Assessing Trend and Cycle Components of Inflation and Employment in Türkiye

by

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To My Dear Family

ABSTRACT

Assessing Trend and Cycle Components of Inflation and Employment in Türkiye
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In this paper, we investigate the permanent and transitory components of both CPI inflation and Aggregate Employment in Turkiye. We construct an Unobserved Component Analysis Model (UCM) to measure trend inflation (employment) and cycle inflation (employment), and conduct empirical analyses to scrutinize the relations among these terms and other several macroeconomic variables such as the USDTRY Parity, Aggregate Credit Stock Growth in Turkiye and the Brent Oil prices. We show that the changes in the USDTRY Parity has statistically significant and positive effect on cycle inflation. Further, we indicate that permanent component of inflation enlarged in recent years and that the volatility of employment increased since 2014. We provide historical decompositions of the CPI inflation and employment in Turkiye, and exhibit our empirical analysis.

ÖZETÇE

Türkiye'deki Enflasyonun ve İstihdamın Trend ve Döngüsel Terimlerini Değerlendirmek

Velihan Baspinar
Ekonomi, Yüksek Lisans
7 Mayıs 2024

Bu makalede, Türkiye'de hem TÜFE enflasyonunun hem de Toplam İstihdamın kalıcı ve geçici bileşenlerini araştırıyoruz. Bir zaman serisini trend ve döngüsel terimlerine ayıran bir Gözlemlenemeyen Parçalar Analizi modeli kurarak Türkiye'deki Tüketici Fiyat Endeksi ile Toplam İstihdam verilerinin trend ve döngüsel terimlerini türetiyoruz. Analiz modelimizin çıktıları olan trend enflasyonu, döngüsel enflasyonu, trend istihdamı ve döngüsel istihdamı veri kabul ederek, bu değişkenlerin çeşitli makroekonomik değişkenlerle olan ilişkilerini inceliyoruz. Bu temel makroekonomik değişkenler, ABD Doları-Türk Lirası döviz kuru, Türkiye'deki toplam kredi büyümesi, küresel Brent petrolü fiyat büyümesi olarak öne çıkıyor. Bu değişkenlerin istatiksel özelliklerini belirlemek için durağanlık ve eşbütünleşiklik testlerini uyguluyoruz. Bu değişkenler arasındaki ilişkileri incelemek için, enstrüman regresyonları ile kayan regresyon yöntemlerini kullanıyoruz. Ampirik analimizin çıktısı olarak, ABD Doları-Türk Lirası paritesinin döngüsel enflasyon üzerinde istatiksel olarak anlamlı ve pozitif etkili olduğunu gösteriyoruz. Ayrıca, enflasyonun kalıcı bileşeninin son yıllarda genişlediğini ve 2014'ten bu yana istihdam oynaklığının arttığını belirtiyoruz. Türkiye'de TÜFE enflasyonunun ve istihdamın güncel tarihsel ayrıştırmalarını sunuyor ve ampirik analizimizi ortaya koyuyoruz.

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ABBREVIATIONS

UCM	Unobserved Component Analysis Model
CBRT	Central Bank of Republic of Turkiye
ECB	European Central Bank
FED	Federal Reserve
NKPC	New Keynesian Phillips Curve
SD	Standard Deviation
CV	Constant Volatility
SV	Stochastic Volatility
GMM	Generalized Method of Moment
OPPT	Oil Price Pass Through

Chapter 1

INTRODUCTION

Achieving and sustaining price stability is among the fundamental pillars of macroeconomic stability and the prime mandate of many central banks' around the world. Price stability, by a common definition in general terms, can be defined as a low and moderate form of inflation. Policy making process requires a well-organized and comprehensive toolkit to investigate the root causes of inflation, monitor the anomalies on the patterns that the inflation pursues and prepare policy responses toward the developments in the economy. Decomposition models can be regarded as purposive and convenient devices in this policy tool box.

The inflation experience of Turkiye comprises the feature of high level of inflation, exceeding the official inflation targets of the Central Bank, 5 per cent, and the average level of CPI belonging to emerging countries. As the Figure 1.1 illustrates the CPI levels over years, the CPI inflation in Turkiye is larger than average of the OECD countries and middle income countries, which can be regarded as a source of macroeconomic fragility, and the inflation has exhibited a soaring behavior in the last years. Therefore, investigating the characteristics of the inflation dynamics in Turkiye is a necessary effort worth performing.

In this paper, our research activity aims to measure the permanent and transitory components of the CPI over four decades and of the aggregate employment in Turkiye, and investigate the behaviors of these components with other macroeconomic variables. However, since these permanent and transitory components cannot be directly observed in the nature, we construct an unobserved component analysis model with constant volatility to disentangle the CPI into two main components, namely trend inflation and cycle inflation. We regard the permanent term of in-

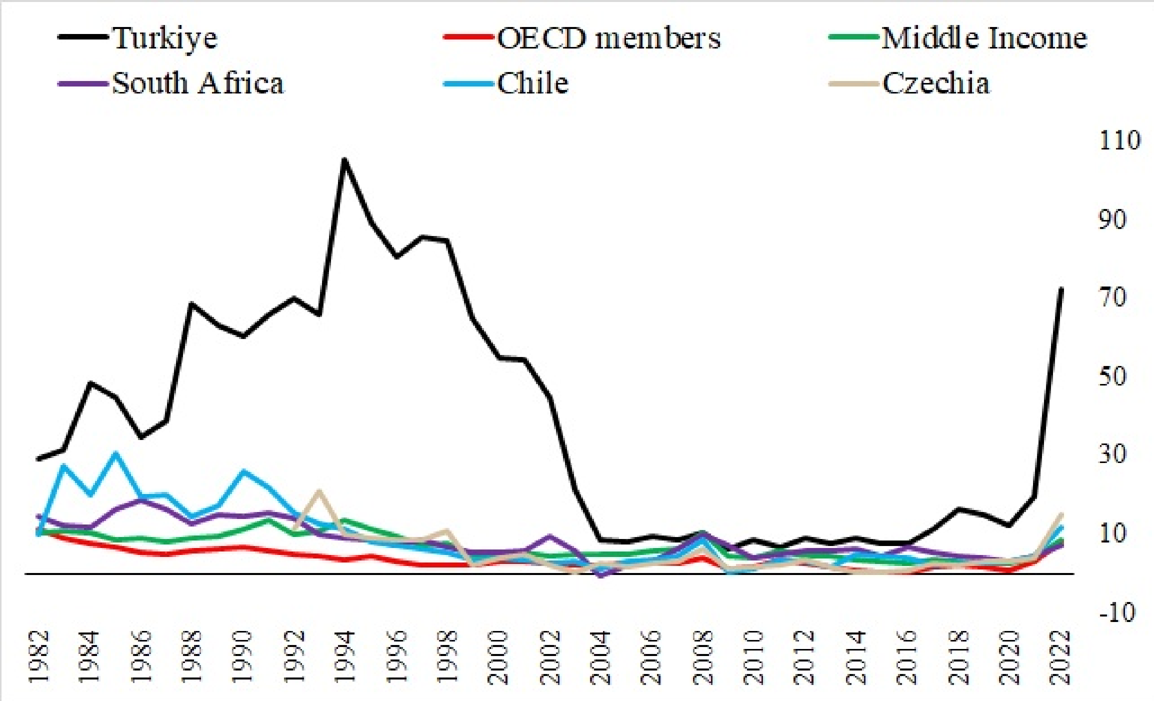

Figure 1.1: Inflation Rates of Turkiye and Other Countries

flation as trend inflation, and the transitory term as cycle inflation. Similarly, we implement the same process on the aggregate employment in Turkiye, and obtain trend and cycle terms of this time series. Moreover, as explained in further sections, we conduct several econometric analyses to investigate the relations among these variables, in addition to several macroeconomic variables.

Many central banks such as CBRT and ECB, have, by their founding law, a sole mandate of achieving and preserving price stability. Some other central banks might have additional mandates. For instance, the Federal Reserve has the mandate of, in addition to sustaining price stability, reaching maximum employment in the USA. At that point, we encounter with the famous trade-off between preserving the price stability and succeeding maximum employment, suggesting negative relation between these terms, [Phillips, 1958].

Central banks aim to generate optimal policy responses towards the development in the inflation dynamics and the ongoing economy. One of the practical way to intervene a soaring inflation is, by changing the policy rates, to raise the cost of funding. Another way is to affect the liquidity conditions and supply of local currency, by actively utilizing the Central Bank balance sheet. Last but not the least, another way to deal with inflation might be forward guidance, in which the central bank aims to manage the expectations of the household and other economic agents, toward the future path of inflation by efficiently employing communication tools such as official reports and public speeches. See [Nelson, 2021].

Changes in the inflation might stem from a bunch of factors, including inflation expectations, demand-driven and supply-driven changes. Inflation expectations might affect the consumption behavior of the economic agents, leading to an increase in the aggregate demand and a rise in the price levels. While the level of aggregate demand might directly affect the prices of goods and services, the supply-related factors, such as disruption of supply chain or the increase in the cost of intermediate goods, can have an augmentative effect on the inflation. Corporate profits, belonging to supply-driven factors, can also be regarded as a cause of the inflation. [Kharroubi and Smets, 2024] model firm profits as a reservation profits on supply side of the New Keynesian model, and provide evidence about profit-driven inflation, indicating that shocks in energy prices lead to decline in the supply side and raise the profit-driven inflation in a sizeable manner. [Hansen et al., 2023] demonstrate that nearly half of the rise in Europe's inflation from 2021 to 2023 can be attributed to the surge in corporate profits.

There are several definitions for the trend inflation. As [Takhashi, 2016] provided, the trend inflation can be regarded as the long-term inflation expectations of the agents, which is a driving factor of the persistent movements in the actual inflation. The economic agents have their beliefs about the future inflation path, and make their preferences in accordance with their expectations.[Garnier et al., 2013] regard trend inflation as the infinite horizon forecast of inflation and adopts Beveridge-Nelson decomposition in their study where they compare the trend inflation estimations in fourteen advanced economies, .

We make contribution to the ongoing literature, especially focusing on the inflation dynamics in Turkiye, by providing a historical decomposition of both inflation and employment series, and investigate their relations with several macroeconomic variables. We separate the observation period over the years 1982 and 2023 into three different episodes, and interpret the characteristics of each episode.

The outline of this paper as follows. Section 2 includes the literature review, where we examine relevant concepts and models in the literature. In the section 3, we exhibit our methodology and explain our decomposition model, which is a local level unobserved component analysis model, and empirical materials. In the fourth section, we introduce our data set and show the descriptive statistics concerning our data set. In the fifth section, the model outputs, including historical decomposition of the CPI inflation and the aggregate employment series in Turkiye, are demonstrated, and we interpret our empirical findings. The remaining sections include conclusion and appendix.

Chapter 2

LITERATURE REVIEW

In this part, we introduce and explain the studies in the relevant literature. We categorize our list of selected papers into three branches. A considerable amount of the literature has been published on decomposing the macroeconomic variables and inflation dynamics, which are exhibited and discussed in the first branch. We explain and demonstrate the studies on Phillipcs Curve and the trend inflation in the second branch. In the last branch, we examine the articles on inflation dynamics and labor force in Turkiye, focusing on some particular features of these topics.

In their seminal paper, [Beveridge and Nelson, 1981] indicate a new methodology to decompose nonstationary series into two components, namely permanent and transitory terms. They accept the assumption that successive changes such as the natural logarithm are stationary in the representation of ARMA process. The authors model the permanent component as a random walk process with drift, and take the difference between the permanent term and the actual value of the series to obtain the momentum of the series, where they regard this momentum as measure of the transitory component of the series. They highlight that the size of innovations depends on the autocorrelation structure of the series. The scholars, further, applies this model on the economic variables in the US to measure the business cycle in the US.

James Stock and Mark Watson make a remarkable contribution, through their several works on decomposition models, to the literature. [Stock and Watson, 2007] investigate the predictability of the US inflation, and suggest that , by an unobserved component trend and cycle model, the process of the univariate inflation can be clearly elucidated. [Stock and Watson, 2016] investigate the measurement of trend inflation, by employing both univariate and multivariate unobserved component models with stochastic volatility and utilizing the sectoral inflation data in the US.

The authors make a definition of the trend inflation as the long term estimate of the inflation rate, and following computing the sectoral trend inflation, they calculate the aggregate trend inflation in the economy, by taking the weighted average of sectoral trends where the weights come from the shares of the sectors in the total inflation. Eventually, one of the important findings of this paper is that multivariate estimates of the trend inflation might be more accurate than the univariate estimates. Further, another significant finding, which can be useful in practice, is that employing sectoral inflation as data, rather than using the headline inflation, might yield larger benefits in estimation.

Disentanglement models for deriving the unobserved components have been widely preferred by many scholars. [Li and Koopman, 2021] examine the US inflation series by generating an unobserved component analysis model with stochastic volatility structure and developing a method of maximum likelihood estimation method, depending on the algorithm of importance sampling. In addition to this comprehensive methodology, a remarkable finding of this article is that the volatility structure of the trend term might be linked with supply-related circumstances such as the energy shocks in the 1970s, which is consistent with the idea that the changes in the trend inflation might be associated with the changes in the expectations and supply-driven factors. Furthermore, another notable finding can be asserted that the transitory term of the inflation in the US might be linked with the demand-driven and monetary factors.

Decomposition models are not only used to measure the trend inflation, but can also be utilized for different aims.[Shapiro et al., 2022] disentangles the personal consumption expenditure (PCE) inflation in the US into two components, namely demand-linked and supply-linked terms. By conducting identifications by sign restriction and employing the data of categorical-level inflation, the scholar measures the contributions of both supply-driven and demand-driven factors to the PCE inflation. [Shapiro et al., 2022] finds that happening at the same time period with the reopening of the US economy after the Covid-19 pandemics, the PCE inflation in the mid-2021 is surged by the dominant contribution of the demand-related component. Similarly, it can be claimed as another finding of this study that the PCE inflation in the USA expanded due to the contribution of supply-driven factors after the Russian invasion of Ukraine in 2022, which may cause an increase in global commodity prices, especially oil.

[Eickmeier and Hofmann, 2022] investigate the effect of supply-associated and demand-associated forces on the inflation in the US, and make effort to disentangle aggregate supply and demand. The authors conduct the disentanglement through employing a structural factor model. The identifications of supply-driven and demand-driven factors are completed by sign restrictions, where the supply factor influences negatively the inflation but positively the economic activity, and the demand factor positively affects both inflation and economic activity in the US. One of the notable findings in this study is that, after the Global Financial Crises in 2008, the low level of inflation in the US is characterised by both decreased demand and strong supply. Similarly, another remarkable finding can be suggested as that the raise in the inflation in the US in the spring of 2021 is occurred with significant contribution of tight supply and large demand conditions.

The relation between output and inflation has been one of building-blocks of macroeconomics. [Phillips, 1958] examines the employment and wage inflation in the UK and indicates a negative relation between these two variables. Further, [Samuelson and Solow, 1960], who coined the term *Phillips Curve*, investigate the link between employment and price inflation, rather than wage inflation. Phillips Curve can be regarded as a menu of trade-offs, showing pairs of levels of unemployment and inflation, and employed as a tool to fine-tune monetary policy and forecast inflation. However, the original Phillips curve was deprived of rational expectations and microfoundation, and there was a need for further developments on Phillips Curve structure.

New Keynesian Phillips Curve (NKPC) is a further modified version of Phillips Curve, which has a strong microfoundation and incorporates key concepts such as price rigidity, marginal costs and rational expectations. In this context, [Galı and Gertler, 1999] show that employing forward-looking behavior and real marginal costs offers a good description of inflation and emphasize the dominance of forward-looking behavior in the model. The NKPC, then, has been a guiding policy tool for many central banks to forecast and evaluate the future inflation paths in their economies. As [Cogley and Sbordone, 2008] defined, we can describe the NKPC as a model of inflation gap that is the difference between current and trend inflation. Furthermore, the NKPC relies on the assumption of zero trend inflation. A proper definition for trend inflation can be as the expected level of inflation after the short-run fluctuations vanish [Cogley and Sbordone, 2008].

Despite its modification, the New Keynesian Phillips Curve might be insufficient to capture the inflation persistence, which is observed in the actual data. Employing purely forward-looking NKPCs might require additional variables such as backward-looking terms or trend inflation to reproduce the persistence. However, since backward-looking behavior may not be regarded as having well-developed microfoundation, utilizing trend inflation in pricing dynamics might be a proper method to capture the persistence in inflation data. [Cogley and Sbordone, 2008] investigate the inflation persistence problem in the NKPC, and provide a solution by incorporating time-varying trend inflation into the NKPC. Moreover, the variations in the trend inflation are important because these shifts might be associated with the changes in the expectations of economic agents. The authors also indicate that much of the inflation persistence stem from shifts in trend inflation. Furthermore, [Cogley and Sbordone, 2008] demonstrate that employing backward-looking terms becomes redundant, if the NKPC model includes time-varying trend inflation.

Understanding the nature of trend inflation and combining it with macroeconomics has been the research question of many studies. [Ascari and Sbordone, 2014] provide a comprehensive literature survey on trend inflation and discuss the concepts of zero inflation and positive trend inflation in the New Keynesian model. The scholars also investigate the effect of positive inflation in the steady state, and suggest that the positive inflation, even in moderate levels, might result in the deterioration of inflation expectations, which as a result may necessitate a more tight monetary policy stance. Another finding worth emphasizing is that the existence of positive trend inflation might lead to the Phillips Curve to take a more flattened form, which raises the life time of persistence of shocks on the macroeconomic terms.

Deriving the trend inflation and its volatility is the research topic of several studies. [Mertens, 2016] investigate the size and uncertainty of trend inflation in the US, by constructing a model similar to Beveridge-Nelson decomposition framework. An important finding of this work is that the estimates of trend uncertainty co-move with the increases in the trend inflation.

The existence of positive trend inflation can affect the implementation of monetary policy. [Ascari and Ropele, 2007] examine the monetary policy under low and positive trend inflation, and emphasize the sensitivity of monetary policy to trend inflation. Another finding that authors propose is that the effectiveness of monetary policy, while balancing the economy, declines as the trend inflation rises.

Trend inflation might be affected by not only the domestic circumstances, but also the global factors. [Kamber and Wong, 2020] investigate the effect of global factors on trend inflation and the inflation gap, which is defined as the difference between the actual and target inflation. After conducting an empirical analysis on several countries, the researchers suggest that global factors, such as commodity prices and variables about global economy, has a larger effect on the inflation gap, than on the trend inflation. Further, another finding is about the different effects of the global factors on inflation, which can be summarized as that commodity price shocks are superior than foreign shocks in terms of impelling the inflation.

Trend inflation has been a popular research topic in central bank studies and many central bankers have generated several works on trend inflation. [Garnier et al., 2013] examine the trend inflation in 14 advanced economies and emphasize, while comparing and explaining the differences in trend inflations in different countries, the effect of country-specific features as a driving factor. [Takhashi, 2016], by employing Beveridge-Nelson decomposition of inflation, measures the trend inflation in Japan. Similarly, [Behera and Patra, 2022] investigate and measure the trend inflation in India, by utilizing a hybrid NKPC framework.

Turkiye has a long experience with high level of inflation, which requires a multidimensional examination of the inflation and its effect on the economic agents. A high and persistent inflation outlook might deteriorate income distribution, impair the welfare of the borrowers and savers, and damage the fundamentals of the economy, all of which could be regarded as obstacles beyond the macroeconomic stability.

[Dibooglu and Kibritcioglu, 2004], in their paper where they examine inflation and output growth in Turkiye over the period between 1980 and 2002, emphasize the existence of high and rigid inflation and regard public deficits, surges in both exchange rates and prices of imported goods and persistent inflation expectations as potential causes behind the inflationary environment in Turkiye. Some of these reasons, such as sudden rises in FX rates and volatility in global commodity prices, are still valid behind the inflation outlook in our sample period.

We examine the relevant literature on inflation in Turkiye through four topics. We examine the effects of exchange rate and oil-price pass through on inflation, persistence in inflation, inflation expectations and inflation aversion studies in Turkiye, respectively.

Turkiye lacks of the sufficient sources of intermediate products and energy commodities, which makes the country a net energy importer and lead to dependence on foreign resources to produce final goods. As a country with a chronicle current account deficit for many years, Turkiye can be regarded as fragile against the shocks in both FX and global commodity, such as oil and natural gases, price shocks, where any sudden spikes in these variables might directly deteriorate the inflation dynamics. Hence, focusing on the exchange and oil price pass-throughs might be beneficial. In this context, exchange rate pass-through refers to the unit effect of the increase in exchange rates on the inflation. Similarly, oil price pass-through is defined as the unit effect of the increase in oil price on the inflation.

[Kara et al., 2005] study the exchange rate pass-through in Turkiye and measure it for different sectors such as core inflation, private and public manufacturing inflations. They measure, over the sample period between 1990 and 2001, the long-run cumulative pass-through in core inflation as 45 per cent, in private manufacturing inflation as 74 per cent, and in public manufacturing as 70 per cent. One of the remarkable finding of this study is that both the size and pace of exchange rate pass through were declined after Turkiye abandoned the managed FX regime in May 2001 and started to implement the floating exchange rate regime. Furthermore, [Kara and Öğünç, 2008] , by employing a closely similar methodology, reveal that the exchange rate pass-through in Turkiye declined and slowed under inflation targetting period after 2005. The inflation targeting regime had a reducing effect on the exchange rate pass-through by advancing central bank credibility and anchoring the inflation expectations. Further, the authors also emphasize that the size of pass-through declined, which was a common phenomenon among emerging economies implementing inflation targetting policies.

As a net energy importer country, the inflation developments in Turkiye has been sensitive to the behavior of global energy commodity prices. [Dedeoğlu and Kaya, 2014] investigate the oil-price pass-through on both consumer and producer inflation over the period between 1990 and 2012. The authors measure the oil-price pass-through to CPI inflation as 0.04 in the short-run and 0.085 in the long-run. Besides, the authors emphasize that the oil-price pass-through has a larger effect on the producer prices rather than consumer prices. In this context, the oil-price pass-through to PPI is 0.10 in the short run and 0.16 in the long run. Further, [Dedeoğlu and Kaya, 2014] suggest that as the oil price increase and take a larger share in production costs in Turkish economy, the pass-through enlarges. They support their claim with providing an empirical evidence showing the increasing trend of the pass-through for the observation period whenever the import prices increased.

In the inflationary environment of Turkiye, inflation might exhibit persistent and rigid behavior, and its link between its past values may be significant. In this context, understanding inflation persistence in Turkiye might provide useful insights prior to examining permanent and transitory components of the inflation. There are several studies aiming to investigate and measure the inflation persistence in Turkiye. Firstly, [Alper et al., 1998] examine the behavior of inflation in Turkiye over the period between 1985 and 1997, and indicate that the inflation persistence was sizeable. Further, the authors suggest that inflation persistent enlarged particularly after the announce of the stabilization program in 1988 where the low public confidence in the program could be regarded as the reason behind high inflation persistence. Secondly, [Bilici and Çekin, 2020], investigate the inflation persistence in Turkiye along the period between 1980 and 2018, where they employ time-varying methods in practice. The scholars show that the inflation persistence was sizeable and exhibited high volatility between 1990 and 2004, and further that inflation persistence declined following 2004 as a result as tight monetary policy. However, the authors suggest that as the level of inflation increases after 2016, the persistence of inflation started to enlarge.

Inflation expectations refer to a union of economic agents' beliefs about the future path of the inflation and play a central role in price formations. Deterioration in the inflation expectations might lead inflation dynamics to take a more rigid form and has the potential to reduce the efficiency of monetary policy. Thus, investigating the inflation expectations might provide insights concerning the inflation dynamics and practical inputs to forecast the current and future paths of inflation. In this context, [Altug and Çakmaklı, 2016] incorporate the inflation expectation surveys into their prediction models and demonstrate the significant contributions in the expectations of inflation. Moreover, the scholars conduct their analysis on both Turkiye and Brazil, and suggest that since the Turkish inflation had a relatively large seasonal component, the models covering cyclical factors such as interest rate and output gap might exhibit a relatively better prediction performance. Further, [Soybilgen and Yazgan, 2017] investigate the accuracy of surveys of inflation expectations, which is conducted by the CBRT to monitor expectations belonging to financial real sector experts in Turkiye. The authors suggest that the surveys of inflation expectations contains systematic forecasting error, which reduce the accuracy of the inflation expectations.

Inflation aversion is a concept covering the negative relation between the level of anticipated inflation and the patience of household, [Wang and Zou, 2011]. Inflation aversion might depend on many factors such as age, income, education, labor market status and political opinion. [Nebioğlu and Soybilgen, 2023] investigate the inflation aversion in Turkiye, and aims to examine the determining factors of the public attitude towards inflation. The authors who employ a comprehensive survey data covering the period between 2004 and 2020 suggest that the unemployed people and the working class can be much more inflation averse. Further, they also assert that those who have right-wing political opinion in Turkiye are less inflation averse.

There are also other several articles published in recent years, focusing on the inflation dynamics in Turkiye. [Yilmazkuday, 2022] examines the driving factors of the inflation in Turkiye, through a structural vector autoregression model that includes monthly percentage changes of unemployment, oil prices, the Consumer Price Index, the policy rate in Turkiye and the USDTRY parity as the variables. A remarkable finding worth highlighting of this study is that shocks of global oil prices and exchange rates are the main driving factors of the Turkish inflation over the last four decades.

[Çekin, 2021] provides an analysis on the inflation in Turkiye by employing a trend-cycle model, and compares the performance of adding constant volatility and stochastic volatility. The sample period, in this study, starts from the first quarter of 1955 and lasts until the beginning of 2020, where the author preferred to use the quarterly change of inflation. The scholar suggests that the inflation trend and volatility of both trend and cycle terms are increased after the FX shock in 2018, and that the unobserved component analysis model with stochastic volatility can be preferred, after comparing the model performances, to the model with constant volatility.

Examining characteristics of labor force in Turkiye requires a comprehensive focus on several features. Turkiye, as of November 2023, has a labor force of nearly 35 million people, and the labor force participation rate is 52,9 per cent. We can suggest several features such as informality, low productivity, relatively low labor force participation rate and migration shock after 2012 to describe the characteristics of the labor market in Turkiye.

Informal sector in Turkiye has been a large part of the economy, and its size is near to 30 per cent of the official gross domestic product [Atesagaoglu et al., 2017]. With its huge size, the informality of Turkish economy stands as an important feature affecting the productivity of the economy and labor force, tax revenues of the central government and sustainability of social security system. In this context, any employee who works without being registered into the social security system is defined as an informal worker. [Atesagaoglu et al., 2017] investigate the effect of the informal economy on the productivity growth in Turkiye. The authors provide evidences about that the informal sector affects the total factor productivity, and suggest that incorporating the informal workers, in addition to formal workers, into their model enhances the performance of estimating productivity levels. Further, although employing informal worker might reduce the production cost of firms since the employer firm would not have to pay social security premiums, the informal workers might generate less income than the formal workers since most of them have relatively less bargaining power on wages and may not have even working permit. At that point, [Baskaya and Hulagu, 2011] examine the wage gap between formal and informal employees in Turkiye, and indicate an approximately 20 per cent wage gap among these two groups.

Turkiye has experienced a strong refugee shock, following to emergence of the Syrian Civil War in 2011. According to United Nations High Commissioner for Refugees (UNHCR) reports, Turkiye hosts nearly 3.7 million Syrian refugees, and only 10 per cent of this population reside in refugee camps. In other words, nearly 3.4 million Syrian population live in urban areas, and mostly enter into the labor market, which leads to an increase in the urban population, a rise in local prices and rents, and directly affects the wages and the cost of production. Examining the effect of the Syrian influx on Turkish economy might provide useful information about the labor market developments. In this context, [Tumen, 2016] provides an analysis about the economic impact of the Syrian influx on the labor market, and suggests that the Syrian influx brought about a decline in informal employment of the native (Turkish) population, since most Syrian workers did not have working permit and therefore preferred to work informally, which resulted in a decline in labor costs of labor-intensive sectors. Further, Tumen emphasizes the increase in the demand for relatively safer neighborhoods after the influx, which might raise the housing rents in the hosting cities. Similarly, [Ceritoglu et al., 2017] depict that after the Syrian influx, there occurred a 2.2 per cent of decline in informal employment of the native population, where the informal Syrian workers became a relatively cheaper substitute for the informal native workers.

The effect of the Syrian influx on the Turkish labor market is heterogeneous. Firstly, as mentioned above, the refugee influx unevenly affected both formal and informal labor markets, where the informal employment of the natives declined. Secondly, education level of the worker might be another source of the heterogeneous effects, where as a result of language barriers and relatively less education, the Syrian workers are preferred in labor-intensive informal sectors rather than formal sector. [Aksu et al., 2022] suggest that every 10 Syrian workers displace 6 native workers, and that the decline in the informal employment of the natives is offset by an increase in the formal employment of the natives. Thirdly, another aspect of the heterogeneous effects might depend on age and gender of the worker. [Aksu et al., 2022] illustrate that female workers are more negatively affected by the influx, and the authors suggest that the displaced women workers exit the labor market.

The influx of Syrian migrants might lead to increase the productivity of the native companies, particularly those performing in labor-intensive sectors, by reducing the labor cost, where the productivity gains can generate additional employment in the formal sector and lead to wage growth. [Aksu et al., 2022] demonstrate that the average wage of the male workers increased after the migration shock, and mention the rise in the marginal productivity of labor in the hosting cities. In addition to the increase in productivity and wages, the Syrian influx might increase the export performance of local firms through enhancing the professional networks with the Middle East and North African (MENA) region. [Akgündüz et al., 2023] investigate the export performance of the local firms, and assert that there is an increase in export volumes of the local firms to MENA region. Similarly, the scholars suggest that the inflow of Syrian immigrants lead to an increase in newly-established firms and enhance the competition in the market, which also supports the advance in business dynamism and productivity.

Chapter 3

METHODOLOGY

In this chapter, we elucidate our methodology to derive unobserved permanent and transitory components from observed time series and exhibit our empirical analysis tools. In the first half of this chapter, we illustrate our Unobserved Component Analysis model (UCM) and explain the working principles of several tools such as Kalman Filter and Likelihood function. Later, in the second half, we introduce several statistical testing procedures to check the existence of stationary of several variables in data and of cointegration among several nonstationary terms. Then, we exhibit regression analysis equations and estimation procedure. We conduct all of these analyses on both CPI and Aggregate Employment in Turkiye over the observation period. Finally, the model outputs and results are discussed and demonstrated in Chapter 5.

3.1 Deriving Trend and Cycle Components

In state space models, an observed time series is formulated as a sum of state variables and an observation error [Kim and Nelson, 2017]. The intuition behind state space models can be explained as such that the observed values of a variable might depend on an unobserved state [Lütkepohl, 2005]. Then,the fundamental aim of state space models is to derive and infer about unobserved variables through observed data. Further, state space models mainly rely on two equations, namely measurement and transition equations. On the one hand, the measurement equation demonstrates the link between the observed time series and unobserved state vector. On the other hand, transition equation illustrates how the state vector evolves between successive periods. State space models are widely employed in controlling engineering, navigation models and econometrics. Further, many regression models such Autoregressive Moving Average (ARMA) or Unobserved Component Models can be employed in the form of state space models.

A time series can be decomposed into its trend, seasonal term and cyclical component. Trend component denotes the long-run mean of the series and shows the direction of the series. Seasonal component illustrates some periodic patterns in the series. Cyclical component indicates cyclical effects on the series. Unobserved Component Analysis Models (UCM) stand as a practical tool to decompose time-series into these components [Harvey, 1990].

In this paper, we aim to derive trend and cycle components of both inflation and employment by disentangling the observed time series of CPI and Aggregate Employment in Turkiye. On the theoretical ground, we mainly rely on and apply Beveridge-Nelson decomposition of inflation, in which inflation is formulated as a sum of permanent and transitory components [Beveridge and Nelson, 1981]. We regard the permanent term of a variable as its trend and the transitory term as its cycle component. Hence, we formulate our observed time series of inflation and employment as a linear sum of their trend and cycle terms.

Designing unobserved component analysis model is particularly important to derive permanent and temporary terms. We formulate the observed time series as a linear sum of permanent and transitory components [Clark, 1987, Kim and Nelson, 2017]. [Clark, 1987] employs an unobserved component analysis model on real GDP and industrial production series in the U.S to derive stochastic trend and cyclical components. While constructing our UCM, we combine Beveridge-Nelson decomposition and Clark's model to derive permanent and transitory terms. We formulate the permanent term as a random walk process where the innovation ψ_t is white noise, $\psi_t \sim \mathcal{N}(0, \sigma_\psi^2)$. [Takhashi, 2016] . Further, we design the transitory component as an autoregressive process with degree two, AR(2), where the coefficients of autoregressive terms are α_1 and α_2, and the innovation term η_t is white noise, $\eta_t \sim \mathcal{N}(0, \sigma_\psi^2)$. [Takhashi, 2016, Garnier et al., 2013]. The transitory component is convergent to zero in limit, and the expected value of the variable approaches to its trend [Takhashi, 2016]. Then, the unobserved component analysis model is exhibited below.

Unobserved Component Analysis Model

$$Y_t = T_t + C_t \tag{3.1}$$

$$T_t = T_{t-1} + \psi_t \tag{3.2}$$

$$C_t = \alpha_1 \cdot C_{t-1} + \alpha_2 \cdot C_{t-2} + \eta_t \tag{3.3}$$

The parameters of this model are the coefficients α_1 and α_2, showing the weight of the lagged terms on the cycle component, and the variances σ_ψ and σ_η, allowing the system to change in time and include shocks. As model outputs, we acquire the permanent component of CPI (Employment) as *Trend Inflation (Employment)*, and the transitory component of CPI (Employment) as *Cycle Inflation (Employment).*

State space form of our unobserved component analysis model is demonstrated below. In the first equation, the measurement equation, which links observed series and unobserved state vector, is illustrated. The second equation denotes the transition equation, in which the dynamic behavior of unobserved state vector is formulated [Kim and Nelson, 2017]. In matrix notation, y_t is observed data vector with size Nx1. β_t is state vector, including unobserved variables, with size Kx1. **H** is, by NxK size, the measurement matrix that associates the unobserved state vector with observed data. **F** is the transition matrix by size KxK, constructing the link between the state vector and its past values. v_t is the vector of prediction error terms by size Nx1 . ϵ_t is the vector of error terms by size of Kx1, including ψ_t and η_t from transition equations. **R** and **Q** are the matrices of covariances belonging to error vectors v_t and ϵ_t respectively, by size KxK. In this context, N represents the number of observations, and we have 500 observations in the CPI series and 223 observations in the Aggregate Employment series. K denotes the number of unobserved state variables, and we have three unobserved state variables, namely $Trend_t$, $Cycle_t$ and $Cycle_{t-1}$.

State Space Version of Unobserved Component Analysis

$$Y_t = \mathbf{H} \cdot \beta_t + v_t \tag{3.4}$$

$$\beta_t = \mathbf{F} \cdot \beta_{t-1} + \epsilon_t \tag{3.5}$$

Relevant Matrices

$$\beta_{\mathbf{t}} = \begin{bmatrix} T_t \\ C_t \\ C_{t-1} \end{bmatrix} \tag{3.6}$$

$$\mathbf{H} = \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} \tag{3.7}$$

$$\mathbf{F} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \alpha_1 & \alpha_2 \\ 0 & 1 & 0 \end{bmatrix} \tag{3.8}$$

$$\epsilon_{\mathbf{t}} = \begin{bmatrix} \psi_t \\ \eta_t \\ 0 \end{bmatrix} \tag{3.9}$$

$$\mathbf{R} = \mathbf{0} \tag{3.10}$$

$$\mathbf{Q} = \begin{bmatrix} \sigma_\psi & 0 & 0 \\ 0 & \sigma_\eta & 0 \\ 0 & 0 & 0 \end{bmatrix} \tag{3.11}$$

3.2 Kalman Filter and Deriving Likelihood Function

In order to estimate the model parameters, we can employ Maximum Likelihood Estimator (MLE), where the estimation methodology is to maximize the likelihood function with respect to parameters, namely α_1, α_2, σ_ψ and σ_η. However, Maximum Likelihood Estimator requires the knowledge of the likelihood function. There are several ways to derive the likelihood function, [Kim and Nelson, 2017]. One of the derivation ways require the knowledge of the joint distribution of variables. However, we do not have the necessary knowledge of the distribution, making the first way to derive the likelihood function inapplicable. The other method for deriving the likelihood function is the Kalman Filter method. Prior to examining the likelihood function derivation procedure, providing more information about the intuitions and working principles of the Kalman Filter might be instructive.

As [Kim and Nelson, 2017] and [Kalman, 1960] explained, the Kalman Filter is a recursive method to compute the estimator of the state vectors at time t, depending on the available information at time t. The Kalman Filter generates the estimate of the state vectors by minimizing the mean of squared errors, which might lead us to call the Kalman Filter as a minimum mean-squared error estimator.

One of the critical practices of Kalman Filter is its utilization to derive likelihood function. If the error terms are normally distributed, then the state vector is normally distributed. Then, triangular factorization of the covariance matrix of the state vector, which should be positive definite and symmetric, is employed in the prediction error decomposition process,[Harvey, 1981].Then Kalman Filter allows the likelihood function to be calculated through the prediction error decomposition, [Kim and Nelson, 2017, Harvey, 1981].

The Kalman Filter offers a minimum mean squared error estimate of the unobserved state vector, [Kalman, 1960, Kim and Nelson, 2017]. The Kalman Filter returns two main outputs, depending upon the information set used. On the one hand, if the information period until a given time t, then the output is called basic filter. On the other hand, if the information in all samples is employed, then the output is called smoothing. Thus, it is important to highlight that if the information set covers all observations, then the basic filter and smoothing generate identical outputs.

We employ the Kalman Filter to derive the following log-likelihood function. Our model has parameters, namely α_1 , α_2 , σ_Ψ and σ_η. We firstly maximize the likelihood function with respect to these parameters, via using Broyden–Fletcher–Goldfarb–Shanno (BFGS) algorithm. Then, after obtaining the estimates of these parameters, we derive the estimate of the state vector β_t given these parameters using the prediction and update equation given below.

$$l(\Theta) = -\frac{1}{2} \cdot \sum ln((2\pi)^n |f_{t|t-1}|) - \frac{1}{2} \sum v\prime_{t|t-1} \cdot f^{-1}_{t|t-1} \cdot v_{t|t-1}$$

3.2.1 Updates

Another remarkable feature of the working principle of the Kalman Filter is updates [Kalman, 1960, Kim and Nelson, 2017]. Kalman Filter utilizes the initial values of the unobserved state vector to predict future values by updating the predictions through the prediction errors. We can highlight two update processes namely time updates (prediction) and measurement update (correction). In the time update, we, by employing the initial values, extrapolate the state and its uncertainty. In the measurement update, we aim to correct predictions by utilizing a useful instrument, the Kalman Gain. The Kalman Gain determines the weight assigned to the new information brought about by prediction error. It's working principle is as follows. The prediction error, which is $v_t = y_t - y_{t|t-1}$, includes new information about β_t beyond $\beta_{t|t-1}$. Then, after observing y_t, one can make a more accurate inference about β_t, and make construct the following decomposition. $\beta_{t|t} = \beta_{t|t-1} + K_T \cdot v_{t|t-1}$. Here, $v_{t|t-1}$ is the prediction error and κ_t is Kalman Gain, which is the weight assigned to the information about β_t.

Following to explaining the working principles of Kalman Filter, our prediction and updating equations are shown below.

Prediction Equations

$$\beta_{t|t-1} = F \cdot \beta_{t-1|t-1} + R \tag{3.12}$$

$$P_{t|t-1} = F \cdot P_{t-1|t-1} \cdot F\prime + Q \tag{3.13}$$

$$v_{t|t-1} = y_t - H \cdot \beta_{t|t-1} \tag{3.14}$$

$$f_{t|t-1} = H \cdot P_{t|t-1} \cdot H\prime + R \tag{3.15}$$

$$\kappa_t = P_{t|t-1} \cdot H\prime \cdot f_{t|t-1}^{-1} \tag{3.16}$$

Update Equations

$$\beta_{t|t} = \beta_{t|t-1} + \kappa_t \cdot v_{t|t-1} \tag{3.17}$$

$$P_{t|t} = P_{t|t-1} - \kappa_t \cdot H \cdot P_{t|t-1} \tag{3.18}$$

3.3 Empirical Analysis

In this part, we exhibit our empirical analyses including several statistical tests and regressions. The previous chapter shows our model for decomposing variables into trend and cycle components. In this empirical study part, we take the outputs from our decomposition model, namely trend inflation, trend employment, cycle inflation and cycle employment, as data and investigate their dynamics and relations with other variables.

Prior to investigating interrelations among variables, we examine their stationarity conditions. To achieve this task, we employ Augmented Dickey Fuller (ADF) test [Fuller, 2009], a widely preferred hypothesis testing procedure whose null hypothesis states that the variable has unit root in time. If a researcher is successful to reject the null hypothesis of the ADF test, it might be asserted that the variable is not stationary in time. Since trend components are formulated as unit root processes and cycle terms are stationary, we only examine the stationarity status of other macro variables such as USDTRY parity, global oil prices and aggregate credit stock growth. The results concerning the stationarity of our variables are demonstrated and discussed in the results section.

If two variables are not stationary but we still suspect a comovement between these two variables, the existence of the cointegration between these variables can be investigated. To define clearly, cointegration occurs when a linear combination of two or more nonstationary variables is stationary. From the perspective of economic theory, we can regard cointegration as a similar concept to the long-term equilibrium. In the long run equilibrium, even if the variables are not stable, the deviations should stable to establish equilibrium. In other words, cointegration illustrates the existence of common stochastic trend(s) among nonstationary variables.

There are several tests to the existence of cointegration. Engle-Granger (1987) proposes a well-known cointegration test, [Engle and Granger, 1987]. The working procedure of the EG test is as follows. While investigating the cointegration relation between two nonstationary variables, let's say p_t and q_t, the Engle-Granger test implements two steps. In the first step, it runs a regression below by OLS estimator.

$$y_t = \theta \cdot X_t + e_t$$

Then, it obtains the residuals $\hat{e_t}$. In the second step, it checks the stationary of the residual vector $\hat{e_t}$ by stationarity tests such as ADF test. If the residual vector is stationary, then the two variables can be called cointegrated. However, the weak side of the EG test is that the test allows cointegration investigation for only two nonstationary variables.

Another test to check the existence of cointegration is the Johansen Maximum Likelihood test, which investigates the cointegration through a test for cointegration restrictions in a VAR representation, [Johansen and Juselius, 1990]. It's further processes include trace test and maximum eigenvalue test. The useful feature of the Johansen Maximum Likelihood test is that the test can work for more than one cointegration relations, rather than the Engle-Granger test.

Under the condition that there is a cointegration relation between two nonstationary series, a researcher can employ Vector Error Correction Model (VECM) to conduct his empirical analysis. VEC models can be regarded a special form of vector autoregressions (VAR), including differences and error correction terms.

3.4 Regression Analyses

The relation between inflation and employment dynamics has been a frequently discussed topic in macroeconomics. The famous Phillips Curve, provided by A. William Phillips in 1957, demonstrates a negative relationship between unemployment and inflation [Phillips, 1958]. After Phillips, many scholars made numerous effort to extend the Phillips Curve, and generated many hybrid versions of it [Samuelson and Solow, 1960, Galı and Gertler, 1999]. We conduct two regression analyses to scrutinize the relationship among variables. Firstly, we construct the following regression to estimate the effects of macro variables on trend and cycle components. We have two regressions, in which trend (and cycle) inflation is placed as dependent variable whereas cycle employment, growth rates of the USDTRY parity, aggregate credit stock and global oil prices are employed in the right side of the regression. However, the problem of potential endogeneity might increase the bias of coefficients. One might suspect that trend inflation, credit growth rate and USDTRY parity can be endogenous. Since Turkiye is a price-taker country in the commodity market and inflation dynamics in Turkiye cannot strongly affect global Brent oil prices, we regard the variable of global oil prices as exogenous. To deal with this potential endogeneity problem, we prefer to use the first lags of these endogenous variables as instruments. We, then, conduct an IV estimation with these terms over the sample period between January 2006 and September 2023. We utilize the Generalized Method of Moment (GMM) estimator. All of the corresponding results are exhibited and discussed in chapter 5.

$$Inflation = c+\gamma_1\cdot Employment+\gamma_2\cdot\Delta Credit+\gamma_3\cdot\Delta USDTRY+\gamma_4\cdot\Delta Oil+\epsilon_t \quad (3.19)$$

Examining dynamic relations among variables might provide practical insights. In order to monitor dynamic changes, we utilize the regression above in recursive rolling regression method. To define clearly, the Rolling Regression runs a linear rolling window regression model whose important feature is that the estimations are done throughout a rolling window on the data. In this case, we set the rolling window as 72 months. Our observation period is starting from 2006-M01 and lasting to 2023-M09, and the estimation method is IV-GMM estimator.

Chapter 4

DATA

Main variables in this study can be counted as Consumer Price Index, Aggregate Employment Level, Aggregate Credit Growth Rate, USDTRY Spot Price and Brent Oil Prices. Data for these variables are collected through the following sources.

The Consumer Price Index in Türkiye is a basket of prespecified products and quantities, whose data is collected by Turkish Statistical Agency (TURKSTAT). As the legal authority to announce monthly and annual levels of inflation, we obtained the Consumer Price Index levels from TURKSTAT. Our observation range for CPI starts from February 1982 and lasts to September 2023. Along the whole observation period, TURKSTAT changed the base year in 2003. Hence, we initially had two subsets of CPI, the observation set for the years between 1982-2003 and the other observation set for the years between 2003-2023. We, then, merged these two sets at their intersection date.

The Aggregate Employment Level shows the aggregate number of the employed population. We obtained the data for this variable from Reuters Eikon Terminal, whereas the data source is TURKSTAT, covering the monthly observations on the time period from January 2005 to September 2023. The unit of observation is millions.

The aggregate credit stock variable include the total stock of loans in Türkiye. We obtained the observations from the Electronic Data Delivery System by the CBRT, covering the period from January 2006 to September 2023. Similarly, we obtained the monthly-basis observations for the USDTRY Spot Rate from the Electronic Data Delivery System by the CBRT, involving the values from January 2005 to September 2023. Furthermore, we obtained the crude Brent oil prices from FRED, covering the values from January 2005 to September 2023.

While investigating our research question and employing these macroeconomic

Table 4.1: Variables

Variable	Observation Period	Frequency	Unit
Consumer Price Index	1982M02 - 2023M09	Monthly	Percentage Change
Aggregate Employment	2005M01 - 2023M09	Monthly	Percentage Change
Aggregate Credit Stock	2006M01 - 2023M09	Monthly	Percentage Change
USDTRY Parity	2005M01 - 2023M09	Monthly	Percentage Change
Brent Oil	2005M01 - 2023M09	Monthly	Percentage Change

variables, we consider the potential seasonality problem and use the Seasonally-Adjusted versions of our variables. The Aggregate Employment Level is provided by TURKSTAT in seasonally-adjusted version. The other variables, however, are not in the adjusted form. To reduce the seasonality in our variables, we employ TRAMO-SEATS tool from EViews and convert our variables into seasonally adjusted version.

Throughout our analysis, we employ these variables on monthly-changing basis. We calculate their monthly changes in percentage via the formula $100*\log(\frac{X_t}{X_{t-1}})$. In the first part where we decompose series into transitory and persistent components, we employ the variables with their all observations. However, in the second part, we conduct the regression analyses on the intersection of observations these variables, which encompasses the time period starting from January 2006 and lasting to September 2023.

The table 4.2 provides the summary statistics for our all observations. As the table illustrate, CPI has the highest average growth rate, and the Brent Oil Price has the most volatile variable along the all observations. However, since we do not have the same number of observations for all variables, the informative power of these descriptive statistics may be limited . To deal with this issue, we construct a particular subset of variables, which are arranged with respect to the intersection of observations dates, and we employ this subset in our further regression analysis.

Variable	Observation	Mean	Standard Deviation	Median	Minimum	Maximum
CPI	500	2,569	2,293	2,004	-1,536	23,116
Employment	223	0,223	0,976	0,176	-5,778	3,158
Credit Growth	213	2,025	2,073	1,811	-4,013	10,462
USDTRY Parity	225	1,319	3,562	0,814	-5,779	26,314
Brent Oil	225	0,350	10,848	1,682	-57,884	45,147

Table 4.2: Summary Statistics Of All Variables

The table 4.3 is the our main data set including the variables within the same observation period, on which we conduct regression analyses. The observation period starts from 2006-M01 to 2023-M09. The Credit Growth variable has the largest mean, which is around 2,025 per cent, on average along the observation period, whereas the Oil Price is the most volatile variable, showing the largest standard deviation of 10,988. Further, the Consumer Price Index (CPI) has a mean of 1,237 per cent on average and a standard deviation of 1,697. Similarly, Employment has a mean of 0,227 per cent and a standard deviation of 0,996, whereas the USDTRY parity growth shows a mean of 1,406 per cent and a standard deviation of 4,305.

The minimum and maximum values of these variable might signal some particular periods and events. For instance, the oil price growth rate has its minimum, a decline of 57,884 per cent, in April 2020, which is close after the emergence of Covid-19 pandemic and lockdowns in March 2020. Similarly, the oil price has its maximum growth rate, an increase of 45,147 per cent, in May 2020, which is a result of a basis effect. To give an instance, when the CPI takes its minimum value, a decline of 1.536 per cent, in November 2018, there were a rapid FX shock in August 2018 as a result of increase in foreign affairs and political disputes. To give another instance, the CPI and USDTRY parity hit their maximum values, respectively 12,871 % and 25,120 % in December 2021 where there occurred another FX shock.

Table 4.3: Summary Statistics Over The Intersection Period

Variable	Observation	Mean	Standard Deviation	Median	Minimum	Maximum
CPI	213	1,237	1,697	0,855	-1,536	12,872
Employment	213	0,227	0,996	0,178	-5,778	3,158
Credit Growth	213	2,025	2,073	1,811	-4,013	10,462
USDTRY Parity	213	1,406	4,305	0,908	-8,656	25,120
Brent Oil	213	0,191	10,988	1,540	-57,884	45,147

Chapter 5

RESULTS

In this section, we exhibit and discuss our model outputs, statistical testing values and estimates of regression analyses. We have four sections in this part. The first and second subsections cover the material from our decomposition model, in which we demonstrate the permanent and transitory components belonging to CPI and Employment in Turkiye, and we discuss the behaviour of these components. In the third part, we illustrate the results of several statistical tests, in which we categorize the variables according to their statistical properties such as stationarity and cointegration. In the fourth part, we illustrate and interpret estimates of regression analyses.

5.1 Permanent and Transitory Components of the CPI in Turkiye

We disentangle the Consumer Price Index in Turkiye into two main components, namely the Trend Inflation and the Cycle Inflation. Trend Inflation covers the permanent part of the CPI series, while the cycle inflation shows the transitory term of the inflation.

Turkiye's inflation experience has not followed a monotone pattern along the observation period. We, therefore, can interpret the inflation components by separating the observation period into three terms. Turkiye experienced a high level of inflation as a result of several economic crises and FX shocks in the period between 1982 and 2003. We, then, call this period as **High and Rigid Inflation Episode**. In the period between 2004 and 2017, since the monthly CPI rates behaved modestly, we call this session as **Low Inflation Episode**. Lastly, during the years between 2018 and 2023, the inflation outlook of Turkiye has begun rapidly fluctuating, and the permanent term of inflation enlarged in a remarkable size. Then, we regard this term as **High and Volatile Inflation Episode**. Figure 5.1 shows the corresponding episodes. The tables 5.1, 5.2 and 5.3 provide the descriptive statistics of the variables for different periods.

Variables	Mean	Std. Dev	Min.	Max.
Actual Inf.	3,8187	2,0784	-0,0864	23,1164
Trend Inf.	3,8638	1,0579	1,5074	6,9501
Cycle Inf.	-0,0496	1,5847	-2,7634	16,1663

Table 5.1: Descriptive Statistics for High and Rigid Inflation Episode

Variables	Mean	Std. Dev	Min.	Max.
Actual Inf.	0,6839	0,4865	-0,7390	2,5687
Trend Inf.	0.7278	0,1646	0,4521	1,4071
Cycle Inf.	-0,0440	0,4552	-1,2096	1,7949

Table 5.2: Descriptive Statistics for Low Inflation Episode

Variables	Mean	Std. Dev	Min.	Max.
Actual Inf.	2,3922	2,5169	-1,5355	12,8718
Trend Inf.	1,8909	1,1131	0,7864	4,3169
Cycle Inf.	0,5013	1,9232	-2,7618	9,8465

Table 5.3: Descriptive Statistics for High and Volatile Inflation Episode

We called the period between 1982 and 2003 as High and Rigid Inflation Period. During these years, Turkiye experienced several economic crises in 1994, 1998 and 2001, witnessed a tremendous calamity of earthquake in 1999 and other circumstances such as the Gulf Wars and political instability. All of these factors might have contributed to this large and rigid inflation dynamic. The permanent component explains a remarkable size of the actual inflation. In this period, the trend inflation is on average 3.86 per cent, whereas the cycle inflation is on average 0.49 per cent on monthly basis. As depicted in the table 5.2 and figure 5.4, in this term, we encounter with an inflation structure, which is mainly driven by a relatively large trend inflation. The figure 5.4 illustrate the behavior of trend inflation and cycle inflation in the High and Rigid Inflation Term.

We call the session between 2004 and 2017 as **Low Inflation Episode**. At the beginning of this term, following the implementation of a comprehensive fiscal and monetary program to achieve macroeconomic stability, the amplitude of the monthly CPI declined and exhibited modest changes. During this period, the trend inflation is on average 1.12 per cent, while the cycle term has the mean of -0.39 per cent. The figure 5.5 illustrates the behavior of transitory and permanent terms in this period.

We regard the remaining period between 2018 and 2023 as High and Volatile Inflation Episode. This stage covers several exceptional circumstances, which might have contributed to deteriorate the inflation dynamics. To illustrate these potential factors, the FX shock in August 2018, the Covid-19 pandemics in 2020, another exchange rate shock in December 2021, and the Russian invasion of Ukraine in February 2022 can be counted as these exceptional events leading to disruption of the inflation behavior.

Throughout this 5-year period, the actual monthly inflation shows rapid raises. We, therefore, encounter with relatively large levels of both trend and cycle components. The mean of the trend inflation is 1.89 per cent, while the cycle inflation is on average 0.50 per cent. Furthermore, as figure 5.6 illustrates, following December 2021, the actual inflation exhibits broader changes, where the trend component has a mean of 3.47 per cent, and the cycle component of inflation is on average 1.24 per cent.

σ_ψ	σ_η	α_1	α_2
0,1978	1,3992	0,4231	-0,0447

Table 5.4: Model Parameters for Inflation Decomposition

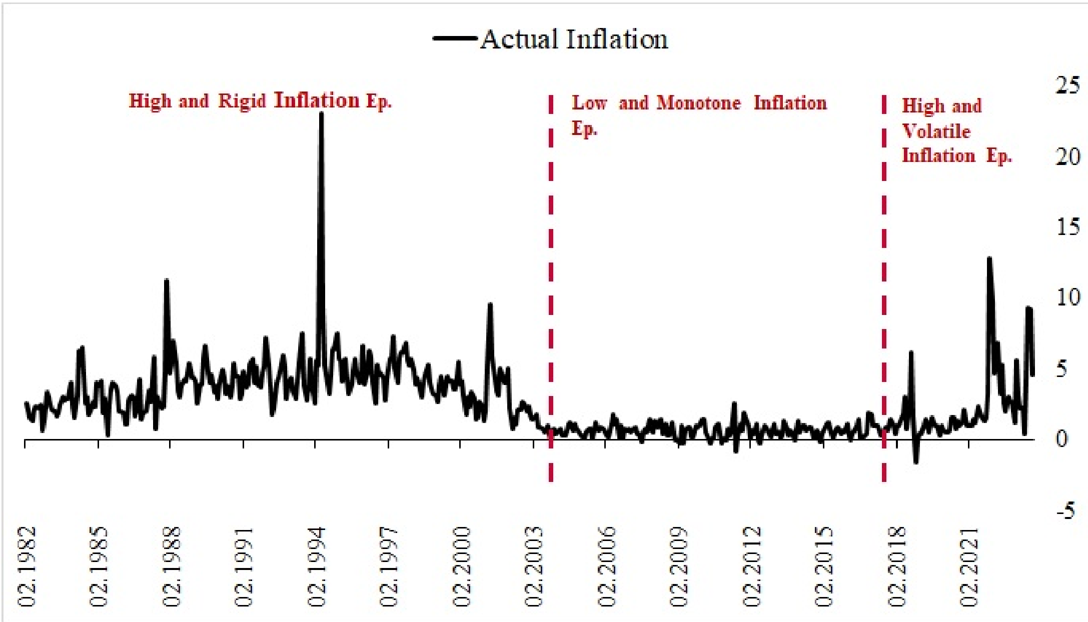

Figure 5.1: Historical Episodes on the CPI Inflation

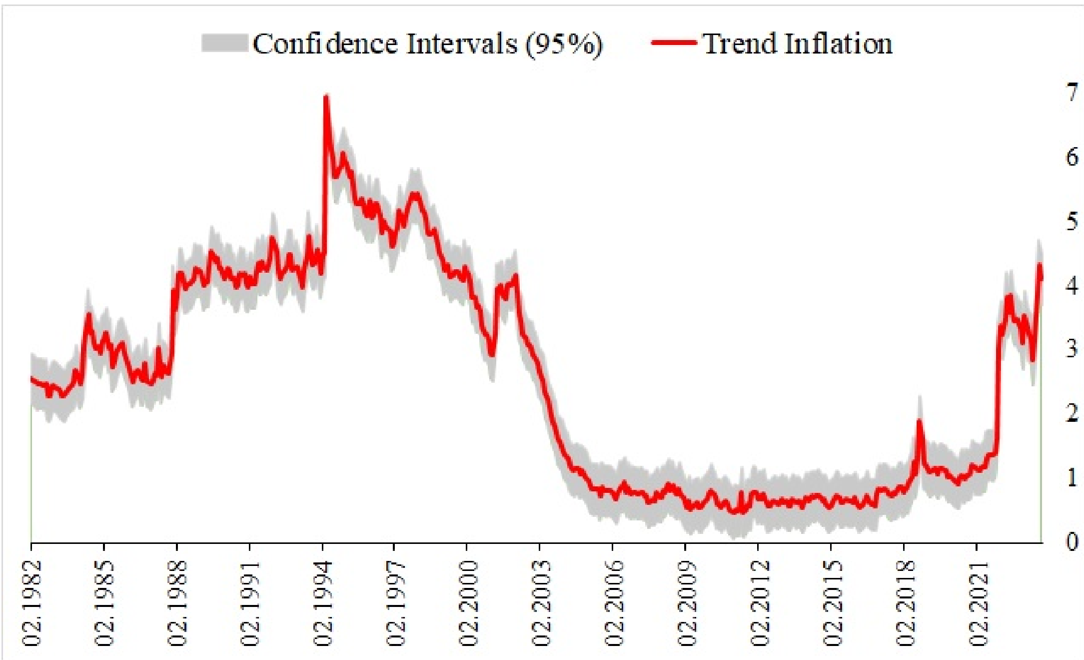

Figure 5.2: Trend Inflation Over The Period Between 1982 and 2023

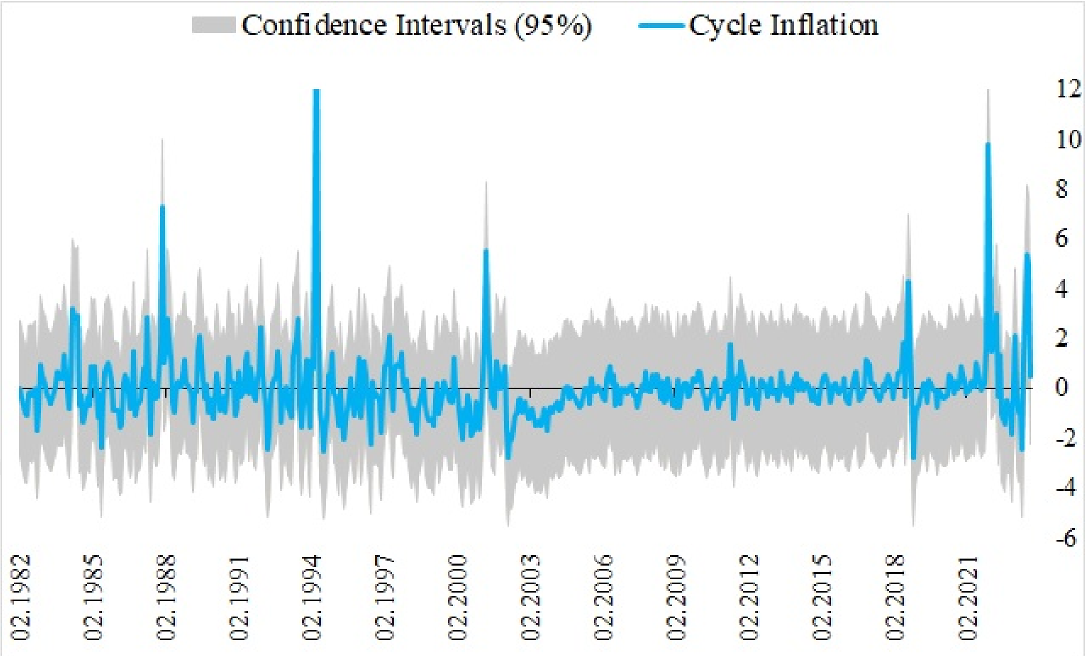

Figure 5.3: Cycle Inflation Over The Period Between 1982 and 2023

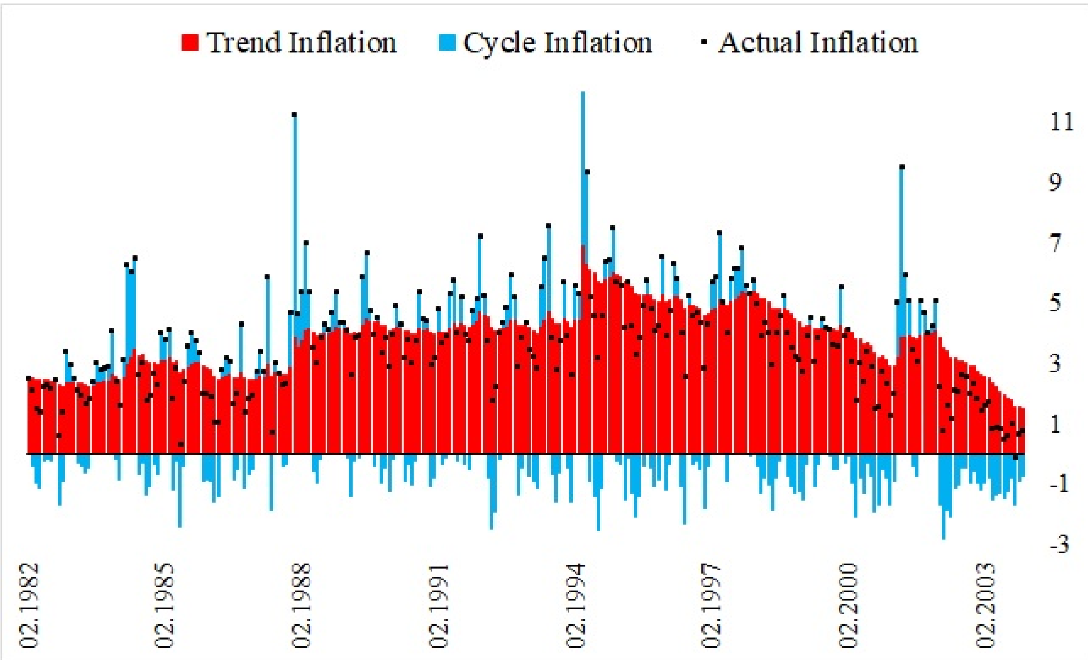

Figure 5.4: Historical Decomposition of Inflation between 1982-2003

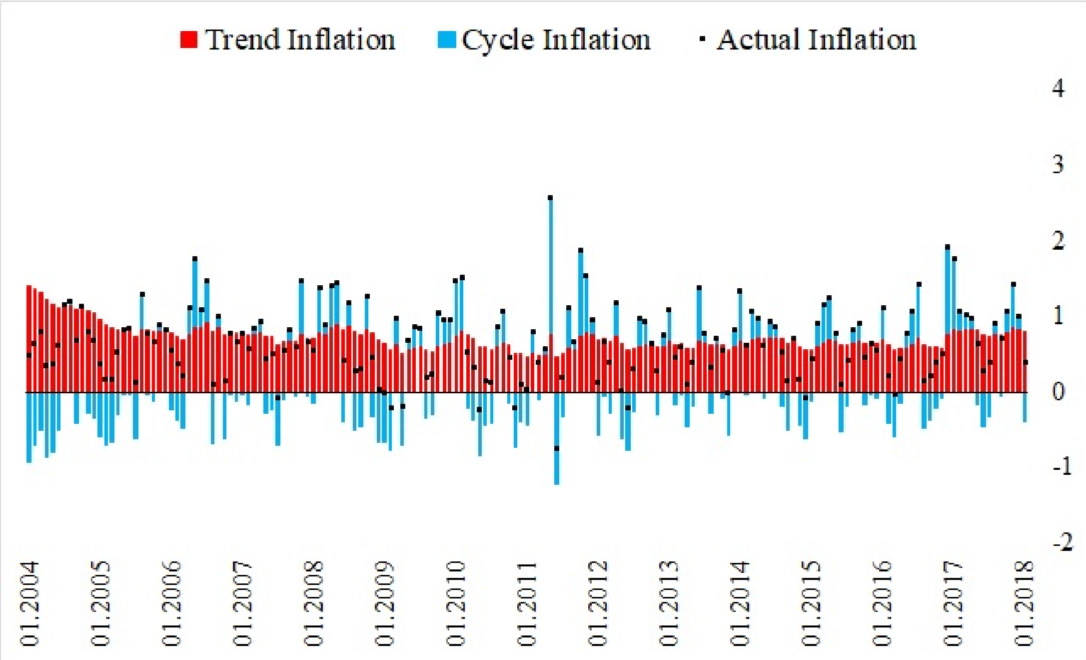

Figure 5.5: Historical Decomposition of Inflation between 2004-2017

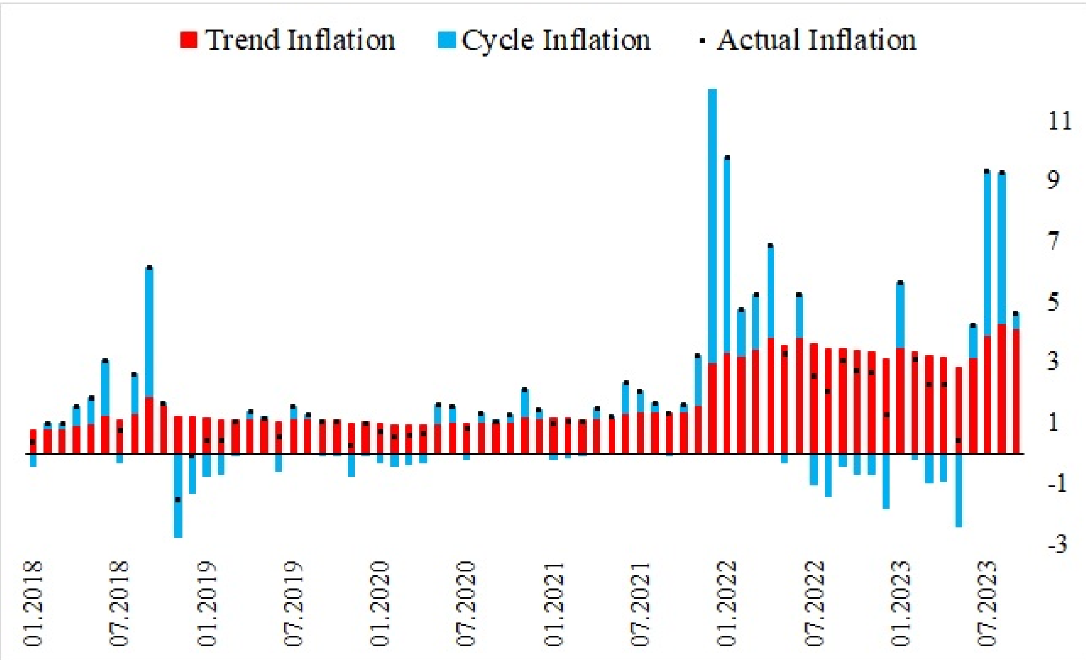

Figure 5.6: Historical Decomposition of Inflation between 2018-2023

5.2 *Permanent and Transitory Components of the Aggregate Employment in Turkiye*

We decompose the monthly percentage changes of employment in Turkiye into trend and cycle components. As explained in the methodology part, we assume the transitory component as cycle employment and the permanent term as trend employment. The corresponding model parameters, σ_ψ and σ_η, are respectively 0.0619 and 0.9763 and demonstrated in table 5.5, suggesting that the cycle term pursues a more volatile pattern than as does the trend component. Figures 5.7 and 5.8 illustrate the disentangled versions of the Aggregate Employment in Turkiye.

σ_ψ	σ_η	α_1	α_2
0,0574	0,9767	0,0047	-5,55E-06

Table 5.5: Model Parameters for Decomposition of the Aggregate Employment Series

The cycle component captures the main behavior of the employment in the period between 2006 and 2023. The contribution of the trend employment to the actual employment has been relatively small. Throughout the period, the cycle component of employment has the mean of 0.072 per cent, whereas the trend term is on average 0.15 per cent. The standard deviation of cycle and trend components are respectively 0.9394 and 0.2327.

Another finding is that the amplitude of the cycle component significantly enlarged after 2014. We can assert that the volatility of the cycle term is raised from 0.5418 to 1.1864. The outlook of cycle employment becomes more explosive.

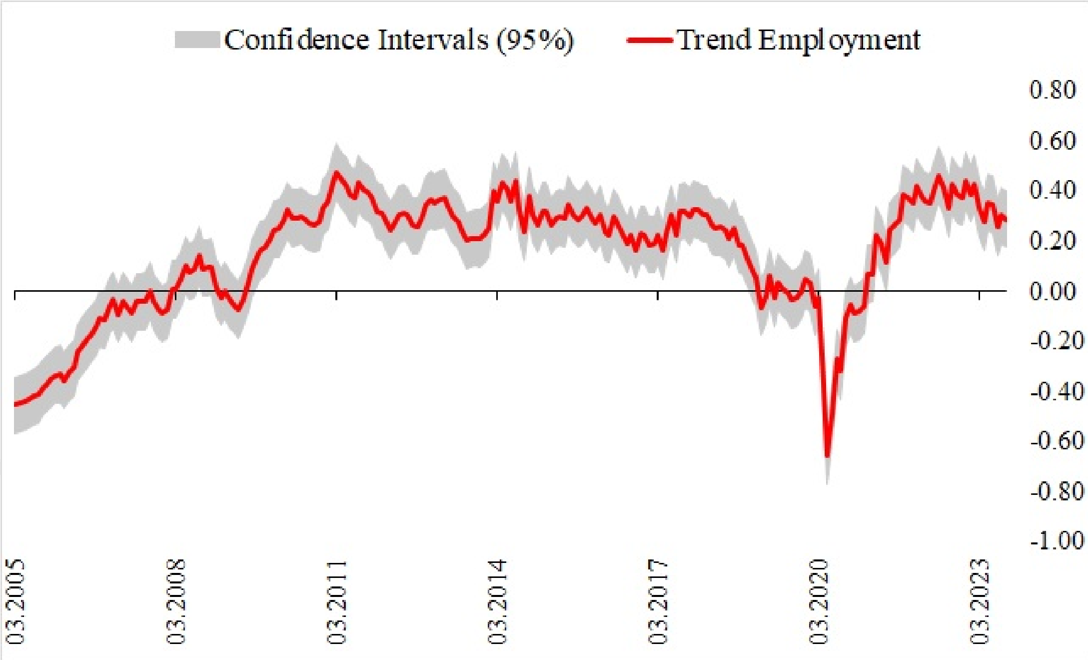

Figure 5.7: Trend of Employment in Turkiye between 2005 and 2023

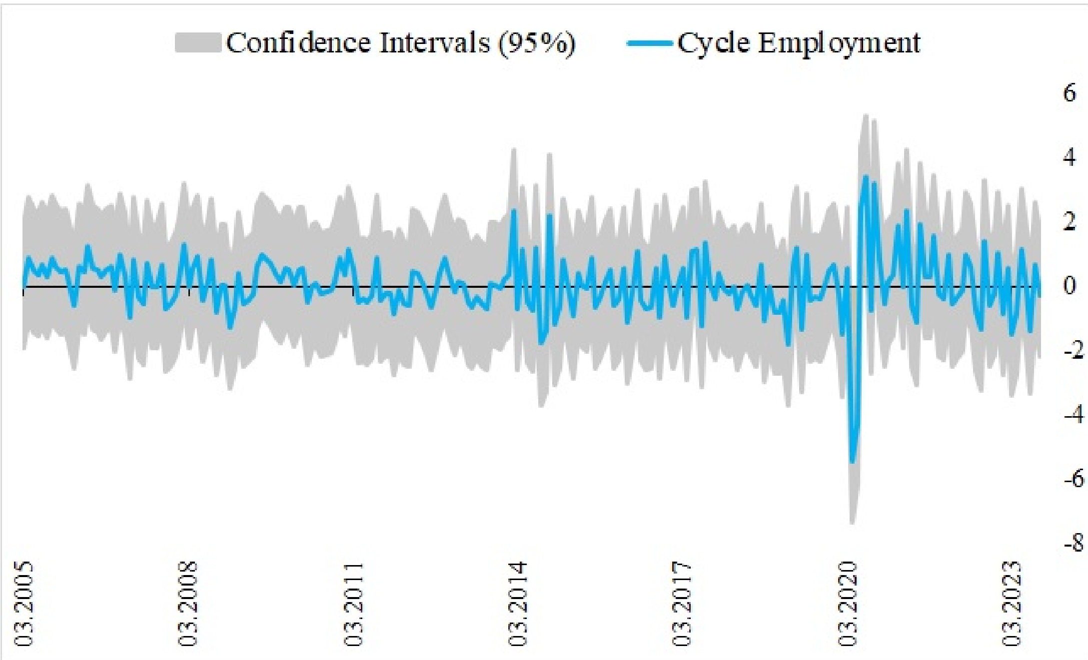

Figure 5.8: Cycle Employment in Turkiye between 2005 and 2023

5.3 Test Results

We have four model outputs, including trend inflation (the permanent term of inflation), the cycle inflation (the transitory term of inflation), the trend employment (the permanent component of employment) and the cycle employment (the transitory component of employment). As explained in the methodology section, we assume these model outputs as data, and we investigate their relationships among them and with other macroeconomic variables namely the exchange rate, global oil prices and aggregate credit stock growth. However, prior to analyze these variables empirically, we impose several statistical tests concerning stationarity and cointegration. The table 5.6 demonstrates the stationary and nonstationary variables in our data set.

Variable	Stationary
Credit Growth	+
USDTRY Parity Growth	+
Brent Oil Prices	+

Table 5.6: Stationary (+) and Nonstationary (-) Variables

Following imposing the Augmented Dickey Fuller test, we propose that the stationary variables are global oil price growth rate, the aggregate credit growth rate in Turkiye and the USDTRY parity growth rate. We utilize these stationary variables in the empirical analyses.

While the transitory components from the Unobserved Component Analysis model are stationary by their formulation, we design the permanent terms as random walk processes. As a result, the trend inflation and trend employment are nonstationary variables, whereas cycle terms of inflation and employment are stationary. However, some nonstationary variables might behave in a harmonic pattern such that their linear combinations might be stationary. At this point, we suspect cointegration among the permanent components of inflation and employment in Turkiye. However, as the table 5.7 and 5.8 demonstrate the results of Engle-Granger Cointegration test and of the Johansen Maximum Likelihood test respectively, the trend components do not exhibit cointegrating behavior, limiting us to conduct further empirical analysis.

Variable	Tau-Stat	P-Value
Trend Inflation	0.630989	0.9976
Trend Employment	-2.804658	0.1685

Table 5.7: Engle-Granger Cointegration Test Results

Variable	Probability
Trace	0.4933
Maximum Eigenvalue	0.4933

Table 5.8: Johansen Maximum Likelihood Cointegration Test Results

5.4 Regression Analyses

In this part, we exhibit and interpret outputs of our empirical analyses, through which we investigate the relationship among permanent and transitory components of inflation and employment in Turkiye, and other macroeconomic variables.

We have two regression analyses, and provide estimates and model outputs. Firstly, we examine the relation between trend inflation and other macroeconomic variables including cycle employment, global oil price prices, the USDTRY parity and credit growth. In this regression, to deal with potential endogeneity problem, we employ the first lagged values of these macroeconomic variables as instruments. We estimated the IV regression through Generalized Method of Moment (GMM) estimator, and results are robust. We also employ second and third lags of these endogenous variables as instruments and their estimates are illustrated in Appendix B.

Table 5.9 indicates the estimates of the IV regression on trend inflation. As the table shows, none of the regressors are statistically significant effect on trend inflation. The exchange rate has positive effect on trend inflation, implying that 1 per cent increase in the USDTRY parity increases the trend inflation by 0.1333 per cent. As pointed in the second IV regression later, the increase in the USDTRY parity has statistically significant and positive effect on cycle inflation as well. The growth rate of aggregate credit stock does not have significant effect on trend inflation, with coefficient of -0.0329, which means that 1 per cent increase in the monthly change of aggregate credit stock in Turkiye reduces trend inflation by 0.033 per cent. Further, global oil price has quite small and negative effect on trend inflation, and has coefficient of -0.0374. Finally the cycle employment, capturing the main behavior of the aggregate employment series, has positive effect on trend inflation. The corresponding coefficient is 1.2671, indicating that 1 per cent increase in the cycle employment leads to 1.27 per cent increase in trend inflation.

In the second regression analyses, we make effort to investigate the cycle inflation and examine its relation between cycle employment and other macroeconomic variables. We employ the same instrumental variables to overcome potential endogeneity

Trend Inflation	Coef.	Robust Std. Err.	z	P>—z—	95% Conf.	Intervals
Cycle Employment	1,2671	2,9255	0,43	0,665	-4,4668	7,001
Credit Growth	-0,0329	0,3612	-0,09	0,927	-0,7409	0,6750
USDTRY	0,1333	0,0836	1,59	0,111	-0,0305	0,2972
Oil Price	-0,0374	0,1167	-0,32	0,748	-0,2663	0,1914
Constant	0,8952	0,7558	1,18	0,236	-0,5862	2,3766

Table 5.9: Estimates on Trend Inflation

problem, and apply the same methodology with the first regression analysis. Table 5.10 demonstrates the corresponding estimates on cycle inflation. The USDTRY parity has a positive and statistically significant effect on cycle inflation where 1 per cent increase in the exchange rate raises the cycle inflation by 0.3407 per cent. We encounter that cycle employment has positive, but insignificant, effect on cycle inflation where 1 per cent increase in the cycle employment leads to 1.5669 per cent increase in cycle inflation. Further, we see that both global oil prices and credit growth have negative and not statistically significant effect on cycle inflation, whose coefficients are -0,0279 and -0,2965, respectively.

Cycle Inflation	Coef.	Robust Std. Err.	z	P >—z—	95% Conf.	Intervals
Cycle Employment	1,5669	4,2462	0,37	0,712	-6,7555	9,8894
Credit Growth	-0,2965	0,5534	-0,54	0,592	-1,3812	0,7882
USDTRY	0,3407	0,1292	2,64	0,008	0,0875	0,5940
Oil Price	-0,0279	0,1714	-0,16	0,87	-0,3639	0,3079
Constant	0,213	1,1296	0,19	0,85	-2,001	2,4270

Table 5.10: Estimates on Cycle Inflation

We employ recursive rolling regressions to examine the dynamic effect of the regressors on the cycle inflation. The window size is 72 months and recursive. In this context, examining the dynamic coefficient of cycle employment on cycle inflation is important, since it provides insights of Phillips curve dynamics in Turkiye. Figure 5.9 demonstrates the coefficients of cycle employment within the confidence intervals, indicating that the effect of the cycle employment was positive between years 2014 and 2020. After 2021, the coefficient becomes negative but very close to zero. The descriptive statistics concerning this rolling regression is given in table 5.11. The other figures showing the coefficients of the exchange rate, global oil prices and aggregate credit growth rate are demonstrated in Appendix C.

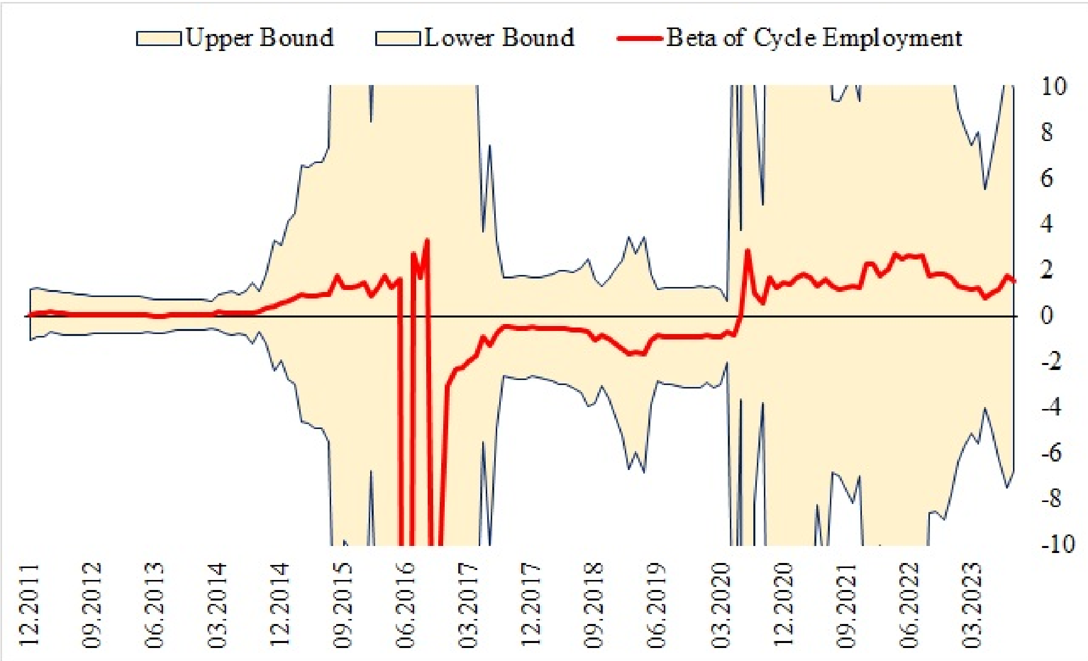

Figure 5.9: Rolling Regression Coefficient of Cycle Employment

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Cycle Employment	142	0,3544	41,136	-1,1063	4,2293
Credit Growth	142	-0,0607	0,0697	-0,1817	0,1590
USDTRY Growth	142	0,0562	0,0382	-0,0049	0,1849
Oil P. Growth	142	0,0146	0,0101	-0,0209	0,0359
Constant	142	0,0540	0,2096	-0,8463	0,2752

Table 5.11: Descriptive Statistics For Rolling Regression

Chapter 6

CONCLUSION

Understanding the nature of inflation dynamics is a crucial prerequisite in the practice of monetary policy. Decomposing inflation into its permanent and transitory components provides an appropriate information about the characteristics of the inflation and employment. While the trend inflation signals the long run inflation expectations of the agents, the cycle inflation covers the noise and short-lived fluctuations. Taking into account all of these concepts, it is a worthwhile effort to measure and assess the trend and cycle components of inflation and employment.

In this paper, we (1) investigate the trend and cycle components of inflation and employment in Turkiye,(2) provide a comprehensive literature review on trend inflation, decomposition models and Turkish inflation dynamics and labour market, (3) examine the behavior of these variables and scrutinize their relations with several main macroeconomic variables such as growth rates of Aggregate Credit Stock in Turkiye, the USDTRY parity and Brent Oil prices, and (4) construct an Unobserved Component Analysis model (UCM) to measure trend and cycle terms.

The contribution we make to the ongoing literature is that we provide an up-to-date monthly historical decomposition of the CPI inflation and Aggregate Employment growth rate in Turkiye, including the trend (permanent) and cycle (transitory) components of these series over the period between 1982 and 2023. Further, we classify and define three different terms, namely *High and Rigid Inflation Episode between 1982-2003*, *Low and Monotone Inflation Episode between 2004-2017* and *High and Volatile Inflation Episode between 2018-2023*, by separating the observation period with respect to the pattern of inflation. we indicate that the exchange rate has statistically significant effect on cycle inflation. Moreover, another finding of our study is that the trend inflation in Turkiye takes a larger and rigid form during high inflation periods. Further, we suggest that since 2014, the growth rate of aggregate employment in Turkiye takes a more volatile form, and mainly the cycle component of the employment captures the behavior of the actual employment data. Finally, we can also suggest that there is no any cointegrating relation between the trend inflation and the trend employment in Turkiye over the sample period between 2006 and 2023.

The inflation experience of Turkiye covers various patterns and volatility dynamics. With no doubt, conducting research on the driving forces of the Turkish Inflation might generate fruitful outputs, most of which can be employed in the process of implementing optimal monetary policy to achieve and sustain the price stability in Turkiye.

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Appendix A

ALTERNATIVE DECOMPOSITION MODEL

In this part, we provide an alternative version of our decomposition model. As mentioned in the methodology chapter, we benefit from [Clark, 1987] and [Kim and Nelson, 2017], while formulating the equations of the decomposition model. In our base model, we put the matrix R as zero, as employed in [Kim and Nelson, 2017]. In this part, we put the matrix R as a parameter, and provide the model outputs and relevant matrix notation below.

As Figure A.1. illustrate, the permanent component of the inflation is larger than the permanent term of the inflation in our base model. Moreover, the trend inflation in our base model is smoother than the latter. Further, one of the weak side of the second model is about derivation of the cycle term. As mentioned in [Kim and Nelson, 2017], identifying cycle term takes a difficult form under this structure. The Figure A.2. shows that the cycle term of inflation is quite small, limiting us to conduct empirical analyses on the transitory component of the inflation. Thus, we prefer the structure in our base model.

$$Y_t = \mathbf{H} \cdot \beta_t + v_t \tag{A.1}$$

$$\beta_t = \mathbf{F} \cdot \beta_{t-1} + \epsilon_t \tag{A.2}$$

$$\beta_{\mathbf{t}} = \begin{bmatrix} T_t \\ C_t \\ C_{t-1} \end{bmatrix} \tag{A.3}$$

$$\mathbf{v_t} = \begin{bmatrix} v_t \end{bmatrix} \tag{A.4}$$

σ_ψ	σ_η	α_1	α_2
0,4415	3,74E-06	-0,0821	0,2754

Table A.1: Model Parameters for Inflation Decomposition

$$\mathbf{H}= \begin{bmatrix} 1 & 1 & 0 \end{bmatrix} \tag{A.5}$$

$$\mathbf{F}= \begin{bmatrix} 1 & 0 & 0 \\ 0 & \alpha_1 & \alpha_2 \\ 0 & 0 & 1 \end{bmatrix} \tag{A.6}$$

$$\epsilon_{\mathbf{t}}= \begin{bmatrix} \psi_t \\ \eta_t \\ 0 \end{bmatrix} \tag{A.7}$$

$$\mathbf{R}=\sigma_{\mathbf{v}} \tag{A.8}$$

$$\mathbf{Q}= \begin{bmatrix} \sigma_\epsilon & 0 & 0 \\ 0 & \sigma_\eta & 0 \\ 0 & 0 & 0 \end{bmatrix} \tag{A.9}$$

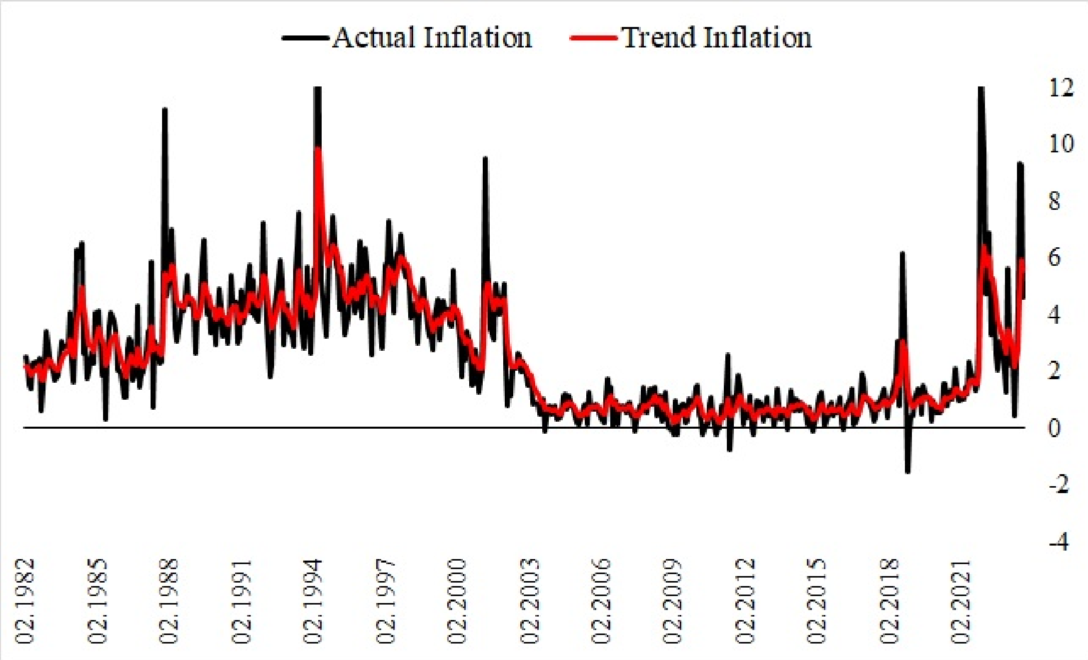

Figure A.1: Trend Inflation

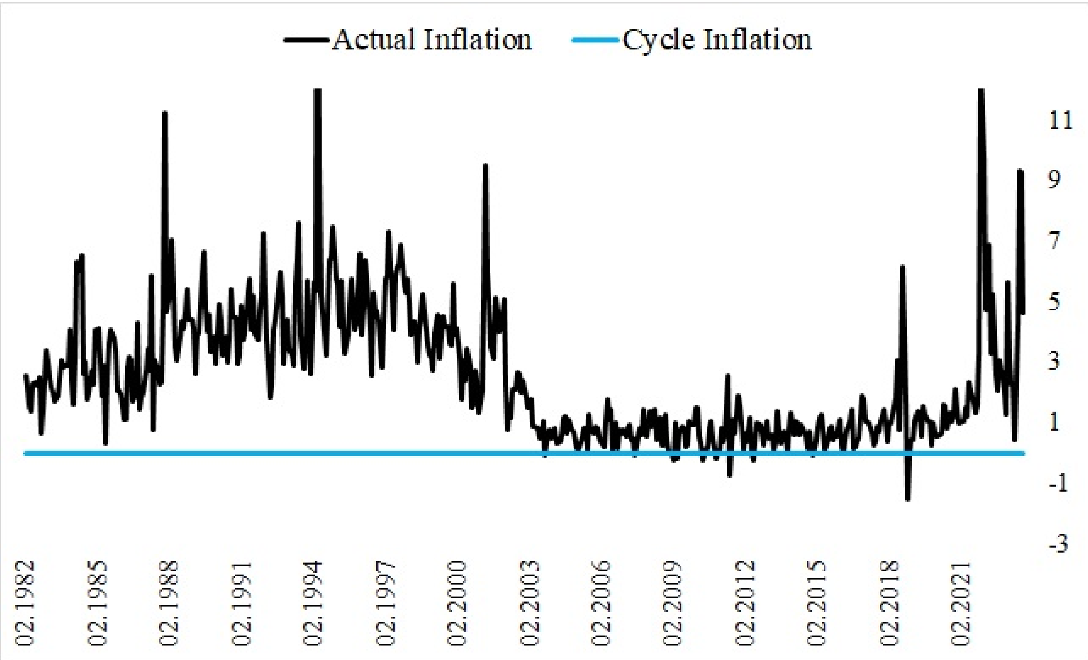

Figure A.2: Cycle Inflation

Appendix B

ALTERNATIVE IV ESTIMATES

In this part, we demonstrate the estimates of alternative IV regressions. As explained in the methodology part, we employ first lags of the potentially endogenous variables as instrument. In this part, we also employ second and third lags of these variables as instrument, and exhibit the estimate tables below.

Trend Inflation	Coef.	Robust Std. Err.	z	P >—z—	95% Conf.	Intervals
Cycle Employment	-8,5395	19,695	-0,43	0,665	-47,1411	30,062
Credit Growth	4,5026	11,1245	0,40	0,686	-17,301	26,306
USDTRY	-1,3018	3,9891	-0,33	0,744	-9,1202	6,5166
Oil Price	0,2308	0,5172	0,45	0,655	-0,7828	1,2446
Constant	-5,8297	16,2848	-0,36	0,72	-37,7474	26,0879

Table B.1: Estimates on Trend Inflation (Second Lags as IV)

Cycle Inflation	Coef.	Robust Std. Err.	z	P > $\|z\|$	95% Conf.	Intervals
Cycle Employment	-8,3797	20,0203	-0,42	0,676	-47,6188	30,8593
Credit Growth	4,0454	11,2284	0,36	0,719	-17,962	26,0528
USDTRY	-0,9266	3,9459	-0,23	0,814	-8,6605	6,8072
Oil Price	0,2549	0,5276	0,48	0,629	-0,7792	1,2891
Constant	-6,3518	16,4924	-0,9	0,70	-38,6764	25,9727

Table B.2: Estimates on Cycle Inflation (Second Lags as IV)

Trend Inflation	Coef.	Robust Std. Err.	z	P > $\|z\|$	95% Conf.	Intervals
Cycle Employment	-2,280	3,9402	-0,58	0,563	-10,003	5,4427
Credit Growth	0,9321	1,5190	0,61	0,539	-2,0451	3,9042
USDTRY	-1,4836	2,3355	-0,64	0,525	-6,0611	3,0938
Oil Price	0,0047	0,0716	0,07	0,948	-0,1356	0,1451
Constant	1,4369	1,9453	0,74	0,46	-2,3758	5,2497

Table B.3: Estimates on Trend Inflation (Third Lags as IV)

Cycle Inflation	Coef.	Robust Std. Err.	z	P > —z—	95% Conf.	Intervals
Cycle Employment	-0,6949	2,0901	-0,33	0,74	-4,7916	3,4017
Credit Growth	0,2506	0,801	0,31	0,754	-1,3183	1,8197
USDTRY	-0,5719	1,2945	-0,44	0,659	-3,1092	1,9652
Oil Price	0,0053	0,0303	0,18	0,861	-0,0540	0,0647
Constant	0,5194	0,9792	0,53	0,596	-1,3997	2,4386

Table B.4: Estimates on Cycle Inflation (Third Lags as IV)

Appendix C

ROLLING REGRESSION GRAPHICS

Graphics showing the corresponding coefficients of the regressors in the rolling regression are depicted.

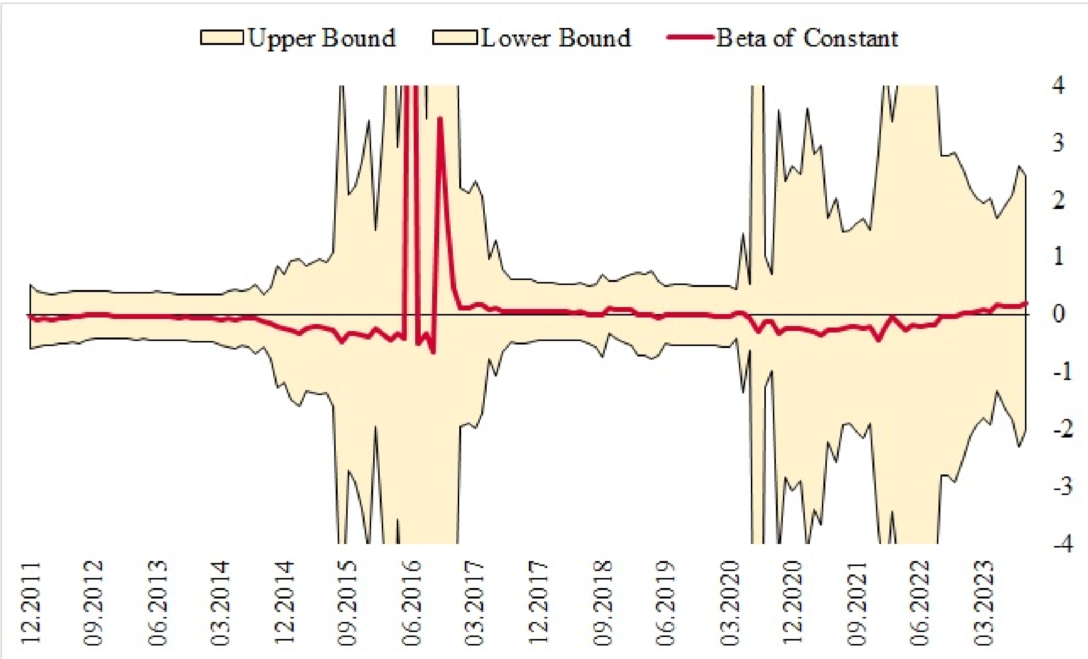

Figure C.1: Rolling Regression Coefficient of Constant Term

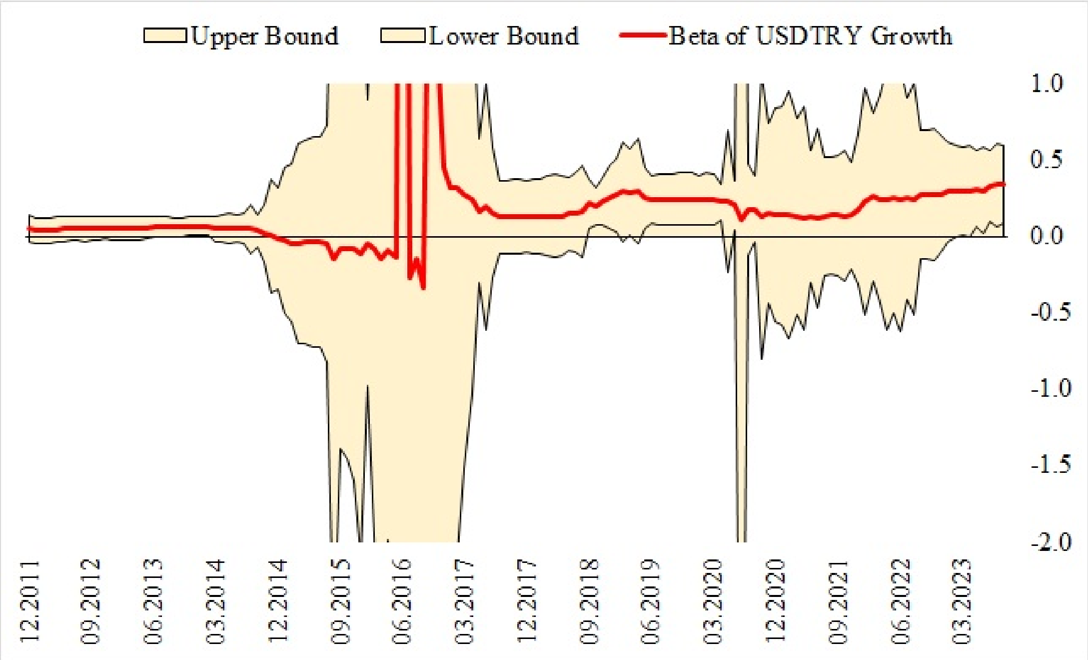

Figure C.2: Rolling Regression Coefficient of the USDTRY Term

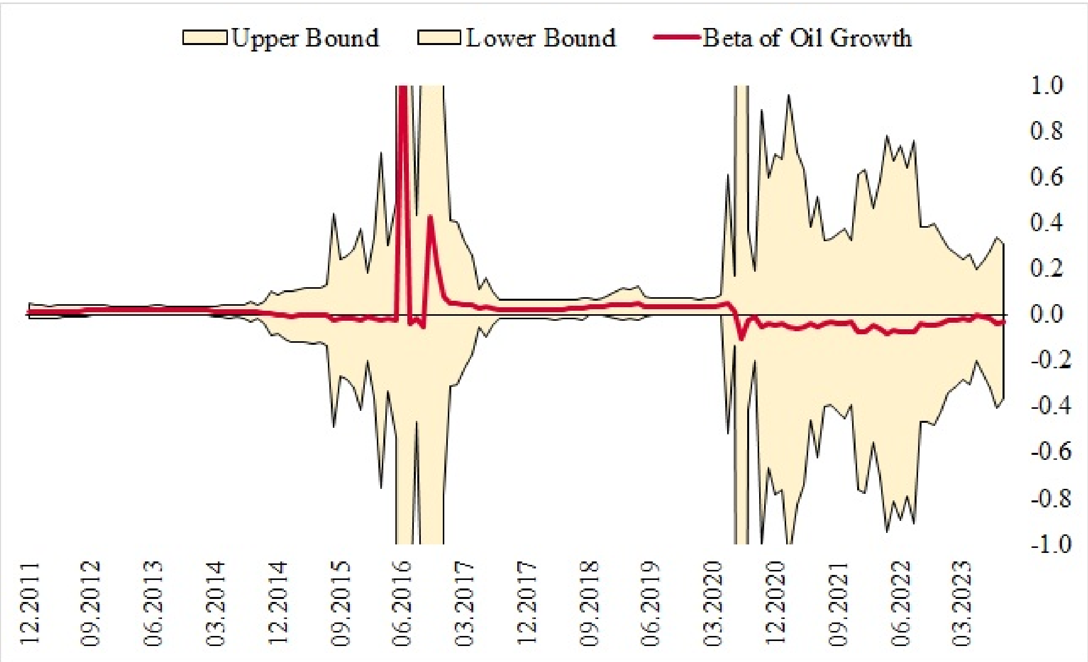

Figure C.3: Rolling Regression Coefficient of the Oil Prices Term

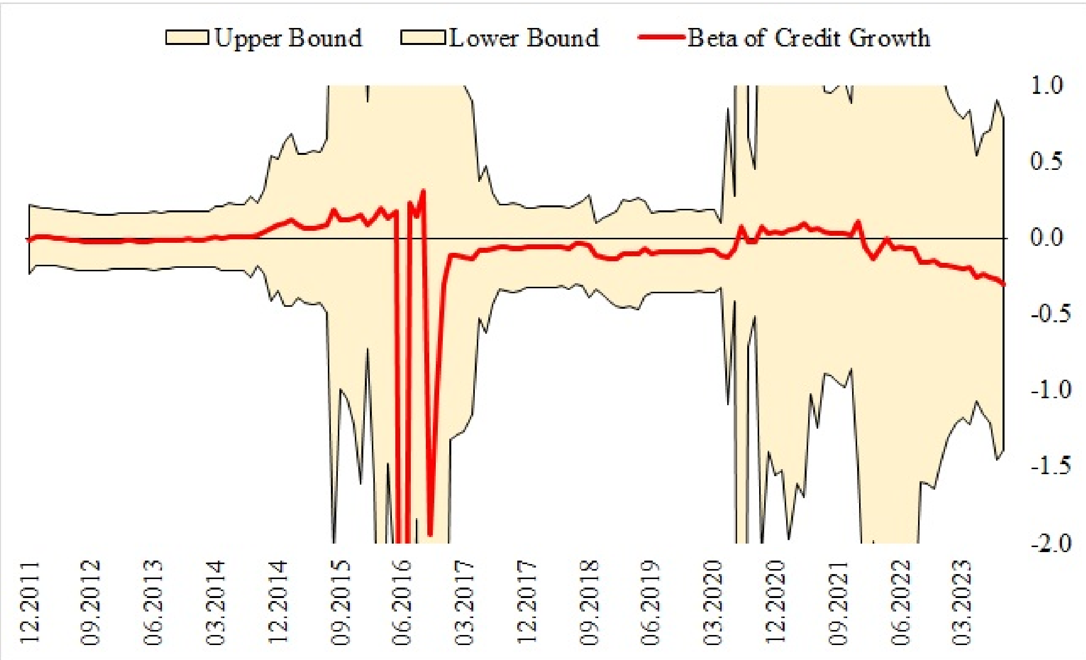

Figure C.4: Rolling Regression Coefficient of the Credit Growth Term