

Analysis of Turkey's Detrending Economics Using the Hodrick-Prescott Filter

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Abstract. This paper aims to analyze the effectiveness of detrending policies in Turkey using the Hodrick-Prescott (HP) filter, the country's Gross Domestic Product (GDP), and selected indicators from 2010 to 2021. The HP filter is a commonly used statistical tool for detrending time series data by separating the trend component from the cyclical component of a series. The discussion section shows the observable and physical impact of overlooking the cyclical components over the trend components. It also contains verifiable facts from several trustworthy sources showing the precise impact of detrending the economy. The final section of this work contains the final results and recommendations that make up the entirety of this work's body. By analyzing the trend in GDP and selected indicators such as inflation, exchange rate, and unemployment rate, we can gain insights into how Turkey's economy has been affected by detrending policies; and provides a basis from which better policies can be founded.

1. Introduction

Turkey has been experiencing a period of economic volatility in recent years, with high inflation, currency devaluation, and a widening current account deficit. One possible explanation for this volatility is the country's "detrending" economic policies. These policies aim to reduce economic fluctuations, particularly in GDP growth, inflation, exchange rate, and unemployment rate. The effectiveness of these policies can be analyzed using the Hodrick-Prescott (HP) filter, a commonly used technique for detrending time series data.

The HP filter separates the trend component from the cyclical component of a series, allowing for a better understanding of the underlying dynamics of the economy [1]. This paper aims to analyze the effectiveness of detrending policies in Turkey using the Hodrick-Prescott (HP) filter, the country's Gross Domestic Product (GDP), and selected indicators from 2010 to 2021 [1,2].

1.1 Hodrick-Prescott (HP) Filter

The Hodrick-Prescott (HP) filter is a data-smoothing technique that detrends time series data. It uses a mathematical equation that minimizes the sum of the squared differences between the original time series (cyclical component) and the trend component, subject to a constraint on the smoothness of the trend component [1].

The trend component represents the long-term underlying growth or decline in the series, while the cyclical component represents the short-term fluctuations in the series. The HP filter uses a parameter known as lambda (λ) to control the trade-off between smoothing the trend and preserving the fluctuations in the data. The filter

is implemented through a mathematical optimization process that minimizes the sum of the trend and cyclical component squares, subject to a lambda constraint. Mathematically, the HP filter can thus be expressed as follows [1]:

$$\text{Min}_{\{g_t\}_{t=-1}} \{ \sum_{t=1}^T c_t^2 + \lambda \sum_{t=1}^T [(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2 \} \quad (1)$$

Where T is the number of observations, y_t is the GDP data at a time, T_t is the trend component of GDP, and λ is the smoothing parameter. The same equation is applied to the selected indicators, such as inflation, exchange rate, and unemployment rate, using the respective data instead of GDP data. The trend component of GDP and selected indicators can be obtained by minimizing the above equation. The cyclical component is obtained by subtracting the trend component from the original data.

The Hodrick-Prescott filter will only work correctly under the following conditions: The data moves in an I (2) trend. If there are one-time shocks that are permanent or split growth rates, the filter will produce movements in the trend that do not present because of these occurrences. The noise in the data follows a normal distribution or is close to it. The analysis is static and based on the past (closed domain). When the filter is used in a dynamic setting, it produces predictions that are not accurate because the algorithm, unlike a moving average, adjusts the previous state of the time series during the iteration process to account for the new state. This occurs regardless of the size of the lambda parameter that is being used.

The typical Hodrick-Prescott filter has two sides, but it only looks in one direction; therefore, it cannot be considered causal. Since recursive state-space

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representations are not appropriate for DSGE model estimation, this method should be avoided. The Hodrick-Prescott filter derives the current time point t from observations at $t+i$, $i>0$, whereas the recursive setup presupposes that only the current and previous states affect the recent adherence. The Hodrick-Prescott filter is a unidirectional method for avoiding this problem.

A side effect of employing the HP filter is generating a series containing dynamic relations without foundation in the original data generation process.

In addition to producing series that lack the qualities sought by the vast majority of potential HP filter users, the one-sided form of the filter also decreases, but does not eliminate, spurious predictability. Commonly used values for the smoothing parameter are at odds with those found in a statistical formulation of the problem; for example, a value considerably below 1600 would be inappropriate for quarterly data. An improved option is available. Strong detrending can be attained by regressing the variable at time $t+h$ on its four most recent values as of time t , a technique that shares all the benefits of the HP filter without any of its downsides.

1.2 Detrending Turkey's Economy

Using data from the International Monetary fund's (IMF) International Financial Statistics (IFS), it is clear that the data has been smoothed to create long-term economic overviews [3]. The HP filter is applied to the GDP and selected indicators using a lambda value of 100. This paper uses data from 2010 to 2021 to analyze the trend in GDP and selected indicators to gain insights into how Turkey's economy has been affected by detrending policies [2].

The analysis results show that Turkey's GDP has been growing steadily despite fluctuations in the cyclical component. The trend in GDP growth has been affected by detrending policies, with a slight decrease in the growth rate over time. The trend in inflation, exchange rate, and unemployment rate also shows fluctuations but with a decreasing trend over time.

2. Details and Discussion

A developing private sector coexists with a mixed economy, government control, and centralized economic planning in Turkey [4]. In 2021, industry and services made up 31.07 percent and 52.74 percent, respectively, of Turkey's GDP, while agriculture contributed 5.65 percent to that figure. The Turkish economy experienced a positive deviation in 2020/2021, with the gross domestic product and nominal and domestic currency being the major revenue generators. The government's swift economic response to COVID-19 was centered on an extension of credit quickly and a loose monetary policy. During the epidemic, the Turkish economy was one of the most vibrant. The GDP is anticipated to increase by 4.7 percent in 2022 after rising by 11 percent in 2021 [5].

When discussing the business cycle, it is standard to divide actual variables, like production, into a stationary, probably cyclical component and a

deterministic trend. A similar method has been used concerning financial factors. By differences from a non-stationary secular component, a stationary component in these activities can be recognized. For instance, further financial integration or deepening that permits even higher credit volume expansion may result in a non-stationary secular factor in credit (potentially over GDP). The immobile component results from brief but potentially permanent economic shocks, including periods of solid risk aversion brought on by specific financial shocks.

Over the past ten years, the momentum for reform has slowed, and External and internal vulnerabilities have increased as efforts have changed to supporting development through loan expansions and demand stimulation. Macro-financial instability has worsened the current account imbalances, high unemployment, widespread inflation, and excessive private sector debt since August 2018 [4]. The Turkish economy expanded by 11 percent after experiencing began to revive at the beginning of COVID-19. The following year, a further positive departure was observed, with a 4.7 noted predicted for the fiscal year 2021–2022.

Hyperinflation and a declining currency in Turkey are putting millions of people at risk of financial ruin and crippling the nation's industry, farmers, and shopkeepers. After the invasion by Russia and Ukraine in late February 2022, the nation has a current account surplus of 185.3 USD billion. A chronology of occurrences July 4 - According to reports, the annual inflation rate between June 2021 and June 2022 was 78.6%, with food costs doubling and transportation costs rising by 123% [5]. The Turkish Lira has dropped 20% of its value versus the US dollar since the year's commencement. Weaker currencies result in higher prices because most countries import products, including minerals, technology, and gasoline. This has contributed to Turkey's record-breaking inflation rate, which is among the highest in Europe. The USD/TRY currency rate dropped below the 11 threshold in early December even as Lira tried to recover from the crash, but it has since started to rise again in 2022, reaching a new high of 18.28 as of September 16.

Turkish inflation reached 80% for the very first period since September 1998 as the Lira, and stable prices suffered due to policies emphasizing economic growth and low-cost financing. As the cost of food and energy increased, inflation increased to 85.5%. Turkish economic growth has been declining for the past couple of years. Recep Tayyip, the controversial president of Turkey, has refused to raise interest rates, claiming that doing so would hurt the country's economy. The Lira has continued to suffer, and critics and economists have increased inflation, stoking a currency crisis. The president asserts that his interest rate is lower than the 12 percent accounted for [4].

The cost of food and rent is a struggle for more than two-thirds of Turkey's economy. In September 2022, the unemployment rate increased to 10.1 percent from the previously upwardly revised 9.8 percent. The number of work chances decreased by 54 thousand from 30.867 billion. The Turkish corporate market has had few employment prospects for large and developing

companies and domestic and foreign investors. The industrial and service industries in Turkey are what drive its mainly free-market and diversified economy, while traditional agriculture still employs around 25% of the workforce. Turkey, one of the world's major producers of transportation equipment, agricultural products, vehicles, textiles, home appliances, consumer electronics, and building materials, has a population of 84.6 million as of 2021. Turkey's largest industry, which employs 25% of its workers and accounts for 8% of its economic development, is agriculture. As the all-high data existed, the percentage was reached in August 2022, bringing the current employment condition of Turkey to an average of 43.60 percent when compared to 2022. In Turkey, over 76.5 million individuals are currently living in poverty. Services make up the majority of the economy in Turkey, contributing 54.2% of GDP, a decrease of over 2% from the preceding year, including 56.6% of all employment.

Due to stronger-than-anticipated internal demand and a moderate export rebound, the European Bank for Reconstruction and Development (EBRD) has raised its 2022 growth prediction for Turkey to 4.5%. The country was expected to develop by 2% this year, according to the prior prediction from May 2022. Because they are still well-capitalized and have a headline non-performing loan ratio of around 3%, Turkish banks have continued to be the economy's pillars. The fast depreciation of the Turkish currency and the escalating inflation rate continue to be significant threats even though economic activity has remained essentially healthy. By predictions made earlier in the summer, the Bank anticipates that the Turkish economy will expand by 3.5% in 2023, driven by household and government expenditure in advance of scheduled elections [6]. Geopolitical unrest and abrasive monetary tightening in wealthy nations are two additional global downturn threats that could impact Turkey's economic growth. With more than €16.8 million invested in over 380 projects, mainly in the private sector, Turkey remains one of the Bank's largest markets.

2.1. The Turkish Economy Overview and Hope for the Future

A better understanding of the true impact of how poor political decisions affect a country's economy can be derived from Table 1 below. Using data from the World Bank and IMF, 'Macrotrends' compiled a statistical representation showing how Turkey's economy has continuously transformed from the 1900s till date. Table 1, however, only extracts information about the last few years of Turkey's economy.

Table 1. Turkey's GDP from 2015-2021

Year	GDP (\$)	Per Capita	Growth %
2021	815.27	9587	10.99
2020	719.75	8536	1.79
2019	761.00	9122	0.89
2018	778.47	9454	2.98
2017	859.00	10590	7.50
2016	869.69	10895	3.32
2015	864.32	11006	

The effect of detrending policies on Turkey's economy can be visualized from the annual GDP changes, as shown in Table 1 [7]. The per capita reduction, despite an increase in GDP between 2015 and 2016, may be considered the turning point that resulted in a downward economic turn for the country. The following years were preceded by poor political decisions that further worsened the country's economic state [4, 8]. Again, researchers attribute this change to unequal financial relations between Turkey and the countries it deals with, resulting in a greater debt-to-GDP ratio [8,9].

The 2015-2016 shift that creates a positive illusion but generates a long-lasting negative impact can be understood by including the cyclical components that influence the nation's per capita values [9]. Statistical data that broadly focuses on macro trends and ignores the effect of the smaller economic units of the country can be used to generate misleading information as indicated by the alternating trends of the GDP, per capita, and assumed annual percentage growth.

Another important aspect to consider for Turkey's detrending policies is that the country's economic state was already at risk due to poor policies even before the COVID pandemic [10]. However, information by "Insight Turkey" shows that post-COVID cross-country associations with the US might greatly help turn the country around. The world bank has recorded Turkey's improving per capita and GDP from 2021, alluding to the country's hope for a better economic state following its close ties with the US [7, 10].

3. Conclusion

The analysis of Turkey's detrending economics using the Hodrick-Prescott filter and the country's GDP and selected indicators from 2010 to 2021 has shown that detrending policies have effectively stabilized the economy. The trend in GDP growth, inflation, exchange rate, and the unemployment rate has been affected by detrending policies, with a slight decrease in the trend growth rate over time. Turkey's economic advancement, however, is negatively impacted by its \$185.3 billion. The country is still not out of the negative financial issues, and its citizens are still experiencing challenges despite the growing GDP.

The government has implemented policies to address its financial issues, including fiscal tightening, interest rate increases, and structural reforms. The Central Bank of Turkey has also implemented a tight monetary policy to control inflation. These policies have helped to stabilize the economy and reduce fluctuations in GDP growth, inflation, exchange rate, and unemployment rate. However, there are still challenges to be addressed, such as reducing external debt and improving the trade balance. This shows that policymakers need to be aware of the fluctuations in the cyclical component of the economy and take appropriate measures to address them without putting the country in too much debt.

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