

Exchange Rates and Interest Rates: An Empirical Investigation of International Fisher Effect Theory - The Case of Egypt (2003-2012)

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Abstract

This paper examines the validity of the International Fisher Effect (IFE) theory for the Egyptian economy. Two case studies are investigated: Egypt vs. USA and Egypt vs. Germany during the period (2003-2012). The long run relationship between nominal changes in exchange rate and nominal interest rate differential for each of the two case studies, is examined using Autoregressive Distributed Lag bounds test approach to co-integration and error correction model. The short run relationship is examined through impulse response function and variance decomposition. Besides, granger causality test is employed to identify the direction of the relationship. The empirical findings revealed partial significance of IFE in the case of Egyptian pound vs. US dollars, while no sign of IFE was detected in the case of Egyptian pound vs. Euro currency. The irrelevance of IFE could be attributed to the irrelevance of Purchasing Power Parity theory in Egypt. This is in addition to Egypt's limited financial integration with international financial markets.

Keywords: International Fisher Effect, Nominal Interest Rate differential, Nominal Exchange Rate Changes, Autoregressive Distributed Lag Bounds, Co-integration, International Financial Integration.

JEL Classification Codes: C22, F31, F37

1. Introduction

Investment decisions involve forecasting future returns and comparing the anticipated risk and return of different investment alternatives. However, international investment decisions involve an additional dimension in the comparison process which is the exchange rate; since changes in exchange rates will affect the future value of current investments. Besides, international trade liberalization and the development of information technology have helped in the integration of financial markets worldwide which, in turn intensified the international capital transfer. This capital mobility has a definite impact on the different currencies and interest rates.

In the interest of studying the link between interest rates and exchange rates, theories regarding the determination and interaction of these monetary variables have evolved. The International Fisher Effect (IFE) is a theory in international finance that states that foreign currencies with relatively high interest rates will depreciate because the high nominal interest rates reflect expected inflation assuming real rate of return is equalized across countries (Madura, 2009). Hence, an expected change in the exchange rate between any two currencies is equivalent to the difference between the two countries' nominal interest rates for that time. IFE theory implies that interest rate differential can be used as a forecast for the changes in the future spot exchange rates. The changes in exchange rate have influential impact on foreign investment decisions, export opportunities and price competitiveness of foreign imports. Thus, there is a need to predict the exchange rate changes being a leading macroeconomic variable.

The uncertain economic and political conditions that Egypt is facing nowadays put forecasting and predicting future exchange rate changes at centre stage. The Egyptian pound has been pegged to the US dollar in the 1990s and it was nearly stable. Then, it was set to crawl within horizontal bands in the beginning of the 2000s; to reduce the shortage in foreign exchange. Afterwards, the Central Bank of Egypt (CBE) announced the floatation of the Egyptian pound in 2003. This had an immediate impact on the exchange rate which depreciated by 30% as shown in fig. (1). CBE eliminated the parallel market through the establishment of the interbank foreign currency market in December 2004. Consequently, the Egyptian pound strengthened vis-à-vis the US dollar. Then, the exchange rate became managed float where the rate fluctuated around 5.5 L.E./ \$ up to year 2010 (CBE report 2009/2010). However, aftermath of January 2011 revolution, the exchange rate depreciated reaching 6.7 L.E. /\$ in March 2013. This is besides the deterioration in the foreign exchange reserves as a repercussion of the uncertainty in the political conditions in Egypt in the wake of the revolution. As a result, the external sector was severely affected where tourism revenues, as well as, capital flows in terms of foreign direct investment (FDI) and foreign portfolio investment (FPI), declined. Thus, net international reserves depleted by around 50 percent in December 2011 compared to December 2010, reaching US\$ 18 billion in December 2011. It even declined further to US\$ 13.4 billion in March 2013 (CBE monthly report, April 2013). As a consequence, it became a vicious circle, in which the depreciation in the Egyptian exchange rate strains on the international reserves, and at the same time, the drainage in international reserves puts pressure on the exchange rate.

Also, the exchange rate of the Egyptian pound with respect to the Euro currency is important to consider since EU is Egypt's main trading partner. The Egyptian pound depreciated against the Euro in 2003 and 2004 after the floatation of the Egyptian pound. Then, it started to appreciate in 2005 - as noted in fig. (2) - as a result of Egypt's trade surplus against EU. However later on, trade deficit led to depreciation in 2006 and 2007 (CBE reports 2004/2005, 2005/2006 and 2006/2007). But the global financial crisis in 2008 resulted in a flow of capital to Egypt and appreciation against the Euro in the same year. This appreciation turned once again into depreciation when the Egyptian economy began to be affected by the financial crisis in 2009 (Sabri et al, 2012). This depreciation continued after January 2011 revolution, where the exchange rate of Egyptian pound per Euro currency increased from 7.8 L.E. / € in 2011 to 8.7 L.E. / € in March 2013 (CBE monthly report, April 2013).

Figure 1: Annual Exchange rate of Egyptian pound per US dollar

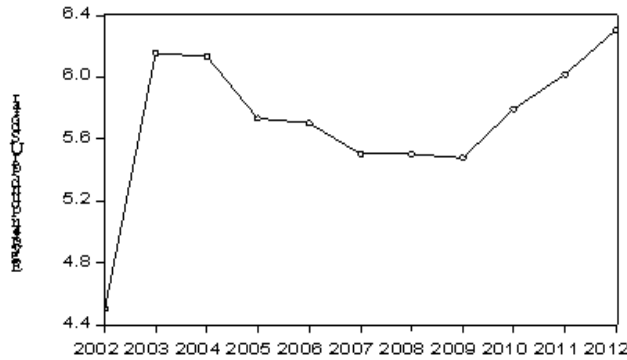
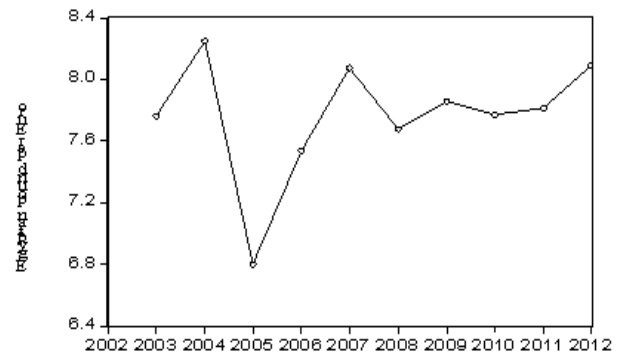


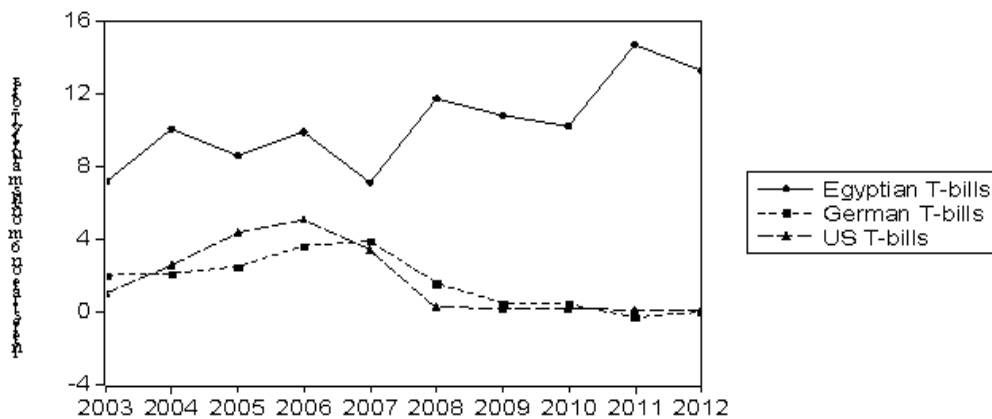
Figure 2: Annual Exchange rate of Egyptian pound per Euro currency



Source: Done by the authors based on data from CBE

The essence of IFE theory entails that the interest rates that are to be compared between different countries must have the same properties. Treasury bills (T-bills) being backed by the government, come closest to a risk free investment. Thus, T-bills across countries are considered perfect substitutes. It can be noted from Fig (3) that the interest rate on Egyptian T-bills is always higher than that of US and German T-bills¹. In the context of IFE theory, real interest rates are supposed to be equalized across countries; accordingly, high interest rate on Egyptian T-bills reflects expectation of high inflation rate in Egypt. Thereby, the Egyptian pound is expected to be depreciating against both US dollar and Euro currency. Accordingly, foreign investors are discouraged, since the interest rate differential is expected to be offset by the depreciation of the Egyptian pound. And this is what this paper is trying to examine.

Figure 3: Interest rate on 6 month maturity Egyptian T-bills, US T-bills and German T-bills



Source: Done by the authors based on data from Bloomberg data base.

The impacts of the depreciation of the Egyptian pound on the economy vary between positive and adverse effects. The positive impact of depreciation is boosting exports. However, domestic firms that depend upon importing intermediate goods are disadvantaged. In addition, depreciation often creates expectations of future depreciation that weaken the domestic and foreign investors' confidence in the economy triggering capital outflow (Abdel Haliem and El Ramly, 2008). Another policy implication if IFE holds for Egypt is the indication of free mobility of capital across borders which have widespread benefits. Capital inflows in the form of FDI often bring improved technology which raises productivity and growth. Besides, FPI flows increase market discipline and lead to a more

¹ Germany has been taken as a representative for the European Union because the European Central Bank reported in 2005 that Germany has the largest share of the European Union (EU) government debt securities issuance.

efficient allocation of resources (Levine, 1997). On the other hand, if the IFE doesn't hold for Egypt, then interest rate differential is not a predictive estimate for exchange rate. Also, this would imply that Egypt is not having free capital mobility.

Accordingly, this paper aims at examining whether nominal interest rate differential is a good forecast for the changes in future spot exchange rate, in order to find out whether the IFE theory holds for the Egyptian economy. The paper is organized as follows. The second section reviews the theoretical literature of IFE theory. The third section highlights some of the empirical studies tackling the IFE theory. The fourth section presents the model and the data employed in investigating the relevance of IFE for Egypt, besides, explaining the methodology adopted. The fifth section displays the empirical results and interpretations. Finally, the sixth section concludes and provides some policy recommendations.

2. Theoretical Literature

This section is divided into two parts. The first part reviews the theoretical foundation of IFE theory. The second part discusses two opposing approaches for the relationship between nominal interest rate differential and nominal exchange rate changes that have conflicting implications.

2.1. Theoretical Foundation of IFE Theory

The theories of Fisher Effect and Purchasing power parity (PPP) are the building blocks of the evolution of the IFE theory. Irving Fisher's seminal article "The Theory of Interest" in 1930 is the corner stone of the *Fisher hypothesis*, which asserts that there is a positive correlation between a country's nominal interest rates and its expected inflation; implying that the real interest rate is constant and independent of monetary measures. An extended version of this hypothesis is the *Generalized Fisher effect (GFE)* that takes into account the countries' interactions. According to GFE, the nominal interest rate differential between two countries is equal to their anticipated inflation differential. The higher inflation rate country should bear higher interest rates relative to the lower interest rate country. Thus, in the absence of government intervention, capital flows towards the higher expected return country until expected real returns are equalized. Hence, capital mobility and capital market integration are important conditions for the GFE (Jeffy and Mandelker, 1975).

A crucial building block for the IFE theory is the *PPP*, which holds when exchange rate adjusts to offset the inflation rate differential between two countries. Hence, an increase in the price level of a country will cause depreciation of its exchange rate relative to other country, thereby keeping the relative price of identical goods the same across both countries (Madura, 2009). However, PPP might not hold in some countries due to that exchange rate movements might be affected by factors other than inflation differential; such as income level differential, expected changes in future exchange rate, terms of trade, balance of current and capital accounts, fiscal and monetary policies, and central banks interventions (Rosenberg, 2003). In addition, PPP might not hold in case of absence of substitutes for traded goods.

The *IFE* theory is the international counterpart of the Fisher Effect. It can be seen as a combination of the GFE and the PPP. IFE uses interest rate differential rather than inflation rate differential to explain why exchange rate changes over time. The IFE² theory asserts that foreign currencies with relatively high interest rates will depreciate because the high nominal interest rates reflect expected inflation (Madura, 2009). It can be represented in the following equation:

² The International Fisher Effect Theory is also referred to as the Uncovered Interest rate parity. If the no-arbitrage condition is satisfied without the use of a forward contract to hedge against exposure to exchange rate risk, then interest rate parity is said to be *uncovered*. Investors are indifferent among the available interest rates in two countries because the exchange rate between those countries is expected to adjust such that the dollar return on dollar deposits is equal to the dollar return on foreign deposits.

$$e_f = \frac{1 + i_h}{1 + i_f} - 1 \quad (1)$$

In equation (1), the e_f denotes the percentage change in the value of the foreign currency denominating the foreign security, while the i_h and i_f denote the home interest rate on home country securities and the foreign interest rate on foreign country securities respectively. IFE theory entails that when i_h is greater than i_f , e_f will be positive in which the home currency will depreciate with respect to the foreign currency due to high inflationary expectations in the home country. This depreciation will reduce the return on home securities, thereby, making returns on home securities no higher than foreign securities. The opposite should happen when i_h is lower than i_f . Thus, IFE theory implies a positive relationship between changes in exchange rate and nominal interest rate differential.

Accordingly, the essence of the IFE is that the spot exchange rate should change to adjust for differences in nominal interest rates between two countries. The adjustment can take place through two ways: either through flow of capital across international money markets or through trade and flow of goods across goods market (Sundqvist 2002). Thus, having free capital mobility is a must for IFE to hold. However, since IFE theory is based on the PPP theory, then IFE theory might not hold for the same reasons that prevent PPP from prevailing.

2.2. The Relationship Between Nominal Interest Rate Differential and Nominal Exchange Rate Changes

International finance theories encompass two opposing approaches to the relationship between nominal interest rate differential and nominal exchange rate changes. One approach, introduced by Frenkel (1976), assumed that prices are perfectly flexible, in which changes in the nominal interest rate reflect changes in the expected inflation rate. When the domestic interest rate rises relative to the foreign interest rate, demand for the domestic currency falls which causes it to depreciate instantly. Thus, there is a positive relationship between the changes in exchange rate and the nominal interest differential which conforms to the IFE theory.

On the other hand, an opposing approach was introduced by Dornbusch (1976) who traced the adjustment of exchange rate to interest rate differential over time. He assumed that goods prices are sticky and they adjust more slowly over time than financial asset prices. For instance, a rise in domestic money supply will result in a decline in domestic interest rate, and consequently, capital will outflow leading to depreciation in the domestic currency and overshooting its long run equilibrium level. However, overtime the currency depreciation will reduce the relative price of domestic goods, stimulating the aggregate demand and inflationary pressures. Besides, the excess money supply will also result in inflationary pressures. Hence, this will be reflected in an increase in the interest rate and appreciation of the exchange rate undoing the initial overshooting. Thus, there is a negative relationship between the changes in exchange rate and the nominal interest differential. This implies that Dornbusch (1976) is against the IFE theory.

However, Frankel (1979) argued that nominal interest rate reflects both real interest rate and inflation. Thus, he developed real interest rate differential model representing the relationship between changes in exchange rate and real interest rate differential. Frankel's (1979) model incorporated the inflationary expectations element of the flexible price model of Frenkel (1976) with the sticky price element of the Dornbusch (1976) model and came out with a conclusion that exchange rate is negatively related to the real interest differential, but positively related to the expected long-run inflation differential. Several empirical studies followed Frankel (1979) and assessed the relationship between exchange rate changes and real interest rate differential (Meese and Rogoff, 1988; Hoffmann and MacDonald, 2009). However, the focus of this paper is studying the relationship between nominal exchange rate changes and nominal interest rate differential under the umbrella of IFE.

3. Empirical Literature

The empirical literature highlights some empirical studies that examined the relevance of IFE in the real world. The studies involve different countries, developed and developing ones and at different time spans.

Sundqvist (2002) examined the IFE theory for USA vs. five industrialized countries: Sweden, Japan, UK, Canada, and Germany. Interest rate differential was regressed against exchange rate changes for each case individually for the period 1993-2003. The empirical investigation revealed that IFE theory holds for USA vs. Japan only. The author concluded absence of a stable predictable relationship between exchange rate changes and interest rate differential.

Ersan (2008) examined the IFE theory within a co-integration framework for Turkey with respect to the G-5 countries, namely USA, UK, Japan, France and Germany over the period 1985 - 2007. The empirical estimation revealed that there is a long run relationship between nominal interest rate differentials and exchange rate changes. The IFE theory proved to hold for Turkey when it was included as home country against the other countries. However, IFE didn't hold for other country pairs, except for France & Germany. The author attributed this to the fact that perfect capital mobility might not been prevailing between the country pairs investigated. In addition to political risk, currency risk and transaction costs that affect investors' decisions.

Shalishali (2012) investigated the IFE theory among eight industrialized countries, namely Indonesia, the Philippines, China, Japan, South Korea, Singapore Malaysia, and India over the period (1990-2009). Time series regression has been adopted. The empirical results were mixed between support and opposition to IFE theory in which the theory held for some countries when used as home country and failed when they were used as foreign countries. The author attributed the results to other factors affecting the exchange rate rather than interest and inflation rates differentials, for instance, expected future exchange rate.

Al-Nashar (2013) tested for the uncovered interest rate parity for Egypt through examining the stationarity of the exchange rate-adjusted interest rate differential between Egyptian and US three-month Treasury bill rates. Monthly data was employed for the period January 2000-December 2011, as well as, for shorter period that had a surge in capital inflows July 2004-June 2008. Augmented Dickey Fuller (ADF) test for stationarity revealed non-stationarity of the exchange rate-adjusted interest rate differential for both periods concluding failure of uncovered interest rate parity to hold. The author attributed the results to the low degree of Egypt's financial integration with international financial markets. In addition, investors are neither rational in their expectations about future spot exchange rate nor risk neutral; implying premium between domestic and foreign interest rates. Also, the variance decomposition of the interest rate spread between Egypt and USA, showed that, expected inflation differential was the most contributor to the variation in the interest rate spread as affirmed by the Fisher theory.

From the preceding empirical literature review, it is realized that there isn't a definite judgment for the validity of IFE theory in predicting exchange rate fluctuations. The studies vary between supporting and opposing the IFE theory. As different countries, different time spans and different types of data have resulted in contradictory outcomes for the nominal exchange rate changes – nominal interest rate differential relationship. In addition, the level of financial development and capital market integration of countries affect the empirical results. Thus, the relevance of the IFE depends upon the individual case of each country and its macro-economic conditions.

4. Data and Methodology

In light of the theoretical and empirical literature previously discussed in sections two and three; this section empirically assesses the validity of the IFE theory for the Egyptian case, with respect to USA and the European Union (EU). This section is divided into 3 parts. The first and second parts present the model and the data employed. Then, the third part discusses the methodology adopted in the empirical analysis.

4.1. The Model

Madura (1995) illustrated the derivation of the IFE model. The formula of effective return on a foreign money market investment r_f is:

$$r_f = (1 + i_f)(1 + e_f) - 1 \quad (2)$$

Where i_f is the interest rate in the foreign country and e_f is the rate of change in the value of foreign currency denominating the security. According to IFE, r_f should equal i_h , the effective return on a domestic money market investment (interest rate in the home country). Thus, substituting by i_h for r_f in Eq. (2) and solving for e_f will result in the following equation:

$$e_f = \frac{i_h - i_f}{1 + i_f} \quad (3)$$

Madura (1995) developed a statistical test of IFE by applying regression analysis. The rate of change of spot exchange rate change over time is modeled as a function of the nominal interest rate differential as follows:

$$e_{ft} = a + \beta \left(\frac{i_h - i_f}{1 + i_f} \right)_t = \varepsilon_t \quad (4)$$

where $\left(\frac{i_h - i_f}{1 + i_f} \right)_t$ is the interest rate differential. α is the constant indicating the rate of change in the

spot exchange rate when the interest rate differential is zero. β is the regression coefficient indicating the rate at which the spot exchange rate will change in response to a change in interest rate differential. ε_t is the error term. According to IFE theory, $\alpha=0$ and $\beta=1$. Thus these are the hypotheses that will be tested in order to find out whether interest rate differentials are unbiased predictors of changes in exchange rates.

4.2. The Data

4.2.1. Dependent Variable: Rate of Change in Spot Exchange Rate (EX)

Quarterly data for the rate of change in Egyptian pound per US dollar spot exchange rate and the rate of change in Egyptian pound per Euro spot exchange rate. The source of data is the CBE. USA and EU were chosen as the foreign countries because they are Egypt's main trade partners.

4.2.2. Independent Variable: Nominal Interest Rate Differential (INTDIFF)

T-bill rate will be used as a proxy for the nominal interest rate. Quarterly data for 6 months maturity for Egyptian T-bills, US T-bills and German T-bills will be employed. The source of the data is Bloomberg database.

4.2.3 Sample Period

The time span of the research will start from year 2003 up to year 2012. In January 2003, Egypt has stepped towards liberalizing the economy and the foreign exchange market, as a result of the CBE's announcement to float the Egyptian pound.

4.3. The Methodology

4.3.1. Unit Root Test

An econometric analysis usually starts with univariate analysis for the variables included in the model before empirical estimation. ADF test will be employed to check for the stationarity of the variables under study. The ADF unit root test is undertaken through the following equation:

$$\Delta Y_t = a + \beta t + (\rho - 1)Y_{t-1} + \sum_{j=1}^p \gamma_j \Delta Y_{t-1} + \varepsilon_t \quad (5)$$

Where Y_t will be replaced by each of the model's variables:

- $EX_{(Eg/US)t}$ rate of change in the spot exchange rate of Egyptian pound per US dollar.
- $EX_{(Eg/EU)t}$ rate of change in the spot exchange rate of Egyptian pound per Euro.
- $INTDIFF_{(EG/US)t}$ nominal interest rate differential between Egyptian & US six months maturity T-bills.
- $INTDIFF_{(EG/GR)t}$ nominal interest rate differential between Egyptian & German six months maturity T-bills.

t refers to the trend and j refers to the no. of lags. The number of lags is chosen to minimize Akaike Information Criterion (AIC) and/or Schwartz Bayesian Criterion (SBC). The null hypothesis of ADF test is $\beta = 0$ and $\rho = 1$ indicating a non-stationary variable. If the absolute ADF test statistic exceeds the absolute Mackinnon critical values, then the null hypothesis is rejected indicating that the variable is stationary.

4.3.2. Autoregressive Distributed Lag (ARDL) Bounds Test Approach to Co-Integration and Error Correction Model (ECM)

The research methodology will address both the long run and short run relationships between nominal exchange rate changes and nominal interest rate differential under the umbrella of IFE theory. The approach that will be undertaken is Autoregressive Distributed Lag (ARDL) bounds test approach to co-integration and error correction model (ECM) initiated by Pesaran et al (2001). Co-integration refers to the long run equilibrium relationship between variables. Two non-stationary variables can be co-integrated if a linear combination of those variables is stationary (Engle and Granger, 1987). Co-integration between variables implies the existence of an adjustment process referred to as “Error Correction” that prevents the errors in long run relationship from becoming larger and drifting apart from the equilibrium. The speed of adjustment toward equilibrium is determined by the ECM. Thus, ECM incorporates both short run dynamics and long run relationship between the variables.

The advantage of Pesaran’s (2001) ARDL approach to co-integration over conventional Engle and Granger (1987) and Johansen (1988) approaches to co-integration is overcoming the problem associated with the uncertainty of whether the series involved in the model are purely $I(0)$, purely $I(1)$, or mutually co-integrated. Pindyck and Rubinfeld (1998) asserted that despite of the fact that ADF test is widely used as unit root test, however, the power of the test is limited. Moreover, the ARDL approach passes up the need to specify endogenous and exogenous variables which is not the case for the conventional approach (Pesaran & Smith, 1998). Besides, the ARDL approach allows the variables to have different number of lags which is not allowed in the conventional approach that sets the same number of lags for all the variables³.

ARDL model means that the dependant variable is expressed as a function of its own lagged values and the current and lagged values of the explanatory variable. The ARDL model of order p and n , ARDL (p, n), is defined as follows:

$$Y_t = \sum_{i=1}^p a_i Y_{t-i} + \sum_{i=0}^n c_i X_{t-i} + \varepsilon_t \quad (6)$$

By rearranging the X ’s obtained with, Δ , first difference operator, the following equation is obtained:

$$Y_t = \sum_{i=1}^p a_i Y_{t-1} + a(1)\beta X_t - \sum_{i=0}^{n-1} \sum_{j=i+1}^n c_j \Delta X_{t-i} + \varepsilon_t \quad (7)$$

The use of this specification has been suggested for co-integration analysis by Pesaran and Shin (1998). Also, another transformation for the sake of co-integration testing is subtracting Y_{t-1} and making use of the fact that $X_t = X_{t-1} + \Delta X_t$, which give the following equation:

$$\Delta Y_t = yY_{t-1} + \theta X_{t-1} = \sum_{i=1}^{p-1} a_i \Delta Y_{t-i} + \sum_{i=0}^{n-1} \phi_i \Delta X_{t-i} + \varepsilon_t \quad (8)$$

³ The case of this research is having two variables under study, so if co-integration exists then there will be one co-integrating vector. However, in case of having more than two variables, the conventional Johansen approach to co-integration estimates the long-run relationships within a context of a system of equations, while the ARDL method employs only one single reduced form equation.

where γ and θ are the long run parameters.

Thus, Pesaran's (2001) augmented ARDL bounds testing approach to test for co-integration between rate of change of spot exchange rate (**EX**) and interest rate differential (**INTDIFF**) is given by the following equation:

$$\Delta EX_t = a_0 + a_1 INTDIFF_{t-1} + a_2 EX_{t-1} + \sum_{i=1}^{p-1} a_{3i} \Delta EX_{t-i} + \sum_{j=0}^{n-1} a_{4j} \Delta INTDIFF_{t-1} + \varepsilon_t \quad (9)$$

Where a_0 is the intercept and ε_t is the white noise error term. a_1 and a_2 are the long run parameters, while p and n are the number of lags selected by minimizing AIC and/or SBC. The joint significant F-test or Wald statistic of the lagged level variables is employed for investigating the existence of long run relationship among the variables. The null hypothesis of having no co-integration, $H_0: a_1 = a_2 = 0$ is tested against the alternative hypothesis, $H_1: a_1 \neq a_2 \neq 0$. The critical values for F-statistic used are those tabulated by Pesaran et al. (2001) for different numbers of regressors. There are two sets of critical values, one upper bound and another lower one. The former refers to I (1) series and the latter to I (0) series. If the computed F-statistic exceeds the upper bound of the critical values, then the null hypothesis of no co-integration is rejected. If it is less than the lower bound value, then the null cannot be rejected. If it falls between the two levels of the bands, then co-integration test becomes inconclusive. Also, Narayan (2004) introduced a reformulation for the critical values for the bounds F-statistic initiated by Pesaran (2001), in order to fit small data sets, between 30 and 80 observations.

If a long-run relationship is established between the variables, then short run dynamics derived from an error correction model (ECM) can be estimated from the following equation:

$$\Delta EX_t = \beta_0 + \sum_{i=1}^m \beta_{1i} \Delta EX_{t-i} + \sum_{j=0}^n \beta_{2j} \Delta INTDIFF_{t-i} + \beta_3 EC_{t-1} + \omega_t \quad (10)$$

Where β_0 is constant, ω_t is error term, β_1 and β_2 are coefficients of the short run dynamics, while β_3 measures the speed of adjustment to long run equilibrium. EC_{t-1} is the lagged error correction term derived from the following long run equation:

$$EC_t = EX_t - \delta_0 - \delta_1 INTDIFF_t \quad (11)$$

4.3.3. Granger Causality Test

In addition, Granger causality test will be conducted to examine the direction of the relationship between **EX** and **INTDIFF**. The intuition of this test is to investigate if **INTDIFF** granger causes **EX**, then the past values of **INTDIFF** can be used to predict changes in **EX**. On the other hand, if **EX** granger cause **INTDIFF**, then the past values of **EX** can be used to predict changes in **INTDIFF**. If a long run relationship between **EX** and **INTDIFF** is found in eq. (9) according to the previously explained ARDL bounds test, then the ECM estimated in eq. (10) can be used to test for the causality running from **INTDIFF** to **EX**, by testing the following null hypotheses (Granger, 1988; Mehrara, 2007):

- Short-run Granger causality: ($H_0: \beta_{21} = \beta_{22} = \dots \beta_{2n} = 0$) tests for the significance of the coefficients of the independent lagged variable **INTDIFF** in eq. (10), in order to assess Granger weak causality which is interpreted as short run causality, since the dependant variable will be responding only to short term shocks (Masih and Masih, 1996).
- Long-run Granger causality: ($H_0: \beta_3 = 0$), in which, β_3 , is the coefficient of the error correction term in eq. (10), representing the speed of adjustment to long run equilibrium. If $\beta_3 = 0$, then **EX** does not respond to a deviation from the long run equilibrium in the previous period.
- Strong Granger causality: ($H_0: \beta_{21} = \beta_{22} = \dots \beta_{2n} = \beta_3 = 0$), to check whether the two sources of causation – short run & long run – are jointly significant, in order to test for Granger causality.

However, if long run relationship is not found, then Granger causality can be examined through a Vector Autoregressive (VAR) model by running eq. (10) after excluding the error correction term and testing for short run Granger causality only (Jenkins and Katircioglu, 2010).

On the other hand, testing for the causality running from EX to INTDIFF, implies running an equation similar to eq. (9) but using INTDIFF as the dependent variable and EX as the independent one, and testing for the long run relationship through ARDL approach to co-integration. If co-integration exists, then ECM can be estimated and used to test for the Granger causality running from EX to INTDIFF. However, if co-integration doesn't exist, then testing for Granger causality can take place through a VAR model.

4.3.4. Impulse Response Function (IRF) and Variance Decomposition (VD)

Though, the ECM estimated in eq. (10) incorporates the long run and short run relationships between EX and INTDIFF, there is still a need to study the dynamics of this relationship in the short run and its projections. Therefore, a VAR model will be estimated and interpreted through impulse response function (IRF) and the variance decomposition (VD) both of which can effectively capture the short run dynamics. The IRF traces the response of an endogenous variable to a shock in that variable and in every other endogenous variable. As for VD, it breaks down the variance of the forecast error for each variable into components that can be attributed to each of the endogenous variables. VD can, therefore, indicate the relative importance of interest rate differential in determining changes in exchange rate.

The preceding methodology will be adopted to examine the existence of IFE once for the case of Egypt vs. USA and another time for the case of Egypt vs. Germany.

5. Estimation Results & Interpretation

Prior to reporting the estimation results, ADF unit root results will be reported for the four variables under study to check for their stationarity and order of integration. Although the ARDL approach to co-integration doesn't prerequisite unit root test, however, it would work as evidence about whether or not the ARDL approach is the appropriate approach to be undertaken. Consequently, this section is divided into five parts. First part reports the unit root test results. Second part presents the estimation results of ARDL approach to co-integration and ECM. Third part provides the results of the Granger causality test. Fourth part displays the IRF and VD. Finally, the fifth part discusses the interpretation of the results for each case individually.

5.1. ADF Unit Root Test

ADF test has been employed to test for the stationarity of the variables under study. Table (1) shows that $EX_{(Eg/US)}$ and $EX_{(Eg/EU)}$ are stationary series, while $INTDIFF_{(Eg,US)}$ and $INTDIFF_{(Eg,Gr)}$ are first order homogenous, I (1).

Table 1: ADF unit root test results

Variable	Level		First Difference	
	ADF test Statistic	Mackinnon(1996) critical values at 5% significance level	ADF test Statistic	Mackinnon(1996) critical values at 5% significance level
$EX_{(Eg/US)}$	-14.2701 <i>at trend *</i>	-3.52976	-11.56549	-1.949856
$INTDIFF_{(Eg,US)}$	-0.382707	-1.949609	-4.718334	-1.949856
$EX_{(Eg/EU)}$	-7.05089	-1.94961	-5.121004 (4)**	-1.951
$INTDIFF_{(Eg,Gr)}$	-2.82605 <i>at trend*</i>	-3.52976	-5.07363	-1.94986

* Trend is significant for $EX_{(Eg/US)}$ at level and $INTDIFF_{(Eg,Gr)}$ at level

**The number between brackets () refers to the number of lags.

5.2. Autoregressive Distributed Lag (ARDL) Approach to Co-Integration and Error Correction Model

Model

The preceding ADF unit root test results supports the choice of ARDL approach to co-integration due to the fact that the variables under study have different orders of integration. ARDL (1, 1) – one lag for each variable – is chosen as it minimizes AIC & SBC. Thus, the following ARDL model was estimated once for the case of Egypt vs. USA and another time for the case of Egypt vs. Germany:

$$\Delta EX_t = a_0 + a_1INTDIFF_{t-1} + a_2EX_{t-1} + a_3\Delta EX_{t-1} + a_4\Delta INTDIFF_t + a_5\Delta INTDIFF_{t-1} \tag{12}$$

Coefficient test is carried for α_1 and α_2 using Wald test. The F-statistic is significant for both cases as shown in table (2) and accordingly has to be compared to the tabulated critical value bounds of F-statistic reported by Paseran (2001). Also, F-statistic will be compared to critical value bounds of Narayan (2004). For the case of Egypt vs. USA, the F-statistic exceeds the upper bound of the tabulated F- critical bound for both Paseran (2001) & Narayan (2004). Hence, the null hypothesis of no co-integration is rejected supporting the existence of a long run relationship between $EX_{(Eg/US)}$ and $INTDIFF_{(Eg,US)}$. Same applies for the case of Egypt vs. Germany. Therefore there also exists a long run relationship between $EX_{(Eg/EU)}$ and $INTDIFF_{(Eg,GR)}$.

Table 2: F-Statistic of co-integration relationship

Egypt vs. USA		Egypt vs. Germany		Pesaran (2001) tabulated critical value bounds for F-statistic at 5% significance level at restricted intercept and no trend			Narayan (2004) tabulated critical value bounds for F-statistic at 5% significance level at restricted intercept and no Trend at n**=38		
F-Test Statistic	P-value	F-Test Statistic	P-value	k*	I(0)	I(1)	K	I(0)	I(1)
13.12331	0.0001	14.12881	0.0000	1	3.62	4.16	1	5.807	6.490

*k refers to the no. of regressors which in this case is equal to one.

**n refers to the number of observations

Since co-integration exists, then the long run model can be estimated as follows:

$$EX_t = a + \beta INTDIFF_t + \varepsilon_t \tag{13}$$

Where the null hypothesis of IFE is $\alpha = 0$ and $\beta = 1$.

Table 3: Long run output

Egypt vs. USA			Egypt vs. Germany		
$EX_{(Eg/US)t} = -0.022869 + 0.369916 INTDIFF_{(Eg,US)t}$			$EX_{(Eg/GR)t} = 0.029498 - 0.169861 INTDIFF_{(Eg,GR)t}$		
Std. Error	0.018188	0.19452	Std. Error	0.03087	0.335882
t-statistic	-1.229706	1.89706	t-statistic	0.952458	-0.492319
Prob.	0.2264	0.0654	Prob.	0.3469	0.6253
R-squared 0.086513 Adjusted R-squared 0.062474 F-statistic 3.598838 Prob. (F-statistic) 0.065439 S.E. of regression 0.044988 Durbin Watson Stat 0.757008			R-squared 0.006338 Adjusted R-squared -0.019811 F-statistic 0.242378 Prob. (F-statistic) 0.625326 S.E. of regression 0.069856 Durbin Watson Stat 1.181002		

In the case of Egypt vs. USA, table (3) shows that, β , the long run coefficient of $INTDIFF_{(Eg,US)t}$, is 0.37. This means that a one percent increase in interest rate differential between Egyptian & US T-bills will result in a 0.37 percent increase (depreciation) in the exchange rate L.E./\$. Although, β value is positive conforming to IFE theory and significant at 10% level of significance as pointed by the p-value. However, it is less than unity, far from the null hypothesis concluding partial significance of IFE in the case of Egypt vs.USA. Accordingly, if interest rates in Egypt are higher than that in USA, then the Egyptian pound will depreciate, however, American investors might still gain profits from

investing in Egyptian securities since interest rate differential isn't equally offset by the depreciation in Egyptian pound.

While, in the case of Egypt vs. Germany, Table (3) shows that, β , the long run coefficient of $INTDIFF_{(Eg.Gr)t}$ is negative and insignificant as pointed by the t-statistic and the P-value. Therefore, real interest rates are not equalized between Egypt and Germany, consequently, there exists opportunities for abnormal gains in portfolio diversification between them in the long run. Accordingly, IFE doesn't apply in the case of Egypt vs. Germany.

Since co-integration exists, then an error correction model can be estimated as follows:

$$\Delta EX_t = \beta_0 + \beta_1 \Delta EX_{t-1} + \beta_{20} \Delta INTDIFF_t + \beta_{21} \Delta INTDIFF_{t-1} + \beta_3 EC_{t-1} + \omega_t \tag{14}$$

Where EC_{t-1} is the residual of the long run model in Table (3) lagged once.

In the case of Egypt vs. USA, table (4) reports the speed of adjustment to long run equilibrium between interest rate differential and exchange rate changes. It is measured by, β_3 , the co-efficient of error correction term (EC_{t-1}) which is highly significant as pointed by the t-statistic and the P-value. It implies that 72 percent of the deviation from the long run path between $EX_{(Eg/US)}$ and $INTDIFF_{(Eg.US)}$ in period t-1 will be compensated in period t.

As for the case of Egypt vs. Germany, table (4) shows that the speed of adjustment to long run equilibrium is negative and highly significant as pointed by the t-statistic and the P-value which strengthens the long run negative relationship between $EX_{(Eg/EU)}$ and $INTDIFF_{(Eg.Gr)}$. The absolute value of the speed of the adjustment is greater than one which implies overshooting the equilibrium level. Therefore, there exists opportunities for arbitrage profits in portfolio diversification between Egypt and Germany in the long run.

Table 4: Error Correction model

Egypt vs. USA					
$\Delta EX_{(Eg/US)t} = -0.008689 - 0.008428 \Delta EX_{(Eg/US)t-1} + 0.248827 \Delta INTDIFF_{(Eg/US)t} + -0.178816 \Delta INTDIFF_{(Eg/US)t-1} - 0.724807 EC_{t-1}$					
Std. Error	0.002947	0.075611	0.2148	0.211662	0.153308
t-statistic	-1.91985	-0.071793	n 1.158877	-0.841984	-4.725816
Prob.	0.0636	0.9432	0.2548	0.4059	0.0000
R-squared 0.42794 Adjusted R-squared 0.3586 F-statistic 6.171568 Prob (F-statistic) 0.000802 S.E. of regression 0.016425 Durbin Watson Stat 1.942721					
Egypt vs. Germany					
$\Delta EX_{(Eg/EU)t} = -0.008681 + 0.088826 \Delta EX_{(Eg/EU)t-1} - 1.117408 \Delta INTDIFF_{(Eg/EU)t} - 0.812884 \Delta INTDIFF_{(Eg/EU)t-1} - 1.048088 EC_{t-1}$					
Std. Error	0.00804	0.117853	0.607179	0.617496	0.193352
t-statistic	-1.110919	0.284474	-1.840317	-0.506157	-5.394616
Prob.	0.2746	0.7778	0.0747	0.6161	0.0000
R-squared 0.575616 Adjusted R-squared 0.524176 F-statistic 11.18996 Prob (F-statistic) 0.000008 S.E. of regression 0.048494 Durbin Watson Stat 1.975371					

5.3. Granger Causality Test

The direction of the relationship between EX and $INTDIFF$ was estimated by Granger causality test. Both directions were examined.

5.3.1. First Hypothesis: $INTDIFF$ Doesn't Granger Cause EX

Long run relationship was found between EX and $INTDIFF$ when EX was taken as the dependant variable in the ARDL approach to co-integration for both cases: Egypt vs.USA and Egypt vs. Germany. Accordingly, the hypothesis: $INTDIFF$ doesn't granger cause EX , was examined by testing

for the significance of the coefficients of the parameters of the ECM reported in table (4). Three hypotheses were tested: long run causality, short run causality and strong causality as shown in table (5). The results revealed same findings for both cases. The error correction term was significant indicating the presence of long run causality. However, the lagged **INTDIFF** was insignificant indicating the absence of short run causality. Yet, the joint significant F-statistic for both short run and long run parameters was significant implying strong causality running from **INTDIFF** to **EX** attributed to long run causality rather than short one.

Table 5: Granger Causality Test – ECM model

	Egypt vs. USA			Egypt vs. Germany		
	Hypothesis	Test statistic	P- value	Hypothesis	Test statistic	P- value
Short run causality	H ₀ : $\Delta INTDIFF_{(Eg,US)t-1} = 0$	t-statistic - 0.841	0.405	H ₀ : $\Delta INTDIFF_{(Eg,GR)t-1} = 0$	t-statistic -0.506	0.616
Long run causality	H ₀ : $EC_{t-1} = 0$	t-statistic -4.72	0.000	H ₀ : $EC_{t-1} = 0$	t-statistic -5.394	0.000
Strong Causality	H ₀ : $\Delta INTDIFF_{(Eg,US)t-1} = EC_{t-1} = 0$	F-statistic 11.26	0.000	H ₀ : $\Delta INTDIFF_{(Eg,GR)t-1} = EC_{t-1} = 0$	F-statistic 16.25	0.000

5.3.2. Second Hypothesis: EX Doesn't Granger Cause INTDIFF

Long run relationship wasn't found between **EX** and **INTDIFF** when **INTDIFF** was taken as the dependant variable using the ARDL approach to co-integration for both cases: Egypt vs. USA and Egypt vs. Germany. The results are reported in appendix A. Accordingly, the hypothesis: **EX** doesn't granger cause **INTDIFF**, was examined by a VAR model in which the null hypothesis was not rejected in both cases as reported in table (6).

Table 6: Granger Causality Test - VAR model

Egypt vs. USA		Egypt vs. Germany	
Null hypothesis: $EX_{(Eg,US)}$ doesn't granger cause $INTDIFF_{(Eg,US)}$		Null hypothesis: $EX_{(Eg,GR)}$ doesn't granger cause $INTDIFF_{(Eg,GR)}$	
Chi-sq (P-value)	0.854018 (0.3554)	Chi-sq (P-value)	1.011800 (0.3145)

Hence, the relationship between **EX** and **INTDIFF** is unidirectional running only from **INTDIFF** to **EX**. Thus, then the past values of **INTDIFF** can be used to predict changes in **EX** conforming to the IFE theory.

5.4. Impulse Response Function and Variance Decomposition

Short run dynamics between **EX** and **INTDIFF** can be examined by estimating a VAR model and interpreting it through IRF & VD. IRFs are reported for 10 quarters in fig. (4) for the case of Egypt vs. USA & in fig. (5) for the case of Egypt vs. Germany. For the case of Egypt vs. USA, fig.(4) shows that $EX_{(Eg/US)}$ increases slightly in response to one standard deviation shock in $INTDIFF_{(Eg,US)}$ in the second quarter, and then the effect of the shock dampens out and fades away by the fourth quarter. Thus, the negligible effect of the shock in $INTDIFF_{(Eg,US)}$ on $EX_{(Eg/US)}$, implies the absence of a short run relationship. This IRF result supports the granger causality test result which entailed the absence of short run causality running from $INTDIFF_{(Eg,US)}$ to $EX_{(Eg/US)}$.

As for the case of Egypt vs. Germany, fig. (5) shows that $EX_{(EG/EU)}$ decreases in response to a shock in $INTDIFF_{(Eg,GR)}$ reaching a trough by the end of the third quarter, then increases gradually during the fourth quarter. And then, dampens out and fades away by the seventh quarter. Therefore, IFE doesn't hold in the short run for the case of Egypt vs. Germany. This result matches the long run result that found negative relationship between changes in exchange rate and interest rate differential between Egypt and Germany.

Figure 4: Egypt vs. USA Impulse Response Function

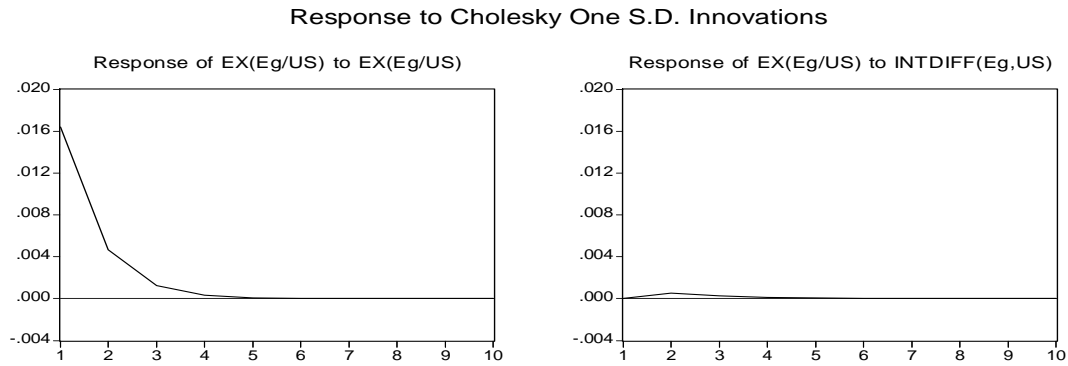


Figure 5: Egypt vs. Germany Impulse Response Function



Regarding the VD, table (7) reports the VD for 10 quarters forecast of $EX_{(Eg/US)}$ in which 99.8 percent of the forecast variance is attributed to $EX_{(Eg/US)}$ shocks, while 0.12 percent to $INTDIFF_{(Eg,US)}$ shocks. On the other hand, 10 quarters forecast of VD of $EX_{(Eg/EU)}$, indicates that 93.82 percent of the forecast variance is attributed to $EX_{(Eg/EU)}$ shocks, while 6.18 percent to $INTDIFF_{(Eg,Gr)}$. VD results imply that $INTDIFF$ has negligible effect on EX in the short run for both cases; Egyptian pound with respect to US dollar and Egyptian pound with respect to euro currency. Hence, VD results support both the IRF results and Granger causality test results which revealed absence of short run causality running from $INTDIFF$ to EX in both case studies.

Table 7: Variance Decomposition

Variance Decomposition of rate of change in spot exchange rate of Egyptian pound per US dollar				Variance Decomposition of rate of change in spot exchange rate of Egyptian pound per Euro currency			
Period	S.E.	$EX_{(Eg/US)}$	$INTDIFF_{(Eg,US)}$	Period	S.E.	$EX_{(Eg/EU)}$	$INTDIFF_{(Eg,Gr)}$
1	0.016397	100	0	1	0.049947	100	0
2	0.017051	99.91106	0.088935	2	0.050222	99.12689	0.873111
3	0.017099	99.88182	0.118176	3	0.051959	93.86162	6.138379
4	0.017102	99.87644	0.123562	4	0.052162	93.8789	6.121104
5	0.017103	99.87568	0.124315	5	0.05231	93.9123	6.087702
6	0.017103	99.8756	0.124404	6	0.052326	93.85755	6.142452
7	0.017103	99.87559	0.124413	7	0.052339	93.82371	6.176294
8	0.017103	99.87559	0.124414	8	0.052344	93.82351	6.176493
9	0.017103	99.87559	0.124414	9	0.052345	93.82371	6.176288
10	0.017103	99.87559	0.124414	10	0.052346	93.82276	6.177244

Cholesky ordering: $EX_{(Eg/US)}$ $INTDIFF_{(Eg,US)}$ Cholesky ordering: $EX_{(Eg/EU)}$ $INTDIFF_{(Eg,Gr)}$

5.5. Interpretation of the Results

This section interprets and analyses collectively the findings of the long run – *co-integration and error correction*– and the short run – *VAR analysis*– estimation results in an attempt to find out the reasons preventing IFE to hold in Egypt. This section is divided into two parts in which each of the cases of Egypt vs. USA and Egypt vs. Germany is analyzed individually.

5.5.1. Egypt vs. USA

The preceding long run and short run estimation results revealed that IFE partially exists in the case of Egypt vs. USA. Although, the results revealed a positive significant relationship between changes in exchange rate and interest rate differential which conforms to IFE theory. However it wasn't one to one relationship. Thus, there might be a tendency of American purchases of Egyptian debt securities, since the interest rate differential is not equally offset by the change in exchange rate. The failure to have full IFE might be attributed to several reasons. One reason is that IFE is based on PPP theory, if PPP doesn't hold then IFE is not likely to hold.

Accordingly, the relevance of the PPP theory for the case of Egypt vs. USA was investigated over the period 2003-2012. The results are reported in appendix B. The results imply that PPP is not holding in the case of Egypt vs. USA. Inflation rate is higher in Egypt than in USA; however, the controversy is that USA imports necessary goods from Egypt which hinders PPP to hold. The Egyptian exports to USA accounted for 35.4% of Egypt's total exports in FY2002/2003. This percentage reached 12.7 % of total exports in FY2011/2012 (CBE annual reports). USA is the main trade partner for Egypt after EU. Moreover, trade barriers might be hindering PPP to hold. Although liberalization is taking place in Egypt, in which tariff rates were reduced from 14.6 percent to 5.5 percent as part of the economic reforms that Egypt embarked on since 2004. However, non tariff barriers still exist affecting the flow of goods from USA to Egypt.

Another possible reason for the irrelevance of IFE in Egypt is the persistence of high inflation rates in Egypt that always pushed the interest rates to be high. While, on the other hand, USA had very low interest rates throughout the period of study. The FED lowered the federal fund rate to one percent during 2003-2004 in order to boost up the economy after the invasion in Iraq. Besides, the financial crisis drove the FED to set federal fund rate around zero percent since 2008. This low rate of return pushed American people, seeking higher nominal rates of return, to look for higher yielding foreign assets (Kliesen, 2010). Thinking in terms of nominal rather than real monetary values is referred to as money illusion. In this respect, Egypt was one of the countries that attracted investors seeking high nominal returns. From the CBE annual reports, it can be noticed that international reserves had a substantial increase from 14.3 billion \$ in FY2003/2004 to 34.6 billion \$ in FY 2007/2008. The expansion in the international reserves was attributed to the increase in oil prices, Suez Canal revenues and upsurge in FDI and FPI inflows.

Also, IFE might not be taking place due to the fact that the exchange rate of L.E. /\$ is not allowed to float freely. The exchange rate only experienced 30% depreciation immediately after the announced floatation in 2003. And then throughout the period of surge in capital inflows (2005-2008), the exchange rate was expected to be vulnerable to high volatility. However, it was nearly stable with 9 percent appreciation due to the sterilized foreign exchange intervention by the CBE in order to avoid exchange rate appreciation. IMF (2007) reported that sterilization measures accounted for one percent of GDP in 2007. Foreign flows were partially sterilized stimulating inflation rate and pushing interest rates upward and in turn raising interest rate differential (Selim, 2012).

Selim (2012) was concerned with the effect of sterilization on the free willingness of exchange rate and estimated a *de facto* classification for Egypt's exchange rate regime for the period of 1982-2008. The estimation revealed that the exchange rate can't be classified as float after the FY 2003/2004. This is supported by the IMF (2007) *de facto* classification of Egypt's exchange rate, in which the regime has been classified as a managed float with a pre-determined path for the exchange

rate since 2003. Then, IMF country report 2010 stated that Egypt exchange rate regime became “other managed arrangements”.⁴

Nevertheless, Ray (2012) argued that even in a regime of fixed exchange rate and perfect capital mobility, real interest rates will be equal across markets implying that IFE would hold. However, in a regime of flexible exchange rate where the capital market is imperfect, real interest rates difference persists opposing IFE. Hence, the question is whether Egypt is having free capital mobility in which capital integration between Egypt and US exists or not.

Marashdeh (2005) examined the financial integration between MENA countries namely, Egypt, Turkey, Jordan and Morocco, and developed markets represented by USA, UK and Germany. He found that MENA countries’ stock markets are co-integrated while no co-integration exists between MENA investigated countries markets and developed markets except for Egypt during 1994-2004. However, Segot and Lucey (2007) had opposing results.

Furthermore, Al-Nashar (2013) used the capital account openness index (KAOPEN), initiated by Chinn and Ito (2006)⁵, to measure Egypt’s degree of *de jure* financial account openness. The author compared Egypt’s *de jure* financial openness with the flows of FPI; as she asserts that FPI is the most relevant proxy for the *de facto* financial openness. KAOPEN index recorded a steady score of 2.44 during (2004 - 2008) – concurrently with banking and financial reforms that took place at that time – which is the highest score compared to industrial countries such as USA, UK and European countries that had the same score of 2.44. Accordingly, Egypt witnessed a surge in capital inflows during 2005-2008. However, the index recorded a gradual decline for Egypt compared to industrial countries during (2009-2011) reaching 1.65 in 2011 due to Egypt’s measures to hedge the risk associated with the global financial crisis and the adverse economic repercussions of January 2011 revolution; where this period witnessed a capital outflow. Hence, despite of the *de jure* financial openness in Egypt, FPI net inflows witnessed high volatility since the early 2000s up till today; implying that the *de facto* financial openness was limited.

Al-Nashar (2013) further investigated the *de facto* capital and financial openness in Egypt empirically by making use of the impossible trinity framework. This trinity asserts that if having fixed exchange rate and free capital mobility, then it is impossible to have autonomous monetary policy, in which central banks can’t influence interest rates. Regarding Egypt, the exchange rate is nearly stabilized as previously explained by Selim (2012) and IMF reports, besides, the KAOPEN index shows a *de jure* financial openness. Hence, Al-Nashar (2013) assessed the monetary autonomy for Egypt and found that the growth rate in the monetary aggregate (M2) –proxy for money supply– Granger causes movements in the exchange rate-adjusted interest rate differential for the periods (2000-2011) and (2004-2008), implying that CBE is preserving its monetary autonomy. Accordingly, Egypt’s monetary autonomy can’t be preserved unless financial integration/capital mobility is imperfect implying limited *de facto* financial openness.

In this context, IMF country report (2010) affirmed that the fact that financial system in Egypt is less integrated with the global economy compared to the real sector was the reason behind Egypt’s quick recovery from the global financial crisis compared to other countries at the same income level. This is in addition to the CBE’s Phase I reforms (2004 - 2008) – banks’ restructuring, consolidation, and cleanup of non-performing loans – which reduced financial vulnerabilities. However, Kosea et al (2011) attributed a country’s limited *de facto* financial openness and integration to the fact that there is a threshold of financial depth and institutional quality that an economy has to attain, in order to witness financial integration. In this respect, Reda (2012) found that Egypt’s banks’ consolidation had a positive effect on managerial efficiency, capitalization and risk management practices, yet financial depth and banks’ intermediation, as reflected by loans to deposits ratio, and banks profitability have

⁴ “other managed arrangement” this category captures countries in which the *de facto* and the *de jure* arrangement differ, which manage their exchange rates but are not floating, and which exhibit frequent or irregular changes in policies.

⁵ KAOPEN is based on the binary dummy variables that codify the tabulation of restrictions on cross boarder financial transactions reported in the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER), for more details see, Chinn and Ito (2006).

weakened. Besides, Nasr (2009) affirmed that Egypt's institutional infrastructure is still not well acquainted with the targeted financial integration. For instance, there are no specialized courts for financial institutions, and no specialized judges with adequate knowledge of financial market risks.

That's why Egypt had a moderate rank in the financial development index⁶ published by World Economic Forum in its first financial development report in 2008. Egypt ranked 37 with a score of 3.3, while US was the top ranked with a score of 5.8. Emerging economies were having higher ranks than Egypt which increased in the financial development report in 2010 while Egypt remained at the same rank. Also, European countries as Germany were highly ranked compared to Egypt.

Furthermore, the justification that might be behind the delayed financial integration and in turn insignificance of IFE is that the route towards financial integration requires sequential prerequisites as indicated by Jedidi and Mensi (2010) based on their empirical investigation of MENA countries. Their findings emphasized that trade openness must be implemented five years before capital account liberalization and a year after achieving macroeconomic stability. Besides, banking system development must be accompanied by a satisfactory level of economic development and an inflation control of five years before liberalizing capital account. In addition, stock market development, as reflected in the performance and the size of its capitalization, must be accompanied by an inflation control process four years in advance. It can be inferred from Jedidi and Mensi (2010) that throughout the period of 2003-2012, Egypt had trade openness. However, Egypt didn't experience full 5 years of controlled inflation and satisfactory economic development in terms of GDP, even before year 2003. Therefore, Egypt hasn't fulfilled the prerequisites of financial openness, which hinders IFE to hold.

It is worthy to note that Egypt has plunged into a political and economical transition subsequent to January 2011 revolution. The banking and financial sectors were affected due to the successive downgrading to Egypt's sovereign credit rating by three credit rating agencies⁷ since the up rise of the revolution up till today. The downgrading affected the soundness of the financial sector in Egypt leading to capital outflows and decreasing the investors' confidence in the Egyptian economy, all of which negatively affected the financial development in Egypt.

Also, psychological barriers might hinder IFE. Besides, legal restrictions and transaction costs act as barriers (Solnik, 2000). Further, the currency risk and tax on yields influences the flow of capital.

5.5.2. Egypt vs. Germany

Long run and short run estimation results revealed that IFE doesn't hold for the case of Egypt vs. Germany. This implies that exchange rate of the Egyptian pound per Euro doesn't offset the interest rate differential between Egypt and Germany. In this respect, German investors are attracted to the high interest rates of Egyptian securities resulting in appreciation in the exchange rate of L.E./ €. As explained previously, the failure to have IFE might be attributed to several reasons including the irrelevance of the PPP.

To the extent of the authors' knowledge, the empirical literature hasn't examined PPP theory between the Euro currency and the Egyptian pound. Thus, this paper tested for long run PPP between the Egyptian pound and the Euro over the period 2003-2012. The results are reported in appendix B. The results implied the failure of PPP to hold between the Egyptian pound and the Euro currency. PPP might be invalid because EU is the main trade partner with Egypt. Although inflation rate is higher in Egypt than in EU, Egypt's exports to the EU accounts for more than 30 percent of Egypt's total exports throughout the studied period. Egypt is ranked the fifth exporter to the EU in the region in 2011. Moreover, the trade between Egypt and EU was further intensified and supported by the EU-Egypt

⁶ Financial development index has a score range (0-7). It ranks 52 of the world's leading financial systems. The World Economic Forum defines financial development as "the factors, policies, and institutions that lead to effective financial intermediation and markets, and deep and broad access to capital and financial service".

⁷ The three credit rating agencies that downgraded Egypt's sovereign credit rating sixteen times since January 2011 revolution are as follows: Standard & Poor downgraded Egypt's sovereign credit rating from BB+ to CCC+, Moody's downgraded from Ba1 to Caa1 and Fitch downgraded from BB+ to B.

Association Agreement that came into force in 2004⁸. Afterwards, a joint EU-Egypt Action Plan was established in 2007 which set an agenda for intensified relations between the two sides in the context of the European Neighborhood Policy (ENP). Accordingly, Egypt acquired about €558 million financial assistance package for the period 2007-2010 to facilitate economic and social reforms. This flow of financial assistance to Egypt might have triggered the appreciation of the exchange rate of L.E. / €.

Furthermore, along the period of 2003-2012, the European Central Bank (ECB) succeeded in keeping inflation around 2 percent in accordance to ECB's objective of price stability. This stable inflation led the ECB to keep the key interest rates low through most of the studied period. The low interest rates might have pushed the European investors seeking high nominal interest rates to approach foreign high yielding asset even if they were riskier than domestic ones.

Besides, other factors could have hindered IFE to hold, that were explained in detail in the case of Egypt vs.USA. These factors include Egypt's limited financial integration with international financial markets. In addition, money illusion, currency risk and political risk, as well as, the adverse impacts of the January 2011 revolution on the financial sector in Egypt.

6. Conclusion

This paper aimed at examining the IFE theory which implies that foreign currencies with relatively high interest rates will depreciate because the high nominal interest rates reflect expected inflation. Two case studies – Egypt vs. USA and Egypt vs. Germany – were investigated during the period (2003-2012). The empirical findings revealed partial significance of IFE in the case of Egyptian pound vs. US dollars, while no sign of IFE was detected in the case of Egyptian pound vs. Euro currency.

The insignificance of IFE in both cases has been attributed to the insignificance of PPP in which exchange rate didn't offset inflation differential and thereby didn't offset interest rate differential. Consequently it would be difficult to utilize interest rate differential to forecast future changes in exchange rate. In addition, the irrelevance of IFE implied that Egypt is having limited financial integration with international financial markets. Besides, money illusion, currency risk and political risk as well as the adverse economic repercussions of the January 2011 revolution on the banking and financial sectors in Egypt can all attribute to the failure of IFE to hold.

Policy recommendations can be deduced from the preceding findings to the policy makers in Egypt. Policy makers need to have a look at eliminating the non-tariff barriers in order to allow free movement of goods and thereby permit PPP to hold which is the building block for IFE to hold. Furthermore, interventions in the foreign exchange market have to be ceased because these interventions overvalue the Egyptian pound and hold back the ability of the exchange rate to adjust to inflation differential and interest rate differential; hindering PPP and IFE to hold.

Despite of the Egyptian steps towards trade openness and banking reforms on two phases in 2004 and then in 2009, yet more effort is needed to enhance the financial depth in the Egyptian economy. Besides, macroeconomic instability is still noticed, in which policy makers need to work on curbing down the inflation rate, stabilizing the output around its potential, and providing a friendly investment environment in order to encourage sustained foreign investment and economic growth. This is in addition to retaining the regional and global confidence in the Egyptian banking sector and financial system after the successive downgrading of the sovereign credit rating in the wake of the economic chaos subsequent to January 2011 revolution.

Nevertheless, the wide benefits perceived from taking steps towards financial integration in terms of development in the domestic financial system, as well as, free capital mobility that stimulates capital and technological accumulation and consequently enhances economic growth. Supporting institutions and conditions have to be in place to mitigate risk associated with fluctuations in capital

⁸ This agreement established a free trade area between Egypt and EU and abolished gradually the custom tariffs on industrial and agricultural products. Besides, this agreement facilitated movement of capital between the two partners. However, the non tariff barriers might be affecting the flow of goods from EU to Egypt.

flows. Hence, policy makers in Egypt are recommended to allow gradual and cautious financial openness until financial markets become well established, developed and capable to hedge risk efficiently.

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Appendices

Appendix A. Results of ARDL Approach to Co-Integration Using Nominal Interest Rate

Differential as the Dependant Variable

A.1. The Model

$$\Delta INTDIFF_t = a_0 + a_1 INTDIFF_{t-1} + a_2 EX_{t-1} + a_3 \Delta INTDIFF_{t-1} + a_4 \Delta EX_t + a_5 \Delta EX_{t-1} \tag{A.1}$$

A.2. Estimation Results

Table A.1: F-Statistic of co-integration relationship

Egypt vs. USA		Egypt vs. Germany		Pesaran (2001) tabulated critical value bounds for F-statistic at 5% significance level at restricted intercept and no trend			Narayan (2004) tabulated critical value bounds for F-statistic at 5% significance level at restricted intercept and no Trend at n**=38		
F-Test Statistic	P-value	F-Test Statistic	P-value	k*	I(0)	I(1)	K	I(0)	I(1)
0.805081	0.4559	1.061030	0.3580	1	3.62	4.16	1	5.807	6.490

*k refers to the no. of regressors which in this case is equal to one.

**n refers to the number of observation.

For both case studies, the F-test statistic is lower than the lower bound of the tabulated F critical bound for both Paseran (2001) & Narayan (2004) as indicated in table (A.1). Therefore, the null hypothesis of no co-integration is not rejected, implying absence of a long run relationship between **EX** and **INTDIFF**, when the latter is taken as the dependant variable. Accordingly, ECM can't be estimated to test for the Granger causality running from **EX** to **INTDIFF**.

Appendix B. Results of Examining PPP Using ARDL Approach to Co-Integration

B.1 The Model

According to Madura (1995), PPP can be examined using the following equation:

$$e_{f_t} = \alpha + \beta \left(\frac{I_h - I_f}{1 - I_f} \right)_t + \varepsilon_t \tag{B.1}$$

where e_{f_t} is the rate of change in the spot exchange rate, I_h and I_f are the home and foreign country

inflation rates respectively, and $\left(\frac{I_h - I_f}{1 + I_f} \right)_t$ is the inflation rate differential. α is the constant, β is the

regression coefficient indicating the rate at which the spot exchange rate will change as a response to a change in inflation rate differential. ε_t is the error term. According to PPP theory, $\alpha = 0$ and $\beta = 1$, where these are the hypotheses that will be tested in order to find out whether inflation rate differentials (**INFLDIFF**) are unbiased predictors of changes in exchange rates (**EX**). The above regression model is to be estimated individually for Egypt vs. USA and for Egypt vs. Germany. The source of quarterly data on inflation rate for Egypt, USA and Germany⁹ is International Financial Statistics (IFS) for the period 2003-2012.

B.2 Estimation Results

Table B.1: F-Statistic of co-integration relationship

Egypt vs. USA	Egypt vs. Germany	Pesaran (2001) tabulated critical	Narayan (2004) tabulated
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⁹ PPP results for the case of Egypt vs. Germany were the same using either the inflation rate in Germany or the inflation rate in the Euro area.

F-Test Statistic	P-value	F-Test Statistic	P-value	value bounds for F-statistic at 5% significance level at restricted intercept and no trend			critical value bounds for F-statistic at 5% significance level at restricted intercept and no Trend at n**=30		
				k*	I(0)	I(1)	k	I(0)	I(1)
10.62051	0.0000	12.29978	0.0000	1	3.62	4.16	1	5.807	6.490

*k refers to the no. of regressors which in this case is equal to one.

**n refers to the number of observations

Since co-integration exists, then the long run model can be estimated as follows:

$$EX_t = a + \beta INFLDIFF_t + \varepsilon_t \tag{B.2}$$

Table B.2: Long run output

Egypt vs. USA			Egypt vs. Germany		
$EX_{(eg/us)t} = 0.02416 - 0.21088 INFLDIFF_{(eg/us)t}$			$EX_{(eg/ger)t} = 0.046697 - 0.39961 INFLDIFF_{(eg/ger)t}$		
Std. Error	0.013583	0.163669	Std. Error	0.023181	0.260633
t-statistic	1.778724	-1.28846	t-statistic	2.014487	-1.53324
Prob.	0.0833	0.2054	Prob.	0.0511	0.1335
R-squared 0.041859 Adjusted R-squared 0.016645 F-statistic 1.660133 Prob. (F-statistic) 0.205375 S.E. of regression 0.046075 Durbin Watson Stat 0.789645			R-squared 0.05826 Adjusted R-squared 0.033477 F-statistic 2.35083 Prob. (F-statistic) 0.133501 S.E. of regression 0.068007 Durbin Watson Stat 1.294018		

The findings reported in table (B.2) indicate that PPP is not holding for both cases: Egyptian pound vs. US dollars¹⁰ and Egyptian pound vs. Euro currency. Due to the fact that, the long run coefficients of both $INFLDIFF_{(Eg.US)t}$ and $INFLDIFF_{(Eg.EU)t}$ are insignificant as pointed by the p-value.

¹⁰ PPP has been examined before for Egyptian pounds against US dollars within panel analysis where the results varied between supporting and opposing PPP in the long run for Egypt (Bahmani-Oskoeee and Tunkai, 2008; Drine and Rault, 2008).