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THE CAUSAL RELATIONSHIP BETWEEN FOREIGN DIRECT INVESTMENT AND ECONOMIC GROWTH IN TURKEY: COINTEGRATION AND ERROR-CORRECTION MODELS

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Abstract: *This paper examines the causal relationships between foreign direct investment (FDI) and economic growth using Turkish annual data for the period 1976-2002, by means of cointegration and error-correction models. The (Augmented) Dickey-Fuller (A) DF and Phillips- Perron (PP) unit root tests are performed and all time series become stationary after first differencing. Since all time series data are stationary in first difference, cointegration tests are necessary. Engle-Granger bivariate cointegration test results indicate these two variables are cointegrated. The results from Granger causality tests based on error-correction models show that there exists bidirectional Granger causality between FDI and economic growth, supporting the feedback hypothesis for Turkey. The diagnostic tests for adequacy of the model also performed and passed.*

Keywords: *Foreign Direct Investment, Economic Growth, Turkey*

TÜRKİYE'DE YABANCI DOĞRUDAN YATIRIM VE EKONOMİK BÜYÜME ARASINDAKİ NEDENSEL İLİŞKİ: KOENTEGRESYON VE HATA DÜZELTME MODELLERİ

Özet: *Bu çalışma, koentegrasyon ve hata düzeltme modelleri yolu ile Türkiye'de 1976-2002 dönemine ilişkin yıllık veriler kullanılarak yabancı doğrudan yatırımlar ve ekonomik büyüme arasındaki nedensellik ilişkilerini incelemektedir. (Augmented) Dickey-Fuller(A)DF ve Phillips-Perron (PP) birim kök testleri yapılmakta ve bütün zaman serileri birinci fark alındıktan sonra durağan hale gelmektedir. Bütün zaman serileri verisi birinci farkında durağan olduğu için, koentegrasyon testlerinin yapılması gerekmektedir. Yapılan Engle-Granger koentegrasyon testinin sonuçları iki değişkenin koentegre olduğunu göstermektedir. Hata düzeltme modellerine dayalı Granger nedensellik testlerinin sonuçları ise, yabancı doğrudan yatırım ve ekonomik büyüme arasında iki yönlü Granger nedenselliğin varlığını göstermektedir. Nedensellik testlerinden elde edilen bu sonuçlar, Türkiye'de iki yönlülük hipotezi desteklemektedir. Ayrıca, modelin yeterliliği için diagnostik testler yapılmış ve bu testler geçilmiştir.*

Anahtar Kelimeler: *Yabancı Doğrudan Yatırım, Ekonomik Büyüme, Türkiye*

I. INTRODUCTION

Foreign direct investment(FDI) is one of the most striking features of the world economy, and many countries see attracting FDI as an important element in their strategy for economic development. Increasingly, foreign direct investment recognised as a powerful engine and major catalyst for development, poverty-reducing growth and the global integration process. Recognizing that FDI can contribute to economic development, all countries want to attract more foreign direct investment. Indeed, the world market for FDI is highly competitive, and in particular, developing countries seek FDI to accelerate their development efforts. However, many countries have not benefited enough from FDI. Many developing and least developed countries had recieved only small amounts of FDI. This situation highlights the need for host countries to have a broader set of policies and institutions in order to attract investment and to maximise the benefits of FDI [1-3].

As mentioned earlier, given the potential role of FDI can play in accelerating economic growth, countries are strongly interested in attracting it. They are taking steps to improve the principal determinants influencing the locational choices of foreign direct investors. There are numerous factors determining the inflow of FDI in developing countries. One of the most important factors determining the surge of FDI inflows into the developing countries in recent years have been the privatization and globalization of protection [2,4]. In addition, political and economic stability, the openness of the host country, infrastructure quality, market demand and market size, labor cost and quality, the level of scientific research, taxes and tariffs, incentive system, build-operate projects [5-9] bureaucratic red tape, fair and predictable tax system, corruption and legal environment, competition policy, property rights, contract enforcement, protection of intellectual property [10-11]. With the advent of liberalization, which was generally benefical, removing many inefficient and uneconomic interventions, FDI is

assuming more prominent role in developing countries in the recent years [6]. However, with liberal policy frameworks becoming commonplace and losing some of their traditional power to attract FDI, governments are paying more attention to measures that actively facilitate FDI. Still, the economic determinants remain key. What is likely to be more critical in the future is the distinctive combination of locational advantages and, especially, created assets that a country or region can offer potential investors [2].

FDI has been of growing importance to the economics of both developed and developing countries. Countries are making efforts to attract more foreign direct investment. FDI has been growing rapidly and is acting as a major force shaping globalisation. According to the World Investment Report prepared by the UNCTAD in 2001, FDI continues to expand rapidly, enlarging the role of the international production in the world economy. FDI grew by 18.2 (from 1.075 in 1999 to 1.270.8 in 2000) percent in 2000. FDI grew faster than other economic aggregates like world production, capital formation and trade, reaching a record $1.270.764 million. Developed countries remain the prime destination of FDI. The value of FDI inflows to developed contries increased by 21 percent and amounted to $1.005.178 million in 2000 . FDI inflows to developing countries also rose. The role of FDI in developing countries has grown over the 1980s and 1990s. The past decade has witnessed a dramadic increase in FDI to developing countries, with increasing from $24 billion in 1990 to $240.2 billion in 2000. FDI flows to developing countries increased ten fold between 1990-2000 [12].

However, FDI flows declined sharply in 2001. This was mainly the result of the weakening of the global economy, notably in the world's three largest economies which all fell into recession, and a consequent drop in the value of cross-border mergers and acquisitions. As a result, the decline in FDI was mainly concentrated in developed economies. World inflows of FDI amounted to $735 billion. Of the $735 billion worth of FDI, $503 billion flowed into developed countries, $205 billion worth went to developing countries and the remaining $27 billion to the transition economies of Central and Eastern Europa(CEE). The economic slowdown has intensified competitive pressures, accentuating the need to search for lower-cost locations. This may result in increased FDI in activities that benefit from relocation to, or expansion in, low-wage economies[13].

In a global economy countries, whatever their development level, must attract FDI in order to stay competitive. Empirical evidence suggests that the fastest growing countries are the biggest FDI host countries [14]. Nevertheless, the causality between FDI and economic growth is not obvious. The causality between FDI and economic growth has been the subject of considerable research for many decades. FDI by multinational enterprises can effect economic growth of host countries through several channels, such as enhancing capital formation, technology transfer, positive effect on total factor productivity, export promotion, the establishment of foreign funded enterprises, positive spillover effects to domestic enterprises, creating employment opportunities and competition and demonstration effects. To sum, FDI not only brings financial resources for capital formation to host countries but also expands their production, employment and foreign trade, and therefore it accelerates growth and development [5,15].

Investigation of the casuality between FDI and economic growth has important implications for development strategies [16]. If the causality runs from FDI to growth, it would lend credence to the FDI-led growth hypothesis. In this hypothesis, FDI not only leads capital formation and employment augmentation but also promotes growth in host countries. If the causality runs from growth to FDI, it would imply that growth may be a prerequisite for developing countries to attract FDI and the amaunt of FDI flows into a country depends on the country's absorptive capacity. If the causality is bidirectional, FDI and growth would have a reinforcing causal relationships.

II. ALTERNATIVE HYPOTHESIS AND PRIOR EMPIRICAL RESEARCH

Three main hypotheses regarding the intertemporal relationships between FDI and economic growth have been put forth: (i) the growth-driven FDI hypothesis, (ii)the FDI-led growth hypothesis, and (iii) the feedback hypothesis, which is a combination of (i) and (ii).

*(i) **Hypothesis of Growth-Driven FDI.*** The growth-driven FDI hypothesis suggests that economic growth effects FDI. This hypothesis emphasizes the necessity of growing market size and improving conditions in human capital and infrastructures for attracting FDI. Other things being constant, a country market size (measured by GNP) rises with economic growth, encouraging foreign firms to increase their investment [16]. The market demand and market size has positive impact on the FDI because it directly affects the expected revenue of investment. In fact, one major motivation for FDI is to look for new markets [7]. In other words, growing market is bound to be extremely attractive to foreign investors. The larger the market size, the more the FDI likely to be attracted. Some empirical studies find such positive relationship [17]. Blomström and Lipsey [18] show a significant size threshold effect for firms' decision to invest abroad.

Rapid economic growth leads to high level of aggregate demand that stimulates greater demand for

investments including FDI. Rapid economic growth could induce more inflow of FDI. Because, rapid economic growth will usually create a high level of capital requirement in the host country and hence the host country will demand more FDI by offering concessional terms for FDI to attract overseas investors. In addition, rapid economic growth in the host country will build confidence of overseas investors for investing in the host country. More importantly, rapid economic growth will create huge opportunities for FDI to invest in industrial sectors, consumer durable goods and infrastructure sectors in the recipient countries [19]. In sum, other things being equal, better economic performance in recipient countries provides foreign investors with a better investment environment and greater opportunities for making profits and so greater incentive for FDI [16,20].

*(ii) **Hypothesis of FDI-led Growth.*** The FDI-led growth hypothesis suggest that FDI effects economic growth. FDI has been able to enhance the economic growth of host country through capital accumulation, employment augmentation, knowledge transfers, export promotion and spillover efficiency and technology transfer. FDI is expected to increase economic growth because it increases the domestic stock of real capital. To the extent that FDI adds to the existing capital stock, FDI may have growth effects that are similar to that of domestic investment, along with alleviating partly or totally the balance of payments deficits in the current accaunt [16]. In addition to employment augmentation, through knowledge transfers, FDI is expected to augment the existing stock of knowledge and to update the skill of the labor force in the recipient economy through labor training and skill acquisition, the introduction of alternative management practices and organizational arrangements [19]. FDI may promote exports by setting up assembling plants and helping host firms access international markets for exports [16]. In addition, FDI may ease the exploitation and disribution of raw materials that are produced in the host country, by means of helping improve the network of transport and communication.

Finally, FDI might also be able to enhance economic growth of host countries through spillover efficiency and technology transfer. The spillover efficiency occurs when advanced technologies and managerial skills embodied in FDI are transmitted to domestic plants simply because of the presence of multinational firms [16]. FDI is one of the main transmission vehicles of advanced technology from leaders to developing countries [21]. FDI may improve the technology and productivity of host country firms as FDI creates backward and forward linkages and foreign firms provide technical assistance to their local suppliers and customers. In addition, the competitive pressure exerted by the foreign affiliates may force local firms to operate more efficiently and introduce new technologies earlier than what would otherwise have been the case [16]. However, the spillover efficiency and technology transfers depends on host countries' absorptive capability that is largely determined by human capital in host countries. Thus, FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy [21].

*(iii) **Hypothesis of Feedback.*** The feedback hypothesis suggests two-way link between FDI and economic growth. This two-way link between FDI and growth has short run and long run dimensions. Over the short run, an outward oriented government policy of the host country as well as lower unit labor cost may attract FDI and thus FDI may have effect on growth via knowledge spillover. On the other hand, technology transfer brought by FDI could have permanent effect on the infrastructure of the home country and thus could impact the recipient country's long run growth favourably [22]. In this hypothesis, countries with fast economic growth, not only generating more demand for FDI but also providing better opportunities for making profits, attract greater FDI. On the other hand, FDI inflows may foster economic growth of host countries through positive direct effects and indirectly spillover effects [16]. Emprically, this hypothesis is characterized by bidirectional causality between FDI and economic growth.

Numerous empirical studies have examined the validity of the hypotheses but with remerkably mixed results. Several factors may have been responsible for such mixed results from prior empirical research, including the use of different time periods, different model specifications, and different methodologies. The bulk of the empirical literature has focused on the FDI in China with the exception of some papers. The growth-driven FDI hypothesis has been supported by the following empirical studies: Zhang [23], Tsai [24], Wheeler and Mody[25], Gypong and Karikari [26], Merlevede[27] and Chowdhury and Mavrotas[28]. The FDI-led growth hypothesis has been supported by the following empirical studies: Blomström, Libsey and Zejan [29], De Gregorio[30], Lee [31], Wei [32], Rodriguez-Clare [33], Blasubramanyam, Salisu and Sapsford [34], Dees [35], Borensztein et al. [21], Sun [36], Thomsen [37], De Melo [38], Gypong and Karikari [26], Markusen and Venables [39], Shatz and Venables [40], Chan [22], Kim and Hwang [41], Wei, Liu, Song, H. And Ramilly [42], Zhang [16], Zhang[43], and Bengoa and Sanchez-Robles[44]. The feedback hypothesis has been supported by the following empirical studies: Liu *et al.* [45], Shan *et.al.* [19], Zhang [20], Zhang [16], Cheng and Kwan [1], Chakraborty and Basu [6], Shan [19] and Chowdhury and Mavrotas[28]. These studies have found evidence of a bi-directional causality between the two variables.

Although there is considerable evidence on the

relationship between FDI and economic growth in both industrial and developing countries, insofar as this author is aware, the relationship between the two variables has not been yet systematically investigated for Turkey. While previous studies focus most on the industrial and developing countries, this paper attempts to make some contributions to this line of research by using recent time series econometric techniques to test the the "Growth-Driven FDI, FDI-led Growth or Feedback" hypothesis in the case of Turkey.

III. TRENDS OF FDI IN TURKEY

FDI in Turkey was minimal until 1980. Prior to 1980, in spite of a liberal legislation dating back to 1954, foreign direct investment has for various reasons played a minor role. In particular the restrictive application of the law by the Turkish administration and lengthy bureaucratic procedures finally led in the 1970s to a situation in which there was no new investment and even the necessary increases of capital could no longer be made [46].

Since 1980 this trend has significantly changed. FDI in Turkey accelerated in the early 1980s within the framework of export-oriented trade policy. Government policies in Turkey, those implemented since the early 1980s, have been targeted at developing a free market economy in Turkey, and have involved adopting a more outward-oriented export-led growth strategy. Significant progress has been recorded in the liberalisation of trade and investment policies and the pursuit of macro-economic stability and economic growth. This policy approach has increased the confidence of foreign investors and contributed to a substantial increase in FDI in the Turkish economy.

After 1980, steps were taken to replace the import substitution growth strategy with an outward-oriented export-led growth strategy. The new startegy is backed up by deregulation concerning exchange rates, interest rates, and product prices of state enterprises. In 1986, a new Foreign Direct Investment Department has been established for foreign investment permissions. There were; the removal of minimum export requirements, the introduction of %100 foreign ownership for all foreign investors in all sectors, more favorable tax legislation for foreign investment and an increased use of the build operate transfer program [47].

FDI inflow to Turkey increased at a very high rate, following the new legal arrangements sanctioned by the government. While foreign direct investments between 1954 and 1979 were realized at a cumulative total of US$228.1 million, 1986 proved to be the turning point, securing a higher level of investments than previously. The total inflow was US$170 million in 1986 and reached a peak level of US$3.288 billion in 2001 including the privatization revenues. After the peak level of 2001, FDI inflows to Turkey fell from US$3.288 billion in 2001 to US$1042 billion in 2002. Turkey's investment inflow increased steadily subsequent to the liberalization of the foreign investment regime. The increase in researh on the privatisation of state-owned enterprises, providing foreign investors opportunities to participate in such enterprises, and at lenght, by decreasing the formalities in dealing with foreign investment applications, were also vital factors that led to the increase in investment in Turkey. Since the mid-1980s, the FDI flows have been playing increasingly prominent role in the economy. The share of FDI in gross domestic investment (GDI) in Turkey over the period 1976-2002 increased significantly from a meagre 0.07% in 1976 and 0.23% in 1980 to 3.77% in 2000. This share with the privatization revenues increased 11.98% in 2001.This share fell from 11.98% in 2001 to 3.3% in 2002. Over the same period the share gross domestic investment in gross national product (GNP) showed little variation and it roughly remained stable around 22.8%. When the proportion of gross domestic investment in GNP is not too high and shows little variation, a sharp increase in FDI flows may have important effect on the national economy despite the fact that FDI is still a small proportion of gross domestic investment [6]. This increase in FDI in Turkey during the 1976-2002 period raises important research questions about the possible cause and effect relationship between FDI and growth in Turkey. As mentioned earlier, this paper focuses on the relationship between FDI and economic growth in Turkey.

IV. DATA AND METHODOLOGY

Our examination of the causal relationship between net FDI inflow and economic growth is based on annual time series data for the period 1976-2002. Net FDI is inflows in the Turkish economy less outflows from the Turkish economy of investments to acquire a lasting management interest in an enterprise operating within the economy. For testing purposes, all series are expressed in real terms using a GNP deflator (1987=100) and in logarithms. Examination of the individual data series make it clear that the logarithmic transformations were required to achieve stationarity in variance; therefore, all the data series were transformed to logarithmic form. The data sources are Central Bank, State Planing Organization and Undersecretariat of Treasury [48]. The rest of the section is devoted to the discussion of methodological issues

To make an empirical assessment of the link between FDI and economic growth, a three step procedure is adopted to investigate possible causal relationship between the two variable. In step 1, the stationarity properties of the data are examined to

determine the order of integration of the series. Step 2 tests for cointegration of the series identified as I(1) in step 1 using the Engle and Granger [49] residual based approach. Finally, step 3 carries out Granger-type causality tests augmented with the error-correction term derived from the appropriate cointegrating relationship.

Unit root tests. To provide a valid empirical evidence to the issue of FDI and economic growth or economic growth and FDI, it is important to address the time-series properties of FDI and economic growth because any empirical analysis from which valid inferences could be drawn must ensure that all series are of the same order of integration in order to avoid the problem of spurious relationships and erroneous conclusions. To avoid spurious relationships and misleading results with respect to the causal relationship between FDI and economic growth, this study employs the cointegration and error-correction models(see [50] and [51]).

This study begins by testing for unit root using (Augmented) Dickey-Fuller's(A)DF and Phillips and Perron's(PP) unit root test. To test the unit root property of the series X_t, we use the following regression equation:

$$\Delta X_t = a_0 + a_1 T + \beta X_{t-1} + \sum_{i=1}^{N} \theta_i \Delta X_{t-i} + \epsilon_t \qquad (1)$$

where Δ is the difference operator, T is the time trend, ϵ_t is a stationary random error and X_t is the series under consideration(either FDI or GNP). The constant and the trend term are retained only if significantly different from zero. i= 1,2,.....,N is the number of lag terms. The optimal number of lags, N, is determined by minimizing the Akaike Information Criterion (AIC). Unit root tests of this type are referred to as Augmented Dickey-Fuller(ADF). The difference between DF test and ADF test is that in the former, $\sum_{\theta i} = 0$.

A problem with the ADF test is that it involves the inclusion of extra differences terms in the testing equation. This result in a loss of degrees of freedom and a resultant reduction in the power of the testing procedure [52]. Alternatively, the Phillips-Perron approach allows for the presence of unknown forms of autocorrelation and conditional heteroscedasticity in the error term, and is based on testing regression(1), expect that N=0. In other words, one of the differences between the alternative unit root test by Phillips and Perron is the ADF test without lagged difference terms (see [52] and [53]). This method uses a nonparametric correction for serial correlation. The statistics are then transformed to remove the effects of serial correlation on the asymptotic distribution of the test statistics. For both tests, the null hypothesis is that X_t is a nonstationary series, and it is rejected when β is negative and significantly different from zero.

Cointegration tests. If the respective time series are difference stationary, I(1), then cointegration regressions can be undertaken to determine whether or not linear combinations of the series are stationary. Given the bivariate nature of our study, the Engle-Granger cointegration procedure is used next to test for the presence of cointegration between the two time series. If both time series are integrated of the same order then one can proceed with the estimation of the following cointegration regressions.

$$LRGNP_t = \alpha_1 + \beta_1 LRFDI_t + \eta_t \qquad (2)$$

$$LRFDI_t = \alpha_2 + \beta_2 LRGNP_t + \mu_t \qquad (3)$$

where LRGNP is the log of the real gross national product, LRFDI is the log of the real net foreign direct investment and η_t and μ_t are the residuals to be tested for stationarity. Granger [54] and Engle and Granger [49] have shown that if variables such as LRGNP and LRFDI are integrated of order one, $I(1)$, and η_t and μ_t are both $I(0)$, that is, if a long-run relationship exists between these two variables, then $LRGNP_t$ and $LRFDI_t$ are said to be cointegrated.

Causality test. Granger [55] points out that if there exists a cointegration between any two or more variables, there must be causality between these variables at least in one direction. Granger [54] and Engle and Granger [49] provide a test of causality that takes into account the imformation provided by the cointegrated proporties of the variables. The model can be expressed as an error correction model (ECM) as follows:

$$\Delta LRGNP_t = \alpha + \sum_{i=1}^{m} \beta_i \Delta LRGNP_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta LRFDI_{t-j} + \delta \eta_{t-1} + u_t \qquad (4)$$

$$\Delta LRFDI_t = a + \sum_{i=1}^{q} b_i \Delta LRFDI_{t-i} + \sum_{j=1}^{r} c_j \Delta LRGNP_{t-j} + d\mu_{t-1} + v_t \qquad (5)$$

here $\Delta LRGNP_t$ and $\Delta LFRDI_t$ are first-difference stationary and cointegrated with η_{t-1} and μ_{t-1} representing the lagged values of the error terms from the cointegrating regressions given by (2) and (3). The absence of this error correction term can cause a bias in the estimation. From Equation (4) the null hypothesis that $\Delta LRFDI_{t-j}$ does not Granger cause $\Delta LRGNP_t$ is rejected either if the

coefficients γ_j's are jointly significant, or if the coefficient on the error correction term is significant. If the coefficient δ is significant, then the null hypothesis of no long-run equilibrium relationship can be rejected. Likewise, from equation (5) the null hypothesis that $\Delta LRGNP_{t-j}$ does not Granger cause $\Delta LRFDI_t$ is rejected either if the coefficients c_j's are jointly significant, or if the coefficient on the error correction term is significant. If the coefficient d is significant, then the null hypothesis of no long-run equilibrium relationship can be rejected. The error-correction coefficients, δ and d, are expected to capture the adjustments of $\Delta LRGNP_t$ in Equation 4 and $\Delta LRFDI_t$ in Equation 5 towards long-run equilibrium, while $\Delta LRFDI_{t-j}$ in Equation 4 and $\Delta LRGNP_{t-j}$ in Equation 5 are expected to capture the short-run dynamics of the model.

As the Granger-causality tests are known to be very sensitive to the order of lags in the autoregressive process, some care must be taken when making this choice. An inadequate choice of the lag lenght would lead to inconsistent model estimates, so the inferences drawn from them would likely be misleading. In this study, we will identify the order of lags for each variable (m,n) and (q,r) by means of Hsiao's [56] sequential procedure. This procedure is based on the Granger's concept of causality and Akaike's minimum final prediction error (FPE) criterion,(see [54], [57], [58]) and avoids imposing often false or spurious restrictions on the model [59]. Hsiao [56] points out that "the FPE criterion balances the risk due to the bias when a lower order is selected and the risk due to the increase of variance when a higher order is selected, and choosing the order of the lags by minimum FPE is equivalent to applying an approximate F-test with varying significance levels". This method is superior to both arbitrary lag length selection and several other systematic procedures for determining lag lenght [60].

V. EMPIRICAL RESULTS

Unit root tests. At first, it is necessary to examine the stationary/nonstationarity property of time series data to determine the most appropriate econometric technique in order to avoid incorrect conclusions. To accomplish that, the two veriables (LRFDI and LRGNP) are tested using the (A)DF and PP procedures. The unit root test results in levels and first differences are reported in Table 1. A constant is included but no time trend in these tests. Given the critical importance of ensuring stationarity, a given variable is judged stationary only if it passes both the ADF and PP tests [61]. The results show that we could not reject the null hypothesis of unit roots for both variables in level forms. However, the null hypothesis was rejected when the ADF and PP tests were applied to the first differences of each variable. Based on the results from ADF and PP unit root tests, it is concluded that all the data series are integrated of order one, (or I(1)). We can thus conclude that the standard regression model is not appropriate in exemining the causal relationship between LRFDI and LRGNP. Instead, we have to use the cointegration techniques to uncover the relationships.

Table.1. Results of Unit Root Tests

Variables	DF/ADF	PP
A.Levels		
LRGNP	-0.5505(1)	-0.5397
LRFDI	-2.3161(0)	-2.5279
B.First Differences		
ΔLRGNP	-6.0891(0)***	-6.0746***
ΔLRFDI	-7.8926(0)***	-9.0915***

*Note: ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively. MacKinnon critical values for rejection of hypothesis of unit root at significance of 1%, 5% and 10% are –3.72, –2.98 and –2.63, respectively. The optimal lag length for the ADF test are chosen on the basis of the AIC and are reported in brackets.*

Cointegration test. Given the respective LRGNP and LRFDI variables are integrated of the same order, we proceed to test for cointegration using the engle-Granger bivariate methodology. Equations 2 and 3 were estimated by ordinary least squares and the respective residuals were tested for stationarity via DF/ADF unit root tests given by equation 1 exluding the constant term. Banerjee et al. [62] point out that cointegration tests of this type either include a constant in the cointegrating regression model, or include a constant in the DF/ADF test model, and both strategies are equivalent [62]. To eliminate any autocorrelation in the residuals ϵ_t, the same lag selection criteria as employed in Section 4 have been applied to choose N.

The long-run cointegrating relationships given by the theoretical models(Equation 2 and 3) are estimated in linear form by the OLS method and are presented in table 2. The DF/ADF and the PP unit root tests were applied on the residuals from this long-run regression in order to examine whether or not the residual series is stationary. The results from both tests suggest that the residuals are strongly stationary. The null hypotheses of no cointegration between LRGNP and LRFDI, and LRFDI and LRGNP are rejected at 5% and 1% levels of significance respectively. Based on this result, we can conclude that the LRGNP and LRFDI variable are strongly cointegrated.

Table.2. Results of Cointegrating Equations (The Engle-Granger Method)

Dependent Variable	Independent Variable	ADF	PP	DW	Adj. R^2
LRGNP	LRFDI	-3.39[b]	-3.41[b]	1.11	0.79
LRFDI	LRGNP	-4.43[a]	-4.43[a]	1.29	0.79

Notes: The Engle-Yoo critical values for cointegration tests are -4.07, -3.37 and -3.03 for 1%, 5% and 10% respectively. a, b and c imply that the statistics are significant at the 1%, 5% and 10%, respectively.

Causality tests results. Engle and Granger [41] show that if nonstationary variables are cointegrated, then a vector autoregression(VAR) in the first differences is misspecified. Since a cointegration relationship is found among LRGNP and LRFDI, en error correction model(ECM) is used (as inticated in Equations 4 and 5) to test for intertemporal causality between these veriables. The empirical results of the estimated error correction models are presented in Table 3. The results show that bi-directional causality exists between foreign direct investment and economic growth. This is based on the statistical significance of the coefficients of the error correction terms.

The results of this Granger causality test presented in Table 3 provide evidence on long-run impact from foreign direct investment to economic growth as well as from economic growth to foreign direct investment. Thus, feedback hypothesis appears to be supported. In addition, this paper finds that the coefficients of the ECT in model are negative. This suggests that the ECT acts as a force which causes the integrated variables to return to their long run relation when they deviate from it. Thus, the larger the deviation, the greater the force tending to correct the deviation.

As reported in Table.4, a number of conventional diagnostic test statistics indicate the robustness of the adopted models: all two equations pass the Jarque-Bera test of non-normality, LM residual correlation test and ARCH heteroscedasticity test. Ramsey RESET misspecification tests suggest that the models have no misspecification problems. Thus, the specification of our model is an adequate representation of the data.

VI. CONCLUSION

This paper investigated the causal relationship between net FDI flows and economic growth for Turkey using annual data for the period 1976-2002. We applied the(Augmented) Dickey-Fuller and Phillips-Perron tests to examine for the non-stationarity of data. Both tests indicate that the real FDI and the real GNP are non-stationary in their levels but stationary in their first differences. The study then applied the Engle-Granger bivariate cointegration approach in order to test several hypothesis concerning the causal relationship between FDI and GNP. Engle-Granger cointegration test results indicate that FDI flows and GNP are cointegrated and that the relationship between both variables is positive and statistically significant. The results from Granger causality tests based on error-correction models suggest a feedback exists between FDI flows and GNP growth, supporting the feedback hypothesis for Turkey over this sample period.

In sum, the causality between the two veriables runs in both directions: FDI has been attracted by the GNP growth, and has at the same time contributed to GNP growth through various channels, such as technology transfer, enhancing capital formation, positive effect on total factor productivity, export promotion, the establishment of foreign funded enterprises, positive spillover effects to domestic enterprises, creating employment opportunities and competition and demonstration effects.

Table.3. Causality Tests Based On Error Correction Terms

	Independent variables			
Dependent Variable	ΔLRFDI	ΔLRGNP	Coefficient of ECT	Causal inference
ΔLRFDI	-----	0.023 (0.878)	-0.516[a] (0.026)	GNP→FDI
ΔLRGNP	1.761 (0.198)	------	-0.188[a] (0.032)	FDI→GNP

Note: Numbers in parentheses are p values. a denotes significance at 5% level. The symbol → represents unidirectional causality in the long run. The lag length was determined by using the Akaike final prediction error criterion(FPE). In no case were more than one lag used.

Table.4. Diagnostic Test Results

Equation	J-B	LM(1)	ARCH	Ramsey
LRFDI	2.109 (0.35)	0.008 (0.93)	0.062 (0.81)	0.142 (0.71)
LRGNP	0.921 (0.63)	0.048 (0.82)	0.166 (0.68)	0.732 (0.40)

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