# The relationship between perceived corruption and FDI: a longitudinal study in the context of Egypt*

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## Abstract

This paper investigates the dynamic relationship between perceived corruption and foreign direct investment (FDI) in Egypt during the period 1970–2019. Using a novel back-casting methodology, it extrapolates perceived corruption time series between 1970 and 1980. The results of the Johansen cointegration technique and the multivariate vector error correction model show a positive relationship between perceived corruption and FDI, supporting the "greasing the wheels" effect of corruption. This positive association can be explained by several factors, such as the cross-interdependence of rent-generating assets with perceived corruption and FDI, and the use of FDI data based on the balance of payments that has growing financial-flows and phantom-FDI components. The findings of this paper have important policy implications. Improving the fundamental governance structure in Egypt should be accompanied by a comprehensive investment facilitation strategy to compensate for the removal of "grease" from the "wheels".

**Keywords:** perceived corruption, FDI, VECM, back-casting, Egypt

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## 1. Introduction

Since the 1980s, the globalization of foreign capital, particularly foreign direct investment (FDI) inflows, has increased significantly in developing countries (UNCTAD, 2020). Over the last 50 years, FDI has dominated economic literature and policymaking circles and has been widely identified as a growth-enhancing factor. Its effects range from influencing production, employment, income, prices, exports, imports and the balance of payments to affecting the economic growth and general welfare of the host countries. Many factors can affect FDI inflows in developing countries. One factor identified as important in determining FDI location choice is the level of rent-seeking and/or corruption in the host economy.

Egypt is a developing economy characterized by low per capita income, low levels of savings, high levels of unemployment, inefficient financial intermediation and high external debt. Like many developing countries, Egypt also suffers from weak public corporate governance, the lack of a well-structured public sector and perceived corruption, which are regarded as crowding out the development of private investment (Pfeifer, 2012).

Between 1974 and 1985, economic growth in Egypt reached an average rate of 8 per cent a year. This was encouraged by a series of windfall rents: high oil prices, Israel returning the Sinai oil fields, the reopening of the Suez Canal and remittances from Egyptian workers in Arab countries. In 1991, the Economic Reform and Structural Adjustment Programme (ERSAP) started in order to address the economic imbalances and to revive economic growth, aiming to reach 7 per cent by 2000. The ERSAP placed special emphasis on the key role of FDI in generating economic growth. Over the 1990s, FDI inflows represented only 1 per cent of gross domestic product (GDP), while domestic investment reached 20 per cent of GDP. The relative decrease of FDI inflows to Egypt during the first half of the decade can be explained by the Gulf War crisis, macroeconomic imbalances and a fall in windfall rents and, hence, economic growth from 7.4 per cent in 1983 to 5.7 per cent in 1990 (table 1).

From 2004 to 2008, FDI inflows to Egypt increased, reaching a peak of 9 per cent of GDP in 2006. This outstanding performance was attributed to the success of the economic reform programme, the enactment of aggressive market reform policies by a newly appointed cabinet of reformists, a decreasing inflation rate, stable exchange and interest rates, and an accelerated privatization process (Pfeifer, 2012). However, the process of privatizing non-competitive industries (that is, of rent-generating sectors) was characterized during 2004–2010 by a prevalence of rent-seeking opportunities (King, 2010).

In 2008, the financial crisis hit the global economy and FDI inflows to Egypt started to slow down, reversing the surge of the preceding four years. The full impact of the crisis was felt in 2009 as global FDI went down by 37 per cent (El-Shal, 2012).

**Table 1. Macroeconomic statistics: Egypt (1970–2019)**

| Period/ Series | 1970–1979 | 1980–1989 | 1990–1999 | 2000–2009 | 2010–2019 |
|---|---|---|---|---|---|
| FDI, net inflows (current million US$ million) | 171 | 860 | 805 | 4 799 | 6 039 |
| FDI, net inflows (% GDP) | 1.1 | 2.6 | 1.2 | 3.8 | 2.1 |
| Real GDP growth (%) | 6 | 6 | 4 | 5 | 4 |
| GDP per capita (constant 2015 US$) | 910 | 1 402 | 1 707 | 3 217 | 3 483 |
| Gross domestic savings (% GDP) | 12 | 16 | 14 | 15 | 14 |
| Gross capital formation (% GDP) | 19 | 28 | 20 | 19 | 18 |
| Trade (% GDP) | 50 | 58 | 50 | 54 | 48 |

*Source:* UNCTAD data.

FDI in Egypt dropped less sharply, though still by 30 per cent. In 2011, the political uncertainty, unprecedented security challenges and widespread labour protests that accompanied the January 25th Revolution exacerbated the trend of FDI. FDI inflows to Egypt were negative $483 million at the end of 2011; however, they turned positive in 2012, to reach about $3 billion by the end of the year.

Over the period 2010–2019, Egypt has made considerable progress in liberalizing its business environment and attracting FDI inflows, to reach $6 billion (see table 1). However, the country still suffers from excessive bureaucracy, corruption, and unstable political and macroeconomic conditions (Springborg, 2017; El-Mikawy and Handoussa, 2001). According to the World Bank's 2019 Ease of Doing Business report, the relative ranking of Egypt as a recipient of FDI deteriorated somewhat during the period, from 110 of 190 countries in 2010 to 114 in 2019. Perceived corruption is often cited by investors as the main impediment to further investment reforms (IMF, 2018). According to the widely used and authoritative Corruption Perception Index of Transparency International, Egypt was positioned in the middle quintile globally in 2019, notwithstanding a somewhat more unfavourable score than in previous periods. Similarly, Egypt's rank in the index is at the midpoint among North African countries, as well as within the Middle East and North Africa region. Notwithstanding that legislation since the 1970s has aimed to encourage private investment, the predominance of the public sector and the growing partnerships between the government and the private sector gave rise to rent-seeking opportunities and, hence, corruption (Bromley and Bush, 1994).

The determinants and the impact of institutional distortions and perceived corruption on FDI in Egypt have not yet been investigated. This type of country-level study is crucial to introducing efficient policies to attract FDI. This paper contributes to the literature by providing fresh evidence on the effect of perceived corruption on FDI using time series data. Past studies on country-level FDI have inconclusive results about effects that arise from social and institutional factors – factors that are included in this study. Most notably, this is the first study to use a back-casting technique to provide historical annual estimates. The back-casting methodology extrapolates recent perceived corruption data into the past based on its historical relationship with data on democracy, to overcome the shortage in perceived corruption estimates. Along with the academic contributions, the findings of this paper provide a source of relevant and reliable information for both investors and policymakers.

After briefly providing background information on the relevant socioeconomic policy in Egypt, section 2 reviews the literature on FDI and perceived corruption. Sections 3 to 5 explain the model specifications, the methodology and the data, respectively. Section 6 reports and analyses the main results. The final section draws conclusions and sets out the policy implications.

## 2. Perceived corruption and FDI determinants: a literature review

Political determinants of FDI mainly include political stability, risk of expropriation and corruption in host countries. Some countries may consider FDI and dependence on foreign countries as a threat to their sovereignty. In such cases, their political orientation affects FDI inflows (Habib and Zurawicki, 2001). Empirical studies on the political determinants of FDI have increased over recent years but they remain less investigated than economic determinants, as the former are harder to statistically measure – especially in developing countries.

The empirical studies assessing the impact of corruption on FDI are inconclusive as to whether corruption hinders or enhances FDI. However, there is a fair amount of theoretical research looking at the relationship between FDI and perceived corruption. From a theoretical perspective, perceived corruption may act either as a “grabbing hand” or as a “helping hand” for FDI inflows (Jain, 2001; Aidt, 2003). The grabbing hand image of the State is proposed and developed by Murphy et al. (1993). Corruption can increase the cost of doing business to the point of making it unprofitable, which reduces FDI. Corruption in that sense falls within the broader negative effects of being a rent-seeking activity that increases transaction costs in the economy. Such costs may be spent instead of on collecting information on partners and market conditions. In addition to transaction costs, corruption entails much higher costs in the form of distortions to the aggregate economy created by corrupt officials to generate payoffs. Distortions to the economy may take the form of inefficient privatization and government contracts, delaying production, giving licences to low-quality goods and services, and illegal activities. In addition, corruption may lead to the distribution of a large share of a country’s wealth to corrupt officials in the form of inflated contract prices. Such high costs should be collected later through raising taxes and cutting spending (Rose-Ackerman and Palifka, 2016).

Furthermore, corruption sways capital inflows towards bank loans and portfolio investment at the expense of FDI (Mauro, 1995). Two possible reasons explain this finding. First, local officials in countries with a higher prevalence of corruption may have a greater tendency than foreign bank lenders to exploit and manipulate international investors to pay bribes so as not to create obstacles. Second, foreign bank lenders have a greater level of protection for their loans through international institutions than international investors who face the possibility of having their investment extorted or nationalized by a country without good governance. This makes a country more vulnerable to currency crisis as bank loans and other portfolio flows can be withdrawn with ease if there are signs of economic problems (Wei and Wu, 2002). Corruption may also have an indirect impact on FDI by deterring domestic investment. Mauro (1995) and Pellegrini and Gerlagh (2004) found evidence that perceived corruption affects the economic activity of a country by lowering investment.

Yet, corruption can also act as a “helping hand” to foster FDI inflows. If corruption substitutes for poor governance, it can lead to economic expansion (Houston, 2007). This argument is based on the efficient grease hypothesis. Through “greasing the wheels” of economic activity, corruption may overcome the obstacles that bureaucracy tends to create. Although most of the studies pinpoint the negative effects of corruption, some studies have proved the validity of the hypothesis (Sadig, 2009). Such studies do not call for retaining corruption but rather strengthening the legal and institutional frameworks of the countries in question.

The literature abounds with numerous studies assessing the determinants of FDI in general, yet empirical research on the relationship between FDI and corruption is relatively limited as data on perceived corruption have been available for only a short time. The empirical literature also tends to focus on cross-country rather than intercountry perceived corruption. Several empirical studies have found a negative relationship between perceived corruption and FDI inflows (Busse and Hefeker, 2007; Asiedu, 2006; Mathur and Singh, 2013). Tosun et al. (2014) report that perceived corruption has a distortive effect on FDI in Turkey for both short- and long-run periods which indicates that “helping hand” perceived corruption does not exist in Turkey. A cross-sectional study in this regard, conducted by Sadig (2009), finds a negative relationship between perceived corruption and FDI in 117 countries. In addition, Habib and Zurawicki (2001) analyse the effect of perceived corruption on FDI in 111 countries and find that the negative effect of perceived corruption on FDI is more significant than its impact on domestic investment. Furthermore, the degree of international openness and political stability of the host country moderated the influence of perceived corruption. Abed and Davoodi (2000) focused on the role of perceived corruption in explaining key measures of economic performance in the transition economies and find that perceived corruption is negatively related to FDI.

In contrast, the second group of studies proposes that perceived corruption could have a positive impact in an economy suffering from a weak level of protection and property rights. There is a point of view that perceived corruption can benefit multinational corporations (MNC) operations in some situations (Zhou, 2007). Some economists show a useful side of perceived corruption, arguing that perceived corruption is the much-needed grease for the squeaking wheel of a rigid administration (Kardesler and Yetkiner, 2009; Jensen et al., 2010; Helmy, 2013).

Egger and Winner (2005) find a positive relationship between perceived corruption and FDI in a sample of 73 developed and developing countries over the period 1995–1999. Their result suggests that administrative controls and bureaucratic discretion are used to allow government officials to share in the profits from FDI. Later, however, Egger and Winner (2006) consider a longer period (1983–1999) and find that the negative impact of perceived corruption on FDI outweighs its positive impact. The empirical work by Bellos and Subasat (2012) suggests that perceived corruption has not deterred, but rather encouraged MNCs to enter selected transition countries over the period 1990–2003.[1]

Contrary to these findings, some studies find either an insignificant or an inclusive relationship between FDI and perceived corruption. Wheeler and Mody's (1992) study of United States firms finds a negative relationship between FDI and the risk factor of the host country, concluding that perceived corruption and all types of judicial and bureaucratic impediments were insignificant. Sadig (2009), Hakkalar et al. (2005) and Dreher and Herzfeld (2005) assert that the evidence on the effect of perceived corruption on FDI is inconclusive depending upon other variables.

## 3. Model specification

In order to examine the effects of perceived corruption on FDI inflows in Egypt, the paper draws from the following model by Li and Liu (2005):

$$FDI_{it}=a_o+a_1\, g_{it}+a_2\, \ln y_{it}+a_3\, SCH_{i,65}+a_4\, Trade_{it}+AX_{it}+\varepsilon \quad (1)$$

where $FDI$ is FDI inflows as a percentage of GDP, $g$ is the per capita GDP growth rate, $\ln y$ is the market size measured by log of real GDP, $SCH_{65}$ is the level of secondary school attainment in 1965 as a proxy for human capital, $Trade$ is the ratio of total trade to GDP, and $AX_{it}$ is a vector of macroeconomic variables such as infrastructure, as proxied by mobile cellular subscriptions per 100 people, and inflation, as proxied by percentage changes in consumer prices.

To investigate the effects of perceived corruption on FDI in Egypt, perceived corruption ($cor_t$) is added to equation (1). Furthermore, $SCH_{65}$ cannot be used for time series as it is a constant figure, which creates multicollinearity. Instead, secondary school enrolment as a percentage of gross enrolment ($hk_t$) is used to proxy for human capital in Egypt.[1] The ratio of domestic investment to GDP ($inv_t$) is another economic determinant of FDI inflows that is highlighted by some empirical studies (e.g., Sader, 1993, Ndikumana and Verick, 2008). The ratio of domestic investment to GDP is used as an indicator of the general investment climate in Egypt. Adding these three variables to the Li and Liu (2005) model and estimating the model over a period of 50 years (1970–2019) yields the following equation:

$$fdi_t=a_0+a_1\,cor_t+a_2\,g_t+a_3 y_t+a_4\,hk_t+a_5\,trade_t+a_6\,inv_t+a_7\,X_t+\varepsilon \qquad (2)$$

In Egypt, FDI is concentrated in the oil and gas industry, which receives about two thirds of total investment (UNCTAD, 2020), followed by construction, manufacturing, real estate and financial services. Hence, in order to assure a reliable result, the model in equation (2) for non-oil FDI inflows is re-estimated, as follows:

$$\text{non-oil } fdi_t=a_0+a_1\,cor_t+a_2\,g_t+a_3\,y_t+a_4 hk_t+a_5\,trade_t+a_6\,inv_t+a_7\,X_t+\varepsilon \qquad (3)$$

with

$$a_1 \lesseqgtr;\ a_2 \lesseqgtr 0;\ a_3 > 0;\ +a_4 > 0\ \ \mathit{or}\ < 0;\ a_5 < 0;\ a_6 > 0 > a_7 > 0$$

The dependent variable is $fdi_t$ and non-oil $fdi_t$ – the amount of non-oil FDI inflows[2] in United States dollars received by Egypt at time $t$.

## 4. Empirical methodology

The empirical literature use either cross-sectional or panel data, which might suffer from problems of data comparability and heterogeneity (Tang et al., 2008). This paper uses pure time series data to overcome these problems. The time series approaches deal with the specificity of an individual country and offer an opportunity to show and analyse the causality pattern between variables. To this end, the investigation follows several steps. It begins by testing stationarity.

[1] Two other measures of human capital (literacy ratio and total enrolment of secondary schools) have been used and yielded the same results. The model specification uses $hk_t$ with only 6 missing observations out of 50 observations, as literacy ratio and total net enrolment of secondary schools have 18 and 10 missing ones, respectively.

[2] Most of the empirical literature on FDI uses inflows rather than stock. An attempt to estimate the model for FDI stock was carried out; however, the results yielded more diagnostic problems than using FDI inflows.

First, the Augmented Dickey-Fuller (ADF) (1981) unit root test and the Phillips-Perron (PP) test (1988) are employed to identify whether the variables contain a unit root and to confirm the stationarity of each variable. As discussed earlier, the Egyptian economy has been subject to major economic policy orientation and political change during the period of this study. In this case, the common ADF and PP unit root tests could not provide reliable results reflecting such structural breaks. To overcome this, many economists insist on the necessity of including a breakpoint that can be determined from the data. In this paper the Zivot and Andrews (1992) unit root test[3] is used as it that allows for endogenous structural breaks, which is important since it prevents a data-dependent arbitrary choice of the break point. The test allows for a one-time structural break in the slope of the trend function.

Second, a cointegration technique developed by Johansen and Juselius (1990) is used for the sake of testing a long-run cointegration relationship between FDI and perceived corruption, as well as other variables defined in equations (2) and (3). A vector error correction (VEC) model is used to uncover the short-run and long-run causality in the relationship in the final step of our estimation, given the evidence of cointegration in the long-run relationship. Equations (2) and (3) are also re-estimated, using an autoregressive-distributed lag (ARDL) model and Stock-Watson dynamic OLS (DOLS) as robustness checks.

## 5. Data

This paper is based on annual time series data over a period of 50 years from 1970 to 2019. Data sources and descriptions appear in table A.1.

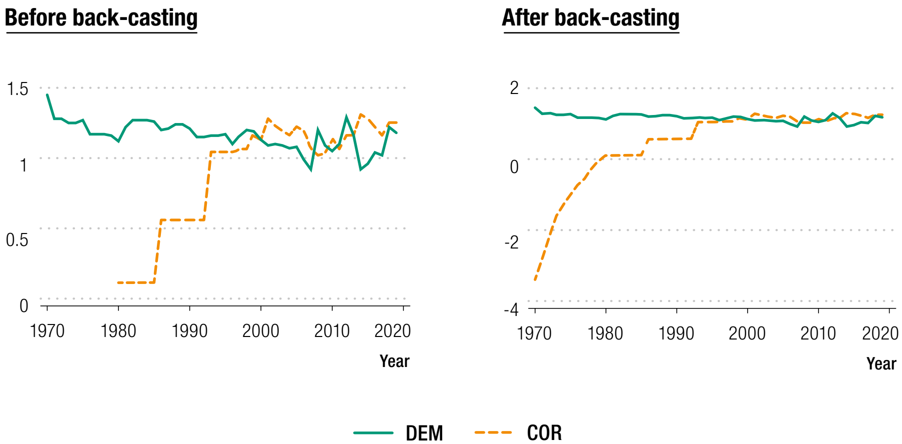
There is no consensus in the literature on the measurement of corruption (Habib and Zurawicki, 2001). Objective measures are hardly available because of the difficulties in quantifying corruption-related activities, but subjective or perception-based measures represent an acceptable alternative. Transparency International, Political Risk Services and the World Economic Forum measure the perception of corruption by relying on questionnaire-based surveys. Interestingly, the three indices are highly correlated (Tanzi, 1998). In this paper, the perceived corruption measure collected by Transparency International is used with annual back runs to 1980.

[3] The null hypothesis of a unit root test is that the model has a unit root with a break, as a dummy variable is incorporated in the regression under the null. The alternative hypothesis is a broken trend stationary process.

*Back-casting perceived corruption.* Following Transparency International, backward extrapolation (back-casting) of the unavailable corruption (COR) data is done from 1970 to 1980 using the Democracy Index (DEM) from the Quality of Government Institute[4] and the Economist Intelligence Unit,[5] with annual back runs to 1946. The back-casting methodology is designed to provide historical annual estimates that are consistent over time. This methodology preserves the broad patterns observed in the published COR estimates.

Figure 1 shows that both COR and DEM are highly correlated (66.8 per cent) over the period 1980–2019. Therefore, DEM is used to predict the perceived corruption index values over the period 1970–1980. The COR values from 1970 to 1980 are estimated by extrapolating and back-casting COR-based estimates from the DEM (the benchmark). Clear documentation on how DEM is used to predict COR prior to 1980 is provided in appendix C.[6]

## Figure 1. Correlation, perceived corruption and democracy




*Source:* Author's estimations.

[4] The Quality of Government Institute is an independent research institute at the University of Gothenburg, Sweden.

[5] The Economist Intelligence Unit is a business within the Economist Group providing forecasting and advisory services through research and analysis, such as monthly country reports, five-year country economic forecasts, country risk service reports and industry reports.

[6] An attempt to estimate the models in equations (2) and (3) with Corruption Perception Index data from 1980 to 2019 is carried out; however, the results yielded more diagnostic problems than with back-casted data from 1970 to 2019.

# 6. Empirical results

## 6.1 Unit root tests and integration order

Table 2 reports the results of the Augmented Dickey-Fuller (ADF) as well as the Phillips-Perron (PP) tests for various specifications. The results reveal that the order of integration is not the same for all variables.

**Table 2. ADF and PP test results**

| Variable | $\tau_\mu$ | | $\tau_T$ | |
|---|---|---|---|---|
| | ADF | PP | ADF | PP |
| **Level** | | | | |
| fdi | -2.740* | -2.354 | -2.725 | -2.725 |
| non-oil fdi | -3.534*** | -3.592** | -3.291* | -3.275* |
| cor | -1.165 | -1.159 | -2.066 | -2.021 |
| g | -3.621*** | -3.621*** | -3.814*** | -3.814*** |
| y | -0.492 | -0.118 | -3.071 | -2.234 |
| hk | -1.836 | -1.836 | -1.941 | -1.940 |
| trade | -2.284 | -2.489 | -2.352 | -2.364 |
| inv | -1.851 | -1.972 | -2.931 | -2.123 |
| infra | 2.639 | 0.960 | 2.527 | -0.570 |
| inflation | -2.056 | -2.547 | -2.214 | -2.878 |
| **1st Difference** | | | | |
| fdi | -4.189*** | -8.238*** | -4.211*** | -8.243*** |
| non-oil fdi | -3.092** | -3.497** | -2.952** | -3.333** |
| cor | -7.966*** | -4.125*** | -7.937*** | -4.890*** |
| g | -7.615*** | -10.675*** | -7.554*** | -11.826*** |
| y | -4.026*** | -3.478** | -3.812** | -3.381* |
| hk | -5.565*** | -4.913*** | -6.187*** | -6.662*** |
| trade | -5.769*** | -5.769*** | -5.877*** | -5.877*** |
| inv | -5.374*** | -5.272*** | -5.626*** | -5.648*** |
| infra | -4.615*** | 16.073*** | -4.104** | 5.591*** |
| inflation | -10.902*** | -11.481*** | -10.868*** | -11.115*** |

*Note:* ADF = Augmented Dickey-Fuller unit root test, PP = Phillips-Perron test. $\tau_\mu$ represents the model with an intercept and without trend; $\tau_T$ is the model with a drift and trend. *, ** and *** denote rejection of the null hypothesis at the 10 per cent, 5 per cent and 1 per cent levels, respectively.

**Table 3. Zivot-Andrews structural break unit root test**

| Variable | T-statistic | Time break |
|---|---|---|
| fdi | -4.224 (2) | 1979 |
| non-oil fdi | -3.088 (0) | 2008 |
| cor | -4.153 (0) | 2000 |
| g | -4.425 (2) | 1995 |
| y | -3.780 (1) | 2003 |
| hk | -3.179 (2) | 1991 |
| trade | -3.362 (1) | 1978 |
| inv | -4.326 (0) | 1979 |
| infra | -3.277 (1) | 1988 |
| inflation | -2.384 (1) | 2006 |

*Note:* Critical values for rejection of the null hypothesis of a unit root with a structural break.

Macroeconomic variables, such as perceived corruption, might be trended – that is non-stationary – and exhibit unit roots over time. Perceived corruption in Egypt appears to be independent of time for the whole life of the series. Consequently, perceived corruption in Egypt is expected to exhibit a non-stationary trend. At first differences, the ADF and the PP test statistics exceed their corresponding critical values for all variables. Consequently, the null hypothesis of the unit root in the first differences of all variables is rejected. This result implies that those variables are stationary in first differences.

The results of the Zivot-Andrews unit root test are reported in table 3. The Zivot-Andrews test with one structural break finds no additional evidence against the unit root null hypothesis relative to the unit root tests without a structural break. In other words, the null hypothesis is not rejected for the variables. This result is consistent with the ADF and PP test results. Overall, the results show that all of the series have the same level of integration, i.e. I (1). As stationarity in series is not achieved and our variables are integrated with the same order I (1), the results from the unit root tests facilitated proceeding to the Johansen cointegration test and VEC model rather than a vector autoregressive (VAR) model.

## 6.2 Cointegration and long-run relationship

Table 4 reports the results of the lag-length selection criteria in the levels of all variables. We usually rely on the Schwarz Criterion (SC) with lag order one, which is more stable. The SC allows for losing less observations. Table 5 reports the Johansen cointegration test results, which reveal that there exists only one cointegrating vector, i.e. that there is a long-run cointegrating relationship among variables. The estimated model is reported in tables 6 and 7, normalized on $\mathrm{fdi}$ and $\mathrm{non\text{-}oil\ fdi}$, respectively.

The results in tables 6 and 7 are consistent with Helmy (2013) and the efficient grease hypothesis, discussed earlier, in the sense that a high level of perceived corruption is associated with a higher level of FDI and non-oil FDI inflows in the long run. The results are also consistent with Houston (2007), Zhou (2007), and Kardesler and Yetkiner (2009), who suggest that particularly in relatively less democratic and less developed countries a rise in FDI inflows is associated with a higher level of perceived corruption. They argue that in such countries, foreign and domestic firms compete to pay bribes to get business contracts. If foreign firms have the flexibility to adjust the local investment environment and get business contracts, the host governments may have weak incentives to eradicate perceived corruption. Therefore, foreign firms can magnify perceived corruption problems.

The results also reveal that economic growth, the market size of Egypt (proxied by y), human capital, domestic investment and infrastructure have statistically significant and positive impacts on FDI and non-oil FDI inflows in the long run. Inflation is significant and negatively affects FDI. The market size of the recipient country is crucial, as the target economies can provide greater economies of scale and spillover effects. Market-oriented FDI establishes or facilitates enterprises that can supply goods and services to local markets (Kinoshita and Campos, 2008; Li and Liu, 2005; Brada et al., 2006; Jabri and Brahim, 2015; Mottaleb and Kalirajan, 2010). Human capital is positively and significantly associated with inward FDI, reflecting that the country's human capital indicators compare very favourably, particularly for a developing country with less achievement in other facets. Egypt has a high rating in the human capital index in terms of literacy rate and schooling rates (Duma, 2007; World Bank, 2011). FDI apparently complements existing domestic investment in Egypt and incentivizes domestic investors to shift their production towards a capital-intensive mode.

The existence of adequate physical infrastructure positively and significantly affects inward FDI performance. Infrastructure in Egypt has experienced a remarkable improvement over the last five decades, which helped to increase FDI inflows. As expected, inflation as a proxy for macroeconomic stability is negatively related to FDI inflows.

## Table 4. VAR lag-length selection criteria

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| 0 | -1191.733 | NA | 54900000 | 57.17775 | 57.55011 | 57.31424 |
| 1 | -802.9634 | 592.4106 | 25777896 | 42.52207 | 46.24564* | 43.88690 |
| 2 | -714.5680 | 96.81401 | 31470772 | 42.16990 | 49.24470 | 44.76310 |
| 3 | -518.0202 | 131.0318* | 815597.6* | 36.66763* | 47.09365 | 40.48918* |

*Note:* * indicates lag order selected by criterion. LR = sequential modified likelihood ratio, FPE = final prediction error, AIC = Akaike information criterion, SC = Schwarz criterion, and HQ = Hannan-Quinn information criterion.

## Table 5. Johansen cointegration tests

| Null | Alternative | Statistic | 95 per cent C.V. | Eigenvalue |
|---|---|---|---|---|
| **Part A: LR test based on maximal Eigenvalue of the stochastic matrix ($\lambda_{max}$)** | | | | |
| r = 0 | r = 1 | 229.644* | 197.371 | 0.821 |
| r ≤ 1 | r = 2 | 155.454 | 159.531 | 0.636 |
| r ≤ 2 | r = 3 | 111.966 | 125.615 | 0.531 |
| r ≤ 3 | r = 4 | 79.445 | 95.754 | 0.438 |
| r ≤ 4 | r = 5 | 54.632 | 69.819 | 0.407 |
| r ≤ 5 | r = 6 | 32.162 | 47.856 | 0.333 |
| r ≤ 6 | r = 7 | 14.727 | 29.797 | 0.171 |
| r ≤ 7 | r = 8 | 6.685 | 15.495 | 0.115 |
| r ≤ 8 | r = 9 | 1.438 | 3.841 | 0.033 |
| **Part B: LR test based on trace of the stochastic matrix ($\lambda_{trace}$)** | | | | |
| r = 0 | r ≥ 1 | 73.933* | 58.434 | 0.821 |
| r ≤ 1 | r ≥ 2 | 43.488 | 52.363 | 0.636 |
| r ≤ 2 | r ≥ 3 | 32.521 | 46.231 | 0.531 |
| r ≤ 3 | r ≥ 4 | 24.813 | 40.078 | 0.438 |
| r ≤ 4 | r ≥ 5 | 22.471 | 33.877 | 0.407 |
| r ≤ 5 | r ≥ 6 | 17.435 | 27.584 | 0.333 |
| r ≤ 6 | r ≥ 7 | 8.042 | 21.132 | 0.171 |
| r ≤ 7 | r = 8 | 5.247 | 14.265 | 0.115 |
| r ≤ 8 | r = 9 | 1.438 | 3.841 | 0.033 |

*Note:* * indicates rejection of the null hypothesis at the 5 per cent level. $H_0$, and $H_1$ are the null and alternative hypotheses, respectively. C.V. is the critical values of the $\lambda_{max}$ and $\lambda_{trace}$ at the 5 per cent level.

**Table 6. Normalized cointegrating vector, coefficients normalized on fdi**

| fdi | cor | g | y | hk | trade | inv | infra | inflation |
|---|---|---|---|---|---|---|---|---|
| -1.000 | 3.371 | 0.679 | 8.084 | 0.711 | -0.027 | 0.107 | 0.608 | -0.353 |
| | (1.332)** | (0.170)*** | (3.545)** | (0.092)*** | (0.046) | (0.121) | (0.221)** | (0.093)*** |

*Note:* Standard error in parentheses. *, ** and *** denote rejection of the null hypothesis at the 10 per cent, 5 per cent and 1 per cent levels, respectively.

**Table 7. Normalized cointegrating vector, coefficients normalized on non-oil fdi**

| non-oil fdi | cor | g | y | hk | trade | inv | infra | inflation |
|---|---|---|---|---|---|---|---|---|
| -1.000 | 13.817 | 1.012 | -0. 571 | 1.696 | -0.248 | 1.324 | 2.287 | -2.000 |
| | (5.793)** | (0.741)* | (15.413) | (0.402)*** | (0.201) | (0.526)** | (0.959)** | (0.404)*** |

*Note:* Standard error in parentheses. *, ** and *** denote rejection of the null hypothesis at the 10 per cent, 5 per cent and 1 per cent levels, respectively.

In appendix B, further experiments are added to the cointegration modelling. These experiments provide comparisons and robustness checks to the main model as well as improving its degrees of freedom. Fortunately, the information on causation is embodied in the VEC model. Thus, the VEC model for equations (2) and (3) is estimated, after determining the optimal number of lags, the suitable mode for testing the models and the number of cointegrating vectors the model should have.

### 6.3 Vector error correction model

The VEC model is applied in tables 8 and 9 with one lag, a deterministic intercept and no trend. The results in tables 8 and 9 are consistent with the results in tables 6 and 7 in the sense that a higher level of perceived corruption is associated with a higher level of FDI inflows in the short run as in the long run for both FDI inflows and non-oil FDI inflows.

In tables 8 and 9, we can see the existence of a long-term equilibrium connection between FDI in Egypt and all the control variables. The empirical results of the estimated VEC model indicate the significance of the error correction term ($ECT_1$), which assures the long-run relationship. From both tables, the value of the $ECT_1$ coefficient indicates that the adjustment speed is slow in the case of Egypt. The deviation between current FDI and the long-run relationship will be corrected by about 30 per cent in the following year. In other words, adjustment to the long-run relationship takes a relatively long time in Egypt.

## Table 8. VECM, dependent variable, fdi

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | -0.640 | 0.770 |
| Δ fdi (-1) | -0.468** | 0.151 |
| Δ cor (-1) | 0.007* | 0.008 |
| Δ g (-1) | 0.042 | 0.089 |
| Δ y (-1) | 0.004* | 0.003 |
| Δ hk (-1) | -0.100 | 0.091 |
| Δ trade (-1) | -0.192 | 0.238 |
| Δ inv (-1) | -0.007 | 0.099 |
| Δ infra (-1) | -0.124*** | 0.018 |
| Δ inflation (-1) | -0.096 | 0.159 |
| $ECT_1$ | -0.290** | 0.148 |
| R-squared | 0.810 | |
| Adjusted R-squared | 0.400 | |
| F-statistic | 2.460*** | |
| Prob. (F-statistic) | 0.008 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC). The $EC_{t-1}$ were generated from the Johansen cointegration test.

## Table 9. VECM, dependent variable, non-oil fdi

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | -0.646 | 0.783 |
| Δ non-oil fdi(-1) | -0.002 | 0.006 |
| Δ cor (-1) | 0.003* | 0.002 |
| Δ g (-1) | -0.000 | 0.022 |
| Δ y (-1) | 0.001 | 0.001 |
| Δ hk (-1) | 0.018 | 0.023 |
| Δ trade (-1) | -0.083 | 0.059 |
| Δ inv (-1) | 0.007 | 0.025 |
| Δ infra (-1) | -0.032*** | 0.004 |
| Δ inflation (-1) | -0.075** | 0.038 |
| $ECT_1$ | -0.298** | 0.149 |
| R-squared | 0.722 | |
| Adjusted R-squared | 0.464 | |
| F-statistic | 2.865*** | |
| Prob. (F-statistic) | 0.009 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC). The $EC_{t-1}$ were generated from the Johansen cointegration test.

## 7. Conclusions and policy implications

The effect of perceived corruption on economic activity has received significant attention in the recent literature. The level of perceived corruption in the host country has been introduced as one factor among the determinants of FDI location. The empirical studies assessing the impact of corruption on FDI show inconclusive results: some studies provide evidence of a negative relationship between corruption and FDI, some studies find a positive relationship between the two variables and others fail to detect a relationship. Most studies are largely based on a cross-sectional analysis that does not account for unobserved country-specific characteristics, with which corruption is correlated. In addition, the simultaneity between corruption and FDI is overlooked. This paper fills the gap in the empirical literature by estimating the effects of perceived corruption on FDI inflows to Egypt while controlling for other FDI determinants.

The main finding of this study is that perceived corruption in Egypt is positively associated with total FDI and non-oil FDI inflows in both the short and long run. Institutionally, this finding is counter-intuitive and challenges the mainstream policy advice that weak governance and, hence, corruption put FDI at risk. On the investment policy front, this observed positive correlation undermines the edifice upon which the investment policy is based at the global, regional and national levels and questions the logic of financial risk ratings for countries. But interestingly, this study is not the first to detect such a positive correlation. A considerable strand of the literature reports a positive association between corruption and FDI and discusses some explanations (Ledyaeva et al., 2015; Quazi et al., 2014; Helmy, 2013; Kolstad and Wiig, 2013; Bellos and Subasat, 2012; Egger and Winner, 2005; Wheeler and Mody, 1992). One possible explanation, for instance, is the efficient grease hypothesis. Nonetheless, it is critical to acknowledge that the findings of such studies are opposed and even dominated by the majority, which typically report that weak governance and, hence, corruption deters FDI.

The positive correlation between FDI and perceived corruption can be justified on two grounds. First, a third factor is at play: the rent-generating assets. The presence of certain rent-generating assets in a country can be positively correlated with both FDI and corruption. The bias in the investment policy in favour of large rent-generating projects implies that corruption may lead to higher (though inefficient), not lower FDI inflows. Moreover, in the presence of pre-existing government and/or bureaucratic failures, corruption may act as a backdoor to generate rents, which can drive FDI figures up (Bardhan, 1997; Aidt, 2003). Second, the use of FDI data based on balance of payments can further explain the positive FDI-perceived corruption correlation. The issue with such data is the growing financial-flows component and the phantom-FDI component (i.e. the unproductive investment when compared with typical greenfield foreign investment). The ability of statistical agencies to track capital flows rather than financial flows in a globally integrated system is complicated by daunting technical difficulties. The result is FDI data that are less reflective of real FDI flows and investment in real productive assets. Intuitively, problematic financial components, such as intra-firm financial flows, transactions and conduit flows, respond to perceived corruption in a different way than real FDI flows.

Apart from corruption, the findings support the importance of economic fundamentals, namely market size, domestic agglomeration, and income or wealth (per capita GDP), as determinants of FDI inflows. The evidence also provides strong support for the view that FDI could be a key source of capital accumulation in Egypt.

The findings suggest several policy recommendations. First, the detected positive correlation and the possible existence of the “grease the wheels” effect do suggest that improving the fundamental governance structure, with particular emphasis on property and contract laws, is a more appropriate target even than directly attacking corruption. As Aidt (2003) points out, the socially most beneficial policy is eliminating corruption rather than circumventing it. Egypt needs to develop new institutional capacities and to create a shift in the culture of the public sector from one of rent-seeking, control and lethargy to one of efficiency, transparency and a results-driven orientation. The Government of Egypt should strengthen the role of anti-corruption agencies. Egypt has a relatively strong legal framework to prevent and stifle corruption, despite the notable lack of a comprehensive anti-corruption law. The most important problem lies in the implementation of existing legislation. Numerous institutions play a role in fighting corruption, but their lack of coordination creates confusion and overlapping responsibilities. The economic courts, started in 2009, should be given priority in the restructuring process in order to absorb the backlog of economic and business-related cases.

Second, the efforts to improve good governance, while a crucial part of economic reforms and promoting productive investment, could be usefully accompanied by an investment facilitation strategy to compensate for the “removal of grease from the wheels”. Such a strategy could include streamlining administrative procedures, reducing the discretion of public officials, facilitating procedures through one-stop shops and single windows, and establishing an organizational ombudsman and dispute resolution system to provide confidential, informal, independent and impartial assistance to investors.

Third, as greater market size and domestic agglomeration are found to attract more FDI in Egypt, government strategies to attract FDI should include pro-growth economic policies and take them into account when designing long-term strategies to enhance the locational appeal of the country to foreign investors. A better knowledge of these economic fundamentals is crucial for devising strategies to not only attract more FDI in the short run, but also promote long-term and sustainable economic development.

The study is not free of limitations, which might constitute a path for future research. First, it does not investigate the specific impact of perceived corruption on FDI driven by contrasting motives (market- and asset-seeking FDI). Project-based FDI data will be required to address this issue. Second, it would be worthwhile to examine the impact of perceived corruption on FDI by the size of the company or project or by the nature of the industry in question.

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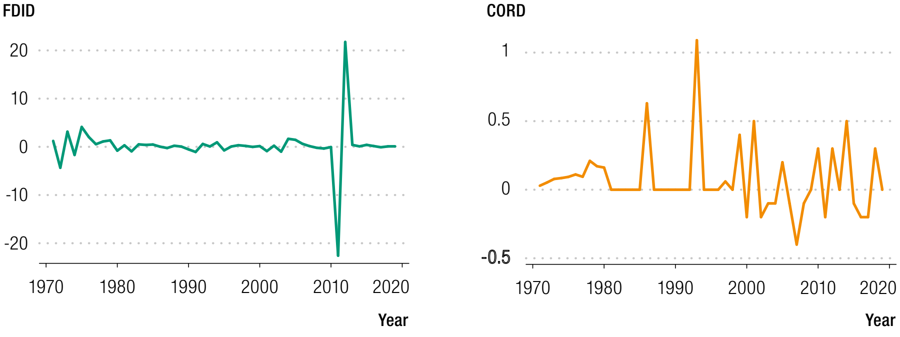
# APPENDIX A

**Table A.1. Description and sources of data**

| Variable | Description | Measure | Unit | Source |
|---|---|---|---|---|
| $fdi_t$ | Natural logarithm of FDI net inflows (BoP, current US$) | FDI | Rate | UNCTAD |
| non-oil $fdi_t$ | Natural logarithm of non-oil FDI net inflows (BoP, current US$) | FDI | Rate | GAFI |
| $cor_t$ | Corruption Perception Index (CPI) | Corruption | Index – ranges from 0 to 10 | Transparency International |
| $g_t$ | Real GDP growth rate (GDP deflator with base year 2005 is used ) | Market dynamics | Percentage per annum | World Development Indicators, World Bank |
| $y_t$ | Natural log of per capita real GDP | Market size | US$ | World Development Indicators, World Bank |
| $hk_t$ | Natural logarithm of secondary school enrolment to gross enrolment ratio | Human capital | Percentage per annum | World Development Indicators, World Bank |
| $trade_t$ | Exports and imports of goods and services to real GDP | Openness | Percentage per annum | World Development Indicators, World Bank |
| $inv_t$ | Gross fixed capital stock to real GDP | Private domestic investment | Percentage per annum | World Development Indicators, World Bank |
| $X_t$ | Mobile cellular subscriptions per 100 people ($infra_t$)<br>Percentage changes in consumer prices ($inflation_t$) | Infrastructure<br>Inflation rate | Percentage per annum | World Development Indicators, World Bank |

## Figure A.1. Plots of first difference series of variables




*Source:* Author's estimations.

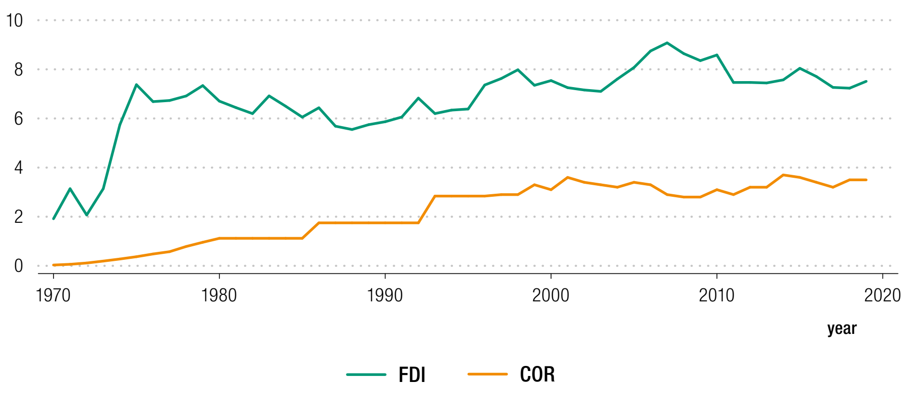
## A.1 Descriptive statistics

Figure A.2 shows the trends of fdi and cor over the period 1970–2019. Both series appear to have an increasing trend over the period of study with lesser fluctuations in the Corruption Perception Index. This result is consistent with the earlier discussion on the deeply embedded perceived corruption networks in Egypt which follow the same pattern over time. In addition, these weak fluctuations in the cor series is expected given the nature of the variable itself (an index ranging between 0 and 10) compared with fdi (percentage of real GDP).

Figure A.2 shows that FDI inflows as a percentage of real GDP increased slowly during the period from 1980 to 2003. As discussed earlier, FDI inflows increased significantly after 2003, owing to the adoption of the openness policy and the ERSAP. There is an increase of about 64 per cent per yer in FDI inflows to Egypt from 1980 to 2006. Figures A.1 and A.2 also expect a positive relationship between fdi and cor in the long run. The cor series in figure A.2 gives the impression of the non-stationarity.

Table A.2 summarizes the descriptive statistics for the variables used in this study. The first look at the data set reveals considerable variation over time in all the variables. The high standard deviation observed for all variables with respect to their means emphasizes the high volatility of the economy over the studied period. This result is consistent with the earlier discussion of strong pro-cyclicality of the economy. Table A.2 also shows that all the variables are positively skewed, except for cor and hk. This result indicates that perceived corruption and human capital are asymmetrical variables. Values of kurtosis are deviated from 3. This result indicates that the variables are not normally distributed.

### Figure A.2. Trends of fdi and cor in Egypt




*Source:* Author's calculations based on table 1.

**Table A.2. Descriptive statistics**

| Statistical Indicator | fdi | cor | g | y | hk | trade | inv | infra | inflation |
|---|---|---|---|---|---|---|---|---|---|
| Mean | 2.403 | 2.026 | 5.052 | 929.445 | 67.050 | 51.838 | 20.701 | 5.527 | 10.662 |
| Median | 1.694 | 1.750 | 4.685 | 887.316 | 74.893 | 51.956 | 19.429 | 3.474 | 10.146 |
| Maximum | 9.321 | 3.700 | 14.627 | 1475.130 | 87.697 | 82.177 | 34.433 | 15.700 | 23.864 |
| Minimum | 0.000 | 0.033 | 0.705 | 440.541 | 28.436 | 32.482 | 11.160 | 0.645 | 2.102 |
| Std. Dev. | 2.369 | 1.173 | 2.876 | 325.291 | 18.239 | 12.563 | 5.705 | 5.041 | 5.827 |
| Skewness | 1.277 | -0.284 | 1.271 | 0.189 | -0.687 | 0.349 | 0.299 | 0.718 | 0.352 |
| Kurtosis | 4.087 | 1.624 | 5.023 | 2.037 | 2.151 | 2.497 | 2.480 | 2.031 | 2.266 |

Table A.3 presents the correlation matrix for all the explanatory variables and FDI as the dependent variable. The correlation matrix provides a first crude expectation of the relationship between the variables. Table A.3 shows that $fdi$ has a positive correlation with $cor$, as anticipated in some of the empirical literature discussed earlier. This positive correlation is confirmed by the earlier analysis of FDI and perceived corruption trends in Egypt.

**Table A.3. Correlation matrix**

| | fdi | cor | g | y | hk | trade | inv | infra | inflation |
|---|---|---|---|---|---|---|---|---|---|
| fdi | 1 | | | | | | | | |
| cor | 0.200 | 1 | | | | | | | |
| g | 0.137 | -0.303 | 1 | | | | | | |
| y | 0.283 | 0.900 | -0.265 | 1 | | | | | |
| hk | 0.314 | 0.949 | -0.272 | 0.890 | 1 | | | | |
| trade | 0.534 | -0.138 | 0.453 | -0.074 | -0.007 | 1 | | | |
| inv | 0.400 | -0.222 | 0.439 | -0.219 | -0.045 | 0.581 | 1 | | |
| infra | 0.335 | 0.818 | -0.189 | 0.872 | 0.785 | -0.013 | -0.336 | 1 | |
| inflation | 0.293 | -0.192 | 0.187 | -0.073 | 0.016 | 0.434 | 0.638 | -0.270 | 1 |

# APPENDIX B

## B.1 Robustness checks

In this subsection, further experiments to the cointegration modelling are added. These experiments provide comparisons and robustness checks to our main model as well as improving its degrees of freedom.

### B.1.1 ARDL model

The ADF and PP unit root tests show that all variables are non-stationary at level and stationary at first difference, except the economic growth, denoted $g$, which is stationary at level. Thus, all variables are I (1), while $g$ is I (0). The combination of I (0) and I (1) gives us a chance to apply the ARDL approach of cointegration, as suggested by Pesaran et al. (2001). The ARDL test results reveal that the calculated F-statistic (1.05) is less than the upper critical bound as indicated in the Narayan (2005) table. Thus, one cannot conclude that the variables have a long-run relationship. Yet, the paper relies on Johansen cointegration results, as the ARDL model comes with an insignificant F-statistic, a small $R^2$ (38 per cent) and a serial correlation problem.

### B.1.2 Johansen cointegration tests

First, the cointegration analysis applied to all specified variables is repeated, with the economic growth variable, denoted $g$, excluded because this variable is stationary at level I (0). Table B.1 reports the Johansen cointegration test results and critical values of the maximum eigenvalue ($\lambda_{max}$) and trace statistics ($\lambda_{trace}$). The Johansen cointegration test is applied with one lag and with the deterministic terms (intercept and no trend in cointegration equation and test VAR). The Johansen cointegration results indicate that the null hypothesis of no cointegration can be rejected at a 5 per cent significance level. There exists only one cointegrating vector, and there is a long-run cointegrating relationship among all the variables in our model, with $g$ excluded.

Table B.2 presents the normalized coefficients of the cointegrating vector and their statistical significance, with $g$ excluded. The estimated cointegrated vector, with $g$ excluded, indicates the same results as shown in table 6. All the variables have significant effects on FDI in Egypt in the long run, except for perceived corruption. Given that the estimates of both models in tables 6 and B.2 yield the same results, this supports the reliability of the econometric methods used and the fact that our estimates are robust.

**Table B.1. Johansen cointegration tests, with g excluded**

| Null | Alternative | Statistic | 95 per cent C.V. | Eigenvalue |
|---|---|---|---|---|
| **Part A: LR test based on Maximal Eigenvalue of the stochastic matrix ($\lambda_{max}$)** | | | | |
| r = 0 | r = 1 | 65.112 | 52.363 | 0.780 |
| r ≤ 1 | r = 2 | 33.240 | 46.231 | 0.538 |
| r ≤ 2 | r = 3 | 31.090 | 40.078 | 0.515 |
| r ≤ 3 | r = 4 | 18.021 | 33.877 | 0.342 |
| r ≤ 4 | r = 5 | 16.015 | 27.584 | 0.311 |
| r ≤ 5 | r = 6 | 10.943 | 21.132 | 0.225 |
| r ≤ 6 | r = 7 | 4.757 | 14.265 | 0.105 |
| r ≤ 7 | r = 8 | 1.205 | 3.841 | 0.028 |
| **Part B: LR test based on Trace of the stochastic matrix ($\lambda_{trace}$)** | | | | |
| r = 0 | r ≥ 1 | 180.384* | 159.530 | 0.780 |
| r ≤ 1 | r ≥ 2 | 115.272 | 125.615 | 0.538 |
| r ≤ 2 | r ≥ 3 | 82.031 | 95.754 | 0.515 |
| r ≤ 3 | r ≥ 4 | 50.941 | 69.819 | 0.342 |
| r ≤ 4 | r ≥ 5 | 32.920 | 47.856 | 0.311 |
| r ≤ 5 | r ≥ 6 | 16.905 | 29.797 | 0.225 |
| r ≤ 6 | r ≥ 7 | 5.961 | 15.495 | 0.105 |
| r ≤ 7 | r = 8 | 1.205 | 3.841 | 0.028 |

*Note:* * indicates rejection of the null hypothesis at the 5 per cent level. $H_0$, and $H_1$ are the null and alternative hypotheses, respectively. C.V. is the critical values of the $\lambda_{max}$ and $\lambda_{trace}$ at the 5 per cent level.

**Table B.2. Normalized cointegrating vector, with g excluded**

| fdi | cor | y | hk | trade | inv | infra | inflation |
|---|---|---|---|---|---|---|---|
| -1.0000 | 4.6272 | 0.1266 | 1.1857 | -0.0981 | 1.4173 | 0.4280 | -1.4694 |
| | (2.3530) | (0.0143) | (0.1604) | (0.0527) | (0.1677) | (0.0509) | (0.1942) |

*Note:* Standard error in parentheses.

Second, further cointegration analysis to all specified variables is applied, with both economic growth and per capita real GDP excluded. The level of GDP can be excluded because it is usually used to proxy market size in models applied to cross-sectional data for comparison reasons.

Table B.3 reports the Johansen cointegration test results and critical values of the maximum eigenvalue ($\lambda_{max}$) and trace statistics ($\lambda_{trace}$). The Johansen cointegration test is applied with one lag and with the deterministic terms (intercept and no trend in the cointegration equation and test VAR). The Johansen cointegration results indicate that the null hypothesis of no cointegration cannot be rejected at a 5 per cent significance level. There is no long-run cointegrating relationship among all the variables in our model, with g and y excluded.

**Table B.3. Johansen cointegration tests, with g and y excluded**

| Null | Alternative | Statistic | 95 per cent C.V. | Eigenvalue |
|---|---|---|---|---|
| **Part A: LR test based on Maximal Eigenvalue of the stochastic matrix ($\lambda_{max}$)** | | | | |
| $r = 0$ | $r = 1$ | 36.413 | 46.231 | 0.571 |
| $r \leq 1$ | $r = 2$ | 31.748 | 40.078 | 0.522 |
| $r \leq 2$ | $r = 3$ | 24.899 | 33.877 | 0.440 |
| $r \leq 3$ | $r = 4$ | 15.462 | 27.584 | 0.302 |
| $r \leq 4$ | $r = 5$ | 8.1715 | 21.132 | 0.173 |
| $r \leq 5$ | $r = 6$ | 4.918 | 14.265 | 0.108 |
| $r \leq 6$ | $r = 7$ | 1.681 | 3.841 | 0.038 |
| **Part B: LR test based on Trace of the stochastic matrix ($\lambda_{trace}$)** | | | | |
| $r = 0$ | $r \geq 1$ | 123.292 | 125.615 | 0.571 |
| $r \leq 1$ | $r \geq 2$ | 86.879 | 95.754 | 0.522 |
| $r \leq 2$ | $r \geq 3$ | 55.132 | 69.819 | 0.440 |
| $r \leq 3$ | $r \geq 4$ | 30.233 | 47.856 | 0.302 |
| $r \leq 4$ | $r \geq 5$ | 14.771 | 29.797 | 0.173 |
| $r \leq 5$ | $r \geq 6$ | 6.540 | 15.495 | 0.108 |
| $r \leq 6$ | $r \geq 7$ | 1.681 | 3.841 | 0.038 |

*Note:* * indicates rejection of the null hypothesis at the 5 per cent level. $H_0$, and $H_1$ are the null and alternative hypotheses, respectively. C.V. is the critical values of the $\lambda_{max}$ and $\lambda_{trace}$ at the 5 per cent level.

### B.1.3 DOLS model

The DOLS model is utilized to estimate equations (2) and (3). The DOLS estimates have better small sample properties and provide superior approximation to normal distribution. The maximum lag length for DOLS model is one based on table 6.

The DOLS results of the long-run coefficient of **cor** match the results of Johansen cointegration in tables 6 and B.2. Given that the estimates of our three models (Johansen cointegration, ARDL and DOLS) yield the same results, this supports the reliability of the econometric methods used and the fact that our estimates are robust. Fortunately, the information on causation is embodied in the VEC model. Thus, the VEC model for equations (2) and (3) is estimated, after determining the optimal number of lags, the suitable mode for testing the VAR models and the number of cointegrating vectors the VECM should have.

**Table B.4. DOLS estimation**

| Variable | Coefficient | Std. Error |
|---|---|---|
| cor | 1.247835 | 0.764900 |
| g | 0.783110*** | 0.212112 |
| y | 0.045715*** | 0.011986 |
| hk | 0.652019*** | 0.143270 |
| trade | 0.006666 | 0.024015 |
| inv | 0.346977*** | 0.150867 |
| infra | 0.177114*** | 0.054862 |
| inflation | -0.815154*** | 0.152969 |
| R-squared | 0.958107 | |
| Adjusted R-squared | 0.828237 | |
| Stability tests:[a] | Stable | |

*Note:* *, ** and *** denote rejection of the null hypothesis at the 10 per cent, 5 per cent and 1 per cent levels respectively.
[a] Stability tests refer to the CUSUM test and CUSUM of Squares test.

# APPENDIX C

## C.1 Back-casting procedures

Following Ellis and Price (2003), the paper uses from the Quality of Government Institute with annual back runs to 1946 to back-cast for the missing COR data from 1970 to 1980. Recent COR data points are extrapolated into the past on the basis of the correlation between DEM and COR. As shown in figure 1, both COR and DEM are highly correlated over the period 1980–2019. Both COR and DEM are upward trended, and their rates of increase are approximately equal. Unit root tests for COR and DEM indicate that both variables are I (1) at standard significance levels. The levels regression or COR versus DEM has residuals that are I (0)- testing without intercept or trend, so the series appear to cointegrate. This implies that the ECM is appropriate.

**Table C.1. Error correction estimation, dependent variable, DCOR**

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | 0.166216*** | 0.065815 |
| $ECT_1$ | -0.322229*** | 0.118884 |
| DCOR (-1) | -0.039532 | 0.193981 |
| DCOR (-2) | -0.041540 | 0.194123 |
| DCOR (-3) | -0.074843 | 0.192299 |
| DCOR (-4) | -0.119853 | 0.191307 |
| DCOR (-5) | -0.148068 | 0.189305 |
| DDEM (-1) | -0.203130** | 0.109516 |
| DDEM (-2) | -0.045233 | 0.113707 |
| DDEM (-3) | -0.079318 | 0.113096 |
| DDEM (-4) | -0.068449 | 0.107010 |
| DDEM (-5) | -0.211770*** | 0.096965 |
| R-squared | 0.496770 | |
| Adjusted R-squared | 0.189240 | |
| F-statistic | 1.615355* | |
| Prob. (F-statistic) | 0.100000 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.

[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC). The $EC_{t-1}$ were generated from the Johansen cointegration test.

Lagged differences in COR are not significant and removed, as shown in table C.2.

**Table C.2. Error correction estimation, dependent variable, DCOR**

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | 0.138966*** | 0.052862 |
| $ECT_1$ | -0.311682*** | 0.103712 |
| DDEM (-1) | -0.195745*** | 0.095553 |
| DDEM (-2) | -0.045758 | 0.102066 |
| DDEM (-3) | -0.088344 | 0.095350 |
| DDEM (-4) | -0.072466 | 0.090513 |
| DDEM (-5) | -0.223141*** | 0.080202 |
| R-squared | 0.469034 | |
| Adjusted R-squared | 0.330521 | |
| F-statistic | 3.386216*** | |
| Prob. (F-statistic) | 0.015301 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC).

Then, the insignificant lags are removed, as shown in table C.3.

**Table C.3. Error correction estimation, dependent variable, DCOR**

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | 0.115229*** | 0.043544 |
| $ECT_1$ | -0.264013*** | 0.072421 |
| DDEM (-1) | -0.166174*** | 0.069743 |
| DDEM (-5) | -0.195808*** | 0.068380 |
| R-squared | 0.469034 | |
| Adjusted R-squared | 0.330521 | |
| F-statistic | 6.952468*** | |
| Prob. (F-statistic) | 0.001376 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC).

Although DDEM (-5) is statistically significant, it is removed because this five-year lag will restrict the applicability of a predictor of COR in 1970–1980. Hence, the ECM will be as shown in table C.4.

**Table C.4. Error correction estimation, dependent variable, DCOR**

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | 0.079837*** | 0.043880 |
| $ECT_1$ | -0.205721*** | 0.074064 |
| DDEM (-1) | -0.168916*** | 0.073164 |
| R-squared | 0.469034 | |
| Adjusted R-squared | 0.330521 | |
| F-statistic | 4.630245*** | |
| Prob. (F-statistic) | 0.017397 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC).

The significance of the model increases when it is estimated in in levels, as shown in table C.5.

**Table C.5. Error correction estimation, dependent variable, DCOR**

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | 0.041467*** | 0.176347 |
| $ECT_1$ | -0.264013*** | 0.072421 |
| COR (-1) | 0.785084*** | 0.074708 |
| DEM (-1) | 0.009572 | 0.078355 |
| DEM (-2) | 0.199178*** | 0.079477 |
| R-squared | 0.911325 | |
| Adjusted R-squared | 0.902458 | |
| F-statistic | 102.7717*** | |
| Prob. (F-statistic) | 0.000000 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC).

Then, the insignificant lags are removed in table C.6.

**Table C.6. Error correction estimation, dependent variable, DCOR**

| Variable | Coefficient | Std. Error |
|---|---|---|
| Constant | 0.049839*** | 0.159885 |
| COR (-1) | 0.787950*** | 0.069794 |
| DEM (-2) | 0.203266*** | 0.070935 |
| R-squared | 0.911281 | |
| Adjusted R-squared | 0.905557 | |
| F-statistic | 159.2092*** | |
| Prob. (F-statistic) | 0.000000 | |
| Diagnostic problems:[a] | None | |

*Note:* *, ** and *** signify 10 per cent, 5 per cent and 1 per cent significance levels, respectively.
[a] Diagnostic problems refer to the four diagnostic tests for serial correlation (SC), functional Form (FF), normality (NM), and heteroscedasticity (HSC).

Consequently, a back series is constructed for COR to 1970. COR over the period 1970–1979 is calculated based on the following equation:

$$\widehat{\mathrm{COR}}_t = 0.050 + 0.788\mathrm{COR}_{t-1} + 0.203\mathrm{DEM}_{t-2}$$

The above equation indicates that COR (-1) and DEM (-2) are good in-sample predictors of COR. Nevertheless, out-of-sample predictions breach the (0-1) limits; consequently, logistic regression is used to predict probabilities because it respects the (0-1) limits. The COR values are transformed so that they have 0-1 limits according to the following equation:

$$\mathrm{COR01} = \frac{\mathrm{COR}}{10}$$

And perform the logistic transformation as follows:

$$\mathrm{CORlogit} = \log(\frac{\mathrm{COR01}}{1 - \mathrm{COR01}})$$

Then, the following regression model is estimated over the period 1980–2019:

$$\mathrm{CORlogitdem.LS\ CORlogit\ c\ CORlogit(-1)\ dem(-2)}$$

The fitted equation: $\mathrm{CORlogit} = \mathrm{b0} + \mathrm{b1} * \mathrm{CORlogit}(-1) + \mathrm{b2} * \mathrm{DEM}(-2)$ is used and converted to an equation for $\mathrm{CORlogit}\ (\text{-}1)$, as follows:

$$\mathrm{CORlogit}(-1) = \frac{\mathrm{CORlogit} - \mathrm{b0} - \mathrm{b2} * \mathrm{DEM}(-1)}{\mathrm{b1}}$$

The time index is shifted by +1: $\mathrm{CORlogit} = \frac{\mathrm{CORlogit}\ (+1) - \mathrm{b0} - \mathrm{b2} * \mathrm{DEM}(-1)}{\mathrm{b1}}$, then used to back-cast the $\mathrm{CPIlogit}$ values, as follows:

$\mathrm{CORlogitfit} = \mathrm{CORlogit}$; and

$$\mathrm{CORlogitfit} = \frac{\mathrm{CORlogfit}(+1) - \mathrm{b0} - \mathrm{b2} * \mathrm{DEM}(-1)}{\mathrm{b1}}$$

The previous steps of logistic transformation are undone and the division by 10 gives the following:

$$\mathrm{CORfit} = \frac{10\ \mathrm{e}^{\mathrm{CORlogitfit}}}{(1 + \mathrm{e}^{\mathrm{CORlogitfit}})}$$

Then fill the rest of the series from observed values according to:

$$\mathrm{CORfit} = \mathrm{COR}$$