UNITED NATIONS UNIVERSITY

UNU-WIDER

World Institute for Development Economics Research

WIDER Working Paper No. 2013/143

The impact of foreign aid on economic growth in ECOWAS countries

A simultaneous-equation model

Patricia A. Adamu*

December 2013

Abstract

This paper investigates the impact of foreign aid on economic growth in member countries of the Economic Community of West African States using panel data for 1990-2009 and a three-equation simultaneous-equations model. The effect of foreign aid on economic growth among these ECOWAS countries was found to be positive and strong. Other important drivers of economic growth include interest rate, foreign direct investment, and the level of international reserves. The results from the equation on foreign aid indicated that domestic investment, exports, and international reserves have a positive relationship with foreign aid. From the equation explaining investment, domestic savings and exchange rate were found to be positively related to investment. A policy implication of the study is that member countries of the Economic Community of West African States should seek foreign aid as it would greatly accelerate their economic growth.

Keywords: foreign aid, economic growth, ECOWAS, simultaneous-equation model

JEL classification: C33, F21, F35, F43

* West African Institute for Financial and Economic Management (WAIFEM), Lagos, paadamu@yahoo.com

This study has been prepared within the UNU-WIDER project 'ReCom–Foreign Aid: Research and Communication', directed by Tony Addison and Finn Tarp.

UNU-WIDER gratefully acknowledges specific programme contributions from the governments of Denmark (Ministry of Foreign Affairs, Danida) and Sweden (Swedish International Development Cooperation Agency—Sida) for ReCom. UNU-WIDER also gratefully acknowledges core financial support to its work programme from the governments of Denmark, Finland, Sweden, and the United Kingdom.

ISSN 1798-7237 ISBN 978-92-9230-720-2

Acknowledgements

This paper has been written as part of a collaboration between UNU-WIDER and the African Economic Research Consortium (AERC) within the UNU-WIDER project 'ReCom–Foreign Aid: Research and Communication', directed by Tony Addison and Finn Tarp.

Acronyms

2SLS	two-stage least squares estimator
3SLS	three-stage least squares estimator
ECOWAS	Economic Community of West African States
FDI	foreign direct investment
WAEMU	West African Economic and Monetary Union

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Liisa Roponen at UNU-WIDER.

1 Introduction

Foreign aid or assistance on concessional terms is often channelled to developing countries, either directly or indirectly through multilateral institutions or private voluntary organizations for the purpose of supporting social and economic development. Specifically, aid contributes to economic development in two ways. First, aid can accelerate the attainment of a steady-state potential growth rate by a country with limited capital. Second, aid can improve a country's ultimate steady growth rate because it brings transfer of technology (knowhow) and encourages good governance and practices (transparency and accountability).

The effectiveness of foreign aid on economic growth has been surrounded by controversy. Aid effectiveness implies how well aid flows have accomplished the purpose for which they were intended. The literature has a lot of divergent opinions on estimating the impact of aid on growth in developing countries, however, it should be noted that the aid-growth issue is of great importance to developing countries. If the question of the impact of aid on growth were to be abandoned by researchers, then the issue would be open to speculative and unhelpful contributions (Arndt et al. 2010). The overarching issue in macroeconomic response to aid inflows is that aid raises the stakes in the development challenge, promising great benefits to the recipient countries if well used, but also risking an exchange rate appreciation that could make the economy uncompetitive and impair the prospects for export-led growth.

The Economic Community of West African States (ECOWAS)[1] was established by the Treaty of Lagos on 28 May 1975 with the mandate to promote cooperation and integration, which would lead to the establishment of an economic union in West Africa, in order to raise the living standards of its peoples, and to maintain and enhance economic stability, foster relations among member states and contribute to the progress and development of the African continent. Inadequate capital has been the bane of rapid growth and development in the ECOWAS countries.

Subsequently, many of these countries have relied and obtained various forms of foreign aid. It is desirable to study the ECOWAS countries because of their heterogeneity in size, resources and language. The subregion also has more than its fair share of post-conflict countries. To achieve the desired development results as well as to tap Africa's innate resourcefulness, potential, institutions and financing for development, it is obvious that better management of aid to complement domestic resources is of critical importance (AU and NEPAD 2011).

Although, there has been a lot of debate[2] on the aid-growth relationship, and on aid effectiveness in particular, examined either with cross-country or panel data analyses or both, there is no study that has concentrated on ECOWAS countries as a subregion.

The objective of this paper is to investigate the impact of foreign aid on the economic growth of ECOWAS countries to determine the effectiveness of aid in the subregion. By applying simultaneous equations and taking thus into account non-linear effects of human capital on economic growth, this paper explores the effect of foreign aid on growth in much greater

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1 ECOWAS is made up of fifteen countries, namely, Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo.

2 See, for example, Bauer (1971); Burnside and Dollar (2000); Hansen and Tarp (2001); Collier and Dollar (2002); Alesina and Weder (2002); Clemens et al. (2004); Roodman (2007); and Dalgaard et al. (2004).

detail than previous studies. The paper is organized into five sections. Following the introductory section is section 2, which reviews relevant literature, both theoretical and empirical evidence for the relationship between aid and growth. Section 3 is devoted to the rationale and theoretical underpinning of the study, as well as methodology, while section 4 presents and analyses the empirical results. Section 5 summarizes and concludes the paper.

2 Theoretical literature

The theoretical foundation for the proposition that aid can promote economic development is the 2-gap model (McKinnon 1964), which posits that development may be hampered in the developing countries by the existence of two gaps, viz., the savings gap and the foreign exchange gap. The savings gap arises from the fact that domestic savings, for various reasons, tend to be low in the typical developing country. Thus, savings will inevitably fall short of the 'required investment', i.e., the investment needed to grow at a target rate. Foreign savings in the form of aid can fill this gap. The role of foreign capital in this sense is that it permits the developing country to invest more than it can save domestically. Similarly, the import surplus, or balance-of-payments deficit, constitutes a foreign exchange gap, which can naturally be filled by aid flows. It has been argued that even when a country has enough savings, it may not be able to 'transform' the savings into foreign exchange for the purchase of needed capital imports. Thus, there can be a foreign exchange gap without a savings gap. There can also be a savings gap without a foreign exchange gap. At times both gaps exist. With respect to the foreign exchange gap, many analysts believe that capital imports, financed by aid flows, will accelerate the rate of capital formation by their very nature (Iyoha 2004b). This two-gap model is akin to the original Harod-Domar model which indicates that investment is constrained by insufficient domestic savings or limited foreign exchange needed to import capital goods.

Beyond the two-gap model utilized by McKinnon (1964), Chenery and Bruno (1962), and Chenery and Strout (1966), a three-gap model was explored by Bacha (1990) by adding the fiscal-gap when domestic tax revenues are insufficient for financing public investment projects or other investments, and the government needs foreign aid to supplement domestic revenue sources. The effect of foreign aid on economic growth can be transmitted via its impact on investment, private and government consumption, as well as capital accumulation. Therefore, to increase the level of investment and hence growth, finance gap can be filled through aid (Hanson and Tarp 2000). Even where no finance gaps exist, aid can change the equilibrium level of investment by raising private investment through improved infrastructure.

Several reasons have been given to buttress the view that aid might not promote growth. These include: mismanagement (waste), corruption, likelihood of currency appreciation that will erode the profitability of the production of all tradable goods (Dutch disease), reduction in savings (both private and government), perpetuating bad governments in power, and hence poor economic policies (Radelet et al. 2004).

2.1 Empirical literature

Evidence supports the view that aid is effective in increasing capital accumulation and hence in furthering growth. To determine whether aid does increase growth, a study by Hansen and Tarp (2001) includes investment and human capital in the growth equation of 53 countries. Their result confirms that aid impacts on growth through capital accumulation and that aid-

investment growth nexus is important. Therefore, they concluded that aid increases growth through investment and human capital, which is not conditional on good policy. Hansen and Tarp (2000) provide a survey of empirical analyses from the last 30 years that make use of cross-country regressions in assessing the effectiveness of foreign aid. The empirical evidence from 131 such regressions shows that aid (i) increases aggregate saving, although not by as much as the aid flow, (ii) increases investment, and (iii) has a positive effect on the growth rate whenever growth is driven by capital accumulation. However, other studies find support that aid stimulates growth in countries with good policies and institutions (see, for example, Islam et al. 1995; Burnside and Dollar 2000, 1997; Collier and Dollar 2002; Radelet et al. 2004).

There is a plethora of literature on the controversies trailing the assertion of foreign aid's effectiveness on the economic growth of recipient countries. According to Iyoha (2004), large aid flows to Africa have done little to promote growth and alleviate poverty, while others researchers see aid as the moral obligation of rich countries for alleviating poverty in developing countries (Sachs 2004). Yet, some economists are of the view that aid has no effect on growth. For example, Easterly and Levine (2001, 2003), Friedman (1958), and Bauer (1971) are of the view that aid has resulted in corruption, bad government and accentuated poverty levels in Africa and have therefore called for the elimination of aid. Conversely, those who supporting aid argue that even though aid at one time or another has failed to elicit growth, it has helped to reduce poverty (see Stiglitz 2002; Stern 2002; Sachs et al. 2004). To corroborate this fact, Radelet et al. (2004) point out that in the four decades since aid became widespread, poverty indicators have fallen in many countries around the world, and health and education indicators have risen faster than any other 40-year period in human history. Aid is an important tool for enhancing the development prospects of poor countries. Thus, to reduce poverty, accelerate growth and improve the standard of living of the people, there should be more inflow of aid and improvement on its effectiveness (Hansen and Tarp 2001).This can be achieved if there is effective aid management in the recipient country. Such aid management should be an integral part of a country's general resources planning so that aid flows would complement other domestic resources and promote the desired goal of rapid economic growth and development (Iyoha 2004b).

It is acknowledged that not all aid is alike in terms of its impact on growth. Most studies look at the relationship between total aid and growth, but large portions of aid—food aid, provision of medicines, bed nets, disaster and humanitarian relief efforts, for example—are not directed at growth. Since growth is not the objective, the impact of aid on growth will be negative or insignificant. Similarly, in standard cross-country growth regressions, assistance for education and health may appear as a high level of aid with zero growth because of the long time needed for the impact to be felt. But aid for infrastructural development like good roads, electricity supply, bridges, telecommunication facilities, etc., will enhance growth quickly. Therefore, a positive relationship between aid and growth can be obtained even in the short term. Radelet et al. (2004) conclude that a combination of the two kinds of aid discussed above will result in mixed results that will show an overall weak relationship between aid and growth.

A recent development in the aid-growth literature is the analysis of the different categories of aid on growth. Researchers are moving away from the examination of the impact of aggregate aid to the analysis of different components. According Rajan and Subramanian (2008), the four different bases for distinguishing aid should include: (i) motives for granting aids (why?); (ii) donor type (who is granting aid?); (iii) the use to which aid is put (for what:

health, social sector, technical assistance?), and (iv) the timing of impact (when?). But they warned that making distinctions between aid categories will lead to fungibility. This is a term used to describe how aid and other government funds are transferable across sectors. This may not depend on the specific purpose the aid was meant for, or the intent behind it, but what matters according to the theory is how well the recipient translates all expenditure to growth.

Arndt et al. (2010) classify aid-growth relationship studies into three generations. According to these authors, first-generation studies show that aid tends to increase total savings, but not by as much as the aid flow, using the Harrod-Domar growth model and the two-gap Chenery-Strout extension. Easterly (1999) criticizes this approach by pointing out that growth is less related to physical capital investment than often assumed. The second-generation studies, employing cross-sectional data, find a positive relationship between aid and investment. It is also argued that if the productive impact of aid depends more on incentives and relative prices as well as the policy environment, then it is vital to consider these factors. It is, however, noted that if aid affects growth through a fixed investment ratio and a constant level of human capital, then aid works through channels that impact on total factor productivity. But if aid leads to the acquisition of inappropriate technology, there will be a negative effect of aid on investment. This may be due to institutional destruction (see Hansen and Tarp 2001). The third generation research uses panel data analysis to investigate the aid-growth relationship. This relationship is perceived to be non-linear due to the weaknesses of previous studies.

The divergent views arising from aid effectiveness are noted to be due to the analytical framework utilized (cross-country or panel data analysis), and the choice of methodology (whether logs, levels, ratios, growth rates, etc.), differences in the assumptions made concerning the exogeneity or endogeneity of variables, and the differences in the choice of data transformation. Using cross-sectional data, Burnside and Dollar (2000) examine the impact of aid on growth conditional on the quality of economic policy. Finding that aid has a positive impact on growth in developing countries with good fiscal, monetary and trade policies, and that in the presence of poor policies, aid does not propel growth, they conclude that aid contributes positively to growth only in good policy environment. Likewise, Hansen and Tarp (2001), using a panel data analysis to examine the aid-growth relationship, conclude that the fewer the policy distortions affecting the incentives of economic agents, the greater the growth will be.

In contrast, Rajan and Subramanian (2008), in examining the effects of aid on growth in cross-sectional and panel data framework, find no robust positive relationship between aid inflows into a country and its economic growth. In particular, they find no evidence to support the view that aid works better in better policy or geographical environment, or that certain forms of aid work better than others. Similarly, studies on aid effectiveness using panel data analysis on a sample of more than 90 countries for the period of 20 years show that aid has no impact on investment and growth (Boone 1994, 1996). Also, Rajan and Subramanian (2008), applying data for the period 1970–2000 for sub-Saharan Africa (SSA) and East Asia, and employing the OLS technique to determine the impact of aid on growth, find no systematic effect of aid on growth. They conclude that aid has no impact on growth, and that political economy dynamics explains the lack of a positive effect of aid on growth.

Criticizing Boone's (1994, 1996) submission of a negative aid-growth relationship, it has been suggested by several authors who believe in the positive impact of aid on growth,[3] that the reason for Boone's assertion of aid's lack of impact on growth may be due to his treatment of the aid-growth relation as linear, whereas it is a non-linear growth model. Hansen and Tarp (2001) maintain that the non-linear relationship between aid and growth is best captured by the diminishing returns to aid. Also, Roodman (2007) points out that the choice of methodology impacts on the results. He concludes that while some aid is likely to increase investment and growth, aid is probably not a fundamentally decisive factor for development. Again, the choice of estimator does matter in determining aid effectiveness. According to Hansen and Tarp (2001), the effects of aid may seem excessively higher in the generalized method of moments (GMM) regression than in an OLS regression.

Arndt et al. (2010) replicate the study by Rajan and Subramanian (2008), but a better instrumentation strategy and improved specification. They obtain results which provided a solid support that the effect of aid on growth is positive. Their findings suggest that an inflow of aid on the order of 10 per cent of the GDP spurs the per capita growth rate by more than one percentage point per annum in the long-run. This result is also consistent with the view that foreign aid stimulates aggregate investment and may also contribute to productivity growth, despite some fraction of aid being allocated to consumption. On the other hand, Trumbull and Wall (1994) and Alesina and Dollar (2000) empirically conclude that a negative relationship exists between aid and income per capita.

The reason for possible endogeneity of aid in growth regressions is the difficulty in perceiving aid as a lump-sum transfer, independent of the level of income. Correlation between aid and growth is negative for levels and insignificant for the differences (Hansen and Tarp 2001). This is an example of the differences between cross-section and time-series analysis. Therefore, it can be argued that high aid/GDP ratio is related to low growth, while increases in the aid/GDP ratio are associated with increasing growth rates.

Few studies have addressed the issue of an appropriate priori with respect to the impact of foreign aid on economic growth. But Rajan and Subramanian, using a neoclassical growth model, and assuming that aid only augments physical capital investment with no effect on productivity, observe that a 10 per cent increase in the ratio of aid to GDP increases the growth rate of per capita by one per cent.

Determining an appropriate timeframe for the manifestation of aid on growth, Arndt et al. (2010) find that the aid-growth relationship emerges over a long timeframe. This is because many aid investments in education and health take a longer time to translate into more rapid economic growth. But according to growth theory, the contribution of these investments to growth is likely to be relatively modest. Therefore, while the impact of aid on growth is difficult to discern in the shorter term, for Arndt et al. (2010) maintain that in the long run, macro-evidence is combined with micro- and meso-level evidence to produce a consistent case for aid effectiveness, hence, there is no micro-macro paradox. Radelet et al. (2004) also lend support to the use of a longer timeframe but caution that the longer the period, the more difficult it is to isolate the impact of aid on growth from other factors. Advancing reasons in support of a longer time horizon, Kraay (2004) and Wacziarg and Welsh (2003) point out that

[3] Among others, Burnside et al. (2000), Obstfeld (1999), Lensink and White (1999), Durbarry et al. (1998), and Hadjimichael et al. (1995).

short-term growth regressions are prone to be affected by cyclical factors, which are hard to control for, and are thus plagued by the problem of extra 'noise'.

3 Rationale and theoretical underpinning

Using panel data and employing simultaneous equations modelling, this paper investigates the impact of foreign aid on the economic growth of ECOWAS member countries. The empirical analysis is based on a sound theoretical framework, as we draw on the growth theory and augment the classical growth model, which consists of initial income, capital stock, labour force, investment, human capital and country dummies.

Consider the standard neoclassical production function:

$$Y=F(A,K,L) \tag{1}$$

where A is the level of technology, K is the capital stock, L is the quantity of labour and Y is output. Assume that the production function is twice differentiable and subject to constant returns to scale, and that technical change is Hicks-neutral.

Differentiation of (1) with respect to time, dividing by Y and rearranging the terms yields:

$$\acute{Y}/Y = \acute{A}/A + (F_K K/Y) \cdot (\acute{K}/K) + (F_L L/Y) \cdot (\acute{L}/L) \tag{2}$$

where: $\acute{Y}/Y$ is the continuous time rate of growth of output, $\acute{K}/K$ is the growth rate of capital stock and $\acute{L}/L$ is the growth rate of labour force; F_K and F_L are the factors (social) marginal products of capital and labour, respectively; and $\acute{A}/A$ is the Hicks-neutral rate of change of technological progress. Thus, the basic Solow (exogenous) growth model gives the growth rate of output or income, depending on the growth rate of technical change, labour or population and capital stock.

In empirical applications, this basic Solow model has been modified to obtain the augmented Solow growth model where the growth rate of income for a given country depends not only on technical change, labour and capital but also on policy variables like trade, fiscal policy, and monetary policy.[4]

Even though the theoretical model underlying modern empirical aid-growth work has moved beyond the Harrod-Domar model, aid is still meant to impact on growth via capital accumulation. To analyse whether aid works through the investment link it is necessary to show that (i) investment impacts on growth, and (ii) aid impacts on investment. Accordingly, we formulate a growth regression in which per capita income is driven by aid, investment, human capital and other factors. Aid itself is explained by a vector of variables that includes investment, the growth rate of population and exports. Finally, investment depends, *inter alia*, on aid, domestic savings, and foreign direct investment (FDI). Note that in order to ensure that all sources of capital accumulation are accounted for in this study, we include gross domestic investment, FDI, and a measure of human capital in the modelling. The measure used for human capital is the mean years of education at primary and secondary levels.

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4 See Barro (1991), Easterly and Levine (2001), Mankiw et al. (1992), and Ologu (2003).

3.1 Model specification

The growth-aid relationship is modelled as a system of equations. The merit in this type of system approach is that it allows for the estimation of more complicated effects of aid (Juselius et al. 2011). In particular, simultaneous-equations modelling allows for the identification and measurement of direct and indirect effects or impacts. The full system is a 3-equation simultaneous equation model. In the first equation, economic growth, proxied by per capita income, is specified to depend on foreign aid, FDI, and other determinants of economic growth like gross domestic investment, human capital, exports, macroeconomic policy environment, and political and linguistic differences captured by a political dummy variable . Note that eight of these countries are French speaking and members of WAEMU (the West African Economic and Monetary Union). A dummy variable is therefore introduced to test whether or not WAEMU membership makes a difference. In the second equation, foreign aid is assumed to depend on gross domestic investment, population growth rate, macroeconomic policy environment and other variables like international reserves, and exports and socio-political considerations proxied by a country dummy variable and a political dummy variable. Finally, in the third equation, gross domestic investment is hypothesized to be a function of gross total domestic savings, foreign aid, the rate of interest, FDI and other variables such as exchange rate, inflation rate, a country dummy variable and a political dummy variable. The country dummy variable is introduced to test the significance of differences in the size of the economies.

Using a neoclassical growth theory, trade theory and economic theory, it is hypothesized that economic growth depends positively on human capital, physical capital (proxied) by investment, exports, FDI, and foreign aid flows. It however depends inversely on interest rate and inflation rate.

Thus, we present the following mathematical equation:

$$PCY = f(AID, INV, HK, FDI, INTR, INFL, XPORT, CDUMMY, u_1) \quad (3)$$

From the literature on theoretical and empirical determinants of foreign aid, it can be surmised that foreign aid flows to ECOWAS countries will depend positively on investment, foreign exchange reserve holdings, exports, and population growth. However, it will depend inversely on the inflation rate.

Hence, we present the following mathematical equation:

$$AID = h(INV, POPGR, INFL, RES, XPORT, CDUMMY, POLDUMMY, u_2) \quad (4)$$

From economic theory and previous empirical studies, it is appropriate to hypothesize that aggregate investment depends positively on domestic savings, FDI, foreign aid inflows, and exchange rate. However, it depends inversely on interest rate and inflation.

Thus, we present the following mathematical equation:

$$INV = g(AID, INTR, SAV, FDI, EXRT, INFL, CDUMMY, POLDUMMY, u_3 \quad (5)$$

where:

PCY = per capita income (a measure of economic development/growth)

AID = foreign aid inflows

FDI = foreign direct investment
INV = gross domestic investment
HK = human capital (measured by mean years of schooling)
POPGR = population growth rate
INFL = inflation rate (a measure of macroeconomic stability)
INTR = interest rate (a measure of macroeconomic stability)
EXRT = exchange rate (nominal)
RES = level of international reserves
XPORT = level of exports
SAV = gross domestic savings
CDUMMY = country dummy, to test the effect of country size
POLDUMMY = political dummy, to test the effect of being Francophone (and membership of WAEMU)

u_1, u_2, u_3 are stochastic error terms.

Taking logarithms of the variables and linearizing equations (3-5) gives the following relations:

$$LPCY = \alpha_0 + \alpha_1 LAID + \alpha_2 LINV + \alpha_3 LHK + \alpha_4 LFDI - \alpha_5 LINTR - \alpha_6 LINFL - a_7 LXPORTS + \alpha_8 CDUMMY + u_1 \quad (6)$$

$$LAID = \beta_0 + \beta_1 LINV + \beta_2 LRES + \beta_3 LPOPGR + \beta_4 LINFL + \beta 5 LXPORT + \beta 6 CDUMMY + \beta_7 POLDUMMY + u_2 \quad (7)$$

$$LINV = \varphi_0 + \varphi_1 LAID - \varphi_2 LINTR + \varphi_3 LSAV + \varphi_4 LFDI + \varphi_5 EXRT + \varphi_6 LINFL + \varphi_7 CDUMMY + \varphi_8 POLDUMMY + u_3 \quad (8)$$

where L stands for natural logarithms.

On *a priori* basis, from Relation 6, it is expected that the coefficients of foreign aid, investment, human capital, FDI and exports will have a positive relationship with per capita income, a measure of economic growth, while interest rate and inflation rate are negatively related to economic growth and the sign of the political dummy variable is indeterminate. In Equation 7, the coefficients of investment, international reserves, population growth rate and exports are directly related to foreign aid while the inflation rate will exhibit a negative sign. The signs of the dummy variables are indeterminate. Finally, in Equation 8, from *a priori* considerations, investment is positively related to foreign aid, gross domestic savings, FDI, and exchange rate, and negatively related to interest rate and the inflation rate. The signs of the dummy variables are *a priori* indeterminate.

3.2 Estimation methodology

In this system of equations, there are a total of 14 variables. There are three endogenous variable, namely, per capita income (PCY), foreign aid (AID) and gross domestic investment (INV) and 11 predetermined variables, viz., FDI (foreign direct investment), HK (human capital, measured by mean years of schooling), RES (level of international reserves), XPORT

(level of exports), INFL (inflation rate), INTR (lending interest rate), EXRT (nominal exchange rate), SAV (total domestic savings), POPGR (growth rate of population), CDUMMY (country dummy), and POLDUMMY (political dummy).

Note that all the equations are identified. They all satisfy the ORDER condition (the necessary condition) of identification. Indeed, each of the 3 equations is over-identified. They also satisfy the RANK condition (the necessary and sufficient condition) of identification. See Appendix 1 for proof.

Since all the equations are over-identified, they can be suitably estimated by the following estimators: (i) two-stage least squares (2SLS) and (ii) three-stage least squares (3SLS). Wooldridge (2010: 191–2, 194–5), Iyoha (2004a: 118–9), and Greene (2003: 398–400, 405–7) show that both the 2SLS estimator and 3SLS estimator yield estimated coefficients that are consistent, asymptotically normal and asymptotically efficient. Therefore, both the 2SLS and 3SLS estimators are employed in this paper, using the MICROFIT 5.0 Econometric software by Pesaran and Pesaran (2009). Since they are all double-log equations, the coefficient estimates obtained are interpretable as elasticities. Econometric results were obtained using both estimators but only the 3SLS results are reported in Appendix 3. Since the 3SLS estimator is a systems estimator, it is presumptively superior in terms of efficiency to the 2SLS estimator, at least asymptotically, see Greene (2003: 413) and Iyoha (2004a: 118–9). Therefore, it was decided to interpret only the 3SLS results here. After estimation, the reduced-form coefficients of the 3SLS results were obtained. These can be interpreted as elasticity multiplier coefficients and give us the change in an endogenous variable for a given change in any exogenous variable. These multipliers are also discussed in the text.

3.3 Data

This paper uses data for ECOWAS countries collected over a 20-year period (1990-2009) giving us panel data. All ECOWAS countries are included in the study with the exception of Liberia, because of non-availability of data. Data for the remaining 14 ECOWAS countries covering the 20-year period give us 280 observations for the estimation of the equations of the model. The data were obtained from the World Bank's World Development Indicators.

4 Presentation and interpretation of empirical results

The 3SLS are given below while the descriptive statistics are reported in Appendix 2. Note that t-values are reported in parentheses below estimated coefficients.

4.1 LPCY: the equation explaining economic growth

LPCY =	-2.76	+	0.374 LAID	+	0.001 LINV	–	0.23 LHK	+ 0.044 LFDI
	(-2.97)		(3.39)		(0.404)		(-5.27)	(3.1)

	-0.086 LINTR	–	0.044 LINFL	+	0.22 LXPORT	+	0.28 POLDUMMY	
	(-2.84)		(-2.77)		(6.42)		(2.81)	

$R^2 = 0.504$; R-bar-sq = 0.49; F(8,271) = 34.4

The equation explaining economic growth in ECOWAS countries exhibits a fairly good fit. It shows an R-squared of over 50 per cent. This is quite good for cross-country analysis. More importantly, the F-statistic exceeds 34 showing that it is significantly different from zero at

the 1 per cent level. Thus, the hypothesis of a significant linear relationship between economic growth and all the regressors in the equation cannot be rejected at the 1 per cent level of significance.

Going into details, the empirical results obtained show that economic growth in ECOWAS countries depends positively on foreign aid and investment. This econometric result showing a positive impact of foreign aid inflows on economic growth is expected and gratifying. It indicates that high levels of foreign aid inflows will promote economic growth, possibly by relaxing the foreign exchange and savings constraints. Foreign aid also at times brings with it technical assistance which could be a driver of economic growth. The t-statistic for AID is approximately 3.4. Thus, this variable is statistically significant at the 1 per cent level. Therefore the hypothesis that foreign aid contributes positively to economic growth in ECOWAS countries is validated. It is worth noting that the elasticity of aid with respect to per capita real income is approximately 0.4. This is a powerful result as it shows that a 10 per cent increase in foreign aid would on average raise per capita real income by 4 per cent in ECOWAS countries. Thus, the impact of foreign aid on economic growth is huge, even enormous, in ECOWAS countries. However, investment with a t-statistic less than unity is statistically insignificant, even at the 10 per cent level. Hence, judging by this equation, the hypothesis that investment drives economic growth in ECOWAS countries is not supported. A possible explanation for this surprising empirical result may be that the strong positive impact of exports, foreign aid and FDI on economic growth may have dominated the contribution of investment to growth. Alternatively, the unexpected empirical result may be due to measurement problems. The human capital variable is incorrectly signed though it is statistically different from zero. This unexpected result is probably due to the selected proxy for the measure of human capital. Future researchers may wish to utilize the production of high-level manpower as the measure of human capital. FDI has the correct sign and is highly significant, easily passing the significance test at the 1 per cent confidence level. Possibly, FDI drives economic growth through its positive contribution to foreign exchange resources, managerial acumen, and employment creation. The interest rate variable is correctly signed and highly significant, as is the inflation rate. Both pass the significance test at the 1 per cent confidence level. The inflation rate is negatively related to economic growth as postulated by theory, indicating that good macroeconomic policies will attract the reward of a rapidly growing economy while a high rate of inflation would tend to reduce the rate of economic growth in ECOWAS countries.

As expected, exports are a key driver of economic growth in ECOWAS. Exports are positively related to per capita income and the coefficient is significantly different from zero at the 1 per cent level. It also reports an elasticity value of 0.22 indicating that a 10 per cent increase in exports would, on average, trigger a 2.2 per cent growth in real per capita income in the countries under review. The political dummy variable (which has a value of unity for Anglophone countries and a value of zero for Francophone countries) has a positive sign and is significantly different from zero at the 1 per cent confidence level. This suggests that Francophone countries, on average, are reporting a lower growth rate of per capita real income than their Anglophone neighbours. Thus, membership in WAEMU apparently does not significantly boost economic growth in the Francophone countries.

4.2 LAID: the equation explaining foreign aid

The equation explaining foreign aid in ECOWAS countries also has a fairly good fit. The reported R-squared of 55 per cent can be considered as acceptable for cross-country analysis. More importantly, the F-statistics of 47.3 is highly significant, passing the significance test at

the 1 per cent level. Thus, the hypothesis of a significant linear relationship between foreign aid and all the regressors used in the equation cannot be rejected at the 1 per cent significance level.

LAID = 7.93 + 0.17 LINV + 0.26 LRES + 0.01 LPOPGR + 0.05 LINFL
(10.19) (7.64) (6.35) (0.18) (1.92)

+ 0.16 LXPORT – 0.006 CDUMMY – 0.11 POLDUMMY
(4.02) (-0.68) (-1.1)

R^2 = 0.55; R-bar-sq = 0.54; F(7,272) = 47.3

Going into details, it is seen that there is a positive relationship between foreign aid and investment in ECOWAS countries. The investment variable is positively signed with a t-statistic of 7.64. Thus, this variable is significantly different from zero at the 1 per cent level. The level of international reserves also exhibits a positive relationship with foreign aid. The reported t-statistic of 6.35 is highly significant, easily passing the significance test at the 1 per cent level. Thus we may conclude that the amount of international reserves held by each country is a principal determinant of foreign aid among ECOWAS countries. The level of exports is also positively related to foreign aid. It is correctly signed and passes the significance test at the 1 per cent confidence level. Population growth is correctly signed but insignificant while inflation has the wrong sign but passes the significance test at the 10 per cent confidence level. The country and political dummy variables are not statistically significant.

4.3 LINV: the equation explaining investment

LINV = 3.7 – 0.24 LAID + 0.366 LINT + 0.997 LSAV – 0.02 LFDI + 0.11 LINFL
(1.68) (-2.25) (3.7) (29.1) (-0.56) (2.4)

+ 0.12 LEXRT + 0.024 CDUMMY – 0.05 POLDUMMY
(3.4) (2.74) (-0.22)

R^2 = 0.82; R-bar-sq = 0.81; F(8,271) = 151.1

The equation explaining aggregate investment in ECOWAS countries has a good fit. The reported R-squared of 82 per cent is extremely good, especially as this is a cross-country study. Using the selected regressors we are able to explain over 82 per cent of the systematic variations in aggregate investment during the 20-year period. More importantly, the F-statistic of 151.1 is highly significant, effortlessly passing the significance test at the 1 per cent level. Hence, the hypothesis of a significant linear relationship between investment and all the regressors in the equation cannot be rejected at the 1 per cent level. Going into details, it is seen that total domestic savings is the most important determinant of aggregate investment in ECOWAS countries. Total savings are positively related to investment as hypothesized and with a t-statistic of 29.1; savings is highly significant, easily passing the significance test at the 1 per cent level. Hence, we may conclude that savings are by far the principal determinant of investment in ECOWAS countries. Both aid and FDI are wrongly signed. Although aid is significant, FDI is not statistically significant. The exchange rate variable is correctly signed and significant at the 1 per cent level. This suggests that following an appropriate exchange rate policy will contribute to increased investment in ECOWAS countries. Given that the nominal exchange rate variable is correctly signed, we can conclude that depreciation (devaluation) will improve the balance of payments. Unfortunately, the interest rate variable is wrongly signed, although statistically significant. The perverse sign of the interest rate variable may be a result of structural rigidities in the financial sectors of these

countries. (See Appendix 3 for detailed results and graphs of both the 2SLS and 3SLS econometric estimation results.)

4.4 Elasticity multiplier coefficients

In order to find the direct and indirect effects (that is, total effects) of the exogenous variables on the endogenous variables (per capita income, foreign aid and gross domestic investment), it is necessary to obtain the elasticity multiplier coefficients. These elasticity multiplier coefficients are obtained by solving for the reduced form of the estimated equation system which yields the following results:

Table 1: The elasticity multiplier coefficients are as follows:

	LHK	LFDI	LINFL	LINTR	LXPORT	LRES	LPOPGR	LSAV	LEXRT	POLDUMMY	CDUMMY
LPCY	-0.220	0.240	-0.100	-0.270	0.100	-0.004	0.010	-0.005	-0.006	0.130	0.002
LAID	0.000	0.510	-0.060	0.160	0.260	0.010	0.041	-0.017	-0.020	0.120	-0.020
LINV	0.000	-0.020	0.370	-0.040	-0.060	-0.002	0.240	0.100	0.120	-0.080	0.040

Source: See text.

Table 1 is the matrix of the reduced-form coefficients. It gives the proportionate effect of a change in each exogenous (predetermined) variable on each endogenous variable. Since all the variables are in logarithms, the coefficients are elasticities. Thus, an examination of the first row shows that the total effect (direct and indirect) of a 10 per cent increase in FDI is to raise per capita real income by 2.4 per cent in the ECOWAS countries. Similarly, an increase in the level of exports tends to jack up real income per capita because a 10 per cent rise in the level of exports increases real income per capita by 1 per cent. Inflation and interest rates have negative effect on economic growth in ECOWAS countries. In addition, a 10 per cent rise in the political dummy will increase the real income per capita by 1.3 per cent, implying that the Anglophone countries in the ECOWAS subregion will have higher growth rate of per capita real income than their Francophone counterparts. In contrast, a 10 per cent increase in inflation and interest rates, respectively, will lead to a decrease of 1 per cent and approximately 3 per cent in per capita real income, respectively. From the second row, it can be seen that the total effect of a 10 per cent rise in FDI increases foreign aid (AID) by 5.1 per cent while a 10 per cent rise in exports will increase AID by 2.6 per cent. Note that the elasticity multiplier coefficient for interest rate is 0.16, indicating that a 10 per cent increase in the rate will raise AID by approximately 2 per cent. Also, a 10 per cent rise in the political dummy will increase per capita real income by 1.2 per cent The third row of the table demonstrates that the direct and indirect effect of a 10 per cent increase in population growth rate will boost investment by 2.4 per cent while the total effect of a 10 per cent increase in savings will raise investment by 1 per cent in the countries under study. Finally, a 10 per cent increase in inflation will perk up investment in the subregion by about 4 per cent.

5 Summary and conclusion

This paper considers the impact of foreign aid on economic growth of ECOWAS countries using data for 1990 through 2009 for 14 out of the 15 ECOWAS member countries (Liberia

was excluded due to lack of adequate data). A 3-equation simultaneous equation model was utilized, and the specification allowed for political and country effects. The model was estimated using both the 2SLS and 3SLS estimators. These estimators yield consistent and asymptotically efficient estimates of structural parameters. A major contribution of the paper to the literature on foreign aid-growth nexus in African countries is the use of simultaneous equations modelling. In addition, we should point out that in contradistinction to previous studies, the paper is a pioneer in its consideration of all the ECOWAS countries and also in allowing for the effect of politicoeconomic dynamics and peculiar country effects.

From our empirical findings, foreign aid is significantly and positively related to economic growth in ECOWAS countries. This result is consistent with some previous studies which find that foreign aid is a major driver of economic growth in developing countries. The inflation rate is noted to be significant and inversely related to economic growth, suggesting that a high rate of inflation tends to reduce economic growth in ECOWAS countries. The level of international reserves, domestic savings and FDI exhibits a positive relationship with economic growth. Exports are also found to be a robust driver of economic growth in ECOWAS countries

The empirical results demonstrate that the amount of international reserves held by each country is a principal determinant of foreign aid among ECOWAS countries, and that FDI is a principal driver of aggregate investment in the subregion. In addition, the richer a country is, *ceteris paribus*, the higher will be its level of investment. A vital policy implication of the result is that the countries in the West African subregion should solicit for foreign aid as it would significantly accelerate their economic growth. Also, an appropriate exchange rate policy, as well as policies that will encourage domestic savings and FDI, would contribute to increased investment in ECOWAS countries and hence spur economic growth.

It is to be noted that the 3SLS estimators were utilized and the reduced-form coefficients of the model were calculated and interpreted as multipliers. These multipliers give us the change in an endogenous variable for a given change in any exogenous variable. From the results obtained, FDI, the level of exports, inflation and interest rates were found to be the most important variables that impacted directly and indirectly on economic growth in the ECOWAS subregion during the period of study.

Arising from the empirical results, a key policy recommendation is that governments of ECOWAS countries should adopt strategies, policies and measures which would encourage increased foreign aid and FDI in their respective countries. In particular, they should adopt policies which would provide a conducive environment for increased foreign aid. Such policies would include the adoption and implementation of sound macroeconomic policies, implementation of economic and structural reforms, adoption and implementation of open trade policies, and avoidance of overvalued exchange rates. In addition, countries should pursue policies which would promote peace and political stability, security of life and property, property rights, and the rule of law. Above all, emphasis should be on improving governance, enthroning transparency and eliminating rent-seeking and corruption.

Appendix 1: Proof of identification of equations of the model

We now show that each of the three equations specified satisfies both the ORDER condition (the necessary condition) and the RANK condition (the necessary and sufficient condition) of identification.

(i) Order condition of identification for equation j.

According to Greene (2003: 392), the ORDER condition of identification for equation j is that K_j* (the number of exogenous variables excluded from equation j) be greater than or equal to M_j (the number of endogenous variables included in equation j).

LPCY Equation: K_j*=5 and M_j=3. Since 5>3, this equation is over-identified.

LAID Equation: K_j*=5 and M_j=2. Since 5>2, this equation is over-identified.

LINV Equation: K_j*=4 and M_j=2. Since 4>2, this equation is over-identified.

(ii) Rank condition of identification

According to Greene (2003: 392), the rank condition imposes a restriction on a sub-matrix of the reduced-form coefficient matrix in order to ensure that there is exactly one solution for the structural parameters given the reduced-form parameters. To proceed, first arrange the structural parameters in a tableau and examine the sub-matrices one by one. For equation j, we form a sub-matrix of the structural coefficients in the other equations on variables that are excluded from equation j and check if all the elements of any column or row are all zero. Such a result will indicate that the equation is not identified.

The sub-matrix for LPCY equation is:

|1 1 0 0 1 |

|0 0 1 1 1 |

Consider the sub-matrix. There are five columns and two rows. Since there are no columns or rows consisting of only zeros, we conclude that the LPCY equation is identified.

The sub-matrix for LAID equation is:

|1 1 1 1 0 0 |

|0 0 1 1 1 1 |

Note that there are no columns or rows consisting of only zeros. Therefore, we conclude that the LAID equation is identified.

The sub-matrix for LFDI equation is:

|1 1 1 0 0|

|0 0 1 1 1|

An examination of this sub-matrix shows that there are no columns or rows consisting of only zeros. Hence the conclusion is that the LFDI equation is identified.

Appendix 2: Descriptive statistics

Sample: 1 to 280

Variable(s)	PCY	AID	INV	FDI	HK	RES
Maximum	1369.7	1.14E+10	6.12E+09	127.7385	2.29E+07	5.36E+1
Minimum	148.7825	3.42E+07	40121.3	-27.0397	71662.0	542845
Mean	413.3714	4.64E+08	7.51E+08	10.4274	2217968	1.54E+0
Std. deviation	228.7919	8.23E+08	8.52E+08	16.1341	4566477	6.16E+0
Skewness	1.5478	9.9497	2.7807	3.3695	3 .3878	6.905
Kurtosis - 3	2.2530	120.3143	10.9951	16.2885	10.2210	49.516
Coef of variation:	0.55348	1.7743	1.1341	1.5473	2.0589	3.996

Sample: 1 to 280

Variable(s):	XPORT	INFL	INTR	EXRT	SAV	POPGR
Maximum	8.59E+10	73.0000	55.0000	5500.0	8.25E+09	4.292
Minimum	1.80E+07	-9.0000	0.00	0.032616	30052.2	-0.8949
Mean	3.48E+09	9.0964	8.6214	608.0535	5.22E+08	2.759
Std. deviation	1.06E+10	12.8532	7.9216	792.1117	8.27E+08	0.9075
Skewness	5.4456	2.3954	2.6177	3.6495	4.4148	-1.800
Kurtosis – 3	31.8902	6.6156	8.3425	16.1520	30.0858	4.760
Coef of variation:	3.0368	1.4130	0.91883	1.3027	1.5851	0.3288

Estimated correlation matrix of variables

	PCY	AID	INV	FDI	HK	RES
PCY	1.0000	0.43348	0.58747	0.35913	0.27165	0.44873
AID	0.43348	1.0000	0.19197	0.27701	0.41001	0.58183
INV	0.58747	0.19197	1.0000	0.34121	-0.12212	-0.091193
FDI	0.35913	0.27701	0.34121	1.0000	0.21922	0.27817
HK	0.27165	0.41001	-0.12212	0.21922	1.0000	0.73988
RES	0.44873	0.58183	-0.091193	0.27817	0.73988	1.0000
XPORT	0.48250	0.52724	-0.065190	0.26178	0.75858	0.87394
INFL	-0.15579	0.0081149	-0.039819	0.015160	0.23692	0.030947
INTR	-0.13244	-0.0087770	0.0073324	0.018448	0.16613	0.062497
EXRT	-0.13320	-0.093308	0.035740	0.11848	-0.17841	-0.12476
SAV	0.47468	0.16611	0.68980	0.22535	-0.081477	-0.055136
POPGR	-0.8779E-3	0.8875E-3	-0.057127	0.071286	-0.091477	-0.071017

Estimated correlation matrix of variables

	XPORT	INFL	INTR	EXRT	SAV	POPGR
PCY	0.48250	-0.15579	-0.13244	-0.13320	0.47468	-0.8779E-3
AID	0.52724	0.0081149	-0.0087770	-0.093308	0.16611	0.8875E-3
INV	-0.065190	-0.039819	0.0073324	0.035740	0.68980	-0.057127
FDI	0.26178	0.015160	0.018448	0.11848	0.22535	0.071286
HK	0.75858	0.23692	0.16613	-0.17841	-0.081477	-0.091477
RES	0.87394	0.030947	0.062497	-0.12476	-0.055136	-0.071017
XPORT	1.0000	0.067928	0.078844	-0.14365	-0.024546	-0.079744
INFL	0.067928	1.0000	0.42972	-0.039850	-0.071781	-0.12901
INTR	0.078844	0.42972	1.0000	-0.13878	-0.040893	-0.19358
EXRT	-0.14365	-0.039850	-0.13878	1.0000	-0.12000	-0.059502
SAV	-0.024546	-0.071781	-0.040893	-0.12000	1.0000	-0.0019975
POPGR	-0.079744	-0.12901	-0.19358	-0.059502	-0.0019975	1.0000

APPENDIX 3: Econometric Estimation Results

3SLS Results with Country and Political Dummies using MICROFIT 5.0

Three Stage Least Squares Estimation
The estimation method converged after 9 iterations

Dependent variable is LPCY
280 observations used for estimation from 1 to 280

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
INPT	-2.7646	.93105	-2.9693[.003]
LAID	.37485	.11053	3.3914[.001]
LINV	.0099796	.024725	.40362[.687]
LHK	-.23362	.044370	-5.2653[.000]
LFDI	.044453	.014320	3.1043[.002]
LINFL	-.044272	.015967	-2.7727[.006]
LINTR	-.086053	.030349	-2.8355[.005]
LXPORT	.21860	.034056	6.4190[.000]
POLDUMMY	.17939	.063872	2.8086[.005]

R-Squared	.50386	R-Bar-Squared	.48921
S.E. of Regression	.34850	F-Stat. F(8,271)	34.4019[.000]
Mean of Dependent Variable	5.8984	S.D. of Dependent Variable	.48763
Residual Sum of Squares	32.9143	Equation Log-likelihood	-97.5793
DW-statistic	.43920	System Log-likelihood	-676.4489
System AIC	-702.4489	System SBC	-749.7012

Three Stage Least Squares Estimation
The estimation method converged after 9 iterations

Dependent variable is LAID
280 observations used for estimation from 1 to 280

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
INPT	7.9341	.77835	10.1935[.000]
LINV	.16540	.021625	7.6484[.000]
LRES	.25943	.040804	6.3581[.000]
LPOPGR	.0099488	.056766	.17526[.861]
LINFL	.052585	.027389	1.9199[.056]
LXPORT	.16135	.040112	4.0225[.000]
CDUMMY	-.0058728	.0086733	-.67711[.499]
POLDUMMY	-.10965	.10054	-1.0906[.276]

R-Squared	.54881	R-Bar-Squared	.53720
S.E. of Regression	.61283	F-Stat. F(7,272)	47.2647[.000]
Mean of Dependent Variable	19.5072	S.D. of Dependent Variable	.90084
Residual Sum of Squares	102.1537	Equation Log-likelihood	-256.1392
DW-statistic	.42791	System Log-likelihood	-676.4489
System AIC	-702.4489	System SBC	-749.7012

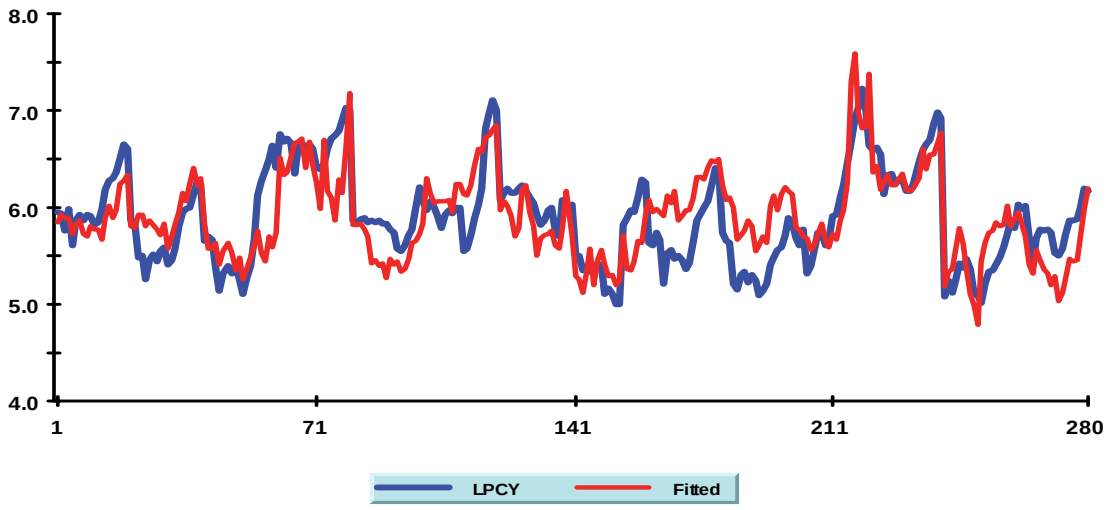
Three Stage Least Squares Estimation
The estimation method converged after 9 iterations

Dependent variable is LINV
280 observations used for estimation from 1 to 280

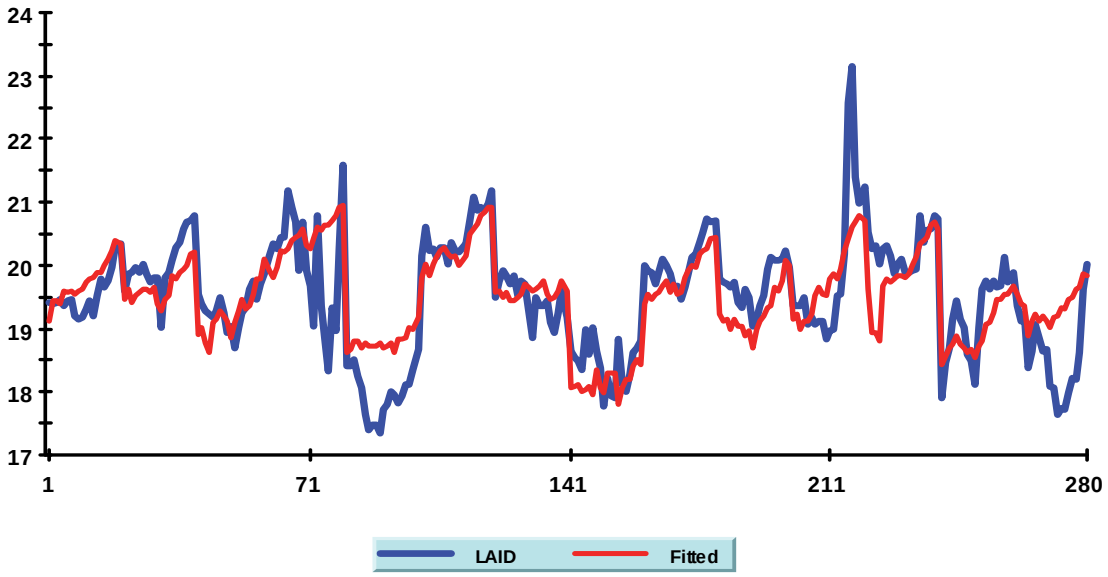
Regressor	Coefficient	Standard Error	T-Ratio[Prob]
INPT	3.6793	2.1926	1.6780[.094]
LAID	-.24231	.10760	-2.2519[.025]
LINTR	.36626	.099035	3.6983[.000]
LSAV	.99740	.034291	29.0864[.000]
LFDI	-.020766	.037313	-.55655[.578]
LEXRT	.11880	.033997	3.4943[.001]
LINFL	.10609	.044258	2.3971[.017]
CDUMMY	.043591	.015920	2.7381[.007]
POLDUMMY	-.047954	.21942	-.21855[.827]

R-Squared	.81691	R-Bar-Squared	.81151
S.E. of Regression	.97289	F-Stat. F(8,271)	151.1478[.000]
Mean of Dependent Variable	19.4371	S.D. of Dependent Variable	2.2409
Residual Sum of Squares	256.5039	Equation Log-likelihood	-385.0324
DW-statistic	.56286	System Log-likelihood	-676.4489
System AIC	-702.4489	System SBC	-749.7012

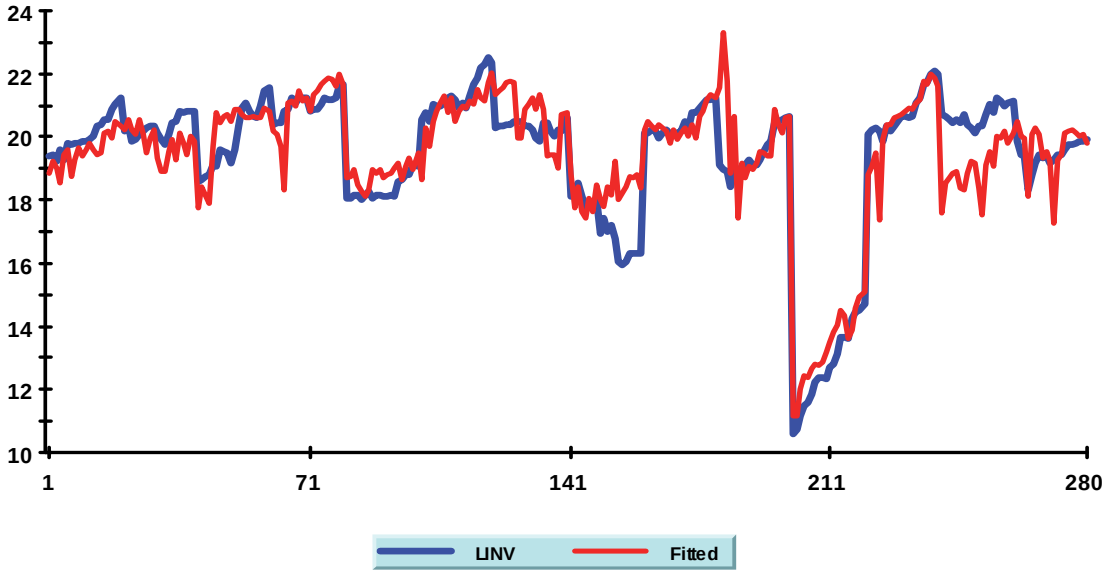
Plot of Actual and Fitted Values of LPCY - 3SLS with Dummies



Plot of Actual and Fitted Values of LAID - 3SLS with Dummies



Plot of Actual and Fitted Values of LINV - 3SLS with Dummies



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