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ADVANCES IN GLOBAL SERVICES AND RETAIL MANAGEMENT: VOLUME 2

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Optimal Fiscal and Price Stability in Germany: Autoregressive Distributed Lags (ARDL) Cointegration Relationship

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Abstract

The impact of optimal fiscal policy measures in a managed fixed exchange rate system were questioned in this study, to evaluate the extent of Integrated Monetary and Fiscal Policy issuing quarterly time series data for Germany, for the period ranged between 1991q1 to 2017q4. The study shows that an optimal utilization of fiscal policy measures for economic growth in Germany is questioned in the light of tax revenue, government expenditure and public debt and consumer price index. The Autoregressive Distributed Lag (ARDL) model was employed due to the fact that one of the data parameters becomes stationary at level by 0.10% with a probability value of 0.0768, as shown in Table 1, while the other data parameter becomes stationary after differencing, as shown in Table 2 below. Numerous tests were employed to identify the stability and causality of the variables. The stability and causal relations of the data were proved by serial correlation Breusch Godfrey LM test and heteroskedasticity test, respectively. The analyses revealed that fiscal policy instruments are used optimally in Germany as proved by the outcome of the research and S. Boubaker (2018).

Keywords: exchange rate, autoregressive distribution lag, fiscal policy, Germany, economic growth

Introduction

Fiscal Policy is a strategy to guarantee long-run indebtedness to bear the ability (Bonam & Lukkezen, 2018). Additionally, it is considered as a standout among the most significant financial policy instruments for the adjustment of output (Markus Eller et al., 2016). Similarly, is considered among the most dominant switches of crude accumulation (Marcelo, 2017) the viability of financial policy in balancing out recurrent variances in product and employment is significant to the extent that vacillations influence social welfare (Staehr, 2007). However, unsustainable monetary deficiencies and open obligation levels made the spectra of financial predominance in numerous nations, prompting high and unstable expansion and raised hazard premix on government obligation. On the other way round price steadiness and the economy rapidly keep running into a noteworthy barricade: there is no accord on the most proficient method to quantify the size and heading of changes in money related approach. The customary methodology, which distinguishes changes in monetary policy with changes in the stock of money, isn't satisfactory since practically speaking the development rates of money related totals rely upon an assortment of non-policy impacts. For instance, on the grounds that the role that monetary policy plays in the

economy and the manner in which it ought to be directed by the Apex banks relying upon the manner in which the policy influences every economy. While fiscal policy includes the utilization of instruments, for example, taxes, spending or grant by government institutions that could make ready for the accomplishment of certain preordained macroeconomic goals. Ideal fiscal approach inside the c of context incorporated European fiscal policy framework is progressively confronting serious difficulties, for example, many years of financial meltdown and GDP growth rates, inflation rate and instability in the segment (Vitor, 2015). These present clear difficulties for the way toward accomplishing growth, which requires the utilization of indispensable instruments and ideal use for improved fiscal development. The impact of fiscal strategy in improving economic situations is, however, a flawed demonstration and necessary review on the subject matter become significant. Utilizing expense measures can impact economic changes either emphatically or adversely. Reducing tax estimates prompts an expansion in the extra cash that changes the monetary interest causing inflationary pressures, as demonstrated by Shahid and Ahmad (2010).

Objective of This Study

1. To inspect the ideal usage of fiscal policy measures in a real GDP in a coordinated economy like Germany
2. To distinguish the influence (relationship) of the tax rate, government consumption and consumer price index on the real GDP of Germany

Research Questions

1. The accompanying examination addresses will accomplish the previously mentioned target:
2. How does a fiscal strategy instrument influence the real Gross domestic product in Germany?
3. What exactly degree have tax rate, government spending and prices influenced the market and economic growth of Germany?

Hypotheses of the Study

Coming up next are the theories to be tried in the examination.

- H_o: $\gamma = 0$ Yt residuals are not sequentially connected and residuals are not heteroscedastic but rather are homoscedastic and ordinarily conveyed
- H_1: $\gamma \neq 0$ Yt residuals are sequentially connected, residuals are heteroscedastic and are not ordinarily conveyed.

Literature Review

Fiscal policy is worked by utilizing charge, spending (consumption) and different devices or instruments that have an immediate bearing on the lives of citizens inside its regions. These methodologies are acknowledged everywhere throughout the world and are especially identified with income and spending programs. These strategies can influence the economic prosperity in this way affecting the control of fiscal frameworks at both smaller scale and large scale levels. Shahid and Ahmad (2010) examined the impact of fiscal strategy on economic development utilizing time series information from Pakistan. They distinguished fiscal strategy as an

administration exertion that can impact the course of the economy through a change in expenses or consumption or both after some time, further expressed that the fiscal methodology under the traditional framework has a negative outcome if government activity just includes the decrease of tax without diminishing public spending. So also, Khilji and Hamood (1997) saw fiscal deficiency as a factor that prompts economic development challenges. This repudiates the supposition of Haq (2003), who accepted that fiscal shortfall has no impact on the major macroeconomic factors like Gross domestic product development, investment, and high price level. Karsten Staehr (2008) portrayed the fiscal policy as a significant topic of discourse in the EU today, which is probably going to assume a noteworthy in future. The use of financial approach has been a standout amongst the most argumentative issues in the task of the Europeans Monetary Union (EMU). The advantages of fiscal and monetary policies in the EMU and the impact of monetary strategy and financial variances have been generally talked about; see, for instance, Ballabriga and Martiniez-Mongay (2003) and Wyplosz (2006) similarly the adequacy of fiscal policy in settling value vacillations in productivity and employment is significant to the extent that changes influence social welfare.

In fiscal or monetary policy, the objective of an economic policy is to accomplish some macroeconomic ambitions such as broad employment, economic betterment, peak resource apportionment and objective income disposition Walter (2018). Economic consolidation encourages the movement of products and services, capital and people, this advances the inherent for mobility of tax infrastructures among countries. Thereafter, constituent countries may plan to increase their personal tax rates by involving income contention. Thus, techniques that are generally expected to induce to less prime tax rates and government spending levels. It is also spontaneously agreed that one can forestall such scarcity by following certain tax adjustment policies Helmuth and Firouz (1999).

Public debt is a particular kind of imaginary capital and that the last is the result of a rationalistic improvement in the substantiation of various sorts of capital, (Marcelo, 2017). Furthermore, El-Khoury 2017 public debt is a key source to finance the spending shortfall, and as a percentage of GDP has as of late exhibited a rising pattern in developed nations (Kazumasa & Motohiro, 2014) public debt is reasonable just under the condition that the state separates an essential excess. The estimation of this essential surplus relies upon the development rate of the economy (Yeşim et al., 2007) public debt impartiality has been a standout amongst the most discussed issues in macroeconomics literatures. Among others, (Phelps & Taylor, 1977) think about the connection among commotion and a functioning adjustment policy.

Methods and Empirical Results

To study of the optimal use of the fiscal policy impact on economic growth of an integrated policy, the researchers employed time series data from 1991Q1 to 2017Q4 to prove the relevance of such measures. The data were sourced from International Monetary Fund (IMF), German Central Bank, European Central Bank etc to examine the relationships between variables, which can be expressed as follows.

Data Generation and Selected Variables

Quarterly data for German on Real GDP, Total Revenue to GDP, Total Public Debt and Consumer Price Index (General Price Level),which covers the period from 1991Q1-2017Q4. The source of data includes among others German Apex Bank statistical page, World Bank Data page, etc.

$$RGDP = (TPDEBT, TRGDP, CPI) \quad \text{.. (1)}$$

To change the equation in to econometrics form, the mathematical terms can simply rewrite to a multiple regression forms as follows:

$$RGDP_t = \beta 0 + \beta_1 TRGDP_t + \beta_2 TPDEBT_t + \varepsilon_t \text{.. (2)}$$

Where:

$RGDP_t$	Real Gross Domestic Product
$TPDEBT_t$	Total Public Debt
$TRGDP_t$	Tax Revenue to GDP
CPI	Consumer Price Index (General Price Level)

Empirical Results

Unit Roots Tests

To enable the researchers to determine the stability of the data under review, Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) (1988) tests, were used to signify the stationarity of the data.

ADF Model

$$\Delta Y_t = \alpha_0 + p1Y_{t-1} + \alpha_2 T + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-1} + u_t \tag{3}$$

$$\Delta yt = \rho yt-1 + (constant, time\ trend) + ut \tag{4}$$

The α_0 mean constant, T stand as trend $\sum_{i=1}^{k}$ refers to summation observation at various times u_t is a white noise. ADF test result indicates both at I(0) and I(1) at different level of significant as shown in Table 1.

Table 1: Augmented Dickey Fuller Test (ADF)

Variables	Trend and Intercept	Trend and Intercept	Values
	Level I(0)	First Difference I (1)	
LnRGDP	-3.3687	-	Statistical Value
	-3.1519		Critical Value
	0.0612**		Probability
LnTRGDP	-1.5608	-10.5508	Statistical Value
	-3.4524	-3.4528	Critical Value
	0.8019	0.0000*	Probability
LnTPDEBT	-2.2308	-11.2453	Statistical Value
	-3.4524	-3.4528	Critical Value
	0.4676	0.0000*	Probability
CPI	-3.3285	-	Statistical Value
	-3.1527		Critical Value
	0.0674**		Probability

*, **Refers at 0.01 and 0.10 levels of significance

Table 2: Phillips Perron (PP) TEST

Variables	Trend and Intercept	Trend and Intercept	Values
	Level I(0)	First Difference I (1)	
RGDP	-3.1069	-7.4914	Statistical Value
	-3.4524	-4.4528	Critical Value
	0.1100	0.0000*	Probability
TRGDP	-2.2192	-11.2453	Statistical Value
	-3.4524	-3.4528	Critical Value
	0.4739	0.0000*	Probability
TPDEBT	-1.5480	-10.5488	Statistical Value
	-3.4524	-3.4528	Critical Value
	0.8066	0.0000*	Probability
CPI	-3.9509	-	Statistical Value
	-3.4526		Critical Value
	0.0132**		Probability

*, **Refers at 0.01 and 0.10 levels of significance

ARDL Bounds Tests for Cointegration

Considering the idea of the data, and the need to break down the connections and impacts of the variables, the autoregressive distributed lag (ARDL) cointegration strategy is considered as the best model. This ARDL cointegration approach was created by Pesaran and Shin (1999) and Pesaran et al. (2001). It has three points of interest in comparison with different past and conventional cointegration techniques. Does not necessitate that all the detectable factors for the investigation must be incorporated of a similar request and it tends to be connected when the fundamental factors are coordinated of I(1), or I(0) incorporated. Is moderately progressively effective with little and limited example data sizes, and it is conceivable to accomplish fair-minded appraisals of the long-run model (Harris & Sollis, 2003)

To test for cointegration using ARDL (P, q1,q2, q3)

$$Ho = \beta 1j = \beta 2j = \beta 3j = \beta 4j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

$$H1 \neq \beta 1j \neq \beta 2j \neq \beta 3j \neq \beta 4j \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

$\Delta LnRGDP_t = a_{10} + \boldsymbol{\beta_{11}LnRGDP_{t-i}} + \beta_{21}LnTPDEBT_{t-1} + \beta_{31}LnTRGDP_{t-1} + \beta_{41}CPI_{t-1} + \sum^{P}_{i=1}a_{1j} \Delta LnRGDP_{t-1} + \sum^{q1}_{i=1} a_{2j} \Delta LnTPDEBT_{t-1} + \sum^{q2}_{i=1} a_{3j} \Delta LnTRGDP_{t-1} + \sum^{q3}_{i=1} a_{3j} \Delta CPI_{t-1} + \varepsilon_{ij} \ldots\ldots(7)$

$\Delta LnTPDEBT_t = a_{20} + \beta_{12}LnRGDP_{t-i} + \boldsymbol{\beta_{22}LnTPDEBT_{t-1}} + \beta_{32}LnTRGDP_{t-1} + \beta_{42}CPI_{t-1} + \sum^{P}_{i=1} a_{1j} \Delta LnTPDEBT_{t-1} + \sum^{q1}_{i=1} a_{2j} \Delta LnRGDP_{t-1} + \sum^{q2}_{i=1} a_{3j} \Delta LnTRGDP_{t-1} + \sum^{q3}_{i=1} a_{3j} \Delta CPI_{t-1} + \varepsilon_{ij} \ldots\ldots(8)$

$\Delta LnTRGDPt = a_{30} + \beta_{13}LnRGDP_{t-i} + \beta_{23}LnTPDEBT_{t-1} + \boldsymbol{\beta_{33}LnTRGDP_{t-1}} + \beta_{43}CPI_{t-1} + \sum^{P}_{i=1} a_{1j} \Delta LnTRGDP_{t-1} + \sum^{q1}_{i=1} a_{2j} \Delta LnRGDP_{t-1} + \sum^{q2}_{i=1} a_{3j} \Delta LnTPDEBT_{t-1} + \sum^{q3}_{i=1} a_{3j} \Delta CPI_{t-1} + \varepsilon_{ij} \ldots.(9)$

$\Delta LnCPIt = a_{40} + \beta_{14}LnRGDP_{t-i} + \beta_{24}LnTPDEBT_{t-1} + \beta_{34}LnTRGDP_{t-1} + \boldsymbol{\beta_{44}CPI_{t-1}} + \sum^{P}_{i=1} a_{1j} \Delta CPI_{t-1} + \sum^{q1}_{i=1} a_{2j} \Delta LnRGDP_{t-1} + \sum^{q2}_{i=1} a_{3j} \Delta LnTPDEBT_{t-1} + \sum^{q3}_{i=1} a_{3j} \Delta LnTRGDP_{t-1} + \varepsilon_{ij} \ldots\ldots\ldots(10)$

Lag Selection

To run a ARDL bound test there is need to determine the lag legs of the model using Akaike Information Criteria (AIC) and Schwarz criterion among the most popular methods of selecting the best lags.

Table 3: Lag Selection Based on AIC and SIC

	Variables	Lags
1	LNRGDP	2
2	LNTPDEBT	1
3	LNTRGDP	1
4	CPI	5

Table 4: Bound Test for Cointegration Using Model 3 (Constant) Unrestricted Constant No Trend

Dependent Variable	F and T Statistic	Cointegration	Action(s)
LNRGDP$_t$	F-Statistic 2.99 I(0) 3.23 I(1) 4.35*	No Cointegration	Estimate ARDL (Short_Run)
	T-Statistic -0.813 I(0) -2.86 I(1) -3.78*		
LNTPDEBT$_t$	F-Statistic 4.03 I(0) 2.72 I(1) 3.77**	Cointegration	ECM (Long-run)
	T-Statistic -2.09 I(0) -2.86 I(1) -3.78*	(WEAK)	
LNTRGDP$_t$	F-Statistic 1.75 I(0) 3.23 I(1) 4.35*	No -Cointegration	Estimate ARDL Short-run
	T-Statistic -0.95 I(0) -2.86 I(1) -3.78*		
CPI$_t$	F-Statistic 5.39 I(0) 3.23 I(1) 4.35*	Cointegration	ECM (Long-Run)
	T-Statistic-373 I(0) -2.86 I(1) -3.78*		

* and **Refers at 0.05 and 0.10 levels of significance

If *there no cointegration relation among the variables*

$$\Delta LNRGDPt = a_{10} + \sum_{i=1}^{p} aij\Delta LNRGDP_{t-1} + \sum_{i=1}^{q1} a2j\Delta LNTPDEBT_{t-1} + \sum_{i=1}^{q2} a3j\ \Delta LNTRGDP_{t-1} + \sum_{i=1}^{q3} a4j\Delta CPIt\text{-}1 + \varepsilon_t \tag{11}$$

If cointegration exist among the variables

$$\Delta LNRGDPt = a_{10} + \sum_{i=1}^{p} aij\Delta LNRGDP_{t-1} + \sum_{i=1}^{q1} a2j\Delta LNTPDEBT_{t-1} + \sum_{i=1}^{q2} a3j\ \Delta LNTRGDP_{t-1} + \sum_{i=1}^{q3} a4j\Delta CPIt\text{-}1 + \lambda ECT_{t-1} + \varepsilon_t \tag{12}$$

The result in the table above indicates that, two cointegration exist at a where LNTRGDP and CPI are dependent variable. Those give further step to conduct an error correction model (ECM) for the two variables and short run ARDL estimation for LNRGDP and LNTRGDP.

Table 5: Short Run Relationship ARDL

Variables	Coefficients	Prob.	Remarks
LNRGDP	0.1763	0.4817	There is no short-run relationship between the variables
LNTPDEBT	0.0001	0.9776	There is no short-run relationship between the variables
CPI	0.0002	0.1763	There is no short-run relationship between the variables

Dependent Variable: LNTRGDP
Method/Model:ARDL (AIC 1, 0, 0, 1)
Dynamic Regressors: LNRGDP, LNTPDEBT, CPI
Sample: 1991Q3-2017Q4

Table 6: ARDL Estimation

Variables	Coefficients	Prob.	Remarks
LNTRGDP	-0.0094	0.0124	There is existence short-run relationship between the variables
LNTPDEBT (-1)	0.0549	0.0000	There is existence short-run relationship between the variables
LNTPDEBT (-2)	0.0412	0.0000	

Dependent Variable: LNRGDP
Method/Model: ARDL (AIC 2,0,2,0)
Dynamic Regressors: LNTRGDP, LNTPDEBT, CPI
Sample: 1991Q3-2017Q4

Table 7: Long Run Relationship and Error Correction Model (ECM)

Variables	Coefficients	Prob.	Remarks
LNTRGDP_(-1)	-0.5092	0.0150	Long-run relationship exist between the variables
ECM_LNTPDEBT (-1)	-0.9256	0.0031	ECM requires 93% speed of adjustment to correct the error of the current proceeding year errors by next accounting period

Dependent Variable: D (LNTPDEBT)
Method: Least Square
Sample: 1991Q3-2017Q4

Table 8: Error Correction Model (ECM)

Variables	Coefficients	Prob.	Remarks
LNTRGDP_(-1)	-1.3573	0.0568	Long-run relationship exist between the variables
LNTRGDP_(-1)	-1.7387	0.0537	
D(LNRGDP)_(-1)	17.3427	0.0051	Long-run relationship exist between the variables
D(LNRGDP)_(-2)	-16.3795	0.0993	
ECM_CPI_(-1)	-1.0461	0.0426	ECM requires 105% speed of adjustment to correct the error of the current proceeding year errors by next accounting period

Dependent Variable: D(CPI)
Method: Least Square
Sample: 1991Q3-2017Q4

Table 9: Summary of Flow of Direction for Short and Long Run Relationship and ECM

S/No	Flow of Directions	Remarks
1	LNRGDP – LNTRGDP	Unidirectional relationship at short-run
2	LNRGDP – LNTPDEBT	Unidirectional relationship at short-run
3	D(LNTPDEBT) – D(LNTRGDP)	There is unidirectional relations exist in the long-run
4	D(CPI) – D(LNTRGDP)	There is unidirectional relations exist in the long-run
5	D(CPI) – D(LNRGDP)	There unidirectional is existent of long-run relationship

Diagnostic Tests

Diagnostic tests was conducted to examined the healthy conditions of the series, the serial correlation (Breusch-Godfrey LM test) and Heteroscedesticity Test were examined as showed in table 10 below. The results displayed that, the model for the analyses are free from serial correlation and are homoscedasticity therefore reflects the stability and the model satisfies the diagnostic tests. The stability of the long-run coefficient is tested by the short-run dynamics. The cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests are applied to assess the parameter stability (Pesaran and Pesaran (1997).

Table 10: Result of Diagnostic Tests

Serial Correlation Breusch Godfrey LM Test		
Variables	**X^2 Statistic**	**Prob.**
LNRGDP	2.3968	F (2,94) 0.3378
LNTPDEBT	1.4471	F (1,99) 0.2446
LNTRGDP	1.3676	F (1,100) 0.2553
CPI	3.9499	F (5,75) 0.6968
Heteroskedasticity Test		
LNRGDP	8.0323	F (8,96) 0.4458
LNTPDEBT	9.7972	F (5,100) 0.0799
LNTRGDP	2.3879	F (4,101) 0.6764
CPI	25.5966	F (21,80) 0.2167

Conclusion

This research was designed to study the fiscal policy in Germany and its effectiveness on price stability, using the Autoregressive Distributed Lag (ARDL) to determine the cointegration relationship between the variables. That's to identify the influence relation of tax revenue,

government (public) debt and price stability on the real GDP of Germany. The analysis indicates that, there's an existence of unidirectional among the variables and in the long-run, for a Germany to make an adjustment for the errors of proceeding period to the next year for the public debt and price index required a speed of 93% and 104% respectively however, there is exist of short run relation between total revenue and real GDP. Similarly, the result in the table 9 shows the unidirectional relationship between real GDP with total revenue to GDP and total public debt equally exist between total revenue to GDP and real GDP with Consumer Price Index (CPI).

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