The Gibson Paradox: An Empirical Investigation for Turkey

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Abstract

This paper tests the existence of Gibson paradox using the traditional and modern time series techniques in the case of annual Turkish data. Even though the results from the traditional Gibson paradox regression suggested a positive relationship between the interest rates and the prices levels in Turkish data, subsequently it was proven to be spurious. On analyzing the time series properties of the variables and the results from the Johansen cointegration procedure, we reveal that there is no support of the Gibson paradox in Turkish data.

Key words: Gibson paradox, co-integration, Turkey.
JEL: E40. E50, C32

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1. Introduction

The existence of a positive correlation between interest rates and prices was initially observed by Tooke (1844) for the UK data but Gibson (1923) presented first empirical evidence that there is a strong positive relationship between price level and interest rates using the UK data over two hundreds year. This finding is commonly regarded as a clear rejection of classical macroeconomic theory since it appears to be a contradiction of classical economists' proposition that the interest rate is independent of the price level. Keynes (1930) coined this phenomenon as Gibson's paradox. Kitchin (1923) and Peake (1928) also presented a positive contemporaneous correlation between short-term interest rates and prices. Since then, this phenomenon has been subject of significant discussion, as there is no direct theoretical relation between interest rates and prices.

Fischer (1930) attempted to solve the Gibson paradox on the basis of slowly adjusting expectations. However, this explanation has been rejected by Cagan (1965), and Friedmand and Schwartz (1982) stating that Fisher's estimated distributed lags were too long. Sargent (1973) stated that Fisher's distributed lags were irrational. Keynes (1930) argued that an increase in the demand for loans could result in higher interest rates, which leads to an increase in monetary aggregates and a higher price level as a result. Similarly, Wicksell (1936), Shiller and Siegel (1977), Barsky and Summers (1988) joined to researchers to resolve this paradox and they concluded that it is a natural result of monetary standard based on a durable commodity. Some researchers suggested that the Gibson paradox is a consequence of the Gold standard period. For example, Friedman and Schwartz (1982), Lee and Petruzzi (1986), Mills (1990), Sumner (1993) present empirical evidence in favour of the paradox on using data covering the Gold standard era. There are also some indirect evidences obtained in Benjamin and Kochin (1984), and Barsky (1987).

Dwyer (1984) revealed that the Gibson paradox is not stable over time and or across countries. On the other hand, Corbae and Ouliaris (1989), using annual UK and US data over the 1920-87 period, argued that the Gibson paradox regressions are spurious and the strong positive correlation nominal interest rates and the price level is a mere statistical anomaly. The empirical evidences on the paradox, prior to the 1990s were dismissed since these studies did not check the time series properties of data on price levels and interest rates. However, the recent empirical studies on the topic still provide mix results. Klein (1995) finds a supporting evidence for the Gibson paradox using the US data over the past four decades. Muscatelli and Spinelli (1996) compares the behaviour of long-term interest rates and prices in Italy, the UK and the USA and finds a weak evidence for Italy. Sertletis and Zestos (1999) provided further support of the existence of the paradox for eight members of the European Union on using quarterly data between the 1957-1991 periods. Dowd and Harrison (2000) concludes that there is a qualified evidence of the paradox for the UK gold period. Atkins and Serletis (2003) fails to provide an empirical evidence for Canada, Italy, Norway, Sweden, the UK and the USA

It seems that all empirical studies relating to the Gibson paradox utilize developed countries' data apart from Sinha (2002) which indicates that this relationship does not hold for India.

As far as this paper is concerned there exists no previous study concerning the Gibson paradox in the case of Turkey. Thus, this paper aims at contributing to the existing literature to this end.
The paper is organized as follows. Section 2 briefly outlines the econometric methodology of unit root testing and cointegration technique that are employed in this study. In section 3, reveals the estimation results. In the last section, findings are summarized along with concluding remarks.

2. Method and Data

The Gibson regression is expressed as follows:

$$lp_t = a + br_t + v_t \quad (1)$$

where lp is the natural logarithm of the price levels, r is the nominal interest rates and v is the classical error term. Some previous empirical studies employing the ordinary least squares (OLS) attempted to test the Gibson paradox without checking the time series properties of interest rates and price levels.

Understanding the univariate time series properties of lp_t and r_t along with their cointegrating properties allow us to make inferences with regard to the validity of the Gibson paradox. Eq.(1) under the assumption that respective time series, lp_t and r_t are stationary in levels when in fact $lgnpd_t$ and r_t follow a stochastic process may lead to spurious regression results would yield inconsistent estimates as argued in Phillips (1986).
In analysing the time series data properties, the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979 and 1981) unit root test is most commonly applied. If the ADF unit root regression equation suffers from a serial correlation, it becomes invalid: applying the Phillips-Peron (PP) (Phillips and Peron, 1988) unit root test is used as one alternative.

Cointegration analysis, on the other hand, provides important long-run information. The pioneering cointegrating study of Engel-Granger (1987), which is based on only a single long-run relationship between the variables, was further developed and extended into the multivariate cointegration technique by Johansen (1988, 1991) and Johansen and Juseliues (1992). The above-mentioned cointegration analysis requires that the time series variables in an estimation procedure should be integrated order of one, which implies that they are stationary in their levels or in their first differenced forms.
The Johansen-Juselius multivariate cointegration technique is based on the error correction representation of the Vector Autoregression (VAR) model with Gaussian errors. The multivariate cointegration technique of Johansen (1991) that is found to be superior to other cointegration techniques as proposed by Gonzalo (1994).
A general unrestricted VAR model with the lag length, *p,* can be expressed in vector format as follows:

$$\Delta X_t = \Pi_0 + \Pi_1 \Delta X_{t-1} + \Pi_2 \Delta X_{t-2} + ... + \Pi_{p-1} \Delta X_{t-p+1} + \pi X_{t-p} + BZ_t + v_t \quad (2)$$

where X_t represents $m \times 1$ vector of $I(1)$ variables, Z_t stands for $s \times 1$ vector of $I(0)$ variables (which can include seasonal dummies or innovations in variables that are exogenous to the VAR), Π's are unknown parameters and v_t is the error term.

The hypothesis that π has a reduced rank $r < m$ is tested using the two likelihood tests, known as the maximum eigenvalue (λ-max) and the trace test statistics, to determine the number of cointegrating vectors (r). The lag length of the VAR structure is decided on the basis of several criteria but the Akaike Information Criterion (AIC) and Schwarz Bayesian Information Criterion (SBC) are the most commonly used. Granger (1997) point outs that the selection of lag intervals in the Johansen cointegration technique is not very straightforward and therefore the Johansen test results are sensitive to changes in the lag intervals selected.

Data

The econometric estimation period for this study is selected as 1950-2002 due to unavailability of published nominal interest rates, (r), before 1950. Turkish central bank annual discount rates were used as proxy for the nominal interest rates before 1970; thereafter-nominal interest rates are employed. Source: Statistical bulletins of Turkish Central Bank, various issues.
Turkish consumer price index of 1938=100, (p), represents the price levels. Source: Main Economic and Social Indicators of Turkey, 1923-1998 and subsequent annual statistics published by the State Institute of Statistics of Turkey.

3. Empirical Results

Using OLS, the Gibson regression equation is estimated. Summary results of the estimated equation is displayed below (absolute t-ratios are in parentheses):

$$lp_t = 1.36 + 0.12 r_t$$
$$(3.22)\ (13.19)$$
$$R^2 = 0.77 \quad \text{DW=0.36 SER=2.14}$$

OLS estimation shows that the Gibson paradox exists but the R^2 exceeds the DW statistics indicating a spurious relationship between the price level and interest rates. We follow the advances in the time series econometrics to overcome the non-stationarity in the variables in eq.(1).

The ADF and PP unit root tests for the variables in eq.(1) are implemented and Table I displays results. All the series appear to contain a unit root in their levels, indicating that they are integrated at order one and thus they are difference stationary.

Table I: Tests for Integration

ADF test statistic Variable					Phillips-Peron test statistic Variable				
Levels		k lag	Differences	k lag	Levels		t lag	Differences	t lag
Lp	-1.27	1	-3.53*	1	Lp	0.08	12	-4.43*	12
r	-1.85	1	-6.44*	1	r	-2.16	12	-5.60*	12

Notes: Sample levels 1956-2002 and differences 1957-2002. Rejection of unit root hypothesis, according to McKinnon's critical value at 5 % is indicated with an asterisk. ADF tests include an intercept and a 1 to 5 lagged difference variable and k stands for the lag level that maximizes the AIC (Akaike Information Criteria). Phillips-Peron tests have also an intercept and t stands for the selected truncation lag level.

The empirical findings of Johansen-Juselius cointegration technique for eq.(1) are summarized in panel A and B of Table II. Neither the eigenvalue nor the trace test suggest that there exist a significant cointegrating vector between the nominal interest rates and the price level either at the 95% or at the 90% level of significance in the VAR under consideration.

Table II: Johansen and Juselius Co-integration Tests and Results

Panel A: Order of VAR

p	AIC	SBC
4	-92.9685	-108.1031
3	-96.1810	-107.5319
2	-99.9580	-107.5253
1*	-125.5459	-129.3295
0	-353.7272	-353.7272

Panel B: the results of λ -max and trace tests

Variables: *Lp*, *r*

Null	Alternative	λ -max statistic	95% CV	90 % CV	Trace statistic	95% CV	90% CV
$r = 0$	$r = 1$	18.03	19.22	17.18	23.18	25.77	23.08
$r \leq 1$	$r = 2$	5.14	12.39	10.55	5.14	12.39	10.55

Notes: * indicates the selected VAR order, p. r =number of cointegrating vectors. CV stands for critical value.

4. Conclusion

This study aimed to test the Gibson paradox empirically using the Turkish data over the period of 1950-2002. Although the OLS results initially show the existence of the Gibson paradox, we have proved that it is a simply spurious relationship in the lights of the advances in time series econometric techniques. To this end, we investigated the time series properties of the interest rates and the price level by applying the ADF and the PP unit root testing procedures. These tests results have revealed that the variables in the Gibson regression are stationary at the same order, which suggests a possible long run relationship between them. However, the results from multivariate cointegration technique indicate that there exist no long-run relationship between the interest rates and the price level.

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