Co-integration relationship between interest rates and per capita income (Case study Saudi Arabia)

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***Abstract*—** Economic theory suggests that there is a common integration relationship between Per capita income (PCI) and interest rate (IR), where the interest rate is one of the tools used monetary policy to tackle Per capita income. In this research we will try to clarify the relationship between the interest rate and Per capita income through the test of cointegration relationship between time-series variables to clarify the degree of complementarily.

***Keywords*—** Saudi Arabia, cointegration relationship, Per capita income, interest rate, causality and time series.

I. Introduction

The interest rates and Per capita income are important variables in the macroeconomic that are often monitored by economists and policy makers [1].

The relationship between these variables has been subject to substantial research. Most of this research has focused on the influence of prices on the interest rate.

The basic reason for adopting price stability as the primary object of monetary policy is to create a stable and non-inflationary environment for resource allocation and to stabilize price expectations.

So that States use the interest rate as an instrument of monetary policy to confrontation the Per capita income and reduce the rate to maintain price stability and macroeconomic indicators.

Saudi economy has witnessed many of the reforms to maintain price stability and the fight against Per capita income, which has seen high rates during the 1997/2015.

II. Theoretical Framework

***A-The definition of the interest rate*:** Interest is the fee that the borrower pays the lender to compensate the lender for the opportunity cost of the funds borrowed. By lending the funds to the borrower, the lender, foregoes other productive uses that the funds could have been invested in.

The interest charged therefore usually, at a minimum, matches the rewards the borrower would have received from the next best alternate use of the funds.

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The interest rate refers to how much interest is charged over a specified time period and is usually expressed as a percentage e.g. 10% per month, 10% per years. The interest payable for each time period is calculated based on the borrowed amount to which the interest rate is applied and the time period for which the amount borrowed is considered held.

B-Types of interest rate: [2]

1-Simple interest: Simple interest is interest that is only applied to the principal or the principal balance outstanding. The formula for calculating simple interest is as follows:

$$I(simple) = (r.Pb).m \qquad (1)$$

where**, (r)** is the period interest rate (= **I/n**, where(**I)** is the stated interest rate and(**n)** is the number of periods), **(Pb)** is the balance on which interest is charged (usually the initial balance), and (**m)** is the number of time periods that have passed.

2- Compound interest: Compound interest is similar to simple interest except that unpaid interest is added to

the principal balance outstanding i.e. interest is also charged on the unpaid interest. The

formula for calculating compound interest is as follows:

$$I(compound) = Pb\left[(1+r)^m - 1\right] \qquad (2)$$

where, **(Pb)** is the balance on which interest is charged (usually the initial balance)، **(r)** is the period interest rate, and **(m)** is the number of time periods that have passed

As is evident from the above, compound interest generally results in higher interest payable. The difference in interest amounts charged between simple and compound interest is proportional to the frequency of compounding and the time period for which interest remains unpaid.

*3-Fixed and floating interest rates***:** Fixed rates are interest rates that remain the same for the term of the loan. Floating interest rates are interest rates that may change over the term of the loan.

These are usually linked to a reference rate e.g. the prime rate. Many loans have a combination of fixed and floating rates. For instance, loans may have an initial introductory period during which the interest rate is lower – the interest rate increases once the introductory period ends**.**

4-Nominal and effective interest rates: Nominal interest rate is defined as a stated interest rate. This interest works according to the simple interest and does not take into account the compounding periods.The nominal interest rate is the periodic interest rate times the number of periods per year

A nominal interest rate for compounding periods less than a

year is always lower than the equivalent rate with annual compounding (this immediately follows from elementary algebraic manipulations of the formula for compound interest)

Effective interest rate is the one which caters the compounding periods during a payment plan. It is used to compare the annual interest between loans with different compounding periods like week, month, year etc. In general stated or nominal interest rate is less than the effective one. And the later depicts the true picture of financial payments.

The effective interest rate is always calculated as if compounded annually[3]. The effective rate is calculated in the following way, where ie is the effective rate,**(r)** the nominal rate (as a decimal, e.g. 12% = 0.12), and **(m)** the number of compounding periods per year (for example, 12 for monthly compounding):

$$I\left(effective\right)=\left(1+r/m\right)^{m}-1 \qquad (3)$$

Converting the nominal rate to the effective rate enables comparison between loans that may have similar nominal rates but different compounding periods. As with the compound interest rate, the effective interest rate increases with the frequency of compounding. It is worth noting that loans quoted in nominal terms (as is often practiced by FIs) can be misleading, as they understate the 'true' interest rate that is paid.

C-The definition of the rate of inflation: In economics, inflation is a persistent increase in the general price level of goods and services in an economy over a period of time. When the general price level rises, each unit of currency buys fewer goods and services[4]. Consequently, inflation reflects a reduction in the purchasing power per unit of money [5] a loss of real value in the medium of exchange and unit of account within the economy. A chief measure of price inflation is the inflation rate, the annualized percentage change in a general price index (normally the consumer price index) over time. A number of central banks have adopted explicit inflation-control targets in recent years. In their conduct of monetary policy, most of these banks are guided by a core measure of the trend of inflation that is obtained by excluding a number of components from the overall price index.

D-Measuring Per capita income (PCI): Per capita income is the average amount of money that a particular group of people receives in one year. In Latin, "per capita" means "by heads," so per capita income is the same as income per person. This calculation gives economists a way of measuring the standard of living or relative prosperity of people in a specific area.

III- PER CAPITA INCOME AND INTEREST RATE IN SAUDI ARABIA

A-The evolution of the interest rate in Saudi Arabia:

TABLE I
INTEREST RATE IN SR (1997-2015)

Years	IR (%)
1997	7.0475
1998	7.3694
1999	6.4769
2000	6.7352
2001	4.4231
2002	2.8442
2003	2.2181
2004	2.3181
2005	4.1699
2006	5.2842
2007	4.9419
2008	3.7563
2009	1.5222
2010	1.0763
2011	0.9692
2012	1.1097
2013	1.0883
2014	1.0728
2015	1.0862

Fig. 1 The evolution of the interest rate in Saudi Arabia (1997-2015)

Through the table I and Figure 1 note that the interest rate in *Saudi Arabia* was negative values from 1997 to 2004, to see the high rate of inflation, after the year 2006 the interest rate became positive values due to the economic reforms carried out by the Saudi government.

B- The evolution of the Per capita income *in Saudi Arabia:*

TABLE II
PCI IN SR (1997-2015)

Years	PCI
1997	8 706
1998	7 525
1999	8 092
2000	9 255
2001	8 777
2002	8 821
2003	9 800
2004	11 484
2005	14 069
2006	15 605
2007	16 667
2008	20 157
2009	16 095
2010	19 113
2011	23 599
2012	25 140
2013	24 816
2014	24 499
2015	20 494

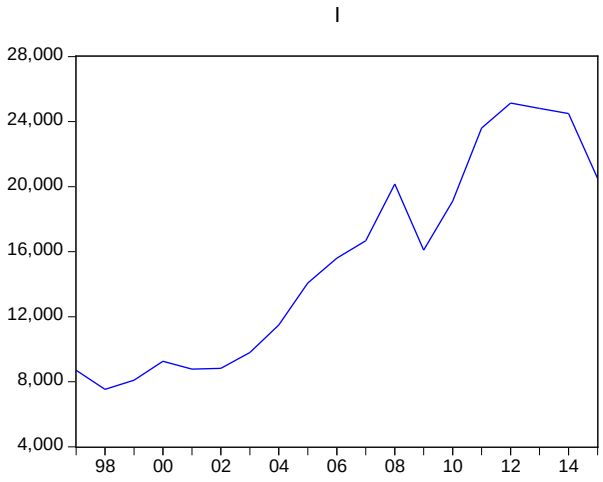

Fig. 2 The evolution of the PCI in Saudi Arabia (1997-2015)

Through the table II and Figure 2 note that PCI in Saudi arabia was at a increasing rate during the period 1997 to 2011 due to higher prices of goods and services as a result of abandoning the policy of strengthening.

After 2011, the PCI rate decreasing .

IV. Test co-integration relationship between the interest rate and PER CAPITA INCOME rate IN SAUDI ARABIA

A-Description variables of the study: We have two variables:

- Interest rate: IR
- Per capita income :PCI

B-Steps of co-integration test::

- Phase I: Tests for stationarity of a time series:

Use the Augmented Dickey–Fuller test, [6]: augmented Dickey–Fuller test (ADF) is a test for a unit root in a time series sample.

We use the least squares method to estimate the three models:

- For interest rates (IR):

$$\Delta IR = \phi IR_{t-1} - \sum_{j=2}^{p} \varphi_j \Delta IR_{t-j+1} + \varepsilon_t \quad (4)$$

$$\Delta IR = \phi IR_{t-1} - \sum_{j=2}^{p} \varphi_j \Delta IR_{t-j+1} + C + \varepsilon_t \quad (5)$$

$$\Delta IR = \phi IR_{t-1} - \sum_{j=2}^{p} \varphi_j \Delta IR_{t-j+1} + C + bt + \varepsilon_t \quad (6)$$

- For the rate of inflation (IF):

$$\Delta IF = \phi IF_{t-1} - \sum_{j=2}^{p} \varphi_j \Delta IF_{t-j+1} + \varepsilon_t \quad (7)$$

$$\Delta IF = \phi IF_{t-1} - \sum_{j=2}^{p} \varphi_j \Delta IF_{t-j+1} + C + \varepsilon_t \quad (8)$$

$$\Delta IF = \phi IF_{t-1} - \sum_{j=2}^{p} \varphi_j \Delta IF_{t-j+1} + C + bt + \varepsilon_t \quad (9)$$

Where: (ΔIR) first Differentiation of the interest rate, (ΔIF) first Differentiation of the inflation, (φ) the lag order of the autoregressive process, (C) is a constant and (b)the coefficient on a time trend.

Using the program *eviwes 6* [7] we get the results in the table III:

TABLE III
AUGMENTED DICKEY–FULLER TEST

Variables	t-statistic	1% level	5% level	10% level
IR	-2.328717	-3.886751	-3.052169	-2.666593
PCI	-0.882846	-3.857386	-3.040391	-2.660551

Through Table III note that the value of the variables ADF bigger than tabular value at the level of significance 1%, 5%, 10%. Therefore, we accept the null hypothesis (H_0: ϕ= 1) means that the presence of unit root. that two variables are non stationarity.

TABLE IV
ADF TEST FOR THE FIRST DIFFERENTIALS

Variables	t-statistic	1% level	5% level	10% level
D(IR)	-4.594073	-4.004425	-3.098896	-2.690439
D(PCI)	-3.517242	-3.886751	-3.052169	-2.666593

Through Table IV note that the value of the ADF smaller than tabular value at the level of significance 1%, 5%, 10%. Therefore, we reject the null hypothesis (H_0: $\phi \neq 1$) means that the Absence of a unit root.

Thus, the two time series of the two variables (interest rate, and Per capita income) static first degree:

IR, IF→ Integrated (1)

- Phase II: Co-integration test:

-Johansen test for co-integration: We use the Johansen test [8] for determining the relationship between the two variables (interest rate, Per capita income) in the long term.

TABLE VI
JOHANSEN TEST
UNRESTRICTED COINTEGRATION RANK TEST (TRACE)

Hypothesized No. Of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**
NONE *	0.566458	16.4231	15.49471	0.0362
AT MOST 1 *	0.122166	2.215063	3.841466	0.1367

Through Table VI note that the value of the trace bigger than critical value at the level of significance 5%. Therefore,We reject the null hypothesis (H_0) And accept the hypothesis (H_1). This means the existence of a Co-integration relationship between the two variables (interest rate and Per capita income) in long-term.

- Test of causality:

Use the Augmented Dickey–Fuller test (ADF)

TABLE V
AUGMENTED DICKEY–FULLER TEST

Pairwise Granger Causality Tests

Sample: 1997 2015

Null Hypothesis:	Obs	F-Statistic	Prob.
PC I does not Granger Cause IR	17	3.98154	0.0472
IR does not Granger Cause PC I		1.09950	0.3644

Through Table V note the p-value of the Null Hypothesis that PCI does not Granger Cause IR smaller than 5%. Therefore, we reject the null hypothesis means that the PCI Cause IR.

We see also that the p-value of the Null Hypothesis that IR does not Granger Cause PCI greater than 5%. Therefore, we accept the null hypothesis means that the IR Cause PCI.

VI. CONCLUSIONS

-There is a relationship between the interest rate and Per capita income in the long term in Saudi Arabia.

-Saudi economy experienced high Per capita income during the period. Forcing the monetary authorities to target through the liberalization of interest rates to control the money supply.

-There exist one cointegration equation between Per capita income and interest rates.

- We found that the Per capita income cause the interest rates.

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