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The Nexus among Domestic Investment, Taxation, and Economic Growth in Germany: Cointegration and Vector Error Correction Model Analysis

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Abstract

The development of endogenous growth theory has opened an avenue through which the effects of taxation on economic growth can be explored. Indeed, several empirical studies have examined the effect of many criteria, typically measured as domestic investment, on economic growth. This study reviews the theoretical and empirical evidence to assess whether a consensus arises as to how taxation affects the rate of economic growth. It is shown that the theoretical models isolate several channels through which taxation can affect growth and that these effects may be very. Our empirical facts record that both taxation of corporate and domestic investment positively influence economic growth, as well as, economic growth can affect taxation.

Keywords: Taxation, Domestic Investment, Economic Growth, Germany, VECM

1. Introduction

There is an exhaustive body of literature about how taxation distorts individuals' and firms' decisions concerning for example how much labor individuals supply, how hard they work, how and where investments are made, and where firms choose to locate. There is also a sizeable literature documenting the overall effect of government size on economic growth. Though the results are scattered, recent literature tends to find that government size, typically measured as total government expenditures as a fraction of GDP, is negatively correlated with economic growth in rich economies (Fölster & Henrekson 2001, Romero-Avila and Strauch 2008; Bergh and Karlsson 2010).

There are numerous researches which have been done on Domestic Investment, tax and economic growth in developed and developing countries. However, there are several studies on this topic which have been done in Asian countries. Tax, as we know, is the main source of government revenue and the collection of the tax will be used by the government for development purposes (Edame and Okoi 2014).

The tax system is the combination of the tax policy and tax administration which is the center of the successful implication fiscal policy and the overall management of the public sector. According to Martinez-Vazquez, (2011), if the tax revenue is less, the government will have difficulties to spend in critical areas for economic growth and also for the development of the country.

Among the issues often discussed on the role of tax as a source of finance government spending. Taxes were collected through the income tax of the companies, individuals, and also through goods and services. Through the collection of taxes, the tax revenue would be used for development purposes. Researchers see the design of the tax as a fundamental element to increase the resources in a way that is done the administrative and political, as well as, promote equity and efficiency as far as possible. However, the tax is seen as a burden to society so that some people who fled from their obligation to pay taxes. In terms of goods and services, tax is seen as a cause of the increase in price value.

The objective of this study is to investigate the role and impact of tax and Domestic Investment on economic development in German. Specifically, considering as one of the most popular topics in economics, we attempt to identify the role of tax in economic growth.

The paper is organized as follows: Section 2 reviews previous literature, while Section 3 describes the data, methodology and model specification. Section 4 presents Empirical Analysis, and finally, section 5 concludes the paper.

2. Literature review

Devereux et al. (2002), Veronika and Lenka (2012), Ferede and Dahlby (2012), and Stoilova (2017), among others, investigated the issue of the taxation of corporations and their impact on economic growth for panel of EU member countries. Indeed, they expected a negative relationship between corporate taxation and long-term economic growth. Their findings show that the new EU member countries were not conclusive, but the old EU member countries show that there is a negative relationship between corporate tax burden and long-term economic growth.

Gale et al. (2015) investigated the relationship between taxes and growth at the state level. This study was used from 1977 to 2011 data to measure the business activity. The variables used in this study are personal per capita income, employment, population ratio, the amount of total state and local tax revenue, statutory marginal personal income tax rate, adjusted marginal personal income tax rate, and unemployment rate. The findings are inconsistent with the view that cuts in top state income tax rates will automatically or necessarily generate growth. Furthermore, the results show that marginal tax rates generally have no impact on employment, and statistically significant but economically small effects on the level of firm formation. In the same spirit, Xing (2012), Zellner and Ngoie (2015) Ojong et al. (2016), Bakari (2018), among others, conducted their study of the impact of tax on economic growth using the Marshallian macroeconomic model. The findings revealed that corporate taxes are harmful to economic growth. Seward, (2008); Ojede and Yamarik (2012); Khobai et al. (2016), treated the effects of taxes on economic growth in industrialized countries. The findings recorded a negative correlation between taxes and economic growth.

3. Data, methodology and model specification

3.1.Data

To examine the nexus among domestic investment, taxation and economic growth in Germany, we will use a time-series database that covers the period 1972 – 2016. The succinct depiction of variables is given below in Table 1.

Table 1: Description of variables

No	Variable	Description	Source
1	Y	Gross domestic product (constant US$)	The World Bank
2	DI	Gross fixed capital formation (constant US$)	The World Bank
3	T	Tax revenue (constant US$)	The World Bank

3.2.Methodology

To search the relationship between tax revenue, domestic investment and economic growth in Germany, we will use correlation analysis and an estimation base on the Sims Model. The empirical methodology of this analysis is as follows: (i) Determination of the order of integration of all variables by using the Augmented Dickey-Fuller test; (ii) Determination the number of lags by using a set of information selection criteria such as AIC, SC, and HQ; (iii) Use the Johansen Test to verify the co-integration between variables; (iv) Estimation the Sims Model (VAR if there is no co-integration; VECM if there is co-integration); (v) Applying stability tests to verify the robustness and credibility of the model and the empirical results.

3.3.Model specification

The augmented production function including domestic investment, tax revenue, and economic growth is expressed as:

$$\mathbf{Y} = \mathbf{F}\,(\mathbf{DI}, \mathbf{T})$$

Where Y, DI, and T depict respectively: Gross domestic product (constant US$); Gross fixed capital formation (constant US$), and Tax revenue (constant US$).

The function can also be represented in a log-linear econometric format thus:

$$\mathbf{Log\ (Y) = \beta_0 + \beta_1\ Log\ (DI)_t + \beta_2\ Log\ (T)_t + \varepsilon_t}$$

Where: β_0: The constant term; β_1: coefficient of the variable (Domestic Investment); β_2: coefficient of the variables (Tax Revenue); t: The time trend. ε_t: The random error term assumed to be normally, identically, and independently distributed.

4. Empirical Analysis

4.1.ADF Test

The ADF Test (Augmented Dickey-Fuller Test) is a statistical test that aims to know if a time-series is stationary that is to say if its statistical properties vary or not in time.

Table 1. Augmented Dickey-Fuller Test

Unit Root Test	**ADF**	
	Constant	***Constant, Linear Trend***
Y	(1.732566)	(1.528092)
	[5.784618]***	[5.852181]***
DI	(0.331443)	(3.208594)
	[4.795900]***	[4.749306]***
T	(0.864023)	(2.192624)
	[5.947167]***	[5.874864]***

*****; ** and * denote significances at 1%; 5% and 10% levels respectively**
( ) denotes stationarity in level
[ ] denotes stationarity in first difference

4.2.Lag order selection

The verification of the number of optimal delays that will be applied in our model estimation is very important. To achieve this goal, we will base on a set of selection criteria that are FPE, AIC, SC, and HQ. Based on the results of AIC and SC, the number of lags is equal to 2.

4.3.Co-integration Analysis

Johansen's co-integration test sheds light on the number of co-integration relationships and its functional form by following different criteria. In our case, we will apply the criterion of the Trace Test and the Eigenvalue Test.

Table 3: Johansen Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	***Eigenvalue***	***Trace Statistic***	***0.05 Critical Value***	***Prob.****
None *	0.985802	180.8835	29.79707	0.0001
At most 1 *	0.651724	36.22487	15.49471	0.0000
At most 2	0.010621	0.363035	3.841466	0.5468
Trace test indicates 2 cointegrating eqn(s) at the 0.05 level				
*** denotes rejection of the hypothesis at the 0.05 level**				
****MacKinnon-Haug-Michelis (1999) p-values**				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	***Eigenvalue***	***Max-Eigen Statistic***	***0.05 Critical Value***	***Prob.****
None *	0.985802	144.6586	21.13162	0.0001
At most 1 *	0.651724	35.86183	14.26460	0.0000
At most 2	0.010621	0.363035	3.841466	0.5468
Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level				
*** denotes rejection of the hypothesis at the 0.05 level**				
****MacKinnon-Haug-Michelis (1999) p-values**				

There are 2 co-integration equations, so the error-correction model can be retained. Otherwise, the equation of long-term equilibrium is written as follows:

4.4.Estimation of VECM

Based on the unit root and cointegration test outcomes, the following Vector Error-Correction Model (VECM) is anticipated to fulfill the nature of the short-run and long-run relationships between the variables.

VECMs representations would have the following form, in equations:

D(DLOG(Y)) = C(1)(DLOG(Y(-1)) + 0.385225145262*DLOG(DI(-1)) - 0.800626531892*DLOG(T(-1)) - 0.00808926456975) + C(2)*D(DLOG(Y(-1))) + C(3)*D(DLOG(Y(-2))) + C(4)*D(DLOG(DI(-1))) + C(5)*D(DLOG(DI(-2))) + C(6)*D(DLOG(T(-1))) + C(7)*D(DLOG(T(-2))) + C(8)*

D(DLOG(DI)) = C(9)(DLOG(Y(-1)) + 0.385225145262*DLOG(DI(-1)) - 0.800626531892*DLOG(T(-1)) - 0.00808926456975) + C(10) *D(DLOG(Y(-1))) + C(11)*D(DLOG(Y(-2))) + C(12)*D(DLOG(DI(-1))) +C(13)*D(DLOG(DI(-2))) + C(14)*D(DLOG(T(-1))) + C(15)*D(DLOG(T(-2))) + C(16)*

D(DLOG(T)) = C(17)(DLOG(Y(-1)) + 0.385225145262*DLOG(DI(-1)) - 0.800626531892*DLOG(T(-1)) - 0.00808926456975) + C(18)*D(DLOG(Y(-1))) + C(19)*D(DLOG(Y(-2))) + C(20)*D(DLOG(DI(-1))) +C(21)*D(DLOG(DI(-2))) + C(22)*D(DLOG(T(-1))) + C(23)*D(DLOG(T(-2))) + C(24)*

The following table shows the results of estimating the equation. If the coefficient of the correction error term {C (1), C (9) and C (17)} is negative and possesses a significant probability. This means that all variables in the long-term relationship are significant in explaining the dependent variables.

Table 4: Estimation of VECM

Estimation Method: Least Squares				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.125334	0.271625	-0.461424	0.6455
C(2)	-0.870210	0.353664	-2.460555	0.0156
C(3)	-0.699810	0.307411	-2.276460	0.0250
C(4)	0.339352	0.158707	2.138224	0.0350
C(5)	0.271934	0.142322	1.910699	0.0589
C(6)	-0.050871	0.165815	-0.306795	0.7596

C(7)	-0.135633	0.095611	-1.418582	0.1592
C(8)	-0.000801	0.003416	-0.234342	0.8152
C(9)	-0.321796	0.546635	-0.588686	0.5574
C(10)	-0.617387	0.711737	-0.867437	0.3878
C(11)	-0.808564	0.618654	-1.306972	0.1942
C(12)	0.170471	0.319393	0.533736	0.5947
C(13)	0.238467	0.286417	0.832587	0.4071
C(14)	-0.065355	0.333696	-0.195852	0.8451
C(15)	-0.322093	0.192414	-1.673953	0.0973
C(16)	0.000517	0.006875	0.075211	0.9402
C(17)	1.816191	0.575123	3.157920	0.0021
C(18)	-1.550847	0.748828	-2.071033	0.0410
C(19)	-1.463342	0.650895	-2.248201	0.0268
C(20)	0.217637	0.336037	0.647658	0.5187
C(21)	0.383071	0.301344	1.271211	0.2066
C(22)	0.216065	0.351086	0.615420	0.5397
C(23)	-0.134864	0.202442	-0.666187	0.5068
C(24)	-0.000456	0.007233	-0.063108	0.9498

In our case, C (1), C (9), and C (17) are not significant. This means that there is no relationship between domestic investment, taxation, and economic growth in the long-run. The following table shows the summarizations that explain better the results of causality in the long run and short run.

Table 5: Estimation of VECM (Results of causality in Long run and short run)

	Y	**DI**	**T**
Y	-	(0.4211)	**(0.0504)***
DI	(0.0608)*	-	**(0.4452)**
T	(0.1660)	(0.0536)*	-
ECT	**[C1 = - 0.125334]**	**[C9 = - 0.321796]**	**[C17 = 1.816191]**

*****; ** and * indicate significance at 1%, 5% and 10%, respectively**

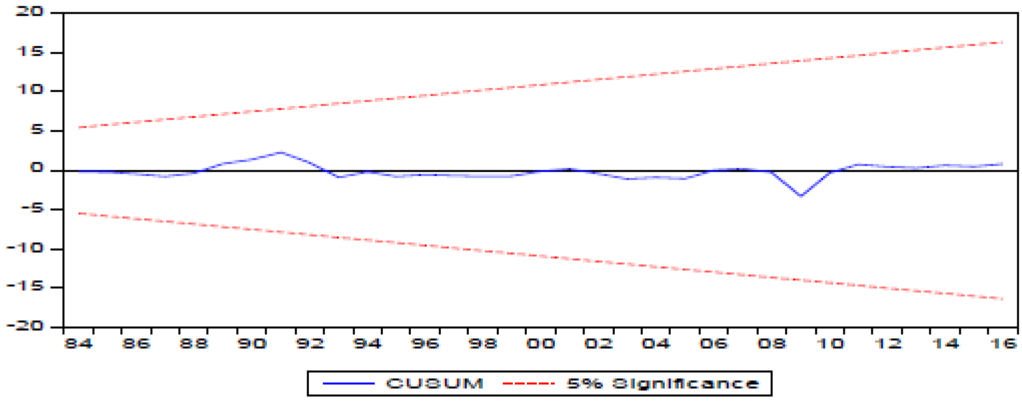
( ) denotes the value of the probability of the variables in the short term

[ ] denotes the significance of long-term co-integration equations

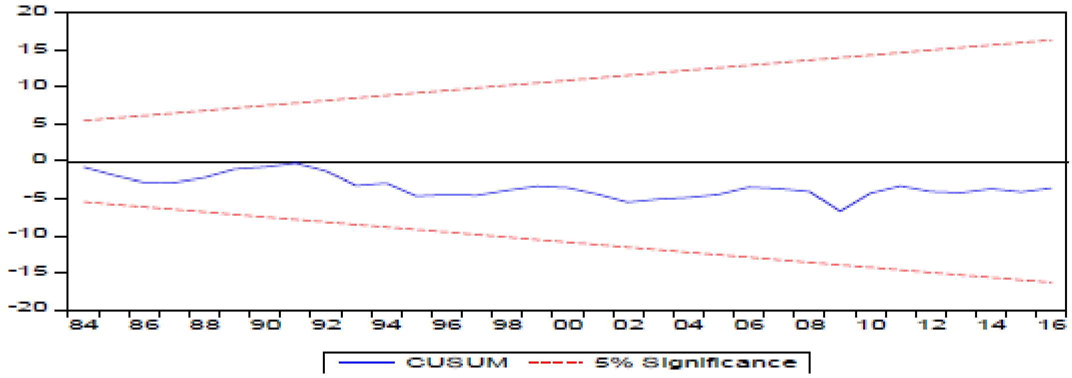
In the short-run, Table 5 shows that domestic investment causes economic growth, economic growth causes taxation, and taxation causes domestic investment.

4.5.Model Stability

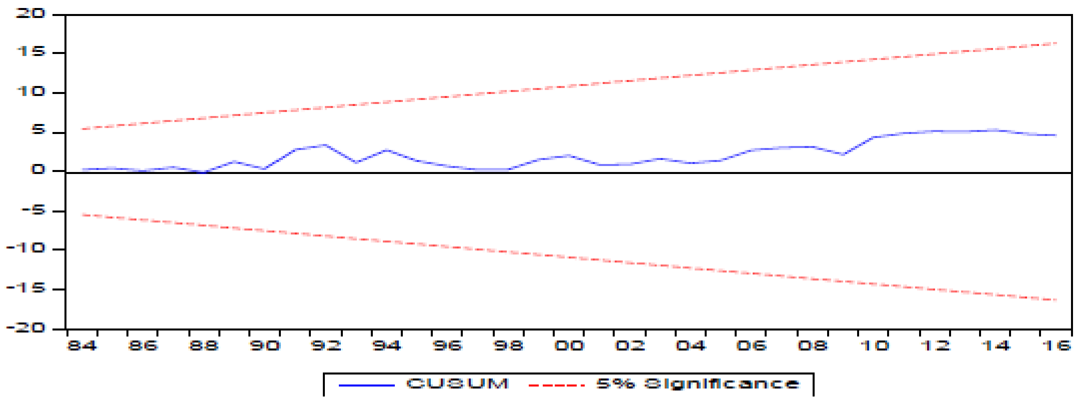
4.5.1. Model Y



4.5.2. Model DI



4.5.3. Model T



The test result of the stability VAR (CUSUM Test) show that the Modulus of all roots is less than unity and lie within the unit circle. Accordingly, we can conclude that our model the estimated VAR is stable and stationary.

5. Conclusion

In spite of the fundamental nexus between tax, investment, and economic growth, motivated by this controversial debate, we inspected the relationship between taxation, domestic investment and economic growth in Germany during the period 1972–2016. To attempt this objective, we use the cointegration analysis and vector error correction model. Empirical results confirm that there is no relationship between domestic investment, taxation, and economic in the long-run.

Most of the previous studies also find the negative and significant relationship between taxes and economic growth. The government should realize effective macroeconomic policies along with momentous improvements in the structure and functioning systems of governance for stabilizing economic growth, such as tax policy changes. According to the results, we found that domestic investment causes economic growth, economic growth causes taxation, and taxation causes domestic investment. From this perspective, a sound, integrated, and harmonious actions are required to maintain the macroeconomic equilibrium's sustainability of the State and to avoid the puzzling scenarios of public finance.

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