An Analysis of Several Factors Affecting the U.S. Dollar Index[*]

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Abstract

US dollar is generally regarded as the national financial strategy carrier of the United States. As the main settlement currency in international trade and the most important currency reserve, the trend of US dollar will have significant effect on the global economy. Review of the trend of exchange rate of US dollar in every previous global economic crisis, we found that great appreciation or depreciation of the US dollar index all corresponded to upgradation or degradation of the world economy.   In our study, the composition of S&P 500 is discussed as the main point by using econometric models with the software Eviews to find the origination. According to S&P 500 industry classification standards, we took S&P 500 index as the US macroeconomic indicators, and the industry index as the economic status of the each sector of US to find the correlation between US dollar index and US economic strength. The same to the relationships among each sector index and the dollar index, we also established models to reflect these correlations. Meanwhile interest rate as a core indicator also be analyzed. In addition, the key factor "capital flows" having great influence on US dollar index will also be explained.

Key Words: S&P 500 Index, US Dollar Index, the Negative Correlation, Econometric Model

1. Importance and background of study

US dollar is generally regarded as the national financial strategy carrier of the United States. As the main settlement currency in international trade and the most important currency reserve, the trend of US dollar will have significant effect on the global economy. Review of the trend of exchange rate of US dollar in every previous global economic crisis, we found that great appreciation or depreciation of the US dollar index all corresponded to upgradation or degradation of the world economy. Through the study of us, we found there are two reasons in

common:

First, the hedge fund treated US dollar as a safe harbor. Because of the security and high liquidity of US dollar, there is no doubt whenever and whoever ,of course including individuals, investment institutions and government monetary authorities, are more willing to hold US dollar assets than other currencies. The government authorities of the United States want to improve the imbalance of US dollar through turning large amounts of global financial assets into the United States' short-term national debt, and at the same time this also prompts the appreciation of US dollar.

Second, the appreciation of US dollar is supported by the forceful capabilities of US. The most previous global economic crises first broke out from the United States, and then diffused to the world. Always for the forceful capabilities of US, the negative influences on the United States' economy brought about by these crises were always smaller than the influences on others, and these might bring about currency crisis. As a result, the leader role of US would be further consolidated and reinforced.

Figure 1: 6-Mth rolling Correlation of the Daily % Change of S&P 500 and US Dollar

Source: http://bespokeinvest.typepad.com/bespoke/currencies/
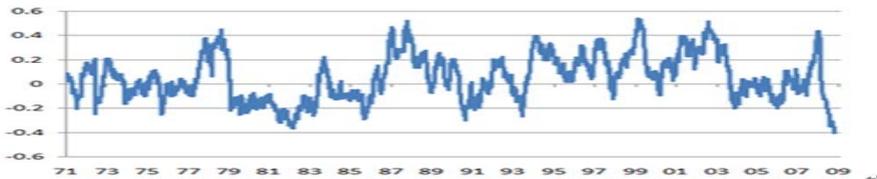
So far, there are some research about how the appreciation or depreciation of US dollar index affects the US economy. In the work of "Chained-Dollar Indexes", by J. Steven Landefeld, Brent R. Moulton, and Cindy M. Vojtech(2003), the correlation between US dollar index and GDP of US was analyzed. In the work of Gordon Platt's "Dollar Stays strong, But Yen Tumbles"(2009), the linkage among several main currencies was analyzed. Juan A. Lafuente-Luengo (2009), in the work of "Intraday realised volatility relationships between the S&P 500 spot and futures market", the correlation analysis to the spot market and futures market was been done. Paul D. Cretien (2009), in the paper of "Currencies, eurodollars, silver and gold: Not your average relationship", his research is about the relevance among US dollar index, eurodollars, gold and silver. In our study, the composition of S&P 500 is discussed as the main point by using econometric models with the software Eviews to find the origination. According to S&P 500 industry classification standards, we took S&P 500 index as the US macroeconomic indicators, and the industry index as the economic status of the each sector of US to find the correlation between US dollar index and US economic strength. The same to the relationships among each sector index and the dollar index, we also established models to reflect these correlations. Meanwhile interest rate as a core indicator also be analyzed. In addition, the key factor "capital flows" having great influence on US dollar index will also be
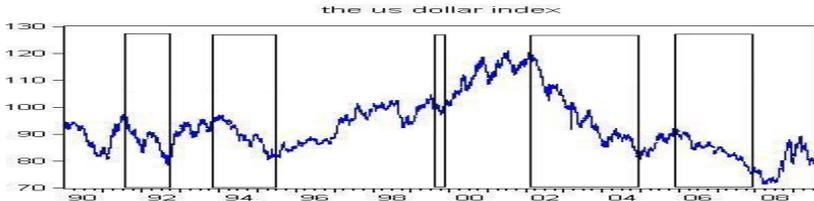
explained.

2. The related data collection and literatures review

2.1 Data collection

2.1.1 US dollar index

Figure 2: The US dollar index from 1990s to 2009s. [1]

The US Dollar Index (USDX)[2] is an Index or measure of the value of the United States dollar relative to a Market basket of foreign currencies. It is a weighted geometric mean of the dollar's value compared to the Euro (EUR), Japanese yen (JPY), Pound sterling (GBP), Canadian dollar (CAD), Swedish krona (SEK) and Swiss franc (CHF).

It was started in March 1973, soon after the dismantling of the Bretton Woods system. At that time, the value of the Dollar Index was 100.000 and has since traded as high as the mid-160s but also into the low 70s.

2.1.2 S&P 500 industries composite and data classification

Firms in S&P 500 are divided into ten broad sectors according to the Global Industrial Classification Standard (see: Table 1), including Energy, Materials, Industrials, Consumer Staples, Consumer Discretionary, Health Care, Financials, Information Technology, Telecommunications Services and Utilities. If it continues, ten broad sectors can be divided into many subsidiary sectors (see: Appendix).

We collected these related data from 1st, Jan 1990 to 21st, July 2009 for each trading day.

Table 1: S&P 500 Global Industry Classification Standard (GICS) Sectors As of June 30, 2009

Sectors	Number of cos.	% of market Capitalization
Consumer Discretionary	81	9.0%
Consumer Staples	41	12.0%
Energy	40	12.4%
Financials	80	13.6%

Health Care	53	14.0%
Industrials[3]	58	9.9%
Information Technology	74	18.3%
Materials	28	3.2%
Telecommunication Services	10	3.5%
Utilities	35	4.1%
Industrials (composite)[4]	375	80.3%

Source: http://www2.standardandpoors.com/

2.2 Literatures review

In the work of "Chained-Dollar Indexes", by J. Steven Landefeld, Brent R. Moulton, and Cindy M. Vojtech(2003), the correlation between US dollar index and GDP of US was analyzed. In the work of Gordon Platt's "Dollar Stays strong, But Yen Tumbles"(2009), the linkage among several main currencies was analyzed. Juan A. Lafuente-Luengo(2009), in the work of "Intraday realised volatility relationships between the S&P 500 spot and futures market", the correlation analysis to the spot market and futures market was been done. Paul D. Cretien (2009), in the paper of "Currencies, eurodollars, silver and gold: Not your average relationship", his research is about the relevance among US dollar index, eurodollars, gold and silver. These models were all built on the causal relations, following with these established models, we established our model as follows:

In accordance with causality, we took the US dollar index as the cause. First, the rising or falling of US dollar index will have a direct impact on the import and export of the US domestic industry. second, S&P 500 can represent the US' economic strength, and is also a indicator reflecting economic status. So we believe the US dollar index is an important factor that affects the S&P 500.

At the same time, I think this causal relationship is not entirely fixed. In my mind, the economic strength of US listed companies can affect the U.S. dollar index too. If the domestic industry develops rapidly, it will inevitably bring US dollar index up.

According to my own assumptions, I established two kinds of causal models as follows:

Under the least squares principle to establish regression function, the following two models are used to test the effect of US dollar index to S&P 500：

（1）S&P 500 is regarded as the variable and US dollar index is the independent variable. We establish the regression equation:

$$S_t = C_0 + C_1 D_t + \varepsilon_t$$ -------------------------------------- （1）5

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[3] S&P 500 Industrials Sector is part of the Global Industry Classification standard (GICS).

[4] S&P 500 Industrials composite is a continuation of the Industrials that have been published by Standard & Poor's for over 40 years, and is provided in recognition of the fact that it is used by analysts and has a long history. It is not the same as the GICS Industrials Sector.

(Here, St: S&P 500 in time t, C: constants; Parameter of regression equation: Dt: US dollar index in time t, εt: random error)

⑵ Using the data of ten sectors in the past 20years, we establish the regression equation to test the effect of US dollar index to the indexes of ten board sectors:

$$ES_t = C_0 + C_1 D_t + \varepsilon_t$$ -- ⑵

(Here, ESt: the index of the each sector including Energy, Materials, Industrials, Consumer Staples, Consumer Discretionary, Health Care, Financials, Information Technology, Telecommunications Services and Utilities in time t, C: constants; Parameter of regression equation: Dt: US dollar index in time t, εt: random error)

⑶ With the data of the subsidiary sectors, we establish the regression equation to test the effect of the index of each subsidiary sector to US dollar index:

$$ESS_t = C_0 + C_1 D_t + \varepsilon_t$$ --------------------------------------- ⑶

(Here, ESSt: each subsidiary industry sector index in time t, Dt: US dollar index in time t, C: constants; Parameters of regression equation:, εt: random error)

The following three models are used to test the effect of S&P 500 to US dollar index with the US dollar index as the variable:

⑷ We establish the regression equation with the S&P 500 as the independent variable:

$$D_t = C_0 + C_1 S_t + \varepsilon_t$$ -- ⑷

(Here, Dt: US dollar index in time t, C: constants; Parameter of regression equation: St: S&P 500 in time t, εt: random error)

⑸ According to the Global Industrial Classification Standard, we can also establish the multiple and regression equation with ten broad sectors to test the effect of each sector to US dollar index:

$$D_t = C_0 + C_1 E_t + C_2 MAT_t + C_3 IND_t + C_4 CD_t + C_5 CS_t + C_6 H_t + C_7 F_t + C_8 INF_t + C_9 TEL_t + C_{10} U_t + \varepsilon_t$$

---(5)

(Here, Dt: US dollar index in time t, C: constants; Parameters of regression equation: Et: Energy sector index in time t, MATt: Materials sector index in time t, INDt: Industrials sector index in time t, CDt: Consumer Discretionary sector index in time t, CSt: Consumer Staples sector index in time t, Ht: Health Care sector index in time t, Ft: Financials sector index in time t, INFt: Information Technology sector index in time t, TELt: Telecommunications Services sector index in time t, Ut: Utilities sector index in time t, εt: random error)

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[5] Refer to the work of "Chained-Dollar Indexes", by J. Steven Landefeld, Brent R. Moulton, and Cindy M. Vojtech(2003).

$$D_t = C_0 + C_1 ES_t + \varepsilon_t$$ -- （6）

(Here, Parameter of regression equation: Dt: US dollar index in time t; ESt: the index of the each sector including Energy, Materials, Industrials, Consumer Staples, Consumer Discretionary, Health Care, Financials, Information Technology, Telecommunications Services and Utilities in time t, C: constants, εt: random error)

Theoretically speaking, we put all sector's indices into one equation, so that we can not only get their impacts on the dollar index, but also the interaction among them would be also easily observed. On the contrary, in the equation 6, we may only separately get the affecting coefficients. Therefore, we believe that equation 5 is the better one..

3. Test the validity of equations and correction equations

3.1 Tests for the rationality and validity of these models

We use the method "reset test" to demonstrate the rationality and validity of log-log model that is better than linear model.

The process is as follows:

I tried to compare the validity between the log-log model and linear model. Through the reset test, I found there was just little difference between them. At last, I took use of the linear model for two reasons. The first one is that the relationship linear model showed may be more direct. The second reason should be more considered that for the existing unit root, the error correction model would be used, and after the difference of order 1, the coefficients of test function will become very small. So after the measured process, we decided to use linear model..

The initial regression model and the error correction model

$$\log(S_t) = C_0 + C_1 \log(D_t) + \varepsilon_t$$
$$\log(S_t) = \beta_0 + \beta_1 \log(D_t) + \beta_2 \log(D_{t-1}) + \mu_1 \log(S_{t-1}) + \varepsilon_t$$

According to the measured, we established the linear regression model

$$S_t = C_0 + C_1 D_t + \varepsilon_t$$
$$S_t = \beta_0 + \beta_1 D_t + \beta_2 D_{t-1} + \mu_1 S_{t-1} + \varepsilon_t$$

(Here, St: S&P 500 in time t, C: constants; Parameter of regression equation: Dt: US dollar index in time t, εt: random error)

Table 2: The result of reset test

RESET TEST : LOGLOG Model			
F- statistic (1 term)	4.598355	Probability	0.032
F- statistic (2 term)	2.607808	Probability	0.078
RESET TEST : LINEAR Model			
F- statistic (1 term)	3.097209	Probability	0.0453

F- statistic (2 term)	5.9302	Probability	0.0149

Results of measured test proved that the rationality and validity of log-log model is better than linear model. So we finally took the log-log model in our analysis.

3.2 Time-series analysis: solution to the unit root

First, unit root test of all variables.

Us dollar index D_t, the Dickey-Fuller test: $\Delta D_t = \alpha_0 + \gamma D_{t-1} + \varepsilon_t$, the value of D-F test statistic is -1.428, the 5% critical value is-2.862. Thus, we think that a unit root does exist.

We took $m_t = \Delta D_t$, then used $\Delta m_t = \alpha m_{t-1} + \varepsilon_t$ to test stationary character. The value of D-F test statistic is -71.5, the 5%[6]critical value is -1.94 D_t data were stationary after differencing once, this series is integrated of order 1. we often say simply that D_t data is I(1).

After test, we found all variables S_t, ES_t, EES_t were integrated of order 1.

3.3 Test the cointegration of all functions

We just set an example: autocorrelation function correction $S_t = C_0 + C_1 D_t + \varepsilon_t$, With the function $\Delta \hat{e}_t = \beta \hat{e}_{t-1} + \mu_t$ to test whether $\hat{e}_t$ is a stationary, or not.

The first case:

If the error is stationary, we may say D_t and S_t are cointegrated. They exhibit a long-term equilibrium relationship that: $S_t = C_0 + C_1 D_t + \varepsilon_t$

we want to establish a error correction model, this function is the base:

$$S_t = \beta_0 + \beta_1 D_t + \beta_2 D_{t-1} + \mu_1 S_{t-1} + \varepsilon_t$$

For convenient description to the correlation between them, we made an error correction model:

$\Delta S_t = \alpha_0 + \alpha_1 \Delta D_t + \alpha_2 S_{t-1} + \alpha_3 D_{t-1} + \varepsilon_t$, Another form of equation can be expressed as:

$$\Delta S_t = \beta_1 \Delta D_t - \lambda \left[S_{t-1} - \alpha_0 - \alpha_1 D_{t-1} \right] + \varepsilon_t \text{ -- (7)}$$

β_1 represents a short-run elasticity of S_t to D_t. α_1 represents a long-run elasticity of S_t to D_t. We take β_1 and $-\alpha_1$ as study indicators to reflect the relationship between two variables.

The second case:

If $\hat{e}_t$ is nonstationary series at 5% significant level. We think D_t and S_t don't have a long-term equilibrium relationship. But we still can describe the relationship with function (8). Because ΔS_t and ΔD_t are both stationary series.

Error correction model：$\Delta S_t = \chi_0 + \chi_1 \Delta D_t + \varepsilon_t$ -------------------------------------- （8）

χ_1 represents short-run elasticity.

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[6] The entire test process in our paper is carried out at the 5% significance level.

4. Empirical results and analysis

1)   Model one: test the correlation between US dollar index and S&P 500

(1) Original: $S_t = 250.914 + 7.183 \times D_t + \varepsilon_t$, error stationary test:

$s.t.$ (47.437)   (0.508)

significant level, tau=-1.633> -1.941.

So we think D_t are S_t not cointegrated. We use $\Delta S_t = 0.125 + 1.120 \times \Delta D_t + \varepsilon_t$ to get the

$s.t.$ (0.1718)   (0.3427)

short-run elasticity $\chi_1 = 1.12$.

(2) Original: $D_t = 87.690 + 0.005413 \times S_t + \varepsilon_t$, error stationary test:

$s.t.$ (0.381)   (0.000383)

$\Delta \hat{e}_t = -0.00103 \hat{e}_{t-1} + \mu_t$, $\hat{e}_t$ at 5% significant level, tau=-1.478> -1.941.

so we think D_t and S_t not cointegrated. We use $\Delta D_t = -0.0034 + 0.00227 \times \Delta S_t + \varepsilon_t$

$s.t.$ (0.00713)   (0.000591)

to get the short-run elasticity $\chi_1 = 0.00227$.

(3) Results: total seven periods including five periods of the vulnerable US dollar index and two periods of this financial crisis :

In the past 20 years, looking at from the monthly changes of the US dollar index, when US dollar index went down, S&P 500 always rose. There are five periods of the vulnerable US dollar   index   from1990:   1991.06—1992.08,   1993.12—1995.04,   1998.07—1998.10, 2002.02—2004.12 and 2005.12—2007.12. [7]

Figure 3: The chart of US dollar index and S&P 500 index from 1990.
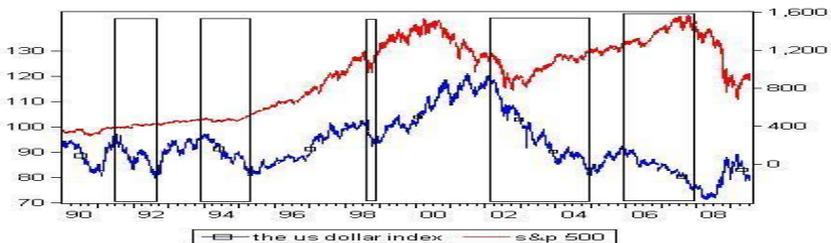
① Within the scope of total time, through the model test results, we can know that they have positive relationship   in long-term.

② In the five vulnerable time of US dollar index, US dollar index and S&P 500 almost do not have a long-term equilibrium relationship, and so we think that the short-term elasticity is more

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[7]   Refer to the study of Gordon Platt's "Dollar Stays strong, But Yen Tumbles"(2009)

effective than long-term elasticity, so we used short-term elasticity to illustrate the relationship between two variables.

③ Because we used different model to get the short-term elasticity, so the values of short-term elasticity are similar with each other.

④ Short-term elasticities are not obviously steady, so we can know there is no obviously positive or negative relationship between them in the five periods

Figure 4: US Dollar Index and S&P 500: 8/08-3/09
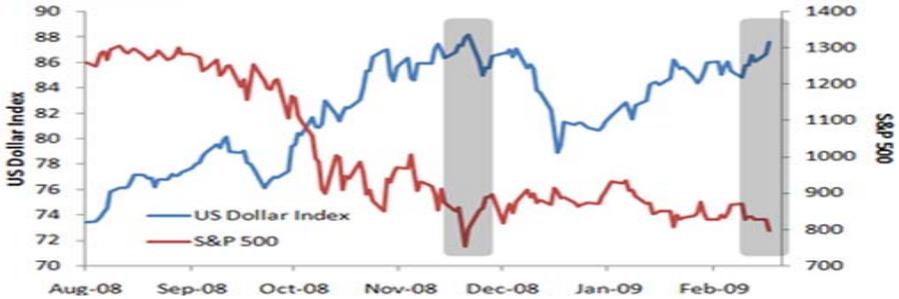
2) Model: Analysis of the correlations among US dollar index and the 10 sectors of industry

First, test cointegration of function 5:

$$D_t = C_0 + C_1 E_t + C_2 MAT_t + C_3 IND_t + C_4 CD_t + C_5 CS_t + C_6 H_t + C_7 F_t + C_8 INF_t + C_9 TEL_t + C_{10} U_t + \varepsilon_t$$

$$D_t = 92.449 + 0.033 U_t + 0.026 TEL_t - 0.017 INF_t - 0.034 F_t - 0.068 E_t - 0.018 CS_t - 0.046 CD_t ,$$
$$-0.052 H_t - 0.235 MAT_t - 0.259 IND_t + \varepsilon_t$$

Error test: $\Delta \hat{e}_t = -0.0096 \hat{e}_{t-1} + \mu_t$, $\hat{e}_t$ at 5% significant level, the value of tau=-4.906<-1.941(the value of statistic), So we think they exhibit a Long-term equilibrium relationship.

$$\Delta D_t = C_1 \Delta E_t + C_2 \Delta MAT_t + C_3 \Delta IND_t + C_4 \Delta CD_t + C_5 \Delta CS_t + C_6 \Delta H_t + C_7 \Delta F_t + C_8 \Delta INF_t + C_9 \Delta TEL_t + C_{10} \Delta U_t - \lambda [D_{t-1} - \alpha_0 - \alpha_1 E_{t-1} - \alpha_2 MAT_{t-1} - \alpha_3 IND_{t-1} - \alpha_4 CD_{t-1} - \alpha_5 CS_{t-1} - \alpha_6 H_{t-1} - \alpha_7 F_{t-1} - \alpha_8 INF_{t-1} - \alpha_9 TEL_{t-1} - \alpha_{10} U_{t-1}] + \varepsilon_t$$

Table 4: The coefficients of the error correction model

	U	TEL	INF	F	E	CS	CD	H	MAT	IND
Short	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
	-0.0013	-0.003	0.00187	0.00793	-0.01155	0.0032	0.0072	0.00064	-0.0345	0.02206
Long	a1	a 2	a 3	a 4	a 5	a 6	a 7	a 8	a 9	a 10
	0.142	-0.0095	-0.0037	-0.0913	-0.09635	0.13668	0.0088	-0.0788	-0.3983	0.43257

Analysis the coefficients of the multiple regression model:

⑴ The sectors having long-term stable and positive correlation with US dollar

index(descending rank): Utilities, Consumer Discretionary, Consumer staples and industrials. Negative sectors: Materials, Energy, Financials, Health Care, Telecommunication services and Information Technology.

⑵ The sectors having   short-term positive correlation with US dollar index(descending rank): industrials, Financials, Consumer Discretionary, Consumer staples, Information Technology and Health Care. Negative sectors: Materials, Energy, Telecommunication services and Utilities.

⑶ Both negative sectors: Mat, E, Tel and Inf; Both positive: Ind, CD and CS.

⑷ Economic growth of industrials sector will devote to the increase of US dollar index. On the contrary, growth of Materials and energy sectors will cause the decrease of US dollar index. Obviously due to economic dependence, US economic growth relay on energy and materials' price. The increasing prices of energy and materials will make U.S. dollar index fell.

⑸ The sectors always keep positive correlation with US dollar index include Industrials, Financials and Consumer Discretionary. On the other hand, materials and energy have negative correlation with US dollar index.

⑹ According to the data of companies listed on US stock market in 2008, an average of 40%-45% of the income is from overseas.

The Energy sector taking the greatest proportion of income from overseas than other sectors has high negative correlation with US dollar index. On the other hand, the Industrials, financials and consumer discretionary sectors taking the lowest proportion of income from overseas than other sectors have high positive correlations with US dollar index.

Table 5: The proportion of every sector income from overseas

Sectors	The proportion of income from overseas	The rank of this proportion	Correlation with US dollar
Energy	more than 50%	First	-0.938
Information Technology	more than 50%	Second	1.096
Consumer Staples	47%	Third	0.111
Materials	39%	Sixth	-0.241
Industrials	38%	Seventh	0.329
Consumer Discretionary	32%	Ninth	0.376
Financials	30%	Tenth	0.683

Source: http://www2.standardandpoors.com/

3)   Relative model: $\Delta ES_t = \chi_0 + \chi_1 \Delta D_t + \varepsilon_t$

Table 6: The coefficients of each function

Sectors	β_1	α_1	χ_1	tau (5%)=-1.9409	cointegrated
Energy	-0.938081	4.3113	-0.935979	-1.49781	No
Materials	-0.241011	-0.71125	-0.240056	-1.97404	Yes
Industrials	0.329230	0.329476	0.83443	-1.61687	No
Consumer Staples	0.111003	-1.55712	0.111501	-1.53488	No
Consumer Discretionary	0.375754	1.56952	0.375326	-1.73572	No
Health Care	0.275371	2.01466	0.274962	-1.57074	No
Financials	0.683021	-8.02696	0.681036	-1.61400	No
Information Technology	1.096378	15.33067	1.096431	-1.82162	No
Telecommunications Services	0.208487	9.41649	0.209035	-1.82568	No
Utilities	-0.033161	1.55906	-0.033522	-1.866584	No

Due to the cointegration, we still use the short-term elasticity to explain these correlations

（1）US dollar index having short-term positive correlation with the sectors as below(descending rank): Information Technology, Financials, Consumer Discretionary, Industrials, Health Care, Telecommunication services and Consumer staples. Negative sectors: Energy, Materials, Utilities.

（2）US has much advantages in the sectors positively affected by US dollar index than other sectors. On the contrary, US needs to import energy, and the economic growth is highly dependent on energy.

4)   Model: test the effect of S&P 500 subsidiary sectors to US dollar index

Taking use of the equations $\Delta EES_t = \beta_1 \Delta D_t - \lambda \left[EES_{t-1} - \alpha_0 - \alpha_1 D_{t-1} \right] + \varepsilon_t$ and $\Delta EES_t = \chi_0 + \chi_1 \Delta D_t + \varepsilon_t$ to test the effect of S&P 500 subsidiary sectors to US dollar index, as far as the detailed data self of S&P 500 subsidiary industry sector is concerned, in subsidiary sectors of top 6 highest negative correlations with the US dollar, 4 sectors came from Energy section. They are such as Coal & Consumable Fuels, Integrated Oil & Gas, Oil & Gas Drilling, Oil & Gas Equipment & Services and Oil & Gas Exploration & Production. 2 sectors came from Utilities section. They are such as Electric Utilities and Gas Utilities.

The reason is due to the characteristics of American energy imports as well as the affected strength of their production costs by US dollar index. In the recent economic crisis, the fall of energy price have direct and biggest influence on the rise of US dollar index.

5)   Descriptive statistics: the effect of interest rate to US dollar index

Except the performance of the American economy and stock market, interest rates should be considered too. But as far as we knew, the positive correlation between interest rate and US dollar index could not completely explain the appreciation or depreciation of the US dollar index. In the five periods of the vulnerable US dollar index, the Fed took the deflation policy of interest rate in 1993.12—1995.04 and 2005.12—2007.1.[8] (I think that maybe refer to the time lag of interest rate policy.)

Table 7: The interest rate in different periods

Period	Us dollar index	Interest rate
1991.06—1992.08	Down	Down(5.90-3.25)
1993.12—1995.04	Down	Up(2.96-6.05)
1998.07—1998.10	Down	Unchanged（5.54-5.51）
2002.02—2004.12	Down	Fall before rise（1.74-0.98(12/03)-1.93）
2005.12—2007.12	Down	Rise(4.16-5.25(07/06)),keep unchanged until 07/07, fall to 4.49
2008.03—2009.08	Up	Down(2.61-0.16)

Table 8: Monthly interest rate of Federal funds (effective) from 1990

	01	02	03	04	05	06	07	08	09	10	11	12
1990	8.23	8.24	8.28	8.26	8.18	8.29	8.15	8.13	8.20	8.11	7.81	7.31
1991	6.91	6.25	6.12	5.91	5.78	5.90	5.82	5.66	5.45	5.21	4.81	4.43
1992	4.03	4.06	3.98	3.73	3.82	3.76	3.25	3.30	3.22	3.10	3.09	2.92
1993	3.02	3.03	3.07	2.96	3.00	3.04	3.06	3.03	3.09	2.99	3.02	2.96
1994	3.05	3.25	3.34	3.56	4.01	4.25	4.26	4.47	4.73	4.76	5.29	5.45
1995	5.53	5.92	5.98	6.05	6.01	6.00	5.85	5.74	5.80	5.76	5.80	5.60
1996	5.56	5.22	5.31	5.22	5.24	5.27	5.40	5.22	5.30	5.24	5.31	5.29
1997	5.25	5.19	5.39	5.51	5.50	5.56	5.52	5.54	5.54	5.50	5.52	5.50
1998	5.56	5.51	5.49	5.45	5.49	5.56	5.54	5.55	5.51	5.07	4.83	4.68
1999	4.63	4.76	4.81	4.74	4.74	4.76	4.99	5.07	5.22	5.20	5.42	5.30
2000	5.45	5.73	5.85	6.02	6.27	6.53	6.54	6.50	6.52	6.51	6.51	6.40
2001	5.98	5.49	5.31	4.80	4.21	3.97	3.77	3.65	3.07	2.49	2.09	1.82
2002	1.73	1.74	1.73	1.75	1.75	1.75	1.73	1.74	1.75	1.75	1.34	1.24
2003	1.24	1.26	1.25	1.26	1.26	1.22	1.01	1.03	1.01	1.01	1.00	0.98

[8] Refer to the study of Paul D. Cretien, 2009, Currencies, eurodollars, silver and gold: Not your average

2004	1.00	1.01	1.00	1.00	1.00	1.03	1.26	1.43	1.61	1.76	1.93	2.16
2005	2.28	2.50	2.63	2.79	3.00	3.04	3.26	3.50	3.62	3.78	4.00	4.16
2006	4.29	4.49	4.59	4.79	4.94	4.99	5.24	5.25	5.25	5.25	5.25	5.24
2007	5.25	5.26	5.26	5.25	5.25	5.25	5.26	5.02	4.94	4.76	4.49	4.24
2008	3.94	2.98	2.61	2.28	1.98	2.00	2.01	2.00	1.81	0.97	0.39	0.16
2009	0.15	0.22	0.18	0.15	0.18	0.21	0.16	0.16				

6) Descriptive statistics: The more decisive factor that affects US dollar index and S&P 500 is capital flows.

From April 2008 to March 2009, US dollar began to appreciate. The value of US dollar index appreciated from 72.62 to 89.62 the highest point in June 6th, 2009. The global financial crisis caused by subprime mortgage crisis resulted in high demand for US dollar for the hedge fund treating US dollar as a safe harbor. Furthermore, US dollar flowed out from the United States causing the decline of S&P 500. At the same time, global financial crisis led to the damage of the entity economy and financial system, and these would also lead the stock price to further decline.

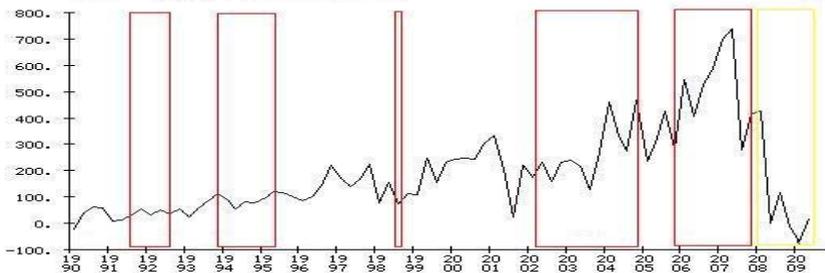Figure 5: Foreign assets in the U.S.: net capital inflow {+}   unit: billons of dollars

Table 9: Quarterly data of net capital inflow of US

Year	I	II	III	IV	Total
1990	66.021	40.868	62.621	59.345	229
1991	7.59	12.016	32.574	56.043	108
1992	30.212	49.732	34.931	53.472	168
1993	24.531	58.599	84.967	111.662	280
1,994	89.488	56.279	81.239	76.168	303
1,995	96.842	121.385	115.499	101.376	435
1,996	84.335	100.61	143.269	219.67	548
1,997	172.247	140.222	166.609	225.372	704
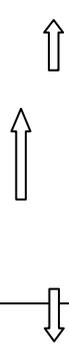
1,998	78.365	154.539	75.193	112.697	421
1,999	108.317	247.211	156.06	230.623	742
2,000	242.782	246.564	245.064	303.816	1,038
2,001	330.767	206.867	24.226	221.01	783
2,002	173.225	231.325	160.335	230.275	795
2,003	240.908	217.732	129.177	270.48	858
2,004	459.483	331.63	274.147	467.941	1,533
2,005	234.182	304.88	425.404	282.881	1,247
2,006	545.648	407.652	525.441	586.428	2,065
2,007	700.961	737.457	278.424	412.618	2,129
2,008	426.058	2.003	117.897	-11.888	534
2,009	-67.757	16.393			

Note: The upward arrow indicates increase of net inflows. Down arrows indicates decrease of net inflow.

From table 9, it is obvious that foreign capital inflow to US promotes the advance of S&P 500 index. From the second quarter of 2008, the net capital inflow to US get reduced suddenly, excluding the seasonal factors, the net capital inflow to US came to 737 billon dollars. In the same quarter of 2008, there was just 2 billon dollars. After that, the net capital inflows in the forth quarter of 2008 and the first quarter of 2009 were both negative. Meanwhile S&P went down.

In addition, the net capital inflow in the third quarter of 1998 was 75 billion dollars. Comparing it with before, we find that it is much less than before. It caused the decline of S&P 500 index. The net capital inflows in the second quarter of 2002 and the first quarter of 2006 were at the peak. So we could anticipate the S&P index was going up.

On the other hand, the fall or rise of US dollar index is the direction indicator of foreign capital flows. The depreciation of US dollar will cause the capital inflow for the domestic capital priced by US dollar worth to invest for foreigners. Otherwise, the capital will flow out.

Looking at from the allocation and flow direction of global capital, in prosperous period, the function of emerging markets to the European and American financial institutions is "a machine to print money", and in setting period it is an ATM. If US dollar comes into the cycle of appreciation, a lot of US dollar will go back to the US, and that will lead to the currency devaluation of the emerging market countries. The capital will continue to flow out from emerging markets.

In this time, the negative correlation between them is significant. So we think the direction of capital flows is the most decisive factor that every country authorities should pay much attention to.

5. Conclusions and predications

The US dollar index is an important one among the factors that affect S&P 500. The correlation between them is uncertain just like imperfection of market. We need to refer to several factors to analyze the trend of S&P 500 such as interest rate policy, monetary policy and capital flows.

We can get conclusions as follows:

1) The sectors always keep positive correlation with US dollar index include Industrials, Financials and Consumer Discretionary. On the other hand, materials and energy have negative correlation with US dollar index.

2)The Energy sector taking the greatest proportion of income from overseas than other sectors has highest negative correlation with US dollar index. Meanwhile, the financials sector taking the lowest proportion of income from overseas than other sectors has highest positive correlation with US dollar index.

3) As far as the detailed data of S&P 500 subsidiary industry sector is concerned, in subsidiary sectors of top 8 highest negative correlations with the US dollar, 4 sectors came from Energy section. They are Coal & Consumable Fuels, Integrated Oil & Gas, Oil & Gas Drilling, Oil & Gas Equipment & Services and Oil & Gas Exploration & Production.

The positive correlation between interest rate and US dollar index could not completely explain the appreciation or depreciation of the US dollar index.

4) The fall or rise of US dollar index is the direction indicator of foreign capital flows. The depreciation of US dollar will cause the capital inflow for the domestic capital priced by US dollar worth to invest for foreigners. Otherwise, the capital will flow out. And foreign capital inflow to US promotes the advance of S&P 500 index. Especially in this crisis, the demand to US dollar leads the appreciation of US dollar with the foreign capital outflow from US. In the same time, the S&P 500 index went down.

5) We can predict the future that low interest rates will lead to inflation, and the US dollar will enter the cycle of depreciation. Foreign capital will flow back to US. The bullish anticipation to the future economic trend will lead to the rise of energy prices and S&P 500 index, at the same time the US dollar will depreciate. And the capital inflows will also cause the rise of S&P 500 index. At present in the United States, high unemployment (9.8%) and low interest rate (0.16%) will lead to depreciation of US dollar. On the other hand, the increase of U.S. household savings will lead to the appreciation of US dollar, and earnings reports issued by financial institutions will promote the rise of US dollar index.

According to many facts, we can predict the current US dollar trend as follows:[9]

(1) Although US dollar appreciates in a short term, it will depreciate in a long term.

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[9] Refer to the study of Chang Wu.

There are several factors to support the appreciation of US dollar in a short term: ① the global de-leveraging process needs a lot of US dollars and this process is far from the end. The process that the hedge fund treated US dollar as a safe harbor will continue. ② a too-strong dollar policy is one of the important economic policies of Obama's Government. American authorities establish many policies to promote economy based on a too-strong dollar to boost confidence of US dollars. This will attract large capital inflows. ③ currently, interest rate policy is beneficial to the appreciation of US dollar. But there is little space left for the Federal Government to continue lowering the interest rate. In the weak background of global economy, the smaller space left for lowering the interest rate, the relatively smaller pressure the currencies depreciation will have. This exactly means that in future US dollar is most likely to take the first step into a further hike cycle. Meanwhile this becomes the potential factor to maintain a too-strong dollar.

After the process of de-leveraging ends, and as well as after the United States economic recoveries, the US dollar will enter into a new cycle of depreciation. Rising fiscal deficit does not support appreciation of US dollar. The data indicated that budget deficit reached 1.75 trillion dollars in 2009 and the proportion of budget deficit in GDP will reach 12.3%, as the highest since 1945. And a long-term of too-strong dollar is bad for American Enterprises. Therefore, US dollar depreciation in step by step, and by stages is a good long-term selection for the US government. According to the Federal research on macroeconomic model, if US dollar depreciates by 10%, the GDP will probably increase by 1.2%.

(2) Looking from the direction of capital flows, the possibility of the outbreak of the currency crisis in emerging markets enlarges in 2009.

Capital flowing to emerging markets is facing a danger of disconnection. As data shows, "hot money" outflows from China amounts to 300 billion dollars just in January. International Monetary Fund (IMF) published "the global financial stability report" on 21st, April and forecasted that emerging markets capital may be a net outflow in 2009. The global economy would not recover until 2012. Particularly Ukraine, Russia and some Central Asian countries, as well as resource-oriented economies, are all facing double pressures coming from commodities prices fell and the continuous outflow of capital. The sniped risk of currency enlarges. At present, the Russian Rouble has depreciated by 45%. In this environment, once an influential currency depreciated continually and in a large scope, it will lead to regional currencies depreciation among neighborhoods, eventually evolving into chain reaction of emerging markets crisis.

What should be paid more attention to is that 40 billion dollars foreign debt of Romania, Croatia, Bulgaria, etc is about to expire. It amounts to 1/3 of the GDP of Eastern European countries. In the environment that the credit market is frozen, Eastern European countries will slide deeper into a slump.

(3) For the zero interest rate policy and big-scale loan, inflation seed has been planted and inflation will occur after recession.

First, zero interest rate policy and large-scale loan will cause inflation after the economic recovery. If each country's central bank constantly made use of currency issue to "dilute" debt and boost the economy, it means that at present we have already had one foot into the mire. From October of 2008, financial crisis overspread all over the world. Many people worried that the global economy would be plunged into deflation lasting for about 3~5 years. However, with developed economies like the United States, Britain and Japan formulated low interest rate policy, people began to worry about the possibility of global inflation, so to speak, Pandora's box is already open.

Second, if the new deal to stimulate the economy of Obama's government works, the United States' economy will first walk out of crisis early than other developed economies. While the American economy goes into the recovery phase, the US dollar will enter the cycle of depreciation. This signal will be promptly reflected by a global commodity prices, inflation will appear at any moment. From the second half of 2009, we will probably face the pressure of input inflation caused by US' debt.

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Appendix: S&P 500 subsidiary industry sectors

Consumer Discretionary	Consumer Staples	Financials
Advertising	Agricultural Products	Asset Management & -Custody
Apparel Retail	Brewers	Banks -Consumer Finance
Apparel, Accessories & Luxury	Distillers & Vintners	Diversified REITs
-Goods	Drug Retail	Diversified Banks
Auto Parts & Equipment	Food Distributors	Industrial REITs
Automobile Manufacturers	Food Retail	Insurance Brokers
Automotive Retail	Household Products	Investment Banking &
Broadcasting	HyperMarkets & Super	-Brokerage
Cable & Satellite	-Centers	Life & Health Insurance
Casinos & Gaming	Packaged Foods & Meats	Multi-line Insurance
Computer & Electronics Retail	-Personal Products	Multi-Sector Holdings
Consumer Electronics	Soft Drinks	Office REITs
Department Stores	Tobacco	Other Diversified Financial
Distributors	**Utilities**	Services
Education Services	Electric Utilities	Property & Casualty -Insurance
Footwear	Gas Utilities	Real Estate Services
General Merchandise Stores	Independent Power -Producers	Regional Banks
Home Furnishings	& Energy -Traders	Residential REITs
Home Improvement Retail	Multi-Utilities	Retail REITs
Homebuilding	**Health Care**	Specialized Finance
Homefurnishing Retail	Biotechnology	Specialized REITs
Hotels, Resorts & Cruise Lines	Health Care Distributors	Thrifts & Mortgage Finance
Household Appliances	Health Care Equipment	**Telecommunication Services**
Housewares & Specialties	Health Care Facilities	Integrated -Telecommunication
Internet Retail	Health Care Services	Services
Leisure Products	Health Care Supplies	Wireless Telecommunication
Motorcycle Manufacturers	Health Care Technology	-Services
Movies & Entertainment	Life Sciences Tools &	**Energy**
Photographic Products	-Services	Coal & Consumable Fuels
Publishing & Printing	Managed Health Care	Integrated Oil & Gas
Restaurants	**Information Technology**	Oil & Gas Drilling
Specialized Consumer Services	Application Software	Oil & Gas Equipment &
Specialty Stores	Communications Equipment	-Services

Tires & Rubber

Industrials

Aerospace & Defense

Air Freight & Logistics

Airlines

Building Products

Commercial Printing

Construction & Engineering

Construction & Farm Machinery
& Heavy Trucks

Diversified Support Services

Electrical Components &
-Equipment

Environmental & Facilities
-Services

Human Resource &Employment
Services

Industrial Conglomerates

Industrial Machinery

Office Services & Supplies

Railroads

Research & Consulting Services

Trading Companies &
-Distributors

Trucking

Computer Hardware

Computer Storage &
-Peripherals

Data Processing & -Outsourced
Services

Electronic Components

Electronic Equipment &
-Instruments

Electronic Manufacturing
-Services

Home Entertainment -Software

Internet Software & -Services

IT Consulting & Other
-Services

Office Electronics

Semiconductor Equipment

Semiconductors

Systems Software

Oil & Gas Exploration &
-Production

Oil & Gas Refining &
-Marketing

Oil & Gas Storage &
-Transportation

Materials

Aluminum

Construction Materials

Diversified Chemicals

Diversified Metals & Mining

Fertilizers & Agricultural
-Chemicals

Forest Products

Gold

Industrial Gases

Metal & Glass Containers

Paper Packaging

Paper Products

Specialty Chemicals

Steel

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