CAUSAL RELATION BETWEEN EXTERNAL DEBT AND ECONOMIC GROWTH: EVIDENCE FROM TURKEY

Project Paper

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CERTIFICATION OF APPROVAL

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DECLARATION

I hereby declare that this project paper is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at INCEIF or any other institutions.

Mehmet Sami Poyraz

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ABSTRACT

There is a growing concern over the tremendous increase in external debt stock of Turkey. In the light of global financial crises, the sustainability of external debt and allocation of external debt to productive investments have become all the more important. Many researches have been done to examine external debt stock and economic growth relationship However, External debt stock has not been broken down into external private debt and external government debt, which might give unreliable and misleading results since the dynamics of power and causality direction of external private debt (EPD) and external government debt (EGD) could be different. The objective of this paper is to make a humble attempt to analyze "the external debt led economic growth" hypothesis by breaking down the composition of external debt into External Private Debt and External Government Debt, particularly for Turkey over the period 1999:Q1-2016:Q3. For our analysis, time series techniques such as, co-integration, long-run structural modeling, vector error correction, variance decompositions, impulse response functions, and persistence profile are adopted. Our findings of empirical analysis suggest that, there is a significant Granger causality from External Private Debt to Gross Domestic Products. These findings are useful and have policy implications for developing countries like Turkey.

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CHAPTER 1: INTRODUCTION

Savings play a crucial role in economic growth as it is transferred to investments and, in consequence, economic growth is achieved (Keynes J.M., 1936). However, in developing countries, capital is scarce and amount of savings are insufficient to fund investments. Hence, low savings lead to low investments and low incomes, which in turn leads back to low savings. In order to break this vicious cycle and achieve economic growth, resorting to external debt is seen as the only solution. However, the rising level of the stock of external debt has raised concerns about whether external debt leads to faster economic growth or a heavier burden for the future generation who would have to bear it. In past studies, the relation between overall external debt stock and economic growth has been tested. However, external debt has not been broken down into external private debt and external government debt. In the case of Turkey, in 2016, 71% external debt is borrowed by private sector, as the government's share is just 29%, which has been decreasing gradually over the last two decades. Thus, using overall external debt for the analysis could give unreliable and misleading results since weightage and effect of external private debt (EPD) and external government debt (EGD) could be different. Thus, analyzing the impact of external private debt on the economic growth and the effect of external government debt separately can highlight the importance of the issue in the literature.

1.1. Problem Statement & Motivation

Due to scarce savings in domestic economies, external debt has become one of the important sources of funds for the domestic investors. The dual gap theory, which explains the savings gap and foreign exchange gap, has highlighted the motivation behind the introduction of external debt into a growth model. The savings gap and foreign exchange gap explains that there are insufficient resources to support the expected level of growth, hence the role of the external borrowing. The importance of external borrowing in economy has been highlighted. The need for external borrowing could rise because of two gaps, i.e. saving-investment gap and/or import-export gap. There has not been any consensus in the literature on the on impact of external debt on economic growth. Choong, Chee Keong, Evan Lau (2010) and Hameed, A., Ashraf, H., & Chaudhary (2008) analyzed the relationship between external debt and economic growth and found that a short-run and long-run negative causality runs from debt service to gross domestic product. However, external debt stock has not been broken down into External Private Debt and External Government Debt.

In Turkey, there is a tremendous expansion in total external debt and it has almost doubled in the past two decades. This has given rise to an important issue: can external debt boost the economic growth? Moreover, high level of debt increases possibility of default, which would stymie future investment into Turkey by investors from abroad due to lower credit ratings. Much would depend on the effect of external debt on the economy. If external debt is efficiently allocated to productive domestic investment, it could contribute to economic growth in the long run, in which case Turkey's external debt would be sustainable.

The objective of this paper is to analyze the causal relation between the external debt and economic growth by breaking down compositions of external debt into External Private Debt and External Government Debt, particularly for Turkey. This analysis is of considerable importance from a policy perspective, as the results can provide inputs for policy formulation.

1.2. Research Objectives and Research Questions

There is a growing concern over tremendous increases in the external debt stock of Turkey. More specifically, in the wake of global financial crises, the sustainability of external debt and allocation of external debt to productive investments have become increasingly important. Many researches have been done to examine external debt stock and economic growth relationship. However, external debt stock has not been broken down into external private debt and external government debt, which might give unreliable and misleading results since power and causality direction of external private debt (EPD) and external government debt (EGD) could be different. In this research, external debt is broken down as external private debt and external government debt since each might have different casual effect on economic growth. It makes this research unique, as it will fill the gap in the literature.

The research questions are as stated below:

RQ 1: Is there a causal relationship between external private debt and economic growth?

RQ 2: Which of the macroeconomic variables play the leader/follower role in this relationship?

For RQ1, it is hypothesized, based on the literature, that there is a causal relation between private debt and economic growth, with the former impacting positively on the latter. For RQ2, the hypothesis is that some macroeconomic variables are likely to be exogenous and some others endogenous, where some may be stronger leaders or weaker followers.

CHAPTER 2: ECONOMIC OVERVIEW OF TURKEY

2.1. Economic Overview of Turkey

Since 2000, Turkey's economic performance has been impressive. The main factors are macroeconomic and fiscal stability. Increasing job creation and incomes make Turkey an upper-middle-income country with USD 12,127 per capita GDP. Poverty incidence has more than halved since 2002, and extreme poverty has fallen even faster. During 2002-2015, Turkey has become increasingly open to foreign trade and finance, urbanized significantly, and greatly expanded access to public services.

Economic growth has been robust in recent years, despite very adverse regional and domestic conditions, which included four national elections, coup attempt, trade restriction with Russia, wars across the southern border and the inflow of millions of refugees. Domestic demand has kept its momentum. The external deficit decreased due to falling oil prices and market share increases especially in the European Union. Growth has been overly funded by debt creating capital inflows and driven mainly by domestic demand.

Over the past 15 years, the growth pattern of Turkey has been characterized by a combination of strong growth and external imbalances. After the 2001 crisis, major institutional and structural reforms were introduced, which served to mitigate "boom-and-bust" cycles of the earlier period, although the external deficit situation continued to worsen. In other words, Turkey is no longer experiencing boom-and- bust cycles. While strong economic growth and external imbalance have led to considerable inflow of foreign capital to Turkey, two very important domestic imbalances also played a crucial

role: 1) private consumption has been excessively contributing to economic growth at the risk of reducing domestic savings, resulting in more external borrowing. 2) The output employment composition of the economy has also been skewed to servicing the domestic market, with too low a share of tradable goods and services. This situation creates a tension between strong growth and external sustainability. To rebalance the growth pattern, the international competitiveness of the economy and the export sector need to be considerably strengthened.

Turkey's strong growth over the past decade has played an important role in pushing living standards closer to that of higher income countries. Improvements in life expectancy and expected years of schooling have stimulated human development. However, income inequality has remained high.

2.1.1. Economic Growth

Turkey's growth performance relative to the past and rest of the world is vigoruous. During the period of 2003-2012, the world economy grew at 3.5 per cent; OECD countries grew 1.7, while Turkey grew 5.1 per cent (OECD).

Table 1 illustrates the evolution of GDP growth in Turkey since 1998. The GDP growth peaked at 11.1 per cent in 2011 and touched the bottom at 5.9 per cent in 2001. During the period of 1998-2016, GDP growth averaged at 4.5 per cent. (Table 1)

Table 1: Gross Domestic Products indicators

Period	GDP (current US$ billion)	GDP growth (annual %)	GDP per capita (current US$)
1998	275	2.3	4,496
1999	255	-0,33	4,108
2000	272	6.6	4,316
2001	200	-5.9	3,119
2002	238	6.4	3,660
2003	311	5.6	4,718
2004	404	9.6	6,040
2005	501	9	7,384
2006	552	7.1	8,034
2007	675	5	9,709
2008	764	0.8	10,850
2009	644	-4.7	9,036
2010	771	8.4	10,672
2011	832	11.1	11,341
2012	873	4.7	11,720
2013	950	8.4	12,542
2014	934	5.1	12,127
2015	859	6	10,984
2016	863	3.1	10,862
Average	**588**	**4.5**	**8,196**

Source: Constructed by the author using World Development Indicators data

During the period of 1998 – 2002, the annual GDP growth rate of Turkey flactuated significantly. The GDP growth rate sharply declined to -3.4 per cent in 1999 from 2.3 per cent in 1998, rebounding dramatically to 6.6 percent in 2000 prior to plummeting to -6.0 per cent in 2001 due to the crises. However, Turkish economy recovered quicky in 2002 with GDP growth rate rising again at 6.4 per cent.

Subsequently, after a relatively slight deceleration in the growth rate, GDP grew at 5.6 per cent in 2003. The pace of GDP growth accelerated to 9.6 per cent in 2004 before moderating to 9.0 per cent in 2005. At the 9 per cent growth levels were the Turkish economy was overheating, it cooled to 7.1 per cent in 2006. The gradual deceleration in the growth rate continued until 5.0 per cent growth rate was realized in 2007. However, in 2008, the growth rate plummeted dramatically down to a mere 0.8 per cent. In the following year, in 2009, the growth rate fell to the lowest level, -4.7 per cent for the whole period. However, Turkish economy recovered quickly and the GDP growth surged to 8.5 percent in 2010. The GDP growth reached its highest level, 11.1 per cent, in 2011 before dropping to 4.8 per cent in 2012. However, it almost doubled in 2013 and reached 8.5 per cent. In 2014, The GDP growth declined to 5.2 per cent, but in 2015 it rose to 6.1 per cent. In 2016, the GDP growth rate halved and reached 3.2 per cent.

2.1.2. Gross Domestic Product

The gross domestic products increased from USD 275 billion in 1998 to USD 863 billion in 2016. The gross domestic product stood at USD 950 billion in 2013, rising from USD 200 billion in 2001. The average gross domestic product for the period of 1998-2016 per annum turned out to be USD 588 billion.

During the 1998-2002 period, gross domestic product was around USD 200 billion. In 1998, gross domestic product stood at USD 275 billion before shrinking to USD 255 billion in 1999. It gained traction in 2000 to reach USD 272 billion. The 2001 crises adversely affected the gross domestic product. Thus, it dramatically plunged, its size contracting to USD 200 billion, which was the lowest for the period of 1998-2016.

The Turkish economy quickly recovered remarkably in next two years. Gross domestic product reached USD 311 billion in 2003. This upward movement continued with GDP rising to USD 404 billion in 2004 and USD501 billion in 2005. After out- performing for two years, the gross domestic product slightly increased and reached USD 552 billion in 2006. It went up significantly to reach USD 675 billion in 2007 and USD 764 billion in 2008. Steeply increasing gross domestic product since 2001 ceased in 2009 when it plunged by USD 120 billion, the steepest fall for the entire period of 1998-2016. However, in 2010, Turkish economy quickly recovered with the gross domestic product rising by USD 137 billion that is the biggest increase in gross domestic product for the period. In 2011, the gross domestic product went up by USD61 billion to reach USD 832 billion. The increase in 2012 was relatively low, USD 41 billion. In 2013, the gross domestic product reached its highest level, USD 950 billion. The gross domestic product hovered above USD 900 in 2014. Then, in 2015, the gross domestic product shrank to USD 859 billion. In 2016, the gross domestic products increased marginally by only USD4 billion and reached USD 863 billion.

2.1.3. Gross Domestic Product Per Capita

The gross domestic product per capita more than doubled over the period of 1998-2016. GDP per capita rose from USD 4,496 in 1998 to USD 10,862 in 2016. During the period 1998-2016, GDP per capita fluctuated between a low of USD 3.119 in 2001 and a high of USD 12,720 in 2012.

During the period of 1998-2000, the gross domestic products per capita were slightly above USD 4,000. The gross domestic product per capita dropped to USD 3,311 in 2001 before rising to USD 3,660 USD 4,718 in 2002 and 2003, respectively. The gross domestic product per capita shot up sharply to USD 6,040 in 2004. This uptrend continued until 2008: rising to USD 7,384 in 2005, USD 8,034 in 2006, USD 9,709 in 2007 and USD 10,850 in 2008. There was a let up in2009 when it shrank to USD 9,036, but it recovered quickly to USD 10,672 in 2010, USD 11, 341 in 2011, USD 11,720 in 2012 and USD 12,542 in 2013. Subsequently, there has been a downtrend from USD 12,127 in 2014 to USD 10,984 in 2015 and to USD 10,863 in 2016.

2.1.4. Unemployment

Unemployment is another important macroeconomic indicator. During the period of 1998-2016, the average unemployment of total labor force hovered around 9.4 per cent. The highest level of the unemployment was 12.6 percent in 2009, the lowest being 6.5 per cent in 2000.

Unemployment in 1998 stood at 6.9 per cent, the second lowest figure during the period. In 1999, unemployment rose to 7.7 per cent before falling to the lowest level for the period 1998-2016, registering 6.5 per cent in 2000. The unemployment figures deteriorated to 8.4 per cent in 2001 and 10.4 per cent in 2002, subsequently staying within the level of 10 percent until 2005: 10.5 per cent in 2003, 10.8 per cent in 2004 and 10.6 per cent in 2005. Unemployment receded to the pre-2001 crisis 8 per cent band, registering 8.7 per cent in 2006 and 8.9 percent in 2007 as shown in Table 2.

Table 2: Economic Indicators

Period	Unemployment, total (% of total labor force)	Inflation, consumer prices (annual %)	External debt stocks (% of GNI)
1998	6.9	84.6	35.5
1999	7.6	64.8	40.3
2000	6.5	54.9	43.4
2001	8.3	54.4	57.8
2002	10.3	44.9	55.3
2003	10.5	25.2	47.0
2004	10.8	10.5	39.9
2005	10.6	10.1	34.9
2006	8.6	9.5	38.6
2007	8.8	8.7	38.8
2008	9.6	10.4	38.3
2009	12.6	6.2	43.7
2010	10.6	8.5	39.3
2011	8.8	6.4	37.0
2012	8.1	8.8	39.0
2013	8.6	7.4	41.4
2014	9.8	8.8	43.4
2015	10.1	7.6	46.6
2016	10.8	7.7	47.7
Average	**9.4**	**23.2**	**42.6**

Source: Constructed by the author using World Development Indicators data

Subsequently, there was a reversal, with unemployment worsening to 9.7 per cent in 2008 and peaking at 12.6 per cent in 2009. In 2010, unemployment declined to 10.7 per cent and continued to improve to 8.8 per cent in 2011, 8.1 percent in 2012, and 8.7 per cent in 2013. However, there was another reversal with unemployment rising to 9.9 per cent in 2014, 10.2 per cent in 2015, and 10.8 per cent in 2016.

2.1.5. Inflation

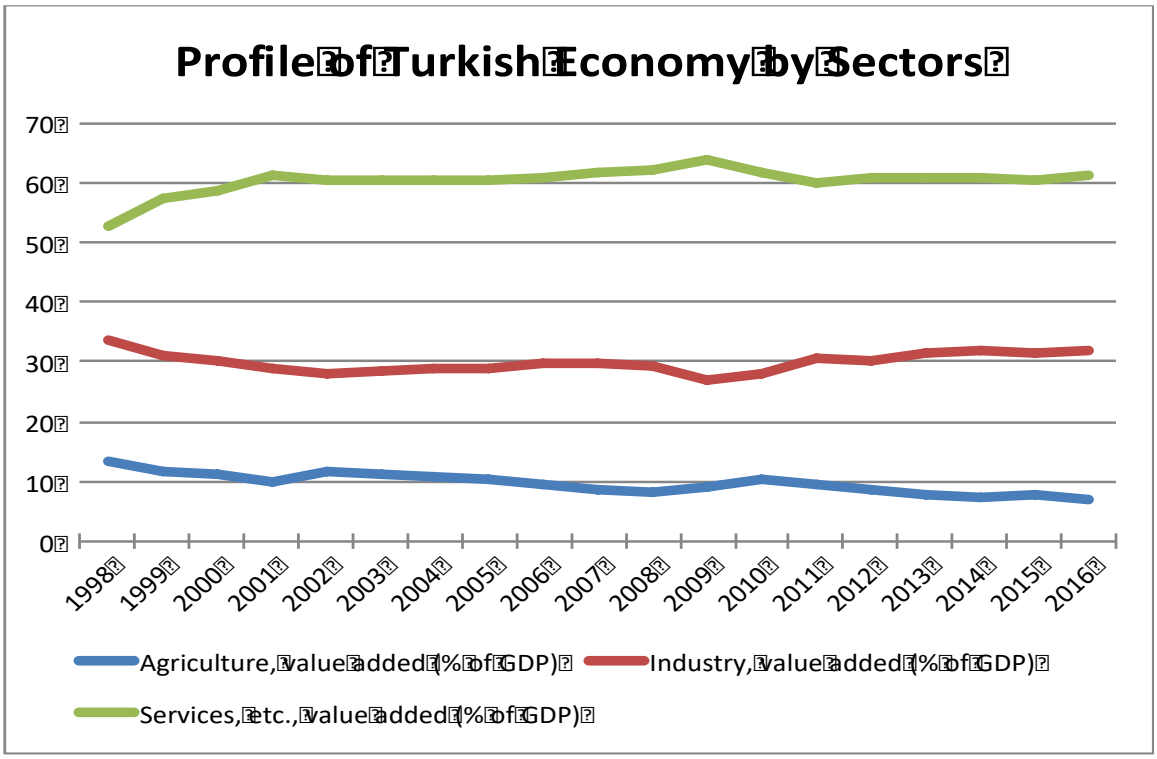
Turkey was experiencing hyperinflation, with inflation peaking at 84.6 per cent in 1998. During the 1998-2016 period, consumer price inflation has oscillated at double-digit and single-digit levels from the peak of 84.6 per cent in 1998 to the bottom of 6.2 per cent in 2009.

Since 1998, consumer price inflation was falling significantly, over 7 years, down to 10 per cent in 2005. It did not revert to the double-digit levels in the next 10 years, except 2008. Subsequently, the consumer price inflation fluctuated between 6.2 to 10.4 per cent. In 2006 and 2007, consumer price inflation stayed at single-digit 9.6 per cent and 8.7 per cent levels, respectively. A hike in the consumer price inflation to a double-digit level 10.4 per cent in 2008 marred this downtrend. It is noteworthy that since 2009 inflation has remained consistently at the single-digit level. In 2009, inflation touched at its lowest point, 6.2 per cent, but the fluctuation within the single-digit band continued in the subsequent years: 8.5 per cent (2010), 6.4 per cent (2011), 8.8 per cent (2012), 7.4 per cent (2013), 8.8 per cent (2014), 7.6 per cent (2015) and 7.7 per cent (2016).

2.1.6 Profile of the Turkish Economy by Sectors

The structure of Turkish economy has remained basically the same during the period 1998-2016. The services sector contributes most to the gross domestic product (GDP) in Turkey, followed by the industry or manufacturing and agriculture sectors. However, the proportion of each sector in GDP has changed slightly, if not marginally, over the period.

The contribution of the services sector increased from 52.7 percent in 1998 to 61.4 per cent in 2011. It remained steady between 2002 and 2007. It peaked at 63.7 per cent in 2009. In the wake of the 2009 mortgage crisis, it decreased to 60 percent in 2011. During the period 2012-2015, it stayed within the band of 60percent. However, it increased to 61 per cent in 2016 as shown in Figure 1.



Source: Constructed by the author using World Development Indicators data

Figure 1: Structure of Turkish Economy

The contribution of the manufacturing sector decreased from 33.8 per cent in 1998 to 27.9 per cent in 2002, unlike the services sector whose GDP share increased during that period. Over the next five years, the manufacturing share grew slightly and reached 29.9 per cent in 2007. Its share shrank during the next two years to 27 per cent in 2009 but increased steadily over the next seven years to 32 per cent in 2016.

During the period 1998-2001, the agriculture sector's contribution to GDP decreased, similar to the manufacturing sector, from 13.5 per cent to 9.9 per cent. It peaked at 11.6 per cent in 2002 before falling significantly to 8.4percent in 2008. Over the next seven years, its GDP share shrank to 7.0 per cent in 2016.

2.1.7. Exports

Turkey's main exports consist of vehicles (15.2% of total exports), machinery including computers (8.8%), gems, precious metals (6.9%), knit or crochet clothing, accessories (5.6%) and iron, steel (5.2%) in 2017 (Worldstopexports, 2018).

Europe is the main destination for Turkish exports, as it accounts for 53.3 per cent of Turkish exports by value in 2017, followed by Asia (29.7%), Africa (7.2%) and North America (6.5%). A much smaller percentage of Turkish exports go to Latin America (excluding Mexico) and the Caribbean (Worldstopexports, 2018)..

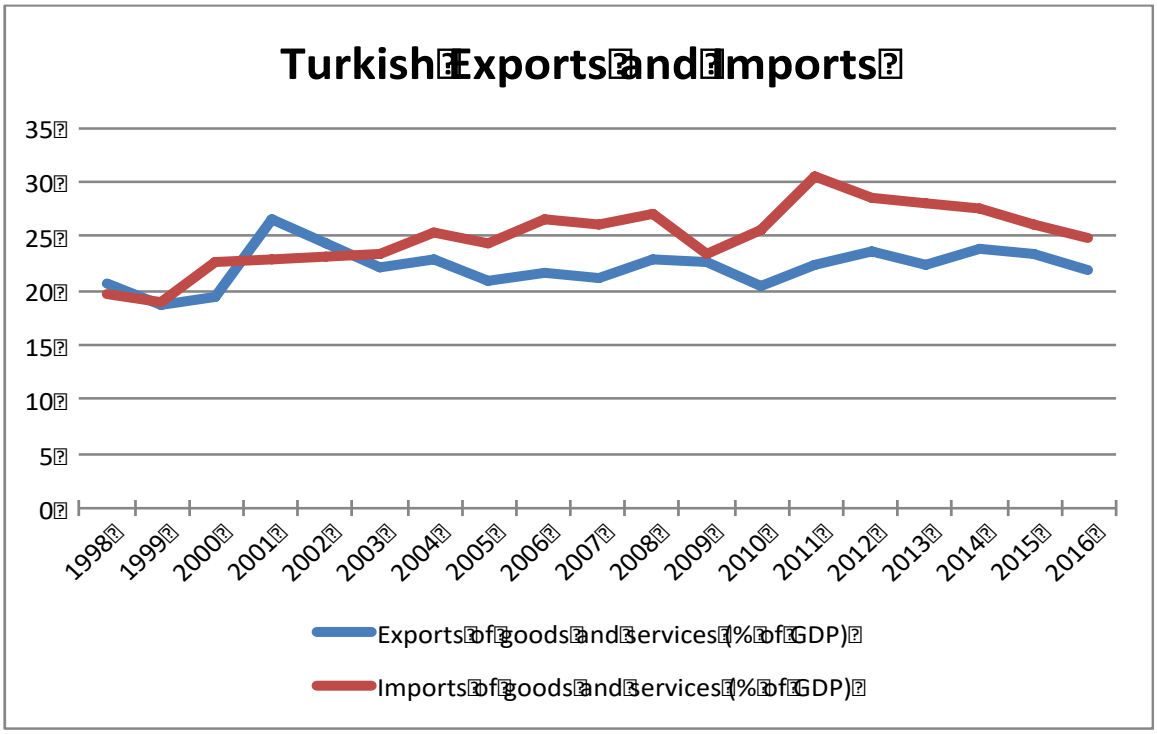
2.1.8. Imports

Turkey's main imports are mineral fuels including oil (15.9% of total imports), machinery including computers (11.6%), electrical machinery, equipment (9%), gems, precious metals (7.5%), and vehicles (7.5%) in 2017 (Worldstopexports, 2018).

Europe is also the most important source of imports for Turkey, accounting for 49.9 per cent Turkey's total imports by value in 2017. Asian trade partners supplied 32.9 per cent of import sales to Turkey, while 6.4percent worth of goods originated from North America. Smaller percentage shares came from Africa (3%) and Latin America excluding Mexico but including the Caribbean (2.6%) (Worldstopexports, 2018).

2.1.9. Imports and Exports

As shown in Figure 2, the ratio of exports and imports to GDP in 2017 is almost same as that in 1998. However, the imports/GDP ratio exceeded the exports/GDP ratio during the period 1999-2000. Subsequently the exports/GDP ratio was fluctuating, while the imports/GDP ratio remained stable between 2000 and 2003. During the next thirteen years, the imports/GDP was greater than exports/GDP but both fluctuate in different size.



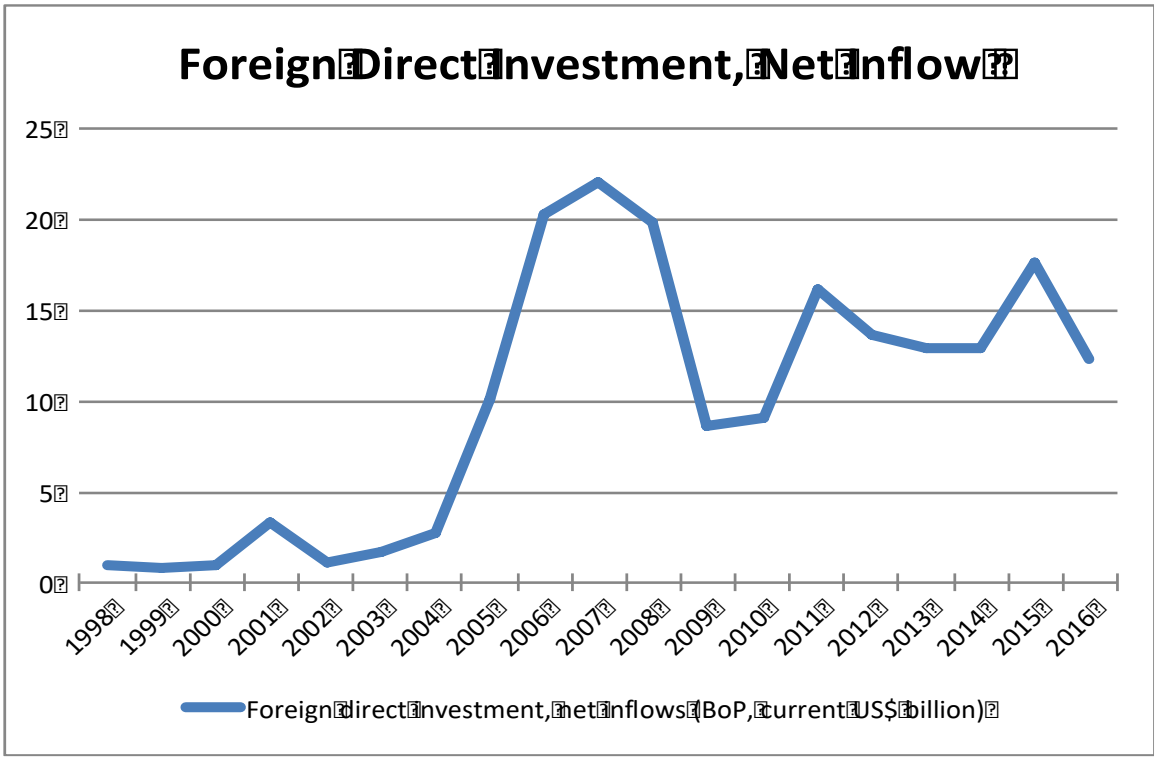
Source: Constructed by the author using World Development Indicators data

Figure 2: Exports vs Imports

2.1.10. Foreign Direct Investment

Foreign Direct Investment (FDI) net inflows are the value of inward direct investment made by non-resident investors in the reporting economy (World Bank). FDI net inflows were within USD 1-3 billion band during the period 1998-2004, prior to a sharp and

significant increase between 2005 and 2007. FDI net inflows peaked its highest level, USD 22 billion in 2007 as shown in Figure 3.



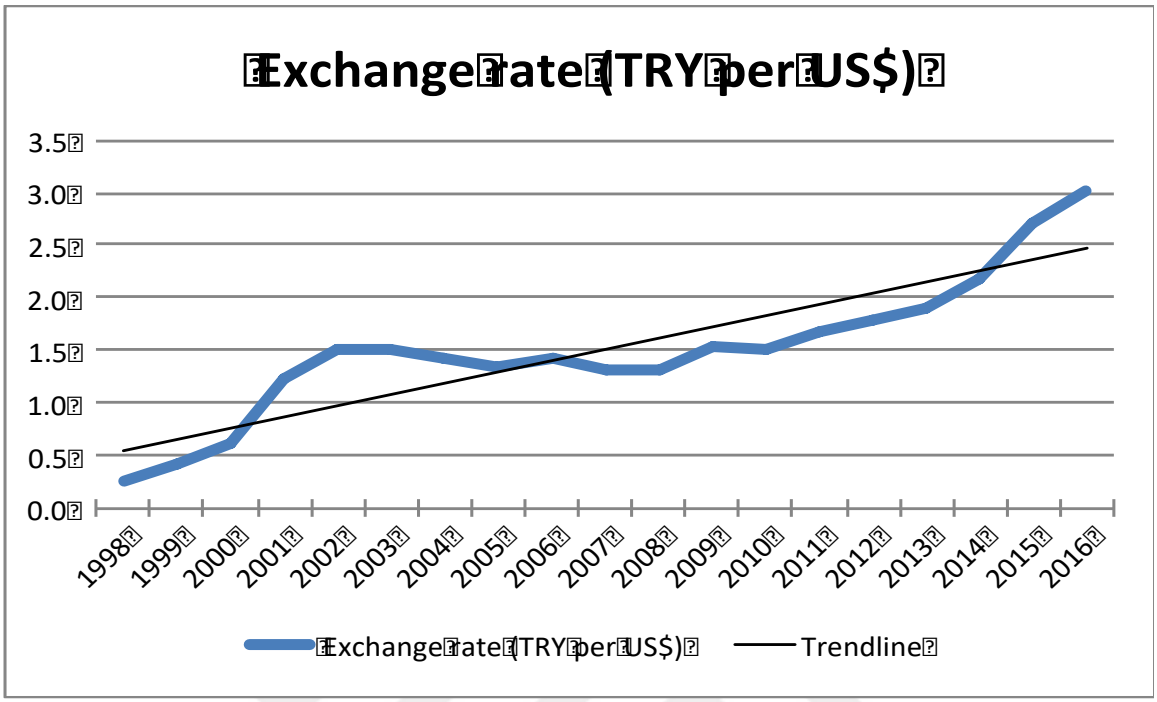
Source: Constructed by the author using World Development Indicators data

Figure 3: Foreign Direct Investments

During the period 2007-2016, annual FDI inflows fluctuated between USD 8.5 billion and USD 17.5 billion.

2.1.11. Exchange Rate

As shown in Figure 4, Turkish lira depreciated significantly over the period 1998-2016. The deprecation of Turkish lira was sharp during the period 1998-2002 and 2010-2016 while it was stable during the period of 2002-2010, within the band of 1.3-1.5.



Source: Constructed by the author using World Development Indicators data

Figure 4: Exchange Rate

2.1.12. Current Account Balance

The current account balance is one the two components of a country's balance of payments, the other one being the capital account balance.

When country's current account balance is positive, incurring a surplus, the country is net lender to the rest of the world. On the other hand, when a country's current account is negative, running a deficit, the country is net borrower from the rest of the world. Thus, there is a strong correlation between current account deficit and external debt of a country.

The current account balance of Turkey incurred USD 2 billion surplus in 1998, which is the only year that surplus had occurred during the period 1998-2016. In 1999, Turkey ran current account deficit of USD 925 million, which significantly increased to

USD 9.9 billion in 2000. The current account deficit decreased to USD 3.7 billion in 2001 and USD 626 million in 2002. However, it rose again to USD 7.5 billion in 2003. Over the next five years, the current account deficit widened significantly to USD 39.4 billion before falling to the lowest level for the period 2004-2016, registering USD 11.3 billion. The current account deficit almost quadrupled in 2010 to USD 44.6 billion. In 2011, it peaked at USD 74.4 billion. Over the next five years, the current account deficit of Turkey halved to USD32.1 billion in 2015. It remained steady in 2016 at USD 32.6 billion (Table 3).

Table 3: Current Account Balance

Period	Current account balance (BoP, current US$ million)
1998	2,000
1999	-925
2000	-9,920
2001	-3,760
2002	-626
2003	-7,554
2004	-14,198
2005	-20,980
2006	-31,168
2007	-36,949
2008	-39,425
2009	-11,358
2010	-44,616
2011	-74,402
2012	-47,962
2013	-63,621
2014	-43,597
2015	-32,118
2016	-32,634

Source: Constructed by the author using World Development Indicators data

2.1.13. Capital Account Balance

The capital account records acquisitions and disposals of non-produced non-financial assets, such as land sold to embassies and sales of leases and licenses, as well as capital transfers, including government debt forgiveness (World Bank). In other word, a capital account reveals the net change in physical and financial asset ownership for a nation. The capital account includes foreign direct investment, portfolio and other investments and changes in reserve account.

Having positive capital account indicates that money is flowing into the country but unlike a surplus in the current account, the inbound flows effectively represent borrowings or sales of assets rather than payment for work. On the other hand, having negative capital account indicates that money is flowing out of the country, and it suggests the nation is increasing its ownership of foreign assets. The capital account balance is negative only when current account balance is positive and vice versa, based on double entry book keeping principle.

According to the data of net capital account that is available since 2007, net capital account of Turkey run USD 8 million deficit, the lowest level, in 2007 (Table 4).

Table 4: Capital Account

Period	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Net capital account (BoP, current US$ million)	-8	-61	-43	-51	-25	-58	-96	-70	-21	23

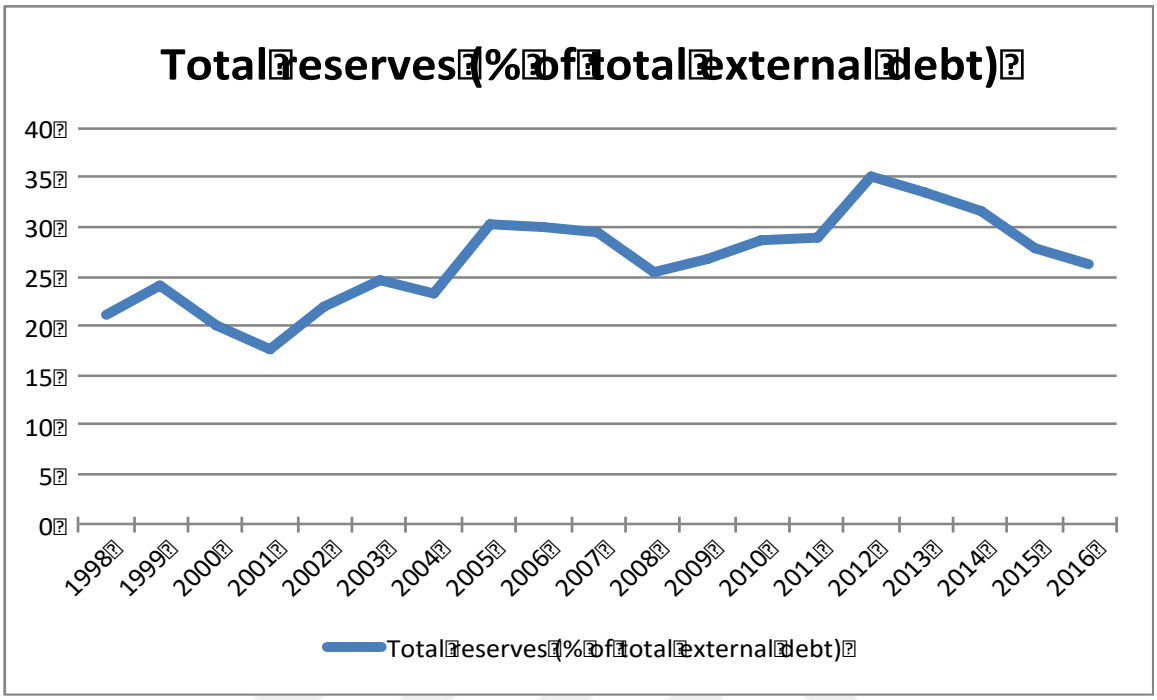
Source: Constructed by the author using World Development Indicators data

The net capital account deficit increased sharply to USD 61 million in 2008. However, It almost halved in 2011 (25 million). Then, it almost doubled to USD 58 million in 2012. It peaked at USD 96 million in 2013 before shrinking to USD 70 million in 2014 and USD 21 million in 2015. The net capital account of Turkey incurred USD 23 million surplus, the only surplus during the period, in 2016. (Table 4)

2.1.14. Total Reserves

The mainstream of total reserves to external debt ratio showed an uptrend even though it fluctuated between 1998 and 2012. It decreased noticeably in the subsequent 2012-2016 period.

The total reserves to external debt ratio increased from 21percent in 1998 to 35 per cent in 2012, due to a sharp increase in external debt stock much higher than the increase in total reserves. However, after 2012, it decreased steadily and significantly down to 26 per cent in 2016 (Figure 5).



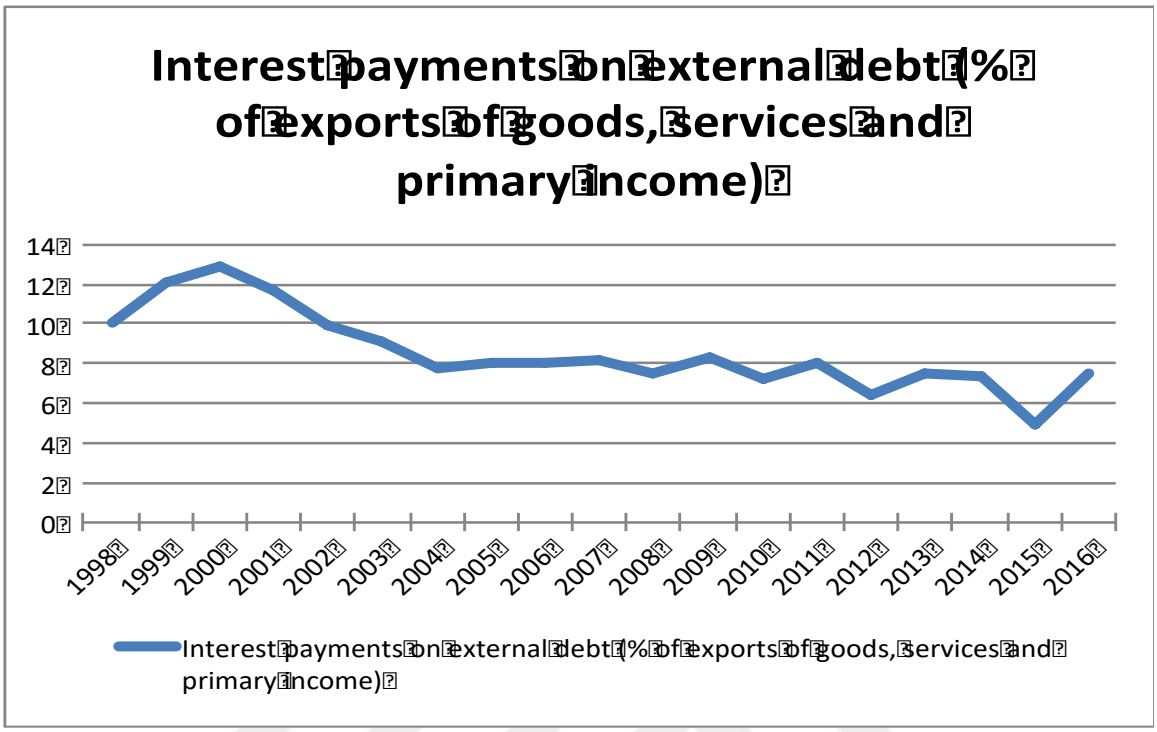
Source: Constructed by the author using World Development Indicators data

Figure 5: Total reserves/Total external debt

2.1.15 Interest Payments on External Debt (Over Exports)

Interest payments on external debt over exports is another important ratio that shows proportion of cost of the debt in terms of foreign currency generating trade activities.

Interest payments on external payment/export earnings increased noticeably between 1998 and 2000, by a sharp continuous decrease until 2004. It remained stable during the next three years, prior to fluctuating within a band of 6-8 per cent between 2008 and 2014. It fell sharply to 4.9 per cent in 2015 and rose to 7.4 per cent in 2016, as shown in Figure 6.



Source: Constructed by the author using World Development Indicators data

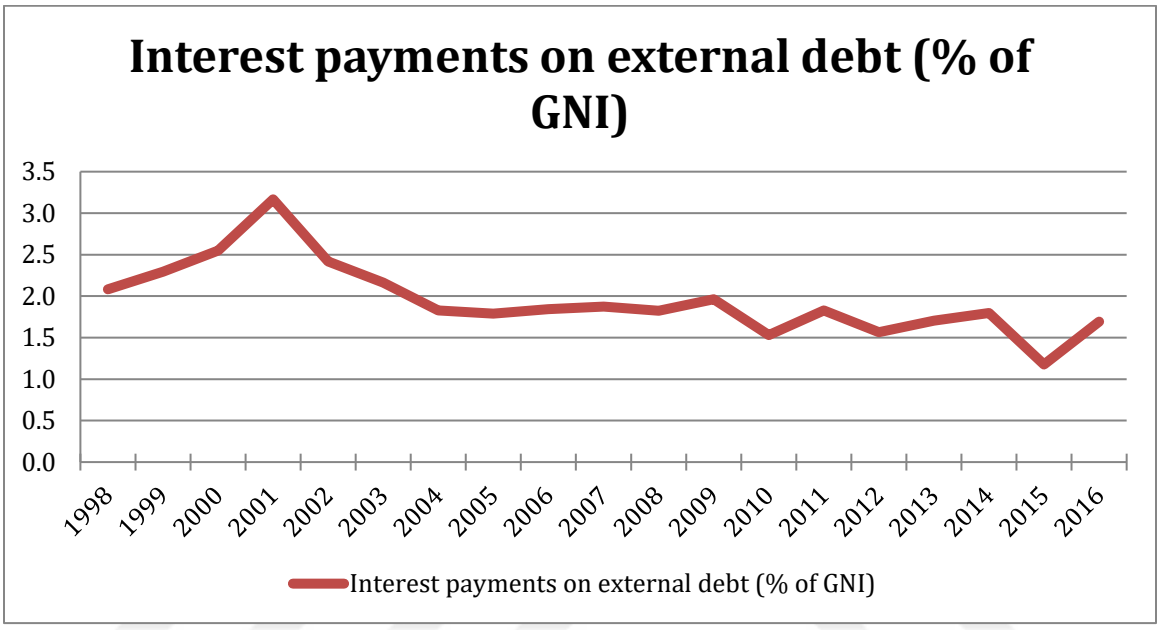
Figure 6: Interest payments on external payment/Export

2.1.16. Interest Payments on External Debt (over GNI)

Interest payments on external debt to gross national income rose sharply from 1998 to 2001. Over the next three years, it decreased significantly and remained within 2.0-1.5 per cent band during the period 2014-2015. In addition, the average of interest payments on external debt to Gross National Income in Turkey stood at 2.0 per cent over the period 1998-2016. Moreover, the ratio has remained below the average since 2004.

The ratio of Interest payments on external debt of gross national income in Turkey increased from 2.1 per cent in 1998 to a peak of 3.2 per cent in 2001. Then, it significantly decreased to 1.8 per cent in 2004 and remained within 1.8-2.0 per cent band until 2009. It dropped by 0.5 per cent in 2010 and it was fluctuating between 1.5 per cent

in 2010 and 1.8 per cent in 2014. However, it fell to a low of 1.2 per cent in 2015 and edged up to 1.7 per cent in 2016, as shown in Figure 7.



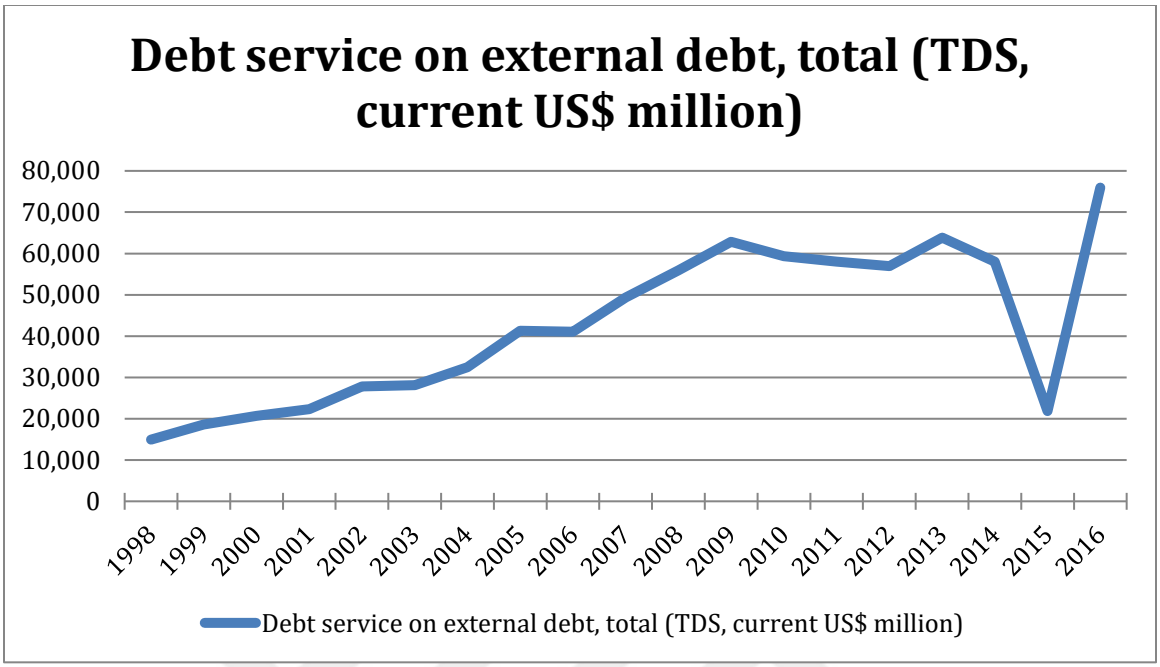
Source: Constructed by the author using World Development Indicators data

Figure 7: Interest payments on external debt/GNI

2.1.17. Debt Service on External Debt

Debt services on external debt in Turkey rose considerably from 1998 to 2009. It remained almost stable during the period of 2009-2012, and sharply decreased in 2014 before a dramatic increase in 2015.

Debt service on external debt increased from USD 14.9 billion in 1998 to USD 62.8 billion in 2009 (Figure 8).



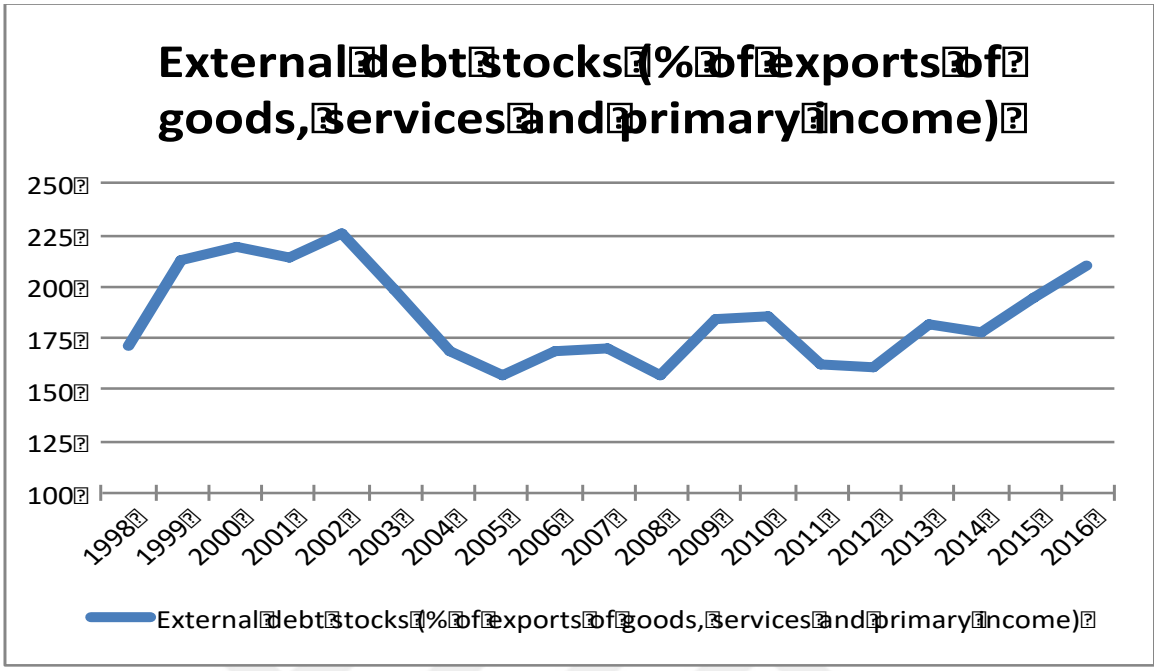
Source: Constructed by the author using World Development Indicators data

Figure 8: Total debt services on external debt

Over the next three years, it decreased gradually and reached USD 56.9 billion. Debt services on external debt went up to USD 63.8 billion in 2013 and sharply went down to USD 21.8 billion in 2015. However, it rose sharply to its highest-level (USD 75.9 billion) in 2016.

2.1.18. External Debt to Exports

The ratio of external debt stocks to exports peaked at 226 per cent in 2002 and reached to a low of 157 per cent in 2005. Over the next nine years, it fluctuated with in the band of 170-185 per cent, which significantly increased between 2014 and 2016, as depicted in Figure 9.



Source: Constructed by the author using World Development Indicators data

Figure 9: External debt stock/Exports

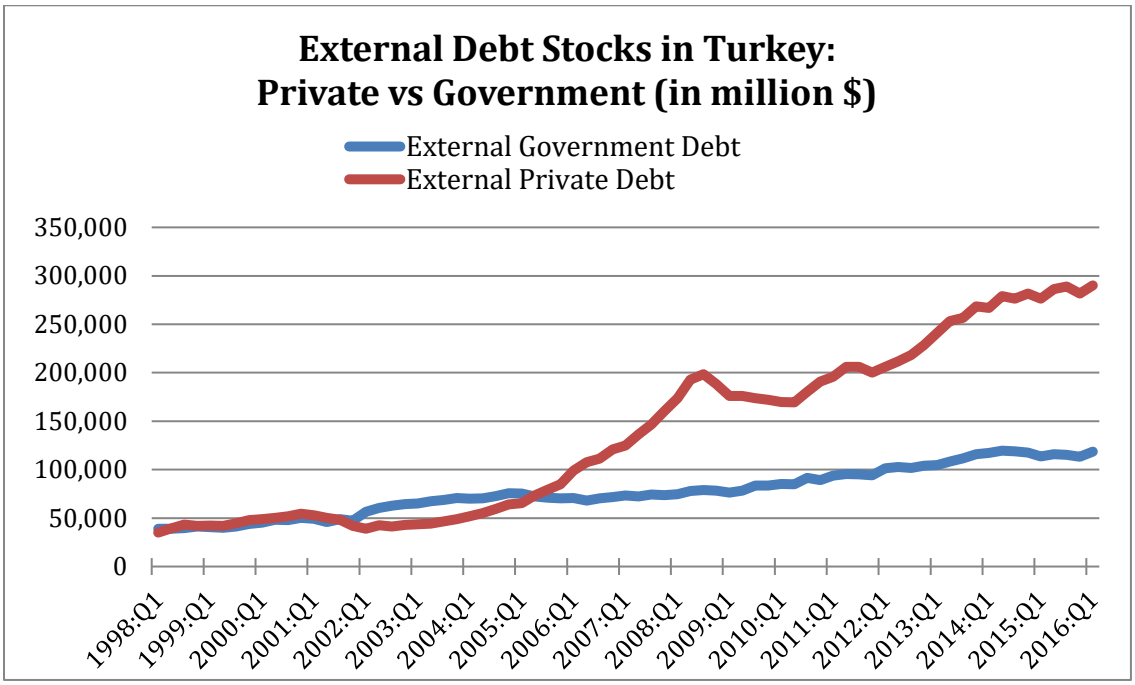
CHAPTER 3: TURKEY'S EXTERNAL DEBT TRENDS

3.1. An Overview Analysis of the Study Period

Between 1998 and 2016, external government debt increased from USD 35 billion to USD 118 billion and external private debt rocketed from around USD 35 billion to USD290 billion. The private external debts decreased from USD 198 billion to USD 169 billion between the third-quarter of 2008 and second quarter of 2010. Apart from that period, private external debts had significantly increased after 2002 until 2016. Figure 10 illustrates the trends in both external private debt and external government debt in quarterly data.

During the period of 1998-2000, the Turkish government external debt and the private external debt were almost at par respectively. Both external private debt and also external government debt was USD 39 billion in 1998; slightly increase and both reached USD 50 billion in 2000. External private debt continued to increase and reached USD 54 billion in 2001, while external government debt remain same at USD 50 billion. After 2001, the trends in external private debt and external government debt changed and moved opposite direction. The government external debts had significantly increased in comparison to the external private debts, which had decreased considerably. In 2002, the external private debt decreased slightly to USD 38 billion, while the external government debt increased to USD 64 billion. At the end of the 2003, the external government debt peaked at USD 70 billion before shrinking slightly to USD 64 billion in 2005, while the external private debt swelled significantly to USD 64 billion in 2005. However, in 2005, the trends showed a reversal, with the external private debt overtaking the government

external debt. Over the nine years (2005-2014), the external government debt almost doubled, increasing from USD 64 billion in 2005 to USD 119 billion in 2014. Figure 10 shows that the external government debt decreased by USD 6 billion to USD 113 billion in 2015. On the other hand, the external private debt sharply increased during the period 2005-2008, peaking at USD 192 billion.

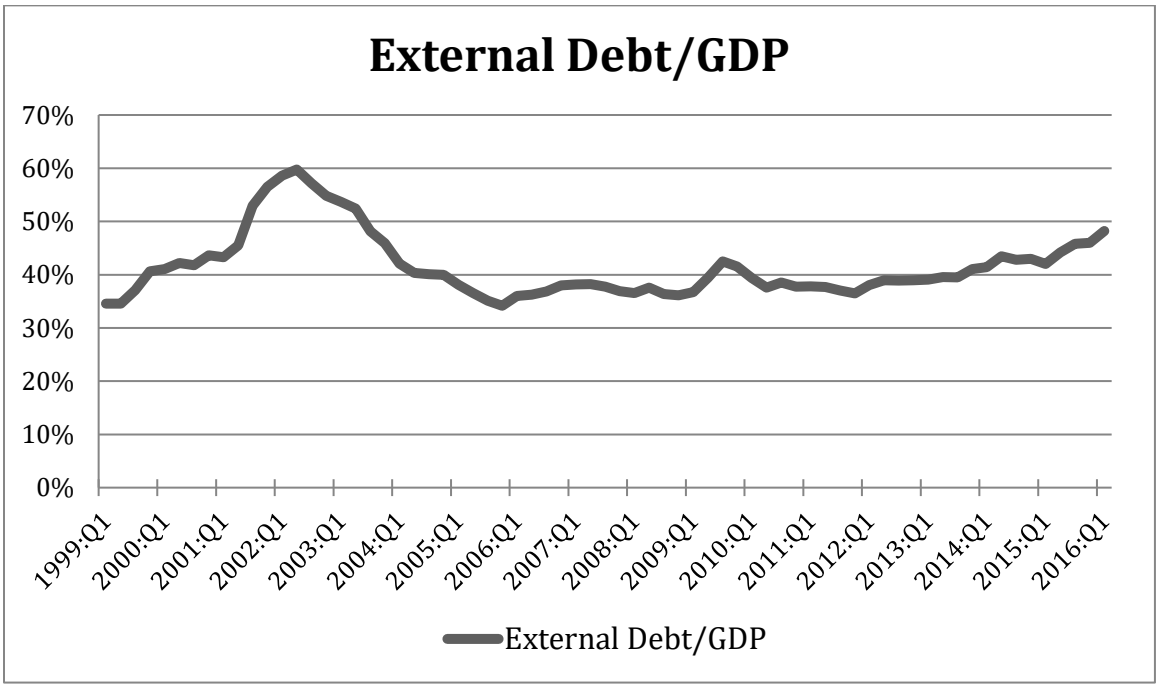


Source: Constructed by the author using World Development Indicators data

Figure 10: External Debt Stocks in Turkey: Private vs Government

The external private debt decreased by USD 19 billion and reached USD169 billion in the first quarter of 2010. It peaked at USD 206 billion in the third quarter of 2011, USD 14 billion more than previous peak in the second quarter of 2008 (USD 192 billion). The external private debt decreased by USD 6 billion and reached USD 200 billion in the fourth quarter of 2011. Over the next three years, the external private debt

constantly increased and reached USD 256 billion in the third quarter of 2013. Between 2013 and 2016, there has been considerable volatility in the external private debt, unseen in previous years.



Source: Constructed by the author using World Development Indicators data

Figure 11: External Debt/GDP

The proportion of cumulative external debt in gross domestic product was the lowest at 35 per cent in 1998. External debt to gross domestic product peaked at 57 per cent in 2001. It decreased significantly over the next 4 years and dropped to 35 per cent again in 2005. During the period 2005-2016, external debt to gross domestic product fluctuated between 35 per cent and 48 per cent. Moreover, the average of external debt to gross domestic product is 42.58 per cent during the period 1998-2016.

The proportion of cumulative external debt to GDP increased from 35 per cent to 41 per cent in 1999. The external debt/GDP ratio slightly increased and reached 45 per cent in the second quarter of 2001. In the second quarter of 2002, the external debt/GDP ratio peaked at 60 per cent, which is the highest figure during the period of 1999-2016. The external debt to GDP ratio was mostly stable within the 34 per cent to 40 per cent band, in the fourth quarter of 2005 and third quarter of 2013 except 2009 when the external debt/GDP ratio increased to 42 per cent from 37 per cent in the third quarter of 2009. In the fourth quarter of 2009, the ratio sank below 40 per cent and didn't surpass that percentage level until 2014. The statistics show a sharp 10 per cent decrease after 2014, but it gradually increased to nearly 50 per cent in 2016.

The January 24 Decisions, the Decree No.32 in 1980, the Stand-by Agreement in 1994 and important domestic events in 1999, have provided a basis for breakdown the Turkish economic policies into three phases (i) 1980-1989 period, (ii) 1990-1999 period, (iii) 2000 and after.

3.2. Turkey's External Debt Experience

3.2.1 External Debt Trends: 1980s -1990s

The fundamental worldwide events in the 1970s and 1980s—particularly the oil price shocks, high interest rates and recessions in the developed countries, and weak primary commodity prices - are usually referred to as the major contributors to the debt explosion in the developing countries (IMF 2000).

Inevitably, Turkey needed a new strategy to structurally reform its policies in order to restore and stabilize the economy, and hence the need for the introduction of the January 24 Decisions in 1980. The main focus of the reforms was to further strengthen Turkey's economic liberalization and policies, aimed at increasing foreign exchange inflows. The foreign trade liberalization and industrialization policies were introduced to encourage exports in sharp contrast to the previous import substitution policies. With the new economic reform policies, tourism industry and remittances was further geared up to encourage and further increase foreign exchange inflows.

The first measure was a devaluation of the Turkish lira by almost 49% (from 47 TL per dollar to 70 TL per dollar), which was the first step into crawling peg nominal exchange rate regime. This was the one of the major requirements of the standby agreement signed by the government with the IMF. In 1980, Turkey signed the longest standby agreement with IMF amounting to SDR 1.25 billion and then signed for USD 225 million in 1983 for one more year.

As a result of the fast and high outward-oriented growth policies, the external debt doubled in the period between 1984 and 1988. Consequently, the ratio of external debt to gross domestic product (GDP), which stood at 20 percent at the end of the1970s, increased up to 40 per cent level in the 1980s.

3.2.2. External Debt Trends: 1990-1999

In the 1990s, while external as well as internal debts were growing, long-term investment was shrinking. The external debt stock in 1990 was USD 49.42 billion, and it doubled in 10 years to reach USD 101.78 billion in 1999. Economic growth rate took a tumble,

substantially decreasing from 9.26 per cent in 1990 to -4.66 per cent in 1994 and -3.38 per cent in 1999.

Turkey faced an economic and financial crisis in 1994 when real interest rate and foreign exchange rate increased significantly. External debt stocks of the Turkish Government went out of the control. Turkish government had to take loans at very high interest rates. In April 1994, the dollar-lira exchange rate increased by 100 per cent, forcing the Turkish currency to be devaluated. There was no demand for government bonds even at 80 per cent interest rate. For example, between January 1994 and April 1994, six out of twenty tenders were cancelled due to lack of market demand. In April 1994, the Turkish Treasury issued 3-month government bonds at 400 per cent interest rate. Interest rate was fenced at 300 per cent until June 1994 and did not dive below 100 per cent until the end of 1999.

In 1994, a Standby Agreement was signed with IMF. During the period of 1985-1994, non-standby period, external debt was used to finance populist government policies such as high wages to government officers, generous subsistence to farmers, financial aids to state-owned enterprises, and in the end very high interest rates had to be sustained. As a result, 7.65 per cent economic growth in 1993 gave way to negative growth in 1994, i.e. -4.66 per cent.

Privatization exercise seemed inevitable for Turkey to get out from the unpredictable and vicious economic uncertainties cycle. However, the Turkish Constitutional Court made a deliberate move by cancelling the privatization exercises. The Turkish government had to bear the extremely high real and opportunity cost of these cancellations. In 1996, for example, Turk Telekom deal, which was worth USD 40

billion, was revoked by constitutional court. Had the deal been realized, it would have paid 60 per cent of current external debt amounting to USD 65 billion. Consequently, the cost of debts rocketed and Turkey entered into another crisis for not been able to pay off its debts on time.

3.3.3. External Debt Trends: 2000s

Before 2000, in order to fulfill short-term liquid needs, government banks used to borrow heavily from domestic banks and as such interest rates in Turkey increased, which constrained their lending to the private sector borrowers. Thanks to subsequent economic improvement and political stability, the private sector borrowings grew at relatively low interest rates. The external private debt continued to increase in the 2000s substantially. The external private debt in 2002 reached USD 43 billion, and in 2005 the figure almost doubled, reaching USD 84 billion, with private external debt surpassing total government external debt.

The November 2000 - February 2001 crisis caused a rapid outflow of capital from the Turkish economy. Additional debts were obtained and stability programs were implemented. The government recorded highest borrowings in the beginning of 2000 from IMF. USD 2.9 billion was transferred from the IMF, and the amount subsequently increased to USD10.2 billion in 2001. The total cumulated amount of debt secured from IMF since 1961 amounted to USD 50 billion, and USD 22 billion of the total debt was repaid by the Government between 2002 and 2010 (Karagöl E.T., 2010).

Up until 2002, GDP fluctuated, while government external debt stock continued to increase. However, after political stability was restored and structured economic policies were in place, fluctuations in the GDP and government external debts subsided substantially. Government debt to GDP ratio decreased from 50.4 per cent to 29 per cent between 2009 and 2015.

CHAPTER 4: LITERATURE REVIEW

Previous empirical evidences have found mixed results on the relation between external debt and economic growth. Also the most of the past studies have examined external debt and economic growth. However, there is only one study, (Çevik & Cural, 2013) that decomposed external debt into external private debt (EPD) and external government debt (EGD) in the case of Turkey. Since changes in EPD might affect GDP differently, there is a need to split external debt into EGD and EPD components. The EGD would be a burden for future generations, which would reveal itself in the form of a reduced flow of income from a lower stock of private capital (as higher public indebtedness crowds out private investment). Moreover, External Government debt have a much longer time frame, and if these are meant for infrastructure, education, etc. there are considerable externalities which may not directly translate into higher economic growth in the near term, whereas EPD translates into higher profits in a much shorter time span.

However, there is a growing empirical literature that also shows a negative correlation between government debt and economic growth (Reinhart and Rogoff, 2010; Kumar and Woo, 2010; Checherita-Westphal and Rother, 2012). Also, Theoretical literature argues that growth models where governments issue debt to fund consumption or capital goods tend to exhibit a negative relationship between government debt and economic growth. Modigliani (1961) argues that government debt is a burden for posterity, which results in waning flow of income from a reduced stock of private capital. It is argued that government debt crowds out capital and leads to a slowdown of output in the long run (Elmendorf and Mankiw 1999). However, EPD is used for funding

productive and income generated business activities, which directly and positively linked with economic growth.

Table 5: Literature Review

References	Country & Data Period	Relation	Empirical Results
Nüket Kirci Çevik & Mehmet Cural (2013)	Turkey 1989:Q1-2012:Q4	N/A	Both external private debt and external government debt has casual relationship with economic growth.
Murat Karagöz, & Ayşe Demirhan (2015)	Turkey 1998:Q1-2013:Q1	+	Unidirectional relationship from Gross External Debts to Gross Domestic Product.
Suna Korkmaz (2015)	Turkey 2003:Q1-2014:Q3	+	External debt was found unidirectional causality from economic growth.
Metin Bayrak & Ömer Esen (2012)	Turkey 1981-2010	+/-	Foreign debts have an effect on the economic growth in the long term yet no such effect is present in the short term.
Udeh Sergius Nwannebuike, Ugwu James Ike & Onwuka Ifeanyi Onuka (2016)	Nigeria 1980-2013	+/-	External Debt had a positive relationship with Gross Domestic Product at short run, but a negative relationship at long run.
Siti Nurazira Mohd Dauda, Abd Halim Ahmad & W.N.W. Azman-Saini (2013)	Malaysia 1991:Q1-2009:Q4	+	External debt contribution to Malaysia's economic growth in long run.
Wadad Saad (2012)	Lebanon 1970-2010	N/A	Bidirectional Granger causality between GDP and external debt servicing.
Maureen Were (2011)	Kenya 1970-1995	-	External debt accumulation has a negative impact on economic growth and private investment
Muhammad Ramzan & Eatzaz Ahmad (2014)	Pakistan 1970–2009	-	External debt has a negative impact on growth, but this adverse effect can be reduced or even reversed in the presence of sound macroeconomic policy.

James Ochieng Babu, Symon Kiprop, Aquilars M. Kalio & Mose Gisore (2014)	East Africa Community (EAC) 1970-2010	-	External debt has a negative significant effect on per capita GDP growth rate
Abdur R. Chowdhury (2001)	35 HIPC 25 Non-HIPC 1982-1999	-	Negative causal impact running from each of the four debt measures to economic growth.
Vincent. N. Ezeabasili, Hamilton O. Isu & Joseph N. Mojekwu (2011)	Nigeria's 1975-2006	-	Unidirectional causality exists between external debt service payment and economic growth.

A numbers of empirical studies have been undertaken that have focused on the impact of external debt on economic growth and have found mixed results. The mostly unilateral Causality from external debt to economic growth has been found except Metin Bayrak & Ömer Esen (2012) who didn't find any relationship between two. Papers, such as Murat Karagöz, & Ayşe Demirhan (2015), of Metin Bayrak & Ömer Esen (2012)-long term debts-, Suna Korkmaz (2015) Siti Nurazira Mohd Dauda, Abd Halim Ahmad & W.N.W. Azman-Saini (2013), Udeh Sergius Nwannebuike, Ugwu James Ike & Onwuka Ifeanyi Onuka (2016) found positive relationship between external debt and economic growth. However, papers, such as, Abdur R. Chowdhury (2001), James Ochieng Babu, Symon Kiprop, Aquilars M. Kalio & Mose Gisore (2014), Udeh Sergius Nwannebuike, Ugwu James Ike & Onwuka Ifeanyi Onuka (2016) (in long run), Martti Randveer, Lenno Uusküla,Liina Kulu(2011), Maureen Were (2011), Muhammad Ramzan & Eatzaz Ahmad (2014), Metin Bayrak & Ömer Esen (2012) (short term debts), Vincent. N. Ezeabasili, Hamilton O. Isu & Joseph N. Mojekwu (2011) found negative relation between external debt and economic growth.

Nüket Kirci Çevik & Mehmet Cural (2013) investigates external debt and economic growth of Turkey over the period of 1989:01-2012:04 by employing vector auto regression models (VAR) and the Toda-Yamamoto causality technique. Their findings suggest unidirectional causality runs from debt to economic growth. However, the "domestic debt leads economic growth" hypothesis could not be proven. They categorized external debt as external debt of public and external debt of private and both variables determined as the Granger causality of the economic growth. They also found that external debt has a positive effect on economic growth.

Murat Karagöz, & Ayşe Demirhan (2015) empirically test the "debt led growth hypothesis" in case of Turkey over 1998:Q1 and 2013:Q1 period. They found a unidirectional relationship from Gross External Debts to Gross Domestic Product. Moreover, external debts have a positively significant effect on the economic growth of Turkey. Their results have confirmed that the external debt of Turkey was sustainably and efficiently used in the last decade.

Suna Korkmaz (2015) studies relation between External debt and Economic growth in Turkey for the 2003:1-2014:03 period by employing granger causality test. They found unilateral causality from external debt to economic growth and external debt has positive impact on economic growth over the given period.

The study of Metin Bayrak & Ömer Esen (2012) examined external debt and economic growth relation and found that while foreign debts have an effect on the economic growth in the long term, no such effect is present in the short term. Moreover, the increasing amount of the short-term loans within the foreign debt stock has a negative impact on economic growth, findings, indicating that long-term debts have a positive

effect on the economic growth have been acquired. While the borrowing affects economic growth in long term, foreign borrowing has no effect on economic growth.

The study of Udeh Sergius Nwannebuike, Ugwu James Ike & Onwuka Ifeanyi Onuka (2016) analyzes the impact of external debt on economic growth in Nigeria for the 1980-2013 period. The study made an attempt to test three hypotheses: first, external debt has no significant impact on gross domestic product in Nigeria; second, external debt servicing has no significant effect on gross domestic product in Nigeria; and third, exchange rate has no significant impact on gross domestic product in Nigeria. The study found that External Debt has a positive relationship with gross domestic product in the short run, but a negative relationship in the long run. Moreover, external debt service payment has a negative relationship with gross domestic product, while exchange rate has a positive relationship with it.

Siti Nurazira Mohd Dauda, Abd Halim Ahmad & W.N.W. Azman-Saini (2013) have analyzed external debt contribution to Malaysia's economic growth in long run for the period 1991 to 2009 and demonstrated the existence of a long-run positive relationship between GDP and external debt over the reference period in Malaysia. In addition, the study also pointed to an optimal stock of external indebtedness by employing the threshold method of Hansen (2000). The positive affect of external debt is associated up to a certain level, above that level, an additional increase in external debt contribute inversely to the Malaysian economy.

Wadad Saad (2012) investigated casual relation between external economic growth, exports, exchange rate and external debt of Lebanon by employing the vector error correction models (VECM) and employed Granger causality techniques over the

period 1970-2010. The results show that both short run and long run relationships exist among these variables. Moreover, the finding suggests, i) bidirectional Granger causality between GDP and external debt servicing, ii) unidirectional Granger causality that runs from external debt to exports, iii) unidirectional causality running from exports to economic growth, and iv) unidirectional causality running from exchange rate to economic growth. These findings provide evidence to support validity of export-led growth hypothesis in the long run.

The study of Maureen Were (2011) tests the "debt overhang hypothesis" using time series data from 1970 to 1995 for Kenya. The investment model showed that "crowding out" of current investment did exist as a result of servicing relatively large amount of external debt. The empirical results indicated that external debt accumulation has a negative impact on economic growth and private investment, which proves debt overhang problem in Kenya. It was also found that current debt flows stimulate investment while debt accumulation deters investment. The results imply that external debt does influence growth directly, if investment is not adversely affected.

Muhammad Ramzan & Eatzaz Ahmad (2014) apply ARDL technique with annual data spanning from 1970–2009 in Pakistan and find evidence of negative impact of external debt on economic growth. However, this adverse effect can be reduced or even reversed in the presence of sound macroeconomic policy. Their findings suggest that sound economic management policy in terms of low inflation, trade openness and low budget deficit is crucial for external debt effectiveness. By implementing appropriate policies such as minimizing budgetary deficit, lowering the inflation rate and achieving trade openness, the positive impact on economic growth can be achieved.

The study of James Ochieng Babu, Symon Kiprop, Aquilars M. Kalio & Mose Gisore (2014) assessed the impact of external debt on economic growth for the East African Community using the annual data from 1970 to 2010 and the results indicate that external debt has a negative significant effect on per capita GDP growth rate in the EAC.

Abdur R. Chowdhury (2001) examines external debt-growth relation in to heavily indebted poor countries (HIPC) and non-HIPC. They found evidence of negative causal impact running from each of the four debt measures, total debt service/GDP ratio (TDS/GDP), total debt service/exports ratio (TDS/EXP), debt/GDP ratio (DEBT/GDP), and debt/exports ratio (DEBT/EXP), to economic growth.

Vincent. N. Ezeabasili, Hamilton O. Isu & Joseph N. Mojekwu (2011) examines the relationship between external debt and economic growth in Nigeria between 1975 and 2006. This study concludes that there was uni-directional causality between External debt service payment (LETDS) and economic growth at the 10 percent level of significance. Moreover, short-run relation between economic growth and external debt is negative in Nigeria.

Choong, C. Keong, Evan & Lau (2010) conducted a granger causality test which showed the existence of short-run causality between external debt and economic growth. Also, their study suggested that the external debt had a negative effect on Malaysia's long-run economic growth.

A study by Babu (2014) showed that external debt has a negative significant effect on per capita GDP growth rate in the East African countries. Similarly, The findings by Siddique (2016) suggested that, in the short-term as well as in the long-term,

an decrease in debt stock would have significantly increased the growth performance of the indebted nations.

CHAPTER 5: DATA AND METHODOLOGY

5.1. Data

The model includes following variables: Real GDP as a proxy of economic growth (GDP), External Private Debt as % of GDP (EPD), External government debt as % of GDP (EGD) and Export as % of GDP (EXP). All the data is collected from Datastream from the period 1998Q1 to 2016Q1 (74 observations) for the Turkish economy. Since the data displays the seasonality effect, the data is de-seasonalized using X11 procedure. The sample size is large enough to allow sufficient degree of freedom.

5.2. Methodology

For our analysis, time series techniques such as, co-integration, long-run structural modeling, vector error correction and variance decompositions are adopted.

Firstly, we will run unit root tests, such as ADF and PP, to identify whether the variables are of I(1) or I(0). If the variables are integrated at 1 then standard VAR/VECM should be applied. However, if the diagnostics suggest mix of I(1) and I(0), then ARDL approach shall be the right method to address the issue.

Unit Root Tests: Most of the financial time series data is of non-stationary nature, implying that they do not have a constant mean, variance and covariance. Applying OLS regression on non-stationary variables generates unreliable results since t-statistic and F-statistic are statistically not valid. Differencing the variables will make them stationary but applying ordinary regression on the differenced variable will not capture the long-run

trend, the theoretical part of the estimation. The unit root tests are performed by using Augmented Dickey-Fuller (ADF) tests and Phillips-Perron (PP) tests.

VAR lag order selection: Before testing the co-integration, the number (order) of the vector auto regressive (VAR) lags should be first determined.

Co-integration Tests: Next we will run Engle-Granger and Johansen co-integration tests to examine whether variables are moving together in the long run. Co-integration test will reveal whether the variables are moving together in long run or not. However, it does not show whether there is a short-run deviation from the long-run equilibrium or not. In order to understand the process of short-run adjustment to bring about the long-run equilibrium, the error correction model will be used.

Long-run structural modeling (LRSM): it will test the long-run coefficient of a variable against the theoretically expected values whether the variable is statistically significant or not.

Vector error correction model (VECM): It tells which variable is leader (exogenous/independent) and which variable is follower (endogenous/dependent). Yet, it cannot tell the relative endogeneity/exogeneity. In other words, it cannot tell which variable is the strongest leader and which variable is the weakest follower.

Vector decomposition (VDC): The exogeneity or endogeneity of the variables are determined using VECM. Yet, the order (relative exogeneity/endogeneity) is not known. Running the VDC reveals the power or strength of the endogeneity or exogeneity of the variables. In other words, VDC can tell which variable is the strongest leader or the weakest follower by ranking the variables based on the degree of dependence on their own past lags. Orthogonalised VDC depends on the particular ordering of the variables in the VAR and assumes that when a particular variable is shocked, all other variables in the system are switched off. Because of that reason, Orthogonolized VDC will not be used in this analysis since such condition is not relevant to integrated macroeconomic system.

Impulse response (IR): It is applied to test the impact of one variable on others, their magnitude of response, and how long it would take to normalize.

Persistence profile (PP): Contrary to IR, which traces out the effects of a variable-specific shock on the long-run relationship, PP shows how long it would take for the whole system to stabilize when there is a system-wide shock, where all the variables are shocked, by some external factors such as the global crisis.

CHAPTER 6: EMPIRICAL RESULTS

6.1 Unit Root Tests:

Table 6 presents the ADF results for level (log) and 1st differenced form data:

Table 6: ADF test

	Variable	Test	Statistic	CV	LL	AIC	SBC	HQC	RESULT
Log Form	LGDP	ADF(2)	-2.9172	-3.4301	225.3686	220.3686	214.7833	218.1527	Non-Stationary
	LEPD	ADF(2)	-1.9187	-3.4301	180.1669	175.1669	169.5816	172.951	Non-Stationary
	LEGD	ADF(1)	-2.2947	-3.4631	190.5476	186.5476	182.0794	184.7749	Non-Stationary
	LXP	ADF(1)	-2.6523	-3.4631	134.9623	130.9623	126.4941	129.1896	Non-Stationary

	Variable	Test	Statistic	CV	LL	AIC	SBC	HQC	RESULT
1st Diff. Form	DGDP	ADF(1)	-4.3683	-2.8527	217.4409	214.4409	211.1117	213.1218	Stationary
	DEPD	ADF(2)	-3.5638	-2.8332	175.3621	171.3621	166.9231	169.6032	Stationary
	DEGD	ADF(1)	-4.418	-2.8527	183.9254	180.9254	177.5961	179.6062	Stationary
	DXP	ADF(4)	-3.1594	-2.8588	134.4008	128.4008	121.7423	125.7625	Stationary

The null hypothesis is that the variable is non-stationary. Based on the AIC and SBC selection criteria, the variables are non-stationary at their level form but stationary in their first difference form. Next we run Phillips-Perron (PP) unit root test. Table 7 summarizes the results of the test for both level and 1st differenced forms:

Table 7: Phillips-Perron test

PP				PP			
Variables	T-Statistics	C.V	Result	Variables	T-Statistics	C.V	Result
LGDP	-2.9334	-3.4406	Non-Statinaory	DGDP	-6.7452	-2.9183	Stationary
LEPD	-1.8941	-3.4406	Non-Statinaory	DEPD	-7.6019	-2.9183	Stationary
LEGD	-1.6681	-3.4406	Non-Statinaory	DEGD	-8.7219	-2.9183	Stationary
LXP	-3.1058	-3.4406	Non-Statinaory	DXP	-7.9107	-2.9183	Stationary

The null hypothesis is that the variable is non-stationary. As it is shown in Table 7 all the variables become stationary after taking the 1st differenced, which is in line with ADF results. So, both unit root tests suggest that the variables are of type I(1) and we can proceed with the co-integration tests using the VAR/VECM approach. Table 8 shows the results of VAR lag order selection.

Table 8: Var lag order selection

Order	AIC	SBC	Adj.LR
5	726.6381	633.4187	21.6724[.154]
4	723.1732	647.7100	46.2897[.049]
3	724.0280	666.3208	65.4439[.048]
2	721.5395	681.5883	88.8265[.022]
1	714.6362	692.4411	117.7925[.004]
0	710.6895	706.2505	143.0191[.001]

AIC suggests 5 order of lags, while SBC prefers 0 lags. AIC is biased upwards, while SBC is biased downwards. Hence, we conduct autocorrelation tests to identify the optimal number of lags (the results are provided in the Appendix). Based on autocorrelation tests, we select 2 lags and move forward with co-integration tests.

Table 9 shows the results of Maximal Eigenvalue and Trace co-integration tests:

Table 9: Co-integration tests

Null	Alternative	Statistic	95% C.V.	90% C.V.
Maximal Eigenvalue test				
r=0	r=1	40.5756	27.4200	24.9900
r<=1	r=2	21.5046	21.1200	19.0200
r<=2	r=3	5.0039	14.8800	12.9800
Trace test				
r=0	r>=1	67.1622	48.8800	45.7000
r<=1	r>=2	26.5866	31.5400	28.7800

According to the Maximal Eigenvalue test, there are 2 co-integrations, whereas the Trace test shows that the variables are moving together in the long run in one direction (1 co-integration). Based on the theory, the variables are expected to have one co-integration. Hence, we proceed with one co-integration as per results of Trace test.

An evidence of co-integration implies that the relationship among the variables is not spurious, i.e. there is a theoretical relationship among the variables and that they are in equilibrium in the long run.

Co-integration, however, cannot tell us the direction of Granger causality as to which variable is leading and which variable is lagging (i.e. which variable is exogenous and which variable is endogenous). For discerning the endogeneity/exogeneity of the variables, we applied the vector error correction modeling technique.

6.2 Long-run Structural modeling (LRSM):

In order to make the coefficients of the co-integrating vector consistent with the theoretical and a priori information of the economy, we applied the 'LRSM' procedure. In this step, we attempt to quantify the theoretical relationship among the variables. Therefore, we will be able to compare the statistical results with theoretical expectations. Based on LRSM, we reject the null hypothesis meaning restriction is not correct for both panel B and Panel C.

Since the main focus of this research is to identify the direction of causality between the real GDP and the External Private Debt (EPD) and External Government Debt (EGD), we first imposed a normalizing restriction of unity on the GDP variable at the 'exactly identifying' stage (Panel A of Table 10) and then experimented with a

restriction of unity on the External Private Debt (EPD) variable at the 'over-identifying' stage (Panel B of Table 10). When we imposed a normalizing restriction of unity on the coefficient of GDP (Table 10, Panel A) we found all the coefficients of the co-integrating vector as highly significant. However, when we imposed an over-identifying restriction of unity on the coefficient of External Private Debt (EPD), it was rejected by the Chi-squared statistic (Table 10, Panel B). As a result, we proceeded with Panel A (rather than Panel B).

Table 10: Long-run structural modeling

	Exact Identification	Over-Identification	Over-identification
Variable	**PANEL A**	**PANEL B**	**PANEL C**
LGDP	1.0000	1.0000	1.0000
	NONE	*NONE*	*NONE*
LEPD	-0.39429	0.0000	-0.41628
	(.059916)	*NONE*	(0.13078)
LEGD	0.81916	1.8131	1.1909
	(0.15371)	(0.55625)	(0.41336)
LXP	0.20778	0.21245	0.0000
	(0.046959)	(0.15795)	*NONE*
CHSQ(1)	NONE	9.0412[.003]	7.2985[.007]
Decision	---	Restriction is not correct	Restriction is not correct

Notes: S.e. in parentheses. Null hypothesis for CHQ(1): Restriction is correct

In other words, the variables, namely external government debt, external private debt and export have significant effect in our model.

6.3 Vector Error Correction Model (VECM):

It is speed of adjustment that tells which variable is the leader or follower based on past data. By examining the results of vector error correction model, we find that economic growth (dLGDP) and external private debt (dLEPD) are exogenously determined, whereas other two variables, i.e. external government debt (dLEGD) and exports (dLXP)

are endogenous variables.

Table 11: Vector Error Correction Model

ecm1(-1)	Coefficient	Standard Error	T-Ratio[Prob.]	Result
dLGDP	-.0017327	0.029050	-.059646[.953]	Exogenous
dLEPD	0.073881	0.055005	1.3432[.184]	Exogenous
dLEGD	-0.195840	0.041836	-4.6811[.000]	Endogenous
dLXP	0.282010	0.107840	2.6151[.011]	Endogenous

Note: Null hypothesis: The variable is exogenous. S.L.=5%

According to the results of vector error correction model, External Government Debt and Export are follower variables while External Private Debt and Gross Domestic Products are leader variables in our model. However, VECM doesn't show relative endogeneity/exogeneity.

The dLGDP and dLEPD variables being exogenous, they would receive market shocks and transmit it to dLEGD and dLXP. A policy maker would be highly interested to monitor movements in dLGDP and dLEPD. Moreover, in VECM, coefficient of ecm1(-1) indicate that it will take a moderate time period to get back to the long-term equilibrium if a variable is shocked.

However, The VECM cannot tell us which variable is relatively more exogenous or endogenous. The variance decomposition technique is designed to indicate the relative exogeneity/endogeneity of a variable by decomposing (or partitioning) the variance of the forecast error of a variable into proportions attributable to shocks (or innovations) in each variable in the system including its own.

6.4 Vector Decomposition (VDC):

Table 12 presents the vector decomposition results (both generalized and orthogonalized). The results of vector decomposition based on generalized model show that external private debt (LEPD) is the most exogenous variable followed by the exports (LXP), whereas external government debt (LEGD) and economic growth (LGDP) are endogenous variables. The relative exogeneity of first two variables (LEPD and LXP) is consistent across different horizons for three years (12 quarters). However, the relative endogeneity of LEGD and LGDP changed after two quarters and remained constant over the period of 24 quarters (6 years). The results slightly differ from VECM. The exogenous variable LGDP of VECM is shown as endogenous in VDC. However, it should be noted that the outputs of Orthogonalized VDC are in line with the findings from VECM. However, one of the shortcomings of Orthogonalized VDC is that it depends on the particular ordering of the variables in the VAR and assumes that when a particular variable is shocked, all other variables in the system are switched off.

Table 12: Vector Decomposition

		Generalized						Orthogonalized					
VARIABLE	**HORIZON**	**LGDP**	**LEPD**	**LEGD**	**LXP**	**SELF DEP**	**RANK**	**LGDP**	**LEPD**	**LEGD**	**LXP**	**SELF DEP**	**RANK**
LGDP	2	58%	19%	7%	16%	58%	4	92%	1%	1%	7%	92%	1
LEPD	2	12%	78%	10%	1%	78%	1	15%	84%	1%	0%	84%	2
LEGD	2	19%	8%	71%	2%	71%	3	26%	1%	72%	1%	72%	3
LXP	2	13%	8%	2%	77%	77%	2	16%	2%	12%	71%	71%	4
LGDP	4	56%	21%	6%	17%	56%	3	90%	1%	1%	8%	90%	1
LEPD	4	9%	77%	12%	2%	77%	1	11%	87%	2%	1%	87%	2
LEGD	4	29%	16%	50%	5%	50%	4	45%	3%	48%	4%	48%	4
LXP	4	14%	12%	1%	72%	72%	2	18%	4%	13%	65%	65%	3
LGDP	8	54%	22%	5%	19%	54%	3	87%	2%	2%	9%	87%	1
LEPD	8	6%	73%	15%	6%	73%	1	7%	85%	6%	3%	85%	2
LEGD	8	35%	27%	24%	13%	24%	4	59%	11%	18%	12%	18%	4
LXP	8	16%	16%	1%	67%	67%	2	20%	7%	15%	59%	59%	3
LGDP	12	53%	23%	5%	20%	53%	3	86%	3%	2%	10%	86%	1
LEPD	12	4%	67%	18%	11%	67%	1	5%	80%	9%	6%	80%	2
LEGD	12	36%	32%	14%	18%	14%	4	60%	16%	9%	16%	9%	4
LXP	12	17%	18%	1%	64%	64%	2	21%	8%	16%	56%	56%	3
LGDP	24	51%	24%	4%	21%	51%	3	83%	4%	3%	11%	83%	1
LEPD	24	3%	51%	22%	24%	51%	2	3%	68%	17%	12%	68%	2
LEGD	24	35%	36%	6%	23%	6%	4	56%	20%	5%	19%	5%	4
LXP	24	18%	21%	1%	60%	60%	1	22%	10%	17%	52%	52%	3

On the other hand, Generalized VDC does not depend on the particular ordering of the variables in the VAR and does not make such an assumption that all other variables switched off. Hence, we use Generalized VDC, which is suitable for our study.

By employing Generalized VDC, we find that LEPD is the exogenous variable with 77 per cent in 3 years period, which is consistent with the error correction result as well. However, LGDP is the most endogenous variable in our model, which conflicts with VECM results. The possible reason of this conflict might be that VECM uses past data while eliminating theoretical part (trend) from the model. However, VDC uses trend and makes prediction. For policy makers, relying on Generalized VDC results would be logical, to formulate polices based on predictions. One of the most important objectives of the policy makers is to increase the economic output, for which focusing on the

appropriate variable is crucial. Knowing which variable is exogenous or endogenous would be useful for policy makers to achieve their goal in the most efficient way.

LXP is exogenous meaning it is determined out of our model. In terms of international effect, exports are influenced by exchange rate. Since free float exchange rate policy is applied in Turkey, LXP is exogenous.

6.5 Impulse Response:

The objective, in this analysis, is to find the reaction of other variables when one another is shocked and how long it takes to come back to equilibrium. Both the Generalized and Orthogonolized Impulse Response graphs show consistent results, with the exception of a shock in External Government Debt. The consistency between two Impulse Response approaches indicates accurate lag order is taken.

As shown in Figure 12, in the Orthogonolized Impulse Response graph, when External Government Debt is shocked, reaction of Export is greater and it takes longer time to come back the equilibrium compare to the Generalized Impulse Response graph.

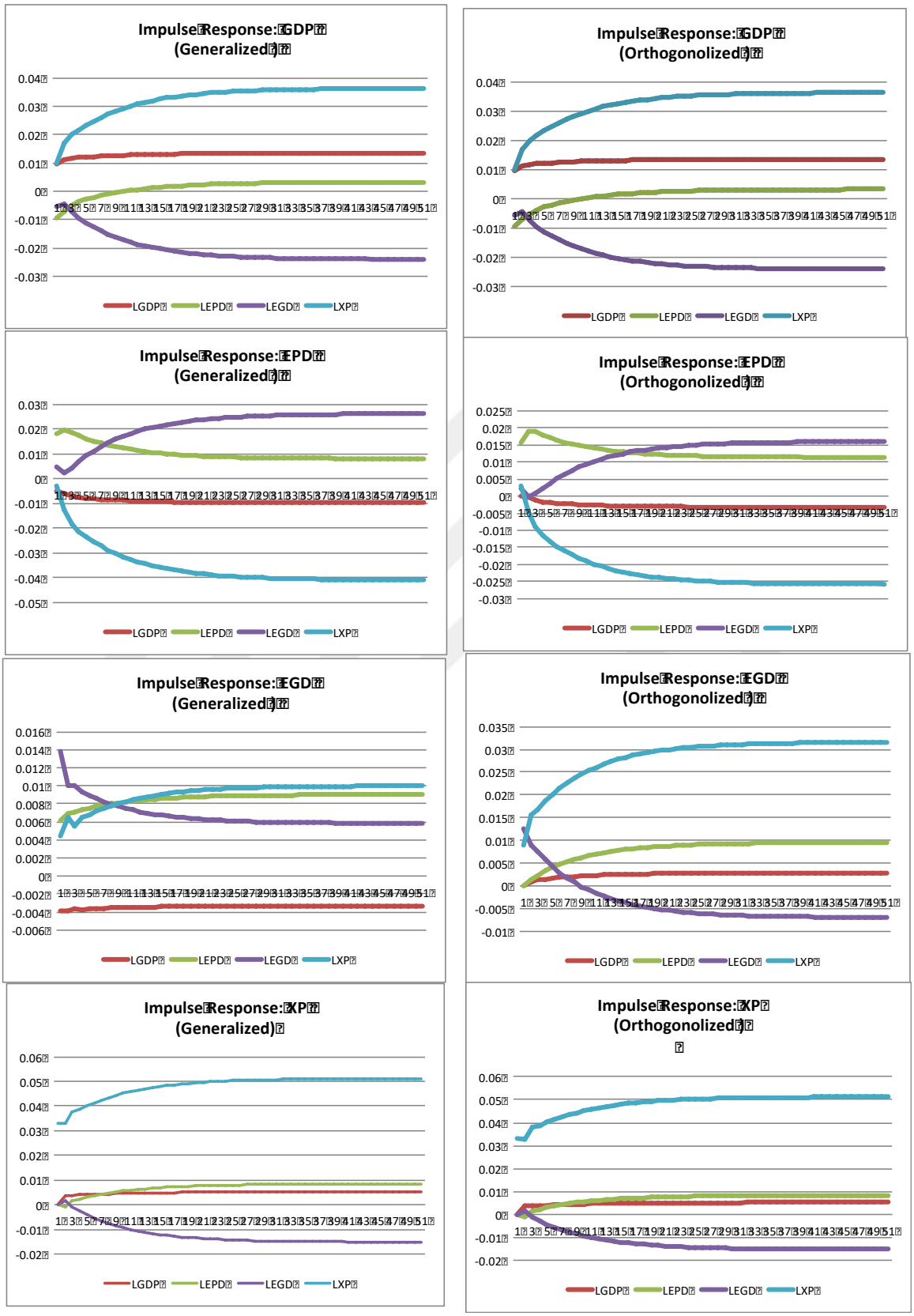


Figure 12: Impulse Response

When Gross Domestic Product is shocked, External Government Debt and Export are the variables that are mostly affected. For Both EGD and XP, it takes 30 quarters, around 7 years, to come back to equilibrium. Similarly, When EPD is shocked; XP and EGD are the most effected variables. However, the direction of the impact of those most effected variables is reverse of the shock in EGD. When EGD is shocked, XP and EGD are the most affected and the direction of effect on both is same but the impact is not as large as shocks in GDP and EPD. Lastly, when XP is shocked, XP and EGD is affected more than how much other variables are affected.

6.6 Persistence Profile:

Figure 13 shows the persistence profile for the co-integration equation of this study. Here the effect of a system-wide shock on the long-run relation is the focus instead of variable-specific shocks as in the case of Impulse Response function.

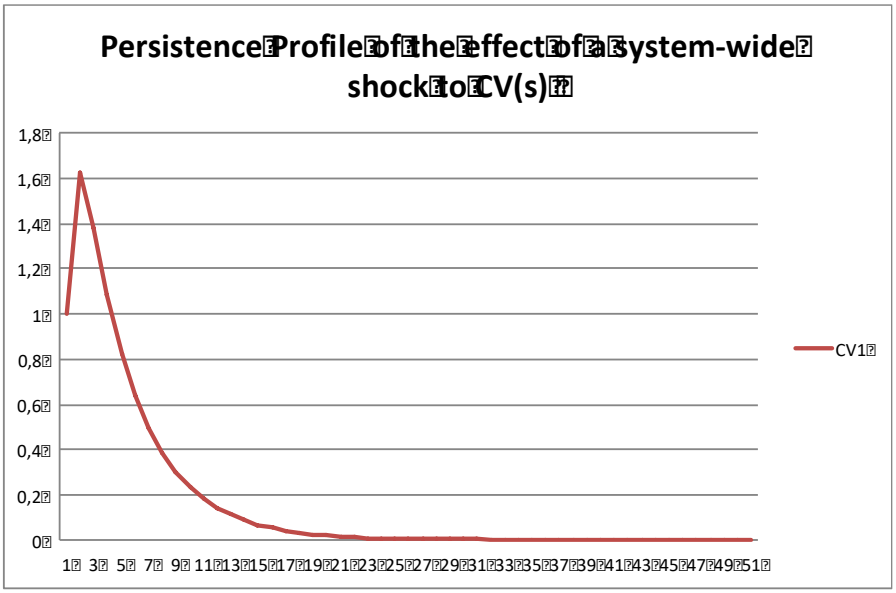


Figure 13: Persistence Profile of the Effect of a System-wide Shock

The chart indicates that it would take 20 quarters, 5 years, for the co-integrating relationship to equilibrium following a system wide-shock.

CHAPTER 7: CONCLUSION AND POLICY IMPLICATIONS

This study makes a humble attempt to explore the lead-lag relationship between Private External Debt and Gross Domestic Product by applying co-integration method, long run structural modeling, vector error correction model, variance decompositions, impulse response functions, and persistence profile. The results obtained in this paper support the idea that external private debt leads economic output. In the VECM approach, our findings suggest that both External Private Debt (EPD) and Gross Domestic Product (GDP) are exogenous.

However, the Generalized VDC approach shows that GDP is endogenous both in long run and short run. VECM is based on past data and eliminates theoretical part of the variables. On contrary, the VDC approach doesn't remove the theoretical part. Another possible reason of the conflict might be because pace of growth in External Private Debt exceeds that in GDP, meaning that EPD is becoming stronger than GDP over the period. To illustrate, between 1998 and 2016, external private debt stock grew three times more than Gross Domestic Product (GDP) growth. Furthermore, removing the trend, as in VECM, might make GDP exogenous.

Relying on our VDC results, and therefore saying that external private debt is the leader of economic output, is in line with neoclassical model of growth - where capital accumulation is viewed as a catalyzer of the economic growth - as well as with other empirical findings (Bamidele, T. B. & Joseph, (2013) and Hameed, Ashraf and Chandhary (2008).

Based on generalized vector decomposition results, five years later, export is forecasted to be the strongest leader in Turkish Economy. Increasing exports in Turkish economy will contribute more to the expansion of gross domestic product.

However, the external debt is a burden on economy - because TRY/USD exchange rate increased significantly over the last 15 years and the amount of external debt in domestic currency increased enormously – and this burden cannot be ignored or downplayed. In other words, debtors have to pay more in domestic currency. Thus, if external private debt is used to finance mainly export-oriented industries and activities, increased export earnings will make it easier for the private sector to service its external debt. Besides, a stronger export growth will increase the demand for the Turkish currency in the foreign exchange market, which will help mitigate foreign exchange exposure and reduce currency risk.

Hence, our findings are plausible and have policy implications for Turkish policy makers. Firstly, increasing external private debt will lead an increase in gross domestic product as long as external private debt is allocated to productive, foreign currency-generating, investments, as has been the case during the period under review. Secondly, the results underscore the need for the Turkish policy makers to continue to monitor not only the movements in the external private debt but also the exchange rate changes. Thirdly, the findings suggest that export-oriented policies will help Turkish economy to grow faster. Fourthly, since inflation eats into the exchange rate of a country's currency, as asserted by the purchasing power parity theory, there is a need for the monetary authorities to constantly rein in on inflationary pressures.

Expecting infinitively positive and leading effect of external private debt on economic output would be a naïve assumption. If the debt goes beyond a certain threshold, positive impact of external debt may turn negative. For future research, the "debt overhang" hypothesis can be empirically tested.

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APPENDICES

Unit Root Tests

ADF Tests

ADF tests for variable LGDP

The Dickey-Fuller regressions include an intercept and a linear trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-2.1235	-3.4392	221.7765	218.7765	215.4253	217.4470
ADF(1)	-2.5136	-3.4631	223.5942	219.5942	215.1260	217.8215
ADF(2)	-2.9172	-3.4301	225.3686	220.3686	214.7833	218.1527
ADF(3)	-2.8086	-3.3886	225.3710	219.3710	212.6687	216.7120
ADF(4)	-2.4008	-3.5226	226.1531	219.1531	211.3337	216.0509
ADF(5)	-2.4171	-3.4944	226.2421	218.2421	209.3057	214.6967

****

ADF tests for variable LEPD

The Dickey-Fuller regressions include an intercept and a linear trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-1.2312	-3.4392	177.2762	174.2762	170.9250	172.9466
ADF(1)	-1.4853	-3.4631	178.1937	174.1937	169.7255	172.4210
ADF(2)	-1.9187	-3.4301	180.1669	175.1669	169.5816	172.9510
ADF(3)	-2.1765	-3.3886	180.8904	174.8904	168.1881	172.2314
ADF(4)	-1.8909	-3.5226	181.1021	174.1021	166.2827	170.9999
ADF(5)	-1.9277	-3.4944	181.2102	173.2102	164.2738	169.6649

ADF tests for variable LEGD

The Dickey-Fuller regressions include an intercept and a linear trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-2.3402	-3.4392	190.5008	187.5008	184.1497	186.171
ADF(1)	-2.2947	-3.4631	190.5476	186.5476	182.0794	184.7749
ADF(2)	-2.4097	-3.4301	191.7661	186.7661	181.1808	184.5503
ADF(3)	-2.4251	-3.3886	191.8489	185.8489	179.1466	183.1899
ADF(4)	-2.4042	-3.5226	191.8693	184.8693	177.0499	181.7671
ADF(5)	-2.5533	-3.4944	192.6377	184.6377	175.7013	181.0923

****

ADF tests for variable LXP

The Dickey-Fuller regressions include an intercept and a linear trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-2.6510	-3.4392	134.6860	131.6860	128.3349	130.3565
ADF(1)	-2.6523	-3.4631	134.9623	130.9623	126.4941	129.1896
ADF(2)	-2.6359	-3.4301	135.8128	130.8128	125.2275	128.5969
ADF(3)	-2.6475	-3.3886	136.0643	130.0643	123.3620	127.4053
ADF(4)	-2.6148	-3.5226	137.5535	130.5535	122.7341	127.4513
ADF(5)	-2.6031	-3.4944	140.4160	132.4160	123.4795	128.8706

****

95% published asymptotic critical value corresponding to ADF(0) = -3.4749

ADF tests for variable DGDP

The Dickey-Fuller regressions include an intercept but not a trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-6.5694	-2.8844	216.9114	214.9114	212.6919	214.0319
ADF(1)	-4.3683	-2.8527	217.4409	214.4409	211.1117	213.1218
ADF(2)	-4.1654	-2.8332	217.7264	213.7264	209.2873	211.9675
ADF(3)	-4.5930	-2.8633	219.4243	214.4243	208.8755	212.2257
ADF(4)	-3.9515	-2.8588	219.4249	213.4249	206.7663	210.7866
ADF(5)	-3.2619	-2.9574	219.7485	212.7485	204.9803	209.6705

****

95% published asymptotic critical value corresponding to ADF(0) = -2.904

ADF tests for variable DEPD

The Dickey-Fuller regressions include an intercept but not a trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-7.0629	-2.8844	174.0611	172.0611	169.8416	171.1817
ADF(1)	-4.4021	-2.8527	175.1957	172.1957	168.8665	170.8766
ADF(2)	-3.5638	-2.8332	175.3621	171.3621	166.9231	169.6032
ADF(3)	-3.7733	-2.8633	176.1808	171.1808	165.6321	168.9822
ADF(4)	-3.4648	-2.8588	176.1979	170.1979	163.5394	167.5596
ADF(5)	-2.7444	-2.9574	177.1527	170.1527	162.3844	167.0746

****

95% published asymptotic critical value corresponding to ADF(0) = -2.9042

ADF tests for variable DEGD

The Dickey-Fuller regressions include an intercept but not a trend

****

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-7.8132	-2.8844	182.0919	180.0919	177.8724	179.2125
ADF(1)	-4.4180	-2.8527	183.9254	180.9254	177.5961	179.6062
ADF(2)	-3.5588	-2.8332	184.0936	180.0936	175.6546	178.3347
ADF(3)	-3.1305	-2.8633	184.1258	179.1258	173.5771	176.9272
ADF(4)	-2.5128	-2.8588	184.7966	178.7966	172.1380	176.1582
ADF(5)	-2.4478	-2.9574	184.8247	177.8247	170.0564	174.7466

****

95% published asymptotic critical value corresponding to ADF(0) = -2.9042

ADF tests for variable DXP

The Dickey-Fuller regressions include an intercept but not a trend

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-7.6216	-2.8844	129.0090	127.0090	124.7895	126.1296
ADF(1)	-4.9129	-2.8527	129.8398	126.8398	123.5105	125.5206
ADF(2)	-4.0718	-2.8332	130.0416	126.0416	121.6025	124.2827
ADF(3)	-4.4319	-2.8633	131.4382	126.4382	120.8895	124.2396
ADF(4)	-3.1594	-2.8588	134.4008	128.4008	121.7423	125.7625
ADF(5)	-2.8736	-2.9574	134.5594	127.5594	119.7912	124.4814

95% published asymptotic critical value corresponding to ADF(0) = -2.9042

ADF tests for variable DXP

The Dickey-Fuller regressions include an intercept and a linear trend

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-7.6051	-3.4434	129.1878	126.1878	122.8585	124.8686
ADF(1)	-4.8811	-3.4117	129.9277	125.9277	121.4887	124.1688
ADF(2)	-4.0166	-3.4426	130.0957	125.0957	119.5469	122.8971
ADF(3)	-4.4089	-3.3969	131.6202	125.6202	118.9616	122.9818
ADF(4)	-3.0281	-3.3127	134.4142	127.4142	119.6459	124.3361
ADF(5)	-2.6814	-3.4043	134.5606	126.5606	117.6826	123.0429

95% published asymptotic critical value corresponding to ADF(0) = -3.4759

ADF tests for variable DINV

The Dickey-Fuller regressions include an intercept and a linear trend

	Test Statistic	CV	LL	AIC	SBC	HQC
DF	-5.2134	-3.4434	154.1882	151.1882	147.8589	149.8690
ADF(1)	-3.9496	-3.4117	154.5798	150.5798	146.1408	148.8209
ADF(2)	-4.5309	-3.4426	156.7614	151.7614	146.2127	149.5628
ADF(3)	-4.5708	-3.3969	157.5231	151.5231	144.8646	148.8848
ADF(4)	-2.8400	-3.3127	162.3939	155.3939	147.6256	152.3159
ADF(5)	-2.5529	-3.4043	162.5409	154.5409	145.6629	151.0232

95% published asymptotic critical value corresponding to ADF(0) = -3.4759

Phillips-Perron Unit Root test

Phillips-Perron Unit Root test applied to LGDP , Window Length = 18

Computations include an intercept but not a trend

```
        Test Statistic   CV
PP        .33394     -2.8682
---------------------------------------------------------------------------
95% published asymptotic critical value corresponding to ADF(0) =  -2.9006

    Phillips-Perron Unit Root test applied to LGDP , Window Length = 18
   Computations include an intercept and a linear trend
---------------------------------------------------------------------------
        Test Statistic   CV
PP       -2.9334     -3.4406
---------------------------------------------------------------------------
95% published asymptotic critical value corresponding to ADF(0) =  -3.4704

    Phillips-Perron Unit Root test applied to LEPD , Window Length = 18
    Computations include no intercept and no trend
---------------------------------------------------------------------------
        Test Statistic   CV
PP       -2.9356     -2.0610
---------------------------------------------------------------------------
CV  = 95% simulated critical value using 74 obs. and 1000 replications


   Phillips-Perron Unit Root test applied to LEPD , Window Length = 18
    Computations include an intercept but not a trend
---------------------------------------------------------------------------
        Test Statistic   CV
PP       -1.5001     -2.8682
---------------------------------------------------------------------------
95% published asymptotic critical value corresponding to ADF(0) =  -2.9006

Phillips-Perron Unit Root test applied to LEPD , Window Length = 18
Computations include an intercept and a linear trend
---------------------------------------------------------------------------
        Test Statistic   CV
PP       -1.8941     -3.4406
---------------------------------------------------------------------------
95% published asymptotic critical value corresponding to ADF(0) =  -3.4704

    Phillips-Perron Unit Root test applied to LEGD , Window Length = 18
     Computations include an intercept but not a trend
---------------------------------------------------------------------------
        Test Statistic   CV
PP       -2.1814     -2.8682
```

```
*************************************************************************
*******
 95% published asymptotic critical value corresponding to ADF(0) =  -2.9006

    Phillips-Perron Unit Root test applied to LEGD , Window Length = 18
     Computations include an intercept and a linear trend
*************************************************************************
*******
       Test Statistic   CV
 PP       -1.6681     -3.4406
*************************************************************************
*******
 95% published asymptotic critical value corresponding to ADF(0) =  -3.4704

     Phillips-Perron Unit Root test applied to LXP , Window Length = 18
     Computations include an intercept and a linear trend
*************************************************************************
*******
      Test Statistic   CV
 PP       -3.1058     -3.4406
*************************************************************************
*******
 95% published asymptotic critical value corresponding to ADF(0) =  -3.4704

    Phillips-Perron Unit Root test applied to DGDP , Window Length = 18
     Computations include an intercept but not a trend
*************************************************************************
******
      Test Statistic   CV
 PP       -6.7452     -2.9183
*************************************************************************
*******
 95% published asymptotic critical value corresponding to ADF(0) =  -2.9012




Phillips-Perron Unit Root test applied to DEPD , Window Length = 18
   Computations include an intercept but not a trend
*************************************************************************
*******
      Test Statistic   CV
 PP       -7.6019     -2.9183
*************************************************************************
*******
 95% published asymptotic critical value corresponding to ADF(0) =  -2.9012
    Phillips-Perron Unit Root test applied to DEGD , Window Length = 18
    Computations include an intercept but not a trend
*************************************************************************
*******
```

```
        Test Statistic   CV
PP       -8.7219     -2.9183
*******************************************************************************
*******
95% published asymptotic critical value corresponding to ADF(0) =  -2.9012
    Phillips-Perron Unit Root test applied to DXP , Window Length = 18
    Computations include an intercept but not a trend
*******************************************************************************
*******
         Test Statistic   CV
PP       -7.9107     -2.9183
*******************************************************************************
*******
95% published asymptotic critical value corresponding to ADF(0) =  -2.9012
```

VAR LAG ORDER SELECTION

AIC suggests 5 order of lags, while SBC prefers 0 lags. AIC is known to be bias upwards, while SBC is biased downwards. Hence, we conduct autocorrelation tests to identify the optimal number of lags based on autocorrelation tests, we select 2 lags and move forward with cointegration tests.

```
Test Statistics and Choice Criteria for Selecting the Order of the VAR Model
*******************************************************************************
*******
Based on  68 observations from 1999Q4 to 2016Q3. Order of VAR = 6
List of variables included in the unrestricted VAR:
DGDP          DEPD          DEGD          DXP
List of deterministic and/or exogenous variables:
INPT
*******************************************************************************
*******
Order    LL        AIC       SBC           LR test          Adjusted LR test
6   827.7744  727.7744  616.7990          ------             ------
5   810.6381  726.6381  633.4187  CHSQ(16)=  34.2726[.005]   21.6724[.154]
4   791.1732  723.1732  647.7100  CHSQ(32)=  73.2023[.000]   46.2897[.049]
3   776.0280  724.0280  666.3208  CHSQ(48)= 103.4927[.000]   65.4439[.048]
2   757,5395   721.5395  681.5883  CHSQ(64)= 140.4698[.000]  88.8265[.022]
1   734.6362  714.6362  692.4411  CHSQ(80)= 186.2764[.000]  117.7925[.004]
0   714.6895  710.6895  706.2505  CHSQ(96)= 226.1697[.000]  143.0191[.001]
*******************************************************************************
*******
AIC=Akaike Information Criterion     SBC=Schwarz Bayesian Criterion
```

```
       OLS estimation of a single equation in the Unrestricted VAR
*******************************************************************************
*******
Dependent variable is DGDP
72 observations used for estimation from 1998Q4 to 2016Q3
```

```
*******************************************************************************
*******
 Regressor          Coefficient      Standard Error       T-Ratio[Prob]
 DGDP(-1)             .10685           .15749           .67847[.500]
 DGDP(-2)             .011687          .14974           .078045[.938]
 DEPD(-1)             .0062882         .072458          .086783[.931]
 DEPD(-2)             -.13551          .071774          -1.8880[.064]
 DEGD(-1)             -.061474         .075783          -.81119[.420]
 DEGD(-2)             -.029930         .070821          -.42262[.674]
 DXP(-1)              .090688          .031942          2.8391[.006]
 DXP(-2)              -.061473         .034531          -1.7802[.080]
 INPT                 .0052740         .0021301         2.4759[.016]
*******************************************************************************
*******
 R-Squared                  .27219      R-Bar-Squared              .17977
 S.E. of Regression         .0092315    F-Stat.  F(8,63)      2.9451[.007]
 Mean of Dependent Variable .0045231    S.D. of Dependent Variable    .01019
 Residual Sum of Squares    .0053689    Equation Log-likelihood      239.9729
 Akaike Info. Criterion     230.9729    Schwarz Bayesian Criterion   220.7279
 DW-statistic               1.9888      System Log-likelihood        804.3042
*******************************************************************************
*******
                        Diagnostic Tests
*******************************************************************************
*******
*    Test Statistics  *       LM Version       *        F Version         *
*******************************************************************************
*******
* A:Serial Correlation*CHSQ(4)  =   4.8152[.307]*F(4,59)      =   1.0571[.386]*
*                 *                  *                    *
* B:Functional Form   *CHSQ(1)  =   2.4179[.120]*F(1,62)      =   2.1544[.147]*
*                 *                  *                    *
* C:Normality         *CHSQ(2)  =  17.8306[.000]*      Not applicable        *
*                 *                  *                    *
* D:Heteroscedasticity*CHSQ(1)  =   .90233[.342]*F(1,70)      =   .88840[.349]*
*******************************************************************************
*******

       OLS estimation of a single equation in the Unrestricted VAR
*******************************************************************************
*******
 Dependent variable is DEPD
 72 observations used for estimation from 1998Q4 to 2016Q3
*******************************************************************************
*******
 Regressor          Coefficient      Standard Error       T-Ratio[Prob]
 DGDP(-1)             .36710           .28604           1.2834[.204]
 DGDP(-2)             .21958           .27196           .80740[.422]
 DEPD(-1)             .081149          .13160           .61665[.540]
 DEPD(-2)             .32251           .13035           2.4741[.016]
 DEGD(-1)             .13464           .13763           .97827[.332]
 DEGD(-2)             -.31761          .12862           -2.4693[.016]
 DXP(-1)              .019614          .058013          .33809[.736]
 DXP(-2)              .098500          .062714          1.5706[.121]
```

```
 INPT                .0022359         .0038687          .57794[.565]
*******************************************************************************
*******


R-Squared                .28473          R-Bar-Squared              .19390
 S.E. of Regression         .016766   F-Stat.    F(8,63)      3.1349[.005]
 Mean of Dependent Variable  .0057261   S.D. of Dependent Variable     .018674
 Residual Sum of Squares      .017709       Equation Log-likelihood       197.0081
 Akaike Info. Criterion      188.0081       Schwarz Bayesian Criterion    177.7631
 DW-statistic               2.0904          System Log-likelihood        804.3042
*******************************************************************************
*******
                    Diagnostic Tests
*******************************************************************************
*******
*    Test Statistics  *       LM Version       *         F Version         *
*******************************************************************************
*******
* A:Serial Correlation*CHSQ(4)  =   6.3372[.175]*F(4,59)     =   1.4236[.237]**
*
* B:Functional Form   *CHSQ(1)  =   .69595[.404]*F(1,62)     =   .60514[.440]*
* C:Normality         *CHSQ(2)  =   .38276[.826]*       Not applicable        *
* D:Heteroscedasticity*CHSQ(1)  =   1.6554[.198]*F(1,70)     =   1.6473[.204]*
*******************************************************************************
*******

OLS estimation of a single equation in the Unrestricted VAR
*******************************************************************************
*******
 Dependent variable is DEGD
 72 observations used for estimation from 1998Q4 to 2016Q3
*******************************************************************************
*******
 Regressor           Coefficient      Standard Error       T-Ratio[Prob]
 DGDP(-1)              -.21594          .26436          -.81682[.417]
 DGDP(-2)               .42798          .25136           1.7027[.094]
 DEPD(-1)              -.32611          .12163          -2.6812[.009]
 DEPD(-2)               .14575          .12048           1.2098[.231]
 DEGD(-1)               .044539          .12721           .35013[.727]
 DEGD(-2)               .26158          .11888           2.2004[.031]
 DXP(-1)              -.036018          .053617          -.67176[.504]
 DXP(-2)              -.083976          .057962          -1.4488[.152]
 INPT                -.0011394         .0035755          -.31866[.751]
*******************************************************************************
*******
 R-Squared                .21505      R-Bar-Squared              .11538
 S.E. of Regression         .015496   F-Stat.    F(8,63)      2.1575[.043]

 Mean of Dependent Variable  .8173E-3   S.D. of Dependent Variable     .016475
 Residual Sum of Squares      .015128   Equation Log-likelihood       202.6810
 Akaike Info. Criterion      193.6810   Schwarz Bayesian Criterion    183.4360
 DW-statistic               2.0373          System Log-likelihood        804.3042
```

```
*************************************************************************
*******
* A:Serial Correlation*CHSQ(4) =   4.1654[.384]*F(4,59)     =   .90574[.467]*
* B:Functional Form   *CHSQ(1) =  12.1027[.001]*F(1,62)     =  12.5276[.001]*
* C:Normality         *CHSQ(2) = 163.3777[.000]*      Not applicable       *
* D:Heteroscedasticity*CHSQ(1) =  12.1111[.001]*F(1,70)     =  14.1558[.000]*
*************************************************************************
******
```

OLS estimation of a single equation in the Unrestricted VAR

```
*************************************************************************
*******
Dependent variable is DXP
72 observations used for estimation from 1998Q4 to 2016Q3
*************************************************************************
*******
Regressor          Coefficient      Standard Error       T-Ratio[Prob]
DGDP(-1)             .17691          .61941           .28561[.776]
DGDP(-2)             1.0418          .58893           1.7690[.082]
DEPD(-1)            -.57517          .28498          -2.0183[.048]
DEPD(-2)             .37589          .28228           1.3316[.188]
DED(-1)             .26738          .29805          .89710[.373]
DEGD(-2)             -.24567          .27854          -.88201[.381]
DXP(-1)             .089947          .12563          .71598[.477]
DXP(-2)              .12770          .13581          .94034[.351]
INPT               -.015139         .0083776         -1.8071[.076]
*************************************************************************
*******
R-Squared                .18328          R-Bar-Squared            .079570
S.E. of Regression       .036307  F-Stat.  F(8,63)     1.7672[.101]
Mean of Dependent Variable  -.013483     S.D. of Dependent Variable    .037844
Residual Sum of Squares     .083047      Equation Log-likelihood      141.3769
Akaike Info. Criterion     132.3769      Schwarz Bayesian Criterion   122.1319
DW-statistic              1.8491         System Log-likelihood       804.3042
*************************************************************************
*******
                    Diagnostic Tests
*************************************************************************
*******
*   Test Statistics  *       LM Version       *         F Version         *
*************************************************************************
*******
* A:Serial Correlation*CHSQ(4) =  18.7796[.001]*F(4,59)     =   5.2047[.001]*
* B:Functional Form   *CHSQ(1) =   9.0369[.003]*F(1,62)     =   8.8987[.004]*
* C:Normality         *CHSQ(2) =   .47093[.790]*      Not applicable       *
* D:Heteroscedasticity*CHSQ(1) =   8.5191[.004]*F(1,70)     =   9.3940[.003]*
```

```
*******************************************************************************
*******

      OLS estimation of a single equation in the Unrestricted VAR
*******************************************************************************
*******
Dependent variable is DGDP
71 observations used for estimation from 1999Q1 to 2016Q3
*******************************************************************************
*******
Regressor          Coefficient      Standard Error       T-Ratio[Prob]
DGDP(-1)             .095458          .17345           .55035[.584]
DGDP(-2)            -.026202          .16736          -.15657[.876]
DGDP(-3)             -.11870          .16122          -.73622[.465]
DEPD(-1)             .039778          .084285          .47195[.639]
DEPD(-2)             -.10833          .081658         -1.3266[.190]
DEPD(-3)             -.11417          .079488         -1.4363[.156]
DEGD(-1)            -.059709          .084864          -.70359[.485]
DEGD(-2)            -.073841          .079191          -.93245[.355]
DEGD(-3)             .023213          .083234          .27888[.781]
DXP(-1)              .10104           .035494         2.8466[.006]
DXP(-2)             -.066842          .035953         -1.8592[.068]
DXP(-3)              .0095121         .038886          .24462[.808]
INPT                .0066928         .0025497         2.6249[.011]
*******************************************************************************
*******

R-Squared                    .28700     R-Bar-Squared                .13948
S.E. of Regression         .0094385     F-Stat.    F(12,58)     1.9455[.047]
Mean of Dependent Variable .0046826     S.D. of Dependent Variable    .010175
Residual Sum of Squares    .0051670     Equation Log-likelihood      237.5048
Akaike Info. Criterion      224.5048    Schwarz Bayesian Criterion   209.7974
DW-statistic                1.8542      System Log-likelihood        809.1338
*******************************************************************************
*******
                    Diagnostic Tests
*******************************************************************************
*******
* A:Serial Correlation*CHSQ(4)  =  11.7948[.019]*F(4,54)     =   2.6895[.041]*
* B:Functional Form   *CHSQ(1)  =   2.3601[.124]*F(1,57)     =   1.9599[.167]*
* C:Normality         *CHSQ(2)  =  20.0985[.000]*      Not applicable       *
* D:Heteroscedasticity*CHSQ(1)  =   1.2734[.259]*F(1,69)     =   1.2601[.266]*
*******************************************************************************
*******

      OLS estimation of a single equation in the Unrestricted VAR
*******************************************************************************
*******
Dependent variable is DEPD
71 observations used for estimation from 1999Q1 to 2016Q3
*******************************************************************************
*******
Regressor          Coefficient      Standard Error       T-Ratio[Prob]
DGDP(-1)             .44066           .31080          1.4178[.162]
```

DGDP(-2)	.19279	.29988	.64290[.523]
DGDP(-3)	.46671	.28889	1.6155[.112]
DEPD(-1)	.040179	.15103	.26604[.791]
DEPD(-2)	.22772	.14632	1.5563[.125]
DEPD(-3)	.24816	.14243	1.7423[.087]
DEGD(-1)	.11590	.15207	.76214[.449]
DEGD(-2)	-.21321	.14190	-1.5025[.138]
DEGD(-3)	.037995	.14914	.25475[.800]
DXP(-1)	-.016237	.063600	-.25530[.799]
DXP(-2)	.096171	.064423	1.4928[.141]
DXP(-3)	-.0016155	.069678	-.023185[.982]
INPT	-.0014983	.0045687	-.32795[.744]

****

R-Squared	.32985	R-Bar-Squared	.19120
S.E. of Regression	.016913	F-Stat. F(12,58)	2.3790[.014]
Mean of Dependent Variable	.0057526	S.D. of Dependent Variable	.018806
Residual Sum of Squares	.016590	Equation Log-likelihood	196.0934
Akaike Info. Criterion	183.0934	Schwarz Bayesian Criterion	168.3860
DW-statistic	1.9124	System Log-likelihood	809.1338

****

Diagnostic Tests

****

* A:Serial Correlation*CHSQ(4) = 5.5859[.232]*F(4,54) = 1.1528[.342]*
* B:Functional Form *CHSQ(1) = .10768[.743]*F(1,57) = .086582[.770]*
* C:Normality *CHSQ(2) = .47715[.788]* Not applicable *
* D:Heteroscedasticity*CHSQ(1) = 3.3735[.066]*F(1,69) = 3.4420[.068]*

****

OLS estimation of a single equation in the Unrestricted VAR

****

Dependent variable is DEGD

71 observations used for estimation from 1999Q1 to 2016Q3

****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	-.32417	.26909	-1.2047[.233]
DGDP(-2)	.76751	.25964	2.9560[.004]
DGDP(-3)	-.20506	.25013	-.81982[.416]
DEPD(-1)	-.32540	.13076	-2.4885[.016]
DEPD(-2)	.24899	.12669	1.9654[.054]
DEPD(-3)	.099342	.12332	.80557[.424]
DEGD(-1)	.0011587	.13166	.0088004[.993]
DED(-2)	.29534	.12286	2.4039[.019]
DEGD(-3)	-.087424	.12913	-.67702[.501]
DXP(-1)	-.0016832	.055066	-.030567[.976]

DXP(-2)	-.059501	.055778	-1.0667[.291]
DXP(-3)	-.15329	.060328	-2.5410[.014]
INPT	-.0038813	.0039557	-.98121[.331]

****

R-Squared	.35460	R-Bar-Squared	.22106
S.E. of Regression	.014643	F-Stat.	F(12,58) 2.6555[.007]
Mean of Dependent Variable	.8415E-3	S.D. of Dependent Variable	.016591
Residual Sum of Squares	.012436	Equation Log-likelihood	206.3237
Akaike Info. Criterion	193.3237	Schwarz Bayesian Criterion	178.6163
DW-statistic	2.0191	System Log-likelihood	809.1338

****

* A:Serial Correlation*CHSQ(4) = 3.3500[.501]*F(4,54) = .66852[.617]*
* B:Functional Form *CHSQ(1) = 6.4670[.011]*F(1,57) = 5.7121[.020]*
* C:Normality *CHSQ(2) = 75.3460[.000]* Not applicable *
* D:Heteroscedasticity*CHSQ(1) = 1.0158[.314]*F(1,69) = 1.0015[.320]*

****

OLS estimation of a single equation in the Unrestricted VAR

****

Dependent variable is DXP
71 observations used for estimation from 1999Q1 to 2016Q3

****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	.32045	.62916	.50933[.612]
DGDP(-2)	.80869	.60706	1.3321[.188]
DGDP(-3)	-1.9107	.58481	-3.2672[.002]
DEPD(-1)	-.42969	.30573	-1.4055[.165]
DEPD(-2)	.67845	.29620	2.2905[.026]
DEPD(-3)	-.76367	.28833	-2.6486[.010]
DEGD(-1)	.47710	.30783	1.5499[.127]
DEGD(-2)	-.55690	.28725	-1.9387[.057]
DEGD(-3)	-.15695	.30192	-.51985[.605]
DXP(-1)	.16666	.12875	1.2945[.201]
DXP(-2)	.13074	.13041	1.0025[.320]
DXP(-3)	.21827	.14105	1.5474[.127]
INPT	.9262E-3	.0092486	.10015[.921]

****

R-Squared	.32691	R-Bar-Squared	.18765
S.E. of Regression	.034237	F-Stat.	F(12,58) 2.3474[.016]
Mean of Dependent Variable	-.013118	S.D. of Dependent Variable	.037986
Residual Sum of Squares	.067984	Equation Log-likelihood	146.0214
Akaike Info. Criterion	133.0214	Schwarz Bayesian Criterion	118.3140
DW-statistic	1.6144	System Log-likelihood	809.1338

****

Diagnostic Tests

```
*******************************************************************************
*******
*    Test Statistics  *       LM Version       *         F Version         *
*******************************************************************************
*******
* A:Serial Correlation*CHSQ(4)  =  15.6792[.003]*F(4,54)      =  3.8262[.008]*
* B:Functional Form   *CHSQ(1)  =  14.5821[.000]*F(1,57)      =  14.7326[.000]*
* C:Normality         *CHSQ(2)  =   1.0620[.588]*       Not applicable        *
* D:Heteroscedasticity*CHSQ(1)  =   4.8388[.028]*F(1,69)      =  5.0464[.028]*
*******************************************************************************
*******

      OLS estimation of a single equation in the Unrestricted VAR
*******************************************************************************
*******
Dependent variable is DGDP
70 observations used for estimation from 1999Q2 to 2016Q3
*******************************************************************************
*******
Regressor          Coefficient      Standard Error       T-Ratio[Prob]
DGDP(-1)             .075301          .17617           .42743[.671]
DGDP(-2)            -.012871          .18396          -.069969[.944]
DGDP(-3)            -.036679          .18294           -.20050[.842]
DGDP(-4)            -.092185          .18229           -.50571[.615]
DEPD(-1)             .048150          .087617          .54955[.585]
DEPD(-2)             -.15617          .091951          -1.6984[.095]
DEPD(-3)            -.070429          .089714          -.78504[.436]
DEPD(-4)             .058683          .087231          .67274[.504]
DEGD(-1)             -.11299          .095440          -1.1839[.242]
DEGD(-2)            -.038081          .088107          -.43221[.667]
DEGD(-3)             .073264          .090600          .80865[.422]
DEGD(-4)             -.12463          .086654          -1.4383[.156]
DXP(-1)              .10431           .038782          2.6897[.010]
DXP(-2)             -.074260          .038899          -1.9091[.062]
DXP(-3)              .012797          .039522          .32378[.747]
DXP(-4)             -.013643          .042481          -.32115[.749]
INPT                .0063889          .0028419         2.2481[.029]
*******************************************************************************
*******
R-Squared                  .32301     R-Bar-Squared              .11863
S.E. of Regression       .0094427     F-Stat.  F(16,53)     1.5804[.107]
Mean of Dependent Variable .0049141   S.D. of Dependent Variable    .010058
Residual Sum of Squares    .0047257   Equation Log-likelihood      236.7875
Akaike Info. Criterion     219.7875   Schwarz Bayesian Criterion   200.6753
DW-statistic               1.7860     System Log-likelihood        813.9036
*******************************************************************************
*******
```

Diagnostic Tests

```
*************************************************************************
******
*    Test Statistics  *       LM Version       *         F Version         *
*************************************************************************
*******
* A:Serial Correlation*CHSQ(4)  =   4.6698[.323]*F(4,49)      =   .87563[.485]*
* B:Functional Form   *CHSQ(1)  =   5.3233[.021]*F(1,52)      =   4.2799[.044]*
* C:Normality         *CHSQ(2)  =  28.0990[.000]*       Not applicable        *
* D:Heteroscedasticity*CHSQ(1)  =   .53771[.463]*F(1,68)      =   .52639[.471]*
*************************************************************************
*******

      OLS estimation of a single equation in the Unrestricted VAR
*************************************************************************
*******
 Dependent variable is DEPD
 70 observations used for estimation from 1999Q2 to 2016Q3
*************************************************************************
*******
 Regressor          Coefficient      Standard Error       T-Ratio[Prob]
 DGDP(-1)             .44238           .32062           1.3798[.173]
 DGDP(-2)             .079534          .33479           .23757[.813]
 DGDP(-3)             .48101           .33293           1.4448[.154]
 DGDP(-4)             .043459          .33175           .13100[.896]
 DEPD(-1)             .055048          .15945           .34523[.731]
 DEPD(-2)             .29460           .16734           1.7604[.084]
 DEPD(-3)             .22762           .16327           1.3941[.169]
 DEPD(-4)             -.11743          .15875           -.73968[.463]
 DEGD(-1)             .12546           .17369           .72231[.473]
 DEGD(-2)             -.29673          .16035           -1.8505[.070]
 DEGD(-3)             -.022432         .16488           -.13605[.892]
 DEGD(-4)             .17974           .15770           1.1398[.260]
 DXP(-1)             -.018435         .070579          -.26119[.795]
 DXP(-2)              .12646          .070792          1.7864[.080]
 DXP(-3)             -.011581         .071927          -.16101[.873]
 DXP(-4)             -.041978         .077312          -.54296[.589]
 INPT               -.0014789        .0051721         -.28595[.776]
*************************************************************************
*******
 R-Squared                .36214          R-Bar-Squared              .16958
 S.E. of Regression       .017185   F-Stat.  F(16,53)   1.8807[.044]
 Mean of Dependent Variable  .0055434    S.D. of Dependent Variable   .018858
 Residual Sum of Squares   .015652       Equation Log-likelihood     194.8725
 Akaike Info. Criterion    177.8725      Schwarz Bayesian Criterion  158.7603
 DW-statistic              1.9025        System Log-likelihood       813.9036
*************************************************************************
*******
*************************************************************************
*******
*    Test Statistics  *       LM Version       *         F Version         *
*************************************************************************
******
* A:Serial Correlation*CHSQ(4)  =   6.6798[.154]*F(4,49)      =   1.2923[.286]*
* B:Functional Form   *CHSQ(1)  =  .078610[.779]*F(1,52)      =  .058462[.810]*
```

* C:Normality *CHSQ(2) = .44111[.802]* Not applicable *
* D:Heteroscedasticity*CHSQ(1) = 4.7475[.029]*F(1,68) = 4.9474[.029]*
****

OLS estimation of a single equation in the Unrestricted VAR
****
Dependent variable is DEGD
70 observations used for estimation from 1999Q2 to 2016Q3
****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	-.31188	.28118	-1.1092[.272]
DGDP(-2)	.83865	.29360	2.8564[.006]
DGDP(-3)	-.20142	.29198	-.68984[.493]
DGDP(-4)	-.24700	.29094	-.84898[.400]
DEPD(-1)	-.30908	.13984	-2.2102[.031]
DEPD(-2)	.29175	.14676	1.9880[.052]
DEPD(-3)	.15276	.14319	1.0669[.291]
DEPD(-4)	-.042841	.13922	-.30772[.760]
DEGD(-1)	-.018626	.15233	-.12228[.903]
DEGD(-2)	.30704	.14062	2.1834[.033]
DEGD(-3)	-.098414	.14460	-.68059[.499]
DEGD(-4)	.053472	.13830	.38663[.701]
DXP(-1)	-.021024	.061897	-.33966[.735]
DXP(-2)	-.047343	.062084	-.76257[.449]
DXP(-3)	-.15504	.063079	-2.4579[.017]
DXP(-4)	.010539	.067801	.15544[.877
INPT	-.0033872	.0045358	-.74676[.459]

****

R-Squared	.37139	R-Bar-Squared	.18162
S.E. of Regression	.015071	F-Stat. F(16,53)	1.9570[.035]
Mean of Dependent Variable	.6866E-3	S.D. of Dependent Variable	.016659
Residual Sum of Squares	.012038	Equation Log-likelihood	204.0611
Akaike Info. Criterion	187.0611	Schwarz Bayesian Criterion	167.9489
DW-statistic	2.0271	System Log-likelihood	813.9036

****
Diagnostic Test
****
* Test Statistics * LM Version * F Version *
****
* A:Serial Correlation*CHSQ(4) = 6.0062[.199]*F(4,49) = 1.1497[.344]*

```
* B:Functional Form   *CHSQ(1)  =   5.9766[.014]*F(1,52)     =   4.8542[.032]*
* C:Normality         *CHSQ(2)  =  35.5431[.000]*       Not applicable       *
* D:Heteroscedasticity*CHSQ(1)  =   .63120[.427]*F(1,68)     =   .61874[.434]*
*************************************************************************
*******
```

OLS estimation of a single equation in the Unrestricted VAR

```
*************************************************************************
*******
 Dependent variable is DXP
 70 observations used for estimation from 1999Q2 to 2016Q3
*************************************************************************
*******
 Regressor          Coefficient      Standard Error       T-Ratio[Prob]
 DGDP(-1)             .17905           .57843           .30954[.758]
 DGDP(-2)              1.2239          .60400           2.0264[.048]
 DGDP(-3)             -2.1623          .60065          -3.5999[.001]
 DGDP(-4)              1.9799          .59851           3.3080[.002]
 DEPD(-1)             -.70516          .28767          -2.4512[.018]
 DEPD(-2)              .82154          .30191           2.7212[.009]
 DEPD(-3)             -1.0846          .29456          -3.6821[.001]
 DEPD(-4)              .89383          .28641           3.1208[.003]
 DEGD(-1)             .54756           .31336          1.7474[.086]
 DEGD(-2)             -.73169           .28929         -2.5293[.014]
 DEGD(-3)              .15440          .29747           .51905[.606]
 DEGD(-4)              .32588          .28451           1.1454[.257]
 DXP(-1)              .33430           .12733          2.6254[.011]
 DXP(-2)              .013769          .12772           .10781[.915]
 DXP(-3)              .18394           .12976          1.4175[.162]
 DXP(-4)             -.10719           .13948         -.76848[.446]
 INPT               -.012629          .0093311         -1.3535[.182]
*************************************************************************
*******
 R-Squared                .47491   R-Bar-Squared              .31639
 S.E. of Regression       .031003  F-Stat.   F(16,53)     2.9959[.001]
 Mean of Dependent Variable  -.012223  S.D. of Dependent Variable    .037498
 Residual Sum of Squares     .050944  Equation Log-likelihood      153.5674
 Akaike Info. Criterion     136.5674  Schwarz Bayesian Criterion   117.4552
 DW-statistic              1.9851   System Log-likelihood       813.9036
*************************************************************************
*******
```

Diagnostic Tests

* Test Statistics *	LM Version	* F Version	*
* A:Serial Correlation	*CHSQ(4) = 11.2705[.024]	*F(4,49) = 2.3508[.067]	*
* B:Functional Form	*CHSQ(1) = 4.1588[.041]	*F(1,52) = 3.2846[.076]	*
* C:Normality	*CHSQ(2) = .42317[.809]	* Not applicable	*
* D:Heteroscedasticity	*CHSQ(1) = 1.3627[.243]	*F(1,68) = 1.3500[.249]	*

OLS estimation of a single equation in the Unrestricted VAR

Dependent variable is DGDP
69 observations used for estimation from 1999Q3 to 2016Q3

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	.013536	.16868	.080243[.936]
DGDP(-2)	.010536	.16706	.063068[.950]
DGDP(-3)	-.073238	.18413	-.39775[.693]
DGDP(-4)	-.052806	.19134	-.27598[.784]
DGDP(-5)	-.55407	.18940	-2.9255[.005]
DEPD(-1)	.025565	.080067	.31929[.751]
DEPD(-2)	-.081429	.088205	-.92318[.361]
DEPD(-3)	-.060622	.094081	-.64436[.522]
DEPD(-4)	.19058	.093413	2.0401[.047]
DEPD(-5)	-.32145	.086724	-3.7065[.001]
DEGD(-1)	-.14157	.089576	-1.5804[.121]
DEGD(-2)	-.026703	.091740	-.29107[.772]
DEGD(-3)	.15859	.093803	1.6907[.097]
DEGD(-4)	-.25903	.084894	-3.0512[.004]
DEGD(-5)	.033696	.081775	.41206[.682]
DXP(-1)	.17160	.041132	4.1719[.000]
DXP(-2)	-.13917	.038466	-3.6179[.001]
DXP(-3)	.036490	.037967	.96109[.341]
DXP(-4)	-.028873	.038783	-.74448[.460]
DXP(-5)	.070186	.038521	1.8220[.075]

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INPT                .011255        .0029403          3.8280[.000]
*******************************************************************************
R-Squared                .50641        R-Bar-Squared             .30074
S.E. of Regression       .0084671   F-Stat.   F(20,48)   2.4623[.006]
Mean of Dependent Variable  .0049563   S.D. of Dependent Variable   .010126
Residual Sum of Squares   .0034412   Equation Log-likelihood     243.8512
Akaike Info. Criterion    222.8512   Schwarz Bayesian Criterion  199.3931
DW-statistic              1.9167     System Log-likelihood       821.7191
*******************************************************************************
                    Diagnostic Tests
*******************************************************************************
*   Test Statistics  *       LM Version      *        F Version        *
*******************************************************************************
* A:Serial Correlation*CHSQ(4)  =   4.8836[.299]*F(4,44)     =   .83785[.509]*
* B:Functional Form   *CHSQ(1)  =   4.2019[.040]*F(1,47)     =   3.0477[.087]*
* C:Normality         *CHSQ(2)  =  30.0727[.000]*     Not applicable       *
* D:Heteroscedasticity*CHSQ(1)  =   1.3331[.248]*F(1,67)     =   1.3199[.255]*
*******************************************************************************
```

OLS estimation of a single equation in the Unrestricted VAR

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*******************************************************************************
Dependent variable is DEPD
69 observations used for estimation from 1999Q3 to 2016Q3
*******************************************************************************
Regressor          Coefficient      Standard Error       T-Ratio[Prob]
DGDP(-1)             .55604           .33799           1.6451[.106]
DGDP(-2)             .071214          .33475           .21274[.832]
DGDP(-3)             .67455           .36895           1.8283[.074]
DGDP(-4)            -.14275           .38339          -.37233[.711]
DGDP(-5)             .67566           .37950           1.7804[.081]
DEPD(-1)             .097706          .16043           .60902[.545]
DEPD(-2)             .17165           .17674           .97122[.336]
DEPD(-3)             .27829           .18851           1.4763[.146]
DEPD(-4)            -.30349           .18717          -1.6214[.111]
DEPD(-5)             .42314           .17377           2.4351[.019]
DEGD(-1)             .14609           .17948           .81397[.420]
DEGD(-2)            -.26106           .18382          -1.4202[.162]
DEGD(-3)             -.11562          .18795           -.61513[.541]
```

DEGD(-4)	.33208	.17010	1.9522[.057]
DEGD(-5)	.051799	.16385	.31613[.753]
DXP(-1)	-.11389	.082418	-1.3819[.173]
DXP(-2)	.19656	.077075	2.5502[.014]
DXP(-3)	-.046554	.076075	-.61195[.543]
DXP(-4)	-.022994	.077710	-.29590[.769]
DXP(-5)	-.041337	.077185	-.53555[.595]
INPT	-.0078500	.0058915	-1.3324[.189]

R-Squared	.43251	R-Bar-Squared	.19605
S.E. of Regression	.016966	F-Stat. F(20,48)	1.8291[.045]
Mean of Dependent Variable	.0057429	S.D. of Dependent Variable	.018922
Residual Sum of Squares	.013816	Equation Log-likelihood	195.8960
Akaike Info. Criterion	174.8960	Schwarz Bayesian Criterion	151.4379
DW-statistic	2.0240	System Log-likelihood	821.7191

Diagnostic Tests

* Test Statistics *	LM Version	* F Version	*
* A:Serial Correlation	*CHSQ(4) = 5.2647[.261]	*F(4,44) = .90863[.467]	*
* B:Functional Form	*CHSQ(1) = 1.3533[.245]	*F(1,47) = .94023[.337]	*
* C:Normality	*CHSQ(2) = .85612[.652]	* Not applicable	*
* D:Heteroscedasticity	*CHSQ(1) = 4.6069[.032]	*F(1,67) = 4.7934[.032]	*

OLS estimation of a single equation in the Unrestricted VAR

Dependent variable is DEGD
69 observations used for estimation from 1999Q3 to 2016Q3

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	-.15185	.29305	-.51818[.607]
DGDP(-2)	.83576	.29023	2.8796[.006]
DGDP(-3)	.035523	.31988	.11105[.912]
DGDP(-4)	-.51225	.33241	-1.5410[.130]
DGDP(-5)	.48332	.32903	1.4689[.148]
DEPD(-1)	-.29285	.13910	-2.1054[.041]

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DEPD(-2)              .18078          .15323          1.1798[.244]
DEPD(-3)              .36793          .16344          2.2511[.029]
DEPD(-4)             -.17684          .16228         -1.0897[.281
DEPD(-5)              .19188          .15066          1.2736[.209]
DEGD(-1)          -.0077887           .15562          -.050051[.960]
DEGD(-2)              .39166          .15938          2.4575[.018]
DEGD(-3)             -.23538          .16296         -1.4444[.155]
DEGD(-4)             .088508          .14748          .60013[.551]
DEGD(-5)              .32900          .14206          2.3159[.025]
DXP(-1)              -.10109         .071457         -1.4147[.164
DXP(-2)             -.016366         .066825          -.24491[.808]
DXP(-3)              -.14788         .065958         -2.2420[.03
DXP(-4)             .0087511          .067376          .12988[.897]
DXP(-5)              -.029375         .066921          -.43895[.663]
INPT              -.0085191        .0051080         -1.6678[.102]
*******************************************************************************
R-Squared                .45480     R-Bar-Squared             .22763
S.E. of Regression       .014710    F-Stat.  F(20,48)    2.0020[.025]
Mean of Dependent Variable  .8309E-3  S.D. of Dependent Variable   .016737
Residual Sum of Squares    .010386    Equation Log-likelihood     205.7422
Akaike Info. Cirterion     184.7422   Schwarz Bayesian Criterion  161.2841
DW-statistic              1.8981      System Log-likelihood       821.7191
*******************************************************************************
                    Diagnostic Tests
*******************************************************************************
*   Test Statistics  *       LM Version      *        F Version        *
*******************************************************************************
  A:Serial Correlation*CHSQ(4)  =   4.7674[.312]*F(4,44)     =   .81643[.522]*
* B:Functional Form   *CHSQ(1)  =   5.6784[.017]*F(1,47)     =   4.2148[.046]*
* C:Normality         *CHSQ(2)  =  28.6705[.000]*      Not applicable       *
* D:Heteroscedasticity*CHSQ(1)  =   .48774[.485]*F(1,67)     =   .47698[.492]*
*******************************************************************************
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OLS estimation of a single equation in the Unrestricted VAR

```
*******************************************************************************
Dependent variable is DXP
69 observations used for estimation from 1999Q3 to 2016Q3
*******************************************************************************
```

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	.36491	.61993	.58862[.559]
DGDP(-2)	1.2538	.61397	2.0421[.047]
DGDP(-3)	-1.8957	.67671	-2.8014[.007]
DGDP(-4)	1.3853	.70319	1.9700[.055]
DGDP(-5)	.11388	.69605	.16361[.871]
DEPD(-1)	-.66662	.29425	-2.2655[.028]
DEPD(-2)	.74179	.32416	2.2883[.027]
DEPD(-3)	-.95675	.34576	-2.7671[.008]
DEPD(-4)	.80637	.34330	2.3489[.023]
DEPD(-5)	-.22795	.31872	-.71521[.478]
DEGD(-1)	.57970	.32920	1.7609[.085]
DEGD(-2)	-.43323	.33716	-1.2850[.205]
DEGD(-3)	.25531	.34473	.74060[.463]
DEGD(-4)	.14045	.31199	.45017[.655]
DEGD(-5)	.10643	.30053	.35415[.725]
DXP(-1)	.32171	.15117	2.1282[.038]
DXP(-2)	-.041730	.14137	-.29519[.769]
DXP(-3)	.16397	.13953	1.1752[.246]
DXP(-4)	-.099577	.14253	-.69863[.488]
DXP(-5)	.22399	.14157	1.5822[.120]
INPT	-.0089487	.010806	-.82813[.412]

****

R-Squared	.48925	R-Bar-Squared	.27644
S.E. of Regression	.031118	F-Stat. F(20,48)	2.2990[.009]
Mean of Dependent Variable	-.011106	S.D. of Dependent Variable	.036582
Residual Sum of Squares	.046479	Equation Log-likelihood	154.0421
Akaike Info. Criterion	133.0421	Schwarz Bayesian Criterion	109.5840
DW-statistic	2.0710	System Log-likelihood	821.7191

****

Diagnostic Tests

****

* Test Statistics *	LM Version *	F Version *

****

* A:Serial Correlation*	CHSQ(4) = 11.5182[.021]*	F(4,44) = 2.2042[.084]*
* B:Functional Form *	CHSQ(1) = 4.1083[.043]*	F(1,47) = 2.9756[.091]*
* C:Normality *	CHSQ(2) = .17187[.918]*	Not applicable *
* D:Heteroscedasticity*	CHSQ(1) = 5.8692[.015]*	F(1,67) = 6.2289[.015]*

****

OLS estimation of a single equation in the Unrestricted VAR

Dependent variable is DXP
69 observations used for estimation from 1999Q3 to 2016Q3

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
DGDP(-1)	.36491	.61993	.58862[.559]
DGDP(-2)	1.2538	.61397	2.0421[.047]
DGDP(-3)	-1.8957	.67671	-2.8014[.007]
DGDP(-4)	1.3853	.70319	1.9700[.055]
DGDP(-5)	.11388	.69605	.16361[.871]
DEPD(-1)	-.66662	.29425	-2.2655[.028]
DEPD(-2)	.74179	.32416	2.2883[.027]
DEPD(-3)	-.95675	.34576	-2.7671[.008]
DEPD(-4)	.80637	.34330	2.3489[.023]
DEPD(-5)	-.22795	.31872	-.71521[.478]
DEGD(-1)	.57970	.32920	1.7609[.085]
DEGD(-2)	-.43323	.33716	-1.2850[.205]
DEGD(-3)	.25531	.34473	.74060[.463]
DEGD(-4)	.14045	.31199	.45017[.655]
DEGD(-5)	.10643	.30053	.35415[.725]
DXP(-1)	.32171	.15117	2.1282[.038]
DXP(-2)	-.041730	.14137	-.29519[.769]
DXP(-3)	.16397	.13953	1.1752[.246]
DXP(-4)	-.099577	.14253	-.69863[.488]
DXP(-5)	.22399	.14157	1.5822[.120]
INPT	-.0089487	.010806	-.82813[.412]

R-Squared	.48925	R-Bar-Squared	.27644
S.E. of Regression	.031118	F-Stat. F(20,48)	2.2990[.009]
Mean of Dependent Variable	-.011106	S.D. of Dependent Variable	.036582
Residual Sum of Squares	.046479	Equation Log-likelihood	154.0421
Akaike Info. Criterion	133.0421	Schwarz Bayesian Criterion	109.5840
DW-statistic	2.0710	System Log-likelihood	821.7191

Diagnostic Tests

* Test Statistics *	LM Version *	F Version *
* A:Serial Correlation	*CHSQ(4) = 11.5182[.021]	*F(4,44) = 2.2042[.084]*
* B:Functional Form	*CHSQ(1) = 4.1083[.043]	*F(1,47) = 2.9756[.091]*
* C:Normality	*CHSQ(2) = .17187[.918]*	Not applicable *
* D:Heteroscedasticity	*CHSQ(1) = 5.8692[.015]	*F(1,67) = 6.2289[.015]*

VECTOR DECOMPOSITON COMPOSTION

GENERALIZED VDC

VARIABLE	HORIZON	LGDP	LEPD	LEGD	LXP	TOTAL
G_LGDP	2	0.92383	0.29855	0.11174	0.24889	1.58301
G_LEPD	2	0.14784	0.95154	0.12106	0.0062487	1.2266887
G_LEGD	2	0.26027	0.1123	0.95041	0.022638	1.345618
G_LXP	2	0.15515	0.099282	0.018207	0.92096	1.193599
G_LGDP	4	0.89802	0.33172	0.097065	0.28125	1.608055
G_LEPD	4	0.10461	0.90115	0.13692	0.021355	1.164035
G_LEGD	4	0.44763	0.24094	0.77072	0.076138	1.535428
G_LXP	4	0.17509	0.14698	0.017593	0.87736	1.217023
G_LGDP	8	0.87222	0.36189	0.082797	0.30565	1.622557
G_LEPD	8	0.066059	0.80518	0.16667	0.068825	1.106734
G_LEGD	8	0.59079	0.45866	0.41009	0.2243	1.68384
G_LXP	8	0.19509	0.19636	0.017458	0.82782	1.236728
G_LGDP	12	0.85635	0.37726	0.074597	0.31814	1.626347
G_LEPD	12	0.048419	0.71699	0.18914	0.12145	1.075999
G_LEGD	12	0.59725	0.54061	0.24383	0.30002	1.68171
G_LXP	12	0.20608	0.22376	0.017518	0.79861	1.245968
G_LGDP	16	0.84529	0.38696	0.069195	0.32603	1.627475
G_LEPD	16	0.039842	0.64224	0.20526	0.16968	1.057022
G_LEGD	16	0.58431	0.5723	0.16767	0.33645	1.66073
G_LXP	16	0.21286	0.24104	0.01758	0.77972	1.2512
G_LGDP	20	0.83724	0.39361	0.06541	0.33145	1.62771
G_LEPD	20	0.035695	0.58155	0.21684	0.21052	1.044605
G_LEGD	20	0.57187	0.58675	0.1277	0.35616	1.64248
G_LXP	20	0.21736	0.25266	0.017627	0.76683	1.254477
G_LGDP	24	0.83123	0.39842	0.062648	0.33537	1.627668
G_LEPD	24	0.033736	0.53297	0.22532	0.24405	1.036076
G_LEGD	24	0.56222	0.59433	0.10419	0.36799	1.62873
G_LXP	24	0.2205	0.26085	0.017663	0.75766	1.256673

ORTHOGONOLIZED VDC

	Horizon	LGDP	LEPD	LEGD	LXP
O_GDP	2	0.92383	0.0045267	0.006992	0.064653
O_GDP	4	0.89802	0.011968	0.011128	0.078884
O_GDP	8	0.87222	0.02067	0.016677	0.090432
O_GDP	12	0.85635	0.026152	0.020651	0.096847
O_GDP	16	0.84529	0.030035	0.023587	0.10109
O_GDP	20	0.83724	0.032888	0.025787	0.10408
O_GDP	24	0.83123	0.035035	0.027461	0.10628
O_LEPD	2	0.14784	0.84266	0.0067704	0.0027302
O_LEPD	4	0.10461	0.86453	0.020676	0.010177
O_LEPD	8	0.066059	0.84541	0.054727	0.033805
O_LEPD	12	0.048419	0.8022	0.089406	0.059973
O_LEPD	16	0.039842	0.75616	0.12004	0.083957
O_LEPD	20	0.035695	0.71456	0.14547	0.10427
O_LEPD	24	0.033736	0.67922	0.1661	0.12094
O_LEGD	2	0.26027	0.011625	0.72023	0.0078839
O_LEGD	4	0.44763	0.032317	0.47969	0.040369
O_LEGD	8	0.59079	0.11074	0.17897	0.11951
O_LEGD	12	0.59725	0.15624	0.088608	0.15791
O_LEGD	16	0.58431	0.17949	0.060297	0.1759
O_LEGD	20	0.57187	0.19255	0.050114	0.18546
O_LEGD	24	0.56222	0.20059	0.046054	0.19113
O_LXP	2	0.15515	0.022062	0.11735	0.70543
O_LXP	4	0.17509	0.041563	0.13188	0.65147
O_LXP	8	0.19509	0.064611	0.1471	0.5932
O_LXP	12	0.20608	0.078373	0.15553	0.56003
O_LXP	16	0.21286	0.087361	0.16076	0.53902
O_LXP	20	0.21736	0.093529	0.16424	0.52487
O_LXP	24	0.2205	0.097928	0.16667	0.5149