The impact of high and volatile commodity prices on public finances in developing countries

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Recent Developments in Commodity Prices & Policy Agenda

- Recent boom and bust in commodity prices
  - Oil price: $40 (2005), $140 (2008), $40 (2009), $120 (2001)
  - FAO Food prices index: 100(2004), 180(2008), 120(2009), 200(2011)

- Commodity prices instability on world governance Agenda
  - Need to improve the stability of world markets (Regulation Agenda)
  - Need to adapt the "aid system" to the vulnerability of developing countries (Aid Agenda)

- High vulnerability of DCs to commodity prices instability

a) a large share of exports earnings is drawn from commodities (foreign currency dependency)

b) a significant share of imports bill consist in food products (food dependency)

$\Rightarrow$ **a large share of public revenues from external trade (tariffs & VAT)**

(public revenues dependency)

Existing literature on Commodity Prices Instability

i) Characteristics and determinants of commodity prices instability

- Stylized facts on commodities real prices:
  - ***asymetry*** of price cycles (Deaton and Laroque, 1992), ***persistence*** of shocks (Cashin et al. 2000), ***correlation*** (Pyndick and Rotemberg, 1990)
- Explanations of these stylized facts:
  - Inertia of supply, market mechanisms (Deaton and Miller, 1995, Akyiama et al. 2003)

ii) *Macroeconomic effects of CP instability*

- Impact on growth: Extensive literature, but controversial results:
  - strong detrimental effect through investment (Bleaney and Greenaway, 2001) vs small and conditional impact (Deaton and Miller, 1995)
- But few studies on focused on Public finance (Kumah & Matovu, 2005, Medina, 2010)

iii) *Optimal policy responses to CP instability*

- Difficulty to **dampening instability** (buffer stocks, international) or to **offsetting its impact** (commodity derivative instruments) (Guillaumont, 1987, Larson et al. 1998, Varangis and Larson, 1996)

Aim of the Paper

Main goal: focus on public finance effects of CP instability

- Analyzing the impact of commodity prices volatility on tax revenues
- Identifying transmission channels between world prices and public finance variables

How to reach these goals?

- *Looking for the i*mpact of commodity prices *volatility* rather than focusing only on price *levels*

- *Looking for heterogeneity between tax categories and productive sectors*

- Disaggregated data on tax revenues (income tax, value added tax and trade tax)
- Disaggregated data on commodity prices (agricultural products, minerals and energy)

Theoretical mechanisms

3 Mechanisms: Price effect / Tax rate effect / Volume effect

	Imports	Exports
Commodity Price level	**Ambiguous** Price effect Tax reductions Volume decreases	**Positive** Price effect Tax rate increases Volume increases
Commodity Price volatility	**Negative** Asymetry of Tax reductions Growth instability	**Ambiguous** Tax increases Marginal taxation Growth instability Dutch disease

Table 12. Pattern of Food Tax Decreases by Tax and Country Characteristics

		Tax reductions				Year of reduction			
	Number of Countries	Import	VAT	Sales	Excise	2007	2008	Countries w/changes	Percent of countries
Income group									
High-income OECD	18	17	0	0	0	16	1	17	94
High-income non-OECD	15	5	1	0	0	4	1	5	33
Upper-middle income	49	20	10	2	0	7	19	23	47
Low er-middle income	43	19	4	1	1	10	14	19	44
Low -income	34	15	7	0	0	12	10	20	59
Net total food trade balance									
Large importer	19	10	5	1	1	4	9	12	63
Small importer	99	47	12	1	0	32	24	28	28
Small exporter	28	15	4	0	0	11	7	9	32
Large exporter	13	4	1	1	0	2	5	6	46
Net cereal trade balance									
Large importer	104	46	16	3	1	21	37	51	49
Small importer	38	20	3	0	0	21	2	22	58
Exporter	17	10	3	0	0	7	6	11	65
All Countries	159	76	22	3	1	49	45	84	53

Sources: IMF (2008a).

Note: Large food importer: net imports greater than 3 percent of GDP; large food exporter: net exports greater than 4 percent of GDP; large cereal importer: net imports greater than 0.2 percnt of GDP.
The count for total changes may differ from the sum of 2007 and 2008 because the same country may have tax changes in both years.

Theoretical mechanisms

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Methodology

- Country-specific index of imported/exported commodity prices :

(Deaton & Miller, 1995; Dehn, 2000)

$$I_{i,t} = \prod_{c=1}^{41} p_{c,t}^{\,w_{i,c}}$$

- p: international price of commodity *c* in year *t*
- w: fixed weight of commodity *c* imports / exports in total commodities imports / exports (average over the period 2000 to 2008)

41 Commodities: - Agricultural products (28) - Metals (10) - Energy (3)

- Volatility Measures:

1) Volatility of the indices (*standard deviation of the first-difference of the **indices***)

2) Volatility of each price (*standard deviation of the first-difference of the **prices***) weighted with w to form a country-specific index of price volatility

=> avoids the price compensations between commodities that occur with the price index

Each index is weighted by the share of imports/exports in the GDP to allow the effect to be larger for countries with higher imports and exports (commodity share not available each year)

Methodology

- Panel: 90 developing countries over 1980-2008

- Estimated Equation (same equation for exports):

$$T_{it} = \alpha + \beta_1 Index_{it}^{M} + \beta_2 .Volatility_{it}^{M} + X'_{it} + \mu_i + \varepsilon_{it}$$

T: - Government revenue, excluding grants (% GDP)

- Income taxes (% GDP) - Domestic Indirect taxes (% GDP) - Trade taxes (% GDP)

X: - Control variables

- Estimator:
  - OLS-FE not consistent because of the presence of the lagged dependent variable
  - System-GMM (Blundell & Bond, 1998)

1. Motivation
2. Transmission channels
3. Methodology
4. **Results**
5. Policy Implications

Import prices (90 countries, 1980-2008)

(2nd indicator, GMM-System, 1770-1483 obs)

		Total revenue (%GDP)	Income Tax (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
All commodities	Price level	**6.2**	-0.013	1,02	**2,94**
	Price volatility	**-0,52**	-0,02	**-0,17**	**-0,49**
Agriculture	Price level	2.9	-1.28	0.81	0.37
	Price volatility	-0.235	0.0303	**-0.15**	-0.11
Energy	Price level	0.81	-0.075	-0.11	**0.62**
	Price volatility	**-0.12**	**-0.004**	**-0.009**	**-0.098**
Minerals	Price level	**2.24**	0.19	**1.34**	1.27
	Price volatility	**-0.104**	**0.0252**	**-0.067**	**-0.0767**

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Minerals	Price level	**2.24**	0.19	**1.34**	1.27
	Price volatility	-0.10	0.025	**-0.067**	-0.077

Main Results

Export prices (34 countries, 1980-2008)

(2nd indicator, GMM-System, 711-604 obs)

		Total revenue (%GDP)	Income Tax (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
All commodities	Price level	**9.69**	**5.99**	0.62	0.72
	Price volatility	**-1.12**	**-0.81**	-0.045	-0.21

Main Results

Main results compared to theoretical mechanisms

	Imports	Exports
Commodity Price level	**Ambiguous** ⇒ **Agriculture: No systematic impact** ⇒ **Energy & Minerals positive (trade & indirect taxes)** (Tax reductions/ Tax base)	**Positive** ⇒ **Positive & strong (Income tax & others rev.)** (Tax base/ Windfall gain taxation)
Commodity Price volatility	**Negative** ⇒ **Negative** (Tax reductions / Growth instability)	**Ambiguous** ⇒ **Negative & strong (Income Tax & others rev.)** (Growth instability)

Policy Implications I : National policies

Fiscal policy

- Result 1: Sensitivity of public revenues to commodity prices **levels and volatility** (trade taxes)
- Result 2: Fiscal impact of tax reductions

- Goal 1 = Reducing the "trade taxes dependency" of public revenues

⇒ Lower vulnerability of VAT revenues to price volatility (vs trade taxes)

⇒ ***Tariff-Tax Reforms*** (Chambas, 2005)

- Goal 2 = Reducing the fiscal impact of food & energy price peaks

- ***Targeted subsidies on poor's*** more efficient than price subsidies (non targeted)
- But can't be implemented in an emergency context

⇒ Need to build poor targeted policies during "quiet" periods

- **Alternative tool to cope with instability**

- Regional markets for Short-term &medium-term Treasury Bonds
- BUT, price shocks are frequently regional shocks

⇒ Need to complement by international cooperation

Policy Implications II: International cooperation

- **Promoting contra-cyclical aid instruments**

Result : Sensitivity of public revenues to commodity prices levels

Goal 3: Access to alternative budget financing

- AFD: Contra Cyclical Loans (CCL) (Cohen et al. , 2007) (floating grace period, export revenues shock)
- IMF: Exogenous shock facility (ESF, 2005, ESF-HAC, 2008, SCF 2011)

But almost unused…

CCL: Hann Bay Project, Senegal + projects of new CCl design

ESF: 3 ESF in 2008 : "light" conditionality still to heavy (Guillaumont, 2009)

The release criteria issue

- "Exports revenues shock" criteria (data problems, partly endogenous)
- "Price shock" (quick and reliable data, exogenous)
- Need to a build a relevant commodity basket for each country
- Need to complement the "price shock" criteria with "volume shock" criteria (rainfall, …)

⇒ ***Budget support based on a "price shock" criteria***

Appendix

1/ Empirical literature on commodity price volatility on public finance

2/ Detailed econometric results

3/ Correlation between commodity prices and tax revenues

Impact of commodity prices volatility on public finance: Literature review

	Studies	Variables	Tools	Main Findings
Commodities level	Collier & Gunning (1999) Leenhardt (2005)	Specific taxes & expenditures on commodities	Case study Case study	Heterogeneity of fiscal responses Heterogeneity of initial tax structure Non-linear relationship oil price/ revenues
Meso-economic level	Collier & Gunning (1999)	Direct/Indirect taxes Transfer expenditures	Case study	Heterogeneity of fiscal responses Indirect taxes = main channel
Macroeconomic level	Talvi & Vegh (2005) Kumah & Matovu (2005,07) Medina (2010)	Overall revenues or expenditures Budget balance	Descriptive Stats VAR VAR	FP procyclical in DC / FP Acyclical in G7 FP procyclical in DC FP sensitivity to CP volatility Heterogeneity in LA

⇒ Difficulty to disentangle theoretical mechanism through quantitative analysis

⇒ Lack of meso-economic analysis

Results

Table 3a. Impact of imported commodities price level and volatility, aggregate index

(System-GMM – 1st indicator of volatility

VARIABLES	Tax Revenue (%GDP)	Income Tax (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
	(1)	(3)	(5)	(7)
Commodity import price index	**3.658***	**-0.287**	**0.139**	**0.639**
Commodity import price volatility	**-0.363****	**-0.0519**	**-0.160****	**-0.310*****
Lagged dependent variable	0.646***	0.842***	0.899***	0.944***
Imports (%GDP)	0.0884***	0.0260**	0.0230**	0.0416***
Population below 14	-0.0676	0.0379	-0.100**	-0.0583
Aid per capita	-0.00213	0.00293	0.000752	0.0132
GDP (log)	-0.776	1.236	-1.375*	-0.713
Agriculture (%GDP)	-0.114	0.0498	-0.0562*	-0.0180
Observations / Nb countries	1,770 / 90	1,483 / 88	1,608 / 88	1,610 / 88

Results

Table 3a. Impact of imported commodities price level and volatility, aggregate index

(System-GMM – 2nd indicator of volatility

VARIABLES	Tax Revenue (%GDP)	Income Tax (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
	(1)	(3)	(5)	(7)
Commodity import price index	**6.182*** **	**-0.0133**	**1.020**	**2.941*** **
Commodity import price volatility	**-0.521*** **	**-0.0224**	**-0.173*** **	**-0.488*** **
Lagged dependent variable	0.646***	0.842***	0.899***	0.944***
Imports (%GDP)	0.131***	0.0201	0.0285*	0.0821***
Population below 14	-0.0808	0.0537	-0.089***	-0.0778*
Aid per capita	0.00148	0.00166	0.00263	0.0151***
GDP (log)	-0.744	1.438*	-1.157**	-0.945
Agriculture (%GDP)	-0.124	0.0535	-0.0501**	-0.0322
Observations / Nb countries	1,770 / 90	1,483 / 88	1,608 / 88	1,610 / 88

Table 3b. Impact of imported commodity price level and volatility, by sector
(System-GMM – 1st indicator of volatility

VARIABLES	Tax Revenue (%GDP)	Income Tax (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
	(2)	(4)	(6)	(8)
Agricultural import price index	1.739	-1.144	0.0583	-0.334
Agricultural import price volatility	**-0.235**	**0.0303**	**-0.153****	**-0.108**
Energy import price index	0.783	-0.0380	-0.192	0.527**
Energy import price volatility	**-0.123*****	**-0.00535**	**-0.0175**	**-0.117*****
Minerals import price index	3.609**	0.457	1.833**	2.279*
Minerals import price volatility	**-0.221****	**0.0117**	**-0.107****	**-0.167****
Control variables included				
Observations / Nb countries	1,770 / 90	1,483 / 88	1,608 / 88	1,610 / 88

Table 4b. Impact of imported commodity price level and volatility, by sector
(System-GMM – 2nd indicator of volatility

VARIABLES	Total Revenue (%GDP)	Income Tax (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
	(2)	(4)	(6)	(8)
Agricultural import price index	2.933	-1.282	0.815	0.373
Agricultural import price volatility	**-0.346***	**0.0498**	**-0.184****	**-0.210***
Energy import price index	0.807	-0.0751	-0.113	0.616**
Energy import price volatility	**-0.117*****	**-0.00421**	**-0.00927**	**-0.0982****
Minerals import price index	2.238*	0.190	1.343**	1.275
Minerals import price volatility	**-0.104**	**0.0252**	**-0.0671****	**-0.0767**
	(0.070)	(0.030)	(0.027)	(0.050)
Control variables included				
Observations / Nb countries	1,770 / 90	1,483 / 88	1,608 / 88	1,610 / 88

Table 5. Impact of exported commodity price level and volatility

(System-GMM – 1st indicator of volatility)

VARIABLES	Total Revenue (%GDP)	Income Taxes and Non Tax Revenue (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
	(1)	(2)	(3)	(4)
Commodity export price index (log)	**6.628****	**4.352***	**0.828**	**0.0632**
Commodity export price volatility (log)	**-0.796***	**-0.584***	**-0.112**	**-0.171**
Lagged dependent variable	0.636***	0.705***	0.827***	0.862***
Exports (%GDP)	0.205	0.149*	0.00176	0.0370
Population below 14	0.392*	0.0283	0.0862	-0.0251
Aid per capita	0.0211	0.00840	-0.00509	0.00492
Imports (%GDP)	0.0218	-0.0283	0.0216	0.0109
GDP (log)	6.465*	1.271	0.998	-0.846
Agriculture (%GDP)	0.262	0.0434	0.0293	-0.0305
Observations	711	604	664	656
Nb of countries	34	33	33	33
Nb of instruments	15	25	23	17
AR(1) p-val	0.001	0.004	0.000	0.000
AR(2) p-val	0.248	0.904	0.342	0.959
Hansen Test	0.442	0.349	0.558	0.628

Table 6. Impact of exported commodity price level and volatility

(System-GMM – 2nd indicator of volatility)

VARIABLES	Total Revenue (%GDP)	Income Taxes and Non Tax Revenue (%GDP)	Consumption Taxes (%GDP)	International Trade Taxes (%GDP)
	(1)	(2)	(3)	(4)
Commodity export price index (log)	**9.694****	**5.994***	**0.620**	**0.718**
Commodity export price volatility (log)	**-1.119****	**-0.806***	**-0.0453**	**-0.218**
Lagged dependent variable	0.652***	0.666***	0.826***	0.862***
Exports (%GDP)	0.236*	0.191*	-0.00653	0.0423
Population below 14	0.453*	0.0202	0.0807	0.00655
Aid per capita	0.0180	0.00614	-0.00648	0.00578
Imports (%GDP)	0.0213	-0.0434	0.0224	0.0111
GDP (log)	7.438*	1.492	0.949	-0.343
Agriculture (%GDP)	0.290	0.0390	0.0259	-0.00969
	(0.180)	(0.070)	(0.033)	(0.062)
Observations	711	604	664	656
Nb of countries	34	33	33	33
Nb of instruments	15	25	23	17
AR(1) p-val	0.001	0.006	0.000	0.000
AR(2) p-val	0.261	0.973	0.352	0.811
Hansen Test	0.464	0.256	0.614	0.623

Appendix 8

Correlation between commodity prices and tax revenues