TÜRKİYE CUMHURİYET MERKEZ BANKASI

Inflation Dynamics in Turkey from a Bayesian Perspective

Fethi ÖĞÜNÇ
Mustafa Utku ÖZMEN
Çağrı SARIKAYA

July 2018

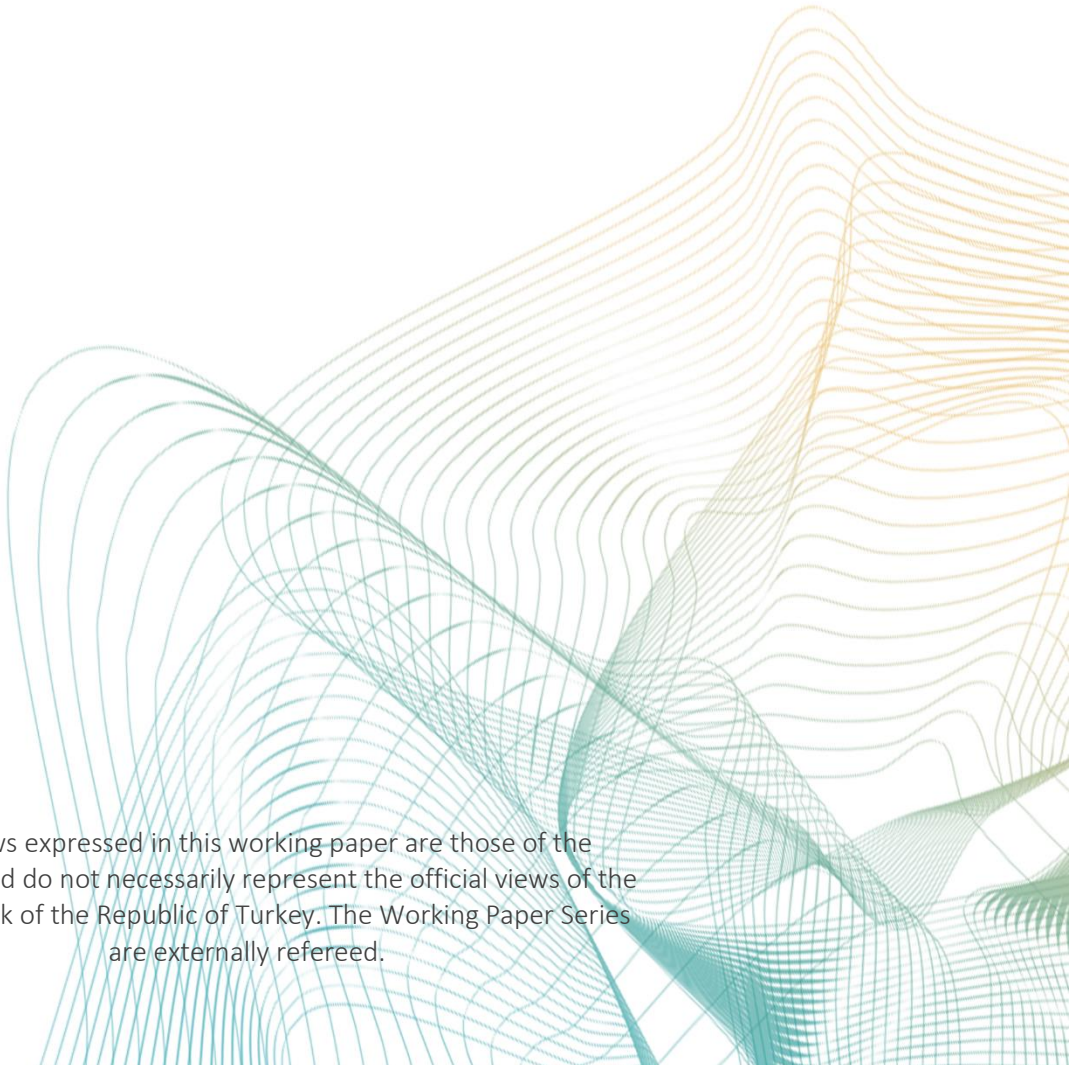
Working Paper No: 18/10

© Central Bank of the Republic of Turkey 2018

Address:
Central Bank of the Republic of Turkey
Head Office
Structural Economic Research Department
İstiklal Caddesi No: 10
Ulus, 06050 Ankara, Turkey

Phone:
+90 312 507 80 04

Facsimile:
+90 312 507 78 96



The views expressed in this working paper are those of the author(s) and do not necessarily represent the official views of the Central Bank of the Republic of Turkey. The Working Paper Series are externally refereed.

Inflation Dynamics in Turkey from a Bayesian Perspective

Fethi Öğünç, Mustafa Utku Özmen and Çağrı Sarıkaya[‡]

Abstract

In this paper, we aim to contribute to the understanding of inflation dynamics in Turkey by estimating a Bayesian VAR (BVAR) model. Our identification strategy is based on a set of zero restrictions and use of exogenous control variables. Main results are as follows: (i) Pass-through from exchange rate to inflation is stronger than that from import prices. Moreover, exchange rate and import price shocks spread over inflation very quickly (most of the adjustment is complete within 9 months), particularly faster for the latter, with the estimates being highly precise (the dispersion around median responses are relatively narrow). (ii) Economic growth has a significant but lagged effect on inflation, yet with a greater uncertainty compared to exchange rate and import price pass-through. (iii) The degree of nominal wage pass-through on inflation is estimated to be close to the degree of exchange rate pass-through, albeit with a longer transmission and a greater uncertainty.

Özet

Bu çalışmada, Türkiye'de enflasyon dinamiklerinin daha iyi anlaşılmasına katkıda bulunmak amacıyla bir Bayesçi vektör otoregresyon modeli (BVAR) tahmin edilmektedir. Ayrıştırma stratejisi, modelde kullanılan belli parametreler için konulan sıfır kısıtlarına ve dışsal kontrol değişkenlerinin kullanımına dayanmaktadır. Çalışmanın temel bulguları şöyle özetlenebilir: (i) Döviz kurundan enflasyona geçiş etkisi ithalat fiyatlarınınkine kıyasla daha güçlüdür. Döviz kuru ve ithalat fiyat şokları enflasyona çok hızlı bir şekilde yansımakta (toplam birikimli geçişkenliğin büyük bir kısmı 9 ay içinde tamamlanmakta) olup, ithalat fiyatlarının geçişi daha çabuk gerçekleşmektedir. Bu tahminlere dair belirsizlik de görece düşüktür (medyan tepkilerin etrafındaki dağılım nispeten dardır). (ii) Ekonomik büyüme, enflasyon üzerinde anlamlı ve gecikmeli bir etkiye sahiptir. Ancak döviz kuru ve ithalat fiyat geçişkenliği ile karşılaştırıldığında, büyümenin enflasyon üzerindeki etkisine yönelik daha büyük bir tahmin belirsizliği söz konusudur. (iii) Nominal ücret şokunun enflasyona geçiş etkisi, daha uzun bir aktarım süresi ve daha fazla belirsizlik içermekle birlikte, döviz kurununkine yakın tahmin edilmiştir.

Keywords: Inflation, Cost pass-through, Bayesian vector autoregression

JEL codes: C11, C15, C32, E31

[‡] Central Bank of the Republic of Turkey, Research and Monetary Policy Department, Istiklal Cad. No:10, 06050, Ulus, Ankara, Turkey. E-mail: fethi.ogunc@tcmb.gov.tr, utku.ozmen@tcmb.gov.tr, cagri.sarikaya@tcmb.gov.tr.
The views and opinions presented in this paper are those of the authors and do not necessarily represent those of the Central Bank of the Republic of Turkey or its staff. Authors gratefully thank to Tayyar Büyükbaşaran for the constructive comments and recommendations which help improve the final version of the paper, and to seminar participants at CBRT and TEK-2016 Conference for their suggestions.

Non-Technical Summary

In this paper, we aim to contribute to the understanding of inflation dynamics in Turkey by estimating a Bayesian VAR model with five variables: Nominal exchange rate, import price, GDP, consumer prices and nominal wage. We are interested in not only the magnitude and speed of pass-through of these shocks but also the uncertainty surrounding them by estimating the impulse responses in a distributional form. In doing so, we make use of Bayesian estimation techniques, which also provide advantages for small sample analysis and serve for better identification purposes.

Main empirical findings can be summarized as follows: Accumulated response of consumer inflation to nominal exchange rate shocks is found to be consistent with earlier studies to a large extent. The accumulated response of inflation to nominal exchange rate shock at the end of two years is estimated to be 17 percent. Exchange rate pass-through is found to be stronger than import price pass-through, estimated to be 13 percent at the end of two years, suggesting that these two shocks cannot be interpreted as similar cost-push shocks with respect to their transmission on inflation. Exchange rate shocks may spread over inflation through various channels depending on the pricing practices of foreign exporters (i.e. producer currency pricing, pricing to market), balance sheet effects, expectations and pull/push factors driving capital flows. Accordingly, the exchange rate shock identified in our model may actually be a combination of different type of shocks, hence the inflationary impact of exchange rate may go well beyond what imported cost channel implies.

We also find evidence for different "speed" of pass-through of these two shocks, where import price shocks are found to transmit relatively faster. More gradual propagation of exchange rate shocks may be related with the expectations of price makers on the nature of the shock, whether permanent or transitory. When it comes to uncertainty around pass-through estimates, the median responses to both shocks are surrounded with much narrow bands, thereby provide clear inferences for inflationary impacts.

While exchange rate and import price shocks spread over inflation very quickly, i.e. most of the adjustment is complete within three quarters, economic growth has a lagged effect with a greater uncertainty compared to exchange rate and import price pass-through. We also find a relatively low elasticity of inflation to economic growth with a wide uncertainty band, which may be indicating the need for a better identification of the source of the shocks.

The degree of nominal wage pass-through on inflation is estimated to be close to the degree of exchange rate pass-through, albeit with a longer transmission and a greater uncertainty. One possible explanation for this uncertainty might be the presence of high degree of informality in the labor market.

1. Introduction

Understanding the impact of macroeconomic variables on inflation with respect to their speed and size is crucial for monetary policy makers, especially for inflation-targeting central banks. The question of how inflation reacts to changes in exchange rates, international commodity prices, economic growth and wages, has high relevance to the conduct of monetary policy. Considering emerging economies, which are generally subject to more frequent shocks and thus more volatile in nature, this question gains more significance. Besides, the shocks that these economies face might be larger in scale compared to those observed in developed economies, and thus, might bring about behavioral shifts for economic agents that economic policies should cope with. For instance, major shocks in 2015, such as the sharp fall in international oil prices and accompanying depreciation in Turkish lira (TL) had crucial implications for inflation outlook of Turkey at that time. Specifically, oil prices dropped by 47 percent and TL depreciated against the US dollar by 24 percent during that year, generating need for estimating the potential impact from each shock to inflation. The 30 percent minimum wage adjustment at the beginning of 2016 can also be deemed as one of the large shocks encountered in recent years.

High and volatile inflation in Turkey often necessitates analyzing both the total impact and the duration of these types of shocks on inflation, as an essential element of monetary policy making. In this context, vector auto-regression (VAR) models emerge as an appropriate tool to examine the propagation of shocks over a certain time horizon via impulse response functions. Besides, Bayesian techniques provide us computational convenience to represent the dynamic interaction among variables. For instance, one may not expect for macroeconomic developments in Turkey to cause changes in international prices, due to its small-open economy characteristic. Hence impulse response functions, particularly for US dollar-denominated import prices, should be consistent with this understanding. Bayesian VARs provide practical ways to impose these type of restrictions for a realistic representation of economic relationships. For that purpose, along with its other advantages, we employ a Bayesian VAR model with an identification strategy based on zero restrictions and on the use of exogenous variables to control for the global winds that may blur structural relationships, i.e. between domestic growth and import prices.

Bayesian inference has its roots in Bayes' theorem on conditional probability and was developed long before the formal adoption of probability models in economic and econometric analysis. Pioneering works of Haavelmo (1944), one of the earlier contributors to the debate on the use of statistical inference in economic research, advocate the incorporation of probability distributions generated through random and repeated experiments in testing economic theory. Hildreth (1963) considers Bayesian elements, i.e. probability values translated into the shape of a likelihood function,

as an efficient way of information transmission from a statistician to client (decision maker). Qin (1996) and Baştürk et al. (2014) well document the historical progress in the related literature. Despite being based on a strong theoretical ground, Bayesian methods has become a widely used tool in macroeconomic forecasting and policy analysis only after computational power has developed in recent years. For instance, Bayesian estimation procedure might necessitate the use of techniques such as Gibbs sampling or the Metropolis–Hastings (MH) algorithm (a sampling technique based on Markov-chain Monte Carlo (MCMC) simulations) for approximating probability distributions. As part of the ongoing technical progress in this field, the introduction of Bayesian Estimation, Analysis and Regression (BEAR) toolbox, a Matlab based package developed by Dieppe et al. (2016), has been an important step in facilitating the application of these complex techniques for analysts.

Econometric estimates are based on past patterns of the relationships between variables and may be surrounded by varying degrees of uncertainty. For most of the time, policy implications of *mean* estimates may be limited, as they generally change along business cycles in time series or across countries in panel studies. In this context, an important benefit of Bayesian estimation is that it provides information about the distributional properties of "true" parameters rather than representing them just as a point estimate with certain standard errors. As argued by Haavelmo (1944), "probability concept has the advantage that it is analytic…" and can be translated into "…a statement about a real phenomenon, the truth of which can be tested". Hence, Bayesian approach may provide an enriched content for a researcher to make econometric inference. Basically, Bayesian parameter estimates are a combination of the information coming from the data and prior knowledge of the expert. A tight prior means that the expert is pretty sure about the true value of a parameter with less uncertainty surrounding it. Technically, this corresponds to initializing the model with a certain *mean* and a relatively low *standard deviation* for the parameter to be estimated. Alternatively, when the expert does not have much information about a parameter, a *let the data speak*-approach may be followed by imposing a large *standard deviation* around a prior *mean*. Besides, Bayesian methods are better equipped to model data with small sample sizes, a particularly crucial advantage in applied work on emerging economies.

Against this background, this paper aims to contribute to the understanding of inflation dynamics in Turkey by estimating a Bayesian VAR model to obtain key elasticities of inflation with respect to exchange rate, import prices, growth and nominal wages. There are a number of past studies focusing on exchange rate and import price pass-through in Turkey, such as Kara and Öğünç (2008, 2012) and Yüncüler (2011), which employ Cholesky-type identification schemes in unrestricted VAR

settings.[1] The main improvement brought upon these studies is two folds: First, Bayesian approach allows us to generate impulse response functions in the form of distributions, thus it is straightforward to make inferences about the dispersion around the median responses.[2] We find that the uncertainty on inflationary effects of wages and economic activity on inflation is larger than those of the exchange rate and import prices. Second, our identification strategy based on zero restrictions and use of control variables helps produce theory-consistent relationships among variables in the entire system. It is also worth to note that, unlike previous studies, we include nominal wage in the model as an additional endogenous variable to account for the interrelation between wages and inflation as one of the key elements of pricing dynamics.

The paper is organized as follows: Section 2 starts with introducing the model and methodology, then proceeds with a detailed discussion on our identification strategy. Here we explain the rationale behind the zero restrictions imposed and the control variables used with reference to general characteristics of Turkey as a small-open economy. Section 3 presents empirical results and elaborates on key macroeconomic elasticities obtained through impulse response functions. Section 4 concludes the study.

2. Methodology

a) Model

The relation between inflation and its key determinants may not be unidirectional. In Turkey's case, we can talk about a dynamic interrelation in which past inflation influences wage increases and in turn increase in wages pushes inflation up. A similar interaction is also observed between exchange rates and inflation. Therefore, we should take into account the endogeneity between these variables. Vector autoregression (VAR) models allow us to analyze such relations and further provide information in terms of speed and size of the relationship among the variables at hand through impulse-response functions. The relatively small sample size due to data constraints is a challenge against precise estimation of parameters in these models given the large number of parameters to be estimated. To overcome this problem, along with its other advantages, we adopt a Bayesian approach and estimate a Bayesian VAR model. With this methodology, it is simple to obtain not only point estimates but also the uncertainty around these estimates by drawing from the posterior density of respective parameters. To this end, we estimate the following BVAR model:

[1] Özmen and Topaloğlu (2017) is a recent study using a similar framework with sub-groups of consumer inflation. The main difference is their indirect approach to estimate exchange rate pass-through with disaggregated data.

[2] The frequentist approach can also provide a measure of uncertainty either theoretical or through sampling techniques from empirical distribution such as bootstrap. While the frequentist approach postulates the true data generating process is known (mostly Gaussian), Bayesian one assumes that true data generating process is unknown, but some prior knowledge about it is assumed.

$$Y_t = c + \sum_{i=1}^{p} B_i Y_{t-i} + e_t,$$

$$VAR(e_t) = \Sigma$$

where Y_t denotes the matrix containing endogenous variables, p is the lag length and e is the reduced form errors with covariance matrix of Σ. We adopt a five-variable model in this study. Y_t comprises the following variables with the respective order: Exchange rate basket (0.5*US dollar/TL+0.5*Euro/TL), import prices in US dollars, GDP, consumer prices excluding unprocessed food and alcohol-tobacco prices (CPI-D) and nominal hourly wages in non-agricultural sector. In addition, the model includes exogenous variables: EMBI-global as a global risk indicator, global GDP, lump-sum special consumption tax on domestic fuel prices and unprocessed food prices excluding fresh fruits and vegetables. The VAR model is estimated with 2 lags based on lag order selection criteria by using stationary forms (growth rate) of the variables, which are seasonally adjusted by TRAMO-SEATS if deemed necessary.[3] The shocks are identified through the Cholesky decomposition. The model is estimated on a quarterly frequency and the sample period covers 2005Q2:2016:Q2.

Since each equation has identical regressors, it is possible to write the above model in the following vectorized form:

$$y = (I_m \otimes X)b + E$$

where X matrix contains constant term, exogenous and endogenous variables, $y = vec(Y_t)$, $b = vec(B)$ and $E = vec(e_t)$. We adopt Independent Normal Inverse Wishart prior for the VAR coefficients and the covariance matrix of Σ, which allows us to restrict some coefficient values close to zero. Therefore, we assume the following Normal and inverse Wishart distributions for the prior of VAR coefficients and covariance of the error terms respectively:

$$p(b) \sim N(b_o, V), \qquad p(\Sigma) \sim IW(S, \alpha)$$

We use Minnesota prior to set the prior distribution of VAR coefficients and assume an autoregressive process for the prior mean of coefficients belonging to endogenous variables owing to their stationary forms.[4] The prior variance of coefficients, V, is shaped with respect to a hyperparameter set, namely $\lambda = (\lambda_1, \lambda_2, \lambda_3, \lambda_4)$, which controls the tightness on the prior for different coefficients.[5] We choose the hyperparameter set on the basis of the marginal likelihood calculations. Specifically, we perform a grid search for possible combinations of λ values by calculating the marginal likelihood, as described in Chib (1995), for each combination. The results of this analysis provided in Appendix B point out that the marginal likelihood is maximized at the values of λ_1=0.2, λ_2=0.9, λ_3=0.5 and λ_4=10. For the prior distribution of Σ, we follow common practice and

[3] Figures concerning the raw and stationary forms of data can be found in Appendix A.
[4] We use a generalization of the Minnesota prior, unlike originally proposed by Litterman (1986).
[5] For further details, see Blake and Mumtaz (2012), chapter 10 of Canova (2007).

set α to N+1, where N is the number of endogenous variables, so we assume a loose (non-informative) prior for the degrees of freedom parameter. Prior scale parameter S is determined on the basis of OLS estimate of Σ.

We use Gibbs sampling to approximate the marginal distributions of VAR coefficients and covariance of the error terms. Gibbs sampling is one particular MCMC technique suitable for this task and it is computationally straightforward to implement. In this context, the conditional posterior distributions of the VAR coefficients are given by

$$p(b|\Sigma, Y_t) \sim N\left(\hat{B}, (\mathrm{V}^{-1} + \Sigma^{-1} \otimes X_t' X_t)^{-1}\right)$$

where $\hat{B} = (\mathrm{V}^{-1} + \Sigma^{-1} \otimes X_t' X_t)^{-1}(\mathrm{V}^{-1} b_o + \Sigma^{-1} \otimes X_t' X_t b_{ols})$ and b_{ols} is the OLS estimates of VAR coefficients in vectorized form. Given the prior for covariance of the error terms, the conditional posterior distributions of Σ is

$$p(\Sigma|b, Y_t) \sim IW(\Psi, T + \alpha)$$

where T is the sample size, $\Psi = \mathrm{S} + (Y_t - X_t b^i)'(Y_t - X_t b^i)$ and b^i is the draw from conditional posterior distributions of the VAR coefficients. We utilize 100,000 draws from the conditional posteriors and use final 10,000 draws to make inference about parameters.

b) Identification Strategy

The common question of the VAR models, and actually all econometric models, is whether the impact/coefficient that is tried to be measured is correctly "identified". In the simplest terms, while making a correlation analysis of two variables, one should first judge if the variables have a common driver. For instance, as will be explained in the following parts in more detail, we can talk about a common component that may cause import prices and domestic economic growth to move in the same direction. Considering time lags (contemporaneous or lagged relationships between variables), control variables and model restrictions help correctly identify the parameters. In short, our identification strategy relies on economic theory.

We employ a Cholesky decomposition to identify structural shocks, which implies a chain-like causal relationship pattern among variables. Technically, this identification scheme defines a lower triangular matrix for the reduced-form VAR residuals, with an increasing degree of endogeneity from top to bottom. This strategy is built on the ordering of the variables, as the most exogenous variable is ordered first. Economic implications of the shock transmission in the system and thus impulse responses may change to a great extent in alternative orderings.

Several studies in the literature, starting from McCarthy (2007), try to measure exchange rate pass-through along a conventional distribution chain, from exchange rate to import prices, then to

producer prices, and finally to consumer prices.[6] In these studies the typical ordering of the variables in the baseline models is as follows:

$$Poil \rightarrow Y \rightarrow E \rightarrow P \rightarrow i \rightarrow M$$

or

$$Poil \rightarrow i \rightarrow Y \rightarrow E \rightarrow P$$

where Y is output/output gap, M is monetary aggregate, E is exchange rate, P represents the price chain consisting of import, producer, consumer price indices (in respective order), Poil is the price of oil, i is the short-term interest rate.

In these models exchange rate comes after output and monetary policy variables (either money supply or short-term interest rate) implying that demand and monetary policy shocks have contemporaneous impact on the exchange rate while they are affected by the exchange rate with a lag. Nevertheless, the source and transmission of exchange rate shocks generally differ in small open economies. For instance, Faruqee (2004) considers monthly exchange rate shocks to be driven by exogenous asset market disturbances and orders exchange rate first, which might be a more realistic assumption in our case. Exchange rate can be considered an exogenous variable for small open economies, which are heavily affected by capital flows shaped by global liquidity conditions and risk appetite.

Considering the small open economy characteristic of Turkey we order the exchange rate variable first in our VAR model. There is no ambiguity on that nominal exchange rate fluctuations affect output and prices contemporaneously in a quarterly frequency setting. On the other hand, the interaction between exchange rate and import prices is not that straightforward. In most models, oil price is ordered first and identified as a supply shock, thus is not expected to be affected by other variables contemporaneously, as shown above. Trehan (1986) argue that since crude oil traded in international markets is priced in dollars, changes in the value of dollar lead to shifts in the supply of and demand for oil, thereby affect the price of oil. Here, there is a clear negative relationship between the price of oil and the value of dollar, hence oil price movements cannot be considered as completely exogenous supply shocks. From a similar point of view, An and Wang (2012) point out that exchange rate movements may trigger changes in trading partners' prices through their mark-ups and marginal costs. Although the causality between exchange rate and oil price can be defined as a two-way relationship, it is reasonable to assume the contemporaneous impact runs from the former on the latter. Hence, we order the exchange rate variable first, preceding the import price index in our model.

[6] See also Hahn (2003), Ca' Zorzi et al. (2007), An and Wang (2012).

Ordering of the next two variables are fairly standard, as output and inflation respond to exchange rate and import price shocks in the same period, as there has been a quick transmission from these cost factors on economic activity and prices in Turkey. Nominal wage, ordered as the last variable, may need a more detailed discussion. Since nominal wage inherently contains a price component apart from its real part, one may naturally expect a contemporaneous impact of inflation on nominal wage. Besides, on a quarterly basis, employers and employees have sufficient time to incorporate the most recent inflation shocks in their wage bargains. Naturally, one may argue that once nominal wages are set and fixed for a certain period of time, i.e. one year, price shocks may not transmit on wages in the short-run until the next wage setting period starts. Here, we assume that at least some portion of wages in the economy is affected by inflation fluctuations. At the same time, exogenous wage shocks, i.e. a minimum wage hike, may also trigger a contemporaneous price change. Hence, the contemporaneous causal link between wage and price inflation may not be one-way. For instance, Fosu and Huq (1988) found evidence for both unidirectional and two-way causality between wages and inflation for different measures of wages. In our setting, inflation responds to nominal wage shocks with a lag.

Now we can proceed with our selection of exogenous control variables. In the model, global risk indicator (EMBI-global), global growth, taxes on domestic fuel-oil prices, and unprocessed food prices excluding fresh fruits and vegetables are used as exogenous variables. The part of fuel-oil prices that cannot be explained by import prices and exchange rates is attributed to the changes in lump-sum special consumption tax, and the share of lump-sum tax in fuel-oil prices is quite high in Turkey. To control for such impacts, we include the related tax variable in the model as an exogenous variable. Unprocessed food prices excluding fresh fruits and vegetables are included in the model to control for the price movements (for instance red meat prices) caused by domestic supply shocks and that cannot be explained by key variables.[7]

The other two exogenous variables in the model (global growth and global risk) reflect our motive to be consistent with the theory on the direction of macroeconomic relations. Periods of strong global growth and increased risk appetite are generally marked by rising commodity prices and at the same time accelerating capital flows to emerging markets that lead to robust economic activity in these countries. This transmission makes import prices and domestic growth move in the same direction and conceals the fact that a rise in import prices is actually an adverse cost shock with respect to domestic economic activity. To be able to identify the cost channel, we control for global growth and risk that are deemed to be the common drivers of the two variables.

[7] Fresh fruits and vegetable prices blur the inflation dynamics due to their highly volatile course. Hence, they are excluded to achieve a more fundamental measure of food price pressures.

Secondly, let us mention the parameter constraints. In small-open economies, international prices are not expected to be influenced by domestic variables. Therefore we include zero restrictions to the model in this sense.[8,9] Another restriction imposed is that wages are not affected by global risk, global growth and changes in taxes on fuel-oil. More clearly, we can assume that these variables have no impact on wages via separate channels other than growth and inflation. In brief, the imposed exogeneity restrictions in the above model are as follows: (i) external variables are not affected by domestic variables (but are affected by import prices, global risk and global growth); (ii) wages remain unaffected by global risk and global growth as well as fuel tax and unprocessed food prices excluding fresh fruits and vegetables.

3. Empirical Results

In this section, we present the results of our BVAR estimation model. As common to vector autoregression analysis, the results are based on the inspection of the impulse response functions. We primarily focus on the impact of exchange rates, import prices, growth and wages on inflation. Thus we compute the pass-through effects of each variable on inflation using the impulse response functions, which helps illustrate the speed and the size of the response of inflation to shocks to macroeconomic variables considered. In the virtue of the Bayesian estimation, we also have the full distribution of impulse responses. In that sense, we not only observe the median pass-through, but at the same time we may also infer the level of uncertainty easily regarding these estimates.

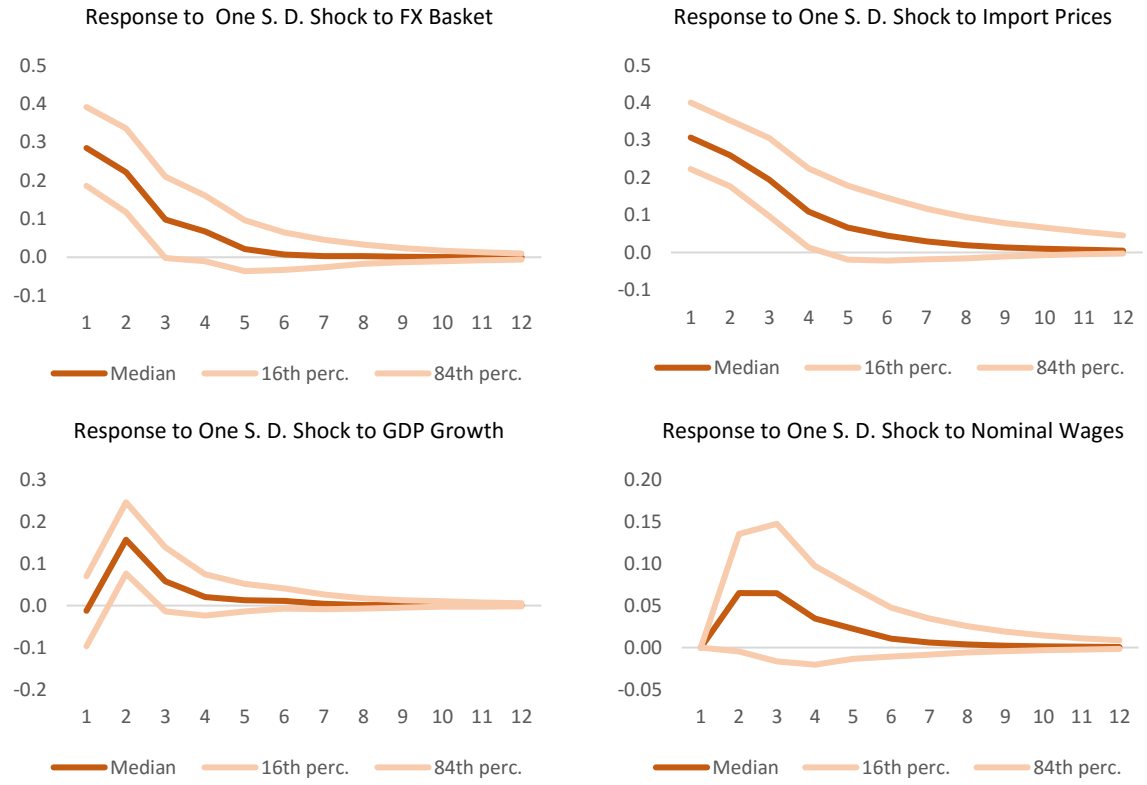
To this end, we first analyze the period by period response of inflation to main macroeconomic variables as presented in Figure 1. The median response indicates that inflationary effect of an exchange rate shock may spread over five quarters, while the impact in the first three quarters

[8] Bayesian approach allows imposing restrictions to the model for cases where a macroeconomic variable is expected to have no simultaneous or lagged effects on other variables. For example, assuming that international prices are not influenced by domestic variables in small-open economies, mean of the prior distributions of the relevant parameters are taken as zero, and their prior variances are assumed to be quite low.

[9] Note that zero restrictions in this study are imposed via restrictions on reduced form parameters following Blake and Mumtaz (2012). However, as stated in Canova (2007), this kind of restrictions conditioned on reduced form parameters are only statistical restrictions. There is one other possibility that these restrictions be placed on structural form (matrices) of the VAR rather than on reduced form parameters, in which case economic implications of the restrictions are more subtle. In addition, the way we introduce zero restrictions (very small open interval in the reduced form space) implies that the feasible reduced form parameter set is an open set. Arias et al. (2014) state that when the restrictions imply open sets on the parameter space, the Jacobian of the transformation (from parameter space to impulse response function space) is a constant over the feasible set of restrictions. Therefore, there would not be any problem on the posteriors one would obtain. One alternative to our approach would be putting exact zero restrictions as in Arias et al. (2014), which would imply that the feasible sets on parameter space is no longer open sets, and Jacobian of the transformation is no longer constant over the boundary points of the feasible set. Arias et al. (2014) prove that if the Jacobian of the transformation is not correctly calculated for the boundary, posterior distributions on parameters and on impulse response functions are affected. Therefore, some caution is needed in interpreting our results.

seems to be more significant. Meanwhile, the response of inflation to import price shock extends to almost eight quarters and appears to be significant in the first four quarters. When it comes to shocks to growth and wages, the response of inflation comes with a lag of one quarter. Inflation significantly responds to growth shock in second and third quarter; meanwhile, response to wages, although extends to a longer period, is not significant after the second quarter.

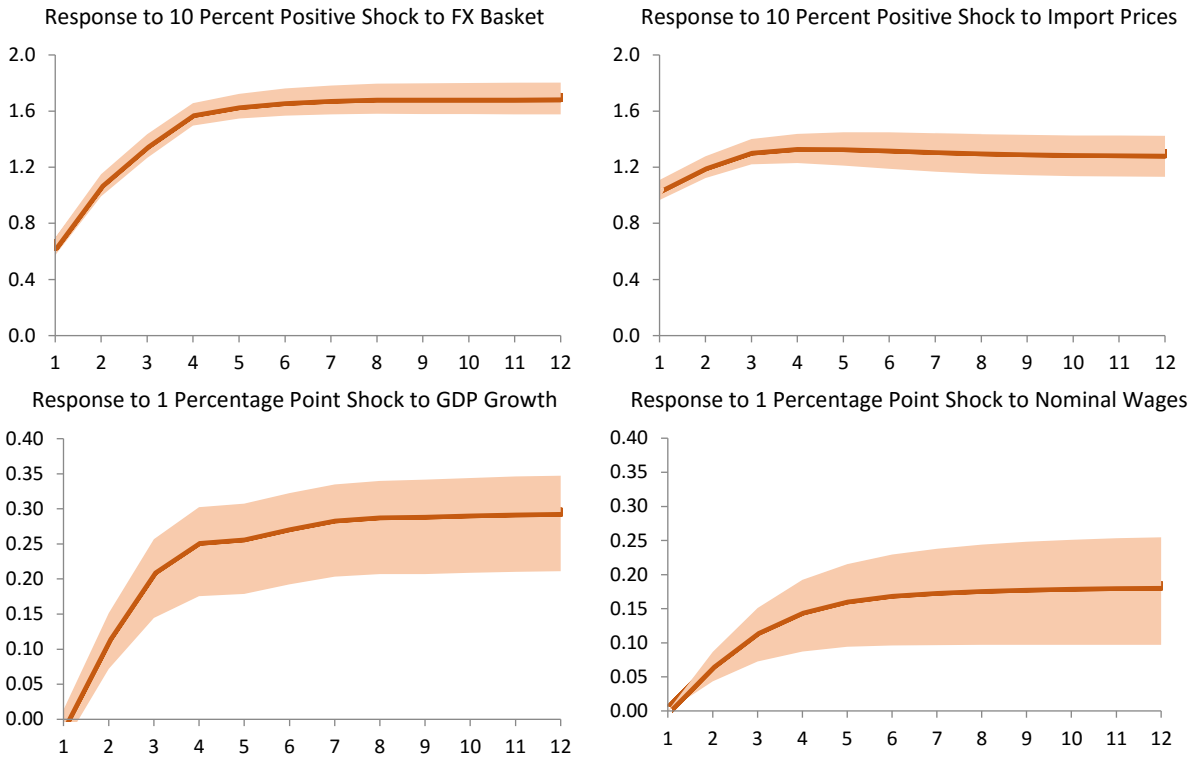
Figure 1: Response of Inflation to Key Macroeconomic Variables (Percentage Point)



Notes: The horizontal axes are quarters.
Source: Authors' calculation.

For a more complete analysis, in Figure 2, we show the pass-through effects on inflation in Turkey generated by using cumulative impulse response functions from the BVAR model. The accumulated pass-through coefficients are presented in a way that the size of each shock is designed for a convenient interpretation. The darker lines denote the median response of inflation to a shock corresponding to the 50th percentile. Meanwhile, the light-shaded interval shows the range of impulse responses corresponding to 35th and 65th percentiles of the distribution. The median impulse responses in fact reveal the key elasticities in Turkish economy regarding inflation, over the sample period. The details are also summarized in Table 1.

Figure 2: Cumulative Response of Inflation to Key Macroeconomic Variables (Percentage Point)



Notes: The horizontal axes are quarters. The darker lines denote the median response of inflation to a shock corresponding to the 50th percentile. Meanwhile, the light-shaded interval shows the range of impulse responses corresponding to 35th and 65th percentiles of the distribution.
Source: Authors' calculation.

Table 1: Summary of Findings: Impact of Shocks on CPI-D Inflation

	SPEED: How much of the total pass-through is completed (%)					**MAGNITUDE: Accumulated pass-through (% point)**			**UNCERTAINTY: 35th and 65th percentile of the accumulated IR distribution (% point)**
	Q1	**Q2**	**Q3**	**Q4**	**Q6**	**Q2**	**Q4**	**Q8**	**Q8**
10 % Shock to									
Exchange Rate	38	63	80	93	99	1.1	1.6	1.7	1.6-1.8
Import Prices	80	93	100	100	100	1.2	1.3	1.3	1.2-1.4
1 % Shock to									
GDP Growth	-	39	71	86	93	0.12	0.25	0.29	0.21-0.34
Nominal Wages	-	37	64	80	94	0.07	0.15	0.18	0.10-0.25

Given that the exchange rate is commonly recognized as one of the primary determinants of inflation in Turkey, we start with the response of inflation to exchange rate shock. The top left panel of Figure 2 depicts the response of inflation to a 10 percent shock to the exchange rate basket. As seen, a 10 percent depreciation of the Turkish lira against the exchange rate basket causes a 1.6 percentage point rise in inflation at the end of the first year. This impact rises to 1.7 points by the

end of the second year (Table 1). Thus, overall exchange rate pass-through to CPI-D inflation appears to be around 17 percent. When it comes to the speed of pass-through, we observe that approximately 40 percent of the pass-through is completed in the first quarter and 80 percent is completed in three quarters. Accordingly, we can assert that there is a remarkable short-run pass-through from exchange rates to inflation.

Findings of Kara and Öğünç (2012) indicate that the pass-through from the exchange rate to inflation under different models for the period covering 2002-2011 is 15 percent on average in one-year period and around 17 percent within a period of two years. Estimates based on a reduced from time-varying parameter Phillips curve model presented in Kara, Öğünç and Sarıkaya (2017) point out 18 percent pass-through for the exchange rate basket. Özmen and Topaloğlu (2017) adopts a disaggregated approach examining pass-through for CPI sub-groups and, with a bottom-up approach, documents that pass-through of exchange rate is about 17 percent on the aggregate CPI.[10] Hence, our results are broadly consistent with recent studies in the literature and suggest that there is no significant change in the average pass-through from exchange rates to domestic inflation over time.[11] Furthermore, our estimations suggest that the uncertainty pertaining to pass-through from exchange rates to inflation is quite low (Table 1). The upper and lower limits of 35th percentile and 65th percentile of impulse responses point to a range of 1.6-1.8 percentage points for the impact of a 10 percent shock to exchange rates on inflation at the end of two years.

We move to the impact of import prices on inflation in Turkey. The top right panel of Figure 2 presents the response of inflation to a 10 percent shock to import price in US dollar terms. Inflation increases by 1.3 percentage points by the end of two year when faced with a 10 percent positive shock to import prices. For a different sample period, findings of Kara and Öğünç (2012) and Yüncüler (2011) report a higher import price pass-through to inflation compared to our findings. On the other hand, time varying-parameter estimates of Kara, Öğünç and Sarıkaya (2017) show that there is a clear decline in import price pass-through in recent years toward 13 percent. Our results indicate that pass-through from import prices to inflation is faster than pass-through from exchange rates to inflation in the short term and most of the pass-through is completed in a relatively shorter time bracket (in the first two quarters). The distribution of impulse response function reveals that the

[10] It should be noted that all of these studies including this paper estimate the "average" historical effect. This average pass-through coefficient may vary according to the economic environment. A recent study by Kara, Öğünç, Özmen and Sarıkaya (2017) reveals that the magnitude and timing of this "average" effect may differ depending on the cyclical position of the economy (level of output gap) and on exchange rate expectations.

[11] Past studies comparing the exchange rate pass-through before and after the inflation targeting period (thereby transition to the floating rate regime in 2001), such as Kara and Öğünç (2008), Damar (2010) and Yüncüler (2011) document that both speed and extent of the pass-through from exchange rates to inflation has shown a marked decline. However, recent studies focusing the period after 2006 reveal relatively similar estimates.

uncertainty pertaining to pass-through from import prices to inflation is also low (Table 1). Taking into account the 10 percent shock, the upper and lower limits of 35th percentile and 65th percentile ranges between 1.2-1.4 percentage points for import prices at the end of two years.

Over the sample period, the exchange rate pass-through being stronger than import price pass-through points to the crucial role of exchange rates in pricing dynamics. Several explanations for this finding seem plausible: (i) The pricing behavior of foreign suppliers –either local currency pricing or producer currency pricing– may affect the response of import prices (denominated in USD dollar terms) to exchange rate movements. Besides, nominal exchange rate movements may also bring about income effects and changes in relative demand for goods, which also depends on various factors such as the degree of home-bias in spending. As discussed by Engel (2000), both pricing behavior of suppliers and real effects (shifts in demand) of nominal exchange rate fluctuations may influence import prices and its reflections on domestic inflation. In our model, accumulated response of import prices to exchange rate basket is found to be negative but statistically insignificant (Appendix C, Figure C1). This negative relationship, albeit statistically weak, between exchange rate and import prices, whether indicating an evidence on the presence of local currency pricing (from foreign exporters' point of view) to some extent or another mechanism, may partly explain the difference in the inflationary effects of the two variable. (ii) Although we control for the effects of pull factors for capital flows by including global growth and global risk variables in the model, exchange rate may still have information about push factors such as future prospects on the growth potential, political stability, institutional quality, etc., which may be captured by the exchange rate shock in our model. (iii) Exchange rate may play a broader role in pricing dynamics due to several structural issues regarding the Turkish economy. High import content of aggregate production in particular sectors, i.e. energy and chemicals, significant degree of liability dollarization due to external financing needs and resulting large current account deficit are the major factors for the exchange rate shocks to propagate over a wide spectrum of financial and real agents (banks, firms, households, etc.) in the economy. In Turkey, exchange rate not only serves as a means of storing value and hedge against inflation, but also has a critical role in shaping inflation expectations and general prospects for the medium and long-term performance of the economy. All in all, empirical evidence that we provide for a stronger pass-through of exchange rate on inflation, compared to that of import prices, indicates that the identified structural shocks to each variable may not only reflect production costs but also many other economic factors.

Next we turn to the question of how growth affects inflation. The bottom left panel of Figure 2 pictures the response of inflation to growth shock. Accordingly, a positive shock of 1 percentage points to the GDP growth causes a 0.25 percentage point rise in inflation at the end of the first year.

The impact edges up to 0.29 percentage point at the end of the second year (Table 1). That is, the bulk of the pass-through from economic activity to inflation is finalized within a year. Regarding the timing of initial impact, while the changes in the exchange rate and import prices have a contemporaneous effect on inflation, the estimations suggest that the effect of growth on inflation is lagged by one quarter. In addition to that, uncertainty for the impact of growth on inflation is higher compared to exchange rate and import prices. The upper and lower limits of 35th and 65th percentile of the impulse response distribution point to 0.21-0.34 percentage points for the impact of a 1 percentage point shock to growth on inflation. In that sense, the information content of the median estimates for the response of inflation to growth is rather limited compared to previous two shocks. We find a relatively low elasticity of inflation to economic growth with a wide uncertainty band, which may be indicating the need for a better identification of the source of the shocks. This point deserves a more detailed discussion: We do not differentiate between demand and supply shocks in our model, hence the identified shock can be interpreted as a combination of the two. Since theoretically, a positive demand shock is supposed to be inflationary whereas a positive supply shock is disinflationary, the response of inflation to GDP shocks reflect the past equilibrium conditions, shaped by the relative dominance of these two shocks.

Finally, we analyze how inflation reacts to shocks to the nominal wages. The bottom right panel of Figure 2 presents the response of inflation to a 1 percent positive shock to nominal hourly wages for non-agricultural workers. Accordingly, a 1 percent shock to nominal wages induces an increase in inflation by 0.15 percentage points at the end of the first year and by 0.18 percentage points at the end of the second year (Table 1). In this regard, nominal wage pass-through on inflation is estimated to be close to that from the exchange rate. Similar to that of economic activity, the effect of wages on inflation is observed with a one-quarter lag. Although the major impact is observed in the first year, the completion of the pass-through from wages to inflation takes longer than other macroeconomic variables considered. When it comes to uncertainty, wages take the lead. The response of inflation to wages has the highest uncertainty. The upper and lower limits of 35th and 65th percentile of impulse responses point to a range of 0.10-0.25 percentage points for the impact of a 1 percent shock to wages on inflation at the end of two years. In this perspective, the median estimates for the response of inflation to wages may be less informative compared to that of exchange rates and import prices. One explanation for uncertainty could be the presence of a high degree of informality in the labor market, i.e. the existence of informal employees, under-reporting wage payments by firms.[12] Hence, regarding the impact of a change in nominal wages on inflation,

[12] See OECD (2008) for a discussion on informal employment in Turkey in comparison to a selected group of countries.

e.g. a minimum wage adjustment, counting on the median estimate may be misleading. In order to make more clear inferences on the potential inflationary impact of wages, micro-level analysis considering the firms' tendency toward informal behavior could be more useful to assess total labor cost pressures in the general economy.

In this study, our main focus is on analyzing the impact of various drivers on inflation. Nonetheless the methodology we employ also provides an opportunity to observe the response of each variable to all others in a consistent manner. The full set of impulse responses are presented in the Appendix C. Not to divert attention from inflation, but to provide an insight on the soundness of our inflation analysis, we simply summarize the main findings of the remaining impulse responses. When economy is hit with an exchange rate shock, inflation rises and growth slows down while wages are unaffected. This suggests that over the sample period, a depreciation in Turkish lira weighs more on the cost channel than on the exports channel. When there is a shock to import prices in US dollar, inflation increases, wages remain stable and growth is hit negatively. Although the initial reaction of growth to import price shock is positive, the overall impact is clearly negative. This is in fact the result of our identification strategy where we control for foreign growth and global risk appetite as described in the previous section. With this strategy, an import price shock rightly translates as a cost shock on growth. In a nutshell, evaluating the impact of both shocks on growth, we can infer that economic activity is more adversely affected by an exchange rate shock than an import price shock. This finding reveals that the exchange rate has a major impact on both inflation and growth operating through distinct channels.

In case of a shock to economic growth, inflation and wages increase, with negligible impacts on exchange rate and import prices. When there is a shock to wages, inflation picks up, growth slows down, while the exchange rate and import prices are mostly unaffected. Finally, when there is a shock to inflation, growth is hit negatively while the wages increase. Out of this analysis, a striking result is the robust two-way relationship between the wages and inflation. Wage increases fuel inflation and inflation hits back wages and so on. This endogenous dynamic feedback mechanism might be among the major sources of the inflation inertia and the longstanding high inflation.

4. Conclusion

This paper aims to contribute to the understanding of inflation dynamics in Turkey by estimating a Bayesian VAR model with five variables: Exchange rate, import price, GDP, inflation and nominal wage. The question of how inflation reacts to changes in its major determinants is addressed through impulse response distributions providing information about not only the speed and magnitude of shock transmission but also the uncertainty surrounding the median estimates. We use Bayesian

approach to benefit from its small sample advantages and better identification facilities as well as its capacity to incorporate expert knowledge into the estimation process.

Our findings can be summarized as follows: Accumulated impact of exchange rate on inflation is estimated to be broadly consistent with earlier studies, as around 17 percent in two years. Exchange rate pass-through on inflation is found to be stronger than that of import prices. This finding indicates that import price and exchange rate shocks cannot be interpreted as similar nominal cost shocks; the identified shocks may differ due to various factors such as the pricing behavior of foreign exporters, economic fundamentals (pull and push factors) regarding capital flows as well as other transmission channels of exchange rate to the economy, i.e. balance sheet and expectations. These channels may amplify the inflationary effects of exchange rate movements beyond what direct cost-push effects would imply. The propagation of exchange rate and import price shocks on inflation takes place very quickly, while it is faster for the latter. Relatively slower pass-through of exchange rate shocks may be related to the role of other channels mentioned as well as the perceptions of price makers on the nature of exchange rate shocks, i.e. whether these shocks are perceived as temporary or permanent. Median responses of inflation to both shocks provide clear inference for policy as they are surrounded by relatively narrow uncertainty bands.

The estimated growth shock in the model is not identified as a demand or supply shock, rather it is a combination of both, depending on their relative dominance in driving economic activity historically. Shocks to economic growth are found to have significant but lagged effect on inflation. The transmission starts with one quarter lag in contrast to the contemporaneous pass-through of exchange rate and import prices. Nevertheless, inflationary impact of economic growth seems to be relatively low with a wide uncertainty band, which may be indicating the need for a better identification of the source of the shocks.

Nominal wage pass-through on inflation is estimated to be close to that from the exchange rate. Nevertheless, inflationary effect of a wage shock is spread over a longer time period in contrast to the rapid pass-through from other cost factors and the uncertainty interval around median estimate is quite sizeable. Hence, the information content of median response of inflation to wage shocks can be interpreted as limited. Employment policy of firms, particularly their tendency toward informal activities, may be highly influential on what would actually happen to *labor costs* to employers.

References

An, L. and Wang, J. (2012). "Exchange Rate Pass-through: Evidence Based on Vector Autoregression with Sign Restrictions", Open Economies Review, 23(2), 359-380.

Arias, J. E., Rubio-Ramirez, J. F., and Waggoner, D. F. (2014). "Inference Based on SVARs Identified with Sign and Zero Restrictions: Theory and Applications", Dynare Working Papers No. 30, CEPREMAP.

Baştürk N., Çakmaklı, C., Ceyhan, S. P. and van Dijk, H. K. (2014). "On the Rise of Bayesian Econometrics after Cowles Foundation Monographs 10, 14", Tinbergen Institute Discussion Paper, TI 2014-085/III.

Blake, A. and Mumtaz, H. (2012). "Applied Bayesian Econometrics for Central Bankers", Technical Handbook, No. 4, Centre for Central Banking Studies, Bank of England.

Canova, F. (2007). Methods for Applied Macroeconomic Research, Princeton University Press, Princeton.

Ca' Zorzi, M., H. Elke and Sanchez, M. (2007). "Exchange Rate Pass-Through in Emerging Markets", European Central Bank Working Paper No. 739.

Chib, S. (1995). "Marginal Likelihood from the Gibbs Output", Journal of the American Statistical Association 90(432), 1313-1321.

Damar, A. D. (2010). "Türkiye'de Döviz Kurundan Fiyatlara Geçiş Etkisinin İncelenmesi"(Analysis of Exchange Rate Pass-through to Prices in Turkey- available only in Turkish), Thesis of Central Bank Expert, June 2010.

Dieppe, A., Legrand, R. and van Roye, B. (2016). "The BEAR Toolbox", ECB Working Paper 1934, July 2016.

Engel, C. (2000). "Local-Currency Pricing and the Choice of Exchange-Rate Regime", European Economic Review, 44(8), 1449-1472.

Faruqee, H. (2004). "Exchange Rate Pass-Through in the Euro Area: The Role of Asymmetric Pricing Behavior", IMF Working Paper No. 04/14.

Fosu, A. K. and Huq, S. (1988). "Price Inflation and Wage Inflation: A Cause-Effect Relationship?", Economics Letters, 27(1), 35-40.

Haavelmo T. (1944). "The Probability Approach in Econometrics", Econometrica 12, 1–115.

Hahn, E. (2003). "Pass-Through of External Shocks to Euro Area Inflation", European Central Bank Working Paper No. 243.

Hildreth, C. (1963). "Bayesian Statisticians and Remote Clients", Econometrica 31(3), 422-438.

Kara, H and Öğünç, F. (2008). "Inflation Targeting and Exchange Rate Pass-Through: The Turkish Experience", Emerging Markets Finance and Trade 44(6), 52-66.

Kara, H. and Öğünç, F. (2012). "Pass-through from Exchange Rates and Import Prices to Domestic Prices (in Turkish)", İktisat İşletme ve Finans 27(317), 09-28.

Kara, H., Öğünç, F., Özmen U. and Sarıkaya, Ç. (2017). "Exchange Rate Pass-Through: Is There a Magical Coefficient?", CBRT Blog, 20 January 2017.

Kara, H., Öğünç, F., and Sarıkaya, Ç. (2017). "Inflation Dynamics in Turkey: A Historical Accounting", Research Notes in Economics, 2017-03.

Litterman, R. (1986). “Forecasting with Bayesian Vector Autoregressions: Five Years of Experience”, Journal of Business and Economic Statistics 4(1), 25-38.

McCarthy, J. (2007). “Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies”, Eastern Economic Journal 33(4), 511-537.

OECD (2008). “Declaring Work or Staying Underground: Informal Employment in Seven OECD Countries”, Chapter 2, OECD Employment Outlook.

Özmen, M. U. and Topaloğlu, M. (2017). “Disaggregated Evidence for Exchange Rate and Import Price Pass-through in the Light of Identification Issues, Aggregation Bias and Heterogeneity”, CBRT Working Paper 17/08.

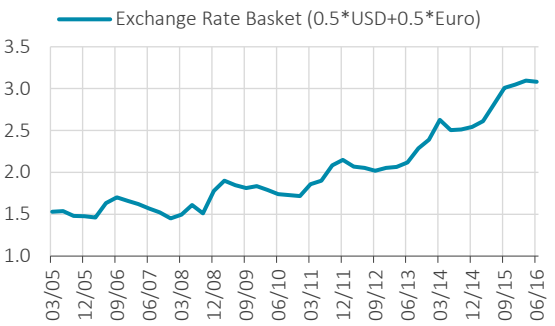
Qin, D. (1996). “Bayesian Econometrics: The First Twenty Years”, Econometric Theory 12(3), 500-516.

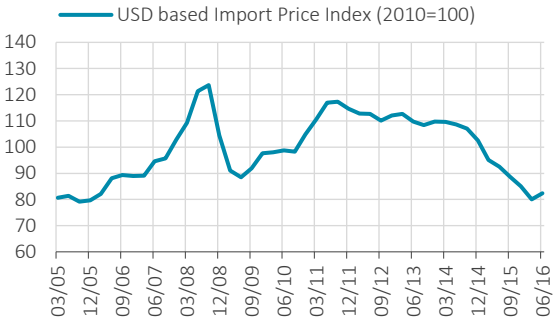
Trehan, B. (1986). “Oil Prices, Exchange Rates and the U.S. Economy: An Empirical Investigation”, Federal Reserve Bank of San Francisco Economic Review No. 4 (Fall), 25–43.

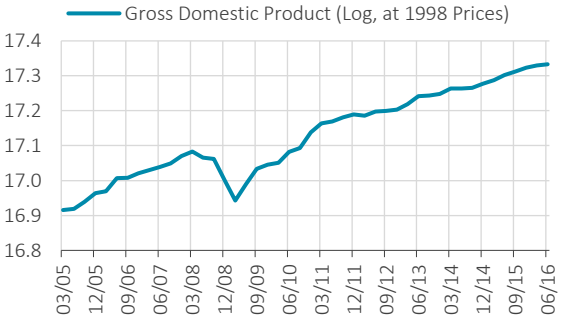
Yüncüler, Ç. (2011). “Pass-Through of External Factors into Price Indicators in Turkey”, Central Bank Review 11, 71-84.

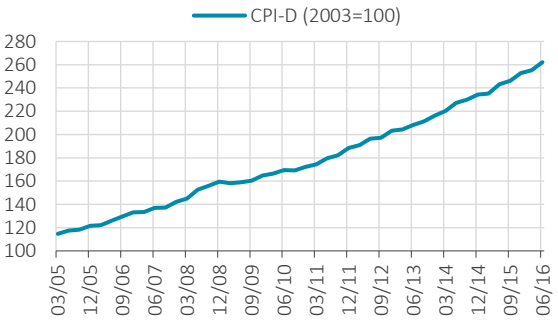
Appendix A

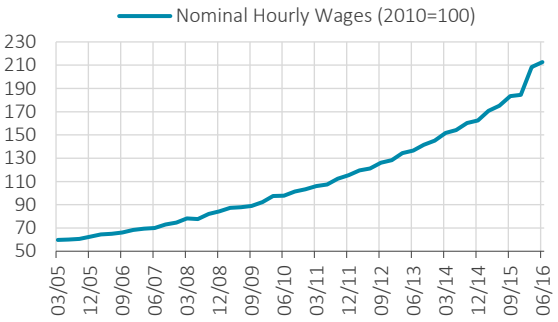
Raw Data



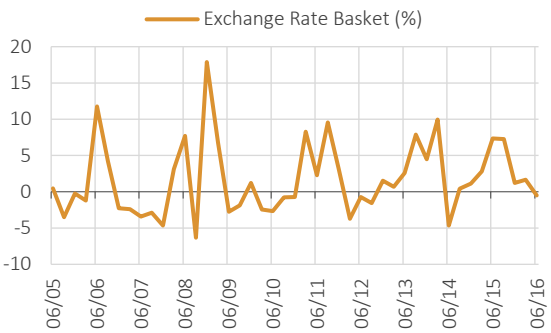


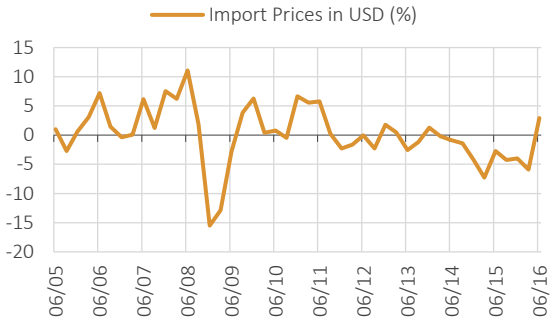


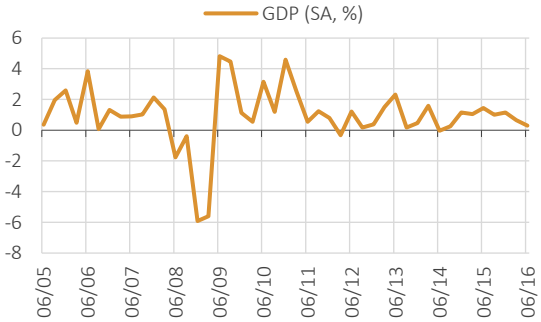


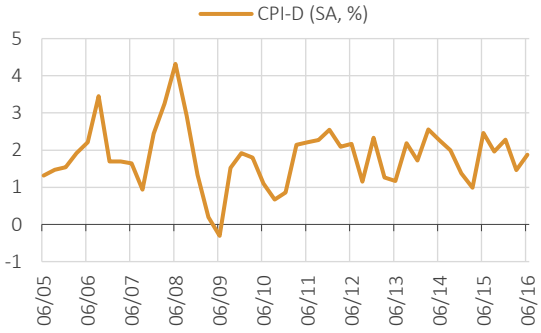


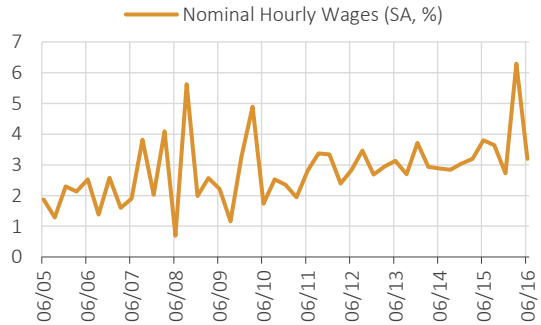
Transformed Data

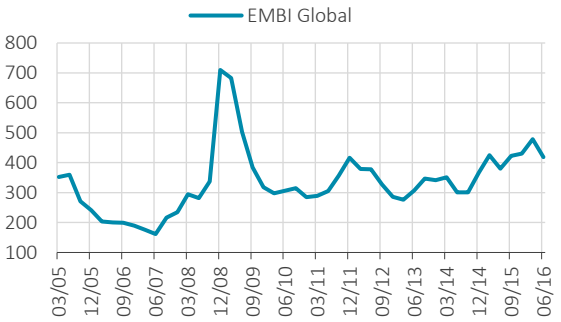


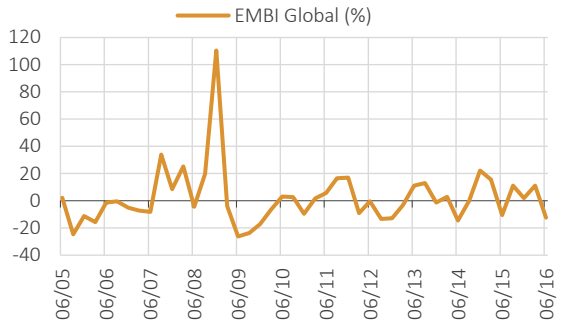


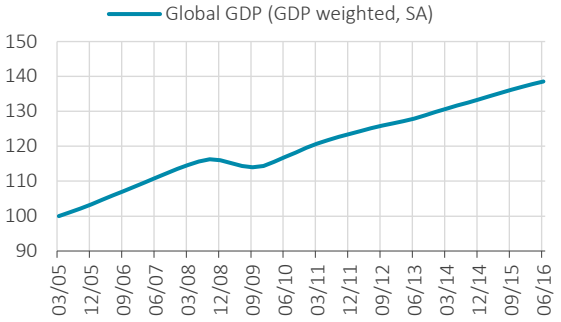


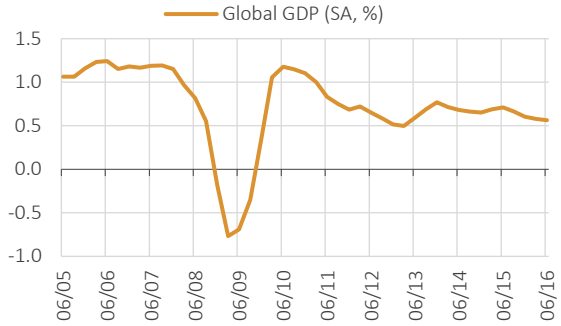


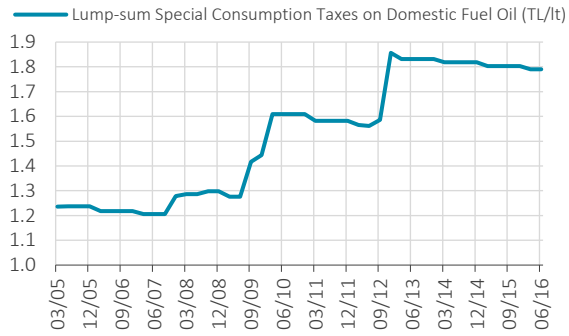


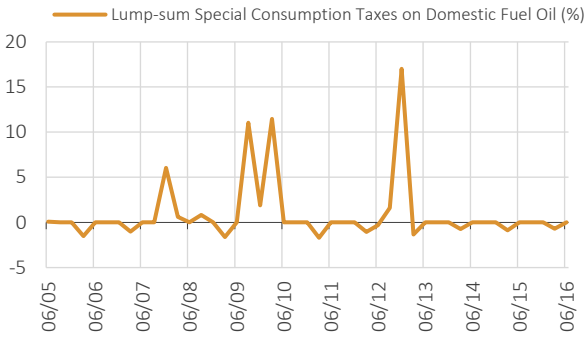

EMBI Global
800
700
600
500
400
300
200
100
03/05
12/05
09/06
06/07
03/08
12/08
09/09
06/10
03/11
12/11
09/12
06/13
03/14
12/14
09/15
06/16

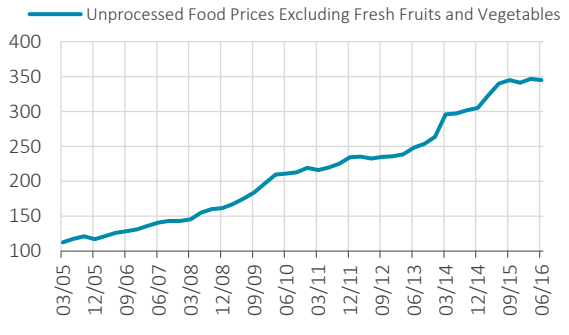

EMBI Global (%)
120
100
80
60
40
20
0
-20
-40
06/05
06/06
06/07
06/08
06/09
06/10
06/11
06/12
06/13
06/14
06/15
06/16

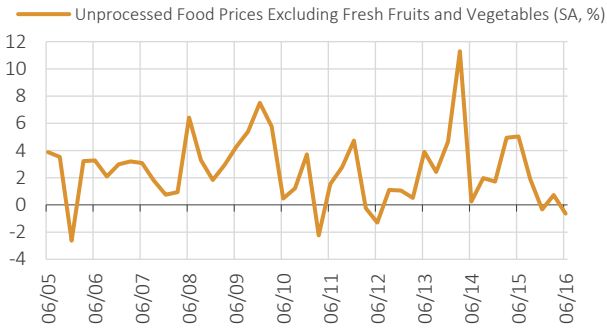

Global GDP (GDP weighted, SA)
150
140
130
120
110
100
90
03/05
12/05
09/06
06/07
03/08
12/08
09/09
06/10
03/11
12/11
09/12
06/13
03/14
12/14
09/15
06/16


Global GDP (SA, %)
1.5
1.0
0.5
0.0
-0.5
-1.0
06/05
06/06
06/07
06/08
06/09
06/10
06/11
06/12
06/13
06/14
06/15
06/16


Lump-sum Special Consumption Taxes on Domestic Fuel Oil (TL/lt)
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
03/05
12/05
09/06
06/07
03/08
12/08
09/09
06/10
03/11
12/11
09/12
06/13
03/14
12/14
09/15
06/16


Lump-sum Special Consumption Taxes on Domestic Fuel Oil (%)
20
15
10
5
0
-5
06/05
06/06
06/07
06/08
06/09
06/10
06/11
06/12
06/13
06/14
06/15
06/16

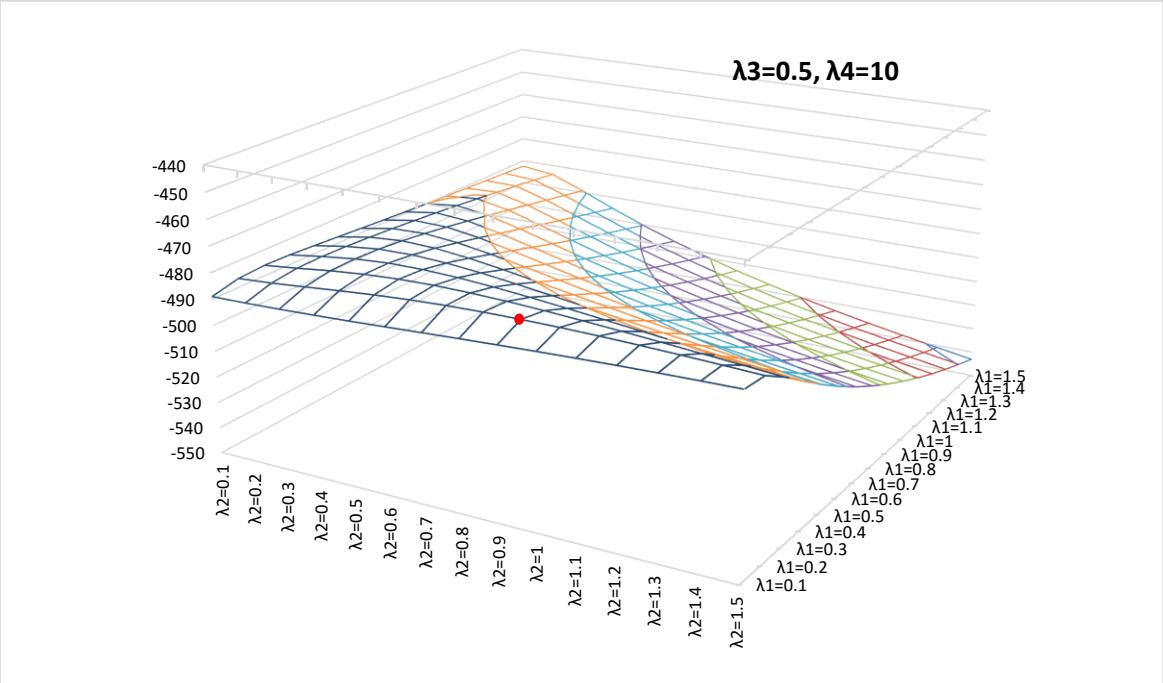

Unprocessed Food Prices Excluding Fresh Fruits and Vegetables
400
350
300
250
200
150
100
03/05
12/05
09/06
06/07
03/08
12/08
09/09
06/10
03/11
12/11
09/12
06/13
03/14
12/14
09/15
06/16


Unprocessed Food Prices Excluding Fresh Fruits and Vegetables (SA, %)
12
10
8
6
4
2
0
-2
-4
06/05
06/06
06/07
06/08
06/09
06/10
06/11
06/12
06/13
06/14
06/15
06/16

Appendix B

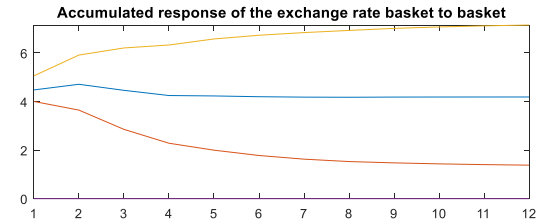
By using Chib (1995) algorithm, we perform a grid search for the following possible values: λ_1= 0.1:0.1:1.5, λ_2 = 0.1:0.1:1.5, λ_3 = 0.5:0.5:2 and λ_4 = 10, which yields 900 different combinations. Below figure shows the combination that maximizes the empirical marginal likelihood, that is λ_1=0.2, λ_2=0.9, λ_3=0.5 and λ_4=10. Results for other combinations are available upon request.

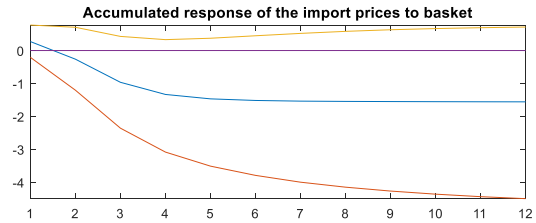
Figure B1. Marginal Likelihood Results for Different λ Combinations

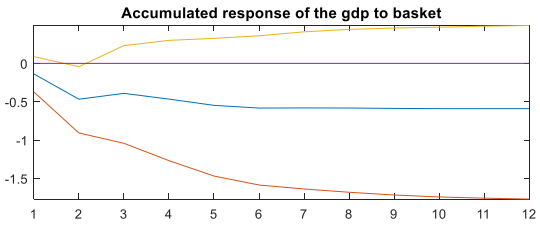


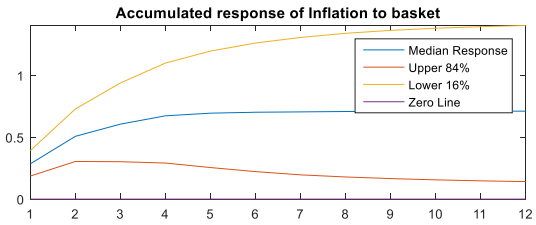
Appendix C

Figure C1. Response of Macroeconomic Variables to a Shock to Exchange Rate Basket









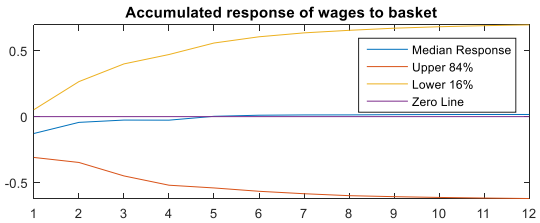
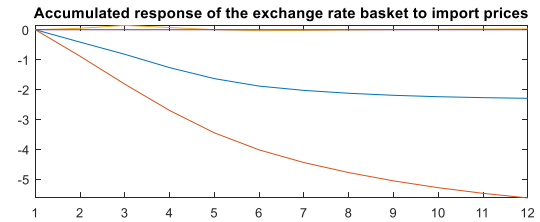
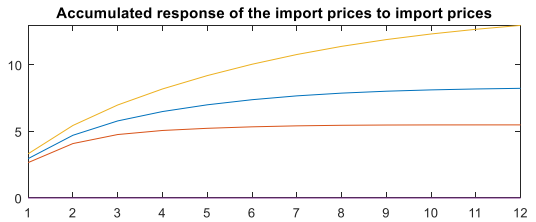
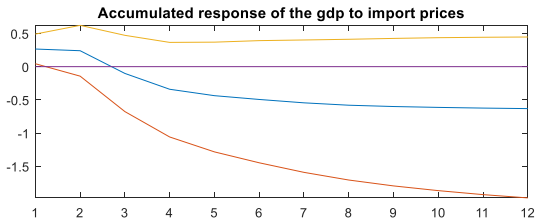
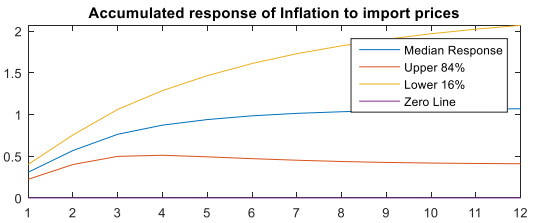


Figure C2. Response of Macroeconomic Variables to a Shock to Import Prices









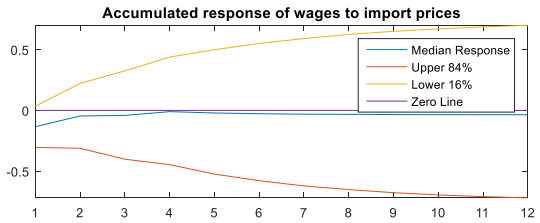


Figure C3. Response of Macroeconomic Variables to a Shock to Growth

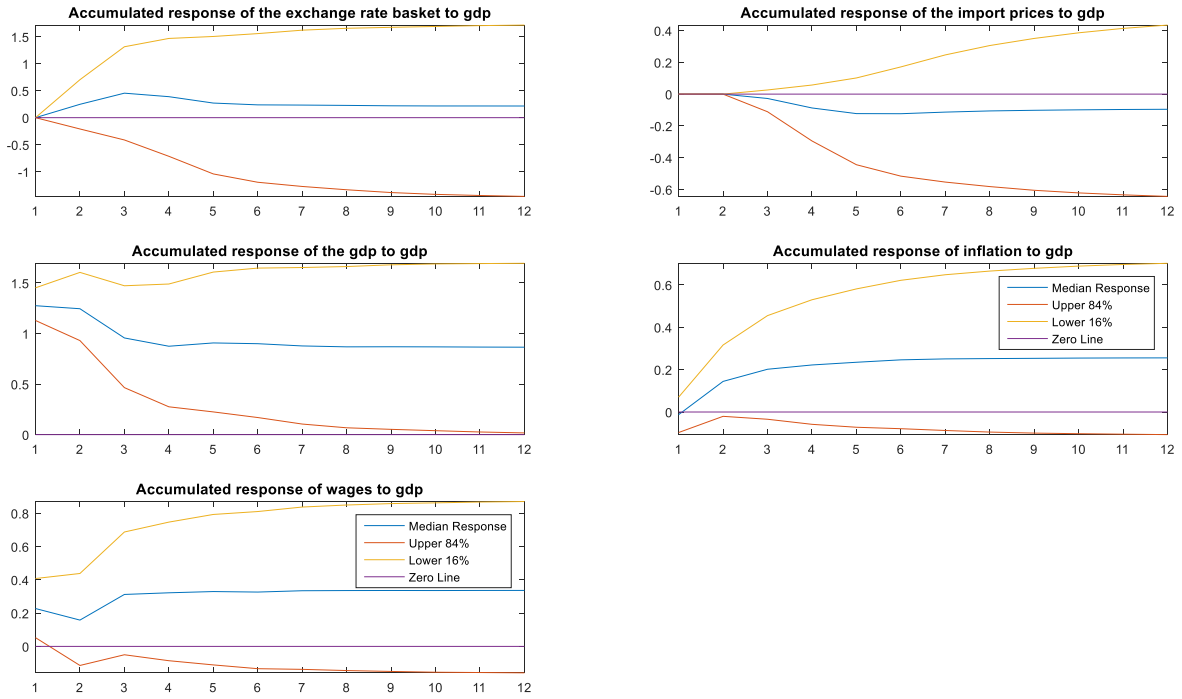


Figure C4. Response of Macroeconomic Variables to a Shock to Wages

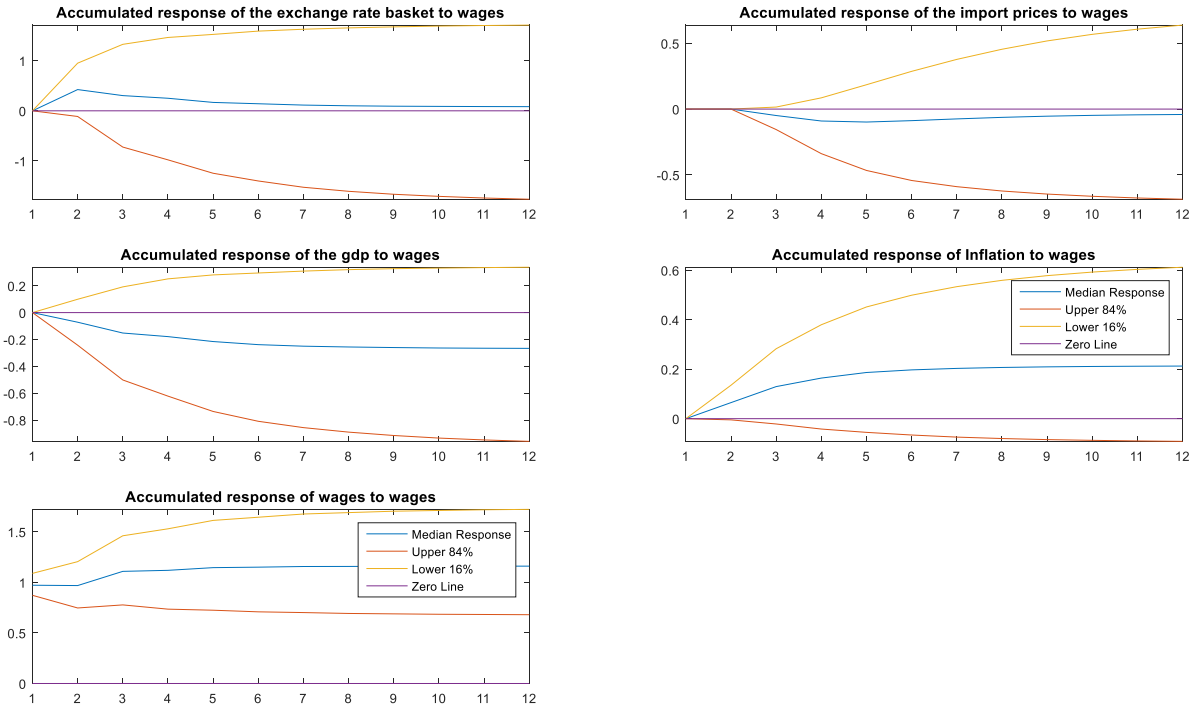
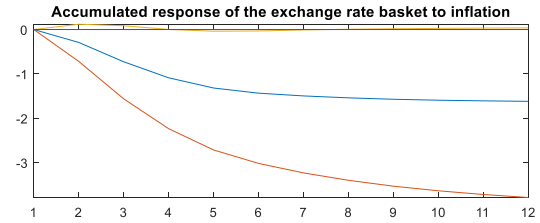
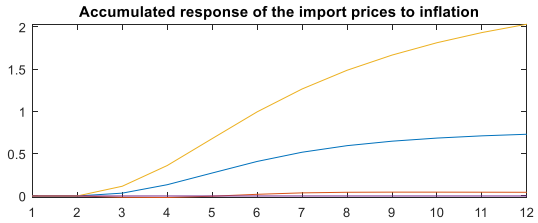
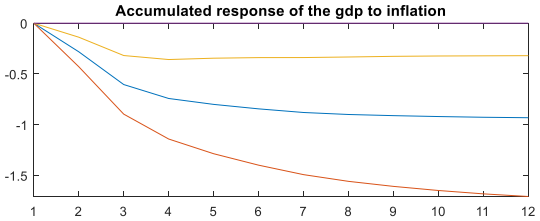
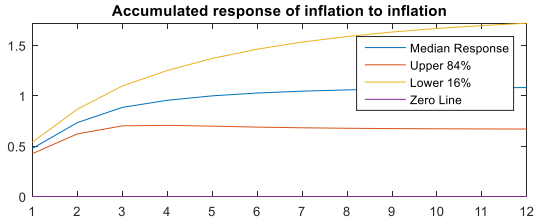


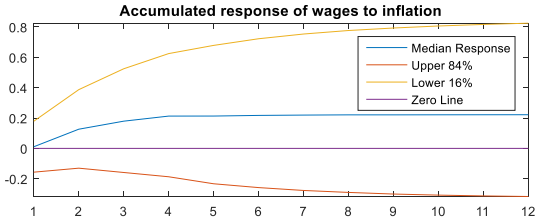
Figure C5. Response of Macroeconomic Variables to a Shock to Inflation











Central Bank of the Republic of Turkey

Recent Working Papers

The complete list of Working Paper series can be found at Bank's website

(**http://www.tcmb.gov.tr**)

The Effect of Fed's Future Policy Expectations on Country Shares in Emerging Market Portfolio Flows
(Zelal Aktaş, Yasemin Erduman, Neslihan Kaya Ekşi Working Paper No. 18/09, March 2018)

Evolution of the University Wage Premium in Turkey: 2004-2015
(Okan Eren Working Paper No. 18/08, March 2018)

Multivariate Filter for Estimating Potential Output and Output Gap in Turkey
(Selen Andıç Working Paper No. 18/07, February 2018)

Quantifying Uncertainty and Identifying its Impacts on the Turkish Economy
(Evren Erdoğan Coşar, Saygın Şahinöz Working Paper No. 18/06, February 2018)

Forecasting Industrial Production and Inflation in Turkey with Factor Models
(Mahmut Günay Working Paper No. 18/05, February 2018)

Türkiye Ekonomisi için Güncellenmiş Doğrudan Çıktı Açığı Göstergesi
(Evren Erdoğan Coşar Çalışma Tebliği No. 18/04, Şubat 2018)

Türkiye İçin İthalat Talep Fonksiyonu
(Olcay Yücel Çulha, Okan Eren, Ferya Öğünç Çalışma Tebliği No. 18/03, Şubat 2018)

Export Behavior of Turkish Manufacturing Firms Under Crises
(Aslıhan Atabek Demirhan, Hakan Ercan Working Paper No. 18/02, January 2018)

Foreign Currency Borrowing, Exports and Firm Performance: Evidence from a Currency Crisis
(Spiros Bougheas, Hosung Lim, Simona Mateut, Paul Mizen, Cihan Yalçın Working Paper No. 18/01, January 2018)

The Empirical Content of Season-of-Birth Effects: An Investigation with Turkish Data
(Huzeyfe Torun, Semih Tümen Working Paper No. 17/21, December 2017)

Do Subsidized Export Loans Increase Exports?
(Yusuf Emre Akgündüz, Süleyman Hilmi Kal, Huzeyfe Torun Working Paper No. 17/20, December 2017)

A Financial Connectedness Analysis for Turkey
(Ferhat Çamlıca, Didem Güneş, Etkin Özen Working Paper No. 17/19, December 2017)

Production Fragmentation and Factor Price Convergence
(Hülya Saygılı Working Paper No. 17/18, August 2017)

Evidence for the Explosive Behavior of Food and Energy Prices: Implications in Terms of Inflation Expectations
(Aytül Ganioğlu Working Paper No. 17/17, July 2017)

Regional Economic Growth in Turkey: The Effects of Physical, Social and Financial Infrastructure Investments
(Hülya Saygılı, K. Azim Özdemir Working Paper No. 17/16, July 2017)

Forecasting the Growth Cycles of the Turkish Economy
(H. Murat Özbilgin Working Paper No. 17/15, June 2017)

Home-ownership, Housing Demand and Household Wealth Distribution in Turkey
(Evren Ceritoğlu Working Paper No. 17/14, June 2017)

Credit Cycles and Capital Flows: Effectiveness of the Macroprudential Policy Framework in Emerging Market Economies
(Salih Fendoğlu Working Paper No. 17/13, May 2017)

Are Macroprudential Policies Effective Tools to Reduce Credit Growth in Emerging Markets?
(F. Pınar Erdem, Etkin Özen, İbrahim Ünalmış Working Paper No. 17/12, May 2017)

Volatility: As a Driving Factor of Stock Market Co-movement
(Ali Gencay Özbekler Working Paper No. 17/11, May 2017)