

# Vulnerability to higher oil prices

Decomposition analysis of 158 countries between 2003 and 2008

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Masami Kojima, World Bank

## Summary

This note examines changes in vulnerability to oil price increases—where vulnerability is defined as the share of GDP spent on net oil imports—over a five-year period ending in 2008, when annual average oil prices were close to the levels seen this year. A decomposition analysis applied to 158 countries, including 120 in IDA and IBRD, found that vulnerability increased in 82 percent of countries, with more than half experiencing vulnerability exceeding 5 percent in 2008 and one fifth experiencing vulnerability exceeding 10 percent. The highest concentrations of countries with vulnerability exceeding 10 percent were in EAP, LAC, and MNA, and those with largest increases in vulnerability were in AFR and LAC. AFR also had the highest share of countries in which rising oil intensity (oil consumed per unit of GDP) exacerbated rising vulnerability. By income, the low-income group had the highest share of countries with increasing vulnerability as well as an increase in vulnerability of more than 5 percentage points of GDP. All Bank regions except ECA were represented in the 10 most vulnerable countries. The 10 countries varied widely in reducing the oil intensity of the economy: Maldives and Jordan reduced oil intensity markedly and, had they not done so, their vulnerability in 2008 would have been about 8 percentage points higher; Tonga, in contrast, saw rising oil intensity increase the country's vulnerability by 4 percentage points. It would be informative to follow up these preliminary findings by studying how some countries managed to adopt effective coping mechanisms as world oil prices surges, while others became even more reliant on oil.

## Background

This note examines the levels of and changes in vulnerability to oil price increases in 158 countries between 2003—the year before the start of the recent rise in world oil prices—and 2008—the last year for which data are available. Among the sample are 120 IDA and IBRD countries. Vulnerability is defined as the ratio of the value of *net* imports of crude oil and oil products to GDP, and rises if oil consumption increases relative to oil production per unit of GDP. Analysis of data through 2008 is informative because the annual average prices of oil in 2008 were close to the average prices to date in 2011—for example, the prices of three marker crudes tracked by the World Bank (Brent, West Texas Intermediate, and Dubai) averaged \$97 a barrel in 2008 and \$105 during the first five months of 2011. Data descriptions and limitations are provided in Annex 1. Although not tabulated in this note for brevity, the results of decomposition analysis covering 10 years between 1998 and 2008 are also discussed where pertinent.

To gain an understanding of the relative contributions of different factors influencing vulnerability, the note follows the methodology explained in a 2008 publication ([http://siteresources.worldbank.org/INTOGMC/Resources/eid1\\_oil\\_price\\_vulnerability.pdf](http://siteresources.worldbank.org/INTOGMC/Resources/eid1_oil_price_vulnerability.pdf)) and uses a refined Laspeyres index to decompose the change in a country's vulnerability between 2003 and 2008 into the sum of the effects of changes in seven parameters, three related to oil production and four

related to oil consumption. Using an accounting identity to decompose changes in vulnerability over time allows the separation of the pure oil price change effect from other changes that affect vulnerability. The production-related factors are the changes in the price of oil, the level of oil production, and the inverse of GDP. The consumption-related factors are the changes in the price of oil, the share of oil in total commercial energy consumption (referred to as oil share), the ratio of commercial energy consumed to GDP (referred to as energy intensity), and the proxy real exchange rate (the ratio of the nominal exchange rates in the two years divided by the ratio of local GDP price deflators). The identity can be written as

change in vulnerability = production effects + consumption effects

$$\begin{aligned} DV = V_{2008} - V_{2003} &= DP && + DC \\ &= (\text{oil price effect through output} + \text{oil production effect} + \text{effect of the inverse of current GDP in US\$}) + \\ &(\text{oil price effect through consumption} + \text{oil share effect} + \text{energy intensity effect} + \text{proxy real exchange rate effect}). \end{aligned}$$

One advantage of this approach is that the seven factors are additive. For example, the sum of the oil share effect and the energy intensity effect yields the effect of changing the oil intensity of the economy (oil consumed per unit of GDP).<sup>1</sup> The decomposition analysis can inform how much changes in individual factors contribute to the overall changes in vulnerability. The results may highlight countries that are experiencing atypical changes in vulnerability and could call for more detailed analysis of why a country might be departing markedly from the global trend of countries with comparable levels of economic development and resource endowments, and what steps could reduce vulnerability.

## Results

Table 1 summarizes the findings by region and income. Vulnerability increased in more than 80 percent of countries, with 26 and 4 countries registering an increase of more than 5 and 10 percentage points of GDP, respectively, all of them Bank client countries. The low-income group had the highest share of countries experiencing an increase in vulnerability as well as an increase in vulnerability of more than 5 percentage points of GDP. Among Bank client countries, vulnerability exceeded 5 percent in 2008 in half or more countries in AFR, EAP, LAC, and SAR, and 10 percent in more than one fifth of countries in EAP, LAC, and MNA.

Focusing on the consumption effect, the sum of the price effect and the proxy real exchange effect was positive in every country. One important mechanism for offsetting the increase in vulnerability from higher oil prices was through reducing oil intensity, which in turn consists of the oil share of energy and the energy intensity of the economy. By income, the low-income group had the highest proportion of countries with rising oil share, followed by upper-middle-income and high-income. For energy intensity, the lower-middle-income group had the highest proportion of countries with rising energy intensity, followed by low-income and upper-middle-income. Combining the two effects, the lower-middle-

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<sup>1</sup> Small differences in the sum of oil share and energy intensity and individual factors reported in this note arise from rounding errors.

income group had the highest proportion of countries with rising oil intensity, closely followed by the low-income group. By region, AFR had a disproportionately high concentration of countries with rising oil intensity, driven by both rising oil share of energy and rising energy intensity. Although not shown in Table 1, AFR also had the smallest proportion of countries in which falling energy intensity more than offset rising oil share to deliver a reduction in oil intensity. More specifically, among the countries with rising oil share, falling energy intensity fully compensated for the increase in the oil share in 54% of the cases in AFR, compared to 67% in LAC, 88% in EAP, 90% in ECA, and 100% in MNA and SAR.

The mean and median values of vulnerability parameters are shown in Table 2 and Table 3, respectively. Large differences between mean and median arise primarily from oil production, where some large net exporters had large negative values, affecting averages significantly. During the period under review, the oil share of energy on average remained essentially the same, but energy intensity fell markedly. Although the exchange rate itself depreciated in 56 countries, including 51 in IDA and IBRD, the proxy real exchange rate appreciated against the U.S. dollar in all countries. The median increase in vulnerability was the highest at 3.2 percentage points in EAP and LAC among the six Bank regions.

The top 20 countries found to be most vulnerable in 2008 are given in Table 4. None of them were oil producers in 2008, and 16 out of the 20 in the table were also in the top 20 in terms of increases in vulnerability. Most also experienced some of the largest increases in vulnerability between 1998 and 2008. The 20 countries are evenly distributed across low, lower-middle, and upper-middle-income countries. LAC and AFR had the largest number of countries (7 and 6, respectively), with all but one country in AFR being low income.

The results of decomposition analysis are provided in Table 5–Table 10 for each of the Bank’s six regions and in Table 11 for the rest of the world.

**Table 1: Percentage of countries with adverse vulnerability characteristics**

Parameter				Region						Income			
	All	Bank	Non-Bank	AFR	EAP	ECA	LAC	MNA	SAR	Low	Lower middle	Upper middle	High
Number of countries	158	120	38	42	17	17	28	9	7	32	43	41	42
Number of oil producers	108	74	34	19	8	16	19	8	4	11	30	29	38
Vulnerability in 2003 > 5%	14	18	0	17	18	18	21	22	14	22	16	20	0
Vulnerability in 2003 > 10%	3	3	0	2	0	0	4	11	14	3	7	0	0
Vulnerability in 2008 > 5%	42	53	8	50	59	47	64	33	57	59	53	54	7
Vulnerability in 2008 > 10%	15	20	0	17	24	0	36	22	14	3	21	22	0
$\Delta V > 0\%$	82	82	84	81	94	82	79	56	100	94	81	73	83
$\Delta V > 5$ percentage points	16	22	0	24	24	6	29	22	14	25	19	22	2
$\Delta V > 10$ percentage points	3	3	0	5	0	0	7	0	0	0	2	5	0
$\Delta C > 0\%$	96	94	100	93	100	82	100	89	100	97	98	90	98
$\Delta \text{Oil share} > 0\%$	46	48	42	57	47	59	43	22	14	59	37	49	43
$\Delta \text{Energy intensity} > 0\%$	20	23	8	29	24	0	21	33	43	22	28	20	10
$\Delta \text{Oil intensity} > 0\%$	21	22	18	36	18	6	18	22	0	25	26	20	14

Table 2: Mean of vulnerability parameters by country category

Country category	Vulnerability					Production effects			Consumption effects			Real exchange rate
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	price	oil share	Energy intensity	
All	-2.2	-0.8	1.4	-1.9	3.4	-11	-2.4	11	7.4	0.0	-0.7	-3.2
Bank	-2.0	-6.2	-4.2	-7.9	3.8	-14	-7.9	14	8.4	-0.1	-0.9	-3.7
AFR	-4.5	-3.8	0.7	-2.6	3.3	-15	-5.4	18	6.7	0.0	-0.5	-2.8
EAP	2.9	-37	-40	-45	5.0	-22	-36	13	8.6	-0.2	0.1	-3.4
ECA	-2.7	-2.7	0.0	-1.5	1.5	-16	-6.0	20	9.5	0.4	-2.7	-5.8
LAC	1.4	4.4	3.0	-1.9	4.9	-6.0	-0.7	4.8	9.1	0.0	-0.7	-3.5
MNA	-12	-12	-0.2	-5.0	4.7	-32	-1.5	29	13	-0.9	-1.0	-6.5
SAR	3.9	7.0	3.1	-0.3	3.4	-0.6	0.0	0.4	7.6	-0.7	-1.3	-2.2
Low	3.3	5.0	1.7	-1.7	3.4	-1.9	-1.9	2.1	7.2	0.1	-0.8	-3.2
Lower middle	-2.7	-17	-14	-18.6	4.2	-21	-16	18	9.3	-0.3	-0.7	-4.0
Upper middle	-3.5	-2.2	1.3	-2.4	3.8	-15	-3.5	16	8.9	0.1	-1.2	-4.0
High	-4.6	-3.9	0.7	-1.4	2.2	-11	-1.7	12	4.1	0.0	-0.3	-1.7

Note: The averages are not weighted. Timor-Leste is excluded because of the large magnitude of its  $\Delta V$  (see Table 6), which would unduly influence the average values.

Table 3: Median of vulnerability parameters by country category

Country category	Vulnerability					Production effects			Consumption effects			Real exchange rate
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	price	oil share	Energy intensity	
All	2.1	4.1	2.2	0.0	2.7	-0.1	0.0	0.0	6.1	0.0	-0.4	-2.2
Bank	2.6	5.4	2.7	0.0	3.2	0.0	0.0	0.0	7.1	0.0	-0.5	-2.8
AFR	2.2	5.0	2.5	0.0	2.4	0.0	0.0	0.0	4.8	0.0	-0.3	-1.8
EAP	3.6	7.3	3.2	0.0	4.6	0.0	0.0	0.0	8.3	-0.1	-0.4	-2.9
ECA	2.6	4.4	1.9	0.0	1.7	-1.5	0.0	0.9	8.8	0.3	-2.3	-4.6
LAC	3.1	6.4	3.2	0.0	3.7	0.0	0.0	0.0	7.6	-0.1	-0.6	-2.3
MNA	-2.3	-0.4	2.0	-4.3	4.2	-17	0.0	9.9	14	-0.5	-0.6	-4.9
SAR	2.7	6.0	2.9	0.0	2.8	0.0	0.0	0.0	7.6	-0.7	-0.1	-2.2
Low	3.0	5.6	2.4	0.0	2.4	0.0	0.0	0.0	5.7	0.1	-0.4	-2.1
Lower middle	-2.9	-0.9	1.9	-2.1	4.0	-14	-2.2	14	9.3	-0.3	-0.8	-4.1
Upper middle	2.3	5.3	2.7	0.0	3.2	-0.3	0.0	0.2	7.9	0.0	-0.8	-3.0
High	1.3	2.7	1.3	-0.1	1.8	-0.2	0.0	0.1	3.7	0.0	-0.3	-1.3

Table 4: Top 20 countries with highest vulnerability in 2008

Country	Income	Vulnerability		
		2003	2008	$\Delta V$
Seychelles	Upper middle	8.3	25	17
Jamaica	Upper middle	8.0	20	12
Liberia	Low	8.9	19	10
Guyana	Lower middle	16	18	2.5
Nicaragua	Lower middle	6.7	17	10
Maldives	Lower middle	11	16	5.7
Fiji	Upper middle	7.2	16	8.7
Sierra Leone	Low	7.0	15	8.4
Jordan	Lower middle	11	15	3.8
Tonga	Lower middle	4.0	13	9.3
Antigua and Barbuda	Upper middle	5.2	13	8.0
Guinea-Bissau	Low	5.5	13	7.1
Benin	Low	4.1	12	8.1
Honduras	Lower middle	4.7	12	7.5
Cambodia	Low	5.4	11	5.9
Gambia, The	Low	5.7	11	5.5
St. Kitts and Nevis	Upper middle	2.3	11	8.9
Lebanon	Upper middle	5.5	11	5.5
Grenada	Upper middle	3.9	11	7.1
Mongolia	Lower middle	7.5	11	3.2

## AFR

The change in vulnerability in 42 AFR countries ranged from 17 percentage points in Seychelles to –40 percent in Chad. Led by Benin, 36 percent of countries—the highest of any region—saw oil intensity increase. In three quarters of the cases, this increase was in part or solely due to rising oil share of energy. The oil share in fact increased in 24 out of 42 countries, compared to 12 out of 42 in which energy intensity rose. Three countries, all with vulnerability in 2003 lower than 9 percent, saw vulnerability surpass 15 percent in 2008: Liberia, Seychelles, and Sierra Leone. In contrast, Mauritania—which had the highest vulnerability in the region in both 1998 and 2003—saw its vulnerability fall by 13 percentage points during the five-year period. Although oil production was an important factor in this large reduction in vulnerability, so was the reduction in oil intensity, which was the second largest among all Bank client countries. As a result, Mauritania was one of only two countries (the other being Angola) where the consumption effect was negative in 2003–08.

When the decade between 1998 and 2008 is considered, the number of countries with rising oil share of energy was basically the same but the number of countries with rising energy intensity was nearly double that in the five-year period 2003–08. Liberia, Seychelles, and Sierra Leone were among the top five most vulnerable countries in AFR in 1998, 2003, and 2008. The vulnerability of Seychelles increased steadily from 3% in 1998 (fifth most vulnerable) to 8% in 2003 (third most vulnerable) and to 25% in 2008 (most vulnerable). The price effect was larger for Mauritania than for Seychelles in both 1998–2008 and 2003–2008. However, the energy intensity effect and the proxy exchange rate effect, both negative, were much larger in magnitude for Mauritania than for Seychelles in both periods.

**Table 5: Decomposition results for Bank client countries in AFR**

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Angola	-65	-82	-17	-17	-0.8	-138	-93	214	4.9	-0.2	-1.5	-4.0
Benin	4.1	12	8.1	0.1	8.0	-0.1	0.2	0.0	9.3	0.1	2.3	-3.8
Botswana	1.4	4.1	2.7	0.0	2.7	0.0	0.0	0.0	3.3	0.3	0.1	-1.0
Burkina Faso	2.0	4.2	2.2	0.0	2.2	0.0	0.0	0.0	3.8	0.0	-0.3	-1.3
Burundi	5.2	7.6	2.4	0.0	2.4	0.0	0.0	0.0	8.6	-1.3	-1.3	-3.7
Cameroon	-3.4	-8.0	-4.6	-7.0	2.4	-10.6	-1.8	5.4	3.6	0.0	0.0	-1.3
Cape Verde	1.5	5.1	3.6	0.0	3.6	0.0	0.0	0.0	3.6	-0.2	1.3	-1.0
Central African Republic	2.2	4.1	1.9	0.0	1.9	0.0	0.0	0.0	3.9	-0.2	-0.2	-1.5
Chad	-13	-53	-40	-40	0.2	-45	-46	51	0.9	0.0	-0.2	-0.5
Comoros	2.2	5.3	3.1	0.0	3.1	0.0	0.0	0.0	4.5	0.1	0.2	-1.7
Congo, Dem. Rep.	-2.6	-2.3	0.3	-2.0	2.3	-6.9	0.6	4.3	3.3	0.5	-0.1	-1.4
Congo, Rep.	-75	-69	6.1	5.1	1.0	-115	6.1	114	3.3	-1.0	1.6	-2.9
Cote d'Ivoire	0.2	-5.3	-5.6	-7.6	2.0	-5.5	-5.1	3.0	3.4	-0.1	0.2	-1.4
Equatorial Guinea	-73	-68	5.1	5.1	0.0	-129	-60	194	0.6	0.2	-0.3	-0.6
Ethiopia	3.4	5.7	2.3	0.0	2.3	0.0	0.0	0.0	6.0	0.1	-0.8	-3.0

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Gabon	-40	-56	-16	-18.3	1.9	-71	-1.7	54	4.0	0.4	0.2	-2.7
Gambia, The	5.7	11	5.5	0.0	5.5	0.0	0.0	0.0	11	0.1	-0.4	-4.7
Ghana	4.7	5.5	0.8	0.1	0.7	-1.6	0.0	1.7	9.2	-0.4	-0.4	-7.8
Guinea	2.6	8.0	5.4	0.0	5.4	0.0	0.0	0.0	6.9	-0.2	-0.7	-0.6
Guinea-Bissau	5.5	13	7.1	0.0	7.1	0.0	0.0	0.0	11	0.1	0.5	-4.3
Kenya	3.8	8.5	4.7	0.0	4.7	0.0	0.0	0.0	7.5	0.5	-0.3	-3.0
Lesotho	1.6	3.8	2.2	0.0	2.2	0.0	0.0	0.0	3.2	0.9	-0.8	-1.1
Liberia	8.9	19	10	0.0	10.4	0.0	0.0	0.0	17	0.2	-0.6	-6.5
Madagascar	3.0	6.9	3.9	0.0	3.9	0.0	0.0	0.0	6.2	0.0	-0.6	-1.6
Malawi	2.4	6.6	4.2	0.0	4.2	0.0	0.0	0.0	5.3	0.4	-0.2	-1.3
Mali	1.0	1.9	0.9	0.0	0.9	0.0	0.0	0.0	1.8	0.0	-0.2	-0.8
Mauritania	19	6.1	-13	-13	-0.4	-7.1	-14	8.7	27	0.2	-11	-17
Mauritius	3.9	8.9	5.0	0.0	5.0	0.0	0.0	0.0	7.6	-0.4	-0.2	-2.1
Mozambique	2.5	4.9	2.4	0.0	2.4	0.0	0.0	0.0	4.7	-0.2	-0.6	-1.6
Namibia	3.6	8.3	4.7	0.0	4.7	0.0	0.0	0.0	7.1	-0.6	0.1	-1.9
Niger	2.1	3.8	1.7	0.0	1.7	0.0	0.0	0.0	3.7	0.0	-0.5	-1.5
Nigeria	-31	-32	-1.1	-1.5	0.4	-54	2.3	51	6.6	-0.6	-1.3	-4.4
Rwanda	3.0	3.8	0.7	0.0	0.7	0.0	0.0	0.0	4.8	0.5	-2.4	-2.1
Senegal	4.7	10	5.6	0.0	5.6	0.0	0.0	0.0	9.0	-0.2	0.3	-3.5
Seychelles	8.3	25	17	0.0	17	0.0	0.0	0.0	20	0.1	-0.7	-2.2
Sierra Leone	7.0	15	8.4	0.0	8.4	0.0	0.0	0.0	14	0.2	-1.1	-4.6
South Africa	1.8	4.5	2.7	-1.2	3.9	-2.4	0.1	1.1	6.1	-0.3	-0.4	-1.4
Sudan	-12	-24	-12	-13	1.4	-33	-16	35	6.2	0.2	-0.8	-4.3
Swaziland	2.1	5.6	3.5	0.0	3.5	0.0	0.0	0.0	4.5	1.2	-0.8	-1.4
Tanzania	2.1	5.5	3.4	0.0	3.4	0.0	0.0	0.0	4.4	-0.4	0.3	-0.9
Uganda	1.8	3.3	1.5	0.0	1.5	0.0	0.0	0.0	3.2	0.3	-0.8	-1.2
Zambia	3.0	3.6	0.6	0.0	0.6	-0.1	0.0	0.1	4.7	0.2	-0.7	-3.6

## EAP

The change in vulnerability in 17 EAP countries ranged from 9 percentage points in Tonga to –700 in Timor-Leste. Timor-Leste, however, had the largest adverse oil intensity effect, 4.7 percentage points—albeit completely dwarfed by the much higher income from oil exports—followed by 4.2 percentage points in Tonga and 1.6 in Kiribati. Timor-Leste also had the largest adverse consumption effect, 12 percentage points, and in fact led the world in having the highest adverse oil share effect. Aside these three countries, all other countries saw oil intensity decline. The oil share of energy rose in seven countries, but that increase was more than offset by falling energy intensity. Measured by vulnerability in 2008 alone, Fiji fared the worst at 16 percent.

When the decade ending in 2008 is considered, the performance of EAP countries with respect to oil intensity was poorer, with about half of the sample countries experiencing an increase in the oil share of energy, energy intensity, and oil intensity.

**Table 6: Decomposition results for Bank client countries in EAP**

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Cambodia	5.4	11	5.9	0.0	5.9	0.0	0.0	0.0	10	-0.2	-1.3	-2.9
China	1.3	3.0	1.7	-0.8	2.5	-3.9	-0.4	3.4	6.2	-0.9	-0.2	-2.5
Fiji	7.2	16	8.7	0.0	8.7	0.0	0.0	0.0	14	0.1	-0.8	-4.5
Indonesia	-0.5	1.4	1.9	-1.7	3.6	-9.0	1.3	6.0	9.1	-1.8	0.3	-4.1
Kiribati	2.4	8.0	5.6	0.0	5.6	0.0	0.0	0.0	5.8	0.1	1.5	-1.8
Korea, Rep.	3.5	8.0	4.4	-0.1	4.6	-0.1	-0.1	0.0	7.0	-0.9	-0.5	-1.0
Lao PDR	1.4	2.1	0.7	0.0	0.7	0.0	0.0	0.0	2.4	-0.3	-0.2	-1.2
Malaysia	-3.5	-3.1	0.4	-3.6	4.0	-13	1.7	8.1	8.3	0.2	-1.5	-3.0
Mongolia	7.5	11	3.2	0.0	3.2	0.0	0.0	0.0	13	1.6	-1.6	-9.5
Papua New Guinea	-7.6	-4.6	3.0	-1.9	4.9	-23	5.3	16	13	0.6	-1.9	-6.7
Philippines	4.2	5.7	1.5	-0.3	1.9	-0.4	-0.2	0.3	7.1	-0.8	-1.5	-2.9
Samoa	3.6	7.3	3.8	0.0	3.8	0.0	0.0	0.0	6.7	0.4	-0.4	-2.8
Solomon Islands	4.0	8.8	4.8	0.0	4.8	0.0	0.0	0.0	7.7	0.1	-0.8	-2.3
Thailand	4.2	7.9	3.6	-2.3	6.0	-3.9	-0.8	2.3	11	-0.9	-0.2	-4.2
Timor-Leste	3.9	-695	-699	-711	12	-305	-589	183	11	-0.1	4.7	-2.8
Tonga	4.0	13	9.3	0.0	9.3	0.0	0.0	0.0	9.7	-0.2	4.5	-4.6



## ECA

The change in vulnerability in 17 ECA countries ranged from 5 percentage points in the Kyrgyz Republic to –28 in Azerbaijan. The Kyrgyz Republic was the only country where oil intensity increased. The oil share of energy rose in 10 countries, but the reduction in energy intensity more than offset the increase in the oil share in 9 out of 10 countries. The highest vulnerability in 2008 was found in Moldova and the Kyrgyz Republic. Surprising for a net oil exporter, Azerbaijan achieved the largest reduction in oil intensity—not only compared to other countries in ECA but also with respect to all other Bank client countries—as well as in the consumption effect.

Taking the decade ending in 2008, Azerbaijan was again the only country with a negative consumption effect, enabled by large reductions in both the oil share of energy and energy intensity. At the opposite end of the spectrum was Turkmenistan, which had the largest adverse consumption effect over 5 as well as 10 years. The performance of ECA countries with respect to oil intensity during the decade was comparable or even better than during the five-year period, with less than half of the sample countries experiencing an increase in the oil share of energy, no country experiencing an increase in energy intensity, and only Albania experiencing an increase in oil intensity.

**Table 7: Decomposition results for Bank client countries in ECA**

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Albania	3.9	6.8	2.9	-0.4	3.3	-2.0	0.2	1.5	8.8	1.2	-2.5	-4.2
Azerbaijan	-31	-59	-28	-20	-8.0	-106	-87	173	19	-2.5	-12	-13
Belarus	6.4	8.1	1.7	-0.1	1.7	-3.2	-0.1	3.2	13	0.4	-3.6	-8.3
Bosnia and Herzegovina	2.7	5.3	2.5	0.0	2.5	0.0	0.0	0.0	5.0	-0.1	-0.1	-2.3
Bulgaria	5.1	7.7	2.6	0.0	2.6	-0.3	0.0	0.2	8.7	1.3	-2.8	-4.6
Croatia	1.9	3.8	1.9	-0.2	2.1	-1.5	0.4	0.9	4.9	0.1	-0.7	-2.2
Georgia	2.6	4.4	1.9	0.5	1.4	-0.8	0.6	0.7	5.4	0.4	-0.7	-3.6
Kazakhstan	-29	-31	-2.2	-1.6	-0.6	-60	-15	73	10	0.3	-2.3	-8.6
Kyrgyz Republic	4.5	9.7	5.2	0.1	5.1	-1.1	0.3	0.8	10	4.8	-3.3	-6.7
Macedonia, FYR	4.5	7.9	3.3	0.0	3.3	0.0	0.0	0.0	7.9	0.0	-1.1	-3.4
Moldova	6.9	9.7	2.8	0.0	2.8	0.0	0.0	0.0	11	1.9	-2.3	-8.0
Poland	2.0	3.3	1.3	-0.1	1.5	-0.2	-0.1	0.2	3.7	0.4	-0.6	-2.0
Romania	1.5	1.9	0.3	0.3	0.0	-3.4	0.4	3.3	5.6	-0.1	-1.5	-4.0
Russian Federation	-14	-15	-0.5	0.1	-0.6	-33	-4	37	9.1	-0.2	-2.1	-7.5
Turkey	2.1	3.1	1.0	-0.1	1.0	-0.3	0.0	0.2	3.7	-0.7	-0.1	-1.9
Turkmenistan	-20	-17	2.8	-4.2	6.9	-55	2.4	48	26	-1.4	-7.4	-10
Ukraine	4.9	5.1	0.2	0.0	0.2	-3.0	-0.2	3.1	10	0.9	-2.6	-8.2

## LAC

The change in vulnerability in the 28 countries in LAC ranged from 12 percentage points in Jamaica to –11 in Ecuador. Five countries saw oil intensity rise, led by St. Kitts and Nevis (vulnerability increasing by 3.5 percentage points as a result) and followed by Haiti (0.8), Grenada (0.7), Jamaica (0.6), and Uruguay (0.1). The oil share of energy actually rose in 12 countries, but the decrease in energy intensity more than compensated for the rise in the oil share to result in falling oil intensity in 8 out of 12. Jamaica, Guyana, and Nicaragua had vulnerability greater than 15 percent in 2008, with Jamaica and Nicaragua having the second and third largest consumptions effect during the study period.

When the decade ending in 2008 is considered, the performance of LAC countries with respect to oil intensity was poorer, with nearly double the number of countries experiencing an increase in energy intensity, resulting in rising oil intensity in 32% of countries.

Table 8: Decomposition results for Bank client countries in LAC

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Antigua and Barbuda	5.2	13	8.0	0.0	8.0	0.0	0.0	0.0	11	0.0	-1.4	-1.4
Argentina	-3.4	-2.0	1.3	-1.4	2.8	-11	1.0	8.7	6.6	0.4	-1.1	-3.1
Belize	6.7	10	3.4	-9.1	13	-3.6	-6.8	1.3	15	-1.2	1.1	-2.0
Brazil	0.4	0.1	-0.3	-1.7	1.4	-6.3	-1.5	6.1	6.3	-0.1	-0.2	-4.6
Chile	3.1	6.0	2.8	0.0	2.8	-0.3	0.1	0.2	6.1	0.9	-0.9	-3.2
Colombia	-3.2	-4.6	-1.4	-2.6	1.3	-10	-0.7	8.6	4.8	-0.2	-0.5	-2.8
Costa Rica	2.5	5.8	3.2	0.0	3.2	0.0	0.0	0.0	5.1	-0.1	-0.6	-1.2
Dominica	3.5	8.5	5.0	0.0	5.0	0.0	0.0	0.0	7.1	-0.2	-1.3	-0.8
Dominican Republic	5.7	9.3	3.6	0.0	3.6	0.0	0.0	0.0	10	0.0	-2.6	-3.8
Ecuador	-9.8	-21	-11	-18	6.7	-30	-5.4	18	11	-0.4	0.0	-3.5
El Salvador	3.0	6.8	3.8	0.0	3.8	0.1	0.0	0.0	5.8	-0.6	-0.3	-1.2
Grenada	3.9	11	7.1	0.0	7.1	0.0	0.0	0.0	8.4	0.0	0.7	-2.1
Guatemala	2.1	4.7	2.7	-0.3	3.0	-1.7	0.5	0.8	5.8	-0.6	-0.2	-1.9
Guyana	16	18	2.5	0.0	2.5	0.0	0.0	0.0	24	0.3	-5.4	-17
Haiti	4.3	7.5	3.2	0.0	3.2	0.0	0.0	0.0	7.8	0.3	0.5	-5.3
Honduras	4.7	12	7.5	0.0	7.5	0.0	0.0	0.0	9.8	-0.1	0.0	-2.3
Jamaica	8.0	20	12	0.1	11	0.1	0.0	0.0	17	0.2	0.4	-5.7
Mexico	-2.7	-3.4	-0.6	-4.6	4.0	-10	1.6	4.0	6.0	-0.2	-0.3	-1.5
Nicaragua	6.7	17	10	0.1	10	0.2	0.0	-0.1	14	-0.9	-1.0	-1.7
Paraguay	4.9	5.7	0.7	0.0	0.7	0.0	0.0	0.0	7.4	0.0	-1.2	-5.5
Peru	1.1	1.4	0.3	-1.7	2.1	-3.1	-0.8	2.1	4.7	-0.5	-0.6	-1.5
St. Kitts and Nevis	2.3	11	8.9	0.0	8.9	0.0	0.0	0.0	6.8	-0.1	3.5	-1.4
St. Lucia	3.9	11	6.9	0.0	6.9	0.0	0.0	0.0	8.4	0.0	-0.7	-0.8
St. Vincent and the	3.8	10	6.6	0.0	6.6	0.0	0.0	0.0	8.0	0.1	-0.5	-1.0

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Grenadines												
Suriname	1.9	-3.2	-5.1	-10	4.9	-17	-6.9	14	16	-0.1	-2.7	-8.7
Trinidad and Tobago	-12	-15	-3.2	-5.6	2.4	-25	1.3	18	5.3	-1.3	0.8	-2.4
Uruguay	3.2	5.8	2.6	-0.1	2.7	-0.1	0.0	0.1	5.9	1.7	-1.6	-3.3
Venezuela, RB	-26	-22	3.8	2.6	1.2	-49	-0.9	53	11	1.0	-3.1	-7.9

## MNA

The change in vulnerability in nine MNA countries ranged from 10 percentage points in the Republic of Yemen to -13 in Algeria. Algeria and Yemen were also the only countries in which oil intensity rose. In both cases the oil share of energy declined but energy intensity rose. Only Libya managed to achieve a negative consumption effect. Vulnerability exceeded 10 percent in 2008 in Jordan and Lebanon, although Jordan had the largest reduction in oil intensity. Had Jordan not achieved such a large reduction in oil use per unit of GDP, its vulnerability by 2008 would have been 7.5 percentage points higher.

When the decade ending in 2008 is considered, the number of MNA countries with rising oil intensity is reduced from two to one. The number of countries with rising oil share actually doubled, but the reduction in energy intensity more than compensated for that increase in 3 out of 4 cases.

**Table 9: Decomposition results for Bank client countries in MNA**

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Algeria	-26	-39	-13	-16	2.5	-51	-6.4	42	6.3	-0.2	0.6	-4.1
Egypt, Arab Rep.	-2.3	-0.4	2.0	-6.2	8.1	-17	0.5	9.9	14	-0.5	-0.3	-4.9
Iran, Islamic Rep.	-19	-26	-7.0	-13.9	6.9	-51	-3.8	41	20	-1.5	0.4	-12
Jordan	11	15	3.8	0.0	3.8	0.0	0.0	0.0	17	-4.6	-2.9	-6.1
Lebanon	5.5	11.0	5.5	0.0	5.5	0.0	0.0	0.0	10	0.3	-3.7	-1.4
Libya	-54	-61	-6.3	-6.2	-0.1	-107	-21	121	16	-0.1	-2.0	-14
Morocco	3.5	7.6	4.2	-0.1	4.2	-0.1	0.0	0.1	6.8	0.2	-0.6	-2.1
Tunisia	0.4	-0.2	-0.6	-4.3	3.7	-6.5	-0.7	3.0	6.8	-0.5	-1.2	-1.4
Yemen, Rep.	-30	-20	9.8	1.9	8.0	-60	18	44	21	-0.9	1.1	-13

## SAR

The change in vulnerability in seven SAR countries ranged from 6 percentage points in Maldives to 2 in Bhutan. Had Maldives not achieved the largest reduction in vulnerability arising from falling oil intensity in the region, –8 percentage points, it would have been far more vulnerable to higher oil prices in 2008. Despite this effort, Maldives suffered from the largest vulnerability in 2008 and was the only country in the region where vulnerability far exceeded 10 percent. No country in SAR saw rising oil intensity between 2003 and 2008.

When the decade ending in 2008 is considered, the performance of SAR countries with respect to oil intensity was identical to that in 2003–08 in terms of the percentage of countries with rising oil share, energy intensity, and oil intensity. The same three countries saw energy intensity rise in the two periods; the oil share rose in Sri Lanka over the decade and in Maldives over the second half of the decade.

**Table 10: Decomposition results for Bank client countries in SAR**

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Bangladesh	1.6	3.9	2.3	-0.1	2.4	-0.3	0.0	0.1	3.5	-0.7	0.0	-0.4
Bhutan	2.0	3.7	1.7	0.0	1.7	0.0	0.0	0.0	3.7	-2.4	1.4	-0.9
India	2.7	6.0	3.3	-1.2	4.5	-2.6	-0.2	1.7	7.8	-0.8	-0.4	-2.2
Maldives	11	16	5.7	0.0	5.7	0.0	0.0	0.0	18	0.1	-8.2	-4.0
Nepal	2.6	4.9	2.2	0.0	2.2	0.0	0.0	0.0	4.7	-0.5	0.1	-2.0
Pakistan	3.4	7.0	3.6	-0.5	4.1	-1.4	0.1	0.9	7.9	-0.8	-0.1	-2.9
Sri Lanka	4.4	7.3	2.9	0.0	2.8	0.1	0.0	0.0	7.6	-0.1	-1.6	-3.1

Lastly, a corresponding table for non-IDA/IBRD countries is provided below.

**Table 11: Decomposition results for other countries**

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
Australia	0.6	1.3	0.7	-0.6	1.3	-2.4	0.1	1.6	3.4	-0.1	-0.2	-1.9
Austria	1.1	2.2	1.1	-0.1	1.2	-0.2	0.0	0.1	2.2	-0.1	-0.2	-0.7
Bahrain	-2.6	-0.7	1.8	-2.5	4.3	-9.0	0.2	6.4	5.9	1.2	-0.2	-2.6
Belgium	2.2	4.9	2.8	0.0	2.8	-0.1	0.0	0.0	4.4	0.2	-0.3	-1.5
Canada	-1.1	-2.6	-1.5	-4.1	2.6	-7.3	-0.4	3.6	5.0	-0.1	-0.3	-1.9
Cyprus	4.1	8.5	4.4	0.0	4.4	0.0	0.0	0.0	7.7	0.0	-0.2	-3.1
Czech Republic	2.0	3.3	1.3	0.0	1.3	-0.3	0.1	0.2	3.7	0.2	-0.6	-2.0
Denmark	-0.9	-1.1	-0.2	-1.1	0.9	-3.2	0.7	1.3	1.7	0.0	-0.2	-0.6
Estonia	2.0	3.1	1.1	-0.5	1.6	-1.2	-0.2	0.9	4.4	0.2	-0.8	-2.2
Finland	1.4	2.7	1.3	-0.1	1.4	-0.1	0.0	0.0	2.6	0.0	-0.5	-0.8

Country	Vulnerability		Changes			Production effects			Consumption effects			
	2003	2008	$\Delta V$	$\Delta P$	$\Delta C$	Price	Output	GDP	Price	Oil share	Energy intensity	Real exchange rate
France	1.1	2.3	1.2	0.0	1.2	-0.1	0.0	0.0	2.2	-0.1	-0.1	-0.7
Germany	1.1	2.4	1.3	-0.1	1.3	-0.1	0.0	0.0	2.2	0.0	-0.2	-0.6
Greece	2.3	4.3	2.0	0.0	2.0	-0.1	0.0	0.0	4.2	-0.1	-0.6	-1.5
Hungary	1.1	2.8	1.7	-0.3	1.9	-1.0	0.2	0.5	3.3	0.4	-0.3	-1.4
Iceland	1.8	4.5	2.7	0.0	2.7	0.0	0.0	0.0	3.7	-1.5	1.0	-0.6
Ireland	1.2	2.6	1.4	0.0	1.4	0.0	0.0	0.0	2.3	-0.1	-0.1	-0.7
Israel	2.2	4.0	1.8	0.0	1.9	-0.1	0.0	0.0	4.0	-0.3	-0.8	-1.0
Italy	1.2	2.3	1.1	-0.2	1.2	-0.2	0.0	0.1	2.4	-0.3	-0.1	-0.8
Japan	1.4	3.5	2.2	-0.1	2.2	-0.1	0.0	0.0	2.9	-0.3	-0.2	-0.2
Latvia	2.8	3.8	1.0	0.0	1.0	0.0	0.0	0.0	4.5	0.7	-1.3	-2.9
Lithuania	2.2	5.2	3.0	0.2	2.8	-0.9	0.4	0.7	5.5	1.3	-1.1	-2.9
Luxembourg	2.0	3.7	1.7	0.0	1.7	0.0	0.0	0.0	3.6	0.0	-0.4	-1.5
Malta	3.8	8.2	4.4	0.0	4.4	0.0	0.0	0.0	7.3	0.0	-0.5	-2.5
Netherlands	1.6	4.4	2.8	-0.1	2.9	-0.3	0.1	0.1	3.8	0.6	-0.2	-1.2
New Zealand	1.4	2.7	1.3	-1.6	2.9	-1.2	-0.8	0.4	3.8	0.1	-0.3	-0.7
Norway	-14	-18	-3.3	-4.0	0.7	-24	5.8	14	1.9	-0.1	-0.1	-0.9
Oman	-37	-39	-1.3	-4.4	3.1	-62	4.1	54	5.7	-0.7	1.9	-3.7
Portugal	2.1	4.0	1.9	-0.1	1.9	-0.1	0.0	0.0	3.9	-0.2	-0.4	-1.3
Qatar	-38	-34	4.4	3.1	1.3	-66	-14	84	5.3	0.6	-1.6	-3.0
Saudi Arabia	-41	-63	-22	-31	8.3	-87	-5.1	62	16	1.5	-0.6	-8.9
Slovak Republic	1.5	2.7	1.2	-0.2	1.4	-0.4	0.0	0.3	3.1	0.4	-1.0	-1.1
Slovenia	1.9	3.8	2.0	0.0	2.0	0.0	0.0	0.0	3.5	0.1	-0.5	-1.2
Spain	1.8	3.4	1.6	0.0	1.6	-0.1	0.0	0.0	3.3	-0.1	-0.3	-1.3
Sweden	1.2	2.5	1.2	0.0	1.3	0.0	0.0	0.0	2.3	-0.2	-0.2	-0.6
Switzerland	0.9	1.9	1.0	0.0	1.0	0.0	0.0	0.0	1.7	0.0	-0.2	-0.4
United Arab Emirates	-28	-34	-6.7	-9.6	2.8	-53	-6.1	50	7.1	-0.2	0.5	-4.6
United Kingdom	-0.4	0.2	0.6	-0.7	1.3	-2.3	0.8	0.7	2.0	0.1	-0.3	-0.4
United States	1.1	2.7	1.6	-1.3	2.9	-1.7	0.1	0.4	3.9	-0.1	-0.4	-0.5

**Annex 1: Data sources**

Data are taken from the U.S. Department of Energy's Energy Information Administration (EIA) and from the World Development Indicators database. Net imports were calculated by taking the difference between domestic crude oil production and domestic consumption. Inaccuracies introduced by this simplified calculation include changes in inventories, differences in the densities of various grades of crude oil and products, and consumption and losses in refining crude oil.

The database of the International Energy Agency (IEA), which contains data for 132 countries, was also consulted, primarily to drop countries where large data discrepancies between the two databases were found. More specifically, net imports computed from subtracting the sum of crude and product exports from the sum of crude and product imports were compared with the net imports computed as described in the above paragraph using the EIA database. Comparison of the two sets of calculations led to Armenia, Bolivia, Cuba, Eritrea, the Syrian Arab Republic, Tajikistan, Togo, Uzbekistan, and Vietnam being dropped from decomposition analysis. Further, both Singapore and Djibouti were found to have excessively large net imports relative to GDP, possibly because they are both significant oil traders and domestic consumption was not accurately measured; they were also dropped.

The volume of net imports was multiplied by the annual average of the prices of three marker crudes—Brent, West Texas Intermediate, and Dubai—in each study year. This introduces further inaccuracies: all refined products other than fuel oil are more expensive than crude oil so that the mix of imports matters, and the cost of transporting crude oil or refined products is also excluded. In terms of changes, the price of crude oil increased by \$68 a barrel between 2003 and 2008, which is the same as the change in the price of gasoline in all the four major refining centers (North America, the Arab Gulf, Western Europe, and Singapore), but the change in the price of diesel was about \$85 a barrel while that for fuel oil was about \$50 a barrel. Therefore, a country heavily reliant on fuel oil imports would have experienced less impact on vulnerability, and conversely a country with a large share of diesel or kerosene imports would have experienced an even greater impact.