A Time Series Analysis of China's Foreign Direct Investment on Senegal's Agriculture

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Abstract:

Since 2000 China has started to strengthen its agricultural co-operation with Africa in trade and other commercial activities. China has increased its agriculture investment in Africa, because of the rapid economic rise of China in many African developing countries. China's investment has developed and opened many opportunities against a backdrop of closer economic ties with many African countries and particularly in Senegal. The purpose of this study was to analysis the times series analysis impact of China's FDI in Senegal's agriculture. The study mainly used secondary data that are collected from World Bank and IMF for a period of 22 years between 1990 and 2012. Descriptive and econometrics model were used to analyze the collected data. Although agricultural growth has increased in Senegal in recent years, food security remains a severe challenge. Despite international and local concerns, China's investment in Senegal in infrastructure and agricultural technology and training could facilitate agricultural growth in Senegal. A time series data is used to get the empirical results for our paper and the estimation's results show that China's FDI is an important element in Senegal's agriculture will increase employment creation, high productivity, access to the finance and markets for smallholders, technology transfer enforcement of production standards and farmers can access more to bank credit.

Keywords: FDI, Agricultural, China, Senegal

I. Introduction

China's involvement in Africa since the turn of the century is increasingly attracting the attention of many African countries such as Senegal. Chinese interest in Sub-Saharan countries is of course not a new phenomenon, but increased cooperation, especially on the economic front, has added a new level of intensity and geopolitical significance to this interest.

We analyze the development cooperation instruments used by China in Senegal; we can see that China is using a wide range of initiatives that are characteristic of their activities in Africa. The People's Republic is clearly trying to develop a good relationship with the country. The relations of partnership China-Senegal is a model of new type in the international relations, which must be strengthened, developed, concretized and ordered. These relations are based on the possibilities of developing the cooperation at the highest level in business and economy, in science and technique.

The People's Republic is also supporting the Senegalese government with grant aid for agriculture. Since November 2006, China has been funding a group of agricultural scientists who are advising on rice cultivation, predominantly in Podor in northern Senegal. In Sangalkam, around 30 kilometers from Dakar, Chinese agricultural advisors run an agricultural training center. Since 2007 they have been offering various training programmers to promote subsistence farming and to increase the yields of small farms. In addition to these trainings programs the Chinese also donate materials for projects such as Great Agricultural Offensive for Food and Abundance (GAOFA)". This program was set up to promote the cultivation of Chinese sesame in Senegal. Up to the beginning of 2009, the People's Republic had donated agricultural equipment to a value of 1.1 million Euros. In 2010, Senegal began operating multi-purpose food preparation equipment donated by China. The development of Senegalese agriculture is a fundamental stake for the population, still with rural majority: the farming sector represents 15 % of the GDP and occupies 70 % of the working population. The country is however far from having reached the food and continuous auto sufficiency to import 70 % of its rice.

Generally, during the last decades, the Senegalese agricultural production had a balance in halftone. The economists evoke even a situation of gloom, with the stagnation, even a falling trend, of the production, the cultivated surfaces, and returns for the most part of cereal, with the exception of the rice. Between 1945 and 1960, the growth of the agricultural production posted rates is superior to 4 % and it's stagnated after 1960. It's the same for the cultivated surfaces, which decrease since the end of 1960s. Between 2008 and 2010, the country still imported 69 % of its rice, the basic food of a population which lives, for 54 %, below the poverty line. Chinese investment provides various opportunities to change the trends and structure in Senegal.

According to our research we shown China's FDI can influence positively whether negatively a country through economic growth. However agricultural sector contributes to the economic growth. It increases the agricultural export quantity and the supply of capital and promotion of technology spillover will accelerate the development of domestic firms and raise the welfare in Senegal and create more jobs.

The objective of our paper is to analyze the impact of China's FDI in Senegal's agriculture. However, our paper presents a times series analysis of China's FDI in Senegal's agriculture, and projects the policies necessary to maximize the development of China FDI in Senegal's agriculture. The rest of the paper is organized as follows section 2 provides the literature review, the third section introduces the methodology, and data used in the research. Section fourth discusses the empirical results, and finally the last section five concludes the paper.

II. Literature Review

Our research is focused in most recent literature, analyzed and discussed the development of FDI impact agriculture. We found they have limited discussion on the potential implications of FDI boosts and contributes to Developing countries Agriculture through economic growth for expanding new cultivable land, raising the productivity of currently cultivated land from the perspective of recipient countries, particularly in regions such as Africa.

According to our research several reasons are focusing on FDI impact agriculture in Africa. Firstly, despite the fact that agricultural FDI accounts for less than 5 per cent of overall FDI in Africa, it has grown on average by 17 per cent during 2003-10 period showing an upward trend (Rakotoarisoa 2011, World Bank 2011).

Msuya (2007) studied the impact of FDI on productivity in the agricultural sector and poverty reduction in Tanzania and observed that productivity growth in the agricultural sector is impacted positively by FDI. The observation of the study was however based on the review of existing literature as opposed to empirical and statistical modeling

Mlachila and Takebe (2011) show in their paper China has become a major investor in Africa through infrastructures, mining, resource industries and the investment has been destined for agriculture, manufacturing and service industries. Recently China's FDI in African agriculture has ranged from poultry industry in Ghana to coffee in Kenya, Peanut in Senegal, sugar in Madagascar to cotton in Mali, Uganda and Zambia. The China-Africa Development Fund (which encourages Chinese private enterprises to make direct investment in Africa) has been increasingly facilitating equity financing in priority areas including agriculture in Africa in recent years (Mlachila and Takebe 2011).

The most important and the key investment in African Agriculture is the support of technology generation and dissemination by means of agricultural R&D, technology transfer and extension. (Fan and Zhang 2008) in their research about investment in agriculture R&D offers the greatest potential for enhancing productivity and reducing poverty). According to analysis by Thirtle, Lin, and Piesse (2003) shows that for every 1 per cent increase in yield brought about by investments in agricultural R&D, two million Africans can be lifted out of poverty.

Analysis by Fan and Zhang (2008) shows that policies and programs promoting fertilizer use, for example will have considerable agricultural productivity and poverty-reduction effects.

Nigeria's economy is one of the largest economies in Africa developed by many sectors oil, agriculture and raw materials. Agriculture has became the most important sector boost economy through FDI providing employment and source of livelihood for the increasing population and accounting for over half of the GDP of the country. The study of Fasminrin and Braga (2009) ascertained that the main reason for the slow of agricultural development in Nigeria despite the volumes of scientific information to engender improvement is due to poor policy formulation and implementation by the federal government, which implies that they should be a strategy to guide the formulation of polices and the implementation of activities that will lead to a set goal.

III. Methodology and data:

The aim of this paper is an analysis of times series of China's Foreign Direct Investment on Senegal's agriculture, the effect of China's FDI in the host economy are normally believed to increase agriculture growth and technology, to reduce poverty and eradicate hunger. The study used yearly data over the period from 1990 to 2012. Our model is based on the assumption that FDI contributes to agriculture through economic growth Data for macro-economic variables are collected from the database of world Bank Website. Our model used can be specified as follows:

$$Agr = f(Fdi, \text{Pop}, Edu - Exp, Lab)$$

In the case of econometric analysis, expecting a relationship between dependent and independents variables, the study used beta (β) for all variables of our model. The main purpose of the estimation is to analysis the times series of China's FDI on Senegal's agricultural. There are explanatory and dependent variables in the model. The dependent variable is agricultural and the explanatory variables are Fdi, population, education expenditure and labor.

Expecting the other factors that may also affect agriculture, the study included other controlled variables such as dependant variable. In order to solve endogeneity problems, the study applied 2SLS which consider the simultaneity of the explanatory variables. Here the endogenous variable is the quantity of agricultural. The following equation provide the model used in this study to observe the impact of FDI in agriculture. All model estimation tests such as correlation test was applied in the study.

To test the effect of FDI on economy growth we adopted the Cobb-Douglas log-linear form to make equation (1) linear

$$\log agric = \beta_0 \ln Fdi + \beta_1 \ln Pop + \beta_2 \ln EduExp + \beta_3 \ln Lab + \varepsilon_{it} \qquad (1)$$

The presents study employs the time series data analysis technique China's Foreign Direct Investment on Senegal's agriculture. In a time series analysis, the results might provide a spurious if the data series are non-stationary. We will check the unit root test for the model to show if a test for the null hypothesis of a unit root is present in the time series sample. The augmented dickey fuller is performed to check the stationary nature of the series. The complete model with deterministic terms such as intercept and trends is shown in equation (2):

$$\Delta y_t = \alpha + \pi + \delta Y_{t-1} + \Delta \beta? y_{t-1} + \varepsilon_t \qquad (2)$$

According to our result we have to check the linear combination for the co-integration test that is stationary. Our times series is integrated the process considered together and it form equilibrium is for long term relationships.

The main method for testing the co-integration in our research here we are going to use the engle Granger of parameters can be done by OLS estimation of linear regression equation: Dickey-Fuller t test is applied to the OLS residuals rejecting the null hypothesis of non-stationary conclude "co-integration relationship" does exist.

$$Y_t = y_o + y_1 Y_{1t} + \ldots + \gamma_M Y_{Mt} + \varepsilon_t \qquad (3)$$

Granger Causality test was conducted to identify causal relationship between the variables Fdi, Machinery, labor, capital, aid, education expenditure, trade-openness, population growth, GDP and land and to determine whether the current lagged values of one variable affect another. Granger causality test check which variables cause which variable. The granger test may be explained with the help of the following equations:

$$X_t = a_0 + \sum_{j=1}^{m} a_j x_{t-j} + \sum_{j=1}^{n} b_j y_{t-j} + e_t \qquad (4)$$

IV. Empirical Analysis:

We estimate the regression model, which provides an estimation of times series of China's of the impact of China's FDI in Senegal's agriculture. We accept the hypothesis that there is relationship between the variable FDI and agriculture and the results of Unit Root test, Co –Integration Test, Granger Causality test and serial correlation are summarized in the following many tables respectively.

4.1 Unit Root

We applied the Augmented Dickey-fuller (ADF) test and the Philips-Perron test to check whether each data series is integrated and has a unit root, thereby testing the stationary of the time series.

However, a Dickey fuller test on the first difference shows that lagri at I(0) ,is stationary with trend and constant doesn't have unit root. We also conducted Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests and found similar result. The results given in Table () show the results with trend and constant in lag(0) for each of the variables included in this study. The test is based on the null hypothesis that the variable lagri is not stationary or contains a unit root, and the alternative is that the variable lagri was generated by a stationary process. With the result we found that the test statistic is more than the critical value we can reject null hypothesis and accept alternative hypothesis means our variable lagri is stationary.

Table 1: Dickey fuller and Philipps Perron Test:

Dickey-fuller test for unit

dfuller lagri , trend regress lags(0)

Number of obs = 22

---------- Interpolated Dickey-Fuller ---------

	Test Statistic	1%critical Value	5% critical value	10%critical value
Z(t)	-3.642	-4.380	-3.600	-3.240

Mackinnon approximate p-value for z(t)=0.6479

DLagri	Coef	Std.Err	T	P>/t/
lagri				
L1.	-.826584	.2269449	-3.64	0.002
_trend	.0163452	.0051955	3.15	0.005
_cons	17.25166	4.732303	3.65	0.002

Phillips-Perron test for unit root

pperron lagri , trend regress

Number of obs = 22

Newey-West lags = 2

	Test Statistic	1%critical Value	5% critical value	10%critical value
Z(t)	-3.642	-4.380	-3.600	-3.240

Mackinnon approximate p-value for z(t)=0.6479

DLagri	Coef	Std.Err	T	P>/t/
lagri				
L1.	.173416	.2269449	0.76	0.454
_trend	.0163452	.0051955	3.15	0.005
_cons	17.25166	4.732303	3.65	0.002

***CONCLUSION: lagri is I(0) , STATIOANARY WITH TREND AND CNSTANT

According to the results of unit root test we found five valid variables (lagri, llab, leduexp, lpopgrowt and lfdi) are all stationary at lag0. Since All the variables are I(0), there is no evidence of long term relationship among our variables, thus, the VECM cannot be performed. It is better to use a VAR table ().

4.2 VAR EXAMINATION (VAR ORDER)

4.2.1 Lag selection:

We can say this table (2) below shows us the lag selection, it will help us to know how many lags we are going to use to run our Johansen co integration test and vector error correction model (VECM). Here the result shows that lag (2) is the most optimum lag to be use for our futures tests. Both models are the system equation like johansen test co integration. We shall use 2 lag to run VAR, VECM and Johansen test Co integration.

Table2: Lag Selection

****SELECTION OF THE VAR/VECM ORDER**

Varsoc: lagri lfdi llab lEduexp dLpop ,maxlag(2)

Selection-order criteria

Sample: 1996-2012 Number of obs =17

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	66.3446				5.1e-10	-7.21702	-7.19266	-6.97195
1	202.534	272.38	25	0.000	1.2e-15	-20.2981	-20.1519	-18.8277
2	258.424	111.78*	25	0.000	9.5e-17*	-23.9323*	-23.6643*	-21.2366*

Endogenous: lagri lfdi llab lEduexp dLpop

Exogenous: _cons

*****CONCLUSION LAG (2)**

In the above table, the lag with the maximum (*) is the best lag for our Var. here, lag **=2**

4.3-VAR ESTIMATION:

The results for The VAR estimation table () shown the coefficients in the equation for lagri , lfdi ,dLpop lEduexp llab dlninv are jointly significant, because their coefficients are jointly different from zero.

The equation will be writing following the coefficient:

$dlagri_t$ = -.0697855 $d.lfdi_{t-1}$ + 10.54697 $d.dLpop_{t-1}$ -13.7821 $d.dLpop_{t-2}$+ 66.75777$d.llab_{t-1}$+-65.28328 $d.llab_{t-2}$

4.3.1 VAR POST-ESTIMATION TESTS

4.3.1.1- Normality test

The table (3) below is the result of VAR post estimation test:

varnorm, jbera skewness kurtosis

Jarque-Bera test

Table3: Var Post Estimation Test

Equation	chi2	df	Prob > chi2
lagri	1.054	2	0.59031
lfdi	0.035	2	0.98277
dLpop	0.581	2	0.74790
lEduexp	0.548	2	0.76043
llab	0.881	2	0.64376
ALL	3.099	10	0.97901

Skewness test

Equation	Skewness	chi2	df	Prob > chi2
lagri	.54013	0.827	1	0.36325
lfdi	.0756	0.016	1	0.89875
dLpop	.42635	0.515	1	0.47297
lEduexp	.24264	0.167	1	0.68296

llab	.23455	0.156	1	0.69299
ALL	1.681		5	0.89135

Kurtosis test

Equation	Kurtosis	**chi2**	**df**	**Prob > chi2**
lagri	2.4331	0.228	1	0.63330
lfdi	2.8381	0.019	1	0.89163
dLpop	2.6949	0.066	1	0.79733
lEduexp	2.2667	0.381	1	0.53711
llab	1.9883	0.725	1	0.39451
ALL		1.418	5	0.92233

The hypotheses used are:

Ho: The sample data are not significantly different than a normal population.

Ha: The sample data are significantly different than a normal population.

According to the the coefficients of the prob, we can say all prob are > 5% for the Jarque–Bera Test, the skewness and kurtosis so our data is matching a normal distribution.

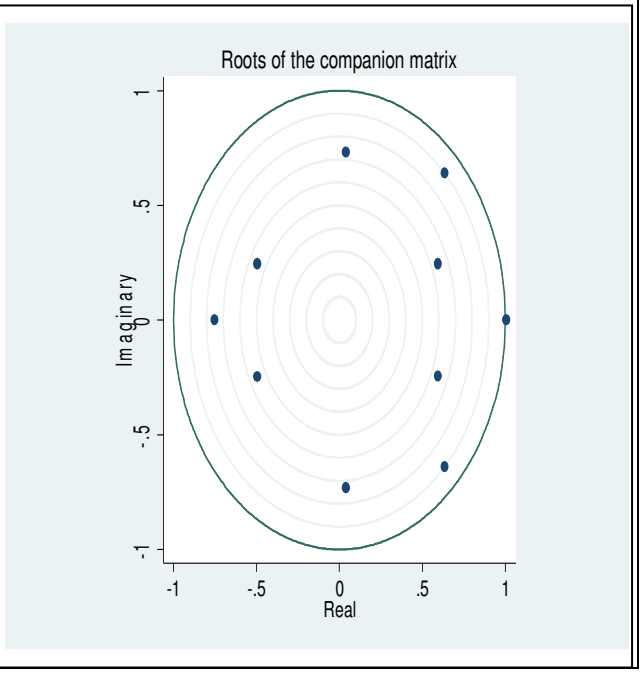
4.3.1.2 Stability test

. varstable, graph

Eigenvalue stability condition

Table4: Stability Test

Eigenvalue	Modulus
1.002988	1.00299
.6324965 + .6392671i	.899285
.6324965 - .6392671i	.899285
-.7528865	.752886
.03867263 + .7302974i	.731321
.03867263 - .7302974i	.731321
.5931352 + .2453823i	.641889
.5931352 - .2453823i	.641889
-.4968378 + .2456655i	.554256
-.4968378 - .2456655i	.554256



At least one eigenvalue is at least 1.0.

VAR does not satisfy stability condition.

Our results show that 1 eigenvalue is strictly GREATER that one, thus showing a non- stability of our model.

4.3.1. 3 Wald lag-exclusion statistics TEST

The wald test in the context of logistic regression is used to determine whether a certain predictor variable X is significant or not. It rejects the null hypothesis of the corresponding being zero. The test consists of dividing the value of the coefficient by standard error.

HO: the endogenous variables at a given lag are jointly zero for each equation and for all equations jointly

Table5: Wald Test

Wald Test

Equation: lagri

Lag	Chi2	df	Prob>Chi2
1	23.99308	5	0.0000
2	27.58121	5	0.0000

Equation: lEduexp

Lag	Chi2	df	Prob>Chi2
1	103.6092	5	0.0000
2	39.36426	5	0.0000

Equation: lfdi

Lag	Chi2	df	Prob>Chi2
1	47.51001	5	0.0000
2	170.3832	5	0.0000

Equation: llab

Lag	Chi2	df	Prob>Chi2
1	36.82921	5	0.0000
2	10.33292	5	0.0000

Equation:dLpop

Lag	Chi2	df	Prob>Chi2
1	252.0744	5	0.0000
2	49.22832	5	0.0000

Equation:All

Lag	Chi2	df	Prob>Chi2
1	1409.163	25	0.0000
2	501.5702	25	0.0000

According to the results for all P value are less than 5%, we strongly reject the hypothesis that the coefficients on the first lag of the endogenous variables are converging to a constant instead of zero in all three equations jointly.

4.4 Causality test results

The objective of this test is to determine the causal relationship among the variables, which is essential in showing the direction of causality among these variables. There are essentially three possible causal relationships to this test. There could be a unidirectional, bi-directional or neutral relationship.

Table 6: Causality Test

Null Hypothesis	chi2	df	Prob>chi2	Decision
Lfdi does not cause lAgri	6.063	2	0.048	**Reject**
Dlpop does not cause lAgri	18.97	**2**	0.000	**Reject**
LEduExp does not cause lAgri	2.78	2	0.248	**Accept**

Llab does not cause lAgri	16.905	2	0.000	**Reject**
Lagri doesn't cause lfdi	1.724	**2**	0.422	**Accept**
dpop does not cause lfdi	25.349	**2**	0.000	**Reject**
Leduexp does not cause lfdi	19.643	**2**	0.000	**Reject**
Llab does not cause lfdi	90.586	**2**	0.000	**Reject**

*Obs.after lag; ** Reject at 5% level of significance

Null Hypothesis Lagged FDI does not cause AGRI

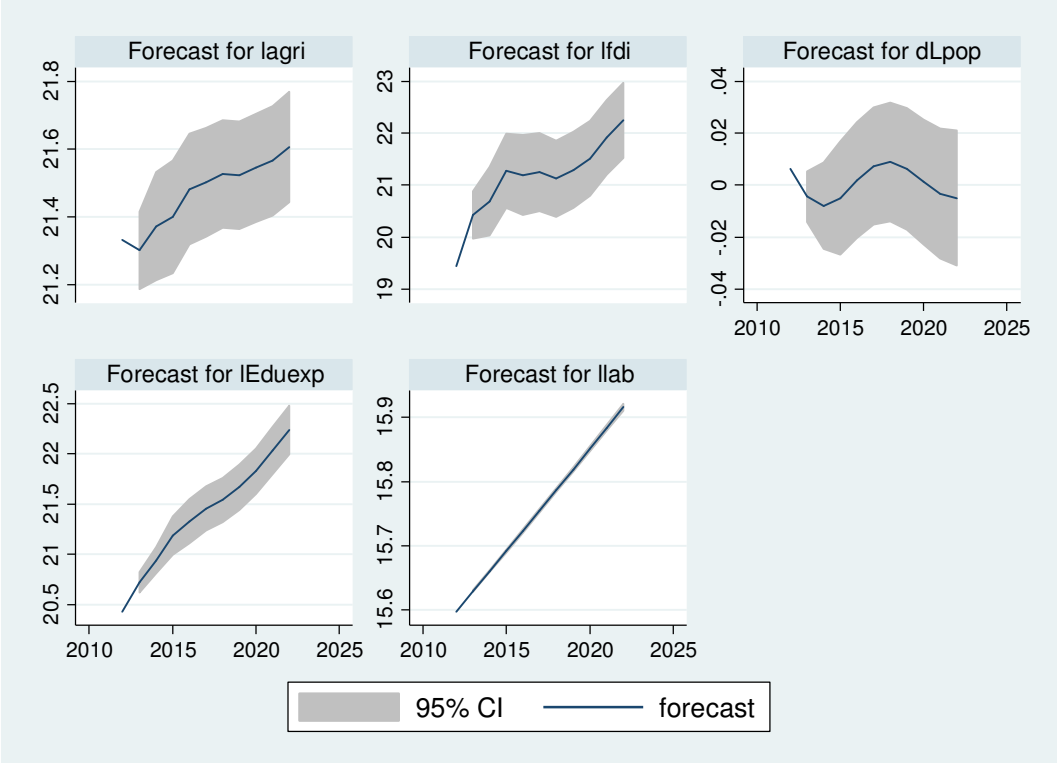
Alternative Hypothesis Lagged Agri does cause FDI

The estimated result obtained from Granger Causality test in the table () above shows that variable like population growth and labor can cause agriculture. And for lagri we can comment that agriculture doesn't cause FDI. According to those results we can say that there is a neutral relationship between FDI and AGRI.

4.5 Serial Correlation

4.5.1 **FORCASTING VAR

We can forecast as our VAR model has passed the diagnostic. Our plan is to forecasting into the future meaning that into 10 years after 2012. After check and compute the program fcast graph VAR1lagri VAR1lfdi VAR1dLpop VAR1lEduexp VAR1llab the results follows the graphs will appear below:



The results for forecasting show the evolution of each variable in the next 10 years.

The Graphs of Agri and FDI show an excessive rise of the curve over the next 10 years, according to these results it will allow us to conclude that agriculture and FDI have positive signs to participate in a positive growth of the economy of a country.

We found that the dLop curve is going slowly until 2022. According to the studies we have done a population that is moving a lot such as a rural exodus will have a negative impact on agriculture.

And finally, the two remaining curves lduexp and llab will follow an increasing ascendancy to show that they are important variables to participate in agriculture development.

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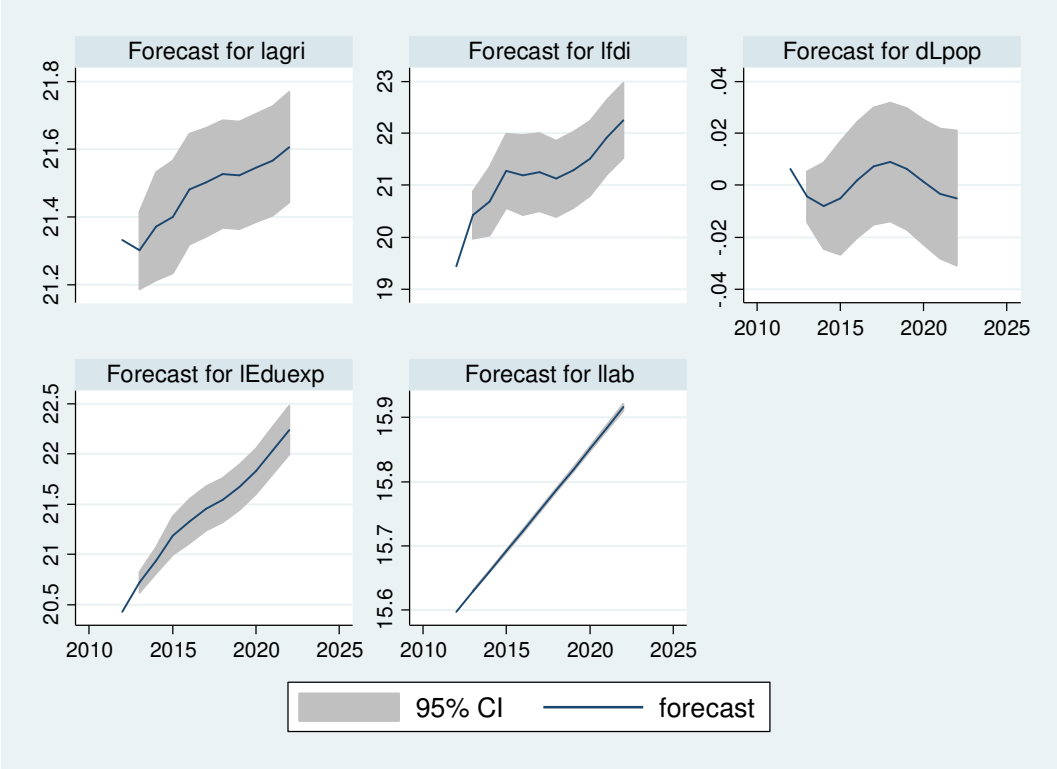

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5 Impulse response analysis:

The Impulse response functions identify the effects over time on various macroeconomic indicators. It's illustrating the shock to a VAR system. It's Helps to quantify the effect of an impulse in a component variable yj,t on another component variable yk,t. . IRF trace the effects of a shock to one endogenous variable on to the other variables in the VAR. It indicates what is the impact of an upward un-anticipated of one-unit change in the "impulse" variable on the "response" variable over the next several periods

Note the following VAR system：

AGRI=B1+ B2*FDIt-1 + B3*AGRI t-i + U1

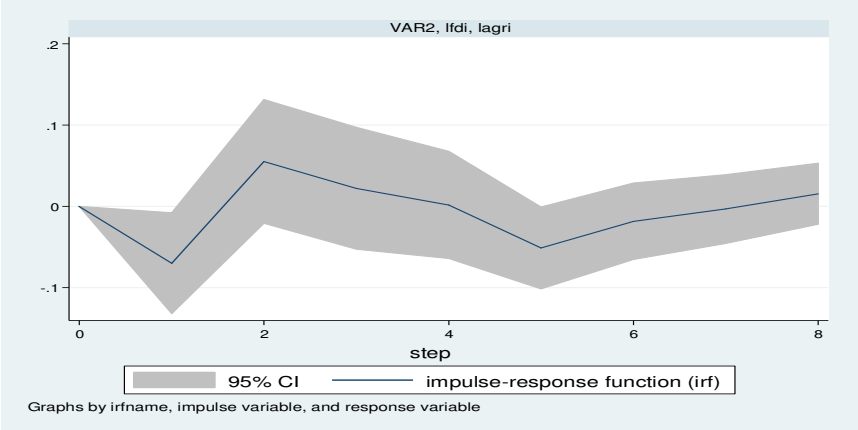
FDI=B4+B5*AGRIt-1 + B6 *FDIt-1 + U2

According to the shock to the innovation or residual, that is on U1 or U2 of the above VAR model to see how its affect the whole VAR model. U 1 and U2 are called impulsiveness or innovation.

According a change in U1 will bring a change in Agriculture. It will change FDI and agriculture during the next period.

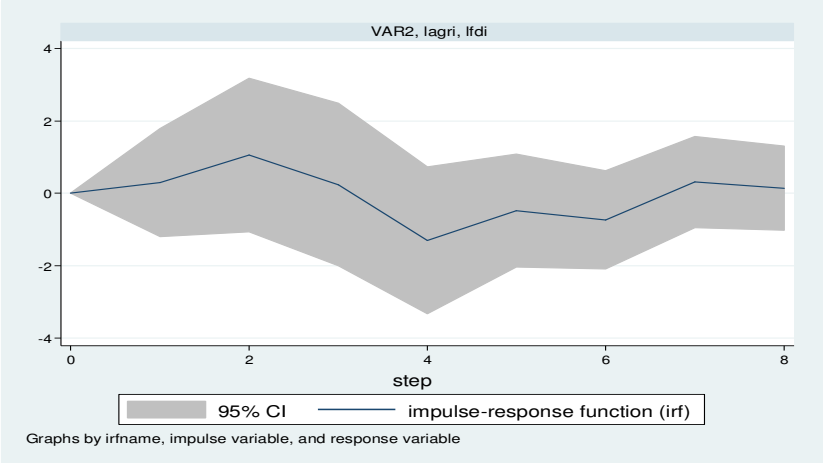
Following the data and SVAR calculations in the previous post this entry is going to graph impulse response functions and generate tables to illustrate how a one unit change in the log difference in Agri impacts FDI.

- **Impulse from FDI to AGRI**



The blue line above represents the impulse response function and the grey band is the 95% confidence interval for the IRF. The affect of an unexpected increase in FDI would impact Agri immediately and these affects would last about one year. After the initial increase in Agri, two quarters later you would expect to see another spike in Agri as some of the feedback affects of of the initial shock reverberate throughout the economy especially economic growth.

- **Impulse from AGRI to FDI**



The graph above shows that the unexpected increase in Agri tends to provide a positive jolt to FDI. The investments in agriculture sector increase the economic growth through FDI. Increased Agri may cause foreign investment to invest more on technology and create more income and demand in the market while farmer may invest more in land and fertilizer.

We can conclude the causal interpretations above are possible because of the restrictions placed on the SVAR, which in this case conveniently followed were Cholesky. In a future post the restrictions on the SVAR will be changed to see how these unexpected changes in the economy dynamically impact each other much like we saw in the description above.

□- Conclusion

The main objective of our paper was to analysis the impact of China's FDI in Senegal's agriculture. Our results showed the unit root test for the variables (lagri, llab, leduexp, lpop and lfdi) are all stationary at lag0 so there is no evidence of long term relationship among our variables. Our VAR model indicates the coefficient in the equation for all variables are jointly significant and their coefficient all different from zero.

We can conclude our model has no serial correlation and the variables are normally residuals. And our test of Granger causality shows that there is a neutral relationship between FDI and AGRI. Because the variables like population growth and labor can cause agriculture. And for lagri doesn't cause FDI.

We can say the aspiration of Senegal's government to improve his agricultural sector will be influenced by several factors. These include substantial domestic public expenditure programs for agriculture, adequate aid allocations for the sector, growth in FDI in agriculture, and good policy and adequate governance and improved infrastructure. We found China's FDI increase the development of Senegal's agriculture and accelerate its economic growth positively.

Our recommendations in our analysis are if Senegal's government would like to increase flow of FDI it should adopt suitable policies. Reduce the high levels of governmental corruption in most of the region might limit the positive effect of FDI on economic growth. The government and private institutions should provide incentives and undertake efforts for greater trade openness, higher domestic investment and low debt. Further, effective steps should also be taken to reduce the internal as well as external imbalances. Last but not the least, there seems to be no substitute for improved political environment to attract FDI.

The effectiveness of agricultural FDI in developing countries, particularly in Senegal will be influenced by several factors: investing in agricultural technology; fostering of local comparative advantage; assessing technical

and socio-economic feasibility of proposed FDI arrangements in a transparent and robust manner; making improvements to the existing weak institutional frameworks for land governance; enhancing and small holder competiveness.

The government should verify that the existing policies, regulations and institutions are adequate in order to maximize the positive impacts of international investment while minimizing the risks. Determine the appropriate tax rate that attracts investors without foregoing too much tax revenue.

Invest in Research and development (R&D) through agriculture result than make new innovation to attract more investors.

Private and financial sector should give more bank credit to the farmers to access of a good harvest result who may influence the agro-Business in African developing countries can accelerate economic growth .

Foreign Direct Investment is one of the good points for African countries to stimulate their economic growth through long term growth, employment generation and productivity enhancement. Increase the development of Human capital resources. So Africa needs to attract more productive FDI to diversify its economy and benefit technology transfers and spill-over effects.

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