OCCASIONAL MACRO NOTE

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The Relationship between Core and Headline Inflation

Headline inflation figures in Turkey suffer from high volatility which in turn complicates interpretation of underlying trend in prices and undermines effective implementation of monetary policy. To alleviate the problem, TURKSTAT reports nine different core price indices, each of which are constructed based on exclusion-type method, alongside the overall Consumer Price Index (CPI). Among these, CPI-H and CPI-I indices are the CBRT's favorites as the inflationary impact of monetary policy is better observed through these indices.

Mere exclusion of items that are insensitive to or irrelevant for monetary policy and/or items that are highly volatile components of the basket is not the optimal way of constructing a core price index. An ideal measure of core inflation must: **i)** relate to headline inflation for all time horizons, **ii)** closely track inflation trend, **iii)** be able to predict future inflation, and **iv)** be exogenous to headline inflation. For a good discussion of this issue and a proposed new indicator of core inflation please refer to *Tekatlı, N. (2010), "A New Core Inflation Indicator for Turkey", Central Bank Review, v. 10, pp. 9-21*.

In this study, we try to extract the common component in core and headline inflation series in order to see if there is a significant co-movement between the two. CPI-H is chosen as the indicator of core inflation since findings in Tekatlı (2010) suggest that it is a more informative measure of core inflation compared to CPI-I indicator. In order to estimate the common component, we use *seemingly unrelated time series equations* (*SUTSE*) model, which is the multivariate extension of unobserved structural time series components model. We defined the common factors in levels and cycles:

$$\begin{bmatrix}\pi_t^h\\ \pi_t^c\end{bmatrix}=\begin{bmatrix}\beta_0\\ 0\end{bmatrix}+\begin{bmatrix}\theta\\ 1\end{bmatrix}\left[F_t\right]+\begin{bmatrix}S_t^h\\ S_t^c\end{bmatrix}+\begin{bmatrix}\beta_1 & \beta_2\\ 0 & 0\end{bmatrix}\begin{bmatrix}\pi_t^{oil}\\ \pi_t^{gold}\end{bmatrix}+\begin{bmatrix}AR1_t^h\\ AR1_t^c\end{bmatrix}+\begin{bmatrix}\varepsilon_t^h\\ \varepsilon_t^c\end{bmatrix}$$

$$F_t=F_{t-1}+\varepsilon_t^F$$

$$\begin{bmatrix}AR1_t^h\\ AR1_t^c\end{bmatrix}=\begin{bmatrix}\rho_1 & 0\\ 0 & \rho_2\end{bmatrix}\begin{bmatrix}AR1_{t-1}^h\\ AR1_{t-1}^c\end{bmatrix}+\begin{bmatrix}\alpha*\varepsilon_t^{AR1}\\ \varepsilon_t^{AR1}\end{bmatrix}$$

$$S_t^i+S_{t-1}^i+S_{t-2}^i+\cdots+S_{t-11}^i=\varepsilon_t^i,\qquad i=h,c$$

$h: headline$

$c: core$

Dependent variables in the model are the monthly percentage changes in related price indices. Instead of seasonally adjusting the series, we prefer to explicitly model seasonality as a stochastic component. We also use first order autoregressive process to capture the short-term cyclical movements in the data.

Year-on-year percentage changes of oil and gold prices in local currency are included as exogenous variables only for headline inflation as core indicator excludes energy and gold by design. We use annual change rather than monthly movements in oil and gold prices to better reflect the shift in price developments of these commodities. We prefer not to control for the exchange rate since it has an impact on both indicators and it would be quite difficult to separate out the effects. Hence, the common components should also include influence of exchange rate.

Common components of headline and core inflation figures, if any, are expected to be observed in levels and cycles. Common level (*F_t*), stochastic seasonality (*S_t*) and common first order autoregressive component (*$AR1_t$*) are all unobserved and therefore can be extracted via Kalman filter. Estimation results are as follows:

Parameters	Coefficient	*Left-bound**	*Right-bound**
θ	0.766	*0.003*	*1.528*
β_1	0.004	*0.002*	*0.005*
β_2	0.003	*0.000*	*0.006*
ρ_1	0.406	*0.148*	*0.729*
ρ_2	0.623	*0.478*	*0.749*
α	0.612	*0.209*	*1.016*
Sample Period: February 2003 – July 2011			
Log-likelihood 94.03			
Convergence achieved after 16 iterations			
**68% confidence interval*			

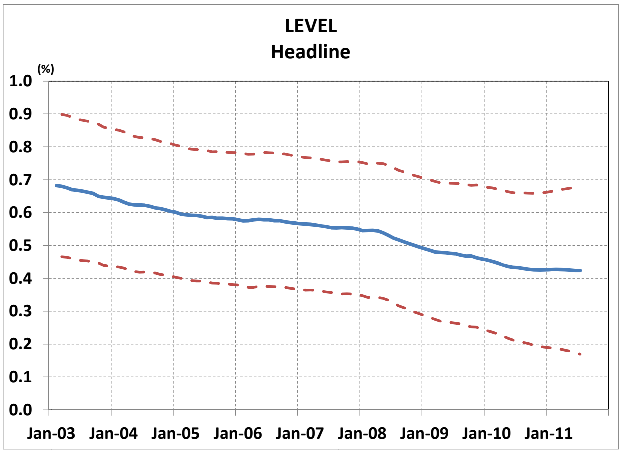
The time series components of the model are presented in the **Appendix** along with 95% confidence intervals. The common level suggests that there is a benign downward long run trend in both headline and core inflation which translates into year-on-year 5.2% for headline inflation and 5.4% for the core inflation as of July 2011. The upper bounds for these estimates are 8.3% and 8.8%, respectively.

The cycles of headline inflation are less persistent and seem to have smaller amplitude than that of core inflation. Moreover, two series have quite different seasonal patterns. The irregular component of headline inflation, which is the unexplained portion by the model, takes larger values compared to core inflation. Although most of these values are considered to be statistically insignificant, we would expect smaller magnitudes if the model had more explanatory power.

The problem is that our original specification forces the model to extract a common component, a process that leads to larger errors if that is not the case in reality. The irregularity in core inflation is much smaller with respect to headline as the common component specification should be dependent on its dynamics as an exogenous variable. However, it is evident from the charts that the volatility has increased particularly after January 2010. Although they are not statistically significant yet, there appears to be some sort of trend formation in opposite directions.

The empirical findings of this study suggest that the link between headline and core inflation might have weakened recently. If so, then we could (continue to) observe distinct patterns in these indicators, at least in the short term. Normally, we would expect the headline inflation to converge to core inflation. However, the weakening link we depicted between the two suggest that either core indicator is not a good representative of core inflation anymore or that dynamics of the excluded items from the core indicator have recently become more dominant.

APPENDIX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(%)
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0.8
0.7
0.6
0.5
0.4
0.3
0.2
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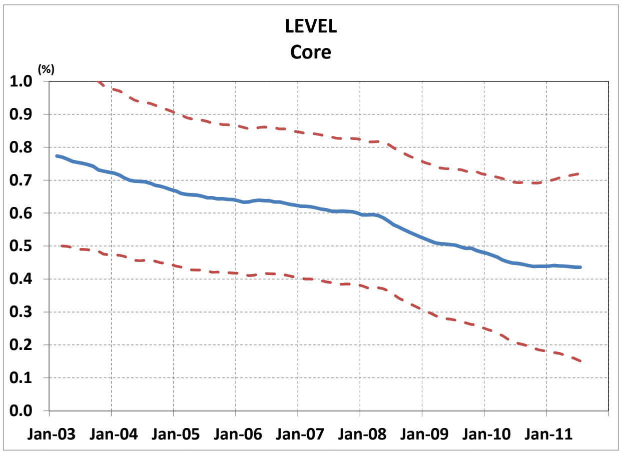
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


LEVEL
Core
(%)
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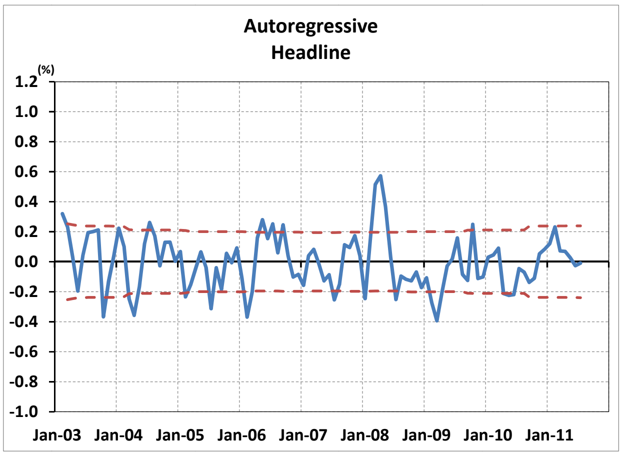
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


Autoregressive
Headline
(%)
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1.0
0.8
0.6
0.4
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0.0
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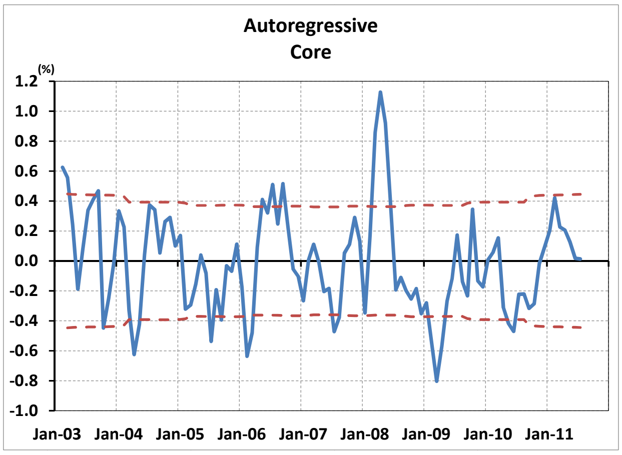
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


Autoregressive
Core
(%)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
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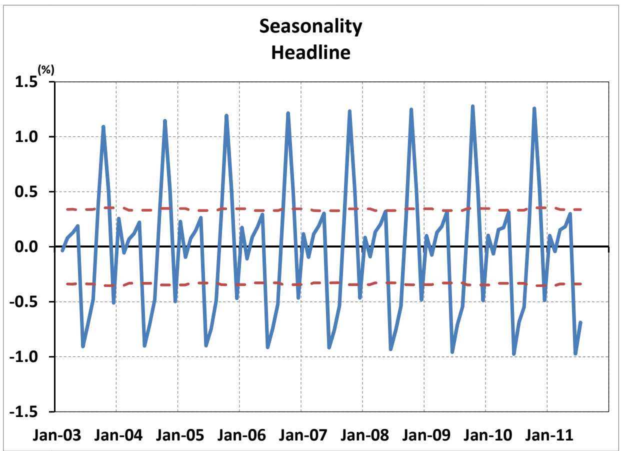
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


Seasonality
Headline
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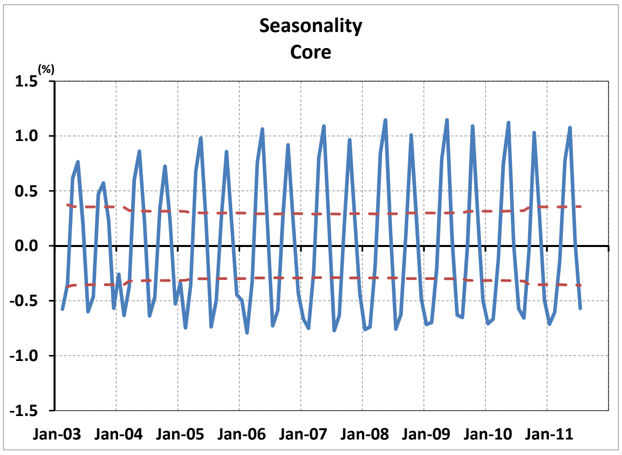
-1.5
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


Seasonality
Core
(%)
1.5
1.0
0.5
0.0
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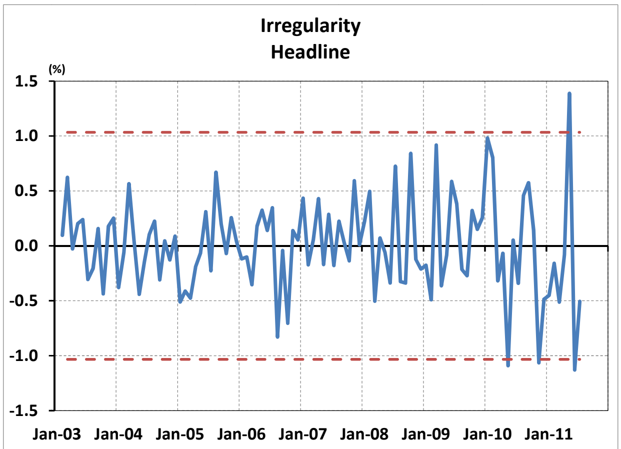
-1.0
-1.5
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


Irregularity
Headline
(%)
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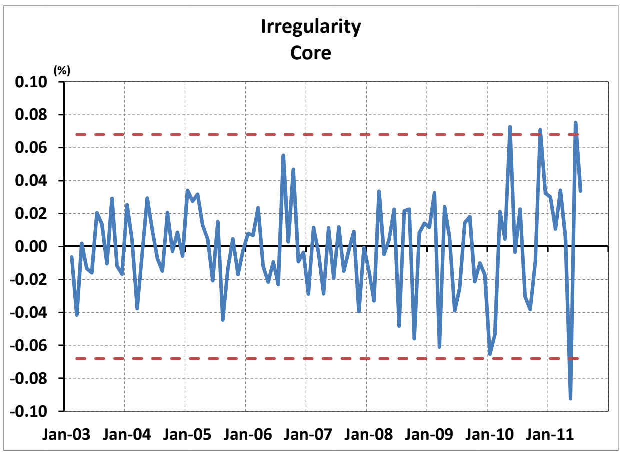
1.0
0.5
0.0
-0.5
-1.0
-1.5
Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11


Irregularity
Core
(%)
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
-0.08
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Jan-03 Jan-04 Jan-05 Jan-06 Jan-07 Jan-08 Jan-09 Jan-10 Jan-11

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