]	[-1.51219]	[1.95214]	[-0.39840]	[-1.77910]
S&P500(-1)	0.177711	0.040830	-0.319166	2.704395	0.016235	1.066071
	(0.14384)	(0.08169)	(0.14180)	(1.21451)	(1.07929)	(0.09511)
	[1.23544]	[0.49980]	[-2.25078]	[2.22673]	[0.01504]	[11.2093]
S&P500(-2)	-0.371895	-0.045881	0.233451	-2.006924	0.223154	-0.105483
	(0.12956)	(0.07358)	(0.12772)	(1.09390)	(0.97210)	(0.08566)
	[-2.87046]	[-0.62355]	[1.82784]	[-1.83465]	[0.22956]	[-1.23140]
C	3.925387	16.50424	-10.79674	-118.0223	-71.57494	-26.78091
	(14.3297)	(8.13833)	(14.1263)	(120.989)	(107.518)	(9.47441)
	[0.27393]	[2.02796]	[-0.76430]	[-0.97548]	[-0.66570]	[-2.82666]
R-squared	0.999829	0.999893	0.999707	0.974774	0.999281	0.996744
Adj. R-squared	0.999819	0.999887	0.999690	0.973297	0.999239	0.996554
Sum sq. resids	276271.9	89110.75	268481.6	19694834	15553237	120771.5
S.E. equation	36.71059	20.84914	36.18931	309.9554	275.4441	24.27198
F-statistic	99630.14	159644.9	58294.73	660.1234	23756.72	6229.932
Log likelihood	-1088.095	-964.7609	-1084.977	-1553.168	-1527.435	-997.8991
Akaike AIC	10.10179	8.970263	10.07319	14.36851	14.13243	9.274304
Schwarz SC	10.30362	9.172111	10.27501	14.57034	14.33426	9.476131
Mean dependent	5595.274	3755.360	4137.038	2924.281	17413.42	345.1848
S.D. dependent	2725.115	1959.069	2055.035	1696.796	9987.196	413.4492

Determinant resid covariance (dof adj.)	1.98E+20
Determinant resid covariance	1.37E+20
Log likelihood	-6909.822
Akaike information criterion	64.10846
Schwarz criterion	65.31942

Table 2: OLS Estimation of Equation (5):

Dependent Variable: CONS
Method: Least Squares
Date: 04/12/08 Time: 21:59
Sample: 1960Q1 2006Q4
Included observations: 188

	Coefficient	Std. Error	t-Statistic	Prob.
C	9.628498	14.17400	0.679307	0.4978
Disposable Personal Income	0.810935	0.010689	75.86285	0.0000
Stock Market Wealth	0.032243	0.003277	9.840674	0.0000
Real Estate Wealth	0.064800	0.004682	13.83890	0.0000
5-Year Treasury Yield	-16.40158	1.729054	-9.485869	0.0000

R-squared	0.999419	Mean dependent var	4131.873
Adjusted R-squared	0.999406	S.D. dependent var	1848.322
S.E. of regression	45.04784	Akaike info criterion	10.47956
Sum squared resid	371363.4	Schwarz criterion	10.56564
Log likelihood	-980.0789	Hannan-Quinn criter.	10.51444
F-statistic	78656.83	Durbin-Watson stat	0.755375
Prob(F-statistic)	0.000000		

Source: Haver Analytics and EViews 5.0.

Table 3: GLS Estimation of Equation (5):

Dependent Variable: CONS
Method: Least Squares
Sample (adjusted): 1960Q2 2006Q4
Included observations: 187 after adjustments
Convergence achieved after 26 iterations

	Coefficient	Std. Error	t-Statistic	Prob.
C	31.14482	36.22239	0.859822	0.3910
Disposable Personal Income	0.773801	0.022709	34.07431	0.0000
Stock Market Wealth	0.030325	0.005996	5.057839	0.0000
Real Estate Wealth	0.082900	0.010124	8.188159	0.0000
5-Year Treasury Yield	-11.98222	3.280437	-3.652630	0.0003
AR(1)	0.702967	0.057006	12.33156	0.0000

R-squared	0.999648	Mean dependent var	4145.490
Adjusted R-squared	0.999639	S.D. dependent var	1843.805
S.E. of regression	35.04716	Akaike info criterion	9.982826
Sum squared resid	222322.9	Schwarz criterion	10.08650
Log likelihood	-927.3942	Hannan-Quinn criter.	10.02483
F-statistic	102923.5	Durbin-Watson stat	2.367040
Prob(F-statistic)	0.000000		

Inverted AR Roots	.70

Source: Haver Analytics and EViews 5.0.

Table 4: Correlation Matrix of Variables in Equation (5[70]):

		CONS	YPDH	FCM5	SMW	REW	OTHERW
Personal Consumption:	**CONS**	1.00	1.00	-0.17	0.73	0.98	0.99
Disposable Pers. Income:	**YPDH**	1.00	1.00	-0.13	0.71	0.97	0.99
5-Yr Treasury Yield:	**FCM5**	-0.17	-0.13	1.00	-0.42	-0.20	-0.16
Stock Market Wealth:	**SMW**	0.73	0.71	-0.42	1.00	0.65	0.77
Real Estate Wealth:	**REW**	0.98	0.97	-0.20	0.65	1.00	0.97
Other Wealth:	**OTHERW**	0.99	0.99	-0.16	0.77	0.97	1.00

Conclusion: High correlations are observed between ROTHERW and CONS, YPDH, RREW.

[70] All figures used are real (adjusted to 2000).

Table 5: Responses of Real GDP (Bil. $) to Varying Shocks to SP500ROG in 1997:Q1

Period	Baseline Real GDP		Real GDP, 20% shock		Real GDP after 30% shock		Real GDP after 40% shock		Real GDP after 50% shock	
	Level	AROG	Level	AROG	Level	AROG	Level	AROG	Level	AROG
1996Q1	8122.71		8122.71		8122.71		8122.71		8122.71	
1996Q2	8203.08	4.02%	8203.08	4.02%	8203.08	4.02%	8203.08	4.02%	8203.08	4.02%
1996Q3	8246.29	2.12%	8246.29	2.12%	8246.29	2.12%	8246.29	2.12%	8246.29	2.12%
1996Q4	8363.48	5.81%	8363.48	5.81%	8363.48	5.81%	8363.48	5.81%	8363.48	5.81%
1997Q1	8419.68	2.72%	8390.57	1.30%	8380.21	0.80%	8369.84	0.30%	8359.48	-0.19%
1997Q2	8507.06	4.22%	8477.95	4.23%	8467.58	4.24%	8457.22	4.24%	8446.86	4.25%
1997Q3	8624.46	5.64%	8595.35	5.66%	8584.99	5.66%	8574.62	5.67%	8564.26	5.68%
1997Q4	8695.75	3.35%	8666.63	3.36%	8656.27	3.36%	8645.90	3.37%	8635.54	3.37%
1998Q1	8825.11	6.08%	8795.99	6.11%	8785.63	6.11%	8775.26	6.12%	8764.90	6.13%
1998Q2	8953.76	5.96%	8924.65	5.98%	8914.28	5.99%	8903.92	5.99%	8893.56	6.00%
1998Q3	9044.41	4.11%	9015.29	4.13%	9004.93	4.13%	8994.57	4.13%	8984.20	4.14%
1998Q4	9172.39	5.78%	9143.28	5.80%	9132.91	5.81%	9122.55	5.81%	9112.18	5.82%

Source: Haver Analytics and Author's Own Calculations

Table 6: Responses of Real GDP (Bil. $) to Varying Shocks to SP500ROG in 2005:Q1

Period	Baseline Real GDP		Real GDP after 20% shock		Real GDP after 30% shock		Real GDP after 40% shock		Real GDP after 50% shock	
	Level	AROG	Level	AROG	Level	AROG	Level	AROG	Level	AROG
2004Q1	10493.39		10493.39		10493.39		10493.39		10493.39	
2004Q2	10550.98	2.21%	10550.98	2.21%	10550.98	2.21%	10550.98	2.21%	10550.98	2.21%
2004Q3	10657.95	4.12%	10657.95	4.12%	10657.95	4.12%	10657.95	4.12%	10657.95	4.12%
2004Q4	10796.6	5.31%	10796.6	5.31%	10796.6	5.31%	10796.6	5.31%	10796.6	5.31%
2005Q1	10790.78	-0.22%	10767.38	-1.08%	10757.02	-1.46%	10746.65	-1.84%	10736.29	-2.22%
2005Q2	10920.16	4.88%	10896.76	4.89%	10886.39	4.90%	10876.03	4.90%	10865.67	4.91%
2005Q3	10967.91	1.76%	10944.51	1.76%	10934.15	1.77%	10923.78	1.77%	10913.42	1.77%
2005Q4	11053.77	3.17%	11030.38	3.18%	11020.01	3.18%	11009.65	3.18%	10999.29	3.18%
2006Q1	11216.68	6.03%	11193.28	6.04%	11182.92	6.05%	11172.55	6.05%	11162.19	6.06%
2006Q2	11229.45	0.46%	11206.05	0.46%	11195.69	0.46%	11185.32	0.46%	11174.96	0.46%
2006Q3	11238.72	0.33%	11215.33	0.33%	11204.96	0.33%	11194.6	0.33%	11184.23	0.33%
2006Q4	11386.33	5.36%	11362.94	5.37%	11352.57	5.37%	11342.21	5.38%	11331.84	5.38%

Source: Haver Analytics and Author's Own Calculations

Table 7: Augmented Dickey Fuller Test Statistic for RSMWROG

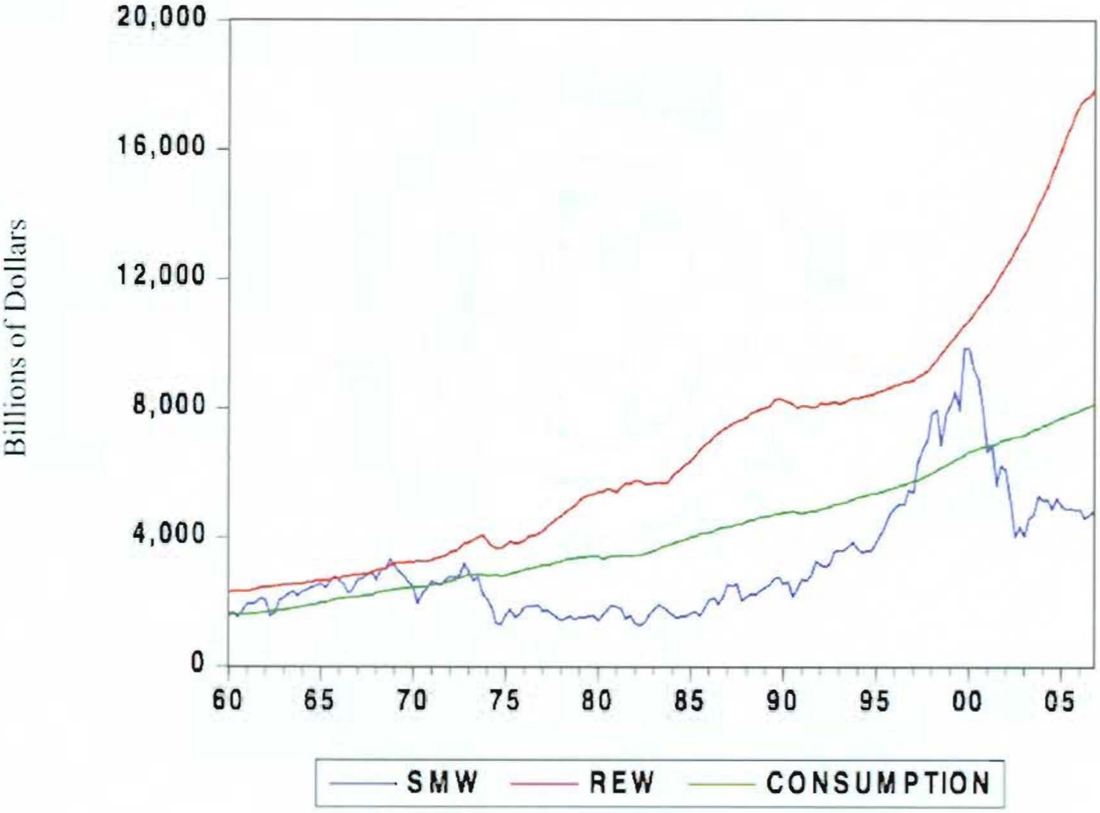
Variable	t-Statistic	Critical t-statistics	
		1% level	-3.465977
RSMWROG	-9.788832	5% level	-2.877099
		10% level	-2.575143

Source: Eviews 5.0[71]

[71] The number of lags was estimated automatically by Eviews 4.1 based on the Akaike Information Criteria with the maximum allowed lag being 14

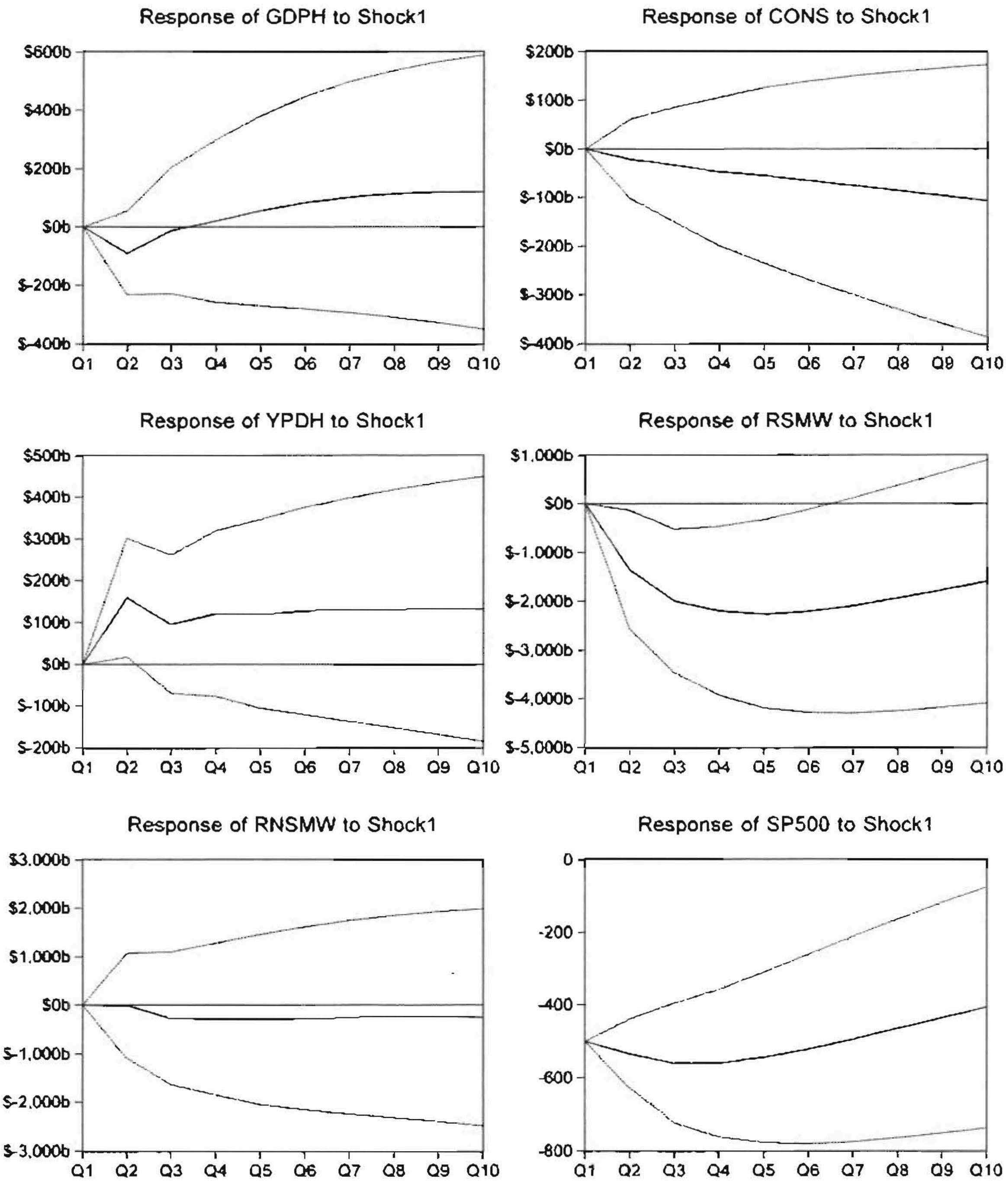
9.2. Appendix Figures

Figure 1: Aggregate Consumption, Real Estate Wealth and Stock Market Wealth (1960 – 2007)



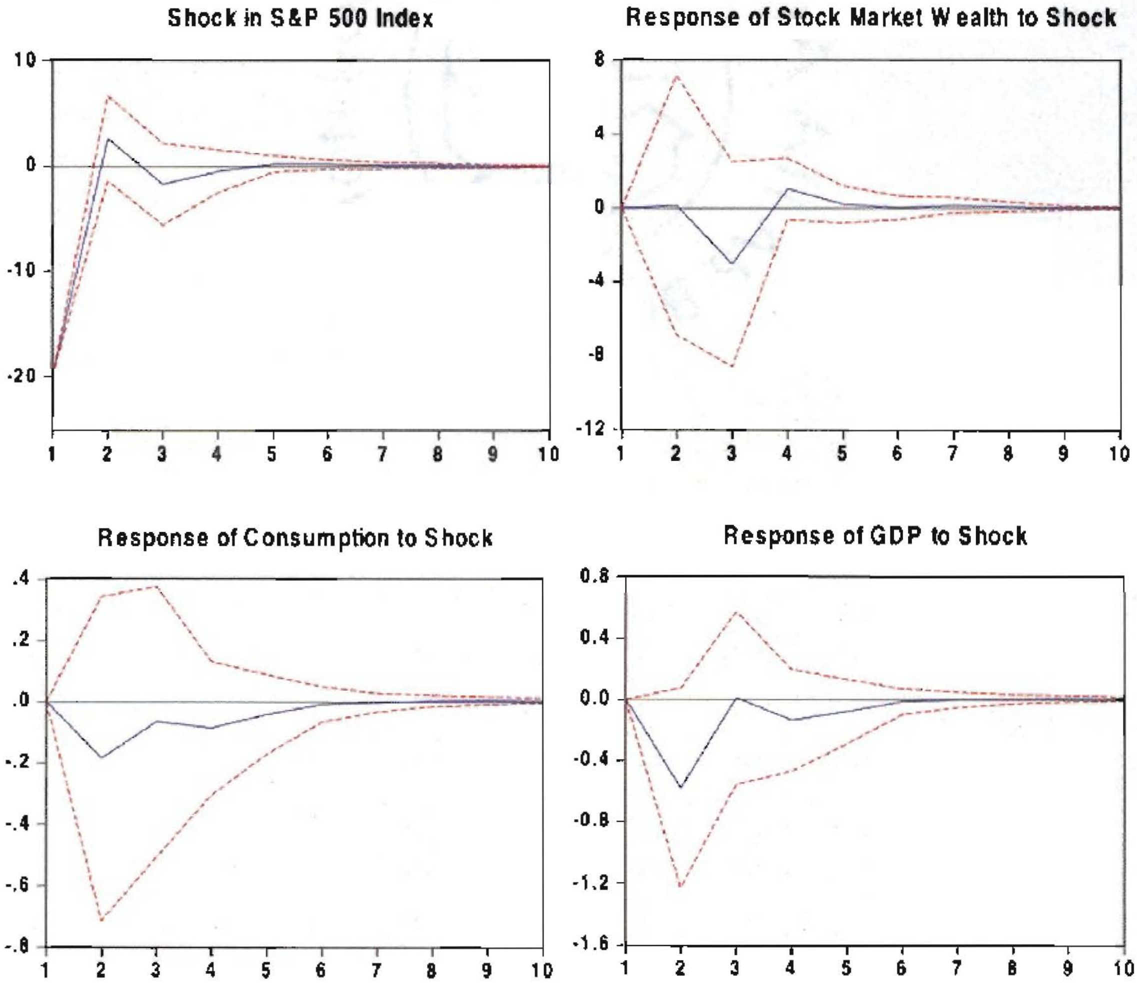
Source: Haver Analytics Database

Appendix Figure 2: Impulse Response Using Absolute Figures[72]
Shock Value = 500 points (38%)



72 Note that the shock to SP500 is 500 points, roughly 38.5% of 1,400 (2007:Q1 value).

Figure 3: Impulse Response Using Average Rate of Growth Figures[73]:
Shock Value = 20% on rate of growth



73 Shock to SP500 is of the magnitude 38.5% of 2007:Q1 value.

Figure 4:
Graph Relating Standard & Poor's 500 to Real Stock Market Wealth