A TAIL INDEX TOUR ACROSS FOREIGN EXCHANGE REGIMES IN TURKEY

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Abstract

There are several econometric studies in the literature discussing the empirics of the the foreign exchange rate movements and the volatility of the foreign exchange and its association with some fundamentals under different exchange rate regimes in Turkey. However, all these concentrate on the volatility aspect of the foreign exchange and not on the tail behavior of the foreign exchange returns. It is by now generally accepted that foreign exchange returns exhibit "heavy tails" as measured by the so called tail index. Applications of extreme value analysis typically assume the tail index to be constant. However, the many switches in foreign exchange regimes in recent history - especially within emerging markets - raises doubts over this constancy assumption. In this study, the tests developed by Quintos, Fan and Phillips (2001) are applied to both full sample covering all regimes and separately to subsamples representing pegged and float regime periods for testing and dating the breaks in tail index. The null of the constancy of the tail index is rejected both for the full sample and subsamples separately, indicating time varying behavior not only accross but also within the fixed and float periods. The break dates detected indicate no association with any foreign exchange regime change and the major breakpoint may be stemming from the overshooting of the exchange rate which also coincides with the abandonment of the pegged in favor of the float regime.

Key words and phrases. tail index, exchange rate regimes, structural breaks.
JEL Classification: F31, G15, G19, C49.

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1. INTRODUCTION

Since the financial liberalisation launched with January 24, 1980 program, Turkey has undergone several episodes of exchange rate regimes. Although the targets and the implementation mechanism varied from regime to regime those before 2001 can all be classified as variants of the fixed exchange rate regime which lasted until February 2001, resulting in the total abandonment of this system and the introduction of the free float regime. The exchange rate had exhibited frequent upswings and downswings before that date and continued to show fluctuations afterwards. In the exchange rate history of the country, two very sharp downfalls one in April 1994 and the other in February 2001 are documented as currency crashes. Since these events occurred following the liberalization of the capital account in 1989, the issue of the exchange rate regime under free capital mobility has become an important concern in Turkey. The Asian crisis in 1997-1998 and the turmoil in Brazil, Argentina and Russia afterwards have played a crucial part in raising this question. Furthermore, the increasing degree of globalization has sped up the international integration of capital markets, augmenting the difficulty of policy conduct for the developing economies.

Due to the inherent complexities associated with the exchange rate management and the added difficulties mentioned above, the study of the sharp swings and outliers in exchange rate returns rather than their causes have become a topic widely investigated in the extreme theory literature which focus on measuring the probability of occurrence of such sharp movements. Since extreme observations are concentrated in the tails of the distribution from which these observations come from, a method frequently applied is the tail index. A well known measure of the tail index is the Hill estimator.

Empirical studies of extreme movements using tail index in foreign exchange markets are numerous[1]. Among them, notably Koedjik et al (1990), Hols and de Vries (1991), Koedijk, Stork and de Vries (1992), have investigated the tail behavior of the empirical distribution of foreign exchange rate returns and, as well as assessing how fat-tailed returns are, they also analyzed the stability of the distributions across different exchange rate regimes. The general finding from these papers is that exchange rate returns are fat tailed but with $\alpha<4$ and, during a variety of fixed exchange rate regimes, have tail indices that are in the region $1<\alpha < 2$[2]. For floating rate regimes, however, α tends to exceed 2, which is interpreted as suggesting that a float lets exchange rates adjust more smoothly than regimes that involve some amount of fixity. Dacarogna et al (1998), on the other hand, conducted similar works using high frequency or tick-by-tick foreign exchange series. Loretan and Phillips (1994) developed a test assuming a known breakpoint. All these studies suggest that any empirical study covering different exchange regime periods should take the tail behavior differences into consideration.

A practical problem frequently encountered is the unequal number of observations accross different regimes if sample is divided in subsamples to allow

[1] We cite applications of tail index to forex markets only. The equity and other asset studies are too long to mention here.
[2] α represents Hill estimate.

structural change. In case no sample splitting is done to circumvent the problem, the constancy of tail index is implicitly assumed and may lead to erronous results by not allowing time varying behavior if it exists. In case sample splitting is done, this implies exogenously determining time(s) of structural changes. Sample splitting however, has the risk of introducing pre-testing bias and is subject to known critics (Christiano,1992). Using the tail index of returns on foreign exchange rate as a summary measure of extreme behavior recently-developed tests for the null of constancy of the tail index, versus the alternative of a change at an unknown date, permit inference on changes in extreme behavior over a long time period while allowing for second-moment dependence in the return data. The recursive, rolling and sequential tests developed by Quintos, Fan and Phillips (2001) is one popular example. A major advantage of the QFP tests for structural change is that because they do not require a priori specification of a break point, they allow possible structural breaks in the Hill estimator by endogenizing the break dates thus pre-testing bias can be eliminated. Further, these tests can be modified to incorporate Hsing's (1991) results to allow for the ARCH-type dependence present in such data. Recently, Candelon and Straetmans (2003) and Quintos (2004) generalized Quintos et al (2001) method towards an analysis of multiple breaks for emerging currency returns.

Despite numerous theoretical and empirical investigations about the exchange rate tail index in the literature, the studies exclusively dealing with the statistical properties of the Turkish foreign exchange returns are rather limited to the study of Akgiray (1990). However, his treatment is somewhat dated and does not incorporate the recent developments. Rather, the frequently investigated issues about the exchange rate behavior about the Turkish experience had been related with either its volatility behavior or linkages with other variables. Some examples include Aysoy et al (1996) which studied the daily volatility in the Turkish foreign exchange market. The study by Berument (2002) investigated the link between exchange rate movements and the inflation dynamics. Guimaraes and Karacadag (2004) investigated the empirics of foreign exchange rate intervention in Turkey, particularly in terms of its effect on volatility. Duttagupta, Fernandez and Karacadag (2004) discuss the operational aspects of moving from pegged to floating exchange rate citing Turkey among other countries used in their study. A recent treatment is by Selçuk and Ardıç (2004) which examine the interaction between the exchange rate and its volatility and the Central Bank policies in the float period.

The present study attempts to provide substantial further evidence on the effects of changes in foreign exchange regimes, for several reasons. First, by concentrating on the overall characterization of the tail of the return distribution rather than on volatility measures, our results are focused on extreme events; we are able to examine the evolution of this measure of extreme behavior over time and across different foreign exchange regimes. Second, by conducting these tests first for the whole historical sample without dividing it in sub samples and then using sub samples of pegged and float regime periods separately, we not only address the issues of pre-testing problems and sample splitting but also separate tail behavior under the float and fixed periods to better capture the effects of the economic developments within these regimes at the same time.

The second question of interest is that of whether we can detect attenuating influences on extreme behavior during the float period which followed the 2001 crisis. The paper proceeds as follows: In the next section the description of the tail index, Hill estimator and QFP tests are presented. This will be followed by a historical account of the foreign exchange regimes and foreign exchange related developments in the third section. The data, descriptive statistics of foreign exchange returns, estimation results and their interpretation are given in the fourth section. Section five concludes.

2. INFERENTIAL METHODS

The tail index characterizes the rate at which probability mass falls away in the tail of a distribution; a relatively high tail index corresponds with relatively low probability of extreme events. Let {Xi} be a sequence of random variables with common distribution function F(x), so that 1 - F(x) is the probability of observing a value exceeding x. Then [see, e.g., Hsing (1991)] 1 - F(x) is said to be regularly varying at 1 if there exists $\alpha > 0$ such that

$$(1 - F(hx) / (1-F(x)) \rightarrow h^{-\alpha} \quad \text{as } x \rightarrow \infty, \ \forall h > 0 \qquad (1)$$

We refer to $\boldsymbol{\alpha}$ as the tail index parameter, and note that by Equation (1), as $x \rightarrow \infty$,

$$(1-F(x)) = O(x^{-\alpha}) \qquad (2)$$

While a number of estimators of a are available, that of Hill (1975) is the most popular for purposes of statistical inference, for several reasons: the estimation procedure does not depend on the existence of the fourth moment of the data; the estimator has been found to perform relatively well on sample sizes available in financial data [Kearns and Pagan (1997)]; and, particularly important for our present purpose, it is the basis of the structural break tests of Quintos, Fan, and Phillips (2001). Other methods have been proposed to reduce bias in such estimates, such as the maximum-likelihood (ML) method of Feuerverger and Hall (1999) and the weighted least squares (LS) regression method of Huisman et al. (2001). However, our interest in this section is not in the absolute level of the tail index, but in possible changes over time, and we concentrate on the raw Hill estimate for which general procedures for inference on structural change are available. As well, the Hill estimator is consistent for a wide range of dependent processes.

Hill's estimator is based on the *m* largest order statistics of the sample. Following the notation of Quintos et al., define the order statistics from the original sample $\{X_1, X_2, \ldots X_T\}$ as $\{X^T_{(1)}, X^T_{(2)}, \ldots X^T_{(T)}\}$, such that $X^T_{(1)} < X^T_{(2)} < \; < X^T_{(T)}$. In the present problem {Xi} = {Fx}, the set of daily TL/USD returns. Choose the largest m_T of these, $X^T_{(T-mT+1)}$ to $X^T_{(T)}$, for estimation on the right tail of the distribution (for the left tail, multiply the smallest m_T values by -1). The Hill estimator of α is then

$$\hat{\alpha}_{\mathbf{T}} = \left[\mathbf{m}_{\mathbf{T}}^{-1} \sum_{\mathbf{j}=1}^{\mathbf{m}_{\mathbf{T}}} (\ln \mathbf{X}_{(\mathbf{T}-\mathbf{j}+1)} - \ln \mathbf{X}_{(\mathbf{T}-\mathbf{m}_{\mathbf{T}}+1)} \right]^{-1} \tag{3}$$

Estimation of the tail index parameter generally requires a relatively large sample, because only a small proportion of the sample occurs, by definition, in the tails; it is common in estimation to use a proportion such as 10% of the sample size, following DuMouchel (1983) who suggested that m_T be a fixed proportion not exceeding 0.1T. All sequences of tail index estimates in the present paper are based on the Hill estimator, and vary only in the definition of the sample used for estimation. In recursive estimation, a sequence of estimators is presented in which the sample size is augmented at each date by the latest data point; in rolling estimation, a fixed sample size is maintained by dropping the earliest data point each time a new data point is added.

The structural change tests of Quintos et al. (2001) are based on these sequences of tail index estimates. The null hypothesis is that the tail index has the constant value α over the real interval $t \in [t_0, T - t_0]$, with alternative of departure from α at some point in the interval, and is tested with sequences of estimates defined over different sets of samples. Recursive estimates produce a sequence of estimates α_t using samples 1, . . t, for $t = t_0, t_0 + 1, ...T - t_0$; rolling estimates use samples $1+ (t-t_0)$, . . . t, with t indexed over the same values, for a constant sample size $t_0 \equiv \gamma T$. The sequential tests use both a recursive set of estimates and a reverse recursive set, labelled $\alpha_t^{(-)}$, defined over samples 1, . . . t and t+1, . . .T respectively, where once again t indexes the values $t_0, t_0 + 1, . . .T - t_0$. The sequences of test statistics are based on the sequences (in a slightly modified notation):

$$Z_1^2(t) = \left(\frac{tm_t}{T} \right) \left(\frac{\hat{\alpha}_t}{\hat{\alpha}_T} - 1 \right)^2 \tag{4}$$

$$Z_2^2(t) = \left(\frac{t_0 m_0}{T} \right) \left(\frac{\hat{\alpha}_{(t_0,t)}}{\hat{\alpha}_T} - 1 \right)^2 \tag{5}$$

$$Z_3^2(t) = \left(\frac{tm_t}{T} \right) \left(\frac{\hat{\alpha}_t}{\hat{\alpha}_t^{(-)}} - 1 \right)^2 \tag{6}$$

where $\alpha_{(t0,\, t)}$ is the tail index estimate on the rolling sample of size t_0 and m_0 is the corresponding number of order statistics. The test statistics are supt Z^2_i (t), i = 1, 2, 3, and in the IID case have asymptotic distributions obtained and tabulated by Quintos et al.(2001).

There are several additional points to be considered for these foreign exchange data. First, the recursive test is consistent only against increases in tail thickness (decrease in α) beyond the breakpoint, a consequence of the fact that a part of the sample with thick tails dominates in estimation of α. For this reason, although the recursive method is the standard approach to structural change tests in many contexts, the recursive tests will not allow us to examine potentially significant decreases in tail thickness in post-crisis floating exchange rate period. As stated earlier, the floating regime is expected to cause an increase in α rather than an decrease so thick tails dominance is likely to lessen. We will therefore not rely on these tests, although we will mention their results below for the part of our problem to which they are applicable.

Second, the foreign exchange returns data that we examine here is not IID, but displays second-moment dependence often modelled, for example, with GARCH processes. Quintos et al. provide modifed versions of the test statistics using the results of Hsing (1991) for dependent processes, applying these to the squares of the logarithmic returns. The modifications are based on a re-scaling of each of the equations of (4-6) to account for the different variance of the Hill estimates when the raw data are serially dependent; with the appropriate re-scaling the same asymptotic distribution holds. That is, serial dependence does not affect the consistency or asymptotic normality, with convergence at rate m12 , of the Hill estimator; see in particular Hsing (1991). The effect of serial dependence is to increase the variance in the asymptotic distribution, and a valid test must embody an estimate of this higher variance. With an appropriately modifed asymptotic variance estimate, inference on changes in tail behavior can then be conducted despite the clustering of large squared returns that arises in such data.

$$\sup(\hat{\eta})^{-1} Z_{it}^{2} \tag{7}$$

$$\hat{\eta} = 1 + \hat{\chi} + \hat{\omega} - 2\hat{\psi} \tag{8}$$

$$\hat{\chi} = 2\hat{\alpha}^{2} m_{w}^{-1} \sum_{j=1}^{w} c_{w,j} c_{w,j+1} \tag{9}$$

$$\hat{\psi} = \hat{\alpha}^{2} m_{w}^{-1} \sum_{j=1}^{w} c_{w,j} d_{w,j+1} + c_{w,j+1} d_{w,j} \tag{10}$$

$$\hat{\omega} = 2 m_{w}^{-1} \sum_{j=1}^{w} d_{w,j} d_{w,j+1} \tag{11}$$

where

$$c_{w,j} = (\ln(X^2)_i^w - \ln(X^2)_{(w-m_w+1)}^w) \tag{12}$$

$$d_{w,j} = I(\ln(X_i^2) > \ln(X^2)_{(w-m_w-1)}^w) \tag{13}$$

where **I**(.) is the indicator function and where it is now understood that $\hat{}\alpha$ is estimated on the squares of the data. We have followed Quintos et al.(2001) in these definitions and in defining the additional notation *w*to indicate the window on which estimation takes place; for the full sample $w = T,$ for a rolling sample $w = \gamma T,$ and so on. The modifed statistics (11), (12), (13) based on (10) account for GARCH(1,1) dependence in the squared returns.

3. REVIEW OF THE FOREIGN EXCHANGE REGIMES IN TURKEY

In Turkey, until the disorderly exit from the crawling peg regime to a float in early 2001, the Central Bank of Turkey (CBT) historically had a dominant role in the foreign exchange market, being virtually the only market maker, quoting on all transactions and acting as counterparty in every transaction. Market participants had grown dependent on the central bank's constant presence in the market and were unprepared to face unpredictable events. Under an IMF supported stabilization program, the CBT gradually withdrew from the market, forcing market participants to trade among themselves. Particular measures were taken to signal the authorities' commitment towards the floating regime and encourage foreign exchange market activity. The major attempts in line with this policy had been the establishment of the interbank money market in early 1986, open market operations and gold market in the same year and the foreign exchange and banknotes market in August 1988. By the year of 1989, although, financial liberalization process had been succesfully completed, the economy could not shift to the free floating exchange rate regime which brings the dillema of free-capital flows and fixed exchange rates. It was not earlier than 2001 February after a financial crises that the CBT issued a press release announcing the discontinuity of the pegged regime. Within this new float regime, the CBT became more tolerant to large fluctuations in the exchange rate without intervening to influence the level of the exchange rate. In fact, there have been long periods without any CBT intervention in the market and recent data suggests that the interbank foreign exchange market turnover is growing rapidly (Guimarães and Karacadag, 2004). Therefore, finally after 2001 February the CBT stepped up its surveillance activity to gather detailed market information that would provide better knowledge about volatile market developments or speculative behavior. Since all these developments occurred in a gradual and evolutionary way, the summary of this transition process in sub-periods as from January 24 1980 program would be helpful.

1980-1989

Since 1980s a financial liberalization policy was adopted with the goal of achieving a long-run economic improvement and a sustainable economic growth in Turkey. The fundamental objective of the January 24 stabilization program was to bring the inflation rate down to manageable proportions. The program set off the abandonment of the import substitution trade regime in favor of the export oriented program with the ultimate aim being an accompanying gradual movement towards the free float regime. Within this framework, the deposit and loan interest rates had been liberalized accompanied with a tight monetary policy and implementation of multiple exchange rates had been abandoned. Therefore, in 1980, the Turkish Lira had been devalued by 48.6% and the exchange rates had started to be determined by daily adjustments in parallel to the purchasing power parity[3]. In other words, until august 1988 adjustable peg system was in effect. These early attempts of liberalization policy by removal of the restrictions on interest rates failed causing volatility in the market rates as the banks were unprepared for a competitive environment with a high rate of inflation. Furthermore, the increase in credit interest rates also led to default loans feeding back new credit to repay the default ones. The measures taken in 1983 reintroduced the control of the market interest rates until 1987.

The year 1986 saw the inauguration of interbank money market under the central banks initiative which played an important role for an efficient use of the financial resources in the short-term. Also, the first monetary program had been implemented which allowed M2 to grow in line with the real exchange and real interest rates. By the year of 1987, the Istanbul Stock Exchange market became operational. Consequently, as of 1987, the impacts of both trade and foreign exchange liberalization led to the growing share of foreign currency denominated deposits in controlling money supply. By late 1987, the country witnessed an increasing gap between official and black market foreign exchange rates due to negative deposit rates in domestic currency. This resulted in a sharp depreciation of the TL vis-à-vis foreign currencies. The growing volume of transactions both in the stock exchange and foreign exchange market also resulted in liquidity surplus causing imbalances in the financial markets leading to mini crises by 1988. A set of new measures was brought in to reverse the trend in favor of domestic currency and TL deposit rates was freed under a certain ceiling rate with an attempt to make the domestic currency attractive. On the other hand, in order to control the increase in reserves, RRR was set at the higher rate of 16%. Finally, the CBT injected 160 million dollars into the market to meet the excess demand for foreign exchange.

The year 1989 was particularly important for the decree related to TL has been amended leading to liberalization of foreign capital flows. Thus foreign residents in Turkey could sell foreign assets in domestic market while residents abroad could buy Turkish assets denominated in TL. Exchange rate regulations with respect to the foreign exchange sale and transfers have been relaxed to ensure the smooth running of the mechanism. To summarize, the first period between 1980 and 1989 can be described as a period of fast restructuring of the economy towards financial liberalization and flexible foreign exchange market during which yet pegged exchange regime was in effect, namely daily adjustment of the foreign exchange rates.

[3] N. Keyder, “Para Teori Politika Uygulama” (Monetary Theory and Policy), Ankara 7ed. 2000

1990-1994

As from 1989 with free capital account, Turkey received substantial capital inflows which, at times, appeared to have constrained the monetary policy. The inflows were attracted by high domestic interest rates driven by a large Public Sector Borrowing Requirements whereby investors attracted by high yields in domestic securities brought foreign currency, converted it into TL and bought domestic securities, later on to convert it back into foreign currency. For banks, capital inflows increased foreign exchange deposits or more broadly, liquidity and stimulated lending both in foreign currencies and in TL, which in turn, through higher consumption, investment and/or imports led to an expansion in aggregate demand.

After 1989 the CBT switched to **managed float** system by changing its foreign exchange policy. In this system, which was to remain in effect between 1991 and 1993, the equilibrium exchange rate would be set according to demand-supply interaction and CBT would only intervene in the event of unexpected sharp swings[4]. During this period central bank has abandoned the targeting of the M1 and M2 monetary variables and shifted to credit balance targeting in order to control the money supply. In 1990 the foreign exchange and interest rate targets were attained with success which is reflected in financial markets and the fluctuations were within acceptable limits. The following year, 1991, the Gulf crisis precluded the implementation of any monetary policy and the withdrawal of foreign exchange deposits from the banks led to the fall of the CBT's reserves by $2.3 billion in the first three months. In 1992, on account of large budget deficits CB announced that it would stick to tight monetary policy and make every effort to contain volatility in foreign exchange market and maintain the foreign exchange increase below inflation rate by intervening directly. This policy led to the appreciation of the TL attracting large sums of short-term capital inflows. On the downside, there was inevitably the deteriorating external trade balance. In 1993 however, the fall in the interest rates, notably in short term bond rates, put an end to that and curbed the attractiveness of the TL. The three devaluations in the first half of the 1994 could not stop the short term capital flight leading to a substantial exchange rate crisis in early 1994.

1994-1998

On March 1994, CB abandoned its interventionalist policy and began to gradually devalue the Turkish Lira[5]. In the same month, a communiqué regarding the standard ratio of foreign exchange net general position to the capital base was put into effect, requiring authorized banks to apply a maximum ratio of 50% of their net general position to their capital base. Governments announced the 3-month austerity program on April 15, to lower inflation and reduce the budget deficit. In 1994, an other important measure as to curb the budget deficit was the modification in the Central Bank law limiting the Central Bank advances to the Treasury. As in 1994, a similar monetary policy had been adopted

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[4] There is no consensus as to the type of exchange rate regime after that period. For instance, according to Bubula and Otker-Robe (2003) the regime is described as 'backward looking crawling peg'. Berument (2002) on the other hand, defines the period up to January 2000 as an 'intermediate exchange rate regime being neither of crawling peg nor of fixed exchange rate regime' type.

[5] Bubula and Otker-Robe (2003) identifies the period as forward looking crawling peg.

for 1995 which used interest rates to defend pre-specified ceilings on gradual exchange rate depreciation as to achieve disinflation. However, the policy implementation was revised in line with the inevitable experience of 1994 crises and in 1995 a crawling band regime was adopted. The predetermined foreign exchange rate was to be kept under the inflation rate with the monthly adjustment ensuring this.

1998-2000

Instead of foreign exchange interventions as a policy tool in controlling money supply, the targeting of the growth rate of net domestic assets was initiated in 1998. The inflation target rate of 69% was set at the same time as an upper bound for the growth rate of net domestic assets. Following the general elections in 1999, a stand-by agreement with IMF was launched and a new program aiming at reducing inflation was started. The main tool of disinflation program has been adoption of a crawling peg regime; i.e., the percent change in the TL value of a basket of foreign exchanges (1 US dollar plus 0.70 euro) was fixed for a year and half period.

In January 2000 a new system was adopted based on the preannouncement of the foreign exchange band. The new practice is based on the follow-up of the net domestic assets within the framework of the exchange rate policy while maintaining an upper limit for net domestic assets at the same time a lower limit for net international reserves. Thus CBT commits itself into purchasing all the foreign currencies on offer at the pre-announced rate.

2001 Crisis

The second crisis was preceded by a financial turmoil that burst in the second half of November 2000 just at the midst of an exchange rate based stabilization program. The pressure in the market calmed down soon after a new letter of intent was presented to International Monetary Fund (IMF). However, as of the end of December, the average interest rates, both the overnight rate and secondary market bond rate, were almost four times higher than their levels at the beginning of November and more than five times higher than the pre-announced year-end depreciation rate of the lira. This unsustainable situation ended on the February 19, 2001, when the prime minister announced that there was a severe political crisis that ignited a crisis in the highly alerted markets due to what had happened at the end of the preceding year. On that day the overnight rates jumped to unprecedented levels of 6200 percent in uncompounded terms. Three days later, the exchange rate system collapsed and Turkey declared that it was going to implement a floating exchange rate system from that time onwards (Özatay and Sak, 2002).

All of the regimes involved in some way or another the CB intervention in the foreign exchange market thus can be categorized as soft peg intermediate regimes in the literature[6]. Crises that occurred in November 2000 and February 2001 not only revealed the uncertainty in the economy but also showed that such soft pegs are unsustainable under free capital flows.

[6] We identify the period until the second crisis as fixed regime despite the implementation of a short-lived managed float system within that period.

<u>Post 2001 Period</u>

In the aftermath of the february 2001, the Central Bank of Turkey repeadedly stressed that it would stick to the floating exchange rate system and the volatility of the nominal exchange rate will be of concern rather its level of direction. Meanwhile, an implicit inflation targeting would be pursued by controlling monetary aggregates and setting an indicative interest rate. In order to control the volatility of the exchange rate, the Central Bank conducted several selling auctions. In fact, during the early stages of the float between March 29, 2001 and November 30, 2001, all interventions were in the form of selling auctions, and the Central Bank sold a sum of $6,553 million. All other episodes of preannounced interventions had been in the form buying auctions. The CBT announced that the purpose of the buying auctions was merely to rebalance the foreign exchange revenues of the CBT[7]. Using a VAR-based impulse response analysis, Selçuk and Ardıç (2004) conclude that the Central Bank had been successful in containing volatility and reducing the average inflation rate in the period before October 2003. However they also proclaim that "the accumulated risks in the economy such as the extreme appreciation of the currency and high real rate of interest can make the system vulnerable to external shocks..

4. DATA AND EMPIRICAL RESULTS

Since tail index estimation is usually based only on data from the tails of the empirical density, very large samples are typically required in order to obtain reliable estimates. As we have abundant data for the fixed exchange rate regime period in which several variants of foreign exchange regimes are implemented, it is statistically feasible to investigate tail index behavior and apply QFP tests separately using only the fixed regime data. On the other hand, the tail behavior following the 2001 crisis- representing the float regime- can also be investigated separately with QFP tests. The small size of this subsample (911 obs) relative to fixed regime period and full sample period might look as a potential problem. However, we note that QFP in their original paper used between 931 and 937 daily observations for stock market returns which is not substantially larger than our subsample.

Figure Ia-Ib-Ic here

The foreign exchange return is constructed as log (p_t/p_{t-1}) from the TL buying price of the U.S dollar downloaded from Central Bank of Turkey data dissemination server. The full historical sample period covers the period between 28.01.1980 and 14.10.2004 spanning various variants of the pegged foreign exchange regime as well as the float period in effect since 2001 February. The fixed regime subsample covers 28.01.1980 and 21.02.2001 periods. The float regime covers 23.02.1980 and 14.10.2001 periods.

Table 1a-Ib-Ic here

[7] CBT Press Announcement No: 2002-25, March 2002.

Prior to empirical investigation some descriptive statistics and plots of the foreign exchange returns for the whole sample as well as pegged and float period sub samples are given. The normality of the distribution is rejected for all periods and subperiods. The distribution is leptokurtic and skewed although with varying degree over the full sample and subsamples (Table Ia-Ic).

Table IIa
Figure IIa here

The first set of empirical results concerns the hypothesis of constancy of the tail index on the full historical sample including the fixed and floating period. The results, for rolling tests using various sample proportions and for the sequential tests, are presented in Table IIa. The base results reported in the tables take m to be 10% of the relevant sample size (the rule proposed by Dumouchel 1983 and used by Quintos et al. These results are easily summarized. On all tests, the null of constancy of the tail index is rejected at a test level of both 0.01 and 0.05; that is, each of the test statistics exceeds (by a substantial margin) the 95 and 99th percentiles of the null distribution. Thus, substantial evidence of breaks is detected by both sequential and rolling test statistics. The latter point to the February 2001 crisis date as the maxima of the statistics for smaller window sizes while for the larger window sizes the breakpoint dates slide back to September 1988. The rolling tail index graphs show that for smaller window sizes, the tail index is moving between 1 -1.6 range until 1994 during which it falls down 0.6 to remain close to that value until 1998. The test statistics, however, show that the index values are not significant from 1988 until late 1998. During this period, the insignificance of the tests may be due to the high interventionalist policy of the CBT into the foreign exchange market. On the other hand, the rebound in the statistics after 1998 can be attributed to the impact of the crisis in Russia. Sequential test depicts a jagged rising trend until 1994 during which it falls only to rise again in the year 2001. All these show that the riskiness of the foreign exchange returns were high and significant during two episodes: first between 1983 and 1988 and second between 1998 and 2001 periods.

Table IIb here
Figure IIb here

The next set of results concerns inference on the fixed regime era for which, as described above, data until 21 January 2001 is used. Now we are investigating whether the tail index may have changed within the fixed regime bearing in mind the implementation dates of the variants of the fixed regime. The results are given in Table IIb. The null hypothesis of constancy of Hill estimator is again rejected for the second time. The breakpoint dates for the window sizes .15 and .20 again point to February 2001 as in the full sample. The rolling tail index graphs for the pegged regime subsample show that the tail index is below the value of 2 as expected. The figures reveal that tail index was rising until 1988 then drops afterwards (Figure IIb). The test statistics are also highly significant in that period however follow the drop in the tail value and become insignificant thereafter. Starting in the early 1999, the test statistic stabilizes slighly above significance level. This low value period is also captured by the rolling tail index of varying window sizes[8]. Although no causality type of inference should be sought, this period witnessed an ever increasing momentum of foreign capital flows.

Table IIc here
Figure IIc here
Figure III here

Table IIc presents the float period results. Here again, the null of the constancy of the tail index is rejected by rolling tests under different window sizes indicating time-varying tail behavior within that period. On the other hand, sequential test is significant at 5% but not at 1% level. In this subsample, the rolling test breakpoint dates are quite close under varying window sizes. Moreover, the sequential test breakpoint date is also very close to those of rolling tests. Since the detected breakpoint date is not associated with any discernible economic program change or any domestic or foreign foreign exchange market development the impact could only be linked with a political event[9].

The tail index in float period subsample exhibit a value less than 2 initially, then rises over that value for a while, then falls back below and remains at that level until around October 2003. Following that date, the index starts to increase considerably and generally is gretaer than 2. Rolling test statistics become highly significant in that segment and this is also confirmed by the rising value of the sequential tests statistic. Altough the initial tail index values may look incompatible with the hypotheses about the tail behavior in the float regime, several reasons may explain this: First reason is the exit from the pegged exchange system not being in a pre-announced or planned way but by the outbreak of a crisis. Naturally, some time had to elapse before economic agents adjusted to the abrupt change and formed their expectations accordingly. Consequently, the effects of the initial large depreciation have not died down immediately but lasted quite some time after february 21, 2001 during which the foreign exchange showed substantial volatility until the upswings and downswings finally settled down thanks to the interventions of CBT in the form of selling auctions. Second, the political issues such as collapse of the coalition government and the upholding of early elections all contributed to the uncertainity associated with economic policy. All these developments occurred in the bigger segment of the subsample and thus reflect the low values of the index.

Table IIIa-b-c here

[8] These are not provided here to preserve space however they are not markedly different .
[9] A major political event date was a referandum in April 24,2004 in Cyprus. The tension buildup in all domestic markets had started earlier.

5. CONCLUSION

This paper used the tests of parameter constancy to asses whether the probability of observing sharp swings in the foreign exchange/TL has been the same across different exchange rate regimes. We find strong evidence of a change in the tail index (increase in the probability of extreme events) not only for the whole historical sample covering pegged and floating regime, but within these regimes as well. Then it follows that the span of Turkish foreign exchange returns from January 28, 1980 up-to-date should not be treated as a sample from a single distribution, particularly when considering the extreme tails of the distribution. The large February 2001 depreciation (overshooting) is detected as major breakpoint in both full sample and fixed regime sub sample periods. This disorderly exit to float regime renders the breakpoint-based separation of the pegged and float regime rather difficult as it is obviously caused by a crisis and not by a switch to another regime. The break dates in the fixed regime is close to the abandonment of the adjustable peg system thus seem to capture at least the first regime change within the fixed regime period. However, whether any cause-effect type of association can be advanced is a highly debatable issue. For instance, until 1988 foreign direct investment was rather low. Moreover, the share of foreign currency denominated assets and liabilities started to increase after 1988. All these factors are equally likely to cause a change in tail thickness. Any additional evidence of an association with the subsequent changes within the pegged regime and breakpoints could not be established. As for the lengthy period covering also the first crisis date of 1994 until early 1999, both full sample and pegged subsample tests failed to provide statistical support for the observed tail thickness increase. When they start rising again two devastating earthquakes had occurred, the impact of the 1998 Russian economic crisis was beginning to be felt and a recession cycle was setting in. The slow but gradual decrease of the tail index in the float period particularly after October 2003 point to the success of the CBT auctions not only in terms of reducing volatility but also in terms of reducing the riskiness. On the other hand, the breakpoint dates captured in the float period sub sample indicate the importance of political events in affecting tail behavior in foreign exchange returns regardless of the exchange regime adopted. All these findings suggest that there are causes other than exchange regime type which may move the foreign exchange returns. Consequently, this study warrants some further research work for testing and dating extremal breaks such as the use of multiple break tests as in Quintos (2004) and Calderon et al (2004) for confirmatory analysis.

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Table 1a. Descriptive statistics for full sample (January 28, 1980-October 11, 2004).

Number of observations	6236
Mean	0.0015957
Std.Devn.	0.010279
Skewness	12.255
Excess Kurtosis	396.37
Minimum	-0.12564
Maximum	0.33473
Asymptotic test: Chi^2(2)	4.0977e+007 [0.0000]**
Normality test: Chi^2(2)	13430. [0.0000]**

** Significant at 1% level.

Table 1b. Descriptive statistics for pegged period subsample (January 28, 1980-February 21, 2001).

Number of observations	5324
Mean	0.0017232
Std.Devn.	0.0084073
Skewness	14.151
Excess Kurtosis	549.46
Minimum	-0.11537
Maximum	0.32851
Asymptotic test: Chi^2(2)	6.7150e+007 [0.0000]**
Normality test: Chi^2(2)	10303. [0.0000]**

** Significant at 1% level.

Table 1c. Descriptive statistics for float period subsample (February 21, 2001-October 11, 2004).

Number of observations	912
Mean	0.00085169
Std.Devn.	0.017584
Skewness	7.8084
Excess Kurtosis	148.39
Minimum	-0.12564
Maximum	0.33473
Asymptotic test: Chi^2(2)	8.4603e+005 [0.0000]**
Normality test: Chi^2(2)	1589.8 [0.0000]**

** Significant at 1% level.

Table IIa. Full-sample rolling and sequential tests of USD/TL log returns, January 28, 1980-October 11, 2004.

Test	5% c.v.	1% c.v.	$\sup(Z_i^2(t))$
Rolling, $\gamma = 0.15$	1.46	1.90	15.29
Rolling, $\gamma = 0.20$	1.75	2.30	23.22
Rolling, $\gamma = 0.25$	1.98	2.55	24.25
Rolling, $\gamma = 0.30$	2.12	2.86	29.45
Sequential, $t_0 = 500$	18.31	28.82	89.37

Critical values recorded are taken from Quintos, Fan, and Phillips (2001).

Table IIb. Subsample rolling and sequential tests of USD/TL log returns, January 28, 1980-February 21, 2001.

Test	5% c.v.	1% c.v.	$\sup(Z_i^2(t))$
Rolling, $\gamma = 0.15$	1.46	1.90	8.92
Rolling, $\gamma = 0.20$	1.75	2.30	11.74
Rolling, $\gamma = 0.25$	1.98	2.55	13.59
Rolling, $\gamma = 0.30$	2.12	2.86	15.14
Sequential, $t_0 = 500$	18.31	28.82	80.15

Critical values recorded are taken from Quintos, Fan, and Phillips (2001).

Table IIc. Subsample rolling and sequential tests of USD/TL log returns, February 23, 2001- October 11, 2004.

Test	5% c.v.	1% c.v.	$\sup(Z_i^2(t))$
Rolling, $\gamma = 0.15$	1.46	1.90	14.55
Rolling, $\gamma = 0.20$	1.75	2.30	19.98
Rolling, $\gamma = 0.25$	1.98	2.55	26.68
Rolling, $\gamma = 0.30$	2.12	2.86	26.98
Sequential, $t_0 = 500$	18.31	28.82	15.71

Critical values recorded are taken from Quintos, Fan, and Phillips (2001).

Table IIIa . Full Sample Breakpoint Dates

day	month	year	Test
1	8	2002	SupSeq
21	2	2001	Roll15
20	2	2001	Roll20
5	9	1988	Roll25
28	9	1988	Roll30

Table IIIb . Fixed Regime Subsample Breakpoint Dates

day	month	year	Test
21	1	1994	SupSeq
15	2	2001	Roll15
20	2	2001	Roll20
4	8	1988	Roll25
23	5	1988	Roll30

Table IIIc. Float Regime Subsample Breakpoint Dates

day	month	year	Test
11	2	2004	SupSeq
27	4	2004	Roll15
22	4	2004	Roll20
22	4	2004	Roll25
22	4	2004	Roll30

SupSeq represents the Supremum Sequential test. All others are Rolling tests at window sizes shown by the suffixes.

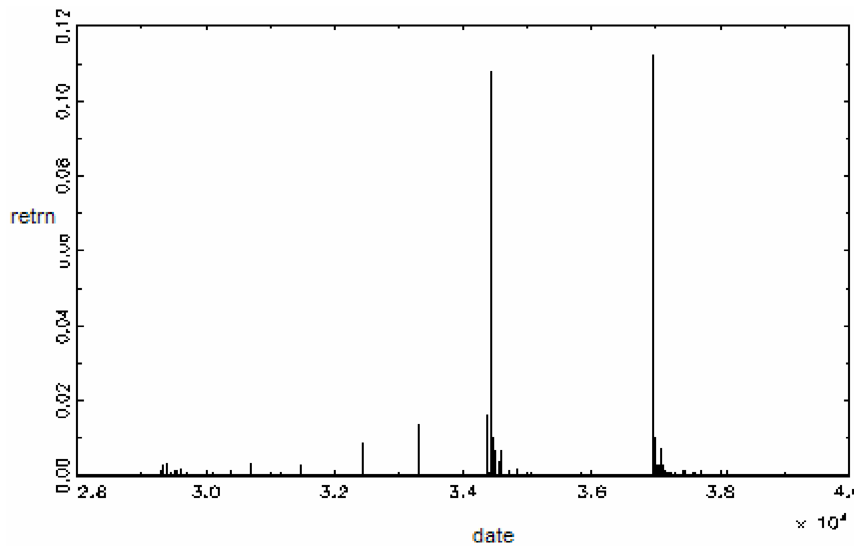

Figure 1a. Full Sample USD/TL exchange returns.

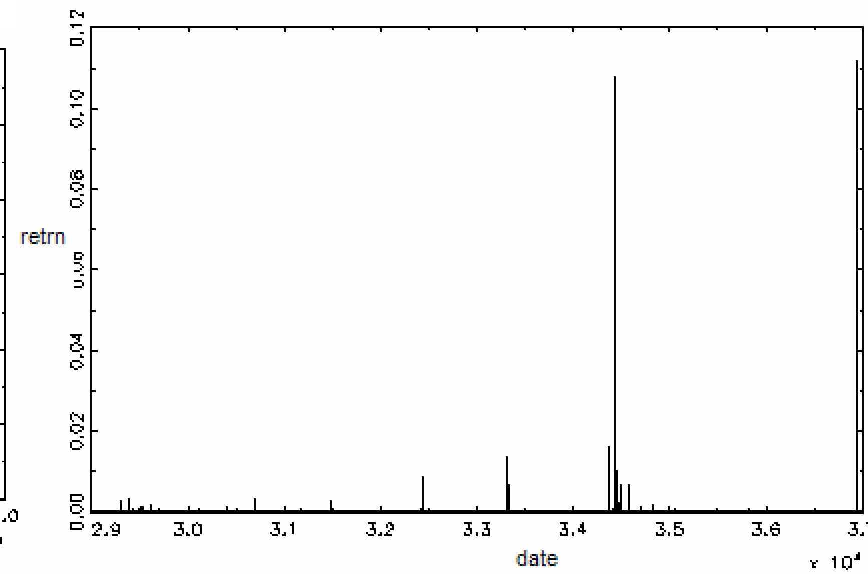

Figure 1b. Fixed Period USD/TL exchange returns.

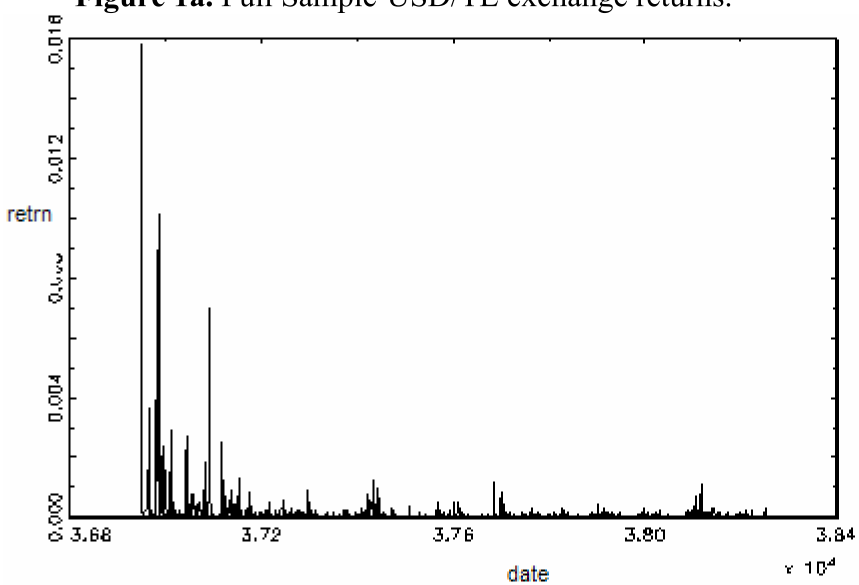

Figure 1c. Float Period USD/TL exchange returns.

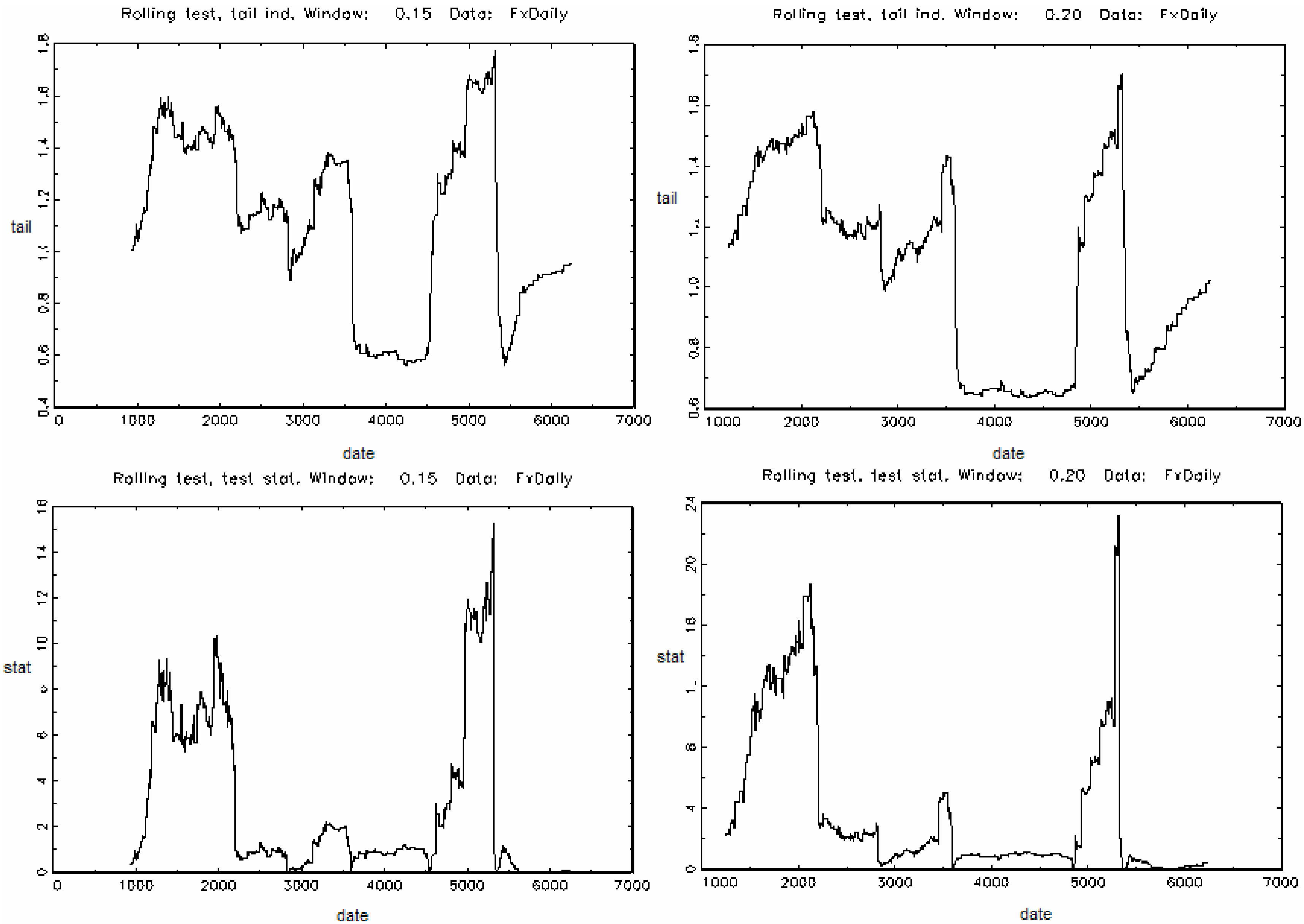

Figure 2a. Full Sample. Upper panels are tail indexes and lower panels are test statistics at 15% and 20% window sizes.

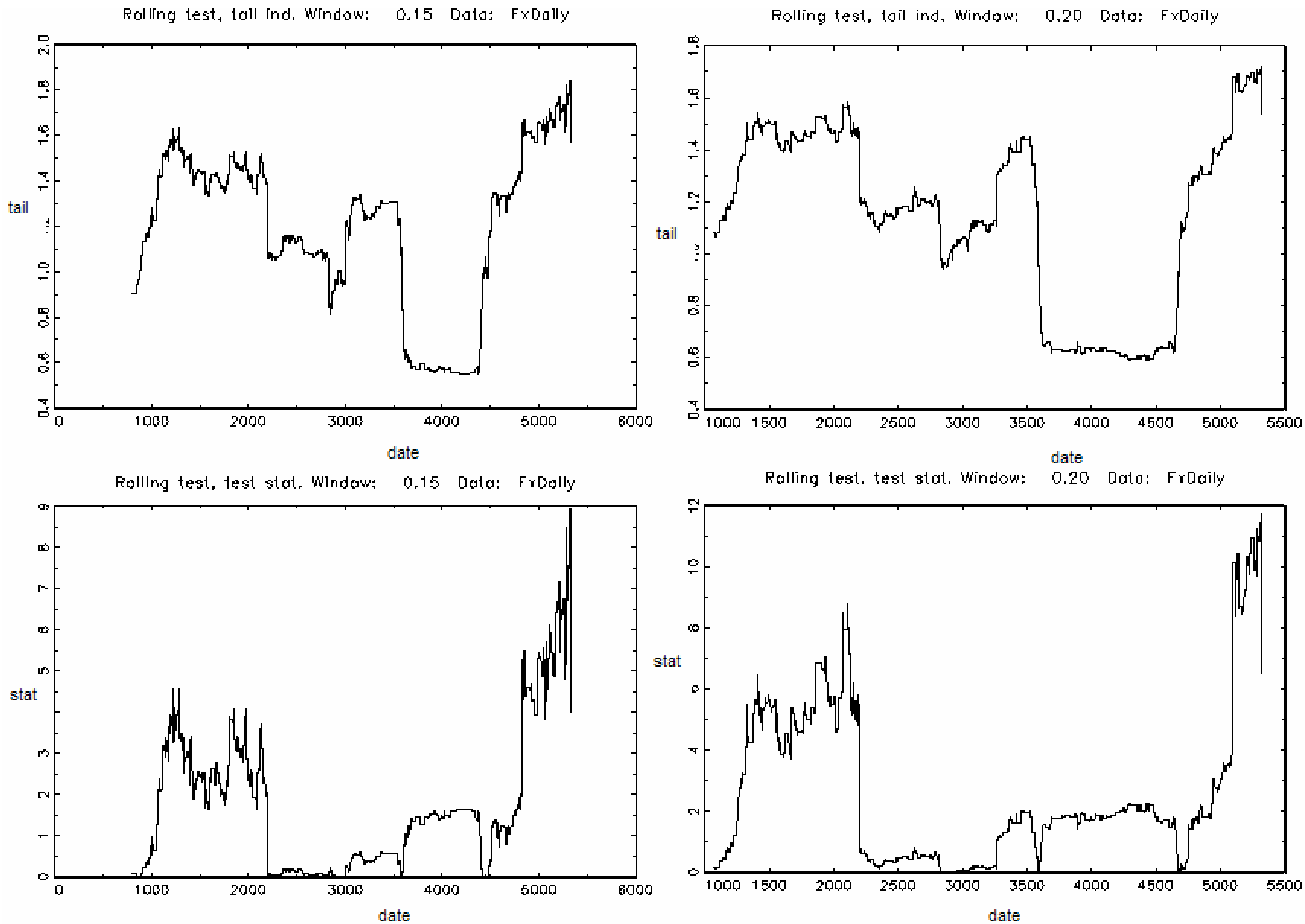

Figure 2b. Fixed period .Upper panels are tail indexes and lower panels are test statistics at 15% and 20% window sizes.

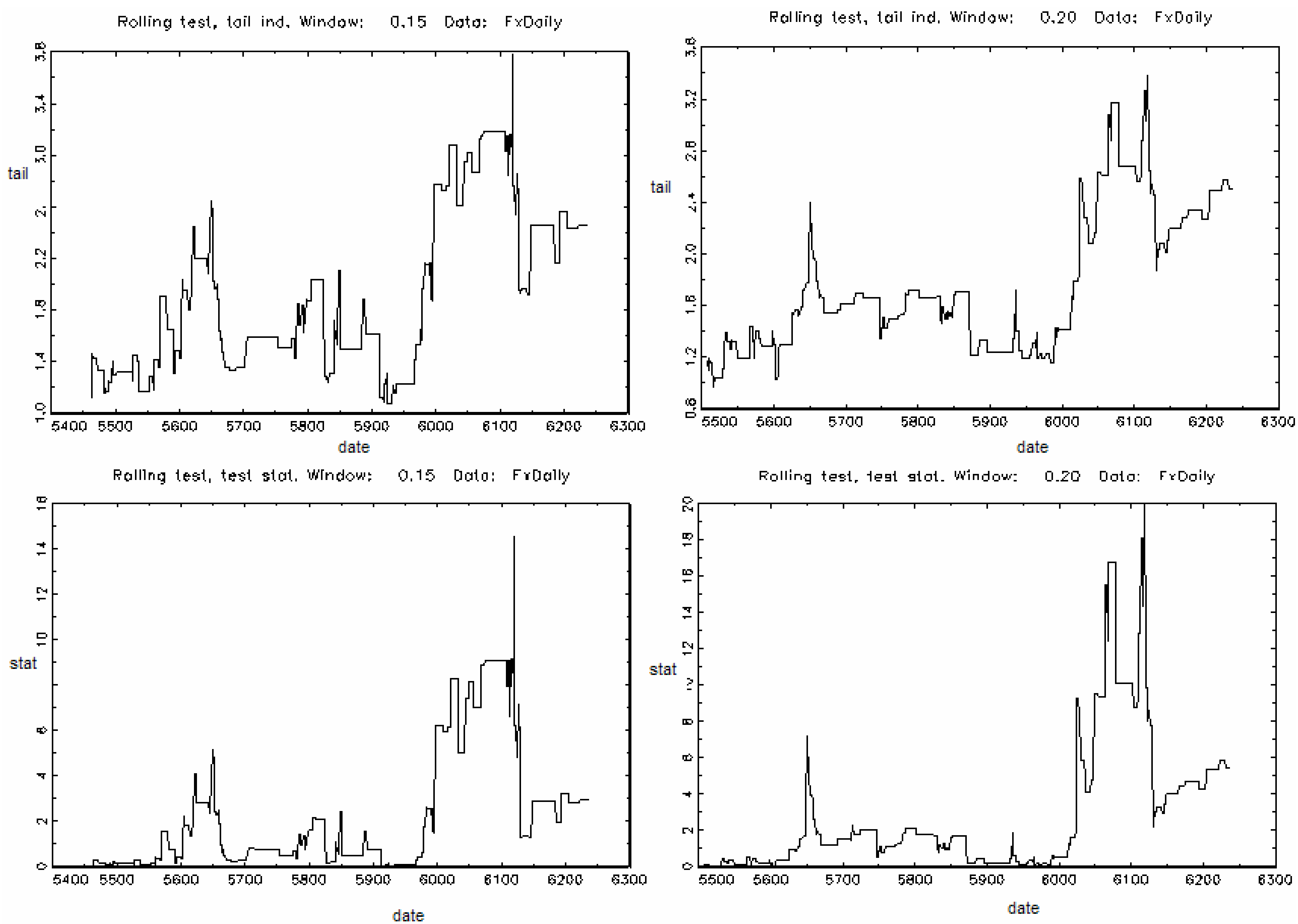

Figure 2c. Float period .Upper panels are tail indexes and lower panels are test statistics at 15% and 20% window sizes).

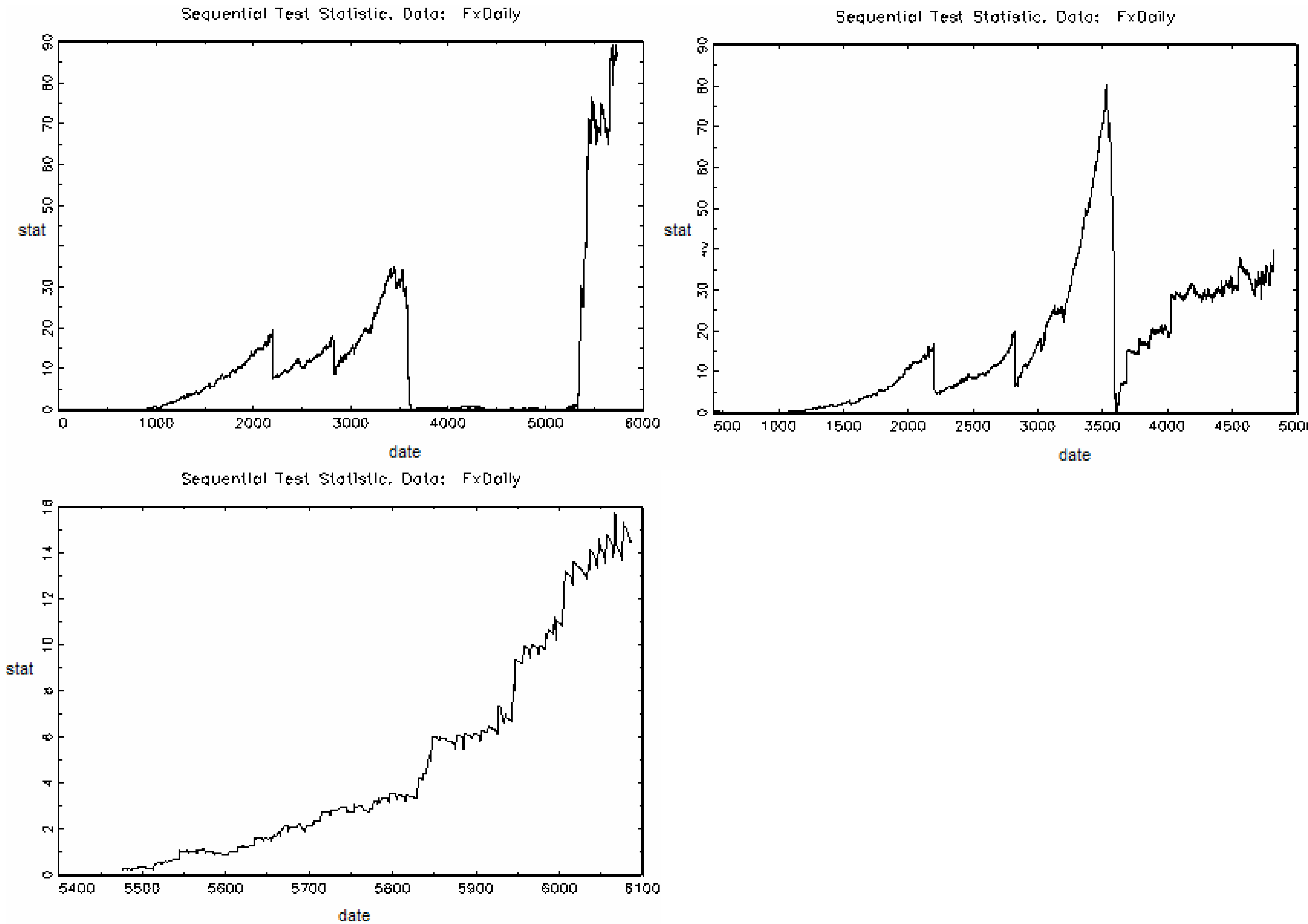

Figure 3. Sequential test statistics. The upper left figure represents full sample, upper right figure and lower figure represent fixed and float periods respectively.