International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2018, 8(4), 89-104.

Investigating Saving and Investment Relationship: Evidence from an Autoregressive Distributed Lag Bounds Testing Approach in Liberia

Joe Garmondyu Greaves*

Department of Economics, Huazhong University of Science and Technology, Wuhan, China. *Email: greavesgarmondyu@yahoo.com

ABSTRACT

The core thesis of this paper is to investigate the long-run relationships between the domestic investment and domestic savings of the Liberian economy using 1970-2016 full sample data and 1970-2012 subsample annual time series data. This paper uses the Augmented Dickey Fuller unit root test to ascertain the order of integration for the 2 time series variables as well as two structural breaks tests to counter check the accuracy of the unit root test. After detecting the mixed order of integration for the bivariate series, the autoregressive distributed lag (ARDL) was employed using the bounds test to study the long-run linkage between the investment and saving series and the unrestricted and restricted error correction techniques within the ARDL framework to delve in the Felstein-Horioka analytical framework. The bounds test approach shows that cointegration coexist using all the samples considered in this study.

Keywords: Cointegration, Saving, Investment, Felstein-Horioka, Liberia, Autoregressive Distributed Lag
JEL Classification: E2

1. INTRODUCTION

Savings rate in Liberia for 4 months period stood at 2.1% in 2008 and dropped to 2.0% for the same 4 months in 2010 (CBL, 2010). Over the next 4 years, another report showed that savings rate was 2.0% for the entire year, see CBL, 2010 for more exhaustive details. The low level of savings rate in Liberia coupled with high level of debt insolvency, low capital stocks, the 15 years political strives that broke down the Liberian economy resulted to the lost of lives, properties and valuable assets including financial savings of individuals and the government as well as corporate and social institutions is alarming and worth investigation. Government expenditures financing in Liberia is hugely channeled through external borrowing which is detrimental to future generation and this also could lead to future challenges of long-run reduction in consumption which is likely for the economy because the funds borrowed will have to be paid back to lenders including interests. These are facets that the government and the people of Liberia must study to narrow down the huge intertemporal budget constrained prevailing in the economy. Moreover, the future of the Liberian economy is still in a chaotic condition because the increase in capital flight as a result of lack of comprehensive regulations on funds leaving the country can distort the financial system and render the economy and people hopeless. Capital flight reduces the investible capital available in the domestic economy (Adetiloye, 2012). As Adetiloye, 2012 states, "investments that lead to increase in capital formation for the economy and act as the foundation for infrastructure or framework for the development of the country cannot be undertaken since there is paucity or inadequacy of capital." Liberia is a low income country that is ranked among the top ten poorest nations on Earth, and it is also the oldest nation in Africa, yet stills wanders in abject poverty with recent report from its statistical institution, LISGIS declaring that half of the population wallows in abject poverty.

Domestic investment in Liberia is very low and the lack of comprehensive and well-financial system still create unfavorable conditions for sound economic stability in the economy. Other things equal, conventional macroeconomic implies that foreign or domestic investment helps to create social welfare and economic growth. These in effects are serious issues in most developing economies of which Liberia is a part and is still dragging to improve various sectors of her economy. While spending on consumption goods provides utility to house holds today, spending on investment goods is aimed at providing a higher standard of living at a later date (Mankiw, 2016), and investment is the component of gross domestic product (GDP) that links the present and the future (Mankiw, 2016). Investment is of concern to most economies especially in emergent nations where policy makers try by all means to bolster their economies to the international communities through undertaking domestic investments by promoting manufactured industries or local facilities that produce goods respectively. Most governments seek to expand their economies to the outside world through different means but the financial connections is of essence because high saving economies attract more investments as compared to low or dissaving economies. Dating back to the Solow growth theory highlighted in the text of (Mankiw, 2016) insinuates clearly that demand for goods as labelled in the context of Robert Solow's model comes from investment and consumption. Conventional macroeconomic has shown that savings is important because it helps drives an economy to prosperity but also, consumption is another key factor that promotes sound economic environment because when goods produced are consumed by the people of an economy, suppliers or producers clear their inventories and this in can remarkably help to keep the labor force well structured. Similarly, when people are working and earning incomes or wages, portion of that are kept safely for future transactions and for other purposes holding other factor constant. Note, that the argument is useful to pinpoint out the usefulness of savings and other key macroeconomic indicators in most nations.

Today, in the Liberian economy, there are several institutions created by past regimes and there are still more to be created. There are sound and interesting laws enacted by past leaderships in the Liberian setting and one such institution is the National Investment Commission (NIC) among others that is responsible to aid in reducing the economic burden through international mediation that will concentrate on investing in infant domestic industries to promote economic growth and development. For example, looking back at the case of Japan and Germany after World War II, these two economies were growth disastrous countries, but during the years 1946 and 1972, growth in these two countries stood at 8.0% per year for Japan and 6.5% per year for Germany because income kept for future were utilized to expand their economies, see Mankiw, 2016. In addition, these two countries also save and invest higher fraction of their output than the US (Mankiw, 2016). The above argument does not necessarily indicate that saving all incomes will automatically yield high growth immediately. It is simply said than done, but at least on the backing of theory, it serves as a conduit that paves the way to economic recovery. The empirical work of Feldstein, 1982 in support of Feldstein and Horioka, 1980 shows evidently from their analysis that sustained increases in domestic savings rates induce approximately equal increases in domestic rates of investment. It is worthy to note that the Feldstein-Horioka approach is solely applicable to cross-sectional work for 16 OECD countries where the authors investigated the savings-investment relationships to detect capital mobility for their sample considered. Several useful studies have followed the empirical arguments of Feldstein and Horioka, 1980 in different certain adopting different methods for empirical investigation extensively considered by most scholars as the puzzle. Blanchard and Giavazzi's 2002 study (as cited in Onafowara et al., 2011) explain that in poorer EU countries, saving declines because economic integration makes anticipated future incomes higher and financial integration offers new instruments (e.g., more flexible mortgages), while investment increases because financial integration lowers the cost of borrowing and economic integration makes it easier to repay the debt (with a higher substitutability of products, the required decline in prices to boost exports is lower). Miller's 1988 study (as cited in Abbott and Vita, 2003) found that domestic investment and national savings were cointegrated under fixed exchange rates but that, due to increasing capital mobility, this long-run relationship disappeared under flexible rates example, using US data for the 1946-1987 period.

Domestic investment is only possible with aggregated domestic savings which itself is a function of the level of income (Adetiloye, 2012) and however, that the rate of investment vis a vis growth has proved to be negligible (Adetiloye, 2012). Gundlach and Sinn 1992, Jansen 1996, Jansen and Schulze 1996 , Sarno and Taylor 1998 , BajoRubio 1998 , Ozmen and Parmaksiz, 2003; 2005 , and Coakley et al., 2004 study (as cited in Mastroyiannis, 2007) explains the findings of these studies which suggest that policy regime changes introduce structural breaks which significantly bias the empirical results towards rejecting the hypothesis of capital mobility. As Mastroyiannis, 2007 notes, "such evidence calls for a "country by country" approach –as opposed to cross section analysis- in order to ensure that the particular characteristics of the economy under examination are incorporated explicitly into the empirical analysis (Corbin 2001 , Coakley et al., 2004 , Taylor 2002 , Jansen 1996 , Mark 2003 , Giannone and Lenza 2004 , provide an analysis of the effects of country heterogeneity on the estimation methodology)." To delve into the ongoing debate on this issue, and to contribute to this development, this current research revisits the empirical question of saving-investment long-run relationship using annual data from Liberia applying the autoregressive distributed lag (ARDL) model through the (Pesaran and Shin, 1999) and (Pesaran et al., 2001) bounds testing approach.

The economy of Liberia stands at a dangling path and pushing for economic recovery despite the innumerable efforts. With this in mind, to understand the myths in the literature on Liberia's prosperity through increased or attractive domestic investments, needs an answer to the question: Is there any relationship between savings and investment that will help to promote economic growth in Liberia in the long-run? It is to this question, that the research attempts to identify if there is any long-run relationship between investment-ratio and savings-ratio. Hence, high savings could also reduce or limit the percentage of external debts owed to foreign institutions and countries. Most previous studies have focused mostly on developed economies and some narrowly addressed the issues in other context of LDCs. In my opinion, this paper contributes to the empirical literature considering Liberia as a case study in the Sub-Saharan region of Africa and among the least developed countries of the world and the empirical methods described in the next section to investigate this link proves pivotal. The key tool adopted which is the bounds testing procedure applied in this work allows testing for the existence of cointegration when it not known with certainty whether the regressors are purely I(0), purely I(1) or mutually cointegrated (Abbott and Vita, 2003). To achieve the purpose of this study, the author employs the following approaches. Firstly, the purpose as previous stated is to identify if there is any long-run relationship between investment-ratio and savings-ratio, and the extent to identify if the correlation is high or low to allow capital mobility or restrict capital mobility in the Liberian setting. Most empirical studies carried out in African economies do not investigate Liberia's data either due to the lack of knowledge about the economy, or due to comprehensive data manipulation for the Liberian sector.

Secondly, this study adopted the unrestricted error correction analysis within the context of the ARDL model to test this long run effect using annual data from 1970 to 2016 of the Liberian economy with some robust fill-in methods to circumvent the data missingness issues. Most studies applied in the African settings do not accurately and convincingly state how the data investigated for macroeconomic variables with missing values are computed. As rightly stated by Honaker and King, 2010 missing data is a ubiquitous problem in social science data. Respondents do not answer every question, countries do not collect statistics every year, archives are incomplete, subjects drop out of panels. The author also points out that most statistical analysis methods, however, assume the absence of missing data, and are only able to include observations for which every variable is measured. Given that Honaker and King, 2010 further argue that data missingness can lead to inefficient results and inaccurate modeling based on the methods used to impute missing observations. The task is to employed the multiple imputation approach of Honaker and King, 2010 Expectation-Maximization with Bootstrapping (EMB) algorithm to fill-in the missing data. This method is different from the list wise deletion, ad-hoc imputation methods, etc. For justifiably reason, this paper compares the imputed missing values using the former approach to another robust method Buuren and Groothuis-Oudshoorn, 2011.

Data missingness is one of the many factors that African economies faced and as such, an analyst has to adopt robust statistical imputation method(s) to fill-in missing values. These methods are not ironclad method because the true sample could be mismatched resulting to misleading information. However, there are several methods proposed in the literature to circumvent these economic challenges, but some methods are not accurate. The second approach is to perform a more comprehensive unit root test and unit root test with structural break as an approach to counter check the traditional unit root test which sometimes lead to inconclusive results. The third step of the paper is to estimate the unrestricted error-correction model of the ARDL model for the investment-ratio function, I/Y and the saving-ratio function, S/Y for both 1970-2016 full sample and 1970-2012; and thereafter, apply the bounds tests based on the standard Wald test statistic with critical that will account for small sample observations found in Narayan, 2005. The sample selection process is discussed in the data section. Next, to achieve the objective is to present the speed of adjustment results if there is long-run relationships between the saving and investment series.

The next sections of this paper are as follow. Section II presents the literature of related studies. Section III demonstrates the econometric methodology and the data source and description of the data. Section IV presents empirical framework for the investment-saving modeling strategy and the ARDL approach. Section V shows the empirical modeling results and conclusion. Finally, Section VI concludes the study and highlights the limitations of the study and gives some policy implications.

2. REVIEW OF THE LITERATURE

The wide range of literature about the Feldstein-Horioka puzzle is huge in the literature, therefore, this current work presents the literature closely related to its motive. Mankiw, 2016 defines investment as consisting of items bought for future use. Further stated, Mankiw, 2016 narrates that investment is divided into three subcategories: Business fixed investment, residential fixed investment, and inventory investment. Miller's 1988 study (as cited in Venkata, 2012) found that in the U.S. (using data for 1946-87) both savings and investment were integrated of order 1 and shared a cointegrating relationship prior to the Second World War period and that the long-run relationship did not exist after. He concluded that this phenomenon could be explained by the increased international mobility after the War. Feldstein, 1982 empirically examined the relationships between savings and investment using 16 OECD countries in a cross-sectional context. The author found that that sustained increases in domestic savings rates induce approximately equal increases in domestic rates of investment. Furthermore, Feldstein, 1982 finds that new estimates for the post OPEC period 1974-1979 imply that each extra dollar of domestic saving increases domestic investment by approximately 85 cents in a sample of 17 OECD countries.

Venkata, 2012 examined the degree of integrating relationship of savings and investment using 43 periods data for India. The results revealed that there in short run relationship which proves there was moderate capital mobility but there was no long run relationship between the savings and investment rates disproving the absence of Feldstein Horioka puzzle for the Indian Economy. Abbott and Vita, 2003 used the bounds testing procedure to cointegration within an ARDL framework using UK quarterly data, they re-examined the nature and degree of the relationship between savings and investment. Their finding of cointegration in all samples considered is consistent with the view that the long-run relationship between savings and investment is not exclusively dependent upon the level of financial integration. Also, Abbott and Vita, 2003 showed that the evidence also indicated that this relationship weakened after the abolition of UK controls on capital flows in 1979, suggesting that the Feldstein–Horioka framework provides at least a partial measure of the degree of capital mobility.

Another study in Nigeria, which considered capital flight as a serious impediment to developing economies growth by Adetiloye, 2012 undertook an empirical investigation of the problem using variables of investment, exchange rates and others in a vector error correction mechanism and the ordinary least regression analyses to test the level of significance of the impacts of each of the adopted variables. Adetiloye, 2012 results indicated that capital flight has negative but insignificant impact on domestic investment in Nigeria. Adetiloye, 2012 result suggested that the high level of capital flight or low level of investment undertaken over the years in the economy resulted to this estimates. Also, the author included the exchange rate but the estimated value was significant in investment but insignificant in capital flight. Adetiloye, 2012 paper recommended further floating of the exchange rate and transparency in its management. It also recommends that policies to encourage autonomous investment by both private and public sector be put in place. Onafowara et al., 2011 examined the relationship between saving and investment in eight advanced economies of the European Union. They tested for cointegration, causality and dynamic effects of shocks to saving and investment, using the ARDL bounds testing approach to cointegration, an unrestricted error correction model (UECM) of the ARDL, and a VAR analysis of forecast error variance decompositions. Onafowara et al., 2011 found evidence of cointegration between saving and investment in six countries based on the UECM of the ARDL. In addition, their results evidently show that there is long-run causality running from saving to investment in the Netherlands and the United Kingdom, a reverse causality in Denmark, Germany, and Luxembourg, bidirectional causality in Belgium, and neutrality in France and Italy. Recently, Mastroyiannis, 2007 examined the degree of integration of the Greek economy into international capital markets using the analytical framework proposed by Felstein-Horioka. The author examined the argument using time series properties of data on current account balance and national savings for the period 1960-2004. Further stated, Mastroyiannis, 2007 applied structural breaks to account for historical evolution of the institutional framework that governs international transactions. Evidently, Mastroyiannis, 2007 suggested that the links of the Greek economy to international capital markets have significantly strengthened after its accession to the European Union. Furthermore, the empirical results add another piece of evidence –albeit small- to the literature on the Feldstein-Horioka puzzle, indicating that the Feldstein-Horioka puzzle does not hold for the Greek economy. Apergis and Tsoulfidis, 1997 investigated the relationship between saving and investment in an effort to shed light on the issue of mobility of capital and whether or not this is prevented by the presence of any barriers. The author used annual data spanning from 1960-1994 period. Apergis and Tsoulfidis, 1997 empirical results showed that for the E.U. countries, saving and the provision of credit are two cointegrated variables, which means that for each E.U. country (Belgium was the only exception) the amount of money saved is closely related to the amount of money that is ultimately invested. Similarly, their result lend support to the view that in E.U. countries the degree of capital mobility plays a minor role in investment, which is primarily influenced by the conditions affecting the domestic provision of savings.

In addition, the econometric analysis shows that the causal linkage is in most countries from savings to investment. Cooray and Sinha, 2007 empirically examined the relationship between the saving and investment rates for 20 African countries using a long period of data excluding Liberia. In their work, they employed the new Ng–Perron unit root tests to examine the stationarity of saving and investment rates. Further, Cooray and Sinha, 2007 showed both Johansen cointegration tests and fractional cointegration tests and their results are inconclusive from their findings. Cooray and Sinha, 2007 further showed results from the Johansen cointegration tests fractional cointegration test results are different. They found that two rates are found to be fractionally cointegrated for the following 12 countries, while 4 countries results showed some evidence of capital mobility while the results for the rest 4 countries are mixed. Hamdi and Sbia, 2013 empirically investigated the saving-relationship for six Middle East and North African countries using time series data ranging from 1980 to 2008. They applied the panel cointegration approach and the ECM to examine the links between the two time series variables. Hamdi and Sbia, 2013 result showed that there is causality between investment and saving for the entire sample, and also they reveal from their study that there is feedback causality between the variables. Coakley et al., 1996 suggested an alternative explanation of the high cross-section association between shares of saving and investment in GDP which Feldstein and Horioka (1980) interpreted as evidence of low capital mobility. In their study on OECD countries, saving and investment shares appear to be integrated of order one. Coakley et al., 1996 showed that a solvency constraint implies that the current balance is stationary and, thus, that saving and investment cointegrate with a unit coefficient irrespective of the degree of capital mobility. Moreover, Coakley et al., 1996 pointed out that it is the long-run relation that the Feldstein-Horioka cross-section regression captures. Adebola and Dahalan, 2012 examined the degree of capital mobility in Tunisia for 1970-2009 period, using Feldstein and Horioka (1980) method of savings and investment comovement. The authors applied ARDL bound test to assess comovement between savings and investment; and thereafter computed the savings retention ratio with fully modified ordinary least squares and dynamic ordinary least squares as complements. Their results reveal low capital mobility, in contrary to Maminingi (1997) who noted perfect capital immobility in Tunisia.

Ma et al., 2013 on the other hand, studied the behavior of China's current account series. They examined these domestic and external imbalances from two perspectives: The saving-investment balance and the effective renminbi exchange rate. Also, Ma et al., 2013 found that China's large external surplus has arisen neither from anaemic consumption nor from weak investment but rather from the saved windfalls from favorable demographics, market liberalization, robust restructuring and World Trade Organization accession. They further stated that looking ahead, as these windfalls fade, saving will subside. The exchange rate is already playing a supporting role in rebalancing the Chinese economy, and the real effective exchange rate based on unit labor costs has appreciated very sharply. Prospective savings-investment and exchange-rate developments point to a higher consumption share and a narrowing of China's current account surplus.

3. ECONOMETRIC METHODOLOGY

3.1. Augmented Dickey Fuller (ADF) Unit Root Testing

To achieve the purpose of this study, I employ the robust empirically used unit root testing procedures outlined in the work of Pfaff, 2008 who presents more detailed explanations of ADF unit root testing procedures respectively. In this study, only the ADF test is implemented because it is the most popular test used. Also, the equations are easy to write out and comprehend. The lag structures and the trend term of an individual test equation are sensitive, and as such, one needs to investigate it well. Most empirical works reviewed in this current literature applied the Dickey and Fuller, 1979, while others used the (Phillips and Perron, testing for a unit root in time series regression, 1988) and the modified version of the two previous tests (Elliott et al., 1996) respectively. On the other hand, some studies only employed the ADF; therefore, this paper uses the ADF version only. There are three well-know possible versions of the ADF method but this study presents the general equation taken from Pfaff, 2008. p. 5 which includes all three deterministic terms, such as, drift/constant/intercept term, and trend term.

$$\Delta y_t = \alpha + yt + \delta y_{t-1} + \sum_{i=1}^{\rho} \phi_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

Where α is the constant or drift term, the γ represents the parameter on the time trend series, δ is the parameter of interest which on the first lagged value of the series (i.e., individual series), ρ denotes the lag order of the autoregressive (AR), Δyt is the first difference of the individual time series at current time t period and its previous 1 year value which could be written as $\Delta yt=yt-y\ t-1$, and the εt is the random error term which indicate that the individual series are serially uncorrelated with mean zero and constant variance. According to Asteriou and Hall, 2007, "unless the econometrician knows the actual data-generating process, there is a question concerning whether it is most appropriate to estimate any of the three versions of the ADF specifications." Empirically, the ADF test can be performed by testing individual series starting with the general form as in Eq. (1) then estimating down to a drift model only when $\alpha=0$, $\gamma=0$ *and* $\delta=0$, then the equation becomes a pure random walk process. Consequently, the null to test in Eq. (1) is written as $H0: \gamma=0$, $Ha: \gamma<0$. The Akaike information criterion (AIC) and the Schwarz Bayesian Criterion are mostly used to determine the maximum lags to be included in the ADF procedures as defined here to test for unit root in the literature. If the null is rejected, the series is declared a stationary process and non-rejection is the reverse.

3.1.1. Unit root test with structural break

Already known in the empirical literature that traditional unit root tests have low power and that the results can result to bias estimation, either due to political change that may affect the level in the data when not critically considered or due to shocks in economic data that cannot easily be seen by visual inspection, and a break can have a long lasting effect on the series. Recent work of Mastroyiannis, 2007 also applied structural break to Greek economy since unaccounted distorted nature in the data leads to biased estimates of the estimated parameters. A more comprehensive work of Glynn et al., 2007 and Pfaff, 2008 reviewed extensively the literature on unit root tests and also accounted for structural breaks, that is for known breaks determined both exogenously and endogenously. Structural shift can ideally be handled by including dummy variable in the testing equation. Not to restate the existing literature, following the specifications based on a single exogenous (known) break approach proposed by Perrron (1989), this study displays the more general equation that allows for a break in the intercept and the slope respectively.

$$y_t = \theta + \beta_1 t + (\theta_2 - \theta_1) DU_t + (\beta_2 - \beta_1) DT \quad (2)$$

Where, DUt is the level series; DUt=1if(t>TB) and zero otherwise; also the slope dummy $DT_t(also DT_t^*)$ is the change in the rate of growth of the linear trend equation; $DT_t^* = t - TB$ and zero otherwise; the crash dummy variable (DTB)=1 if it is known that t=Tτ+1, and zero otherwise; where the TB represents the break date respectively. The null to be tested is that the specification (2) is nonstationary with break, while the alternative states that the process is stationary with trend break. The above describe process is an exogenous break test function. But this approach has come into being criticized in the literature because Zivot and Andrew (1992) work, (as cited in Pfaff, 2008. p. 110) states that the risk of data mining exists if the break point is set exogenously by the researcher. Also as noted in Pfaff, 2008 who further points out that Z-A propose a test that circumvents this possibility by endogenously determining the most likely occurrence of a structural shift. With this backdrop, most recently, Narayan, 2005 also applied the Z-A method to his work to investigate the long-run relationships between saving and investment in China. The below equations are similar to the likes of Narayan, 2005.

$$\Delta y_t = k + \varphi_1 y_{t-1} + Yt + \theta_1 DU_t + \sum_{i=1}^{k} d_i \Delta y_{t-i} + u_t \quad (3)$$

This model allows for the change in the level of the intercept term. Consequently, the below model accounts for both the intercept and the trend to deal with the limited awkward and restricted case as in (3):

$$\Delta y_t = k + \varphi_1 y_{t-1} + Yt + \theta_1 DU_t + \mu DT_t + \sum_{i=1}^{k} d_i \Delta y_{t-i} + u_t \quad (4)$$

Where the first difference is Δ, and the ut is white noise with σ^2 respectively, and the sample is spanned from t=1,2,…,T. Also the DUt (τ)=1 if t>Tτ and 0 otherwise; and $DT_t^*(\tau) = t - T\tau$ ô for t>Tτ and zero otherwise[1]. The lag length is based on the ADF t-sig. This approach also has been criticized but the interested reader can follow the debate in the extensive literature.

3.1.2. Data strategy and source

In this study, I attempt to investigate the long-run linkage between the investment-ratio (I/Y) which is defined as gross domestic investment divided by GDP, the savings-ratio (S/Y) which is gross domestic savings divided by GDP (Y) respectively as defined by Feldstein, 1982 using 1970-2016 annual time series data for the Liberian economy. The variables used in this study are GDP (Y), gross domestic saving (S) = (GDP – private consumption – government consumption), and gross domestic investment (I) = gross fixed capital formation as defined by many studies defined below. Onafowara et al., 2011 study used similar variables

1 Pfaff, 2008 showed that because of the estimated τ, the appropriate critical value to use of the Phillips and Perron (1989) is now depended upon the Zivot and Andrews (1992) critical value

for 8 E.U. countries. They calculated the gross domestic saving variable by subtracting private consumption and government consumption. Similarly, they calculated the gross domestic investment by summing the gross fixed capital formation plus changes in capital taking the logarithmic transformation. The authors did not specified the unit of measures of their variables which is substantial in empirical research.

Abbott and Vita, 2003 defined investment as gross fixed capital formation, income variable as GDP, and gross savings GDP less household consumption, consumption of non-profit institutions and general government expenditure using quarterly UK data. They used seasonal adjusted data for their variables in absolute form and all variables data in current prices. Furthermore, Venkata, 2012 used 1970-2012 Indian annual time series data and collected data for net savings instead of gross savings, income variable as real GDP, and domestic investment variable respectively. Likewise, Cooray and Sinha, 2007 considered saving variable as GDP minus private and government consumption, investment as gross fixed capital formation in the context of 20 African economies. As Feldstein, 1982. p. 11 states, "if there were no problems of measuring savings, investment and international transactions, the difference between gross domestic savings and gross domestic investment would be equal to the balance on current account (CA). This suggests that, instead of using the conventional national income account measure of domestic savings, the value of gross domestic savings could be defined as the sum of gross domestic investment and the current account balance." This study follows the empirical computations of the savings-investment variables as defined by many previous studies. The current study chose data from 1970-2016 to avoid several missing values. The domestic savings variable in (current US$) and domestic investment (Current US$) contained 13 years missing values. Note, that all variables used in this study are extracted from the World Bank Development Indicators. The study uses the absolute form of the variables. Also, this paper defines investment as gross fixed capital formation.

4. EMPIRICAL FRAMEWORK FOR THE INVESTMENT-SAVING RATIOS ANALYSIS AND THE ARDL APPROACH

This current work closely follows (Islam et al., 2013), (Abbott and Vita, 2003) and (Giles, 2014) but narrowly deviate from the empirical specifications and the data computing procedures. In addition to the determination of the order on integration of the two time series in this study, if two series are considered to be unit process, but after differencing or detrending them they become stationary, then, it known that the series are either differenced stationary (DS) or trend stationary (TS). In the time series setting, most empirical application is focused on the difference stationarity approach instead on the TS process. Moreover, if it is found that the series have been absolutely differenced, this I(d) times, then they are said to be differenced stationary d-times. But intuitively, we always hope and rely on economic theory that the order of integration of most time series will be stationary after taking their first difference, or short hand form, I(1) which declares the process to be integrated of order one. In contrast to the same order of integration applying the Johansen's or Engle-Granger methodologies, a recent development of Pesaran et al., bounds testing approaches to the analysis of level relationships, 2001 have focused on the ARDL bounds testing approach because this approach seems to be appropriate for individual series integrated at different order, I(0) or I(1) respectively other things equal. This study adopts this ARDL approach to test for long-run equilibrating forces that will distort the investment ratio (I/Y) and the saving ratio (S/Y) from drifting over the entire sample under consideration. Now, following the representation of Feldstein and Horioka, 1980 and presenting the equation in a time series context instead of the cross-section form, the equation of the two ratios series take the form

$$(I/Y)t=\alpha+\beta(S/Y)_t+e_t, \tag{5}$$

Where, as defined before, I = gross domestic investment, S = gross domestic saving, and Y = GDP and β equals the unknown parameter, *et* is the white noise error term. The coefficient β-referred to as the "savings retention coefficient"- measures the "proportion of the incremental savings that is invested domestically" (Feldstein and Bacchetta, 1989 ; as cited in; Abbott* and Vita, 2003). It is worth noting that if the parameter, β=1, it means that that there is evidence that the domestic savings helps promote domestic investment; whereas, if β=0, then it implies that there is perfect capital mobility. "Feldstein and Horioka argue that if capital is mobile internationally, "there should be no relationship between domestic savings and domestic investment" (p. 317) since, in search for the highest financial returns available worldwide, savings will flow to countries that offer more favorable investment opportunities" (Abbott and Vita, 2003. p. 71). Already known, that most LDCs economies have very low savings rates which is not surprising because stated previously, unemployment rate is on the increase year-in-year-out in these settings, therefore, the economies have to rely on foreign direct investment or external borrowing to finance government expenditures and create narrowly small-skilled jobs for the lucky ones in these economies. It will be interested to identify strength between these variables in the Liberian economy because policies that will be recommended to stimulate investment through the savings domestically is marginal and as such the government will need to foster more economic activities and promote the agricultural sectors to keep the economy alive and encourage national savings that will be used to finance future investment. These are issues that we hope to see from the empirical investigation in this study. The sample under consideration is sufficient to capture any structural shifts in the Liberian economy because it includes the war years of 1989, 1991, 1992 and onward. Also, the second war of 2003 and the outbreak of the deadly Ebola Virus of 2014 and the election periods of 2005 and 2011 respectively. These periods are essential to this study because they will help determine whether there is any long-run relationship or whether the structural shifts can help explain the Feldstein-Horioka puzzle.

4.1. Estimation Strategy

Moving further, to implement the (Pesaran et al., bounds testing approaches to the analysis of level relationships, 2001) methodology that the bivariate system of the variables can be written in the contest of an UECM as defined in the work of Narayan, 2005 that the I-S function can be written as a conditional ARDL which will include the optimal lag-length of the data generating process. If the two ratios series are denoted S/Y as X_t and I/Y as W_t, then the ARDL form for investment-saving ratios which can take the and both X_t and W_t are I(1) or I(0) variables, then written as below:

$$\Delta W_t = b_0 + \lambda_1 W_{t-1} + \lambda_2 X_{t-1} + \sum_{i=}^{p} " W_{t-i} + \sum_{j=0}^{p} \zeta_j " X_{t-j} + \mu_t \quad (6)$$

Where εt is the "error" with a zero mean and a time invariant positive definite covariance matrix $E\left(\varepsilon_t \varepsilon_t^{\top}\right) = \Sigma_{\varepsilon}$ as a white noise process. The standard ordinary least squares is sufficient enough to estimate the parameters of the specification (4). The short-run parameters from the equation (4) are ϖ and ζ. The null hypothesis of "no cointegration" in (4) is stated as H0: λ1=λ2=0 which is tested against the alternative hypothesis H1:i1≠λ1≠λ. The decision to be made is based on the F-statistic compared to the tabulated critical bounds value of Narayan, 2005 for small sample data. The lagged one value of the two series in (4) will be tested based on the standard Wald statistic and their values will be compared to the critical values herein cited[2].

Our task here is to construct the cointegrating equation that will detect any long-run relationship between the two series, therefore, the (Giles, Econometrics Beat: Dave Giles' Blog: A resource for econometrics students and practitioners, 2014) presents a practical issue of how to handle structural breaks in a cointegration case. However, following (Barbi, 2016), (Hassler and Wolters, 2005), (Pesaran and Shin, 1999) and (Giles, 2014) specifications closely, this paper also presents fully-detailed equations that is equivalent to (4) but in different form with brief description. Giles, 2014 writes out the conventional ECM which is analogous to equation four but includes the ECT as

$$\Delta W_t = B_0 + \sum_{i=1}^{p} B_j \Delta W_{t-j} + \sum_{i=0}^{q_1} \gamma_j \Delta X_{1t-j} + \sum_{i=0}^{q_2} \delta_k \Delta X_{2t-k} + \vartheta z_{t-1} + e_t \quad (7)$$

Where z represents the error-correction term. As statted, the ECT zt is only replaced by the lagged values of reformulating the conventional ECM to maintain the same lagged numbers as is with the case of the regular ECM but now restricting the coefficients-unrestricted ECM/conditional ECM as labeled by Giles, Econometrics Beat: Dave Giles' Blog: A resource for econometrics students and practitioners, 2014). This turnout to be formulated as

$$\Delta W_t = B_0 + \sum_{i=1}^{p} B_j \Delta W_{t-j} + \sum_{i=0}^{q_1} \gamma_j \Delta X_{1t-j} + \sum_{i=0}^{q_2} \delta_k \Delta X_{2t-k} + \varnothing_0 W_{t-1} + \varnothing_1 X_{2t-1} + \varnothing_2 X_{2t-1} + e_t \quad (8)$$

The error-correction term z_t is now $z_{t-1} = (w_{t-1} - \alpha_0 - \alpha_1 t - \alpha_2 x_{1t} - \alpha_3 x2_t)$ as defined from the OLS residuals series from the long-run cointegrating regression is written as:

$$W_t = \alpha_0 + r_1 t + \alpha_2 X_{1t} + t_3 X_{2t} + v_t \quad (9)$$

See Giles, 2014 for brief exhaustive and intuitive description on this process. Equation 8 is the model of focus and for the bound testing to be reliable, there should be no serial or autocorrelations and the model should be a stable model. To perform the bound tests on the suitable estimated model as in 8. The null hypothesis which is implemented by an F-test is *H0: Ø0=Ø1=Ø2=0* against the alternative. When the null of "no cointegration" is rejected after implementing the bounds test, then the conditional long-run function as in (9) is estimable as extracted from its reduced counterpart in (8)[3] More discussion on this outlined in the below subsection. The W and X represent the I/Y and S/Y variables as already defined. Note that equation (8) can contain trend and vector of exogenous variable such as dummy intervention variable.

Moving in a more detailed and complicated context of Barbi, 2016 presents this specification assuming that the series W_t has no trend and the x_t as defined previously is the only weakly exogenous variable, and therefore, the equation is presented which does take into account structural breaks

$$w_t = c + \beta w_{1-1} + \eta_{1xt} + \eta_1 x_{t-1} + \phi d_t + \varepsilon_t \quad (10)$$

Where the $\varepsilon_1, \ldots, \varepsilon_t$ are NID process with zero mean and variance covariance matrix. Notice that the expression (10) takes into consideration only one lagged period, but there could be many lagged values added to the representation and also contain a trend. The d_t is the variable representing dummy that need not take lagged values nor be differenced in any way. Also, the wt can be assumed to be I(1) with a random walk process as defined by:

$$x_t - x_{t-1} + \in_t^x \quad (11)$$

Where, the exogenous variable, x_t can be of different order, that is, I(0) or I(1). The cointegration relationship can be tested for between the series xtand the w_t using the F-test and t-test respectively[4]. On the other hand, the equation (10) could be restructured to form the error correction term (ECT or ECM) for the differences of the series which could be w_{t-1}+Δwt which is the first difference of the regressand and the regressor can also be of the form wt+Δw_t. With this in hand, the ECT of these series is presented in their absolute form as and the equation can be rearranged as collecting all the levels terms in a combined.

$$\Delta w_t = c + + \eta_1 x_t - (1-\beta) w_{1-1} + (\eta_1 + \eta_2) x_{t-1} + \phi d_t + \varepsilon_t \quad (11.1)$$

$$\Delta w_t = c + + \eta_1 x_t - (1-\beta)(w_{1-1} - \frac{c}{1-\beta} - \frac{\eta_1 + \eta_2}{1-\beta} x_{t-1}) + \phi d_t + \varepsilon_t$$

(11.2)

The short-run or static effect is $\frac{\partial w_t}{\partial x_t} = \eta_1$; while the dynamic or the long-run effect is $\frac{\partial w_t}{\partial x_t} = \frac{\eta_1 + \eta_2}{1-\beta}$. Note, that the denominator

2 Narayan, 2005 discussed that these hypothesis can be examined using the standard Wald or F statistic. The F test has a non-standard distribution.

3 Similar argument was demonstrated by, Abbott and Vita, 2003. p.73.

4 Barbi, 2016 demonstrated how the X_t may be I(0) or I(1) and that the t-test or the F-test can be applicable to test for long-run relation between the dependent variable and the independent variable.

1-β is the speed of convergence to the equilibrium effect of the equilibrium error, $(w_{1-1} - \frac{c}{1-\beta} - \frac{\eta_1 + \eta_2}{1-\beta} x_{t-1})$. In the same way that equation (10) and (11.2) are equivalent, the regressor defined here to be weakly exogenous, x_t and its Δx_t is uncorrelated with the ECM/term which can be empirically tested based on the null hypothesis. Pesaran and Shin (1999) study (as cited in Barbi, 2016. p. 2) "show that the least squares (LS) estimation of this model provides consistent estimators with super-consistent properties for the long term coefficients: These estimators converge to the true parameter value at speed proportional to T, fater than the ususal $\sqrt{T}$ convergence of LS estimators." One good this about this scenario just described is that, small samples can be utilized, however, the ARDL model has come across criticism that we do not intend to investigate in this literature. Going further, Barbi, 2016 demonstrated in his work the way in which the long-term coefficient s and the variance of the long-term coefficients can be computed. Follow in that, the equations are presented as:

$$\hat{\Theta} - g\left(\hat{\eta},\hat{\beta}\right) - \frac{\hat{\eta}}{1-\beta} - g\left(\hat{\Phi}\right) \quad (12)$$

Where $\hat{\Theta}$ this holds the long-term coefficients to be estimated as $\hat{\eta}$ *and* $\hat{\beta}$ respectively. In addition, the variance of the Θ can be modeled following the delta approach as defined by

$$\mathrm{V}\left(\hat{\Theta}\right) = \left(\frac{\partial \mathrm{g}\left(\hat{\Phi}\right)}{\partial\hat{\Phi}}\right)' \mathrm{V}\left(\hat{\Phi}\right)\left(\frac{\partial \mathrm{g}\left(\hat{\Phi}\right)}{\partial\hat{\Phi}}\right) \quad (13)$$

What is normally implemented in most computer statistical packages as defined in Barbi, 2016 work to compute the variance is given as continuing, the sample average $\overline{X}$ of the weakly defined exogenous variable and D_T is given to be:

$$V\left(\hat{\Theta}\right) = \frac{\hat{\sigma}_{\varepsilon}^2}{(1-\hat{\beta})^2}\left(1,\hat{\Theta}\right)\frac{1}{D_T}$$
$$\begin{bmatrix} \Sigma(w_{t-1}-\overline{w})^2 & -\Sigma(w_{t-1}-\overline{w})\left(x_t-\overline{x}\right) \\ -\Sigma\left(w_{t-1}-\overline{w}\right)\left(x_t-\overline{x}\right) & \Sigma(x_t-\overline{x})^2 \end{bmatrix} \frac{1}{\hat{\Theta}_T} \quad (14)$$

$$D_t = \left[\sum(x_t-\overline{x})^2\right]\left[\sum(w_{t-1}-\overline{w})^2\right] - \left[\sum(w_{t-1}-\overline{w})(x_t-\overline{x}\right]^2 \frac{1}{\hat{\Theta}_T} \quad (15)$$

As this representation clearly show that the long-run or the cointegrating term is a stationary process of the form $\left(w_t - \hat{\Theta}x_t\right) \sim I(0)$ which can be individually tested with the conventional t-test. In addition, in Pesaran et al. (2001) study, (as cited in Barbi, 2016) states that the "bound test" of the series with and without level of the regressor, the model to be checked is given as:

$$d(w_t) = c + \sum_{j=0}^{m}\pi_j\begin{pmatrix} w_{t-1-j} \\ x_{t-j}\end{pmatrix} + \sum_{i=0}^{p}\beta_i\begin{pmatrix} d(w_{t-i}) \\ d(x_{t-i})\end{pmatrix} + \omega_t \quad (16)$$

Where the d_t denotes the d-difference operator, and the mull hypothesis to be checked for the bound test result is given is to be π1=π1=⋯=πm=0, $\Pi_t = (\Pi_t^w, \Pi_t^x)$ and $\beta_t = \left(\pi_t^w, \pi_t^x\right)$ respectively. Rejecting the null means there is cointegration between the series ratios. Another thing to watch out for is the way in which the F-test is conducted because as correctly stated by Giles, Econometrics Beat: Dave Giles' Blog: A resource for econometrics students and practitioners, 2014, the "distribution of the test statistic is totally non-standard (and also depends on a "nuisance parameter," the cointegrating rank of the system) even in the asymptotic case where we have an infinitely large sample size." Here, we have taken the w_t to be the I/Y and the x_t as the S/Y as defined previously. As for the model selection, this study uses the AIC and the Schwarz Bayesian Information (BIC) criterion respectively. The next Section presents the data description and techniques to this empirical-applied study for the Liberian economy.

5. EMPIRICAL RESULTS

5.1. Empirical Results

The data as was previous discussed and described, this section presents the empirical results of the two time series variables which have been widely investigated empirically for different sectors and different timeframe. This study investigates the two ratios discussed here using the annual data for the Liberian economy. Liberia is a very low income country and a low populated nation which relies on foreign direct investment and external borrowing to facilitate or undertake developments in various sectors. However, the government predominantly expend most of her income resulting into very low savings and even dissaving in the economy. To identify the relationships between the two variables in this study, the sample is sub-divided into different periods. The economy has experienced series of political strives including war periods and pestilence outbreaks which affected macroeconomic variables including these ones under consideration; therefore, we partitioned the data as 1970-2016 for the full sample to capture the nature of association between the savings and the investment series before and after the war and pestilence outbreaks dates. Also, the one sub-period is considered, that is, 1979-2012 respectively.

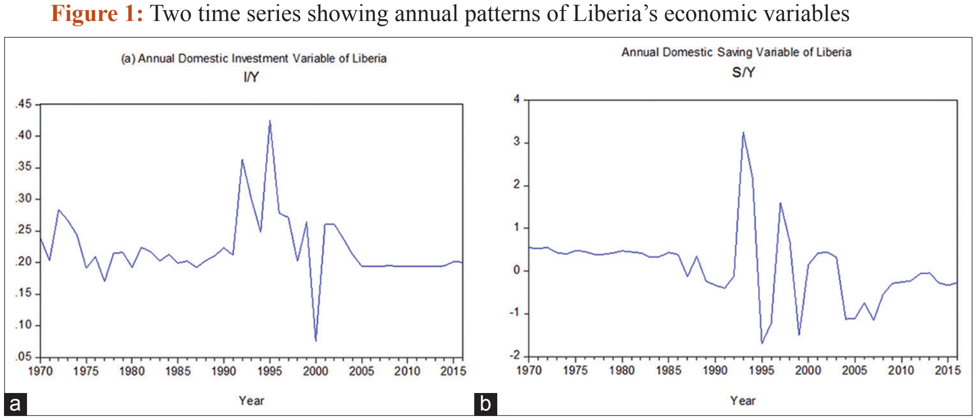
Figure 1 shows the absolute time plot of the S/Y ratio to the I/Y ratio series for the full period. Similarly, it shows annual Liberia government saving-investment ratios 1970-2016 data. The two time series variables appear to have a time variant pattern with both upward and downward drift that would be difficult to forecast as continuing into the future, and they seem to show less apparent seasonal patterns. Interestingly, the series show jumps in multiple periods which led to the decomposition of the data under study. Another thing worth noticing in these series is that they show no clear definite trend. The time series properties of I/Y and S/Y after employing the traditional ADF unit root test, the results are given in Table 1 using the full sample size, and the sub-sample respectively. Table 1 shows interesting results for the Liberian economy data. The ADF test for the two ratios using the full sample and the subsample indicate that the null hypothesis for the I/Y series cannot be rejected at the 5% level which implies that the ratio series is non-stationary at the level data; whereas, the null is rejected for the S/Y ratio at the level data using the 1970-2016 full sample and the subsample only when the general ADF model

Table 1: Different unit root test results for the Liberian economy

Sample						
	1970-2016			1970-2016		
	Series		Lag	Series		Lag
Statistics (levels)	$(I/Y)_t$			$(S/Y)_t$		
τ_T (ADF)	−2.929		(1)	−3.635*		(2)
τ_μ (ADF)	−2.884		(1)	−2.768		(2)
	Critical values			Critical values		
	τ_T CV	τ_μ CV		τ_T CV	τ_μ CV	
1%	−4.175	−3.584		−4.180	−3.588	
5%	−3.513	−2.928		−3.515	−2.929	
10%	−3.186	−2.602		−3.188	−2.603	
Statistics (first differences)	$\Delta(I/Y)_t$		Lag	$\Delta(S/Y)_t$		Lag
τ_T (ADF)	−7.262***		(1)	NA		
τ_μ (ADF)	−7.358***		(1)	−6.070***		(3)
	Critical values			Critical values		
	τ_T CV	τ_μ CV			τ_μ CV	
1%	−4.180	−3.588			−3.584	
5%	−3.515	−2.929			−2.928	
10%	−3.188	−2.63			−2.60	
Statistics (levels)	1970-2012			1970-2012		
	Series			Series		
	$(I/Y)_t$		Lag	$(S/Y)_t$		Lag
τ_T (ADF)	−2.779		(1)	−3.504*		(2)
τ_μ (ADF)	−2.789		(1)	−2.690		(2)
	Critical values			Critical values		
	τ_T CV	τ_μ CV		τ_T CV	τ_μ CV	
1%	−4.198	−3.600		−4.205	−3.605	
5%	−3.523	−2.935		−3.526	−2.936	
10%	−3.192	−2.605		−3.194	−2.606	
Statistics (first differences)	$\Delta(I/Y)_t$		Lag	$\Delta(S/Y)_t$		Lag
τ_T (ADF)	−6.896***		(1)	NA		
τ_μ (ADF)	−6.996***		(1)	−5.738**		(3)
	Critical values			Critical values		
	τ_T CV	τ_μ CV			τ_μ CV	
1%	−4.205	−3.605			−4.615	
5%	−3.526	−2.936			−2.941	
10%	−3.194	−2.606			−2.609	

*Assume stationary at the 5% significant level; the optimal lags are enclosed in parentheses and test assumed the trend plus drift terms. Lags were chosen based on the AIC and SIC. NA means not applicable, as the variables are already stationary in absolute levels. The $^{\tau}T$ represents the ADF model with both the constant/drift and trend; while the τ_μ is the model with a drift. P values are based on *MacKinnon (1996) one-sided P values

Figure 1: Two time series showing annual patterns of Liberia's economic variables



is estimated. On the other hand, the first difference was applied to the data ratio that are not stationary from the preliminary test ADF unit root test. As can be clearly seen from the Table 1, there are NAs for the S/Y first difference ADF which implies that the series does not have to be differenced because it is a stationary process for that particular deterministic term at level. In other words, when the I(0) series is differenced or detrended, it leads to over-differencing which can create errors, therefore, only the nonstationary series are first differenced to make them stationary. Our results above seems to be slightly inconclusive, but again seems to be same order of integrated process.

Jumps in the ratios series could distort the normal unit root testing and thereby leading to false rejection of stationarity. In this work as was defined in the previous section about taking into account structural breaks, this paper adopts the, (Zivot and Andrews, 1992) and (Phillips and Perron, 1989) unit root test with break and the result are shown above in Tables 2 and 3 respectively. Table 2 illustrates the result of the unit root test allowing for structural break(s) at the different sample decompositions using the (Phillips and Perron, 1989) approach. Clearly, the conventional ADF and the modified ADF with break test give almost the same results, but in Table 2, both the crash model with the intercept term and the trend term are considered. This specification could be termed as the change in both the intercept and the slope. In addition, the intercept term only is considered which could also be termed as the change in the levels of the series. The test results with break as seen in Table 2 cannot reject the null hypothesis of unit root with break for the saving-investment ratios for all the full sample 1970-2016 and the S/Y data for 1970-2012 with the intercept and trend term specification as well as the intercept only term at the 5% significance level and even the 1% and 10% levels. Looking at Table 3, the full sample and the 1970-2012 subsample data when the intercept and trend term were used, we fail to reject for the I/Y and S/Y series and also when the intercept term was used only, we fail to reject the null hypothesis that the series are characterized by a one-time changes in the series. The results are consistent but with our sample, these results need to be taken with care for the model specification. The additive outlier results not shown here also supports the nonrejections of the null hypothesis for all the sample sizes. With this in hand, the next step is to estimate the ARDL model framework with break. After the first-differencing, it is now clear that all the two series have mixed order, that is I(0) without any differencing and the I(1) after taking the first difference of the absolute series. Note, that there is no I(2) process for our bivariate system. For more recent investigation on unit root test with structural break(s) accounted for, see Libanio, 2005 for more discussion. There are two variables (k + 1) = 2, the bound testing will involve k =1 variable.

In the empirical literature, this situation is easily realized in empirical applications and this can be circumvented with the help of the ARDL approach. Since there are mixture of order for the variables series, I(0) and I(1), the ARDL bound testing approach prosed by Pesaran et al., 2001 is implemented. The lower and the upper bounds given by the authors for the distribution of the F-statistic is also utilized in this study. As already stated, the bounds of the critical values will determine whether there is long-run relationships because when the calculated F-statistic is lower than the lower bound, then one can conclude a I(0) process and the usual OLS can be applied as there is no cointegration. On the other hand, if the computed F-statistic is above the upper bound, in this context we say that there is long-run relationships and the standard OLS can be applied to the levels data for the long-run equation and the ECM/ECT for the short-run dynamics between the series. The below Table 4 illustrate the investment-saving output of the ARDL unrestricted and restricted ECM using annual 47 time series data of the Liberian economy. Table 4

Table 2: Phillips and Perron (1989) unit root test with exogenous breakpoint

Investment						Saving			
Sample	1970-2016		1970-2012		Sample	1970-2016		1970-2012	
Model	Intercept only	Intercept and trend	Intercept only	Intercept and trend	Model	Intercept only	Intercept and trend	Intercept only	Intercept and trend
t-statistic	−2.789	−4.672	−2.521	−4.908		−4.263	−3.497	−3.897	−5.041
Break date	2003	1991	2003	1991		2003	2004	2003	1992
K	7	9	7	7		7	9	7	8
Critical values									
1%	−4.945	−5.711	−4.945	−5.711		−4.945	−5.711	−4.945	−5.711
5%	−4.432	−5.155	−4.432	−5.155		−4.432	−5.155	−4.432	−5.155
10%	−4.182	−4.860	−4.182	−4.860		−4.182	−4.860	−4.182	−4.860

*Assumes stationary with break at the 5% level; lags is selected based on the t-statistic. *Vogelsang (1993) asymptotic one-sided P values are given

Table 3: Zivot and Andrews (1992) unit roots test with one endogenous structural break

	Investment					Saving			
Sample	1970-2016		1970-2012		Sample	1970-2016		1970-2012	
Model	Intercept only	Intercept and Trend	Intercept only	Intercept and Trend	Model	Intercept only	Intercept and Trend	Intercept only	Intercept and Trend
t-statistic	−4.398	−4.817	−4.249	−5.062		−4.291	−4.682	−4.429	−4.982
Break Date	1992	1992	1992	1992		2004	2004	1993	1993
K	1	1	1	1		2	2	2	2
Critical values									
1%	5.34	−5.57	−5.34	−5.57		−5.34	−5.57	−5.34	−5.57
5%	−4.93	−5.08	−4.80	−5.08		−4.80	−5.08	−4.80	−5.08
10%	−4.59	−4.82	−4.58	−4.82		−4.58	−4.82	−4.58	−4.82

*Denotes statistical significance at the 5% and ***denotes statistical significance at the 1% and 10 levels respectively depicts the annual 1970-2016 full sample size results for the two macroeconomic variables considered. In that table the dependent variable is taken to be the first difference I/Y series with lagged values and also for lagged values on the S/Y as well as the trend and dummy terms respectively serving as regressors. The main focus estimates is the one representing the ECT which is computed to be -0.979564 for the full sample as displayed in Table 4 and it is negative with the right sign. The estimated parameter is highly statistically significant. The value indicates that about 97.9% using full sample data of any disequilibrium between I/Y and S/Y are corrected for within a specified period of 1 year. The result is an expected outcome since we infer that there is cointegration between the I/Y and S/Y. Interestingly, the desirable ECM value of 0 and -1 seems to be feasible here but is close to one which is robust speed of adjustment. This large correction term is not unstable, but it is significant. There are sensitivity analysis test shown in this table, only the normality assumption is violated but the rest of the test results show large p-values declaring the model estimated suitable enough for the sample size under investigation for the Liberian economy.

The results in the Appendix 1 of Tables A1 and A2 are results estimated for the S/Y function when taken as dependent variable for the two sample sizes as well as the I/Y subsample size. The ECT in the saving model using the full sample size in Table A2 is −0.991193 which is negative and suggest an effective feedback approach to rebalance the disequilibrium within a year or so.

5.2. The ARDL Deterministic term Procedures, Lag Structure Determination and Diagnostic Checking Results

Lag selection and deterministic term process is tantamount in the empirical analysis of model selection process and term inclusion. There are guidelines setup to help practitioners how to accurately select lags and determine the term to be included in estimating ARDL model. Here in this paper, the demonstration is wholly concentrated on the theoretical principles and analyst judgement. To efficiently determine the lag length used for the two samples in a more desirable way the first difference investment series is estimated in a vector autoregression (VAR) model including intercept plus lagged terms for the I/Y, S/Y and the first difference of S/Y all as fixed regressors[5]. The ECM is estimated are based on the IC. Even though, the (Giles, 2014) approach may seem expedient, but this does not indicate enough empirical literature to validate its usefulness in this application, however, it may still be reliable as it will lead to proper lags justification for our small size in this setting. The ARDL (2,1) model was selected for the I/Y series when chosen as dependent variable, while the ARDL (2,2) was selected when the S/Y series was taken as dependent variable. The results of each estimated unrestricted ECM is not presented to save space, but the diagnostic checking results are given in the below table.

Conclusively, there is a cointegration relationship which can be further seen from Figure 2 when the saving data when used as dependent variables in the two specified cases, it is important that the pictorial representation of the fit between the saving and investment variables and the long-run or equilibrating equation should be presented to further make the results just presented valid. The time plots below are extracted from the ECT of the saving variable to further confirm the long-run relationship. On this note, it is worth presenting the short-run and the long-run regression results. In other words, it is prudent enough to analyze the speed of adjustment equation in this study for the investment-saving data and the saving-investment variables. It is worth pointing out that the results of the ARDL cointegrating and long run relationship form are presented in Table 5 for the two series using the full sample of 47 observations and the subsample 43 observations.

5 This approach is analogous to that of Giles, 2014 who demonstrates an excellent way of how to implement the information criteria in helping to determine the appropriate lag lengths.

Table 4: The Results of the unrestricted ECM using 1970-2016 data

Dependent variable is Δ(I/Y)				
Variable	Coefficient	Standard error	t-statistic	P
C	0.262434***	0.066063	3.972463	0.0003
Dummy	0.107181**	0.036386	2.945676	0.0056
Trend	−0.003389*	0.001421	−2.384599	0.0225
$\Delta(I/Y)_{t-1}$	0.042930	0.208581	0.205818	0.8381
$\Delta(I/Y)_{t-2}$	0.120857	0.148170	0.815665	0.4201
$\Delta(S/Y)_{t-1}$	−0.016877	0.009054	−1.863997	0.0705
$(I/Y)_{t-1}$	−1.095531***	0.249944	−4.383102	0.0001
$(S/Y)_{t-1}$	0.028313*	0.011084	2.554340	0.0150
R^2=0.594005				
Adjusted R^2=0.515061				
Akaike info criterion=−3.240570				
Schwarz criterion=−2.916172				
Hannan-Quinn criter.=−3.120268				
F-statistic=7.524420				
Durbin-Watson stat=1.709188				
Prob (F-statistic)=0.000014				

*Assume 5% significance level, **10% and ***1% level. ECM: Error correction model

Table 5: The results of the restricted ECM using 1970-2016 data

Dependent variable is Δ(I/Y)				
Variable	Coefficient	Standard error	t-statistic	P
C	0.035896	0.019671	1.824808	0.0761
Dummy	0.107120**	0.038871	2.755814	0.0090
Trend	−0.004003*	0.001495	−2.676983	0.0110
$\Delta(I/Y)_{t-1}$	−0.043446	0.219735	−0.197718	0.8443
$\Delta(I/Y)_{t-2}$	0.046765	0.155078	0.301556	0.7647
$\Delta(S/Y)_{t-1}$	−0.002577	0.007488	−0.344079	0.7327
ECT_{t-1}	−0.979564***	0.262357	−3.733712	0.0006
R^2=0.523788				
Adjusted R^2=0.446565				
Akaike info criterion=−3.126504				
Schwarz criterion=−2.842656				
Hannan-Quinn criter.=−3.021239				
F-statistic=6.782752				
Prob (F-statistic)=0.000066				
Durbin-Watson stat=1.762479				
Sensitivity checking				
Serial correlation LM=1.865; P value=0.1401				
ARCH test=0.211; P value=0.6481				
Normality test=8.709; P value=0.000				
Q (20)=24.634; P value=0.216				

ECM: Error correction model

Note, that the S/Y variable denotes the saving variable, while the I/Y denotes the investment variable as described previously. The trend term T parameter is statistically found to be significant and the D is the dummy, therefore, it is included in the short-run specification. The below Table 5 display the results of the dynamic short-run from the restricted ECM-ARDL specification using annual Liberian domestic I/Y ratios data for the study 1970-2016 period. On the next estimating procedures, the preceding equations 8 and 15, which are the unrestricted ECM are estimated for the I/Y series serving as dependent variable where it is vividly seen in Table 4 that the long-run multiplier between the Liberian domestic saving S/Y and domestic investment I/Y is −(0.028313/(−1.095531)) = 0.0258 which implies that in the long-run, an increase of 1% in the domestic saving will automatically lead to an increase of 2.58% which is similar to the figure projected in the published report of the Central Bank of Liberia 4 months period rate of 2.1% in 2008 but dropped to 2.0% for the same 4 months in 2010, see CBL, 2010 for descriptive report.

Table 6 illustrates the UECM-ARDL estimated to check the residuals before performing the cointegration through the bounds testing approach based on the Wald statistic. The diagnostic results of the subsample and the full sample size of Liberia's two macroeconomic variables in levels respectively. Also, Table 6 shows the results of (i.e., Breusch-Godfrey LM statistic), heteroscedasticity test (i.e., ARCH test), normality test (i.e., Jarque Bera test), and the Ljung-Box Q-statistic from the different estimated ARDL equations with dummy intervention variables. The results obtained from the estimating ARDL(2,1) and (2,2) models for the (I/Y) and S/Y functions were estimated and empirically tested before doing the long-run relationship through the bounds testing approach as it remains the sole objective of this paper. The optimal lags for the UECM-ARDL modeling looking at Table 6 was based on the AIC because it does not select simpler model that may not be true model for this empirical study. The AIC was compared to the SC, in which the latter chose a much simpler model leading to some issues in the analysis such as serial correlations, etc. The JB test statistic for normality for the I/Y and S/Y is nonormal for the full sample size of 47 observations for the cases 5 and 3 assumption, as well as for the subsample of 43 observations. The low p-values declare the models errors to be normal. By contrast, the rest of the other tests show remarkable large p-values and nonsignificant values which suggest that the models are adequate when the two samples are used as shown for the cases. The appropriate critical values are extracted from Narayan, 2005[6]. Theoretically, it is already known that any model where the time series variable wanders about a nonconstant zero or not centered about zero will definitely have to include a drift/

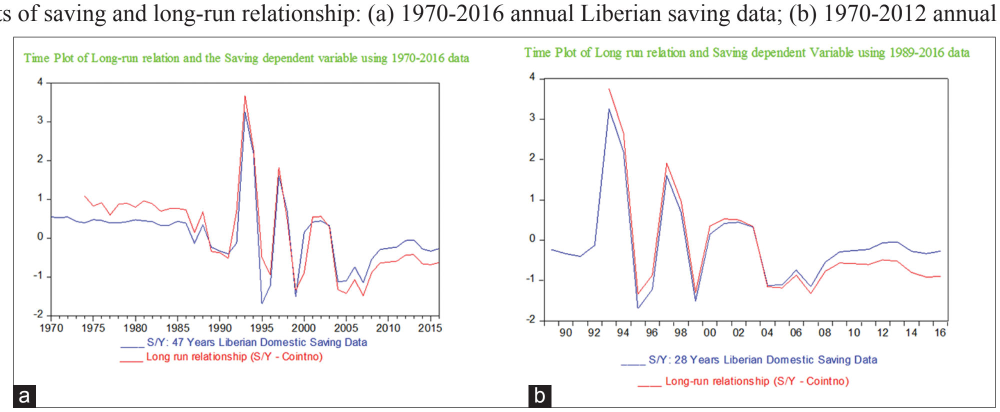
6 This study uses the (Narayan, 2005) critical values instead of Pesaran et al. (2001) due to the small sample size which is deem appropriate

Table 6: ARDL estimation diagnostic results for (I/Y) and (S/Y) models using 1970-2016 and 1970-2012 subsample

Equations	χ^2J-Bera	χ^2BG-LM	χ^2ARCH	Q-stat
Sample size: 1970-2016 unrestricted intercept and unrestricted trend case (5) Panel I				
Diagnostic checking output				
(I/Y)$_t$	38.944	1.889	0.023	Q (20)=20.981
	[0.000]*	[0.1666]	[0.8792]	[0.398]
(S/Y)$_t$	7.048	0.387	0.021	Q (20)=15.326
	[0.029]*	[0.6819]	[0.8862]	[0.755]
Unrestricted intercept and no trend case (3) Panel IA				
(I/Y)$_t$	26.166	0.181	0.590	Q (20)=10.229
	[0.000]*	[0.8354]	[0.4469]	[0.964]
(S/Y)$_t$	17.819	0.761	0.533	Q (20)=16.638
	[0.000]*	[0.4751]	[0.4693]	[0.677]
Sample size: 1970-2012 Unrestricted intercept and unrestricted trend case (5) Panel II				
Diagnostic checking output				
(I/Y)$_t$	26.587	1.764	0.003	Q (20)=19.644
	[0.000]*	[0.1886]	[0.9593]	[0.480]
(S/Y)$_t$	3.859	0.112	0.00	Q (20)=16.963
	[0.145]	[0.8944]	[0.9948]	[0.655]
Sample size: 1989-2016 Unrestricted intercept and no trend case (3) Panel IIA				
(I/Y)$_t$	17.536	0.176	0.305	Q (20)=10.441
	[0.000]*	[0.8396]	[0.5842]	[0.959]
(S/Y)$_t$	11.511	0.697	0.703	Q (20)=16.186
	[0.003]	[0.5057]	[0.4072]	[0.705]

Regression of I/Y on S/Y in absolute form (PANEL I and II); and regression of S/Y on I/Y in absolute form (PANEL I and II) respectively. In Panel I and Panel II, is the estimated results of the unrestricted ECM with the unrestricted intercept and trend case. In Panel IA and Panel IIA, the UECM with the unrestricted intercept and no trend case. Both are estimated on the null that the lagged level coefficients of the (I/Y)$_{t-1}$ and the (S/Y)$_{t-1}$ are equal to zero (joint F-test). In addition, the 1970-2016, and the 1970-2012 samples include dummy intervention variables to capture any shifts. Here 5% is set as the pre-specified critical benchmark value for the bound test. ARDL: Autoregressive distributed lag

Figure 2: Time plots of saving and long-run relationship: (a) 1970-2016 annual Liberian saving data; (b) 1970-2012 annual Liberian saving data



constant term, while when there is a trend term exhibited, then an inclusion of trend term is welcoming. For more details of how to properly include deterministic terms in the model specification presented in this text, see Giles, Econometrics Beat: Dave Giles' Blog: A resource for econometrics students v practitioners, 2014 and (Eviews, 2017).

Further, Tables 7 and 8 are sub-divided into cases based on the deterministic terms for the bound tests. Looking at the output in Table 7, cases 5 and 3 which imply that there is unrestricted constant/intercept and unrestricted trend, whereas, case 3 which assume the unrestricted constant and no trend case in the ARDL equation. Further shown in this Table 6, the calculated F-statistic of cases 5 and are 11.06791 and 7.316017 for the investment and saving variables. Looking at the bounds test table displaying the critical values in Table 7, the calculated F(I/Y) function exceeds the upper bound at the 5% significance level. With this, we can conclude that there is long-run relationship between the two macroeconomic variables of Liberia to further confirm the result, the author compared the t-ratios on the $I⁄Yt-1$ using the both cases again and the values calculated from the estimated models are −4.159 for case 5 and −3.500 for the latter case (i.e., case 3). When the author compared these values to the critical values of the t-ratios in Narayan, 2005, the values are [−3.13, −3.63], [−3.41, −3.95], and [−3.96, −4.53] for case 5; whereas, the case 3 values are [−2.57, −3.21], [−2.86, −3.53], and [−3.43, −4.10]. Our results are consistent but there seems to be a little marginal result for the case 3 t-ratio compared to the critical value in the cited reference bound tests table at the 5% level I(1)-upper bound but not the 1%. With the large computed F-statistic, there is a long-run relationship as the subsample size also confirm this result.

The results of the saving equation F(S/Y) starting with the full sample and for the case 5 is 9.743052 compared against the proper critical bounds tests table as described previously for the 10%, 5% and 1% significance levels are [4.58,5.60], [5.55,6.75], and [7.98,9.41]. Clearly seen, the computed F-statistic exceeds the upper bound at the 5% significance level, therefore, we confirm cointegration relationship for the [S/Y and I/Y] series using annual data from Liberia. As for case 3, the unrestricted intercept and no trend case, the F(S/Y) is 6.029631 compared against the 10%, 5% and 1% levels as defined in the cited author's table, we have [3.44,4.47], [4.27, 5.47], and [6.18, 7.87] respectively. Equivalently, it is suggested once again that there exist long-run relationship between the two variables (at this level of significance or lower). The subsample size of 1970-2012 calculated F(S/Y) is 9.977766 for case 5 and case 3 is 5.334854 which is higher than the 5% bound tests table critical value for case 5 but not for case 3. Here, there is a little conflict but it is not surprising as the sample size not very large.

Table 7: Full sample size cointegration test results for the I/Y function

Panel I sample: 1970-2016			Panel I sample: 1970-2016		
Null hypothesis (H_0): No long-run relation exist, i.e., H_0:pi=0 PSS case 5 (unrestricted intercept, unrestricted trend) Regressors K=1			Null hypothesis (H_0): No long-run relation exist, i.e., H_0:pi=0 PSS case 3 (unrestricted intercept, no trend) Regressors K=1		
	I (0)	I (1)		I (0)	I (1)
10%	4.58	5.60	10%	3.44	4.47
5%	5.55	6.75	5%	4.27	5.47
1%	7.98	9.41	1%	6.18	7.87
F-statistic	11.06791		F-statistic	7.316017	

The result is based on the 5% significance level. The test is also performed using the Wald Statistic implemented in Eviews 9 for the joint test restriction on the lagged one values of [I/Y and S/Y]

Table 8: Subsample size conintegration test results for the I/Y function

Panel I sample: 1970-2012			Panel I sample: 1970-2012		
Null hypothesis (H_0): No long-run relation exist, i.e., H_0: pi=0 PSS case 5 (unrestricted intercept, unrestricted trend) Regressors K=1			Null hypothesis (H_0): No long-run relation exist, i.e., H_0: pi=0 PSS case 3 (unrestricted intercept, no trend) Regressors K=1		
	I (0)	I (1)		I (0)	I (1)
10%	4.58	5.60	10%	3.44	4.47
5%	5.55	6.75	5%	4.27	5.47
1%	7.98	9.41	1%	6.18	7.87
F-statistic	9.903914		F-statistic	7.120826	

The result is based on the 5% significance level. The test is also performed using the Wald Statistic implemented in Eviews 9 for the joint test restriction on the lagged one values of [I/Y and S/Y]

6. CONCLUSION

This sole aim of the paper is to study the long-run relationships between two macroeconomic variables of Liberia proposed by Feldstein-Horioka and using the UECM-ARDL approach. The F-H argument examined in this literature is based on the correlations of the saving-investment series. Accordingly, a high correlation would imply a restricted capital mobility, while a low correlation including no cointegration, could simply mean that there is no restriction on capital mobility for a given economy. Most of these arguments have been investigated in developed and OECD nations with little studies done in low-income nations. Our approach of conducting such a study in Liberia seems comprehensive because, this work drives away from many studies conducted in either OECD countries or individual middle and high income countries. Another key reason that this might be useful is that we have used imputed values for the missing observations adopting a more reliable and comprehensive multiple imputations method as described in section 3 of this work. Though, this approach may lead to some problems resulting into criticism from the results with imputed missing values. The two unit root tests considered structural breaks are another vital procedures applied in this work because these tests accounted for any structural shifts that might have had long lasting effects on the series.

To be in accord with statistical principle and theories of hypothesis testing as labeled in this situation, the two sample observations used in this study confirm that the null hypothesis of "no cointegration" was undoubtedly rejected using both series manually but stringent measures were taken to avoid inaccurate and biased analysis. Though, we may have concluded previously that there is long-run association between the S/Y and I/Y, but we appraised the situation carefully from the preliminary stage which was the missing values imputation to obtain a complete and more reliable sample data. But with nothing giving for nothing slogan, the results in here may be fragile and needs to be carefully monitored.

Next in line, we estimated the restricted ECMs for the ARDL case, where the results as discussed previously in section 5 showed that both the I/Y and S/Y ratios series ECTs showed high negative and statistically significant values over the two sample periods. As for the restricted error correction results for the two variables, we realized that the lagged correlations for the I/Y series model are low but not statistically significant for the two sample periods. The trend and dummy interventions variables included have significant impacts on these variables. In contrast, the correlations on the lagged of the S/Y variable models show low and statistically significant values which could mean that the low savings in the Liberian economy might have resulted from unrestricted capital mobility in previous time. But this is not also surprising as investments in the Liberian economy are wholly based on huge foreign direct investment. Though there is long-run relationship in this study, but we cannot say that capital mobility exist, nor neither can we say that there is restriction on capital mobility.

The economic argument of saving-investment relationships considered in this paper is quite simple and elegantly narrated using annual time series data for the Liberian economy. This approach applied in here is a good way to start the theoretical and empirical argument, however, this is in no way leads to the end of the whole story because, there might be large and different frequency data used with larger models adopted to investigate this puzzle that has been tested for the Liberian economy. Liberia financial institutions are not fully organized to encourage sound banking facilities that will stir savers to keep their money in commercial banks that can attract local investment in the economy. Most people are home savers because the little income they accrue overtime from their little farms produce cannot be kept for longer time in banks because unemployment rate is very high and price instability can also dictate to the consumer choice making between saving in banks and saving at home or with some business individuals. These are not sound financial practices because they will exacerbate the economic woes in the Liberian economy if not properly managed. The intertemporal budget constrained the economy continue to face that leads to continuous budget deficits results from huge administrative expenditure which needs to be cut down. Liberia's external debts is on the increase every time and it makes the country to be reliance on borrowing to compensate for the loss in revenue in order to undertake infrastructure development. Therefore, the monetary authority and fiscal authority need to work very high to improve the financial system that can lead to the creation of stock markets and futures markets. With these innovation well employed, I strongly believe that GDP growth will increase and reduce financial panic that could drive away foreign investments. Also, high savings will encourage more domestic investments and promote economic stability, etc.

REFERENCES

Abbott, A.J., Vita, G.D. (2003), Another piece in the feldstein–horioka puzzle. Scottish Journal Of Political Economy, 50(1), 69-89.

Adebola, S.S., Dahalan, J. (2012), Capital mobility: An application of savings-investment link for Tunisia. International Journal of Economics And Financial Issues, 2(1), 1-11.

Adetiloye, K.A. (2012), Capital flight versus domestic investment in developing countries: An empirical analysis from Nigeria. International Journal of Economics And Finance, 4(2), 175-186.

Apergis, N., Tsoulfidis, L. (1997), The relationship between saving and finance: Theory and evidence from E.U. countries. Research in Economics, 51(4), 333-358.

Asteriou, D., Hall, S.G. (2007), Applied Econometrics: A Modern Approach Using Eviews and Microfit (Revised Ed.). New York: Palgrave Macmillan.

Barbi, F.C. (2016), Estimating ARDL Models in R. Available from: http://www.file:///D:/Useful%20R1/ardl-vignette.pdf.

Bajo-Rubio, O. (1988), The saving-investment correlation revisited: The case of Spain 1964-1994. Applied Economics Letters, 5, 769-772.

Barbi, F.C. (2016), Estimating Ardl Models in R. Available from: D:/Useful%20R1/ardl-vignette.pdf. [Last retrieved on 2016 Jun 07].

Buuren, S.V., Groothuis-Oudshoorn, K. (2011), Mice: Multivariate imputation by chained equations in R. Journal of Statistical Software, 45(3), 1-67.

Coakley, J., Fuertes, A.M., Carisma, F.S. (2004), Is the Feldstein–Horioka puzzle histoty? The Manchester School, 72(5), 1463-6786, 569-590.

Corbin, A. (2001), Country specific effects in the Feldstein–Horioka paradox: A panel data analysis. Economic Letters, 72, 297-302.

CBL. (2010), Fact Sheet on Key Economic and Financial Indicators. Monrovia: Central Bank of Liberia.

Coakley, J., Kulasi, F., Smith, R. (1996), Current account solvency and the feldstein-horioka puzzle. Economic Journal, Royal Economic Society, 106(436), 620-627.

Cooray, A., Sinha, D. (2007), The feldstein–horioka model re-visited for African countries. Applied Economics, 39, 1501-1510.

Dickey, D.A., Fuller, W.A. (1979), Distribution Of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74(366), 427-431.

Elliott, G., Rothenberg, T.J., Stock, J.H. (1996), Efficient tests for an autoregressive unit root. Econometrica, 64(4), 813-836.

Eviews. (2017), Econometrics Analysis Insight Blog. From Autoregressive Distributed Lag (Ardl) Estimation. Part 1-Theory. Available from: Http://Blog.Eviews.Com/2017/04/Autoregressive-Distributed-Lag-Ardl.Html. [Last retrieved on 2018 Apr 04].

Feldstein, M., Horioka, C. (1980), Domestic saving and international capital flows. Economic Journal, 90(358), 314-29.

Feldstein, M. (1982), Domestic Saving and International Capital Movements in the Long Run And the Short Run. National Bureau of Economic Research.

Feldstein, M., Horioka, C. (1980), Domestic saving and international capital flows. Economic Journal, 90(358), 314-329.

Giannone, D., Lenza, M. (2004), The Feldstein-Horioka Fact', ECARES, Universit´e Libre de Bruxelles, May 2004.

Gundlach, E., Sinn, S. (1992), Unit root tests of the current account balance: Implications for international capital mobility. Applied Economics, 24, 617-625.

Giles, D. (2014), Econometrics Beat: Dave Giles' Blog; Ardl Models-Part Ii-Bounds Tests. L'amable, On, Canada: I'm Now Retired as Professor Emeritus from the University of Victoria.

Glynn, J., Perera, N., Verma, R. (2007), Unit root tests and structural breaks: A survey with applications. Journal of Quantitative Methods for Economics and Busines Administration, 3(1), 63-79.

Hamdi, H., Sbia, R. (2013), Are investment and saving cointegrated? evidence from middle East and North African countries. International Journal of Business And Finance Research, 7(4), 103-113.
Hassler, U., Wolters, J. (2005), Autoregressive Distributed Lag Models And Cointegration, Discussion Papers 2005/22. Diskussionsbeiträge Des Fachbereichs Wirtschaftswissenschaft Der.
Honaker, J., King, G. (2010), What to do about missing values in time-series cross-section data. American Journal of Political Science, 54(2), 561-581.
Islam, F., Shahbaz, M., Butt, M.S. (2013), Is there an environmental kuznets curve for Bangladesh? Evidence from ardl bounds testing approach. Bangladesh Development Studies, 35(4), 1-23.
Jansen, W.J. (1996), Estimating saving-investment correlations: Evidence for OECD countries based on an error correction model. Journal of International Money and Finance, 5, 749-781.
Jansen, W.J., Schulze, G.G. (1996), Theory-based measurement of the saving-investment correlation with an application to Norway, Economic Inquiry, 34, 116-132.
Libanio, G.A. (2005), Unit roots in macroeconomic time series: Theory, implications, and evidence. Nova Economia-Belo Horizonte, 15(3), 145-176.
Mamingi, N. (1997), Savings-investment correlations and capital mobility: The experience of developing countries. Journal of Policy Modeling, 19, 605-626.
Ma, G., Mccauley, R., Lam, L. (2013), The roles of saving, investment and the renminbi in rebalancing the chinese economy. Review of International Economics, 21(1), 72-84.
Mankiw, N.G. (2016), Macroeconomics. 9th ed. New York: Worth Publisherd.
Mastroyiannis, A. (2007), Current account dynamics and the feldstein and horioka puzzle: The case of Greece . The European Journal of Comparative Economics, 4(1), 91-99.
Narayan, P.K. (2005), The saving and investment nexus for China: Evidence from cointegration tests. Applied Economics, 37, 1979-1990.
Ozmen, E., Parmaksiz, K. (2003), Policy regime change and the Feldstein-Horioka puzzle: The UK evidence. Journal of Policy Modeling, 2, 137-149.
Onafowara, O.A., Owoye, O., Huart, F. (2011), The temporal relationship between saving and investment: Evidence from advanced eu countries. International Journal of Business and Social Science, 2(2), 1-12 .
Perron, P. (1989), The great crash, the oil price shock, and the unit root hypothesis. Econometrica, 57(6), 1361-1401.
Pesaran, M.H., Shin, Y. (1999), An Autoregressive Distributed Lag Modelling Approach To Cointegration Analysis. In: Strom, S., editor. Econometncs And Economic Theory in the 20st Century:The Ragnar Frisch Centennial Symposium.
Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16(3), 289-326.
Pfaff, B. (2008), Analysis of Integrated and Cointegrated Time Series with R. New York: Springer Science+Business Media, Llc.
Phillips, P.C., Perron, P. (1988), Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.
Phillips, P.C., Perron, P. (1989), The great crash, the oil price shock, and the unit root hypothesis. Econometrica, 57, 1361-1401.
Sarno, L., Taylor, M.P. (1998), Exchange controls, international capital flows and saving investment correlations in the UK: An empirical investigation. Weltwirtschaftliches Archive, 134, 69-97.
Taylor, A.M. (2002), A century of current account dynamics. Journal of International Money and Finance, 21, 725-748.
Venkata, S.S. (2012), Savings and investment in india: The feldstein horioka puzzle. Applied Econometrics And International Development, 12(2), 1-10.
Vogelsang, T. J. (1993). Unpublished Computer Program.
Zivot, E., Andrews, D.W. (1992), Further evidence on the great crash, the oil price shock, and the unit root hypothesis. Journal of Business and Economic Statistics, 10(10), 251-270.

APPENDIX

Table A1: Restricted ECM for the Liberian economy using 1970-2012 annual data

Dependent variable is $\Delta(S/Y)$				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P**
C	0.663729**	0.241500	2.748355	0.0093
Dummy	0.546947	0.319417	1.712329	0.0954
Trend	−0.040572**	0.014385	−2.820431	0.0078
$\Delta(S/Y)_{t-1}$	0.530870***	0.136564	3.887333	0.0004
$\Delta(S/Y)_{t-2}$	−0.248607	0.141706	−1.754385	0.0879
$\Delta(I/Y)_{t-1}$	7.428258***	1.588323	4.676794	0.0000
$\Delta(I/Y)_{t-2}$	4.262860*	1.628877	2.617055	0.0129
ECT_{t-1}	−0.991193***	0.221638	−4.472128	0.0001

R^2=0.794999
Adjusted R^2=0.755137
Akaike info criterion=1.707225
Schwarz criterion=2.031623
Hannan-Quinn criter.=1.827527
Durbin-Watson stat=1.932538
F-statistic=19.94410
Prob(F-statistic)=0.000000
Sensitivity analysis
Serial correlation LM=0.330; P value=0.7209
ARCH test=0.043; P value=0.8358
Normality test=6.725; P value=0.035
Q(20)=15.140; P value=0.768

ECM: Error correction model

Table A2: Restricted ECM for the liberian economy using 1970-2012 annual data

1970-2012 dependent variable is Δ(I/Y)					1970-2012 dependent variable is Δ(S/Y)				
Variable	**Coefficient**	**Standard error**	**t-statistic**	**P***	**Variable**	**Coefficient**	**Standard error**	**t-statistic**	**P***
C	0.039551	0.022708	1.741706	0.0909	C	0.483413	0.246650	1.959919	0.0585
Dummy	0.114065	0.043260	2.636696	0.0127	Trend	−0.022323	0.010167	−2.195767	0.0352
Trend	−0.004477	0.001788	−2.504450	0.0174	$\Delta(S/Y)_{t-1}$	0.497727	0.147110	3.383359	0.0019
$\Delta(I/Y)_{t-1}$	−0.050838	0.231952	−0.219175	0.8279	$\Delta(S/Y)_{t-2}$	−0.284860	0.152513	−1.867779	0.0707
$\Delta(I/Y)_{t-1}$	0.040258	0.163682	0.245949	0.8072	$\Delta(I/Y)_{t-1}$	7.767640	1.718044	4.521210	0.0001
$\Delta(S/Y)_{t-1}$	−0.002112	0.007917	−0.266830	0.7913	$\Delta(I/Y)_{t-2}$	4.313446	1.771722	2.434607	0.0205
ECT_{t-1}	−0.977226	0.277513	−3.521372	0.0013	ECT_{t-1}	−0.911023	0.236186	−3.857233	0.0005
R^2=0.524390					R^2=0.778548				
Adjusted R^2=0.437915					Adjusted R^2=0.738284				
Akaike info criterion = −3.001148					Akaike info criterion = 1.864925				
Schwarz criterion = −2.705594					Schwarz criterion=2.160479				
Hannan−Quinn criter. = −2.894285					Hannan-Quinn criter. = 1.971788				
Durbin-Watson stat=1.760894					Durbin-Watson stat = 1.902550				
F-statistic=6.064094					F-statistic=19.33612				
Prob (F-statistic) = 0.000233					Prob(F-statistic) = 0.000000				
Serial correlation LM=1.472; P value=0.2364					Sensitivity analysis				
Serial correlation LM=1.472; P value=0.2364					Serial correlation LM= 0.151; P value=0.8603				
Serial correlation LM=1.472; P value=0.2364									
ARCH test=0.250; P value=0.6199					ARCH test=0.448; P value=0.5075				
Normality test=59.357; P value=0.000					Normality test=2.783; P value=0.000				
Q(20) = 20.917; P value=0.402					Q(20) = 17.681; P value=0.608				

ECM: Error correction model