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Towards Measurement of Political Pressure on Central Banks in the Emerging Market Economies: The Case of the Central Bank of Egypt

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Towards Measurement of Political Pressure on Central Banks in the Emerging Market Economies: The Case of the Central Bank of Egypt

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Abstract:
This paper assesses whether the legal independence granted to the Central Bank of Egypt (CBE) under the latest legislation is factual. I followed Fry's methodology, which assumes that the level of independence of the central bank is determined by fiscal attributes. In an attempt to develop Fry's method, I used a simple criterion to assess the central bank's independence, namely, that the central bank is actually independent if it can fulfill its money supply target. Applying this criterion to the CBE and some other CBs in the developed countries and emerging market economies, we find that: (i) the legal independence granted to the CBE under the latest legislation is not factual; although the final objective of monetary policy is to achieve price stability, the CBE failed to fulfill its money supply target and achieve price stability, because it was responsive to political pressure and did not react to fulfill its money supply target; (ii) such political pressure on the CBE is due to fiscal attributes, as measured by domestic credit to the government; (iii) CBs whose independence is factual, according to our criterion, showed a negative relationship between the legal indices, as measured by the GMT index, and the fiscal attributes measured by DCGY. However, the relationship was anomalous when measured by the rate of inflation.

Keywords: monetary policy; central bank independence; fiscal dominance; political pressure

JEL: E51, E59, H75, C23.

1. Introduction

With the problem of higher inflation facing the industrialized economies during the 1970s and early 1980s, one important argument pointed to an inherent inflation bias in discretionary monetary policy. Under rational expectations an expansionary monetary policy will not affect real output, but average inflation will be higher. This explanation raises the question ‘Why might central banks prefer economic expansions or have output goals that exceed the natural rate of output?’ Economists frequently point to political pressures on the Central Bank (CB). Numerous studies have tried to measure politicians’ influence on monetary policymakers. The fundamental assumption of these studies is that the CB is more concerned than the elected government with maintaining low and stable rates of inflation. Consequently, if the CB became less subject to political pressure it would be able to deliver lower rates of inflation.

One branch of these studies has tried to measure Central Bank Independence (CBI) by constructing indices for CBI derived from CBs’ charters and estimating the relationship between such indices and the rate of inflation. The major defect of these studies is that legal indices may not reflect the relationship between governments and CBs that exists in reality. In countries with a lower degree of democracy and where the rule of law is less strongly embedded in the political culture, as in most developing countries, there can be a wide gap between the formal legal institutional arrangements and the actual practice. Thus, for developing countries, these CBI indices may not be accurate, because legal independence does not mean actual independence.

“Actual independence is impossible to quantify” (Cukierman, 1992, p. 273). Another branch of these studies did not take Cukierman’s advice and tried to measure the actual independence of CBs using some indicators of political pressure. The central tenet of this approach is that political pressure on the CB will arise even if the CB is legally independent. A CB with any degree of independence is still part of the system of government. Consequently, politicians always try to influence the CB to adopt policies compatible with their preferences. The degree of responsiveness of the CB to such political pressure depends on the extent to which the CB is actually independent. Then, by constructing an indicator of political pressure on the CB, we can measure the degree of responsiveness of the CB to such political pressure and consequently judge whether CB independence is *de facto* (factual) or just *de jure*. The major defects of these studies are that the channels through which political pressure might work are not clear and the reaction of the CB to fiscal policy is ambiguous.

Furthermore, some studies give more attention to CBI in the developing countries, relying on the fiscal dominance hypothesis. In the developing countries the fiscal situation will constrain if not dictate the CB's activities and therefore determine the extent of CBI. Fry (1998) tried to measure actual CB independence by estimating the reaction of the CB to the government's demands to increase credit. In fact, domestic credit to the government is a crossing point between the CB and the government. Consequently, the reaction of the CB to such demands (pressure) represents a linkage between political pressure on the CB and the actual independence of the CB.

In this paper I followed Fry's methodology for assessing the legal independence of CBs. I tried to develop Fry's method using a new criterion to assess the legal independence of the Central Bank of Egypt (CBE), namely, that the CB is actually independent if it can fulfill its money supply target.

I organized this paper as follows: section 2 presents previous studies of CBI and political pressure on CBs. Section 3 assesses the previous studies. Section 4 focuses on Fry's methodology. Section 5 focuses on our attempt to develop Fry's method. Section 6 assesses the legal independence granted to the CBE under the latest legislation. Section 7 concludes.

2. Previous studies of CB independence and political pressure on CBs

Greater attention has been focused on the relationship between monetary policymakers and politicians. In the literature there are two broad approaches to measuring this relationship. The first consists of studies based on legal attributes and therefore addressing the legal independence of CBs. The second involves studies based on non-legal attributes and therefore addressing political pressure on CBs. Besides these two approaches, there is another branch of studies which addresses the actual independence of CBs based on the fiscal dominance hypothesis. In this part I will briefly present each of these approaches.

2.1 Previous studies of the legal independence of CBs[1]

The theoretical basis of these studies depends on the notion that CBs in democratic countries are more concerned with maintaining low and stable rates of inflation than the elected government. If a CB becomes free of political pressure it will be able to deliver stable and low rates of inflation. In the theoretical models, CBI is introduced by means of the weight placed on inflation objectives in the loss function. The CB will be more independent if such weight in the loss function exceeds that of the government. The CB in this case is described as a Rogoff-conservative CB.

To measure how independent a CB is, empirical studies have constructed CBI indices based on the CB's legal characteristics. To investigate the relationship between CBI and the inflation rate, empirical studies (Eijffinger and Keulen, 1995, p. 57) have used this equation:

Average monthly inflation $(\pi) = \alpha_0 + \alpha_1 (CBI) + \varepsilon_1$

Using legal indices for CBI, many studies try to prove the theoretical assumption that higher levels of CBI, as detected by legal indices, will lead to lower rates of inflation. These studies have also used panel data about developing and developed countries to find such a negative correlation/relationship between CBI and the rate of inflation. Finding such a relationship is important to judge whether the legal independence of the CB is factual (*de facto*) or just formal (*de jure*).

[1] For more details and other subsequent empirical studies, see Arnone et al. (2006a).

Bade and Parkin (1977) presented the first empirical study of CBI using an index based on legal attributes. The study comprises twelve industrial countries during the period 1951–1975. They measured the independence of the CB according to the following criteria: (i) the primary objective of the CB according to the law; (ii) the degree of government influence over CB policy (the government's ability to appoint the members of the board of directors, government representation in the board of directors, and which authority controls monetary policy).

Alesina (1988, 1989) includes monetary financing rules, thus enlarging Bade and Parkin's index of policy independence to include the following criterion: the obligation of the CB to buy short-term treasury papers, as the monetary financing obligation can seriously harm CBI with respect to monetary policy making. Alesina (1988) examines how the degree of CB autonomy affects the magnitude of political influence over the economy and monetary policy. An independent CB is able to reduce fluctuations in monetary policy brought about by the election cycle.

Grilli, Masciandaro, and Tabellini (1991) built a two-part legal index for CBI. The authors defined "political autonomy" as the ability of the CB to select the final objectives of monetary policy, and defined "economic autonomy" as the ability of the CB to select monetary policy instruments. They constructed an index from eight criteria for each part, and assigned one point for each criterion if it is satisfied[2]. The overall index, the total sum of the points of the two-part index, is a measurement of CBI.

Cukierman (1992) constructs three indices of CBI. The first index (LVAU-LVAW) contains 16 indicators grouped under four main headings; a heading about the chief executive officer (CEO), a heading about policy formulation (PF), a heading about the objectives of the central bank (OBJ), and a heading about the limitations on the CB for lending to the government (LL). The second index, the turnover rate of the CB's governor (TOR), is based on the assumption that the higher is the TOR the lower is the CB's autonomy. The third index (QVAU-QVAW) is constructed on the basis of responses given to a questionnaire exploring various aspects of the CB's autonomy by focusing not only on the legal aspects, but also on the instruments used by the CB.

Alesina and Summers (1993) constructed another CBI index using the average of Bade and Parkin, expanded by Alesina (1988, 1989) and GMT (1991).

Describing policy independence, like GMT, as the capacity of the CB to choose the final objectives of monetary policy, Eijffinger and Schaling (1993) constructed another legal index for CBI. It comprised the formal responsibility of the CB with regard to monetary policy, the relationship between the CB and the government/parliament in the formulation of monetary policy, and the procedures for the appointment of the board of directors.

Arnone et al. (2006b) presented an update of the GMT index based on the CB legislation as of the end of 2003. The index comprised a set of developing countries, emerging market economics, and OECD countries. The authors presented a reconstruction of the GMT index based on Cukierman (1992) for a smaller set of countries, and evaluated the changes in CB autonomy between 1992 and 2003. Their results point to a significant increase in CB autonomy particularly for developing countries. Improvements in CB autonomy had, in most cases, involved a three-stage process: an initial stage in which the political foundations for CB

[2] Grilli, Masciandaro, and Tabellini (GMT) (1991) define CB independence as autonomy in setting objectives and autonomy in setting instruments. But the most common terminology for defining CBI is due to Debelle and Fisher (1994), who defined CBI as "goal independence" and "instrument independence."

autonomy were laid, a stage in which operational autonomy developed, and further political autonomy in terms of policy formulation and the appointment of senior management.

Since the legal indices of CBI may not reflect the real relationship that exists in practice between the government and the CB, another methodology (see Mahadeva and Sterne, 2000) tried to avoid this limitation by asking central bankers directly, using two methods. The first method interprets responses to the general subjective question, 'How would you define CBI?' then uses the answers to construct an index of self-assessment of CBI. The second method involves asking central bankers, 'How independent are your own institutions?' The answer to this question depends on the answers to a number of objective indicators. Using probit regression, the study attempts to explain which objective indicators of CBI explain the subjective self-assessment. One of the important results of this study is that self-assessment of CBI is strongly associated with both the degree of instrument independence measured and the absence of a deficit finance obligation. Also, the results for developing countries are similar to those of the entire sample. The absence of a deficit finance obligation and instrument independence explain the self-assessment variable. Considering the study group together with developing and transitional economies, the results show that the deficit finance limits have the most important influence on the perception of CB independence.

2.2 Previous studies of political pressure on CBs

The analysis of political pressure under this approach has been established on the background of the political business cycle. Drazen (2002) argues that reconsidering the pre-electoral political monetary cycle as an explanation for political pressure on the CB is important for the following reasons: (i) there may be indirect effects of the electoral cycle on monetary policy; (ii) in countries with independent central banks, pre-electoral monetary cycles are noticeable, with money growth rates rising before elections and the inflation rate rising after elections; (iii) using policy tools other than monetary policy to influence election outcomes may have a significant effect on monetary policy. The nature of this effect depends on the interaction between the CB and politicians.

Drazen presented a theoretical model for political pressure on the CB. Since accommodating monetary policy is worth more to politicians in election years than in non-election years, the amount of pressure differs over the electoral cycle. This induces an electoral cycle in monetary policy even though the CB is independent and has no electoral motive per se. In equilibrium, the monetary authority accommodates the politicians' desired policies in electoral years, but generally it is free of political influence in non-election years. An electoral cycle in fiscal policy may intensify the political monetary cycle, while an electoral structure that allows the government to call early elections may lessen it.

Empirical studies have tried to construct an indicator for political pressure on CBs. From the point of view of these studies, political pressure on CBs will occur even if the CB is legally independent, as politicians always try to influence the CB to adopt policies compatible with their preferences. But the degree of responsiveness of the CB to such political pressure depends on the extent to which the CB is actually independent. With a higher degree of CBI, such influence will arise only in indirect ways (since the CB, despite its independence, is still part of the system of government). So, by constructing an indicator for political pressure on the CB we can measure the degree of responsiveness of the CB to such political pressure, and consequently judge whether the independence of the CB is *de facto* or just *de jure*.

Havrilesky (1993) constructed an index for political pressure on CBs. This index was based on the number of newspaper reports in which politicians revealed their preferences about a more or less restrictive monetary policy. Any article calling for a monetary easing was assigned the value +1, while any article calling for monetary tightness was assigned the value –1. The final index, as an indicator of the net political pressure, is the net summation of the negatives and positives. Havrilesky applied his study to the Federal Reserve by counting the number of reports in the Wall Street Journal of politicians arguing in favor of more or less restrictive monetary policy. He found that the Federal Reserve's polices responded to this index.

Maier et al. (2002) applied Havrilesky's approach to the Deutsche Bundesbank after extending the analysis to include the pressure arising from other interest groups and analyzing press reports in different newspapers. He concluded that the Bundesbank did not respond to political pressure and its policies were in line with the wishes of the banking sector.

Using the extended version of Havrilesky's approach (1993) by Maier (2002), Gersl (2006) tried to measure and explain the political pressure on the Czech National Bank (CNB). He concluded that the CNB faced considerable political pressure toward a monetary easing in the period 1997–2005, comparable with the pressure on the Federal Reserve and slightly higher than the pressure on the Deutsche Bundesbank. However, the CNB did not succumb to such pressure. Therefore, political pressure did not have any systematic impact on the direction of monetary policy. Hence the legal independence of the CNB was proved to be factual as well.

2.3 Previous studies of the actual independence of CBs based on the fiscal dominance hypothesis

This approach gives more attention to CBs in developing countries, relying on the fiscal dominance hypothesis. In developing countries the fiscal situation will constrain, if not dictate, the CB's activities and therefore determine the extent of the CB's independence. To assess how independent a CB is, Fry (1998) used a simple measure based on an action that all CBs can take: reaction to increased credit demands by the government. Using the change in domestic credit as a proxy for monetary policy, he constructed a monetary policy reaction function. His hypothesis states that the extent of neutralization depends on both the size of the government deficit and the methods by which it is financed. Since governments can finance their deficit in four ways (borrowing at zero cost from the CB, borrowing from domestic commercial banks at below-market interest rates, borrowing abroad in foreign currency, and borrowing at market interest rates from the voluntary domestic private sector), the CB will be less independent if the government deficit is higher and the government uses the first two methods to finance its deficit.

Fry measured the degree of CB independence by the value of the neutralization coefficient, that is, the reaction of the CB to the government's demand for more credit to finance the budget deficit. Since domestic credit plus net foreign assets constitute the assets backing the monetary stock, an increase in net foreign assets must be offset by a decrease in domestic credit to prevent any change in the money stock or to make the CB able to fulfill its money supply target. To examine whether CBs in developing countries are independent, Fry estimated the neutralization coefficient for a variety of developing countries. His result was that a larger deficit and greater government reliance on the domestic banking system are associated with less neutralization, and consequently less CBI.

As determined in open-economy macroeconomics, a CB-engineered increase in the real interest rate makes domestic government debt more attractive and leads to a real appreciation. However, if the increase in the real interest rate also increases the probability of default on the debt, the effect may be instead to make domestic government debt less attractive, and leads to a real depreciation. That outcome is more likely the higher the initial level of debt, the higher the proportion of foreign-currency-denominated debt, and the higher the price of risk. In such case, fiscal policy, not monetary policy, is the right instrument to decrease inflation. Blanchard (2004) argues that this is the situation found in the Brazilian economy in 2002 and 2003.

3. Assessment of previous studies

The general conclusion found in the literature pertaining to the empirical studies of legal CBI can be summarized as follows (Ferreira de Mendonca, 2005, and Arnone et al., 2006): (i) among industrial economies there is a strong negative correlation between *de jure* CBI and inflation; (ii) in developing countries there is no evident relationship between legal CBI and inflation; (iii) there is a positive correlation between the political vulnerability of the CB and the variation of inflation; (iv) countries in which the monetary authorities announced their goals for inflation presented lower rates of inflation; (v) legal CBI is not correlated with the average real growth rate; (vi) CBs with a higher degree of independence do not finance deficits.

One of the main defects of the legal indices for CBI is that the concept of independence differs across such indices, even though they deal with the same thing. In other words, there is no homogeneous concept of CBI across the legal indices. Ferreira de Mendonca (2005) examines this point using a correlation analysis for the three indices frequently used in empirical studies of CBI (Alesina and Summers, Cukierman, and GMT). Focusing on 15 industrialized countries and performing the analysis for independence indices and independence rankings, the finding was that there is no relationship between these measures of independence after the most independent countries (Germany, Switzerland, and United States) are omitted from the analysis.

Another defect of the legal indices is that they may not reflect the relationship between the government and the CB that exists in practice. In countries with a lower degree of democracy and where the rule of law is less strongly embedded in the political culture (as in most developing countries), there can be a wide gap between the formal legal institutional arrangements and the actual practice. Thus, for developing countries these CBI indices may not be accurate.

Economists have pointed out other defects in the empirical studies based on the legal indices of CBI (Walsh, 1998, pp. 379–381, and Arnone et al., 2006). (i) Average inflation and the degree of CBI might be jointly determined by the strength of the political constituencies opposed to inflation. In the absence of these constituencies, increasing CBI will not affect inflation. This means that even if the CB is independent, higher political pressure with no equivalent opposite directions may result in inflation. (ii) Another problem with the estimations of the equation given above is that it fails to correct for country-specific factors that may affect inflation and may also be correlated with the indices of CBI. Correcting for potential bias requires the inclusion of other determinants of inflation in the above equation. (iii) Most economists cast doubt on the relationship between CBI and average inflation. A complete understanding of this relationship requires a better understanding of the factors that have led to the variations in CBI across countries. The best way to understand such differences is to estimate the above equation directly for one-country rather than cross-section comparisons. However, this task is not easy. (iv) While CBI raises the issue of subjecting the CB to democratic control, the linkage between CBI and CB accountability is not clear in most of these studies.

Moreover, the political pressure approach is also criticized. Besides the other flaws of Havrilesky's approach (see Gersl, 2006, p. 4) the major defects are as follows. (i) The channels through which political pressure might work are not clear. (ii) The reaction of the

CB to fiscal policy is ambiguous. (iii) Without complete coordination between fiscal policy and monetary policy, the CB may be coerced to conduct monetary policy in favor of politicians' interests. Such coordination between monetary and fiscal policy reflects the government's desire, side by side with the CB, to curb inflation. This point is also not clear in this literature.

Some important lessons from the previous studies are as follows. (i) Political pressure on CBs will occur with any degree of CBI. This is simply because CBs with the highest degree of independence are still within the system of government. (ii) The degree of inflation resulting from political pressure on CBs depends on whether CBI is factual or only formal. (iii) Since the degree of resulting inflation is the product of the interaction between the political pressure on the CB for a monetary easing and a higher or lower degree of responsiveness of the CB, then we can assess the degree of CBI by the ability of the CB to fulfill its money supply target in the face of political pressure. (iv) One of the crossing points between fiscal policy and monetary policy, and consequently between the government and the CB, is "domestic credit to the government." On the one hand, this is one of the sources of political pressure on the CB. On the other hand, it constitutes an essential part of the assets backing the money supply, and so it is important for monetary policy to keep it under control.

The fiscal dominance hypothesis, discussed by Fry, represents a step in that direction. The reaction of the CB to the government's demands to increase credit represents a linkage between political pressure on the CB and CBI. Such a reaction measures to what extent the CB is actually independent, especially in developing countries. Since CBs in the developed countries may or may not be asked to provide credit to central government, this measure (the reaction of the CB to the government's demand for higher credit) can be developed into a comprehensive indicator of the actual independence of CBs. In the following two sections I will present Fry's methodology in more detail and then develop it to serve my purposes.

4. Fry's methodology

Fry began with this equation:

$$DDCY = f(DNFAY, X_i) \qquad (1)$$

where DDCY represents the change in domestic credit scaled by GDP, DNFAY represents the change in net foreign assets scaled by GDP, and X_i represents the other explanatory variables other than DNFAY (the gap between domestic inflation and inflation in the industrialized economies, the gap between actual and potential output, economic growth…). Complete sterilization of net foreign assets on the supply of money implies a coefficient of DNFAY equal to –1. Since domestic credit equals domestic credit to the government (DCG) plus domestic credit to the private sector (DCP), the above equation might be written as follows:

$$DDCPY = f(DNFAY, X_i) - DDCGY \qquad (2)$$

where DDCPY is the change in domestic credit to the private sector scaled by GDP, and DDCGY is the change in domestic credit to the government scaled by GDP. The last equation represents the monetary policy reaction function that Fry used to estimate the neutralization coefficient. Complete neutralization of the government's extra borrowing requirements implies a coefficient of –1 for DDCGY. Partial neutralization will produce a coefficient less than zero and higher than –1, and no neutralization entails a coefficient of zero. Complete neutralization represents the highest level of CBI, while zero neutralization represents, in fact, complete subordination of the CB to the government. Fry argues that,

'a central bank that says to the government "we cannot resist your financing demands, but we shall neutralize them by squeezing the private sector and we shall tell the private sector exactly why we have to squeeze credit" is surely acting more independently than one that

simply lets domestic credit rise by the full extent of any extra government borrowing from the banking system.'

Fry used a system of simultaneous equations. He treated the variable change in domestic credit to the government (DDCGY) as exogenous, and the variables the inflation gap (INFGAP) and the change in net foreign assets (DNFAY) as endogenous. He used 3SLS. The instruments are: lagged DNFAY, lagged INFGAP, and lagged money and growth rates, the rate of change in oil prices, the OECD growth rate, and the world interest rate. The estimated monetary policy reaction function was as follows:

$$DDCPY = b_1 DNFAY + b_2 DNFAY_{t-1} + b_3 DDCGY + b_4 DDCGY_{t-1} + b_5 INFGAP + b_6 L.DNFAY + b_7 L.DNFAY_{t-1} + b_8 L.DDCGY + b_9 L.DDCGY_{t-1} + b_{10} L.INFGAP \quad (3)$$

where L is a dummy variable taking a value of zero for countries in the high group and one for countries in the low group.

Fry's method does have some defects. (i) Although the variable DDCGY is treated as exogenous the instruments used for the endogenous variables may affect it. For example, an increase in the inflation rate may increase DDCG. But Fry argues that the effect of the inflation rate on DDCG may be offset by an opposite effect on the economic growth rate, as economic growth tends to reduce the government's borrowing requirements. (ii) Even if we assumed that the opposite effects of these two variables are equal, the increase in the budget deficit may shift the whole equation if the CB sought to finance it by issuing new money. If this happened (as is the case in the majority of developing countries) overall domestic credit would increase. In such case we may find a positive relationship between DDCPY and DDCGY. Fry's equation does not consider the case that the coefficient of DDCPY/DDCGY might be positive. (iii) The CB will be actually independent if it can fulfill its money supply target by offsetting changes in NFA and changes in DCG with changes in DCP. Since increasing the interest rate penalizes the government, the CB may be coerced to keep the interest rate unchanged despite an increase in DCG or an increase in the inflation rate. Again, Fry's equation did not consider this probability.

5. Developing Fry's methodology

In spite of these limitations in Fry's methodology, the idea is valuable. We may develop it to derive a comprehensive indicator of actual CB independence. The government's credit requirement is a channel for political pressure on the CB. An increasing public debt and budget deficit lead to increasing government demand for credit. Consequently, the political pressure on the CB will also increase. Without a budget deficit, the government's credit requirements would vanish and the political pressure on the CB might vanish too. Where the public debt and budget deficit exist with a higher ratio (as in most developing countries) the CB will be actually independent if it can neutralize them. "Neutralizing" means that the CB will not miss its money supply target. To fulfill its money supply target, the CB will also sterilize changes in NFA. Since the CB cannot affect DCG, the CB will change DCP to offset changes in NFA and fulfill its money supply target.

The criterion for an actually independent CB is the ability of the CB to fulfill its money supply target. This means that we should not evaluate the success of the CB only by the value of the neutralization coefficient. Given this money supply target:

$$M^* \equiv NFA + DCP + DCG \quad (4)$$

the CB can fulfill its target $(M)^*$ if it can satisfy the right-hand side of (4). To satisfy it, the CB should offset any change in NFA and DCG by changing DCP. Consequently, the coefficient sign of the estimation DCP/NFA, DCG may serve as indicator that the CB can or cannot fulfill its money supply target. We can assess the legal independence of CBs simply by estimating (5):

$$DCPY = a_1 + a_2\,NFAY + a_3\,DCGY \qquad (5)$$

Thus, we have two possibilities: (i) if coefficients a_2 and a_3 are negative, then the CB behaves in such a way that it fulfills its target, and so the CB is actually independent, or the legal (formal) independence granted to the CB is factual; (ii) if at least one of these two coefficients is positive, then the CB cannot fulfill its target and so the legal (formal) independence granted to the CB is not factual.

In the following section I will use this simple indicator to assess the legal independence granted to the Central Bank of Egypt (CBE). And I will check the results by applying the same indicator to some developed countries and emerging market economies.

6. Assessing the legal independence of the Central Bank of Egypt (CBE)

At the beginning of the 1990s, Egypt – acting in agreement with the IMF and WB – implemented an "Economic Reform and Structural Adjustment Program" (ERSAP). The purpose was to reform the country's macroeconomic policies and increase the role of the private sector in the economy. Under the ERSAP, Egypt liberalized its interest rate in 1991 and applied an active privatization program starting from this date. During this period the CBE was targeting the exchange rate. In January 2003, Egypt floated its exchange rate. The CBE changed its policy from exchange rate targeting to monetary growth targeting as an intermediate objective for monetary policy. New legislation was promulgated. Law No. 88 of 2003, as amended by Law No. 162 of 2004 and Law No. 93 of 2005, is a comprehensive law governing the CB, the banking sector, and money[3]. Under the current new legislation, the final objective of monetary policy is to achieve price stability.

In this part, before assessing the legal independence granted to the CBE by the new legislation, I will first present the legal position of the CBE under this new legislation.

6.1 The legal position of the CBE under the current legislation

6.1.1 Management of the CBE:

The governor of the CBE is appointed by decree of the president of Egypt, upon his/her nomination by the prime minister, for a renewable term of four years, and is treated the same as a minister in terms of his/her pension. The resignation of the governor is accepted by decree of the president. The governor has two deputies appointed by decree of the president, upon their nomination by the governor, for a renewable term of four years. The CBE has a board of directors (BoD) under the chairmanship of the governor, with fourteen members (two deputy governors, the chairman of the Capital Market Authority, three members representing the ministries of finance, planning and foreign trade, and eight experts in monetary, financial, banking, legal, and economic affairs, designated by the president for a renewable term of four years. The BoD is the authority responsible for realizing the objectives of the CBE by formulating and implementing monetary, credit, and banking policies. The BoD also determines the instruments required to achieve the objectives; particularly, the instruments of monetary policy to be followed, the structure of credit and discount rates, the

[4] Article 1 of this Law repeals the following former laws: (i) the banks and credit law promulgated by Law No. 163 of 1957, (ii) Law No. 120 of 1975 concerning the central bank of Egypt and the banking sector, (iii) Law No. 205 of 1990 concerning the secrecy of bank accounts, (iv) Law No. 38 of 1994 regulating dealing in foreign exchange, and (v) Law No. 155 of 1998 regulating the private sector's contribution to the capital of public sector banks. See: www.cbe.org.eg/.

regulatory and supervisory standards to guarantee the soundness of the financial position of banks, and the regulation of auctions and tenders.

6.1.2 The objectives and functions of the CBE:

The primary objective of the CBE is to achieve price stability and banking system soundness within the context of the general economic policy of the state. The CBE sets, in agreement with the government, the objectives of monetary policy through a coordinating council formed by decree of the president. To achieve its objectives, the CBE has the following traditional powers: issuing banknotes, managing liquidity, conducting open market operations, influencing banking credit by using monetary policy tools, supervising the units of the banking sector, managing the gold and foreign exchange reserves of the state, regulating and managing the foreign exchange markets, supervising the national payment system, and monitoring the external debt of the state. In case of financial crises, the CBE stands as the last resort of the banking sector. Also, the CBE guarantees the finance and credit facilities obtained by public legal persons from banks, financial institutions, and foreign or international institutions.

6.1.3 The relationship between the government and the CBE:

The CBE acts as a financial advisor and agent for the government. Consequently, the CBE executes banking transactions pertaining to the government and public legal persons, as well as internal and external finance, with banks according to the conditions set by the BoD. The CBE, acting as the bank of the government, charges fees on the services it renders to the government and public legal persons according to its own list of fees on banking services, and the government may designate the CBE to act on its behalf in issuing government bonds and bills of all types of maturities. The CBE extends financing to the government, upon its request, to cover the seasonal deficit on the general budget, provided that the amount of such finance does not exceed 10% of the average revenues of the general budget in the three previous years. The term of such finance is three months renewable for other similar periods, with a maximum of twelve months. The conditions concerning this finance are determined upon agreement between the ministry of finance and the ECB[4].

6.2 Assessing the legal independence of the CBE

Using IMF data (see Appendix 1), I estimated equation 5 for the CBE over the period 1996–2006. To verify my results for the CBE I also estimated equation 5 for some other countries which have different degrees of CBI as determined in the literature. These countries are Brazil, the Czech Republic, the USA, the UK, Germany, Poland, New Zealand, Israel, Japan, and Nigeria. I estimated equation 5 separately for each country so that the equation takes different formulas for each country. This is because the required steps for stationarity of the time series are different and constancy of the variances (as OLS assumes) does not exist in most cases (see Appendix 3).

Table 1 includes the estimation results for all the countries in the sample. For Egypt, a significant positive relationship is found between the second difference of $DCPY^{**}$ and the second difference of $DCGY^{**}$. A similar positive relationship is found in Brazil, Nigeria, and Japan. For Poland and Israel a positive relationship is found between DCPY and NFAY. In all the aforementioned countries, the CBs are not actually independent according to our criteria.

[3] Articles 26–27.

That is, the CBs are not actually independent if there is a positive relationship between DCPY and either DCGY or NFAY or both of them. For the rest of the countries in the sample, a significant negative relationship is found between DCPY and DCGY. These countries are the UK, the USA, Germany, and New Zealand. For the Czech Republic, a negative and significant relationship is found between the difference of the logarithmic value of DCPY** and the difference of NFAY**. In the latter group of countries the CBs are actually independent according to our criteria.

Focusing on the Egyptian case, the positive relationship between DCPY and DCGY leads us to extract the following results. (i) While the CBE sterilizes the changes in NFA by changing DCP in the opposite direction, it does not offset the changes in DCG to fulfill its money supply target. One explanation for such parallel movement of DCP and DCG is that the CBE cannot freely move the rate of interest despite increasing DCG, as the CBE is obliged to finance the general budget and the conditions of such financing are determined upon agreement between the ministry of finance and the CBE. ‘Agreement’ means that the rate of interest imposed on the government’s credit will in the best of cases be lower than the market interest rate. Thus, the higher the government’s demand for credit, the higher the overall domestic credit at the prevailing market interest rate. Consequently, the CBE misses its money supply target, and so the legal (formal) independence granted to the CBE is not factual. (ii) This result also means that there is influential political pressure on the CBE, and such political pressure may be due to fiscal dominance[5].

[5]A similar analysis may also apply in the other similar cases of dependent CBs. For example, in the second half of 1999, the Central Bank of Brazil (CBB) applied an inflation targeting approach. Despite its commitment to inflation targeting, and an increase in the rate of inflation from mid-2002 on, the CBB did not increase the real interest rate until the beginning of 2003. As Blanchard (2004) has argued, the solution in such case is fiscal policy and not monetary policy. Also, Maier (2002) and Gersl (2006) reach the same conclusion for the Bundesbank, the Federal Reserve Bank, and the Czech National Bank, that is, there was influential political pressure on these CBs, but they behaved independently, as mentioned in section 2.2.

Table 1: Estimation results of the equation: DCPY/NFAY, DCGY

State / Method	Enter all variables				Stepwise		
Egypt	$(1-L)^2$ DCPY** = -0.0035 - 2.259 $(1-L)^2$ NFAY** + 0.587$(1-L)^2$ DCGY**				$(1-L)^2$ DCPY** = -0.001+ 0.935$(1-L)^2$ DCGY**		
	t	-0.052	-1.043	1.469	t	-0.148	4.242*
	R^2	76.3 %			R^2	72 %	
	d	2.031			d	1.99	
Brazil	(1-L)LN DCPY = -0.139 +0.509(1-L) LN NFAY + 0.878(1-L) LN DCGY				(1-L)LN DCPY = -0.157 + 0.918(1-L) LN DCGY		
	t	-1.671	2.765*	11.885*	t	-1.355	9.077*
	R^2	96.6 %			R^2	92.2 %	
	d	2.405			d	2.405	
Nigeria	DCPY** = 0.319 – 0.241 (1-L) NFAY** + 0.399 DCGY**				DCPY** = 0.31 + 0.44 DCGY**		
	t	16.33*	-1.004	2.566*	t	18.055*	2.923*
	R^2	61.4 %			R^2	55 %	
	d	1.734			d	1.84	
Poland	(1-L) DCPY = -0.262 +1.604 NFAY- 0.197(1-L) DCGY				(1-L) DCPY = -0.301 +1.852 NFAY		
	t	-4.406*	4.563*	-2.053	t	-4.431*	4.644*
	R^2	85.6 %			R^2	75.5 %	
	d	1.457			d	1.945	
Japan	DCPY = 0.603 +3.989 NFAY+ 4.234(1-L) DCGY				DCPY = 0.966 + 3.574(1-L) DCGY		
	t	0.952	0.575	2.989*	t	13.952*	4.533*
	R^2	75.9 %			R^2	74.6 %	
	d	1.921			d	1.607	
Czech Republic	(1-L) LN DCPY** = -0.0341 + 0.309 (1-L) NFAY** - 0.607(1-L) DCGY**				(1-L) LN DCPY** = -0.0655 + 0.274 (1-L) NFAY**		
	t	-0.575	3.246*	-1.735	t	-1.022	2.594*
	R^2	66.1 %			R^2	49 %	
	d	2.147			d	1.106	
New Zealand	DCPY* = -7.849 – 0.275 NFAY*+ 1.087 DCGY*				DCPY* = -6.753 + 1.152 DCGY*		
	t	-0.781	-0.582	9.737*	t	-0.714	176.982*
	R^2	100 %			R^2	100 %	
	d	1.047			d	0.932	
USA	(1-L) DCPY = 0.0229 + 0.78 (1-L) NFAY – 0.912 (1-L) DCGY				(1-L) DCPY = 0.019 – 0.891 (1-L) DCGY		
	t	10.49*	3.597*	-43.202*	t	5.787*	-25.393*
	R^2	99.9 %			R^2	99.1 %	
	d	2.472			d	2.472	
UK	(1-L) DCPY = 0.133 –0.273 NFAY– 2.292 DCGY				(1-L) DCPY = 0.133 – 2.345 DCGY		
	t	4.037*	-0.882	-2.85*	t	4.808*	-2.972*
	R^2	60.9 %			R^2	55.8 %	
	d	1.649			d	1.727	
Germany	$(1-L)^2$ DCPY = 0.287 –0.288$(1-L)^2$ NFAY– 1.116 DCGY				$(1-L)^2$ DCPY = 0.352 – 1.379 DCGY		
	t	2.809*	-2.063	-2.846*	t	2.814*	-2.892*
	R^2	81.9 %			R^2	62.6 %	
	d	1.831			d	2.536	
Israel	DCPY/√DCGY = 0.892 +3.344(NFAY/√DCGY) +1.11(1-L)(√DCGY)				DCPY/√DCGY = 0.874 +3.302(NFAY/√DCGY)		
	t	4.953*	14.312*	0.246	t	5.716*	22.363*
	R^2	98.6 %			R^2	98.6 %	
	d	0.879			d	0.816	

* Significant at the 0.05 level.   L: A lag operator for one period.
For more details about the estimation process see Appendix 3.

One method for investigating whether fiscal dominance is the main reason for the political pressure on the CBE is to examine the relationship between the legal indices of CBI and domestic credit to the government[6]. Appendix 2 includes the distribution of the GMT indices calculated by Arnone et al. (2006b) for the periods 1991–1992 and 2004. Previous studies, using panel data, examined the relationship between the average rate of inflation and the legal indices. As mentioned, this method is criticized in most of the literature because the direction of the causality between the CBI indices and the average rate of inflation is not determined. That is, does CBI lead to lower rates of inflation? Or is it a higher rate of inflation that leads governments, especially in the emerging market economies, to tie their hands and give CBs more legal independence? As mentioned in most of the literature, no general rule applies and studies that directly address individual country cases are recommended.

Following the tradition, I estimated inflation (π) on the CBI indices. As an alternative method, I estimated DCGY on the CBI indices. For the USA and the Czech Republic, I could not examine the relationship between the legal indices and the average rate of inflation and domestic credit to the government because of the constancy of the value of the GMT index in the case of the USA and the unique value of the GMT index in the case of the Czech Republic. For the same reason, I could not examine the relationship between political independence and inflation and DCGY in the case of Japan and Israel (see Appendix 2). For the other countries, I estimated the relationship between the GMT index and the inflation rate (the annual percentage change in the CPI) and DCGY during the period 1996–2005.

Table 2 shows the following estimation results. (i) The relationship between the rate of inflation (π) and CBI as measured by the GMT index was anomalous for the developed countries group in the sample (the UK, Germany, and New Zealand). The higher the level of CBI (as detected by the GMT index), the higher the rate of inflation. The relationship between DCGY and CBI as measured by the GMT index was accurate for the same group of developed countries. The higher the level of CBI, the lower the level of DCGY. The negative correlation between CBI and DCGY verifies our result about the independence of CBs in the developed economies. As shown in Table 1, the CBs in this group of countries are actually independent. (ii) For the rest of the countries in the sample – Egypt, Brazil, Poland, Israel, Japan, and Nigeria – the relationship between the rate of inflation and CBI was accurate (except in the case of Nigeria). The higher the level of CBI, the lower the level of π. For the same group of countries, the relationship between DCGY and CBI was also accurate (except in the cases of Japan and Brazil). The higher the level of CBI, the lower the level of DCGY. For Japan and Brazil, a higher level of CBI was correlated with a higher DCGY. In all the countries of the last group, the CBs are not actually independent according to our calculations in Table 1. (iii) Despite the negative correlation between CBI and DCGY in some countries (Poland, Israel, and Nigeria), the CBs in these countries are not actually independent according to the results shown in Table 1. As an explanation for such contradiction, Table 1 focuses on the significant (positive or negative) relationship, while Table 2 focuses only on the sign (positive or negative) of the relation. Consequently, DCGY might be decreasing, as a result of a gradually increasing level of CBI, but still has a significant effect on the CB's decisions in this group of countries.

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[6] Using panel data for 20 countries, Fry (1998) used the same methodology.

Table 2: Estimation results using GMT indices

Indicator/ Equation	π / CBI Indices	DCGY / CBI Indices	Indicator/ Equation	π / CBI Indices	DCGY / CBI Indices
Egypt			**New Zealand**		
Political index	-14.88	-0.16	Political index	3.782	-0.0076
Economic index	24.7	0.275	Economic index	3.782	-0.0076
General index	-55	-0.6	General index	3.782	-0.0076
Brazil			**Israel**		
Political index	-4.2	1.62	Political index	-	-
Economic index	-0.7	0.27	Economic index	-5.95	-0.205
General index	-1.28	0.5	General index	-13.128	-0.45
UK			**Japan**		
Political index	1.64	0.02	Political index	-	-
Economic index	1.09	-0.01	Economic index	-0.518	2.336
General index	1.3	-0.02	General index	-1.027	4.636
Germany			**Poland**		
Political index	1.9	-0.08	Political index	-4.633	-0.061
Economic index	- 3.9	0.15	Economic index	-5.791	-0.067
General index	*7.88*	-0.31	General index	-5.097	-0.076
Nigeria					
Political index	*32*				-0.48
Economic index	*26.5*				-0.4
General index	*29.32*				-0.44

Focusing on Egypt, the relationship between DCGY and the GMT index is compatible with the same relation between the inflation rate and the GMT index. A decrease in the level of CBI was accompanied by an increase in both DCGY and π. Adding this result to the previous result extracted from Table 1, we conclude that the current level of independence granted to the CBE is not factual.

7. Conclusion

To assess whether the legal independence granted to the Central Bank of Egypt, (CBE) under the latest legislation is factual, I followed Fry's methodology, which assumes that the level of independence of the central bank is determined by fiscal attributes. In an attempt to develop Fry's method, I used a simple criterion to assess the central bank's independence, namely, that the central bank is actually independent if it can fulfill its money supply target. Applying this criterion to the CBE and some other CBs in the developed countries and emerging market economies, we find that: (i) the legal independence granted to the CBE under the latest legislation is not factual; although the final objective of monetary policy is to achieve price stability, the CBE failed to fulfill its money supply target and achieve price stability, because it was responsive to political pressure and did not react to fulfill its money supply target; (ii) such political pressure on the CBE is due to fiscal attributes, as measured by domestic credit to the government; (iii) CBs whose independence is factual, according to our criterion, showed a negative relationship between the legal indices, as measured by the GMT index, and the fiscal dominance attributes measured by DCGY. However, the relationship was anomalous when measured by the rate of inflation.

However, the study assessed the actual independence of CBs by concentrating on only one point of conflict between monetary policy and fiscal policy, namely, the government's demand for higher credit. But there are other possible points of such conflict. The rate of interest deserves further research as a point of conflict between CBs and governments.

Appendix 1: Data Used in Regression

Years Indicators/	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Czech Republic (billions of korunas)										
GDP	1567.0	1679.9	1839.1	1902.3	2189.2	2352.2	2464.4	2577.1	2781.1	2970.3
NFA	265.44	325.50	421.52	607.64	676.60	808.14	924.38	821.56	863.45	1076.51
DC	1131.92	1214.25	1180.04	1136.31	1081.43	1074.78	1041.33	1252.35	1258.29	1297.86
DCP	1159.02	1272.53	1224.76	1159.58	1072.33	957.13	759.22	819.36	918.03	1102.71
DCG	-27.1	-58.28	-44.72	-23.27	9.10	117.65	282.11	432.99	340.26	195.15
π		8.448	10.682	2.105	3.931	4.706	1.785	0.108	2.827	1.846
Egypt (millions of Egyptian pounds)										
GDP	229400	257200	287400	307600	340100	358700	378900	417500	485300	538500
NFA	52717	49194	36111	25092	22860	21270	18875	34049	55415	112754
DC	190938	207724	247195	278013	302731	334522	378621	436655	508289	527845
DCP	95164	105545	133799	159958	176693	197038	207089	225023	262270	275526
DCG	95774	102179	113396	118055	126038	137484	171532	211632	246019	252319
π		4.626	3.873	3.080	2.684	2.270	2.737	4.508	11.271	4.869
USA (billions of US dollars)										
GDP	7813.2	8318.40	8781.50	9274.30	9824.60	10128.00	10469.60	10960.80	11712.50	12455.80
NFA	-127.5	-137.60	-100.20	-118.00	-79.50	-59.80	-134.30	-372.50	-552.70	-611.40
DC	6006	6493.70	7148.40	7696.20	8420.90	9164.40	9666.80	10245.80	11036.90	11970.30
DCP	5026.9	5444.50	6082.80	6622.90	7277.40	5305.80	5491.90	5892.80	6519.40	7215.90
DCG	979.1	1049.20	1065.60	1073.30	1143.50	3858.60	4174.90	4353.00	4517.50	4754.40
π		2.338	1.552	2.188	3.377	2.826	1.586	2.270	2.677	3.393
Germany (billions of German marks until 1998 – billions of euros from 1999)										
GDP	3586	3666.60	3769.90	1978.60	2062.50	2113.20	2143.20	2161.50	2207.20	2241.00
NFA	296.6	271.70	233.00	266.10	271.30	361.90	486.50	594.40	719.00	925.80
DC	4837.1	5137.00	5496.50	2917.10	2999.40	3042.30	3051.00	3043.30	3046.40	3050.90
DCP	3900.1	4137.60	4471.90	2326.40	2445.70	2497.40	2505.80	2497.40	2479.70	2504.60
DCG	937	999.40	1024.60	590.70	553.70	544.90	545.20	545.90	566.70	546.30
π		1.88	O. 936	0.57	1.471	1.975	1.373	1.048	1.667	1.954
Brazil (millions of reais)										
GDP	778887.0	870743.0	914188.0	9738461	1101255	1200060	1346028	1556182	1766621	1937598
NFA	52860.00	44458.00	36331.00	32805.00	47041.00	38259.00	53403.0-	9926.00-	16899.00	81777.00
DC	332285.0	400011.0	532086.0	526305.0	545319.0	701310.0	1119295	1275787	1427618	1653422
DCP	249996.0	287958.0	330074.0	349551.0	381941.0	410676.0	441353.0	475626.0	546520.0	651762.0
DCG	82289.00	112053.0	202012.0	176754.0	163378.0	290634.0	677942.0	800161.0	881098.0	1001660
π		6.926	3.196	4.859	7.044	6.840	8.450	14.715	6.598	6.870
UK (billions of pounds sterling)										
GDP	762.21	811.07	859.38	902.46	950.42	996.99	1048.77	1110.30	1176.53	1224.46
NFA	-9.31	-17.79	27.31	3.59	4.44	-17.9	-57.6	-56.7	-80.28	-24.67
DC	961.86	1015.92	1052.60	1131.45	1271.68	1389.66	1515.93	1652.78	1845.60	2032.08
DCP	912.27	973.37	1023.66	1100.02	1262.91	1373.15	1487.53	1630.96	1813.56	2001.80
DCG	49.59	42.55	28.94	31.43	8.77	16.51	28.40	21.82	32.04	30.28
π		3.132	3.418	1.555	2.927	1.821	1.634	2.914	2.964	2.830

Israel (millions of shekels)										
GDP	313001	352331	387211	405021	443048	498908	517975	524187	548936	582291
NFA	29854	49949	70986	67618	70665	74639	79226	98304	118105	149080
DC	259086	278521	315834	365240	389482	433967	459760	4363312	436365	469877
DCP	219842	254886	303434	347382	390938	439228	480467	462949	482871	540180
DCG	39244	23635	12401	17858	-1457	-5261	-20707	-26637	-46506	-70303
π		9	5.4	5.2	1.14	1.1	5.63	.71	-0.41	1.32
Poland (millions of zlotys)										
GDP	387827	472350	553560	615115	744622	779205	807859	842120	923248	980666
NFA	61524	82808	96281	110548	131725	133899	132020	135871	143234	170808
DC	128582	160990	194228	231341	243237	272037	279045	301512	305889	319604
DCP	57095	78565	104097	137936	197827	212598	221831	236674	245284	268982
DCG	71487	82425	90131	93405	45410	59439	57214	64838	60605	50622
π		15.08	11.72	7.27	10.06	5.49	1.9	0.78	3.57	2.107
New Zealand (millions of New Zealand dollars)										
GDP	96910	99982	100627	104775	110558	120002	130983	139752	148927	156088
NFA	-10896	-18224	-24575	-30980	-33300	-36349	-30427	-32298	-42704	-54697
DC	92084	103955	112023	122884	129423	137813	147836	162593	180242	206170
DCP	94647	105190	112124	121884	129301	138805	147781	162631	180764	207673
DCG	-2564	-1235	-101	1001	122	-991	55	-38	-522	-1503
π		1.187	1.266	-0.114	2.615	2.62	2.677	1.75	2.29	3.03
Japan (trillions of yen)										
GDP*	510802	521862	515835	511837	501068	496777	489618	490544	496058	502457
NFA	41.94	53.33	43.36	44.77	27.73	40.71	37.23	33.11	39.49	50.14
DC	667.36	675.96	690.11	712.82	1233.19	1192.56	1161.14	1176.25	1168.12	1156.62
DCP	575.88	578.79	583.35	570.91	972.87	564.41	521.58	498.77	486.84	499
DCG	81.42	88.15	98.42	133.85	244.72	246.79	261.82	312.34	325.29	332.97
π		1.76	0.66	-0.33	-0.712	-0.758	-0.85	-0.29	-0.008	-0.27
Nigeria (millions of naira)										
GDP	2824000	2940000	2837000	3320000	4981000	4864000	5603000	7191000	8553000	12440000
NFA	237359.0	228494.0	234954.0	662507.0	1275072	1322480	1282217	1388239	2644679	3894366
DC	371079.0	365871.0	512490.0	632010.0	472012.0	829528.0	1328183	1701210	1262071	1169839
DCP	252292.0	310661.0	366127.0	447843.0	582606.0	820793.0	932783.0	1184669	1496542	1938885
DCG	118787.0	55210.00	146363.0	184167.0	-110594	8735.00	395400.0	516541.0	-234471	-769046
π		8.53	10	6.61	6.93	18.87	12.87	14.03	15	17.86

* billions of yen
Source: IMF, IFS
NFA= net foreign assets, DC = domestic credit, DCP = domestic credit to the private sector, DCG = domestic credit to the government, π = rate of inflation (percentage annual change in CPI)

Appendix 2: Distribution of GMT Indices

CBI Indices	1991–1992	2004	CBI	1991–1992	2004
Czech Republic*			**New Zealand**		
Political index (score out of 7 points)	-	7	Political index	0	0.25
Economic index (score out of 8 points)	-	7	Economic index	0.375	0.625
General index	-	14	General index	0.188	0.438
Egypt			**Poland**		
Political index	0.5	0.167	Political index	0	1
Economic index	0.6	0.8	Economic index	0.2	1
General index	0.545	0.455	General index	0.091	1
USA			**Israel**		
Political index	0.625	0.625	Political index	0.333	0.333
Economic index	0.875	0.875	Economic index	0.2	0.8
General index	0.75	0.75	General index	0.273	0.545
Germany			**Japan**		
Political index	0.75	1	Political index	0.125	0.125
Economic index	0.875	0.75	Economic index	0.625	0.75
General index	0.813	0.875	General index	0.375	0.438
Brazil			**Nigeria**		
Political index	0.167	0.333	Political index	0.167	0.333
Economic index	0	1	Economic index	0.6	0.8
General index	0.091	0.636	General index	0.364	0.545
UK					
Political index	0.125				0.375
Economic index	0.625				1
General index	0.375				0.688

Source: Arnone et al. (2006b).
* Not available for the period 1991–1992

Appendix 3: Stationarity Test and Estimation Results

The unit root test is one of the most popular tools used over the past several years to check the stationarity of time series. Since the sample used in the study is not large I will use an alternative method to check stationarity, namely, the autocorrelation function (ACF). Formally, we examine the null hypothesis that the autocorrelation coefficients in the ACF are not significantly different from the true values of the society at a determined level of significant. Comparing the computed value of Box-Ljung (BL) with its critical value extracted from a chi-square distribution at degrees of freedom equal to the number of lags and the determined level of significant (0.05), one can reject or accept the null hypothesis. I will use the OLS method to estimate the parameters of the equation DCPY/NFAY, DCGY. I will also check the validity of the assumptions of OLS for all cases used in the sample. Using SPSS I will estimate the previous equation for eleven countries: Egypt, Brazil, Nigeria, the Czech Republic, Poland, Israel, New Zealand, Japan, the UK, the USA, and Germany. The ACF and the estimation results are as follows:

1. Egypt

A linear correlation is found between the residuals of the sum of the squares and NFAY. As a solution, I used the following transformed form: DCPY/√NFAY= A1 + A2 (√NFAY) + A3 (DCGY/√NFAY). The resulting time series is changed to stationary after the second difference is taken for all the variables. Table 1 shows the stationary ACF for all the variables, where the value of X^2 at 7 df and a level of significance of 0.05 is equal to 14.067.

Table 1: ACF – The second difference

```
Autocorrelations: DCPYWR: DCPY/ √NFAY

Transformations: difference (2)
     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
  *******   .          284.   326.-  1ó          .                1.313   .252
  2   .080   .266          .          ó**        .                1.404   .496
  3   .011   .246           .          *        .                1.406   .704
  4  -.240   .225            .    *****ó        .                 2.543   .637
  5  -.105   .201             .      **ó       .                  2.819   .728
  6  -.039   .174              .      *ó      .                   2.869   .825
  7   .002   .142               .      *     .                    2.869   .897
```

```
Autocorrelations: DCGYWR: DCGY/ √NFAY

Transformations:  difference (2)
     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
  *******   .          284.   331.-  1ó          .                1.357   .244
  2   .013   .266          .           *        .                 1.359   .507
  3  -.263   .246           .    *****ó        .                  2.496   .476
  4   .176   .225            .         ó****   .                  3.108   .540
  5  -.087   .201             .      **ó      .                   3.296   .654
  6  -.073   .174              .      *ó     .                    3.470   .748
  7  -.021   .142               .      *    .                     3.492   .836
```

```
Autocorrelations: NFAYWR: √NFAY

Transformations:  difference (2)
     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  *******   .         284.   363.-  1ó          .                1.627   .202
  2   .183   .266          .          ó****      .                2.100   .350
  3  -.264   .246           .     *****ó         .               3.248   .355
  4   .073   .225            .        ó*        .                3.353   .501
  5  -.072   .201             .      *ó        .                 3.480   .626
  6  -.115   .174              .    **ó       .                  3.916   .688
  7  -.138   .142               .  ***ó      .                   4.864   .677
```

The estimated parameters are:

$(1\text{-}L)^2$ DCPY** = -0.0035 - 2.259 $(1\text{-}L)^2$ NFAY** + 0.587$(1\text{-}L)^2$ DCGY**

t	-0.052	-1.043	1.469
n	9		
R^2	76.3 %		
d	2.031		

where DCPY** = DCPY/√NFAY, NFAY** = √NFAY, and DCGY** = DCGY/√NFAY.

Using a stepwise method:

$(1\text{-}L)^2$ DCPY** = -0.001 + 0.935$(1\text{-}L)^2$ DCGY**

t	-0.148	4.242*
n	9	
R^2	72 %	
d	1.99	

2. Brazil

The best formula making all the variables stationary is the first difference of the logarithmic value of all the variables. Table 2 shows this case.

Table 2: ACF – The logarithmic formula

```
Autocorrelations: DIFF(LNDCPY,2)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  **********.         284.   520.-  1ó          .                 3.352   .067
  2   .006   .266          .          *         .                3.352   .187
  3  -.001   .246           .         *        .                 3.352   .340
  4   .018   .225            .        *       .                  3.358   .500
  5   .015   .201             .       *      .                   3.364   .644
  6  -.017   .174              .      *     .                    3.374   .761
  7   .001   .142               .     *    .                     3.374   .848
```

```
Autocorrelations: DIFF(LNNFAYY,2)

      Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  *****     .         284.   261.-  1ó          .                  .842   .359
  2  -.234   .266          .     *****ó         .                1.617   .446
  3   .115   .246           .         ó**      .                 1.834   .608
  4  -.039   .225            .       *ó       .                  1.864   .761
  5   .064   .201             .       ó*     .                   1.964   .854
  6  -.103   .174              .    **ó     .                    2.314   .889
  7  -.024   .142               .     *    .                     2.343   .938
```

```
Autocorrelations: DIFF(LNDCGY,2)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
  ********* .          284.   467.-  1ó          .                2.697   .101
  2   .064   .266          .         ó*          .                2.754   .252
  3  -.155   .246           .     ***ó          .                 3.148   .369
  4   .016   .225            .       *        .                   3.153   .533
  5   .021   .201             .      *      .                     3.164   .675
  6   .026   .174              .     ó*     .                     3.186   .785
  7  -.005   .142               .    *     .                      3.187   .867
```

The estimated parameters are:

$$(1\text{-}L)LN\ DCPY = -0.139 + 0.509(1\text{-}L)\ LN\ NFAY + 0.878(1\text{-}L)\ LN\ DCGY$$

t	-1.671	2.765*	11.885*
n	9		
R^2	96.6 %		
d	2.405		

Using a stepwise method:

$$(1\text{-}L)LN\ DCPY = -0.157 + 0.918(1\text{-}L)\ LN\ DCGY$$

t	-1.355	9.077*
n	9	
R^2	92.2 %	
d	2.405	

3. Nigeria

The residuals of the sum of the squares are found to be linearly correlated with NFAY. As a solution, I used the following formula:

$$DCPY/\sqrt{NFAY} = A_1 + A_2(\sqrt{NFAY}) + A_3(DCGY/\sqrt{NFAY})\ \text{or,}$$
$$DCPY^{**} = A_1 + A_2\,NFAY^{**} + A_3\,DCGY^{**}$$

The resulting time series was stationary, except in the case of NFAY. Table 3 shows the stationary time series for all the variables after the first difference is taken for $NFAY^{**}$, where the value of X^2 at 8 df and a level of significance of 0.05 is equal to 15.5073.

The estimated parameters are as follows:

$$DCPY^{**} = 0.319 - 0.241\ (1\text{-}L)\ NFAY^{**} + 0.399\ DCGY^{**}$$

t	16.33*	-1.004	2.566*
n	9		
R^2	61.4 %		
d	1.734		

Table 3: ACF – The transformed form

```
Autocorrelations: DCPYW: DCPY/ √NFAY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
            .          274.   169.   1ó***       .                 .382   .536
  2  -.617   .258        **.*********ó          .                 6.090   .048
  3  -.326   .242           .  *******ó          .                 7.912   .048
  4   .142   .224            .       ó***      .                  8.316   .081
  5   .362   .204             .      ó*******.                   11.467   .043
  6   .041   .183              .     ó*     .                    11.517   .074
  7  -.242   .158               .*****ó    .                     13.867   .054
  8  -.066   .129                .   *ó   .                      14.126   .079
```

```
Autocorrelations: DCGYW: DCGY/ √NFAY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòú
             .            274.   197.   1ó****        .                .517   .472
  2  -.487   .258              **********ó            .              4.068   .131
  3  -.161   .242              .      ***ó            .              4.512   .211
  4   .295   .224               .        ó******   .                6.256   .181
  5   .190   .204                .       ó****    .                 7.126   .211
  6  -.164   .183                 .   ***ó      .                   7.935   .243
  7  -.125   .158                  .  ***ó     .                    8.564   .286
  8  -.101   .129                   .  **ó    .                     9.182   .327

Autocorrelations: NFAYW_1: (1-L)( √NFAY)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòôòòòòòòòòú
  950.   004.                .          *          .            284.   018.-  1
*******   .             266.   352.-  2  ó          .                1.756   .416
  3  -.306   .246              .   ******ó          .               3.297   .348
  4  -.101   .225               .      **ó         .                3.498   .478
  5   .389   .201                .       ó********                  7.253   .203
  6  -.063   .174                 .     *ó      .                   7.384   .287
  7  -.079   .142                  .   **ó     .                    7.692   .361
```

Using a stepwise method:

$DCPY^{**} = 0.31 + 0.44\ DCGY^{**}$

t	18.055^{*}	2.923^{*}
n	9	
R^2	55 %	
d	1.84	

4. Czech Republic

A nonlinear correlation is found between the residuals of the sum of the squares and NFAY. As a solution, I used the following formula:

$$DCPY/NFAY = A_1 + A_2 1/NFAY + A_3\ DCGY/NFAY$$

The resulting time series was stationary, except for the variable 1/NFAY. The first difference and the semi-log formula were taken as follows:

$$(1\text{-}L)\ LN\ (DCPY/NFAY) = A_1 + A_2\ (1\text{-}L)(1/NFAY\ ) + A_3\ (1\text{-}L)(DCGY/NFAY) \text{ or,}$$

$$(1\text{-}L)LN\ DCPY^{**} = A_1 + A_2\ (1\text{-}L)\ NFAY^{**} + A_3\ (1\text{-}L)DCGY^{**}$$

Table 4 shows the stationary time series for all the transformed variables, where the value of X^2 at 7df and a level of significance of 0.05 is equal to 14.0671.

The estimated parameters of the above transformed form were as follow:

$(1\text{-}L)\ LN\ DCPY^{**} = -0.0341 + 0.309\ (1\text{-}L)\ NFAY^{**} - 0.607(1\text{-}L)\ DCGY^{**}$

t	-0.575	3.246^{*}	-1.735
n	9		
R^2	66.1 %		
d	2.147		

Using a stepwise method:

$(1\text{-}L)\ LN\ DCPY^{**} = -0.0655 + 0.274\ (1\text{-}L)\ NFAY^{**}$

t	-1.022	2.594^{*}
n	9	
R^2	49 %	
d	1.106	

Table 4: ACF – The transformed form

Autocorrelations: LNDCPY_1: (1-L) LN DCPY**

```
     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
            .          284.   293.   1ó******    .                 1.063   .303
  2  -.057   .266           .         *ó         .                 1.109   .574
  3   .018   .246            .         *        .                  1.114   .774
  4  -.272   .225             .   *****ó        .                  2.582   .630
  5  -.353   .201              .*******ó       .                   5.664   .340
  6  -.131   .174               .   ***ó      .                    6.234   .397
  7  -.016   .142                .     *     .                     6.247   .511
```

Autocorrelations: NFAYW_1: (1-L) NFAY**

```
     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
            .          284.   259.   1ó*****     .                  .833   .361
  2   .064   .266           .          ó*        .                  .891   .641
  3   .040   .246            .         ó*       .                   .917   .821
  4  -.263   .225             .   *****ó        .                  2.292   .682
  5  -.379   .201              ********ó       .                   5.838   .322
  6  -.188   .174               .  ****ó      .                    6.999   .321
  7  -.054   .142                .    *ó     .                     7.143   .414
```

Autocorrelations: DCGYW_1: (1-L) DCGY**

```
     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
            .          284.   279.   1ó******    .                  .963   .327
  2  -.275   .266           .     *****ó         .                 2.030   .362
  3  -.227   .246            .    *****ó        .                  2.879   .411
  4  -.162   .225             .     ***ó       .                   3.396   .494
  5  -.103   .201              .     **ó      .                    3.657   .600
  6  -.221   .174               .  ****ó     .                     5.263   .511
  7   .047   .142                .     ó*    .                     5.371   .615
```

5. New Zealand

The time series is found to be stationary for all the variables. A nonlinear correlation is found between the residuals of the sum of the squares and DCGY. As a solution I used the following formula:

$$DCPY^* = A_1 + A_2\ NFAY^* + A_3\ DCGY^*,$$

where $DCPY^*$ = DCPY/ DCGY, $NFAY^*$ = NFAY/ DCGY, and $DCGY^*$ =1/DCGY. The resulting time series was also stationary, as shown in Table 5.

The estimated parameters are as follows:

$DCPY^* = -7.849 - 0.275\ NFAY^* + 1.087\ DCGY^*$

t	-0.781	-0.582	9.737*
n	10		
R^2	100 %		
d	1.047		

Using a stepwise method:

$DCPY^* = -6.753 + 1.152\ DCGY^*$

t	-0.714	176.982*
n	10	
R^2	100 %	
d	0.932	

Table 5: ACF – The transformed form

```
Autocorrelations: NFAW: NFAY/ DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1  Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  ********  .         274.   381.-  1ó          .                1.934   .164
  2   .075   .258             .        ó*        .                2.018   .365
  3  -.172   .242             .     ***ó         .                2.524   .471
  4  -.155   .224              .    ***ó        .                 3.007   .557
  5   .154   .204               .      ó***    .                  3.575   .612
  6   .008   .183                .      *     .                  3.577   .734
  7  -.027   .158                 .    *ó    .                    3.607   .824
  8  -.001   .129                  .    *   .                    3.608   .891
```

```
Autocorrelations: DCGW: 1/DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1  Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  ********  .         274.   403.-  1ó          .                2.169   .141
  2   .052   .258             .        ó*        .                2.209   .331
  3  -.132   .242             .     ***ó         .                2.507   .474
  4  -.146   .224              .    ***ó        .                 2.931   .569
  5   .153   .204               .      ó***    .                  3.490   .625
  6   .005   .183                .      *     .                  3.491   .745
  7  -.030   .158                 .    *ó    .                    3.526   .832
  8   .000   .129                  .    *   .                    3.526   .897
```

```
Autocorrelations: DCPYW: DCPY/ DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1  Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  ********  .         274.   397.-  1ó          .                2.097   .148
  2   .053   .258             .        ó*        .                2.139   .343
  3  -.137   .242             .     ***ó         .                2.462   .482
  4  -.141   .224              .    ***ó        .                 2.857   .582
  5   .148   .204               .      ó***    .                  3.384   .641
  6   .004   .183                .      *     .                  3.384   .759
  7  -.031   .158                 .    *ó    .                    3.424   .843
  8   .000   .129                  .    *   .                    3.424   .905
```

6. Poland

The time series was non-stationary for all the variables except for NFAY. Taking the first difference for the variables DCPY and DCGY, the time series is changed to stationary for all the variables, as shown in Table 6.

The estimated parameters are:

(1-L) DCPY= -0.262 +1.604 NFAY- 0.197(1-L) DCGY

t	-4.406^{*}	4.563^{*}	-2.053
n	9		
R^2	85.6 %		
d	1.457		

Using a stepwise method:

(1-L) DCPY = -0.301 +1.852 NFAY

t	-4.431^{*}	4.644^{*}
n	9	
R^2	75.5 %	
d	1.945	

Table 6: ACF

```
Autocorrelations: DCPY_1: (1-L)DCPY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
            .          284.   480.   1ó**********.                   2.849   .091
  2   .116   .266           .           ó**        .                 3.039   .219
  3  -.051   .246            .         *ó         .                  3.082   .379
  4  -.430   .225             *********ó         .                   6.745   .150
  5  -.372   .201              .*******ó        .                   10.173   .070
  6  -.155   .174               .    ***ó      .                    10.967   .089
  7  -.076   .142                .    **ó     .                     11.256   .128
```

```
Autocorrelations: NFAY


     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
            .          274.   281.   1ó******     .                  1.050   .306
  2   .086   .258            .          ó**       .                  1.161   .560
  3  -.355   .242            .  *******ó         .                   3.325   .344
  4  -.404   .224             .********ó        .                    6.587   .159
  5  -.316   .204              . ******ó       .                     8.979   .110
  6  -.004   .183               .       *     .                      8.979  .175
  7   .027   .158                .      ó*    .                      9.009   .252
  8   .266   .129                 .     ó*****                      13.244   .104
```

```
Autocorrelations: DCGY_1: (1-L)DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  *****     .          284.   275.-  1ó          .                    .935   .334
  2  -.018   .266           .           *        .                    .939  .625
  3  -.238   .246            .    *****ó        .                    1.872   .599
  4   .003   .225             .         *      .                     1.872  .759
  5   .009   .201              .        *     .                      1.874  .866
  6   .016   .174               .       *    .                       1.883  .930
  7   .003   .142                .      *   .                        1.883  .966
```

7. Japan

The time series was stationary for all the variables except for DCGY. Taking the first difference for DCGY, the time series is changed to stationary, as shown in Table 7.

The estimated parameters are:

DCPY = 0.603 +3.989 NFAY+ 4.234(1-L) DCGY

t	0.952 0.575 2.989^*
n	9
R^2	75.9 %
d	1.921

Using a stepwise method:

DCPY = 0.966 + 3.574(1-L) DCGY

t	13.952^* 4.533^*
n	9
R^2	74.6 %
d	1.607

Table 7: ACF

```
Autocorrelations: DCPY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                    ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
            .          274.   031.   1ó*         .                  .013   .910
  2  -.069   .258            .        *ó         .                  .085   .958
  3  -.179   .242            .     ****ó         .                  .632   .889
  4  -.215   .224             .    ****ó        .                  1.557   .817
  5  -.159   .204              .    ***ó       .                   2.166   .826
  6   .034   .183               .      ó*     .                    2.202   .900
  7   .028   .158                .     ó*    .                     2.233   .946
  8   .021   .129                 .    *    .                     2.260   .972


Autocorrelations: NFAY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                    ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  967.   002.                .          *          .           274.   011.-  1
*        .            258.   026.-  2  ó         .                  .012   .994
  3  -.175   .242            .     ****ó         .                  .537   .911
  4  -.025   .224             .       *ó        .                   .550   .968
  5  -.371   .204              .*******ó       .                   3.859   .570
  6  -.111   .183               .    **ó      .                    4.231   .645
  7  -.002   .158                .     *    .                     4.232   .753
  8   .217   .129                 .    ó****.                      7.062   .530


Autocorrelations: DCGY_1: (1-L)DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                    ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  **        .          284.   106.-  1ó          .                  .140   .708
  2  -.341   .266           .  *******ó          .                 1.786   .409
  3   .095   .246            .         ó**      .                  1.936   .586
  4  -.012   .225             .        *      .                   1.938   .747
  5  -.234   .201              .  *****ó      .                    3.296   .654
  6  -.039   .174               .     *ó     .                     3.346   .764
  7   .082   .142                .     ó**   .                     3.679   .816
```

8. USA

After the first difference is taken for all the variables, the time series is changed to stationary. Table 8 shows this case.

The estimated parameters are:

(1-L) DCPY = 0.0229 + 0.78 (1-L) NFAY – 0.912 (1-L)DCGY

t	10.49^{*}	3.597^{*}	-43.202^{*}
n	8		
R^2	99.9 %		
d	2.472		

Using a stepwise method:

(1-L) DCPY = 0.019 – 0.891 (1-L) DCGY

t	5.787^{*}	-25.393^{*}
n	8	
R^2	99.1 %	
d	2.472	

Table 8: ACF

```
Autocorrelations: DCPY

Transformations:  difference (1)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  **          .         296.   104.-  1ó          .                .124   .725
  2  -.159   .274           .        ***ó         .                .463   .793
  3  -.286   .250            .    ******ó        .                1.775   .620
  4  -.089   .224             .       **ó       .                 1.935   .748
  5   .062   .194              .        ó*     .                  2.037   .844
  6   .047   .158                .      ó*   .                    2.125   .908


Autocorrelations: NFAY

Transformations:  difference (1)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
              .         296.   455.   1ó*********  .              2.367   .124
  2  -.076   .274           .        **ó          .               2.445   .295
  3  -.273   .250            .    *****ó         .                3.634   .304
  4  -.234   .224             .   *****ó        .                 4.728   .316
  5  -.275   .194              .  *****ó       .                  6.738   .241
  6  -.131   .158                .  ***ó     .                    7.426   .283


Autocorrelations: DCGY

Transformations:  difference (1)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  *           .         296.   073.-  1ó          .                .060   .806
  2  -.211   .274           .       ****ó         .                .652   .722
  3  -.265   .250            .     *****ó        .                1.778   .620
  4  -.084   .224             .       **ó       .                 1.919   .751
  5   .064   .194              .        ó*     .                  2.028   .845
  6   .047   .158                .      ó*   .                    2.117   .909
```

9. UK

The time series is found to be stationary for all the variables except for DCPY. Table 8 shows the stationary time series for all the variables after the first difference is taken for the variable DCPY, where the value of X^2 at 8 df and a level of significance of 0.05 is equal to 15.5073.

The estimated parameters are:

(1-L) DCPY = 0.133 –0.273 NFAY– 2.292 DCGY

t	4.037^{*}	-0.882	-2.85^{*}
n	9		
R^2	60.9 %		
d	1.649		

Using a stepwise method:

(1-L) DCPY = 0.133 – 2.345 DCGY

t	4.808^{*}	-2.972^{*}
n	9	
R^2	55.8 %	
d	1.727	

Table 8: ACF

```
Autocorrelations: DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1  Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
             .         274.   475.   1ó**********.                3.010   .083
  2   .157   .258            .        ó***       .                3.382   .184
  3  -.025   .242            .         *        .                3.392   .335
  4  -.369   .224             . *******ó        .                 6.116   .191
  5  -.192   .204              .   ****ó       .                  7.000   .221
  6  -.164   .183               .   ***ó      .                   7.805   .253
  7  -.193   .158                . ****ó     .                    9.289   .233
  8  -.105   .129                 .  **ó    .                     9.952   .268
```

```
Autocorrelations: NFAY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1  Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
             .         274.   507.   1ó**********.                3.426   .064
  2   .292   .258            .        ó******    .                4.709   .095
  3  -.171   .242            .      ***ó         .                5.211   .157
  4  -.419   .224             .********ó        .                 8.730   .068
  5  -.318   .204              . ******ó       .                 11.162   .048
  6  -.324   .183               .******ó      .                  14.303   .026
  7  -.020   .158                .     *     .                   14.319   .046
  8  -.047   .129                 .   *ó    .                    14.454   .071
```

```
Autocorrelations: DCPY_1: (1-L) DCPY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1  Box-Ljung  Prob.
                   ùòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòôòòòòòú
             .         284.   298.   1ó******     .               1.097   .295
  2  -.257   .266           .     *****ó          .               2.030   .362
  3  -.233   .246            .    *****ó         .                2.924   .403
  4   .152   .225             .       ó***      .                 3.384   .496
  5   .203   .201              .      ó****    .                  4.402   .493
  6  -.196   .174               .  ****ó      .                   5.676   .460
  7  -.300   .142                ******ó     .                   10.133   .181
```

10. Germany

The time series is changed to stationary for all the variables after the second difference is taken for DCPY and NFAY, as shown in Table 10.

The estimated parameters are:

$(1\text{-}L)^2$ DCPY = 0.287 –0.288$(1\text{-}L)^2$ NFAY– 1.116 DCGY

t	2.809^*	-2.063	-2.846^*
n	7		
R^2	81.9 %		
d	1.831		

Using a stepwise method:

$(1\text{-}L)^2$ DCPY = 0.352 – 1.379 DCGY

t	2.814^*	-2.892^*
n	7	
R^2	62.6 %	
d	2.536	

Table 10: ACF

```
Autocorrelations: DCPY_2: DIFF(DCPY,2)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  ********   .         309.   395.-  1ó          .               1.638   .201
  2   .093   .282           .        ó**        .               1.748   .417
  3   .046   .252            .       ó*        .                1.782   .619
  4  -.157   .218             .    ***ó       .                 2.303   .680
  5   .273   .178               .    ó***** .                  4.648   .460
```

```
Autocorrelations: DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
            .          284.   415.   1ó********  .               2.136   .144
  2   .216   .266           .        ó****      .               2.793   .247
  3  -.074   .246            .      *ó         .                2.883   .410
  4  -.208   .225             .   ****ó       .                 3.740   .442
  5  -.248   .201              .  *****ó     .                  5.257   .385
  6  -.413   .174              *.******ó    .                  10.875   .092
  7  -.106   .142                .    **ó   .                  11.428   .121
```

```
Autocorrelations: NFAY_2: DIFF(NFAY,2)

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  ************         309.   593.-  1ó          .               3.697   .055
  2   .048   .282           .        ó*         .               3.726   .155
  3   .121   .252            .       ó**       .                3.956   .266
  4   .007   .218             .      *        .                 3.957   .412
  5  -.188   .178               .  ****ó     .                  5.071   .407
```

11. Israel

A linear correlation is found between the residuals of the sum of the squares and DCGY. As a solution, I used the following transformed form: DCPY/√DCGY= A_1 + A_2 (NFAY/√DCGY) + A_3 (√DCGY). The resulting time series was stationary for all variables except for (√DCGY). Taking the first difference of (√DCGY) the time series is changed to stationary for all the variables, as shown in Table 11.

Table 11: ACF

```
Autocorrelations: DCPYW: DCPY/√DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
            .          274.   262.   1ó*****     .                .915   .339
  2   .103   .258            .       ó**       .                1.075   .584
  3   .056   .242            .       ó*        .                1.128   .770
  4  -.045   .224             .     *ó        .                 1.168   .883
  5  -.083   .204              .   **ó       .                  1.332   .932
  6  -.159   .183               .  ***ó     .                   2.090   .911
  7  -.182   .158                . ****ó   .                    3.412   .844
  8  -.228   .129                 *****ó  .                     6.524   .589
```

```
Autocorrelations: NFAYW: NFAY/√DCGY

     Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
            .          274.   251.   1ó*****      .                 .843   .359
  2   .070   .258            .          ó*        .                 .915   .633
  3  -.014   .242            .          *        .                 .919   .821
  4  -.067   .224             .        *ó        .                1.007   .909
  5  -.079   .204              .      **ó       .                 1.158   .949
  6  -.120   .183               .     **ó      .                  1.589   .953
  7  -.127   .158                .  ***ó     .                    2.230   .946
  8  -.197   .129                 .****ó    .                     4.551   .804
```

```
Autocorrelations: DCGYW_1: √DCGY

      Auto- Stand.
Lag  Corr.   Err. -1  -.75  -.5 -.25   0   .25  .5   .75   1   Box-Ljung  Prob.
                   ùòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòôòòòòú
  *         .          284.   027.-  1ó           .                 .009   .925
  2   .011   .266           .          *          .                .011   .995
  3  -.072   .246            .        *ó         .                 .096   .992
  4  -.092   .225             .      **ó        .                  .264   .992
  5  -.014   .201              .       *       .                   .269   .998
  6  -.411   .174              *.******ó      .                   5.837   .442
  7   .007   .142                .     *     .                     5.839   .559
```

The estimated parameters are:

DCPY/√DCGY = 0.892 +3.344(NFAY/√DCGY) +1.11(1-L)(√DCGY)

t	4.953^*	14.312^*	0.246
n	9		
R^2	98.6 %		
d	0.879		

Using a stepwise method:

DCPY/√DCGY = 0.874 +3.302(NFAY/√DCGY)

t	5.716^*	22.363^*
n	9	
R^2	98.6 %	
d	0.816	

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