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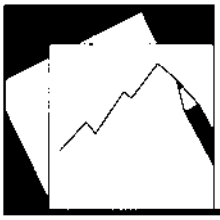

IMF Working Paper

Commodity Prices and Inflation in the Middle East, North Africa, and Central Asia

Joseph Crowley

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Commodity Prices and Inflation in the Middle East, North Africa, and Central Asia

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Abstract

Inflation followed a strikingly uniform pattern in all countries of the Middle East, North Africa, and Central Asia during the period 1996-2009, falling until about 2000 and then rising. International fuel prices do not help explain this pattern. This conclusion is robust even when different cross sections of countries are tested or when different regression variables are included. The pattern of inflation is explained mainly by past inflation, the strength of the US dollar, US inflation, and—depending on the subset of countries analyzed—monetary and exchange rate policies and nonfuel commodity prices.

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I. INTRODUCTION

1. Throughout the world, substantial gains were made in the fight against inflation during the 1990s, and there was optimism that a new era of low inflation had begun (IMF 2001, Bernanke 2005). High profile countries, particularly in Latin America and Eastern Europe, had succeeded in bringing inflation from triple digit levels or higher to single digits, and in maintaining price stability. Inflation had stabilized in the US and other industrialized nations following a problematic post-Breton Woods period.

2. Similar gains were achieved in the countries of the Middle East, North Africa, and Central Asia (MENACA) region. Bouts of high inflation had been brought under control in countries such as Algeria, Lebanon, and Syria, and even relatively stable countries, such as Egypt, Morocco, and Jordan had seen substantial improvements. Greater understanding of the causes and dangers of inflation appeared to have generated the will and the capacity to keep inflation at bay.

3. After 2000, however, inflation made a comeback around the world (Economist 2004, Heath 2004). In the MENACA region the increase has been broad and steady since 2000. In 2007 almost every single country in this region had higher inflation than in 2000. Inflation was on an accelerating trend until 2009, when it was stopped by the global financial crisis.

4. Inflation is driven by many factors, and the interest and exchange rate policies that central banks implement, the money supply growth that they allow, and the exchange rate regimes that constrain them are ultimately the most important. In the MENACA region, central bank policy decisions clearly bear significant responsibility for the reemergence of inflation. Many countries (particularly in the Maghreb) have failed to increase nominal interest rates in the face of increasing inflation, largely because of the constraints of official or unofficial pegs to the US dollar. Others, including in the GCC, have increased rates in spite of the peg, but not enough to keep up with inflation. Often the key policy decision has been to maintain adherence to an official or unofficial peg.

5. But the reemergence of inflation around the world was so uniform that it is hard to attribute it entirely to shifts in the policies of individual central banks. Meanwhile, there were striking developments in certain global variables, particularly during the period following 2000, and it would be logical to consider global factors in any study of inflation.

6. Global factors may have a significant impact on inflation and this impact may have increased in importance in recent years. Borio and Filardo (2007) argue that global factors are important and since the 1990s have become increasingly important in determining inflation, even replacing domestic factors in some cases. Rogoff (2004) argues that globalization, by increasing competition, has changed the shape of the Phillips curve, making the inflation-output tradeoff less favorable to policymakers who might be willing to accept higher inflation in return for higher output. Other authors have similarly argued that greater openness reduces the benefits of unanticipated monetary expansion (Romer 1993) or otherwise has effects that make narrowing output gaps more costly in inflation terms (Razin 2004). Chen (2004) finds that openness had a downward influence on prices in the EU during 1988-2000. D'Agostino (2007) finds evidence that US inflation is more closely related to

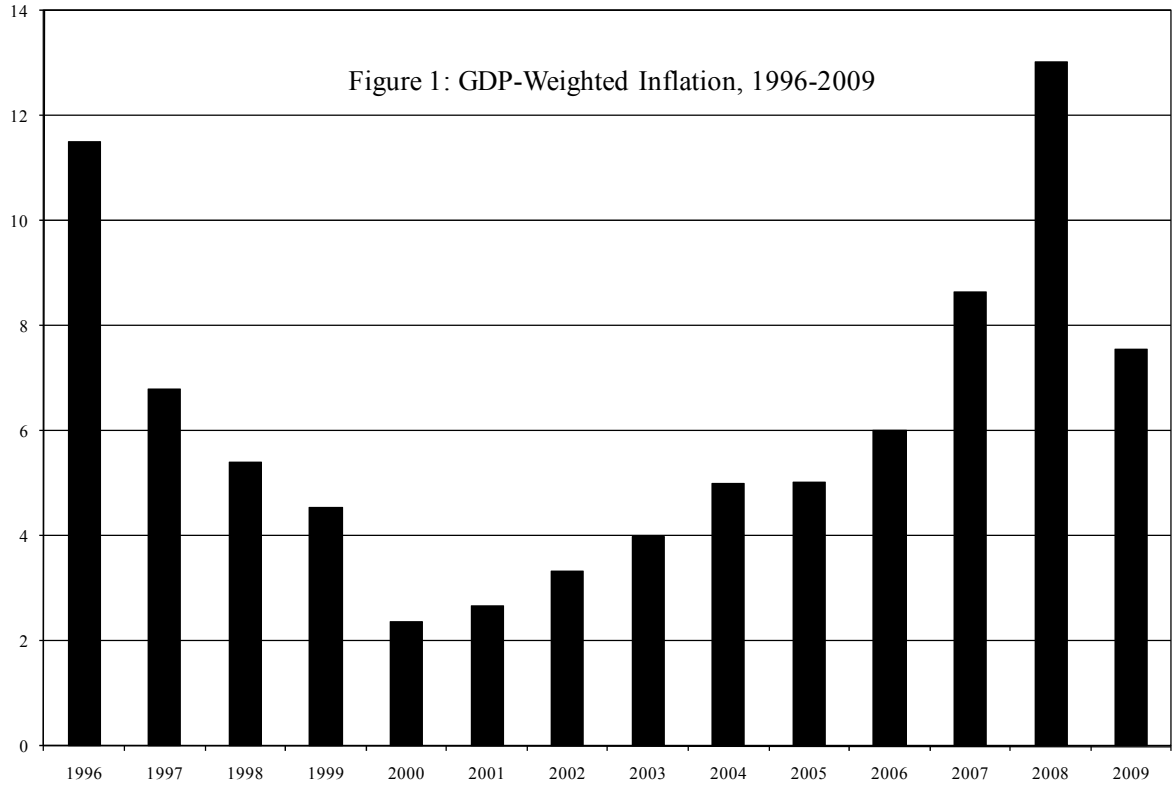
global liquidity than to US liquidity. Ball (2006), however, disputes these claims. He provides evidence that the Phillips curve has changed shape, but in the wrong direction to support the conclusions that are drawn. He also provides evidence that US inflation is not dependent on output in other countries.

7. It is hard not to notice that the comeback in inflation coincided with a sharp increase in food and energy prices, and it is tempting to infer that these increases in commodity prices drove the resurgence in inflation. The IMF's April 2008 Regional Economic Outlook (REO) for Latin America noted that "Rising domestic food prices, reflecting both sharp increases in world commodity prices and some local supply disruptions, have been widely viewed as a key element in the uptick in inflation." In a cross regional paper on inflation in emerging and developing countries, Habermeier, et al (2009) concluded that the main causes of the increase in inflation were demand pressures and commodity prices, and that the initial impact of commodity price increases was followed by second-round effects. The Economist magazine indicated in May 2008 that a main cause of higher world inflation was higher food and oil prices.

8. The conclusion that recent inflation has been driven by commodity prices could lead to the hope that the recent softening in energy and food prices will bring with it reduced inflationary pressure. The decline in the value of the US dollar has also been tied to commodity prices and to world inflation, and this raises the possibility that the recent strengthening of the US dollar could also reduce world inflation. In the case of the MENACA region, the benefits of lower commodity prices may be limited. A stronger dollar may have a more important impact.

II. Background and Overview of Inflation in the MENACA Region

9. From 1996 until 2000 regional inflation, weighted by GDP, declined from 11.5 percent to 2.5 percent. Since 2000, however, this trend was reversed. A small increase in 2001 was followed by increases in every year until 2008 when inflation jumped into double digits and was again a priority policy issue. The global financial crisis has at least temporarily brought down inflation and reduced the urgency of addressing this issue, but understanding the reasons for the recent increases can help address any post crisis resurgence in inflation that may emerge.



10. Behind the overall trend are some significant variations in inflation rates in individual countries. But these differences are mainly in levels rather than in patterns. In spite of an enormous variety of starting levels, almost all of the countries in the sample experienced a decline in inflation between 1996 and 2000 and an increase from 2001 to 2008. During 1996 to 2000 Sudan brought its rate down from triple digits to single digits, while Tajikistan lowered it from over 400 percent to just over 30 percent. Meanwhile, Kuwait lowered its rate from 3 percent to 1.6 percent and Saudi Arabia lowered its rate from 0.9 percent to minus 1.1 percent. In some countries the trough may not have come exactly in 2000 or the decline or the rise in inflation may not have been uniformly steady during the two periods, but in a heterogeneous region with a wide variety of income levels, different exchange rate regimes, and only a moderate level of economic integration, the inflation patterns are remarkably similar.

Table 1. Inflation, 1996-2007
(In Percent)

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Algeria	18.7	5.7	5.0	2.6	0.3	4.2	1.4	2.6	3.6	1.6	2.5	3.6	4.5	4.6
Armenia	18.7	14.0	8.7	0.6	-0.8	3.1	1.1	4.7	7.0	0.6	2.9	4.4	9.0	3.0
Azerbaijan	19.8	3.7	-0.8	-8.5	1.8	1.5	2.8	2.2	6.7	9.7	8.4	16.6	20.8	2.2
Bahrain	-0.2	4.6	-0.4	-1.3	-11.2	-1.2	-0.5	1.7	2.2	2.6	2.0	3.3	3.5	3.0
Djibouti	3.5	2.5	2.2	0.2	1.6	1.8	0.6	2.0	3.1	3.1	3.5	5.0	12.0	5.5
Egypt	7.1	6.2	5.0	3.7	2.8	2.4	2.4	3.2	8.1	8.8	4.2	11.0	11.7	16.2
Georgia	39.3	7.0	3.6	19.1	4.0	4.7	5.6	4.8	5.7	8.3	9.2	9.2	10.0	1.2
Iran, I.R. of	23.0	17.4	18.1	20.0	12.8	11.3	15.7	15.6	15.3	10.4	11.9	18.4	25.4	12.0
Jordan	6.5	3.0	3.1	0.6	0.7	1.8	1.8	1.6	3.4	3.5	6.3	5.4	14.9	0.2
Kazakhstan	39.1	17.4	7.3	8.4	13.3	8.4	5.9	6.4	6.9	7.6	8.6	10.8	17.2	7.5
Kuwait	3.0	0.8	0.6	3.1	1.6	1.4	0.8	1.0	1.3	4.1	3.1	5.5	10.5	4.6
Kyrgyz	32.0	23.4	10.4	35.9	18.7	6.9	2.1	3.1	4.1	4.3	5.6	10.2	24.5	8.0
Lebanon	8.9	7.7	4.5	0.2	-0.4	-0.4	1.8	1.3	1.7	-0.7	5.6	4.1	10.8	2.5
Libya	4.0	3.6	3.7	2.6	-2.9	-8.8	-9.9	-2.1	1.0	2.9	1.4	6.2	10.4	5.0
Mauritania	5.2	5.1	6.0	3.6	6.8	7.7	5.4	5.3	10.4	12.1	6.2	7.3	7.3	4.9
Morocco	3.0	1.0	2.7	0.7	1.9	0.6	2.8	1.2	1.5	1.0	3.3	2.0	3.9	2.8
Oman	0.5	-0.4	0.4	0.5	-1.2	-0.8	-0.3	0.2	0.7	1.9	3.4	5.9	12.6	3.3
Pakistan	10.8	11.8	7.8	5.7	3.6	4.4	2.5	3.1	4.6	9.3	7.9	7.8	12.0	20.8
Qatar	7.3	2.6	2.9	2.2	1.7	1.4	0.2	2.3	6.8	8.8	11.8	13.8	15.0	0.0
Saudi Arabia	0.9	-0.4	-0.2	-1.3	-1.1	-1.1	0.2	0.6	0.4	0.6	2.3	4.1	9.9	4.5
Sudan	132.8	46.7	17.1	16.0	8.0	4.9	8.3	7.7	8.4	8.5	7.2	8.0	14.3	11.0
Syria	8.9	1.9	-1.0	-3.7	-3.9	3.4	-0.5	5.8	4.4	7.2	10.4	4.7	15.2	7.5
Tajikistan	418.5	88.0	43.2	27.5	32.9	38.6	12.2	16.4	7.2	7.3	10.0	13.2	20.4	8.0
Tunisia	3.7	3.6	3.1	2.7	2.3	2.0	2.7	2.7	3.6	2.0	4.5	3.1	5.0	3.5
United Arab Emirates	3.0	2.9	2.0	2.1	1.4	2.7	2.9	3.2	5.0	6.2	9.3	11.1	12.3	2.5
GDP weighted inflation	**11.5**	**6.8**	**5.4**	**4.5**	**2.4**	**2.7**	**3.3**	**4.0**	**5.0**	**5.0**	**6.0**	**8.6**	**13.0**	**7.6**

Source: IMF IFS Statistics

11. Grouping countries into subgroups reveals that the pattern of inflation is not attributable to one region or to the behavior of prices in oil exporting countries. The GCC countries, the Maghreb countries, the countries of the Former Soviet Union, and the remaining group all followed a similar pattern of inflation falling and then rising. The same is true if countries are grouped into major oil exporter, moderate oil exporter, and countries that export little or no oil. One exception in the overall pattern is that the countries that export little oil did not experience a drop off in inflation after the global financial crisis.

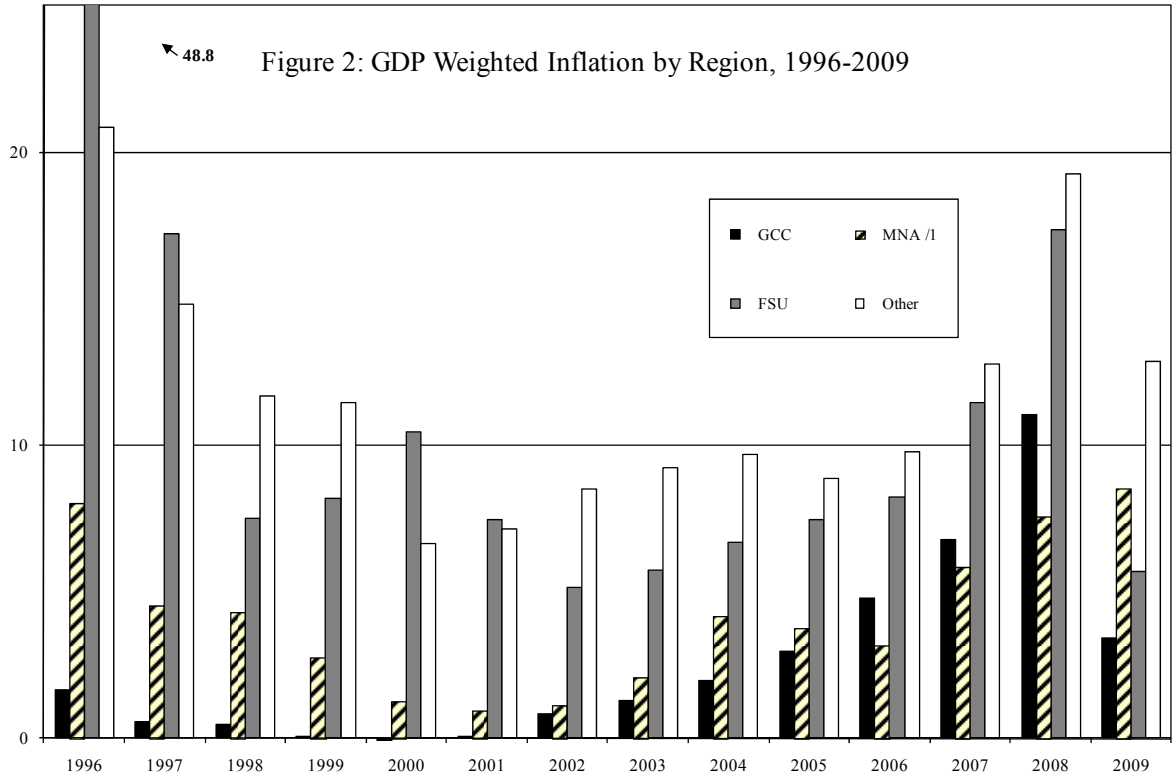


Figure 2: GDP Weighted Inflation by Region, 1996-2009

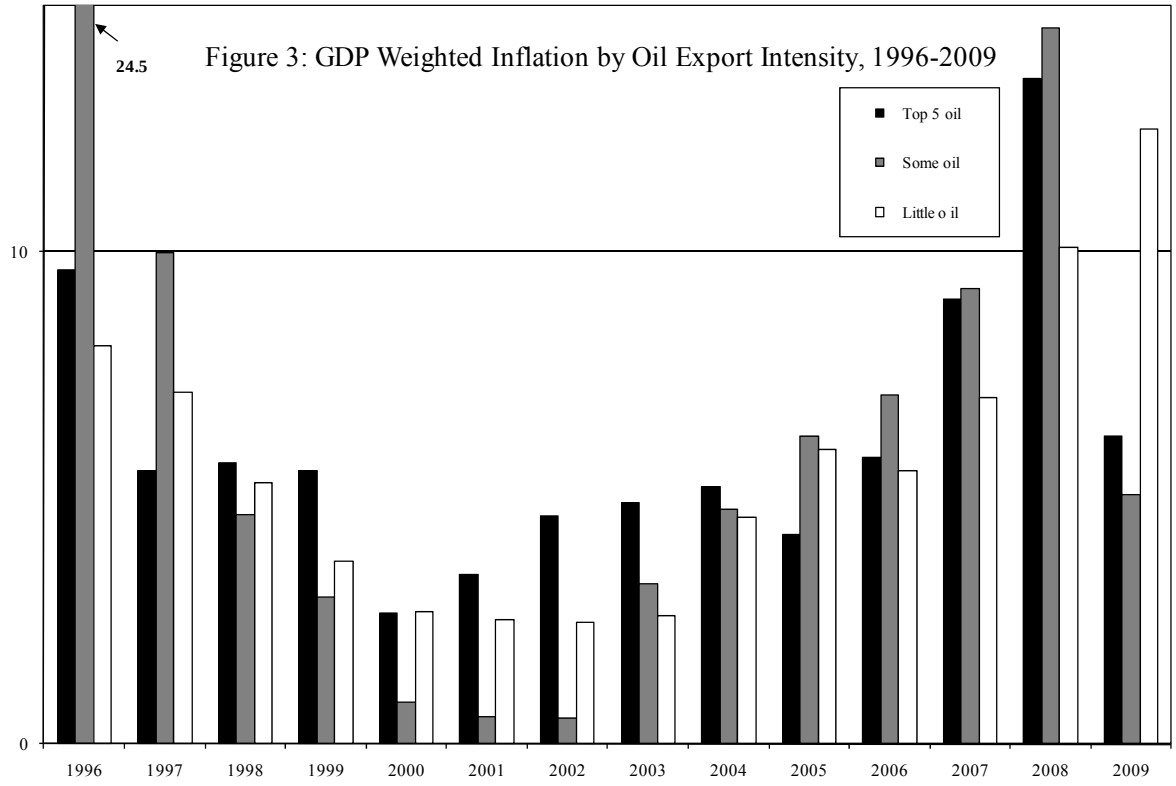


Figure 3: GDP Weighted Inflation by Oil Export Intensity, 1996-2009

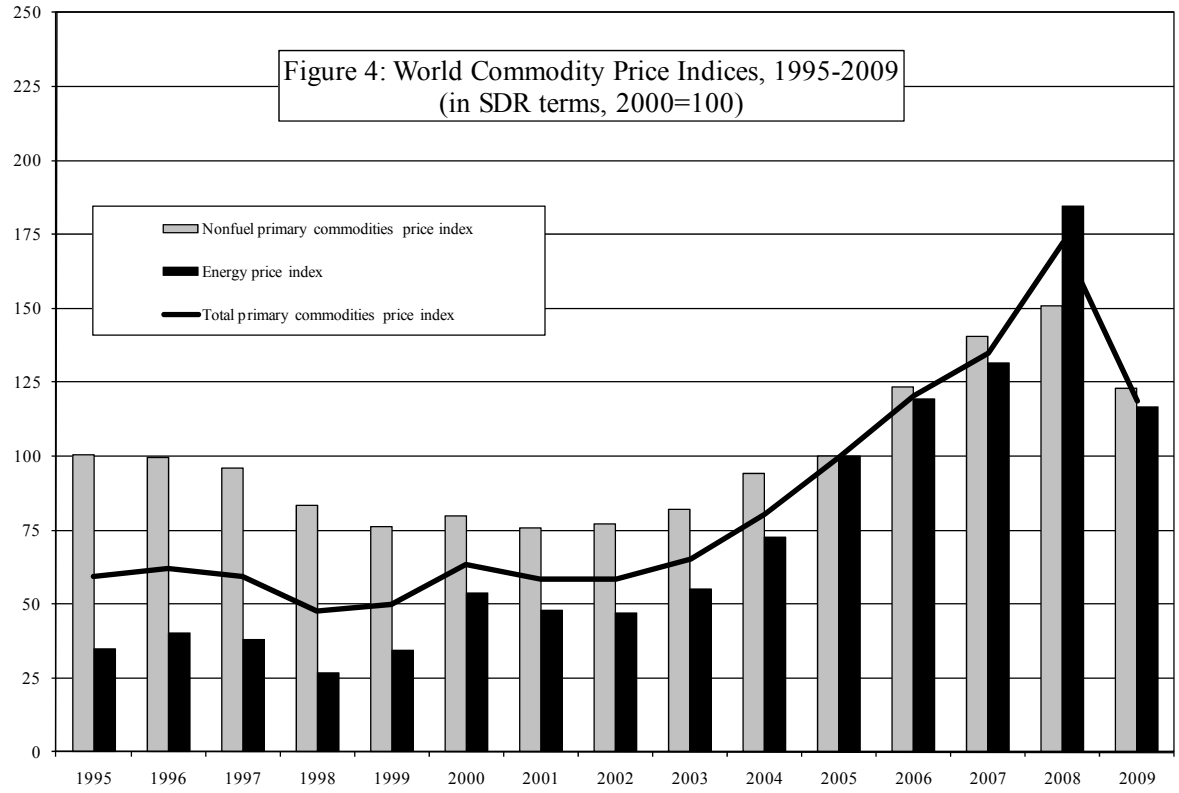
1/ Middle East and North Africa. North Africa includes Algeria, Djibouti, Egypt, Libya, Mauritania, Morocco, Sudan, and Tunisia.

III. Analysis of Factors Determining Inflation

A. Factors affecting inflation

12. Factor input costs are important determinants of consumer prices. Investigating the relationship between them and inflation is one of the primary motivations for this paper. In the MENACA region the relationship between local prices and world prices is complicated by local price controls, taxes and subsidies. Price controls on petroleum products and food items are particularly prevalent in the MENACA region. Nevertheless, world commodity prices are factors for which comprehensive data exist and which would seem likely to have an important impact on prices. Commodity prices are often divided into fuel and nonfuel prices, and this division would be particularly relevant in the MENACA region where several countries are heavily dependent on oil exports and where there is a prevalence of fuel price controls and subsidies. Increases in commodity prices would be expected to lead to higher inflation, and as discussed above this has been noted as a likely determinant inflation around the world, but there could be differences in the response of prices to increases in nonfuel commodity prices versus fuel prices, particularly if the controls on fuel prices are more prevalent or of a different nature than those on other commodities.

13. There appears to be a correlation in recent years between higher inflation and higher energy prices in the region. But the steep rise in energy prices began later than the rise in inflation, and there was also no corresponding decline in energy prices in the late 1990s when inflation fell. So until recently, it is hard to say whether there might be a clear link between world energy prices and inflation in the MENACA region. Nonfuel commodity prices have followed a pattern that is more closely related to that of inflation, declining (though modestly) during the 1990s and rising starting in 2002.



14. In most MENACA countries the majority of commodities are imported, and one might therefore expect import prices to be at least as good a predictor of inflation. Differences between the impacts of commodity prices and of import prices would be attributable to imports of manufactured goods and of services and to the share of GDP that is represented by local production of commodities. Most countries in the MENACA region are heavily dependent on imports for nonfuel commodities, but many of the countries are net fuel exporters.

15. Numerous studies have examined the impact of commodity price shocks on inflation in developing countries as well as the lag of the impact. Duma (2008) found low pass-through of external shocks to inflation in Sri Lanka and the pass-through of oil price increases in particular was low and negative. They also found that most pass-through had occurred after 4 months, though Leigh and Rossi (2002) found that in Turkey full pass-through of external shocks was complete after one year. Studies of other countries have found that higher oil prices result in higher inflation. Gottschalk et al (2008) found this relationship in Sierra Leone.

16. Habermeier et al (2009) concluded that all commodity prices, including fuel prices, were responsible for inflation. They based this conclusion largely on the observation that core inflation, particularly in the Middle East, was significantly lower than headline inflation. They did not, however, distinguish between food and fuel prices. Loungani and Swagel (2001) found both fuel and nonfuel commodity prices to have a significant impact on inflation in fixed exchange rate regimes among developing countries.

17. One of the most obvious factors affecting inflation in any period would be inflation in the previous period. Inflationary momentum is well-documented and is caused by factors that include adaptive inflationary expectations and overlapping contracts. Regional and country studies have noted this effect. Monfort and Peña (2008) found that in Paraguay inflationary momentum was significant (as were food prices and US inflation). Differences have been noted in the persistance of inflation between fixed and floating rate regimes (Loungani and Swagel 2001).

18. The output gap has been identified as an important factor related to inflation, but since output gap is difficult to measure directly economic growth is often used as a proxy (Gali and Gertler, 1999). Shocks to aggregate demand or aggregate supply can cause either a negative or a positive relationship between economic growth and inflation (Mohanty and Klau 2001), but in general, the relationship between growth and inflation has been found to be positive (Coe and McDermott, 1996), since movements in aggregate demand are normally larger and more common than movements in aggregate supply. Khan (2004) found a negative relationship between growth and inflation in many high-inflation countries in the MENACA region which he attributed to a backward-bending Phillips curve. Barnichon and Peiris (2008) found that output gap and money are both significant in sub-Saharan Africa. Diouf (2007) found inflation in Mali to be associated with increases in real income, the exchange rate, and the deposit interest rate and decreases in the discount interest rate. In the MENACA region as a whole, weighted by GDP, economic growth was significantly higher after 2000 than before 2000, but there was no U-shaped pattern of growth over time corresponding to the behavior of inflation.

19. Local real interest rates affect aggregate demand. Higher real interest rates should be associated with lower aggregate demand and therefore lower inflation. However analysis of real interest rates is complicated because their measurement is not always reliable in all countries. Real interest rates are calculated by subtracting inflation from nominal interest rates, so any randomness in the data will have an asymmetrical effect, tending to generate a negative relationship between inflation and real interest rates. Consider the extreme case where both reported nominal interest rates and reported inflation are simply random independent series rather than accurately reported data. In this case there would be a negative relationship between inflation and real interest rates, since there is a negative relationship between any series and itself subtracted from a random series.

20. Furthermore, interest rates do not always move freely, which can complicate the relationship between interest rates and inflation. Restrictions on the free adjustment of interest rates would strengthen the negative correlation between the inflation data and the real interest rate data, while at the same time making the relationship meaningless. Al-Mashat and Billmeier (2007) found that interest rates in Egypt began to have a greater impact on inflation following the adoption of an interest rate corridor in 2005.

21. Nominal interest rates are also likely to be related to inflation. But the relationship is likely to be positive since higher inflation is usually associated with higher nominal interest rates and the causation would be the reverse of that suggested by a regression of inflation on real interest rates, so any regression with nominal interest rates in it would suffer from endogeneity problems.

22. Money growth in the long run should be directly positively related to inflation, as long as economic growth is included in the regression and there is no reason to expect significant shifts in money velocity. Money growth would affect inflation through its impact on aggregate demand, which in turn would be impacted by interest rates (to the extent that these are flexible) or other measures of the availability of credit (Nelson 2002). Berger and Stravrev (2008) describe the debate over the importance of money growth in determining inflation in the European Union, and Berger and Österholm (2008) do so for the US. Several country studies conclude that money growth is the predominant factor in determining inflation (Lissovolik 2003). Nelson (2002) provides evidence for the US and UK that money growth matters even when interest rates are included in the regression. Bonato (2007) found that in Iran money growth is the main determinant of inflation, though real interest rates, real output, and the exchange rate are also important. Khan and Schimmelpfennig (2006) found that monetary factors, including M2 and private sector credit growth, were dominant in Pakistan with a lag of 12 months. But Fanizza and Söderling (2007) argue that monetary policy has little effect on inflation in the Middle East and North Africa and that money velocity shifted significantly in the early 2000s. This discrepancy could be at least partly resolved by the finding of Saizar and Chalk (2008) that monetary policy is more effective in floating rate regimes in emerging market countries.

23. A country's nominal effective exchange rate might influence inflation directly by affecting the prices of importables, as well as affecting it indirectly by influencing the current account and thus aggregate demand. Billmeier and Bonato (2004), however, find low exchange rate pass-through in Croatia due to administered prices, a situation that prevails in many MENACA countries.

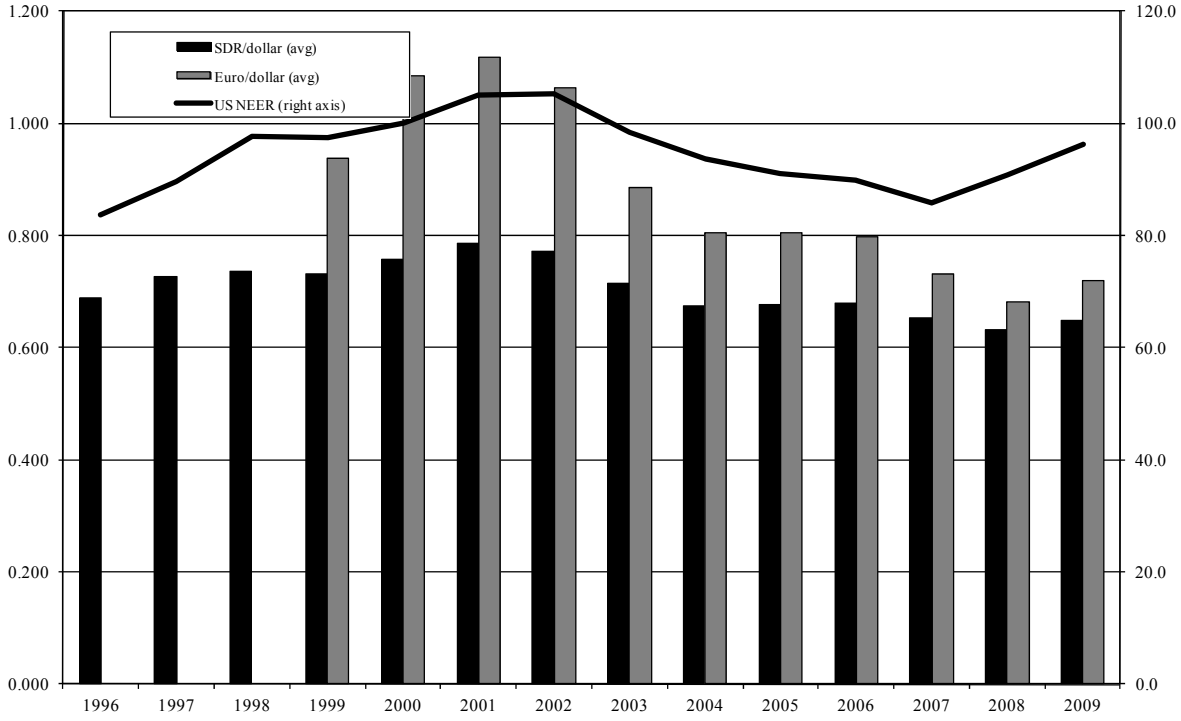
24. International factors other than commodity prices may also influence aggregate demand. World interest rates and exchange rates, in countries that have official or de facto fixed currency regimes and therefore no monetary policies of their own, could have an effect similar to that of policy rates in floating currency countries. Even in countries with flexible currency regimes, world interest rates will have a significant impact on aggregate demand to the extent that capital movements are unrestricted. Also, the major world interest rates (US Treasury rates, LIBOR, etc …) are more reliably measured and more reliably market determined than many local interest rates, so any impact on inflation should be easier to detect and stronger. Al-Hassan (2008) incorporated international as well as regional interest rates in a study of inflation in the GCC countries.

25. A problem with using world interest rates as an explanatory factor for inflation in some countries is that capital controls could reduce their impact. Also, in countries with a flexible exchange rate arrangement or in fixed exchange rate countries where there are any doubts at all about the soundness of the arrangement the impact of world interest rates on local aggregate demand would have to be adjusted to take into account expectations about currency movements, something that is not practical. It is unclear, then, how world interest rates might be associated with inflation in MENACA countries.

26. Movements of the major currencies in the world would affect aggregate demand in other countries. In countries without comprehensive exchange rate and price data they could serve as proxies for real effective exchange rate data or nominal effective exchange rate data.

In the MENACA region, where many countries link their currencies explicitly or implicitly to the US dollar, a decline in the value of the US dollar could have the same effect as a decline in the value of the local currency. Similarly an appreciation of the euro could affect inflation in the same way as a depreciation of the local currency in countries that are linked to the dollar but have a high volume of trade with the euro zone.

Figure 5: US Dollar Exchange Rates, 1996-2009



27. Levels, as well as movements, of major currencies, could affect inflation in the MENACA region. A strong US dollar would reflect policies regarding the dollar, such as high interest rates, that could spill over into countries that align their currencies with the dollar and that might not be fully captured by other variables (even certain US interest rates). Also, according to a similar logic, US inflation could be a factor (Hasan and Alogeel 2008). Feyzioğlu and Willard (2006) found evidence that inflation in the US affected inflation in China, and this was in line with Crowder (2006), who found that a reserve currency country exports its inflation.

28. It has been noted that the fall and rise of inflation in the MENACA region has roughly corresponded to the increased strength and subsequent weakness of the US dollar. Clark (2004) notes that there was a historically unusual divergence of goods inflation and services inflation during the 1990s and early 2000s and concludes that the appreciation of the dollar was likely responsible. But the bivariate correlation between the strength of the dollar and inflation has been limited. The increase in inflation in this region had already begun by 2001, in the middle of a dollar surge against the euro during 2000-2002. Then the dollar plateaued against the euro during 2004-06, while inflation in the region became more deeply entrenched. Finally, the countries in the Middle East and North Africa have a broad range of

trading partners that includes China, India, Korea and the US and movements in the dollar against these currencies were significantly less dramatic than against the euro. SDR exchange rates and the US nominal effective exchange rate (NEER) show more moderate patterns.

29. The time frame of movements in associated factors is also important. Changes in factor input costs and shifts in aggregate demand are not always quickly reflected in prices. Some variables may be closely associated with inflation but only when a lag is introduced.

B. The model

30. Based on the discussion in the previous section, the model that was tested was:

$$\textit{Inflation}_t = F(\alpha_0 + \alpha_1 \textit{inflation}_{t-1} + \alpha_2 \textit{US NEER}_t + \alpha_3 \Delta \textit{US NEER}_t + \alpha_4 \Delta \textit{exchange rate}_t + \alpha_5 \textit{local interest rate (or monetary aggregate)}_t + \alpha_6 \Delta \textit{commodity prices}_{t,t-1} + \alpha_7 \Delta \textit{import prices}_{t,t-1} + \alpha_8 \textit{GDP growth}_t + \alpha_9 \textit{international interest rates, exchange rates, and inflation})$$

31. Tests were done using annual data. Tests were repeated with monthly data, but many series were not available monthly. In monthly tests inflation was lagged by 1 month and the other lagged variables were usually lagged by 12 months, though different lags were tested.

32. Simple nominal exchange rates were used for the MENACA region since nominal effective exchange rates were not available for most countries. Nominal effective exchange rates were tested, then regressions were run with simple nominal exchange rates using only the countries for which nominal effective rates were available.

33. Commodity prices were measured in SDRs and in dollars. The SDR series was considered a more stable series and more representative of the trading partners of MENACA countries, but a dollar index was also tested for comparison. Indices for commodity prices, nonfuel commodity prices, and energy prices were tested. The average crude index and US Gulf wheat prices were also examined to see if narrow commodity price measures behaved similarly to the aggregate indices.

C. Main Results

Commodity prices

34. For the region as a whole, tests revealed a positive correlation between inflation and changes in nonfuel commodity prices, and either no relation or in some cases a negative relationship between inflation and changes in fuel prices (Tables 2-7). The coefficients on nonfuel commodity prices were in the range of four to six percent in most regressions, meaning that even a doubling of commodity prices would only suggest an increase of four to six points to inflation. This was consistent with the coefficient of 7 percent that was estimated for Brazil in the April 2008 IMF REO for Latin America and only marginally higher than the coefficient of roughly 3.3 percent that was estimated for the region as a whole for 2006-07 in that report. The coefficients on fuel prices were tiny, indicating a pass-through

of only one or two percent, and in the rare cases when they were significant they were negative.

35. The relationship was tested with commodity price changes and with changes lagged one year and with the indices measured in dollars and in SDRs. All variants yielded similar results. Interchanging the wheat price index and a crude oil price index with the broader nonfuel commodity price and energy price indices yielded results that were in line with those using the broader indices. The significance of the coefficients on changes in nonfuel commodity prices was not very robust when the sample of countries was divided into subregions.

Table 2. Inflation Regressions, 1997-2008

Constant	11.862	9.314	6.913	6.317	9.158	11.950	7.310	0.332	0.464
	(4.33)	(3.23)	(1.78)	(1.61)	(3.17)	(3.98)	(1.82)	(0.98)	(1.33)
Inflation 2/	**0.45**	**0.46**	**0.46**	**0.45**	**0.45**	**0.47**	**0.48**	**0.49**	**0.48**
	(8.67)***	**(8.84)*****	**(8.88)*****	**(8.70)*****	**(8.63)*****	**(8.81)*****	**(8.98)*****	**(10.21)*****	**(9.94)*****
USNEER	**-0.12**	**-0.09**	**-0.08**	**-0.07**	**-0.09**	**-0.10**	**-0.07**		
	(-5.39)***	**(-4.01)*****	**(-2.42)****	**(-2.24)****	**(-3.93)*****	**(-4.27)*****	**(-2.14)****		
US inflation	**0.47**	**0.51**	**0.71**	**0.73**	**0.50**	**0.49**	**0.86**		
	(2.12)**	**(2.34)****	**(2.33)****	**(2.40)****	**(2.30)****	**(2.25)****	**(2.82)*****		
Exchange rate 3/	**-0.06**	**-0.07**	**-0.07**	**-0.07**	**-0.07**			**-0.06**	**-0.05**
	(-3.67)***	**(-4.21)*****	**(-3.85)*****	**(-3.74)*****	**(-4.15)*****			**(-3.35)*****	**(-2.77)*****
M2 2/ 3/	**0.08**	**0.07**	**0.07**	**0.07**	**0.07**			**0.08**	**0.08**
	(5.35)***	**(4.48)*****	**(4.48)*****	**(4.51)*****	**(4.51)*****			**(5.08)*****	**(5.20)*****
Nonfuel commodity prices 2/ 3/ 4/		**0.04**	**0.06**	**0.05**	0.04	**0.04**	**0.06**	**0.08**	**0.09**
		(2.57)**	**(2.57)****	**(2.22)****	(1.96)*	**(2.41)****	**(2.96)*****	**(5.06)*****	**(5.23)*****
Fuel prices 2/ 3/ 4/			-0.01	-0.01			-0.02		-0.01
			(-0.92)	(-1.07)			(-1.74)*		(-1.42)
Import prices 2/ 3/ 4/				0.02	0.02				
				(1.07)	(0.92)				
Adjusted R-Square	0.73	0.74	0.74	0.74	0.74	0.71	0.71	0.68	0.69
Observations	284	284	284	284	284	300	300	289	289

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent.
2/ Lagged one period. Inflation also capped at 10 percent.
3/ Percent change from previous period.
4/ Measured in SDRs.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

36. The lack of any positive significance of the coefficients on changes in fuel prices was robust across all cross sections. The relationship, oddly, was even negative in some regressions, though always with a coefficient of at most about two percent (suggesting that inflation would decrease by only one percent if oil prices increased by 50 percent). The April 2008 IMF REO for Latin America found that "world fuel price shocks have had statistically significant but smaller effects than those of world food prices" for the period 2006-07, and the coefficient that was estimated was 0.6 percent, a value that would not be inconsistent with many of the regressions shown here, given the standard deviations.

37. These results are consistent with Habermeier, et al (above) given that their measurement of the impact of all commodity prices would have captured the effect of nonfuel prices. Furthermore, they looked at the shares of food and fuel in the CPI basket and found that these shares were not statistically significant in determining inflation, but their findings were that the relationship was positive for food and negative for fuel, so they found

different effects of food and fuel, in line with the results found here. They attributed the lack of statistical significance to subsidies and price controls.

38. A negative relationship between fuel prices and inflation, to the extent that one might exist, could result from the impact of fuel subsidies on government spending. Higher fuel prices would mean that increased subsidy payments would leave less money left over for other expenditures. This could offset the effect whereby higher levels of public debt have been found to be associated with higher levels of inflation (Sargent and Wallace 1981).

39. Another explanation is suggested by Lueth and Ruiz-Arranz (2006), who found that remittances were positively correlated with oil prices in Sri Lanka; a relationship that is likely to prevail in many MENACA countries. Higher remittances at times of high oil prices could lead to lower inflation in recipient countries if higher remittances support the real exchange rate. In oil producing countries, high oil prices could also result in investment inflows for oil exploration that could similarly increase the real exchange rate. In regressions by region (see below) the nonFSU countries—a group of countries that are more likely to include remittances related to oil income—have small negative coefficients on oil prices in inflation regressions. (Larger, though usually not significant, negative coefficients when the US NEER is omitted are not shown.) Meanwhile FSU countries, which might benefit much less from oil remittances, have positive oefficients on fuel prices in inflation regressions.

40. One might expect commodity prices to affect inflation simply because commodities are widely imported and all import prices affect inflation, but evidence was found that changes in commodity prices are not simply a proxy for changes in overall import prices. When an import price index (changes, same year or lagged one year) was included in a regression the coefficient was not significant and including the variable had little impact on the nonfuel commodity price coefficient (Table 2). In regressions using uncapped inflation, however, import prices were significant and reduced the coefficients on nonfuel commodity prices.

Other explanatory variables

41. Inflation in the previous period was the most significant explanatory variable, with a coefficient of about 50 percent in most regressions (or 20-30 percent if inflation was not capped). The significance was always well above the 99.99 percent level.

42. A stronger US dollar was associated with lower inflation. The US NEER, US$/SDR, and US$/euro exchange rates and US treasury bill rate all had significant coefficients. The level of the value of the dollar appeared to be more important than the change. The changes in the US NEER, dollar/SDR, and dollar/euro exchange rates were usually not significant in regressions or were barely significant with 95 percent confidence, but with lower confidence and resulting in a lower R-squared for the regression than if the level were used.

43. The significance of the level of the US dollar could reflect the linkages between the US dollar and many currencies in the Middle East and North Africa (MENA) region. A strong US dollar would be a good proxy for tight monetary policy in the countries that use these currencies. In fact, in regional regressions, the coefficients on variables measuring the

strength of the dollar were significant with a high degree of confidence for MENA countries, but were insignificant or barely significant with 95 percent confidence in regressions using only FSU countries, whose monetary policies are more independent of US monetary policy.

44. Berger and Harjes (2009) found that US liquidity developments led Euro area liquidity. If the same were the case regarding the MENACA region higher liquidity in the US could lead MENACA liquidity, causing inflation in the MENACA region and a weaker US dollar to occur contemporaneously. This would result in a correlation between the level of the dollar and inflation in the MENACA region. Lagging the US exchange rate variables gave similar though slightly less significant results.

45. US inflation was found to be significant in regressions including the entire sample and the coefficients were large, at about a half, suggesting that every percent increase in US inflation could result in a half percent increase in the MENACA region. The coefficients increased to between 70 and 90 percent when fuel prices (not significant) were included in the regression. The significance was not robust when countries were divided into subregions.

46. Coefficients and standard errors of the variables discussed above were robust when monetary and exchange rate variables were added or deleted. If exchange rates and money growth were dropped from regressions that included variables measuring the strength of the US dollar (since there could be strong interdependence between these variables), or vice-versa, the results were not substantially altered. Neither the change in the exchange rate, the growth of the money supply, nor variables measuring the strength of the US dollar were much affected by one another, though removing the US NEER did result in the change in nonfuel commodity prices being significance with a much greater confidence margin. Removing any of these variables resulted in lower adjusted R-squareds for the regression.

47. The percent change in the exchange rate had a negative coefficient of six or seven percent in cross-country regressions with capped inflation and was significant with over 99.99 percent confidence. The coefficient was much larger if inflation was not capped, but regressions by region suggest that most of the significance may be attributable to FSU countries.

48. The percent change in broad money had a robust coefficient of seven or eight percent with a high level of confidence. Regional regressions also revealed a difference in FSU countries, however, where the coefficients were smaller and significant with a lower level of confidence. Growth of credit to the private sector was substituted for broad money growth and yielded similar results, but with a smaller coefficient significant at a lower confidence level, and with a smaller adjusted R-squared for the regression.

49. Moriyama (2008) found that in Sudan changes in the exchange rate and money supply affected inflation with an 18-24 month lag. Tests with lagged changes to the exchange rate and money supply did not exactly confirm this result for the MENACA countries as a group. When the exchange rate was lagged by a year the coefficient on the exchange rate shrank very slightly and was significant with slightly lower probability. The coefficient and t-statistic on money supply growth were maximized with a lag of one year. When either variable was lagged by two years it became insignificant. The coefficient on the exchange

rate is consistent with other studies (Eichenbaum, Burstein, and Rebelo 2002; Laflèche 1997).

50. Some evidence was found that international interest rates mattered. LIBOR was not significant in regressions, but the US Prime rate and the US T-bill rate were significant. Among countries that link their currencies to the US dollar this is not surprising, but these same results were found for the FSU region, where there are fewer such countries.

Other variables that were not found to be significant

51. Real growth is significant in some regressions, but not when any variable measuring the strength of the US dollar or money supply was included in the regression. The suggestion would be that real growth simply captures monetary and exchange rate effects. Including real growth in regressions or excluding it had little effect on other coefficients. When it was significant it had a positive coefficient. Real nonoil growth (estimated by subtracting oil imports from GDP) was also tested and found not to be significant.

52. Import prices were not found to be significant in any regression. Including them in a regression did not change the significance of other variables, including most notably commodity prices.

53. The importance of exports was tested. The change in exports divided by GDP was not found to be significant in regressions. Oil exports were also tested and found not to be significant, even in the subset of GCC countries.

Local interest rates

54. Regressions using interest rates have certain problems noted above and are treated separately in this paper. Nominal deposit and lending rates were not significant in regressions and including them increased the coefficient on the US NEER and reduced the confidence level of the significance of the coefficients on US inflation and the exchange rate (Table 3). It is not particularly surprising that local interest rates would interact separately from a global variable, though the apparent independence of it from exchange rates and the local money supply could suggest market rigidities.

55. Real deposit and lending rates were negatively related to inflation with over 99.99 percent confidence. The coefficient on the real deposit rate was larger and significant at a greater confidence level than that on the lending rate. This is not surprising, since the deposit rate is more stable and hence the real deposit rate would more closely mirror inflation. Real interest rates were calculated by simply subtracting inflation from the nominal interest rate. If adaptive expectations were used—subtracting the previous period's inflation from the nominal interest rate—the coefficients on real deposit and lending rates were insignificant.

Table 3. Inflation Regressions with Interest Rates, 1997-2008

Constant	16.952	-0.148	15.876	12.541	9.855	4.847	10.929	11.081	10.330
	(4.61)	(-0.31)	(5.25)	(3.37)	(2.57)	(0.89)	(2.68)	(3.28)	(2.66)
Inflation 2/	**0.42**	**0.56**	**0.37**	**0.41**	**0.41**	**0.40**	**0.39**	**0.38**	**0.40**
	(6.04)***	**(8.24)*****	**(5.46)*****	**(6.01)*****	**(5.96)*****	**(5.93)*****	**(5.35)*****	**(6.81)*****	**(5.50)*****
USNEER	**-0.15**		**-0.14**	**-0.13**	**-0.10**	-0.06	**-0.11**	**-0.09**	**-0.10**
	(-5.18)***		**(-5.34)*****	**(-4.23)*****	**(-3.29)*****	(-1.51)	**(-3.38)*****	**(-3.28)*****	**(-3.33)*****
US inflation	0.48			0.49	0.54	**0.96**	0.55	0.00	0.49
	(1.61)			(1.65)*	(1.82)*	**(2.17)****	(1.75)*	(-0.01)	(1.67)*
Exchange rate 3/		-0.04		**-0.06**	**-0.07**	**-0.06**	**-0.06**	**-0.04**	**-0.07**
		(-1.76)*		**(-2.50)****	**(-2.76)*****	**(-2.23)****	**(-2.38)****	**(-2.02)****	**(-3.12)*****
M2 2/ 3/		**0.13**	**0.09**	**0.09**	**0.08**	**0.07**	**0.07**	**0.06**	**0.08**
		(6.23)***	**(4.39)*****	**(4.51)*****	**(3.73)*****	**(3.65)*****	**(3.18)*****	**(3.59)*****	**(3.82)*****
Nonfuel commodity prices 2/ 3/ 4/					**0.05**	**0.08**	**0.06**	0.02	**0.05**
					(2.41)**	**(2.60)*****	**(2.53)****	(0.89)	**(2.24)****
Fuel prices 2/ 3/ 4/						-0.02			
						(-1.28)			
Nominal deposit rate	0.03	-0.05	0.03	0.00	0.02	0.04			
	(0.72)	(-1.16)	(0.63)	(-0.08)	(0.43)	(0.82)			
Nominal lending rate							0.03		
							(0.78)		
Real deposit rate								**-0.21**	
								(-7.13)***	
Real deposit rate with adaptive expectations									-0.02
									(-0.64)
Adjusted R-Square	0.67	0.63	0.67	0.68	0.69	0.69	0.68	0.76	0.69
Observations	211	202	202	202	202	202	183	202	202

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent.
2/ Lagged one period. Inflation also capped at 10 percent.
3/ Percent change from previous period.
4/ Measured in SDRs.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

56. Because of the problems of endogeneity and the prevalence of controls on interest rates in MENACA countries, it is risky to draw insights from regressions that include interest rates. However, the fact that the behavior of the coefficients on most other variables, in particular commodity prices, does not change in most cases when interest rates are added to regressions is noteworthy.

D. Differences by Region

57. Examining the data separately by region yielded many similar results and confirmed the results of the aggregate regressions, but some interesting differences were also uncovered (Table 4). The group of countries that is arguably most dissimilar from the other countries in the sample is the countries of the FSU.

58. In some regressions using only data for FSU countries lagged inflation had a somewhat smaller coefficient than in other regressions. This was consistent with Loungani and Swagel (2001). Also consistent with Loungani and Swagel, the coefficient on the local exchange rate was found to be larger and significant at a much higher level of confidence; the coefficient on the money supply was smaller and significant at a much lower level of confidence; and the coefficient on US exchange rates was somewhat smaller and significant with a lower level of confidence. The coefficient on the exchange rate in FSU countries was roughly equal to that for Romania estimated in Nicoleta (2007) in a paper devoted to estimating exchange rate pass-through.

Table 4. Inflation Regressions by Region, 1997-2008

Countries 2/	FSU	FSU	NoFSU	NoFSU	NoFSUnoGCC	NoFSUnoGCC	GCC	GCC
Constant	10.402	7.907	13.485	7.851	14.164	9.990	11.856	5.546
	(1.52)	(0.80)	(4.56)	(1.89)	(3.69)	(1.78)	(2.56)	(0.91)
Inflation 3/	**0.41**	**0.38**	**0.43**	**0.44**	**0.42**	**0.44**	**0.41**	**0.39**
	(4.22)* **	**(4.12)*** **	**(6.60)*** **	**(6.85)*** **	**(5.47)*** **	**(5.59)*** **	**(2.88)*** **	**(2.76)*** **
US NEER	**-0.11**	-0.08	**-0.13**	**-0.08**	**-0.13**	**-0.10**	**-0.12**	-0.07
	(-2.03) **	(-1.08)	**(-5.45)*** **	**(-2.45)** **	**(-4.34)*** **	**(-2.15)** **	**(-3.12)*** **	(-1.45)
US inflation	0.80	0.73	0.26	**0.63**	0.14	0.36	0.60	**1.21**
	(1.40)	(0.94)	(1.10)	**(1.97)** **	(0.46)	(0.83)	(1.79)*	**(2.36)** **
Exchange rate 4/	**-0.12**	**-0.17**	-0.01	-0.01	0.00	0.00	**-0.13**	-0.07
	(-3.77)* **	**(-5.17)*** **	(-0.56)	(-0.31)	(0.13)	(0.03)	**(-2.46)** **	(-1.03)
M2 3/ 4/	**0.07**	**0.05**	**0.10**	**0.09**	**0.11**	**0.10**	**0.08**	0.06
	(2.67)* **	**(1.98)** **	**(5.27)*** **	**(4.30)*** **	**(4.09)*** **	**(3.69)*** **	**(2.59)*** **	(1.44)
Nonfuel commodity prices 3/ 4/ 5/		**0.12**		0.05		0.04		0.07
		(2.36) **		(1.94)*		(1.22)		(1.59)
Fuel prices 3/ 4/ 5/		0.01		-0.02		-0.01		-0.03
		(0.56)		(-1.59)		(-0.64)		(-1.43)
Adjusted R-Square	0.61	0.66	0.75	0.76	0.72	0.72	0.80	0.80
Observations	64	64	220	220	148	148	72	72

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent.
2/ FSU = Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgystan, and Tajikistan.
NoFSU = Original sample with FSU countries excluded.
3/ Lagged one period. Inflation also capped at 10 percent.
4/ Percent change from previous period.
5/ Measured in SDRs.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

59. The increased significance of the exchange rate in FSU countries calls to mind research showing that Russian inflation is largely explained by exchange rate policy (Ohnsorge and Oomes, 2004). As with the larger sample, changes in nonfuel commodity prices were positive, but the coefficients varied and were not always robust. Coefficients on changes in fuel prices remained consistently insignificant. This insignificance in FSU countries is consistent with Lougani and Swagel, as well as Cheung and Yuen (2001).

60. In regressions with the FSU countries excluded from the sample the change in the exchange rate was not significant while the coefficient on money growth was much larger, at least for non GCC countries. The lack of significance of the exchange rate may reflect the greater prevalence of controls in MENA countries that would insulate citizens from the impact of exchange rate movements.

61. The coefficients on the US NEER were stable and significant across regions, but the confidence levels were lower for the FSU sample. The coefficients on US inflation were not robust across regions. They were larger and significant with greater confidence in the GCC, consistent with Hasan and Alogeel (2008). In the GCC, the coefficients on the changes in the exchange rate and in the money supply were not robust. Adjusted R-squareds were lowest in the FSU regressions and highest in the GCC countries, likely reflecting differences in data quality.

E. Differences by Oil Intensity

62. The results when countries are divided according to oil export intensity (Table 5) are in line with the aggregate regressions, but here too there are some interesting distinctions. All changes in fuel prices were insignificant in all regressions and the significance of nonfuel commodity price changes broke down in most regressions. Inflationary inertia was significant in all regressions, but the coefficients were substantially larger for countries with more oil.

63. There was evidence that inflation in countries with less oil is more driven by the strength of the US dollar relative to local variables. Countries with little oil had substantially larger coefficients on the US NEER with greater likelihood of significance than other countries. Medium oil producers had coefficients that are slightly larger with slightly greater likelihood of significance than large oil producers. Meanwhile, the reverse was the case with broad money. Countries with more oil had larger coefficients with greater likelihood of significance on the change in broad money. So the large oil producers might have more independent monetary policies than other countries. This may seem at odds with the fact that the GCC countries had the lowest T-statistic on broad money growth, except that the GCC countries are more likely to have fixed exchange rate regimes (see below), and this latter characteristic may be more important than oil intensity. Also, a large part, though not all, of the difference is due to FSU countries being more heavily represented among the low oil producers. The exchange rate also is only significant in the low oil producing countries, and the significance disappears when the FSU countries are excluded from the sample.

Table 5. Inflation Regressions by Oil Export Intensity, 1997-2008

Oil export intensity 2/	High	High	Med	Med	Low	Low	Low-NoF	Low-NoF
Constant	6.888	1.282	9.965	1.200	19.813	18.914	17.214	15.929
	(1.72)	(0.22)	(1.86)	(0.16)	(4.65)	(3.18)	(3.50)	(2.38)
Inflation 3/	**0.50**	**0.51**	**0.49**	**0.49**	**0.33**	**0.33**	**0.29**	**0.30**
	(4.12)***	**(4.15)*****	**(5.70)*****	**(5.73)*****	**(3.98)*****	**(4.04)*****	**(2.41)****	**(2.43)****
US NEER	**-0.08**	-0.03	**-0.11**	-0.03	**-0.17**	**-0.16**	**-0.15**	**-0.14**
	(-2.35)**	(-0.64)	**(-2.43)****	(-0.55)	**(-5.29)*****	**(-3.48)*****	**(-4.06)*****	**(-2.69)*****
US inflation	0.30	0.76	0.55	1.15	0.27	0.10	0.15	0.13
	(0.95)	(1.71)*	(1.25)	(1.88)*	(0.85)	(0.23)	(0.40)	(0.26)
Exchange rate 4/	-0.02	0.00	-0.03	-0.03	**-0.10**	**-0.11**	-0.02	-0.03
	(-0.58)	(0.10)	(-1.12)	(-0.90)	**(-4.09)*****	**(-4.63)*****	(-0.57)	(-0.68)
M2 3/ 4/	**0.15**	**0.14**	**0.08**	**0.07**	0.02	0.01	**0.10**	0.09
	(4.59)***	**(3.47)*****	**(3.68)*****	**(3.16)*****	(0.57)	(0.19)	**(2.16)****	(1.94)*
Nonfuel commodity prices 3/ 4/		0.03		0.08		0.04		0.02
		(0.82)		(1.83)*		(1.23)		(0.63)
Fuel prices 3/ 4/		-0.02		-0.02		0.01		0.00
		(-1.51)		(-1.29)		(0.68)		(0.08)
Adjusted R-Square	0.88	0.88	0.74	0.74	0.64	0.65	0.63	0.62
Observations	60	60	106	106	118	118	83	83

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent. Commodity prices measured in SDRs.

2/ High = Algeria, Iran, Kuwait, Saudi Arabia, U.A.E.
Med = Azerbaijan, Bahrain, Kasakhstan, Tajikistan, Libya, Mauritania, Oman, Qatar, Sudan, Syria, Tajikistan.
Low = Armenia, Djibouti, Egypt, Georgia, Jordan, Kyrgystan, Lebanon, Morocco, Pakistan, Tunisia.
Low-No F = Djibouti, Egypt, Jordan, Lebanon, Morocco, Pakistan, Tunisia.

3/ Lagged one period. Inflation also capped at 10 percent.

4/ Percent change from previous period.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

F. Fixed exchange rates versus floating exchange rates

64. The sample was separated into data points for fixed exchange rate regimes and data points for non-fixed ("floating") exchange rate regimes and regressions were run separately on each data set (Table 6). Overall the results from the all-inclusive regressions were replicated. There was significant inflationary inertia, and fuel prices were not significant (except for one regression where fuel prices were significant with a small negative coefficient), and nonfuel commodity prices were usually significant, though often only with 90 percent confidence. However, there were some differences between the regimes. Oddly the coefficient on the change in the exchange rate was larger for the fixed-rate regimes. (Recall that most fixed rates are fixed against the US dollar, while the exchange rates used here are measured against the SDR, so including them in the regression is not meaningless.) In fixed rate countries the exchange rate is likely to capture part of the effect of the US NEER. Excluding exchange rates from the regression had little effect on the other variables.

Table 6a. Inflation Regressions by Exchange Rate Regime, 1997-2008

Exchange rate regime	Fix	Fix	Fix	Fix	Float	Float
Countries 2/	All	All	All	All	All	All
Constant	15.980	14.087	8.059	10.298	11.938	5.590
	(3.13)	(2.75)	(1.26)	(1.61)	(3.46)	(1.06)
Inflation 3/	**0.32**	**0.31**	**0.31**	**0.29**	**0.46**	**0.48**
	(2.76)* **	**(2.72)*** **	**(2.74)*** **	**(2.62)*** **	**(7.37)*** **	**(7.59)*** **
US NEER	**-0.16**	**-0.15**	-0.09	**-0.11**	**-0.11**	-0.06
	(-3.80)* **	**(-3.50)*** **	(-1.79)*	**(-2.14)** **	**(-4.05)*** **	(-1.45)
US inflation	0.68	**0.91**	**1.23**	**1.06**	0.18	0.58
	(1.91)*	**(2.48)** **	**(2.48)** **	**(2.12)** **	(0.61)	(1.38)
Exchange rate 4/		**-0.10**		-0.11	**-0.05**	**-0.06**
		(-1.97) **		(-1.87)*	**(-2.62)*** **	**(-2.77)*** **
M2 3/ 4/	**0.09**	**0.07**	0.05	0.04	**0.08**	**0.07**
	(2.93)* **	**(2.50)** **	(1.41)	(1.24)	**(4.52)*** **	**(4.21)*** **
Nonfuel commodity prices 3/ 4/			**0.09**	0.07		0.05
			(2.53) **	(1.78)*		(1.83)*
Fuel prices 3/ 4/			-0.02	0.00		-0.01
			(-1.41)	(-0.12)		(-1.15)
Adjusted R-Square	0.69	0.70	0.71	0.71	0.72	0.72
Observations	112	112	112	112	172	172

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent. Commodity prices measured in SDRs.
2/ FSU = Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgystan, and Tajikistan.
NoFSU = Original sample with FSU countries excluded.
3/ Lagged one period. Inflation also capped at 10 percent.
4/ Percent change from previous period.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

Table 6b. Inflation Regressions by Exchange Rate Regime, 1997-2008

Exchange rate regime	Fix	Fix	Fix	Fix	Float	Float
Countries 2/	NoFSU	NoFSU	NoFSU	NoFSU	NoFSU	NoFSU
Constant	15.980	14.087	8.059	10.298	14.261	8.789
	(3.13)	(2.75)	(1.26)	(1.61)	(3.98)	(1.61)
Inflation 3/	**0.32**	**0.31**	**0.31**	**0.29**	**0.45**	**0.45**
	(2.76)* **	**(2.72)*** **	**(2.74)*** **	**(2.62)*** **	**(5.36)*** **	**(5.24)*** **
US NEER	**-0.16**	**-0.15**	-0.09	**-0.11**	**-0.12**	-0.08
	(-3.80)* **	**(-3.50)*** **	(-1.79)*	**(-2.14)** **	**(-4.26)*** **	(-1.83)*
US inflation	0.68	**0.91**	**1.23**	**1.06**	-0.34	0.18
	(1.91)*	**(2.48)** **	**(2.48)** **	**(2.12)** **	(-1.09)	(0.41)
Exchange rate 4/		**-0.10**		-0.11	0.02	0.03
		(-1.97) **		(-1.87)*	(0.89)	(1.27)
M2 3/ 4/	**0.09**	**0.07**	0.05	0.04	**0.12**	**0.12**
	(2.93)* **	**(2.50)** **	(1.41)	(1.24)	**(4.40)*** **	**(4.42)*** **
Nonfuel commodity prices 3/ 4/			**0.09**	0.07		0.02
			(2.53) **	(1.78)*		(0.59)
Fuel prices 3/ 4/			-0.02	0.00		-0.02
			(-1.41)	(-0.12)		(-1.82)*
Adjusted R-Square	0.69	0.70	0.71	0.71	0.80	0.80
Observations	112	112	112	112	108	108

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent. Commodity prices measured in SDRs.
2/ FSU = Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgystan, and Tajikistan.
NoFSU = Original sample with FSU countries excluded.
3/ Lagged one period. Inflation also capped at 10 percent.
4/ Percent change from previous period.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

65. The coefficient on inflationary inertia was found to be greater for non-fixed rate countries than for fixed rate countries (in contrast to Loungani and Swagel; 2001). The coefficient increased from about a third to about half. The coefficient on the US NEER was

also unsurprisingly significantly larger for fixed rate regimes than for floating rate regimes, though it was still significant for non-fixed rate regimes. This could reflect the difficulty in separating regimes into fixed and non-fixed, or it could show that the non-fixed-rate regimes do not manage their monetary and exchange rate policies completely independently of their neighbors' policies or of US policies. Further evidence of spillovers or that there might not be a clear or accurate line between the two regimes is the fact that the exchange rate is not significant in regressions using only non-FSU countries with non-fixed exchange rate regimes. Many countries officially allow their exchange rates to float, but in practice either fix them or keep them closely aligned with another currency, usually the US dollar (Calvo, Rheinhart 2000).

66. US inflation was significant in some regressions with fixed rate regimes, but never with floating rate regimes. This was in line with Cheung (2001), who argued that inflation in the US would have a larger impact on a small economy if it had fixed exchange rates rather than floating rates (though US exchange rates display more impact in these regressions than US inflation).

67. A coefficient representing either a fixed or a floating exchange rate regime had no significance in any regression, and no coefficient was found that behaved significantly differently when it was filtered to be included only for fixed rate regimes or floating rate regimes, though the significance of some variables was found to differ among the FSU countries (more of which have floating exchange rates).

G. Other tests

68. Results using monthly data were similar to the results using annual data, though the range of tests was restricted because many series were not available monthly. The coefficients on the change in the exchange rate and the growth of the money supply remained significant, but were smaller and significant at a lower level of confidence. The coefficients on changes in fuel prices remained insignificant and the coefficients on changes in nonfuel commodity prices significant.

69. Political developments could potentially have an impact on inflation. Aisen and Veiga (2006) find higher inflation to be associated with greater ideological polarization, and Alesina and Drazen (1991) find it to be related to greater reliance on seignorage that results from political standoffs. No variables quantifying political factors were available, but dummies testing for breaks in 2001 (9/11) as well as all other years during 1998-2005 were tested. A break in 2001 was found to be significant, while breaks in all other years were insignificant.

70. Several other variables were tested and no robust significance was identified. These included export ratios, investment rates, fiscal balances, and levels of total or per capita GDP.

H. The Global Financial Crisis

71. The regressions described above were run using data from 1997 through the most recently available data (Table 2b). To ensure that results were not being driven by quirks related to the global financial crisis the same tests were run using data through 2007. It

should be noted that inflation reached a peak in 2008, though the rise had already been stopped by the end of 2008. The crisis strengthened the results somewhat by increasing the size and significance of some coefficients, but almost all coefficients that were significant using data through the crisis were also consistent using data that stop before the crisis. It should be noted that most post-crisis regressions only have complete data through 2008, so the difference between the pre- and post-crisis regressions is just that one year

Table 2b. Inflation Regressions, 1997-2007

Constant	10.658	8.050	9.657	9.208	7.919	10.882	10.328	0.332	0.317	0.346
	(3.85)	(2.79)	(2.48)	(2.34)	(2.74)	(3.65)	(2.59)	(0.97)	(0.89)	(1.01)
Inflation 2/	**0.42**	**0.43**	**0.42**	**0.41**	**0.42**	**0.42**	**0.42**	**0.48**	**0.48**	**0.47**
	(8.00)* **	**(8.15)*** **	**(7.88)*** **	**(7.70)*** **	**(7.90)*** **	**(7.81)*** **	**(7.71)*** **	**(9.69)*** **	**(9.60)*** **	**(9.29)*** **
USNEER	**-0.10**	**-0.08**	**-0.09**	**-0.08**	**-0.07**	**-0.09**	**-0.08**			
	(-4.44)* **	**(-3.15)*** **	**(-2.84)*** **	**(-2.68)*** **	**(-3.07)*** **	**(-3.50)*** **	**(-2.65)*** **			
US inflation	0.21	0.25	0.09	0.11	0.24	0.23	0.29			
	(0.91)	(1.10)	(0.25)	(0.32)	(1.05)	(1.05)	(0.83)			
Exchange rate 3/	**-0.05**	**-0.06**	**-0.06**	**-0.06**	**-0.06**			**-0.05**	**-0.05**	**-0.05**
	(-3.07)* **	**(-3.65)*** **	**(-3.69)*** **	**(-3.58)*** **	**(-3.57)*** **			**(-3.17)*** **	**(-3.06)*** **	**(-3.09)*** **
M2 2/ 3/	**0.08**	**0.07**	**0.07**	**0.07**	**0.07**			**0.08**	**0.08**	**0.08**
	(5.28)* **	**(4.32)*** **	**(4.33)*** **	**(4.32)*** **	**(4.32)*** **			**(5.14)*** **	**(5.10)*** **	**(5.12)*** **
Nonfuel commodity prices 2/ 3/ 4/		**0.05**	0.04	0.03	**0.04**	**0.05**	**0.05**	**0.07**	**0.07**	**0.06**
		(2.77)* **	(1.65)*	(1.41)	**(2.14)** **	**(2.86)*** **	**(2.23)** **	**(4.29)*** **	**(3.85)*** **	**(3.21)*** **
Fuel prices 2/ 3/ 4/			0.01	0.00			0.00		0.00	
			(0.62)	(0.48)			(-0.21)		(0.16)	
Import prices 2/ 3/ 4/				0.02	0.02					0.02
				(0.82)	(0.91)					(1.27)
Adjusted R-Square	0.73	0.74	0.74	0.74	0.74	0.71	0.71	0.72	0.72	0.72
Observations	264	264	264	264	264	275	275	264	264	264

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent.
2/ Lagged one period. Inflation also capped at 10 percent.
3/ Percent change from previous period.
4/ Measured in SDRs.

* - 90 percent significan
** - 95 percent significa
*** - 99 percent signific

I. Time Trend

72. The justification for including a time trend variable in regressions is that there may be variables that have changed over time that are not included in the regression, perhaps because they are difficult to measure. One such factor that has changed over time is that almost all countries have experienced financial deepening in ways that might not be entirely captured by changes in the money supply or other variables. Since they justification is vague a trend was not considered in the main body of this paper.

73. A trend (or "year") variable was significant in almost every regression with a high level of confidence. The coefficients were large, at around 15 percent, meaning that inflation would increase by about 0.15 points every year independently of the factors included in these regressions. It is not surprising that a trend variable would be significant, since there are uncountable factors that impact inflation, many of them difficult to quantify, such as psychology, weather, politics, … but the size of the coefficient might be surprising.

74. The regressions in Table 2 were run again, this time including the year in the regressions. The impact of this change on most coefficients was minimal. The two exceptions were US inflation and nonfuel commodity prices. The coefficients on US inflation shrank greatly and became insignificant when the year was added to the regression. The impact on the coefficients on changes in nonfuel commodity prices was equally dramatic, with the

coefficients shrinking and becoming insignificant (although if the US NEER was excluded from the regression the coefficients increased and were again significant). Changes in fuel prices remained insignificant in all regressions.

Table 7. Inflation Regressions with a Time Trend Variable, 1997-2008.

Constant	-328.290	-299.489	-289.623	-302.744	-309.613	-311.060	-320.609	-329.510	-283.261
	(-3.59)	(-3.06)	(-2.90)	(-3.02)	(-3.35)	(-3.27)	(-3.41)	(-2.95)	(-2.00)
Inflation 2/	**0.48**	**0.49**	**0.48**	**0.48**	**0.47**	**0.49**	**0.49**	**0.51**	**0.48**
	(9.27)* **	**(9.31)*** **	**(9.13)*** **	**(9.21)*** **	**(8.98)*** **	**(10.32)*** **	**(10.14)**	**(9.38)*** **	**(8.99)*** **
Year	**0.17**	**0.15**	**0.15**	**0.16**	**0.16**	**0.16**	**0.16**	**0.17**	**0.15**
	(3.75)* **	**(3.18)*** **	**(3.03)*** **	**(3.16)*** **	**(3.51)*** **	**(3.28)*** **	**(3.42)**	**(3.06)*** **	**(2.04)** **
USNEER	**-0.10**	**-0.09**	**-0.09**	**-0.10**	**-0.09**			**-0.09**	**-0.09**
	(-4.39)* **	**(-3.99)*** **	**(-4.15)*** **	**(-4.35)*** **	**(-4.12)*** **			**(-3.76)*** **	**(-2.81)*** **
US inflation		0.19						0.14	0.09
		(0.83)						(0.58)	(0.20)
Exchange rate 3/	**-0.06**	**-0.06**	**-0.06**	**-0.07**	**-0.06**	**-0.06**	**-0.06**		**-0.07**
	(-3.64)* **	**(-3.73)*** **	**(-3.76)*** **	**(-3.98)*** **	**(-3.69)*** **	**(-3.03)*** **	**(-3.43)*** **		**(-3.86)*** **
M2 2/ 3/	**0.07**	**0.07**	**0.06**	**0.06**	**0.07**	**0.07**	**0.07**		**0.06**
	(4.50)* **	**(4.43)*** **	**(4.30)*** **	**(4.05)*** **	**(4.45)*** **	**(4.25)*** **	**(4.19)*** **		**(4.08)*** **
Nonfuel commodity prices 2/ 3/ 4/			0.02	0.00		**0.06**	**0.04**	0.01	0.00
			(0.97)	(0.23)		**(2.91)*** **	**(2.17)** **	(0.62)	(0.12)
Fuel prices 2/ 3/ 4/				0.01		-0.01		0.00	0.01
				(1.30)		(-0.91)		(-0.82)	(0.48)
Import prices 2/ 3/ 4/					0.02		0.02		0.02
					(1.37)		(0.93)		(0.92)
Adjusted R-Square	0.74	0.74	0.74	0.74	0.74	0.70	0.70	0.72	0.74
Observations	284	284	284	284	284	289	289	300	284

1/ Fixed effects. T-statistics are shown in parentheses. Inflation is capped at 10 percent.
2/ Lagged one period. Inflation also capped at 10 percent.
3/ Percent change from previous period.
4/ Measured in SDRs.

* - 90 percent significance
** - 95 percent significance
*** - 99 percent significance

J. Summary and Conclusions

75. This paper, while agreeing with much previous research, arrives at a number of controversial results that differ from conventional wisdom. The main one is that changes in energy prices were generally not found to be significant in regressions on inflation, or in some cases the coefficients were even negative. This result was robust across regressions with different mixtures of variables, and using different subsets of countries separated according to geographical area, oil intensity, and exchange rate regime, and using different lags. The prevalence of price controls on petroleum products may make this result less surprising, though direct price increases are not the only mechanism through which higher fuel prices could affect inflation. A similar result was found for import prices. Subsidies and price controls in the MENACA region are one of the most likely factors that would explain this curious result, though many of these subsidies have been or are in the process of being removed. In contrast, nonfuel commodity price changes were found to be significant in most regressions, though the significance was not robust across subsets of countries or in many regressions that included a trend variable.

76. The paper confirms previous research and current impressions that the strength of the US dollar has a significant impact on inflation. The coefficient was greater for fixed rate countries and for countries with less oil, but was significant in at least some regressions in all cross sections. It is not surprising that the strength of the US dollar would have a significant

impact in countries that link their currencies to the US dollar, and if countries that don't link to the dollar are surrounded by countries that do one might expect at least spillover effects if not direct effects. This could explain why inflation in floating rate non-FSU countries in the sample showed a greater correlation with the US dollar than inflation in FSU countries; the FSU countries are not geographically intermixed with countries that are fixed against the dollar.

77. The importance of inflationary inertia was confirmed. Some differences in the size of the coefficient were found across different subgroups, but in all regressions the coefficient was large and significant. Inflationary persistence was found to be more significant when the regression was limited to non-fixed exchange rate regimes.

78. Exchange rates and money supply were found to be significant factors, but with variances across different cross sections of countries. In FSU countries and countries with fixed exchange rates, changes in exchange rates were found to have larger coefficients, while the coefficients on changes in the money supply were found to be larger for non-FSU countries, particularly ones with floating exchange rate regimes and with more oil. Real growth was not significant in any regressions. Credit growth was found to behave similar to money supply growth in regressions, but it generated lower coefficients, lower adjusted R-squareds for the regression, and hence there was no reason to think that it contained more useful information than did money supply growth.

79. A trend variable was significant, suggesting that there may be additional factors influencing inflation that were not captured in the discussions above, with one possibility being financial deepening. A dummy representing a structural break in 2001 was significant, suggesting that political pressures or other changes following 9/11 had an impact on inflation.

80. Countries with exchange rate flexibility have monetary and exchange rate policies that can be used to combat inflation and any resurgence of inflation should be met with a strong policy response. Some countries may have been slow to react to the resurgence in inflation, and responding may have been more difficult in a region where neighbors or countries themselves are likely to have their currencies linked directly or indirectly to the US dollar. One conclusion that is strongly suggested is that countries should be cautious about relying on falling fuel prices to address high inflation, though there is reason to believe that falling nonfuel commodity prices may have a beneficial impact on inflation.

81. In many countries, particularly those with official or unofficial policies linking the national currency to the dollar, the options to address inflation are limited. Such countries might want to consider greater exchange rate flexibility, as was being considered by the GCC countries shortly before the global financial crisis. Fortunately, at such times, the pressure would be in the direction of appreciation, which might be more politically acceptable than depreciation. The alternative would be to remain aligned with the US dollar, which would provide stability benefits, but may impose costs when the country's economic cycle does not align with that of the US.

Table 8. Summary of Regression Variables

Variable	Expected result	Actual result
Inflation in previous period	Should be highly significant with a coefficient between one and zero.	Highly significant and robust with a coefficient of about 0.5, but which varies from 0.3 to 0.5 in some subsample regressions.
Strength of the US dollar (NEER, exchange rate versus the SDR or the euro)	A higher level and an appreciation might both be associated with lower inflation since several MENACA countries align their monetary and exchange rate policies with the US. Tight monetary policy in the US would increase the value of the dollar and the should result in tight monetary policy and lower inflation in MENA countries.	The US NEER is robustly significant, even when local exchange rates and money growth are included in the regression. The US REER behaves almost identically in regressions, but with a slightly lower confidence interval and adjusted R-squared. The US Treasury bill rate also yields similar results. The rate of change of the US NEER is not significant in most regressions or is barely significant and yields a lower R-squared than the level of the US NEER.
US inflation	A higher level of US inflation could be associated with higher inflation in other countries, particularly those that link their currencies to the US dollar.	US inflation is significant in many regressions, usually right at the 95 percent confidence level. The coefficient for large samples is usually large at about 0.5, but in many cases with subsamples of countries it has a large coefficient close to or even higher than one (full transmission)!
Change in the exchange rate (versus the SDR)	Depreciation should be associated with higher inflation.	Coefficients are positive and significant, but the significance vanishes when FSU countries are excluded from the regression sample. Significance is high for FSU countries. NEER gives similar results, but it reduces the sample size.
Change in money plus quasi-money	Higher money supply growth should be associated with higher inflation.	Significant positive coefficient, but smaller and sometimes not even significant when US NEER or US/euro exchange rate are included. Coefficient decreases for FSU and GCC countries, and vanishes for low oil producers.
Change in nonfuel commodity prices (denomiated in dollars or SDRs)	Would be expected to have a positive coefficient since increasing the price of any factor input should lead to inflation. Subsidies could lessen the impact.	Significant in most full sample regressions, but not robust when regressions are divided into subregions. Impact appears stronger in FSU region.
Change in fuel prices (denomiated in dollars or SDRs)	Could result in inflation by increasing fuel prices, though subsidies could lessen the impact.	Insignificant in almost all regressions and in the few regressions where it is marginally significant the coefficient is tiny.
Real economic growth	Uncertain effect. Could have either positive or negative impact.	Coefficient is usually positive but is not significant in almost any regression.
Import prices (denominated in dollars or SDRs)	Increasing import prices should be associated with higher inflation, as should increasing any prices.	Not singificant in most regressions and usually does not undermine the significance of the coefficient on nonfuel commodity prices in those regressions where the coefficient on nonfuel commodity prices is significant.
International interest rates	Higher international interest rates could drive tighter monetary policies in MENACA countries.	International interest rates behave much like the US NEER, but with lower adjusted R-squareds and confidence levels for the regressions.
Local real and nominal interest rates	Problematic variables to include in the regressions. Real interest rates should be negatively correlated while nominal interest rates in practice would most likely be positively correlated. There are endogeneity problems with using interest rates. These variable are included mainly to test the robustness of other conclusions	Real interest rates are significantly negatively correlated and nominal interest rates are insignificant. The coefficietn on the US NEER increases when interest rates are added to the regression. Exchange rates become insignificant when interest rates are added to the regression.
Fixed or floating exchange rate	Inflation might behave differently in countries with different exchange rate regimes. In particular countries with more flexible exchange rates might suffer less inflation since they would he able to address real exchange rate changes with nominal exchange rate movements.	Fixed or floating exchange rate regimes were not significant in any regression. However, determining values for this variable can be tricky since many countries are not transparent about the true nature of their regime. Separate regressions run for each regime found that money supply and the US NEER were more important for floating rate countries and US inflation was more important for fixed rate countries.
Breaks in years 1998-2005	Breaks in any of the years 2001-04 could be associated with increased political uncertainty due to 9/11 or the war in Iraq, and this could lead to higher inflation.	A break in 2001 resulting in higher inflation was found to be significant. Breaks in no other years were significant.
Time trend	Uncertain. A time trend (the year or month) can capture effects that are left out of the regression.	Highly significant with a positive coefficient in most regressions, suggesting that inflation has had upward drift over time or that a factor that has been causing inflation to increase has been left out of the regression. Causes the increase in nonfuel commodity prices to become insignificant.

Unit Root Tests

82. Fisher type unit root tests based on augmented Dickey-Fuller tests were conducted on inflation and inflation capped at 10 percent. Four types of tests were conducted:

Inverse chi-squared (50)
Inverse normal Z
Inverse logit t(129)
Modified inv. chi-squared Pm

83. For inflation, unit roots were rejected with over 99.99 percent confidence for all tests. For inflation capped at 10 percent the confidence levels weren't quite as conclusive, but still the confidence values ranged from 99.53 percent to 99.97 percent.

Data and Countries Analyzed

84. This survey focuses on the countries covered by the IMF's MCD department for which data were available. This list included: Algeria, Armenia, Azerbaijan, Bahrain, Djibouti, Egypt, Georgia, Iran, Jordan, Kazakhstan, Kuwait, Kyrgyz Republic, Lebanon, Libya, Mauritania, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Sudan, Syria, Tajikistan, Tunisia, and United Arab Emirates. The countries that were excluded because of lack of data were Afghanistan, Iraq, Somalia, Turkmenistan, Uzbekistan, West Bank and Gaza, and Yemen.

85. Inflation was measured using CPI data from IMF IFS Statistics. Period average CPI data were used because there was greater coverage for this series. Tests were run using end-period CPI data and similar results were obtained. Commodity prices, import prices, deposit and lending rates, and exchange rates, and monetary aggregates were taken from IMF IFS Statistics. GDP data were taken from IMF WEO Statistics. The inflation series was tested to ensure that it was stationary and it was.

86. The data in the paper cover the period 1996-2009. This includes a volatile period with a steep drop in inflation followed by a resurgence, which most would argue is an interesting period. Longer time series are normally desirable, but in this case going back farther has drawbacks. Prior to 1996 the data become patchier, so sample sets would become smaller depending on which variables are added and it would therefore be necessary to control the results for reductions in the sample set. The alternative is to allow the periods to vary according to the variables added, and in this case truncating the periods would be necessary to make the results comparable, which is in effect what was done. Truncating the sample set does not seem necessarily preferable to truncating the period. Furthermore, there have been significant developments in financial markets and significant financial deepening since the period prior to 1996, so going back too far might capture effects that are no longer relevant.

87. The inflation series that was used in most regressions incorporated a cap of 10 percent on inflation in any year for any country. This is because some countries, notably Sudan and Tajikistan, experienced periods of very high inflation that could be suspected of driving some results. In fact, capping inflation at 10 percent (or at 15 percent, which was also tested) did

not qualitatively change the results, though it resulted in somewhat more stable coefficients and somewhat diminished the coefficient on the exchange rate.

88. Lagged variable for commodity prices were used in regressions because they resulted in higher adjusted R-squareds in the regressions and the coefficient on nonfuel commodity price changes was significant with a greater level of confidence. When unlagged commodity prices were used the coefficient on fuel prices was more negative.

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