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Exchange Rate Pass-Through in Turkey: Has it Changed and to What Extent?

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Abstract

This study analyzes the impact of exchange rates on domestic prices in Turkey. We seek to demonstrate the variations (if any) in the exchange rate pass-through across different exchange rate regimes, identify the determinants of this change, and characterize the degree and extent of pass-through across different sub-sectors. Our empirical results reveal that the pass-through of exchange rates to domestic prices has declined in the post-2001 period in comparison with the earlier episodes—thanks to a decline in the "indexation" behavior. These findings suggest that switching to floating exchange rate regime and implementing an ambitious disinflation policy have contributed, to a large extent, to the reduction in the pass-through. Nevertheless, the impact of exchange rate on inflation, especially in the traded goods is still notable, pointing out that the effect of nominal exchange rate movements on relative prices have increased in the float period.

Keywords: Exchange rate pass-through, Time-varying parameters, Seemingly unrelated regressions, Disinflation, Floating exchange rate regime.

JEL Classification Codes: C51, E31, E58.

Table of Contents

List of Tables

List of Figures

I. INTRODUCTION

Understanding and quantifying the impact of exchange rate shocks to the domestic prices has always been interest to both academicians and the central banks. The fact that in recent years most of the emerging market economies abandoned fixed exchange rate regimes in favor of inflation targeting regimes makes this question even more interesting: Most of the emerging market economies have lived with fixed exchange rate regimes for many years. These regimes, by definition, create a strong relation between nominal exchange rates and other nominal variables such as the price level. Switching to a floating exchange rate regime along with an inflation targeting strategy is expected to weaken this relationship. Otherwise, given that exchange rate is almost unpredictable in a floating exchange rate regime, forecasting future inflation would be virtually impossible—a highly undesirable situation for the monetary authorities.

The Turkish economy, which has adopted floating exchange rate regime after years of managed/pegged exchange rate regimes, is an interesting laboratory in this respect. Using Turkey as an experimental tool, this study discusses the relation between exchange rate and prices (pass-through) in small-open-emerging market economies. We aim to analyze the evolution of exchange rate pass-through process, demonstrate the change (if any) in this process, identify the determinants of this change and characterize the extent of pass-through across different sub-sectors.

Most of the theoretical and empirical studies that focus on industrialized countries define "exchange rate pass through" (ERPT henceforth) as the percentage change in local currency import prices resulting from a percentage change in the exchange rate, as mentioned in Goldberg and Knetter (1997). However, the literature on emerging market economies treats ERPT as the impact of exchange rate on domestic prices as well. Such a difference in definition is intuitive since most of the emerging economies can be viewed as small open economies, where pricing to market is believed to be small, implying a full pass-through from exchange rates to local currency import prices. In such cases, domestic prices are much more sensitive to changes in the nominal exchange rate.

There are other important factors as well, which validate to focus on the role of exchange rates on domestic prices for emerging market economies. First, these economies are highly dependent on imported intermediate goods in the production process, either in the form of raw materials or capital goods. With the implicit assumption of limited substitution possibilities between imported and domestic inputs, a change in the exchange rate will be reflected directly and rapidly to the prices of domestic goods. Second, depreciation in the exchange rate[1] increases the Turkish Lira value of the imported goods and hence the consumer price index (CPI). The effect will be stronger, the larger the share of the traded goods in the CPI basket.[2] As important as these two well-known factors, exchange rates are likely to affect domestic prices through another distinct channel, which can be named as "indexation". Montiel and Ostry (1993) describe this mechanism as:

"…exchange rate depreciations, in turn, raise the rate of inflation by increasing expectations of inflation, which are then accommodated by the monetary authorities or through a wage indexation mechanism. The latter would occur if the frequency of indexation increases due to inflationary expectations associated with devaluation."

Consistent with the above explanation, in a persistent inflationary environment, where domestic currency loses its function of being "unit of account" and "store of value", a high rate of indexation is likely to be observed.[3] Moreover, under fixed/crawling peg exchange rate regimes or real exchange rate targeting, price setters regard exchange rates as a "nominal anchor". [4] Unless some measures are taken to change the expectation of "devaluation is equal to inflation", this process continues.[5]

Ho and McCauley (2003) state that episodes of rapid and large devaluation/depreciation and consequent high inflation may lead to the use of foreign currency in transaction and financial contracting, which could increase the degree of exchange rate pass-through beyond the levels implied by the cost channel. Therefore, besides the cost channel, which operates through imported intermediate and final

[1] In this case nominal exchange rate is defined as domestic currency/USD.
[2] For example, approximately 60 percent the CPI basket for the Turkish economy is traded goods.
[3] Anaya (2000), Honohan and Shi (2002), Ize et al (2002) provide evidence, albeit conflicting, about the link between "financial dollarization", that is currency substitution, and "real dollarization", which is the indexation channel of exchange rate pass-through.
[4] Warjiyo and Hutabarat (2002) report the results of a survey for Indonesia, which reveals that all companies are concerned with exchange rate movements, 46% for price setting, 43% for the need to import raw materials and 9% for external debt obligations.
[5] In fact, the main motivation behind an exchange rate-based stabilization program is the attempt to break this inflationary process. In turn, however, exchange rate based stabilization programs may further tighten the link between exchange rates and inflation in emerging market economies.

goods, it is very likely that there exists another channel from exchange rates to domestic prices, which operates through "expectations".[6] However, existence of this channel may also lead to a dramatic decline in indexation after switching from fixed exchange rate to floating exchange rate regime due to a change in the exchange rate dynamics. The fact that, float is often accompanied with an inflation-targeting recipe, helps indexation channel to weaken further. Thereby, our second hypothesis of interest is to test whether indexation channel of exchange rate pass-through has changed after the adoption of the floating exchange rate regime in Turkey.

Similar to the experience of other emerging market economies, Turkey has a history of high inflation, currency crises and financial dollarization. These in turn, created an environment, in which price makers either set prices in foreign currency or take the exchange rate movements as price signals, regardless of the share of imported input in their production. In light of the arguments above, our focus throughout the study rests exclusively on emerging markets. We thus define the pass-through as the percentage change in domestic prices resulting from a one-percentage change in the nominal exchange rate. In this respect, dollarization manifests itself as a part of the "expectations" channel whereby the changes in the exchange rate are reflected on domestic prices. Along with this indexation mechanism, the impact of the exchange rate due to changes in input costs should also be taken into account, given the fact that most of the intermediate inputs in Turkey are imported.

Needless to say, pass-through can vary significantly over time and between sectors. In this respect, a time-varying parameter model emerges as a suitable framework, where one can account for the varying degrees of pass-through for different subgroups. In addition, since the time-varying parameter setup does not allow for detailed statistical analysis about the changes in the pass-through, a seemingly unrelated regression model is also employed in the study.

Our empirical results reveal that the pass-through of exchange rates to domestic prices has gone down in the post-2001 period in comparison with the earlier episodes—thanks to a decline in the indexation behavior. Under a particular specification, we find that the exchange pass-through to inflation has dropped to 15% for traded and 8% for non-traded sectors in a four-month period from their pre-float

[6] Ho and McCauley (2003), Mihaljek and Klau (2001) and Berument(2002) all specify the expectations channel in addition to the cost channel in their studies related to emerging market economies.

values of 68% and 45%, respectively. We also find that variations in the nominal exchange rates have a significant impact on the relative prices.

In the remaining of this introductory section, we discuss the impact of exchange rates on the relative prices and the role of exchange rate pass-through in the inflation-targeting framework. We also highlight the change in the exchange rate dynamics for the Turkish economy in order to set out the base for our discussion of exchange rate pass-through. The next section presents and interprets the time varying parameter estimates for two alternative specifications. We highlight the differences among pass-through to the price of tradables and non-tradables in an attempt to figure out whether indexation behavior has changed during the sample span. The third section repeats the same exercise using a Seemingly Unrelated Regression (SUR) analysis. This method allows us to conduct statistical tests to demonstrate the change in the exchange rate pass-through. We also test several hypotheses regarding the pass-through across sectors in this setup. Finally, the fourth section presents a summary of the results along with concluding remarks.

I.1. Role of Pass-Through on Relative Prices

Analyzing ERPT becomes even more important when the changes in the exchange rate exert varying degrees of pressure to the prices. That is, depending on whether the good is traded or the share of imported inputs is large, dramatic changes in the relative prices can be observed in the economy due to a change in the exchange rates, which can also distort the allocation efficiency of the factors of production. As a result, similar to the effects of monetary policy on relative prices, unforeseen innovations to exchange rates can also result in a similar change. Therefore, after controlling for sector-specific factors, measuring the degree of ERPT for different sectors has the potential to provide important insights for the economy.

Complementary to the argument above, one can also build up an indirect link between ERPT and monetary policy actions, based on the findings of Mankiw *et al.* (2003). They find that relative price variability can induce significant disagreement in public regarding inflation expectations, which creates an extra incentive for monetary policy to take further actions. If it is observed that ERPT exerts asymmetric pressure on the prices of the goods from different sectors, then it can be characterized as a factor that causes relative price variability, which, in turn, increases uncertainty and may induce monetary authorities to revise their policies. In another study, Longworth (2000), while discussing the Canadian experience of inflation targeting, marks change in relative prices as a key element in the short-run inflation process. Therefore, it can be concluded that the varying degrees of ERPT can lead to an indirect effect on inflation through changing relative prices in the economy.

I.2. The Role of Exchange Rate Pass-through in the Inflation Targeting Framework

The last decade witnessed increasing number of central banks –both from industrialized and emerging countries- adopting inflation targeting regimes in an attempt to achieve price stability. Taking inflation forecasts as the nominal anchor, exchange rates in such a framework is just a forward looking variable that is pinned-down by publicly known set of macroeconomic targets and forecasts. However, after switching to an IT framework, some agents may continue to perceive the exchange rate as a nominal anchor, i.e. they attribute a great deal of importance to nominal exchange rate movements and may reshape their behavior accordingly. This importance may arise from basically four channels, the first of which is fairly structural and is directly related to the costs of imported inputs. Secondly, it may take some time for economic agents to learn the new regime. Thirdly, the nominal exchange rate is an easy-to-capture and well-packed daily indicator of what is simultaneously happening in markets; that is, the nominal exchange rate is resultant of the daily monetary policy operations, daily developments in the secondary bond market and probably the stock market. And finally, uncertainty on a daily basis is mostly captured by the exchange rate developments and hence the agents' expectations may depend largely on these. Needless to say, currency substitution, or dollarization in specific, should always stand above all as the basic cause of indexation mechanisms to operate in a dominant manner.

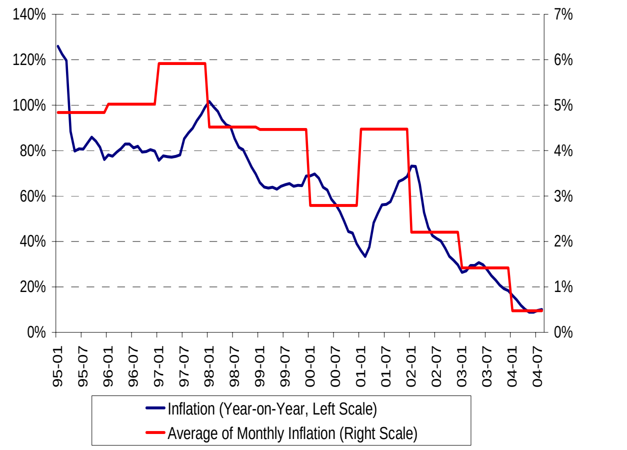
Understanding the pass-through process is important for the inflation-targeting regime. The extent to which the inflation of traded and non-traded groups is affected by movements in exchange rate is important. The speed as well as the extent of pass-through to final goods prices constitutes major considerations, since a delayed pattern of pass-through reduces the impact of temporary exchange rate movements on inflation rate.

Inflation targeting central banks are mostly inflation forecast targeters. Inflation forecasts, however, can be significantly affected by the developments in the exchange rates. If shocks to inflation exhibit a significant portion of the forecast error variance of exchange rate, which is likely to occur in an economy where there is significant degree of ERPT, then there emerges an extra incentive for central banks to monitor the changes in exchange rate dynamics closely. In this respect, characterizing the ERPT has always been high interest to central banks—especially to the emerging market monetary authorities.

I.3. Exchange Rate Dynamics for the Turkish Economy

Before conducting the analysis of exchange rate pass through, it is important to document the disinflation and change in exchange rate dynamics in Turkey, which may have a major impact on exchange rate pass-through.[7]

Figure 1. A Brief History of Inflation in Turkey



[7] Taylor (2000) hypothesize that the decline in the pricing power of firms and the fact that firms pass through smaller part of changes in costs onto the prices, is due to the decrease in inflation. Furthermore, it is also stated that the observed change in the pricing power is, in part, due to the change in the expectations of persistence of exchange rate changes. It is problematic to identify the impact of disinflation and change in exchange rate regime on ERPT due to the fact that these events occur simultaneously after 2001 crisis. An example that identifies the contribution of each structural change on ERPT can be found in Steel and King (2004) for New Zealand where two regime switches occur at different periods.

Inflation, measured as year on year change, has declined from 125 percent in January 1995 to 10 percent in 2004 (Figure 1). However, the disinflation process has been far from a linear one. Only after the 2001 crisis, a continued stabilization effort[8] succeeded in bringing inflation down to low levels. Therefore compared to the 1990's Turkey has experienced a continued disinflation.

Another change during the 2001 crisis was the adoption of the floating exchange rate regime. The change in exchange rate regime brought about a structural change in the exchange rate dynamics. There are mainly two differences in the exchange rate behavior between two periods, pre-float and floating exchange rate regime.

One of the changes in exchange rate dynamics is the increased likelihood of nominal appreciation of TL. After the adoption of the floating exchange rate regime, periods of depreciation in the exchange rate have been followed by periods of appreciation, which is in contrast with the periods of continued depreciation of Turkish Lira in 1990s (Figure 2). This marked difference stems from the fact that in 1990s monetary policy was conducted so as to stabilize real exchange rate with the aim of supporting the price competitiveness of Turkish exports (Alper, 2003). In other words, accommodative exchange rate policy and "real exchange rate targeting" ensured that exchange rate depreciated in line with past inflation.[9] However, in the floating exchange rate regime, the monetary policy is directed solely to maintaining price stability and the Central Bank of Republic of Turkey (CBRT) do not have any mandate over level of exchange rate.[10] As a result, exchange rate maintains its own course as determined by market forces. Accordingly, unlike the pre-crisis period, there were many episodes where exchange rate appreciated in nominal terms (Figure 2). The fact that depreciation can be followed by a subsequent appreciation affects expectations about the persistence of exchange rate movements -the perceptions of the price setters regarding the future marginal costs- and thereby the exchange rate pass-through to prices.

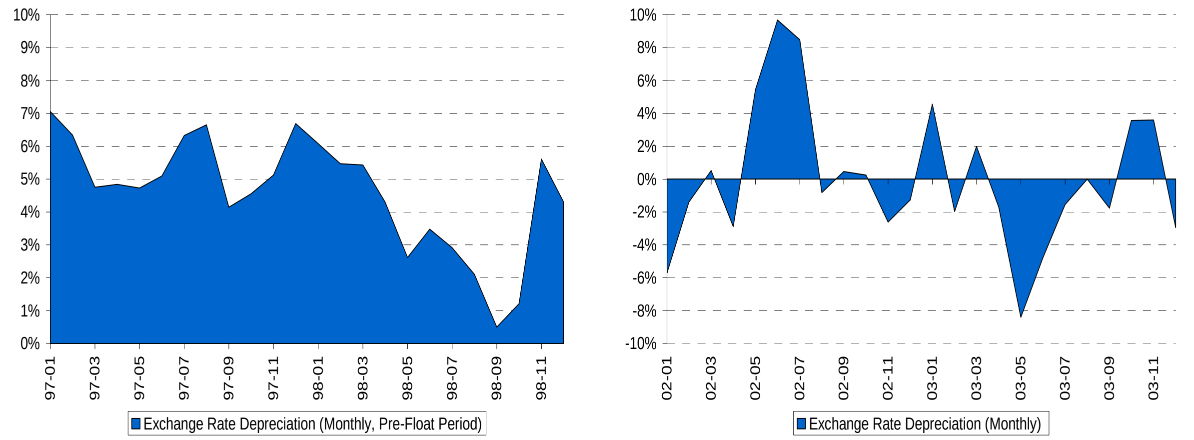
[8] One of the important features of the stabilization effort is the change in Central banking law, which makes the price stability the primary objective of Central Bank with an operational independence. Secondly, fiscal consolidation, which aimed at curbing domestic debt burden by setting targets on primary surplus, is critical to the credibility of stabilization effort. The credibility of disinflation in the case of Turkey is documented in Rossi and Rebucci (2004).

[9] Similar case is observed in EU accession countries (Coricelli *et al.* 2004)

[10] Indeed, during 2002-2004 periods, apart from periods of excessive volatility in FX markets, CBRT did not intervene in the FX markets.

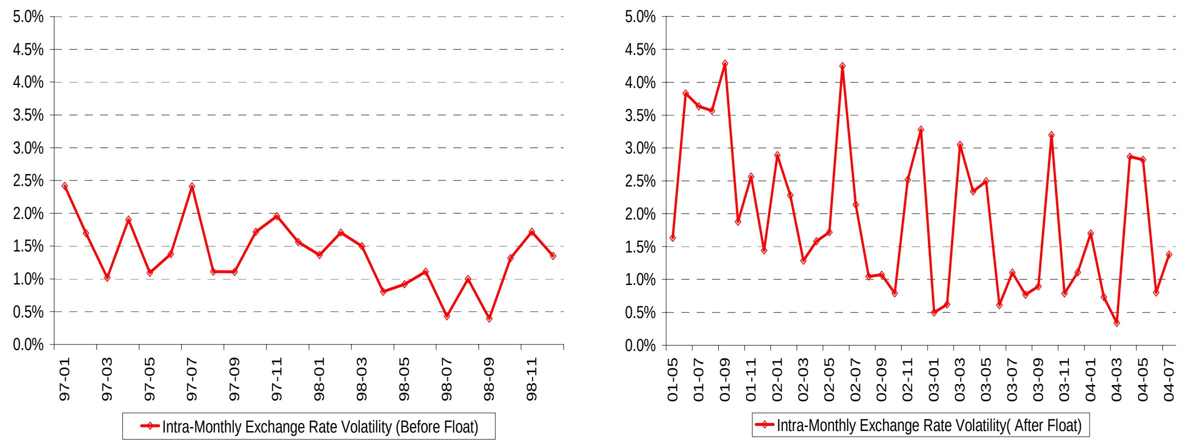
Figure 2. Change in Exchange Rate Dynamics 1: From Depreciation/ Depreciation to Depreciation/Appreciation

Pre-float Float



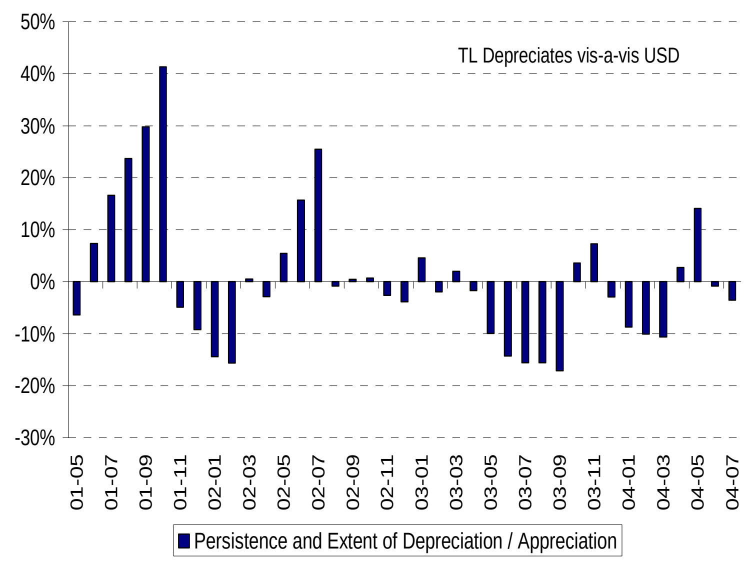
Another marked difference between the two periods is the increase in intra-monthly volatility of exchange rate (Figure 3). Increased volatility, in turn decreased the information content of the exchange rate, previously a well-packed indicator for transactions.

Figure 3. Change in Exchange Rate Dynamics 2: Intra-Monthly Exchange Rate Volatility



The cumulative depreciation (appreciation) in the successive depreciation (appreciation) periods is depicted in Figure 4. In this way, the extent of depreciation (appreciation) or the duration of these periods can be observed. A cursory look at the figure reveals that the extent of consecutive persistent changes in the exchange rate diminishes over time. This is due to the exchange rate overshooting after the crisis of 2001. Secondly, there is an asymmetry between periods of appreciation and depreciation. Depreciation periods are short periods with higher absolute changes, whereas appreciation periods are longer. Thirdly, in line with figure 2, periods of depreciation, which take about 2 months in the recent periods, are followed by periods of appreciation. Thereby in ex-post terms, the persistence of the exchange rate changes has diminished significantly in the floating exchange rate regime.

Figure 4. Duration and Extent of Exchange Rate Changes (*)



(*)For instance a successive depreciation period starts in June 2001 and lasts for five months with a cumulative depreciation of app. 40 percent on average term.

II. TIME-VARYING PARAMETER (TVP) ANALYSIS OF ERPT

As mentioned in the introduction, the degree of ERPT can vary significantly between regimes, through time and between sectors. Therefore, it may be more appropriate to model the degree of ERPT as a time-varying process, most suitably in a time-varying parameter framework. In that sense, first we have studied the pass-through behavior in Turkey using a time-varying parameter approach equipped with Kalman filter.[11] This approach allows us to obtain point wise estimates of the parameters of interest and hence to observe their patterns of change over time. In this section, we present the results of the time-varying parameter models.

Our time-varying parameter (TVP) estimates of the exchange rate pass-through (ERPT) coefficients are obtained from the following alternative specifications:

Specification 1

$$\pi_t = \alpha_{0,t} + \alpha_{1,t}\pi_{t-1} + \beta_{0,t}q_t + \beta_{1,t}q_{t-1} + \varepsilon_t$$
$$\alpha_{0,t} = \alpha_{0,t-1} + e_{1,t}$$
$$\alpha_{1,t} = \alpha_{1,t-1} + e_{2,t}$$
$$\beta_{0,t} = \beta_{0,t-1} + e_{3,t}$$
$$\beta_{1,t} = \beta_{1,t-1} + e_{4,t}$$

$e_{i,t}$ *are white noise stochastic processes.*

Specification 2

$$\pi_t = \alpha_{0,t} + \alpha_{1,t}\pi_{t-1} + \beta_t q_t^{MA(2)} + \varepsilon_t$$
$$\alpha_{0,t} = \alpha_{0,t-1} + \eta_{1,t}$$
$$\alpha_{1,t} = \alpha_{1,t-1} + \eta_{2,t}$$
$$\beta_t = \beta_{t-1} + \eta_{3,t}$$

$\eta_{i,t}$ *are white noise stochastic processes.*

where, π_t and q_t are the inflation and nominal depreciation in period *t*, respectively. $q_t^{MA(2)}$ stands for the two-months moving average figure of monthly depreciation. Both specifications include a time-varying intercept term, as well. Each of the estimated coefficients, namely α_{0t}, α_{1t}, β_{0t}, β_{1t}, and β are designated so as to follow individual random walk processes as expressed above.[12]

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[11] For a technical discussion of the estimation technology employed in this section, the reader might visit Hamilton (1994).

[12] The appropriate lag orders for our specifications are obtained using the Schwarz Information Criterion. Based on this criterion the optimal lag length has been selected as 2 months for both headline CPI and the headline WPI. In Specification 1, hence, the contemporaneous value and the first lag of the depreciation are included. In the same spirit, in Specification 2, the moving average depreciation is computed by using the contemporaneous

The motivation behind these specifications is as follows: Specification 1 is utilized to capture the pass-through dynamics with sufficient number of lags, equivalently without introducing redundant further lags. Indeed, the TVP estimation procedure does not produce stable results for higher numbers of lags. On the other hand, in Specification 2, we basically measure the impact of a more smoothed depreciation series on inflation outcomes in each month. In this way, we provide a framework to crosscheck for the findings that Specification 1 yields.

We examine the pass-through behavior of inflation series, considering two broad categories. The first category contains the headline CPI (consumer price index), and its subcategories such as traded[13], non-traded, processed food, and energy prices. The second category includes the subcomponents of the headline WPI, such as agriculture, total manufacturing, and energy prices. Regarding that the private and public manufacturers might have different behaviors, total manufacturing has further been assessed in terms of its private and public sector components. The series have been seasonally adjusted whenever they demonstrate statistically significant seasonal patterns.

II.1. Estimated TVP Coefficients: Consumer Prices

In this subsection, we present and interpret the pass-through to consumer prices. Findings regarding the consumer prices are especially important, as the inflation targets are set in terms of CPI inflation in Turkey.

The sample period for all estimations presented in this section runs from 1995:04 to 2004:06 at a monthly frequency. The starting point is selected as 1995:04 in order to avoid the erratic crisis period of the year 1994. Furthermore, while plotting the estimated pass-through and inertia coefficients, we have omitted the first four months of the sample period.[14] Consequently, all the parameter estimates are plotted for 1995:08-2004:06 periods.

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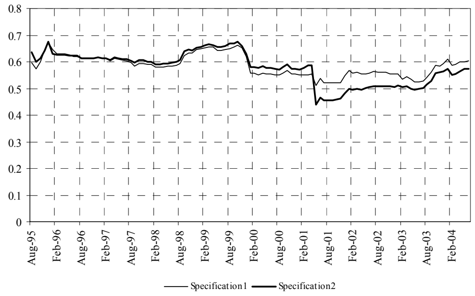
value and the first lag of monthly nominal rate of depreciation. In order to ensure comparability, this lag configuration has also been employed on other series of concern.

[13] In this study, we have used the terms traded and tradables, non-traded and nontradable interchangeably. The details of data series used can be found at the Appendix.

[14] The TVP estimation procedure starts with (1) the state-space representation of a model and (2) initial setups of the initial parameter vector and the variance-covariance matrix. During the procedure, given the stochastic process with which the parameter vector evolves and the realized data, the parameter vector and the variance-covariance matrix is updated at each sample point conditional on the forecast error at the previous sample point. Evidently, at the beginning of the sample, updates of the parameter vector and the variance-covariance matrix occur in a radical manner until these entities gain an adequate level of average stability.

Figure 5. Consumer Price Index-Headline

a. Coefficient of Lagged Inflation



b. Pass-through Coefficient

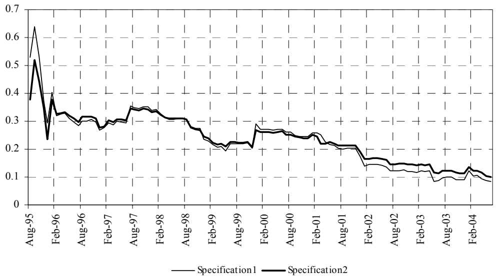


Figure 5 presents the estimates for the CPI. The evolution of the intercept term over time is omitted for convenience. Furthermore, the TVP pass-through estimates for Specification 1 are reported in terms of the sum $\beta_{0t} + \beta_{1t}$ (sum of coefficients on the contemporaneous and lagged monthly depreciations), whereas it is simply β_t (moving average) in the case of Specification 2. Figure 5 suggests that, the coefficients on the lagged exchange rates have been declining in size—pointing to a steady fall in the pass-through.[15] On the other hand, the coefficient of lagged inflation exhibits almost a stable pattern through time, slightly decreasing in 2001 and reverting to its pre-2001 values after then.

A closer inspection of pass-through coefficients in **Figure 5** reveals that the pass-through coefficient slightly elevated at the end of 1999, as a natural outcome of the introduction of crawling peg exchange rate regime. However, it has started declining as of the beginning of 2000 and jumped only slightly in the February 2001 crisis. After the crisis, it kept declining in a gradual manner. From January to February 2001, it had a nearly 5% downward jump and settled around 15% until June 2003. From June 2003 to the present time, it followed its latest stable plateau around 10%. This plateau-wise decline of the pass-through coefficient is especially intuitive as the pass-through coefficients are in visual harmony with the policy changes.

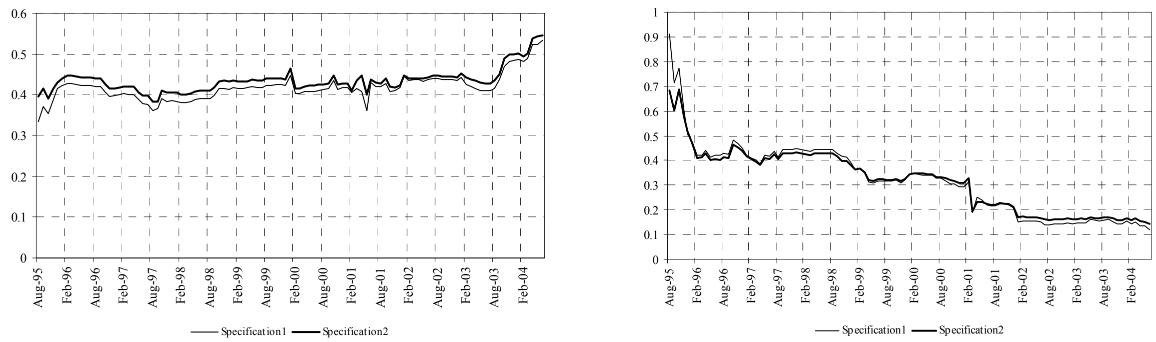
Similar shift is also applicable to the traded, non-traded, processed food and energy prices; as seen in **Figure 6** through **Figure 9**. However, it should also be noted that the pass-through in processed food and energy prices are more stable and higher throughout the sample history. Given that energy prices are administered by the government and set (indexed) in tandem

[15] Our choice of presenting the estimates in graphical/pictorial format stems from the high number of estimated figures. For instance, each run of Specification 1 yields number of estimates that is four times the sample size. The estimated parameter series are available from authors upon request.

with the cost of imported commodities, the relatively high pass-through in energy prices should not come as a surprise.

Figure 6. Traded (under CPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient



In the case of traded goods (under CPI) the inertia coefficient estimates, shown in **Figure 6**, follow around a value of 40% from the beginning of sample span up until August 2003 and climbs up to nearly 55% as of June 2004, which might need further explanation or assessment. On the other hand, the clear plateau-wise drop of the pass-through coefficient is worth mentioning. From February 1999 to February 2001, it is around 30% after assuming a value of 40% between February 1996 and February 1999. As of the February 2001 crisis it has a sudden drop to 20% and this value is maintained until January 2002. Since that date, the pass-through coefficient has been around 15%. As a result, it has been observed in **Figure 5** and **Figure 6** that the decrease in pass through coefficients coincides with increasing inertia coefficient. It can be the case that as long as pass-through effect has weakened, inflation can better be explained by a univariate specification.

Figure 7. Non-traded (under CPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient

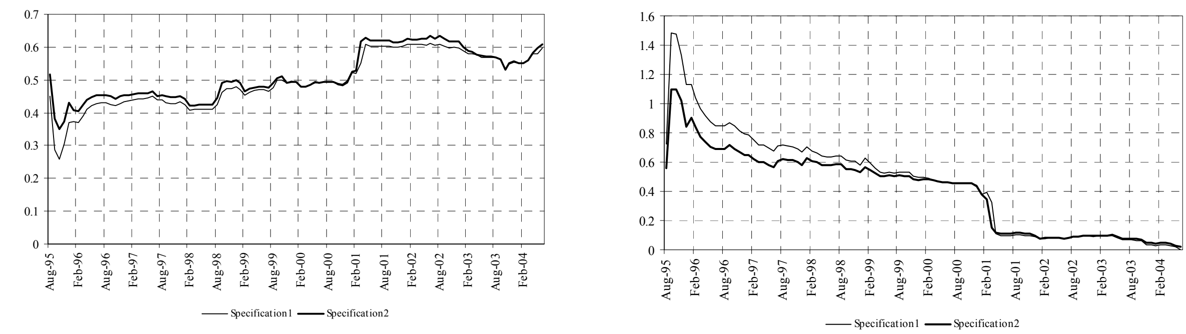
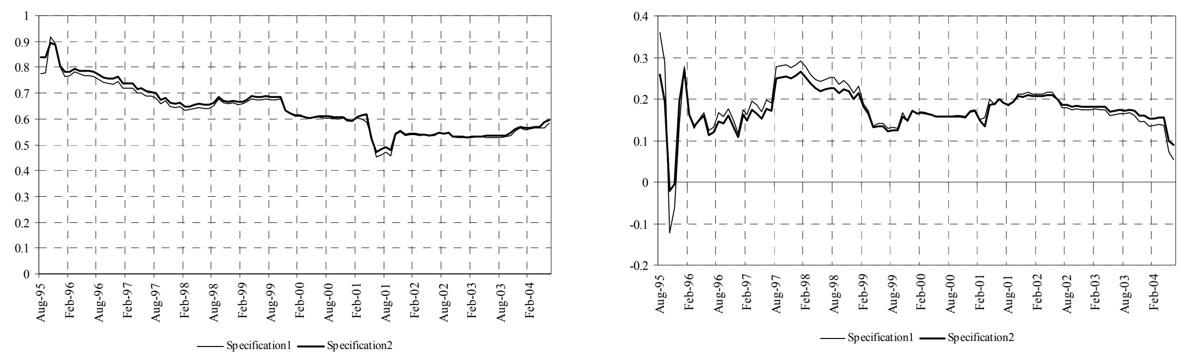


Figure 7 presents the estimates for non-traded (under CPI). In this case, the inertia coefficient slowly climbs from 40% up to 50% in the February 1996-February 2001 period. Then, until May 2001, the coefficient had a sharp increase to about 65% and assumes this value further until February 2003. It is only after this date that we observe a slight decline. However, the behavior of the pass-through coefficient estimate is fairly well characterized in this case. As **Figure 7** suggests, this coefficient displays continuously decreasing values from 80% to 40% between February 1996 and January 2001, yet it has a sudden fall to nearly 15% in February 2001 crisis, which is maintained after then. These results suggest that the pass-through in non-traded items might be subject to a structural shift, which remains to be tested.

Figure 8. Processed Food (under CPI)

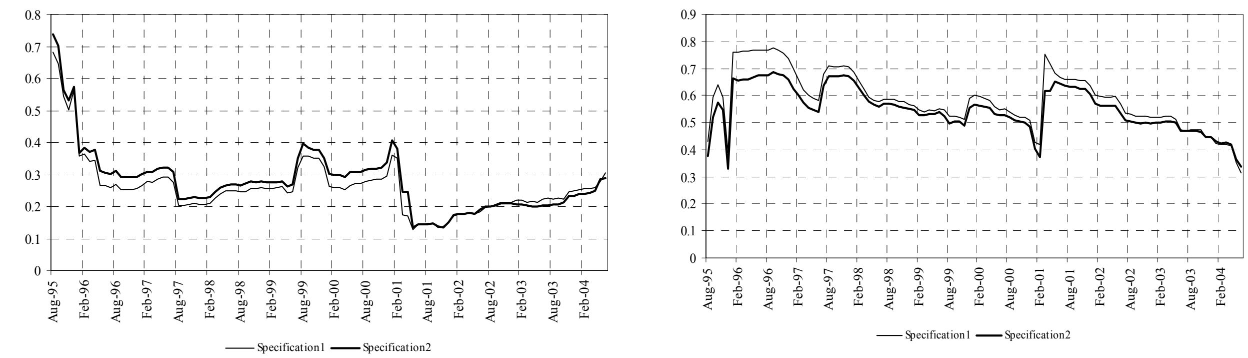
a. Coefficient of Lagged Inflation b. Pass-through Coefficient



The findings for processed food (**Figure 8**) are not as stylized as the previous figures. There is basically a single period in time, which separates two plateaus of inertia coefficients, namely the February-August 2001. Before this period, the inertia coefficient is about 65% on the average and settles around 55% thereafter. Pass-through coefficient estimates are not that much of clear-cut: Only observation that we can safely utter is the steady decline of pass-through after July 2002.

Figure 9. Energy Prices (under CPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient



Finally, the energy prices (under CPI) are assessed in **Figure 9**. It is fairly the case that the inertia has declined sharply after August 1995 and has had an average value of 30% between February 1996 and January 2001. In February 2001 crisis, it has fallen to 15% in a sharp manner and climbed up to 30% until June 2004. The pass-through coefficients, on the other hand, has almost always been high, averaging around 60% and only recently took values below 40%. Given the pricing behavior in the energy sector, these results are not surprising. Energy prices are sensitive to exchange rate changes by their very nature, as the government, with a certain lag, automatically adjusts the prices of oil products along with the changes in domestic currency price of imported oil. However, the political authority had a wide room to determine the timing and extent of price updates. Also, another important determinant of energy price inflation is world oil prices (in foreign currency), which is not captured in our model. Taking these points into account, the relatively unstable inertia coefficient is not surprising.

In a nutshell, **Figure 5** through **Figure 9** suggest a decline in pass-through behavior in Turkey, especially after the 2001 financial crisis—a period that is characterized by the latest stabilization program. Lower pass-through marks limited feedback from the exchange rate to domestic prices as compared to the past/historical experience. This observation has salutary implications about the overall stance of the Turkish economy. However, the seemingly increased inertial behavior should also be noted for most of the examined series, which is probably a reflection of the successful disinflation performance after May 2001. As discussed before, a univariate inflation specification can emerge as a more suitable specification as the pass-through in the economy decreases. As a result, we may observe an increase in the estimated inertia coefficients at the last phase of the sample period.

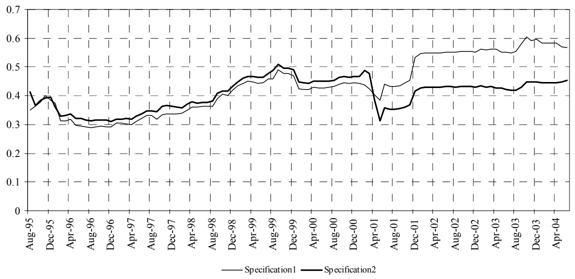
II.2. Estimated TVP Coefficients: Wholesale Prices

In this subsection, we use the same model template as defined by Specification 1 and Specification 2 for overall consistency and comparison purposes. We elaborate the findings for the agriculture, total manufacturing, public manufacturing, private manufacturing, and energy prices under WPI. Among these sub-indices, the comparative behavioral patterns of public versus private manufacturing sectors reveal an important change due to the behavior of public sector in the post-2001 period. Moreover, there are considerable insights for the comparison of energy prices under WPI and CPI.

We begin by presenting the results for headline WPI. **Figure 10** suggests that the lagged coefficient of headline WPI moved from 0.40 in 1995 to around 0.45 to 0.55 in 2004, based on Specifications 1 and 2. The fall in the ERPT coefficients are also evident in the figure. The pass-through coefficient is around 60% at the beginning of sample span exhibiting a gradual decline through the sample period. The decline in the pass-through becomes more pronounced after the end of 2001. At the end of sample span, the pass-through coefficient turns out to be between 10-15%.

Figure 10. Wholesale Price Index-Headline

a. Coefficient of Lagged Inflation



b. Pass-through Coefficient

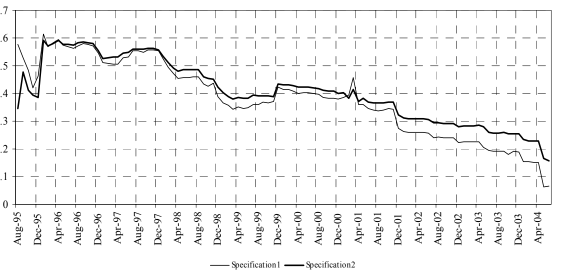
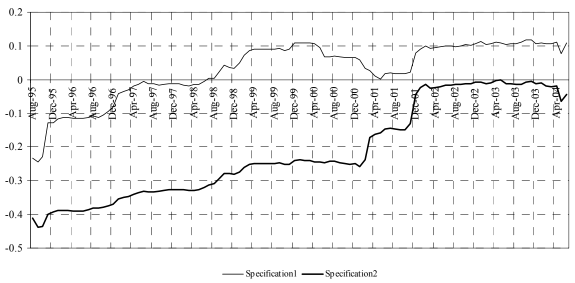
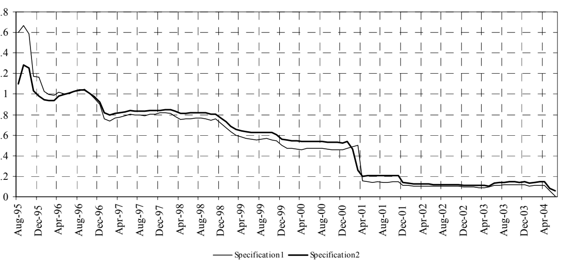


Figure 11. Agriculture (under WPI)

a. Coefficient of Lagged Inflation



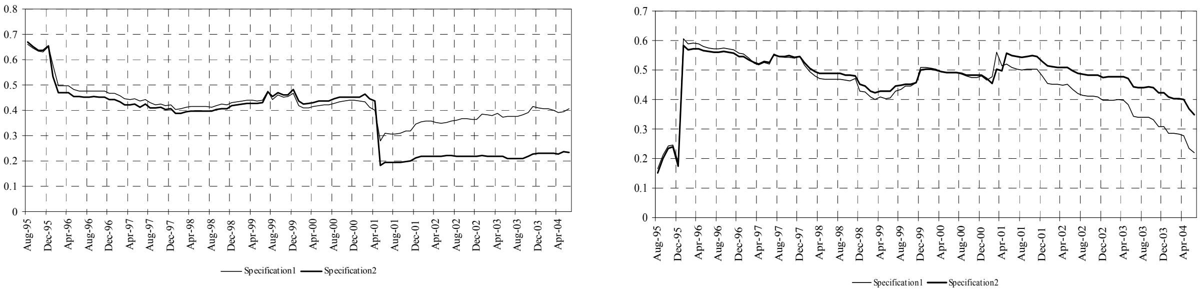
b. Pass-through Coefficient



In **Figure 11**, we repeat the same exercise for agricultural prices under WPI. Surprisingly, the sign of the lagged coefficient is negative for a sufficiently large portion of our sample. This is not surprising, since agricultural price dynamics are driven largely by exogenous factors such as government policy and weather conditions. However, even in this situation, the pass-through coefficients depict a plausible time-path and seem to have declined to a large extent. Evolution of the pass-through coefficient through time demonstrates two major plateaus, one averaging nearly to 65% before February 2001 and the other averaging to 15% afterwards. The de-elevation between these plateaus occurs in a sudden manner and coincides with the February 2001 financial crisis.

Figure 12. Total Manufacturing (under WPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient



Lagged coefficient of total manufacturing sector prices demonstrates a decline In **Figure 12**; however, the decline is from a higher plateau to a lower one, instead of a steady decay. At the same time, the pass-through steadily falls. Having a look at the time-varying pass-through coefficients, we observe that until May 2001, it maintains an average of 50% and until June 2004 falls to nearly 35% (with specification 2). Although not quite impressive, this finding is still important in the sense that the pass-through coefficients demonstrate a clear-cut fall relative to its history.

As a matter of fact, this result can be better understood after disentangling the behavior of public versus private manufacturing sector prices. As suggested by **Figure 13**, pass-through for public manufacturing prices has always been on a high-path, averaging historically around 60%, falling only very slightly during the course of 2004. At the same time, given the administered nature of the public prices in general, low inertia of the public manufacturing prices should not come as a surprise.

Figure 13. Public Manufacturing (under WPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient

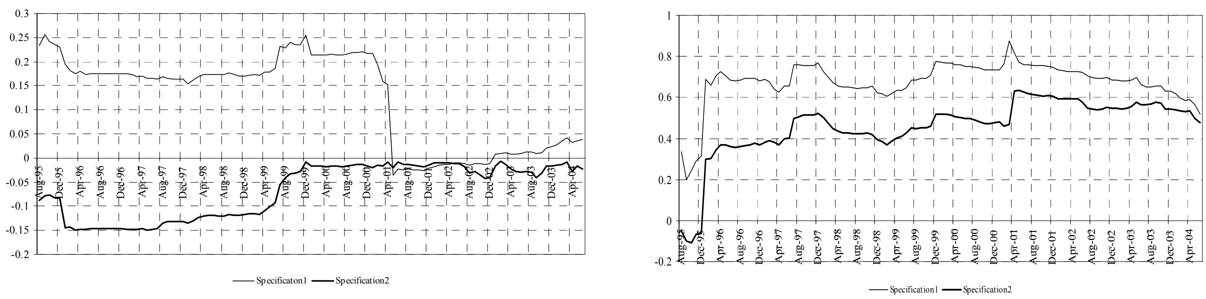
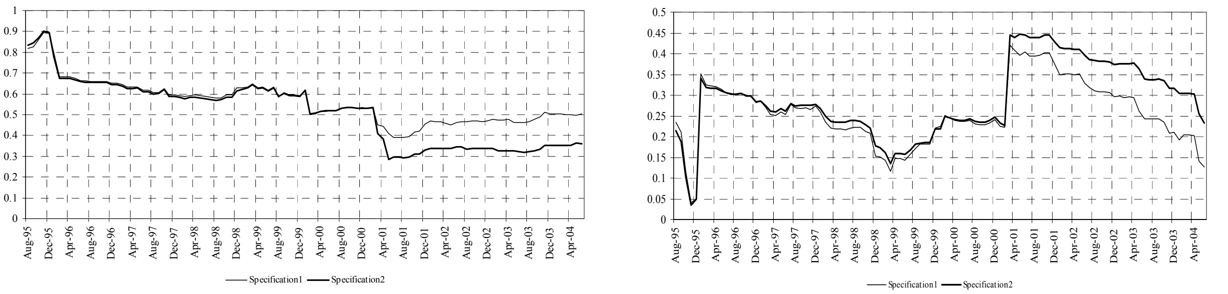


Figure 14. Private Manufacturing (under WPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient

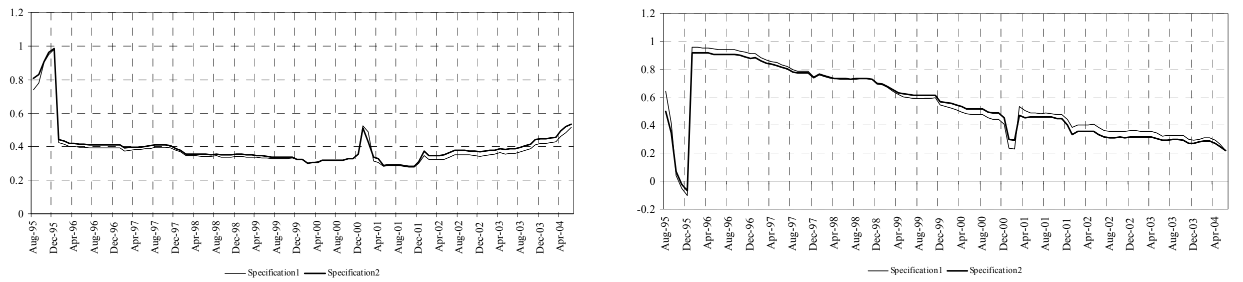


On the other hand, **Figure 14** reveals that it is the shift in private manufacturing sector behavior that has pulled down the pass-through of overall manufacturing prices to a lower plateau after 2001. After the 2001 crisis, the pass-through coefficient in private manufacturing prices jumped to the highest peak ever and then steadily fell. Consolidating together the findings in **Figure 12**, **13** and **14**, one can safely argue that the pass-through in private manufacturing sector is much lower than the public sector.

Finally, the pass-through coefficients of energy prices reveal a declining pattern, with the one-time and temporary fall in the pass-through coefficient in February 2001 (**Figure 15**). We should also note that the inertia coefficient averages about 40% over our sample span. Furthermore, the fall in the pass-through to WPI energy prices is steadier than that of the CPI energy prices, and the time pattern of pass-through coefficients is less volatile in the case of WPI energy prices.

Figure 15. Energy Prices (under WPI)

a. Coefficient of Lagged Inflation b. Pass-through Coefficient

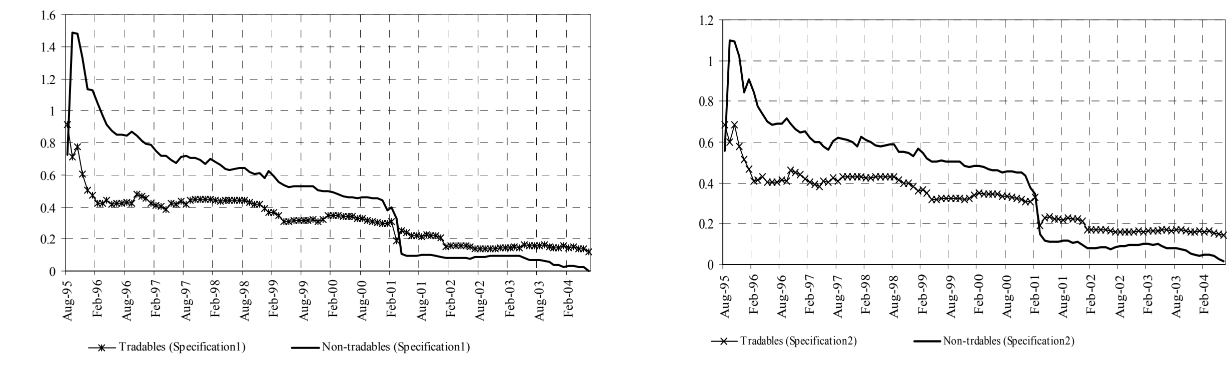


II.3. Assessment of Indexation

Is it possible to identify the "indexation" behavior by looking at the pass-through coefficients? Within the current technical framework, indexation can be identified by looking at the difference of the pass-through coefficients regarding traded and non-traded sectors. Under the absence of indexation, where price setters respond to only input costs, traded goods prices are expected to reveal higher exchange rate pass-through than the non-traded items. However, when a significant fraction of price setters index their prices to exchange rates, regardless of the type, one should expect a high pass-through. Therefore, comparing the time-varying pass-through coefficients for tradables and nontradables may yield valuable information on the extent of indexation.

Figure 16 replicates the findings of **Figure 6** and **Figure 7** for convenience. It is quite surprising to observe that the pass-through to non-traded inflation is higher than that to traded inflation before 2001. This might be an indicator of strong indexation behavior. This is in harmony with the observed currency substitution behavior and fixed exchange rate regime that is prevalent in this period. On the other hand, it is quite interesting to observe that there have been a sizeable decline in the indexation behavior -in the sense that the pass-through in the non-tradable sector has went down drastically- after the introduction of floating exchange rate regime along with the stabilization program in 2001.

Figure 16. Measurement of Indexation



II.4.Pass-Through Comparisons

The analysis of the pass-through for CPI (**Figure 5** through **Figure 9**), WPI (**Figure 10** through **Figure 15**) and their sub-components conveys further messages when their results are consolidated together. The pass-through in headline CPI and headline WPI has declined to a wide extent for both, especially after May 2001, whereas the decline is historically larger in the case of wholesale prices. At the same time, the inertia in consumer prices has almost always been higher than that in wholesale prices.

Having compared the pass-through behavior of all series of interest, we can say that the highest pass-through, regardless of being consumer or wholesale, is in energy prices—a subcomponent whose price is administered. Our findings suggest a relatively high pass-through for public manufacturing sector prices (under WPI) as well. These points suggest that the administered prices almost directly absorb the effects of exchange rates. High possibility of discretion by the public sector—as to the choice of when and how to reflect the exchange rate changes onto prices—is also embedded in this finding. From a structural perspective, small-open economy characteristic of Turkey amplifies the pass-through effects. Similarly, budgetary considerations and overall fiscal stance of the economy, which can be characterized by high needs of financing, should be considered as an important determinant of public sector pass-through.

A final observation regards the pass-through behavior in non-traded (under CPI) and agricultural prices (under WPI). In both of these cases, pass-through has decreased from very high levels to historically low figures. Considering this observation together with the pass-through behavior of other series of interest, we can conclude that indexation behavior has considerably diminished after May 2001.

These consolidated findings convey a basic message: There is a change in the structure of pass-through parameters after the floating exchange rate regime and the latest macroeconomic stabilization period. Given the disinflation process and lower pass-through, other factors such as the industrial productivity or the output gap can also be considered as other factors that helped this decline. However, the pass-through coefficients remained quite steady at the end of the sample period, where the output gap slightly picked up. Such an observation implies that output dynamics does not seem to account for mush of the change in the pass-through coefficients.

II.5. Analysis of Structural Change

In the previous sections, we have visually identified the decline in the ERPT following the adoption of the floating exchange rate regime. In this section, we formally test for a structural change in the time-varying ERPT coefficients within a statistical framework. Since we are interested in the possibility of a structural change in the time-varying ERPT coefficients rather than the parameters of the model used to estimate them, we utilize unit-root tests that allow for a structural break instead of using stability tests for the whole model.

Using the methodologies of Zivot and Andrews (1992) and Perron (1997), we search for an endogenous structural break in both the intercept and the slope of the unit root test equation for the time-varying ERPT coefficients. The unit-root framework is particularly relevant since the ERPT coefficients are defined as a random-walk process in the state-space model (namely, Specifications 1 and 2). Although the tests give both the structural break points and the unit-root test results, we are only interested in the former as the estimated time-varying pass-through coefficients are integrated of order one by construction. Indeed, the tests reveal a unit-root in the majority of instances, a listing of which is available from authors upon request.

The computer procedures we have employed involve testing for a single structural break point within a time series of concern, as they are designed in line with Zivot and Andrews (1992) and Perron (1997).[16] Considering the possibility of multiple structural break points given the instability of the Turkish economy, we carried out these single-break tests within a recursive scheme and identified one structural break point for each moving sub-sample that has a different starting point and a fixed end point. For example, the test carried out for the sub-sample of January 1996-June 2004, identifies February 1997 as a structural break point. The same test yields December 1999 as the structural break point, when carried out for March 1997-June 2004. Changing the starting date of the sample from January 1996 to May 2001, and keeping the end date as June 2004 in each regression, we regenerated such tests. In total, we came up with 65 separate replications of each test.

Our recursive approach of identifying structural breakpoints helps also to check for the sensitivity of test results to the choice of time span covered by the unit-root tests.[17] In this way, by recursively regenerating the tests, we obtain a structural break point for each (recursively narrowed down) sub-sample of January 1996-June 2004 period. [18]

The recursively applied Zivot-Andrews test points out to two distinct structural break points in the exchange rate pass-through to the headline CPI, which are December 1999 and December 2001, irrespective of including intercept and/or time trend terms.[19] Up to the sub-sample starting with September 1999, the tests identify December 1999 as the structural break point. Afterwards, December 2001 is identified as a structural break point. These dates are

[16] We have used the RATS procedures Zivot.src and Perron97.src from Estima web site, accessible at http://www.estima.com

[17] If they are really sensitive to such choices then one should pay extra attention to what is going on.

[18] The smallest sample that we allow for is the one that starts at May 2001 and that has 38 observations, which provides sufficient degrees of freedom.

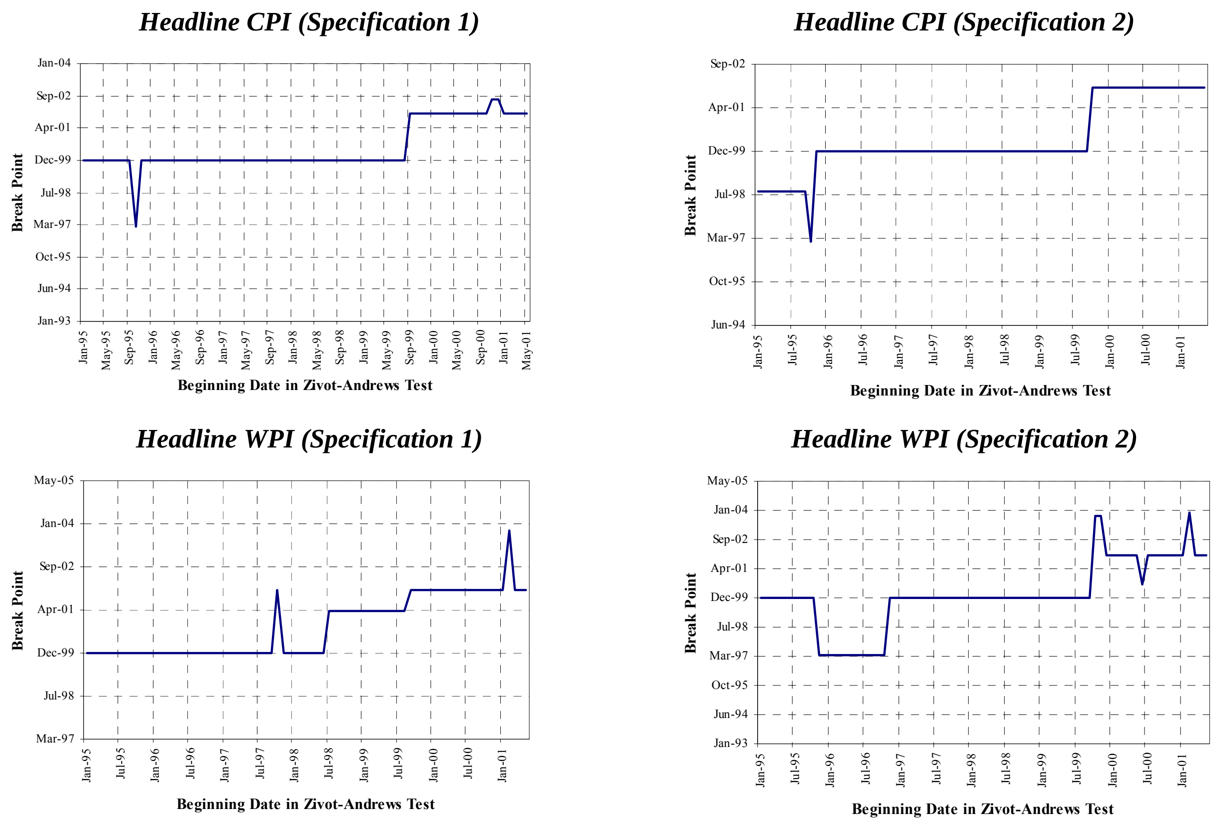
[19] This exercise allowed us to observe how the structural break point changes conditional on the considered time-span of analysis. Equivalently, it helps checking for the robustness of the structural break point against sample selection. The output tables that show the break points for all recursive samples are available from the authors upon request.

quite in line with our prior expectations as December 1999 marks the beginning of the exchange rate based stabilization program that involved an officially set predetermined path for the exchange rates; and December 2001, although not officially announced, corresponds to the start of the implicit inflation targeting regime, marking the start of the latest disinflation process.

As put forth by many studies including Darvas (2001) and Steel and King (2004), ERPT might be higher in an exchange rate targeting framework since changes in exchange rates might be regarded as more permanent than in a floating exchange rate regime. Besides, according to Taylor (2000), in a low-inflation environment, where firms have a lower pricing power compared to a high-inflation environment, ERPT should be relatively low. With the currency crisis of February 2001, there has been a shift to a floating exchange rate regime for the first time in Turkey's history. Prior to the floating exchange rate regime, it was more common for the Turkish lira to depreciate against the foreign currencies. The float period, on the other hand, has been characterized mostly by consecutive appreciations. Besides, the exchange rate has displayed a significantly higher volatility compared to the pre-float period. Moreover, starting from the beginning of the year 2002, Turkey has witnessed a continuous disinflation period, in which CPI inflation first fell down to 29.7 percent at the end of 2002 from 68.5 percent at the end of 2001, then declined further to 18.4 percent by the end of 2003 and to 9,3 percent by the end of 2004. Therefore, the fact that the endogenous structural break tests point out to December 2001 as a structural break point is no coincidence; it is a theoretically consistent and expected finding. Indeed, in the previous sections, we have visually identified the decline in the ERPT after the adoption of the floating exchange rate regime. In Figure 17, we plot the exact date of the structural change.

The other structural break point picked up by the Zivot-Andrews tests, which is December 1999, marks an important shift in the monetary and exchange rate policy. Although, the CBRT had already been following a predetermined exchange rate path in the 1995-1999 period, keeping the depreciation rate in line with the changes in the WPI, this path was *unannounced.* Indeed it was an implicit real exchange rate targeting, rather than a crawling peg. However, in the context of the stabilization program put into place at the end of 1999, the CBRT *pre-announced* the *nominal* depreciation rate of the Turkish lira against an exchange rate basket for a one-year period. In our opinion, this way of setting the exchange rate as an *explicit* nominal anchor strengthened the already common perception that the changes in the exchange rates are permanent. This, in turn, rendered the nominal exchange rates more of an explicit "anchor" for pricing decisions, imposing a level shift in the ERPT coefficients compared to the previous period in which exchange rate was an *implicit* nominal anchor.

Figure 17: Break Points of the Estimated Pass-through Coefficients*



* The break points obtained from the recursive testing scheme employed in the paper are plotted on the vertical axis against the starting date of the Zivot-Andrews test. In each round of the test, the ending date is June 2004.

Approximately the same dates appear as structural break points in the ERPT coefficients of the WPI, which are December 1999, April 2001 and December 2001. April 2001 is found as a structural break point in 14 of the 65 sub samples for the first model specification and suggests that the structural change in the ERPT to WPI might have occurred earlier than December 2001. Interestingly, this period also coincides with announcement of the post-crisis stabilization program. According to specification 2 for the WPI, however, April 2001 is not identified as a structural break point but December 1999 and December 2001 are.

We have also carried out tests due to Perron (1997). The recursive estimation of the test equation revealed that the Perron (1997) test is more sensitive to the choice of the starting point than the Zivot and Andrews (1992) test as it identified more structural break points. However, the structural break dates identified by the Perron (1997) test are close to those identified by the Zivot-Andrews test: they are either prior to the beginning of the 2000 stabilization program or after the adoption of the floating exchange rate regime. [20]

II.6. What Factors Affect ERPT?

Background

Once a time series for ERPT is obtained, an insightful analysis would be to investigate the factors, which may have affected ERPT over time. In this context, both microeconomic and macroeconomic factors come in to the picture. For OECD countries, Campa and Goldberg (2002) state that the most important determinants of changes in pass-through over time are micro based in nature and they relate to the industry composition of country's import bundle. On the other hand, Mihaljek and Klau (2001) point out inflation as a possible determinant of the degree of ERPT, which implies a two-way causality between the two variables. Therefore, an appropriate way to proceed seems to control for microeconomic and sector-specific factors while investigating the role of macroeconomic dynamics on varying degrees of ERPT. Actually, in the previous analysis, it was pointed out that the decline in the pass-through coefficients seemed to be insensitive to the changes in the output dynamics. This section will provide a more detailed discussion about this point.

At this point, it is necessary to ask which macroeconomic factors emerge as possible determinants of ERPT. In this regard, i) output gap, which is the difference between actual output and non-inflationary potential output, ii) exchange rate misalignment as the deviation of real exchange rate from its long-run trend, and iii) the type and credibility of monetary/exchange rate policy regime emerge as possible candidates to explain the pass-through.

Output gap may affect the degree of ERPT to the extent that it reflects a measure of the excess aggregate demand. Consider a small open economy in which imported intermediate goods constitute a sizeable fraction of inputs (micro-phenomenon). In such a situation, movements in the production costs would largely be determined by exchange rate fluctuations. If actual output is higher than its "potential", which implies excess aggregate demand (macro-phenomenon), then price setters can reflect the changes in the exchange rate to full extent while keeping the same mark-up. Such a case results in a high degree of pass-through. In the opposite case, i.e., during a slowdown in economic activity, retailers might be

[20] Results of the Perron (1997) test are available from the authors upon request.

forced to postpone the passing of any cost increase to final price and thus reduce their profit margins in order not to lose their market share. Therefore, the extent of pass-through is expected to be pro-cyclical, increasing during booms and declining during periods of low economic activity.

Exchange rate misalignment can also be an important factor in determining the varying degrees of pass-through. Significant deviations of real exchange rate from its long-run trend increase uncertainty about the future exchange rates, which may affect the degree of ERPT in the economy. Finally, the type and credibility of the policy regime can be a vital factor for ERPT. For example, pass-through should be lower under floating exchange rate regime with inflation targeting than under a fixed exchange rate/crawling peg regime. Moreover, if the announced inflation targets are regarded as credible, both the extent of dollarization and the degree of pass-through is likely to decline. Such an implication is particularly important from the perspective of inflation targeting framework.

Case Study Analysis

The preceding discussion implies that there may be an asymmetry in the estimated pass-through coefficients depending on the state of the economy and the trend of the exchange rate. In order to clarify any asymmetry in the ERPT coefficients, we have divided our sample into four, depending on whether output gap is negative or positive, or there is appreciation or depreciation.[21]

The summary measures match with our intuition: ERPT is stronger in periods of positive output gap than the periods of negative output gap. Moreover, averaging over CPI or WPI across different specifications indicate that, ERPT, on average, is higher during the periods of depreciation. Not surprisingly, we find average ERPT to be highest in periods where output gap is positive and exchange rate depreciates (Table 1).[22]

[21] It is important to remind that ERPT series follows random walk. We have conducted regressions on ERPT and the differenced ERPT series in order to explain the underlying factors of pass-through. The regression analysis did not present robust results.
[22] It is also important to note that observations regarding the each period are not evenly distributed; therefore average of periods with small number of observations should be treated with care.

Table 1. Average of Time Varying ERPT Coefficients

i.) Average ERPT								
	ERPT (CPI, Spec 1)				**ERPT (CPI, Spec 2)**			
		Gap>0[23]	*Gap<0*			*Gap>0*	*Gap<0*	
CPI	App	**0.21**	**0.13**	0.14	App	**0.21**	**0.15**	0.14
	Dep	**0.30**	**0.23**	0.26	Dep	**0.29**	**0.23**	0.26
		0.29	0.20			0.29	0.21	
	ERPT (WPI, Spec 1)				**ERPT (WPI, Spec 2)**			
		Gap>0	*Gap<0*			*Gap>0*	*Gap<0*	
WPI	App	**0.31**	**0.23**	0.24	App	**0.35**	**0.29**	0.30
	Dep	**0.48**	**0.37**	0.42	Dep	**0.49**	**0.39**	0.44
		0.46	0.32			0.48	0.36	
	ii.) Number of Observations							
		Gap>0	*Gap<0*			*Gap>0*	*Gap<0*	
	App	4	20	**24**	App	4	20	**24**
	Dep	41	42	**83**	Dep	41	42	**83**
		45	**62**	107		**45**	**62**	107

The finding that periods of positive output gap are associated with a higher ERPT is consistent with the findings of many studies including Goldfajn and Werlang (2000), Garcia and Restrepo (2001), Morande and Tapia (2002). On the other hand, the finding that ERPT is higher on average in periods of depreciation may be attributed to several (not necessarily independent) factors. One explanation might be related to expectations. The history of high inflation together with economic instability created an environment where a fall in prices was regarded as unlikely and an appreciation of the domestic currency as temporary to most of the price-setters. This might be another reason, why price-setters tend to reflect appreciation to a smaller extent compared to depreciation. Another explanation may be related to a compensation of the fall in the profit margins during the first few months following the 2001 crisis. The economic recession and high rates of depreciation in this period, have led many firms to reduce their profit margins. In this respect, it is conceivable that firms have rather not reflected the consequent domestic currency appreciation fully to prices and increased their markups to compensate for the fall in their profit margins. Finally, living with high inflation rates may have created "habit persistence" for the price setters in the sense that downward adjustment in prices is perceived as something unusual. This, in turn, may have led prices setters to be reluctant in lowering prices.

[23] We use output gap derived by Ece et al. (2005) for the Turkish economy.

III. ANALYZING PASS-THROUGH WITH SEEMINGLY UNRELATED REGRESSIONS (SUR)

In this section, we present an alternative set up to further inquire into the change in the pass-through process in Turkey. The previous section on time varying parameter (TVP) models documented a decline in the exchange rate pass through (ERPT) with the adoption of floating exchange rate regime in Turkey. However, the TVP framework does not allow performing detailed statistical analysis about the decline in ERPT. This section fills this gap by employing statistical tests. As a second exercise, we re-investigate whether the indexation channel has weakened after the adopting the floating exchange rate regime.

Putting aside the indexation channel of pass-through, another aim of this section is to infer about the impact of exchange rate on prices through the input costs, i.e. the cost channel. The share of imported inputs in production costs differs across sectors; the higher the share of imported inputs, the stronger price setters should pass through the changes in exchange rate. However, addressing these hypotheses is not problem-free considering the limited number of observations related to the floating exchange rate regime period. One way to ameliorate the degrees of freedom problem is to use information contained in the variation of cross sectional units of CPI. For this end, with a core inflation perspective, six groups of CPI have been identified and used.[24] In turn, the use of cross sectional units will help to avoid a possible problem of aggregation bias, which might have been imparted if the analysis were conducted on headline CPI or WPI series. In addition, using disaggregated data in a core inflation perspective will help to understand the role of cost channel in exchange rate pass-through across different sectors.

Rather than just looking at the total impact, analyzing the time pattern is also helpful in finding out whether there is any room for policy action until the total impact is completed. In this respect, we also study different dimensions of exchange rate pass-through, namely the time dimension (delay) and the total effect (extent).[25]

[24] Detailed information, content, statistical tests, on the sub items used in the study is described in appendix section.

[25] Previous studies utilizing VAR analysis used half life measures or the impulse response analysis to figure out the time of the peak effect. In a VAR framework, this would correspond to the cumulative impulse response (extent), and the lag where the highest impact takes place, or the last significant lag. The example can be found in Leigh and Rossi. (2002).

III.1. Why SUR?

Given the fact that the data involve disjoint aggregate subgroups of CPI, panel data setup seems to be suitable for analysis. However, as the number of the subgroups we are interested is rather limited, using a time-series model occurred as a natural way to proceed. [26] Therefore time series techniques, such as Seemingly Unrelated Regressions (SUR) or Vector Auto-regressions (VAR), emerge as natural candidates for the problem at hand.[27]

We have chosen the SUR method for our analysis, because for the problem at hand, there are several advantages of SUR over a VAR setup. First of all, the disaggregated nature of the analysis do not allow for a theoretical basis for adopting a structural VAR system. Secondly, had we chosen to work with VAR, we could have easily used up the degree of freedom, given that we have at least five different (price) variables to start with. The SUR setup, on the other hand, allows for cross equation restrictions.[28] Moreover, the lags of the endogenous variables need not enter each equation of the system. For example, processed food inflation and its lags are not relevant in explaining energy inflation and vice versa. What is more, the SUR system need not be symmetric with respect to the lag dimension of the variables included in the system. For instance, output gap, may have different lead-lag relation across different subgroups of CPI: While output gap may not be a relevant variable in explaining energy prices, it may be crucial in the equation explaining the non-traded prices. To summarize, since we use sector-specific price series and they exhibit sector-specific dynamics, SUR comes in to the picture as a more suitable methodology for our purpose.[29]

III.2. Empirical Findings

We use two types of models to estimate the exchange rate pass-through to inflation. The first model, which focuses on the statistical relationship between exchange rates and inflation, is defined as follows:

[26] In other words, the test asymptotics is obtained as cross section is fixed and time series dimension tends to infinity.

[27] Indeed, there are numerous studies on the pass-through in Turkey based on VAR analysis. Leigh and Rossi (2002), Alper (2003), Arbatli (2004) provide examples of these studies.

[28] However each VAR model is also a SUR model, therefore we could have constructed parallel SUR setup to test for cross equation restrictions in a VAR.

[29] Details of SUR models can be found in Judge et al. (1993), Erlat (2004), Greene (2004), Srivastava and Giles (1987).

$$\pi_t^j = \alpha^j + \beta^j \pi_{t-1}^j + \sum_{i=0}^{n} \varphi_i^j q_{t-i} + \varepsilon_{jt} \qquad \text{(Eq. 1)}$$

Where π_t^j is the inflation rate of subgroup *j*, and q_t is the depreciation rate in period *t*.

The second model is similar to the first model but, in addition, includes variables to control for cost and demand shifters as suggested by Goldberg and Knetter (1997). The primary control variable in Goldberg and Knetter (1997), which investigates ERPT to *import prices* by approaching the problem from the point of view of the foreign exporter, is the exporter costs. The counterpart of this primary control variable in our model is the foreign currency value of import prices since we are dealing with ERPT to *domestic* prices. As put forth by Mihaljek and Klau (2001):

"One rationale for looking at import prices measured in foreign currency as a separate pass-through channel could be that firms and households in the emerging market economies have started to follow more closely foreign price developments and take them into account in formulating their business decisions, thus affecting domestic inflation."

Besides the controls for foreign costs, Goldberg and Knetter (1997) include real GDP in the destination market to control for demand shifters. Given the fact that we work with monthly data in order to gain in degrees of freedom for the float analysis, we use output gap, capacity utilization rate and some other sector-specific demand-related variables, instead of real GDP, to ensure that the pass-through coefficient estimates are not adversely affected by the omission of an important determinant of inflation. Therefore, our second model takes the form:

$$\pi_t^j = \delta^j + \gamma^j \pi_{t-1}^j + \sum_{i=0}^{k} \eta_i^j \Delta imp_{t-i}^j + \sum_{i=0}^{l} \delta_i^j gap_{t-i}^j + \sum_{i=0}^{n} \lambda_i^j q_{t-i} + \varepsilon_{it} \qquad \text{(Eq. 2)}$$

Consequently, in model (2) Δimp^j represents the percentage changes in import prices, while gap^j represents a variable such as the output gap or the capacity utilization rate.[30] The superscript *j* implies that different sector-specific import prices or demand proxies may be used for each subgroup in the SUR analysis. For example, prices of manufactured-food

[30] We use output gap derived by Ece et al. (2005) for the Turkish economy. The methodology is a multivariate filtering technique along with time varying parameters. See the paper for an explicit discussion of measuring output gap in emerging markets.

imports may be used in the equation for processed food inflation, while total import price inflation may be used in the equation for traded sector inflation.

On the other hand, following Campa and Goldberg (2002), the short-run pass-through is defined as the contemporaneous elasticity, measured by the coefficient φ_0^j for the first model and λ_0^j for the second model. Besides, they define the long-run elasticity as the sum of the coefficients on the contemporaneous exchange rate and *n* lags of exchange rate terms $\sum_{i=0}^{n} \varphi_i^j$. However, as our model also includes the lags of the inflation terms, we follow Dabusinskas (2003), Otani *et. al.*(2003) and adjust Campa and Goldberg (2002)'s definition of long-run pass-through as $\sum_{i=0}^{n} \varphi_i^j / (1-\beta^j)$ for the first specification and $\sum_{i=0}^{n} \lambda_i^j / (1-\gamma^j)$ for the second one.

Campa and Goldberg (2002) prefer the second model to the first one in interpreting the exchange rate pass-through, since the first model represents a non-structural statistical relationship. Yet, whether foreign cost and demand controls would be significant in explaining inflation or the pass-through elasticities would differ across the two models are critical questions that need to be answered empirically.

It is the case that our empirical analysis places more emphasis on the floating exchange rate regime period. As the results of the TVP analysis in the preceding section shows, the switch to the floating exchange rate regime together with the start of the new disinflation program implied a major structural change both for the Turkish economy and the pass-through coefficients. Besides, theoretically, pre-float and float periods are expected to have totally different exchange rate and price dynamics. Therefore, using the whole sample with the restriction of constant parameters and unchanged price dynamics would be misleading. In this respect, before the analysis of the float period, we *formally* test our hypothesis of a structural change in the ERPT coefficients compared to the pre-float period by carrying out Wald tests over the full sample of 1995:01 and 2004:06. What is more, we compare the estimated exchange rate elasticities over the pre-float period, 1995:01-2001:04, with the float period, 2001:05-2004:06; and verify the extent of the fall in ERPT by using interaction dummies for the exchange rate variables for the latter period.[31]

[31] Although the floating exchange rate regime practically started with the collapse of the exchange rate peg in February 2001, we started our estimation sample from May 2001 because this latter period marks the launch of

Table 2. Testing for Structural Change in ERPT Coefficients within Each Subgroup

	MODEL 1				**MODEL 2**			
	ERPT in Pre-float		***Δ in ERPT in Float***		*ERPT in Pre-float*		***Δ in ERPT in Float***	
	SR	LR	SR	LR	SR	LR	SR	LR
T1	0.11	0.61	-0.12	-0.43	0.10	0.68	-0.11	-0.52
	(0.01)	(0.00)	(0.04)	(0.00)	(0.03)	(0.00)	(0.05)	(0.00)
NT1	0.03	0.49	-0.004	-0.43	0.01	0.45	0.01	-0.38
	(0.69)	(0.00)	(0.96)	(0.00)	(0.85)	(0.00)	(0.95)	(0.01)
FP	0.03	0.48	0.02	-0.25	0.03	0.53	0.01	-0.33
	(0.61)	(0.00)	(0.86)	(0.13)	(0.70)	(0.00)	(0.94)	(0.05)
EN	0.23	0.75	-0.11	-0.49	0.20	0.82	-0.10	-0.58
	(0.00)	(0.00)	(0.33)	(0.00)	(0.02)	(0.00)	(0.35)	(0.00)

Note: p-values are in parenthesis. The long-run structural change coefficients are given by $\sum_{i=0}^{-3} \Omega_i^j / (1-\beta_j)$, where Ω_i represent the coefficients of the interaction dummies for exchange rate depreciation and β_j represent the coefficient of inflationary inertia. Detailed Results of SUR analysis is available upon request.

Table 2 presents the estimated short-run and long run pre-float ERPT coefficients as calculated in Campa and Goldberg (2002) and Dabusinskas (2003) as well the structural change coefficients. [32] It is worth mention at this point that our definitions of short-run and long run differ from the ones used in these studies since we use monthly models while their analysis is based on quarterly models. In other words, although we both define the short-run coefficient as the coefficient on the contemporaneous exchange rate term, their short-run refers to a quarter, while ours refers to a month. This difference matters even more for the long run. By putting four lags of the exchange rate term besides the contemporaneous term in the model, these studies span a period of more than a year, which seems reasonable to call as "long-run". However, in our models, three lags of the exchange rate term plus the contemporaneous term are used, hence our models span a much shorter period, which is four months.

In choosing the lag length for the exchange rate term in our models, we focused on the dynamics of the floating exchange rate period. Thus, our lag choice was constrained by the fact that the float period only has 38 monthly observations, which obviously impedes choosing long lags. Secondly, we wanted to use the same lag length structure for exchange

the new stabilization program with policy commitments on the monetary and exchange rate policy. The February-April period was characterized by excessive exchange rate fluctuations and lack of an explicit policy anchor. The monthly average depreciation rate of TL vis-à-vis the US dollar was 10.1%, 30.9%, 24.9% for February, March and April 2001.

[32] The specification of the model used for structural change test is the same (except for the interaction dummies) as the one used to analyze the exchange rate pass-through in the float period, which is given in the next section.

rate depreciation in all subgroups in the SUR in order to ensure that the short-run and long-run ERPT coefficients are comparable. Therefore, we needed to select a lag length that would be relevant for the whole CPI. Given these constraints and consistent with the previous studies[33], which document that the pass-through to CPI inflation in Turkey is mostly completed in four months, we decided to include contemporaneous and 3 lagged values of exchange rate depreciation in our models. [34]These previous findings partly justify applying the long-run definition of Campa and Goldberg (2002) and Dabusinskas (2003) to a four months period. To sum up this discussion, throughout the rest of the paper, the short-run ERPT refers to the contemporaneous month, while the long-run ERPT refers to the four months period. [35]

In line with these definitions, the highest short-run ERPT coefficients in the pre-float period are in the energy and traded subgroups respectively, whereas short-run ERPT is not statistically different than zero for the non-traded and processed food subgroups, irrespective of the model choice. On the other hand, long-run ERPT coefficients are significantly positive for all subgroups, with energy and traded subgroups again having the highest long-run ERPT coefficients.[36] In fact, the order of the ERPT coefficients exactly follow the order of the share of imported inputs in the related sectors' total inputs, i.e. energy subgroup, which has the highest imported input share has the highest ERPT, showing that the cost channel is an important determinant of the ERPT in Turkey in the pre-float period.[37] Furthermore, the fact that the difference in the long-run ERPT coefficients is not proportional to the difference in the imported input contents of the subgroups, points out to the role played by the indexation channel in determining the ERPT during the pre-float period.

Although short run ERPT coefficients are not statistically significant from zero for the non-traded and processed food subgroups in the pre-float period according to both models, we still report the short-run structural change coefficients for these subgroups along with the others. As expected, no structural change is found in these already insignificant coefficients.

[33] See Leigh and Rossi (2002), and Arbatli (2004).

[34] For robustness checks we carried out the estimations also by using 2 and 4 lags of exchange rate depreciation. The major results did not change.

[35] The reasons for choosing this lag structure is given in the next section "A Closer Look at the ERPT in the Float Period".

[36] For the significance of the long-run coefficients $H_0 : \sum_{i=0}^{-3} \varphi_i^j /(1-\beta_j) = 0$ is tested.

[37] According to the calculations made by utilizing the Input-Output Matrix of 1996, which is the last available one, the share of imported inputs in energy and traded (excl. food and energy) sectors are 53.7 percent and 22 percent, respectively. The shares fall down to 6.5 percent for non-traded (excl. food and energy) and 6 percent in processed food sectors.

On the other hand, there is a significant decline in the short-run ERPT in the traded sector in the post-float period: The coefficient, which was significant in the pre-float period, diminished in the post-float period. Furthermore, the short-run ERPT in the energy sector fell by nearly 50 percent compared to the pre float period. However, this *decline* is not statistically different from zero owing, to a great extent, to the presence of a strong cost channel that directly links the changes in the domestic currency value of import prices on to the prices in this subgroup.

The long-run structural change tests' main results do not differ to a great extent both across the models and the subgroups. According to both models, long-run ERPT has significantly declined for traded, non-traded and energy subgroups. While there is no significant fall in the long run pass-through in the processed food group according to the first model, the opposite is true according to the second model (**Table 2**).

According to the second model, the percentage decline in the long-run ERPT in the post-float period compared to the pre-float period has been 76 percent in traded, 84 percent in non-traded, 62 percent in food processed and 71 percent in energy sectors.[38] The dramatic fall in the long-run exchange rate pass-through in the non-traded sector, which has a lower share of imported inputs and thus a weaker cost channel compared to traded and energy subgroups, suggests that there might have been a decline in the role of indexation channel in the price-setting process, which is a result also supported by the TVP analysis.

So far, we have carried out a *within* group analysis, in the sense that the Wald tests only involved within equation restrictions. However, it is also possible to test cross equation restrictions in a SUR setup. When this analysis is performed, as Table 3 shows, the hypothesis of no structural change in the short-run ERPT is not rejected when tested across all subgroups. This result partly stems from the fact that the pre-float short-run ERPT coefficients for certain subgroups like non-traded and processed food are already insignificant. In fact, when we carry out the same analysis excluding the non-traded and processed food sectors from the SUR system, the hypothesis of no structural change in the short-run is rejected (Table 3). On the other hand, cross equation Wald tests strongly reject the "no structural change" hypothesis for long-run ERPT.

[38] According to the first model, the percentage decline in the long-run ERPT in the post-float period compared to the pre-float period has been 70 percent in traded, 88 percent in non-traded, 52 percent in food processed and 65 percent in energy sectors.

Table 3. Testing for Structural Change in ERPT Coefficients Across the Subgroups

Wald Test (p-values)	M1	M2
$\mathbf{H_1}$: *No significant change in short-run ERPT in Post-Float*		
Across all subgroups	0.29	0.33
Across all subgroups excluding processed food & nontradables	0.11	0.00
$\mathbf{H_2}$: *No significant change in long-run ERPT in Post-Float*		
Across all subgroups	0.00	0.00

To sum up, the findings in this section suggest that with the adoption of a floating exchange rate regime together with an implicit inflation targeting framework, the exchange rate began to lose its function as a nominal anchor in the pricing behavior of economic agents.

A Closer Look at the ERPT in the Float Period:

Having compared the exchange rate pass-through coefficients across the pre-float and float samples, we proceed with a more detailed analysis of the ERPT in the float period. We use the same model specification as in the case of the models for structural change discussed above. But, we estimate the models only for the float period without including structural change dummies.

The estimated ERPT coefficients are given in **Table 3**. First, we observe that short run exchange rate pass-through is not statistically different than zero for all subgroups except the energy sector. This is an expected result because in the floating exchange rate regime, where prices are also sticky, agents wait to see whether the exchange rate change is transitory or permanent and make the pricing decision accordingly. On the other hand, since one of the most important determinants of prices in the energy subgroup is the refinery output price, which is reconsidered in every seven days according to the automatic pricing mechanism, short-run ERPT in this subgroup becomes highly significant.

Despite the insignificance of short-run ERPT (except for the energy prices), long-run ERPT is significantly different from zero for all subgroups.[39] Therefore, we can conclude that, exchange rate pass-through to inflation is still significant in the post-float period, but to a smaller extent and with a delay compared to the pre-float period. To illustrate, the short-run ERPT in tradable goods dropped to null in the float period from 10 percent in the pre-float

[39] Statistical significance is measured at the %10-confidence level.

period (see **Table 2**, Model 2 column in the previous part), while the long-run ERPT displayed a dramatic fall from 68 percent in the pre-float to 15 percent in the post-float.

Another interesting test is whether exchange-rate pass-through differs significantly across the sub-groups of the CPI. Such an exercise is important because if there is a significant difference in ERPT coefficients across the subgroups, it implies that exchange rates have real effects on the economy through their effects on relative prices. According to model 1, the hypothesis that ERPT is equal across the subgroups is rejected both in the short and long run, meaning that a change in the exchange rate affects the subgroups of the CPI in varying degrees both contemporaneously and in the long run.

Table 4. ERPT Coefficient Estimates for 2001:05 and 2004:06

			MODEL 1		MODEL 2	
	Category	**Weight, %**	**Short Run**	**Long Run**	**Short Run**	**Long Run**
T1	Traded Excl. Food & Energy	**26**	-0.01 (0.87)	0.19 (0.05)	-0.03 (0.46)	0.15 (0.02)
NT1	Non-traded Excl. Food & Energy	**33**	0.03 (0.32)	0.10 (0.05)	0.04 (0.18)	0.08 (0.08)
FP	Processed Food	**20**	0.07 (0.24)	0.30 (0.10)	0.05 (0.41)	0.24 (0.30)
EN	Energy	**10**	0.12 (0.01)	0.28 (0.00)	0.09 (0.04)	0.27 (0.00)
	Hypothesis		**p-values**		**p-values**	
H_{01}	ERPT is zero across all sectors		0.01	0.00	0.15	0.00
H_{02}	ERPT is equal across all sectors		0.01	0.02	0.09	0.00
H_{03}	ERPT is equal across T1 and NT1		0.43	0.34	0.16	0.37

Note: Values in parenthesis are p-values. Short-run ERPT is given by φ_0^j, while long-run ERPT is calculated as $\sum_{i=0}^{-3} \varphi_i^j / (1-\beta_j)$ for the first specification. (See Eq 1 on page 32). Similar formula applies for the second specification.

The coefficients of Model 1 in **Table 4** reveal that the highest pass-through is in the energy subgroup with a coefficient of 0.12 for the short run, and 0.28 for the long-run. The finding that the energy sector has the highest pass-through in the post-float period as in the pre-float period is consistent with the fact that the energy sector has the largest share of imported inputs. One controversial finding is that, according to model 1, ERPT in the processed food group is higher than that in energy prices with a coefficient of 0.30. However, we had shown previously for the pre-float period that, the processed food had the lowest ERPT among all the subgroups, as it was the sector least dependent on imported inputs. What is more, the long-run ERPT in the processed food sector is not robust to model specification as it turns out to be statistically not different from zero under model 2. Thus, we consider energy as the subgroup of highest ERPT.

In the float period, long run ERPT in the traded sector is higher than the ERPT in the non-traded sector with a coefficient of 0.19 compared to 0.10. In fact, the ERPT in the traded sector should be significantly higher than that in the non-traded sector in the post-float period if the indexation channel has really weakened and the cost channel has become dominant. However, according to the cross-equation Wald test, ERPT does not significantly differ across these two subgroups both in the short run and the long-run. The unexpected finding that ERPT is not statistically different between traded and non-traded sectors over the long-run may indicate that indexation is still prevalent in the post-float period. However, considering the limited sample length, this finding should be interpreted with caution.

Next, we will present our findings with model 2, in which we control for the effects of import prices and demand shifters on inflation and therefore on pass-through. As explained above, we allow for sector-specific control variables and try various import price series, such as total import price index, consumer import price index, food import price index (only for processed food), refined petroleum import price index, international crude oil prices (only for energy) and various demand variables such as capacity utilization rate, capacity utilization gap, industrial production gap, annual change in industrial production index in the total and food manufacturing industries, electricity and oil production (only for energy), unit labor costs and real wage (mostly for the non-traded sector).

We based the decision of which import price or demand variable to use in the equations on a single-equation framework. In doing so, we tried the variables in the same category one at a time to avoid multicollinearity, i.e. we did not use the capacity utilization rate and the industrial production gap at the same time in the same equation, and we relied on general to specific methodology in deciding about the lag length of the control variables. We tried to choose equations with statistically significant and economically meaningful estimated coefficients and relatively higher explanatory powers. After deciding on which control variables to use for the subgroups on the basis of single-equation framework, we rechecked our variable choice by estimating the single-equations via SUR.

Although the control variables are found to be significant in explaining inflation in the float period across all subgroups, their inclusion in the system did not imply a major change in the main results of model 1. Therefore, the results of the previous analysis remained robust to inclusion of other variables. In other words, the following findings for the post-float period are supported both by model 1 and model 2:

i) **Short-run ERPT is zero for all subgroups except energy. Long-run ERPT, on the other hand, is statistically significant and positive across all subgroups.** These findings verify that although the changes in exchange rates are reflected on the prices with a delay in the floating exchange rate regime, ERPT to inflation is still important in Turkey.

ii) **ERPT is not equal among all the subgroups in the long-run,** consistent with the fact that ERPT differs with respect to import shares of the sectors.

iii) **The difference between ERPT coefficients of traded and non-traded sectors is not significantly different from zero**, implying that the role of indexation mechanism can not be completely ruled out although it has weakened to a great extent.

However, two differences in the test results are worth to mention. First, the hypothesis that short-run ERPT is equal to zero across all subgroups (tested by imposing cross-equation restrictions) was rejected according to model 1 with a p-value of 0.01 (because of the high significance of short run ERPT in the energy sector), but not rejected by model 2 with a p-value of 0.15. Secondly, although the hypothesis that long-run ERPT is equal to zero across all subgroups is strongly rejected using both of the models, the long-run ERPT in the processed food group is found to be insignificant with a p-value of 0.30 in model 2, while it was found to be significant at %10 according to model 1.

Although the main conclusions of the hypotheses tests are shown to be robust to the use of the control variables, we prefer to take into account the ERPT coefficients estimated in model 2 in line with Campa and Goldberg (2002). In this perspective, according to model 2, we can claim that the exchange pass-through to inflation is 27% for energy, 24% for processed food, 15% for traded and 8% for non-traded sector in a four-month period.

IV. SUMMARY AND CONCLUDING REMARKS

IV.1. Summary: A Comparison of the Results of the SUR and TVP Models

We have approached ERPT from two distinct channels: The traditional cost channel due to the use of imported inputs, and the indexation channel that is closely related to the financially unstable environment of the emerging market economies. In order to detect the possible changes in the exchange rate pass-through in such a setting, we have used a time varying parameter model.

Our results on both the headline indices and over different sub-groups of CPI and WPI show that there is a marked decline in the ERPT after the adoption of the floating exchange rate regime. In order to infer the source of the change in ERPT, i.e., whether it is due to the indexation channel or the cost channel, we contrasted the time varying ERPT of sectors which depend heavily on imported inputs—traded goods, energy sector in particular—with that of sectors which has low share of imported inputs, for instance the non-traded goods. The finding is that, with the adoption of floating exchange rate regime, ERPT in the non-traded sector prices have fallen more sharply than the pass-through in the traded sectors. This finding, which is robust to different measures of inflation, hints the weakening in the indexation channel of ERPT.

In order to formally test for a weakening of the indexation channel of the ERPT, we formulated a Seemingly Unrelated Regression (SUR) model, which directly controlled for other factors, for instance the domestic demand. The SUR model supports the major finding of the TVP analysis that there is a decline in ERPT following the adoption of the floating exchange rate regime. Furthermore, to make inferences about the source of the change in ERPT, we tested whether the differences in ERPT across sectors are significant. While we documented that the extent of the fall in the ERPT to non-traded prices is higher than that to traded prices, implying that there is a weakening in indexation, we could not find a significant difference between the ERPT coefficients across the traded and non-traded prices. Nevertheless, this finding should be handled with caution since the post float period covers only 3 years.

Another motivation of this study was to understand the ERPT dynamics across different sub-sectors of CPI. In order to facilitate the comparison across sectors, we have defined short run ERPT and long run ERPT, in line with Campa and Goldberg (2002) and Dabusinskas (2003) within the SUR framework. The results show that there is a marked decline in the contemporaneous month's ERPT whereas, the decline is to a lesser extent in the ERPT measured over four months. Moreover, both frameworks demonstrate that the ERPT is the highest in the energy sector, underscoring the importance of the cost channel in both the pre-float and float periods.

Finally, by contrasting the difference in contemporaneous and four month ERPT, we make inferences about the delay structure of ERPT. The main finding regarding the dynamic structure of ERPT is that it takes more time to pass-through the changes in exchange rate to prices after the floating exchange rate regime.

IV.2. Concluding Remarks

Although exchange rate pass through is generally referred as the percentage change in local currency import prices resulting from a percentage change in the exchange rate, different macroeconomic dynamics peculiar to emerging market economies make it necessary to extend the analysis to domestic prices as well. Low pricing to market, high weight of the tradable goods in the consumer basket, dependence on imported intermediate goods in the production process, and the "indexation" behavior of the agents in a high-inflationary environment with massive currency substitution can be named as some of these characteristics. Needless to say, depending on micro and macro factors, exchange rate pass-through can differ significantly through time and between sectors. Keeping in mind the changing role of exchange rates in inflation targeting regimes and the possibility that exchange rate pass through can affect the relative prices in the economy; we have argued that the notion of pass-through deserves a thorough analysis, especially for the emerging market economies.

Turkish economy surely exhibits a very interesting case in this context. The weight of the traded goods in the consumer basket is around 60%. The economy suffered from a high and persistent inflation during 1990's under fixed/crawling peg exchange rate regimes, which led a sizable fraction of price setters to "index" their prices to the variations in the nominal exchange rate. Moreover, the exchange rate based stabilization program in year 2000 ended with the deepest financial crisis of its history. Finally, during the post-crisis period, the Central Bank has started to implement an "implicit inflation targeting", where the role of the exchange rates in the policymaking process has been reshaped. In this new era, there have been several changes in the policy framework and institutional settings. To name a few, central bank independence has been strengthened, disinflation program was successfully implemented and floating exchange rate was adopted. Taking these factors into account, it is not surprising to observe a change in the inflation dynamics and thus pass-through process. However, we have demonstrated that the question of “in which sectors, how and to what extent” could provide valuable information, both from academic and practical policy perspectives.

Our results indicate that the pass-through has significantly declined during the floating exchange rate regime period. Furthermore, the decline is stronger for the non-traded sector, implying that the indexation effect has weakened. On the other hand, the structural break tests show that there has been a break in the pass-through coefficients on December 1999, April 2001 and December 2001. Reminding that December 1999 marks the beginning of the exchange rate-based stabilization program and April 2001 denotes the beginning of the floating regime period, the results are not surprising. However, the results obtained in the floating exchange rate period show that while long-run pass through is statistically significant for all sub-groups, short-run coefficient is close to zero, pointing out that, although the changes in exchange rates are reflected on the prices with a delay in the floating exchange rate regime, ERPT to inflation is still important in Turkey.

Finally, exchange rate pass-through has been revealed to be higher in the depreciation periods than it is in the appreciation periods. Moreover, it is higher on average in the periods of booms (positive output gap) than those during recessions (negative output gap). As a consequence, our findings suggest that exchange rate pass-through is the highest in periods of exchange rate depreciation and output above the potential.

As a conclusion, our empirical results reveal that the pass-through of exchange rates to domestic prices has sizably gone down in the post-2001 period in comparison with the earlier episodes—thanks to a decline in the indexation behavior. However, the impact of exchange rate on inflation, especially in the tradable sectors, is still sizable in the long run. What is more, movements in the nominal exchange rates have a significant impact on the relative prices. All in all, these findings suggest that, although switching to floating exchange rate regime and implementing a inflation-oriented monetary policy can diminish the pass-through, role of exchange rates in shaping domestic inflation should not be disregarded in a small and highly open economy with notably dependence on imported intermediate goods.

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Appendix

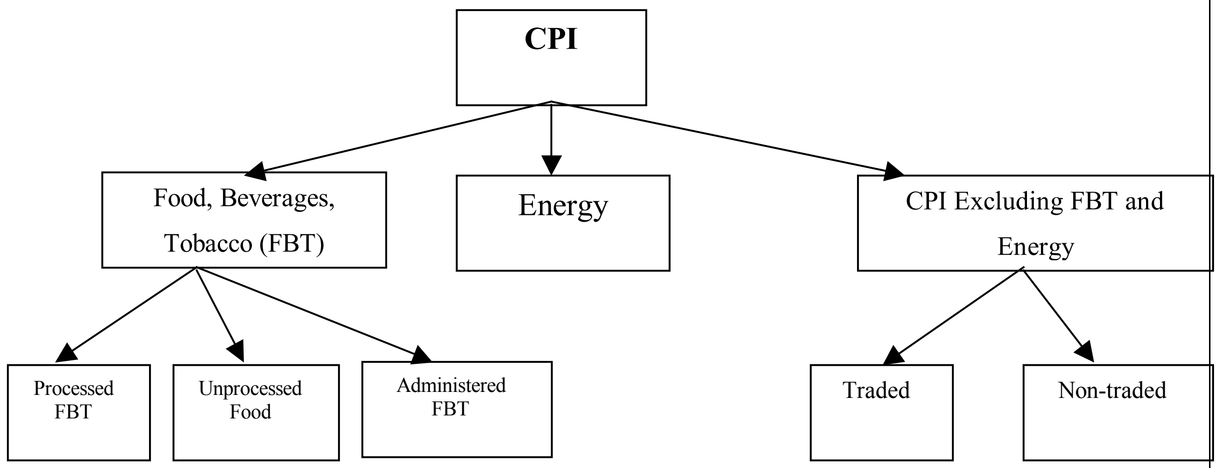
Brief Information about the Subgroups Used in the Pass-through Study

The price indices utilized in the study are the Consumer Price Index (CPI) and the Wholesale Price Index (WPI), which take 1994 as the base year. The CPI includes the retail prices of commodities and services purchased by consumers, whereas the WPI covers the prices of commodities produced or sold at the wholesale level by firms, institutions etc. While the CPI includes both the prices of imported *final* and *intermediate* goods, the WPI only includes *intermediate* imported goods. Therefore, while the pass-through from exchange rates to consumer prices is realized through both the prices of imported *final* goods and prices of imported *intermediate* goods, the pass-through to wholesale prices realizes through the latter. As a result, assuming that markup rates are constant, a higher pass-through from exchange rates to CPI is expected.

Considering different patterns of price adjustments and changes, treating the subgroup of food prices separately give certain information regarding different pass through in different sectors. Depending on different notions of pass-through, the food, beverage, tobacco and energy prices are treated differently from the rest of the consumer prices. In food, beverage and tobacco group, there are administered items. For instance, the prices of tobacco and alcoholic beverages are adjusted on an irregular basis. Second subgroup, which consists of the unprocessed food items, is marked with strong seasonal patterns. Third group is the processed food group that reflects the manufacturing sector items. Energy prices, on the other hand, reflect the direct pass through mechanism (Appendix Figure 18).

To see the effect of the expectations channel on exchange-rate pass-through to domestic consumer prices more clearly, we divided the remaining groups of CPI into traded and non-traded components. Since non-traded prices do not in general include the prices of imported final or intermediate goods, the pass-through from exchange rates to non-traded prices is expected to reflect the expectation channel (indexation). Pass-through to traded goods prices, on the other hand, is expected to reflect both the cost and expectation channels. However, in that respect, one should take into account the characteristics of certain subgroups in CPI. In particular, the unprocessed food, beverage, tobacco and energy prices should be treated differently.

Appendix Figure 18: Classification for the CPI[40]



We also considered a more disaggregated analysis by introducing more specific subgroups such as durables, non-durables etc. However, we ended up with very volatile series with apparent outliers, which do not have desirable time-series properties, for instance inflation rates in durables, non-durables, services sectors are found to be non-stationary. Therefore, we preferred to use the above-mentioned classification, which includes food (processed, unprocessed, administered), energy, traded and non-traded subgroups excluding food and energy. As shown in **Appendix Table 5**, the monthly inflation rates in all these subgroups are found to be stationary[41].

Furthermore, it is important to take the seasonal pattern into account, in this context clothing in the traded group exhibit strong seasonality. Since our priority is to detect the dynamics of a structural relation from exchange rates to prices, price indices are seasonally adjusted with TRAMO-SEATs using Demetra prior to further econometric analysis[42].

[40] Classification of CPI is based on 103 sub items. The detailed list of items can be found in Appendix Table 6.
[41] One exception is due to the non-traded inflation that is found to contain unit root. However, as can be seen from the graph, this can be due to the structural break in the series. Secondly Phillips-Perron test, which is more robust to structural changes in data than ADF, it is seen that non-traded inflation is stationary.
[42] A detailed analysis on the seasonal adjustment program and its use on macroeconomic data can be found in Atuk and Ural (2002)

Appendix Table 5: Unit root test results: Monthly Inflation Figures (1995:1-2004:6)

Variable	ADF		Phillips-Perron Test	
	i.) ADF LAG	ADF(k), p-val	ii.) PP Band with	PP (bw), p-val
S_T	0	0.00	5	0.00
S_NT	11	0.99	6	0.00
S_FP	0	0.00	6	0.00
S_FUP	0	0.00	9	0.00
S_FAD	4	0.00	1	0.00
EN	0	0.00	4	0.00
USD	5	0.06	2	0.00
S_WPI	0	0.00	5	0.00
S_CPI	0	0.01	3	0.02

Notes 1.) *Variables*
S_T: Seasonally Adjusted Traded Prices
S_NT: Seasonally Adjusted Non-traded Prices
S_FP: Seasonally Adjusted Processed Food Prices
S_FAD: Seasonally Adjusted Administered Food Prices
EN: Energy Prices

USD: Nominal TL/USD Exchange Rate

S_WPI: Seasonally Adjusted WPI

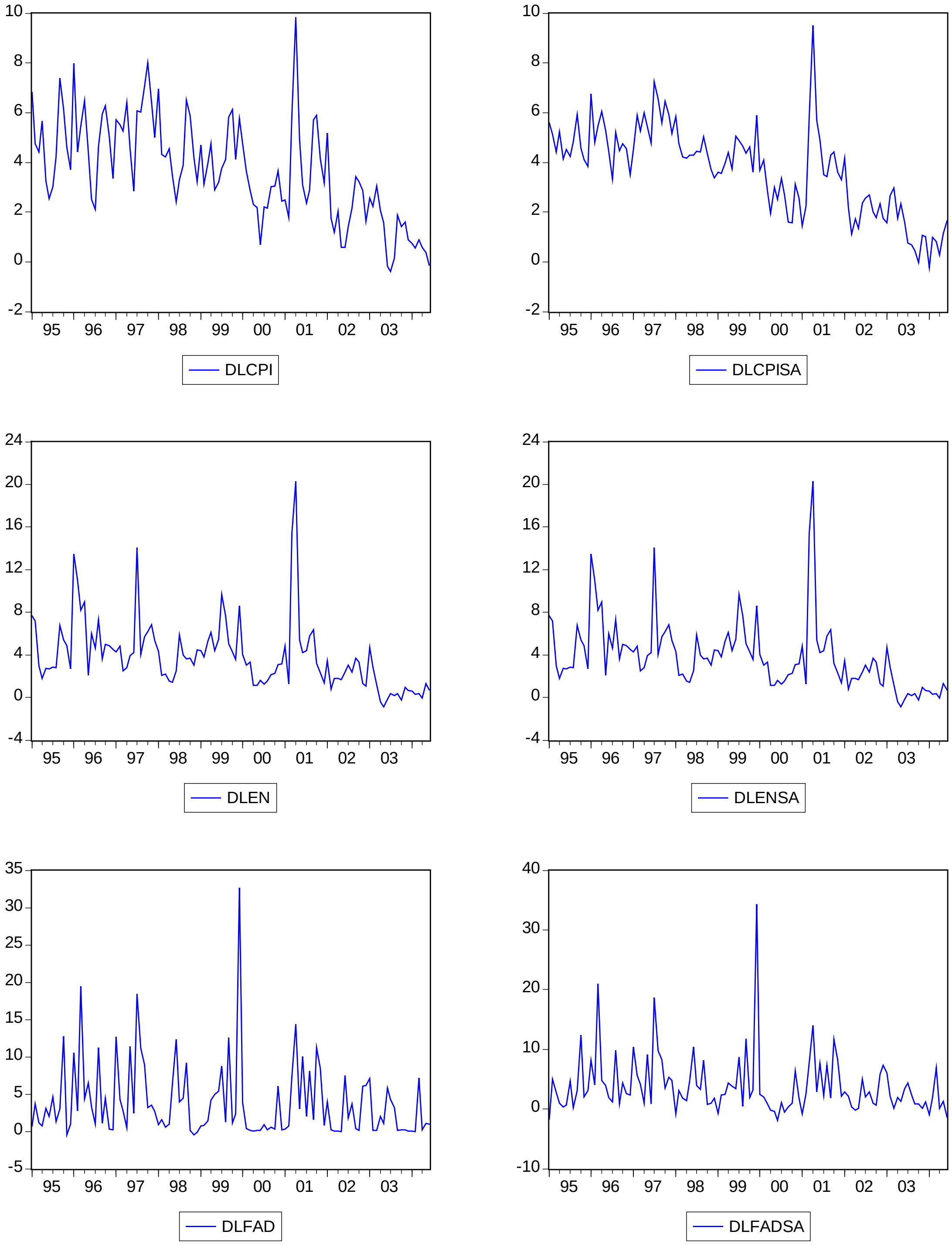
S_CPI: Seasonally Adjusted CPI

2.) Unit root tests are conducted with a constant term
3.) Lag length and band width are determined by automatic selection procedures by contrasting different information criteria for ADF, and by Newey-West Bartlett Kernel for Phillips Perron Test. Computations are carried out in E-views 4.0
4.) In the
Appendix Figure 19-20-21 time series plot of the variables can be found.

Appendix Table 6: Classification of the CPI

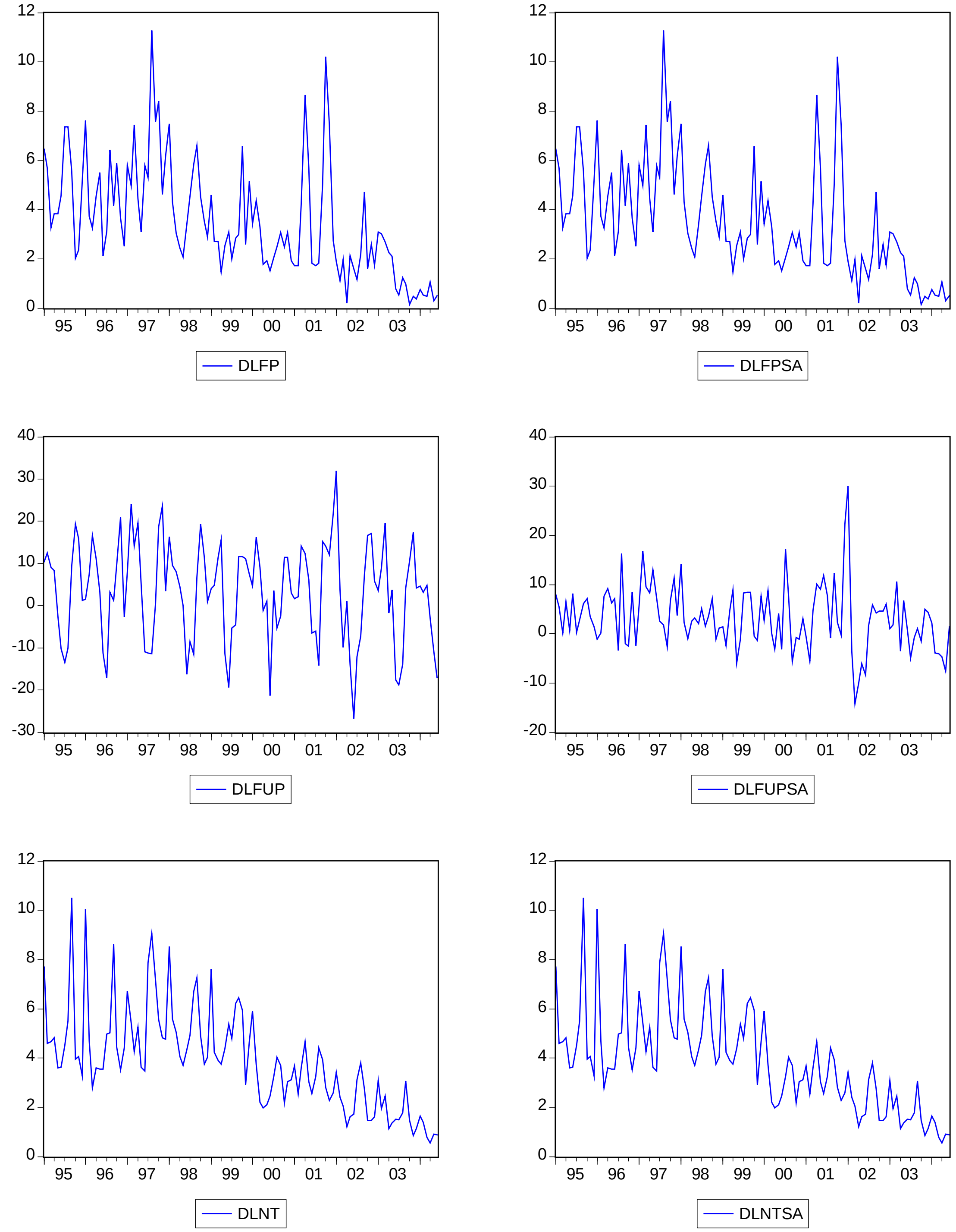
FOOD (31.1)	Household Appliances (Electric- Non-Electric)
	Glassware, Tableware and Household Utensils
Bread	Tools and Equipment for the House and Garden
Cereals and Cereal Products	Non-durable Household Goods
Meat	Pharmaceutical Preparations and Products
Meat Products	Therapeutic Appliances and Equipment
Fish	Purchase of Vehicles
Milk, Cheese and Eggs	Spare Parts and Accessories of Vehicles.
Oils and Fats	Equip for receiving and rec. Sound, picture
Jam, Honey, Chocolate and	
Other Confectionaries	Equip. for sports, camping and open-air Rec.
Salt, Spices, Condiments and Others	Other Equip for sports etc.
Coffee and Cocoa	Newspapers, Books and Stationery
Water	Personal Care (Elec. Appliances)
Non-Alcoholic Beverages	Personal Care (Other Appliances)
	Other Personal Care Equip.
Fresh- Dried Fruits	***NONTRADED (33,0)***
Fresh- Dried Vegetables	Clothing repair, cleaning and maintenance
Canned Vegetables	Footwear repairs
Tubers	Rent (Actual and Imputed)
	Services for the Maintenance and Repair of Dwelling
Sugar	Repair of household Appliances
Tea	Domestic Services
Alcoholic Beverages	Other Medical Products
Cigarettes and Tobacco	Non-Hospital Medical and Para-medical Services
ENERGY (10,0)	Hospital Services
Water (as used in Housing)	Maintenance and Repair of Pers. Trans. Equipment
Electricity	Other Services in respect of Pers. Trans. Equip.
Natural Gas	Transports Services
Liquid Fuels	Repair of Equip. and Acc. For leisure and Culture
Other Fuels	Recreational and Cultural Services
TRADED (25,8)	Educational Services
Garments (Women, Men, Children)	Catering (Restaurants, Pastries)
Fabrics	Hotels
Clothing Accessories	Personal Care Services
Footwear (Women, Men, Children)	Jewelry
Products for the maintenance and repair	
Of Dwelling	Communication
Furniture	Financial Services
Floor Coverings	Other Services
Household Textiles	

Appendix Figure 19: Monthly Inflation based on price indices used in analysis and their unadjusted forms



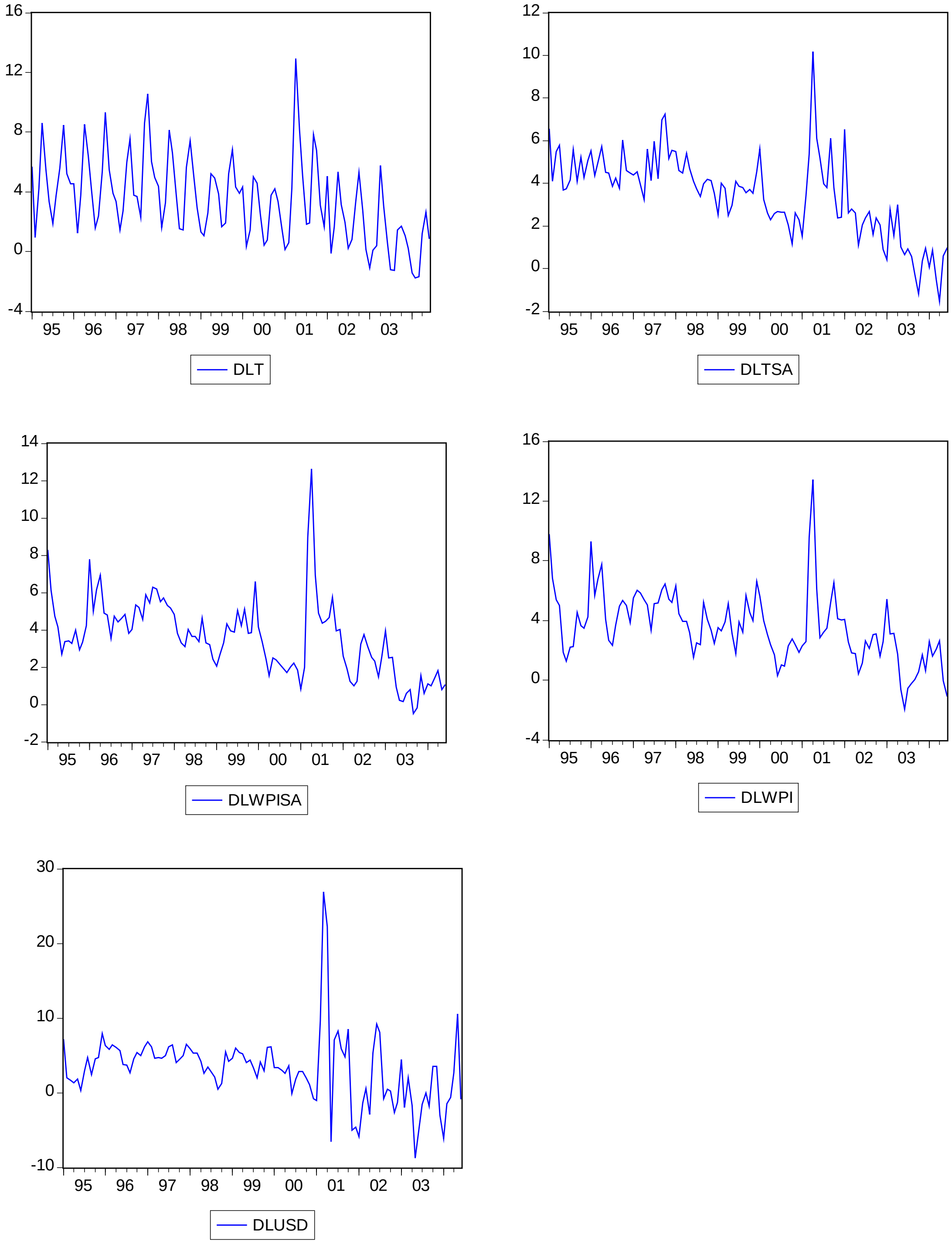
DLCPI: First difference of log of CPI, DLCPISA: First difference of log of seasonally adjusted CPI
DLEN: First difference of log of Energy
DLFAD: First difference of log of administered Food Prices
SA-suffix: is used to indicate that inflation measure is based on seasonally adjusted series.

Appendix Figure 20: Monthly Inflation based on price indices used in analysis and their unadjusted forms



<u>DLFP:</u> First difference of log of processed Food
<u>DLFUP:</u> First difference of log of unprocessed Food
<u>DLNT:</u> First difference of log of non-traded Prices
<u>SA</u>-suffix: is used to indicate that inflation measure is based on seasonally adjusted series.

Appendix Figure 21: Monthly Inflation based on price indices used in analysis and their unadjusted forms



<u>DLT:</u> First difference of log of traded prices
<u>DLWPI:</u> First difference of log of WPI
<u>DLUSD:</u> First difference of log of nominal exchange rate (TL / USD)
<u>SA</u>-suffix: is used to indicate that inflation measure is based on seasonally adjusted series.