

## 5

## *Dealing with Commodity Price, Terms of Trade, and Output Risks*

As shown in chapter 2, output volatility continues to be significantly higher for most developing countries than for developed countries, as a consequence of higher exposure to both real and capital exogenous shocks and of the amplifying effects of balance sheet currency and maturity mismatches and the procyclicality of capital flows and macroeconomic policies. The previous two chapters discussed financial instruments and the actual and potential role of financial innovations by multilateral development banks specifically designed to help countries reduce and mitigate the effects of liquidity and currency risks. This chapter reviews instruments that are specifically designed to reduce and mitigate the effects of real external shocks and output volatility—in particular commodity price derivatives and two types of indexed debt, linked to commodity prices (or terms of trade) and GDP-indexed debt. Again, we should stress that all of these instruments can indirectly help reduce liquidity and output volatility risks.

As shown in chapter 2, developing countries' use of currency and interest rate derivatives is quite limited as compared with the explosive development of these markets in developed countries. Commodity price derivatives have also developed significantly, though for most products maturities are still relatively short term. This is the case for most commodities in which developing countries are the larger exporters, with the partial exception of oil (table 5.1). By way of contrast, corn markets are deeper and have longer

**Table 5.1. Commodity derivative volumes (number of contracts)**

	Type of contract	Up to 6 months	6 months to 1 year	1 year to 2 years	2 to 3 years	3 to 5 years
Crude oil	Futures/forward	7.214	21.767	21.229	3.379	15.254
	Call options	732.721	374.969	172.138	35.367	na
	Put options	664.472	418.033	194.995	32.159	na
Soybean	Futures/forward	418.048	36.797	54.264	1.534	na
	Call options	256.892	4.137	10.184	na	na
	Put options	179.204	2.448	9.355	na	na
Coffee	Futures/forward	125.657	26.603	11.635	na	na
	Call options	106.439	26.973	242	na	na
	Put options	51.075	24.804	70	na	na
Copper	Futures/forward	72.771	8.083	795	na	na
	Call options	1.478	264	na	na	na
	Put options	894	675	na	na	na
Wheat	Futures/forward	247.902	85.476	28.404	2.396	na
	Call options	103.494	47.810	1,522	na	na
	Put options	68.628	34.010	762	na	na
Corn	Futures/forward	550.993	524.944	153.347	17.377	na
	Call options	405.341	529.968	115.716	10.330	na
	Put options	260.706	387.471	60.173	9.732	na

na is not applicable.

Source: From Cordella and Levy Yeyati 2007.

maturities. These differences are partially due to the observed fact that derivative markets are sensitive to credit risk. Thus, developing country exporters can usually access these markets at high prices and short maturities, which are not adequate to help stabilize incomes over medium-term commodity price cycles.

In addition, political economy limitations are especially severe in this area. Officials hesitate to incur the financial and political costs of paying high upfront fees for insurance or options that would protect their successors from eventual downward risks in commodity prices. Hedging can avoid the upfront costs related to insurance and simple option fees, but it brings political economy problems of its own. There have been several cases in which officials have been accused of malfeasance for giving up government revenues, when prices turned out to be higher than the hedged price.<sup>1</sup>

1. Examples include boards and managers of CODELCO (the Chilean state copper company) and Ecopetrol (the Colombian state oil company).

As an illustration of these problems, a recent study estimated that covering all downward risk through rolled-over options for the price of Mexican oil exports would have cost about 10 percent of the gross actual price in June 2007.<sup>2</sup> It is not surprising then that Mexican authorities have limited themselves to covering just one-year downward risks to prevent potential budgetary liquidity crunches<sup>3</sup> and have paid the corresponding fees from the Oil Stabilization Fund, avoiding political debates in Congress about why a high fee is being paid.

As a consequence of these problems, developing countries that are either substantial net exporters or importers of commodities do not use derivative markets much to protect themselves from commodity price risks. Instead, they attempt to self-insure through the use of Commodity Stabilization Funds, a common practice among both net exporters and net importers. These funds, however, carry a high financial cost and are not exempt from political economy problems of their own.<sup>4</sup>

Another alternative for a net exporter country could be to issue debt indexed to commodity prices (and for a net importer country to invest in such financial assets). In theory, either interest or amortization payments could be indexed to those prices. Indexation of amortization payments could give more liquidity protection against shocks by basically permitting the government to postpone or slow down repayments in bad times in exchange for advancing or accelerating repayments in good times. Debt indexed to commodity prices could be, in theory, a useful way of mitigating some problems associated with the procyclicality of capital inflows, reducing liquidity risks and limiting the need to apply procyclical fiscal policies. It should be a very attractive option for issuers whose income is highly dependent on commodity exports or sales. These instruments could also be attractive to investors because they reduce the issuer default risk. They can also provide hedges for investors that are at the same time buyers of those commodities. However, although such proposals have been discussed for some time, very few countries or companies have actually issued such indexed debt, and, in the few cases in which they have, magnitudes have tended to be too limited and short term to permit a significant stabilization effect. As with other financial innovations, indexed debt presents problems associated with pricing and liquidity, with first-mover costs and coordination problems that may help to explain their slow market development.

Now, debt indexed to commodity prices would be a useful instrument only for countries or companies that are highly dependent on a specific commodity price. An instrument that would be more useful for a larger group of developing countries could be debt indexed to terms of trade, because developing countries in general exhibit

---

2. Cordella and Levy Yeyati 2007.

3. Once the budget is approved, based on a projected oil price, if the latter turns out to be lower than expected, unexpected cash deficits emerge that tend to be very hard to meet, given budgetary and indebtedness rule rigidities.

4. See Perry (2007).

**Table 5.2. Correlations of terms of trade**

<b>USA</b>						
	<b>East Asia and Pacific</b>	<b>Europe and Central Asia</b>	<b>Latin America and the Caribbean</b>	<b>Middle East and North Africa</b>	<b>South Asia</b>	<b>Sub-Saharan Africa</b>
Region	-0.362	-0.173	-0.193	0.018	-0.121	-0.210
Higher	0.512	0.935	0.648	0.370	0.146	0.508
Media	-0.148	0.068	0.055	-0.190	-0.151	-0.111
Lower	-0.733	-0.943	-0.622	-0.686	-0.458	-0.821
<b>OECD</b>						
	<b>East Asia and Pacific</b>	<b>Europe and Central Asia</b>	<b>Latin America and the Caribbean</b>	<b>Middle East and North Africa</b>	<b>South Asia</b>	<b>Sub-Saharan Africa</b>
Region	-0.108	-0.172	-0.242	-0.220	-0.053	-0.097
Higher	0.518	0.938	0.712	0.253	0.186	0.551
Media	-0.124	0.058	0.079	-0.311	-0.095	-0.100
Lower	-0.768	-0.952	-0.764	-0.774	-0.460	-0.860
<b>Region</b>						
	<b>East Asia and Pacific</b>	<b>Europe and Central Asia</b>	<b>Latin America and the Caribbean</b>	<b>Middle East and North Africa</b>	<b>South Asia</b>	<b>Sub-Saharan Africa</b>
Higher	0.630	0.903	0.944	0.959	0.978	0.850
Media	0.075	-0.086	0.438	0.449	0.513	0.104
Lower	-0.640	-0.916	-0.393	-0.384	-0.068	-0.517
Period	1980–2005	1990–2005	1980–2005	1980–2005	1980–2005	1980–2005

*Note:* Reported values correspond to the weighted average of correlations of terms of trade for each region with the United States and the industrial countries. There is also a report of higher, average, and lower correlations obtained by an individual country in each region. The bottom panel presents these values with respect to the weighted regional average.

*Source:* Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

significantly higher terms of trade volatility than developed countries, as shown in chapter 2. Correlations of average regional terms of trade with the United States or an OECD basket tend to be negative or small, and individual correlations tend to be quite low across countries in some developing regions (East Asia and Pacific, Europe and Central Asia, and Sub-Saharan Africa). See table 5.2. Principal components explain between 30 percent and 50 percent of the variance within regions and around 40 percent

**Table 5.3. Terms of trade, principal component analysis  
(Proportion of variance explained by the first and second components)**

Component	Latin America and the Caribbean	Europe and Central Asia	East Asia and Pacific	Middle East and North Africa	South Asia	Sub-Saharan Africa	Developing countries	World
1	0.3932	0.5118	0.3436	0.4114	0.4274	0.312	0.4193	0.405
2	0.1915	0.2016	0.1942	0.2469	0.3152	0.138	0.283	0.2827
Sample period	1980-2005	1990-2005	1980-2005	1980-2005	1980-2005	1980-2005		

Note: Calculations correspond to the contribution of first and second principal components to explaining the variance in terms of trade for each group of countries.

Source: Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

in a global pool (table 5.3). Thus, investors holding a global portfolio and even some regional portfolios of debt indexed to terms of trade could achieve substantial risk diversification. There would be, admittedly, significant coordination problems in developing such options. In addition, terms of trade indexation presents more significant technical problems than commodity price indexation because of the need to rely on an agency to estimate terms of trade based on issuers' supply of information, a process likely fraught with significant delays and with verifiability and political economy problems.

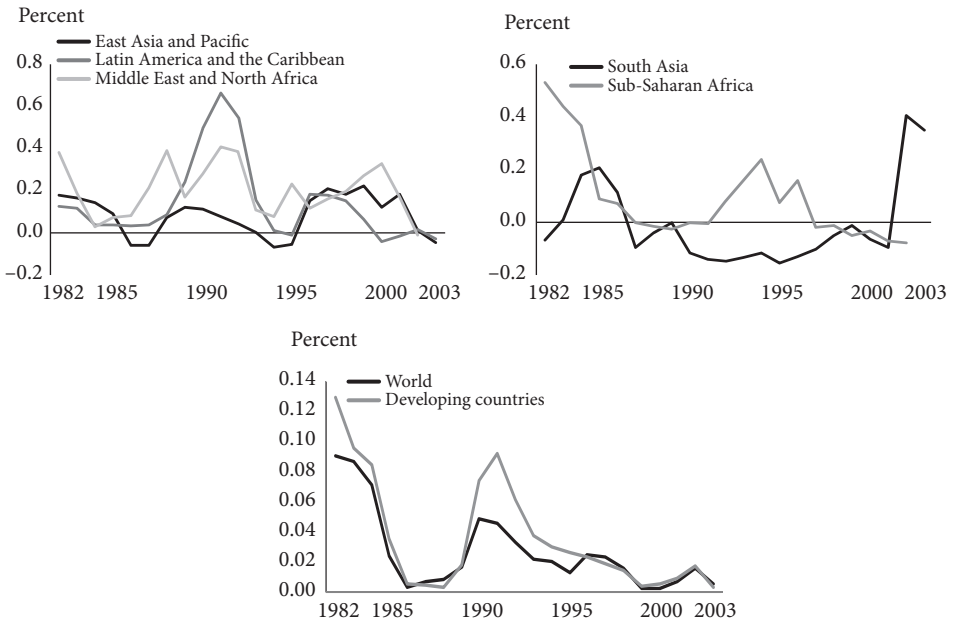
Figure 5.1, a plot of the average of pairwise correlations of terms of trade, confirms that regional comovement of terms of trade are much lower than those of nominal exchange rates (see figure 4.8 above) and seldom achieve high values. Thus, investors could achieve significant diversification benefits in holding regional pools of debt indexed to terms of trade. A similar conclusion can be derived from a plot of the performance of principal components over time (see figure 1 in the appendix).

Even more useful for most sovereign governments would be to rely on debt indexed to GDP.<sup>5</sup> After all, what any country would like is to be able to mitigate problems associated with output volatility, whatever its cause, whether exogenous or endogenous. In theory, GDP-indexed debt would permit a sharp reduction in the procyclicality of capital flows and fiscal policy that tends to amplify the effects of both exogenous shocks and endogenous business cycles, leading to high output volatility. Thus, debt indexed to GDP has the potential to achieve significant reductions in output volatility and liquidity and default risk, and hence to improve the long-term growth potential for any country.<sup>6</sup>

A few simulations, shown below, for the aggregate of Latin America and Sub-Saharan Africa, as well as for particular country cases, illustrate the importance that

5. Variance in terms of trade explains only about 10 percent of GDP variance (Hoffmaister and Roldós 1997).

6. See Shiller (2005b); Borensztein and Mauro (2004); and Griffith-Jones and Sharma (2006).

**Figure 5.1. Comovement of terms of trade (Rolling correlations)**

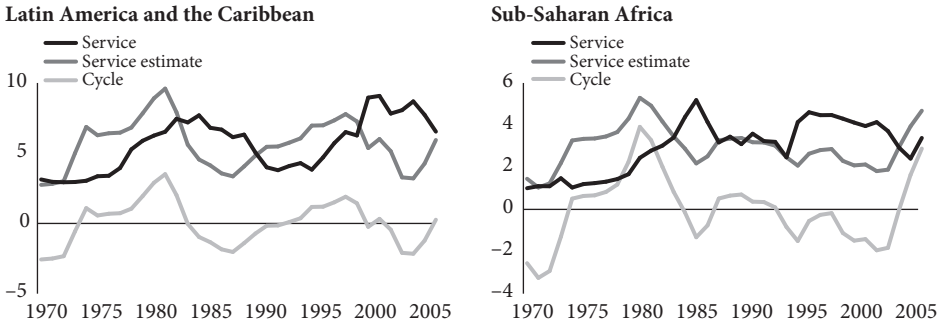
Note: Comovement is defined as the average of pairwise correlations for countries within each region.

Source: Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

indexing debt to GDP might have for developing countries. To simplify calculations, these simulations assume that amortizations had been perfectly indexed to the variations of GDP growth around its trend, from 1970 to 2005, and show what debt service or amortizations would have looked like in comparison with their actual behavior. In practice, amortizations would be indexed to GDP growth, and thus responsive both to cyclical variations (as in this exercise) and to GDP trends. From figure 5.2 it is apparent that the so-called debt crises of the 1980s in Latin America, as well as the balance of payments and fiscal stress at the end of the last decade, would have been considerably smoothed out if these countries had issued the same amount of foreign debt that they did in previous periods, but with debt service perfectly indexed to the GDP cycle. The same would have been true for Sub-Saharan Africa, where the currency and fiscal crises of the second half of the 1990s would have been considerably smoothed out. To achieve such smoothing, these regions would have accelerated debt payments during the booms of the late 1970s and early 1980s and, in the case of Latin America, also during the boom of the early 1990s, under the GDP-indexed debt case.

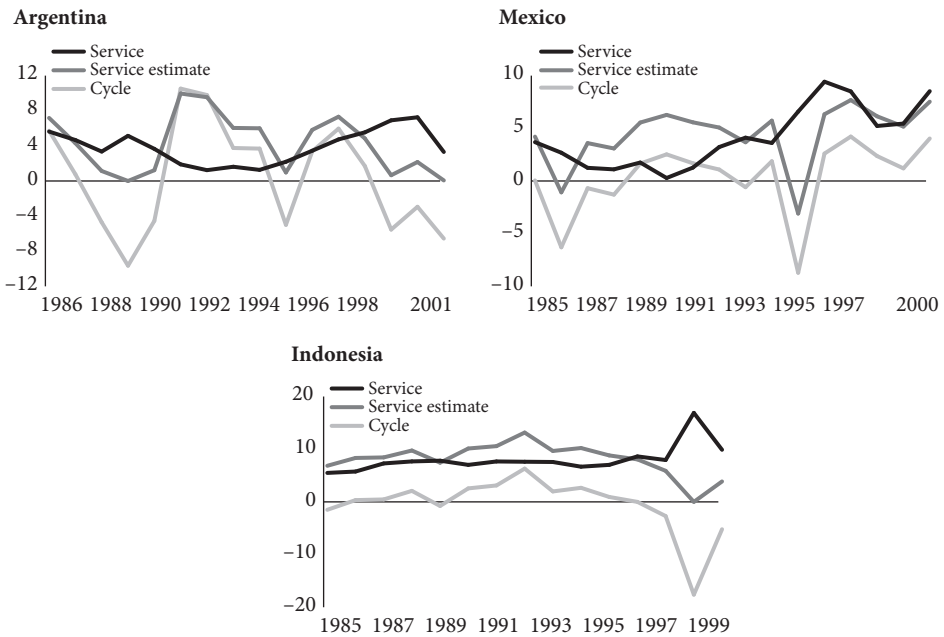
Figure 5.3 shows the stabilization potential of GDP-indexed debt even more dramatically for three country cases. In the case of Argentina, debt service would have been much higher during the strong boom of the early 1990s, rapidly reducing debt

**Figure 5.2. Stabilization potential of GDP indexed debt  
(Aggregate simulations)**



Source: Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

**Figure 5.3. Stabilization potential of GDP-indexed debt  
(Individual countries)**



Source: Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

burdens, in contrast with the observed deterioration of the underlying structural fiscal situation that took place.<sup>7</sup> Correspondingly, debt service would have been much lower during the recession at the end of the 1990s. The 2001 debt crisis might have been avoided or, at least, it would have been much less severe than it was. Mexico would have accelerated debt service during the boom of 1987–1993, significantly reducing remaining debt burden and possibly escaping the dramatic 1994 Tequila crisis, or at least significantly reducing its cost. Indonesia would have accelerated debt service during the boom of 1987–1995 and significantly eased the stress during the 1997/98 Asian crisis.

From the point of view of investors, a broad portfolio of GDP-indexed debt could help to maximize risk diversification. Shiller has shown that more than 50 percent of individuals' income risk in developed countries is associated with, and actually determined by, GDP risk.<sup>8</sup> This is also likely to be the case for citizens of developing countries, perhaps more so. The only way to diversify away that risk is to invest part of one's portfolio in other countries' risks. This can be only partially achieved through investing in debt and equity instruments because normally banks and equity markets intermediate only a small share of a country's GDP.<sup>9</sup> Thus, the ultimate risk-diversification potential could be achieved only through a portfolio of debt indexed to the GDP of a wide variety of countries. The remaining undiversifiable risk would then be associated with the comovement of countries' GDPs, that is, to worldwide GDP risk.

Tables 5.4 and 5.5 show the low GDP growth correlations at regional levels (except in Europe and Central Asia) and, especially, at global levels. These correlations are significantly lower than those for terms of trade or for nominal exchange rates (as can be seen by comparing these estimates with those of tables 5.2 and 5.3 and tables 4.3 and 4.4). These results illustrate the high risk-diversification potential of regional or global portfolios of GDP-indexed debt. Furthermore, figure 5.4 shows that either the regional or, especially, the global comovement of GDP growth rates has been quite low during most of the last decades and significantly lower than the corresponding comovement of nominal exchange rates or terms of trade (compare figure 5.4 with figures 5.1 and 4.8). The same conclusion is derived from observation of the performance of principal components over time (figure 5.5), which also shows that global comovement of GDP growth rates is not only lower but also more stable over time than the comovement of terms of trade or nominal exchange rates (compare with figures 1 and 2 in the appendix).

However, for all their theoretical attractiveness, both for issuer countries and worldwide investors, these "macro" markets have not been developed. Actual individual

---

7. See Perry and Servén (2002).

8. Shiller 2004. More precisely, between 50 and 75 percent of five-year household income variances are explained by GDP variations in the United States.

9. Stocks listed represent at most 10 percent of GDP in emerging countries (Borensztein and Mauro 2002 and 2004).

**Table 5.4. Correlations of GDP growth rates (Rolling correlations)**

<b>USA</b>						
	<b>East Asia and Pacific</b>	<b>Europe and Central Asia</b>	<b>Latin America and the Caribbean</b>	<b>Middle East and North Africa</b>	<b>South Asia</b>	<b>Sub-Saharan Africa</b>
Region	0.200	0.284	0.175	0.051	0.299	0.084
Higher	0.385	0.787	0.518	0.147	0.299	0.360
Media	0.072	0.299	0.084	-0.004	0.176	0.026
Lower	-0.089	0.028	-0.250	-0.190	0.041	-0.393
<b>OECD</b>						
	<b>East Asia and Pacific</b>	<b>Europe and Central Asia</b>	<b>Latin America and the Caribbean</b>	<b>Middle East and North Africa</b>	<b>South Asia</b>	<b>Sub-Saharan Africa</b>
Region	0.527	0.364	0.294	0.155	0.366	0.287
Higher	0.879	0.743	0.536	0.896	0.366	0.893
Media	0.264	0.328	0.163	0.159	0.149	0.089
Lower	-0.034	0.038	-0.197	-0.177	0.033	-0.460
<b>Region</b>						
	<b>East Asia and Pacific</b>	<b>Europe and Central Asia</b>	<b>Latin America and the Caribbean</b>	<b>Middle East and North Africa</b>	<b>South Asia</b>	<b>Sub-Saharan Africa</b>
Higher	0.604	0.934	0.808	0.662	0.990	0.733
Media	0.359	0.717	0.390	0.460	0.256	0.240
Lower	-0.063	0.296	-0.100	0.192	-0.070	-0.041
Period	1970–2005	1990–2005	1970–2005	1962–2005	1980–205	1961–2005

*Note:* The reported values correspond to the correlations of the weighted average GDP growth rates for each region with the United States and the industrial countries. Also reported are higher, average, and lower correlations obtained by individual countries within each region. The lower panel presents these values with respect to the weighted regional average.

*Source:* Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

country experience with GDP-indexed debt has been sporadic, generally associated with debt restructuring episodes, when coordination problems and liquidity risks are significantly reduced. Indeed, the best known cases have been associated either with Brady deals (Bulgaria and Costa Rica) or more recent debt restructuring deals (Argentina and Bosnia). However, even then, they have often been costly for issuers. The Argentine case has been particularly costly to the issuer, partly as a result of design

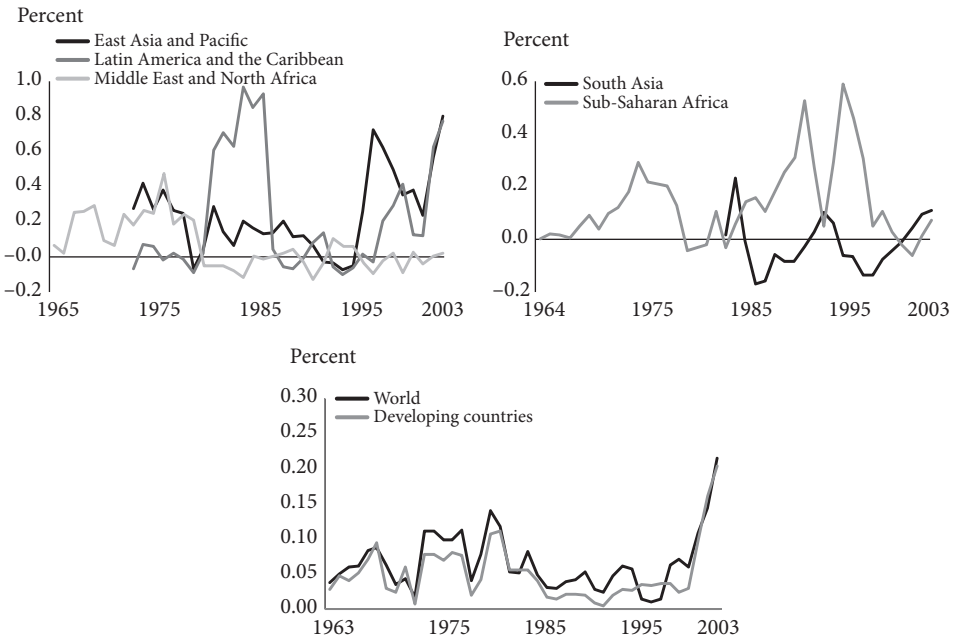
**Table 5.5. Principal component analysis—GDP growth**  
(Proportion of variance explained by the first and second components)

Component	Latin America and the Caribbean	Europe and Central Asia	East Asia and Pacific	Middle East and North Africa	South Asia	Sub-Saharan Africa	Developing countries	World
1	0.2458	0.5954	0.4337	0.2715	0.2481	0.116	0.2877	0.27
2	0.1046	0.1758	0.1777	0.1761	0.2404	0.1008	0.1247	0.1402
Sample period	1970–2005	1990–2005	1970–2005	1962–2005	1981–2005	1961–2005		

Note: Calculations correspond to the contribution of first and second principal components to explaining the variance in terms of trade for each group of countries.

Source: Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

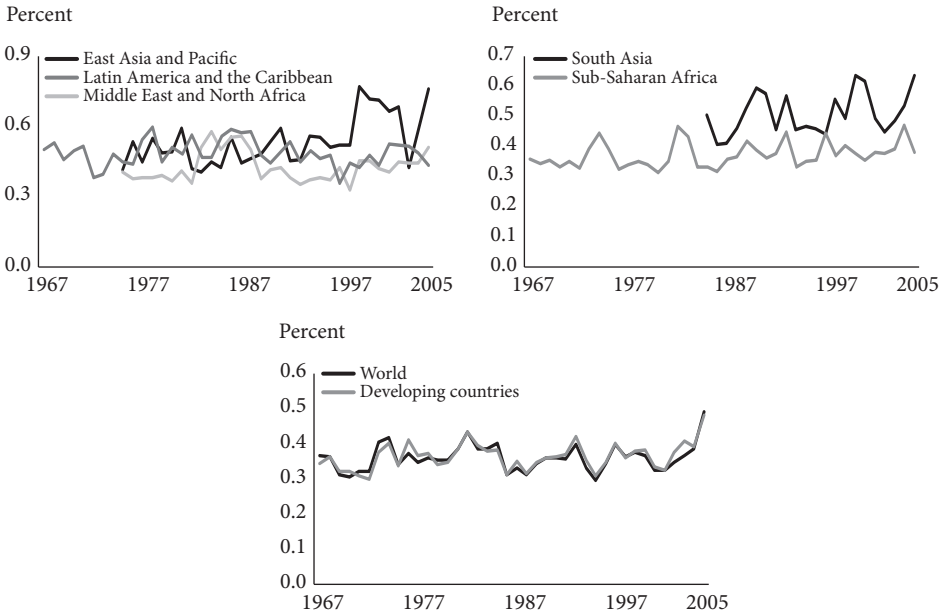
**Figure 5.4. Comovement of GDP growth rates (Rolling correlations of GDP growth rates)**



Note: Comovement is defined as the average of pairwise correlations for countries within each region.

Source: Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

**Figure 5.5. Comovement of GDP growth rates (Principal components performance over time)**



*Note:* Comovement is defined here as the proportion of variance explained by the first and second principal components by region.

*Source:* Author's calculations based on data from *World Development Indicators* (World Bank 2007b).

problems and the strong unexpected growth recovery after the 2001 crisis. But, more generally, high costs and marginal market development are consequences of the high risks associated with just one or a few issuers, when the benefits of diversification associated with a regional or global portfolio of GDP-indexed debt cannot be achieved. Thus, first-mover costs and coordination problems appear to be particularly severe for the development of GDP-indexed debt markets, for the same reasons that they are quite severe for developing country currency and terms of trade-indexed debt markets.

Once more, multilateral development banks, especially those with global reach, are in a privileged position to help solve some of these problems and help develop these markets. John Williamson recently put forward a practical proposal<sup>10</sup>: a multi-lateral development bank would support and help coordinate the simultaneous issuing of GDP-indexed debt for a number of small countries. The group of countries included should have low GDP correlations among them and with OECD countries, so that they would offer interesting diversification benefits to investors. Furthermore, by virtue of their being small countries, the amounts issued would be small enough to

10. Williamson 2008.

be easily placed in the markets and, at the same time, large enough in relation to the countries' GDP as to offer significant stabilization benefits to the issuers.<sup>11</sup>

There have been other more technical arguments offered to explain the slow development of these theoretically attractive markets. Some refer to the assumed difficulties of pricing and the expected high premiums. However, a recent paper by Chamon and Mauro<sup>12</sup> shows that these arguments have been overdone. Indeed, liquid GDP-indexed bonds should not be much more difficult to price than plain vanilla sovereign bonds and certainly not more expensive because the key parameter in determining price—the probability of default risk (liquidity considerations aside)—should be lower for GDP-indexed bonds and not more difficult to calculate than for plain vanilla bonds. The critical issues for pricing and premiums are thus really those related to liquidity and risk-diversification potential, as discussed above.

Other arguments offered against these types of bonds refer to “moral hazard” or data-manipulation risks. These, too, seem to have been overdone. It is difficult to conceive of a case in which GDP-indexed debt would give authorities a strong enough incentive to adopt policies that reduce GDP growth, as the political costs associated with such an outcome would be several orders of magnitude higher than whatever political cost is associated with higher debt payments. Indeed, most authorities would gladly pay some additional debt service costs for the benefits associated with higher growth, including those of higher tax revenues from which the additional debt payments could be easily made. The same is true, although admittedly to a lesser extent, for data-manipulation risks. If governments have incentives to cheat about GDP growth figures, they all tend toward the direction of exaggerating growth rates. Adding negative financial incentives, such as those associated with higher debt payments of GDP-indexed debt, would hardly alter the net sign of the overall incentive structure.<sup>13</sup> In any case, to minimize this risk, the international financial institutions could play a role in promoting agreements that guarantee good GDP accounting and disclosure practices, much as is currently done with respect to debt, fiscal, and monetary statistics.

---

11. For discussions and estimates of the “optimal level” of GDP debt indexation for a given country, see Shiller (1993) and Durdu (2005).

12. Chamon and Mauro 2005.

13. Theoretically, it could alter incentives in the margin due to sharp discontinuities in the design of indexed debt contracts, which is an argument for adequate design and not against the instrument per se.