Forecast of the total carried freights and Analysis of the Impact of Rural Exodus on the level of activities: case of the Port of San Pedro

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Introduction

Ivory Coast is a major exporter of cocoa and coffee in the world. That is why, maritime transportation is a key factor in economic development of the country. Moreover, the Ivorian economy is dominated by the primary sector especially by agriculture. Then, since that agricultural field is still not modernized, we could naturally think that the agricultural production fluctuates according to the changes in the amount of labor available. Furthermore, rural exodus is a very common phenomenon in most of the African developing countries. However the link between that phenomenon and the level of agricultural production is ambiguous. Indeed, that relationship depends on whether those people moving from rural places to urban ones were indispensable to production or not. In this paper, we will study the relationship between that rural exodus and the level of activities of the port of San Pedro. We will also deal with the matter of forecasting of the quantity of load transported by the port. This study is of major interest as much as its objective is to give some advices to public authorities concerning some of their demographic policies and to provide annual forecasts of the carried freights in San Pedro. What's more, as far as the literature on this topic, if it exists, is not abundant, this paper aims at contributing to the knowledge of the link between rural exodus and the level of activities. To reach our goal, we use two rather recent econometrics modeling approaches: the Pesaran et al. (2001) approach to cointegration and the procedure for non-causality test of Toda and Yamamoto (1995). Besides, the forecast of the traffic were derived through an ARDL (Auto regressive Distributed Lag) modeling procedure. That said, we will organize this paper in two sections: in the first section, we will make a short description of the econometric framework concerned by this study. In the second one, we will point out the main results derived. We will finish with a conclusion.

1. The econometric framework

In this section we write about our data source and we give short details about the econometrics methods used in this paper. As said before, we used not only the Pesaran et al. (2001) approach to cointegration and the procedure for non-causality test of Toda and Yamamoto (1995), but also the ARDL modeling approach in order to derive forecasts.

1.1 Data and variables

We use the annual data of the total of load conveyed (y_t) through the Port of San Pedro to reflect the level of activities of the Port. This data was taken in the statistics department of the Port of San Pedro. We also use the urban growth rate (z_t) of the urban population of the World Development Indicator of the World Bank as a proxy of rural exodus. Indeed, that is possible because our calculation of the annual net migration rates for the past decade were approximately 0 per cent. That is why we could assume that the growth of the urban population is due to the increasing of the number of people moving from rural places to urban ones. For the ARDL modeling approach, we

add the growth rate of the production (x_t) to comply with most of the macroeconomic theories like the RMSM-X model for which exportation and importation depends on the global production. Also, according to their availability, the data used in this paper run from 1972 to 2009.

1.2 The Cointegration approach

As we already said above, we will use the bound testing approach developed by Pesaran et al. (2001). This is mainly because of the following reasons stated by Masih (2000) and Narayan and Peng (2007): First of all, the estimators derived from this procedure have better properties in small samples than the Johansen and Juseluis (1990) approach. What's more, contrary to that Johansen and Juseluis method, the Pesaran et al. procedure does not require the series to be integrated of the same order. In practice, we considered the fifth case of unrestricted intercept and unrestricted trend (Pesaran et al. (2001)). Thus, we tested the existence of a relation of cointegration between y_t, x_t and z_t through the following specification:

$$\Delta y_t = d_0 + d_1 t + d_2 y_{t-1} + d_3 x_{t-1} + d_4 z_{t-1} + \sum_{i=1}^{p} c_i \Delta z_i + \sum_{i=1}^{p} b_i \Delta x_i + \sum_{i=1}^{p} a_i \Delta y_i + \epsilon_t \quad (1)$$

The null hypothesis of no relation of cointegration between y_t and z_t or between y_t and x_t is then: $d_2 = d_3 = d_4 = 0$. Following Narayan(2005), the F-Statistic of this test has not a standard distribution. That's why we used the critical values computed by Narayan for small samples.

1.3 The Causality approach

The Toda and Yamamoto's approach is used in this paper so as to guarantee that the Wald statistic used for the test of causality has an asymptotic distribution of χ^2. In fact, Phillips and Toda (1993) showed that the non-causality test of Granger in an unrestricted VAR is based upon a Wald's statistic which asymptotic distribution involves nuisance and non-standard distribution. That's the reason why, Toda and Yamamoto proposed in 1995 a non-causality test on a VAR augmented of the maximum number of integration between the variables taken into account. Another advantage of this procedure is that it permits to test the causality between a system of variables which may be non-stationary or even cointegrated. To test whether x_t does not cause y_t, we estimate (2):

$$y_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} y_{t-i} + \sum_{j=k+1}^{k+d_{max}} \beta_{2j} y_{t-j} + \sum_{i=1}^{k} \alpha_{1i} x_{t-i} + \sum_{j=k+1}^{k+d_{max}} \alpha_{2j} x_{t-j} + \gamma_1 t + \mu_{1t}$$

$$x_t = \theta_0 + \sum_{i=1}^{k} \theta_{1i} x_{t-i} + \sum_{j=k+1}^{k+d_{max}} \theta_{2j} x_{t-j} + \sum_{i=1}^{k} \lambda_{1i} y_{t-i} + \sum_{j=k+1}^{k+d_{max}} \lambda_{2j} y_{t-j} + \delta_1 t + \eta_{1t}$$

Where k is the optimum lag of the level VAR and d_{max} , the maximum order of integration. The null hypothesis of x_t does not cause y_t is: $\alpha_{11} = \alpha_{12} = \alpha_{1k} = 0$

1.4 The ARDL modeling approach

According to Madinier and Mouillard (1983), this ARDL method was introduced in economy mainly for two reasons. The first one is to take into account how economic agents make their anticipation with respect to the information to their disposal. The second reason is to point out the delays that an agent's decision or action take before realizing. We proceeded by two rather different methods of estimation to derive the ARDL model: the first one was the method of least squares using Almon' polynomial and the second method was the mere ordinary least squares. The criteria used to

classify estimated models were the quality of adjustment and the minimization of information criteria. In practice, we aimed at deriving a model through the estimation of all the possible ARDL with the following specification:

$$\Delta y_t = d_0 + d_1 t + d_2 y_{t-1} + d_3 x_{t-1} + d_4 z_{t-1} + \sum_{i=1}^{r} c_i \Delta z_i + \sum_{i=1}^{q} b_i \Delta x_i + \sum_{i=1}^{p} a_i \Delta y_i + \epsilon_t$$

2. The empirical results

We started the empirical work by making unit root tests. In fact, following L. J. Esso (2009), even if it is not necessary for the Pesaran and al.'cointegration approach to be conducted, it is important to make sure that the variables are not integrated of an order more than one. What's more, these unit root tests will provide us the maximum order of integration d_{max} for the Toda and Yamamoto causality analysis. The presence of unit root has been studied with the Augmented Dickey-Fuller test. The result of that unit root tests on y_t, x_t and z_t are resumed in the following table:

Unit root tests on y_t, x_t ***and*** z_t

Series	**Levels**		**First differences**	
y_t	$-2,88$	$(-2,94)$	$-6,24^*$	$(-2,94)$
x_t	$-6,76^*$	$(-1,95)$		
z_t	$-1,11$	$(-3,54)$	$-5,62^*$	$(-3,54)$

The numbers between parentheses are the critical values at 5 per cent and * denotes rejection of the null hypothesis of presence of unit root.

Thus, we will take $d_{max} = 1$ for the causality analysis between y_t and x_t and between y_t and z_t. Concerning the cointegration analysis, we estimated (1) for p=1 to 5; the appropriate lag length to make the test was determined via the Akaike and Schwarz Bayesian information minimization criteria. We then used the Lagrange multiplier statistics (L-Stat) to test the hypothesis of no residual correlation against orders 1 and 2 denoted $\chi^2(1)$ and $\chi^2(2)$ respectively. Thus we computed the bounds F-statistics as follow:

Cointegration test

Appropriate p	**L-Stat(P-values)**		**F-Statistics**	**5% lower cv**	**5% upper cv**
	$\chi^2(1)$	$\chi^2(2)$			
2	0,24	0,49	6,812	5,457	6,570

cv:critical value

The F-Statistics is greater than the 5% upper critical value and the residual correlation test suggest that there is no residual correlation. Accordingly, we derive that there is long run relationship between y_t, x_t and z_t.

For the causality analysis between y_t and z_t, we mainly used the Akaike Information criterion to determine k. After that, (2) was estimated by the Seemingly Unrelated Regression method. The result of these causality analyses are resumed in the following table:

Causality analysis

Null Hypothesis	$k + d_{max}$	**Wald Statistics**	**p-values**	**Outcome**
z_t does not cause y_t	8	28,86	0,0001	z_t causes y_t
x_t does not cause y_t	8	12,81	0,0461	x_t causes y_t

Concerning the forecasts of the total of load conveyed by the Port of San Pedro, not only the criteria of minimization of information criteria and the adjusted R-Squared, but also the residual tests leaded us to the following specification to explain the dynamic of the series studied:

$\Delta y_t = d_0 + d_1 t + d_2 y_{t-1} + d_3 x_{t-1} + d_4 z_{t-1} + \sum_{i=1}^{6} c_i \Delta z_i + \sum_{i=1}^{7} b_i \Delta x_i + \sum_{i=1}^{7} a_i \Delta y_i + \epsilon_t$ with $b_4 = 0$.

Moreover, the residual series ϵ_t has a conditional variance σ_t^2 given by: $log(\sigma_t^2) = \alpha + \beta * \frac{Abs(\epsilon_{t-1})}{\sigma_{t-1}^2}$.

Thus, we found a ARDL model with Egarch errors. Information about the characteristics of the model are gathered as follow:

Characteristics of the model

Adjusted R squared	0.987894	Akaike info criterion	20.03955
F-stat	88.64766	Schwarz criterion	21.34734
P-Value(F-stat)	0.011213	Standard error of regression	13130.01

The modified test of Lagrange as suggested by Durbin (1970) was also conducted to study the no residual correlation series. It concluded to no residual correlation. Moreover the normality test of Jarque-bera and the non parametric tests of normality of Kolmogorov, Kuiper and that of Cramer-Von Mises all lead to no rejection of the hypothesis of normality of the residual series. What's more, the estimated parameters are all significant and are resumed in the following table:

Estimated parameters

a_1	1.755557	b_0	-15158.21	c_0	102564.3	d_0	2392492
a_2	1.537583	b_1	-5324.349	c_1	-80682.68	d_1	9901.034
a_3	1.392767	b_2	-11765.35	c_2	-203782.7	d_2	-2.644303
a_4	1.362518	b_3	11258.47	c_3	-193786.8	d_3	-14131.55
a_5	1.260378	b_5	12521.21	c_4	-371263.6	d_4	64902.33
a_6	0.942657	b_6	3657.787	c_5	-230684.7	α	12.99800
a_7	0.930850	b_7	11065.83	c_6	-213532.3	β	2.795594

Therefore, the long term equation is: $y_t = 904772 + 3744 * t - 5344 * x_t + 24544 * z_t$.
According to the estimation of the c_i parameters, we can state that a policy aiming at diminishing the urban growth rate by 1 per cent will lead, all equals the same, to the increase of the load conveyed by the Port by 1191168 tons. This could be explained by the fact that the agriculture in Ivory Coast is still not modernized. Hence, the level of the production depends on the level labor available. To derive a one step ahead forecast of y_t, estimated values of x_{t+1} and z_{t+1}. Projection of x_t is provided by many sources like the National Statistical Institute. Hence, we determined the dynamic of x_t which is $x_t = 0,98 * x_{t-1} + \epsilon_t$; with ϵ_t a Gaussian white nose. Thus,taking 3% as the estimated value of production growth rate for 2010, the one step forecast of y_t is:

One Step forecast of y_t

Lower confidence interval value	Forecasted Value	Upper confidence interval value
1123608	1134138	1144669

With a Root Mean Squared Error equals to 1995 and a Mean Absolute Percent Error of 0,18.

Conclusion

This study has examined the relationship between the total of load conveyed through the Port of San Pedro, the Urban growth Rate and the Gross Domestic Production (GDP) growth rate. The total of load conveyed could be seen as a proxy of the level of the agricultural production and the Urban growth rate as a proxy of rural exodus. Therefore, we showed that there is a negative relationship, in the short as well as in the long run, between the agricultural production and the rural exodus. So, the finding of this paper comply with the general acceptation according which the more people move from rural places to urban ones, the less becomes the level of agricultural production. Therefore, the implication policy of this paper is that Authorities should encourage the return of inactive urban youths to rural places so as to boost up the agricultural production and by ricochet the GDP.

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ABSTRACT

The Port of San Pedro (Ivory Coast) is the top in the world of the ports exporter of cocoa. Therefore, to maintain its position, it runs many studies in order to boost the level of its activities. The aim of this paper is to examine the impact of rural exodus on the level of activities of The Port of San Pedro and to build a model explaining the dynamic of the quantity of load conveyed there. The main issue is to give some arguments to public authorities concerning some of their demographic policies and to provide annual forecasts of the carried freights. Accordingly, we use two rather recent econometric approaches for the impact analysis: the Pesaran et al. (2001) approach to cointegration and the procedure for non-causality test of Toda and Yamamoto (1995). Besides, the model we propose was pointed out through an ARDL (Auto Regressive Distributed Lag) modeling approach. We also show that there is a negative long run relationship between rural exodus and the activities of the Port of San Pedro. To finish, based on the proposed model, we dealt with the topic of the forecast of the traffic.