Conference Paper

Increasing Impact of Stock Market Performance on Government Tax Revenues

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Abstract

The aim of this paper is to investigate the relationship between fiscal policy, economic growth and stock market in the United States. This issue has gained importance in the last decade because the market has changed. A significance break has been detected which impacts the nature of the nexus between certain variables. The correlation between the tax revenues and the stock market has increased noticeably, encouraging the revision of the current approach to fiscal policy. This study examines relationship between three variables, namely real GDP, federal government current tax receipts and the stock market represented by the Wilshire 5000 Total Market Index. Quarterly data from 1971 to 2015 are used, divided into two subsets in the year 2000, because there is an obvious change in trend and volatility of the variables. The analysis uses ADF and KPSS unit root tests to find the order of the integration of the data. Subsequent analysis applies Johansen cointegration test, vector error correction model, Granger causality tests and variance decomposition analysis. The results demonstrate that the selected variables are cointegrated, and performance of the stock market significantly increases its influence on government tax revenues in the second period. The findings of this paper are significant for policy makers. Understanding how stock market development and economic growth influence tax revenues and vice versa is crucial for the efficient implementation of successful fiscal policy. Investors in the economy of the United States will be also able to benefit from these results which will help them to understand economic conditions and improve their investment decisions.

Keywords: Economic growth, stock market, tax revenue, VECM, variance decomposition

1. Introduction

The economic growth is a core topic in economics for very long time. A large number of economic theories and empirical studies have tried to understand its nature. It is very important topic because economic growth helps to improve wealth and standard of living in a given country. It has been demonstrated how important could be development of financial markets and fiscal policy for the economic growth. This paper reexamines nexus between these three variables.

Numerous economic theories and empirical studies, regarding to the issue of economic growth, have been conducted. Relationship between economic growth and fiscal policy is often discussed among economists and politicians. Marsden (1986) and [10] found that the nations with the greater rate of tax experience lower economic growth. According to [8], states that raised their income tax rates more than their neighbors had slower income growth and their per capita income decreased. Similar findings provide [12]. [17] applied panel data analysis for countries from EU-15 from 1960 to 2001 and found that direct taxation negatively influences economic growth while public investment has positive impact.

Also, the nexus between economic growth and financial markets has been examined extensively. A large number of studies have documented this relationship. We could mention for example [4, 16].

It has been also demonstrated that financial markets and fiscal policy are linked in many ways. [1] investigated effects of fiscal policy on investment. They used panel data from OECD countries and they found negative effect of public spending on profits and investment which was higher than negative effect of various types of taxes. [7] investigated the effect of tax reforms on financial market, and he found that tax laws could encourage more productive economy and influence financial markets in several ways. Negative effect of higher tax rate for stock market returns suggested [2, 3].

Illievski (2015) used panel data set of 96 countries over the period 1990-2008 to examine relationship between stock market total value traded and tax revenue. When the stock market increases relative to GDP it means that more financial resources for investments are available. He showed that the effect of total stock market value traded to tax revenue is positive and statistically significant. In general, the stock market positively influences the government's ability to raise tax revenue.

However, little research has been conducted about nexus between these three variables. [13] puts it together in his endogenous growth model. Results from his study claims that the stock market and the tax policy mutually affect the economic growth. He showed in his model that taxing or impeding financial market activity lowers per capita economic growth rate.

The aim of this paper is to examine nexus between the economic growth, the stock market and the federal government tax revenues in the United States. We point out the structural break in the development of these variables, which occurred around year 2000, and investigate how the relationship of these three economic indicators has changed.

The rest of the paper is organized as follows. In section 2, there is a description of the data and methodology. Section 3 presents results from our analysis and the last section 4 contains summary and conclusions.

2. Data and Methodology

The main objective of this study is to examine interlinks between the three important macroeconomic variables, namely the stock market, the economic growth and the tax revenue in the USA. Quarterly data from 1971 to 2015 are used and are divided into two subsets. The first investigated time period is for the data from 1971 to the end of 1999.

Variable	Label	Units	Source
Wilshire 5000 Total Market Index	W5000	Index	Bloomberg
Gross domestic product, real	GDP	Billions of USD	Bloomberg
Federal government current tax receipts	TAX	Billions of USD	Federal Reserve Bank of St. Louis [1]

Table 1: Variables description. *Source: https://research.stlouisfed.org/fred2/series/W006RC1Q027SBEA.*

	Full period			1971-1999			2000-2015		
Statistic	GDP	W5000	TAX	GDP	W5000	TAX	GDP	W5000	TAX
Number of observations	179	179	179	116	116	116	63	63	63
Mean	9.157	8.324	6.504	8.932	7.702	6.087	9.573	9.469	7.272
Standard deviation	0.375	1.091	0.760	0.262	0.835	0.612	0.078	0.259	0.202
Minimum	8.483	6.310	4.918	8.483	6.310	4.918	9.422	8.958	6.924
Median	9.157	8.399	6.566	8.935	7.562	6.149	9.589	9.461	7.256
Maximum	9.706	9.996	7.678	9.419	9.533	7.125	9.706	9.996	7.678

Table 2: Descriptive statistics. *Source: Author's calculations.*

The second period contains the rest of the data from 2000 to 2015. Both subsets are investigated separately due to an obvious change in trend and volatility of the time series in the second period.

In the following Table 1 there are all examined variables. The first column contains variable name, then we can see the label for each variable used in the rest of the paper. Units for each variable and source of the data are also listed in this table. Our subsequent analysis uses all data in natural logarithms.

Stock market performance is represented by Wilshire 5000 Total Market Index, which measures the performance of all U.S. equity securities with readily available price data. Over 5000 capitalization weighted security returns are used to adjust the index. It is widely regarded as the best single measure of the U.S. equity market and is also the oldest one.

The second investigated variable is the real gross domestic product measuring the final market value of all goods and services produced within a country. It is the most frequently used indicator of economic activity and measures total final expenditures including exports less imports. This data are adjusted for inflation. The last variable shows the federal government current tax receipts.

Table 2 provides descriptive statistics of the comprised dataset and Figure 1 shows the graphs of the data in levels (panel A) and in first differences (panel B). All data are after logarithmic transformation. We can see that all variables in levels are increasing over time and show strong common trend. The first differences of the data seem to be stationary despite the presence of some outliers.

The first step in our analysis is to formally examine order of integration of the data using Augmented Dickey–Fuller (ADF) test [6] and KPSS test [11]. If all variables have the same order of integration, we can start with cointegration analysis to investigate

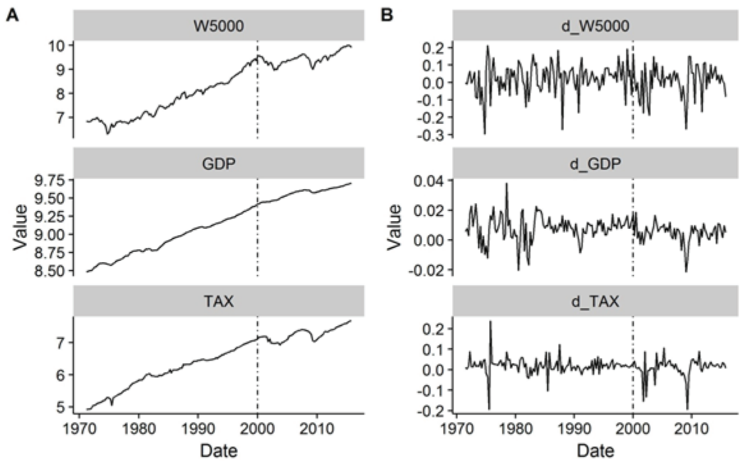

Figure 1: Data in levels and in first differences. *Source: Author's calculations.*

long term relationship between them. For this purpose Johansen's methodology is used [9]. Unit roots of the time series will be tested formally in the following chapter. But according to visual inspection of the Figure 1, we can assume that all variables are I(1) and are also cointegrated. We have three variables in our model which implies that this situation is more complex. The number of linear combinations of these variables that are stationary could be 0, 1, or 2. The Johansen cointegration test allows us to test all three variables together and find proper number of cointegrating relationships.

The presence of the cointegrating relationship leads us to model known as the vector error correction model (VECM). In this model the equation is differenced, and an error-correction term measuring the previous period's deviation from long-run equilibrium is included.

VECM for two variables in general might look like:

$$\Delta y_t = \beta_{y0} + \beta_{y1}\Delta y_{t-1} + \cdots + \beta_{yp}\Delta y_{t-p} + \gamma_{y1}\Delta x_{t-1} + \cdots + \gamma_{yp}\Delta x_{t-p} - \lambda_y\left(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}\right) + v_t^y,$$

$$\Delta x_t = \beta_{x0} + \beta_{x1}\Delta y_{t-1} + \cdots + \beta_{xp}\Delta y_{t-p} + \gamma_{x1}\Delta x_{t-1} + \cdots + \gamma_{xp}\Delta x_{t-p} - \lambda_x\left(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}\right) + v_t^x,$$

where $y_t = \alpha_0 + \alpha_1 x_t$ is the long-run cointegrating relationship between the two variables and λ_y and λ_x are the error-correction parameters that measure how y and x react to deviation from long-run equilibrium. Then we use [18] approach for testing Granger causality.

Final step in our analysis is to construct forecast-error variance decomposition, which indicates the amount of information each variable contributes to the other variables in the model. In other words, it measures the extent to which each shock contributes to the variation in each variable.

3. Results

For formal confirmation that our variables are stationary at first differences the Augmented Dickey-Fuller test and the KPSS test are used. The main advantage of using

	Data in levels				Data in first differences			
	ADF test		KPSS test		ADF test		KPSS test	
Variable	t-statistic	p-value	t-statistic	p-value	t-statistic	p-value	t-statistic	p-value
GDP_1	-3.129	0.108	3.932	0.010	-4.475	0.010	0.084	0.100
W5000_1	-2.494	0.371	3.789	0.010	-5.462	0.010	0.352	0.098
TAX_1	-2.064	0.550	3.844	0.010	-5.143	0.010	0.109	0.100
GDP_2	-1.850	0.636	2.938	0.010	-2.811	0.247	0.193	0.100
W5000_2	-2.516	0.366	1.683	0.010	-3.932	0.019	0.208	0.100
TAX_2	-2.910	0.206	2.042	0.010	-2.981	0.178	0.239	0.100

Table 3: Unit root tests. *Source: Author's calculations.*

	1st period, test statistic	2nd period, test statistic	Critical value 5%
$r \leq 2$	7.74	5.97	9.24
$r \leq 1$	11.76	14.07	15.67
$r = 0$	**24.30**	**24.72**	22.00

Table 4: Johansen's cointegration tests. *Source: Author's calculations.*

these two tests is that they have exactly opposite null hypothesis. Null hypothesis in case of the Augmented Dickey-Fuller test is that variable is non-stationary and KPSS test uses null hypothesis about stationarity of the variable. The results of both tests for data in levels and first differences are presented in Table 3.

Variables GDP_1, W5000_1 and TAX_1 represented the first observed period. GDP_2, W5000_2 and TAX_2 are variables from the second time period. It is obvious from graphs of the data that all variables in both time periods are non-stationary. Our assumptions are confirmed because we are not able to reject the null hypothesis on significance level 5% in case of ADF test, and on the other hand we reject the null hypothesis in case of KPSS test.

Data in first differences do not show strong results. In the first time period the stationarity at first differences is proved by both tests. But in the second period only KPSS test allows us to accept this assumption. ADF test suggests that first differences of GDP and TAX are not stationary, which is caused mainly by big outlier during crisis in 2009. If we take into account visual inspection of the plots and results from our formal unit root tests, we can assume that all variables are integrated of order 1.

Now we can proceed to Johansen's cointegration test to find out how many cointegrating relationships are present between variables in each investigated time period. This test helps us to describe long term equilibrium relationship between variables. Values of test statistics and critical values of test are shown in the following Table 4. According to our results, we are able to conclude that there is one cointegrating relationship present in both cases. We reject the null hypothesis about no cointegrating relationship on significance level 5%.

	Equation 1: $\Delta W5000_t$	Equation 2: ΔGDP_t	Equation 3: ΔTAX_t
ECT_{t-1}	-0.0883(0.0363)**	0.0077(0.0033)**	0.0232(0.0165)
Intercept	-1.8127(0.7575)**	0.1642(0.0694)**	0.5019(0.3446)
$\Delta W5000_{t-1}$	0.1047(0.0972)	0.0202(0.0089)**	-0.0377(0.0442)
ΔGDP_{t-1}	0.5915(1.0829)	0.2550(0.0991)**	1.0896(0.4927)**
ΔTAX_{t-1}	0.3300(0.2271)	-0.0020(0.0208)	-0.4025(0.1033)***
$\Delta W5000_{t-2}$	-0.1416(0.1016)	0.0228(0.0093)**	0.0717(0.0462)
ΔGDP_{t-2}	-1.4028(1.0632)	0.0721(0.0973)	0.0253(0.4837)
ΔTAX_{t-2}	-0.0885(0.2305)	0.0145(0.0211)	-0.0089(0.1049)

Table 5: VECM estimates for the 1^{st} period. *Note: significance at *10%, **5%, ***1%. Source: Author's calculations.*

	Equation 1: $\Delta W5000_t$	Equation 2: ΔGDP_t	Equation 3: ΔTAX_t
ECT_{t-1}	-0.4060(0.1665)**	0.0146(0.0105)	-0.0234(0.0797)
Intercept	-1.7553(0.7236)**	0.0662(0.0457)	-0.1096(0.3465)
$\Delta W5000_{t-1}$	0.2892(0.1773)	0.0089(0.0112)	0.0947(0.0849)
ΔGDP_{t-1}	3.1927(2.6374)	0.1480(0.1666)	2.2047(1.2629)*
ΔTAX_{t-1}	-0.3461(0.3114)	0.0161(0.0197)	-0.2507(0.1491)*
$\Delta W5000_{t-2}$	0.1445(0.1614)	0.0003(0.0102)	0.1689(0.0773)**
ΔGDP_{t-2}	1.2991(2.5795)	0.0002(0.1630)	1.6446(1.2352)
ΔTAX_{t-2}	-0.2581(0.2825)	0.0053(0.0178)	0.0558(0.1353)

Table 6: VECM estimates for the 2^{st} period. *Note: significance at *10%, **5%, ***1% Source: Author's calculations.*

As the long term relationship has been estimated, the next step is to proceed to short term analysis. For this purpose we create vector error correction model. The results of our model for the 1^{st} period are presented in Table 5 and for the 2^{nd} period in Table 6.

In equations for W5000 significance occurs only in case of the intercept and the error correction term in both periods. While the estimated coefficients for the intercept are very similar, coefficient for the error correction term changed dramatically. This variable has coefficient -0.0883 in the first period and -0.4060 in the second one. The estimated coefficient indicates that about 9% of this disequilibrium is corrected in the first period and then this value rises up to 40%.

Economic growth measured by variable GDP noted a big difference between both periods. In the first period error correction term and intercept are statistically significant on significance level 5%. The coefficients of the W5000 of both first-order lag and second-order lag are positive with similar coefficients 0.0202 and 0.0228 respectively. This means that the stock market was positively related to the economic growth in period from 1971 to 2000. Therefore in the short term the rising stock market could bring the economic growth up. To the economic growth itself, the lagged period of GDP has positive and statistically significant influence on current period. On the other hand, the second time period gives completely different results. None of the investigated variables are statistically significant. It indicates important change in relationship between variables.

	1st period		2nd period	
	t-statistic	p-value	t-statistic	p-value
W5000 do not Granger-cause GDP	21.216	0.00002	3.42	0.064
GDP do not Granger-cause W5000	2.64	0.267	1.789	0.181
W5000 do not Granger-cause TAX	8.557	0.014	7.915	0.005
TAX do not Granger-cause W5000	4.282	0.118	0.211	0.646
GDP do not Granger-cause TAX	10.576	0.005	20.905	0.00003
TAX do not Granger-cause GDP	1.484	0.476	0.999	0.607

Table 7: Granger causality. *Source: Author's calculations.*

Short term equations for TAX demonstrate that the error correction term is not statistically significant in any time period. This shows that TAX does not significantly respond to the deviation from the long run relationship. GDP for first-order lag has positive effect on the tax revenue in both time periods. In the second period the estimated coefficient is approximately two times higher but is statistically less significant than in the first period. This relationship in both periods is logical because it is obvious that more economic activity causes that more taxes are paid and the government tax revenue increases. For the TAX itself, the first-order lag is negative and significant in both periods, but in the second one, both the coefficient and the statistical significance are lower. This indicates decreasing impact of this variable. But what is probably more important is the fact that two-lagged period of the stock market appeared to be statistically significant and positively related to the tax revenue in the second period. Therefore, in the short term raise of the stock market could increase the government tax revenue.

In the following Table 7 are results of Granger causality tests. We use [18] approach and apply bivariate analysis. These results are comparable in both time periods. We can say that stock market Granger-causes GDP and TAX whilst GDP Granger-causes TAX. The influence of the stock market to GDP seems to be higher in the first period due to lower p-value. On the contrary, other relationships exhibit higher significance in the second period.

The final step in our analysis is to examine forecast error variance decomposition in our models. It allows us to observe amount of information each variable contributes to the other variables. This reveals how much of the changes in each variable may be explained by itself and how much is explained by other variables in our model. Tables 7-9 report the variance decomposition for 10 horizons.

The variance decomposition of W5000 in Table 7 shows us that forecast error variance of the stock market due to the economic growth and the tax revenue is very small in the first period. But in the second period we can notice a significant increase of this

Period	W5000_1	GDP_1	TAX_1	W5000_2	GDP_2	TAX_2
1	1.000	0.000	0.000	1.000	0.000	0.000
2	0.981	0.008	0.011	0.986	0.013	0.001
3	0.983	0.007	0.010	0.967	0.029	0.004
4	0.984	0.006	0.010	0.944	0.039	0.018
5	0.984	0.006	0.010	0.917	0.047	0.037
6	0.982	0.008	0.010	0.889	0.053	0.058
7	0.979	0.010	0.011	0.863	0.058	0.079
8	0.975	0.013	0.011	0.841	0.063	0.096
9	0.971	0.018	0.012	0.823	0.067	0.110
10	0.965	0.023	0.012	0.807	0.071	0.122

Table 8: Variance decomposition of W5000. *Source: Author's calculations.*

Period	W5000_1	GDP_1	TAX_1	W5000_2	GDP_2	TAX_2
1	0,003	0,997	0,000	0,386	0,614	0,000
2	0,054	0,946	0,000	0,524	0,476	0,000
3	0,143	0,856	0,002	0,589	0,411	0,001
4	0,192	0,805	0,002	0,623	0,376	0,002
5	0,226	0,771	0,003	0,640	0,357	0,003
6	0,250	0,747	0,003	0,649	0,348	0,003
7	0,268	0,729	0,003	0,653	0,343	0,004
8	0,283	0,714	0,003	0,656	0,340	0,004
9	0,296	0,701	0,003	0,658	0,338	0,004
10	0,307	0,690	0,003	0,660	0,336	0,004

Table 9: Variance decomposition of GDP. *Source: Author's calculations.*

forecast error variance especially in case of TAX. Federal government tax revenues gain higher importance for explaining changes in the stock market.

Table 8 contains results of variance decomposition of GDP. Influence of the tax revenues remains very small in both periods. More significant change is observed for contribution of the stock market to changes in GDP. The impact of W5000 is significantly greater from year 2000 especially in the earlier periods.

The last variance decomposition for the variable TAX is shown in Table 9. In the first period the variance contribution of stock market is very small and variance contribution of GDP increases in early periods and then revolves around value 0.2. The situation in the second period is completely different. Forecast error variance of TAX due to GDP drops to values around 0.05, but variance contribution of stock market increases dramatically and stabilizes around 66%.

4. Conclusions

This paper tests nexus between economic growth, stock market and tax revenue from 1971 to 2000 and from 2000 to 2015. The long term equilibrium relationship between

Period	W5000_1	GDP_1	TAX_1	W5000_2	GDP_2	TAX_2
1	0.026	0.094	0.879	0.307	0.004	0.689
2	0.027	0.166	0.807	0.437	0.018	0.544
3	0.028	0.185	0.787	0.593	0.035	0.371
4	0.032	0.204	0.764	0.639	0.049	0.312
5	0.035	0.210	0.755	0.661	0.059	0.280
6	0.040	0.210	0.749	0.667	0.065	0.268
7	0.045	0.209	0.746	0.667	0.070	0.263
8	0.049	0.206	0.745	0.665	0.073	0.262
9	0.053	0.203	0.743	0.663	0.076	0.261
10	0.057	0.200	0.743	0.661	0.078	0.262

Table 10: Variance decomposition of TAX. *Source: Author's calculations*.

variables in both time periods has been investigated by Johansen's cointegration test. We have identified one cointegrating relationship in both cases. Therefore vector error correction model has been constructed to address short term relationships between variables.

The results from our model suggest that we are able to spot very important change in case of GDP. In the first time period the stock market in first-order and second-order lags and also the lagged period of GDP itself are positively related to the economic growth. These results are logical because the stock market is often considered as a forward looking predictor of future economic performance, which our analysis confirms. And that the past value of GDP influence its present value is not very surprising. However, in the second time period we have completely different results. None of the investigated variables are statistically significant which indicates important change in the nexus between GDP, the stock market and the tax revenue.

Short term equation for the tax revenue demonstrates that this variable is positively affected by GDP for first-order lag and negatively by first-order lag of itself in both periods. But interesting finding occurs in the second period, where the stock market is also important. Past performance of the stock market has started to be statistically significant and positively related for future tax revenues.

As a next step, Granger causality has been tested applying [18] approach. According to our bivariate analysis, the stock market Granger-causes the economic growth and the tax revenue. Moreover, we confirm that GDP Granger-causes the tax revenue. All of these relationships are present in both periods.

In the final step, we investigate forecast error variance decomposition to find out the amount of information each variable contributes to the other variables. In the second period the tax revenue contains more information about the stock market, and the stock market shows to be more important for the economic growth in comparison with the first time period. But the most interesting result occurs in the variance decomposition of the tax revenue. We indicate significant increase of this forecast error variance in case of the stock market and small decrease regarding to GDP. What is surprising is the size of this change that appears between the stock market and the tax revenue. In other words, the development of the stock market influence the tax revenue in much larger extends in the second observed period.

This is an important issue for future research. Further studies, which take these variables into account, will need to be undertaken. These results suggest that the federal government tax revenue, which is the main source of income for the government, is highly dependent on the stock market performance. This could cause a risk of moral hazard because the government has higher motivation to drive the stock market up in order to increase its revenues.

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