Exploring the Relationship between Consumer Credits and Interest Rates in Turkey: A Fractional Cointegration Analysis

RESEARCH PAPER

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Abstract

This paper investigates the relationship between consumer credits and interest rates in Turkey based on the fractional cointegration approach by using daily observations over the period from 4 January 2002 to 24 December 2010. First, we ignore the possible structural breaks in the series and perform the Geweke and Porter-Hudak (GPH) test on the residuals for fractional cointegration. Second, we determine the structural breaks "endogenously" by using a minimum LM unit root test and reapply the GPH test on the new residuals obtained from a cointegrating regression estimated with the detrended series. The results indicate that consumer credits and interest rates are fractionally cointegrated in both cases, with and without structural breaks.

Keywords: consumer credits, interest rates, fractional cointegration, structural breaks, Turkey
JEL classification: C20, E40

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1 Introduction

Prior to the introduction of the 2000 disinflation program, bank management was very complex in Turkey due to macroeconomic instability characterized by high volatility in real interest rates, chronic inflation, persistent fiscal imbalances and balance of payment crises, which resulted in high credit, sovereign and foreign exchange risks, as well as very short planning horizons (Alper, Berument and Malatyalı, 2001: 81). The Turkish economy witnessed serious financial crises in November 2000 and February 2001 and these crises prompted the Turkish banking sector to launch a process of restructuring as a result of which banks and financial institutions started to operate in a more efficient way. Since the Central Bank Law was modified in 2001, so that price stability became the primary goal of the monetary policy and the Central Bank declared its new policy as "implicit inflation targeting", the Turkish banking industry has grown in size, accounting for as much as 75 percent of the financial system as a whole (Başçı, 2006: 367). In line with the positive developments and expectations, banking sector assets increased by 23 percent at the end of 2004 compared to the previous year and amounted to 306.5 billion Turkish new liras. In real terms, the total assets of the sector increased by 12.3 percent (Central Bank of the Republic of Turkey, 2005: 48).

As of 2003, banks have placed greater emphasis on private banking services, hence the increase in credit cards and consumer credits has played a significant role in increasing credit volume. The annual net growth of consumer credit in Turkey from 2004 to 2005 was 57.2 percent, whereas the annual net rise in corporate credits for the same period was only 18.3 percent. When we analyse consumer credits in terms of subcategories, the fastest increase was recorded in automobile loans in 2004 due to a tax incentive on new car purchases. After May 2005, housing loans gained momentum and their share exceeded that of automobile loans. While all types of consumer loans increased in 2005, housing loans increased most. In addition to these, the construction sector and its subsidiary industries were expected to grow further after the introduction of the legal framework for the mortgage system in 2006 (Başçı, 2006: 369).

With regard to consumer loans, although commercial banks seem to be the natural point of reference, lending long-term loans is not profitable due to unsuitable macroeconomic and legal conditions such as inflation or restrictions on interest rates (Jaffee and Renaud, 1996: 13). Also, there are certain risks that commercial banks have to combat, such as credit risk, liquidity risk, interest rate risk and prepayment risk (Teker, 1996: 7). A major new area of risk for the Turkish banking system is the interest rate risk which banks may face in the event of interest rate changes. According to Jaffee and Renaud (1996), short-term funding creates an interest rate risk for the lenders, since an increase in market interest rates raises the cost of deposits without immediately raising the return on mortgage assets. In Turkey, even though the majority of total loans are short-term (0-12 months), the share of short-term loans decreased in 2005. The majority of loans are granted at fixed interest rates. Fixed rate loans accounted for 70 percent of loans at the end of 2002 and increased to 91 percent in 2005. This indicates that Turkish banks are becoming more vulnerable to unexpected interest rate increases (Başcı, 2006: 371).

In view of the importance of the topic, in this paper we investigate the relationship between consumer credits and interest rates in Turkey in the period from 4 January 2002 to 24 December 2010. There are a number of papers in the literature which explore the structure of consumer credits and their relationships with interest rates (Crook, 2001; Zhang and Wan, 2002; Allesie, Weber and Hochguertel, 2005; Erceg and Levin, 2006; Wachter, 2006; Ak, 2007; Boylu, Günay and Terzioglu, 2007; Ibicioglu and Karan, 2009; Arslan and Karan, 2009). The contribution of our paper to the literature is twofold. First, we investigate the relationship between consumer credits and interest rates by using the Geweke and Porter-Hudak (GPH) test (Geweke and Porter-Hudak, 1983) for fractional cointegration instead of classical approaches. We do so because traditional cointegration methods, which assume that all the variables are integrated of order one, $I(1)$, and confine the error correction term to $I(0)$, are too restrictive and suffer from low power when the residuals are mean reverting but not $I(0)$. The fractional cointegration approach allows residuals to be fractionally integrated rather than stationary. The second contribution of the paper is that we repeat the same analysis for both stages, which means that we both ignore the possible structural breaks in the series and determine these breaks "endogenously" by using the minimum Lagrange multiplier (LM) unit root test of Lee and Strazicich (2004), after which the GPH test is applied taking into account the determined structural breaks.

The paper is structured as follows: Section 2 outlines the methodology of the GPH test for fractional cointegration. Section 3 describes the data and presents the empirical results. Conclusions are reported in the last section.

2 Geweke and Porter-Hudak (GPH) Test for Fractional Cointegration

This section of the paper briefly describes the GPH test which is used as an alternative method for estimating the fractional differencing parameter d. This parameter can take any real value in the following fractionally integrated time series process proposed by Granger and Joyeux (1980) and Hosking (1981):

$$(1-L)^d X_t = u_t \ , \quad t = 1,2,... \tag{1}$$

where L is the lag operator and u_t is an $I(0)$ process. Here X_t is considered to be a fractionally integrated $I(d)$ process. If d=0 in Equation (1), X_t=u_t and a "weakly autocorrelated" X_t is allowed for. When d>0, X_t is said to be "strongly autocorrelated" or "strongly dependent." When d=1, X_t is considered to be a unit root process. When d<1, the process X_t is said to be a mean reverting process. If 0<d<1, the process is a long memory process. If 0.5<d<1, the process is nonstationary and exhibits long memory, while the process is stationary and exhibits long memory if 0<d<0.5. It is important to note that when d<0.5, the process is stationary as well as mean reverting and when 0.5≤d, the process is nonstationary even if the fractional parameter is significantly lower than 1. For estimating the d parameter, Geweke and Porter-Hudak (1983) developed a nonparametric test. According to their approach, the mentioned parameter can be estimated consistently from the least squares regression:

$$\ln(I(w_j)) = \theta - d\ln(4\sin^2(w_j/2)) + v_j\ , \quad j = 1,\ldots,J \qquad (2)$$

where θ is a constant, $w_j=2\pi j/T$ (j=1,...,T–1) denotes the Fourier frequencies of the sample, $J=f(T^{\mu})$ is an increasing function of T which is the number of observations, and $0<\mu<1$. $I(w_j)$ is the periodogram of the series at frequency w_j. In empirical analysis, $J=f(T^{\mu})$ is used with μ ranging from 0.5 to 0.7. Since one can choose different values of μ, different estimates of the fractional parameter for the same process can be obtained. The GPH test is carried out on the first differences of the series to ensure that stationarity and invertibility are achieved. The differencing parameter in the first differenced data is denoted by $\tilde{d}$ in which case the fractional differencing parameter for level series is $d=1+\tilde{d}$. The existence of a fractional order of integration can be tested by examining the statistical significance of the differencing parameter. If the OLS estimator $\hat{d}$ is significantly different from zero, then time series are fractionally integrated and thus exhibit a long memory process.

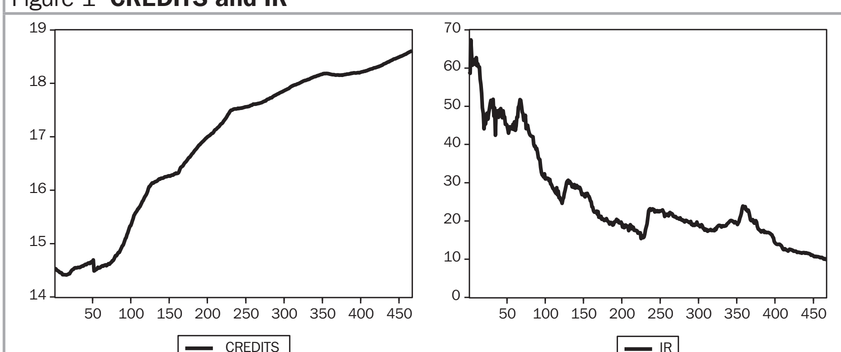
Cheung and Lai (1993) suggest that the GPH estimator can be used to construct a test for the fractional cointegration concept of Granger (1981) which allows the equilibrium error to possess long memory. In contrast to conventional cointegration methods which require a linear combination of $I(1)$ variables to be $I(0)$, a set of $I(1)$ variables are fractionally cointegrated if their linear combination is $I(d)$ with $d<1$. Dueker and Startz (1998) extend Cheung and Lai's work by allowing the estimates for individual and residual series to all be $I(d)$, where $d\in[0,1]$. They note that only a lower order of integration for the residuals compared to the individual series is required (Dueker and Startz, 1998: 420). This shows that they relax the assumption that individual series are $I(1)$. Dueker and Startz (1998) allow the estimate for the order of the individual series (d) and the residuals (d') to take any value of d. If $d'<d$, then the series are fractionally cointegrated.

We follow the fractional cointegration approach of Cheung and Lai (1993) in our paper. In their approach, the d parameter is estimated for the equilibrium error obtained from a cointegrating regression and the null hypothesis d=1 is tested against the alternative d<1. Sephton (2002) computed a set of critical values to use when applying the GPH test for fractional cointegration. These values are computed for different sample sizes, different numbers of cointegration variables and different μ values equal to 0.40, 0.45, 0.50, 0.55 and 0.60. The reason for this is that the distribution of the test statistic is negatively skewed. Therefore, the standard normal distribution values cannot be used for fractional cointegration.

3 Data and Empirical Results

This paper uses daily data for consumer credits and interest rates obtained from the Central Bank of the Republic of Turkey over the period from 4 January 2002 to 24 December 2010 (467 observations). We use consumer credits (CREDITS) as a total of housing (mortgage), automobile and other loans granted in Turkish liras (TL) by banks to consumers. Interest rate (IR) is established by calculating the standard mean of the interest rates applied on the housing (mortgage), automobile and other loans. We convert the consumer credits data into the natural logs before the analysis and illustrate the plots of the series in Figure 1.

Figure 1 **CREDITS and IR**



Note: CREDITS data are converted into natural logs and IR data are expressed in percentages.
Source: Central Bank of the Republic of Turkey.

Table 1 **Results of ADF and PP Unit Root Tests**		
Series	**ADF**	**PP**
CREDITS	-1.036	-0.278
ΔCREDITS	-4.222[a]	-19.420[a]
IR	-3.070	-2.390
ΔIR	-8.359[a]	-26.617[a]

Notes: [a] indicates significance at a 1 percent significance level. The critical values of ADF and PP unit root tests are -3.97, -3.41 and -3.132 for 1 percent, 5 percent and 10 percent levels of significance, respectively.

According to the plots in Figure 1, it can be seen that CREDITS and IR series have a nonstationary appearance and there is a significant increase in the credits while there is a significant decrease in the interest rates. In other words, when the interest rates decrease, there is higher demand for credits. In addition, some structural breaks occur in the series. As a first step, we neglect the possible structural breaks and investigate the unit root properties of the data by using augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) unit root tests. The results are tabulated in Table 1.

As can be seen from the results, the CREDITS and IR series are nonstationary in level but stationary after first differencing. After finding that both series are $I(1)$, our next step is to perform the fractional cointegration test. Fractional cointegration analysis involves two steps. First, the residuals (ε_t) are obtained from the following cointegrating regression:

$$CREDITS_t = c + \alpha\, IR_t + \varepsilon_t \quad . \tag{3}$$

Then, the value of d is estimated for the residuals and the null hypothesis d=1 tested against the alternative d<1.[1] When d<1, there is evidence of fractional cointegration. However, critical values from the standard normal distribution cannot be used when testing for fractional cointegration because the distribution of the test statistic is negatively skewed. The

[1] *We investigate the unit root properties of the residuals by using the ADF test and find stationarity. These results are available on request. Although the residuals are stationary, we decide to test for fractional cointegration. The reason behind this is that traditional cointegration methods are too restrictive and have low power. The fractional cointegration approach allows residuals to be fractionally integrated rather than stationary.*

results of applying the GPH test on the residuals for the values of μ ($J=T^{0.40},T^{0.45},T^{0.50},T^{0.55},T^{0.60}$) are reported in Table 2.

Table 2 **Results of the GPH Test on the Residuals**

μ	**d**	**t-statistics**
0.40	0.470	-1.033
0.45	-0.155	-1.845[c]
0.50	-0.225	-2.600[b]
0.55	0.024	-2.264[b]
0.60	0.248	-2.271[a]

Notes: To test statistical significance, the unit root (i.e., d=*1) is used as the null hypothesis versus* d<*1.* [a], [b] *and* [c] *indicate that the unit root null hypothesis is rejected at 2.5 percent, 5 percent and 10 percent significance levels, respectively.*

The results in Table 2 show that the null hypothesis of no fractional cointegration is rejected for all μ values except 0.40. It can be concluded that there is strong evidence to support the presence of a fractional cointegration relationship between the CREDITS and IR series. Since the plots of the series in Figure 1 show that some structural breaks occur over the observed period, we also examine the fractional cointegration relationship between CREDITS and IR by taking into account possible structural breaks in both series. We do so because the existence of structural breaks may invalidate the previous results. Following this possibility, in the next step of our analysis, the structural breaks are determined by using the minimum LM unit root test with one structural break proposed by Lee and Strazicich (2004). This test determines the structural breaks “endogenously” and avoids problems of bias and spurious rejections. In addition, it is unaffected by breaks under the null. Before tabulating the results, we give a brief description of the minimum LM unit root test. The data generating process (DGP) of the test with one break is expressed by:

$$y_t = \delta' Z_t + e_t,\ e_t = \beta e_{t-1} + \varepsilon_t \tag{4}$$

where Z_t consists of deterministic terms and $\varepsilon_t \sim iidN(0,\sigma^2)$. The LM unit root test with one structural break can be considered as follows. Model A allows one structural break in the intercept and is described by $Z_t=[1,t,D_t]$, where

$$D_t = \begin{cases} 1 & \text{if} \quad t \geq TB+1 \\ 0 & \text{otherwise} \end{cases} .$$

Here, TB denotes the break date. Model C includes one break in the intercept and the trend, and is described by $Z_t=[1,t,D_t,T_t]$, where

$$T_t = \begin{cases} t-TB & \text{if} \quad t \geq TB+1 \\ 0 & \text{otherwise} \end{cases} .$$

The LM unit root test statistic is obtained from the following regression:

$$\Delta y_t = \alpha^{'} \Delta Z_t + \phi \tilde{S}_{t-1} + \sum \gamma_i \Delta \tilde{S}_{t-i} + \mu_t \tag{5}$$

where $\tilde{S}_t$ is a detrended series such that $\tilde{S}_t = y_t - \tilde{\psi}_x - Z_t\tilde{\delta}_t$, t=2,...,T. $\tilde{\delta}$ is a vector of coefficients in the regression of Δy_t on ΔZ_t; $\tilde{\psi}_x = y_1 - Z_1\tilde{\delta}$ and y_1 and Z_1 are the first observations of Y_t and Z_t, respectively. Δ is the difference operator. The lagged terms $\Delta \tilde{S}_{t-i}$, i=1,...,k are inserted to correct for serial correlation in Equation (5). The number of augmentation terms $\Delta \tilde{S}_{t-i}$, i=1,...,k is determined by following a "general-to-specific" procedure. The unit root hypothesis is tested via the t-ratio of ϕ, with this statistic denoted as $\tilde{\tau}$. The null hypothesis of a unit root is tested against the alternative hypothesis of trend stationarity. Structural break (TB) is determined by selecting all possible break points for the minimum t-statistic as follows:

$$LM_\tau = \inf_\lambda \tilde{\tau}(\lambda) \tag{6}$$

where $\lambda=TB/T$. The critical values are tabulated in Lee and Strazicich (2004) for the case of one break. In our analysis, we perform the minimum LM unit root test for Model A and Model C and find that Model A is the appropriate model for both the CREDITS and the IR series.

Table 3 **LM One Break Unit Root Test Based on Model A**					
Series	**TB**	**k**	S_{t-1}	**c**	D_t
CREDITS	20 Dec 2002	4	-0.001 (-1.949)	0.010[a] (21.36)	-0.225[a] (-30.808)
IR	30 May 2003	3	-0.014 (-2.262)	-0.223[a] (-3.538)	-3.011[a] (-3.520)

Notes: TB *is the break date,* k *is the lag length,* S_{t-1} *is the coefficient on the unit root parameter. Figures in parentheses are t-statistics.* [a] *denotes statistical significance at 1 percent. For Model A, critical values depend on the location of the break and are taken from Lee and Strazicich (2004). They are -4.239, -3.566 and -3.211 for 1 percent, 5 percent and 10 percent significance levels, respectively.*

The results in Table 3 indicate that the unit root null hypothesis cannot be rejected since the minimum LM test statistics (-1.949 and -2.262) are lower than the critical values (-4.239 for 1 percent, -3.566 for 5 percent and -3.211 for 10 percent significance levels) for the CREDITS and IR series, respectively. The TB column of Table 3 shows the estimated break points. The break in the intercept occurs on 20 December 2002 for the CREDITS series and on 30 May 2003 for the IR series. As expected, there are significant breaks in the structures of both series. These breaks are related to the restructuring process of the Turkish banking sector as mentioned in the Introduction. Therefore, we need to take into account these breaks in the analysis. The next step of the analysis is to detrend the effects of structural breaks in the series and obtain new residuals from the cointegrating regression estimated with the new detrended series.[2] We reapply the GPH test on these residuals and tabulate the results in Table 4.

Table 4 **Results of the GPH Test on the Residuals after Taking into Account Structural Breaks**		
μ	**d**	**t-statistics**
0.40	0.492	-3.386[a]
0.45	0.477	-4.842[a]
0.50	1.017	0.081
0.55	0.873	-0.835
0.60	0.876	-1.097

Notes: To test statistical significance, the unit root (i.e., d=*1) is used as the null hypothesis versus* d<*1.* [a] *indicates that the unit root null hypothesis is rejected at a 2.5 percent significance level.*

[2] *Since the CREDITS and IR series have significant breaks in the intercept (20 December 2002 and 30 May 2003), we need to take the break points into account. Therefore, we detrend the series through the following regression:* $y_t = \theta_1 D_t + \tilde{y}_t$ *, where* $\tilde{y}_t$ *is the detrended series.*

It can be seen from Table 4 that the null hypothesis of no fractional cointegration is rejected for μ=0.40 and 0.45 values, implying evidence for the presence of a fractional cointegration relationship between detrended CREDITS and IR series. These results are consistent with the previous results obtained without taking into account the structural breaks. It can be concluded that deviations from the long-run relationship shared by consumer credits and interest rates in Turkey take a long time to dissipate before reaching their equilibrium level.

4 Conclusions

In this paper we examine the relationship between consumer credits and interest rates in Turkey by using the fractional cointegration definition of Cheung and Lai (1993) over the period from 4 January 2002 to 24 December 2010. As a first step, the possible structural breaks, which can be seen from the plots of the series, are ignored and the GPH test is applied on the residuals obtained from an estimation of the cointegrating regression. In the analysis we also consider the impacts of possible structural breaks and determine them "endogenously" by using the minimum LM unit root test proposed by Lee and Strazicich (2004). By taking into account these breaks, the series are detrended and a new cointegrating regression is estimated with these detrended series. The GPH test is applied on the obtained new residuals. According to the results, consumer credits and interest rates are found to be fractionally cointegrated in both cases, with and without structural breaks. This means that deviations from the long-run relationship shared by consumer credits and interest rates in Turkey take a long time to dissipate before reaching their equilibrium level.

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