Oil Prices, Drought Periods and Growth Forecasts in Morocco

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Abstract

The Moroccan economy suffers deeply from two exogenous shocks: high oil prices and drought periods. The irregular rainfall and instability of oil prices increase the volatility of economic growth and the uncertainty around growth forecasts. We exploit the vulnerability to these shocks in order to forecast the economic growth in Morocco. We use for this an Error Correction model linking output and trade balance in a vector augmented by oil prices and cereal production as exogenous variables over the period 1962-2012. The results are in the range and comparable to those of other national institutions and IMF. For example, based on the hypotheses of 97.7 $ per barrel and a moderate cereal production of 70 million quintals, growth is forecasted to be around 3%, in 2014, with a lower and upper bound of 2.5% and 3.4% respectively. The IMF and the High Commission for Planning forecast respectively 3.8% and 2.5%.

Key Words: Trade Balance, GDP Volatility, Cereal Production, VECM-X model.

JEL Classification: C53, E27.

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1. Introduction

The Moroccan economy has two major and persistent constraints that harm the economic sustained growth. The first one is related to drought. Moroccan economy is still relying importantly on agricultural sector. This latter contribute by 15 to 22% to the total value added. Furthermore, it employs about 40% of the total employment. Cereal production which has a share of about 75% on the total agricultural production is completely dependent on rainfall. Of the 8.7 million hectares of arable land, only 14.3% of the area is irrigated. The irregularity of the rainfall gives to economic growth a trend saw tooth as a consequence of the strong dependence on agriculture.

The second constraint is the surge of the oil prices. As Morocco is a net oil importing country, high energy prices have a direct effect by widening the trade balance deficit. Furthermore, oil prices put pressure on the government budget as domestic prices are heavily subsidized. The total amount of subsidy is continually increasing from 1% of GDP in 2003 to reach 6.6% in 2012. This is especially due to the increasing share of subsidized petroleum products that jumped from 17.6% in 2003 to 87.3% in 2012 of the total subsidy.

Moroccan economic growth is very volatile. A big portion of this is due to the mentioned shocks effects augmenting the uncertainty surrounding the growth forecasts. The purpose of this paper is to take advantage of this relevant dependency of the economy to these external shocks to produce GDP forecasts. We use a Vector Auto-Regressive (VAR) model augmented by two exogenous shocks: cereal production to catch the rainfall impact and oil prices for the energy impact. According to many authors, VAR models are believed to be powerful in forecasting compared to structural models and other economic theory based models; (Sargent, 1979), (Sargent, 1984), (Leamer, 1985), (Litterman, 1982) and (Litterman, 1984).

Our empirical results suggest an evidence of short and long run effects of drought periods and oil prices on the economic growth via the validation of a specification vector error correction model. In addition to the direct effects of oil prices on trade balance and cereal production on GDP, causality test shows that trade balance Granger causes the economic growth; this helps predict GDP. In term of forecasting, the results of our model are in the range and comparable to those of other national institutions and IMF. Based on the hypotheses of 97.7 $ and 99.2 $ per barrel for respectively 2013 and 2014, and a realization of 97 million quintals for 2013 and moderate cereal production of 70 million quintals, growth is estimated at 5.5% in 2013 and forecasted to be around 3.0% in 2014. High Commission for Planning and IMF forecast respectively 4.6% and 5.1% for 2013 and, 2.5% and 3.8% for 2014.

The following section analyses the impacts of drought and oil prices on economic growth and trade balance. The third section presents methodology of the Vector Error Correction Model with exogenous variables (VECM-X) used as a tool to produce forecasts. The fourth section draws some results of scenarios forecasting. For the robustness check of our results, a set of tests and scenarios are presented in the fifth section. Finally, the last section concludes.

2. Drought and Oil Prices: Effects on Trade Balance and GDP growth

We use the following sources for annual data over the sample 1960-2012: Gross Domestic Product in constant $ of 2005 are extracted from the World Development Indicators World Bank database. Trade balance of goods as percent of GDP is from the UNCTAD database. Oil prices, in $ per barrel adjusted for inflation are from the link: http://inflationdata.com/Inflation/Inflation_Rate/Historical_Oil_Prices_Table.asp and cereal production data, in metric tons, are from High Commission of Planning (HCP)[1].

Droughts have direct impact on GDP growth by reducing the agricultural value added. The irregularity of the rainfall implies a high GDP's volatility (figure 1) and makes it difficult to sustain the economic growth. The indirect effects are felt when reducing the farmers' income and increasing the unemployment. On trade balance, drought has two side effects: it reduces agricultural export from one side while increasing the imports of unsatisfied supply, especially of cereals. The result is a widening in trade balance deficit.

The effect of the oil prices passes principally via trade balance as illustrated in the figure 2: high oil prices deepen the trade deficit. While all energy prices are totally subsidized, the general budget is stressed and this could have medium to long run negative effects on public productive investments. In fact, the public investment budget has been cut considerably in the 2013 by 15 billion dirham, about 1.8% of GDP, and a further cut is expected in the budget law of 2014 due to the high load of subsidies. Reforming the system of subsidies is still ongoing while oil prices keep surging. To reduce the effect, partial gasoline prices indexation was adopted in September 2013.

Table 1 emphasizes the previous analysis. The correlations are high between the exogenous variables and the corresponding dependant variables. To make differences between long run tendency correlations and short run correlations describing fluctuations, we present in this table correlations between variables; in levels and in growth rates. We produce the correlations over the whole sample 1962-2012 and over the following subsamples; 1972-2012, 1982-2012, 1992-2012 and 2002-2012. We aim by this to highlights the importance of these correlations over the time and across different periods of time where the structure of the economy is supposed to change.

The first remark about this table is that GDP and cereal production are positively and highly correlated in levels and growth rates over all periods: 1962-2012, 1972-2012, 1982-2012, 1992-2012 and 2002-2012, but the important is that these correlations decreases over the samples for the variables in levels from 46.9% for the whole sample to 15.4% in the last reduced sample 2002-2012. The most important is that, in growth rates, we highlight the opposite: correlations increase from 68.5% for the sample 1962-2012 to 84.2% for the sample 2002-2012. We may deduce that while the long run and short run effects of the droughts (cereal production) on the production are strong, we observe that the long run effects are diminishing while the short run effects are emphasized by time.

The second remark is that oil prices and trade balance are, in levels, highly and negatively correlated (from -89.4% over 1962-2012 to -95.5% over 1992-2012 and 2002-

[1]It is a translation of the French label "Haut Commissariat au Plan" (HCP). Its web site is www.hcp.ma.

2012). This is also clear if we look at the figure 2 where the two corresponding curves are completely opposites. For the growth rate variables, the correlation is important only over the period 1982-2012 and the other subsequent periods. You may notice that the correlations over these periods are positive, but that means an increase in oil prices (positive growth rate) should increase the trade balance deficit (positive growth rate of negative numbers). However, an increase in cereal production growth rate should reduce the imported cereals bill and thus reducing the trade balance deficit (reducing its growth rate). This is reflected in the opposite sign of correlations from -22.3% over 1962-2012 to -60.7% over 1992-2012 and -40.6% over 2002-2012.

Finally there are also high negative correlations in levels between the two dependant variables (GDP and trade balance deficit) ranging from -80.7% to -87.5% for respectively the whole and last subsample.

3. VARX methodology

The technical approach used to forecast economic growth is a Vector Auto Regressive (VAR) model. This approach was developed by Sims as an alternative of econometric modeling based on the estimation of structural equations which have been subject to much criticism from (Lucas, 1976) and (Sims, 1980). The development of the econometric softwares has made easier their implementation and reinforced their use especially in forecasting by many Central Banks and research institutions. According to many authors[2], forecasting with VAR models showed better results than all other type of models. Furthermore, compared to big macroeconomic models, VAR models can quickly integrate new information and speedily be re-estimated.

Standard VAR models in their reduced form are defined such as k variables of a vector Y supposed to well describe the dynamic behavior of a sector or subsector of the economy. Each variable of the vector is linearly dependent variable to its past and the past of the other variables of the Y vector. The VAR representation can also integrate a vector of exogenous variables X, consequently called VARX. A formal Simplified representation of such models is described below:

$$Y_t = C + \sum_{j=1}^{p} A_j Y_{t-j} + BX_t + \varepsilon_t$$

Where Y_t, C and ε_t are $k \times 1$ vectors of respectively endogenous variables, constant terms and error terms. A_j is a $k \times k$ matrix of coefficients to be estimated for every $j = 1,\ldots,p$. B is the vector column of parameters associated with the vector of the exogenous variables X. Errors ε_t can be correlated to current values but are uncorrelated with their past values and are uncorrelated with all other variables in the right-hand side of the VAR-X system.

[2] (Sargent,1979), (Sargent, 1984), (Leamer,1985), (Litterman, 1982), (Litterman, 1984)…

Since only lagged values of the endogenous variables appear on the right side of each equation, there is no problem of simultaneity, and Ordinary Least Square (OLS) is an appropriate estimation technique.

The variables involved in a VAR model must have temporal interdependencies (causality linkages). These properties are usually tested by the most used causality test of Granger. Furthermore, the system VAR must be stable which requires all the endogenous variables to be stationary. The stationary properties are checked by the most used tests of Dickey-Fuller and Phillips-Peron and cointegration method to test the stability of the long run relationship. Finally, the number of lags p is obtained by tests of information criteria such as Akaike Information Criterion (AIC) and Schwartz Criterion (SC).[3]

The weaknesses of the VAR are that they need larger time series for a growing number of variables and or the presence of a large number of lags. For our case, this is not an issue since we have sufficiently longer time series over the period 1962-2012.

4. Forecasting Results and Discussions

The granger causality test shows that there is bidirectional causality between GDP and trade balance (table 2). The probabilities associated with both null hypotheses are respectively 5.1% and 2.0%. This means that trade balance causes GDP in almost 95% cases while GDP causes trade balance in 98%. However, looking at the levels of the data could be misleading if the times series are not stationary and the results of the test could change over time (Granger, 1969).

In fact, all series are non stationary. Table 3 presents results of a set of unit root tests for this purpose: Augmented Dickey Fuller (ADF), Phillips Peron (PP), Kwiatkowski-Phillips-Schmidt-Shin (KPSS), Elliot-Rothenberg-Stock (ERS) and Ng Peron[4]. An explanation of the features and the logic of these tests are displayed in the footnotes below the corresponding table. All these tests summarize that, in general, series must be first differentiated to be stationary. Differentiating the two series of GDP and Trade Balance, the Granger causality test shows, this time, that only trade balance could Granger cause GDP (rejection probability = 0.007 in table 2). We conclude from the test that trade balance could help predict GDP in the short run.

Furthermore, series of GDP and trade balance are co-integrated: Johansson method confirms this co-integration as stated in the table 2. Consequently, the suitable model considering the cointegration phenomenon is an error correction model. This model form, named Vector Error Correction Model (VECM), takes into account the short run fluctuations and the long run tendency (equilibrium).

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[3] The econometric software E-Views offers a test to select the minimum lag length based on five criteria that are: FPE for Final Predictor Error, AIC for Akaike Information Criterion, SC for Schwarz Information Criterion, HQ for Hannan-Quinn and LR for sequential modified Log likelihood Ratio test. For more lectures on the subject refer to (Burnham and Anderson, 2002) and (Zucchini, 2000).

[4] In practice, the Dickey-Fuller test is sensitive to the number of lags p introduced in it. Problems like serial correlation could affect the test for non optimal lags. (Ng and Perron, 2001) suggest a lag length selection procedure that results in optimal size and maximizes power gain.

One of the most important criteria for the quality of the forecasts is the capability to reproduce the history of the data. Figure 3 shows the back casting simulation of the two dependant variables and the corresponding absolute error for each. The error is defined as the actual minus the fitted measured in percentage points. The model seems powerful in reproducing the history especially in the last decade (2002-2012). The error over this period for the two variables trade balance and GDP growth is less than 1% and is decreasing at the end of the period.

Table 4 presents forecasting results for the economic growth. We exploit both stochastic and deterministic simulations allowing for a dynamic solution. We simulated results for the years 2011 and 2012 and produce forecasts for 2013 and 2014, based on hypotheses of oil prices and cereal production. The error between actual and simulated is respectively 0.20 and 0.17 percentage points for the years 2011 and 2012. For the hypotheses, we admit the World Bank oil prices forecasts adjusted for inflation: Real oil prices are estimated for the year 2013 to 99.2 $ per barrel and expected to be 97.7 $ per barrel in 2014. Cereal production is known for the year 2013 and is about 97 metric tons as recorded by the official statistics. For 2014, we consider a moderate production of 70 metric tons. The assumptions of oil prices and cereal production are the same as those considered by the High Commission of Planning and the Central Bank of Morocco to produce their forecasts. This allows comparing our forecasts to others on the basis of the same hypotheses. Based on these two assumptions, Moroccan economy is expected to grow at 5.6% in 2013, then to slow to 2.8%, in the next year, following an expected fall in the cereal production by 27.8%.

For the two consecutive years, 2013 and 2014, the High Commission of Planning predicted in its official forecasts 4.6% and 2.5%. The Central Bank (Bank Al Maghrib) reported growth interval estimates of 4.5% to 5.5% for 2013 and 2.5% to 3.5% in 2014. The International Monetary Fund, in his last World Economic Outlook report of October 2013, forecasts the GDP to grow by 5.1% in 2013 and 3.8% in 2014. The Department of Studies and Financial Forecasts (DEPF) from the Ministry of Economy and Finance forecasts 4.8% for 2013 and 4.2% for 2014[5]. Finally, the "Centre Marocain de Conjoncture", CMC reported 4.9 and 3.7 for his growth forecasts in 2013 and 2014. It seems that the VECMX model produce comparable results to those reported by specialized institutions supposed to get their forecasts from complete structural models. The conclusion is that, for the purpose of forecasting, relying on times series models could save time and money and deliver quick and good quality forecasts.

5. Diagnostic Tests and Robustness Check

The comparison to other institutions forecasts is supported via robustness check of the VECMX. We compare the output simulation of the model to the actual data and to alternative models: unrestricted VAR with two lags and VECM in which we omit the presence of the exogenous shocks of drought and oil prices. We want to show how

[5] DEPF stands for "Direction des Etudes et des Prévisions Financières" anglicized as Department of Studies and Financial Forecasts. Its forecasts are presented on a report entitled « Economic and Financial Report » accompanying the Budget Law project discussed and voted in the parliament at the end of each year.

important these two variables in forecasting growth. The results are summarized in the figure 4. While the simulated VECMX growth exhibit approximately the same path as actual data, the other models output fluctuate slightly around an average growth rate of 4.1% especially at the end of the period. In fact, we used double scale to better show the fluctuations because with one scale the other models exhibit a line constant path as the fluctuations are very small. We also produced forecasts for growth omitting the effect of oil prices and the results was 5.2% in 2013 and 2.9% in 2014. Referring to the causality linkages results, we show previously that only trade balance "Granger cause" GDP in the short run, we made restrictions over the short run coefficients of the lagged variable of GDP (we set it to be null). We found the forecasts values to be around 5.56% in 2013 and 3.08% in 2014.

We also run a variety of tests for the model residuals which are summarized in the table 6. The statistics of Kurtosis, Skewness and Jarque Berra indicate that residuals have approximately the properties of normality. This normality is also confirmed by the plot of a Quantile-Quantile graph (Q-Q Plot) in the figure 5. For the normality issue, the residuals distribution should lie with the straight line curve in Q-Q plot which is the case. The White Heteroskedasticity test indicates that the residuals are homoskedastic as the test rejects the Heteroskedasticity: the residuals have a uniformed variance.

6. Conclusion

Taking the advantage of the development of time series models, we construct a VAR Model, with co-integrated dependant variables: GDP and trade balance and incorporating exogenous information that highly influences the production in Morocco. It is used for the purpose of forecasting the economic growth. This model succeeded to a battery of tests and robustness check. The results are comparable to those produced by other national and international institutions.

The results are also conditioned by the accuracy of forecasting the exogenous variables. For the case of this model, cereal production of the next year is well estimated knowing the quantity of rainfall in the fourth quarter of the current year. At the end of the first quarter of each year, cereal production is declared approximately known by the Ministry of the Agriculture and the model could be re-estimated incorporating the updated value and then adjusts the economic growth forecasts.

The VAR models are used widely for forecasting short and medium terms. They can also be used to analyze the effects of economic policies and external shocks through impulse response functions and variance decomposition. Simpler and less expensive in estimation, they can be re-estimated frequently to incorporate updated information. They can provide short-term forecasts of at least similar accuracy to structural models and other cumbersome methods. If these models could not replace the structural models because of their weaknesses to describe the economic agents' behaviors, they are proved to be very useful in producing economic forecasts. Hence, they can help to strengthen the tools forecasts and spread the culture of prediction based on the external random shocks.

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Table 1: Summary of correlations over different samples

Samples	**Variables in Levels**		**Variables in growth rates**	
1962-2012	GDP	Trade Balance	GDP	Trade Balance
Trade Balance	-80.7%	--	-4.3%	--
Cereal Production	46.9%	-22.5%	68.5%	-22.3%
Oil Prices	87.9%	-89.4%	-6.3%	1.2%
1972-2012	GDP	Trade Balance	GDP	Trade Balance
Trade Balance	-70.5%	--	0.3%	--
Cereal Production	40.7%	-7.5%	70.2%	-24.0%
Oil Prices	84.6%	-87.5%	-5.4%	1.7%
1982-2012	GDP	Trade Balance	GDP	Trade Balance
Trade Balance	-77.3%	--	-35.8%	--
Cereal Production	28.4%	-2.3%	76.8%	-41.2%
Oil Prices	86.2%	-94.6%	-21.7%	53.8%
1992-2012	GDP	Trade Balance	GDP	Trade Balance
Trade Balance	-88.2%	--	-44.3%	--
Cereal Production	37.7%	-12.6%	80.3%	-60.7%
Oil Prices	94.1%	-95.5%	-1.4%	49.3%
2002-2012	GDP	Trade Balance	GDP	Trade Balance
Trade Balance	-87.5%	--	-7.2%	--
Cereal Production	15.4%	14.2%	84.1%	-40.6%
Oil Prices	88.4%	-95.5%	12.5%	59.8%

Table 2: Granger Causality[i] and Johansen Cointegration Tests

Variables	**Pairwise Granger Causality Tests**			
	Null Hypothesis:	Obs	F-Statistic	Prob.[iii]
In Levels	TBTOGDP does not Granger Cause GDP	51	3.1767	0.051
	GDP does not Granger Cause TBTOGDP		4.2499	0.02
In 1st differences	D(TBTOGDP) does not Granger Cause D(GDP)	51	7.7133	0.007
	D(GDP) does not Granger Cause D(TBTOGDP)		1.0099	0.32

Johansen System Cointegration Test[ii]				
Unrestricted Cointegration Rank Test (Trace)				
Number of Cointegrated Errors	Eigenvalue	Trace Statistic	5% Critical Value	Prob. [iii]
None [iv]	0.45	38.72	25.87	0.0007
At most 1	0.15	8.12	12.52	0.2420
Conclusion: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Number of Cointegrated Errors	Eigenvalue	Max-Eigen statistic	5% Critical Value	Prob.[iii]
None [iv]	0.451223	30.60319	19.38704	0.0008
At most 1	0.147184	8.119808	12.51798	0.242
Conclusion: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				

[i] The variable ***y*** is said to be Granger-caused by ***x*** if ***x*** helps in the prediction of ***y***, or equivalently if the coefficients on the lagged ***x***'s are statistically significant.
[ii] Trend assumption: Linear deterministic trend (restricted).
[iii] MacKinnon-Haug-Michelis (1999) p-values.
[iv] Denotes rejection of the hypothesis at the 0.05 level.

Table 3: Summary results of "Unit Root Tests" for the model variables.

		ADF[i]		PP[ii]		KPSS[iii]		ERS[iv]		Ng Perron[v]	
		Level	1st dif	Level	1st dif	Level	1st dif	Level	1st dif	Level	1st dif
Critical Values at 5%	Intercept	-2.919		-2.919		0.463		2.972		3.170	
	Trend and Intercept	-3.500		-3.500		0.146		5.718		5.480	
	None	-1.947		-1.947		--		--		--	
GDP	Intercept	6.140	-3.159	5.154	-8.470	0.926	0.658	852.07	19.84	2.442	15.70
	Trend and Intercept	2.358	-5.260	1.255	-11.16	0.213	0.151	122.68	20.47	2.264	25.04
	None	9.920	-1.416	11.47	-5.258	--	--	--	--	--	--
Trade Balance % of GDP	Intercept	-0.782	-5.322	-0.580	-7.468	0.862	0.132	19.99	0.049	14.35	1.192
	Trend and Intercept	-2.321	-5.339	-2.395	-7.553	0.132	0.066	10.43	0.067	10.43	0.695
	None	0.454	-5.185	0.867	-7.290	--	--	--	--	--	--
Oil Prices	Intercept	-1.349	-5.374	-1.438	-7.309	0.379	0.127	6.665	0.774	5.171	0.891
	Trend and Intercept	-1.644	-5.351	-1.759	-7.349	0.148	0.098	9.499	2.668	9.615	2.891
	None	0.079	-5.323	0.089	-7.222	--	--	--	--	--	--
Cereal Production	Intercept	-3.623	-8.922	-7.104	-26.91	0.717	0.049	3.184	2.696	3.469	3.976
	Trend and Intercept	-4.833	-8.824	-8.819	-26.48	0.043	0.033	0.502	8.124	0.515	6.191
	None	-0.629	-8.984	-1.476	-28.13	--	--	--	--	--	--

[i] I fixed lag length equal to 1 to take into account the ADF test and not the normal DF test with zero lags and also to avoid differences caused by the automatic selection with different information criteria. The decision test is made comparing the t-statistic to the critical values. We reject the null hypothesis "series have a unit root" at 5% when the critical value is less than the t-statistic test. The critical values reported for the tests ADF are those of MacKinnon (1996), one sided p-values.

[ii] For the PP test, I used bandwidth=3 with Newey-West and Bartlett Kernel option, the decision is made upon comparing the Adjusted t-stat test to the critical values. The strategy is the same as ADF test. The critical values reported for the tests ADF are those of MacKinnon (1996), one sided p-values.

[iii] For KPSS, I used bandwidth equal 3 with Newey-West and Bartlett Kernel options. The statistics reported are those of LM-test to be compared to the critical values of Kwiatkowski-Phillips-Schmidt-Shin (1992, table 1). We reject the null hypothesis when the reported value test is greater than the critical value.

[iv] I used lag length 3 with "AR spectral OLS" estimation method. The critical values are those of Elliott-Rothenberg-Stock (1996, table 1).

[v] I used "Fixed spectral GLS-detrended AR" estimation method with lag length =3. The reported values are for "MPT" statistic to be compared with the asymptotic critical values at 5% : Ng Peron (2001, table1).

Table 4: Moroccan GDP Growth Forecasts by the VECM-X model[i]

	Actual Exogenous		GDP Growth, %			
	Cereal Production (metric tons)	Real Oil Prices ($ per barrel)	Actual	Simulated		
2011	86.9	90.1	4.99	4.79		
2012	53.2	87.7	2.69	2.52		
	Exogenous Hypotheses		Growth rate Forecasts in %			
			Stochastic solution			Deterministic solution
	Cereal Production (metric tons)	Real Oil Prices ($ per barrel)	Lower Bound	Growth Rate	Upper Bound	
2013	97	99.2	5.0	***5.6***	6.0	***5.5***
2014	70	97.7	2.5	***2.8***	3.4	***3.0***

Table 5: VECM-X model Forecasts versus other Departments Forecasts.

	VECM-X	HCP	BAM[ii]	IMF	DEPF	CMC	Average
2013	5.5	4.6	5.0	5.1	4.8	4.9	5.0
2014	2.8	2.5	3.0	3.8	4.2	3.7	3.4

[i] The sample is 1962-2014. We choose the Baseline Scenario with the following Solve Options: Dynamic-Stochastic Simulation with Broyden Solver and maximum iterations of 5000. The convergence is $\varepsilon = 1.e^{-14}$. Requested repetitions are 1000, allowing up to 2 percent failures. The innovation generation method is kept to bootstrap.

[ii] The Central Bank of Morocco; Bank Al Maghreb (BAM) delivered an interval of growth estimates in which the forecast should be between 4.5% and 5.5% for 2013 and between 2.5% and 3.5% for 2014.

Table 6: Vector Error Correction residual Normality and Heteroskedasticity tests.

VEC Residual Normality Tests : Orthogonalization: Cholesky (Lutkepohl)					
Null Hypothesis: residuals are multivariate normal					
		Skewness	Chi-sq	df	Prob.
	Trade balance Residuals	-0.643127	3.240	1	0.072
	GDP Residuals	0.10486	0.086	1	0.769
	Joint		3.326	2	0.190
		Kurtosis	Chi-sq	df	Prob.
	Trade balance Residuals	3.982	1.888	1	0.170
	GDP Residuals	2.291	0.986	1	0.321
	Joint		2.873	2	0.238
		Jarque-Bera		df	Prob.
	Trade balance Residuals	5.127		2	0.077
	GDP Residuals	1.072		2	0.585
	Joint	6.199		4	0.185
VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)					
Joint test			Chi-sq	df	Prob.
			47.49944	42	0.2586
Individual components					
Dependent	R-squared	F(14,32)	Prob.	Chi-sq(14)	Prob.
res1*res1	0.199	0.568	0.870	9.353	0.808
res2*res2	0.310	1.029	0.452	14.588	0.407
res2*res1	0.486	2.159	0.035	22.831	0.063
VEC Residual Heteroskedasticity Tests: Includes Cross Terms					
Joint test			Chi-sq	df	Prob.
			109.2744	105	0.3681
Individual components					
Dependent	R-squared	F(35,11)	Prob.	Chi-sq(35)	Prob.
res1*res1	0.684	0.681	0.812	32.158	0.606
res2*res2	0.871	2.125	0.091	40.944	0.226
res2*res1	0.856	1.862	0.136	40.213	0.250

Figure 1: High dependancy of economic growth to the rainfall represented by cereal production

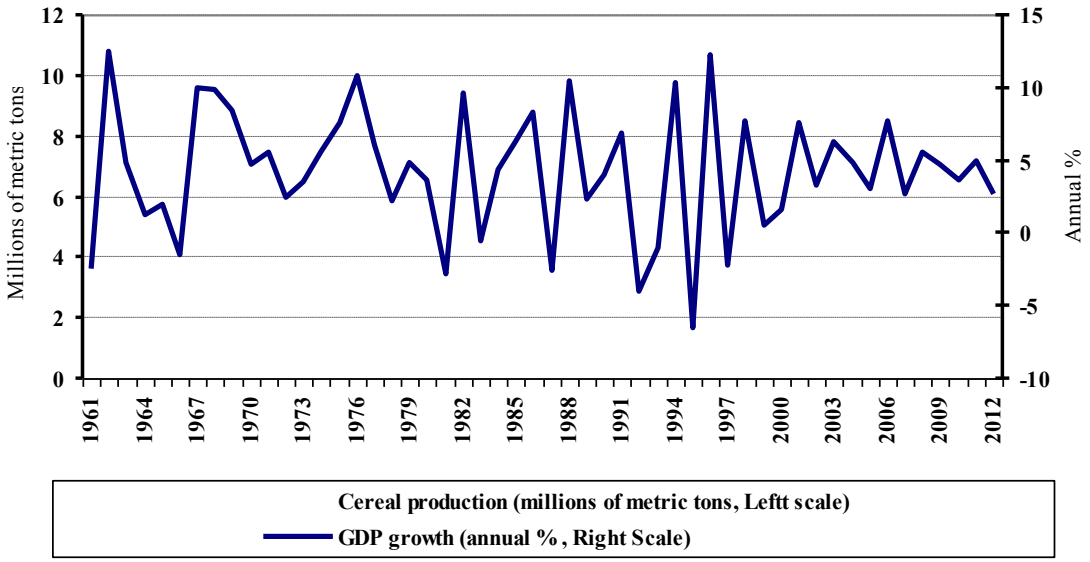

Figure 2: Impact of Oil Prices on the Moroccan Trade Balance

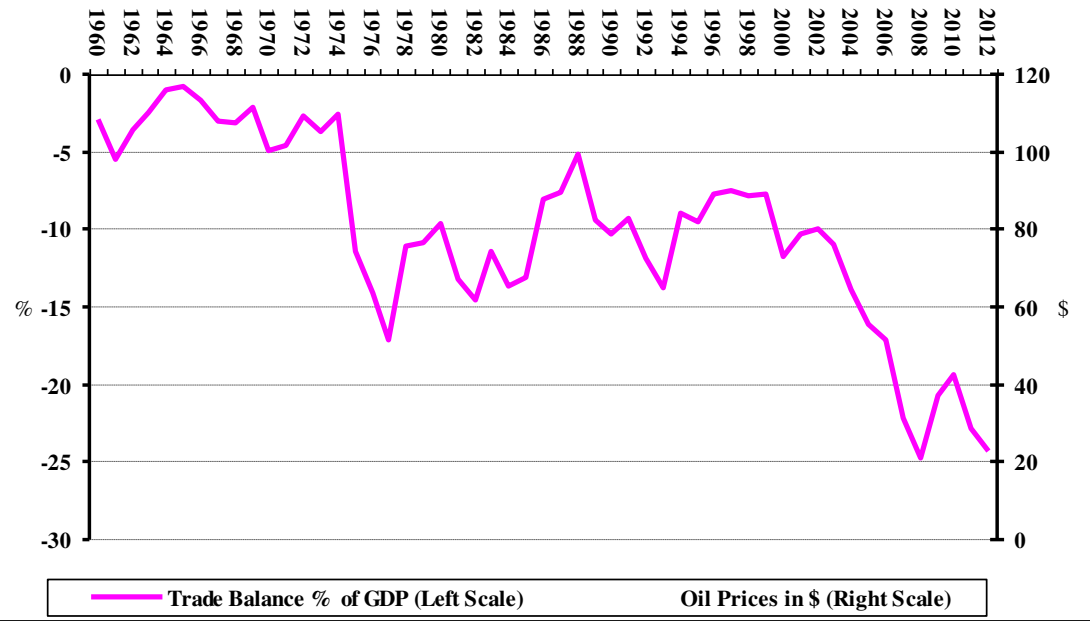

Figure 3: backward simulation of the trade balance and economic growth

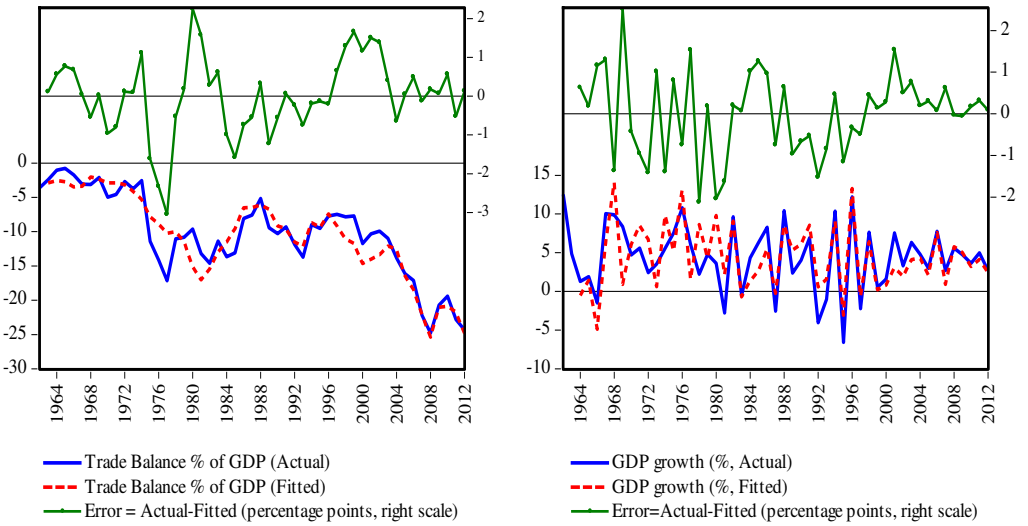

Figure 4: Simulation of VECMX model versus models omitting exogenous shocks

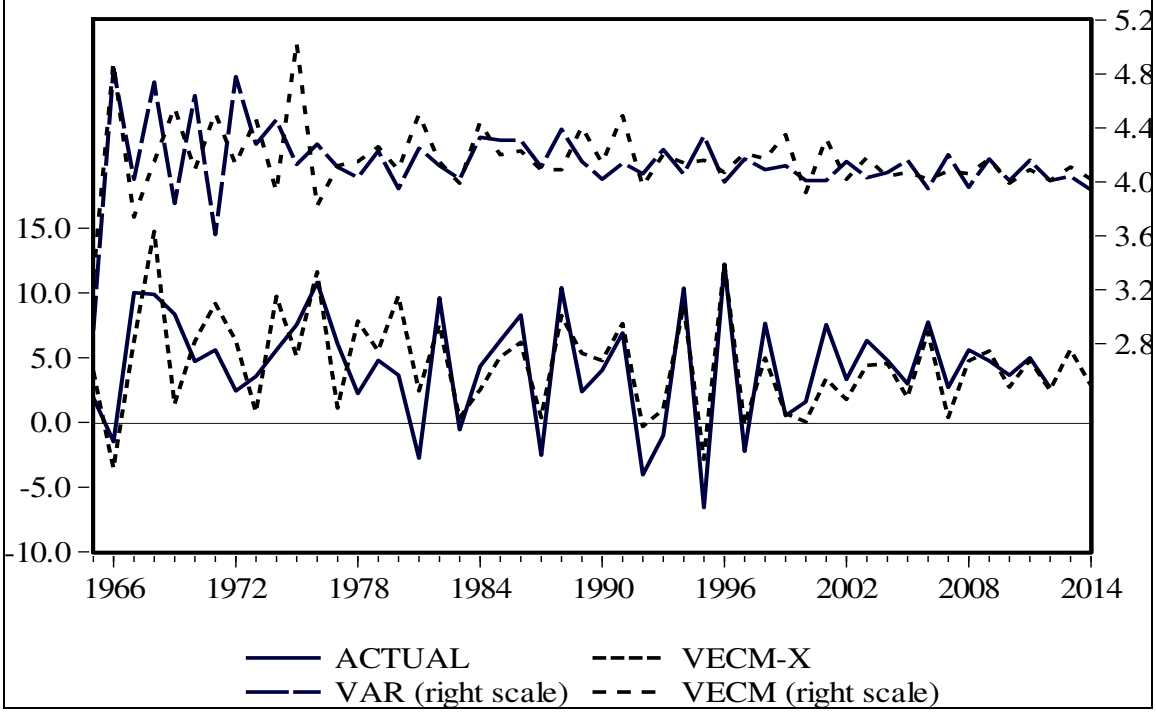

Figure 5: Normality Tests by Quantile-Quantile Curve.