A SMALL SCALED BUSINESS-CYCLE ANALYSIS OF THE TURKISH ECONOMY: SOME COUNTER-CYCLICAL EVIDENCE USING NEW INCOME SERIES

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Özet

Bu çalışmada Türkiye ekonomisi için küçük ölçekli bir iş-çevrimi çözümlemesi gerçekleştirilmeye çalışılmaktadır. Bu amaçla 1998: 100 temelli yeni gelir serisi verisini dikkate alan reel gelir ve fiyatlar/enflasyon arasındaki çevrimsel bağıntıların bilgisi açığa çıkartılmaya çalışılmakta ve sonra bu büyüklüklerin öncü- veya ters-çevrimsel tanımlayıcı özellikleri incelenmektedir. Tahmin bulgularımız hem deflatör temelli fiyat düzeyinin hem de enflasyonun arz-çekişli iş-çevrimi modellerinin öngörülerini destekleyecek şekilde reel çıktı ile ters-çevrimsel bir ilişkiye sahip olduğunu göstermektedir. Fiyat düzeyi/enflasyon ve reel gelirin çevrimsel bileşenleri arasındaki ilişkilerin yönünü inceleyebilmek için ayrıca genelleştirilmiş etki tepki çözümlemesine başvurulmuştur. Sonuçlar reel çıktı ve fiyat düzeyi/enflasyon arasında veri tutarlı güçlü negatif bir etkileşimin bulunduğunu onaylamaktadır. Bütün bu bulgular dikkate alınarak, duruma-bağlı takep-çekişli Keynesgil politikalara Türkiye ekonomisi tarafından tanıklık edilen iş çevrimlerinin etkilerinin istikrar amaçlı olarak denetlenebilmesi için bir günenilirlik bileşeni atfedilmemesi gerektiği ve çıktı ile fiyatlar arasında negatif bir etkileşime yol açacak arz şoklarına olanak sağlayan politikalara, daha ziyade, iktisadi birimler ve politika yapıcılar tarafından önem verilmesi gerektiği sonucuna ulaşılmaktadır.

Anahtar Kelimeler: *Enflasyon; Çıktı; İş Çevrimleri; Filtreleme/Ayrıştırma; Ters-Çevrimsel Fiyatlar/Enflasyon; Genelleştirilmiş Etki Tepki Çözümlemesi; Türkiye Ekonomisi;*

JEL Sınıflaması: C22; C32; E31; E32;

Abstract

In this paper, a small scaled business cycle analysis is tried to be conducted for the Turkish economy. For this purpose we try to extract the knowledge of cyclical correlations between real income and prices/inflation considering 1998: 100 based new income series data and then examine pro- or counter-cyclical

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characteristics of these aggregates. Our estimation results indicate that both deflator based price level and inflation have a counter-cyclical relationship with real output in a way supporting what the supply-driven business cycle models bring out. To further examine the direction of the relationship between the cyclical components of price level/inflation and real income, we apply to the generalized impulse response analysis. The results verify that there exists a data consistent strong negative interaction between real output and price level/inflation. Considering all these findings, we conclude that no credibility must be attributed to the discretionary demand-driven Keynesian policies to stabilize the effects of the business cycles witnessed by the Turkish economy and that the policies permitting to supply shocks which will lead to a negative interaction between output and prices, rather, must have been of a special importance in the eyes of economic agents and policy makers.

Key words: *Inflation; Output; Business Cycles; Filtering/Decomposing; Counter-Cyclical Prices/Inflation; Generalized Impulse Response Analysis; Turkish Economy;*

JEL Classification: C22; C32; E31; E32;

1. SOME STYLIZED FACTS OF INFLATION AND GROWTH IN TURKEY

One of the stylized facts identifying the Turkish economy for the last 30-years period is the coincidence of a two-digits chronic inflationary period with an unstable real income growth process, and to a great extent these benchmark characteristics of the economy, but by no means solely, are able to shape the expectations of economic agents as to the future periods. The raw data of the post-1980 period indicate that inflation rate takes annual values within the range of 30% - 50% for the 1981 - 1987 period, while the average real income growth takes a value of 5.01%. Following this sub-period, the economy witnesses a jump in annual inflation rates and a lower growth rate occurs with a highly erratic behaviour till the 1994 such that inflation fluctuates between 60% - 80% and average growth decreases to 4.55% for the 1988 - 1993 period. The 1994 economic crisis conditions lead to a one-time upward jump in annual inflation rates over three-digits levels and inflation lies between 80% - 100% interval for the 1995 - 1998 period. Following the -6.10% slump of real income in 1994, when the real income growth rates have been taken into account, the real income growth rate tends to have an increasing trend with an annual average 6.83%. For the post-1998 period, annual inflation rates follow a downward trend, however, inflation cannot be drawn back below the 55% - 60% minimum

threshold levels of the previous periods till the year 2000, and the economy once more experiences a -6.10% slump in 1999. As of the first months of 2000, the Turkish economy embarked on an anti-inflationary stabilization program based on a crawling peg / band regime to fight domestic inflation and policy makers aimed at mainly forming the expectations of economic agents in line with the policy issues consistent with nominal exchange anchor. Although seemed to be successful in bringing inflation down instantly to the 35% annual level for the first 10 months realization, the subsequent two economic crisis periods ended the program. Following the collapse of the nominal exchange anchor based dis-inflation stabilization program, a massive economic crisis took place in 2001, that led to a great slump in real income by about -9.50% and in turn this period coincided with an upsurge of annual inflation within the range of 60% - 65%. For the post-2002 period, policy makers have decided to establish an inflation targeting framework that has been applied implicitly for the pre-2006 period under the acceptance of the indepencence of the monetary authority in implementation of the monetary stabilization policies. The policy has been turned out to be rather explicit targeting for the post-2006 period through announcements of annual targets determined in a co-ordinated way with the central government. In this period, annual inflation steadily drops till the 8% - 10% threshold values but has been subject to an inertia which prevents to be further dropped, while the real income growth resurrects with an average growth rate 7.46% per year for the 2002 - 2006 period. Thus the post-1980 experience of the Turkish economy indicates that inflation tends to mainly be characterized with realizations of self-peculiar characteristics as to the sub-periods rather than with a stable long-run path, and that growth rates have been subject to a highly volatile course. Note that Ertugrul and Selcuk (2002) also give a brief outline of the Turkish economy for the whole 1980s and 1990s that led to the implementation of the 2000 dis-inflation stabilization attempt. Below in Tab. 1 are shown the annual statistics of various inflation measures as well as of the real income growth represented by annual per cent change in real gross national product (*GNP*).

In the light of these stylized facts, many researchers try to examine the dynamics of inflation, growth and business cycles of the Turkish economy. Among many others considering a business cycle perspective, Ateşoglu and Dutkowsky (1995) using annual data running from 1960 to 1988 interest in the determination of aggregate output and price level and estimate that the Turkish

economy seems to behave in a consistent way with the predictions of a simple real business cycle model. They find that output follows an autoregressive structure with trend and that monetary policy is neutral. Altuğ and Yılmaz (1998) estimate in their dynamic vector autoregression modelling framework that shocks to inflation in Turkey would lead to a significant negative response in real activity proxied by industrial production. Alper (1998) using monthly data for the 1978 – 1997 period observe that price, inflation and interest rate se-

Table 1: Annual real *GNP* Growth and Inflation (%)

Years	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
dY	4.80	3.10	4.20	7.10	4.30	6.80	9.80	1.50	1.60	9.40
dCPI	34.0	28.4	31.4	48.4	45.0	34.6	38.9	73.7	63.3	60.3
dPPI	36.8	27.0	30.5	50.3	43.2	29.6	32.1	68.3	63.9	52.3
dDEF	44.1	28.2	26.3	48.2	53.1	36.0	33.6	69.3	75.5	58.3
Years	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**
dY	0.30	6.40	8.10	-6.10	8.00	7.10	8.30	3.90	-6.10	6.30
dCPI	65.9	70.1	66.1	106.3	88.0	80.4	85.7	84.7	64.9	54.9
dPPI	55.4	62.1	58.4	120.7	86.0	76.0	81.8	71.8	53.1	51.4
dDEF	58.8	63.7	67.8	106.5	87.2	77.8	81.5	75.7	54.2	49.2
Years	**01**	**02**	**03**	**04**	**05**	**06**	**07**			
dY	-9.50	7.90	5.90	9.90	7.60	6.00	---			
dCPI	54.4	45.0	25.3	8.6	8.2	9.6	8.8			
dPPI	61.6	50.1	25.6	14.6	5.9	9.3	6.3			
dDEF	52.9	37.4	23.3	12.4	7.1	9.3	8.1			

Notes: All the data have been taken from the Turkish Statistical Institute Statistical Indicators 1923-2007. In the table, dY is the annual per cent change of real GNP, dCPI the annual per cent change of consumer price index, dPPI the annual per cent change of producer price index, dDEF the annual per cent change of gross domestic product deflator. For the base years of each of these indices, see Turkish Statistical Institute (2008).

ries are all counter-cyclical giving support to a supply-driven model for the Turkish economy. Likewise, Alper (2002) using quarterly data from 1987 to 2000 report that both price level and inflation rate turn out to be moving counter-cyclically, suggesting the appropriateness of a supply-driven business cycle model rather than of a demand-driven one. The findings indicate that labor inputs and productivity are pro-cyclical but do not lead the output cycle and that capital inflows, especially long-term inflows, seem to matter since they turn out to be strongly pro-cyclical and lead the cycle in a consistent way with the appropriateness of a supply-driven model. Metin-Özcan et al. (2001) using annual data for the 1969 – 1996 period verify the argument that variations in the price level depict quite strong negative correlation with real gross domestic

product (*GDP*), thus supporting a counter-cyclical pattern of fluctuations of the price level *vis-á-vis* real *GDP*. Karaca (2003) tries to examine the relationship between inflation and growth using a time series analysis with quarterly data for the 1987 – 2002 period. Based on the Granger causality estimation results, the author observes a uni-directional causality running from inflation to growth in the sense that inflation seems to have a negative impact on growth. Dibooglu and Kibritcioglu (2004) study output and inflation using a dynamic aggregate supply and aggregate demand model with imperfect capital mobility. Using quarterly data for the 1980 – 2002 period, their results obtained from structural vector autoregressions indicate that terms of trade, monetary, and balance of payments shocks figure prominently in the inflationary process and that output is mainly driven by terms of trade and supply shocks. Finally Berument et al. (2008) in a recent paper analyze the dynamic relationships between inflation and growth considering also effects of the dynamic course of the real exchange rate for the 1988 – 2007 period with quarterly data and then conduct some extended experiments in affecting inflation – output relationship conditional upon some other macroeconomic indicators assumed as exogenous factors such as oil prices, broad money supply, government spending and tax revenue. Their results verify that there exists a negative relationship between inflation and output growth in Turkey and that the real exchange rate has an underlying role as an explanatory factor for this relationship.

In this paper, our aim is to re-examine these issues of interest for the Turkish economy considering 1998: 100 based new income series data. To this end, the outline of the paper is as follows. The next section reports a brief account of the business cycle phenomenon in the economics literature. The third section tries to reveal the importance of discerning pro- and counter-cyclical characteristics of the prices. The fourth section employs some contemporaneous filtering methods to extract the cyclical components of inflation and output from the trend course of these aggregates. In the fifth section, some innovation accounting methods are used to further examine the dynamic relationships between cyclical components of inflation and output. The last section summarizes results to conclude the paper.

2. A BRIEF METHODOLOGICAL ACCOUNT OF THE BUSINESS CYCLE PHENOMENON

In a seminal paper upon the business cycle analysis, Lucas (1977) attributes business cycle to the movements about trend of gross national product in the sense that these movements do not exhibit uniformity of either period or amplitude, that is to say, they do not resemble the deterministic wave motions which sometimes arise in the natural sciences but can be well-described by stochastically distributed difference equations. In line with Lucas, Fiorita and Kollintzas (1994) and Serletis and Krause (1996) define growth of a variable as its smoothed trend and the cyclical components of a variable as the deviation of the actual values of the variable from the smoothed trend. Considering an economics policy perspective, in this respect, decomposing the business cycles into their non-stationary long-term trend and stationary short-term cycle components between a peak and a trough of aggregate economic activity and estimating the correlations or structural dynamic interactions between the latter type stationary components would easily help researchers cover both classical cycles and growth cycles and determine which kind of policies to be implemented so as to obtain *ex-ante* specified policy targets and to examine whether the effects of stabilization policies would be permanent or transitory which also lead policy makers to decide whether to respond at all and how to respond to the disturbances occurred in the economy (Dornbusch and Fischer, 1994).

On this point, it would be useful to define classical and growth cycles to grasp that how economists make cyclical fluctuations data-apparent from their theoretical and empirical analyses so that they arrive at the knowledge of cyclical properties as well as of the some underlying macroeconomic characteristics of the economies, amounted to be indicators of the future course of the economic activity. It is of the nature of contemporaneous economic analysis, therefore, that through such analyses carried out by researchers, expectations as to the behaviors of economic agents can be followed and also to some extent managed by the policy makers. In this line of thought, Cashin and Ouliaris (2001) define classical cycles or cyclical movements in trend-adjusted output, mainly matched by the classical study of Burns and Mitchell (1946) in economics literature, as the movements in actual economic time series which are recurrent but not periodic, that is to say, the identification of recessions,

contractions and revivals which merge into the expansion phase of the next cycle in the absolute level of aggregate economic activity. This approach is predominant particularly in the studies of the National Bureau of Economic Research (NBER) using US historical data and concentrating on timing and other aspects of non-seasonal fluctuations in series between groups of leading, coincident, and lagging indicators that in many cases show pronounced long-term trends (Zarnowitz and Özyıldırım, 2002). On the other side, the growth cycle or cyclical movement in trend-adjusted output refers to the deviations in economic activity from a long-term trend so that growth expansions (growth contractions) are described as periods when the growth rate is above (below) the long-term trend rate of growth in aggregate economic activity (Stock and Watson, 1998). In such a distinction between classical and growth cycles, whereas classical cycles tend to have recessions that are considerably shorter than expansions because of underlying trend growth, growth recessions and expansions have approximately the same duration.

Through the framework such kind of analyses tend to provide, researchers are able to have obvious implications for the future course of the economic activity in the sense that enables us to assess the effectiveness of discretionary or rule-based stabilization policies in affecting the course of boom-bust cycles in the economy yielding also possible time lags in policy implementation process (Altuğ, 2001). Considering contemporaneous economics literature, for the last two decades, benchmark papers for business cycles come especially from the pioneers of the real business cycle (RBC) school of economic thought, yielding stochastic dynamic general equilibrium models cabaple of generating artificial data (Fiorita and Kollintzas, 1994) and viewing aggregate economic variables as the outcomes of the decisions made by many individual agents to maximize their utility subject to production possibilities and resource constraints of which basic model of economic dynamics is the neoclassical model of capital accumulation (Plosser, 1989) and by which model constructing process comes to be widely used as laboratories for policy analysis otherwise given the difficulties to experiment within actual economies (Rebelo, 2005). Of all the others, on this issue of interest, see, e.g. Kydland and Prescott (1982), Long and Plosser (1983), King and Plosser (1984), Kydland and Prescott (1991), Backus et al. (1992), Backus et al. (1995), and Chari et al. (1995). Rebelo (2005) documents an extensive survey for the RBC school also providing related literature emphasizing many different

aspects of this theory. These serve to the use of various intruments by economists to begin an analysis of the real world with an account of what we now contemporaneously tend to call business cycle analysis, to which old-fashioned ideas of economic research in general was to be contrasted due to their lack of explaining economic phenomenon in the light of weak performance of the use of late estimation techniques.

Also an important point to be considered here is whether the researchers can obtain general business cycle facts so as to construct the dynamics of economic theory. But such an effort would not be easy due to the different characteristics of macroeconomic fluctuations which require different courses of adjustments to long waves of economic growth in both developed and developing countries. Woitek (1997) separates this set of stylized facts into three classes, that is to say, the inventory-cycle or the Kitchen-cycle with a duration of three to four years, which refers to Kitchen (1923), the equipment-cycle or the Juglar-cycle with a duration of seven to ten years, which refers to Juglar (1889), and the building-cycle or the Kuznets-cycle with a length of about twenty years, which refers to Kuznetz (1958). The length of each cycle is related to the speed with which the level of the associated capital stock can be adjusted.

Following such type issues of business cycle analysis, the use of potentially inappropriate conclusions regarding the stylized facts or broad regularities of macroeconomic fluctuations in different country cases can adversly affect the efficacy of stabilization policies. Economic policy is often contingent on whether or not a country is experiencing a cyclical contraction or expansion, and so it is vital that appropriate tools be used to extract the country-specific business cycle facts from the data (Cashin and Ouliaris, 2001). These would compel the researchers to take into consideration the stylized facts of various country cases so as to see whether boom-bust cycles in the level of real output resemble each other. To examine such an issue, we must note that, although there is a long tradition of viewing classical cycles in terms of turning points, as mainly followed by the researchers of the NBER, the papers of the recent literature on growth cycles tend to neglect the issue of the timing of deviation from trend, prefering, instead, to concentrate on the analysis of the variances of filtered time series and on the covariances of movements in selected key series with filtered output.

3. AN IMPORTANT QUESTION: ARE PRICES PRO- OR COUNTER-CYCLICAL?

Of special emphasis in business cycle analysis has been given to whether or not the prices are pro- or counter-cyclical. Although Lucas (1977) refers to that prices are generally pro-cyclical as one of the commonly held beliefs among business cycle regularities, which leads to the use of equilibrium models with monetary policy or price surprises in the policy implementation process as the main source of fluctuations so that monetary disturbances would appear to be the only possible source of fluctuations, papers from contemporaneous literature considering different country cases upon this issue are able to yield conflicting estimation results mainly revealing the counter-cyclical role of prices and inflation against output as a fact of business cycles. In this sense, estimating whether the price level and inflation are pro- or counter-cyclical will provide policy makers with a knowledge of in what way the stabilization policies *ought to* be designed, and provided that price level and inflation turn out to be counter-cyclical, supply-driven models of business cycles including real business cycle models will be appropriate to analyze the implications of business cycles (Chadha and Prasad, 1994). Otherwise that the prices move in the same direction with output will point out the importance of demand side disturbances that lead policy makers to design and implement discretionary Keynesian "*leaning against the wind*" type fiscal and monetary policy interventions (Alper, 2002).

On this point, we must state that in line with Kydland and Zarazaga (1997), science makes progress precisely when it encounters observations that the prevailing paradigm cannot explain. For instance, thinking of inflation stabilization *ought to* be, if necessary, subject to changes in minds as to the past explanations of theories and/or policies. Such an assumption would compel the researchers and policy makers to require new paradigms consistent with the stylized facts of the usual economic environment. Therefore, if nominal shocks have not been found as the predominant characteristics of the business cycles and, rather, if real or supply-side factors have been constituting the main reasons driving economic fluctuations, stabilization programs based on nominal anchors using some variant of monetary aggregates as reference policy tools have been possibly subject to be failed, leading to the policy inference that it is time to give real factors their fair chance to account for significant fraction of

the business cycles. Following Ahmed and Park (1994), in other words, if external and domestic supply disturbances are found to be important in explaining macroeconomic fluctuations and domestic aggregate demand disturbances are not, this would imply that policy makers' attempts to *fine-tune* the economy will prove ineffective.

When we examine some contemporaneous literature on this issue, we observe that the evidence in general tend to be in favor of counter-cyclical prices as regards the case of pro-cyclical prices. Thus, now, those matters do require our attention here to somewhat inform readers about leading papers carried out upon some country cases. As we shall see below in due course, such type stylized facts of the world economies can also be generalized in a way including the experience of the Turkish economy. For the developed country cases, Chadha and Prasad (1994) and Fiorita and Kollintzas (1994) find that price level is counter-cyclical for the G-7 countries, while the former also find that inflation rate is pro-cyclical thus suggest that the cyclical behavior of the price level and inflation do not provide conclusive grounds for rejecting either demand-determined or supply-determined models of the cycle. Kydland and Prescott (1990) for the US, Backus and Kehoe (1992) for ten developed countries of the postwar period, Serletis and Krause (1996) for the US, and Cashin and Auliaris (2001) for Australia reveal the importance of counter-cyclical prices with output, suggestive of predominance of shocks to aggregate supply in the economy. Besides, Lopez et al. (1997) employing a structural VAR identification procedure based on a simple macro model to extract the knowledge of Spanish business cycles estimate that inflation is mainly supply-driven and in the light of this finding suggest that strong dis-inflationary demand policies could prove inefficient and very painful, leading to suggest the need to more active supply policies.

As to the developing country cases, Rand and Tarp (2002) confirm the negative relationship between the price level and real income for a set of developing countries, providing support for a supply-driven interpretation of the business cycles including real business cycle models. Agénor et al. (1999) also find counter-cyclical variation of prices and inflation against cyclical component of output in many of developing countries including Turkey.

4. DECOMPOSING CYCLICAL SERIES FROM THEIR TRENDS

Having briefly examined the general characteristics of business cycle phenomenon and brought out the importance of cyclical properties of the prices, we will now proceed to an empirical analysis for the case of the Turkish economy. In order to properly specify the modelling issues in identifying the main characteristics of the business cycles, policy inferences extracted from empirical analyses are required to be cautiously appreciated. Following Agénor et al. (1999) at least two factors may help account for this in a developing country perspective. First, availability of relevant data and limitations on data quality and frequency based data problems for the researchers would be constraining factors in analyzing the path of cycles. Of special importance upon this issue, besides, for developing countries such as Turkey is the fact that they have frequently been subject to sudden crises and market gyrations in macroeconomic variables, often making it difficult to discern any type of cycle or economic regularities. For these reasons, we will first try to extract the knowledge of how cyclical the prices and inflation *vis-à-vis* real income and then try to re-examine the reliability of the results by employing some contemporaneous innovation accounting methods based on a system vector autoregressive process. We must note, on this point, that following Canova (1998) a critical issue connected with de-trending arises from a standard 'measurement without theory' concern leading researchers to the question of statistical *vs*. economic based decomposition, of which the former assumes that the trend and the cycle are un-observable but uses different statistical assumptions to identify the two components, and the latter requires that a theory explaining the mechanism generating economic fluctuation is to be needed. But we here should consider that economic-based decomposition of actual time series would give rise to using arbitrary filtering procedures which reflect the preferences of the researcher to establish business cycle facts. However, dynamic economic theory may not indicate the type of economic trend that series may display nor the exact relationship between secular and cyclical components.

The data used from the Turkish economy consider the time span of 1998Q1 – 2008Q4 with quarterly observations of 1998: 100 based new income series. The sample period has not been divided into sub-periods since the period in an annual basis is highly small for the Turkish economy when compared with

international evidence, and as Fiorita and Kollintzas (1994) state, the smoothed trend can capture the most important structural breaks. The real income data (*GDP*) are represented by the gross domestic product with 1998: 100 based constant prices. For the price level series (*DEF*) we consider the *GDP* deflator, thus, the differenced form of this series indicates the domestic inflation (*INF*). All the variables have been taken in their natural logarithms and obtained from the electronic data delivery system of the Central Bank of the Republic of Turkey (CBRT). It is worth noting that various estimation methods have been come into use in contemporaneous economics literature to reveal the interactions between macroeconomic time series, namely, structural vector autoregression models and alternative data decomposing techniques of the macroeconomic time series into their trend and cyclical components after linearizing them and using various filtering approaches of mostly popular filters proposed by Hodrick and Prescott (1997) and Baxter and King (1999) to estimate the correlations between, by definition in the long-run, stationary cyclical series of the economic aggregates. Granted this, in this paper, we tend to employ the latter type decomposing techniques to the Turkish data and so try to extract some fundamental cyclical relationships between real income and prices/inflation. We think suffice it to note that our approach followed must be taken as a preliminary analysis of the business cycles experienced by the Turkish economy which requires that further analyses based on more complicated estimation techniques are to be needed so as to verify whether our results in fact reflect, at least, somewhat true data-generating process of the Turkish business cycles.

For this purpose, we first de-seasonalize all the time series using US Census Bureau's X12 adjustment program and apply to additive (difference from moving average) method considering data taking on negative values. Having de-seasonalized the time series, we linearize them by taking natural logarithms to smoothen the changes in those, and then apply to the widely used Hodrick-Prescott (henceforth HP) filter to obtain a smooth estimate of the long-term trend of a series. We can define HP filter as a two-sided linear filter that computes the smoothed series x_t^{pot} observed for any period t from the original x_t series by minimizing the variance of x_t around x_t^{pot}, subject to a penalty that constraints the second difference of x^{pot}. That is, the HP filter chooses x^{pot} to minimize:

$$HP_{x_t} = \sum_{t=1}^{s}(x_t - x_t^{pot})^2 + \lambda \sum_{t=2}^{s-1}[(x_{t+1}^{pot} - x_t^{pot}) - (x_t^{pot} - x_{t-1}^{pot})]^2 \quad (1)$$

where s is the sample size and λ is a parameter that penalizes the variability of trend. Thus the penalty parameter λ would control the smoothness of the series. The larger the λ the smoother the trend path of the series would be expected. If $\lambda = 0$ an extreme real business cycle model would have been taken into consideration where all of the fluctuations, e.g. in real output, would be caused by technology shocks, and in this case the HP trend would be the same as the historical time series itself (Metin-Özcan et al., 2001). As $\lambda = \infty$, x^{pot} approaches a linear deterministic trend. Following Canova (1998) the optimal value of λ is of the form $\lambda = \sigma_t^2 / \sigma_c^2$ where σ_t^2 and σ_c^2 are the standard deviation of the innovations in the trend and cycle, respectively. HP assume that a 5 percent cyclical component is moderately large, as is a one-eighth of 1 percent change in the growth rate in a quarter, which leads us to select as a value for the smoothing parameter:

$$\sqrt{\lambda} = 5/(1/8) = 40 \Rightarrow \lambda = 1600 \quad (2)$$

Thus we set $\lambda = 1600$ in our paper as well. However, even though it is one of the mostly applied de-trending methods in economics literature, HP filter has also been criticized in several ways. See, e.g. King and Rebelo (1993) and Cogley and Nason (1995) upon this issue.

In the light of these methodological explanations, when we aim to conduct a business cycle analysis based on data filtered throught HP decomposition, some empirical regularities to be considered have been of a special importance for the researchers. If the cross-correlation $\rho(j)$, $j \in \{0, \pm 1, \pm 2, \ldots\}$ between the two series such as Y_t and X_{t+j} up to four quarters reaches the maximum for a negative j, the series leads the reference cycle, that is to say more explicitly, reaches its turning points j units of time earlier than Y_t. In the other case, if the cross-correlation is maximum for a positive j, the series' cycle lags behind the Y_t cycle by j units of time (Woitek, 1997). For instance as Kydland and Prescott (1990) state, productivity is a series that leads the cycle, whereas the stock of inventories is one that lags the cycle. If the cross correlation between Y_t and X_{t+j} is maximum for $j = 0$, the cycle of X is synchronous. Also if contemporaneous correlation coefficient $\rho(0)$ is positive,

zero, or negative, the series *X* would be considered pro-cyclical, *acyclical*, or counter-cyclical, respectively (Kydland and Prescott, 1990; Fiorita and Kollintzas, 1994). In our sample of 44 observations of the period 1998Q1 – 2008Q4 with quarterly data, the unknown population contemporaneous correlation coefficient can be taken to be significant when $0.30 < |\rho| < 1.00$ leading us not to reject at the 5% level of significance the hypothesis that the population correlation coefficient is not zero in a two-sided test for bi-variate normal random variables.

For informative purposes, we must state that as Agénor et al. (1999) emphasize, estimation results in this paper are based on un-conditional correlations between filtered output and price level/inflation series, and such correlations do not necessarily imply causal relationships and thus may require at least some bi-variate exogeneity tests. Nevertheless, our findings will provide *a priori* knowledge for the cyclical characteristics of the business cycles of the Turkish economy. Below in Table 2 are given both the value of the autocorrelation function (AC) of the *GDP* series and the volatility measures represented by standard deviations (σ) of the cyclical component of each variable. Following these preliminary methodological explanations, the cross-correlations between the filtered cyclical series of *GDP* and *DEF* as well as of *GDP* and *INF* are reported in Table 3 and Table 4. We specify the maximum correlation coefficient in bolds.

Table 2: AC Function of the Cyclical *GDP* Series and Volatility of the Cyclical Series (x 100)

AC function									σ_{GDP}	$\sigma_{DEF}/\sigma_{GDP}$	$\sigma_{INF}/\sigma_{GDP}$
Period	1	2	3	4	5	6	7	8	0.033	1.811	0.939
	0.625	0.348	0.061	-0.052	-0.037	-0.022	0.046	0.077			

Table 3: Cross-Correlations Between Cyclical *GDP* and *DEF* Series

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}
-0.011	-0.092	-0.326	-0.447	**-0.626**	-0.624	-0.579	-0.496	-0.384

Table 4: Cross-Correlations Between Cyclical *GDP* and *INF* Series

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}
0.198	0.172	0.082	0.028	-0.324	-0.220	**-0.382**	-0.099	0.062

The de-trended *GDP* data are strongly positively autocorrelated that reflect persistence in business cycle fluctuations. The first autoregressive coefficient is 0.625. See Göktaş (2005) for a more detailed technical information of econometrics upon this issue. Such a finding somewhat supports the estimation results of Kydland and Prescott (1990) and Backus et al. (1992) for the US economy which both estimate the value of first-degree autoregressive coefficient as 0.85, while Fiorita and Kollintzas (1994) report also high first-degree autoregressive coefficients for the G-7 countries ranging from the maximum of 0.85 for the US to the minimum of 0.55 for the UK. Backus et al. (1995) confirm this result for 11 developed countries as well. Agénor et al. (1999) report strong positive autocorrelations for a set of developing countries indicating considerable persistence in the cyclical components and interpret these results as suggesting that it is appropriate to view these developing countries as having short-term fluctuations that could be reasonably characterized as business cycles. Aguiar and Gopinath (2007) also reveal similar estimation results considering both 13 developed and 13 developing countries including Turkey with significant first-degree autoregressive coefficients ranging from 0.49 to 0.92. Dealing with the Turkish case, Alper (2002) finds the degree of the persistence of the shocks in the cyclical component of the real *GDP* with a coefficient of 0.58, while Aguiar and Gopinath (2007) estimate the same coefficient as 0.67. However, Alper (1998) and Agénor et al. (1999) using industrial production data report lower findings for the relevant coefficient such that both find the degree of persistence of output fluctuations about its trend as 0.38. The percentage standard deviation of real income, 3.28, is in line with the findings of Alper (2002) and Aguiar and Gopinath (2007), which estimate 3.48 and 3.57, respectively. When we compare the volatility values of filtered real output of developed and developing countries, Aguiar and Gopinath emphasize that emerging market economies on average have a business cycle two times as volatile as their developed counterparts. Having filtered the real output series, the volatility in developed countries is in general found higher than the value of 2.00 extending to the value of 4.00, whereas for developed countries the standard deviation of output fluctuations is smaller than the value of 2.00 in a way supporting the findings of Backus et al. (1995).

As is briefly explained above, Chadha and Prasad (1994) reveal that price level is counter-cyclical but inflation is pro-cyclical using postwar quarterly data for the G-7 economies and that it is necessary to make a clear distinction between inflation and the cyclical component of price level when reporting and interpreting stylized facts regarding business cycles. As so, they consider that the pro-cyclicality of inflation rate rather than of price level retains credibility of demand-driven models. However, Rand and Tarp (2002) estimate that the cyclical patterns of inflation and price level are in general same for both developed and developing countries, suggesting that supply-driven business cycle models are appropriate in describing cyclical patterns in developing countries also in line with the findings of Hoffmaister and Roldós (1997). As Fiorito and Kollintzas (1994) emphasize, a benchmark RBC model can easily account for a negative correlation between output and prices, as technology shocks shift the aggregate supply of output upward. Our estimation results in Table 3 and Table 4 verify that both the deflator based price level and inflation have a counter-cyclical characteristic with real output in a way supporting what the supply-driven business cycle models bring out. We find that even though the price level considered is synchronous, the inflation rate seems to lag the cycle by two-quarters.

On this point, we also apply to some bi-variate Granger causality tests so as to extract more information from the data that are able to provide some additional inferences at the extent to which variables precede each other. We find that bi-variate Granger causality tests carried out under the H_0 hypothesis of no causal relationship yield results in favor of uni-directional causality running from cyclical real output to cyclical price level with an F-statistic 4.08 (prob. 0.05) using lag one against a reverse causal relationship with an F-statistic 0.49 (prob. 0.49), and from cyclical real output to cyclical component of inflation with an F-statistic 2.16 (prob. 0.08) using lag two against a reverse causal relationship with an F-statistic 1.01 (prob. 0.46), of which the lags are determined according to the model selection Akaike information criterion statistics. Briefly to say, these causality test results support the cross-correlations reported above in the sense that the course of the cyclical real output component tends to precede the course of the cyclical price level and inflation. Thus, as Chadha and Prasad (1994) express, even though it is widely perceived that temporary movements in output are associated with shocks to demand while longer-term movements in output are associated with movements

in supply, the counter-cyclical variation of prices suggests that even temporary movements in output may be due to the supply shocks.

5. GENERALIZED IMPULSE RESPONSES

To control the direction of the relationship between the cyclical components of price level/inflation and real income, we apply to the generalized impulse response (*GIR*) analysis proposed by Koop et al. (1996) for non-linear dynamic systems and further developed by Pesaran and Shin (1998) for linear multivariate models. As Koop et al. (1996) state, at the heart of the impulse response analysis has been the postulate to answer what the effect of a shock hitting an endogenous variable system at time t on the state of the system at time $t+n$ given that no other shocks hit the system. Green (2000) also define the impulse response functions as the path whereby the variables of the system return to their equilibrium values, if so, also supporting their stationary characteristics when the impact of the shock introduced at date t tends to return to zero thereafter.

In this sense, the *GIR* analysis can be considered an alternative to orthogonalized impulse responses. The *GIR*s which take account of the historical patterns of correlations observed among different shocks provide researchers to be invariant to the ordering of the variables in the system. To briefly explain this methodology, let us follow Pesaran and Shin (1998) and consider the infinite moving average representation of a vector autoregressive (VAR) model as follows:

$$x_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i} \tag{3}$$

where x_t is n x 1 vector of the variables. The coefficient matrices A_i can be obtained according to:

$$A_i = \Phi_1 A_{i-1} + \Phi_2 A_{i-2} + ... + \Phi_p A_{i-p} \quad i = 1, 2, \ldots \tag{4}$$

with $A_0 = I_n$ and $A_i = 0$ for $i < 0$. If Ω_{t-1} is a non-decreasing information set that identifies the known history of the economy up to time t-1, considering a forecast horizon N, the *GIR*s for a shock hitting the system can be represented as:

$$GIR_{(N,\varepsilon_t,\omega_{t-1})} = E(X_{t+N} \mid \varepsilon_t = \varepsilon_t^0, \omega_{t-1}^0) - E(X_{t+N} \mid \varepsilon_t = \varepsilon_t^0, \omega_{t-1}^0) \quad (5)$$

where E represents a conditional expectation operator, ε_t is a random shock, and ω_{t-1}^0 is a particular historical realization of the information set Ω_{t-1} at time t-1. Given the structure of the VAR model constructed so far, we can write:

$$GIR_x = A_{N\varepsilon_t^0} \quad (6)$$

with the property of being independent of the history of the process. This function, instead, exhibits dependence on the composition of shocks defined by ε_t^0 which is assumed to be normally distributed with the process $\varepsilon_t \sim N(0, \Sigma)$. Further assume that:

$$E(\varepsilon_t \mid \varepsilon_{it} = \delta_i) = (\sigma_{1i}, \sigma_{2i}, \ldots, \sigma_{ni})' \sigma_{ii}^{-1} \delta_i \quad (7)$$

where $\delta_i = (\sigma_{ii})^{-1/2}$ represents one standard error shocks. Following Pesaran and Shin (1998), if e_i is n x 1 vector with the i^{th} element equal to one and all other elements equal to zero, the *GIR*s function indicates for a one standard deviation shock to the i^{th} equation in the VAR model on the j^{th} variable at horizon N:

$$GIR_{ij,N} = \frac{e_j' A_N \Sigma \varepsilon_i}{\sqrt{\sigma_{ii}}} \quad , i, j = 1, 2, \ldots, n \quad (8)$$

We must state that the impulse responses emerging from the *GIR*s function are unique and invariant to the ordering of the variables of the system since impulse responses tend to account for the contemporaneous correlation inherent in the non-diagonality of Σ by integrating out their effects according to the observed distribution of the residuals. However, even though the generalized impulse reponses are invariant to the ordering of the variables in the system that seems to provide an advantage for estimation purposes, they do not enable researchers to make pre-assumptions based on economic considerations for the recursive relationships between the endogenous variables in the VAR system.

For this purpose, we now construct unrestricted VAR models for the endogenous variable vectors (*GDP DEF*)′ and (*GDP INF*)′. Using the maximum lag length five for the quarterly data, we consider sequential modified

LR test statistics, employing small sample modification, and Akaike information criterion and find that both information criteria suggest to use the lag order four for the (*GDP DEF*)′ and the lag order five for the (*GDP INF*)′ variable vector. Furthermore, the largest root of the characteristic polynomial is 0.8763 for the (*GDP DEF*)′ vector and 0.8125 for the (*GDP INF*)′ vector, therefore we can infer that the VAR models satisfy the stability condition that enables us to implement impulse response analysis for the dynamic interactions between the variables. Note that statistical significance of the impulse response functions coincides also with the case that the upper and lower confidence bands carry the same sign. The generalized impulse response estimates using 2000 Monte Carlo repetitions of ± 2 standard deviations (s.d.) are reported below.

Several results emerge from the impulse response functions. When we consider the dynamic interactions between the cyclical components of output and price level, we see that output responds to own shocks positively and that the statistically significant effect of these shocks seems to prevail by about four periods. A one s.d. immediate effect of an output shock upon itself is a 2.0% increase, and after 4 periods this effect is still 1.0%, the half of the impact effect, and then the response of output to the initial shock dies out. We also find a significant negative dynamic impact of the price level on output. A one s.d. positive shock on the price level leads to 1.2%, 0.9% and 1.1% decrease in output for the three successive periods following the shock. Given the symmetric nature of impulse responses, we can infer that the lower the price level the larger the cyclical output, supporting a negative dynamic relationship between the two components of our business cycle analysis. When we deal with the shocks occurred on the price level, we estimate that the effect of cyclical output on the price level is a 1.6% decrease and even four periods later than the shock the price level witnesses a 2.1% decrease, and the effect of shock steadily dies out the longer the period considered. We also observe a significant degree of price stickiness due to the strong positive response of the price level to its own shocks.

Figure 1: Generalized Impulse Responses for the *GDP-DEF* Relationship

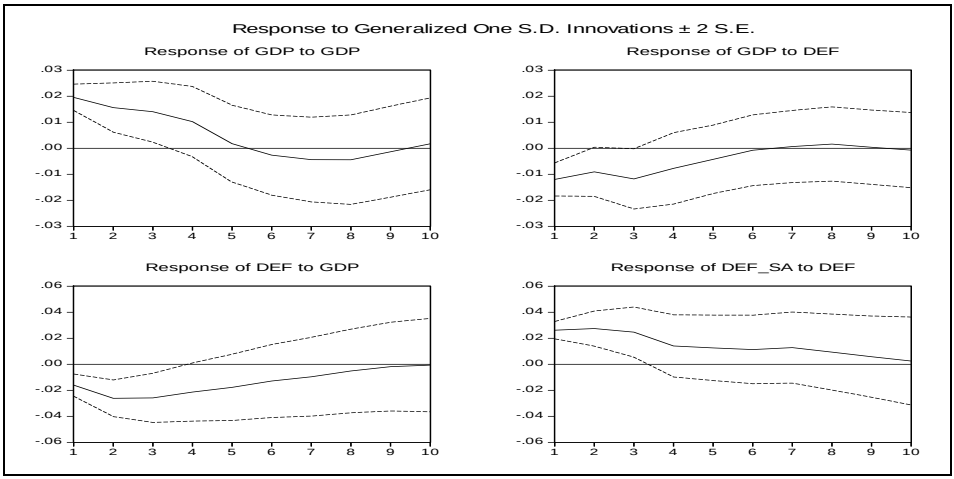
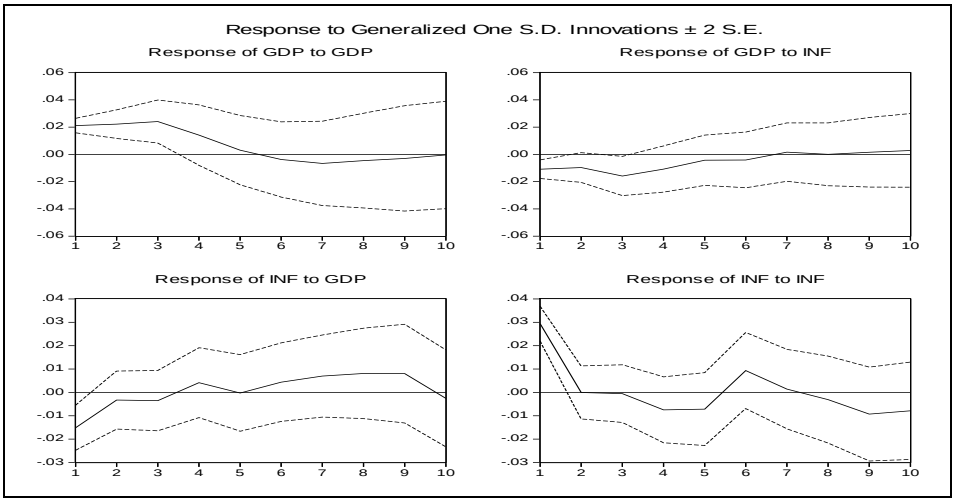


Figure 2: Generalized Impulse Responses for the *GDP-INF* Relationship



If we use cylical component of inflation instead of price level against the cyclical output, in our empirical analysis, no considerable change can be observed. Output is mainly driven by the shocks upon itself in a positive way and this effect lasts by about four periods in a statistically significant way. Following a one s.d. positive shock, as to the speed of adjustment of the economy towards new equilibrium, the impact effect occurred on output is a

2.1% increase, and then output tends to further increase steadily 2.2% and 2.4% for the second and third periods, and after by about 5 periods later than the shock the adjustment process of output to new equilibrium seems to be completely dying out. We find that a one s.d. positive shock on inflation significantly decreases output 1.1%. In a similar vein, we can easily notice that a positive output shock has an immediate strong negative effect on inflation, that is, a one sd. positive shock on output leads to a 1.5% decrease in inflation, which supports our counter-cyclical correlations between output and inflation obtained in the former sections. As can be expected, we observe that inflation reacts to own shocks positively. We see that a one s.d. positive shock on inflation results in a 2.5% increase upon itself which means the presence of a considerable inertia in inflation. We must also note that as to the diagnostic structure of the models estimated, both the *GDP-DEF* and the *GDP-INF* models have been subject to no 1^{st} or 4^{th} order serial correlation problem. Under the null hypothesis of no serial correlation, the LM-statistics yield LM-AR(1) = 4.63 (prob. 0.33), LM-AR(4) = 5.23 (prob. 0.26) for the *GDP-DEF* model, and LM-AR(1) = 1.02 (prob. 0.91), LM-AR(4) = 2.19 (prob. 0.70) for the *GDP-INF* model.

Thus these findings support our former cross-correlation analysis implemented between the filtered cyclical series of real income and price level/inflation with an emphasis made upon counter-cyclical relationships of the two business cycle components in the Turkish economy. All in all, our results obtained through decomposition analysis of cyclical series from their trends and through contemporaneous generalized impulse response analysis indicate that there seems to be a *data consistent* strong negative relationship between output and price level/inflation. We think that the estimation results in this paper do not give credibility to the discretionary demand-driven *so-called* Keynesian policies to stabilize the effects of the business cycles affecting the Turkish economy inside the period examined. Instead, the policies permitting to supply shocks which lead to a negative interaction between output and price level/inflation must have been of a special importance in the eyes of economic agents and policy makers. In this sense and in line with the reference papers examined upon the Turkish economy, the extent of variations in real exchange rate and the role of capital flows in affecting various underlying domestic macroeconomic aggregates may be among the primary factors that are able to serve to yield the effects of supply-based business cycle shocks on the Turkish economy. Such an

inference, of course, requires future researches to examine the effects of real exchange rate and capital flows on the course of the Turkish business cycles.

6. CONCLUDING REMARKS

The coincidence of a chronic inflationary framework with an unstable real income growth path defines one of the salient properties that identify the course of the Turkish business cycles for the last three decades, and these benchmark characteristics of the economy, but by no means solely, are able to shape the expectations of economic agents as to the future periods as well. On this point, it is convenient to assume that policy makers are likely to be reached to the stabilization purposes provided that they could estimate some underlying relationships between macroeconomic aggregates and only when they succeed in achieving this task will the policy outcomes reflect the desired consequences as for the stabilization purposes. Otherwise, discretionary policies are able to only partially correct disequilibrium conditions stemmed from current macroeconomic framework as well as being not fully justified in a theoretical sense. Nor can we offer any precise judgement about how appropriate the competing models would be considered better when compared with the others.

In this paper, we try to shed some light upon this issue of interest and re-examine the cyclical characteristics of the real income and prices/inflation considering 1998: 100 based new income series data. Having reported a brief methodological account of the business cyclical phenomenon and touched upon the importance of discerning whether prices are pro- or counter-cyclical, we employ some contemporaneous filtering methods to extract the cyclical components of inflation and output from the trend course of these aggregates and examine correlations between these decomposed series. Our estimation results indicate that the de-trended real income data are strongly positively autocorrelated that reflect persistence in business cycle fluctuations and that both the deflator based price level and inflation have a counter-cyclical characteristic with real output in a way supporting what the supply-driven business cycle models bring out. We find that even though the price level considered is synchronous, the inflation rate seems to lag the cycle by two-quarters. On this point, we also apply to some bi-variate Granger causality tests so as to extract more information from the data that are able to provide some additional inferences at the extent to which variables precede each other and

find that in a way supporting the cross-correlation results, the course of the cyclical real output component tends to precede the course of the cyclical price level and inflation, which leads us to infer that even temporary movements in output may be due to the supply shocks. To further control the direction of the relationship between the cyclical components of price level/inflation and real income, then, we apply to the generalized impulse responses analysis. The results verify that there exists a *data consistent* strong negative interaction between real output and prices/inflation. Considering all these findings, we conclude that, had there not been a counter-cyclical relationship between real income and prices/inflation witnessed by the Turkish economy inside the period examined, other things being equal, the demand-driven policies could have been suggested for various stabilization purposes. However, our estimation results do not give credibility to the discretionary demand-driven *so-called* Keynesian policies to stabilize the effects of the business cycles affecting the Turkish economy, rather emphasize that the policies permitting to supply shocks which lead to a negative interaction between output and price level/inflation must have been of a special importance in the eyes of economic agents and policy makers.

Were these the past and quite robust explanations of business cycles in the Turkish economy for the last decade with a negative correlation between prices/inflation and real income so much so that we tempted to jump immediately to the conclusion that the economy was mainly to be dominated by the supply shocks, in this sense, we suggest that papers studying the extent of variations in real exchange rate and the role of capital flows in affecting various underlying domestic macroeconomic aggregates would be highly complementary to our paper as a future research to further analyse the effects of supply-based business cycle shocks on the Turkish economy.

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