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Nominal stylized facts of Turkish business cycles

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Abstract

This paper investigates the basic nominal stylized facts of business cycles in Turkey using monthly data from 1978:1 to 1997:7 and the methodology suggested by Kydland and Prescott (1990). In particular, correlations of the cyclical part of the data are found using two different filtering techniques, namely the Hodrick-Prescott filter and the twelve-month percentage change.Next the robustness of the results across these two techniques is evaluated. No clear-cut pattern emerges for the various measures of money. Price, inflation and interest rate series are all countercyclical giving support to a supply-driven model for the Turkish economy.

1. Introduction

The emergence of the Real Business Cycle (henceforth RBC) Theory initiated by Kydland and Prescott (1982) and Long and Plosser (1983) expedited research on business cycles since the early 1980s. RBC models are given the name *real business cycles* because they are supply-determined neoclassical growth models that attribute the cyclical behavior of aggregate economic activity to serially correlated technology shocks. The major impact of the RBC literature has been to propose a new methodology for macroeconomics. This has been of two types: empirical description of business cycle phenomenon and the construction of a general equilibrium model consistent with the empirical description. The empirical description of the business cycle phenomenon refers to the determination of

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business cycle facts that is defined as the statistical properties of the co-movements of deviations from trend of various economic aggregates with those of real output. RBC models have performed surprisingly well in imitating the statistical properties of major macroeconomic aggregates.

RBC models abstract from monetary phenomena and prices and cannot address questions regarding the nominal side of the economy. According to Mankiw (1990), one of the major controversies of the RBC models is that money and prices do not matter. Recent empirical research finds somewhat mixed results concerning the role of money and prices. King and Plosser (1984) report evidence in favor of the view that monetary changes do not have an important role as a source of real output fluctuations for the U.S. economy. Kydland and Prescott (1990) present empirical evidence suggesting countercyclical prices and procyclical but lagging monetary base for the U.S. economy. Danthine and Donaldson (1993), Fiorito and Kollintzas (1994), Chadha and Prasad (1994) and Kim (1996) find non-systematic findings for the role of money, countercyclical prices but procyclical inflation. This paper investigates the effects of changes in nominal variables on aggregate economic activity for Turkey adopting the methodology introduced by Kydland and Prescott (1990).

Section 2 provides information about the data and methodology. Nominal facts for the Turkish economy are presented at Section 3. Section 4 concludes.

2. Data and methodology

Our data are from the internet database of Central Bank of Turkey, the monthly data bank of Özmucur (1992) and International Currency Analysis Yearbook. Majority of the monthly series at the Central Bank of Turkey start from 1986. Using the approach suggested by Tunalı (1995) we combined the data at the Central Bank with the monthly data bank reported by Özmucur (1992). Monthly Industrial Production Index, available for the period January 1978 - June 1997, is used as a proxy for aggregate economic activity. The money measures employed are Central Bank Money (M0), money easily used in transactions (M1), the broad definition of money (M2), and the broad definition including the foreign exchange denominated deposits (M2Y). All monetary measures and prices are available during the January 1978 - July 1997 period except for M2Y which starts from January 1985, and the treasury bill rate which is available after 1987. The exchange rate measure available until 1983 is the black market TL/USD rate from International Currency Analysis Yearbook while for the post-1983 period, the Central Bank's buying rate is used. The three-month Treasury bill rate is calculated by the author.

All data were originally seasonally unadjusted. The Multiplicative X-11 method of the US Bureau of Census is used to seasonally adjust the data except for the inflation and the Treasury bill rates for which the additive version of X-11 was used. After seasonal adjustment, the natural logarithms of the series are taken and the series are detrended.

We follow the standard practice of the RBC literature and adopt the definition of business cycles by Lucas (1977) as deviations of aggregate real output from its smoothed trend where the smoothed trend represents the growth component of a variable. We make use of two different detrending techniques namely the Hodrick-Prescott (henceforth HP) filter (see Prescott, 1986) and the 12-month percentage change filter.

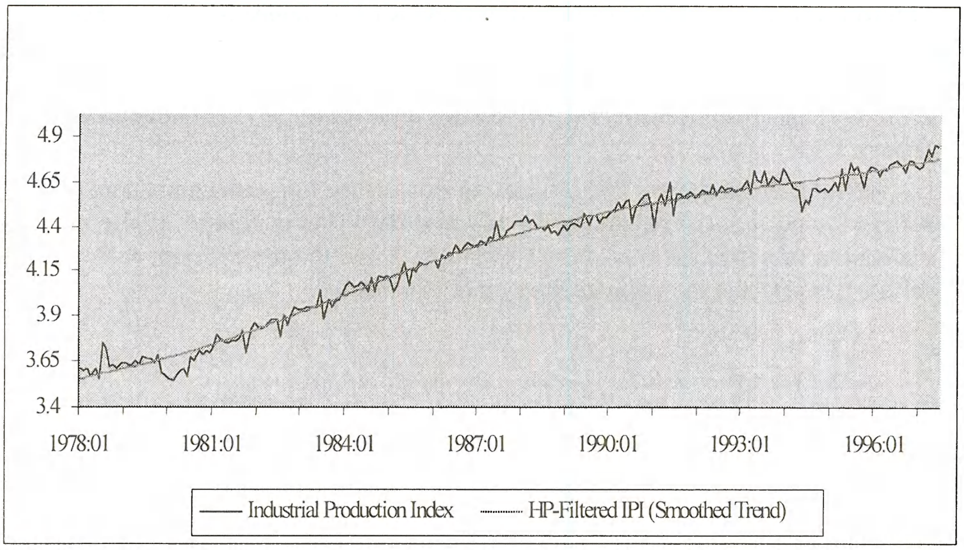
HP filter is a high pass linear filter that extracts the long-run component of the series leaving it stationary up to the fourth order. This method uses the partial realization of a stochastic process Y of length T and the trend component of the series, τ, is selected to minimize the sum of squares

$$\sum_{t=1}^{T} (Y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2$$

where the first term is the sum of the squared deviations from the trend, and the second term is the multiple λ of the sum of squares of the trend component's second differences. This second term penalizes variations in the growth rate of the trend component, the penalty increasing with the value of λ. For monthly data, we use $\lambda = 129{,}600$ as suggested in literature. Figure 1 depicts an illustration of this HP filter using monthly seasonally adjusted Industrial Production Index in natural logarithm. The HP filtering technique, however, is not free of shortages. King and Rebelo (1993) and Cogley and Nason (1995) criticize the method of HP filtering technique on the grounds that it may cause spurious cyclical behavior and may change measures of persistence and co-movement. They also state that the HP filter, which is a high-pass filter when the data is trend-stationary, does not operate like a high-pass filter in the case of difference stationary data series. On the other hand, Baxter and King (1995) and Krause and Serletis (1996) argue that results obtained using the HP filter are reasonably robust across business cycle filters. In order to get around possible problems associated with the HP filtering technique, we employ another filter, namely the 12-month percentage change, and evaluate the robustness of the results across these two techniques.

Figure 1

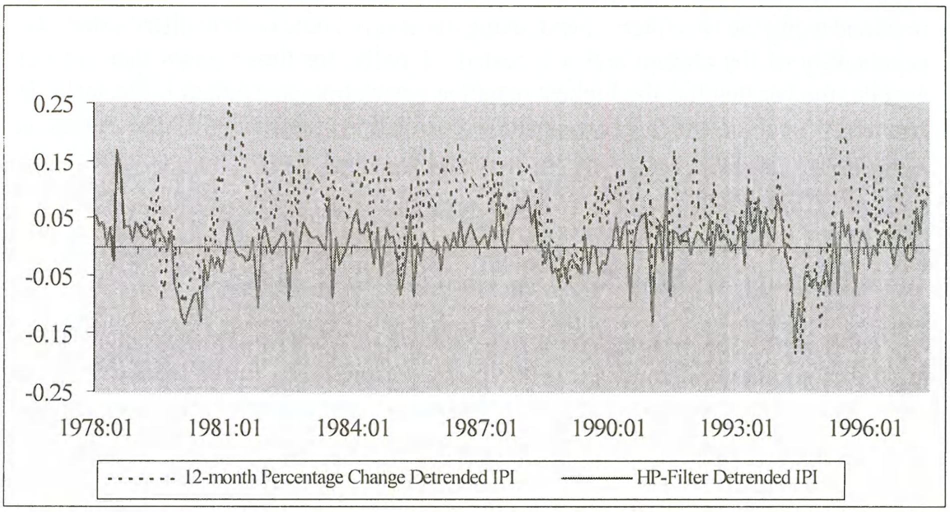
Industrial Production Index and HP Filtered IPI



A variety of unit root tests are employed and the results suggest that except for the inflation rate series, all series are level and trend nonstationary. Ercoşkun and Metin (1996) detect unit roots at seasonal frequencies as well as the long-run frequency for the monthly Turkish macroeconomic aggregates they analyze. A natural way to eliminate possible stochastic seasonality effects inherent in the data is to take twelve-month differences of the series. Since the series are in natural logarithms, this detrending technique corresponds approximately to taking twelve-month percentage changes of the data. An illustration of the detrended series using these two techniques is given in Figure 2.

Figure 2

Changes in Detrended IPI and HP Filtered Detrended IPI



After obtaining the cyclical component of the series using the two detrending techniques described above, the next step is to describe empirically nominal business cycle facts for Turkey. This consists of reporting the degree of co-movement of the cyclical components of the nominal series with that of the cyclical component of the Industrial Production Index. The degree of co-movement is measured with the correlation coefficient *R(j)* where $j \varepsilon (0, \pm 1, \pm 2, ..., \pm 6)$. The chosen series is said to be leading, synchronous, or lagging the cycle of industrial production if the absolute value of *R(j)* is maximum for a negative, zero or positive j, respectively. If the contemporaneous correlation, *R(0)*, between the series and the industrial production is positive, zero or negative, the series is said to be procyclical, acyclical or countercyclical, respectively. The next test is to determine whether the chosen series is acyclic or not. If the statistic *R* denotes the correlation coefficient of a random sample from the bivariate normal distribution, then the random variable $W = 1/2 \ln ((1+R / (1-R))$ has an approximate normal distribution with mean $1/2 \ln [(1+\rho)/(1-\rho)]$ and the standard deviation of $\sqrt{1/(n-3)}$. Thus using the contemporaneous correlation, *R(0)*, between the series and the IPROD, one can test whether the series is acyclical or not (H_0: $\rho=0$) using the aforementioned distribution. If $|R(0)| \leq 0.20$ then the series is said to be acyclic. The cutoff point

0.20 was chosen because it corresponds in the samples (0.178 for the t-bill rate, 0.169 for M2Y and 0.133 in all other series) to the value required to reject the null hypothesis at the 5% level of significance.

To recapitulate, the methodology consists of three sequential stages. First the cyclical component of each of the seasonally adjusted series in our data set is obtained using the two filters. Next, using the approximate normal distribution, the acyclicality of the chosen series is tested. Finally, for those series that are not acyclic, the lag that has the highest negative correlation coefficient if the series is countercyclical or the highest positive correlation coefficient if the series is procyclical is picked to see if the series is leading, synchronous or lagging the cycle of industrial production.

3. Nominal stylized facts for the Turkish economy

Table 1 reports findings of series that are seasonally adjusted, in natural logarithm and detrended using the HP-filtering technique. In the second column the percentage standard deviation of each of the variable with the longest available sample period is presented. The first row gives the autocorrelation function of the Industrial Production Index and the rest of the rows give cross correlations (contemporaneous and at lags and leads through six months) of this series with the nominal monetary aggregates and prices. We do not report results for sub-periods since the smoothed trend should take care of any structural breaks inherent in the data.

Volatility measure of the series reveal that quasi-money, exchange rate and the Treasury bill rate series are more volatile than others. We see that the autocorrelation function of industrial production reveals a very low persistence of output fluctuations about its trend. The value 0.38, although significant, is lower than the findings for the G7 countries reported by Fiorito and Kollintzas (1994). They report first-order autocorrelations at the range 0.85 to 0.55, the highest for the U.S. and the lowest for the U. K. economy.

Alternative money supply measures including "quasi-money" definitions such as M2Y-M2 and M2-M1 series are all acyclical with the only exception of M2Y, which is countercyclical and lags the Industrial Production Index by three to four months. This finding is consistent with the view of Kydland and Prescott (1986, 1990) that technology shocks cause aggregate fluctuations while nominal variables do not matter. Danthine and Donaldson (1993) and Gavin and Kydland (1996) argue that monetary aggregates do not yield robust results due to the wide range of monetary policies implemented and the shifts in the money supply rules. This argument may be especially valid for Turkey because starting with the five-year

Table 1

Correlations of HP-Filtered Nominal Variables with HP-Filtered Industrial Production

		Coefficient of Industrial Production Index with												
Variable[*], X	Volatility (% s. d.)	X_{t-6}	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}	X_{t+6}
IPROD[**]	4.90	0.20	0.25	0.20	0.28	0.42	0.38	1.00	0.38	0.42	0.28	0.20	0.25	0.20
M0	8.46	0.01	0.02	0.07	0.09	0.09	0.06	-0.03	-0.02	-0.06	-0.08	-0.08	-0.12	-0.11
M1	6.76	0.09	0.07	0.14	0.10	0.09	0.06	-0.10	-0.11	-0.24	-0.22	-0.28	-0.29	-0.30
M2	8.17	0.27	0.23	0.23	0.17	0.13	0.06	-0.04	-0.11	-0.21	-0.22	-0.26	-0.27	-0.27
M2Y	5.62	0.13	0.10	0.07	-0.02	-0.11	-0.21	-0.31	-0.34	-0.44	-0.44	-0.45	-0.43	-0.41
M2-M1	13.84	0.28	0.25	0.23	0.19	0.15	0.10	0.05	-0.01	-0.08	-0.10	-0.12	-0.12	-0.15
M2Y-M2	13.46	-0.12	-0.07	-0.09	-0.10	-0.11	-0.08	-0.05	0.02	0.04	0.04	0.06	0.09	0.12
CPI	8.34	-0.13	-0.17	-0.23	-0.31	-0.36	-0.42	-0.46	-0.48	-0.49	-0.49	-0.46	-0.47	-0.46
WPI	7.23	-0.09	-0.14	-0.20	-0.28	-0.34	-0.42	-0.47	-0.49	-0.50	-0.48	-0.44	-0.44	-0.44
INFCPI	2.30	-0.19	-0.18	-0.18	-0.21	-0.30	-0.19	-0.26	-0.13	-0.11	-0.06	0.02	0.09	0.00
INFWPI	2.54	-0.14	-0.16	-0.14	-0.19	-0.27	-0.19	-0.24	-0.16	-0.09	-0.02	0.05	0.11	0.02
FXR	10.59	-0.20	-0.24	-0.25	-0.33	-0.40	-0.50	-0.51	-0.49	-0.47	-0.38	-0.31	-0.29	-0.23
TBILLR	12.64	-0.10	-0.14	-0.21	-0.21	-0.33	-0.36	-0.36	-0.30	-0.16	-0.06	0.07	0.23	0.20

[*] Monthly data from sample period 1978:01-1997:07 except for M2Y and TBILLR that are available after 1985:01 and 1987:01 respectively. All series except for the inflation and 3-month treasury bill rates are first seasonally adjusted using X-11 multiplicative adjustment method, and then linearized by taking the natural logarithm. Inflation and the treasury bill rates are seasonally adjusted using X-11 additive adjustment method.

[**] For the Industrial Production Index only, reported numbers are the autocorrelations.

development plans in 1963, monetary policy has been subordinate to fiscal policy since public sector borrowing has been met by the Central Bank. Also, during the 1980s financial liberalization took place and new financial instruments were introduced in the financial markets. Krause and Serletis (1996) find acyclic monetary aggregates for the U.S. economy whereas Kydland and Prescott (1990) report procyclical M0 and M1.

The Wholesale Price Index, the Consumer Price Index, the inflation rates derived from these, the foreign exchange rate and the interest rate are all found to be countercyclical. In terms of timing, the price level series lag the cycle by two months, inflation rates lead the cycle by two months, Treasury bill rates lead by one-month and the foreign exchange rate is synchronous. The findings that both price level series and the inflation series are countercyclical with the industrial production cycle and monetary aggregates are acyclic suggests a supply-driven economic model for the Turkish economy rather than a demand-driven one. Countercyclical prices are also reported by Kydland and Prescott (1990) and Serletis and Krause (1996) for the U.S. economy, Danthine and Donaldson (1993) and Fiorito and Kollintzas (1994) for the G-7 countries, Austria, Australia, South Africa and Switzerland, and Kim (1996) for Korea and Taiwan. Countercyclical inflation rates, however, is not a widely observed phenomenon (see Chadha and Prasad (1994) and Kim (1996)).

The three-month Treasury bill rate also turns out to be countercyclical. This finding is also particular to Turkey since Krause and Serletis (1996) and Danthine and Donaldson (1993) report procyclical short-term interest rates and no systematic relation vis-à-vis long-term rates for eleven countries. Countercyclical behavior of nominal interest in Turkey may be suggestive of a strong crowding out effect of government consumption. Also, for a high inflation country like Turkey with high uncertainty, three-month interest rate may be regarded as a long-term rate.

Table 2 provides results using series that are seasonally adjusted, in natural logarithm and detrended using twelve-month percentage change filter. The results are identical except for the minor difference that the Treasury bill rate lags the cycle of industrial production by one month rather than being synchronous. This observation is supportive of the view that that results obtained using the HP filter are reasonably robust across business cycle filters.

One possible criticism of this research may arise due to the importance of the agricultural sector in Turkey. Since the Industrial Production Index excludes agricultural production, can it be considered to be a good indicator of aggregate economic activity? As a remedy to this problem, bearing in mind that monthly GNP/GDP figures are not available for Turkey, the same analysis is repeated using monthly Turkish import data in U.S. dollars instead of the Industrial Production Index. Tables 3 and 4 report cross correlation results using imports. There are several minor differences compared to the previous findings. The foreign exchange denominated deposits series are now countercyclical while M2Y is now acyclic. All the monetary aggregates except for M1 turn out to be acyclic, M1 is procyclical and lags the cycle by four months. The price level indices are acyclic, whereas, inflation rates, Treasury bill rates and the exchange rate series are again countercyclical. Again similar findings are observed using the two different filtering techniques.

Table 2

Correlations of 12-Month Percentage Changes of Nominal Variables with 12-Month Percentage Changes of Industrial Production

Variable*, X	Volatility (% s. d.)	Correlation Coefficient of Industrial Production Index with												
		X_{t-6}	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}	X_{t+6}
IPROD**	7.41	0.27	0.36	0.33	0.40	0.53	0.54	1.00	0.54	0.53	0.40	0.33	0.36	0.27
M0	14.79	-0.02	-0.03	0.01	0.04	0.04	0.01	-0.05	-0.07	-0.11	-0.14	-0.15	-0.20	-0.21
M1	13.04	-0.02	-0.04	-0.01	-0.01	-0.03	-0.07	-0.17	-0.21	-0.29	-0.30	-0.35	-0.38	-0.41
M2	14.86	0.10	0.07	0.06	0.02	-0.04	-0.10	-0.18	-0.25	-0.33	-0.35	-0.37	-0.37	-0.38
M2Y	14.40	-0.02	-0.07	-0.10	-0.17	-0.25	-0.31	-0.39	-0.43	-0.49	-0.50	-0.49	-0.49	-0.46
M2-M1	22.65	0.16	0.13	0.11	0.07	0.02	-0.02	-0.07	-0.13	-0.18	-0.20	-0.20	-0.20	-0.20
M2Y-M2	18.36	-0.10	-0.10	-0.13	-0.17	-0.17	-0.16	-0.12	-0.05	-0.06	-0.05	-0.01	0.01	0.06
CPI	16.11	-0.21	-0.26	-0.31	-0.38	-0.43	-0.48	-0.52	-0.54	-0.54	-0.54	-0.51	-0.51	-0.50
WPI	15.57	-0.17	-0.22	-0.27	-0.34	-0.40	-0.45	-0.50	-0.51	-0.52	-0.51	-0.48	-0.47	-0.47
INFCPI	3.55	-0.20	-0.14	-0.19	-0.26	-0.35	-0.26	-0.27	-0.19	-0.10	-0.03	0.05	0.13	0.02
INFWPI	4.04	-0.14	-0.11	-0.16	-0.22	-0.32	-0.25	-0.23	-0.23	-0.07	-0.03	0.08	0.13	0.03
FXR	19.76	-0.27	-0.32	-0.34	-0.41	-0.48	-0.56	-0.57	-0.54	-0.52	-0.44	-0.39	-0.36	-0.31
TBILLR	21.39	-0.24	-0.23	-0.29	-0.33	-0.44	-0.51	-0.48	-0.43	-0.26	-0.11	0.01	0.19	0.21*

* As in table 1.

** The numbers reported are autocorrelations.

Table 3

Correlations of HP-Filtered Nominal Variables with HP-Filtered Imports

Variable*, X	Volatility (% s. d.)	Coefficient of Industrial Production Index with												
		X_{t-6}	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}	X_{t+6}
IMPORT**	16.31	0.17	0.18	0.29	0.44	0.42	0.51	1.00	0.51	0.42	0.44	0.29	0.18	0.17
M0	8.46	0.17	0.17	0.19	0.20	0.17	0.17	0.15	0.14	0.07	0.02	-0.01	-0.05	-0.08
M1	6.76	0.35	0.35	0.37	0.34	0.29	0.30	0.25	0.22	0.11	0.07	0.06	-0.02	-0.07
M2	8.17	0.29	0.29	0.30	0.28	0.23	0.21	0.15	0.10	0.02	-0.01	-0.01	-0.03	-0.03
M2Y	5.62	0.34	0.30	0.23	0.15	0.07	-0.05	-0.17	-0.23	-0.32	-0.36	-0.38	-0.37	-0.37
M2-M1	13.84	0.13	0.13	0.16	0.15	0.12	0.12	0.06	0.04	0.02	0.01	0.00	0.03	0.06
M2Y-M2	13.46	-0.29	-0.30	-0.35	-0.38	-0.41	-0.42	-0.43	-0.42	-0.39	-0.37	-0.35	-0.30	-0.26
CPI	8.34	0.38	0.37	0.35	0.29	0.24	0.18	0.14	0.13	0.09	0.06	0.05	0.03	-0.03
WPI	7.23	0.33	0.30	0.26	0.19	0.13	0.06	0.01	-0.01	-0.03	-0.06	-0.08	-0.08	-0.15
INFCPI	2.30	0.02	0.01	0.00	-0.10	-0.23	-0.20	-0.25	-0.17	-0.06	-0.17	-0.11	-0.06	-0.10
INFWPI	2.54	0.03	-0.06	-0.10	-0.15	-0.23	-0.20	-0.25	-0.15	-0.07	-0.09	-0.07	-0.06	-0.02
FXR	10.59	0.06	-0.02	-0.06	-0.14	-0.21	-0.30	-0.34	-0.32	-0.33	-0.28	-0.19	-0.23	-0.21
TBILLR	12.6398	-0.23	-0.30	-0.38	-0.41	-0.50	-0.49	-0.52	-0.47	-0.36	-0.27	-0.15	0.00	0.07*

* As in table 1.

** The numbersreported are autocorrelations.

Table 4
Correlations of 12-Month Percentage Changes of Nominal Variables with 12-Month Percentage Changes of Imports

	Volatility	Coefficient of Industrial Production Index with												
Variable*, X	(% s. d.)	X_{t-6}	X_{t-5}	X_{t-4}	X_{t-3}	X_{t-2}	X_{t-1}	X_t	X_{t+1}	X_{t+2}	X_{t+3}	X_{t+4}	X_{t+5}	X_{t+6}
IMPORT**	26.10	0.18	0.24	0.34	0.51	0.54	0.63	1.00	0.63	0.54	0.51	0.34	0.24	0.18
M0	14.79	0.22	0.22	0.25	0.25	0.22	0.22	0.20	0.17	0.11	0.04	-0.01	-0.06	-0.11
M1	13.04	0.32	0.31	0.34	0.32	0.27	0.27	0.22	0.19	0.12	0.06	0.01	-0.06	-0.12
M2	14.86	0.31	0.28	0.28	0.25	0.18	0.16	0.09	0.03	-0.03	-0.09	-0.11	-0.13	-0.13
M2Y	14.40	0.30	0.25	0.20	0.14	0.07	-0.01	-0.11	-0.16	-0.22	-0.25	-0.26	-0.26	-0.24
M2-M1	22.65	0.19	0.16	0.16	0.13	0.07	0.06	0.01	-0.03	-0.05	-0.08	-0.08	-0.06	-0.03
M2Y-M2	18.36	-0.23	-0.28	-0.34	-0.40	-0.44	-0.45	-0.46	-0.43	-0.39	-0.35	-0.30	-0.26	-0.20
CPI	16.11	0.30	0.29	0.27	0.22	0.17	0.12	0.08	0.06	0.03	0.02	0.01	-0.01	-0.04
WPI	15.57	0.24	0.21	0.17	0.12	0.06	0.00	-0.05	-0.06	-0.08	-0.09	-0.10	-0.10	-0.13
INFCPI	3.55	0.00	0.01	-0.03	-0.14	-0.24	-0.22	-0.30	-0.19	-0.07	-0.16	-0.07	-0.05	-0.07
INFWPI	4.04	-0.03	-0.04	-0.11	-0.21	-0.25	-0.23	-0.29	-0.18	-0.08	-0.09	-0.04	-0.03	0.00
FXR	19.76	0.06	-0.01	-0.07	-0.15	-0.23	-0.31	-0.36	-0.33	-0.33	-0.27	-0.16	-0.19	-0.15
TBILLR	21.39	-0.28	-0.35	-0.45	-0.51	-0.58	-0.59	-0.59	-0.55	-0.42	-0.30	-0.15	0.03	0.12

* As in table 1.
** The numbers reported are autocorrelations.

4. Conclusion

This paper adopts the methodology of Kydland and Prescott (1982) and presents nominal stylized facts of the Turkish economy using monthly data for the period 1978:1-1997:7. The results suggest that prices are countercyclical and there is no clear-cut pattern for money in Turkey. These findings are more or less consistent with those reported for the G-7 countries. Countercyclical behavior of inflation and the Treasury bill rates is particular Turkey and may be suggestive of a strong crowding out effect of government consumption.

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Özet

Türkiye'deki nominal konjonktürel dalgalanmaların biçimlenmiş özellikleri

Bu makalede 1986:01–1997:07 arası aylık veriler kullanılarak Türkiye'deki nominal konjonktürel dalgalanmalar Kydland ve Prescott (1990)'un metodolojisi ile incelenmektedir. Özellikle, Hodrick-Prescott ve 12-Aylık yüzde değişiklik filtreleri kullanılarak elde edilen yönseme etrafı dalgalanmaların arasındaki korelasyon ele alınmakta ve bu iki filtreden çıkan sonuçlar karşılaştırılmaktadır. Sanayi Üretim Endeksi'ndeki dalgalanmaların konjonktürel dalgalanmaları belirttiği varsayımı altında çeşitli para tanımlarının dalgalanmalar üzerindeki etkilerinin belirsiz olduğu sonucu ortaya çıkmıştır. Fiyat, enflasyon, ve faiz hadleri değişkenlerinin konjonktürel dalgalarına karşı hareket etmekte olduğu gözlenmiş ve Türkiye için arz tarafından belirlenen modellerin daha iyi sonuçlar verebileceğini destekler bulgular ortaya çıkarmıştır.