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Algeria: Selected Issues Paper

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ALGERIA

SELECTED ISSUES

December 21, 2012

Approved By
Middle East and Central Asia Department

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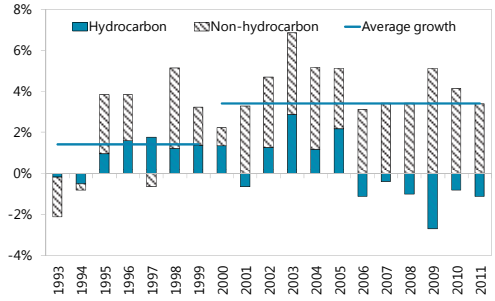
PROMOTING FASTER GROWTH IN ALGERIA[1]

A. Introduction

1. Despite the availability of large hydrocarbon resources and the recent windfalls from high hydrocarbon prices, Algeria's growth has been lackluster. Overall GDP growth has been relatively low, below 4 percent per year on average over 1995–2010, resulting in low growth of per capita GDP (2.1 percent annualized over 2000–11, following a decade of almost zero growth per capita). The hydrocarbon sector (which accounted for about 30 percent of nominal GDP over 1992–2011) grew at a slow pace over the period, with a negative contribution to real GDP growth since the mid-2000s.

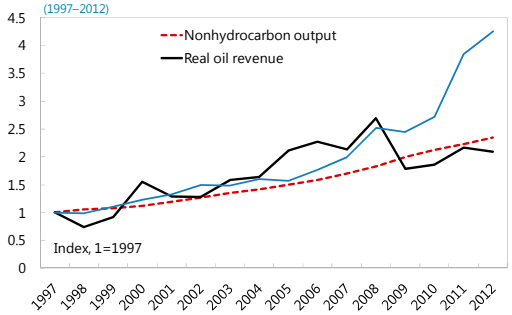
Hydrocarbon and Non-Hydrocarbon Growth
(Contribution to growth, in percent)



Sources: Algerian authorities; and IMF staff calculations.

2. Nonhydrocarbon growth has been the main driver of overall growth, but is heavily dependent on performance in the hydrocarbon sector. The rapid growth in the nonhydrocarbon sector (3.4 percent on average over the last decade) bolstered overall growth. However, this performance was largely made possible by massive transfers of resources to the nonhydrocarbon sector by way of public spending, the transfers themselves driven by large hydrocarbon revenues from high international prices.

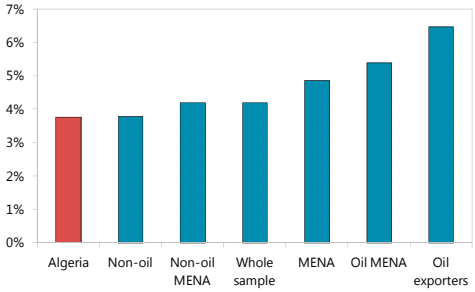
The Nonhydrocarbon Sector: Growing Thanks to Hydrocarbon Revenues
(1997–2012)



Sources: Algerian authorities; and IMF staff calculations.

3. Algeria's growth needs to be bolstered and diversified. The country lags behind other economies in the region; faster growth in the nonhydrocarbon sector is needed to reduce reliance on resources rent and provide the young and growing population with satisfying employment opportunities.

Annualized Real GDP Growth
(1995–2010)



Source: IMF staff calculations.

4. This paper identifies the main sources of growth for Algeria within a cross-country framework, and draws policy recommendations to support faster growth. A growth accounting exercise is undertaken in Section 1 to identify the contribution of factors accumulation and total factor productivity (TFP) growth to Algeria's economic performance. The determinants of growth are

[1] Prepared by A. Lahreche and G. Albertin (both MCD).

econometrically identified in Section 2, and policy recommendations drawn in Section 3. Section 4 concludes.

B. A Growth Accounting Exercise

Source of Growth: The Role of Factor Accumulation and Total Factor Productivity

5. A standard growth accounting framework is used to identify the main factors contributing to real growth in Algeria. Assuming a constant return to scale production function for output (*Y*) in physical capital (*K*), human capital (*H*)—modeled as the product of labor quantity and quality—and total factor productivity (TFP) (*A*)[2], output growth can be decomposed into the contributions from the accumulation of production inputs and TFP as:

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{A}_t}{A_t} + \alpha \cdot \frac{\dot{K}_t}{K_t} + (1-\alpha) \cdot \frac{\dot{H}_t}{H_t}$$

Output growth is given by TFP growth, i.e., the efficiency with which inputs of production are used, plus a weighted sum of the growth rate of physical capital and human capital, with α being the share of capital remuneration in total income.[3] In the rest of this section, we use this growth accounting framework to identify the sources of Algeria's overall real GDP growth as well as of real growth in the hydrocarbon sector and in the nonhydrocarbon sector.

Algeria: Inputs
(Change in percent)

Sources: World Bank; TED; and IMF staff calculations.

6. The analysis provides a decomposition of Algeria's real growth over 1990–2010, put in perspective using a cross-country comparison. Two subperiods are singled out (1990–99 and 2000–11). We use series for real GDP and investments provided by the Algerian National Statistical Office and construct the physical capital stock using a perpetual inventory method.[4] Human

[2] We assume a constant return to scale production function expressed as $Y_t = A_t \cdot K_t^{\alpha} \cdot H_t^{(1-\alpha)}$

[3] In turn, the growth rate of total factor productivity can be derived as the growth rate of output less the weighted sum of the growth rate of physical capital and human capital.

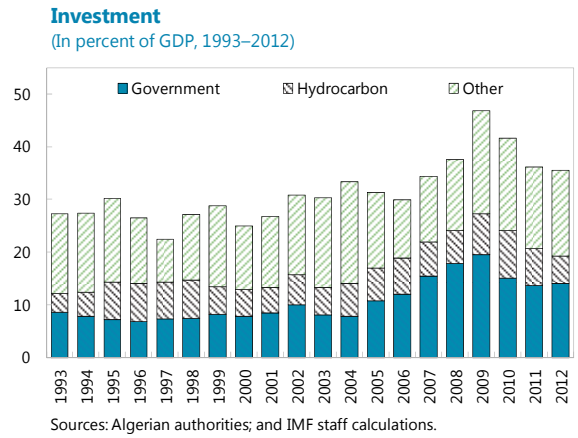
[4] Physical capital stock is modeled as a function of investment (I) and the depreciation rate (δ) as $K_t = (1-\delta)K_{t-1} + I_t$. The initial capital stock for Algeria K_0 is calculated as $K_0 = I_0/(\delta + g)$ based on a constant depreciation rate and initial output growth rate (g). As common in the literature, we assume δ = 0.06 and a g =0.05 as the average of emerging markets.

capital is computed using employment data provided by the Algerian National Statistical Office and adjusted for the quality of labor using the Total Economy Database (TED).[5] As in IMF (2007) and TED (2012), a constant capital share of 0.5 percent is assumed. The growth decomposition data provided by TED for over 120 countries are used to benchmark Algeria's performance against various samples of countries.

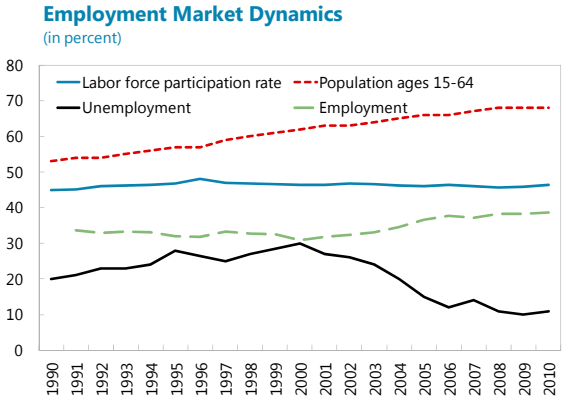
7. Employment was the factor with the fastest growth over the period, while capital growth picked up at the end of the 2000s. Employment grew on average by 3.6 percent a year, reflecting a growing labor force and stable participation rate. Capital barely grew until the start of the 2000d, because the low investment level in the 1990s that was just enough to offset capital depreciation. Labor quality growth was slow and stable.

Capital and Labor Accumulation

Low and stable investment in the 1990s weighed on capital accumulation, while employment grew as a result of the fast increase in working-age population and decline in unemployment, and despite the stable participation rate.



Sources: Algerian authorities; and IMF staff calculations.



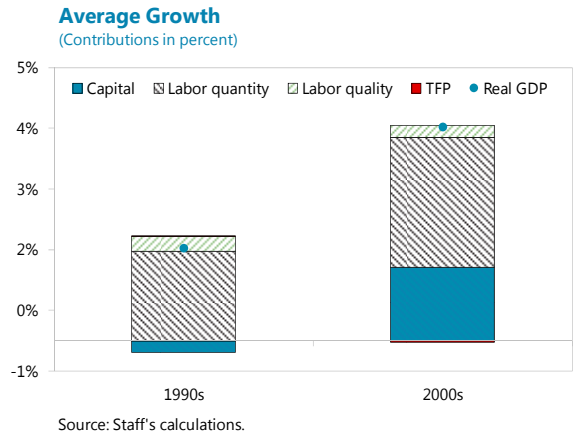
Sources: Algerian authorities; and World Bank.

8. Overall real GDP growth was mostly driven by the accumulation of factors of production while TFP growth was negligible on average. The accumulation of human capital consistently provided the most important contribution to real GDP growth, with growth in labor quantity playing a dominant part, while the contribution of labor quality was positive but relatively limited. Physical capital accumulation contributed negatively to real growth during the 1990s, reflecting relatively low investments compounded by the civil unrest at the time. During the following decade, the contribution of physical capital accumulation picked up, fueled by large public

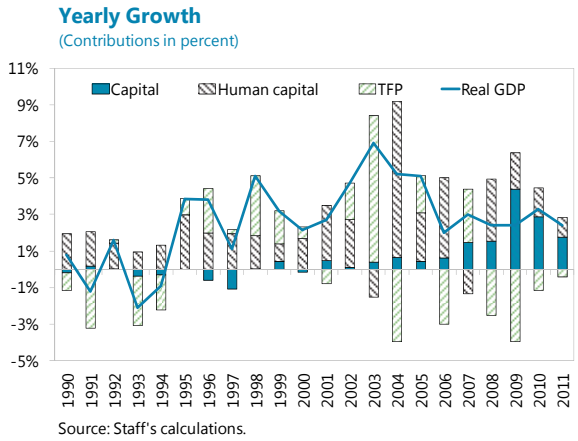
[5] Following the methodology used in TED (2012), the quality of labor is measured using a Tornqvist index based on the shares of labor in low, medium, and high skill groupings, weighted with their relative wages.

investments, and significantly contributed to real growth. Finally, TFP growth was negligible, becoming episodically negative toward the end of the period.[6]

Overall Growth Decomposition



Source: Staff's calculations.



Source: Staff's calculations.

9. The driving role of the nonhydrocarbon sector for overall growth calls for an investigation of the sources of growth within each sector. The hydrocarbon sector accounts for a large share of GDP, but tends to be relatively insulated from the rest of the economy.[7] As a consequence, the analysis of overall growth might be biased by developments in the hydrocarbon sector which are not reflected in the nonhydrocarbon sector, and it is important to understand the sources of growth in the nonhydrocarbon sector, which has been driving overall growth and is the main source of employment. The growth accounting analysis is therefore applied separately on the hydrocarbon and nonhydrocarbon sectors.[8]

10. The contributions of labor, capital, and TFP growth to hydrocarbon growth have been uneven. During the 1990s, TFP was the main determinant of real growth in the hydrocarbon sector. During the period, a healthy international demand for hydrocarbon products, coupled with limited investment, explains both the limited contribution of capital and the large contribution of TFP growth. During the late 2000s, physical capital accumulation became the main source of growth, reflecting the substantial pick–up of Sonatrach investments in the hydrocarbon sector. The negative contribution of TFP growth can be explained by (1) the slowdown in production, itself partly due to

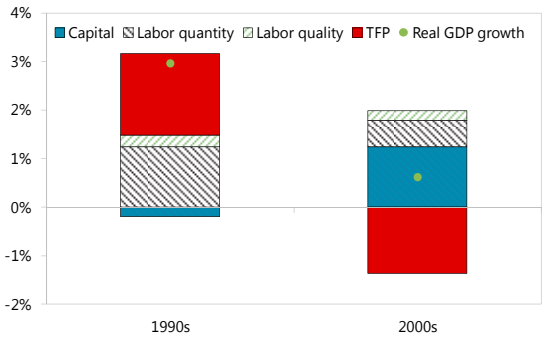
[6] The results on TFP growth are robust to the use of various employment data, and to the use of different assumptions on the shares of labor and capital (Appendix).

[7] For instance, Sonatrach employment is only 0.6 percent of total employment.

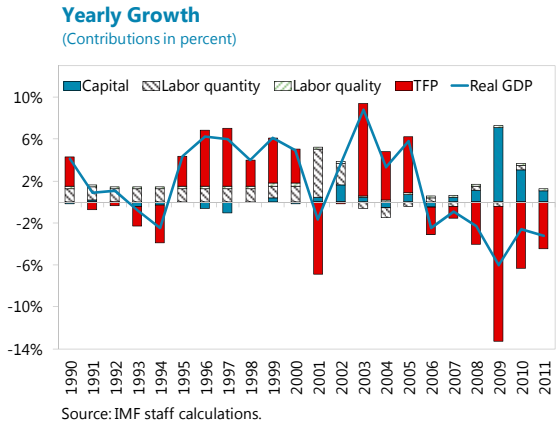
[8] See Appendix for a definition of data.

ageing infrastructure and (2) the delayed impact on output of recent large infrastructure investments.[9]

Hydrocarbon Sector Growth Decomposition



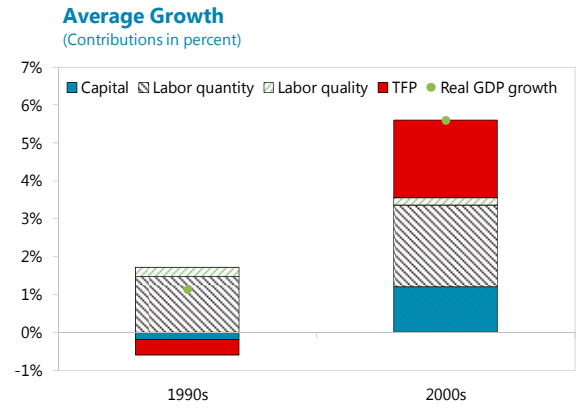
Source: IMF staff calculations.



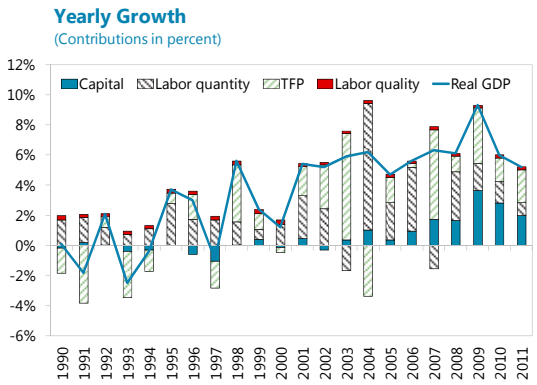
Source: IMF staff calculations.

11. Human capital accumulation was a major source of growth in the nonhydrocarbon sector, with TFP growth providing a significant positive contribution in the 2000s. TFP growth accounted for 36 percent of overall growth in the 2000s. Rapid employment growth was the main contributor to growth, while labor quality had a marginal impact.

Nonhydrocarbon Sector Growth Decomposition



Source: IMF staff calculations.



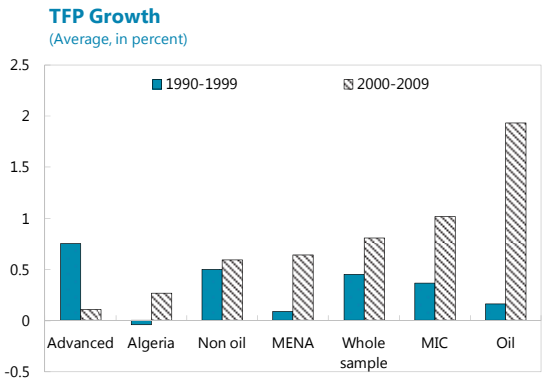
Source: IMF staff calculations.

[9] An additional downward bias on TFP in the hydrocarbon sector comes from the fact that measuring the hydrocarbon sector output by physical production ignores the fact that hydrocarbon investment does not only increase production, but also increases reserves.

12. These results are consistent with existing analysis on oil-exporting countries. So far, only a few growth accounting exercises have distinguished between the sources of growth in the hydrocarbon and nonhydrocarbon sectors, but available analysis confirms the findings for Algeria. For instance, a recent analysis on Saudi Arabia points to the overwhelming role of factor accumulation in explaining growth; it also underscores a slowdown in overall TFP growth over the 2000 decade; and provides evidence of more robust TFP growth in the non-oil sector than in the economy as a whole.[10]

Strengthening Algeria's Growth: Lessons from a Cross-Country Comparison

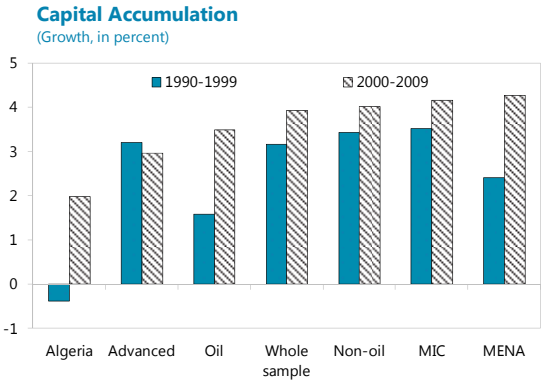
13. A cross-country analysis highlights that, over the last two decades, lackluster TFP growth and insufficient physical capital accumulation have hampered Algeria's growth performance compared to other economies. The TED database provides data on the drivers of growth for a large number of countries over 1995–2010.[11] For this study, Algeria's performance is benchmarked against a number of relevant subgroups.



Sources: Staff's calculations using TED and authorities' data

14. TFP growth in Algeria has been lagging behind international averages. During the 1990s TFP growth in Algeria was close to zero percent, well below the performance of oil exporters, emerging markets, advanced economies, and low-income countries. During the 2000s, TFP growth improved somewhat, but the gap with international averages remained large.

15. The rate of physical capital accumulation improved significantly in Algeria during the 2000s but remained well below comparator groups. During the 1990s, the accumulation of physical capital in Algeria was, on average, negative, as the civil unrest in the country and limited hydrocarbon resources weighed on investment. In all other country groups, capital accumulation was positive. During the 2000s, physical capital accumulation grew faster as public investment picked up, but it



Sources: Staff's calculations using TED and authorities' data.

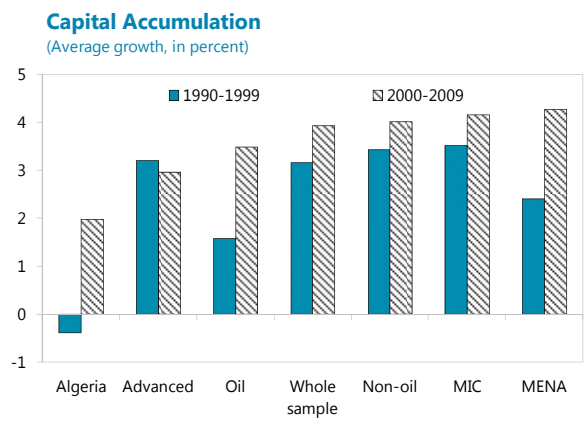
[10] Saudi Arabia—Selected Issues, IMF Country Report No. 12/272, http://www.imf.org/external/pubs/ft/scr/2012/cr12272.pdf

[11] The TED database provides comprehensive annual data covering GDP, population, employment, labor quality, capital accumulation, and total factor productivity for about 123 countries worldwide.

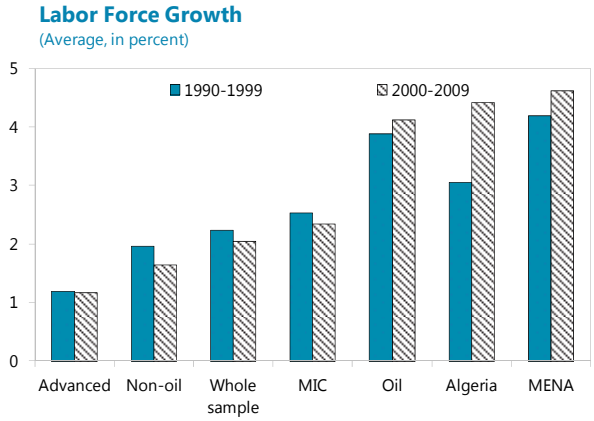
remained significantly below other group averages.

16. Algeria performed relatively well with respect to human capital. During the 1990s, the labor force grew on average by a healthy 3 percent a year, and increased further during the second half of the period to reach about 4½ percent, well above the sample average. In addition, labor quality compared favorably to other group averages.[12]

Human Capital Growth



Sources: Algerian authorities; TED; and IMF staff calculations.



Sources: Algerian authorities; TED; and IMF staff calculations.

17. These cross-country comparisons suggest that Algeria's growth potential that could reach 6 percent per year. Algeria would have been growing faster had the country performed as well as the average of the sample in capital accumulation and TFP growth.

- Had TFP growth been aligned with the international average, growth would have increased by about 0.8 percentage points annually.
- In addition, a pick-up in investments to bring physical capital accumulation to the international average would have added about 0.65 percentage points to annual real growth.

Adding up the two effects would therefore have brought yearly growth to almost 6 percent on average.

[12] This result should however be taken with some caution as international comparison data are otherwise lacking (for instance, Algeria does not participate in the OECD PISA rating exercise).

C. Determinants of Growth: A regression analysis

The Growth Equation

18. A standard growth equation is estimated to assess the contribution of various determinants to growth and compare Algeria's performance in a cross-country setting. The growth equation is estimated on a panel of 106 countries, over a 15-years period (1995–2010), and includes determinants traditionally identified in the literature (see for instance Bouis et al., 2011 or Berg and Miao, 2010)

$$g_{it} = \alpha_0 + \beta \boldsymbol{X}_{it} + \mu_i + \nu_t + \varepsilon_{it}$$

where i denotes the country and t the year; g_{it} is the real GDP per capita growth rate, $\boldsymbol{X}_{it}$ is a vector of variables including the main determinants of growth, μ_i and ν_t are fixed effects for countries and years, respectively, and ε_{it} is the residual.

The main determinants of growth account for

- *Catch-up effects*, with the lagged real GDP level. Countries with lower initial GDP per capita are expected to grow faster, because the lower stock of capital implies higher marginal returns to investment (and hence higher growth), and because these countries can benefit from their exposure to existing technologies and institutions in more developed countries. The ability to benefit from the exposure to the technological advance in the rest of the world is measured by openness.

- *Factor accumulation*: growth of the working age population; human capital (measured by the secondary enrollment rate); investment to GDP ratio; knowledge accumulation (measured by R&D spending in USD to capture the fact that R&D may require a critical mass to effectively impact growth). An increase in the working age population, in the quality of labor, in the stock of capital, or in the overall knowledge stock of the economy, is expected to enable growth.

- *Policy-related variables*: current government spending in percent of GDP, inflation (level and standard deviation), and exchange rate misalignment. Current spending is generally seen as creating pressure on available financing resources, thereby generating a crowding-out effect on the private sector that can negatively affect investment and growth. Higher and more volatile inflation reflects macroeconomic instability that affects the planning horizon of agents, and constrains their ability to invest. Finally, overvaluation tends to divert resources from the tradable sectors, thereby lowering the positive externalities that come through the exposure to technological progress and know-how, and negatively weighing on growth.

- *Governance*: government effectiveness and political stability. A more effective government is expected to create a more enabling environment for private-sector growth and to ensure that public resources are used at their best. Political stability is expected to improve the planning horizon of agents, thereby also enabling investment decisions.

The equation is estimated both on yearly data, and on four-year (nonoverlapping) averages, to ensure robustness of the results.

The results suggest that:

- Countries with lower initial GDP tend to grow faster, consistent with the catching-up hypothesis;
- Factor accumulation contributes to growth, and is dominated by the contributions of population growth and investment. Knowledge accumulation is also significant (although only at the 15 percent level on the four-year average estimate), while human capital has a positive but nonsignificant contribution to growth (with a significance level of about 15 percent);
- Higher current spending and higher and more volatile inflation tend to lower growth, pointing to the importance of policy and environment variables for growth. More open countries and countries with less exchange-rate misalignment also tend to grow faster; and
- Finally, governance-related variables affect growth, with better government effectiveness and higher political stability supporting growth.

Growth Equation Estimation Results

	Yearly data	4-year averages
Lagged GDP	-7.51*	-10.51***
Log of gross fixed capital formation	4.45**	1.74***
Working age population growth	0.50	0.77*
Log of secondary gross enrollment rate	0.90	2.12
Log of R&D spending (USD)	1.58*	0.88
Log of public current spending/GDP	-3.14***	-4.41***
Inflation	-0.05***	-0.02*
Inflation, 3-year standard deviation	-0.01***	-0.00
Log of openness	3.30***	3.54***
Real exchange rate misalignment	3.92***	3.15**
Government effectiveness index	1.89**	3.54***
Political stability index	1.75***	2.21
Constant	73.59***	91.26***
Year fixed effects	YES	NO
Country fixed effects	YES	YES
R-squared, within	0.49	0.44
Nb groups	104	106
Nb obs.	703	335

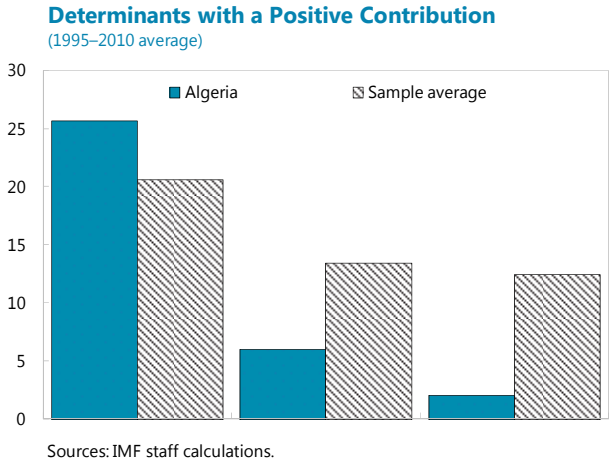
Source: IMF staff calculations.

***, ** and * denote significance at the 1, 5 and 10 percent levels, respectively
Student t are corrected for heteroskedasticity.

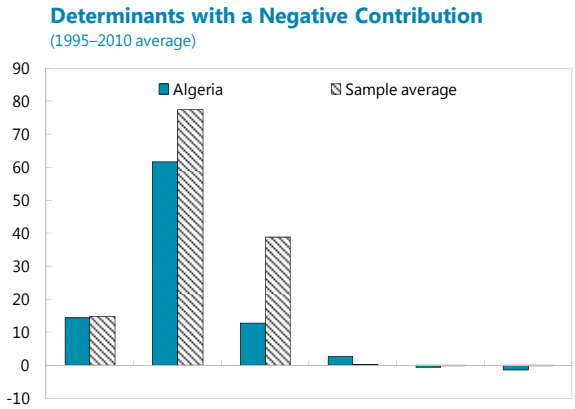
Estimating the Growth Potential

19. Although Algeria performed relatively well on a few variables, its performance was below the average of the sample for a number of important determinants.[13] A stable macroeconomic environment and a relatively high investment ratio were the main strengths of the country compared to the average of the sample. Conversely, Algeria displayed a somewhat higher level of current spending, less openness, less R&D, and slightly more real appreciation than the sample average. Over the period, political stability was lower, due to the civil unrest in the 1990s, and government effectiveness was below the sample average.

Algeria's Performance and Determinants of Growth

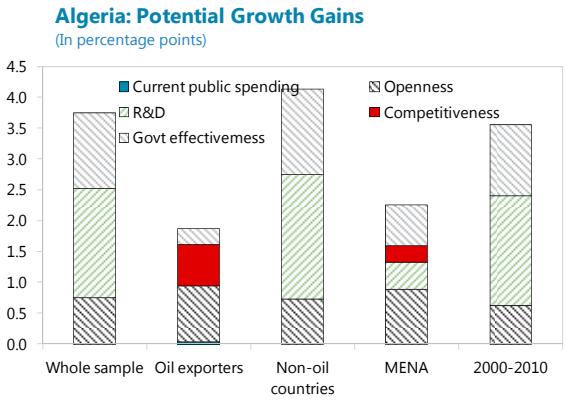


Sources: IMF staff calculations.



Sources: IMF staff calculations.

20. Simulations are run to assess Algeria's potential growth. Performance on the three indicators on which Algeria performed well is kept unchanged. The simulation assesses the gain in yearly growth that would have been observed had other significant determinants been brought to the average performance of the sample, and of a number of subsamples (oil exporters, non-oil-exporting countries, MENA countries, and the whole sample over the 2000–10 subperiod).



Sources: IMF staff calculations.

[13] Working-age population growth and the enrollment ratio have no significant impact on growth and are therefore not shown on the graphs. Note that the investment data and the capital data in the previous section are not directly comparable: investment data do not take into account capital depreciation; in addition, the sample for international comparison is different in the two exercises.

21. Algeria's growth potential could be as high as 5.7 percent a year.[14] Algeria's growth would have been up to 4 percentage points higher had it performed as well as non-oil countries in the sample, in terms of knowledge accumulation (R&D), openness, government effectiveness, and competitiveness.[15] If Algeria had performed as well as the overall sample, its gain would have been 3¾ percent a year. Averaging the potential gains computed over the different subsample, the potential growth gain would have been 3.1 percentage points. With growth hovering around 2.6 percent per year over 2008–11, these results suggest, Algeria's growth potential would have been 5.7 percent a year—in line with the broad outcome of the growth accounting exercise.

D. Policy Recommendations

22. Algeria's growth is underpinned by a number of strong fundamentals. The large hydrocarbon resource has so far been managed prudently, allowing the country to enjoy sizeable buffers in a stable domestic macroeconomic environment, marked, until 2011, by low and stable inflation, a flexible exchange rate, and limited external vulnerabilities outside of the exposure to the hydrocarbon sector. Overall, these advantages have allowed Algeria to rank favorably in macroeconomic stability indicators (Algeria ranks 23rd in macroeconomic environment in the World Economic Forum's *Global Competitiveness Report* 2012–13, its best ranking among all components of the global competitiveness index). However, the empirical analysis underscores areas where progress would support faster growth, notably capital accumulation, knowledge incorporation, and employment growth.

Increasing Capital Accumulation

23. The empirical analysis suggests that a major source of growth could be found in faster capital accumulation. Investment rates increased significantly in the second half of the 2000s, reaching almost 47 percent of GDP in 2009. However, this increase came after years of lower investment rates, notably in the private sector (which includes state-owned enterprises). Sustaining a high level of productive and efficient public investment and fostering private investment will be critical to strengthen capital accumulation.

24. Public capital spending should be directed toward projects that generate positive spillovers onto the rest of the economy. Public capital spending is likely to remain the main source of investment in the short term. Despite the recent push in public investment and the progress achieved (for instance in electricity connection, phone access, and road development) there remains great need for infrastructure, which is essential to removing bottlenecks to factor mobility and productivity growth. The World Economic Forum survey ranks the inadequate supply of

[14] The simulations ignore the impact of improving political stability because the estimate for Algeria is biased by the long period of civil unrest in the country.

[15] The impact of current spending is limited over the estimation period, because Algeria was very close to the average in terms of current spending to GDP until 2011. The current level of current spending to GDP (close to 30 percent in 2012) suggests that the impact on growth would be large if current values were used.

infrastructure as the fourth most important impediment to business in 2011. For instance, improvements are needed in port or railway infrastructure, or in broadband access.

Infrastructure in Algeria and Selected Neighboring Countries

	Year	Algeria	Egypt	Morocco	Tunisia	Turkey
Quality of port infrastructure	2011	3.0	4.0	4.5	4.6	4.2
	2007	3.3	3.5	4.1	4.8	3.4
Container port traffic (TEU: 20 foot equivalent units)	2011	265.6	6,709.1	2,058.4	466.4	5,547.4
	2007	200.1	5,181.6	916.4	420.5	4,678.7
Rail lines	2011	3,512.0	5,195.0	2,109.0	1,119.0	9,594.0
Air transport, registered carrier departures worldwide (in thousan	2011	44.0	11.0	92.0	44.0	40.0
Mobile cellular subscription (per 100 people)	2011	99.0	101.0	113.0	117.0	89.0
Fixed broadband subscriptions (per 100 inhabitants)	2011	2.8	2.2	1.8	5.1	10.3
Roads, paved (percent of total roads)	2009	74.0	89.4	70.3	75.2	88.7

Sources: World Bank; and International Telecommunication Union.

25. Increasing infrastructure investment requires an effort on the quality of spending, and better leverage of the private sector. Algeria is in a fortunate position as it can devote large public resources to infrastructure spending, but absorption capacity and delays in implementation have so far been a constraint. Measures to improve the efficiency and quality of public spending, such as integrated PFM IT systems and improved tracking of program authorizations, are needed; especially as large investment needs have to be balanced by the necessity to maintain a sustainable medium-term fiscal stance. Avenues should also be explored for increasing private-sector participation whenever synergies can be found. Notably, implementation of the government's large housing program would be accelerated by greater private-sector involvement, including foreign direct investment.

26. The environment for private investment needs to be improved. The weak business climate is an impediment to private-sector development in Algeria, and a number of measures can be identified that would bring improvements.

- *Lowering the cost of creating a business.* The cost of creating a business is high, due to the large number of procedures and the length of time it takes to start a business. The efficiency of one-stop shops should be improved, and all the necessary administrative services should be available.

- *Improving tax administration and revisiting the tax system*. Overall corporate taxation is burdened by the TAP (*Taxe sur l'Activité Professionnelle*)—a tax on turnover that funds local governments—which raises effective corporate taxation and can complicate tax payment for businesses that have a large geographic spread.[16] Eliminating this tax while ensuring revenue

[16] The recent establishment of a large corporate administration in the Ministry of finance, which collects the TAP and redirects it to local governments, has improved the situation for large businesses.

neutrality to preserve nonhydrocarbon revenues would support economic activity. Similarly, facilitating the payment of taxes by developing wire transfer and online payment systems is warranted.

- *Facilitating trade*. The time needed to process both exports and imports is long in Algeria, despite the establishment of green lines by the customs administration; faster customs procedures would provide some improvements. The requirement to use trade credit to finance imports is costly for businesses, and could be lifted.

- *Improving access to finance*. Access to finance is ranked as one of the main impediments to businesses, and seems particularly to affect very small enterprises with limited balance sheets. On that front, the modernization of the credit bureau is a welcome step, and more could be done; for instance, through the establishment of rating agencies. Reforms to the capital markets, to encourage equity and debt finance, are also needed, and would need to be initiated by the public sector, where most of the strong enterprises are.

Supporting Faster Accumulation of Knowledge and a More Efficient Economy

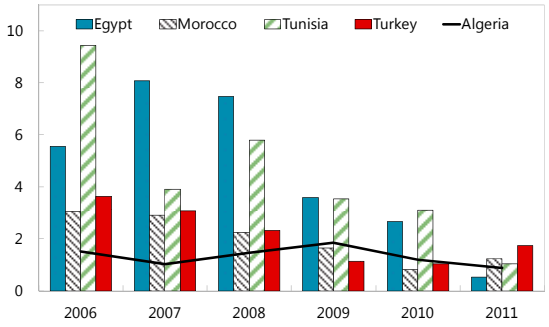
27. Productivity gains are largely related to knowledge improvements, which are enhanced by openness. Measures to support a faster accumulation of knowledge include:

- *Trade openness*. The empirical analysis suggests that trade openness is associated with faster growth: trade increases productivity and spurs knowledge accumulation through imitation and reaction to competitive pressure. To support a more diversified export sector, Algeria needs to strengthen its exports promotion policy and facilitate trade transactions, notably by speeding up WTO accession.[17] To encourage exports, the requirement that exporters surrender a part of their nonhydrocarbon export revenues to commercial banks could be eased.

- *Labor mobility*. Algeria could envisage policies to tap more effectively into its large network of workers abroad, notably the highest skilled, in order to enhance knowledge accumulation.

- *Foreign direct investment*. In particular, developing a climate welcoming to FDI will be of critical importance. FDI inflows into Algeria are small by international standard (about 1 percent of GDP), and the country missed the opportunity of the mid-2000s when large FDI flows were channeled into other countries of the region. Moreover, FDI is mostly concentrated in the hydrocarbon sector, where

Foreign Direct Investment in Selected Countries
(In percent of GDP)



Sources: IMF, WEO.

[17] Algeria's Working Party at the WTO was established in 1987.

spillover effects into knowledge and private-sector growth are limited. The decision taken in 2009 to impose an across-the-board 51 percent national stake in all FDI projects has worsened Algeria's attractiveness, even in the hydrocarbon sector (Appendix 3). Opening the FDI regime, at least in nonstrategic sectors, would support faster capital accumulation in the short term, and may also support knowledge diffusion within the economy through the network of local suppliers.

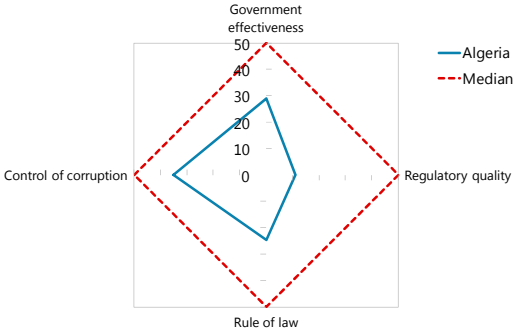
28. Policies to enable innovation and increase absorptive capacity are also needed.

- *Investment in education is needed*. Cooperation between enterprises and universities should be developed to ensure that higher education matches the needs of the productive sector, in addition to providing strong teaching and research resources.

- *Institutions to foster innovation also need to be boosted.* Because most of the financial resources in Algeria are concentrated in the hydrocarbon and public sectors, actors such as capital venture firms are lacking. The authorities have established investment funds at both the national and regional level, but activity remains low and could be increased, and business selection models could be improved to ensure the most effective use of public resources. Efforts to develop startup incubators are welcome but should be reinforced.

29. Governance is key to ensuring that policies yield the expected outcomes, and that factors are allocated to their best use. While Algeria ranks relatively high in terms of macroeconomic governance, its performance in terms of other indicators has room for improvement. In particular, a sound competitive environment, a strong business climate, and efficient use of public resources should be encouraged.

Algeria: Governance Indicators
(Percentile ranking in 2011)

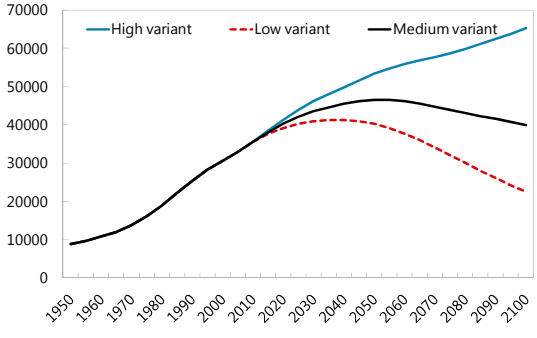


Sources: World Bank Governance indicators.

Preserving Algeria's Existing Strengths

30. Algeria also needs to maintain its main strengths. Labor quantity has been critical in driving growth over the last 20 years and it will be important to ensure that this source of growth continues to be tapped as effectively as possible. The natural rate of population growth is expected to slow down in the UN baseline scenario, and natural population increase will be a lesser source of human capital growth, as the country undergoes its demographic transition. To ensure that Algeria preserves its growth potential, policies need to address the labor market by:

Algeria: Population Projections
(In thousands)



Sources: US, World Population Prospects, 2010

- *Using 46 percent in 2010 the largely untapped population of nonparticipating workers*. Algeria's low participation rate implies that a large source of employment growth is still to be tapped, notably among women and youth, where the employment rates are only 12 percent and 20 percent, respectively.

- *Enhancing labor quality*. Labor quality is difficult to measure, and the TED might be painting a somewhat optimistic portrait of labor quality. Other sources suggest there is room to improve labor quality in Algeria—for instance, Algeria only ranks 108 on higher education and training in the WEF 2012–13 Report. In particular, an effort is needed to improve the jobs/skills match which is not favorable in Algeria and leads to high unemployment among the high-education population.

- *Improving labor market flexibility*. Official employment is marked by the overwhelming size of the public sector (36 percent of the working population are permanent wage earners, of which 76 percent are in the public sector), where employment is guaranteed and unit labor costs have been increasing following the recent wage increases; higher wages in the civil service have probably increased the reservation wage in other sectors. Reducing the cost of hiring and firing, facilitating recruitment, and reducing unit labor costs will be key.

E. Conclusion

31. Algeria has large untapped growth potential. Following a lost decade of civil unrest, real growth reached 3.5 percent per year in the 2000s, higher than during the 1990s, but below the performance of other oil exporters and emerging markets, and below its potential level, estimated to be around 6 percent a year.

32. To achieve higher growth, Algeria will have to preserve its strengths and engage in wide-ranging structural reforms. Preserving macroeconomic stability is critical to maintaining an enabling macroeconomic environment; ensuring that the youth and women participate in the labor market will be essential to preserving one of the country's main sources of growth. Efforts will also be needed to improve on a number of areas where progress has hitherto been insufficient. Because capital accumulation is critical to growth, it will be important to ensure that public investment remains sufficient, is well prioritized and well targeted to areas where positive spillovers to growth can be expected, such as infrastructure and human capital development. Efforts to ensure the labor force remains up to the requirements of modern business will also be needed, as well as policies to enhance the flow of workers within the domestic economy. Reforms to the business environment are also required to ensure that the business climate enables private investment, both foreign and domestic. Beyond factor accumulation, knowledge is essential to growth; for Algeria, staying the course will require efforts to improve the flow of knowledge from outside by stepping up trade, labor, and capital flows with the rest of the world.

References

Berg, A., and Y. Miao, 2010, "The Real Exchange Rate and Growth Revisited: The Washington Consensus Strikes Back?" IMF Working paper WP/10/58 (Washington: International Monetary Fund).

Bouis, R., R. Duval, and F. Murtin (2011), "The Policy and Institutional Drivers of Economic Growth Across OECD and Non-OECD Economies: New Evidence from Growth Regressions," OECD Economics Department Working Papers, No. 843, OECD Publishing. http://dx.doi.org/10.1787/5kghwnhxwkhj-en (Paris: Organization for Economic Cooperation and Development)

IMF (2007), Algeria: Selected Issues, IMF Country Report No. 07/61, February (Washington: International Monetary Fund).

Tabova, A., and C. Naker, 2011, "Determinants of Non-oil Growth in the CFA-Zone Oil-Producing Countries: How Do They Differ?" IMF Working paper WP/11/233 (Washington: International Monetary Fund).

Total Economy Database, http://www.conference-board.org/data/economydatabase/

Appendix 1. Data Description

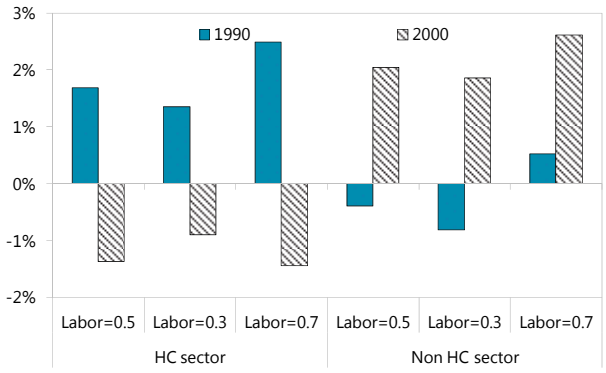
Variable	Source and definition
Real GDP	IMF WEO; real GDP in LCU
Log of gross fixed capital formation	Gross fixed capital formation (WEO) in percent of nominal GDP (WEO)
Working age population growth	World Bank, WDI
Log of secondary gross enrollment rate	World Bank, WDI
Log of R&D spending (USD)	World Bank, WDI
Log of public current spending/GDP	World Bank, WDI
Inflation	WEO
Inflation, 3-year standard deviation	WEO
Log of openness	Total exports and imports of goods and services, WEO, GDP, WEO
Real exchange rate misalignment	See below
Government effectiveness index	World Bank WGI
Political stability index	World Bank WGI

Real exchange rate misalignment is computed following Berg and Miao (2010) and Tabova and Baker (2011).

Appendix 2. Sensitivity Analysis

A sensitivity analysis shows that the main conclusion—that TFP worsened in the hydrocarbon sector but increased in the nonhydrocarbon sector over the period under study—is robust to various assumptions regarding the shares of capital and labor in the production process.

TFP Calculation Sensitivity Analysis
(TFP in percent, under various assumptions on the labor share)



Sources: Staff's calculations.

Appendix 3. Foreign Equity Ownership: A Cross-Country Comparison

(Index: 100 = full foreign ownership allowed)

		Mining, oil and gas	Agriculture and forestry	Manufacturing	Telecom	Electricity	Banking	Insurance	Transport	Media	Construction	Health care
Algeria	A new FDI legislation was introduced in 2009 setting, a 49 percent ceiling on foreign investors' stakeholding in any new FDI project. This was extended to foreign participation in investments in the financial sector in 2010.	49	49	49	49	49	49	49	49	49	49	49
Maghreb countries												
Morocco	Most sectors have been fully opened up to foreign investors participation. However, some statutory ownership restrictions remain. Airport and port operation and the electricity sectors are closed to foreign capital participation. Foreign ownership in companies providing domestic or international air transportation services is limited to a maximum of 49 percent. In the oil and gas sector, the National Agency retains a share of 25 percent of any recognition license or exploitation permit.	93.8	100	100	100	0	100	100	39.8	100	100	100
Tunisia	All sectors have been opened up to full foreign capital participation. As the only exception, the electricity transmission and distribution sectors are closed to foreign ownership. Foreign capital participation is not restricted by law in electricity generation, but the public monopoly and difficulty of obtaining the required operating license make it difficult for foreign investors to engage.	100	100	100	100	71.4	100	100	100	100	100	100
MENA oil exporters												
Saudi Arabia	Saudi Arabia has opened up many sectors of its economy to foreign investors. However, sectors such as mining, oil and gas, air and railway transportation, health care, and media are closed to foreign equity ownership. Foreign capital participation in the financial services sectors is allowed up to a maximum share of 60 percent. Unlike most other countries in the Middle East and North Africa region, Saudi Arabia does not impose any legal ownership restrictions on the electricity sector.	0	100	75	70	100	60	60	40	0	91.7	50
Yemen	Many sectors are fully open to foreign equity ownership. However, a number of restrictions remain in service sectors. Foreign ownership in electricity transmission is limited to a maximum of 49 percent. Furthermore, the telecommunications, electricity distribution, airport, and port operation sectors are closed to foreign capital participation.	100	100	100	50	71.1	100	100	60	100	100	100
Other MENAP countries												
Afghanistan	Afghanistan is among the countries with the least statutory restriction on foreign ownership. Among all sectors covered by the indicators no such restrictions were identified.	100	100	100	100	100	100	100	100	100	100	100
Egypt	Most sectors are fully open to foreign investors participation. Statutory ownership restrictions are imposed on some sectors, including the media. In other sectors, such as construction and air transportation, foreign ownership is limited to a minority stake.	100	100	100	100	100	50	100	76	50	83	100
Pakistan	Several sectors are fully open to foreign equity ownership. However, a number of restrictions remain in the service sectors, including the media. Foreign capital participation in such companies is permitted only up to a maximum of 25 percent and is further subject to government approval. Foreign ownership in nationwide television channels is limited to a less-than-50 percent stake. In the financial services sector, a maximum of 49 percent foreign ownership of Pakistani banks is allowed, while foreign capital participation in insurance is allowed up to a 51 percent share.	100	100	100	100	100	49	51	79.6	37	100	100
Regional averages												
Middle East and North Africa		78	100	95	84	68.5	82	92	63.2	70	94.9	90
High-income OECD		100	100	93.8	89.9	88	97.1	100	69.2	73.3	100	91.7
Eastern Europe and Central Asia		96.2	97.5	98.5	96.2	96.4	100	94.9	84	73.1	100	100
Sub-Saharan Africa		95.2	97.6	98.6	84.1	90.5	84.7	87.3	86.6	69.9	97.6	100

Source: World Bank, Investing Across Borders, 2010.

UNDERSTANDING INFLATION IN ALGERIA[1]

This paper analyzes the determinants of inflation in Algeria. It first examines the factors behind the spike in inflation in early 2012. It also looks at the short- and long-run determinants of inflation in Algeria during the period between 2002 and 2011 using a bivariate and multivariate analysis. Finally, the paper discusses the appropriate policies needed to contain recent inflation pressures.

A. Introduction

1. After a period of stable prices, inflation picked up in early 2012. During the past ten years, Algeria succeeded in containing inflation at around 4 percent despite some spikes in prices in 2004 and 2009, which were mainly due to rise in international food and commodity prices. During that period, the central bank used several measures to absorb the excess liquidity in the banking sector. In particular, it (i) raised the amount of deposit auctions; (ii) increased its policy interest rate several times; (iii) lengthened the maturities of a large portion of the deposit auctions from one week to three months in July 2005; and (iv) set up on overnight deposit facility in September 2005. However, inflation increased to an unprecedented level of 11 percent in early 2012 and has become a real concern for the authorities.

2. The paper examines the factors behind this recent increase in inflation and the policies that should be implemented to bring inflation back to the level targeted by the monetary authorities (4–4.5 percent). The paper will aim at clarifying the sources of the inflation surge that started in early 2012, and will look into policy measures to rein in inflation in Algeria. The underlying assumption is that while the 2012 spike was in part driven by short-term demand-side shocks, it also reflects more structural issues related to abundant liquidity and the lack of appropriate instruments to contain it, as well as to other issues pertaining to market structures.

3. After explaining the recent increase in inflation, the paper uses two approaches to explore the determinants of inflation. The paper uses a bivariate approach to reveal the leading indicators of inflation, by running Granger causality tests. It uses also a price model that includes both domestic and foreign factors to explain change in domestic prices based on the results of the bivariate analysis. The sample period for the empirical investigation covers the period 2003–11; quarterly data are used. Given the nonstationary in the variables and the existence of long term co-integrating relationships, the story uses a vector error correction model (VECM) to estimate the price model.

4. The rest of the paper is organized as follows: The next section describes the recent development of inflation in Algeria. Section C presents a review of the literature on the determinants of inflation in oil-producing countries. Section D presents the results on the bivariate and VECM

[1] Prepared by S. Ben Naceur (ICD).

estimation of the price equation. Section E prescribes some policies to contain recent inflation pressures, and section F concludes the analysis.

B. Recent Development of Inflation in Algeria

5. After years of relatively low inflation, prices began to increase rapidly at the start of 2012. The inflation rate in Algeria has widely fluctuated between 2003 and 2011, going from a low of -1 percent in 2003 to a high of 7 percent in 2009. At the start of 2012, prices increased again through April 2012, when inflation peaked at 11 percent. Prior to 2007, inflation in Algeria was most of the time lower than in its trading partners; but from 2007 onwards it became higher, with a large and a widening gap in 2012.

6. Food inflation has been a major contributor to the recent spike in inflation in Algeria. A simple decomposition of inflation covering the period 2011–12 shows that the contribution of food in overall inflation increased from 2 percent in late 2011 to almost 8 percent in April , explaining most of the 2012 spike in inflation. This increase in food inflation was mostly driven by fresh food. Excluding fresh foods, the CPI increased by at least 1 percent in April 2012 compared to its level in April, but in May 2012 it began to decline again.

7. The large demand injected through public spending in a situation of large liquidity has also provided an enabling environment. Large increases in real wages and other transfers have translated into higher inflation. Besides, credit to the public sector increased by more than 20 percent in 2012, contributing to inflation pressures, while growth in credit to the private sector was subdued at 10 percent in 2012. The authorities stepped in by raising the reserve requirement on deposits in the banking system from 9 to 11 percent and by enlarging their liquidity absorption by DZD 250 billion (+23 percent), which contributed to a decline in the banking free liquidity (excess reserves in BA and deposit facilities) in the second and third quarters of 2012.

C. Relevant Literature

8. There is extensive published research on the determinants of inflation in oil-importing and non-oil producing countries. Researchers have modeled inflation using domestic factors (supply side, demand, and money factors) and external factors (price of imported goods, nominal exchange rate). They have used several economic models (mark-up or Phillips curve models) and econometric techniques (VAR, VECM, panel data estimators). The focus of this review will be on the oil-producing countries. This inflation's determinant literature on oil-producing countries has evolved along two lines: GCC studies and country-specific papers.

9. Hasan and Alogeel (2008) explored the determinants of inflation in Saudi Arabia and Kuwait using co-integration and error correction models. They show, that in the long run, higher inflation in trading partners' countries is the main driving factor for inflation in the two countries. The pass-through from the exchange rate appears to be low in both countries. The speed of domestic price adjustment is relatively high with a half-life of only nine months for both countries. In

the short run, excess demand and excess money supply are significant drivers of inflation in Kuwait while excess money supply is the only driver in Saudi Arabia.

10. Kandil and Morsy (2009) study the determinants of inflation in GCC countries using annual data from 1970 to 2007. They use a vector error-correction model to capture long- and short-run dynamics of inflation. They consider domestic and external factors affecting inflation. In the long run, prices in major trading partners appear to be the most important foreign factor affecting inflation in the GCC, while money growth is inflationary in Bahrain and the United Arab Emirates (UAE) only. In Kuwait, Oman, and the UAE, government capital spending has eased inflation pressure in the long run. Oil prices have also contributed to inflation through an increase in credit growth and government spending. In the short run, excess demand has increased prices in Kuwait, Oman, and UAE. The authors have advised GCC countries to mitigate the procyclical stance of their fiscal policy and to prioritize public capital spending in order to reduce structural bottlenecks.

11. Basher and Elsamadisy (2012) explore the main sources and transmission of inflation in the GCC countries over the 1980–2008 period. They apply nonstationary panel data economic models. Money is the main driving factor in the short- and long-term, suggesting that GCC countries could benefit from having an autonomous monetary policy. Foreign prices and the nominal exchange rate affect domestic prices only in the long run. The speed of adjustment of domestic prices is relatively low, it takes about three years for half of a shock to the long-run equilibrium to disappear.

12. Sultan (2011) investigates the determinants of inflation in Saudi Arabia both in the short and long run applying the bound test method developed by Pesaran (2001) from 1980 to 2008. Sultan finds that world inflation, money supply, and the nominal exchange rate explain inflation in the short- and long-term. Domestic output may be the other way to relieve inflation pressures. Al-Bassam (1979) studies the sources of inflation in Saudi-Arabia using a single equation model from 1970–95. Domestic as well as external factors are included in the inflation model. The results indicate that three variables are exerting strong effects on Saudi prices, namely, the growth rate of the money supply, the growth rate of real income, and the changes in the nominal exchange rate against the U.S. Dollar.

13. Bonato (2008) explores the determinants of inflation in Iran, both in the short and long run over 1988–2005 period. Bonato finds a long-term relationship between price level and money, its rate of return, real income and the exchange rate. Money is the main driving force in determining the equilibrium price level. Money is also the most important factor explaining inflation in the short run. The decline in inflation is entirely explained by the lagged impact of the past decrease in M1 growth.

14. Alavirad and Athwale (2005) looked at the impact of the budget deficit on inflation in Iran. Alavirad and Athwale use a univariate co-integration test and error correction model based on annual data from 1963–99. The results indicate a positive relationship in the long run between prices

and government budget deficit. The adjustment of domestic prices to their long-term equilibrium level is slow, with an error correction coefficient of -0.2.

15. Koranchelian (2004) studies the characteristics of the inflation process in Algeria and its determinants using monthly data from 1997–2003. Koranchelian found that both monetary and real factors affect inflation in Algeria. In the long run, inflation is positively related to money supply and the exchange rate, and negatively related to income. In the short run, only M1 and income drive CPI changes. The author advises the government to pursue more prudent monetary policy to avoid inflation pressure. She suggests a more flexible exchange rate, since exchange rate movement has a mild effect on inflation. She encourages also the Algerian authorities to implement structural and institutional reforms as well as infrastructure investment to increase total factor productivity and thus help maintain price stability.

16. Klein and Kyei (2009) explore the factors that affect inflation in Angola using a VEC model. As domestic prices appear to be affected mainly by the nominal exchange rate, Klein and Kyei suggest that a more flexible exchange rate could help attenuate inflation pressure by reducing import prices and limiting money growth. Besides, the results show that excess liquidity increases inflation pressure with a lag by adding to demand pressures. The authors encourage the authorities to closely monitor money growth and improve liquidity forecasting.

D. Empirical Methodology

Empirical Model of Inflation

17. This section describes the empirical model to be used in our multivariate analysis based on theory. The theoretical model used in this paper is based on Koranchelian (2003), Nassar (2005) and Iimi (2007), the characteristics of the country (oil-producing country), and the data availability. The price level is a weighted average of tradable prices (CPI_t) and nontradable prices (CPI_n). As implied by the law of one price of tradable, the price level of tradable goods depends on the world price in foreign currency and the exchange rate. Both a decrease in the exchange rate (it means here depreciation) and a rise in foreign prices will lead to an increase in domestic prices. The price of nontradables depends on the disequilibrium between money demand and money supply (a policy variable). If actual money supply exceeds demand, there will be inflation pressure. Money demand is a function of real GDP and nominal interest rate. A higher interest rate increases the opportunity cost of holding money and reduces money demand, whereas higher growth increases transaction needs for money.

More specifically, the price level in the long run can be written as:

$P = f$(LOGM2EXSON, LOGNOGDP, LOGNEER, LOGINFP, LOGOIL, T-BILLR)
+ - - + + -

where P is the domestic price level measured by the log of consumer price index (LOGCPI), LOGNEER is the log of nominal effective rate which is measured as the foreign currency price per

local currency (captures exchange rate pass-through), LOGM2EXSON is the log of broad money without Sonatrach deposit (captures money supply), LOGOIL is the log of the world oil price (captures government expenditures), LOGINFP is the log of the import price index calculated by the "*Office Nationale des Statistiques*" deflated by the nominal exchange rate (captures cost of imported goods), LOGNOGDP is the log of real non-oil GDP (included to capture money demand and productivity improvement), [2] and T-BILLR is the 26-weeks treasury bill yield (captures money demand).

Bivariate Analysis

18. The Granger-Causality tests will choose the variables that give significant information for predicting inflation in Algeria, which, in turn, could be used in the empirical price model and play a crucial role in designing economic policies. This technique studies the directional relationship between inflation and the various cost-push and demand-pull factors. More specifically, inflation is regressed on both its past values as well as on the past values of each of its determinants. The equations estimated in the bivariate Granger causality tests are in the following form:

$$X_t = \alpha + \sum_{i=1}^{m} X_{t-i} + \sum_{i=1}^{m} Y_{t-i+} + \epsilon_t$$

where: X represents the LOGCPI. *Y* is an element in the set of indicator variables, which includes LOGM2EXSON, LOGNEER, T-BILLR, LOGNOGDP, LOGINFP, and LOGOIL.

Multivariate Analysis

19. Following earlier studies, the empirical model combines the short- and long-run determinants of inflation using a vector error-correction (VEC) model with two lags[3]:

$$\begin{aligned}\Delta\mathrm{LOGCPI}_t = {} & \beta_0 + \sum_k \beta_{1k}\Delta\mathrm{LOGCPI}_{t-k} + \sum_k \beta_{2k}\Delta\mathrm{LOGNEER}_{t-k} + \sum_k \beta_{3k}\Delta\mathrm{LOGM2EXSON}_{t-k} \\ & + \sum_k \beta_{4k}\Delta LOGOGDP_{t-k} + \sum_k \beta_{5k}\Delta\mathrm{LOGINFP}_{t-k} + \sum_k \beta_{6k}\Delta\mathrm{LOGOIL}_{t-k} \\ & + \beta_7\mathrm{GAPNOIL}_{t-1} + \beta_8\mathrm{EC}_{t-1} + \varepsilon_t\end{aligned}$$

Where: Δ is the first difference, EC is an error correction term used to assess how fast the price index converge to its equilibrium level and ε is a standard error term. Following Hasan and Alogeel (2008), this study introduces a measure of excess demand into the model to account for demand pressures

[2] The large contribution of the oil sector in the GDP of Algeria affects the accuracy of this measure because changes in the level of oil revenue that are not used into higher government expenditures would not impact on demand and exert inflation pressures (Hasan and Alogeel, 2008).

[3] The vector auto correction has 2 lags on each variable which is based on AIC criteria.

that may exert inflation pressures. To be consistent with the long term price equation, nonhydrocarbon output gap is used to measure excess demand:

$$\text{GAPNOIL}_t = \text{LOGNOGDP}_t - \overline{\text{LOGNOGDP}}_t$$

where: $\overline{\text{LOGNOGDP}}$ is the potential nonhydrocarbon real GDP[4] approximated by the de-trended value using a HP filter. Lagged excess demand is included in the price model to augment the specification of the short-run components.

22. The dynamic process of inflation in the short run could be studied using both impulse response functions (IRFs) and variance decomposition functions (VDCs). The IRFs trace the dynamic responses to the impact of a shock in one variable on itself and on all the other endogenous variables. They are useful in showing the sign of the response (positive or negative), but they do not display the actual size of the impact. This is done by the VDCs, which show the percentage of the forecast error variance that is explained by its own innovations and, by the fluctuations of the other endogenous variables. The innovations of current and past one-step-ahead forecasts are orthogonalized using the Cholesky decomposition. However, it is generally recognized that the results of IRFs and VDCs are potentially sensitive to the ordering of system variables. The ordering here will be based on theoretical background. More specifically, this study first assumes that price movements in oil are driven by exogenous developments. We also assume that output and the price level respond to current innovations in domestic policy variables (monetary policy) as well as to foreign variables (nominal effective exchange rate and import prices). Following the literature, the study places the domestic prices at the bottom of the ordering, the assumption that the price variable is contemporaneously impacted by all other variables while the price is not affected contemporaneously by other shocks (see Hahn, 2003). Besides, the Granger-Causality test indicates that M2 Granger causes the nominal effective exchange rate and not the other way around, so M2 will precede NEER in the ordering. This ordering of M2 allows for a contemporaneous impact of monetary policy shocks on exchange rate and output (see Saha and Zhang, 2012). The ordering chosen for this study is the following: LOGOIL, LOGM2EXSON, LOGNEER, LOGNGDP, LOGINFP, and LOGOIL.[5]

E. Empirical Results

23. The Augmented Dickey-Fuller (ADF) tests show that all the variables have a unit root. The long-run analysis is based on the Johensen-Juselius (1990) co-integration test. It includes two steps: the first to assess whether the variables are integrated in the same order using the unit root test, the second is to determine the number of co-integration vectors. If there is

[4] The Denton PFD benchmarking method is used to transform annual GDP to quarterly GDP based on the quarterly industrial production index (De Fonzo and Marini, 2012).

[5] The order of LOGNEER and LOGM2EXSON were invested and the results were unchanged.

co-integration between I (1) variables, a vector error correction (VEC) is estimated, if not, a VAR model is estimated. Table 1 lists the Augmented Dickey-Fuller; the tests indicate that all variables are nonstationary in levels but stationary in their first difference, except the T-Bill rate which is stationary in levels.

Table 1. Unit Root Tests

Variables	*Description*	*I(1)*	*I(2)*
LOGCPI	Consumer Price Index	0.56	-3.01**
LOGNOGDP	Non-oil Real GDP	-0.09	-2.63*
LOGMONEY	Nominal Money Supply (M2)	1.82	-6.15**
LOGNEER	Nominal Effective Exchange Rate	-2.23	-5.57***
LOGOIL	World Oil Price	-1.57	-5.15***
LOGINFP	Imported Price Index	-1.03	-4.66***
T-BILLR	T-bill rate	-3.52**	-

*, ** and *** denote rejection at the 10, 5 and 1 percent significance level, respectively.

24. M2 and non-oil real GDP Granger-cause domestic prices. The overall results from the Granger-Causality tests indicate that money supply and nonhydrocarbon real output are good leading indicators for domestic price changes confirming the quantity theory of money. Besides, there is no pass-through effect, either from nominal exchange rate or from foreign prices (price of imported goods and world oil price). The T-bill rate is not Granger-causing domestic prices.

Table 2. Granger-Causality Tests

Variables	*F-Statistic*	*P-values*
LOGM2EXSON → LOGCPI	9.96386	0.0004
LOGNGDP → LOGCPI	4.65143	0.0166
LOGNEER → LOGCPI	0.03149	0.9690
LOGINFP → LOGCPI	0.40650	0.6693
LOGOIL → LOGCPI	0.65227	0.5274
T-BILLR → LOGCPI	0.04963	0.9517

Note: → indicates the direction of causality.

25. The Johansen and Juselius (1990) co-integration tests indicate the existence of long-run relationships between domestic prices, money supply, non-oil real GDP, world oil prices, and prices of imported goods.[6] After determining that the variables are of order I(1), the existence of co-integration relationships is examined. The results of the trace statistics show that there are two

[6] Nominal effective exchange rate, imported price index, and world oil price are included in the multivariate estimations in order to test the existence of a short- and long- run pass-through.

co-integrating relations (Appendix 3). Given the above, the long-run price equation is estimated as follows:

$$\underset{}{LOGCPI} = \underset{}{2.91} + \underset{[11.08]}{0.30\ LOGM2EXSON} - \underset{[-4.19]}{0.20\ LOGNOGDP} - \underset{[-2.77]}{0.10\ LOGNEER} + \underset{[7.61]}{0.20\ LOGINFP} + \underset{[12.48]}{0.04\ LOGOIL}$$

26. A long-term relationship exists between domestic prices, nonhydrocarbon real GDP, money supply, oil prices, nominal effective exchange, rate and prices of imported goods. Money supply and real GDP are by far the most important determinants of long-term price changes. The estimated dynamic error-correction inflation equation is displayed in Appendix 5. The estimated equation passes all the specification tests (see Appendix 6 for all the tests).[7] All variables are significant and have the expected sign. The results also indicate that money supply is the driving factor for inflation in the long run which supports the monetarist hypothesis on the power of money in the long-run inflation process. A 1 percent increase in money supply results in a 0.30 percent increase in the price level in Algeria. The coefficient of money is much lower than unity (as required by the homogeneity condition). This difference could be related to extensive price controls (see Bonato, 2008). Non-oil GDP is found to be another important factor explaining change in domestic prices in the long run. Rises in non-oil real income ease inflation pressures in the long run. A 1 percent increase of nonhydrocarbon real output results in 0.20 percent decline in domestic price levels. Prices of imported goods also seem to play a significant role in explaining domestic price changes in the long run. An increase of 1 percent in imported prices contributes to an increase of 0.20 percent in domestic prices. The results show also that the exchange rate is negatively and significantly associated with domestic prices in the long run. A 1 percent depreciation of the NEER will increase domestic prices by 0.10 percent. The long-term pass-through seems to be relatively low for a developing country. Algeria could have used subsidies or trade tariffs to alleviate increase in the price of basic imported commodities following exchange rate depreciation. In the absence of data, the above hypothesis could not be tested. Finally, the impact of oil price seems to be low; a 1 percent increase in the world oil price is reflected by a rise of only 0.04 percent in domestic prices in the long run, which highlights the fact that oil prices are highly subsidized in Algeria.

27. The short-run analysis shows that money supply and prices of imported goods are the dominating factors in the short run. Besides, price tends to adjust to equilibrium rather quickly.

Short-term inflation equation could be written:

$$\Delta LOGCPI_t = \underset{}{-0.00} + \underset{[1.29]}{0.31\Delta LOGCPI_{t-1}} - \underset{[-2.04]}{0.47\Delta LOGCPI_{t-2}} - \underset{[-0.51]}{0.07\Delta LOGM2EXSON_{t-1}} - \underset{[0.31]}{0.04\Delta LOGM2EXSON_{t-2}}$$
$$+ \underset{[0.65]}{0.27\Delta LOGNOGDP_{t-1}} + \underset{[0.98]}{0.58\Delta LOGNOGDP_{t-2}} - \underset{[-1.44]}{0.27\Delta LOGNEER_{t-1}} - \underset{[-0.31]}{0.05\Delta LOGNEER_{t-2}}$$

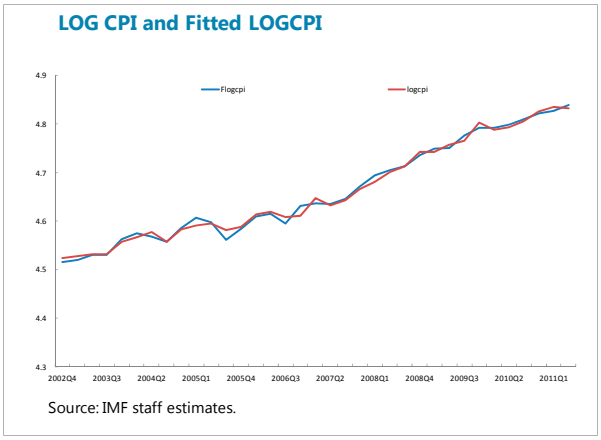
[7] The errors are uncorrelated, normally distributed and homoscedastic.

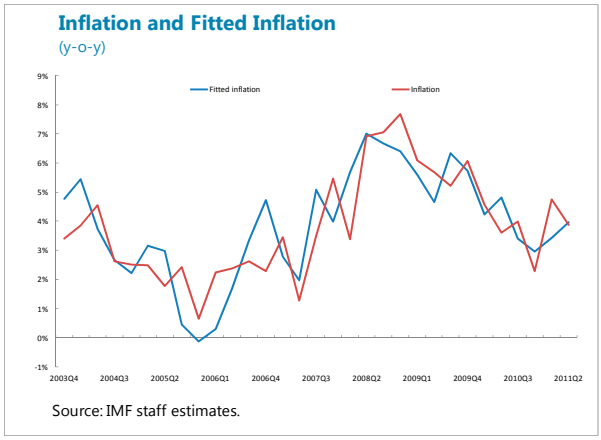
$$+0.02\Delta LOGOIL_{t-1} \underset{[1.41]}{} -0.013\Delta LOGOIL_{t-2} \underset{[-0.73]}{} +0.18\Delta LOGINFP_{t-1} \underset{[1.02]}{} +0.11\Delta LOGINFP_{t-2} \underset{[0.65]}{} +0.97GAPNOIL_{t} \underset{[1.75]}{} -0.60EC_{t-1} \underset{[2.26]}{}$$

The negative and significant error correction term confirms the existence of at least a co-integration relationship between domestic prices and their determinants. It also implies that if inflation is 1 percent below its equilibrium level in one quarter, inflation will increase by about 0.60 percent in the following quarter. This result suggests that the speed of adjustment is high and it takes less than one quarter to eliminate one-half of the deviation from the long-run equilibrium.[8] Besides, a positive nonhydrocarbon output gap contributes to price increases in the short run. The second lag of the change in domestic prices enters with large negative coefficients, showing that change in domestic prices is mean-reverting.

The model tracks prices and inflation quite well. The fitted and actual values of the prices and their changes are graphed in Figure 1: -the model adequately captures the general trend of prices and inflation. The estimated equation passes almost all the specification tests. The residuals appear to be normally distributed, with no evidence of heteroskdasticity or autocorrelation (see test details in Appendix 6).

Figure 1. Actual and Fitted CPI and Inflation



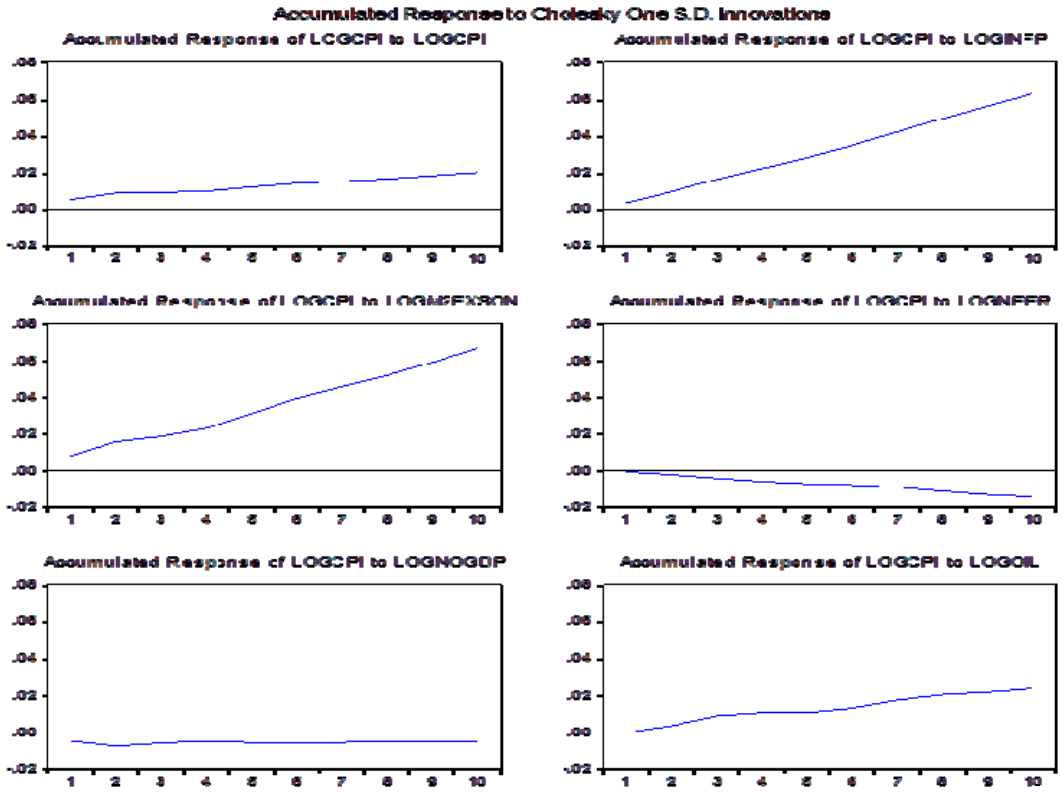


28. The impulse reaction functions show that shocks to M2 and to prices of imported goods significantly increase and persistently domestic prices in Algeria. The focus here is only on the impact on inflation. As Figure 2 reveals, a one-time standard deviation shock applied to M2 induces a contemporaneous increase of 0.01 units in the price level. However, the increase in price rises in magnitude and reaches, e.g. 0.07 units at the 10th quarter; therefore the impulse is permanent. The response of inflation to a one-unit shock to imported prices is also strong and permanent, reaching 0.06 units at the 10th quarter. The impulse reaction function suggests also that a shock in world oil prices pushed up inflation by less than 0.01 units after two quarters, with the

[8] The speed of adjustment is the number of quarters needed to reduce one-half of a deviation from the long-run equilibrium. It is measured as log (0.5) / log (1+ error-correction coefficient).

impact reaching 0.02 units at the 10th quarter. Another interesting result from Figure 8 is a shock in nominal effective exchange rate leads to a small decline in price and the impact begins to show only at the second quarter. Finally, the impact of a shock of non-oil real GDP on inflation is negative and small at almost 0.01 units at the first quarter, and remains permanently at about that level. Overall, the impulse responses of the price level are quite consistent with the long-run impact in sign and size, except for the real output that displays a smaller impact on prices in the short run.

Figure 2. Impulse Response of Inflation to Shocks



Source: IMF staff estimates.

29. The variance error decomposition of domestic prices indicates that money supply shock and the price of imported goods shock are the main determinants of the short-term fluctuations in domestic prices in Algeria. VDC indicates the proportion of the forecast error in a given variable that is accounted for by innovations in each endogenous variable. The results of the VDC are presented in Table 3. It shows that the direct effect of domestic price variable on itself is high in the beginning but declines sharply as the forecast horizon expands, reaching a low of 5 percent in the 10th quarter which confirms the small inertia in inflation found in the previous section. Innovations in M2, on the other hand, seem to explain a proportionally large portion of the variance in domestic prices, reaching a peak of 48 percent at the first quarter but declining slightly in period 10 to reach 43 percent. Consistent with the impulse response functions, a very large proportion of the variance in domestic prices is explained by the price of imported goods reaching a

peak of 37 percent after 10 quarters. Innovations in non-oil GDP explain a large proportion of domestic price variation at the beginning, with 21 percent; but this proportion declined as the forecast horizon was extended to reach 3 percent in quarter 10. Finally, the proportion of the domestic price forecast error variance due to the world oil price and NEER are both minimal amounting to less than 13 percent.

Table 3. Variance Decomposition of Inflation

Period	S.E.	LOGCPI	LOGINFP	LOGM2EXSON	LOGNEER	LOGNOGDP	LOGOIL
1	0.011169	20.93155	8.379573	48.53290	0.251379	21.61779	0.286812
2	0.016220	14.88143	18.76077	46.01709	1.177418	13.24398	5.919320
3	0.018825	11.08378	27.06760	36.63937	1.948877	10.61514	12.64523
4	0.020409	9.522450	31.41384	35.78808	2.448398	9.378681	11.44855
5	0.022904	8.622959	31.45295	40.99210	2.232147	7.606640	9.093214
6	0.025505	7.626161	32.42555	43.54597	1.879948	6.186091	8.336284
7	0.027712	6.614228	34.60716	42.06433	1.808160	5.288152	9.617968
8	0.029553	6.000548	36.47225	41.25670	2.114742	4.692756	9.463007
9	0.031371	5.673912	37.24267	42.05723	2.266868	4.165101	8.594223
10	0.033160	5.357658	37.67843	43.04571	2.161453	3.727939	8.028806

Cholesky Ordering: LOGOIL LOGM2EXSON LOGNEER LOGNOGDP LOGINFP LOGCPI

Source: IMF staff estimates.

F. Policy Implications

30. The response to inflationary pressures should rely on sound fiscal policy, and the government deficit should be financed by bond issuances to contain liquidity injections. Fiscal policy has a key role in fighting inflation; the large increase in civil service wages in 2011 and 2012 was the principal factor behind the increase of banking sector liquidity, which was the main driver of the 2012 inflation surge. It will be necessary to avoid any new increase in the wage bill which would trigger a wage-price spiral and fuel new inflationary pressures. In the medium term, wage increases should be aligned with productivity gains. Fiscal financing requirements are currently met by drawings on the oil stabilization fund, which increases bank liquidity. Greater resort to bond market financing would reduce excess liquidity, with limited risks of private sector crowding-out, given the current level of excess liquidity and very low interest rates.

31. Further monetary policy tightening is vital to contain inflation. The decision by the Bank of Algeria (BA), in May 2012, to increase the required reserves rate and to reinforce liquidity absorption reduced excess liquidity and contributed to the subsequent year-on-year decline in inflation (see Appendix 1). These measures were not, however, sufficient to make inflation converge to the BA's target of 4–4.5 percent. Further tightening of monetary policy is recommended. Liquidity management should be supported by raising the discount and liquidity absorption rates, notably on

the three-month window. A simple application of a Taylor rule[9] shows that the discount rate was at least 3 percent less than what it should have been by the end of 2011.

32. The exchange rate is not a powerful tool for containing inflation in Algeria. Although nominal exchange rate could be used to fight inflation, the small exchange rate pass-through, as well as competitiveness concerns, should encourage authorities to focus on making sure that real exchange rate is not moving away from its fundamental value.

33. Longer-term structural measures would help increase real output and maintain price stability. Some structural reforms also need to be implemented to increase real output, which is found to be a key to reducing prices in Algeria. We recommend strengthening infrastructure development, to remove the bottlenecks to factor mobility and to increase productivity. We also encourage the authorities to improve the business climate and to create a sound competitive environment. This should be done by enhancing the efficiency of one-stop shops for new businesses, by modernizing taxation, by ensuring an FDI-friendly environment to facilitate technology transfers and support capital accumulation, and by modernizing the financial sector.

34. Supply-side shocks that fuel inflation need to be addressed. The authorities see both inefficiencies in the distribution chain (notably for fresh food) and dominant positions as disrupting price formation. Some of the distribution issues are being addressed by developing market infrastructure, such as storage capacity and regional markets. We recommend that the competition authority be set up, and FDI restrictions on the retail sector be removed.

G. Conclusions

35. After years of relatively low inflation, prices started to increase rapidly at the beginning of 2012. Food inflation has been a major contributor to the recent spike in inflation in Algeria. This increase in food inflation is mostly driven by fresh foods. Nonfood inflation also started to contribute significantly to overall inflation. The large demand injected through public spending, against the backdrop of excess liquidity, has also provided an enabling environment. The authorities stepped in by raising the reserve requirement on deposits in the banking system from 9 percent to 11 percent and by enlarging their liquidity absorption by DZD 250 billion, which contributed to a decline in the banking sectors free liquidity (excess reserves in BA and deposit facilities) in the second and third quarters of 2012.

36. This paper provides empirical evidence on the short-and long-run determinants of inflation in Algeria. Factors affecting prices in the long run are money supply, non-oil real output, prices of imported goods, NEER, and world oil price. M2 is by far the most important determinant of

[9] The Taylor nominal rate = ***r* + pi + 0.5 (pi - pi*) + 0.5 (y - y*)*** where r* = real interest rate (usually 2%), *pi* = rate of inflation, *p** = target inflation rate (4 percent as an implicit target by the BA) y = logarithm of real output y* = logarithm of potential output calculated using an HP filter.

long-term price changes, followed by non-oil real GDP and the price of imported goods. Exchange rate pass-through is relatively low, and the world oil price effect on domestic prices is muted.

37. The short-run analysis shows that money supply and imported goods prices are the driving factors of inflation in the short run, and that domestic prices tend to adjust to equilibrium rather quickly. The results indicate that it takes less than one quarter to reduce one-half standard deviation from the long-run inflation equilibrium. The impulse reaction functions show that M2 and price of imported goods shocks significantly and persistently increase inflation in Algeria. The variance decomposition of domestic prices indicates that after the monetary policy shock, the price of imported goods shocks are the second main determinant of short-term fluctuation of domestic prices in Algeria.

38. Fighting inflation will require a mix of monetary and fiscal policies accompanied by structural reforms. Containing current public spending and tightening monetary policy by raising the interest rate should help contain inflation pressures. Additionally, authorities should address the sources of supply-side shocks that fuel inflation. TFP growth and capital accumulation should be bolstered to spur real GDP growth, which is found to be a key factor in reducing domestic inflation in Algeria.

References

Al-Bassam, K., 1999, "Domestic and External Sources of Inflation in Saudi Arabia: An Empirical Study", *Journal of King Abdulaziz University: Economics and Administration,* Vol. 13 (1) pp. 3–30.

Alavirad, A., and S. Athawale, 2005, "The Impact of the Budget Deficit on inflation in the Islamic Republic of Iran," *OPEC Review*, Vol. 29 (1), pp. 37–49.

Basher, S.A., and E.M. Elsamadisy 2012, "Country Heterogeneity and Long-run Determinants of Inflation in the Gulf Arab States," *OPEC Energy Review*, 2012, Vol. 36(2), pp. 170–203.

Basher, S.A., 2010, "Has the Non-oil Sector Decoupled from Oil Sector? A case study of Gulf Cooperation Council countries". *Manuscript*.

Bonato L., 2007, "Money and Inflation in the Islamic Republic of Iran," IMF Working paper 07/119, (Washington: International Monetary Fund).

Di Fonzo, T., and Marini, M., 2011, "A Newton's Method for Benchmarking Time Series according to a Growth Rates Preservation Principle," IMF Working Paper 11/179 (Washington: International Monetary Fund).

Dreger, C.K., K. Kholodilin, K. Lommatzsch, J. Slacalek, and P.Wozniak, 2009, "Price Convergence in an Enlarged Internal Market," *Eastern European Economics*, 46, pp. 57–68.

Hahn, E., 2003, "Pass-Through of External Shocks to Euro Area Inflation", *European Central Bank Working Paper* No. 243.

Hasan, M., and H. Alogeel, 2008,"Understanding the Inflationary Process in the GCC Region: The Case of Saudi Arabia and Kuwait", IMF Working Paper 08/193, (Washington: International Monetary Fund).

Iimi, A., 2007, "A note on Inflation," Selected issues and Statistical Appendix, IMF Country Report 07/228, (Washington: International Monetary Fund).

Johansen, S., and K. Juselius, 1990, "Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money," *Oxford Bulletin of Economics and Statistics,* 52, pp. 169–210.

Kandil, M., and H. Morsy, 2009. "Determinants of Inflation in GCC," IMF Working Paper 09/82. (Washington, DC: International Monetary Fund,).

Klein, N., and A. Kyei, 2009, "Understanding Inflation Inertia in Angola," IMF Working Paper 09/98 (Washington: International Monetary Fund).

Koranchelian, T., 2004, "Determinants of Inflation in Algeria," *Selected issues and Statistical Appendix*, IMF Country Report 04/31, (Washington: International Monetary Fund).

Mundell, A.R, 1963, "Capital Mobility and Stabilization policy Under Fixed and Flexible Exchange Rates," *Canadian Journal Economics*, 27, pp. 475–85.

Nassar, K., 2005, "Money Demand and Inflation in Madagascar," IMF Working Paper 05/236 (Washington: International Monetary Fund).

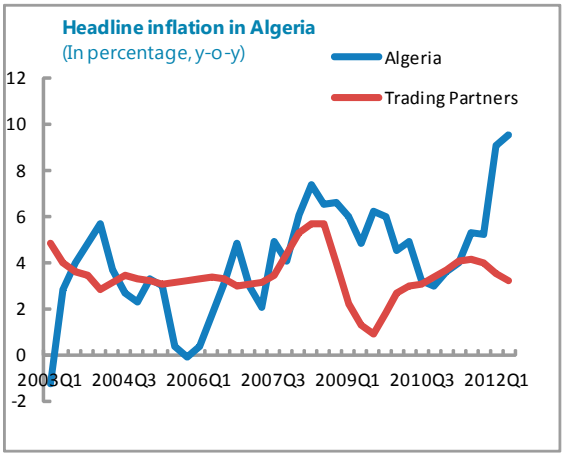
Pesaran, M.H, Y. Shin, and R. J. Smith, 2001, "Bounds Testing Approaches to the Analysis of Level Relationships," *Journal of Applied Econometrics*, 16 (3), pp. 289–326.

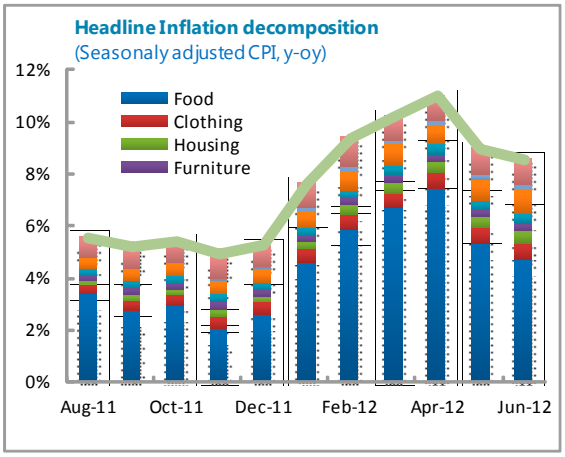
Saha S., Z. Zhang, 2012, "Do Exchange Rates Affect Consumer Prices? A Comparative Analysis for Australia, China and India," *Mathematics and Computers in Simulation*, (forthcoming).

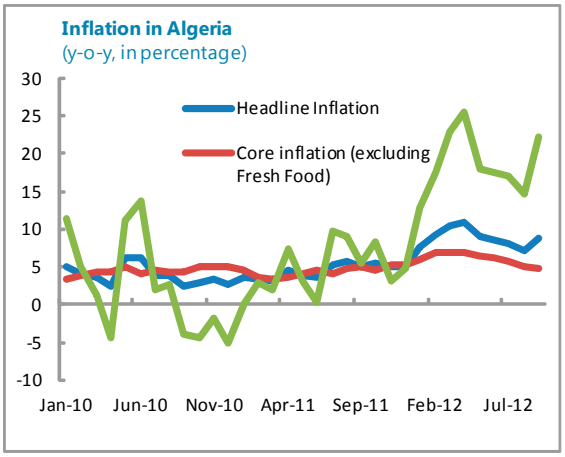
Sahadudheen, I. 2011, "Demand for Money and Exchange Rate: Evidence for Wealth Effect in India," *Undergraduate Economic Review*, 8 (1).

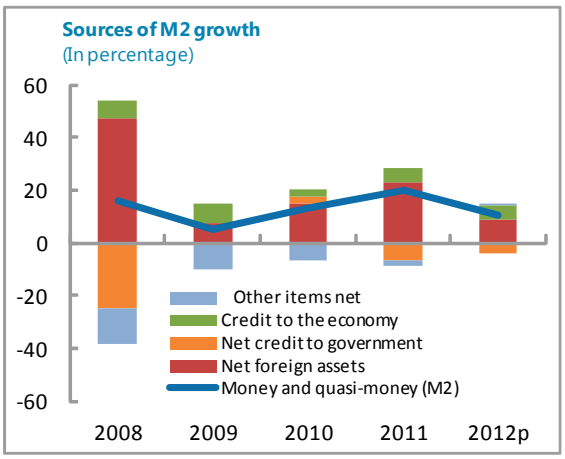
Sultan Z. A., 2011, "Inflation in the Kingdom of Saudi Arabia: A Bound Test Analysis," *European Journal of Social Sciences*, 24 (2).

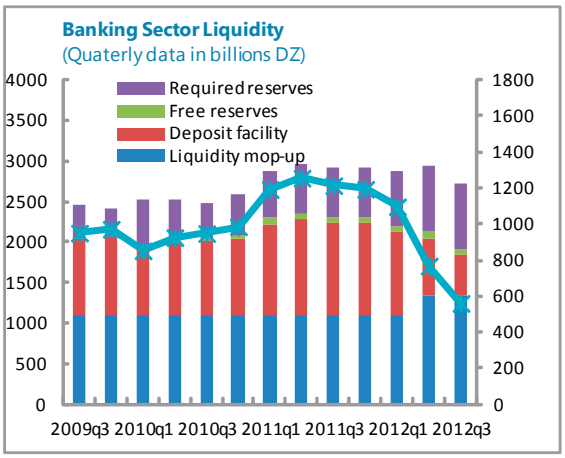
Appendix 1. Inflation and Money last developments (2009–12)

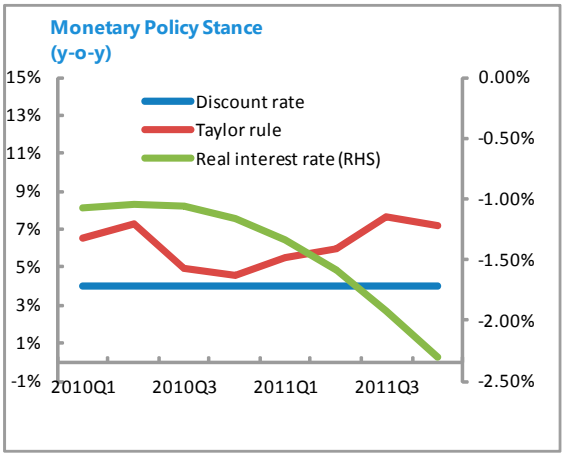






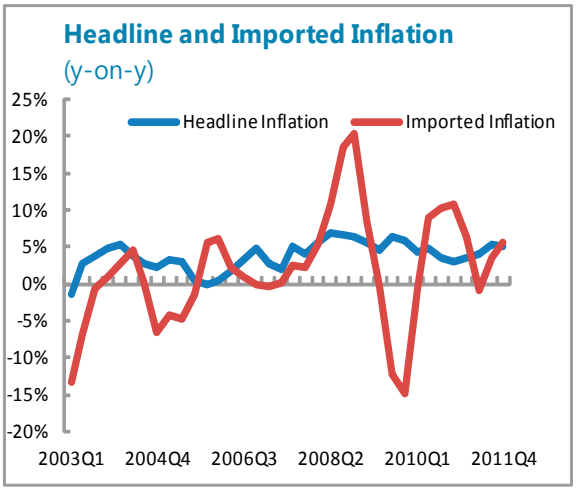


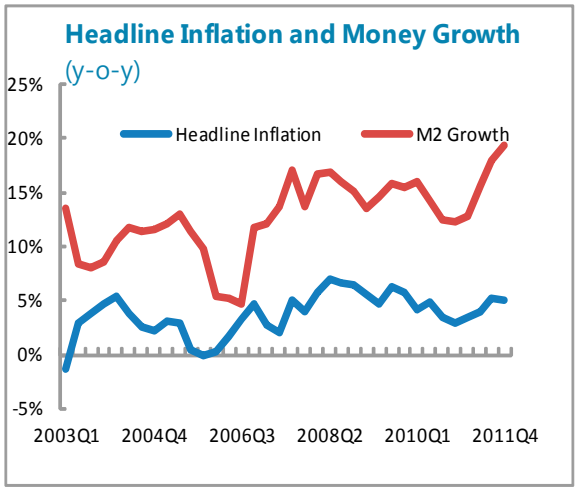


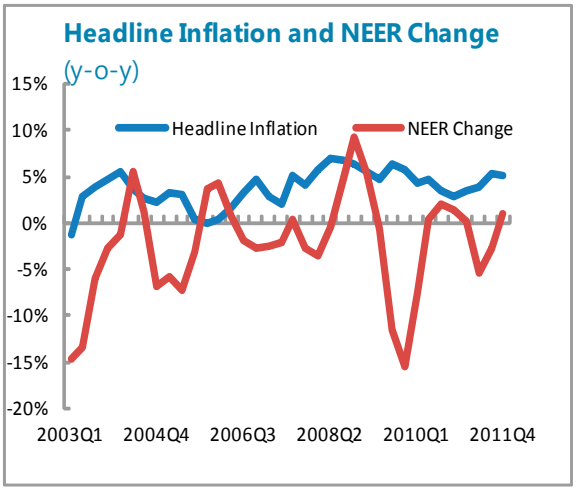


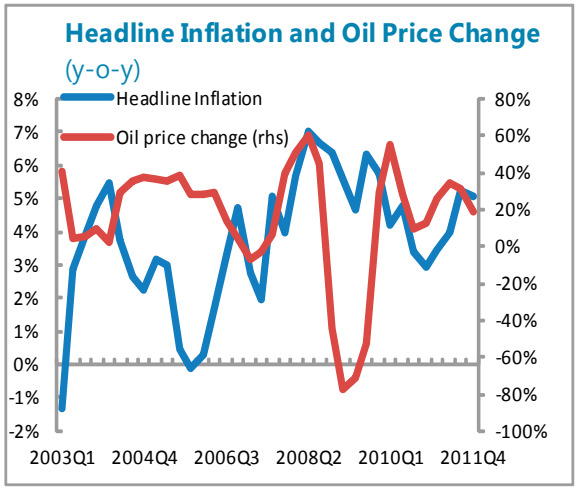
Sources: Algerian authorities; and IMF staff estimates.

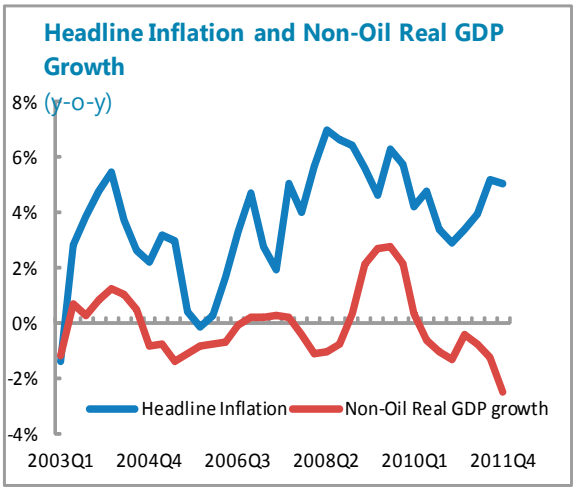
Appendix 2. Algeria: Inflation and its theoretical determinants (2003–11)

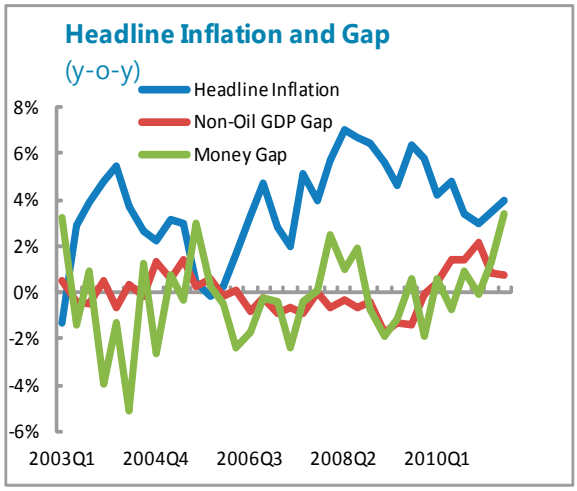












Sources: Algerian authorities; and IMF staff estimates.

Appendix 3. Co-integration Test for Inflation Equation

Sample (adjusted): 2002Q3 2011Q4
Included observations: 38 after adjustments
Trend assumption: Linear deterministic trend
Series: LOGCPILOGINFP LOGM2EXSON LOGNEER LOGNOGDP LOGOIL
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.728278	119.7719	95.75366	0.0004
At most 1 *	0.545068	70.25878	69.81889	0.0461
At most 2	0.398168	40.32972	47.85613	0.2109
At most 3	0.272345	21.03420	29.79707	0.3555
At most 4	0.205808	8.952950	15.49471	0.3697
At most 5	0.005161	0.196621	3.841466	0.6575

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.728278	49.51314	40.07757	0.0033
At most 1	0.545068	29.92906	33.87687	0.1378
At most 2	0.398168	19.29552	27.58434	0.3920
At most 3	0.272345	12.08125	21.13162	0.5396
At most 4	0.205808	8.756329	14.26460	0.3070
At most 5	0.005161	0.196621	3.841466	0.6575

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 4. Granger Causality Tests

Pairwise Granger Causality Tests
Sample: 2002Q1 2014Q4
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGINFP does not Granger Cause LOGCPI	38	0.40650	0.6693
LOGCPI does not Granger Cause LOGINFP		7.30514	0.0024
LOGM2EXSON does not Granger Cause LOGCPI	38	9.96386	0.0004
LOGCPI does not Granger Cause LOGM2EXSON		0.85601	0.4341
LOGNEER does not Granger Cause LOGCPI	38	0.03149	0.9690
LOGCPI does not Granger Cause LOGNEER		5.69815	0.0075
LOGOIL does not Granger Cause LOGCPI	38	0.65227	0.5274
LOGCPI does not Granger Cause LOGOIL		3.60998	0.0382
GAPNOIL does not Granger Cause LOGCPI	38	0.52614	0.5958
LOGCPI does not Granger Cause GAPNOIL		0.55047	0.5819
LOGNOGDP does not Granger Cause LOGCPI	38	4.65143	0.0166
LOGCPI does not Granger Cause LOGNOGDP		0.30187	0.7415
TILLRATE does not Granger Cause LOGCPI	38	0.04963	0.9517
LOGCPI does not Granger Cause TILLRATE		1.38029	0.2656
LOGM2EXSON does not Granger Cause LOGINFP	38	6.41872	0.0044
LOGINFP does not Granger Cause LOGM2EXSON		0.38464	0.6837
LOGNEER does not Granger Cause LOGINFP	38	13.8115	4.E-05
LOGINFP does not Granger Cause LOGNEER		7.30562	0.0024
LOGOIL does not Granger Cause LOGINFP	38	10.6081	0.0003
LOGINFP does not Granger Cause LOGOIL		2.88729	0.0699
GAPNOIL does not Granger Cause LOGINFP	38	0.89225	0.4194
LOGINFP does not Granger Cause GAPNOIL		0.69012	0.5086
LOGNOGDP does not Granger Cause LOGINFP	38	5.90084	0.0064
LOGINFP does not Granger Cause LOGNOGDP		1.85956	0.1717
TILLRATE does not Granger Cause LOGINFP	38	2.98711	0.0642
LOGINFP does not Granger Cause TILLRATE		0.27217	0.7634
LOGNEER does not Granger Cause LOGM2EXSON	38	0.36610	0.6962
LOGM2EXSON does not Granger Cause LOGNEER		5.96281	0.0062
LOGOIL does not Granger Cause LOGM2EXSON	38	0.42354	0.6582
LOGM2EXSON does not Granger Cause LOGOIL		3.14887	0.0560
GAPNOIL does not Granger Cause LOGM2EXSON	38	1.25881	0.2973

LOGM2EXSON does not Granger Cause GAPNOIL		0.67302	0.5170
LOGNOGDP does not Granger Cause LOGM2EXSON	38	1.79949	0.1812
LOGM2EXSON does not Granger Cause LOGNOGDP		0.55949	0.5768
TILLRATE does not Granger Cause LOGM2EXSON	38	3.18868	0.0542
LOGM2EXSON does not Granger Cause TILLRATE		2.21504	0.1251
LOGOIL does not Granger Cause LOGNEER	38	1.33135	0.2779
LOGNEER does not Granger Cause LOGOIL		6.74228	0.0035
GAPNOIL does not Granger Cause LOGNEER	38	1.45535	0.2479
LOGNEER does not Granger Cause GAPNOIL		1.49999	0.2380
LOGNOGDP does not Granger Cause LOGNEER	38	7.02256	0.0029
LOGNEER does not Granger Cause LOGNOGDP		2.38034	0.1082
TILLRATE does not Granger Cause LOGNEER	38	1.28296	0.2907
LOGNEER does not Granger Cause TILLRATE		2.10061	0.1384
GAPNOIL does not Granger Cause LOGOIL	38	1.45837	0.2472
LOGOIL does not Granger Cause GAPNOIL		2.69355	0.0825
LOGNOGDP does not Granger Cause LOGOIL	38	3.04339	0.0612
LOGOIL does not Granger Cause LOGNOGDP		2.02192	0.1485
TILLRATE does not Granger Cause LOGOIL	38	0.77434	0.4692
LOGOIL does not Granger Cause TILLRATE		1.06167	0.3574
LOGNOGDP does not Granger Cause GAPNOIL	38	4.88462	0.0139
GAPNOIL does not Granger Cause LOGNOGDP		7.38538	0.0022
TILLRATE does not Granger Cause GAPNOIL	38	0.51812	0.6004
GAPNOIL does not Granger Cause TILLRATE		1.40477	0.2597
TILLRATE does not Granger Cause LOGNOGDP	38	0.31031	0.7353
LOGNOGDP does not Granger Cause TILLRATE		2.19005	0.1279

Appendix 5. Detailed VECM Results

Vector Error Correction Estimates
Sample (adjusted): 2002Q4 2011Q2
Included observations: 35 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LOGCPI(-1)	1.000000
LOGINFP(-1)	-0.202280 (0.02659) [-7.60869]
LOGM2EXSON(-1)	-0.300406 (0.02711) [-11.0797]
LOGNEER(-1)	0.104190 (0.03766) [2.76669]
LOGNOGDP(-1)	0.200099 (0.04765) [4.19937]
LOGOIL(-1)	-0.038104 (0.00305) [-12.4820]
C	-2.910422

Error Correction:	D(LOGCPI)	D(LOGINFP)	D(LOGM2EXSON)	D(LOGNEER)	D(LOGNOGDP)	D(LOGOIL)
CointEq1	-0.600597 (0.26570) [-2.26047]	-0.134671 (0.65298) [-0.20624]	0.120658 (0.45332) [0.26617]	-0.157822 (0.61720) [-0.25571]	-0.557577 (0.05519) [-10.1033]	11.10953 (2.94092) [3.77757]
D(LOGCPI(-1))	0.307381 (0.23694) [1.29727]	0.147012 (0.58232) [0.25246]	-0.451322 (0.40426) [-1.11640]	-0.132212 (0.55041) [-0.24021]	0.244015 (0.04922) [4.95808]	-3.964666 (2.62268) [-1.51168]
D(LOGCPI(-2))	-0.465021 (0.22793) [-2.04019]	0.544954 (0.56017) [0.97284]	-0.114827 (0.38888) [-0.29527]	0.622797 (0.52947) [1.17627]	0.278681 (0.04734) [5.88641]	-7.488775 (2.52290) [-2.96833]
D(LOGINFP(-1))	0.183097 (0.17949) [1.02008]	0.714737 (0.44112) [1.62026]	0.317760 (0.30624) [1.03762]	0.455310 (0.41695) [1.09200]	0.002011 (0.03728) [0.05395]	1.164808 (1.98675) [0.58629]
D(LOGINFP(-2))	0.107371 (0.16463) [0.65220]	0.271250 (0.40460) [0.67042]	0.112974 (0.28088) [0.40221]	0.246586 (0.38242) [0.64480]	-0.041985 (0.03419) [-1.22780]	1.504535 (1.82223) [0.82565]

D(LOGM2EXSON(-1))	-0.074600	0.292617	-0.004238	0.185769	0.015311	-0.418050
	(0.14712)	(0.36157)	(0.25101)	(0.34176)	(0.03056)	(1.62846)
	[-0.50706]	[0.80929]	[-0.01688]	[0.54357]	[0.50103]	[-0.25672]
D(LOGM2EXSON(-2))	-0.039066	0.005626	-0.005252	-0.121396	-0.022174	1.048813
	(0.12700)	(0.31211)	(0.21668)	(0.29501)	(0.02638)	(1.40571)
	[-0.30761]	[0.01803]	[-0.02424]	[-0.41150]	[-0.84059]	[0.74611]
D(LOGNEER(-1))	-0.266407	-0.656293	-0.331206	-0.285284	-0.035548	-2.094343
	(0.18491)	(0.45445)	(0.31549)	(0.42955)	(0.03841)	(2.04677)
	[-1.44070]	[-1.44414]	[-1.04981]	[-0.66415]	[-0.92553]	[-1.02324]
D(LOGNEER(-2))	-0.053089	-0.355835	-0.116007	-0.472753	0.006096	-1.371820
	(0.17161)	(0.42176)	(0.29279)	(0.39864)	(0.03565)	(1.89952)
	[-0.30936]	[-0.84370]	[-0.39621]	[-1.18591]	[0.17103]	[-0.72219]
D(LOGNOGDP(-1))	0.265581	-0.458845	1.612468	-0.223470	-0.384654	-3.659208
	(0.40766)	(1.00188)	(0.69553)	(0.94697)	(0.08467)	(4.51229)
	[0.65148]	[-0.45799]	[2.31833]	[-0.23598]	[-4.54272]	[-0.81094]
D(LOGNOGDP(-2))	0.576542	-1.156777	0.490386	-1.224330	-0.374725	10.29287
	(0.58357)	(1.43421)	(0.99567)	(1.35561)	(0.12121)	(6.45942)
	[0.98795]	[-0.80656]	[0.49252]	[-0.90316]	[-3.09145]	[1.59347]
D(LOGOIL(-1))	0.022465	0.080284	0.026833	0.014051	-0.013710	0.334711
	(0.01599)	(0.03929)	(0.02727)	(0.03713)	(0.00332)	(0.17694)
	[1.40533]	[2.04351]	[0.98381]	[0.37837]	[-4.12889]	[1.89162]
D(LOGOIL(-2))	-0.013280	-0.017448	-0.011454	-0.004694	-0.012993	-0.336056
	(0.01818)	(0.04467)	(0.03101)	(0.04222)	(0.00378)	(0.20119)
	[-0.73060]	[-0.39059]	[-0.36932]	[-0.11118]	[-3.44131]	[-1.67032]
C	-0.002391	0.001396	-0.000249	0.002364	0.022341	0.004410
	(0.01236)	(0.03038)	(0.02109)	(0.02872)	(0.00257)	(0.13683)
	[-0.19341]	[0.04594]	[-0.01180]	[0.08234]	[8.70096]	[0.03223]
GAPNOIL	0.970867	-0.079209	-0.264858	0.243813	1.151643	-19.37204
	(0.55517)	(1.36440)	(0.94720)	(1.28963)	(0.11531)	(6.14503)
	[1.74877]	[-0.05805]	[-0.27962]	[0.18906]	[9.98704]	[-3.15247]
R-squared	0.673091	0.608208	0.338500	0.496503	0.947999	0.695495
Adj. R-squared	0.444256	0.333954	-0.124550	0.144055	0.911598	0.482341
Sum sq. resids	0.002495	0.015069	0.007262	0.013462	0.000108	0.305658
S.E. equation	0.011169	0.027449	0.019056	0.025944	0.002320	0.123624
F-statistic	2.941371	2.217681	0.731022	1.408726	26.04337	3.262880
Log likelihood	117.4427	85.97084	98.74427	87.94337	172.4493	33.29832
Akaike AIC	-5.853868	-4.055477	-4.785387	-4.168193	-8.997103	-1.045618
Schwarz SC	-5.187290	-3.388899	-4.118809	-3.501615	-8.330525	-0.379040
Mean dependent	0.009909	0.004973	0.031002	-0.005006	0.015157	0.040230
S.D. dependent	0.014982	0.033633	0.017969	0.028043	0.007802	0.171823

Determinant resid covariance (dof adj.)	6.53E-23
Determinant resid covariance	2.27E-24
Log likelihood	654.7264
Akaike information criterion	-31.92722
Schwarz criterion	-27.66113

Appendix 6. VECM Specification Tests

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h

Lags	LM-Stat	Prob
1	50.03952	0.0600
2	49.85624	0.0621
3	22.06977	0.9670
4	41.61014	0.2397
5	45.56301	0.1319
6	31.00957	0.7048
7	49.90134	0.0616
8	45.22539	0.1393
9	38.52237	0.3561
10	29.98414	0.7495
11	29.37658	0.7747
12	33.65044	0.5808

Probs from chi-square with 36 df.

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal

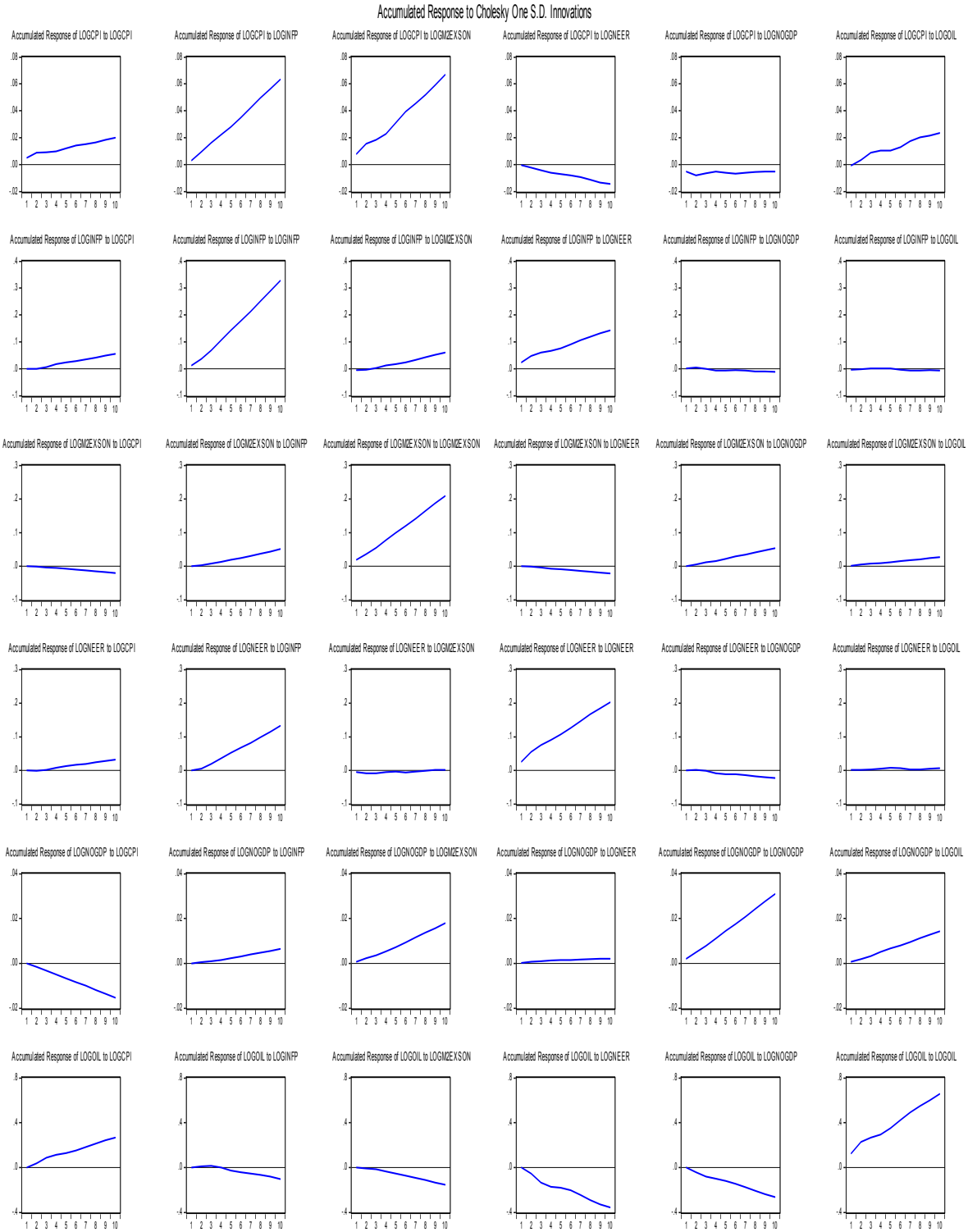
Component	Jarque-Bera	df	Prob.
1	0.048387	2	0.9761
2	1.397356	2	0.4972
3	0.613195	2	0.7359
4	5.665965	2	0.0588
5	3.000254	2	0.2231
6	0.043575	2	0.9784
Joint	10.76873	12	0.5488

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Joint test:

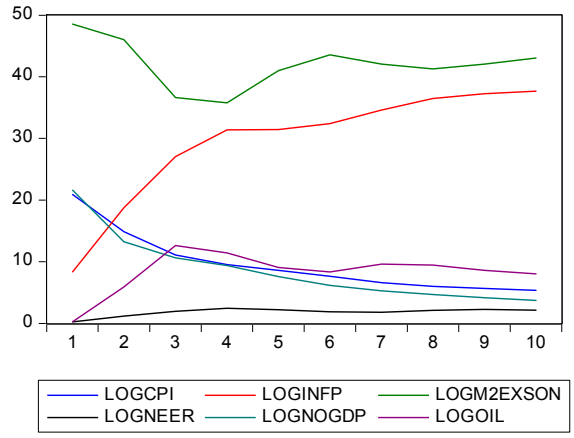
Chi-sq	df	Prob.
597.1023	588	0.3884

Appendix 7. Impulse Responses to One S.D. Innovations

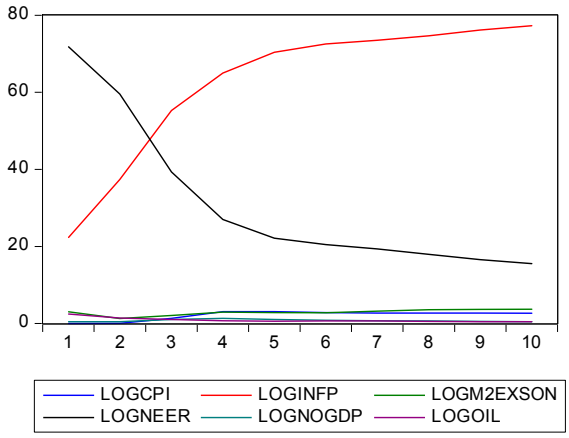


Appendix 8. Variance Decomposition

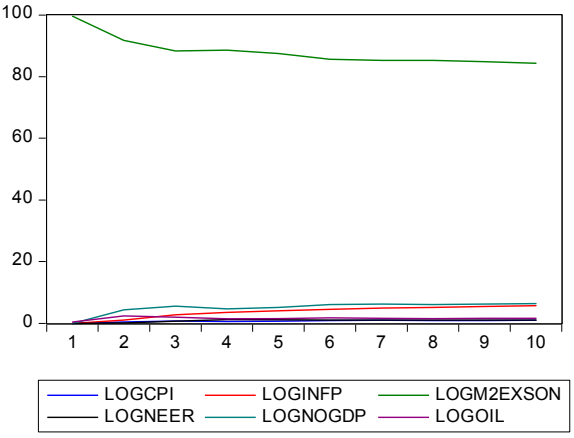
Variance Decomposition of LOGCPI



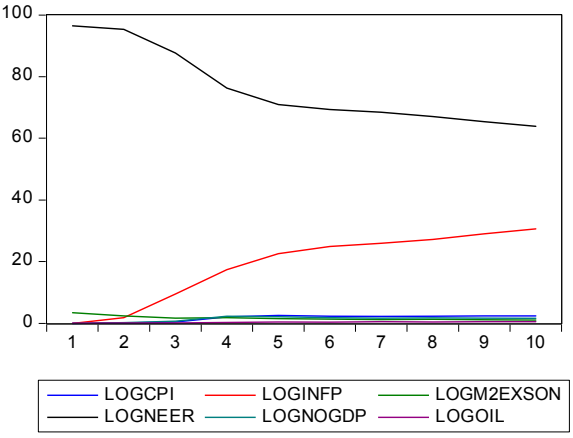
Variance Decomposition of LOGINFP



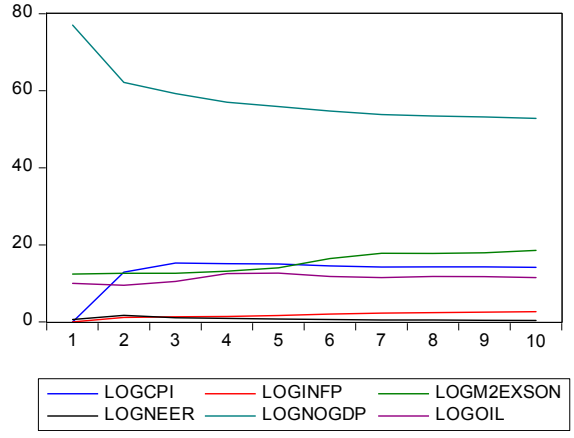
Variance Decomposition of LOGM2EXSON



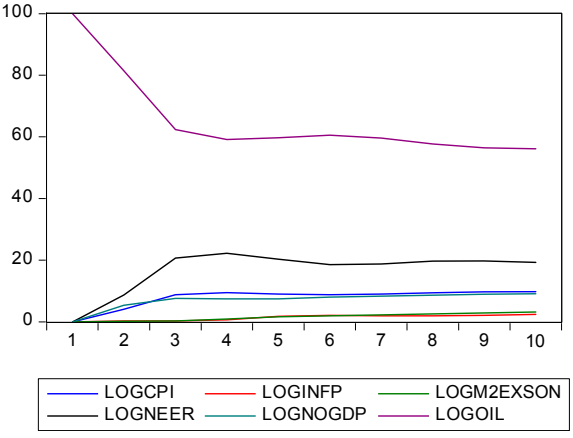
Variance Decomposition of LOGNEER



Variance Decomposition of LOGNOGDP



Variance Decomposition of LOGOIL



Appendix 9. Money Demand Equation

This appendix gives the results of the money demand estimation. The money demand model was created on the basis of quarterly data, running from the first quarter of 2002 to the second quarter of 2011. More specifically, the money demand function to be estimated can be written as:

$$\text{LOGM2EXSON} = f(\text{LOGNOGDP, LOGNEER, T-BILLR, LOGCPI})$$
$$+ \quad +/- \quad - \quad +$$

where LOGM2EXSON is the log of broad money without Sonatrach deposit, LOGNOGDP is the log of real non-oil GDP , LOGNEER is the log of nominal effective rate which is measured as the foreign currency price per local currency, T-BILLR is the 26 weeks treasury's bill yield) and LOGCPI is the log of the consumer price index. Consistent with theory, the expected signs are: positive for non-oil real output and domestic prices, negative for nominal interest rate and a priori indeterminate for nominal effective exchange rate.[10]

The nominal money equation is estimated as follows using an OLS:

$$\text{LOGM2} = \underset{[-8,90]}{-6.13} - \underset{[0.63]}{0.07}\,\text{LOGNEER} + \underset{[11.03]}{1.69}\,\text{LOGNOGDP} - \underset{[-2.26]}{0.01}\,\text{T-BILLR} + \underset{[2.49]}{0.559}\,\text{LOGCPI}$$

All variables are significant and have the expected sign except nominal exchange rate which is negative and non significant. The impact of the nonhydrocarbon real output effect is positively and significantly associated with change in money demand. The income elasticity of the money demand function is significantly above unity. An elasticity higher than one suggests a declining trend in velocity and usually implies an increase in the demand for money supported by wealth (Dreger et al. 2009). In addition, higher domestic prices generate higher money supply in accordance with the quantity theory of money. The T-bill rate is negatively and significantly associated with money demand, meaning that a rise in interest rate decreases the demand for money in Algeria.

Figure 3 shows that the residual (which is by definition excess money) begins to increase starting at 2011 which a prelude for inflation pressures building up.

[10] Mundell (1966) was the first to include in the money demand equation the exchange rate. He considers two effects of exchange rate on money demand: the wealth effect and the substitution effect. The wealth effect suggests that a depreciation of the national currency will increase the value of foreign assets in terms of domestic currency. The substitution effect suggests that exchange rate depreciation may increase the anticipation of further depreciation and thus, lead to a substitution of domestic currency by foreign assets (Sahadudheen, 2011).

Figure 3. Actual, fitted, residuals of money demand