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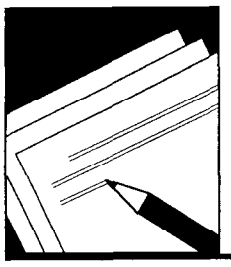

IMF Policy Discussion Paper

Reviving the Case for GDP-Indexed Bonds

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INTERNATIONAL MONETARY FUND

 PDP/02/10

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Research Department

Reviving the Case for GDP-Indexed Bonds

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September 2002

Abstract

This paper seeks to revive the case for countries to self-insure against economic growth slowdowns by issuing GDP-indexed bonds. We simulate the effects of GDP-indexed bonds under different assumptions about fiscal policy reaction functions and their output effects and find that they could substantially reduce the likelihood that debt/GDP paths become explosive. The insurance premium would likely be small, because cross-country comovement of GDP growth rates is low and cross-country GDP growth risk is thus largely diversifiable for an investor holding a portfolio of GDP-indexed bonds. Potential obstacles to the emergence of a market for these bonds include the verifiability of GDP data, the trade-off between insurance and moral hazard, and the need for liquidity. The paper discusses institutional fixes and suggests an approach to attempting to start up a market.

JEL Classification Numbers: F33, F34, F36, G13, G15

Keywords: Emerging markets, GDP-indexed bonds

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[1] We are grateful to Priyadarshani Joshi for research assistance and to Olivier Jeanne and several other colleagues for helpful comments.

I. INTRODUCTION

The sustainability of a country's sovereign debt position hinges crucially on its economic growth. Slow growth underlies many debt crises, including the Latin American debt crisis of the 1980s and the debt crisis of the highly indebted poor countries (HIPCs) in the 1980s and 1990s (Easterly, 2001). Not surprisingly, the ratio of external debt to GDP is a significant and robust predictor of external debt crises (Detragiache and Spilimbergo, 2001). While it is an open question whether Argentina's government debt became unsustainable because of slow economic growth in addition to its lax fiscal policy, Argentina's growth slowdown since 1998 surely contributed to triggering its recent crisis. How can countries protect themselves from slow growth resulting in debt crises in the future?

This paper argues that countries could self insure against possible growth slowdowns by issuing bonds indexed to the real growth rate of their own GDP. Consider a country whose GDP has been growing for many years at 3 percent, and is expected to continue doing so; assume that this country can issue regular, plain vanilla bonds at, say, 10 percent interest. That country could consider issuing GDP-indexed bonds whose yearly coupon payments will be reduced by, for example, 2 percentage points for every percentage point by which GDP growth falls short of its 3 percent trend. In years when growth turns out to be 1 percent, the coupon will be 6 percent (plus a small insurance premium, to be discussed below), and in years when growth turns out to be 5 percent, the coupon will be 14 percent (plus the same insurance premium). Thus when GDP growth turns out lower than usual, debt payments due will also be lower than in the absence of indexation, helping maintain the debt/GDP ratio at sustainable levels, and avoiding what could be a costly and politically difficult adjustment in the primary balance at a time of recession. Conversely, when GDP growth turns out higher than usual, the country will pay more than it would have without indexation, thus reducing its debt/GDP ratio less than it would have otherwise. In sum, this insurance scheme keeps the debt/GDP ratio within a narrower range. For this insurance, the borrowing country will pay a premium above the interest rate that it would ordinarily be charged. As shown below, this premium could be relatively small.

While focusing on GDP risk for the sake of simplicity, we recognize that there are many sources of risk affecting the debt-service capacity of emerging markets. Terms of trade risk has been stressed in this regard, supporting the idea of debt instruments that are adjusted to the world price of some key commodity, for example. Sharp changes in the exchange rate can also impair the ability to service foreign debt, or foreign-currency denominated debt more generally. These different risks are not independent: a terms of trade deterioration would put pressure on the exchange rate and depress incomes; a currency crisis may result in a sharp economic downturn, and so on. To be sure, a country's debt-service capacity is affected by many shocks, which will often have a direct impact in addition to their impact through the country's GDP. In this paper, we focus on GDP as a good summary of the effects of a variety of shocks, but this is not to deny the merits of analyzing the ultimate sources of risk separately.

A number of questions may be raised about the feasibility of creating a market for securities such as the one proposed here. Would international investors be willing to take on the additional risk resulting from GDP indexation? Would GDP-indexed bonds reduce countries' incentives to grow rapidly? Would GDP-indexed bonds reward inefficiency? Could countries misreport their growth rates? We discuss these and related issues and argue that none of the objections present insurmountable difficulties. It is not likely, however, that a market for contingent claims of this kind would emerge spontaneously, owing largely to the same reasons that many other innovative financial instruments were only made possible by official intervention. We argue that there is a case for official intervention in this regard, to set statistical standards and verify the reliability of the national accounts, and to foster a dialogue among potential participants in a market for GDP-indexed instruments.

II. Related Proposals and Previous Experience

In many ways, the desirability of issuing GDP-linked bonds is not a new idea. A first wave of interest in indexing debt to GDP, exports, or key commodity prices emerged in the aftermath of the debt crisis of the 1980s. Bailey (1983) suggested the conversion of debt into proportional claims on exports. Krugman (1988) and Froot, Scharfstein, and Stein (1989)

considered the relative merits of indexing debt to variables out of the debtor country's control (such as commodity prices) versus variables partially under the country's control (exports or GDP). A second wave of interest originated from Shiller's (1993) proposal to create "macro markets" for GDP-linked securities. In Shiller's specific proposal, these were to be perpetual claims on a fraction of a country's GDP. The present paper's proposal is closely related: issuing a bond whose coupon payments are indexed to GDP growth is equivalent to issuing a plain vanilla bond while going short on a security indexed to the issuing country's own GDP growth rate. At the same time, this paper's proposal may be easier to implement: it simply requires introducing an indexation clause in otherwise standard sovereign bonds. By contrast, Shiller security markets would have to be set up from scratch. Obstfeld and Peri (1998) have adapted Shiller's idea to the European context. They suggest that individual governments in the European Union should issue perpetual euro-denominated liabilities indexed to domestic nominal per-capita GDP growth. They argue that nominal rather than real indexing would protect buyers of the securities against inflation.

For emerging market economies, the case for contingent debt contracts has received new impetus after the financial and debt crises of the 1990s. Haldane (1999) argues that emerging markets would benefit from indexing debt to commodity prices. Daniel (2001) argues that many governments would benefit from hedging oil price risk through existing financial instruments and markets, and that international institutions should encourage them to explore this possibility. Caballero (2001) recommends that Chile should issue bonds indexed to the price of copper. Drèze (2000) suggests the use of GDP-indexed bonds (with a deductible) as part of a strategy to restructure the debt of the poorest countries. Varsavsky and Braun (2002) make the case for restructuring Argentina's debt into GDP-indexed bonds.

A handful of emerging market economies have already issued a few bonds with elements of indexation.[2] Mexico has issued bonds indexed to oil prices. Some private Chilean firms have issued bonds indexed to the price of copper. Most interestingly,

[2] There are also reports that a market for options on U.S. Economic Statistics may emerge in the near future.

Costa Rica, Bulgaria, and Bosnia and Herzegovina have issued bonds containing an element of indexation to GDP. These bonds, which were issued as part of Brady restructuring agreements, contain clauses or warrants that increase the payoff to bondholders if GDP (or GDP per capita) of the debtor country rises above a certain level. In the case of Bulgaria, the bonds provide for a GDP "kicker" such that, once real GDP exceeds 125 percent of its 1993 level, creditors will be entitled to an additional 0.5 percent in interest for every 1 percent of real GDP growth in the year prior to interest payment (Goldman Sachs, 2001). At the same time, these bonds are callable by the issuer and even at the time of issue it was widely expected that Bulgaria would repay the principal and refinance it, should the kicker appear likely to be triggered by rapid economic growth. Indeed, Bulgaria has already swapped a portion of its indexed bonds for newly issued, non-indexed bonds. In any case, indexed bonds are very much exceptions, and in the few instances when they have been issued the indexation clause was set so far "out of the money" that it was unlikely ever to be triggered. Nobody in international policy circles has seriously acted on the idea of fostering the use of debt indexed to GDP on a large scale, despite a number of potential advantages.

III. Advantages of GDP-indexed bonds

The main advantage of GDP-indexed bonds is that they restrict the range of variation of the debt/GDP ratio, thereby reducing the likelihood of debt crises. Detragiache and Spilimbergo (2001) show that a rise in the debt/GDP ratio by 10 percentage points is associated with a 20 percent increase in the probability of a crisis. Easterly (2002) shows that a one percentage point decline in average annual GDP growth is associated with 1½ more debt reschedulings in the following 15 years.

A simple numerical example may illustrate how GDP-indexed bonds would help to stabilize debt/GDP ratios. Consider a hypothetical country starting off in period 0 with a debt/GDP ratio of 30 percent, "trend" growth of 3 percent, a fixed primary deficit of 0.5 percent of GDP, and facing an 3.2 percent interest rate on international markets. The country can issue either (i) plain vanilla bonds at 3.2 percent; or (ii) indexed bonds with yearly coupon payments of 3.2 percent plus 0.7 times the difference between actual growth

and "trend growth" of 3 percent; in addition, the issuer will pay a relatively small yearly insurance premium (an assumption discussed below) here arbitrarily set at 0.4 percentage point, payable regardless of the growth rate. For simplicity, all variables in the exercises presented below are in real terms. This implies that the (real) exchange rate is perpetually fixed. In addition, we focus on sovereign debt exclusively, although the benefits of GDP-indexed debt would also extend to private contracts.

Relying on the well-known identity

$$D_t / Y_t = (1 + r - g_t)(D_{t-1} / Y_{t-1}) - s_t$$

where D_t is government debt, Y_t is output, s_t is the primary surplus as a share of GDP, g_t is the growth rate, and r is the interest rate, Figure 1 reports the debt/GDP ratio paths, with and without indexation, under the following scenarios:

1. Growth drops to 0.5 percent from year 6 onwards. As a result, by year 20 the debt/GDP ratio rises to 71 percent without indexation, but only to 52 percent with indexation.

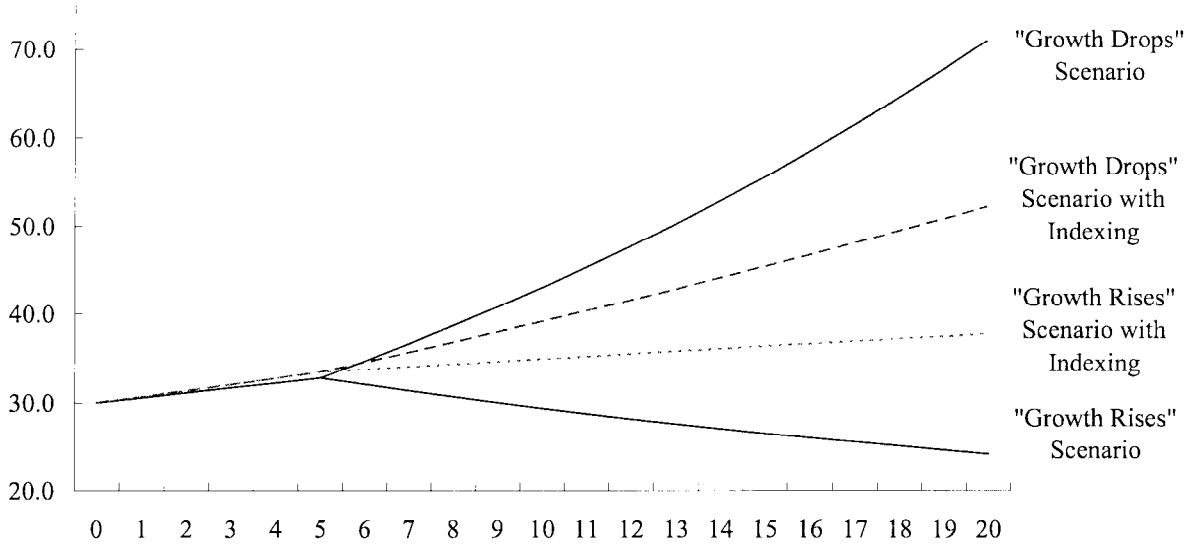
2. Growth rises to 7 percent from year 6 onwards. As a result, by year 20 the debt/GDP ratio falls to 24 percent without indexation, but rises to 38 percent with indexation.

While this illustrates that the potential benefits of indexation may be large holding the primary surplus constant, it is also important to consider that fiscal policy may well respond to developments in economic growth and in the interest bill and, furthermore, that changes in the primary surplus will have an impact on economic growth.

During economic downturns, emerging market countries are often forced to tighten fiscal policies to maintain credibility and access to international financial markets. Gavin and Perotti (1997) find that during deep recessions the fiscal surplus *increases* on average by about 2 percentage points of GDP in Latin American countries, whereas the fiscal surplus *falls* by 4½ percentage points of GDP in OECD countries.

GDP-indexation of bond repayments would reduce the need for emerging market countries to engage in procyclical fiscal policy. When GDP growth is below trend, the

Figure 1. Debt Profiles With and Without Indexing: Simplest Scenarios



The primary deficit is 0.5 percent of GDP throughout. Output growth is 3 percent until period 5; thereafter it is -1 percent in the "growth falls" scenario and 7 percent in the "growth rises" scenario. The interest rate on standard debt contracts is assumed to be 3.2 percent. With indexing, the interest rate is reduced by 0.7 times the difference between the actual growth and trend growth of 3 percent. (Indexing is symmetric here, i.e. the country pays a higher interest rate if actual growth turns out to be above trend.) The insurance premium is 0.4 percentage points, added to the market interest rate.

government will be able to have a lower primary surplus (higher primary spending and lower taxes) with indexation than without it; conversely, when GDP growth is above trend, the government will need to have a higher primary surplus (lower primary spending and higher taxes) than without indexation. Thus GDP-indexation of bond repayments tends to make for smoother paths of the primary surplus, taxes, and primary spending, over the cycle. With diminishing marginal benefits to primary spending and increasing marginal costs of taxation, GDP indexation will thus tend to improve welfare. This reasoning is valid regardless of the exact specification of how estimates of trend growth are updated and how the government adjusts the primary surplus to changes in growth or trend growth. Moreover, adjusting the primary balance (for example, by raising new taxes or laying off government employees) in times of economic and financial distress may be especially costly.

An alternative framework, whose details are spelled out in Box 1, may further illustrate the benefit of GDP-indexed bonds when the feedback between fiscal policy and

changes in economic growth is taken into account. Specifically, we explore the case where the government responds to growth slowdowns by *increasing* the primary surplus, effectively implying that fiscal policy is procyclical. This seems to be especially realistic for emerging markets, where the government may be liquidity-constrained or may attempt to prove its credibility to international investors by striving to maintain the debt on a sustainable path. The benefits of indexation are again considerable: this is illustrated in Figure 2, which reports the paths for the debt to GDP ratio with and without debt indexation.

IV. Diversifiability of Growth Across Countries, and the Insurance Premium

Several studies show that there are large, unrealized gains from international risksharing. The potential gain arises from the fact that income growth rates are not highly correlated across countries, at a variety of horizons. Athanasoulis and van Wincoop (2000) and Athanasoulis, Shiller, and van Wincoop (1999) estimate that the probability that per capita GDP will unexpectedly rise by 50 percent in the best performing country relative to that of the worst performing country is 20 percent at the 15-year horizon, 40 percent at the 20-year horizon, 80 percent at the 25-year horizon, and 100 percent at the 35-year horizon.[3]

Similar considerations in the context of the Capital Asset Pricing Model (CAPM), which we use as a starting point to evaluate how markets would price GDP-indexed bonds, suggest that the insurance premium on GDP-indexed bonds issued by emerging markets would likely be small. In fact, the CAPM implies that only the systematic portion of risk is reflected in expected returns, because unsystematic risk can be diversified away by investors (Box 2). The systematic portion of risk involved in an individual country's GDP growth rate is typically rather small. To compute it, one needs to decide what "market portfolio" return is relevant for this purpose. Reasonable candidates include world GDP growth, US GDP growth, world real stock returns, and US real stock returns. Simple regressions of individual countries' GDP growth rates on worldwide growth show that unsystematic variation is far

[3] They compute these probabilities beginning from the residuals obtained from a cross-country regression model of economic growth.

Box 1. Benefits of Indexation—Allowing for Interactions Between Fiscal Policy and Output

In this simulation, the government sets the ratio of the primary surplus to GDP, s_t, equal to the debt/GDP ratio times the difference between the interest rate, r, and a weighted average of "trend" economic growth, $\bar{g}$, and current economic growth, g_t:

$$s_t = (D_t / Y_t)\{r - [\phi \cdot g_t + (1-\phi) \cdot \bar{g}]\}$$

In other words, the government responds to growth slowdowns by *increasing* the primary surplus, effectively implying that fiscal policy is procyclical.

Finally, we assume that when the primary budget surplus is higher than a critical level, it curbs economic growth. Thus the growth rate of GDP is given by:

$$g_t = \bar{g} + u_t - \gamma(s_t - \bar{s}), \qquad \forall s_t \geq \bar{s}$$

where $\bar{s}$ is the critical level of the primary surplus, $\bar{g}$ is a constant, and u_t is an exogenous shock to the growth rate of GDP. We set γ=5 and $\bar{s}$=0.1 percent of GDP.

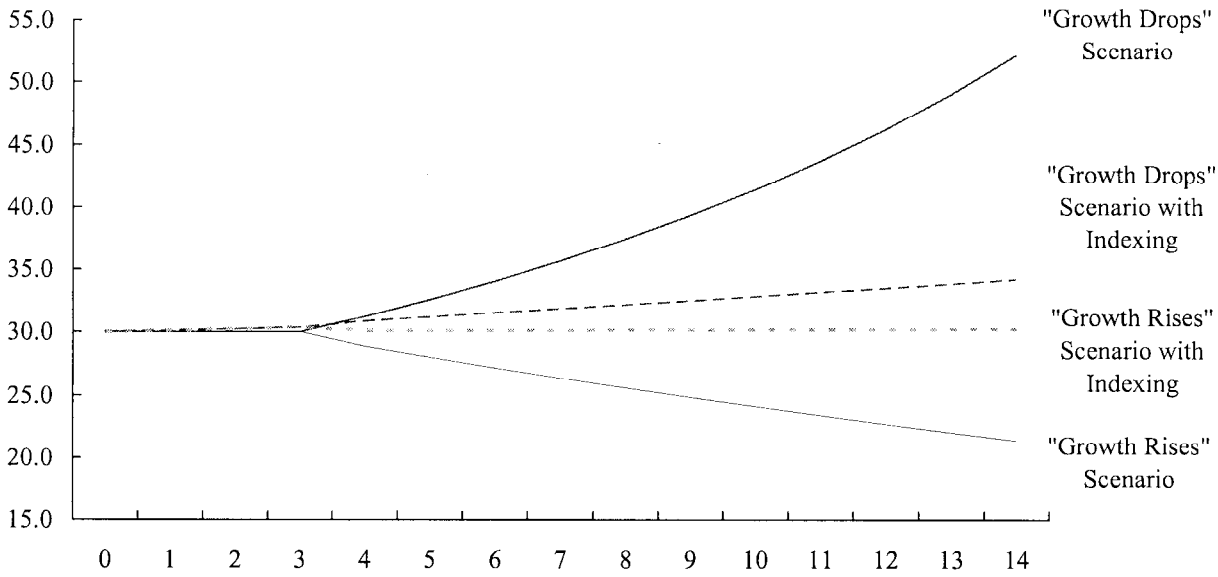
As in the previous exercise, under standard debt contracts the interest rate is assumed to be a constant, $r_t = \bar{r}$= 3.2 percent; under GDP indexation, the interest rate is given by

$$r_t = \bar{r} + \Omega + \alpha(g_t - \bar{g}),$$

where Ω=0.4 is an indexation premium and α=0.7 is the extent to which debt contracts are adjusted to changes in the growth rate: if the growth rate falls short of its trend value by one percent, the coupon rate on the bond will be reduced by 70 basis points.

We simulate the above framework for cases where u_t, the exogenous shock to GDP growth, takes the value –4 percentage points ("growth drops" scenario) or +4 percentage points ("growth rises" scenario), beginning in year 4.

Figure 2. Debt Profiles With and Without Indexing: Model Simulations



The market interest rate is assumed to be 3.2 percent. Output growth is 3 percent until period 3; thereafter the "growth falls" scenario assumes a negative shock of 4 percentage points, and the "growth rises" scenario assumes a positive shock of 4 percentage points. The government sets the primary surplus such that the debt/gdp ratio would be constant if growth were a weighted average of long-run growth and actual growth (with weights of 0.8 and 0.2, respectively). A primary surplus above a minimum threshold adversely affects the current growth rate.

larger than systematic variation (Table 1). For emerging market countries, the R^2 coefficient ranges from 0.00 (Argentina, Bulgaria, etc.) to 0.39 (Botswana) with an average of 0.10 for 1970–2001. The beta coefficients range from –1.4 (Jordan) to 3.00 (Botswana), with an unweighted average of 0.81. (Following standard reasoning, the weighted average of the beta coefficients equals one when the country weights are the same as those used to compute world growth.) The average of the absolute value of the difference between 1 and the beta coefficient is 0.78. Comovement across countries is somewhat higher for advanced countries, and marginally lower for developing countries, but the basic message is the same. Similar regressions using U.S. GDP growth, world real stock returns, or U.S. real stock returns on the right hand side yield even lower R^2 coefficients, the beta coefficients tend to be lower (the weighted average of the beta coefficients no longer needs to equal one), and smaller in absolute value.

Box 2. The Size of the Insurance Premium in CAPM-like Reasoning

The insurance premium required by investors to hold GDP-indexed bonds according to the CAPM can be derived as follows. Recall that the return on GDP-indexed bonds is:

$$\rho_i = R + \alpha(\tilde{g}_i - \bar{g}_i)$$

where R is the interest rate that the country faces on plain vanilla bonds, α determines the degree of indexation, and g_i is the country's output growth rate, with $\tilde{g}_i$ being equal to actual growth and $\bar{g}_i$ being equal to trend growth.

According to the CAPM, any asset with return $\tilde{r}_i$ must yield

$$E(\tilde{r}_i) = r_F + [E(\tilde{r}_M) - r_F]\frac{Cov(\tilde{r}_i, \tilde{r}_M)}{Var(\tilde{r}_M)}$$

where r_F is the risk-free rate and $\tilde{r}_M$ is the return on the market portfolio.

Applying this to the return on GDP-indexed bonds:

$$E[\rho_i] = r_F + [E(\tilde{r}_M) - r_F]\frac{Cov\{[R + \alpha(\tilde{g}_i - \bar{g}_i)], \tilde{r}_M\}}{Var(\tilde{r}_M)}$$

which can be rewritten as

$$E(\rho_i) = r_F + \alpha[E(\tilde{r}_M) - r_F]\frac{Cov(\tilde{g}_i, \tilde{r}_M)}{Var(\tilde{r}_M)}$$

Note that in this informal argument we are abstracting from the distinction between R and r_F.

To illustrate the implications of the above equation for the pricing of GDP-indexed bonds, the following example may be considered. Assume that the relevant portfolio for investors is the US stock market, the risk-free rate of return is 3 percent, the expected return on the market portfolio is 8 percent and, taking the case of Argentina in Table 1b, that the β of the country's growth rate with respect to the return on the US stock market is 0.22. Then, for a value of α of 1, the indexation premium will be 1*(8-3)*0.22, i.e., approximately 1 percentage point per year—fairly small compared with the spreads often observed in

Table 1a : Comovement of Individual Country Real GDP Growth with World Market Portfolio, Advanced Countries

	Real GDP Growth						Real Stock Returns					
	World			United States			World			United States		
Advanced Countries	R^2	coeff	std. error	R^2	coeff	std. error	R^2	coeff	std. error	R^2	coeff	std. error
AUSTRIA	0.186	0.646	0.269	0.011	0.096	0.149	0.052	0.059	0.060	0.018	0.038	0.052
AUSTRALIA	0.354	0.850	0.182	0.269	0.506	0.128	0.205	0.122	0.043	0.125	0.106	0.044
BELGIUM	0.123	0.739	0.375	0.053	0.275	0.120	0.159	0.159	0.050	0.020	0.063	0.045
CANADA	0.627	1.398	0.211	0.403	0.630	0.153	0.231	0.162	0.047	0.051	0.084	0.044
CHINA, P.R.: HONG KONG	0.348	2.200	0.596	0.104	0.672	0.359	0.111	0.241	0.112	0.018	0.107	0.197
CYPRUS	0.150	2.145	1.223	0.196	1.555	0.891	0.146	0.403	0.236	0.209	0.535	0.360
DENMARK	0.287	0.796	0.169	0.290	0.506	0.131	0.057	0.069	0.051	0.090	0.097	0.041
FINLAND	0.341	1.402	0.596	0.045	0.308	0.308	0.329	0.257	0.088	0.034	0.092	0.062
FRANCE	0.470	0.830	0.181	0.128	0.285	0.099	0.377	0.129	0.037	0.046	0.050	0.033
GERMANY	0.072	-1.675	2.246	0.078	-0.910	1.301	0.086	-0.290	0.303	0.019	-0.169	0.196
GREECE	0.395	1.431	0.284	0.135	0.526	0.192	0.028	0.068	0.085	0.003	-0.023	0.079
ICELAND	0.231	1.349	0.368	0.041	0.289	0.160	0.238	0.232	0.051	0.023	0.079	0.082
IRELAND	0.116	0.995	0.307	0.076	0.434	0.248	0.174	0.236	0.149	0.356	0.377	0.119
ISRAEL	0.059	0.527	0.511	0.005	0.122	0.182	0.000	-0.002	0.066	0.025	0.065	0.050
ITALY	0.464	1.109	0.187	0.086	0.326	0.123	0.245	0.152	0.054	0.007	0.030	0.072
JAPAN	0.266	1.153	0.363	0.031	0.278	0.183	0.061	0.097	0.070	0.009	-0.041	0.093
KOREA	0.150	1.179	0.405	0.024	0.252	0.191	0.002	0.023	0.094	0.002	-0.030	0.128
NETHERLANDS	0.435	0.843	0.207	0.202	0.379	0.100	0.100	0.073	0.044	0.124	0.090	0.039
NEW ZEALAND	0.065	0.521	0.385	0.007	0.100	0.207	0.039	0.077	0.081	0.042	0.090	0.095
NORWAY	0.026	0.288	0.247	0.009	0.099	0.189	0.003	-0.018	0.042	0.002	0.019	0.060
PORTUGAL	0.410	1.605	0.512	0.054	0.281	0.231	0.306	0.252	0.096	0.090	0.152	0.111
SINGAPORE	0.189	1.357	0.549	0.008	0.181	0.270	0.002	0.023	0.112	0.012	0.071	0.095
SPAIN	0.373	1.011	0.234	0.102	0.354	0.140	0.324	0.180	0.039	0.117	0.120	0.042
SWEDEN	0.145	0.744	0.308	0.019	0.160	0.214	0.275	0.189	0.041	0.047	0.086	0.055
SWITZERLAND	0.246	0.930	0.215	0.056	0.264	0.199	0.370	0.202	0.084	0.218	0.172	0.099
UNITED KINGDOM	0.455	1.109	0.211	0.218	0.353	0.136	0.185	0.138	0.052	0.142	0.134	0.044
UNITED STATES	0.508	1.208	0.259	1.000	1.000	0.000	0.186	0.138	0.042	0.228	0.170	0.044
Average	0.277	0.988	0.430	0.135	0.345	0.245	0.159	0.125	0.083	0.077	0.095	0.088
Average of Abs (1-coeff)		0.431			0.696			0.875			0.905	

Sources: International Monetary Fund and Morgan Stanley Capital International.

Note: Regressions of individual country real GDP growth rates on world (or U.S.) real GDP growth or world (or U.S.) real stock returns (one-year lead).

Table 1b : Comovement of Individual Country Real GDP Growth with World Market Portfolio, Emerging Markets

	Real GDP Growth						Real Stock Returns					
	World			United States			World			United States		
Emerging Markets	R^2	coeff.	std. error	R^2	coeff.	std. error	R^2	coeff.	std. error	R^2	coeff.	std. error
ARGENTINA	0.001	0.108	0.932	0.016	0.395	0.395	0.002	-0.037	0.158	0.070	0.223	0.087
BANGLADESH	0.056	-0.771	0.658	0.011	-0.203	0.348	0.014	-0.068	0.086	0.007	-0.051	0.099
BOTSWANA	0.387	3.005	1.025	0.003	0.165	0.553	0.142	0.344	0.183	0.007	-0.085	0.149
BRAZIL	0.291	1.903	0.321	0.081	0.691	0.300	0.019	0.089	0.100	0.018	-0.096	0.095
BULGARIA	0.002	1.041	1.922	0.006	0.748	0.547	0.017	-0.629	1.123	0.052	-1.232	0.969
CHILE	0.013	0.549	1.292	0.097	0.799	0.460	0.020	0.129	0.229	0.115	0.346	0.227
CHINA, P.R.: MAINLAND	0.004	0.205	0.517	0.015	0.251	0.305	0.000	0.004	0.119	0.067	0.161	0.066
COLOMBIA	0.238	0.989	0.238	0.026	0.180	0.130	0.000	0.002	0.079	0.019	-0.056	0.098
COTE D'IVOIRE	0.069	0.767	0.437	0.020	0.236	0.268	0.027	-0.092	0.119	0.123	-0.218	0.108
CZECH REPUBLIC	0.283	1.450	0.674	0.049	0.265	0.235	0.024	0.080	0.143	0.063	-0.144	0.061
ECUADOR	0.247	2.085	0.943	0.043	0.485	0.292	0.003	0.045	0.176	0.026	-0.147	0.135
EGYPT	0.011	-0.245	0.698	0.003	0.078	0.291	0.057	-0.107	0.149	0.115	-0.170	0.125
GHANA	0.047	0.761	0.751	0.025	0.312	0.391	0.069	0.176	0.167	0.179	0.317	0.120
HUNGARY	0.269	1.817	0.873	0.025	0.311	0.462	0.147	0.217	0.148	0.001	0.018	0.108
INDIA	0.015	-0.251	0.349	0.023	-0.204	0.218	0.029	-0.067	0.081	0.000	0.009	0.088
INDONESIA	0.090	1.011	0.563	0.002	-0.092	0.308	0.034	-0.120	0.132	0.050	-0.163	0.189
JAMAICA	0.008	0.267	0.584	0.004	0.118	0.290	0.006	0.041	0.075	0.013	0.064	0.092
JORDAN	0.065	-1.384	0.809	0.007	0.263	0.480	0.056	-0.229	0.114	0.013	-0.122	0.189
KENYA	0.228	1.280	0.497	0.044	0.337	0.287	0.084	0.147	0.094	0.000	-0.002	0.114
LITHUANIA	0.198	2.314	1.253	0.014	0.288	0.232	0.181	0.420	0.277	0.007	-0.089	0.108
MALAYSIA	0.091	0.957	0.627	0.024	0.270	0.226	0.005	-0.042	0.136	0.000	0.000	0.151
MAURITIUS	0.110	1.181	0.711	0.005	0.185	0.333	0.042	0.137	0.081	0.014	0.088	0.078
MEXICO	0.056	0.715	0.329	0.031	0.315	0.206	0.015	0.072	0.113	0.005	-0.048	0.118
MOROCCO	0.000	0.057	0.447	0.046	-0.485	0.230	0.000	0.000	0.087	0.022	-0.122	0.090
PAKISTAN	0.044	-0.362	0.344	0.007	0.099	0.150	0.006	0.019	0.047	0.098	-0.087	0.065
PERU	0.006	0.327	0.367	0.000	-0.044	0.245	0.006	0.065	0.152	0.012	0.102	0.159
PHILIPPINES	0.079	0.783	0.469	0.010	0.127	0.216	0.002	0.023	0.083	0.050	-0.134	0.061
POLAND	0.262	1.899	0.803	0.226	1.010	0.474	0.000	0.006	0.102	0.001	-0.018	0.128
RUSSIA	0.193	2.242	1.094	0.011	0.263	0.234	0.203	0.435	0.257	0.018	-0.143	0.105
SAUDI ARABIA	0.284	2.872	0.972	0.005	0.204	0.447	0.030	0.167	0.157	0.002	-0.044	0.118
SLOVENIA	0.198	1.459	0.716	0.082	0.601	0.416	0.027	0.100	0.135	0.009	-0.065	0.100
SOUTH AFRICA	0.114	0.640	0.356	0.012	0.137	0.237	0.084	0.101	0.055	0.004	-0.024	0.069
SRI LANKA	0.015	0.256	0.353	0.016	-0.148	0.211	0.075	-0.063	0.041	0.000	-0.003	0.039
THAILAND	0.023	0.513	0.440	0.037	0.299	0.162	0.041	-0.133	0.152	0.084	-0.211	0.190
TRINIDAD AND TOBAGO	0.003	0.194	0.426	0.006	-0.154	0.342	0.001	0.016	0.142	0.001	0.018	0.127
TUNISIA	0.039	0.547	0.469	0.008	0.164	0.173	0.004	0.032	0.074	0.001	0.014	0.075
TURKEY	0.031	0.590	0.451	0.023	0.285	0.264	0.000	-0.012	0.105	0.006	0.055	0.162
VENEZUELA	0.018	0.463	0.587	0.001	-0.070	0.307	0.002	0.025	0.108	0.002	0.033	0.168
ZIMBABWE	0.017	-0.661	0.766	0.041	-0.550	0.410	0.002	-0.040	0.104	0.013	-0.117	0.133
Average	0.105	0.810	0.668	0.028	0.203	0.310	0.038	0.032	0.151	0.033	-0.055	0.137
Average of Abs (1-coeff)		0.783			0.797			0.968			1.055	

Sources: International Monetary Fund and Morgan Stanley Capital International.

Note: Regressions of individual country real GDP growth rates on world (or U.S.) real GDP growth or world (or U.S.) real stock returns (one-year lead).

Table 1c : Comovement of Individual Country Real GDP Growth with World Market Portfolio, Developing Countries

	Real GDP Growth						Real Stock Returns					
	World			United States			World			United States		
Developing Economies	R^2	coeff	std. error	R^2	coeff	std. error	R^2	coeff	std. error	R^2	coeff	std. error
ALGERIA	0.076	0.923	0.468	0.013	0.325	0.365	0.009	-0.060	0.153	0.037	-0.134	0.120
BELARUS	0.148	1.662	0.709	0.022	0.310	0.202	0.225	0.388	0.210	0.001	0.033	0.155
CAMEROON	0.001	0.153	1.025	0.000	0.013	0.378	0.018	0.114	0.210	0.014	-0.113	0.116
COSTA RICA	0.260	1.394	0.624	0.376	0.958	0.258	0.040	0.104	0.079	0.124	0.204	0.083
CROATIA	0.260	2.336	1.293	0.084	0.796	0.595	0.088	0.257	0.237	0.011	-0.102	0.105
DOMINICAN REPUBLIC	0.202	1.345	0.442	0.002	0.098	0.323	0.116	0.188	0.062	0.035	0.115	0.086
EL SALVADOR	0.068	0.816	0.861	0.144	0.681	0.438	0.041	-0.123	0.079	0.011	0.072	0.137
GUATEMALA	0.234	1.020	0.365	0.090	0.362	0.162	0.021	0.058	0.056	0.018	0.059	0.052
IRAN, I.R. OF	0.000	0.091	1.411	0.003	0.205	0.479	0.034	-0.220	0.212	0.002	0.060	0.253
KAZAKHSTAN	0.202	1.999	0.935	0.022	0.328	0.287	0.251	0.419	0.228	0.006	-0.075	0.083
KUWAIT	0.029	2.325	2.420	0.098	2.309	1.131	0.012	-0.286	0.447	0.007	0.252	0.314
LEBANON	0.010	1.896	3.358	0.051	2.298	1.816	0.009	0.344	0.639	0.098	1.280	0.488
LIBYA	0.155	2.294	1.108	0.147	2.037	1.101	0.021	0.162	0.177	0.008	-0.113	0.182
NIGERIA	0.138	2.165	1.049	0.006	-0.321	0.531	0.009	0.074	0.114	0.006	0.067	0.119
OMAN	0.224	-3.231	1.241	0.067	-0.977	0.980	0.178	-0.557	0.280	0.227	-0.699	0.304
PARAGUAY	0.066	0.816	0.282	0.001	-0.039	0.190	0.000	-0.001	0.093	0.131	-0.248	0.116
QATAR	0.205	2.922	0.830	0.097	1.105	0.487	0.079	0.345	0.196	0.049	0.303	0.326
ROMANIA	0.128	1.528	1.015	0.034	0.434	0.456	0.000	0.018	0.190	0.091	-0.276	0.127
SLOVAK REPUBLIC	0.297	1.907	1.052	0.064	0.370	0.290	0.097	0.209	0.201	0.002	-0.033	0.095
SYRIAN ARAB REPUBLIC	0.062	-1.440	0.723	0.034	-0.672	0.642	0.069	-0.282	0.207	0.122	-0.416	0.257
UKRAINE	0.126	2.105	1.093	0.013	0.318	0.303	0.201	0.502	0.290	0.029	-0.212	0.108
UNITED ARAB EMIRATES	0.073	1.797	0.876	0.011	0.404	0.462	0.000	0.012	0.165	0.004	0.083	0.209
URUGUAY	0.002	0.134	0.701	0.001	0.049	0.308	0.001	-0.022	0.127	0.000	-0.007	0.138
UZBEKISTAN	0.212	1.340	0.602	0.016	0.202	0.168	0.161	0.215	0.124	0.008	-0.053	0.064
VIETNAM	0.006	-0.213	0.557	0.000	-0.016	0.339	0.064	-0.134	0.073	0.013	0.068	0.081
YEMEN, REPUBLIC OF	0.064	0.948	0.828	0.000	0.047	0.296	0.029	0.100	0.082	0.008	-0.058	0.067
Average	0.125	1.117	0.995	0.054	0.447	0.500	0.068	0.070	0.190	0.041	0.002	0.161
Average of Abs (1-coeff)		0.963			0.841			0.930			1.019	

Sources: International Monetary Fund and Morgan Stanley Capital International.

Note: Regressions of individual country real GDP growth rates on world (or U.S.) real GDP growth or world (or U.S.) real stock returns (one-year lead). To conserve space, the sample consists of developing countries with larger overall GDP.

emerging markets. This premium is in excess of the rate that the country pays on plain vanilla bonds, that is, it is in addition to the premium that compensates for default risk. It is likely, however, that default risk would go down significantly if a country were to convert a large portion of its debt into indexed bonds such as these. For simplicity, the above assumes that the default risk is uncorrelated with the GDP growth risk. The appeal of indexed bonds is even greater when this assumption is relaxed, letting default risk rise when growth falls.

V. Possible Difficulties with GDP-Indexed Bonds, and Potential Solutions

Would international investors be willing to take on the additional risk resulting from GDP indexation? International investors already invest heavily in stocks of emerging market countries, which are much more volatile than the GDP growth rates of the same countries. Moreover, international investors are already highly exposed to GDP risk under standard debt contracts, though implicitly: if low GDP growth renders a country's debt position unsustainable, the country will likely default. It is surely better for international investors to receive lower debt repayments through indexation that is agreed upon in a contract from the outset, rather than face uncertain recovery values through a chaotic default process.

Would GDP-indexed bonds be too complicated to be accepted by international investors? Investors are often turned away by instruments that are difficult to understand and price. Yet the complexity of GDP-indexed bonds should not be overstated. They are a form of floating-rate bond, where the coupon rate is related to the rate of growth in the borrowing country instead of the LIBOR or other interest rate. Furthermore, the indexation mechanism is not alien to financial markets, as inflation-indexed bonds are well-established in many sovereign debt markets in both advanced and developing countries. In addition, as noted above, a few emerging market countries have already issued bonds that include payment conditions that are contingent on GDP or export developments.

Could countries misreport their GDP growth rates? Indeed, if the proposed instruments were to constitute a large fraction of a country's external debt, that country's authorities might be tempted to understate its growth rate. How strong that temptation would be, and whether it could be resisted, are open questions, but they might reasonably make

investors more reluctant to hold GDP-indexed bonds. Our own impression, however, is that this concern should not be overemphasized. It is, in fact, high growth rather than low growth that is typically considered a success and gets politicians re-elected. In addition, it would be difficult for a country to under report its GDP growth rate substantially for many years in a row, certainly not without placing its reputation at stake. Finally, some of the new bonds would likely be purchased by domestic investors, who might then constitute a powerful domestic lobby to ensure the accuracy of the country's statistics.

At any rate, it would be desirable for the international community to add GDP to the list of variables included in its current drive toward increasing transparency and improving the quality of statistics, and international agencies could help guarantee the reliability of countries' GDP statistics. One precedent in this regard is the EU's Maastricht convergence process and the Stability and Growth Pact among EMU countries. This shows that countries can agree on common statistical standards to define and monitor GDP data for an important purpose. Eurostat has played a key role in this respect in the European case. Moreover, CPI-indexed bonds have been used extensively in many countries, including emerging markets such as Chile, showing that it is possible for statistical offices to provide sufficient guarantees to investors, although arguably it may be more difficult to estimate real GDP accurately than it is to measure consumer prices.

Would GDP-indexed bonds reduce countries' incentives to grow rapidly? Would GDP-indexed bonds reward inefficiency? Studies in the "debt overhang" tradition (such as Krugman, 1988 and Sachs, 1989) argue that if it were possible to reduce—through debt forgiveness—the share of the debtor country's future output going to repay foreign creditors, then "the country" would have greater incentives to invest and grow. A similar argument would apply to GDP-indexed bonds (in the opposite direction): by increasing debt repayments in case GDP growth is higher than usual, such bonds might reduce the debtor country's incentives to grow. However, the main determinant of a country's growth rate are decisions by individual businesses, which are too small to take into account their impact on the country's GDP. Individual entrepreneurs would not restrict their company's investments because the government's debt is indexed to GDP. Any "moral hazard" argument would

apply through those government policies that might affect the country's growth rate (e.g., public investment). The extent to which GDP-indexed bonds would lead a government (whether benevolent or kleptocratic) to alter substantially the degree of growth-orientation of its policies for many years is an open question. Nevertheless, these considerations would make GDP-indexed debt particularly appealing for those countries that are able to commit credibly to good policies (e.g., through an IMF-supported program or a system of fiscal rules and peer monitoring such as the Growth and Stability Pact in the European Union).

Ultimately, the key question is not whether there is moral hazard associated with GDP-indexed bonds, but rather whether such moral hazard is higher than with plain vanilla bonds, on which after all default is possible. Models of optimal incentive-compatible contracts in sovereign debt typically show that, even in the presence of moral hazard, the optimal contract is of a contingent type (see, for example, Obstfeld and Rogoff, 1996, Chapter 6).

A more general point is that the incentives for countries to misreport their GDP and to adopt policies aimed at pursuing other objectives than growth will be low if the amount of GDP-indexed debt is small. Of course, the related insurance benefits would be correspondingly limited. Our contention is that, in the trade-off between insurance and moral hazard/measurement problems, the optimal share of GDP-indexed bonds is likely to be non-zero.

Would it be better to index bond repayments to commodity prices rather than to GDP? As argued by Krugman (1988), the same concern regarding incentives to undertake growth-oriented policies would suggest that indexing to commodity prices (over which an individual country usually has no control) may be preferable to indexing to GDP (over which a country's authorities have some degree of control). Indexing debt to commodity prices reduces uncertainty regarding the debt/GDP ratio to the extent that commodity prices determine a country's revenues and GDP developments. Thus, commodity price indexing

would be more appealing to Mexico (oil) or Chile (copper) than to Argentina or Brazil.[4] However, studies based upon vector autoregressions tend to find that, for the typical emerging market country, a relatively small share of output fluctuations can be attributed to terms of trade shocks (e.g., no more than 10 percent according to Hoffmaister and Roldós, 1997). Moreover, both investors and sovereign debtors may feel that existing markets for futures and options on commodity prices provide sufficient opportunities for insurance against commodity price fluctuations (although the liquidity of these markets is rather low beyond a few years). By contrast, GDP-indexed bonds would create an altogether new opportunity for investors to take a view on a country's economic growth prospects. This would be particularly attractive in the case of emerging market countries where the stock market is not well diversified and where stock market fluctuations may have little to do with the country's fundamental growth prospects.

Is GDP the right measure to index to? The basic objective is to preserve debt sustainability. In general, this would require choosing a contingency that adjusts the value of debt to the repayment capacity. In this paper, we consider the case of government debt and the fiscal constraints that it implies. For the external debt of a country as a whole, the volume of exports is probably a relevant measure of repayment capacity. For this reason, the debt-to-exports ratio is a closely watched indicator. Thus, indexing to exports may be a reasonable alternative. Indeed, for many developing countries data on exports tend to be more reliable than data on GDP. At the same time, government policies may affect trade openness more directly than they affect GDP. Yet another alternative might be industrial production, which is highly correlated with GDP for some emerging market countries. While GDP is the most comprehensive measure of a country's income, other measures might be more accurate and harder to tamper with, depending on the country. At the same time, it would be desirable for the bonds of different countries to be indexed to the same economic variable, be it the individual countries' GDP, exports, or industrial production. This would make it easier for

[4] Similarly, some small countries might benefit from catastrophe insurance.

investors to benefit from the opportunity to diversify risk across countries as mentioned above.

Would the contracts be enforceable in the event of higher-than-expected growth? Most models of sovereign debt assume that the debtor country will repay only if the amount to be repaid is lower than the cost of sanctions (the incentive compatibility constraint). The cost of sanctions is typically assumed to be proportional to the country's output. This is consistent with the observation that it is extremely rare for countries to default on their external debt obligations in times when their output growth is relatively high. With GDP-indexed bonds, therefore, in the event of higher-than-expected output growth the amount to be repaid would be higher than average, but the cost of sanctions would probably also be higher than average.

Could GDP-indexation make it difficult to allow debtors to "recall" the bonds? One clear drawback of GDP-indexation is that it is unlikely to be consistent with the callability of bonds. Suppose that a GDP-indexed bond were callable: should GDP growth turn out better than expected, the interest rate faced by the country on plain vanilla bonds would presumably fall (because the country now looks more solvent); the borrower would then have an incentive to recall the indexed bonds and issue plain vanilla bonds at a lower interest rate. (This is a likely scenario for the Bulgarian bonds mentioned above). At present, less than 5 percent of all emerging market bonds are effectively callable.[5] However, the ability to recall a bond is another important form of insurance—in this case, against fluctuations in interest rates. Therefore, in theory at least, the appeal of GDP-indexed bonds will depend on the relative importance of uncertainty over interest rates and uncertainty over GDP growth. Countries facing substantial uncertainty over GDP growth are still expected to draw clear advantages from GDP indexation.

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[5] Many Brady bonds are in principle callable, but at par, and with a few exceptions they are usually trading well below par.

If the advantages of GDP-indexed debt are as large as claimed above, why have they not been adopted yet? Possible reasons in addition to some of the difficulties mentioned above may include the following:

- On the investor's side, new and complex instruments tend to be illiquid, and pricing them involves computational costs. In the absence of a concerted effort to ensure a certain "critical mass" for the new instruments, which would help guarantee market liquidity and spread computational costs over a large market capitalization for the new instruments, it is easy to understand why investors have reacted coolly to the idea of GDP-indexed bonds.

- On the borrower's side, it typically takes years for unsustainable debt positions to emerge. The proposed indexation system is likely to make a substantial difference only for relatively long-term bonds, with an original maturity of—say—5 years or more. Politicians' horizons are often shorter than that: today's finance ministers may be unlikely to pay an insurance premium to issue indexed bonds that might make life significantly easier for their successors several years down the road.

What are the differences between GDP-indexed bonds and Shiller-type securities, and why would a market for GDP-indexed bonds emerge, given that a market did not emerge for Shiller-type securities? GDP-indexed bonds consist of a plain vanilla bond and a security indexed to a country's GDP. There are three key differences between Shiller-like securities and the GDP-indexed component of the bonds being proposed here. First, Shiller-type securities are perpetual claims on a country's GDP, whereas with GDP-indexed bonds the portion indexed to GDP matures at the same time as the bonds do. A limited horizon might increase the marketability of the bonds (few bonds today are of the perpetual kind) and even reduce the scope for speculative bubbles. Second, Shiller envisages individuals buying *and selling* Shiller-type securities, whether directly or through financial intermediaries such as mutual funds. By contrast, at least initially, GDP-indexed bonds would probably be issued only by governments. Third, it seems fairly straightforward to introduce GDP-indexation by adding a related clause to standard sovereign debt contracts, and one can envisage a market

for GDP-indexed bonds piggy-backing on existing markets for sovereign bonds. By contrast, Shiller-type securities would involve greater institutional set-up costs. While Shiller-like securities may one day become a reality, and provide tremendous risk-sharing benefits to large sections of the population, a market for GDP-indexed bonds appears to be a step in the right direction, if a less ambitious one.[6]

Is there a role for official intervention to foster financial innovation in this area? Allen and Gale (1994) suggest that financial innovation often fails to emerge because of a number of market failures that could be resolved through government intervention:

---*Product uncertainty.* When a new financial instrument is introduced, investors are uncertain about exactly what they are buying: investors will therefore demand a premium if they are to hold the new instrument, especially if it is complex and likely to be illiquid; that premium may deter borrowers from issuing the new instrument in the first place.

---*Externalities and coordination problems.* Investors need to learn to price the new financial instruments and may need a large number of borrowers to issue them in order to be able to diversify risk. However, an individual borrower considering whether to issue the new financial instrument will not take into account that by teaching investors to price its own instrument it also helps them price those issued by other borrowers; nor will an individual borrower take into account the social benefit of the new risk-sharing opportunities provided by the new instrument. Thus, when all other issuers are using standard instruments, each individual issuer is likely to continue to use standard securities.

---*The highly competitive structure of financial markets.* A private financial institution would have to incur costs to develop a new type of financial instrument. However, it may be unable to maintain a monopoly over its provision: patents are rarely used for financial instruments and imitation is usually easy, implying that any monopoly profits would soon be competed

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[6] Athanasoulis, Shiller, and van Wincoop (1999) discuss in greater detail issues related to the introduction of Shiller-type securities, and financial innovation more generally.

away. Thus the private incentive to develop the instrument in the first place may be quite low, even if its social benefit may be high.

Owing to these factors, government intervention has historically played a key role in fostering financial innovation. Recent examples include the markets for mortgage-backed securities in the US and bonds indexed to consumer prices in various countries. In the case of GDP-indexed bonds to be issued by sovereign governments, international institutions could play a leading role in fostering the creation of markets.

VI. Concluding Remarks

This paper has argued that GDP-indexed bonds could play a role in helping prevent future debt crises. International financial institutions (IFIs) are ideally placed to foster the creation of a market for GDP-indexed bonds. Potentially fruitful areas of involvement include the following:

- Gauging interest on the supply side of these securities through the IFIs' privileged position vis-à-vis their member governments. Promoting the use of bonds indexed to GDP through the surveillance dialogue with member countries, and encouraging country authorities to take a longer-horizon perspective than is often dictated by electoral cycles.

- Gauging interest on the demand side for these securities among potential investors, using contacts on international capital markets. Providing information on the likelihood that a critical mass of issuing countries would be willing to use GDP-indexed bonds.

- Encouraging countries to ensure the independence of their statistical agencies. Providing technical assistance to improve the quality and transparency of national income statistics, and helping guarantee their reliability.

- Contributing to gathering of the necessary information for pricing of the instruments, including estimates of comovement of output among countries and the relationship between economic variables and default risk.

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