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Can inflation targeting regimes be effective in developing countries? The Turkish experience

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ABSTRACT

This paper examines the performance of Turkey's inflation targeting (IT) experience. We find the IT regime to be an effective framework. Our judgment is based on three broad conclusions supported by empirical analyses. First, fiscal stability is an effective tool for a successful monetary policy. Second, the overnight policy of the Central Bank of Turkey rate is a significant determinant of the changes in market lending rates, which is the preliminary step in the monetary transmission mechanism. Third, recent developments on the broader issue of the effectiveness of interest rate policy in controlling inflation through aggregate demand management and through other channels are encouraging. Based on our findings, we argue that the impact of policy rate changes on economic activity and inflation have become more predictable and changed in the direction in line with theory, improving the transmission capacity of monetary policy.

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1. Introduction

For an inflation targeting (IT) regime to work, a central bank needs to be able to set its monetary instrument so as to steer inflation towards the announced target, and the connection between the two is the monetary transmission mechanism. There is little doubt that the stronger the transmission links are and the better they are understood, the more effective will be the IT policy framework in delivering and maintaining lower levels of inflation while ensuring sustainable growth. Understanding the transmission channels of monetary policy is important for achieving further gains in disinflation and the maintenance of price stability going forward.

The main objective of this paper is to examine the dynamics of the monetary transmission process in Turkey under the IT framework. In 2002, the Central Bank of Turkey (CBT) introduced an implicit inflation targeting (IIT) framework. Succesful disinflation and progress in the policy environment led to the introduction of full-fledged IT in 2006. Turkey's IT experience is important for several reasons. First, during the pre-IT period, Turkey had a high level of public debt, a very high inflation rate, high pass-through, backward-looking pricing, and a weak banking system. For example, at the end of 2001, inflation was 68%, and public debt reached 90% of GDP, causing severe fiscal dominance.[1] Second, the Turkish economy has been highly dollarized. Investigating the experience of Turkey is therefore important to draw important policy lessons based on her

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[1] See Kara and Ogunc (2004) and Ersel and Ozatay (2008) for a discussion of exchange rate pass-through and fiscal dominance issues, respectively.

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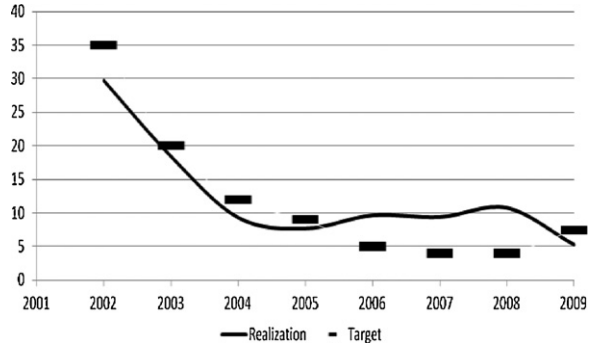

Fig. 1. Inflation target and realization.
Central Bank of Turkey.

experience during both implicit inflation targeting and full-fledged IT regimes. Third, evidence on the effectiveness of inflation targeting mainly comes from developed countries.[2] Experience of some developing and emerging markets that have adopted a regime of inflation targeting has also been investigated.[3] However, to our best knowledge, there is no comprehensive evidence on the effectiveness of inflation targeting regime in Turkey, and her experience may provide valuable lessons for other developing and emerging economies. Fourth, Turkey is a candidate for the European Union membership, and some member states of the Union have already adopted inflation targeting regimes.[4] Finally, inflation targeting is consistent with the Maastricht criteria for joining the European Monetary Union; if Turkey can conduct an effective IT regime, this can help her also satisfy the inflation criteria (Akyurek & Kutan, 2008).

This paper is organized as follows. Section 2 provides a short discussion of the path of interest rates and identifies the main drivers of policy changes seen under the new framework including a presentation of main arguments with the help of a simple Taylor Rule framework. Section 3 provides an empirical analysis of the effects of interest rate policy on key economic variables. As such, Section 3.1 presents an empirical analysis of interest rate pass-through from policy rate changes to commercial lending rates. Section 3.2 takes on the broader issue of monetary transmission and looks at whether the data suggest the existence of a plausible transmission from short-term policy rates to inflation and to level of economic activity. The performance of the IT regime during the recent global crisis is evaluated in Section 4. Concluding remarks are presented in Section 5.[5]

2. Interest rate policy

2.1. Path of policy rates

The CBT's interest rate policy helped to guide inflation from 70% at year end-2001 to 5.56% by year end-2009.[6] In due course, CPI year-end inflation actually fell below targets over the period 2002–2005 but was above them for 2006–2008, while 2009 was again below the target (Fig. 1). Along the way, successive policy rate cuts by the CBT brought the overnight interest rate from 59% to 13.75% over the first 48 months and 7% over the next 48 months. For most of the period, it seemed that the pace of CBT's nominal policy rate changes had more or less reflected the pace of decline in inflation expectations, as rate cuts appeared to be more aggressive at times of sharper decline in the credibility gap (inflation expectations less target path) and more passive (smaller cuts and occasional pause) during slow or no convergence of inflation expectations (see Fig. 2).

Four factors in particular seemed to have complicated interest rate policy in the environment of floating exchange rates and IT. First, the vulnerability of public sector debt required excellent coordination between fiscal policy and interest rate policy. When markets are concerned about public sector debt rollover, policy rate changes can have a powerful unconventional impact on expectations. As such, if rates are increased or cuts are delayed, the markets become concerned

[2] Recent studies include Dodge (2002), Johnson (2002), and Carare and Stone (2006).
[3] For individual country experiences, see Brash (2002) for the New Zeeland; Torres (2003) for Mexico. Amato and Gerlach (2002) provide evidence from many developing countries and emerging markets. More recently, Gonçalves and Salles (2008) provides evidence from 36 emerging markets and they find that those countries followed an IT regime did have a better economic performence than those that did not. Siklos (2008) examines the experince of 29 inflation and noninflation targeting countries, including both industrial and emerging market economies. An important finding is that IT regime may not be fragile in emerging market economies.
[4] Following studies focus on the experience of the new member states: Amato and Gerlach (2002), Siklos and Abel (2002), Golineli and Rovelli (2005), Orlowski (2005), and Holub and Hurnik (2008). In a recent study, Yilmazkuday (2008) finds that the introduction of an IT regime is observed in the estimated Taylor rules for some of the member states, namely, the Czech Republic and Poland.
[5] Some analysis in this section draws on Akyurek and Kutan (2008).
[6] For a policy analysis of the pre-2001 crisis period in Turkey, see Akyurek (2006).

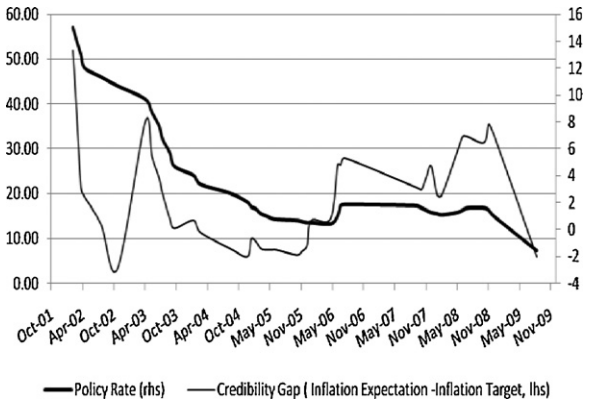

Fig. 2. Policy rate and credibility gap.
Central Bank of Turkey.

over debt dynamics and expect future monetization of debt. Thus, tighter monetary policy could lead to higher inflation. Fiscal developments and debt management played a very significant role in shaping the path of interest rate policy during 2002–2009. Secondly, the perception of risks regarding the implementation of the IMF program heavily dominated market expectations and seemed to be a key variable affecting policy rate decisions.[7] Thirdly, there were ambiguities regarding the transmission mechanism of interest rates, as indicated by the CBT. For example, the effectiveness of the impact of interest rate changes on inflation through the demand channel was questionable given the relatively low level of financial intermediation. Moreover, the existence of a relatively stable and predictable link between the output gap and inflation was in question as well. Finally, the real exchange rate appreciated strongly (by 38% between 2002 and 2009), which was due to strong capital inflows and partial de-dollarization (e.g., see Kara, 2006). This complicated the gauging of monetary conditions, as the exchange rate channel of monetary transmission was conjectured to be strong and quick in Turkey. The question of how much real appreciation the CBT should have allowed became an issue shortly after the introduction of IIT. To the extent that a subsequent correction of the appreciation would have implications for the inflation target, it would have been justified for some direct intervention.

2.2. Taylor rule estimations

To test the impacts of the four factors (discussed above) that complicate interest rate policy, a formal analysis of the interest rate policy may be done with the estimation of policy rate movements using a Taylor rule framework that could provide a simple starting point for understanding monetary policy.[8] In order to capture the risk issues discussed above, suppose that real interest rates are the sum of two components – the Wicksellian natural real rate and the risk premium, which is endogenous and a function of, say, fiscal (in)discipline. In such a case, the Taylor rule is expressed as follows:

$$r^p = r^* + \rho r^p(-1) + \beta(\pi - \pi^*) + \alpha(X) + \gamma(q) \tag{1}$$

where r^p is the nominal short-term policy rate ($r^p(-1)$ is the lagged r^p) and r^* is an estimated nominal equilibrium interest rate that is consistent with the target inflation rate. The latter can be expressed as $r^* = r^{eq} + \pi^*$ with r^{eq} being the equilibrium Wicksellian natural real interest rate. While $(\pi - \pi^*)$ shows the difference between actual and target inflation, (X) denotes possible additional explanatory variables that are highly accepted to be useful in the literature (e.g., output gap, exchange rate depreciation, foreign interest rate, etc.), and (q) measures the risk premium. As is evident, the selection of variables in the Taylor rule mostly reflect the intuitive discussion about the factors that complicate the monetary policy in the presence of an inflation targeting regime with floating exchange rates.

The inclusion of the risk premium is the key here. As the fiscal policy becomes more virtuous or credible, two things will happen: (i) as the risk premium decreases, and as long as the policy (interest) rate is left unchanged, then the policy stance becomes progressively more counter-inflationary; this, in turn, will cause (ii) actual inflation to decrease, which again renders the policy stance progressively more counter-inflationary.

This story uncovers the following central point: with fiscal credibility gradually imposing itself, monetary policy needs to do nothing to ensure that inflation will come down. This point is well taken by other observers: For instance, as Kara (2006) suggests, CBT almost never raised interest rates during the implicit inflation targeting period of 2002–2005; instead, CBT pushed for fiscal reforms and directed all its communication efforts to convince the public that economic fundamentals were

[7] There were significant delays in completion of program reviews during 2002–2009. For a recent analysis of risk premium in Turkey, see Başçi and Ekinci (2005).
[8] See Taylor (1993) for the original presentation.

Table 1
Taylor rule estimation.

α is the coefficient of	r^*	ρ	β	γ	α	R-bar sqd.
–	1.18*	0.74*	0.13*	0.68*	–	0.99
	(0.37)	(0.05)	(0.03)	(0.17)		
Output gap (λ = 14,400)	1.18*	0.73*	0.13*	0.69*	0.02	0.99
	(0.37)	(0.05)	(0.03)	(0.18)	(0.09)	
Output gap (λ = 129,600)	1.08*	0.73*	0.14*	0.70*	0.05	0.99
	(0.38)	(0.05)	(0.03)	(0.17)	(0.05)	
Exchange rate depreciation	1.42*	0.82*	0.04	0.48*	0.05*	0.99
	(0.34)	(0.05)	(0.03)	(0.17)	(0.01)	
Foreign interest rate	0.14	0.74*	0.13*	0.70*	0.36†	0.99
	(0.65)	(0.05)	(0.03)	(0.17)	(0.19)	

Notes: * and † represent the significance at 5% and 10% levels, respectively. The standard errors are in parentheses. λ stands for the HP smoothing parameter. *B* stands for the selection of the break(s) by BIC, *L* stands for the selection of the break(s) by LWZ, and *S* stands for the selection of the break(s) by the sequential procedure. The sup $F_T(k)$ tests, which test the null hypothesis of no structural break ($m = 0$) against $m = k$ breaks, are all insignificant for k between 1 and 5, i.e., there is no suggested structural change in the sample period. The results of the double maximum tests, named UD_{max} and WD_{max}, which test the null hypothesis of no structural break against an unknown number of breaks, supports that there is no suggested structural change in the sample period. These tests have been employed for each estimated equation separately.

getting sounder under the new stabilization program.[9] We test this hypothesis below by estimating the Taylor rule. In order to consider possible nonlinearities in the analysis, for robustness, we employ two additional methods besides OLS, namely OLS with structural breaks and rolling OLS.

2.2.1. Data

The monthly CPI series (to be log-differenced), short-term (i.e., overnight) interest rate, industrial production (to be HP filtered), exchange rate, and Euro area interest rate (as a measure of foreign interest rate) are downloaded from the online version of International Financial Statistics (IFS) and are seasonally adjusted. The inflation targets are obtained from the Central Bank of the Turkish Republic (CBRT).[10] The risk premium is the JPMorgan Emerging Markets Bond Index Plus (EMBI+) for Turkey.[11] The output gap is calculated as the deviation of the industrial production from its Hodrick-Prescott (HP) trend, where two alternative HP smoothing parameters are considered for monthly data, namely 14,400 and 129,600; while the former is suggested by Hodrick and Prescott (1980) and Backus and Kehoe (1992). The depreciation of the exchange rate is used. Since the earliest available data for risk premium start at 1999:M7, in the estimations, we use (annualized) monthly data covering the period over 1999:M7–2008:M7. To capture the outlier effects of the 2000–2001 twin crises, we interpret all data as residuals from the projection on the dummy variables representing the period between 2000:M11 and 2001:M2. This process leads to exactly the same results with directly including these dummy variables in the OLS regression with no structural breaks; nevertheless, we choose taking their effect out of the picture, mostly for our structural break and rolling regression analysis, where we do not want to have biased results while considering possible nonlinearities in the Taylor rule.

2.2.2. OLS with structural breaks

We achieve the following estimations by using Eq. (1):

- Estimation of the Taylor rule without considering any structural break.
- Estimation of the Taylor rule by considering structural breaks via two methods:
  - Global optimization
  - Sequential procedure of Bai and Perron (1998, 2003)

The technical details of these estimations can be found in the working paper version of this study.

As a benchmark, we start with the estimation of the Taylor rule without considering any structural breaks. Table 1 reports the results. When there is no additional explanatory variable in the estimation (i.e., *X* is an empty matrix in Eq. (1)), there is a significant degree of interest rate smoothing in the estimated period. The coefficient of inflation is significantly and positively estimated as 0.13, which suggests that when the inflation increases by 1%, the CBT has increased the short-term interest rates by 0.13 basis points, on average, during the estimated sample period. This result is important, because it shows that inflation has been taken into account in forming monetary policy. The scale effect of the risk premium is significantly estimated as

[9] In fact, the only decision that the monetary authorities must take in these circumstances, when both risk premia and actual inflation decrease, is how much to decrease nominal interest rates, in order to prevent that monetary policy should become too much contractionary.
[10] The discontinuous year-end inflation targets have been converted to continuous monthly targets by a linear transformation.
[11] EMBI+ is a benchmark index for measuring the total return performance of international government bonds issued by emerging market countries that are considered sovereign.

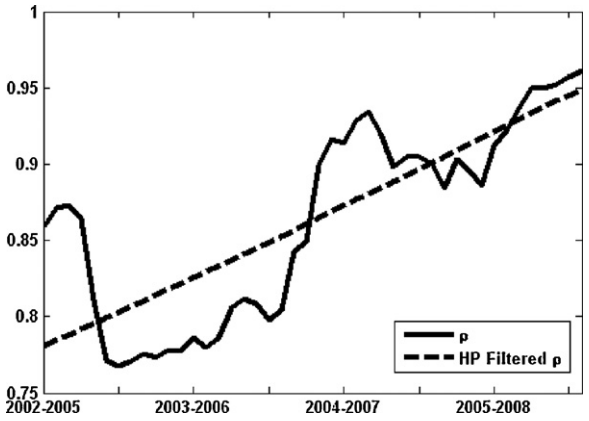

Fig. 3. Taylor rule – the rolling estimates of ρ. *Notes*: The window size for the rolling regression is 36. The *x*-axis represents the rolling regression windows. To have a long-run trend measure, HP filter with a smoothing parameter of 129,600 is used.
Authors' calculations.

0.68, which suggests that it has an independent effect in the determination of the short-term interest rates. This result is important in support to our claim related to the effect of risk premium on the real interest rate and thus the monetary policy.

The results almost remain the same when we include output gap; the equilibrium Wicksellian natural real interest rate becomes insignificant when foreign interest rate is included, mostly due to stable foreign interest rates during the sample period; the inflation becomes insignificant when we include exchange rate depreciation, mostly due to high correlation between them, especially during the flexible exchange rate period. Since the first row of results is estimated as a restricted version of other rows, we can also test this restriction by using an *F*-test or a Wald-test. Both tests suggest that the inclusion of output gap, exchange rate, or foreign interest rate is irrelevant; thus the first row of results is superior to other rows.[12]

In order to check for some possible structural breaks, we restrict the coefficient of the risk premium to be constant across different segments, mostly because it is a scale effect. Allowing for a break in this particular coefficient would correspond to a change in the measurement of the risk premium which is less likely the case for a rating index. Under this assumption, we consider two different cases: (i) there is no break in the estimated nominal equilibrium interest rate r^*, (ii) there is a break in r^*. In both cases, both of our structural break methods (i.e., the global optimization and the sequential procedure) suggest that there are no breaks in the estimated sample period.

Finally, the explanatory powers of all estimations are high in Table 1, suggesting that our modified Taylor rule is an effective tool in explaining the monetary policy of CBT during the sample period.

2.2.3. Rolling OLS

In order to have a more detailed nonlinear analysis of the Taylor rule, we also employ rolling regressions in addition to the structural break analysis. As in the structural break analysis, we keep the coefficient of the risk premium constant during the whole period, because this coefficient is supposed to represent a constant scale effect through time. In particular, to control for the constant coefficient for risk premium, we interpret all other data as residuals from the projection on the risk premium. In order to capture the short-run dynamics of the Taylor rule, we employ a window length of 36 in our analysis.[13] The results are reported in Figs. 3 and 4, where the 36-months windows are depicted in the *x*-axes and the estimated values are depicted in the *y*-axes. Besides the row estimated values, we also plot the HP trend (with a smoothing parameter of 129,600) of each variable to show their trend behavior.

According to Fig. 3, the interest-rate smoothing has become more important in determining the monetary policy of CBT; this is an indicator of improving stability in financial markets during the inflation targeting period. In addition to this, the most important result is depicted in Fig. 4, where there is a positive HP trend of the inflation coefficient rising over time. After also considering the fact that the risk premium (measured by the JPMorgan Emerging Markets Bond Index Plus, EMBI+, for Turkey) has decreased significantly after the introduction of the inflation targeting regime, the results in Fig. 4 support our claim that as the fiscal policy becomes more virtuous or credible, the policy stance becomes progressively more counter-inflationary, which in turn causes actual inflation to decrease. In our opinion, this is the story behind the success of the inflation targeting regime in Turkey, which has significant policy implications for other developing countries, especially in terms of the interaction between fiscal and monetary policies.

[12] These test results are available upon request.
[13] The results are very similar using different window lengths up to 48 months, after which we mostly have longer term dynamics. These alternative results are available upon request.

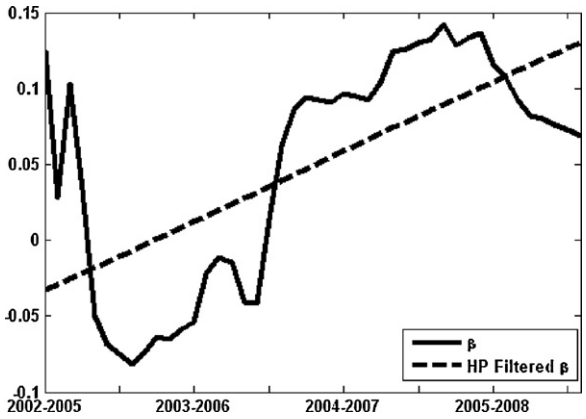

Fig. 4. Taylor rule – the rolling estimates of β. *Notes*: The window size for the rolling regression is 36. The *x*-axis represents the rolling regression windows. To have a long-run trend measure, HP filter with a smoothing parameter of 129,600 is used.
Authors' calculations.

3. Channels of monetary transmission

3.1. Interest rate pass-through

3.1.1. Theoretical issues

How changes to the overnight policy rates affect the lending rates banks and other financial intermediaries charge to businesses and consumers is the preliminary step in the transmission mechanism. It is assumed that lending rates are taken into consideration by households and firms in making consumption and investment decisions, which ultimately influences the level of inflation with some lag. Hence, not only the degree but also the speed with which policy rate changes affect lending rates is very critical to this initial step in the transmission process.

Theoretically, the rate of interest charged by lenders is a function of the marginal cost of funds to the lenders. The cost to a bank of borrowing from other banks or the cost of using the short-term lending facility provided by the central bank to banks can be useful proxies of the opportunity cost of funds for banks. Then, changes in these rates can be expected to be passed through to market lending rates. Complete pass-through occurs when a movement in the policy rate leads to a one for one change in lending rates.

Several factors ranging from structural issues in the financial industry to changing economic conditions may render the policy rate more or less effective in causing changes in the market lending rates in the desired direction. As well, the effectiveness of the policy rate may change over time. Ineffectiveness in this sense may be a result of low degree of monetization, underdeveloped financial markets, and the existence of capital controls. Likewise, the lesser the degree of competition in the banking industry (due to regulation, collusion by banks or fixed costs of entering the market), the higher will be the spread between the policy rate and lending rates, and the slower will be the adjustment of the latter to the former. Lags in the adjustment of bank lending rates may occur also due to the difficulty of deciphering whether changes in policy rates are permanent or temporary and whether changes in policy rates are expected or unexpected. For example, expected monetary policy changes may have already been factored into lending rates by banks prior to the changes in policy rates. Equally important could be whether the main source of funds for intermediaries are derived from short-term or long term capital markets. If it is the former, the pass-through will be strong and quicker from the policy rate changes. Structural excess liquidity in the banking sector could render the policy rate ineffective. If commercial banks typically have substantial deposits over and above reserve requirements at the central bank, the policy rate merely reflects an opportunity cost instead of reflecting the marginal costs of funding for the commercial banks. Since banks may react differently to cost increases than to revenue decreases, excess liquidity could cause such asymmetric behavior of banks. The balance sheet problems in the banking and corporate sectors are also frequently mentioned as a cause of policy rate ineffectiveness. Finally, it may be that there is not one-way causality running from money market to retail rates. To a varying degree, all these issues may apply to the Turkish case. Yet, we would expect interest rate pass-through to have improved in recent years given the improvement in the specific features of the monetary framework, banking sector and economic conditions, as described in the previous section.

3.1.2. Empirical findings

In line with the discussion above, an econometric model of policy rates and bank deposit/lending rates can be written as

$$r_t^l = \gamma + \lambda\, r_t^p + \beta r_t^f + \varepsilon_t \tag{2}$$

where r_t^l is the deposit rate (i.e., a proxy for the bank lending rate for which there are no available data), r_t^p is the policy rate, r_t^f is the Euro area interest rate, γ is a markup parameter, and λ reflects the demand elasticity of deposit/lending rates with

respect to policy rates. This particular econometric model is considered to capture the effectiveness of the policy rate (i.e., the interest pass-through), together with the role of banking mark-ups and foreign interest rates in the determination of the deposit rates. In order to consider possible structural breaks in the regression, as in the estimation of the Taylor rule, we employ two different methods, namely OLS with structural breaks and rolling OLS.

3.1.3. Data

We use (seasonally adjusted and annualized) monthly data covering the period over 1994:M1–2008:M7 obtained from online version of International Financial Statistics (IFS). We start the analysis from 1994, because it is the earliest available date for Euro area interest rate in IFS. As in the estimation of the Taylor rule, to capture the outlier effects of the 1994 currency crisis and the 2000–2001 twin crises, we interpret all data as residuals from the projection on the dummy variables representing the periods of 1994:M2–1994:M6 and 2000:M11–2001:M2.

3.1.4. OLS with structural breaks

The analysis of structural breaks here has the very same technical details as the one we employed for the Taylor rule. Table 2 reports the results. Panel A of Table 2 shows the results for the benchmark estimation with no structural breaks. In such a case, both the policy rate and the foreign interest rate significantly enter the estimation with positive signs. Nevertheless, the estimated value of λ for the whole sample has a low value of 0.48 implying that if the policy rate increases by 1%, the deposit rates increase by only 0.48%. This is a sign of a low interest rate pass-through. But, how robust is this result to structural breaks? To answer this question, as in the estimation of the Taylor rule, we employ two structural break methods, namely global optimization and sequential procedure. The results suggest that at least one structural change is present.

The results obtained by the global optimization are reported in Panel B, while the results obtained by the sequential procedure are reported in Panel C in Table 2. As is evident in both Panel B and Panel C, the estimated value of λ gets higher and higher, especially after the introduction of the inflation targeting regime. This is the second important result of this paper (the first one is the importance of the interaction between fiscal and monetary policies) supporting the view that inflation targeting of CBT has been successful in raising the interest rate pass-through meaning that the monetary policy has become much more effective in Turkey during the estimated period.

Compared to Panel A, the R-bar squared values in Panel B and Panel C are significantly higher, suggesting that the considered econometric model (with structural breaks) captures the interest rate pass-through in Turkey well during the estimated sample period.

Table 2
Interest rate pass-through estimation.

	γ	λ	β	R-bar sqd.
Panel A: Estimates with no breaks				
Whole sample	−0.70	0.48*	5.19*	
	(1.17)	(0.04)	(1.13)	0.63
Panel B: Estimates with three breaks obtained by global optimization (B, L)				
1994:1–1996:2	3.20	0.23*	5.18*	
	(3.21)	(0.12)	(1.85)	
1996:3–1998:11	24.04*	0.14*	0.55	
	(1.83)	(0.06)	(1.32)	
1998:12–2001:1	−1.57	0.99*	−2.15	
	(1.31)	(0.11)	(2.55)	
2001:2–2003:3	8.12*	−0.03	22.98*	
	(1.94)	(0.04)	(3.16)	
2003:4–2008:7	−6.05*	0.75*	0.55*	
	(0.60)	(0.02)	(0.16)	0.95
Panel C: Estimates with four breaks obtained by sequential procedure (S)				
1994:1–1996:2	3.20	0.23*	5.18*	
	(3.21)	(0.12)	(1.85)	
1996:3–1998:12	24.89*	0.12*	−0.24	
	(1.74)	(0.06)	(1.20)	
1999:1–2001:2	0.99	0.20*	−17.63*	
	(2.16)	(0.03)	(2.57)	
2001:3–2003:6	−0.85	1.13*	2.45	
	(3.83)	(0.42)	(7.03)	
2003:7–2005:8	−11.55	0.74*	12.15*	
	(9.31)	(0.03)	(5.80)	
2005:9–2008:7	5.10	1.10*	−0.56*	
	(3.61)	(0.11)	(0.24)	0.94

Notes: * represent the significance at 5% levels. The standard errors are in parentheses. B stands for the selection of the break(s) by BIC, L stands for the selection of the break(s) by LWZ, and S stands for the selection of the break(s) by the sequential procedure. The sup $F_T(k)$ tests, which test the null hypothesis of no structural break ($m = 0$) against $m = k$ breaks, are all significant for k between 1 and 5, which means that at least one structural change is present. The results of the double maximum tests, named UD_{max} and WD_{max}, which test the null hypothesis of no structural break against an unknown number of breaks, supports that there is at least one structural change.

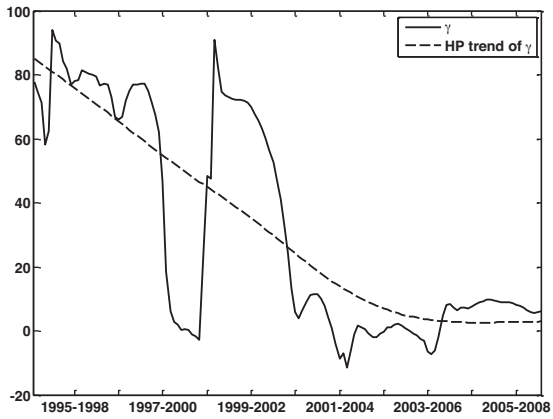

Fig. 5. Interest rate pass-through – the rolling estimates of γ. *Notes*: The window size for the rolling regression is 36. The *x*-axis represents the rolling regression windows. To have a long-run trend measure, HP filter with a smoothing parameter of 129,600 is used.
Authors' calculations.

3.1.5. Rolling OLS

In order to have a more detailed nonlinear analysis of the interest rate pass-through, we also employ rolling regressions in addition to the structural break analysis. In order to capture the short-run dynamics of the pass-through, we again employ a window length of 36 months in our analysis. The results are reported in Figs. 5 and 6, where the 36-months windows are depicted in the *x*-axes and the estimated values are depicted in the *y*-axes. Besides the row estimated values, we again plot the HP trend (with a smoothing parameter of 129,600) of each variable to show their trend behavior.

Fig. 5 suggests a decreasing level of mark-ups in the banking sector. Fig. 6 is the most important figure here showing that the estimated value of λ of gets higher and higher through time, especially after the introduction of the inflation targeting regime. This is an alternative supporting result for the success of the inflation targeting regime in Turkey.

3.2. Effect of policy rates on inflation and output

3.2.1. Theoretical issues

A natural extension of the analysis of interest rate pass-through presented in the previous part lies in analyzing the complete interest rate channel of monetary policy, from policy rate changes to movements in the consumer price index and changes in the level of economic activity. This is part of a broader issue of effectiveness of interest rate policy in controlling inflation by affecting aggregate demand and through other channels. As suggested before, against the backdrop of a move to an IT framework, it has become progressively more important to have a better insight into the transmission channels of monetary policy in Turkey.

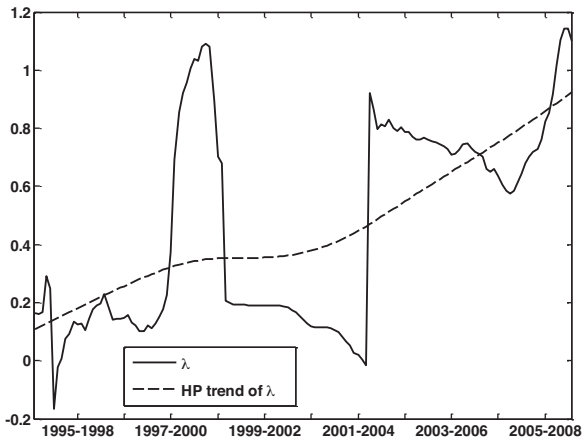

Fig. 6. Interest rate pass-through – the rolling estimates of λ. *Notes*: The window size for the rolling regression is 36. The *x*-axis represents the rolling regression windows. To have a long-run trend measure, HP filter with a smoothing parameter of 129,600 is used.
Authors' calculations.

The understanding about these transmission mechanisms is more established for mature economies. As such, for a relatively closed economy, the main channels through which monetary policy effects inflation are aggregate demand and expectations. If prices are sticky, an increase in the short-term nominal rates will increase real interest rates. This, in turn, is likely to adversely affect spending on durable goods, such as fixed investment and inventories, and spending on housing and consumer durables. Apart from this traditional "interest rate channel", Bernanke and Gertler (1995) noted that there is also a complementary "credit channel" focusing on endogenous developments in credit markets, which disseminate and intensify shocks to the macroeconomy. The credit channel magnifies monetary policy actions by affecting firms' balance sheets, net worth, collateral and risk of default.[14] In relatively more open economies, the exchange rate channel gains significance. Monetary actions affect the trade balance and therefore aggregate demand through their effect on nominal and real exchange rates. Thus, interest rate, credit, and exchange rate channels induce changes in aggregate demand, which in turn, affect output in the short-run, and prices in the long-run.

However, for developing market economies, the transmission mechanism is typically less straightforward as the impact of interest rate changes is thought to be weak in those countries for a number of reasons. The lack of maturity and depth of the financial system have been shown to impede the smooth transition of monetary policy impulses. In particular, the impact of interest rate changes on credit has been found to be weak, owing to highly inelastic lending policies of banks burdened by nonperforming loans, undeveloped financial markets, large holdings of government debt and volatile capital inflows. Further uncertainty in the channels of interest rate policy may be caused by a strong and fast-working exchange rate channel. There may be a real exchange rate effect on aggregate demand via the relative prices of foreign and domestic goods. As well, the impact of the exchange rate on the price of domestically produced goods, through the price of imported intermediate inputs could be significant. In addition, a more open economy will be affected to a greater extent by possible wealth effects through the exchange rate as an asset price and foreign shocks. Changes in the exchange rate may cause balance sheet effects in the presence of currency mismatches. In light of these issues, an empirical analysis of the transmission mechanism should treat the exchange rate and measures of aggregate demand as endogenous variables to be able to capture the indirect effect of interest rate policy on inflation through those variables in developing countries. It is also important to note that transmission channels of monetary policy may change over time. A variety of factors including changes in the monetary regime, structural reforms in banking, financial markets and other areas as well as changes in the overall credibility of economic policies could cause dynamic relationships to shift over time. Nevertheless, plausible transmission channels may be found, and the issue to a large extent seems to be an empirical matter.

3.2.2. Empirical analysis

The analysis here has mainly two objectives. First and broadly speaking, we trace the dynamic relationships between variables involved in the monetary transmission mechanism. More precisely, we look at whether the data suggest the existence of a plausible transmission from short-term policy rates to inflation and the level of economic activity. Secondly, we investigate if these dynamic relationships have changed following the introduction of the IIT regime.

We estimate a five-variable Vector Auto Regression (VAR) with the following Cholesky ordering: Overnight interest rates, spread between overnight interest rate and deposit rates, the depreciation of real exchange rate, output gap, and CPI inflation.[15] We estimate the model using two lags of each variable.[16] In order to consider possible structural breaks in the VAR analysis, we employ two different methods, namely VAR with structural breaks and rolling VAR.

3.2.3. Data

We use (seasonally adjusted and annualized) monthly data covering the period over 1989:M1–2008:M7 obtained from online version of International Financial Statistics (IFS). The output gap is defined as the HP-filtered industrial production.[17] As before, to capture the outlier effects of the 1994 currency crisis and the 2000–2001 twin crises, we interpret all data as residuals from the projection on the dummy variables representing the periods of 1994:M2–1994:M6 and 2000:M11–2001:M2.

[14] Suppose nominal rates are increased. The traditional view predicts that firm profits drop because of a contraction in sales and increased cost of financing. Simultaneously, however, the firms' asset value is likely to be reduced because future revenues are discounted at higher interest rates. Hence, firm balance sheets deteriorate, net worth is reduced, the amount of collateral is reduced, and the probability of default on outstanding loans increase (the 'balance sheet effect'). Then banks will take into effect the adverse impact of monetary tightening on their clients' balance sheets, and accordingly tighten their supply of credit, thereby increasing lending spreads. As bank credit and other forms of financing are not perfect substitutes, firms cannot simply offset a reduction in bank credit, for example by issuing their own debt. As a result, some investments will not be undertaken which further depresses aggregate demand, output and net profits ('bank lending effect').

[15] We investigated the possibility of cointegration between the real exchange rate and CPI series, the two variables that were included in our five-variable VAR model in first differences. While Granger tests indicated that the two series were not cointegrated, the Johansen method showed cointegration at the 7% significance level. Hence we added the error correction term obtained from a vector error correction model of the CPI and real exchange rate series to our five-variable VAR model. The results were not found to be different than the VAR excluding the error correction term, which are the results presented in this section.

[16] We use different criteria before determinig the lag length to be 2. While Akakike information (AIC), final prediction error (FPE), and Hannan-Quinn (HQ) information criteria indicated 2 lags to be optimal, Schwarz information (SC) criterion pointed at 1 lag. We use two lags here because of the well-known lags in monetary policy.

[17] We use a smoothing parameter of 14,400.

Table 3
VAR with structural breaks – variance decomposition.

	Standard error	Interest rate	Spread	Real exchange rate	Output gap	Inflation
Panel A: Variance decomposition between 1989:1 and 1999:4						
Interest rate	13.8	92.4	3.7	1.3	0.8	1.8
Spread	9.7	82.6	10.7	3.3	2.5	0.9
Real exchange rate	22.6	3.7	8.7	83.2	2.0	2.4
Output gap	57.4	1.6	1.5	0.5	95.5	0.9
Inflation	13.7	8.7	1.5	21.3	2.7	65.8
Panel B: Variance decomposition between 1999:5 and 2002:10						
Interest rate	14.7	77.2	9.4	7.4	0.8	5.2
Spread	8.7	17.0	81.0	1.5	0.1	0.4
Real exchange rate	76.8	24.2	22.3	51.9	0.3	1.2
Output gap	74.0	25.7	30.1	4.5	36.6	3.0
Inflation	21.1	34.8	35.2	1.6	3.9	24.5
Panel C: Variance decomposition between 2002:11 and 2008:7						
Interest rate	2.9	56.8	20.6	16.1	1.2	5.3
Spread	1.3	44.5	46.0	7.1	1.7	0.7
Real exchange rate	42.4	5.4	8.5	79.6	3.9	2.6
Output gap	41.9	7.0	10.4	10.7	70.5	1.4
Inflation	6.2	3.3	16.4	17.9	3.1	59.3

Notes: The variance decomposition values have been calculated by using a forecast of six periods ahead.

3.2.4. VAR with structural breaks

We employ the sequential procedure of Qu and Perron (2007). The results suggest two structural breaks, 1999:M4 and 2002:M10. While the first break coincides with the aftermath of the 1998 Russian crisis, the second break mostly coincides with the aftermath of the introduction of the implicit inflation targeting regime.[18]

The two estimated structural breaks imply three segments of VAR analysis. We focus on the variance decomposition implications of the analysis to understand the impacts of different shocks on the macroeconomic variables under the IT regime. The results, which have been calculated by using a forecast of six periods ahead, are reported in Table 3. As one may expect, the standard errors of both output gap and inflation rate take their highest values between 1999 and 2002, which is the pre-inflation-targeting period with many crises for the Turkish economy. As is also evident, the standard errors of both the output gap and the inflation rate take their lowest values during the post-2002 period, which suggests that inflation targeting regime has dramatically decreased the volatility in these variables.

3.2.5. Rolling VAR

In order to have a more detailed short-run VAR analysis, we also employ rolling VAR in addition to VAR with structural breaks. We again employ a window length of 36 in our analysis. The variance decomposition results are reported in Fig. 7, where the 36-months windows are depicted in the *x*-axes and the estimated values are depicted in the *y*-axes, as before. The figure for each variable is in absolute values. To have a smooth representation of the variance decomposition results, figures represent the HP trend values with a smoothing parameter of 100/9 to have a smoother representation of the short-run dynamics, where 100/9 is calculated by the suggested formula in Backus and Kehoe (1992) for 36 months. Consistent with the VAR with structural break analysis, the most important result of Fig. 7 is that both output gap and inflation rate have become much less volatile starting from the introduction of IIT. As is also evident, both output gap and inflation rate have started becoming their main own determinants, an indicator for the stability of these variables. Nevertheless, starting from 2006, it seems that both output gap and inflation rate have started to be affected by the changes in the real exchange rate, which sheds light to slightly more volatile inflation rates after 2006. Overall, success of the inflation targeting regime is also supported by both VAR with structural break and rolling VAR analyses.

4. Performance of IT regime during the recent financial crisis period

Another way to assess the success of Turkey's IT regime is to observe its performance during unusual times, such as the recent 2007–2009 global financial crisis, which began showing its effects in the middle of 2007 and into 2008. However, the Turkish economy was not significantly affected by the global crisis due to IMF-sponsored reforms, effective macroeconomic policy management, and robust financial supervision and banking sector prior to the crisis. Actually, the Turkish economy experienced the very first serious shock to IT regime starting in May 2006 due to changes in international capital conditions. Inflation rate in the second and third quarter of 2006 increased to about 10.5% level, but it declined to 9.3% in the last quarter of 2006. The CBT explained the reasons of this deviation of inflation from its

[18] All technical details can be found in the working paper version of this study available from authors upon request.

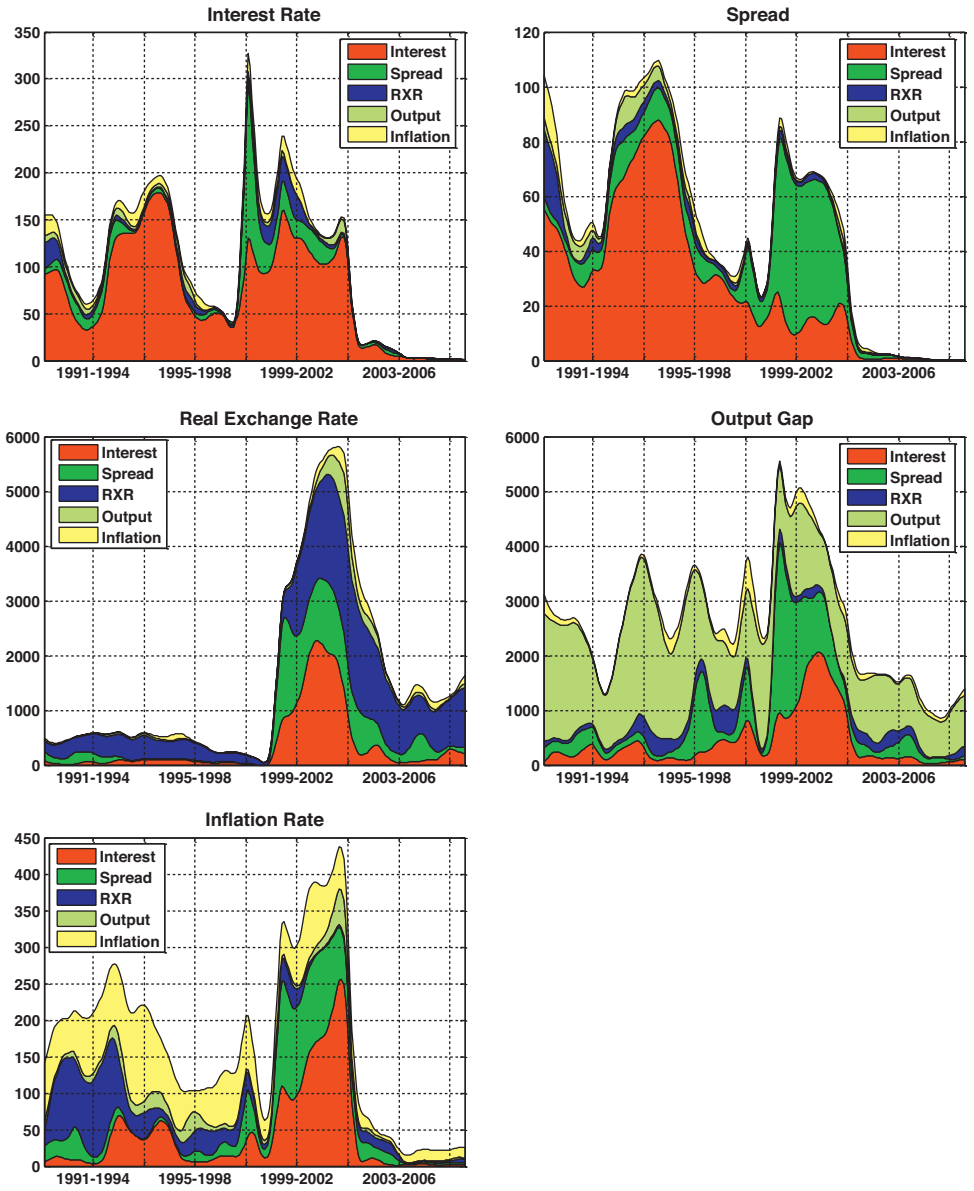

Fig. 7. Rolling VAR – variance decomposition.
Authors' calculations.

target to the government and shared its policy measures with the public necessary to bring down the inflation consistent with the target. These actions improved the communication channel of the Bank and played an important role in lowering inflationary expectations. For example, the 12-month expected inflation rate, which was 10% in the last quarter of 2006, went down to 7.45% in the first quarter of 2007. Inflation target remained to be 4% for 2007 and 2008, and the CBT decided to keep the uncertainty band around the target at 2% for 2007.

Inflation declined in the first quarters of 2007, but increased in the last quarter of the year due to significant increases in food prices and adjustments in administrative prices. The significant weight of energy prices within the CPI increased the volatility of CPI inflation in 2007. As a result, inflation rate in 2007 continued staying outside the uncertainty band. This brought about an increase in expected inflation rate in the last quarter of 2007. Pursuing an effective and open communication strategy, the CBT explained to the government and the public that such price movements were temporary and beyond its control. A series of supply shocks that took place in 2006 and 2007 had underlined the importance of special or "core" CPI aggregates that excluded energy, food, and administered prices and had played an important role in communication of monetary policy decisions with the public. Such communication helped reduce the expected inflation rate to 7.27% in the first quarter of 2008 from 8.71 in the last quarter of 2007. Given the belief of the CBT that the economy was

facing some temporary supply shocks that were beyond the control of the Bank, the CBT decided to keep inflation target of 4% for 2008 and 2009.

In 2008, rapidly increasing food and energy prices in international markets caused inflation to show an upward trend. Inflation rate reached to double digits starting in the third quarter of 2008, and inflation rate continued staying above the target rate three years in a row since the introduction of the formal IT regime. It appeared that supply shocks were more persistent than what the CBT expected. In addition, continuing turbulence in financial markets due to the global financial crisis, combined with domestic political uncertainties, kept depreciating the domestic currency significantly. Given all these developments, it became very difficult for the CBT to maintain an inflation target of 4%. As a result, in June 2008, the CBT proposed setting new targets for the medium term to control the growing inflationary expectations and to reclaim the reputation of the IT regime. The government accepted this proposal and the revised inflation targets became 7.5, 6.5, and 5.5% for 2009, 2010 and 2011 respectively. Once the CBT has revised its target rate upward in June 2008, the credibility gap improved significantly in 2009.

During 2009, favorable supply shocks, along with diminishing political uncertainties and monetary tightening, caused a significant drop in inflation and inflationary expectations. Inflation rate dropped to about 5% in the last quarter of 2009, 12-month expected inflation rate by the end of 2009 was 5.4%, and inflation rate was below its target rate.

Overall, IT regime has performed well during the 2007–2009 crisis period, thanks to the effective communication of the Bank with the public and the revision of inflation targets in 2008.

5. Concluding remarks

This paper has evaluated the performance of the inflation targeting regime in a developing small open economy, Turkey. Although the results are mostly in line with the requirements of a healthy inflation targeting regime in the literature (e.g., see Mishkin, 2008), the empirical focus has been mostly on macroeconomic stability (i.e., the absence of fiscal dominance, external stability, level of inflation at adoption of full-fledged inflation targeting), and the conduct of monetary policy (especially, the selection of short-term interest rates as a policy instrument, transmission of monetary policy, and better inflation forecasting). In addition to that, this paper has also investigated the real (business-cycle) effects of the inflation targeting regime through employing variance decomposition analyses on Turkish macro variables.

It has been shown that the monetary policy has been successful in terms of decreasing the inflation rate from 70% in 2001 to below 10% in 2004, which has been stable from that point on; besides, the volatilities of output, inflation, and interest rates have all decreased during the inflation targeting period. Hence, inflation targeting has been an effective framework in Turkey with more progress to come. Despite increasing effects of international shocks through movements in the real exchange rates, the successful monetary policy has been mostly achieved through fiscal discipline and improving interest rate pass-through from policy rate changes to commercial lending rates; hence, the results have important policy implications for developing countries: (i) Fiscal stability is an effective tool for a successful monetary policy; (ii) the overnight policy rate is a significant determinant of the changes in market lending rates, which is the preliminary step in the monetary transmission mechanism; (iii) recent developments on the broader issue of the effectiveness of interest rate policy in controlling inflation through aggregate demand management and through other channels is encouraging. Based on these findings, one can argue that the impact of policy rate changes on economic activity and inflation have become more predictable and changed in the direction in line with theory, improving the transmission capacity of monetary policy. Moreover, the IT regime performed well during the recent 2007–2009 global crisis period. An effective central bank communication with the public and the willingness of the Bank to be flexible in terms of adjusting its inflation targets played an important role in the successful performance of the regime.

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