Macroeconomics

Afsin SAHIN,
Yilmaz AKDI

CONVERGENCE OF INFLATION INDICES: EVIDENCE FROM TURKEY

Abstract

In this paper, we have investigated whether Consumer Price Index (CPI), its seven basic components (Housing, Food, Clothing, Furniture, Health, Transportation, Culture) and Wholesale Price Index (WPI) inflations have converged during the period from 1988:01 to 2007:10. We have found that all series have been converged in respect of the results obtained from the ADF and PP unit root tests. KPSS test results also do not reject the null hypothesis of stationary except for CPI-Housing and Clothing-Housing.

Key words:

Convergence, Inflation.

JEL: E31, C01.

Sahin, Afsin, Department of Economics, Selcuk University, Konya Turkey.
Akdi, Yilmaz, Department of Statistics, Faculty of Science, Ankara University, Tandogan, Ankara, Turkey.

1. Introduction

This paper tries to test convergence hypothesis within different indices for Turkey from 1988:01 to 2007:10. We have analyzed Turkish inflation rates forasmuch as it is one of the important candidate countries trying to integrate its economy into the European Union. Besides, there are striking facts about its inflation history. For instance, in Turkey from 1980 to 2001 we observed high and persistent inflation often seen in developing countries. Although the general expectation was that Turkey would enter to the *Dead Cat Bounced* period, we observed a period called transition from high inflation to low inflation period through 2002–2007. Within the latter period, several contractionary economic policies have been implemented to stabilize prices. According to national programs and inflation target of Central Bank, it is expected to enter to a low inflation period and convergence in levels of the member states after 2010.

As an emerging market economy, Turkey experienced currency crisis in April, 1994, November, 2000 and February, 2001 [17]. The economic crisis generally arose from deficit issues. Following the crises several economic programmes have been adopted to stabilize inflation rates.

Latest inflation stabilization programme includes inflation targeting regime. The Central Bank of the Republic of Turkey targets consumer inflation rates during the last years. Consequently the analysis of the behavior of sub indices of CPI has carried weight. For this purpose we have employed the convergence tests for to explore possible relations among different inflation series.

In the literature, there are several studies trying to search for a convergence relationship among countries [2; 6; 10; 11; 13]. Specifically for Turkey, Yilmazkuday [15] finds no evidence of a convergence in the pre-inflation targeting regime, but he finds evidence for absolute convergence among the bilateral pairs of regions in the post-inflation targeting regime. Besides, some of the papers examine the issue with disaggregated data. For instance; Bryne and Fiess [5] claim that while aggregate national inflation rates are diverging, disaggregate inflation rates converging.

The rest of the paper is organized as follows. Section II presents the data characteristics and introduces the model employed in the paper. Section III of the paper reports the empirical evidence.

2. Data and Methodology

2.1. Data

In this article Consumer Price Index (X1 = CPI, 1987 = 100) and its seven sub components: Food (X2), Clothing (X3), Furniture (X4), Health (X5), Transportation (X6), Culture (X7), Housing (X8) and Wholesale Price Index (X9 = WPI, 1987 = 100) is used in testing the null hypothesis of convergence and stationarity of inflation series. The data gathered from the Turkish Statistical Institute. Seasonally has been removed using X-11 historical, additive method. The data are at a monthly frequency with logarithmic first differences of the price indices. Figure 1 presents year on year graphs of the inflation series.

2.2. Methodology

Ordinary, single series unit root tests include Augmented Dickey-Fuller (ADF), GLS detrended Dickey-Fuller (DFGLS), Phillips-Perron (PP), Kwiatkowski, *et al.* (KPSS), Elliot, Rothenberg and Stock (ERS) Point Optimal and Ng and Perron (NP). Unit root tests are mostly useful to establish whether two variables are in the process of converging, with large part of the gap between them depending on initial conditions. Shocks to a stationary time series are necessarily temporary. By the time being, the effects of shocks will dissipate and the series will revert to its long-run mean level. Long-term forecasts of a stationary series will converge to the unconditional mean of the series. Stationary time series exhibit mean reversion has a finite and time-invariant variance and a correlogram which decreases slowly as the lag length increases. A non-stationary time series has a time-dependent variance and goes to infinity.

Following Busetti et al. [6] we test the hypothesis of convergence by employing ADF and PP unit root tests. Following the convergence hypothesis, we also test stationarity by KPSS.
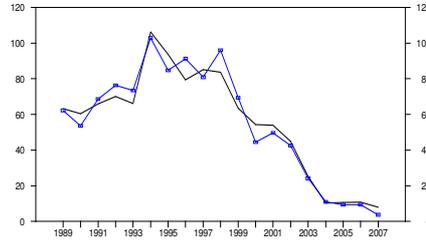
Graph 1.

CPI, Sub-Categories, and WPI 1988-2007 Seasonally Adjusted
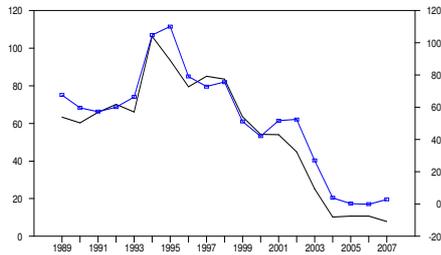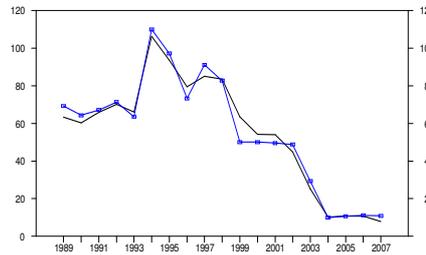(Solid lines are CPI).

CPI and WPI Monthly
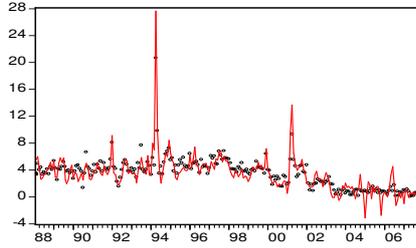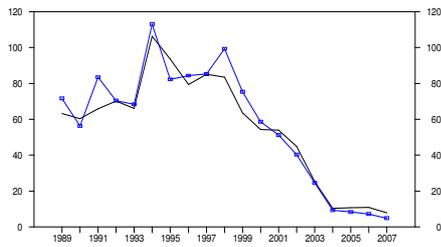
CPI and Culture, Year on Year
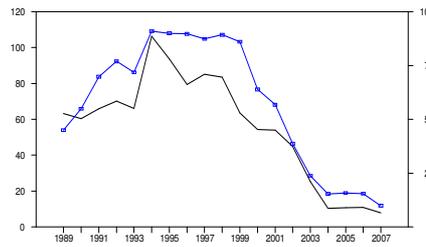
CPI and Clothing, Year on Year
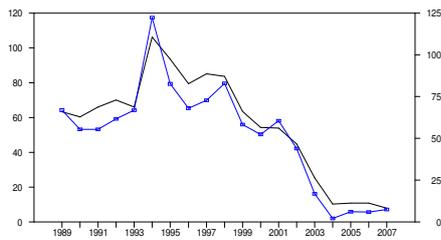
CPI and Food, Year on Year
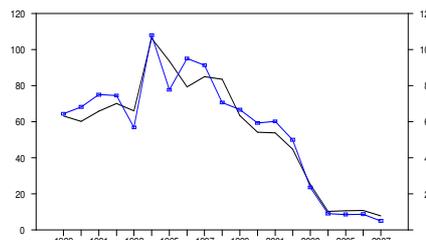
CPI and Health, Year on Year

CPI and Housing, Year on Year

CPI and Furniture, Year on Year

CPI and Transport, Year on Year

Let Φ_t and Ψ_t denote for the Consumer Price Index and Wholesale Price Index monthly inflation rates respectively:

$$\{\Phi_t\} = \left[\frac{(P_{i,t} - P_{i,t-1})}{P_{i,t-1}} \cdot 100 \right] \tag{1}$$

$$\{\Psi_t\} = \left[\frac{(P_{i,t} - P_{i,t-1})}{P_{i,t-1}} \cdot 100 \right] \tag{2}$$

The *spread* between CPI_t and WPI_t will then be defined by (3) denoting for the contrast inflation.

$$\{\Omega_t\} = \Phi_t - \Psi_t \tag{3}$$

For to test convergence and stability, we initially applied univariate tests.

If $\{\Omega_t\}$ is a sequence having the number A as a limit, we may write

$$\lim_{t \to \infty} \{\Omega_t\} = A \tag{4}$$

or specifying (4) where the expectations are assumed to be rational:

$$\lim_{t \to \infty} E((\Phi_t - \Psi_t) \mid I) = A \tag{5}$$

I denotes for the available information before the formation of expectations for the future value of the variable. Following Bernard and Durlauf [4] and Busetti et al. [6] we call equation (5) as an absolute convergence case if A=0. Following Durlauf and Quah (1999) we name it as conditional convergence if (5) is different from zero.

The limit of the sequence, if it exists, is unique and bounded. Let $\{\Omega_t^i\}$, $\{\Omega_t^j\}$ and $\{b_t\}$ be sequences such that for $\forall t \in N$;

$$\Omega_t^i \le b_t \le \Omega_t^j \tag{6}$$

If $\{\Omega_t^i\}$ and $\{\Omega_t^j\}$ both converge to A, then $\{b_t\}$ also converges to A.

Let $\{\Omega_t\}$ be a sequence of real numbers for $t = 0, 1, \ldots$ The infinite series of functions $\sum_{t=0}^{\infty} \Omega_t x^t$ is called power series in x, centered at origin. Also if the power series as $\sum \Omega_t x^t$ converges for a value $x = x_0$, then it converges absolutely for all x satisfying the inequality $|x| < |x_0|$. For the divergence case, the fol-

lowing theorem holds; if $\sum \Omega_t x^t$ diverges for a value $x = x_0$, then it diverges for all x satisfying $|x| > |x_0|$.

It is possible to apply autoregressive process for modeling convergency issue. Following Burnetti *et al.* (2007) this paper models convergency as *AR(p)* in error correction form (Equation 7) where $\hat{\lambda} = A(1 - k)$ and $0 < k < 1$.

$$\Delta \Omega_t = \hat{\lambda} + (k - 1)\Omega_{t-1} + \hat{\lambda}_1 \Delta \Omega_{t-1} + \hat{\lambda}_{p-1} \Delta \Omega_{t-p+1} + \zeta_t, \qquad (7)$$

The data should be stationary for modelling an autoregressive process. Autoregressive models are univariate models. $\hat{\lambda}$ is the mean of $\Delta \Omega_t$. ζ_t is white noise (0, σ^2). ζ_t is also expressed as martingale difference innovations. If the data is stationary then $E(\Omega_t) = E(\Omega_{t-1}) = \hat{\lambda}$, the mean of it will be constant. Also the variance of the data should be constant for stationarity condition. Unit root tests employed for searching whether k is equal to 1 or not.

Following Harvey and Carvalho [8] and Harvey and Bates [9] we claim that CPI and WPI have converged if the inflation differential ($\Delta \Omega_t$) is a stationary process with strictly positive and bounded with the long run variance. We also employed KPSS test proposed by Kwiatkowski et al. [12] for stationarity. In addition to test convergency we included dummy variables for April 1994, November 2000, February 2001 economic crises. This specification is shown in equation 8.

$$\Delta \Omega_t = \hat{\lambda} + \gamma \Omega_{t-1} + d94 + d00 + d01 + \sum_{i=2}^{p} \beta_i \Delta \Omega_{t-1} + \zeta_t \qquad (8)$$

3. Empirical Evidence

Time series plots of all the pairs related with CPI are shown in Figure 1. As it is seen from the figures, all of the components of CPI inflation move together with the general CPI inflation. Besides, CPI moves together with the WPI. That is, it is meaningful search whether these series converged or not. In order to check whether they were converged or not ADF and PP tests are employed. ADF test results for the inflation contrasts are presented in Panel A of Table 1. Lags in the ADF regression were selected according to the Akaike Information Criterion. Panel B of Table 1 presents PP test results. For the period 1988:01-2007:10 we reject the unit root at 1% significance level for all pairs by ADF and PP tests. Both ADF and PP tests give parallel results. ADF test are also employed by inserting dummies for April, 1994; November, 2000; February, 2001. We also employed KPSS test whether these series are stationary or not. Almost all the series give parallel results with ADF and PP except for the CPI-Housing and Clothing-Housing. The

ADF (2) test statistic results including dummies are presented in Panel D. By estimating equation 8 we also reject the hypothesis of no convergence.

We have provided evidence over the convergence properties of CPI and its seven sub-components and WPI inflation rates. We have used univariate unit root and stationarity tests to show that convergence occurred between 1988:01-2007:10.

There are important economic interpretations derived from the empirical results: (a) The results are parallel with Berument, Sahin and Saracoglu [3], claiming that the response of inflation rate to relative price variability is positive. (b) The results are also strengthening the findings of Akdi and Sahin [1], which indicates a cointegration relationship among different price indices. (c) KPSS test results reject the null hypothesis of stationary for CPI-Housing and Clothing-Housing. That is interesting and meaningful and coherent with Sahin [14] claiming that the inflation persistency levels are high for housing and clothing sectors in Turkey, therefore leading to distortions in the economy. (d) We also suggest from the results that Central Banks employing inflation targeting regime also stabilizes the most of the sub-components of the CPI inflation.

Table 1.

Convergence Test Results

	A	B	C	D		A	B	C	D
Cont.	**ADF (1)**	**PP**	**KPSS**	**ADF (2)**	**Cont.**	**ADF (1)**	**PP**	**KPSS**	**ADF (2)**
X1-X2	-8.644	-12.519	0.098	-8.855	**X3-X7**	-16.361	-16.367	0.097	-16.216
X1-X3	-5.033	-13.612	0.415	-4.950	**X3-X8**	-3.922	-11.015	0.521	-3.779
X1-X4	-16.447	-16.376	0.160	-16.550	**X3-X9**	-10.044	-12.043	0.374	-11.894
X1-X5	-17.006	-17.111	0.360	-17.092	**X4-X5**	-4.341	-17.792	0.112	-4.319
X1-X6	-9.052	-14.959	0.140	-9.277	**X4-X6**	-11.621	-14.763	0.038	-12.533
X1-X7	-17.645	-18.256	0.111	-17.677	**X4-X7**	-16.707	-16.759	0.055	-16.599
X1-X8	-3.890	-9.927	0.528	-4.584	**X4-X8**	-8.160	-12.987	0.386	-8.244
X1-X9	-9.422	-10.577	0.114	-10.846	**X4-X9**	-10.073	-14.419	0.332	-10.812
X2-X3	-9.440	-13.929	0.273	-9.672	**X5-X6**	-9.124	-16.201	0.097	-9.122
X2-X4	-8.295	-15.722	0.112	-8.015	**X5-X7**	-17.129	-17.312	0.080	-17.012
X2-X5	-15.170	-15.183	0.231	-15.571	**X5-X8**	-16.476	-16.434	0.964	-16.407
X2-X6	-8.715	-12.930	0.098	-8.753	**X5-X9**	-14.528	-14.518	0.377	-15.580
X2-X7	-16.582	-16.763	0.103	-16.839	**X6-X7**	-10.298	-17.315	0.080	-10.713
X2-X8	-8.426	-10.791	0.438	-9.095	**X6-X8**	-6.611	-12.569	0.362	-7.896
X2-X9	-9.026	-12.205	0.096	-9.150	**X6-X9**	-12.202	-13.485	0.234	-12.040
X3-X4	-14.185	-14.195	0.120	-13.766	**X7-X8**	-17.164	-17.164	0.429	-17.102
X3-X5	-5.764	-15.605	0.061	-5.768	**X7-X9**	-15.313	-15.316	0.137	-16.160
X3-X6	-9.297	-14.011	0.065	-9.720	**X8-X9**	-7.920	-9.108	0.162	-10.541

Bibliography

1. Akdi, Y. – Sahin, A., «The Relationships between Price Received by the Farmers, Aggregate Price Indices and the Exchange Rate», *Economics, Management and Finance*, Vol. 21, No. 252: 116–126.

2. Beck, G.W. – Hubrich, K. – Massimiliano, M. (2006), «Regional Inflation Dynamics within and across Euro Area Countries and a Comparison with the US», *European Central Bank Working Paper*, No. 681, October: 1–59.

3. Berument, H. – Sahin, A. – Saracoglu, B., (2008), «The Choice of Monetary Policy Tool and Relative Price Variability: Evidence from Turkey», mimeo.

4. Bernard, A. B. – Durlauf S. N. (1995), «Convergence in International Output», *Journal of Applied Econometrics*, Vol. 10, No. 2, April: 97–108.

5. Bryne, J. P. – Norbert F. (2007), «Euro Area Inflation: Aggregation Bias and Convergence», *Department of Economics, University of Glasgow, Working Paper No. 41,* October: 1-33, available at: http://www.gla.ac.uk/media/media_49319_en.pdf.

6. Busetti, F. – Forni, L. – Harvey, A. – Venditti, F. (2007), «Inflation Convergence and Divergence within the European Monetary Union», *International Journal of Central Banking*, Vol. 3, No. 2 June: 95-121

7. Durlauf, S. – Quah, D. (1999), «The New Empirics of Economic Growth», in J.B. Taylor and M. Woodford (Eds.) *Handbook of Macroeconomics*, Vol. 1, Ch. 4, Amsterdam: Elsevier Science: 235–308.

8. Harvey, A. C. – Carvalho, V. (2002), «Models for Converging Economies», Cambridge Working Papers in Economics, No. 216: 1–33. available at: http://www.econ.cam.ac.uk/dae/repec/cam/pdf/wp0216.pdf.

9. Harvey, A. C. – Bates, D. (2003), «Multivariate Unit Root Tests and Testing for Convergence», *Cambridge Working Papers in Economics,* No. 0301, University of Cambrige.

10. Holmes, M. J. (2002), «Panel Data Evidence on Inflation Convergence in the European Union», *Applied Economics Letters*, Vol. 9, No. 3: 155-158.

11. Honohan, P. – Lane, P.R. (2003), «Divergent Inflation Rates in EMU», *Economic Policy*, Vol. 18, No. 37: 357-394.

12. Kwiatkowski, D. – Phillips, P.C.B – Schmidt, P. – Shin, Y. (1992), «Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure are We that Economic Time Series have a Unit Root?», *Journal of Econometrics*, Vol. 54: 159–178.

13. Mentz, M. – Sebastian, S. P. (2003), «Inflation Convergence after the Introduction of the Euro», *Center for Financial Studies Working Paper*, No. 2003/30.

14. Sahin, A. (2008), *Sectoral Inflation Persistency Analysis on CPI and WPI in Turkey*, Selcuk University, Department of Economics, Unpublished Doctor of Philosophy in Economics Dissertation Thesis.

15. Yilmazkuday, H. (2007), «Inflation Targeting and Convergence within Turkey», *Social Science Research Network*, October: 1–27, available at:

16. http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1021281

17. Yilmazkuday, H. and Akay. H. (2008), «An Analysis of the Turkish Economy Under Regime Shifts», *Economic Modelling,* (article in press).

The article was received on February 3, 2009.