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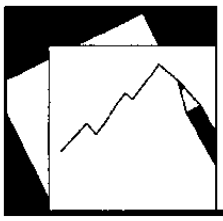

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Comparative Macroeconomic Dynamics in the Arab World: A Panel VAR Approach

Alexei Kireyev

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Comparative Macroeconomic Dynamics in the Arab World: A Panel VAR Approach

Prepared by Alexei Kireyev[1]

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Abstract

The paper presents a comparative analysis of macroeconomic dynamics of 18 Arab countries based on a panel vector autogression estimation. Comparing growth performance, fiscal and current account developments in these countries, the study concludes that (1) in the short run, external and country-specific factors play an almost equal role in explaining macroeconomic fluctuations, but in the long run external factors dominate; (2) on average, program countries are less vulnerable to adverse exogeneous shocks than nonprogram countries; (3) to mitigate the negative impact of an external shock, domestic policy response should be consistent with the size of the shock.

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Author's E-Mail Address: AKireyev@imf.org-

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I. Introduction

> "I prefer to use the term 'theory' in a very narrow sense, to refer to an explicit dynamic system, something that can be put on a computer and *run*."
>
> Robert Lucas (1989).

1. The macroeconomic dynamics of small open economies—the underlying pattern of their fluctuations around the equilibrium—are broadly determined by the outside world. Countries that were economically strong at one point can be in serious economic strain soon thereafter, not apparently because of developments within their borders, but because of a shock coming from abroad—either a collapse of international prices for their main export product, demand shortfalls, interest rate fluctuations, or withdrawal of foreign investment. The series of financial crisis of the late 1990s aggravated by sharp oil price fluctuations seems a perfect example of exogenous macroeconomic dynamics that affected the Arab world.

2. The purpose of this paper is to examine the impact of external and domestic shocks on macroeconomic dynamics of the Arab countries and to compare the impact of these shocks on selected groups of countries—IMF program and nonprogram countries, oil-producing and non-oil producing countries, as well as nonprogram non-oil producing countries. The composition of these groups is not based on formal homogeneity or clustering testing, but rather driven by the requirements of comparative policy analysis. The paper also demonstrates how panel vector autoregression (PVAR), and innovation accounting (variance decomposition and impulse response function) in particular, could be used for interpreting the effect of exogenous shocks on macroeconomic policies and domestic economic performance.

3. The paper is organized as follows. Section II reviews the literature on the stochastic approach to macroeconomic dynamics of small open economies, catalogs the menu of VAR techniques, and describes the data used in the analysis. Section III presents model identification, econometric results of a panel VAR estimation, tests of hypothesis, and interpretations of the results. Finally, Section IV contains the conclusions. Specific technical issues, including those related to PVAR, are addressed in the appendices.

II. Stochastic Approach to Macroeconomic Dynamics

A. Literature at a Glance

4. Current macroeconomic dynamics have a clearly stochastic nature, and no simple monocausal theory can explain growth or fluctuations. With innovations and unforeseen shocks continuously bombarding the actual economy, growth by itself becomes a dynamically interdependent phenomenon that can not be quantified even by an exhaustive set of growth determinants or through a meticulous growth accounting exercise. In other words, the economy has an essentially stochastic nature and, as noted by Blanchard and Fischer (1989), it should be recognized that deviations from the steady state are an essential ingredient of any macroeconomic theory. According to Prescott (1986), stochastic growth models are a "paradigm for macro analysis," as they enable economists to track the dynamic effects of any shock—internal or external—to the modeled system. Solutions for stochastic models for an economy outside the steady state, as forcefully claimed by Campbell (1994), are complicated and can be found only under a set of unrealistically restrictive assumptions. Rather he suggests seeking an approximate analytical solution and using it to explore the effects of various shocks on the dynamic behavior of the economy.

5. Sources of macroeconomic dynamics in small open economies have been recently studied with application to individual countries or groups of countries. Within the individual country framework, Ahmed and Park (1994) examine the impact of external and country-specific shocks on output, inflation, and trade balance of each of seven OECD countries; Prasad and Gable (1998) concentrate on the impact of such shocks on output, exchange rate, and trade-related variables (trade balance, exports, and imports) in twenty-two industrial countries individually; and Clarida and Gali (1994) empirically test Dornbusch (1976) exchange rate overshooting model by administering nominal shocks to the real exchange rate of four developed countries. While the above authors look at the dynamic characteristics of each economy individually, Hoffmaister and Roldós (1997) and Hoffmaister, Roldós, and Wickham (1997) compare business fluctuations of Asian and Latin American countries, and the CFA franc countries with the non-CFA franc countries, respectively, using panel data approach. Rebucci (1998) applies the mean group estimator to the panel data and, using homogeneity analysis, attempts to capture the differences in macroeconomic dynamics among Asian, African, and Latin American counties.

6. The analysis of stochastic behavior of macroeconomic variables in the framework of both individual countries and their groups has been a traditional application for the pragmatic and, to some extent, atheoretical VAR techniques. The VAR models pioneered by Sims (1980) have been used for at least two decades to measure the response of macroeconomic variables to shocks and the degree to which each shock accounts for their variability through time. All these years, the VAR models have been subject to a significant controversy, ranging from admiration and unquestionable acceptance to sharp criticism and rejection. For example, according to Pagan (1989), in studying macroeconomic phenomena, VAR models in levels with no a priori distinction between endogenous and exogenous variables should be viewed as

"a major methodological approach to econometrics," whereas Cooley and LeRoy (1985) conclude that the VAR approach "is based on incorrect analysis" and that "VAR models are not useful for analyzing interventions either in parameters or in variables." Nevertheless, VAR is an easy econometrics technique that "can be put on a computer and *run*" and, as such, remains appealing to most researchers, who keep on refining its particular elements. Rapach (1998), for instance, indicates that VAR should be estimated in a covariance stationary form, which requires that all variables in it be stationary. If it is not the case, Naka and Tufta (1997) note that the VAR is flexible enough, and when two or more variables have common stochastic trends (i.e., they are cointegrated), VAR can be estimated as its vector error correction presentation. Finally, using the mean group estimator suggested by Pesaran and Smith (1995) and combining the traditional VAR and modern computational capabilities, makes it easier to estimate VAR on a panel (panel VAR), which is a relatively new technique in time series econometrics.

B. Estimation Strategy and Data Sources

7. Analysis of the macroeconomic dynamics of Arab countries used in the paper is based on a PVAR (Appendix I). The estimation strategy is the following: (i) identify the model (stationarity, lag selection, causal ordering, and restrictions); (ii) estimate individual structural VARs for each country; (iii) compute individual forecast error variance decompositions; (iv) compute individual impulse response functions; (v) based on the group mean estimator, pool the outcome of the variance decomposition across each of four groups of countries; (vi) based on the same estimator, pool the outcome of the impulse response across each of four groups of countries; (vii) test for homogeneity among the groups; and (viii) provide comparative interpretation of the results.

8. This estimation strategy has been applied to the sample of 18 Arab countries, of which 6 have been classified as program countries, 12 as nonprogram countries, 8 as oil-exporting, 10 as non-oil countries, and 5 as non-oil nonprogram countries (Table 1). The majority of nonprogram countries are oil countries, whereas the majority of program countries are non-oil countries. Thus, the pattern of macroeconomic dynamics of nonprogram and oil countries can be reasonably expected to be close, although not entirely identical. Deficiencies of the data as provided in the IFS and WEO databases, have been corrected to the best possible extent with the help of IMF country desk economists. The data are annual for 1971–97. The time series have not been filtered for well-known exogenous shocks that affected the region during this period, such as the oil price shocks of 1974 and 1988, the Gulf and Iran-Iraq wars of 1980s and early 1990s, respectively.

Table 1. Arab Countries: Classification

	Country Groups				
	Program Countries	Nonprogram Countries	Oil Countries	Non-oil Countries	Non-oil nonprogram Countries
Algeria	x		x		
Bahrain		x	x		
Djibouti 1/		x		x	x
Egypt	x			x	
Jordan	x			x	
Kuwait		x	x		
Lebanon		x		x	x
Libya		x	x		
Mauritania	x			x	
Morocco	x			x	
Oman		x	x		
Qatar		x	x		
Saudi Arabia		x	x		
Sudan		x		x	x
Syria		x		x	x
Tunisia	x			x	
U.A.E.		x	x		
Yemen 1/		x		x	x
Program countries	6				
Nonprogram countries		12			
Oil countries			8		
Non-oil countries				10	
Non-oil nonprogram countries					5
		Program countries		**Nonprogram countries**	
Oil countries		1		7	
Non-oil countries		5		5	

Sources: IFS and WEO databases; Staff reports.

1/ Djibouti and Yemen were excluded from program countries as they embarked on IMF-supported programs only in 1996, and the impact of adjustment policies would be difficult to capture over such a short period.

Note: Program countries are defined as countries that have undertaken at least two IMF-supported programs since early 1980s. Data were not available for Afghanistan and Somalia, which therefore have been excluded from the sample of Arab countries. Countries are classified as oil producing countries and non-oil countries in accordance with the IMF World Economic Outlook (WEO) classifications.

9. The model considers two sets of interdependent variables to recover the pattern of shocks (Appendix II) for program (Appendix III) and other Arab countries. The first set includes variables common across countries that convey external shocks to the domestic economy. Although these external disturbances are common to each country, they are assumed to affect each country in a unique way owing to (i) country-specific characteristics and endowments; (ii) different domestic policy responses; and (iii) dissimilar size of the shocks affecting each country. The second set includes country-specific variables, which, on one hand, are subject to exogenous shocks, but, on the other, convey internal disturbances to the economy to itself. Variables common for all countries included in the model are: P^{oil} - the real oil price defined as an average of U.K. Brent, Dubai, and West Texas Intermediate crude oil spot prices index deflated by the U.S. PPI, P^{nfc} - the real non-fuel commodities price specified as a weighted average price index of 39 primary commodities deflated by the U.S. PPI, Y^* - the index of industrial production in 22 advanced economies, R - the world real interest rate constructed as the six-month LIBOR on deposits in U.S. dollars deflated by a recursive one-period-ahead ARMA (1,1) forecast of expected U.S. CPI inflation rate. Country-specific variables include: Y - real per capita GDP growth, F - fiscal balance as a percent of GDP, and C - current account balance also as a percent of GDP. All variables are included in the PVAR in a logarithmic form in levels.

III. Econometric Results and Interpretation

A. Model Identification

10. In order to construct a congruent statistical system and establish a particular form in which each variable should enter the PVAR, the following characteristics of the time series and the model itself have been analyzed: stationarity properties of external and country-specific variables, cointegration between the external variables, an appropriate number of lags of each variable to be included in the PVAR, causal ordering for the sequencing of all variables, and the corresponding restrictions to be imposed on the PVAR.

11. **Stationarity analysis**. An eye-ball test on external variables using graphs as well as the ACF and PACFs suggested that P^{oil}, P^{nfc}, Y^*, and R may be mean-nonstationary (Figure 1). To test formally the preliminary results, all external variables have been checked for unit root using a fifth order augmented Dickey-Fuller (ADF) test. Applying the general to specific methodology, the most general specification—with a constant, time trend, and five lags as dictated by the sample size—was used as the starting point. As indicated by t-statistics capturing residual autocorrelation, the most appropriate lag-length for all external variable was 1, with the trend variable being insignificant (Table 2). The ADF test has been run for the levels of the variables (all in logs) and for their first differences. For the levels, the null hypothesis of a unit root could not be rejected against the alternative of stationarity for P^{oil}, P^{nfc}, and R, with Y^* exhibiting a stationary I(0) process in the specification that includes

Table 2. ADF (1) Statistics for Testing for a Unit Root in External Variables
(t-D at one lag)

Null order	P^{oil}	P^{nfc}	Y*	R	MacKinnon critical values 5 percent	MacKinnon critical values 1 percent
Constant and trend						
I(0)	-2.276	-3.515	-4.659 **	-1.830	-3.594	-4.355
	(-0.7816)	(2.1003)	(-0.7816)	(2.7971)		
I(1)	-3.852 *	-5.138 **	-3.744 *	-4.914 **	-3.603	4.374
	(0.3733)	(2.5011)	(2.2094)	(2.5733)		
Constant						
I(0)	-2.308	-1.738	-1.096	-2.521	-2.980	-3.708
	(-0.3559)	(1.0748)	(0.5132)	(2.3424)		
I(1)	-3.398 *	-5.252 **	-5.050 **	-4.8875 **	-2.985	-3.720
	(-0.2090)	(2.5571)	(2.2384)	(2.5864)		

Source: Staff estimates.

Notes:

1. First order augmented Dickey-Fuller statistics ADF (1) and *t*-statistics for the significant lag in parentheses.
2. Asterisks * and ** denote rejection of the null of unit root at the 5 percent and 1 percent critical values.

constant and trend.[2] In first differences, all variables become stationary at least at 5 percent significance level under any specification. Thus, all four series are treated below as if they are I(1), although a I(0) process in Y^* cannot be excluded on formal grounds.

12. A visual impression of country-specific variables for four randomly selected countries from each of the four groups defined above suggested that, with marginal exceptions, Y, F, and C in levels exhibited a nonstationary pattern. A formal test for unit roots on country specific variables using one country from each group—Algeria (program country), Syria (nonprogram country), Saudi Arabia (oil country) and Jordan (non-oil country)—has broadly confirmed the initial impression of an I(1) process in Y, F, and C in most countries (Appendix IV). Depending on a country-specific characteristics, the appropriate model specification included a constant and 1 to 3 lags; in most cases, the trend was not significant.

13. **Cointegration analysis** performed on external variables helped to clarify their long-run relationship and to take a decision on a particular form in which these integrated variables should enter the PVAR. Although, given a relatively small number of observations neither 4 nor 1 lag could be accepted owing to a nearly singular matrix of determinants. Thus, beginning with third order VAR in P^{oil}, P^{nfc}, Y^*, and R with a constant term, it was statistically acceptable by sequential reduction to simplify it to both first and second-order VARs with AIC selecting the latter (Appendix V). Further cointegration analysis was based on the Johansen (1998, 1991) procedure with two lags (Table 3). The maximum eigenvalue (0.748) and trace eigenvalue statistics (λ_{max} and λ_{trace}) strongly rejected the null hypothesis of no cointegration in favor of at least one cointegration relationship. Moreover, high eigenvalues (0.594) and significant λ_{max} at 21.6 significant at 5 percent level suggest that at least two cointegrating relationships can be a possibility. Parallel statistics with a degree of freedom adjustment (λ^a_{max} and λ^a_{trace}) gave a similar picture, although the evidence in favor of a second cointegration relationship was not accepted. In common notation, the first cointegrating vector β' normalized on P^{oil} can be written as

$$P^{oil} = K + 4.255P^{nfc} + 3.446Y^* + 1.445R \qquad \textbf{(1)}$$

where K is a constant. Given the evidences of stationarity of Y^* from the regular ADF test, at least one cointegrating relationship should be present in the system. Taking into account the marginal evidences in favor of presence of the second cointegration relationship, the second cointegration vector normalized on P^{nfc}, can be written as

$$P^{nfc} = K - 0.889P^{oil} - 1.1616Y^* + 0.269R \qquad \textbf{(2)}$$

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[2] For $k \geq 0$, the notation I(k) indicated that a variable must be differenced k times to make it stationary.

14. The coefficients of the first column of α measure the feedback effect in the ECM of the lagged disequilibrium in the cointegration relations onto the variables in the VAR. In particular, the estimated feedback coefficient of -0.227 for the P^{oil} equation shows a very high speed of corrections for arising short-run disequilibriums from the long-run trend—about 23 percent of the disequilibrium is corrected each period—pointing at a relatively stability of at least one of the cointegrating vectors. Finally, taking into account a broader set of information including the presence of cointegrating vectors, the stationarity of each variable was checked again by performing a restricted cointegration analysis by sequentially imposing unitary values on each variable in β' assuming r=2. Since in this case the null hypothesis is that of stationarity, stationarity of P^{oil} and R could not be rejected at conventional levels, whereas a unit-root process in P^{nfc} and Y^* still seems a possibility.

15. The issue whether the variables in a VAR need to be stationary has not yet been satisfactorily solved in the literature.[3] On one hand, the ADF test has shown nonstationarity of most variables in levels suggesting they should be differenced at least once to induce stationarity. On the other hand, based on the cointegration analysis of external variables, the existence of at least two cointegrating relationships between them can be reasonably assumed and the stationarity of at least two variables based on a broader information set has been proved empirically. Thus, although nonstationary individually, the subset of external variables can be broadly viewed as stationary jointly. The test for joint stationarity performed on country-specific variables for a number of randomly selected countries, with the exception of a few borderline cases, failed to reject the hypothesis of no cointegration between them. The usual approach in this case is to work in levels since imposing stationarity by differencing may remove important information concerning the comovements from the time series. For these reasons, in order to maintain a uniform specification, all variables were included in the PVAR in their level forms.

16. Correct **lag-length selection** is critical for PVAR since excessively short lags may fail to capture the system's dynamics, lead to omitted variables, bias the remaining coefficients, and likely produce serially correlated errors. Meanwhile too long a lag leads to a rapid loss of degrees of freedom and to overparametarization. Given that the number of variables included in PVAR and the time dimension of the time series, the system cannot be tested for a lag length more than three.[4] Considering all equations in the system jointly in order to preserve the symmetry, the multivariate generalization of the Akaike Information Criterion (AIC) and Schwarz Criterion (SC) have been used as indicators of the correct lag length, since the

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[3] Sims (1980), Doan (1992), Harvey (1990) argue that the goal of VAR is to determine the interrelationship among the variables, and not to exactly estimate the coefficients. Hamilton (1994) discusses estimating VAR in levels versus differencing.

[4] If lag length is p, each of the n equation in the system will contain np+1 coefficients. In our case with 27 data points, the maximum lag-length is three, in which case PVAR will have to estimate 22 coefficients.

Table 3. Cointegration Analysis of External Variables

Eigenvalue	0.748	0.594	0.231	0.031
Null hypothesis	$r = 0$	$r \leq 1$	$r \leq 2$	$r \leq 3$
λ_{max}	33.1**	21.6*	6.3	0.8
λ^{a}_{max}	27.6*	18.0	5.3	0.6
95 percent critical value	27.1	21.0	14.1	3.8
λ_{trace}	61.8**	28.7	7.1	0.8
λ^{a}_{trace}	51.5*	23.9	5.9	0.6
95 percent critical value	47.2	29.7	15.4	3.8
Standardized eigenvectors β'				
Variable	P^{oil}	P^{nfc}	Y*	R
	1.000	-4.255	-3.446	-1.445
	0.889	1.000	1.616	-0.269
	0.609	2.163	1.000	-2.153
	-0.521	1.120	8.184	1.000
Standardized adjustment coefficients α				
A	-0.227	-0.562	0.041	-0.008
B	0.057	-0.207	0.026	-0.001
C	0.014	-0.040	0.004	-0.004
D	-0.029	-0.001	0.146	-0.017
Multivariate statistics for testing stationarity				
	P^{oil}	P^{nfc}	Y*	R
$\chi^2(1)$	1.565	4.325*	4.957*	1.351

Source: Staff estimates.

Notes: VAR includes a single lag of each variable and a constant term. Estimation period is 1974-97. λ_{max}, λ_{trace} and λ^{a}_{max}, λ^{a}_{trace} are Johansen's maximum eigenvalue and trace eigenvalue statistics for testing cointegration without and with a corresponding degree of freedom adjustment r is cointegration rank. Rejection of the null hypothesis is the evidence in favor of at least one cointegrating vector. Standardized eigenvector β' is the matrix of cointegrating vectors, standardized adjustment coefficients α is a matrix of feedback coefficients in the ECM. Multivariate statistics for testing the stationarity of a variable in β' are conditioned on $r \leq 2$. The null hypothesis is that of stationarity.

standard likelihood ratio test is based on asymptotic theory and by itself is not very useful in the small samples. The procedure trades off reduction in generalized residual variance that arises when additional lags are added against some function of the number of additional parameters estimated. The SC places more of a penalty on additional parameters and tends to choose a more parsimonious model. Using the same sample period by taking into account the number of lost observation with each additional lag, the lowest value of the criteria for the same four sample countries attested that a uniform lag-length of two should be selected (Appendix VI). A lag length of one was not sufficient to yield a white noise residual in a number of cases.

17. To identify multivariate PVAR correctly and allow for meaningful interpretation of the impulse response function, the study assigns a number prior **restrictions** on the coefficients of the model through a Choleski decomposition.[5] Causal ordering of the variables used in the paper (P^{oil}, P^{nfc}, Y^*, R, Y, F, and C) stems from both economic theory and orthogonality of structural innovations. External developments are highly significant for domestic macro dynamics in all Arab countries. For this reason, all external variables (P^{oil}, P^{nfc}, Y^*, and R) are assumed to impact country specific variables (Y, F, and C), but none of the country specific variables is assumed to influence the external variables. Among the external variables, the first variable in the ordering (variable P^{oil}) is assumed to have contemporaneous effect on all other variables, but none of other variables is assumed to have contemporaneous effect of the first. Given the importance of oil for most Arab countries, in the structure of the model the oil price was selected as the first variable contemporaneously affecting all other variables. The second variable in the ordering—non-fuel commodity prices—is assumed to have contemporaneous effect on all other external and country specific variables, except the first. The rest of the ordering of external variables has been determined in a similar way.[6] Ordering of the country-specific variables is based on the idea that real GDP developments (Y) are critical for the saving-investment balance in the public sector (F), which in turn affects the external current account (C). As immediately seen from the causal ordering, all Arab countries are considered to be small economies, which implies that shocks to country-specific variables do not affect external variables. For instance, real GDP developments in all countries have contemporary effect on all other country-specific variables (fiscal and current account balances) but do not influence world prices, production or interest rate.

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[5] For any symmetric positive definite matrix Ω, there exists a unique lower triangular matrix A with 1s along the principal diagonal and a unique diagonal matrix D with positive entries along the principal diagonal such that $\Omega=ADA'$. If $D^{1/2}$ is the diagonal matrix whose (j,j) element is the standard deviation of u_{jt}, then the Choleski decomposition of the matrix Ω is $\Omega= AD^{1/2} D^{1/2} A'=PP'$, where $P=AD^{1/2}$. For a seven-variable VAR, $(n^2-n)/2=21$ restrictions are required.

[6] Correlation between all variables in the system has been checked. In a number of cases (between P^{nfc} and Y^*) the correlation coefficient slightly exceeded 0.2, which might suggest considering the effect of reversion the causal ordering for this two variables. Overall, the results of estimations may be sensitive to the causal ordering imposed on PVAR.

18. Such interpretable restrictions help simplify the system but are not sufficient to identify it since the errors are never totally uncorrelated. When the errors are correlated they have a common component that cannot be identified with any specific variable. To deal with this problem, all the effect of any common component has been arbitrary attributed to the variable that comes first in the PVAR system, i.e., the oil price. Or more technically, the errors have been orthogonalized by the Choleski decomposition so that the covariance matrix of the resulting innovations is diagonal. In general, the limitations of the PVAR modeling, that are important to have in mind for the analysis below, are such that the impact of a shock to P^{mfc} is distorted by the shock to P^{oil} coming earlier in the ordering and has to be interpreted as a shock conditional on the latter. In the same vein, the impact of a shock to Y^* is shown by the impulse response functions given the shocks to P^{oil} and P^{mfc}, and so on.

B. Model Estimation and Interpretation of the Results

19. Summary statistics for the sample allow for preliminary analysis of comparative growth, fiscal, and current account developments during the period in consideration (Table 4). Average real per capita growth in the Arab world have been overall low. Only program and oil countries have been growing faster than the average. Nonprogram countries have broadly stagnated in real per capita terms and exhibited a high instability of growth performance. The most prominent feature of growth in the Arab world has been a persistent decline of real per capita GDP in most oil-producing countries. In fact, the economies of six out of nine oil-producing countries have been shrinking in real per capita terms. Fiscal deficits have been on average considerably higher in non-oil countries with oil countries exhibiting high volatility in their fiscal positions, reflecting fluctuations in world oil prices. As expected, fiscal deficit in program countries has been above average indicating the need of fiscal consolidation and adjustment. The current account has been positive in all oil-exporting countries and nonprogram countries with standard deviations well above the sample average, suggesting a high vulnerability of the external position to exogenous shocks. Thus, the main features important to have in mind for the analysis of macro dynamics in Arab countries are a positive real per capita growth rate and above-average fiscal and current account deficits in program countries; an anemic growth pattern, average level of fiscal deficit, and a positive current account in nonprogram countries; a negative real per capita growth rate and positive fiscal and current account balance in oil countries; and, finally, an above-average growth rate and fiscal and current account deficits in non-oil countries.

20. **All Arab countries**. Macroeconomic dynamics of all 18 Arab countries and their groups have been summarized by their pooled variance decomposition (Table 5).[7] Regardless a substantial diversity of Arab countries, their pooled group can be considered a benchmark case in terms of the analysis of the relative importance of various shocks for macroeconomic

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[7] The time horizon used in the decomposition is defined as short-term (1 year), medium-term (2–5 years), and long-term (6–20 years).

Table 4. Arab Countries: Summary Statistics, 1971-1997

	Real per capita growth (percent)			Fiscal balance (percent of GDP)			Current account (percent of GDP)		
	Mean	S.D.	Variation 1/	Mean	S.D.	Variation	Mean	S.D.	Variation
Algeria	-0.3	4.2	28.0	2.6	5.9	3.9	-1.7	4.8	9.8
Bahrain	0.8	6.3	9.8	-0.7	6.7	14.7	0.6	11.4	29.0
Djibouti	-1.7	5.8	4.7	-1.8	6.7	5.6	-15.2	17.3	1.1
Egypt	2.5	3.4	3.2	-14.9	6.6	0.7	-2.7	4.5	6.1
Jordan	1.0	7.6	8.1	-12.9	10.5	0.8	-14.5	28.2	1.1
Kuwait	-1.3	12.2	6.3	15.4	43.4	0.7	22.7	41.7	0.7
Lebanon	1.3	26.3	6.2	-22.6	9.5	0.5	-17.3	22.1	1.0
Libya	-1.5	11.9	5.3	-6.3	7.7	1.6	3.7	8.9	4.4
Mauritania	1.1	5.5	7.2	-9.8	9.4	1.0	-10.1	11.9	1.6
Morocco	1.6	5.1	5.0	-5.8	4.2	1.7	-4.8	4.4	3.4
Oman	2.4	9.7	3.4	-2.1	7.5	4.9	0.6	11.7	26.2
Qatar	-2.3	8.0	3.5	2.1	18.2	4.9	8.0	23.4	2.1
Saudi Arabia	1.2	7.2	6.9	-1.2	15.0	8.4	4.4	25.8	3.8
Sudan	1.3	5.6	6.4	-11.6	4.9	0.9	-13.6	10.7	1.2
Syria	2.9	7.2	2.8	-10.6	7.6	1.0	4.4	25.8	3.8
Tunisia	3.1	4.0	2.6	-4.2	1.5	2.4	-4.8	3.7	3.4
U.A.E	-5.8	8.8	1.4	-3.2	6.5	3.1	16.0	26.2	1.0
Yemen	2.4	5.8	3.3	-18.4	11.2	0.6	4.3	14.8	3.9
All Arab countries	0.5	8.0	16.6	-5.9	10.2	1.7	-1.1	16.5	14.8
Program countries	1.5	5.0	5.3	-7.5	6.3	1.4	-6.4	9.6	2.6
Nonprogram countries	0.0	9.6	234.3	-5.1	12.1	2.0	1.5	20.0	10.7
Oil countries	-0.5	8.0	16.7	-0.9	13.0	11.0	5.7	17.6	2.9
Non-oil countries	1.4	8.1	5.6	-10.9	7.3	0.9	-8.0	15.4	2.1

Sources: IFS and WEO databases, national authorities, staff estimates.

1/ Variation coefficient is the sample standard deviation divided by the absolute value of the mean.

Table 5. Arab Countries: Factors Affecting Macroeconomic Dynamics
(Pooled variance decomposition, percent)

Time horizon (years)	All Arab countries			Program countries			Nonprogam countries			Oil countries			Non-oil countries			Non-oil nonprogram countries		
	External factors	Country-specific factors	S.E. 1/	External factors	Country-specific factors	S.E.	External factors	Country-specific factors	S.E.	External factors	Country-specific factors	S.E.	External factors	Country-specific factors	S.E.	External factors	Country-specific factors	S.E.
							Factors affecting real per capita GDP growth											
1	50.8	49.2	0.11	53.9	46.1	0.11	49.0	51.0	0.11	44.2	55.8	0.11	55.6	44.4	0.11	63.5	36.5	0.11
2	56.1	43.9	0.17	54.9	45.1	0.16	56.8	43.2	0.18	53.6	46.4	0.18	57.9	42.1	0.17	66.5	33.5	0.17
3	59.4	40.6	0.20	57.3	42.7	0.19	60.7	39.3	0.21	57.6	42.4	0.21	60.8	39.2	0.19	69.4	30.6	0.20
4	60.4	39.6	0.22	57.9	42.1	0.21	61.9	38.1	0.23	58.9	41.1	0.23	61.6	38.4	0.21	70.2	29.8	0.22
5	61.0	39.0	0.23	58.4	41.6	0.22	62.6	37.4	0.24	59.4	40.6	0.25	62.2	37.8	0.23	71.2	28.8	0.23
10	61.8	38.2	0.27	59.9	40.1	0.26	62.9	37.1	0.27	60.0	42.8	0.27	63.0	37.0	0.27	70.8	29.2	0.26
20	62.1	37.9	0.28	60.2	39.8	0.28	63.3	36.7	0.29	60.6	42.2	0.29	63.3	36.7	0.28	70.8	29.2	0.28
							Factors affecting fiscal balance											
1	48.1	51.9	0.11	41.4	58.6	0.12	51.9	48.1	0.10	63.2	36.8	0.10	37.0	63.0	0.12	36.5	63.5	0.10
2	55.4	44.6	0.13	53.0	47.0	0.14	56.8	43.2	0.12	67.2	32.8	0.12	46.8	53.2	0.13	43.3	56.7	0.11
3	58.1	41.9	0.14	58.5	41.5	0.15	57.8	42.2	0.13	67.0	33.0	0.13	51.6	48.4	0.15	46.6	53.4	0.12
4	59.9	40.1	0.15	62.3	37.7	0.16	58.5	41.5	0.14	67.0	33.0	0.14	54.7	45.3	0.15	48.5	51.5	0.13
5	60.9	39.1	0.15	63.5	36.5	0.16	59.5	40.5	0.14	67.5	32.5	0.14	56.2	43.8	0.16	50.0	50.0	0.14
10	62.6	37.4	0.16	65.1	34.9	0.17	61.1	38.9	0.15	68.5	31.5	0.15	58.3	41.7	0.17	52.7	47.3	0.15
20	63.2	36.8	0.17	65.6	34.4	0.18	61.9	38.1	0.16	68.9	31.1	0.16	59.1	40.9	0.17	53.7	46.3	0.16
							Factors affecting current account balance											
1	51.9	48.1	0.08	49.3	50.7	0.10	53.5	46.5	0.07	58.8	41.2	0.06	47.0	53.0	0.10	48.6	51.4	0.07
2	62.9	37.1	0.08	54.2	45.8	0.10	68.0	32.0	0.07	70.7	29.3	0.06	57.3	42.7	0.10	63.2	36.8	0.07
3	66.6	33.4	0.09	58.8	41.2	0.11	71.2	28.8	0.07	72.5	27.5	0.07	62.4	37.6	0.10	68.0	32.0	0.08
4	67.4	32.6	0.09	60.3	39.7	0.11	71.6	28.4	0.08	73.1	26.9	0.07	63.2	36.8	0.10	68.7	31.3	0.08
5	67.3	32.7	0.09	60.6	39.4	0.11	71.2	28.8	0.08	72.8	27.2	0.07	63.3	36.7	0.10	68.2	31.8	0.08
10	67.5	32.5	0.09	62.3	37.7	0.11	70.6	29.4	0.08	72.4	27.6	0.07	64.0	36.0	0.11	67.8	32.2	0.08
20	68.1	31.9	0.09	63.7	36.3	0.11	70.7	29.3	0.08	72.6	27.4	0.07	64.8	35.2	0.11	67.8	32.2	0.08

Sources: Staff estimates.

1/ Standard error of VARs for individual countries averaged by groups of countries.

dynamics, their magnitude, persistency through time, transmission into the domestic economy, and propagation mechanism. In the short run, fluctuations in real per capita GDP growth of an average Arab economy are almost equally explained by both external and country-specific factors. Among the external factors, terms of trade related shocks as represented by oil and non-fuel commodity prices are most important for the short-run fluctuations (Appendix VII). Country-specific factors are dominated by supply shocks (shocks to GDP) that explain almost all output growth fluctuations. In the medium and long run, however, the picture is different—external factors clearly acquire predominant weight in determining macroeconomic dynamics. The main factor behind this trend is an increase of the impact of non-fuel commodities prices and foreign demand. The decline of the share of country-specific factors in the medium and long run is attributable primarily to a significant decrease of impact of supply shocks, which are not offset by a more pronounced importance of current account and, especially fiscal, developments.

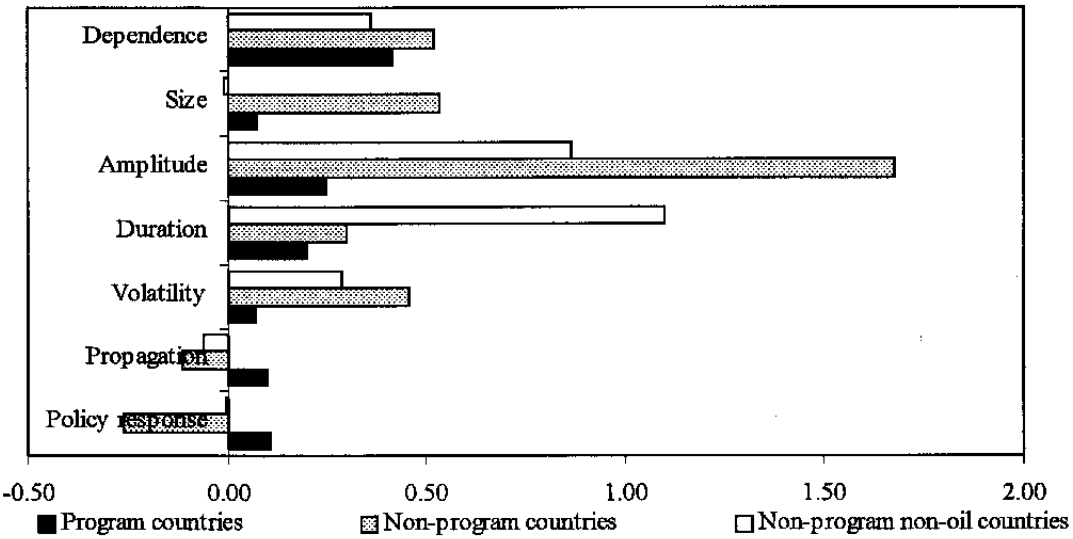
21. The dynamic adjustment to a positive impulse administrated to external variables in an average Arab country reveals the trends broadly consistent with macroeconomic profile of the Arab world. Owing to the high share of oil-producing countries in overall output, an increase in world oil price seems to contribute positively to real GDP growth and improves fiscal and current account balances in the short run, whereas an interest rate shock has a clear negative impact owing, in part, to the fact that many Arab countries have to service a high level of external debt. The impacts of nominal demand shocks on GDP and on fiscal and current account balances are ambiguous, which could be explained by the extreme heterogeneity of the Arab world and call for a more disaggregated approach to analysis of their macroeconomic dynamics. For this reason, the Arab countries have been subdivided into program/nonprogram and oil/non-oil subgroups, and the following analysis concentrated on their comparative macroeconomic dynamics.

22. **Program and nonprogram countries**. The sources of macroeconomic dynamics in program and nonprogram countries have been different, particularly if viewed against various time horizons (Appendix VIII, Tables 1–3). Judging by the variance decomposition of internal variables—the percentage of the variance of real per capita GDP, fiscal balance, and current account balance due to shocks to internal and external variables—in the medium and long run real growth in program countries becomes more resistant to shocks emanating from the world economy. On the other hand, if the long-term impact of domestic debt accumulation is disregarded, the fiscal deficit by its nature is mainly a short-run phenomenon, since it must be addressed and financed in the year it occurs. The program countries exhibit much less dependence of their fiscal balance on external factors than do nonprogram countries (Box 1). By the same token, the current account is both a short-and medium-term phenomenon, because its deficit should be covered immediately, and medium-term external viability is critical for the long-term sustainability of growth. The current account of program countries in the short and, particularly, in the medium run, has been much more resistant to external volatility compared with nonprogram countries.

Text BOX

Comparative Dynamics of Arab Countries

(Impact of an oil price shock on fiscal balance)



Source: IMF staff estimates

The short-term *dependence* of fiscal balances in nonprogram countries on oil price shocks external factors (indicated by the share of total variance decomposition due to external factors) is considerably higher (52 percent) than in program countries (41 percent). The absolute dimension of the shock measured by the *size* of one standard deviation of the post-shock trend from the baseline in the first year is larger for nonprogram countries (0.54 as compared to only 0.07 in program countries). The *amplitude* of post-shock fluctuations represented by absolute value of the difference between the maximum and minimum values of the post-shock trend is incomparably higher in nonprogram countries (1.68 versus only 0.25). *Duration* of the shock (time until the trend first returns to the baseline level normalized by 10) is about 2.3 years in program and 3.4 years in nonprogram countries. Post-shock *volatility* measured by standard deviation of the post shock trend from the mean in years from 2 to 20 is also higher in nonprogram countries. *Propagation* of the shock defined as an average size of the shock in years 2 to 20 aims at capturing the impact of a disturbance moving the system out of the equilibrium. In the case of nonprogram countries this impact is clearly negative, but positive for program countries. Finally, *policy response*, as indicated by the average size of the trend after the shock first makes negative effect, suggests higher policy efforts to restore the fiscal equilibrium by governments in program countries, than in nonprogram countries.

23. Program countries seem to be better insulated from exogenous shocks and external volatility than nonprogram countries owing to the more significant role of fiscal policies, especially in the medium and long run, which are used as one of the primary tools to mitigate the impact of external shocks on domestic economy (Appendix IX, Tables 1, 2). Even if the impact of structural reforms is not taken into consideration, in program countries fiscal policies have obviously had a well-pronounced effect on the fiscal balance in the short run, but also on real GDP growth and current account, implying that fixed and time-varying characteristics of the two groups of countries clearly matter for the propagation of external shocks into domestic economy. Interestingly enough, the role of fiscal policy in output growth has been consistently higher in program countries. The low and almost insignificant impact of current account developments on both real GDP growth and fiscal balance also attest to better insulation of program countries from exogenous volatility.

24. The pattern of dynamic adjustment also differs between the two groups of countries with program countries exhibiting much less volatility of domestic variables and less persistence of exogenous shocks (Figure 2). A hypothetical one-unit shock administered to the set of external and country specific variables of the model has the expected sign. Impulse responses of real GDP in program countries overall is not significant, although since most of the countries are oil importing, it inevitably translates, with a 2–3 years lag, into a moderate decline in growth rate of output, which broadly reverts to the steady state after 4 years. In contrast, in the case of nonprogram countries, an oil price shock leads to an immediate decline of real per capita GDP growth by about 1.7 percentage points in the first year and it takes more than six years to revert to the steady state. An extreme volatility of fiscal balances after an oil price shock in the nonprogram countries and almost negligible response in the program countries clearly reflects the fact that the majority of program countries are non-oil countries, whereas the majority of nonprogram countries are oil countries. Although, it can also confirm that the size and persistence of the shocks depend on the government's policy response and their efforts to prevent direct transmission of external shocks into domestic economies. The lagged decrease of the fiscal balances in the nonprogram countries is sharp and persistent, as the fiscal situation does not revert to the baseline trend even in the medium term.

25. The higher vulnerability of nonprogram countries seems also obvious from the current account prospective. It is worth noting that the absolute size and persistency of a unitary shock from oil prices to their current account is larger than that of the fiscal shock with a short-term negative impact of about 2.5 percent of GDP. After the shock, their current account remains below the baseline level for at least six years, whereas in program countries the shock has a positive short-term impact and the current account reverts to its baseline level after three years. Because most nonprogram countries are oil-producing countries, the impulse responses of their current accounts to an oil price shock are inevitably close.

26. Interpretation of other shocks is somewhat fuzzy and at times hard to reconcile with the standard theory owing to the limitations of the VAR model itself and the causal ordering imposed a priori on the variables. Nevertheless, broadly speaking, the nominal price shock, which is a negative supply shock for non-fuel importing countries, produces initially a negative

impact on GDP growth in program countries replaced by positive growth in the medium term. The interpretation of the impact on nonprogram countries is ambiguous. Such a shock also affects fiscal and current account balances in both groups of countries and, as would be expected from the previous discussion, has a much more pronounced effect on nonprogram countries. A similar pattern is revealed by the demand and interest rate shocks, with volatility and persistence of response of country-specific variables in nonprogram countries being higher than that in program countries.

27. **Oil and non-oil countries**. The sources of macroeconomic dynamics in oil and non-oil countries have been also different, in particular, if viewed against various time horizons (Appendix IX, Tables 3, 4). The time frame is of interest in this case as the response to exogenous shocks of these two groups of countries should be diametrically opposite, in particular in the short run. An increase in oil prices is a positive shock for oil exporting countries but a negative supply shock for non-oil countries. Similarly, an increase in the interest rate is a positive shock for oil exporters deriving a significant portion of their fiscal revenue and current account receipts from investment income abroad, and a negative shock for non-oil countries, many of which bear the burden of foreign debt. As indicated by the variance decompositions of the country-specific variables in the short run (Table 5), external factors have a larger effect on non-oil than on oil countries, whereas in the medium and long run external factors clearly dominate in both groups of countries with no particular difference in the impact between them. On the other hand, reflecting the high share of oil revenue in the budget structure and proceeds from international oil sales in the current accounts of oil countries is much higher than in non-oil countries accross all time horizons. This feature is most noticeable in the short run owing to the macoreconomic nature of fiscal and current account balances as of predominantly short- and medium-term phenomena.

28. A positive unitary shock to oil prices produces at first glance an impulse response inconsistent with the predominant way of thought—in oil-producing countries it leads to a decrease in real GDP growth in per capita terms with returns to the steady state only after five years (Figures 2(a-c)). If the limitations of the PVAR approach (discussed in Appendix I) are disregarded, one possible interpretation of this result suggests lack of incentive to enhance productivity in the countries benefiting from the terms of trade effect owing to windfall gains from higher than expected oil prices. In the non-oil countries, because of the negative supply shock, output declined below the implied steady state level. According to expectations, an oil price increase leads to a short-term improvement in fiscal and current account positions of oil countries, which revert to the baseline level after 2–3 years. The impact on fiscal and current account balances of non-oil countries seems neither significant nor persistent.

29. The pattern of dynamic adjustment of oil and non-oil countries to other shocks has an obvious stochastic nature with oil countries exhibiting higher volatility and vulnerability to adverse external development. In particular, it is seen in the response of country-specific variables to nominal shocks and the response of fiscal and current account to demand and interest rate shocks. Overall, such an easy transmission of external shocks into oil economies,

can be explained by higher overall openness of oil economies and isolation of non-oil countries, by deficiencies in domestic macroeconomic policies in oil countries, which have not been able to mitigate the impact of exogenous forces, or by both reasons. The PVAR analytical framework does not allow for a clear discrimination between these reasons for fluctuations in country-specific variables, although it attests to the conclusion that both of them have an impact on macroeconomic dynamics in Arab countries.

30. **Program and nonprogram non-oil countries**. The differences in macroeconomic dynamics between program and nonprogram countries discussed above can stem from the dissimilarities of their basic economic structure. Indeed, as Table 1 clearly indicates, most program countries are non-oil countries, whereas the majority of nonprogram countries are oil countries. Similarly, the time profile of impulse responses to hypothetical exogenous shocks, and to an oil price shock in particular, represented in Figures 2(a-c) demonstrates a close, although not identical, pattern for nonprogram and oil countries. As expected, the closest similarity between the two groups can be observed in responses of the fiscal balance and current account to an oil price shock, whereas the time profile of adjustment of real GDP per capita growth has been remarkably different. To better distill the impact of sound policies on macroeconomic performance and eliminate the inevitable distortions introduced by the presence of oil countries in the nonprogram countries group, macroeconomic dynamics of program countries have been compared to the dynamics of non-oil nonprogram countries. The hypothesis that the program countries can better manage exogenous shocks compared to nonprogram non-oil countries has been broadly confirmed.

31. In terms of the factors affecting macroeconomic dynamics, real GDP growth in program countries, against any time horizon, seems to be much better isolated from adverse exogenous developments than in non-oil nonprogram countries (Table 5). This is due to the fact that all terms of trade related shocks have less propagation power in the domestic economies in program countries. Although the fiscal balance is subject to a more pronounced impact by external factors in program countries in both the short and long run, the current account of non-oil non program countries is clearly more vulnerable to exogenous developments within any time framework. Higher exposure to external volatility of the current account in parallel to a lower exposure of the fiscal balance in non-oil nonprogram countries compared to program countries can be explained by the overwhelming importance of the fiscal policies for the former group, in particular in the medium-run. As follows from the variance decomposition of the country-specific factors (Appendix IX, Tables 1 and 5), among the factors affecting macroeconomic dynamics, the relative share of the fiscal policy in non-oil nonprogram countries outweighs the corresponding indicator in both program and nonprogram countries by at least 10–15 percentage points.

32. A positive unitary shock to oil and non-fuel commodities prices reveals a distinct dynamic adjustment pattern for the two groups (Figure 3). The absolute size of the shock is dramatically larger for nonprogram non-oil countries for all macroeconomic indicators regardless the type of the shock, clearly suggesting their excessive vulnerability to adverse external developments (Box 1). The amplitude of post-shock fluctuations is also higher in non-oil nonprogram countries although somewhat lower than in all nonprogram countries, obviously capturing the oil-related

fluctuations in the latter. Duration of the shock is about 10 years in non-oil nonprogram in the case of the fiscal balance, or significantly higher than in program countries. Post-shock volatility in non-oil nonprogram countries is, on average, more pronounced than in program countries, although lower than in nonprogram countries in general. Propagation of the shock, which captures the impact of a disturbance moving the system out of the equilibrium, is negative for nonprogram non-oil countries, but positive for program countries. Finally, policy response defined as the average size of the trend after the shock first makes negative effect, suggests higher policy efforts to restore the fiscal equilibrium by governments in program countries, and is negligible in non-oil nonprogram countries. In sum, the pattern of macroeconomic dynamics of non-oil nonprogram countries is broadly consistent with that of all nonprogram countries, although their implied macroeconomic volatility is lower, which is a clear evidence of excessive external vulnerability of other oil-based economies in the nonprogram countries group.

C. Diagnostic and Hypothesis Testing

33. The distribution of Arab countries in between groups has been based on previously known information about their participation on IMF-supported programs and respective oil endowments. To reconfirm the hypothesis of the validity of such a grouping, a test for homogeneity of program versus nonprogram and oil versus non-oil has been performed on stacked data for both groups (Table 6). The test based on general linear restrictions rejected the null hypothesis that the slope coefficients in the panel VAR model for the country-specific variables in different groups of countries were the same. Rejection was stronger for the groups of oil versus non-oil countries suggesting that, in fact, these two groups are different and have unique characteristics. The null of homogeneity between groups was also rejected for program and nonprogram countries although the probability was lower, reflecting, probably, the fact that some oil countries have been included in both groups. Conditional upon validity of the model itself, these results suggest that the grouping used in this study seems cogent.

Table 6. Test for Group Homogeneity
(Wald linear restrictions)

		Probability
Oil versus non-oil countries		
F-Statistic	8.36387	0.0003
Chi-square	25.09160	0.0002
Program versus nonprogram countries		
F-Statistic	2.46356	0.02615
Chi-square	14.78135	0.02203
Source: IMF Staff estimates.		

34. The causal ordering of variables used in this study is based on a small open economy assumption that country-specific variables do not affect external variables. The Granger pair wise two-way causality test was performed on stacked data for the whole sample in order to test for the validity of the assumed causal ordering and to test the hypothesis that the external variables Granger cause specific variables in a sense that P^{oil}, P^{nfc}, Y^*, and R help in predicting Y, F, and C have some explanatory power for them, and, thus, should really precede them in the ordering (Appendix X). The set of external variables demonstrated a strong two-way causality suggesting extreme interdependence of shocks in an open economy environment and possibility for an alternative causal ordering of these variables in PVAR. Country-specific variables, with the exception of the obvious link between fiscal and current account balances, did not uncover any specific ordering pattern. Even at the 10 percent confidence level, the null of no direct causality has been rejected only for the influence of non-fuel commodity prices on fiscal and current account, and the impact of the interest rate shock on fiscal and current account balance. Interaction between demand shocks and current account has been characterized by a two-way causality. The explanatory power of oil shocks for domestic variables has been surprisingly low, reflecting, in part, its dynamic two-way interaction with the country-specific variables. In brief, the Granger causality test provided only a partial confirmation of the validity of the causal ordering, suggesting additional caution in interpretation of the results.

IV. Conclusions

35. The conclusions of this study should be treated only as suggestive, because it draws its inferences from a PVAR model that is relatively new for macroeconomic analysis and encompasses a number of theoretical issues that have not been satisfactorily solved in the literature. Nevertheless, such a new approach, after adequate refinement, could become a highly powerful analytical tool and a useful addition to the existing menu of instruments traditionally used in comparative macroeconomic analysis. PVAR captures both the stochastic patterns and co-movements of macrovariables and allows the study of macroeconomic dynamics in terms of deviation from equilibrium, which seems more appropriate in the contemporary convoluted world then the search for the steady state equilibrium path. The stochastic approach to macroeconomic dynamics attests also to a more general conclusion that in every crisis, when the external situation deteriorated and negatively affected the domestic economy, there have been good domestic economy reasons for such an easy transmission of adverse external shocks: weak macroeconomic fundamentals, unwarranted openness, or inadequate policy response.

36. The pattern of macroeconomic dynamics—the underlying cause of variations around the equilibrium—has been remarkably distinct in different groups of Arab countries. In Arab countries jointly, external and country-specific factors play almost equal roles in explaining macroeconomic fluctuations in the short run, whereas external factors clearly dominate over domestic in the medium and long run. Nonprogram countries demonstrate higher medium-

and long-run vulnerability to external disturbances than program countries, and oil countries are more dependent on external factors than non-oil countries, in particular in the short run. When the presence of oil-producing countries among the nonprogram countries is taken into account by separating non-oil nonprogram countries, the latter exhibits even higher external vulnerability of real GDP growth and current account compared with all nonprogram countries and program countries. Although these external disturbances have been common for all groups of countries, the differential impact of external shocks on different countries and their groups have been related to country-specific characteristics, adequacy of policy responses to the shocks, the initial size of the shocks themselves, and their propagation pattern.

37. On average, program countries are less vulnerable to adverse exogenous shocks than nonprogram countries. All relevant indicators—lower dependence on external factors, smaller absolute dimension of the shocks, narrower amplitude of post-shock fluctuations, shorter duration of the shock, more moderate post-shock volatility, and relatively modest propagation of the shock through time—reflect both economic structure of nonprogram countries and, probably, efficient efforts undertaken by governments in program countries in order to restore the equilibrium. Correction for the presence of oil countries in the nonprogram countries group does not distort this conclusion, although the fluctuations of most dynamic macroeconomic indicators become more moderate, suggesting additional vigilance in interpreting the PVAR when applied to a panel of heterogeneous countries. Sound macroeconomic policies affect macroeconomic dynamics of program countries through their capacity to appropriately filter the transmission of external shocks into the domestic economy. To adequately mitigate the negative impact of external shocks, domestic policy responses should be consistent with the size and the time profile of such shocks.

38. The evidence provided in this paper is broadly consistent with that obtained recently by other authors, in particular Rebucci (1998), Hoffmaister and Roldós (1997), and Prasad and Gable (1998). In particular the evidence confirms the importance of sound macroeconomic policies for mitigation of adverse exogenous shocks and different levels of external vulnerability depending on country-specific characteristics. In counterbalance to Hoffmaister and Roldos' (1997) findings that domestic shocks are the main source of macroeconomic fluctuations, for the Arab countries external shocks seem to be at least as important in the short run as domestic shocks, and terms of trade shocks are important not only for the fiscal and current account but also for real output dynamics.

39. An interplay between time-varying exogenous and endogenous factors calls for a further development of the stochastic approach to macroeconomic dynamics based on PVAR models. The following extensions and refinements could be particularly fruitful: (i) bringing more theory into the analysis of the process underlying the macroeconomic dynamics, (ii) testing for homogeneity inside the groups instead of imposing grouping based on a priori assumptions of homogeneity; (iii) controlling for overlapping effects, which inevitably distort the picture (for example, oil countries with very specific characteristics are included in both

program and nonprogram countries groups); (iv) further disaggregating the exogenous shocks, which would allow modeling a clean effect of a particular shock on all other variables without the distortions introduced by lining up the variables through causal ordering; (v) analyzing the indirect effects of the propagation of exogenous shocks on the domestic economy in addition to the direct effects specified and discussed above; (vi) explicitly selecting through testing and identification procedures the set of exogenous shocks most relevant to macroeconomic dynamics in a particular group of countries given their specific characteristics; (vii) modeling the effects of permanent and transitory shocks separately.

40. Ultimately, there is much work still to be done in developing analytical tools which will make it possible to identify separately the impact of good policies implemented by the Fund according to the IMF's advice from other macroeconomic policies conducted by a program country. The analytical approach used in this paper, as well as alternative models based on PVAR techniques, can be further developed to efficiently study issues related to policy development and review of economic performance of the countries benefiting from IMF financial resources, technical assistance, and policy advice.

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Panel Vector Autoregression (PVAR)

41. Following Hamilton (1994), a *p*th-order standard VAR can be written using lag operators as:

$$[I_n - \Phi_1 L - \Phi_2 L^2 - \ldots - \Phi_p L^p] y_t = c + \_t \quad (3)$$

where y_t is an (n x 1) vector of $I(0)$ variables, c is an (n x 1) vector of constants and $\Phi_j(L)$ denotes an (n x n) matrix polynomial in the lag operator L^p for l=1, 2,..., p, and ε_t is a vector generalization of white noise with $E(\varepsilon_t)=0$ and $E(\varepsilon_t \varepsilon'_\tau)=\Omega$ for $t=\tau$ and 0 otherwise, and where Ω is an (n x n) symmetric positive definite matrix. The VAR is covariance stationary if all values of z satisfying:

$$|I_n - \Phi_1 z - \Phi_2 z^2 - \ldots - \Phi_p z^p| = 0 \quad (4)$$

lie outside the unit circle. By checking for stationarity of individual time series and transforming them accordingly, the VAR process can be transformed into a covariance-stationary and thus the consequences of any given ε_t must eventually die out. The disturbance term ε_t is not correlated in (1) with $y_{t-a}..., y_{t-p}$ by the definition of Φ_j. Thus, the parameters of VAR can be consistently estimated with n OLS regressions. The assumption that the vector y_t follows VAR implies that p lags are enough to recover all dynamic correlations within y_t.

42. The estimated coefficients of a standard VAR were used to retrieve the information on how the dependent variable responds to a one standard deviation shock attached to the error term in one or more equations in the system through the impulse response function. If the error term increases by one standard deviation, this shock will change the function in the current as well as the future periods. Noting that $\Psi(L)= [\Phi(L)]^{-1}$, a VAR in a vector MA(∞) form can be written as:

$$y_t = \mu + \_t + \Psi_1 \_{t-1} + \Psi_2 \_{t-2} + \ldots = \mu + \Psi(L) \_t \quad (5)$$

where, the matrix Ψ_s has the interpretation

$$\Psi_s = \frac{\delta y_{i,t+s}}{\delta \_jt} \quad (6)$$

and identifies the consequences of a one unit increase in the *j*th variables innovations at time t for the value of the *i*th variable at time $t+s$, holding all other innovations at all dates constant.

Plots of the row I, column j element of Ψ_s of the impulse response functions presented in this paper describe percent deviation of country specific variables $y_{i,t+s}$ from the baseline in response to a one-time impulse in y_{jt} with all variables dated t or earlier held constant under the restriction imposed accordingly.

43. In order to assess relative importance of random innovations s periods ahead, forecast error variance decomposition was constructed and analyzed. Since the MA(∞) presentation of VAR identifies the error in its forecast s periods ahead, the mean squared error (MSE) of such forecast can be written as the sum of n terms, one arising from each of the disturbances u_{jt} as follows

$$MSE(\hat{y}_{t+s|t}) = \sum_{j=1}^{n} [Var(u_{jt})[a_j a_j' + \Psi_1 \Psi_1 a_j a_j' + \Psi_2 \Psi_2 a_j a_j' + \ldots + \Psi_{s-1} \Psi_{s-1} a_j a_j']] \qquad (7)$$

Using this expression, it is possible to decompose the s-step ahead forecast MSE into the contribution of each of the jth orthogonalized innovations or shocks. Such decomposition shows relative importance of each shock as well as the proportion of the movements in a sequence owing to country-specific shocks versus shocks to the external variables. It is equally important to note that in order to identify structural VAR, impulse response functions, and variance decomposition, the Ψ_s matrix has to be appropriately restricted at the identification stage.

44. With the help of **group mean estimator,** the results of individual VARs (both impulse response and variance decomposition) were pooled across four groups of countries to produce a PVAR. As was shown by Pesaran and Smith (1995), the PVAR, traditionally used in panel data procedures of pooling, aggregating, and averaging group estimates, if applied to a dynamic case when coefficients differ across groups, can give inconsistent and potentially misleading estimates of coefficients. The group mean estimator suggests that individual equations should be estimated separately and the averages of estimated parameters and their standard errors calculated explicitly. Thus, the mean group coefficients are compiled as

$$\hat{a} = \sum_{i=1}^{N} \frac{a_{ij}}{N} \qquad (8)$$

where standard errors are given by

$$se=\sqrt{\frac{1}{N}\sum S_i^2} \quad (9)$$

Since the group mean estimator is a simple arithmetic average of time series estimates, the PVAR is given by the average of the function rather than the function of the average. This approach allows performing a VAR on a panel without losing consistency and, moreover, further testing for homogeneity of the groups, which is critical for the IMF policy assessment

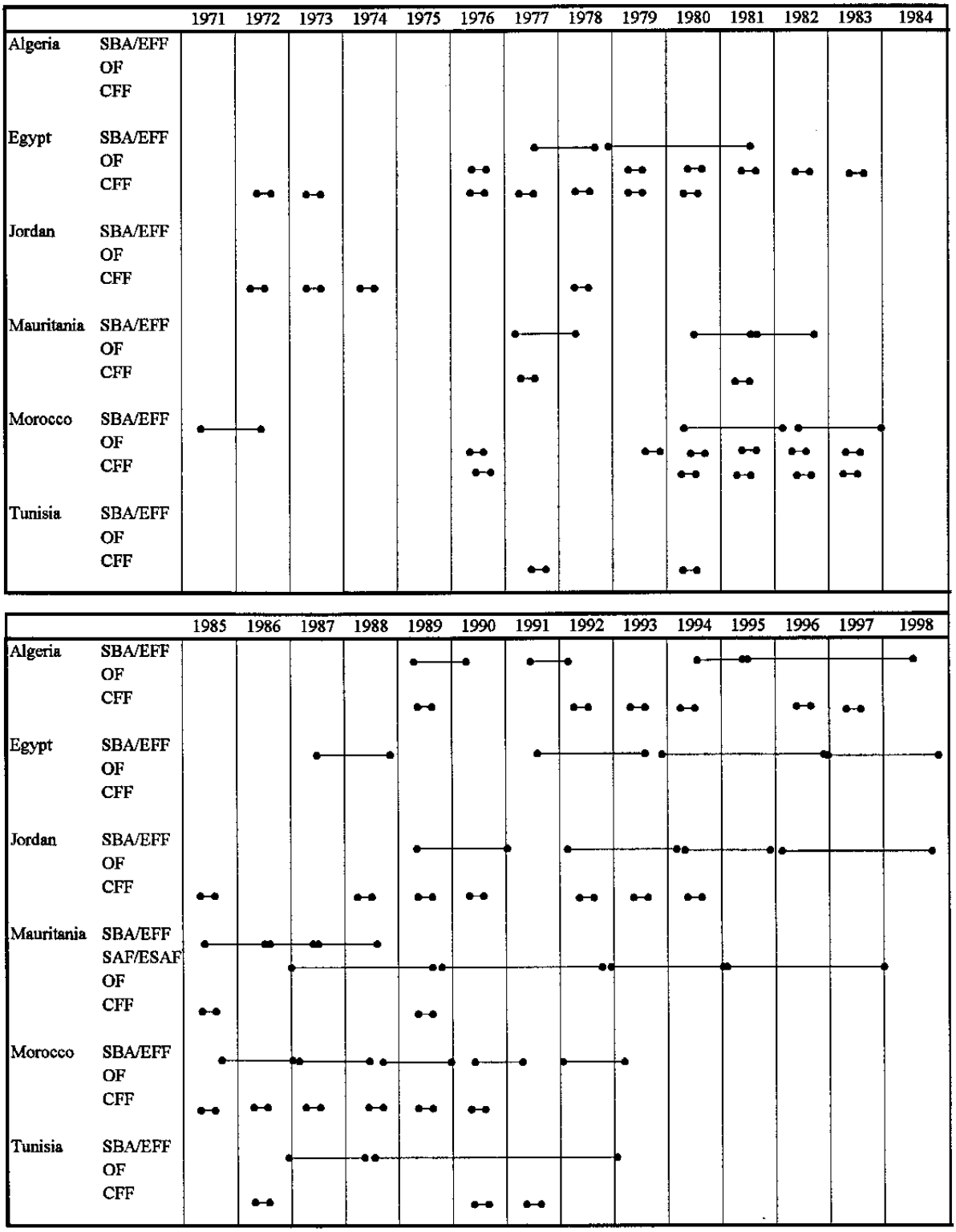
45. The panel vector autoregression approach (PVAR) has clear **practical advantages** as an explicit dynamic system that is the most appropriate way for studying macroeconomic dynamics. First, being neutral with respect to any particular growth or development theory, PVAR imposes a statistical model on the contemporary movements of the variables rather than being driven by a particular macroeconomic concept, which, if not accurate, can be distorting. Second, reflecting the realities of interdependence, PVAR does not distinguish between exogenous and endogenous variables, but rather treats all variables as jointly endogenous. Each variable in PVAR depends on its past realization and on all other variables, suggesting a true simultaneity among them and their treatment on an equal footing. Third, PVAR permits modeling both endogenous and exogenous shocks, which currently are indisputably the main sources of macroeconomic dynamics in small-open-economies. Fourth, PVAR is comparatively easy to estimate both in a single country case and on a panel comprising several countries. Each equation separately can be estimated by OLS, which is consistent and asymptotically efficient. Finally, PVAR has a clear practical value as a handy tool for a comparative analysis of the macroeconomic performance of IMF member countries, in particular in assessing the impact of sound macroeconomic policies supported by IMF financial resources, technical assistance, and policy advice.

46. A word of caution, however, is warranted by the obvious **limitations of PVAR**. As legitimately pointed out by Hendry and Dornik (1996), VAR is not and cannot be viewed as a growth accounting or findings determinants of growth exercise. Taking into account the shrinking, with each additional lag, the number of degrees of freedom, VARs inevitably suffer from overparametarisation, thus raising the issue of a parsimony of the approach itself. Interpretation of the restrictions, which should be imposed, is not obvious if an innovation to one variable does not affect any other variable, while the system is still simultaneous. Finally, conclusions are sensitive to the choice of lag length and the number of included variables, for neither of which there is an agreed choice mechanism.

Definitions of Variables

Variables		Definition	Symbol	Construction	Sources
Common across countries variables	Real oil price	Index of average of UK Brent, Dubai, and West Texas Intermediate crude oil spot prices deflated by U.S. PPI. 1990=100	P^{oil}	ln (POILAVGW) -ln (11163A..ZF)	WEO line POILAVGW; IFS: line 11163A..ZF
	Real non-fuel commodity prices	Index of average of world market prices for 39 primary weighted by their share in 1987-89 world exports of non-fuel commodities deflated by U.S. PPI. 1990=100	P^{nfc}	ln(W1PXP.A) - ln(11163A..ZF)	WEO lines W1PXP.A
	Industrial production in advanced economies	Seasonally adjusted annual index of industrial production for 22 industrial countries	Y^*	ln(11066..IZF)	IFS line 11066..IZF
	World real interest rate	Six-month LIBOR on deposits in U.S. dollars deflated by recursive one period ahead ARMA(1,1) forecast of expected U.S. CPI inflation rate	R	$\text{Ln(W111FLIBOR.A)}_{t-}{}_{1}\text{ln(W111PCPI)}_{t}$	WEO lines W111FLIBOR.A and W111PCPI
Country-specific variables	Real per capita GDP growth rate	Index. Real GDP divided by total population	Y	ln(W443NGDPRPC) index	WEO line Wcountry codeNGDPRPC
	Fiscal balance	General government balance divided by nominal GDP in local currencies	F	level	WEO line Wcountry codeGGB and Wcountry codeNGDP
	Current account balance	Current account divided by nominal GDP in U.S. dollars.	C	level	WEO line Wcountry codeBCA and W443NGDPD
Deflators		Average annual. 1990=100 U.S. product price index	USPPI	Index	IFS line 11163A..ZF...
		Average annual. 1990=100 U.S. consumer price index	USCPI	Index	WEO line W111PCPI

IMF Arrangements in Selected Arab Countries, 1971–98 1/



Sources: International Financial Statistics Yearbooks.

1/ Theses abbreviations refer to IMF programs available to its member countries: SBA–Stand-by Arrangement; EFF–Extended Fund Facility; SAF–Structural Adjustment Facility; ESAF–Enhanced Structural Adjustment Facility;CFF–Compensatory Financing Facility; OF–Oil Facility.

ADF (1) Unit Root Test for Country Specific Variables

Null order	Y	F	C	MacKinnon critical values 5 percent	MacKinnon critical values 1 percent
		Program country, ADF (3)			
Constant and trend					
I (0)	-4.287 *	-1.793	-4.564 **	-3.622	-4.417
I (1)	-3.721 *	-2.952	-4.779 **	-3.633	-4.442
Constant					
I (0)	-3.260 *	-1.207	-1.935	-2.997	-3.750
I (1)	-3.829 **	-3.103 *	-4.826 **	-3.004	-3.768
		Nonprogram country ADF (2)			
Constant and trend					
I (0)	-2.103	-4.345 *	-3.320	-3.612	-4.395
I (1)	-4.630 **	-3.240	-4.583 **	-3.622	-4.418
Constant					
I (0)	-1.971	-2.031	-1.964	-2.991	-3.734
I (1)	-4.651 **	-3.330 *	-6.544 **	-2.997	-3.760
		Oil country, ADF (2)			
Constant and trend					
I (0)	-2.384	-0.875	-3.316	-3.612	-4.395
I (1)	-4.117 *	-3.048	-7.618 **	-3.622	-4.418
Constant					
I (0)	-2.756	-1.567	-1.963	-2.991	-3.734
I (1)	-3.811 **	3.655 *	-6.548 **	-2.997	-3.760
		Non-oil country, ADF (1)			
Constant and trend					
I (0)	-2.608	-3.401	-3.293	-3.603	-4.375
I (1)	-3.691 *	-3.389	-4.775 **	-3.612	-4.395
Constant					
I (0)	-2.597	-0.715	-3.808 **	-2.985	-3.720
I (1)	-3.767 **	-3.527 *	-3.189 *	-2.991	-3.735

Source: Staff estimates.

Note: Asteriscks * and ** denote rejection of the null of unit root at the 5 percent and 1 percent critical values.

External Variables: Lag Selection for Cointegration Analysis

	Null hypothesis				Maintained hypothesis	
System	p	L	SC	AIC	VAR(3)	VAR(2)
VAR(3)	52	284.8	-16.84	-18.50	...	
					...	
					...	
VAR(2)	36	262.2	-17.08	-19.73	1.3324	...
					[0.2531]	...
					(16, 25)	...
VAR(1)	20	242.5	-17.56	-19.21	1.5516	1.6556
					[0.1122]	[0.1020]
					(32, 31)	(16, 37)

Source: Staff estimates.

Notes:

1. Entries under the null hypothesis are: system–order of VAR considered, p–the number of unrestricted parameters, L–the log-likelihood, SC–Scwarz criterion, AIC–Akaike criterion.

2. The maintained hypothesis entries show the test results for sequential system reduction. They are: F statistic for testing the null hypothesis against the maintained hypothesis, [the tail probability associated with that value of F], and (the degrees of freedom for the F statistics).

Selected Arab Countries: VAR Lag Selection

	AIC		SC	
Program country (Algeria)				
Two lags	-25.18	*	-20.06	*
One lag	-19.98		-17.27	
Nonprogram country (Syria)				
Two lags	-19.19	*	-14.07	*
One lag	-15.37		-12.66	
Oil country (Saudi Arabia)				
Two lags	-17.54	*	-12.42	*
One lag	-14.91		-12.20	
Non-oil country (Jordan)				
One lag	-17.02	*	-11.90	
One lag	-14.82		-12.12	*

Source: Staff estimates.

Note: Asterisk (*) denotes the lowest value of the information criterion for a particular VAR system.

All Arab Countries: External and Country-Specific Factors Affecting Macroeconomic Dynamics

(Pooled variance decomposition in percent)

Time horizon (years)	External factors				Country-specific factors		
	Oil price	Non-fuel prices	Foreign demand	Interest rates	GDP	Fiscal balance	Current account
			Factors affecting real GDP growth				
1	18.5	15.7	7.6	9.0	45.8	2.1	1.3
2	18.4	16.9	11.2	9.7	34.5	5.8	3.6
3	20.3	18.9	10.9	9.4	30.5	6.3	3.8
4	19.5	19.5	11.4	10.0	28.8	6.7	4.1
5	19.2	20.4	11.5	10.0	27.8	6.8	4.3
10	18.9	21.1	11.8	10.0	26.0	7.4	4.9
20	18.9	21.3	11.9	10.0	25.4	7.5	5.0
			Factors affecting fiscal balance				
1	13.0	12.3	13.2	9.6	9.4	42.5	0.0
2	15.0	15.1	14.9	10.4	8.9	32.8	2.9
3	15.7	15.9	16.0	10.5	10.6	27.9	3.4
4	16.0	17.2	15.1	11.6	10.5	25.3	4.3
5	16.4	17.9		11.9	10.6	23.7	4.7
10	17.0	19.5	14.1	12.0	10.2	21.8	5.4
20	17.9	19.6	13.7	12.0	10.1	21.3	5.4
			Factors affecting current account balance				
1	16.3	13.9	12.5	9.3	11.6	9.4	27.1
2	15.1	22.5	14.1	11.2	9.3	8.3	19.5
3	16.9	23.0	15.9	10.8	8.9	8.2	16.3
4	17.3	24.1	15.1	10.8	8.8	8.3	15.5
5	17.5	24.6	14.4	10.8	9.3	8.6	14.8
10	18.0	24.0	14.6	11.0	9.3	8.8	14.3
20	18.7	24.0	14.2	11.1	9.1	8.9	13.9

Source: Staff estimates.

Table 1. Factors Affecting Growth of Real Per Capita GDP

	All Arab countries	Program countries	Nonprogram countries	Oil countries	Non-oil countries	Non-oil nonprogram countries
Variance decomposition (percent)						
Short-run						
External factors	51	54	49	44	56	63
Country-specific factors	49	46	51	56	44	37
Medium-run						
External factors	59	57	60	57	61	69
Country-specific factors	41	43	40	43	39	31
Long-run						
External factors	62	60	63	60	63	71
Country-specific factors	38	40	37	43	37	29
Impulse response to:						
An oil price shock						
Short-run	+	+	+	-	+	+
Medium-run	-	-	-	-	+	-
Long-run	+	-	+	+	-	-
A nominal price shock						
Short-run	-	-	+	-	+	+
Medium-run	+	+	+	-	+	-
Long-run	+	+	-	+	+	-
A demand shock						
Short-run	-	-	-	-	-	-
Medium-run	+	-	+	+	-	-
Long-run	+	-	+	+	+	-
An interest rate shock						
Short-run	-	-	-	-	-	+
Medium-run	+	+	+	+	+	-
Long-run	+	+	+	+	+	-

Source: Staff estimates.

Table 2. Factors Affecting Fiscal Balance

	All Arab countries	Program countries	Nonprogram countries	Oil countries	Non-oil countries	Non-oil nonprogram countries
Variance decomposition (percent)						
Short-run						
External factors	48	41	52	63	37	37
Country-specific factors	52	59	48	37	63	63
Medium-run						
External factors	59	59	58	67	52	47
Country-specific factors	41	41	42	33	48	53
Long-run						
External factors	63	65	61	69	58	53
Country specific factors	37	35	39	31	42	47
Impulse response to:						
An oil price shock						
Short-run	+	+	+	+	-	-
Medium-run	-	+	+	-	-	-
Long-run	+	+	-	-	+	-
A nominal price shock						
Short-run	+	-	+	+	-	-
Medium-run	+	-	+	+	-	-
Long-run	-	-	-	-	-	-
A demand shock						
Short-run	+	+	+	+	-	-
Medium-run	-	+	-	-	+	-
Long-run	+	+	-	-	+	-
An interest rate shock						
Short-run	-	+	-	-	-	-
Medium-run	-	-	-	-	-	-
Long-run	-	-	+	-	-	-

Source: Staff estimates.

Table 3. Factors Affecting Current Account

	All Arab countries	Program countries	Nonprogram countries	Oil countries	Non-oil countries	Non-oil nonprogram countries
Variance decomposition (percent)						
Short-run						
External factors	52	49	53	59	47	49
Country-specific factors	48	51	47	41	53	51
Medium-run						
External factors	66	58	70	72	62	67
Country-specific factors	34	42	30	28	38	33
Long-run						
External factors	68	63	71	73	64	68
Country-specific factors	32	37	29	27	36	32
Impulse response to:						
An oil price shock						
Short-run	+	+	+	+	-	-
Medium-run	-	+	-	-	-	-
Long-run	-	+	-	-	+	-
A nominal price shock						
Short-run	+	-	+	+	+	+
Medium-run	+	-	+	+	-	-
Long-run	-	-	-	-	-	-
A demand shock						
Short-run	+	+	+	+	+	+
Medium-run	-	+	-	-	-	-
Long-run	-	+	-	-	-	-
An interest rate shock						
Short-run	-	-	-	-	-	-
Medium-run	-	-	-	-	-	-
Long-run	-	-	-	-	-	-

Source: Staff estimates.

Table 1. Program Countries: Variance Decomposition

(In percent)

Time (years)	S.E.	External factors				Country-specific factors			External factors	Country-specific factors
		P^{oil}	P^{nfc}	Y*	R	Y	F	C		
Real GDP per capita growth										
1	0.1	23.7	13.8	7.3	9.0	40.2	4.8	1.1	53.9	46.1
2	0.2	19.8	15.8	10.6	8.7	33.4	9.9	1.8	54.9	45.1
3	0.2	21.1	16.7	10.8	8.6	30.7	9.9	2.1	57.3	42.7
4	0.2	21.0	17.1	10.5	9.3	29.3	10.6	2.1	57.9	42.1
5	0.2	20.6	17.9	10.4	9.5	28.5	10.9	2.2	58.4	41.6
10	0.3	20.1	19.4	11.1	9.3	26.4	11.1	2.6	59.9	40.1
20	0.3	20.2	19.6	11.2	9.2	26.0	11.2	2.7	60.2	39.8
1 year	0.1	23.7	13.8	7.3	9.0	40.2	4.8	1.1	53.9	46.1
2-5 years	0.2	20.6	16.9	10.6	9.0	30.5	10.3	2.1	57.1	42.9
6-20 years	0.3	20.2	19.4	11.1	9.3	26.4	11.1	2.6	59.9	40.1
Fiscal balance										
1	0.1	12.6	5.2	15.0	8.6	8.5	50.0	0.0	41.4	58.6
2	0.1	16.7	7.7	20.3	8.4	8.7	36.1	2.2	53.0	47.0
3	0.2	17.3	9.7	23.2	8.3	8.8	30.2	2.5	58.5	41.5
4	0.2	17.6	14.3	19.6	10.9	8.3	25.9	3.5	62.3	37.7
5	0.2	17.9	15.7	18.2	11.7	8.2	24.1	4.3	63.5	36.5
10	0.2	18.5	16.5	17.8	12.3	7.4	22.4	5.1	65.1	34.9
20	0.2	19.6	16.4	17.1	12.5	7.2	22.1	5.1	65.6	34.4
1 year	0.1	12.6	5.2	15.0	8.6	8.5	50.0	0.0	41.4	58.6
2-5 years	0.2	17.4	11.8	20.3	9.8	8.5	29.1	3.1	59.3	40.7
6-20 years	0.2	19.0	16.4	17.3	12.3	7.4	22.4	5.1	65.0	35.0
Current account balance										
1	0.1	11.0	21.1	13.7	3.5	8.4	12.0	30.3	49.3	50.7
2	0.1	10.3	20.4	14.5	9.0	7.9	12.6	25.4	54.2	45.8
3	0.1	11.0	19.6	19.8	8.4	7.5	13.0	20.7	58.8	41.2
4	0.1	10.3	23.8	17.7	8.5	7.7	12.5	19.5	60.3	39.7
5	0.1	11.4	24.6	15.7	9.0	8.4	12.5	18.5	60.6	39.4
10	0.1	13.3	23.7	16.3	9.0	8.3	12.7	16.8	62.3	37.7
20	0.1	14.9	23.4	15.8	9.6	7.9	12.5	15.9	63.7	36.3
1 year	0.1	11.0	21.1	13.7	3.5	8.4	12.0	30.3	49.3	50.7
2-5 years	0.1	10.7	22.1	16.9	8.7	7.9	12.6	21.0	58.5	41.5
6-20 years	0.1	14.0	23.6	15.8	9.2	8.1	12.6	16.6	62.7	37.3

Source: Staff estimates.

Ordering: P^{oil}, P^{nfc}, Y*, R, Y, F, C.

Table 2. Nonprogram Countries: Variance Decomposition

(In percent)

Time horizon (years)	S.E.	External factors				Country-specific factors			External	Internal
		P^{oil}	P^{nfc}	Y*	R	Y	F	C		
Real GDP per capita growth										
1	0.1	15.4	16.9	7.7	9.0	49.0	0.5	1.5	49.0	51.0
2	0.2	17.6	17.5	11.5	10.3	35.2	3.4	4.6	56.8	43.2
3	0.2	19.8	20.1	10.9	9.8	30.3	4.2	4.8	60.7	39.3
4	0.2	18.7	21.0	11.9	10.3	28.5	4.4	5.2	61.9	38.1
5	0.2	18.4	21.8	12.1	10.3	27.4	4.5	5.5	62.6	37.4
10	0.3	18.2	22.0	12.3	10.4	25.7	5.2	6.2	62.9	37.1
20	0.3	18.2	22.4	12.3	10.5	25.1	5.4	6.3	63.3	36.7
1 year	0.1	15.4	16.9	7.7	9.0	49.0	0.5	1.5	49.0	51.0
2-5 years	0.2	18.6	20.1	11.6	10.2	30.4	4.1	5.0	60.5	39.5
6-20 years	0.3	18.2	22.2	12.3	10.4	25.6	5.2	6.2	63.1	36.9
Fiscal balance										
1	0.1	13.3	16.4	12.1	10.2	10.0	38.1	0.0	51.9	48.1
2	0.1	14.1	19.4	11.8	11.6	9.1	30.8	3.3	56.8	43.2
3	0.1	14.7	19.5	11.8	11.9	11.7	26.6	3.9	57.8	42.2
4	0.1	15.1	18.9	12.4	12.0	11.8	24.9	4.7	58.5	41.5
5	0.1	15.5	19.2	12.8	12.0	12.0	23.5	5.0	59.5	40.5
10	0.2	16.1	21.2	12.0	11.8	11.9	21.4	5.6	61.1	38.9
20	0.2	16.9	21.5	11.7	11.8	11.8	20.8	5.6	61.9	38.1
1 year	0.1	13.3	16.4	12.1	10.2	10.0	38.1	0.0	51.9	48.1
2-5 years	0.1	14.9	19.3	12.2	11.9	11.2	26.5	4.2	58.2	41.8
6-20 years	0.2	16.4	21.1	11.9	11.8	11.9	21.3	5.5	61.3	38.7
Current account balance										
1	0.1	19.3	9.7	11.8	12.6	13.4	7.9	25.2	53.5	46.5
2	0.1	18.0	23.8	13.9	12.4	10.1	5.8	16.1	68.0	32.0
3	0.1	20.4	25.0	13.6	12.2	9.7	5.4	13.8	71.2	28.8
4	0.1	21.4	24.3	13.7	12.2	9.4	5.8	13.2	71.6	28.4
5	0.1	21.0	24.6	13.6	11.9	9.7	6.4	12.7	71.2	28.8
10	0.1	20.8	24.1	13.6	12.1	9.9	6.6	12.9	70.6	29.4
20	0.1	20.9	24.4	13.4	12.0	9.8	6.8	12.7	70.7	29.3
1 year	0.1	19.3	9.7	11.8	12.6	13.4	7.9	25.2	53.5	46.5
2-5 years	0.1	20.2	24.4	13.7	12.2	9.7	5.8	14.0	70.5	29.5
6-20 years	0.1	20.9	24.4	13.4	12.0	9.8	6.7	12.8	70.7	29.3

Source: Staff estimates.

Ordering: P^{oil}, P^{nfc}, Y*, R, Y, F, C.

Table 3. Oil Countries: Variance Decomposition

(In percent)

Time horizon (years)	S.E.	External factors				Country-specific factors			External	Internal
		P^{oil}	P^{nfc}	Y*	R	Y	F	C		
Real GDP per capita growth										
1	0.1	14.2	16.2	7.2	6.5	55.2	0.3	0.3	44.2	55.8
2	0.2	17.0	17.3	10.8	8.5	38.3	3.7	4.3	53.6	46.4
3	0.2	17.8	20.8	10.5	8.4	33.1	5.1	4.2	57.6	42.4
4	0.2	17.4	21.6	10.6	9.3	31.5	4.9	4.7	58.9	41.1
5	0.2	16.8	22.3	10.9	9.4	30.6	4.8	5.1	59.4	40.6
10	0.3	16.4	22.4	11.9	9.3	28.8	8.3	5.7	60.0	42.8
20	0.3	16.5	22.9	11.9	9.3	28.1	8.0	6.1	60.6	42.2
1 year	0.1	14.2	16.2	7.2	6.5	55.2	0.3	0.3	44.2	55.8
2-5 years	0.2	17.2	20.5	10.7	8.9	33.4	4.6	4.6	57.4	42.6
6-20 years	0.3	16.5	22.7	11.8	9.3	28.6	8.1	5.8	60.2	42.6
Fiscal balance										
1	0.1	17.4	21.8	12.3	11.6	8.9	27.8	0.0	63.2	36.8
2	0.1	17.8	25.8	12.1	11.5	8.9	20.5	3.4	67.2	32.8
3	0.1	18.8	25.5	12.5	10.3	12.3	16.6	4.1	67.0	33.0
4	0.1	19.4	24.5	12.6	10.4	11.8	16.3	4.8	67.0	33.0
5	0.1	19.4	24.4	12.8	10.9	11.5	16.1	4.9	67.5	32.5
10	0.2	18.8	27.0	11.6	11.1	11.1	15.0	5.4	68.5	31.5
20	0.2	19.1	27.4	11.2	11.1	11.1	14.7	5.3	68.9	31.1
1 year	0.1	17.4	21.8	12.3	11.6	8.9	27.8	0.0	63.2	36.8
2-5 years	0.1	18.8	25.1	12.5	10.8	11.1	17.4	4.3	67.2	32.8
6-20 years	0.2	19.0	27.0	11.6	11.1	11.1	15.0	5.3	68.6	31.4
Current account balance										
1	0.1	28.8	11.5	6.5	12.1	11.0	6.9	23.3	58.8	41.2
2	0.1	23.6	26.3	9.3	11.4	7.8	7.1	14.5	70.7	29.3
3	0.1	24.0	27.8	9.3	11.3	8.5	6.4	12.7	72.5	27.5
4	0.1	24.2	28.0	9.3	11.6	8.2	6.7	12.0	73.1	26.9
5	0.1	23.6	28.2	9.6	11.4	8.7	6.9	11.6	72.8	27.2
10	0.1	23.7	27.7	9.6	11.4	8.9	7.1	11.5	72.4	27.6
20	0.1	23.6	28.1	9.6	11.4	8.8	7.2	11.4	72.6	27.4
1 year	0.1	28.8	11.5	6.5	12.1	11.0	6.9	23.3	58.8	41.2
2-5 years	0.1	23.9	27.6	9.4	11.4	8.3	6.8	12.7	72.3	27.7
6-20 years	0.1	23.6	28.0	9.6	11.4	8.9	7.1	11.5	72.5	27.5

Source: Staff estimates.

Ordering: P^{oil}, P^{nfc}, Y*, R, Y, F, C.

Table 4. Non-Oil Countries: Variance Decomposition

(In percent)

Time horizon (years)	S.E.	External factors				Country-specific factors				
		P^{oil}	P^{nfc}	Y*	R	Y	F	C	External	Internal
Real GDP per capita growth										
1	0.1	21.5	15.4	7.8	10.8	39.0	3.4	2.1	55.6	44.4
2	0.2	19.4	16.5	11.4	10.6	31.8	7.2	3.0	57.9	42.1
3	0.2	22.1	17.5	11.1	10.0	28.6	7.2	3.5	60.8	39.2
4	0.2	21.1	18.1	12.0	10.4	26.8	8.0	3.6	61.6	38.4
5	0.2	21.0	18.9	11.9	10.4	25.8	8.3	3.7	62.2	37.8
10	0.3	20.7	20.0	11.8	10.5	23.9	8.8	4.2	63.0	37.0
20	0.3	20.6	20.2	11.8	10.6	23.4	9.0	4.3	63.3	36.7
1 year	0.1	21.5	15.4	7.8	10.8	39.0	3.4	2.1	55.6	44.4
2-5 years	0.2	20.9	17.8	11.6	10.4	28.2	7.7	3.5	60.6	39.4
6-20 years	0.3	20.7	20.0	11.9	10.5	23.9	8.8	4.3	63.1	36.9
Fiscal balance										
1	0.1	9.8	5.3	13.8	8.1	9.8	53.1	0.0	37.0	63.0
2	0.1	13.0	7.3	17.0	9.6	8.9	41.7	2.5	46.8	53.2
3	0.1	13.4	8.9	18.6	10.7	9.4	36.2	2.9	51.6	48.4
4	0.2	13.6	11.9	16.8	12.4	9.6	31.8	3.9	54.7	45.3
5	0.2	14.2	13.1	16.2	12.6	10.0	29.2	4.6	56.2	43.8
10	0.2	15.7	14.0	16.0	12.7	9.6	26.7	5.3	58.3	41.7
20	0.2	17.0	13.9	15.4	12.7	9.4	26.1	5.5	59.1	40.9
1 year	0.1	9.8	5.3	13.8	8.1	9.8	53.1	0.0	37.0	63.0
2-5 years	0.1	13.6	10.3	17.1	11.3	9.5	34.7	3.5	52.3	47.7
6-20 years	0.2	16.3	13.9	15.6	12.7	9.6	26.7	5.4	58.4	41.6
Current account balance										
1	0.1	7.2	15.7	16.9	7.2	12.0	11.2	29.8	47.0	53.0
2	0.1	9.0	19.7	17.5	11.0	10.4	9.2	23.2	57.3	42.7
3	0.1	11.7	19.6	20.6	10.5	9.2	9.5	19.0	62.4	37.6
4	0.1	12.3	21.3	19.4	10.3	9.3	9.4	18.1	63.2	36.8
5	0.1	13.0	22.0	17.9	10.5	9.6	9.9	17.2	63.3	36.7
10	0.1	13.9	21.2	18.2	10.6	9.6	10.1	16.4	64.0	36.0
20	0.1	15.2	21.0	17.6	11.0	9.3	10.1	15.7	64.8	35.2
1 year	0.1	7.2	15.7	16.9	7.2	12.0	11.2	29.8	47.0	53.0
2-5 years	0.1	11.5	20.6	18.8	10.5	9.6	9.5	19.4	61.5	38.5
6-20 years	0.1	14.5	21.2	17.8	10.7	9.5	10.1	16.2	64.2	35.8

Source: Staff estimates.

Ordering: P^{oil}, P^{nfc}, Y*, R, Y, F, C.

Table 5. Non-oil Nonprogram Countries: Variance Decomposition

(In percent)

Time horizon (years)	S.E.	External factors				Country-specific factors			External factors	Country-specific factors
		P^{oil}	P^{nfc}	Y*	R	Y	F	C		
Real GDP per capita growth										
1	0.1	22.4	20.3	9.4	11.4	32.8	0.8	3.0	63.5	36.5
2	0.2	23.3	19.0	12.3	11.8	26.0	3.4	4.2	66.5	33.5
3	0.2	27.3	20.1	11.3	10.7	22.6	3.2	4.8	69.4	30.6
4	0.2	24.8	20.6	13.6	11.2	20.6	4.0	5.1	70.2	29.8
5	0.2	24.3	22.2	13.7	11.0	19.1	4.5	5.1	71.2	28.8
10	0.3	23.1	22.6	13.7	11.4	17.7	5.4	6.1	70.8	29.2
20	0.3	22.7	22.8	13.8	11.5	17.1	5.8	6.3	70.8	29.2
1 year	0.1	22.4	20.3	9.4	11.4	32.8	0.8	3.0	63.5	36.5
2-5 years	0.2	24.9	20.5	12.7	11.2	22.1	3.8	4.8	69.3	30.7
6-20 years	0.3	23.0	22.6	13.8	11.5	17.6	5.4	6.2	70.9	29.1
Fiscal balance										
1	0.1	5.0	7.4	18.2	5.8	11.2	52.3	0.0	36.5	63.5
2	0.1	7.3	9.3	17.0	9.7	8.9	45.0	2.8	43.3	56.7
3	0.1	8.1	10.8	15.2	12.4	9.7	39.9	3.8	46.6	53.4
4	0.1	9.0	10.7	16.2	12.5	10.4	36.0	5.0	48.5	51.5
5	0.1	10.1	11.5	16.5	11.8	11.5	32.9	5.6	50.0	50.0
10	0.2	12.6	12.3	16.1	11.7	11.6	29.6	6.0	52.7	47.3
20	0.2	14.1	12.2	15.7	11.7	11.5	28.5	6.3	53.7	46.3
1 year	0.1	5.0	7.4	18.2	5.8	11.2	52.3	0.0	36.5	63.5
2-5 years	0.1	8.6	10.6	16.2	11.6	10.1	38.5	4.3	47.1	52.9
6-20 years	0.2	13.1	12.1	16.0	11.7	11.6	29.5	6.1	52.9	47.1
Current account balance										
1	0.1	7.5	5.3	24.3	11.4	16.7	8.7	26.1	48.6	51.4
2	0.1	10.4	15.7	24.5	12.5	13.3	5.3	18.2	63.2	36.8
3	0.1	15.2	16.7	23.7	12.5	11.2	5.3	15.4	68.0	32.0
4	0.1	16.7	17.1	23.1	11.9	10.9	5.5	14.9	68.7	31.3
5	0.1	16.6	17.5	22.6	11.6	10.7	6.8	14.3	68.2	31.8
10	0.1	16.0	17.3	22.6	11.9	10.7	6.7	14.8	67.8	32.2
20	0.1	16.5	17.3	22.2	11.8	10.6	7.1	14.5	67.8	32.2
1 year	0.1	7.5	5.3	24.3	11.4	16.7	8.7	26.1	48.6	51.4
2-5 years	0.1	14.7	16.7	23.5	12.1	11.5	5.7	15.7	67.0	33.0
6-20 years	0.1	16.3	17.4	22.4	11.8	10.6	6.9	14.6	67.9	32.1

Source: Staff estimates.

Ordering: P^{oil}, P^{nfc}, Y*, R, Y, F, C.

APPENDIX X

Pairwise Granger Causality Tests

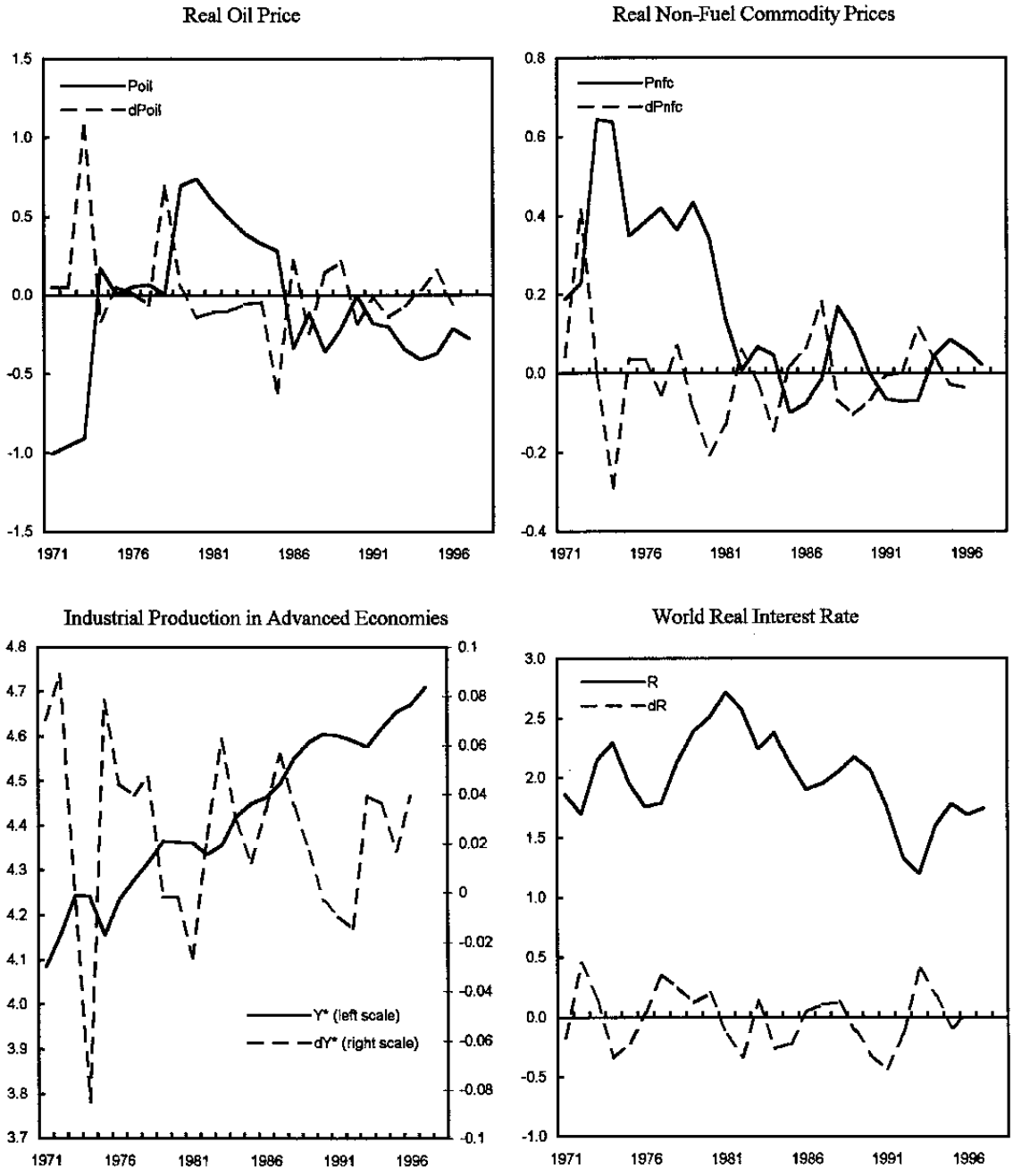
(2 lags, 425 observations)

Null hypothesis	F-Statistic	Probability	Null hypothesis	F-Statistic	Probability
Direct causality			Reverse causality		
P^{oil} does not cause Y*	83.5915	0.0001	P^{nfc} does not cause P^{oil}	131.2430	0.0010
P^{oil} does not cause P^{nfc}	83.1224	0.0003	Y* does not cause P^{oil}	12.7204	0.0005
P^{oil} does not cause R	5.4944	0.0045	R does not cause P^{oil}	67.4112	0.0032
P^{oil} does not cause Y*	1.2581	0.2854	Y does not cause P^{oil}	0.5775	0.5618
P^{oil} does not cause F	1.8298	0.1619	F does not cause P^{oil}	1.3018	0.2733
P^{oil} does not cause C	1.1699	0.3115	C does not cause P^{oil}	0.4392	0.6449
P^{nfc} does not cause Y*	3.8387	0.0224	Y* does not cause P^{nfc}	20.3080	0.0000
P^{nfc} does not cause R	13.2838	0.0003	R does not cause P^{nfc}	40.3964	0.0013
P^{nfc} does not cause Y	0.4730	0.6235	Y does not cause P^{nfc}	1.9458	0.1443
P^{nfc} does not cause F	4.0734	0.0178	F does not cause P^{nfc}	0.8654	0.4217
P^{nfc} does not cause C	9.0353	0.0002	C does not cause P^{nfc}	1.3107	0.2709
Y* does not cause R	19.1175	0.0001	R does not cause Y*	14.2086	0.0001
Y* does not cause Y	0.2081	0.8123	Y does not cause Y*	0.4789	0.6198
Y* does not cause F	1.6679	0.1901	F does not cause Y*	0.0639	0.9381
Y* does not cause C	2.8980	0.0564	C does not cause Y*	5.1744	0.0061
R does not cause Y	0.6847	0.5049	Y does not cause R	0.1918	0.8255
R does not cause F	3.7106	0.0254	F does not cause R	0.7100	0.4923
R does not cause C	3.0791	0.0472	C does not cause R	0.6498	0.5227
Y does not cause F	0.8192	0.4416	F does not cause Y	1.7825	0.1697
Y does not cause C	0.1112	0.8948	C does not cause Y	2.1183	0.1217
F does not cause C	8.3175	0.0003	C does not cause F	5.7342	0.0035

Source: Staff estimates.

P^{oil}, P^{nfc}, Y*, R–external variables, Y, F, C–country-specific variables.

Figure 1. Evolution of External Variables, 1971-97
(In logs)

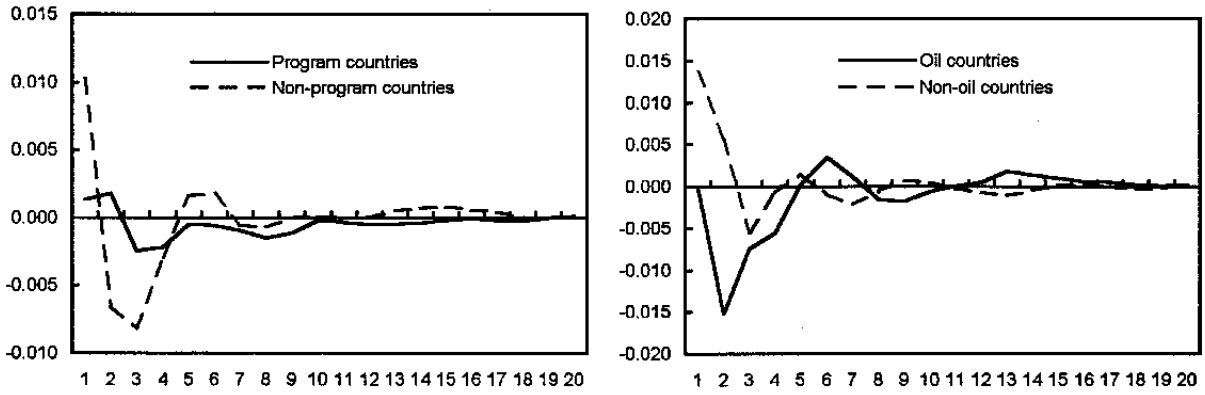


Sources: IFS and WEO databases; staff estimates.

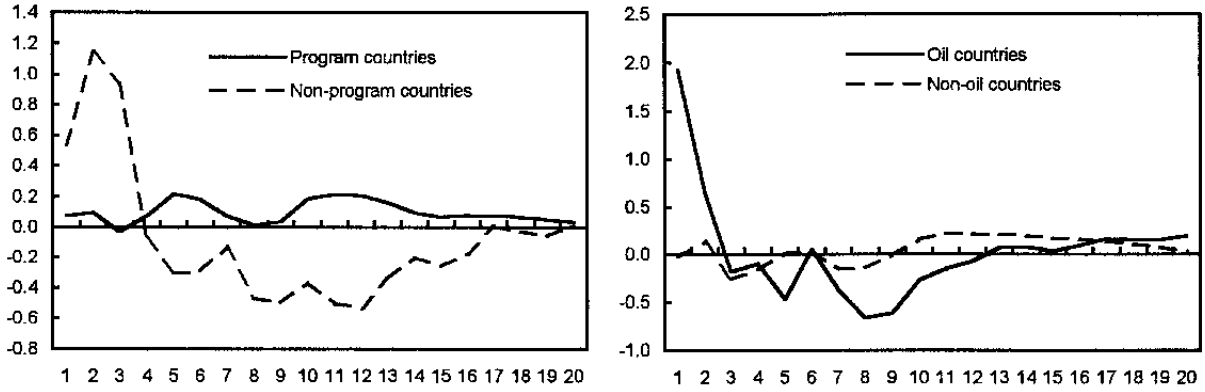
Figure 2. Arab Countries: Impact of an Oil Price Shock

(Percentage points, percent of GDP, years)

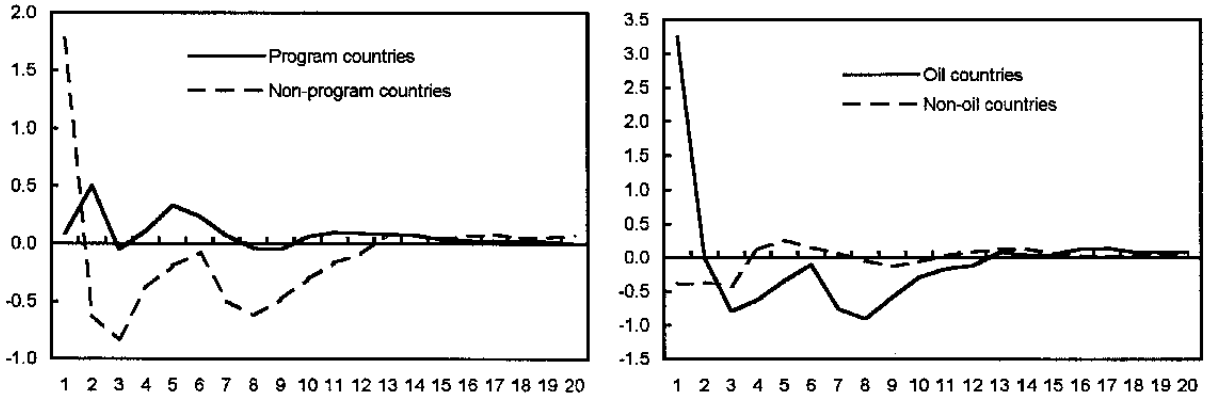
Impact on real GDP per capita growth



Impact on fiscal balance



Impact on current account

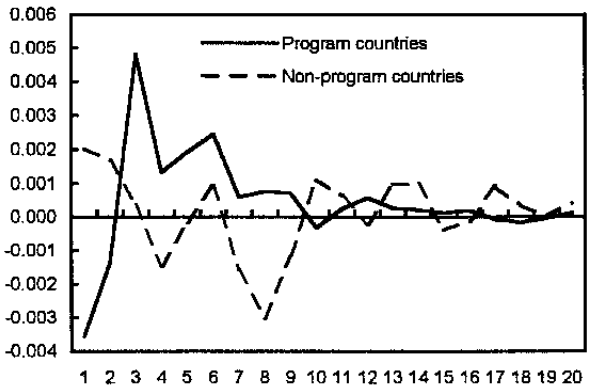


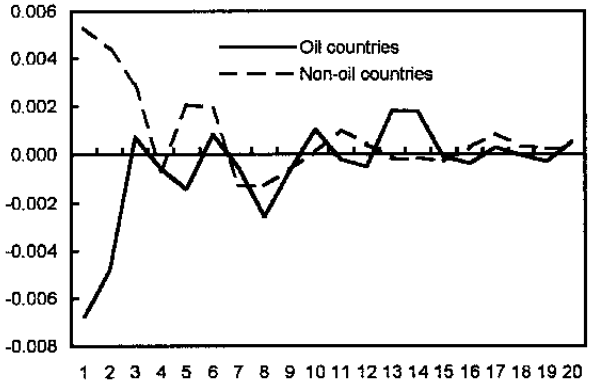
Sources: Staff estimates.

Figure 2a. Arab Countries: Impact of a Nominal Price Shock

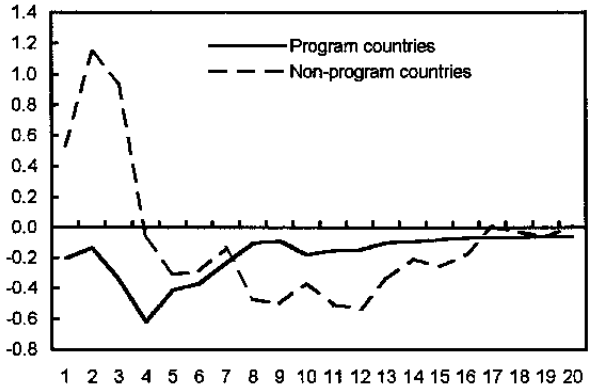
(Percentage points, percent of GDP, years)

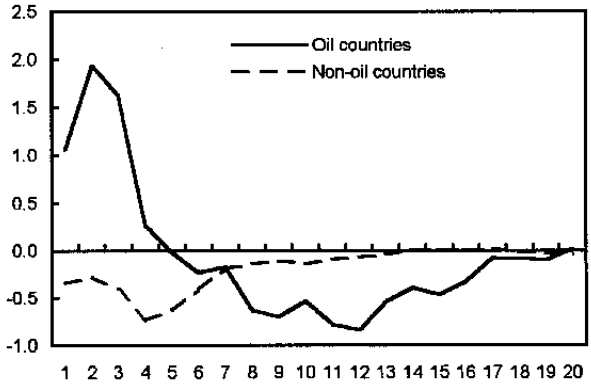
Impact on real GDP per capita growth



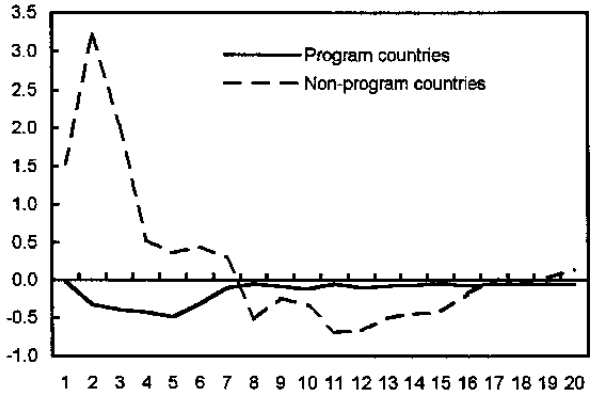


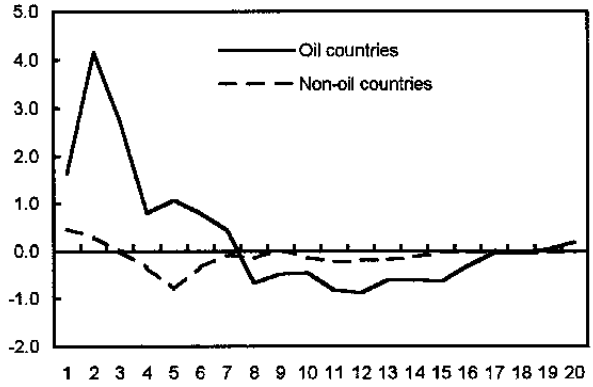
Impact on fiscal balance





Impact on current account



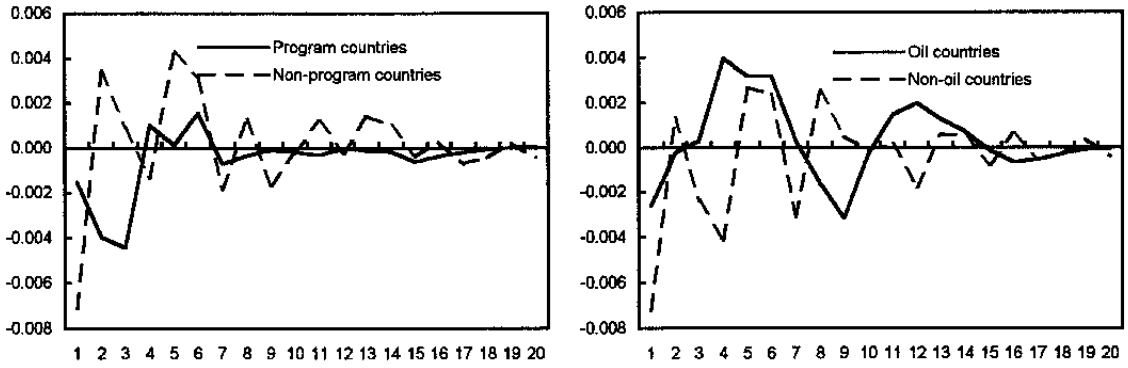


Sources: Staff estimates.

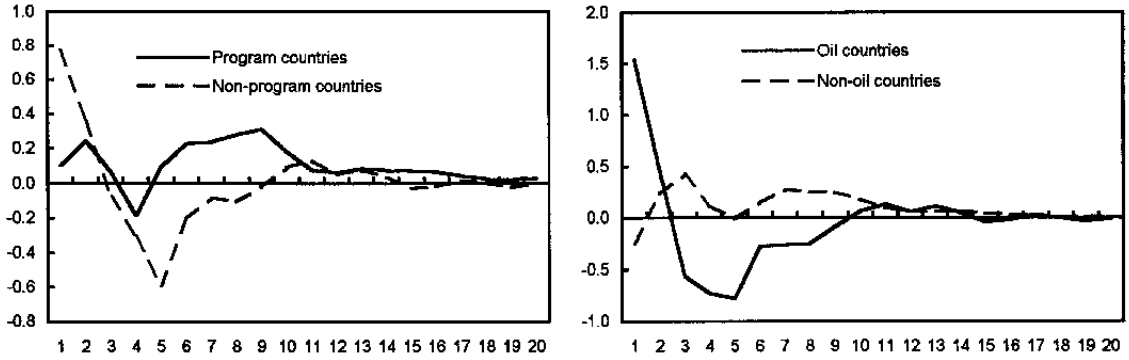
Figure 2b. Arab Countries: Impact of a Demand Shock

(Percentage points, percent of GDP, years)

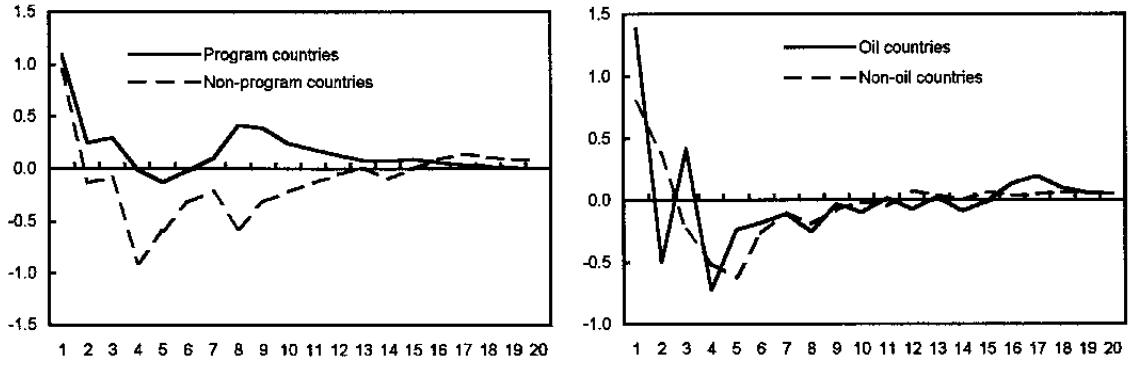
Impact on real GDP per capita growth



Impact on fiscal balance



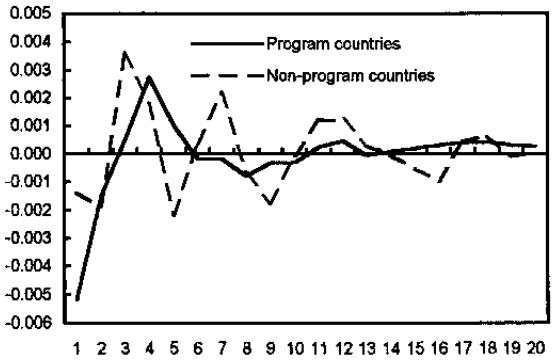
Impact on current account

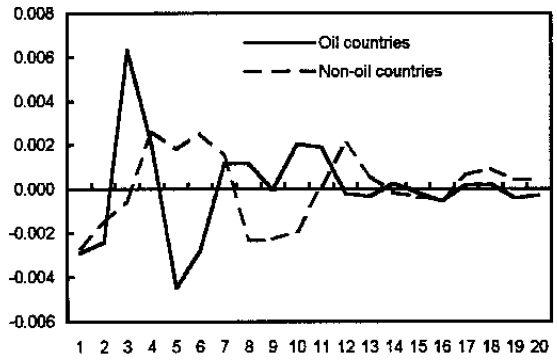


Sources: Staff estimates.

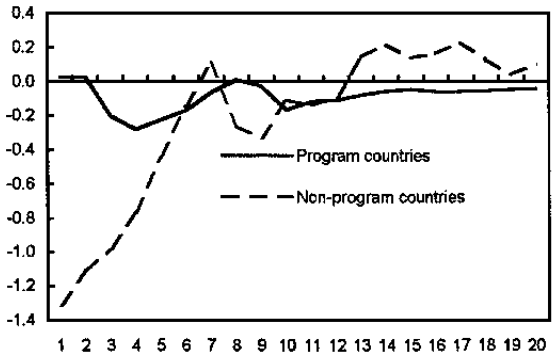
Figure 2c. Arab Countries: Impact of an Interest Rate Shock
(Percentage points, percent of GDP, years)

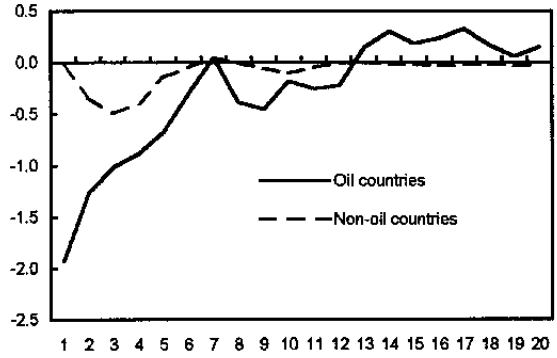
Impact on real GDP per capita growth



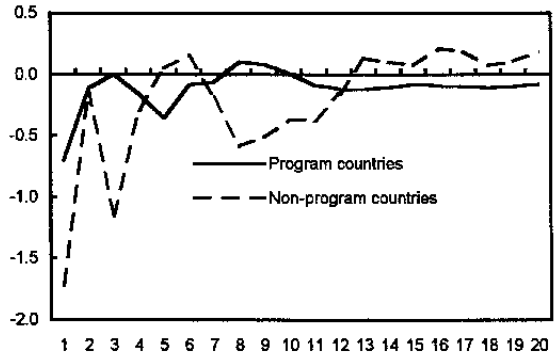


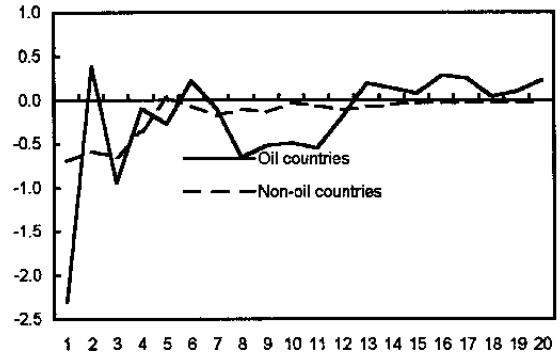
Impact on fiscal balance





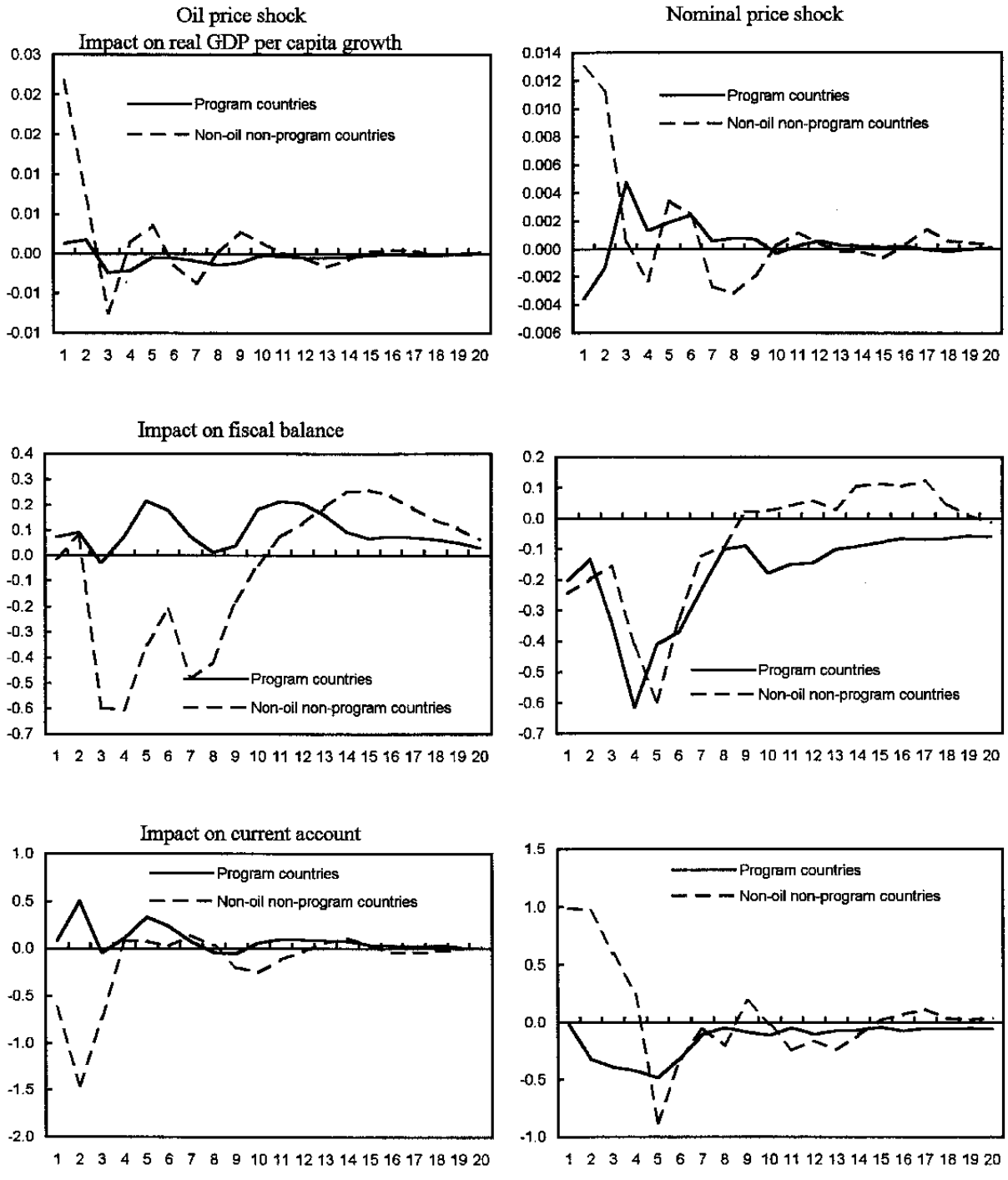
Impact on current account





Sources: Staff estimates

Figure 3. Program and Non-Oil Non-Program Countries: Impact of Selected Shocks
(Percentage points, percent of GDP, years)



Sources: Staff estimates.