# What are the factors that drive economic growth? evidence from Turkey

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18 April 2018

# What are the factors that drive economic growth? evidence from Turkey

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## Abstract

The paper focuses on the factors determining the economic growth. Turkey is used as a case study. Because of the regional tensions in the Turkish region, we want to help the policy makers know what factors of economic growth they should focus on to promote growth. The standard time series techniques are used for the analysis. The findings tend to indicate that the GDP is the most endogenous (i.e., dependent) variable and the inflation rate is the most exogenous (i.e., independent) variable. Based on the generalized variance decompositions, it appears that the Granger-causal chain is driven mainly by the inflation rate leading to gross capital formation, Government consumption, trade openness and GDP. Our findings recommend that the Turkish policy makers should focus on the above factors to enhance economic growth.

**Key Words:** Economic Growth, Trade Openness, Inflation, Granger-Causality, Turkey.

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## 1. Introduction

In the time of turbulent geopolitical conflicts taking place in Turkey and the region, we want to investigate the relationship between Turkish economic growth and its determinants. Our results are meant to help policy makers understand the existing relationship between the variables and take action accordingly, especially in the context of the regional and international tensions.

We took into account Turkey's conditions and we did some necessary changes in choosing the variables which will be developed later in the paper. As far as we know, no such study was performed on Turkey's economy. This paper is supposed to explore the long term relationship between economic growth and its determinants in the context of Turkey's economic conditions.

Economic growth remains the driving motivation of any country and its enhancement is always a high priority for policy makers. The empirical and theoretical literature are full of research papers that have placed a special emphasis on growth's relationship with its determinants in order to determine endogenous and exogenous factors that are likely to impact economic growth (Abdullah, 2012; Hussin, 2013; Afzal, 2013; Srinivasan, 2013). Through the present paper, we are trying to answer the following questions: "is economic growth in Turkey an endogenous or exogenous variable? "How does trade openness affect growth?" "What does affect gross domestic investment and government consumption, and how do they influence growth?" "How does inflation affect growth?"

In order to answer these questions and see their policy implications, we will use the standard time series techniques to analyze data. Our focused variables will be GDP to capture economic growth, government consumption, gross capital formation, trade openness and foreign domestic investments (FDI). However, when we started running the data we failed to find a cointegration between the variables and hence we had to remove the FDI variable to move on with the analysis. Furthermore, we introduced an additional variable which is inflation rate (IN). We are controlling for inflation because of the long history Turkey has had with high inflation levels that pushed the Turkish governments to always try to implement programs aiming at reducing inflation to single-digit levels (Dibooglu & Kibritcioglu, 2004).

The paper is structured as follows: Section 2 presents the literature review on economic growth and its determinants. Section 3 elaborates on the data used and its sources. Section 4 describes in

detail the methodology used for this analysis and discusses the results. Section 5 concludes the paper with a summary of the findings and their policy implications.

## 2. Literature review

In a study, (Hossain & Mitra, 2013) investigated the dynamic causal relationships between economic growth and its determinants in 33 highly aid-dependent African countries for the period 1974-2009. They found that the long-run effects of trade openness, domestic investment and government spending on economic growth are significantly positive. In addition, (Bagdigen & Cetintas, 2003) tested the long run relationship between GDP and public expenditure and found that there is no causality relationship between public expenditure and GDP in the Turkish case whereas, in theory, the former should be an outcome of growth. Also, (Hsieha & Laia, 1994) tested the relationship between government expenditure and economic growth in the G-7 countries, and found that this relationship can vary significantly across time as well as across the major industrialized countries that have similar growth levels. In addition, no consistent evidence was found that government spending can increase or decrease per capita output growth. Public spending contributes at best a small proportion to the growth of an economy.

When it comes to openness, (Sinha & Sinha, 2000) tried to explore how growth of openness and the growth of domestic investment contribute to growth of GDP in Asian countries and found that the growth rate of GDP is positively related to the growth rates of openness and domestic investment. (Moral-Benito, 2010) found in his study that the investment ration is the sole variable that causes long-run economic growth. Moreover, (Fetahi-Vehapi, Sadiku, & Petkovski, 2015) studied the effects of openness to trade on economic growth of South East European countries and found that there are positive effects of trade openness on economic growth but conditioned by the initial income per capita and other explanatory variables. They also showed that the trade openness is more beneficial to countries with higher level of initial income per capita, as well as trade openness favors countries with higher gross fixed capital formation. A similar study about the impact of trade openness on growth in Brazilian states found that openness is more beneficial to states with a high level of initial per capita income. Furthermore, trade openness favors more industrialized states, rather than states whose economic activity is mainly based on agriculture (Daumal & Özyurt, 2011).

(Leon-Gonzalez & Vinayagathasan, 2015) explored the determinants of growth in 27 Asian developing economies (from 1980 until 2009) and found that an economy's investment ratio is positively correlated to growth, while government consumption expenditure and terms of trade are negatively correlated. They also concluded the existence of a nonlinear relationship between inflation and economic growth, that is, inflation impedes economic growth when it exceeds 5.43% but does not have any significant effect on growth below that level.

(Bick, 2010) revisited the relationship between inflation and economic growth and concluded that the detrimental impact for inflation rates above the threshold turns significantly and doubles in magnitude, and that keeping inflation below the threshold has a stronger beneficial effect. Moreover, (Khan & Semlali, 2001) studied the threshold effects in the relationship between inflation and growth and found that the threshold level of inflation above which inflation significantly slows growth is estimated at 1-3 percent for industrial countries and 11-12 percent for developing countries. (Dibooglu & Kibritcioglu, 2004) focused in their study on output and inflation in Turkey in the last two decades and found that terms of trade, monetary, and balance of payments shocks figure prominently in the inflationary process. Output is mostly driven by terms of trade and supply shocks. They highlighted the importance of a credible disinflation program and structural reforms that restrain discretionary aggregate demand policies.

## 3. Data

We are examining the relationship between growth and its determinants and therefore we are using the following variables: “GDP” for Gross Domestic Product, “GC” for Government Consumption Expenditure, “GFCF” for Gross Capital Formation, “TO” for Trade Openness which is the sum of exports and imports of goods and services measured as a share of gross domestic product[1]. Giving Turkey’s long years of high levels of inflation, we added the variable “IN” as an indicator for Consumer Price Index.

All data was extracted from Datastream. We used quarterly data for all variables for 18 years starting from 1998Q1. The start date is dictated by the availability of data for GDP according to TurkStat data (Turkish Statistical Institute) which only offer quarterly data for the last 17 years. A total of 70 observations were obtained.

[1] http://data.worldbank.org/indicator/NE.TRD.GNFS.ZS

The Inflation is proxied by the Consumer Price Index using the year 2003 as basis, all other variables used are expressed in Thousands New Turkish Lira and are based on 1998 prices. GDP figures are Total Constant Prices using Production Approach. Exports and Imports figures are used to calculate Trade openness and both refer to total constant prices of Goods and Services using Expenditure Approach. GC numbers are Total Constant Prices that refer to the Final Consumption Expenditure (General Government) based on Expenditure Approach. And GFCF figures are fixed overall Total Constant prices based also on Expenditure Approach.

## 4. Methodology, Analysis and Discussion of the Results

To investigate the empirical relationship between GDP and the other variables, we will use the standard time series technique notably, unit root test, determination of lags of the VAR model, cointegration and Long Run Structural Modeling to test theory first. Unlike regression approach where theory assume the causality relationship, time series enables us to check empirically the existence of such relationship. Later on, we move to Error Correction Modelling, Variance Decomposition analysis, Impulse response when we shock each variable and the Persistence Profile of the whole system.

*Unit Root test*

To begin our study, we check first the stationarity[2] of our data. Ideally, we should find that all variables are non-stationary in the level form but stationary at the first differenced form. To normalize variables' scale we log all variables in the level form then we difference them by deducting the difference of their log forms. We use the Augmented Dickey-Fuller (ADF), Phillips–Perron (PP) and KPSS tests to test stationarity of the variables. Results are the following:

[2] A variable is stationary when its mean, variance and covariance are constant over time.

| Tests | ADF | | | PP | | | KPSS | | |
|---|---|---|---|---|---|---|---|---|---|
| Variables | T-Stat | CV | Comment | T-Stat | CV | Comment | T-Stat | CV | Comment |
| Variables in Level Form | | | | | | | | | |
| LGDP | -.36497 | -2.8421 | NS | -2.0860 | -2.9484 | NS | .52171 | .38958 | NS |
| LGC | 1.1595 | -2.8681 | NS | -5.9854 | -2.9484 | S | .53948 | .38958 | NS |
| LGFCF | -.69266 | -2.8421 | NS | -1.0137 | -2.9484 | NS | .47011 | .38958 | NS |
| LTO | -2.1597 | -2.8407 | NS | -2.3365 | -2.9484 | NS | .46147 | .38958 | NS |
| LIN | -2.8127 | -2.8421 | NS (SBC) | -7.7291 | -2.9484 | S | .51432 | .38958 | NS |
| Variables in Differenced Form | | | | | | | | | |
| DGDP | -4.5893 | -2.8315 | S | -14.8754 | -2.8844 | S | .12535 | .38958 | S |
| DGC | -46.8400 | -2.8658 | S | -49.8411 | -2.8844 | S | .11042 | .38958 | S |
| DGFCF | -4.5046 | -2.7705 | S | -11.8418 | -2.8844 | S | .10889 | .38958 | S |
| DTO | -4.6921 | -2.8315 | S | -18.6734 | -2.8844 | S | .12317 | .38958 | S |
| DIN | -2.9721 | -2.8071 | S (SBC) | -3.5573 | -2.8844 | S | .41160 | .38958 | S |

*NS: Non-Stationary, S: Stationary.

For the above tests we based our choices on the highest computed value of AIC criterion at 95% confidence level, and on the tables including intercept without trend. The results between the different tests are conflicting between ADF[3], KPSS[4] and PP[5] case. Based on ADF and KPSS test we are good to go and continue with the remaining steps. However, if we choose PP results we will have to go with ARDL technique. We have run the two techniques but found out that all variables are endogenous according to Error Correction model in ARDL. We think that because ARDL is a single equation model and that our model might have more than two equations to estimate the required model, we got such inconclusive results. Therefore, we will follow ADF and KPSS results that show that all our variables are I(1), and continue with the other tests.

[3] In ADF, the null hypothesis is that the variable is non-stationary. As long as the test statistic is lower than the critical value we cannot reject the null. Conversely in the first differenced form, as long as the test statistic is higher than the critical value we can reject the null and conclude that the variable is stationary

[4] In KPSS, the null hypothesis is that the variable is stationary. As long as the test statistic is lower than the critical value we cannot reject the null. Conversely in the first differenced form, as long as the test statistic is higher than the critical value we can reject the null and conclude that the variable is non-stationary.

[5] In PP, the null hypothesis is that the variable is non-stationary. As long as the test statistic is lower than the critical value we cannot reject the null. Conversely in the first differenced form, as long as the test statistic is higher than the critical value we can reject the null and conclude that the variable is stationary.

*Determination of Order of the VAR Model*

We need to determine the optimal number of lags of the Vector Auto Regression (VAR) to use to test for cointegration. The unrestricted VAR table below shows conflicting results between AIC, SBC and Adjusted LR test. The highest value of AIC criteria suggests 4 lags, SBC's suggests 2 lags while Adjusted LR suggests 3 lags.

```
Order    LL        AIC      SBC             LR test          Adjusted LR test
 6    751.8665  601.8665  441.1314             ------             ------
 5    716.4874  591.4874  457.5415  CHSQ(25)=  70.7583[.000]   37.0639[.057]
 4    704.6123  604.6123* 497.4555  CHSQ(50)=  94.5085[.000]   49.5045[.493]
 3    671.2383  596.2383  515.8707  CHSQ(75)= 161.2565[.000]   84.4677[.213]*
 2    629.6256  579.6256  526.0473* CHSQ(100)= 244.4817[.000]  128.0619[.031]
 1    516.4655  491.4655  464.6763  CHSQ(125)= 470.8020[.000]  246.6106[.000]
 0    348.8613  348.8613  348.8613  CHSQ(150)= 806.0105[.000]  422.1960[.000]
*******************************************************************************
 AIC=Akaike Information Criterion     SBC=Schwarz Bayesian Criterion
```

We test next for autocorrelation and we find that there is no autocorrelation problem in all our variables (Check Appendix II for more details). Normally we need to go with 2 lags but given some issues we found in the cointegration part, we decided to go with 3 lags.

| Variable | F test p-value | Result at 5% significance level |
|---|---|---|
| DGDP | .278 | There is no autocorrelation |
| DGC | .833 | There is no autocorrelation |
| DGFCF | .079 | There is no autocorrelation |
| DTO | .854 | There is no autocorrelation |
| DIN | .362 | There is no autocorrelation |

*Testing Cointegration*

So far we have proved that all our variables are stationary at the differenced level form I(1) and that the optimal order of VAR model is 3 lags. Now we move to cointegration test. We start first by using Engle and Granger test to verify the presence of at least one cointegration relationship between our variables.

```
        Test Statistic      LL          AIC          SBC          HQC
 DF         -7.4764      103.7936     102.7936     101.6913     102.3574
 ADF(1)     -7.5726      107.1156     105.1156*    102.9109*    104.2432
 ADF(2)     -5.8911      107.2165     104.2165     100.9095     102.9079
*************************************************************************
 95% critical value for the Dickey-Fuller statistic =  -4.6268
 LL  = Maximized log-likelihood      AIC = Akaike Information Criterion
 SBC = Schwarz Bayesian Criterion    HQC = Hannan-Quinn Criterion
```

The table shows that the t-value is higher than ADF 95% critical value and therefore we reject the null hypothesis that there is no cointegration. From this test, we know that at least there is one cointegration between our variables. This implies that the movement of one of the variables is likely to influence the others' movement, in a way or another and to some degree. It also confirms the theoretical relationship of the variables and that the relations are not spurious or by chance. Indeed, the variables move together in the long run. In other words, the variables might behave differently in the short run but would realign again in the long term given their cointegration.

Next, we run another cointegration test using Johansen method to find the exact number of cointegration existing.

| Criteria | Maximal Eigenvalue | Trace | AIC | SBC | HQC |
|---|---|---|---|---|---|
| Number of Cointegrating vectors | **1** | **4** | **5** | **1** | **5** |

At 3 lags, and based on both Maximal Eigenvalue of the Stochastic Matrix and the highest value of SBC, we find that there is ***one*** cointegration vector between the variables[6]. However, when we check the Trace of the Stochastic Matrix and the highest values of AIC and HQC criteria based on the Model Selection Criteria we find ***four and five*** cointegration vectors respectively (Check Appendix III). For simplicity, we choose to go with one cointegration vector based on the similar results of Maximal Eigenvalue of the Stochastic Matrix and the highest value of SBC.

[6] In the case of Maximal Eigenvalue and Trace, the test statistic for null of r = 0 is greater than the 95% critical value whereas for other null hypotheses, statistic is less than the critical values.

**Granger-causality**

We found an evidence of one cointegration vector but we still need to figure out the nature of causality between the variables; whether it's uni- or bi-directional causality. To answer this question, we used Granger causality to see the direction of causality and determine which variable Granger-causes the other variable. We end up with the following results:

Pairwise Granger Causality Tests
Sample: 1998Q1 2015Q2
Lags: 2

| Null Hypothesis: | Obs | F-Statistic | Prob. At 95% |
|---|---|---|---|
| GC does not Granger Cause GDP | 68 | 6.00077 | 0.0041* |
| GDP does not Granger Cause GC | | 169.650 | 4.E-26* |
| GFCF does not Granger Cause GDP | 68 | 10.1802 | 0.0001* |
| GDP does not Granger Cause GFCF | | 5.93022 | 0.0044* |
| TO does not Granger Cause GDP | 68 | 15.0434 | 5.E-06* |
| GDP does not Granger Cause TO | | 5.61927 | 0.0057* |
| IN does not Granger Cause GDP | 68 | 31.4332 | 3.E-10* |
| GDP does not Granger Cause IN | | 4.03486 | 0.0224* |
| GFCF does not Granger Cause GC | 68 | 7.97411 | 0.0008* |
| GC does not Granger Cause GFCF | | 30.0507 | 7.E-10* |
| TO does not Granger Cause GC | 68 | 32.1977 | 2.E-10* |
| GC does not Granger Cause TO | | 5.14251 | 0.0085* |
| IN does not Granger Cause GC | 68 | 29.0008 | 1.E-09* |
| GC does not Granger Cause IN | | 4.74026 | 0.0121* |
| TO does not Granger Cause GFCF | 68 | 8.57653 | 0.0005* |
| GFCF does not Granger Cause TO | | 3.02937 | 0.0554** |
| IN does not Granger Cause GFCF | 68 | 10.6751 | 0.0001* |
| GFCF does not Granger Cause IN | | 4.76526 | 0.0118* |
| IN does not Granger Cause TO | 68 | 2.81593 | 0.0674** |
| TO does not Granger Cause IN | | 6.33091 | 0.0031* |

*Significant at 5% level. ** Significant at 10% level

Interestingly, we find that all variables have a bi-directional causality at 95% significant level except for GFCD and TO, and IN and TO where we failed to reject the null. This means that Trade Openness has a uni-direction causality with both Gross Capital Formation and Inflation where TO Granger-causes the two but they don't. Trade openness is not an outcome of gross capital formation neither inflation, but these two are the outcome of the former. In other words, change in inflation

or in gross domestic investment levels don't Granger-cause changes in trade openness of Turkey, but they do based on 90% confidence level. Moreover, TO has a bi-direction causality with GDP and government expenditures. Basically, openness enhances GDP and enables the government to increase its consumption while the increase of GDP and GC would also improves trade openness of Turkey. For the other variables GDP, GC, GFCF and IN it seems that they all Granger-cause each other. These results show that all Turkey's policies regarding each of these variables are crucial because they will affect the other ones. It is difficult to ascertain at this stage which variable must be most considered by policy makers because almost all Granger-causes all, and we don't know to which extent. We would still need to know the relative exogeneity of the variables to make more inferences.

*Long Run Structural Modeling (LRSM)*

Having one cointegration means that we need to identify the equation to test its coefficients against the theoretical expectations. Since it is difficult to estimate the coefficients based on theoretical assumptions which are not clear, we believe that assigning randomly any coefficients we might think about will be a form of speculation and it would bias our study. We decided then to go for Johansen (1991) Just estimation and let the computer generates the empirical coefficients based on Johansen approach. Actually, it is worth to mention that when we tried normal exact- and over-identification, the results were different every time the restrictions change which is a normal result of changing coefficients. However, this didn't reflect the real empirical testing of variables. For example, when we restricted GDP to the value of 1, GFCF and GC were significant whereas TO and IN were not. However, when we over-identified all at once, the null hypothesis was rejected implying that these restrictions were incorrect. Fear of being subjective in this scientific study, we preferred adopting Johansen's just-identification restrictions which yielded the results below. The coming tests i.e. Error correction model, Variance decomposition, Impulse Response, and

Persistence Profile will be based on Johansen's coefficients. Johansen's Just Estimation results are the following:

| Variable | Coefficient | Standard Error | t-value | Implication ($CV_{95\%}$=1.95) |
|---|---|---|---|---|
| LGDP | 6.9008 | -1.0000 | -6.9008 | Significant |
| LGC | -4.8150 | .69774 | -6.90085 | Significant |
| LGFCF | -1.9328 | .28008 | -6.90089 | Significant |
| LTO | -1.3222 | .19160 | -6.90084 | Significant |
| LIN | -.20014 | .029003 | -6.90067 | Significant |
| Trend | .020267 | -.0029368 | -6.90105 | Significant |

The table's results confirm our intuition and compiles the results of different studies presented in the theoretical part of this paper. All variables turned to be significant. This means that none of them should marginalized or ignored while making economic policies.

Based on these results we get the following ***cointegration equation*** (figures between parentheses represent standard deviations):

6.90*LGDP – 4.81*LGC – 1.93*LGFCF – 1.32*LTO – 0.20*LIN ➔ I(0)
(-1) (0.70) (0.28) (0.19) (0.03)

*Vector Error Correction Model (VECM)*

So far, we found that our variables are cointegrated, Granger-cause each other at 90% confidence level, and are all significant. In order to understand more the variables' relationship we need to know which variable is more or less exogenous than the other. Such information will be very useful to policy makes to know which variable should they focus on and target first. By knowing the leader variable, any changes in it will lead to significant impacts on the other variables.

| Variable | Coefficient (Speed of adjustment) | ECM 1 (-1) t-ratio p-value | Implication at 5% SL |
|---|---|---|---|
| LGDP | -.010372 | -.33926[.736] | Exogenous |
| LGC | .28827 | 6.1822[.000] | Endogenous |
| LGFCF | .25165 | 3.9504[.000] | Endogenous |
| LTO | .13024 | 3.7926[.000] | Endogenous |
| LIN | -.077457 | -3.5911[.001] | Endogenous |

In this vector, only GDP is exogenous the other variables (GFCF, GC, TO and IN) are endogenous. These results support the nature of each variable. Government expenditures are controlled by the government decisions, gross capital formation is directly affected by the country's economic policies; trade openness is linked to policies regarding import and exports policies (such as trade barriers, tariffs, managed float of exchange rate…) and hence can be controlled; and inflation is the automatic consequence of Turkey's central bank monetary policy. On the other hand, Gross Domestic Product is the outcome of several factors and thus less likely to directly control. VECM's results showed that GDP is the only exogenous variable in Turkey's case whereas the other variables are endogenous.

GDP's error correction coefficient is -0.010372 which is slightly less than 0. This means that there is slow speed of convergence to equilibrium. We will see this conspicuously when we depict impulse response and persistence profile graphs. The other variables' coefficients are also close to 0 in absolute terms. Their impulse response graphs show the slow adjustment more clearly.

Now that we know which is the leading variable and which is the lagging one, we still don't have a clear idea about their relative self-dependence. To get more accurate details we will move next to Variance Decomposition test to find the most/least endogenous variable among our variables.

*Variance Decompositions:*

After we discussed cointegration, Granger-causality, long run relationship and found which variable is exogenous or endogenous, now we would like to check the relative endogeneity/exogeneity of each variable, i.e. which is the most leader and which is the most

follower. VDC decomposes the variance of forecast error of each variable into proportions attributable to shocks from each variable in the system, including its own, the least endogenous variable is thus the variable whose variation is explained mostly by its own past variations .

Since Orthogonalized VDCs method is usually biased by taking into account the order of the inputs and by assuming that when a variable is shocked the others are switched off, we move directly to the Generalized VDCs method. We start by summing up the numbers of each horizon row and normalizing the variables' numbers so they can a total equal to 1. Next, for each variable and at a specified horizon, we divide that variable's figure by the total sum of the row in order to get the percentage of self-dependence of the said variable. By applying the Generalized VDCs method, we get the following results:

Forecast at Horizon = 4 quarters

| | LGDP | LGC | LGFCF | LTO | LIN | TOTAL | SELF-DEP | RANKING |
|---|---|---|---|---|---|---|---|---|
| LGDP | 43.91% | 2.02% | 41.67% | 11.50% | 0.90% | 100.00% | 43.91% | 5 |
| LGC | 17.24% | 62.40% | 8.11% | 8.85% | 3.39% | 100.00% | 62.40% | 2 |
| LGFCF | 31.97% | 4.72% | 55.39% | 7.10% | 0.81% | 100.00% | 55.39% | 3 |
| LTO | 19.47% | 4.33% | 25.70% | 49.25% | 1.25% | 100.00% | 49.25% | 4 |
| LIN | 3.49% | 6.43% | 16.58% | 1.93% | 71.57% | 100.00% | 71.57% | 1 |

Forecast at Horizon = 8 quarters

| | LGDP | LGC | LGFCF | LTO | LIN | TOTAL | SELF-DEP | RANKING |
|---|---|---|---|---|---|---|---|---|
| LGDP | 42.92% | 1.59% | 43.58% | 10.91% | 1.00% | 100.00% | 42.92% | 5 |
| LGC | 19.75% | 56.18% | 9.31% | 9.87% | 4.89% | 100.00% | 56.18% | 2 |
| LGFCF | 31.23% | 6.18% | 55.73% | 6.02% | 0.85% | 100.00% | 55.73% | 3 |
| LTO | 20.38% | 3.96% | 26.37% | 47.32% | 1.96% | 100.00% | 47.32% | 4 |
| LIN | 2.43% | 10.80% | 14.96% | 0.94% | 70.88% | 100.00% | 70.88% | 1 |

Forecast at Horizon = 12 quarters

| | LGDP | LGC | LGFCF | LTO | LIN | TOTAL | SELF-DEP | RANKING |
|---|---|---|---|---|---|---|---|---|
| LGDP | 42.25% | 1.41% | 44.39% | 10.71% | 1.24% | 100.00% | 42.25% | 5 |
| LGC | 21.33% | 52.21% | 9.82% | 10.28% | 6.36% | 100.00% | 52.21% | 3 |
| LGFCF | 30.68% | 6.85% | 55.76% | 5.61% | 1.09% | 100.00% | 55.76% | 2 |
| LTO | 20.81% | 3.53% | 26.41% | 46.59% | 2.66% | 100.00% | 46.59% | 4 |
| LIN | 1.91% | 12.74% | 13.82% | 0.60% | 70.92% | 100.00% | 70.92% | 1 |

Forecast at Horizon = 20 quarters

| | LGDP | LGC | LGFCF | LTO | LIN | TOTAL | SELF-DEP | RANKING |
|---|---|---|---|---|---|---|---|---|
| LGDP | 30.85% | 6.63% | 55.73% | 5.82% | 0.97% | 100.00% | 30.85% | 5 |
| LGC | 24.81% | 37.47% | 8.70% | 9.17% | 19.86% | 100.00% | 37.47% | 4 |
| LGFCF | 28.23% | 9.28% | 55.00% | 4.56% | 2.93% | 100.00% | 55.00% | 2 |
| LTO | 21.42% | 1.62% | 24.51% | 45.39% | 7.06% | 100.00% | 45.39% | 3 |
| LIN | 1.04% | 16.66% | 11.52% | 0.16% | 70.61% | 100.00% | 70.61% | 1 |

The table below summarizes the variables' self-dependence ranking, at different horizons, according to the Generalized VDCs method:

| | Variable Relative Exogeneity | | | |
|---|---|---|---|---|
| Number | At horizon 4 | At horizon 8 | At horizon 12 | At horizon 20 |
| 1 | LIN | LIN | LIN | LIN |
| 2 | LGC | LGC | LGFCF | LGFCF |
| 3 | LGFCF | LGFCF | LGC | LGC |
| 4 | LTO | LTO | LTO | LTO |
| 5 | LGDP | LGDP | LGDP | LGDP |

From the above results, we conclude the following:

- Generalized VDCs results show intriguing different results from VECM. Totally the opposite.
- The relative rank of exogeneity is almost stable. Only GFCF and GC have changed by switching ranks, after 12 quarters (3 years)
- The separation between the most exogenous and the least exogenous is about 30% which is a considerable difference.

The results displayed by Generalized VDCs cast doubt on VECM's findings. This conflict of results can be explained by the fact that VDC forecasts go beyond the period within which VECM estimates its results.

*Impulse Response Function (IRF)*

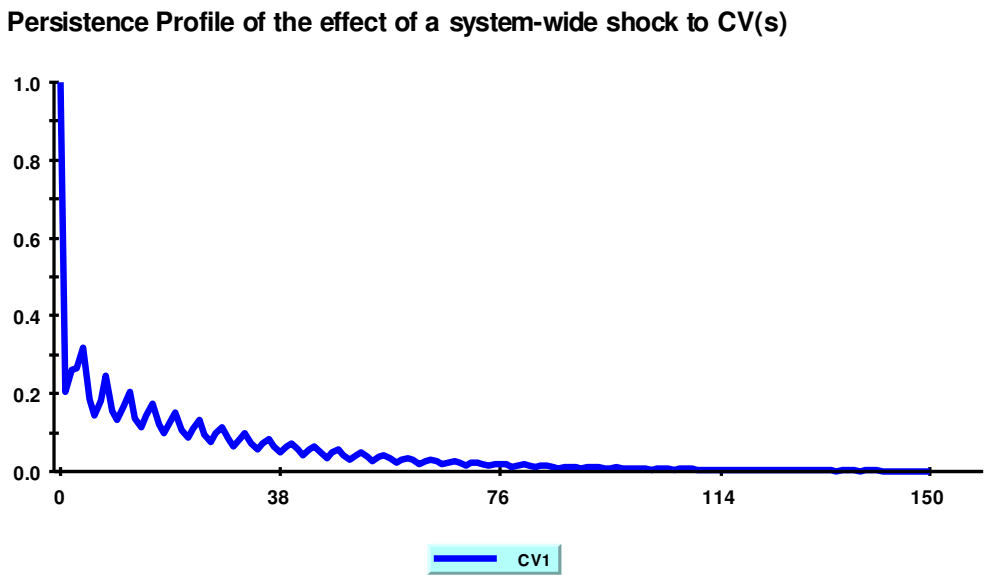
The rationale behind using this technique is to provide additional information that VDC method cannot. The impulse response has the advantage of producing the same information as the VDCs but in graphical form. In order to preserve the homogeneity of the paper, we preferred to test the impulse response graphs.

Adopting VECM and IRF results enable us to urge policy makers in Turkey to focus on the government expenditures and gross capital formation primarily in order to enhance their economic growth. Later comes, trade openness and inflation levels. We can also reconcile these findings with what VDC showed; meaning that policy makes need to pay particular attention to inflation by recalling the long and tiring years when Turkish economy suffered from the adverse effects of high inflation rates. By following VDC logic, when inflation takes leadership, economic growth becomes most endogenous. This shows the interferences and interventions government need to take in order to keep the economy in check and immune from the negative impacts of inflation.

*Persistence Profile*

The persistence profile enables us to see how long does it take for the entire cointegration equation, once shocked, to go back to its equilibrium level. In this situation, we are not shocking only one or two variables rather the whole system.

By shocking the cointegration vector we get the following chart:




The persistence profile confirms the interpretation of the variables' coefficients provided by VECM analysis which all indicated the slow adjustment and convergence to equilibrium. Similarly, we see that shocking the whole system takes a long time (about 80 quarters or 20 years) to stabilize. This outcome should alert policy makers and make them more careful in their decision-making. The plans ought to be long term ones in order to prevent such disastrous scenario. Policy makers must also implement plans to serve as economic buffers so they can dilute the effects of such shock when it occurs.

## 5. Conclusion

The present analysis gave us a relative exhaustive understanding of the relationship existing between economic growth and its determinants. We have used different tests (cointegration,

Granger-causality, Error correction model, Variance decomposition…) to comprehend the nature of this relationship and answer our previous queries. In the present study, we found that economic growth is the most exogenous variable when inflation is curbed. When it's not, GDP turns to be the most endogenous variable and inflation takes leadership. We also found evidence of bi-directional Granger-causality between all variables at 90% confidence level especially between GDP and trade openness. At 95%, Trade Openness makes the exception with a uni-direction causality with both Gross Capital Formation and Inflation. We recommend Turkish policy makers to focus on government spending and gross capital formation to enhance economic growth while always keeping inflation in check in order to ensure its sustainability in the long run.

As far as we know, this is the first study that investigates the nexus existing between GDP and its determinants in Turkey, therefore more studies should be conducted on this topic by trying to include other variables such as FDI, education or exclude other variables to support or question our findings.

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