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Multilateral indexed loans and debt sustainability

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Abstract We evaluate the benefits and costs of indexing multilateral loans to variables related to developing countries' ability to pay; i.e. whether a reform of multilateral lending is feasible and economically justified. The analysis covers 40 International Development Association (IDA) countries from 1990 to 2010 and focuses on three types of debt: GDP-indexed loans; export-indexed loans; inflation-indexed loans denominated in local currency. The insurance that indexed debt might offer against macroeconomic shocks depends on the conditional covariances of GDP growth, real exchange-rate depreciation, and net exports that we estimate as the covariances of the forecast errors obtained from a vector autoregression (VAR) model. The analysis shows that both GDP-indexed loans and inflation-indexed local-currency loans would help to stabilize the debt ratio of the majority of IDA countries in our sample. However, the adverse policy incentives created by local currency debt tends to favour GDP-indexed debt. The cost of indexation would be small; the estimation of a capital asset pricing model (CAPM) suggests that loans indexed to GDP could be introduced at current interest rates since the estimated risk premium is less than 1 per cent. Any additional risk for multilateral lenders would be more than offset by a lower frequency of debt crises.

Keywords: debt sustainability, low-income countries, export-indexed debt, GDP-indexed debt, local currency debt, multilateral loans, risk insurance, VAR forecasting

JEL classification: F34, F37, G11, H63

I. Introduction

It is commonly held that GDP indexation, by introducing contingencies in sovereign debt, may help to stabilize the debt-to-GDP ratio, reduce the likelihood of debt crises and sovereign defaults, and limit the pro-cyclicality of fiscal policy (see, for example, Shiller, 1993; Borensztein and Mauro, 2004; Griffith-Jones and Sharma, 2006). The idea is that indexed debt can provide valuable insurance since its payments are linked to the underlying conditions of the borrower, notably those that impact on its ability to pay. While debt instruments can either be indexed to GDP, exports, or commodity

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prices, the key feature is that they imply lower payments in times of output contractions, export shortfalls, or terms of trade shocks, that is, precisely when a country struggles to honour its debt.

In this paper we evaluate the benefits and costs of indexing the loans made by Multilateral Development Banks (MDBs) to low-income countries (LICs) and thus whether a reform of multilateral lending is feasible and economically justified. To this end, we provide new evidence for a group of 40 IDA countries over the 1990–2010 period for three types of debt: (i) foreign currency loans indexed to real GDP; (ii) foreign currency loans indexed to the dollar value of exports; (iii) inflation-indexed loans denominated in local currency.

We investigate the role of indexed loans in reducing IDA countries' vulnerability to adverse macroeconomic shocks in a model where indexed debt may help stabilize the debt ratio and thus reduce the likelihood of a debt crisis. The optimal type of indexation depends on the conditional variances and covariances of GDP growth, real exchange-rate depreciation, and net exports that we estimate as the covariances of the forecast errors obtained from a VAR model of each IDA country. In doing so, we pay particular attention to the currency denomination of debt obligations, an issue so far neglected in the literature on GDP indexation, studying to what extent GDP- or export-indexed loans can also reduce debt vulnerability to exchange rate movements. Finally, to assess the cost for multilateral lenders of a programme of indexed lending, we examine the potential for risk diversification, studying the risk-return characteristics of a portfolio of indexed loans to IDA countries.

Portfolio risk analysis shows that individual country risk could be easily diversified, since the volatility of the MDBs' portfolio is much lower than the average volatility of individual loans for all types of indexation considered. However, the estimation of a capital asset pricing model (CAPM), where OECD growth is taken as the relevant market-portfolio return, suggests that the risk of export-indexed loans is difficult to hedge because IDA countries' exports are strongly correlated with OECD growth and thus with the fiscal resources of multilateral lenders. By contrast, loans indexed to GDP or denominated in local currencies could be introduced at current interest rates because their risk premium is less than 1 per cent and more than offset by the lower risk of debt distress.

The estimation of the optimal shares of indexed loans provides strong evidence in favour of both inflation-indexed local-currency loans and GDP-indexed loans. Lending in the borrower's currency helps to stabilize the debt ratio against unanticipated movements in the real exchange rate which are a main cause of debt vulnerability. Likewise, GDP indexation would stabilize the debt ratio against output contractions, and it would also provide insurance against real depreciations to most IDA countries, since depreciations are often associated with output contractions. Although GDP-indexed debt benefits a lower number of countries it does not give rise to adverse incentives, whereas local-currency debt may alter LICs' policy in favour of currency depreciation.

The paper is organized as follows. After this introduction, section II presents preliminary evidence on macroeconomic risk affecting LICs. Section III discusses the benefits of indexation. Section IV reports the optimal shares of GDP-indexed debt, export-indexed debt, and local currency debt. Such shares depend on the conditional covariances of debt returns with GDP, net exports, and the real exchange-rate, which are estimated as the covariances of the forecast errors of individual country VAR models.

Section V evaluates the cost of indexation for multilateral lenders by investigating the potential for portfolio diversification. Section VI discusses policy issues and makes a proposal to introduce GDP indexation. Section VII concludes.

II. The need for insurance: stylized facts

Sudden changes in GDP, exports, and the real exchange rate may determine large variations in the debt-to-GDP ratio of LICs, and undermine their ability to pay. By making debt payments contingent on GDP or exports or immune from currency risk, indexed loans would provide valuable insurance against adverse realizations of such variables. Evidence on the volatilities of GDP, exports, and the real exchange rate gives some preliminary indication of the need for insurance and the benefits of indexed loans.

Table 1 shows the standard deviations of the annual growth rates of real GDP in local currency, of the dollar value of exports, and of the real exchange rate (more precisely, the dollar deflator) for 64 IDA countries and 31 OECD countries over the period 1990–2010.[1] The volatility of GDP growth for the IDA group is 5.4 per cent, while it is only 2.9 per cent for OECD economies. Although growth in developing countries is known to be unstable, its volatility in IDA countries is sizeable; it is almost two times that of industrial economies. Interestingly, the volatility of growth and thus the need for insurance increase with debt, as shown by a 0.53 correlation with the debt ratio in 2000.

Export growth is even more volatile; its standard deviation in the IDA group is 20.8 per cent, three times higher than the 6.7 per cent of OECD countries. This result does not depend on the presence of outliers, as shown by the maximum standard deviation and a median volatility only slightly lower than the average. Since exports are the main source of foreign exchange needed to service the external debt, their uncertainty exposes IDA countries to repayments difficulties and more debt accumulation.

IDA countries are also exposed to exchange-rate risk because of the foreign currency denomination of their debts. In fact, their capacity to pay depends not on the value of their GDP in local currency, but on their GDP in current US dollars. This implies that changes in the dollar deflator of GDP, say, the real exchange rate, are destabilizing; their wealth effects are a major cause of debt vulnerability and crises. Table 1 shows that the rate of depreciation of the real exchange rate in IDA countries is 10 times more volatile than in OECD economies. Since this evidence may depend on few episodes of hyper-devaluations, we computed the average standard deviation excluding three outliers.[2] Despite this correction, the average volatility of the real exchange rate remains high at 17.6 per cent, twice as large as in OECD economies. Highly indebted countries appear to be particularly exposed to real exchange-rate risk, since its correlation with the debt ratio is almost 0.5. Hence, not only does the exchange rate matter for debt service, but it tends to be more volatile at high levels of debt. A possible objection is that the GDP in current US dollars is a more relevant indicator of a country's ability to pay than its exchange rate. However, Table 1 shows that the volatility of dollar GDP

[1] All data are from the World Bank World Development Indicators database except for data on exports that are taken from the UNCTAD database.

[2] We excluded Angola, Congo Democratic Republic, and Nicaragua.

Table 1: Volatility of growth rates GDP, exports, and real exchange rate

	IDA countries average	OECD countries average	IDA countries		IDA countries	
					Correlation	Rank correlation
	St. dev.	St. dev.	Min.	Max.	with debt	with debt
GDP growth	5.4	2.9	0.8	31.8	0.53	0.27
	(3.8)	(2.3)				
Exports growth	20.8	6.7	7.2	49.6	0.21	0.04
	(19.2)	(6.3)				
RER depreciation	103.5	9.3	2.2	4,512.1	0.23	0.55
Without outliers	17.6	9.3	2.2	74.3	0.49	0.49
	(16.7)	(9.3)				
GDP nominal growth	14.9	10.7	4.2	30.1		
	(14.4)	(10.6)				

Note: Country averages of standard deviations (st. dev.). Median in parenthesis. RER: real exchange rate.

remains sizeable at 14.9 per cent, similar to that of the real exchange rate, even after excluding countries with hyper-devaluations.

We have so far examined the uncertainty of GDP, exports, and the real exchange rate over 1 year, which is a very short time horizon from the perspective of debt sustainability. In fact, it can be argued that the annual volatilities of such variables do not matter for LICs' ability to pay, since the debt they owe to multilateral creditors is very long term. Looking at the average growth rates of GDP and exports, and the rate of depreciation of the real exchange rate of IDA countries for two periods, we find an enormous difference between 1990–2000 and 2000–10 (Table C1 in the on-line appendices[3]). Viewed in a long-term perspective, the uncertainty surrounding LICs' ability to pay is even worse than what the annual volatilities suggest. The performance of such countries over a long future horizon is very difficult to predict on the basis of their historical experience, which raises doubts on the reliability of Debt Sustainability Analysis (DSA) as a way to decide which countries are worth receiving large loans and which should instead obtain only grants, as currently happens for IDA assistance under the Debt Sustainability Framework (DSF).

The welfare gains from insuring LICs against the disruptive effects of macroeconomic risk are substantial. For example, Table C1 shows that the 75 percentile of the distribution of the differences (in absolute value) of annual growth rates between the 1990s and the 2000s is 4 per cent. This lower GDP growth, if compounded over 10 years, would imply an increase in the debt ratio from 36.6 per cent (the sample average) to 55 per cent; a debt ratio of 50 per cent would rise up to 75.2 per cent. If low growth persisted over 20 years, the debt ratio would more than double; from 36.6 to 82.8 per cent. The effects of exchange-rate volatility on the real value of debt are likewise significant. During the 2000s, contrary to the previous decade, all countries in our sample gained from substantial real appreciations, with the median country displaying an annual improvement of 6.7 per cent. Had this appreciation not taken place, the debt

[3] The three appendices to this article are available on-line at http://oxrep.oxfordjournals.org/lookup/suppl/doi:10.1093/oxrep/grv028/-/DC1

ratio would have been almost twice as high as it actually was; e.g. 70 instead of 36.6 per cent. There is no doubt that avoiding such large variations in indebtedness would benefit LICs and enhance the sustainability of their debt.

III. The benefits of indexed debt

Indexed debt would provide debtor countries and their citizens with insurance against shocks affecting their income, net exports, and tax revenues. In particular, GDP-indexed debt would stabilize the debt ratio against output contractions and slow growth, while export-indexed debt would limit the accumulation of external debt due to terms-of-trade shocks or low global demand. Hence, contingent debt makes a country's debt position resilient to adverse shocks and enhances its sustainability. By linking debt payments to the borrower's ability to pay, debt either indexed to GDP or exports reduces the likelihood of debt crisis and default. In addition, to the extent that indexation provides automatic relief to countries in distress, it avoids the loss of value associated with prolonged debt crises and delays in debt restructuring. Another source of vulnerability is the foreign currency denomination of conventional debt that exposes debtor countries to the valuation effects of exchange-rate fluctuations. Debt denominated in the borrower's currency would avoid such risk.

Interest in GDP indexation has been revived by the work of Shiller (1993, 2003, 2004, 2005) and Borensztein and Mauro (2004).[4] With the aim of improving international risk sharing, Shiller proposes to create 'macro markets' for GDP-linked securities, taking the form of perpetual claims on a fraction of a country's GDP. Borensztein and Mauro argue for the introduction of bonds with coupon payments augmented by the growth rate of GDP to reduce cyclical vulnerability and the probability of debt crises. In their view, indexed debt would make fiscal policy less procyclical by reducing the need for fiscal adjustment in bad times, when output is lower than expected, while forcing fiscal moderation in good times, when output is unexpectedly high.[5]

More recently, the case for GDP indexation has been put by Griffith-Jones and Sharma (2006) and Kamstra and Shiller (2010), while issuers' and investors' concerns have been addressed in two studies by the UN (2005, 2006) with the aim of finding workable solutions and defining a strategy for implementation. In fact, the introduction of GDP-indexed bonds is difficult. A first problem is the delay with which estimates of GDP become available and their later, sometimes substantial, revisions. A second problem is the complexity of the instrument that makes its pricing difficult.[6]

Pricing is by contrast not an obstacle for indexing non-marketable loans, such as those provided by MDBs to LICs. This makes the introduction of indexed loans by MDBs a more realistic project that is worth investigating. Moreover, indexed loans

[4] Early proposals were made by Lessard (1987) and Helpman (1989), who argued for output indexation as a risk-sharing mechanism: risk-averse countries could shift some of their exposure to better diversified lenders.

[5] The literature on debt management also stresses that GDP-indexed debt minimizes tax-rate adjustments by providing a hedge against shocks to the tax base (see, for example, Barro (1995) and Missale (1997)).

[6] For an analysis of pricing GDP-indexed bonds see, for example, Kruse *et al.* (2005), Pernice and Fagundez (2005), Chamon and Mauro (2006), Costa *et al.* (2008), Ruban *et al.*(2008).

would bring specific benefits to MDBs that have not been considered in the literature so far. In particular, multilateral lenders would gain from a lower risk of debt distress and a lower frequency of debt crises, since indexation would reduce the probability that debtor countries run into repayment difficulties and eventually file for debt relief. Indeed, providing explicit insurance against macroeconomic shocks can be more effective than debt relief in dealing with repayment difficulties because it avoids delays in delivering assistance and saves on the costs associated with debt restructuring.

Another advantage of making debt payments contingent on economic performance is that multilateral lenders need not decide in advance which countries are worth receiving large loans and which should instead obtain only grants, as currently happens for IDA assistance under the DSF. As poor growth or export performance would reduce payments on indexed loans and make them similar to grants, indexed loans could also be extended to countries where debt sustainability is considered at risk. To the extent that LICs' economic performance and thus returns on the MDBs' portfolio of indexed loans are not correlated across countries, the high returns from best performing LICs would pay for the losses on loans to LICs that incur bad realizations of output or exports. Hence, a programme of multilateral indexed lending may work as a risk-sharing mechanism where transfers between countries are implemented (via the MDBs' loan portfolio) through amortization payments that depend on uncorrelated realizations of GDP or exports.

A few papers exist, closely related to our analysis, which examine the potential for a reform of multilateral lending. Tabova (2005) proposes that MDBs make loans to LICs with amortization payments conditional on the growth rate of GDP. In particular, she examines the effectiveness of a scheme that partially exempts countries from debt service when growth is lower than expected using historical simulations of debt service to IDA. Drèze (2002) suggests the use of GDP-indexed bonds (with a deductible) as part of a strategy to restructure the debt of the poorest countries. However, there is no general agreement that GDP-indexed loans are superior to other debt instruments. Guillaumont *et al.* (2003) and Cohen *et al.* (2007) contend that MDBs should extend loans to LICs with amortization payments indexed to the value of exports.[7] On the other hand, Hausmann and Rigobon (2003) and Levy Yeyati (2007) argue that MDBs should provide inflation-indexed loans denominated in local currencies to reduce developing countries' exposure to real exchange-rate movements which are a main source of debt vulnerability.[8]

In this paper we compare three types of indexed loans: (i) foreign currency loans indexed to real GDP in local currency units; (ii) foreign currency loans indexed to the dollar value of exports; (iii) local currency loans indexed to inflation.

IV. The stabilizing debt structure: An empirical assessment

For the external debt to be sustainable, the LIC and the MDB must stabilize the debt ratio at a level that makes the country's financial position not vulnerable to shocks. We

[7] See Bailey (1983) for an early proposal in this direction.

[8] According to Levy Yeyati (2007) local currency loans to emerging countries could be funded by multilateral securities denominated in the same currencies that would attract the demand of domestic residents for credit risk-free assets.

assume that they minimize the probability that the debt ratio exceeds a given threshold. In general, this objective implies a trade-off between risk and cost minimization, since higher expected interest payments lead to a higher expected debt ratio. In on-line Appendix A we present a formal model that derives the optimal shares of each type of indexed debt subject to this cost–risk trade-off. However, if we assume that the expected return that the MDBs ask on indexed loans is the same as on conventional loans, i.e. that the risk premium is equal to zero,[9] then the problem reduces to finding the debt strategy that minimizes the volatility of the debt ratio, i.e. that stabilizes the debt ratio around its expected value. Intuitively, this is optimal because bad shocks to the debt ratio raise the probability of a debt crisis, while good shocks of the same size do not affect it.

Under the assumption of zero risk premia, the optimal shares of debt indexed to real GDP, γ^*, of debt indexed to the dollar value of exports, x^*, and of inflation-indexed debt denominated in local currency, h^*, are

$$\gamma^* = 1 - \frac{Cov\left(g_{t+1}\left(e_{t+1} - \pi_{t+1}\right)\right)}{Var\left(g_{t+1}\right)} + \frac{Cov\left(g_{t+1} nx_{t+1}\right)}{Var\left(g_{t+1}\right) B_t} \tag{1}$$

$$x^* = \frac{Cov\left(v_{t+1} g_{t+1}\right)}{Var\left(v_{t+1}\right)} - \frac{Cov\left(v_{t+1}\left(e_{t+1} - \pi_{t+1}\right)\right)}{Var\left(v_{t+1}\right)} + \frac{Cov\left(v_{t+1} nx_{t+1}\right)}{Var\left(v_{t+1}\right) B_t} \tag{2}$$

$$h^* = 1 - \frac{Cov\left(\left(e_{t+1} - \pi_{t+1}\right) g_{t+1}\right)}{Var\left(e_{t+1} - \pi_{t+1}\right)} - \frac{Cov\left(\left(e_{t+1} - \pi_{t+1}\right) nx_{t+1}\right)}{Var\left(e_{t+1} - \pi_{t+1}\right) B_t} \tag{3}$$

where $Var(\bullet)$ and $Cov(\bullet)$ denote variances and covariances conditional on the information at time t g_{t+1} is the growth rate of real GDP, e_{t+1} is the rate of depreciation of the exchange rate, π_{t+1} is the inflation rate, nx_{t+1} is the ratio of net exports to GDP, v_{t+1} is the nominal growth rate of exports, and B_t is the debt ratio.

The optimal shares show that the stabilization/hedging properties of indexed debt do not only depend on their role in offsetting shocks of the variables to which they are indexed, but also on how their returns correlate with the other variables affecting the debt ratio. In particular, if output fluctuations were the only source of uncertainty, then all the debt should be indexed to GDP; i.e. $\gamma^* = 1$. If, instead, GDP growth and debt payments were unexpectedly high when net exports fall and/or the value of debt increases following a real depreciation, then the optimal share of indexed debt would be lower than one. Export indexation is effective as an insurance instrument if export growth and thus debt payments covary positively with GDP growth and net exports, and negatively with the real exchange rate. On the other hand, the optimal share of export-indexed debt decreases when export growth is associated with output contractions and/or real depreciations that lead to a higher debt ratio. Finally, inflation-indexed local-currency debt is a perfect hedge against movements in the real exchange rate. If the latter are uncorrelated to other variables affecting the debt, the optimal share is $h^* = 1$. The immunization that local currency debt provides is even more valuable if real depreciations come together with low GDP and net exports. If, on the other

[9] We investigate the feasibility of this policy in section V where we examine the cost of indexed lending.

hand, GDP growth and net exports are correlated with exchange-rate depreciations, then some exposure to currency risk is optimal and the share h^* is lower than one.

The optimal shares (1)–(3) only depend on the conditional variances and covariances of their returns with GDP growth, real exchange-rate depreciation, and net exports (and the debt ratio). In what follows we present the econometric strategy to estimate these covariances.

(i) Conditional variances and covariances: A VAR approach

Our empirical strategy is to recover the theoretical conditional variances and covariances from the estimation of the variances and covariances of forecast errors obtained from a vector autoregression (VAR) analysis of the relations between GDP growth, real exchange-rate depreciation, and net exports. This approach appears particularly suitable in the present case for a number of reasons. First, the forecast errors capture both the deviation of the variable realization from the conditional mean (the forecast) and the error made in the forecast, for example, in estimating the baseline GDP trend. Second, we are interested in the projected, out-of-sample, relations between the unanticipated components of the relevant variables. Third, we are interested in estimating such relations over a long future horizon because IDA loans have a long maturity, currently of 38 years. Fourth, this approach is consistent with DSA stress tests, but, unlike the latter that consider a combination of shocks, it captures the stochastic relations between shocks as estimated from VAR analysis.

The strategy consists in estimating, for each country, a VAR model for the following variables: the log of the real GDP (in local currency units), the log of the real exchange rate (i.e. the log of the reciprocal of the dollar deflator), the log of the dollar value of exports, and the ratio of net exports to GDP. A set of exogenous variables is also included to improve the forecasting ability of the model: the lagged US long-term interest rate, the log of the real GDP of OECD countries in the previous year, and the lagged debt-to-GDP ratio, as well as a constant term and a linear trend. All data are from the World Bank World Development Indicators database except for data on exports that are taken from the UNCTAD database. More details on the econometric model are reported in Appendix B.

(ii) Estimation results

We derive the optimal shares of indexed debt using in equations (1), (2), and (3) the variances and covariances of the forecast errors (at the 5-year and 10-year horizons) obtained from the VAR model described in the previous section and estimated for each country over the period from 1990 to 2010.[10] The estimated conditional covariances relative to conditional variances are reported in Tables C2 and C3 in Appendix C.

The optimal shares of indexed debt at the 5-year and 10-year horizon are shown in Tables 2 and 3, respectively, for the 40 IDA countries for which data on exports are available. The shares are reported in fractional units rather than in percentage terms, so that, for example, a value of 0.20 means 20 per cent. As a result, values equal to

[10] The optimal number of lags for both the endogenous and exogenous variables has been determined by minimizing the Bayesian Information Criterion (BIC).

Table 2: Optimal shares of indexed debt: 5-year horizon

		Relative variances		Optimal shares		
Countries	**Debt ratio**	$V(x)/V(g)$	$V(e-p)/V(g)$	γ^*	x^*	h^*
Angola	22	21.7	6.6	9.0	2.0	3.6
Bangladesh	25	228.9	33.4	4.4	0.2	0.9
Benin	18	249.1	339.3	–6.7	0.5	0.6
Burundi	33	82.7	12.0	–1.2	0.2	1.0
Cambodia	42	3.7	3.5	3.3	1.5	1.7
Cameroon	13	156.2	206.4	6.4	0.6	1.0
Congo, Rep.	32	35.5	58.9	10.0	1.7	1.3
Côte d'Ivoire	50	11.5	14.2	0.7	0.8	0.7
Djibouti	72	22.6	0.7	–0.7	–0.1	–1.6
Ethiopia	24	11.4	30.8	1.3	0.6	0.4
Ghana	27	3.3	118.4	15.5	5.3	1.5
Guinea	65	117.1	34.2	0.3	0.2	0.9
Guyana	61	2.7	15.3	5.6	3.1	1.3
Haiti	7	198.2	186.4	50.6	4.4	5.5
Honduras	27	6.5	3.1	–1.6	0.4	1.7
Kenya	27	182.1	149.9	0.9	–1.4	1.6
Kyrgyz Republic	86	13.8	7.2	4.1	1.0	1.6
Lao PDR	76	238.4	163.6	10.3	0.6	0.9
Lesotho	34	3.6	1.4	–0.2	0.4	2.0
Madagascar	26	5.4	7.0	–0.1	0	1.1
Malawi	18	5.6	18.1	5.6	0.5	–0.2
Maldives	64	6.1	0.6	3.0	1.3	1.7
Mali	25	30.3	22.6	6.3	1.0	1.5
Moldova	79	11.9	3.3	2.1	0.6	1.2
Mongolia	39	24.1	8.8	6.5	1.7	1.5
Mozambique	43	40.1	35.6	–3.6	–0.4	1.4
Nepal	29	51.0	12.7	3.5	0.5	0.5
Nicaragua	73	28.0	121.1	2.5	1.5	1.2
Niger	20	71.1	50.0	5.8	0.8	0.9
Nigeria	4	69.4	35.0	28.6	5.9	7.5
Rwanda	14	2.8	0.6	5.7	2.6	4.8
Senegal	28	28.7	90.2	7.7	1.2	0.8
Sierra Leone	41	18.9	0.9	0.7	0.1	1.3
Solomon Islands	32	16.2	1.1	2.8	0.5	–0.1
Sudan	35	125.7	56.5	–1.4	0.7	1.0
Tanzania	38	194.2	75.1	4.7	0	0.8
Togo	55	9.7	12.0	–0.3	0.9	1.0
Uganda	18	39.6	13.2	3.1	0.6	1.5
Vanuatu	21	8.3	10.9	–4.1	–1.1	–2.4
Yemen, Rep.	24	58.1	110.8	–0.5	1.3	0.6
Number of countries with:		$0 < \text{share} \leq 0.5$		1	10	2
		$0.5 < \text{share} < 1$		3	9	9
		$1 \leq \text{share}$		25	15	25
Number of countries with indexed-debt share > 0.5				28	24	34

or greater than 1 should be interpreted as meaning that the entire debt should be indexed. Importantly, the optimal shares are obtained from pairwise comparison of each type of indexed debt against conventional debt, so that values in different columns should be viewed as independent. In fact, the analysis aims to investigate whether a country would benefit from having the entire debt of a particular

Table 3: Optimal shares of indexed debt: 10-year horizon

Countries	Debt ratio	Relative variances		Optimal shares		
		$V(x)/V(g)$	$V(e-p)/V(g)$	γ^*	x^*	h^*
Angola	22	12.4	3.1	5.0	1.6	3.2
Bangladesh	25	138.1	17.9	2.8	0.2	0.9
Benin	18	55.4	16.4	1.8	–0.8	1.4
Burundi	33	14.7	3.7	–2.8	0.2	1.5
Cambodia	42	2.6	3.0	3.3	2.1	1.9
Cameroon	13	123.0	226.2	8.9	0.2	0.9
Congo, Rep.	32	35.9	59.1	5.8	1.0	0.7
Côte d'Ivoire	50	4.3	9.2	–0.5	0.8	0.5
Djibouti	72	14.1	0.6	–0.7	–0.3	–1.5
Ethiopia	24	10.0	134.8	1.5	0.6	0.3
Ghana	27	0.03	100.8	14.2	78.5	1.4
Guinea	65	1826.8	1293.3	12.0	0.7	0.9
Guyana	61	2.0	13.3	5.0	3.6	1.0
Haiti	7	191.8	203.8	82.2	5.9	5.8
Honduras	27	3.3	1.7	–2.3	1.4	2.2
Kenya	27	132.9	201.3	–12.3	–2.2	2.1
Kyrgyz Rep.	86	13.8	7.2	4.1	1.0	1.6
Lao PDR	76	234.6	315.4	8.7	0.5	0.9
Lesotho	34	2.1	1.8	1.4	0.9	4.8
Madagascar	26	5.5	7.5	–0.2	–0.1	1.2
Malawi	18	4.6	17.8	5.3	0.1	–0.3
Maldives	64	6.1	0.6	3.0	1.3	1.7
Mali	25	68.3	24.9	0.9	0.8	1.6
Moldova	79	13.3	3.6	2.2	0.6	1.2
Mongolia	39	20.0	21.7	–0.6	2.6	–3.9
Mozambique	43	40.9	38.0	–1.3	–0.2	1.5
Nepal	29	68.4	14.3	4.7	0.6	0.6
Nicaragua	73	24.2	70.7	2.6	0.9	1.2
Niger	20	136.4	86.5	7.0	0.6	0.8
Nigeria	4	45.5	22.3	33.0	5.6	7.6
Rwanda	14	3.4	0.7	5.6	2.4	5.0
Senegal	28	32.6	97.0	7.3	1.1	0.8
Sierra Leone	41	15.9	0.6	1.1	0.2	1.3
Solomon Islands	32	12.1	0.9	2.7	0.6	0.8
Sudan	35	104.2	65.3	–1.7	0.3	0.2
Tanzania	38	328.3	52.0	8.5	0.1	0.5
Togo	55	0.9	1.2	1.3	1.2	0.9
Uganda	18	31.6	9.2	4.1	0.4	1.3
Vanuatu	21	9.2	26.3	–13.2	–4.3	–2.8
Yemen, Rep.	24	37.7	97.2	–2.9	0.5	0.2
Number of countries with:		$0 < \text{share} \leq 0.5$		0	10	5
		$0.5 < \text{share} < 1$		1	10	10
		$1 \leq \text{share}$		28	14	21
Number of countries with indexed-debt share > 0.5				29	24	31

indexation type rather than to estimate optimal proportions. This is because, for policy purposes, all multilateral loans would have to be either indexed (one way or another) or not. In light of this policy requirement, shares greater than 0.5 assume particular relevance in that they clearly suggest that indexed loans should be preferred to conventional loans.

Each table reports: the debt ratio in column 2; the ratio of the variance of exports to the variance of GDP in column 3; the ratio of the variance of real exchange-rate depreciation to the variance of GDP in column 4; the optimal share, γ^*, of debt indexed to real GDP in column 5; the optimal share, x^*, of debt indexed to the dollar value of exports in column 6, and; the optimal share, h^*, of inflation-indexed debt denominated in local currency in column 7.

Despite the relatively low volatility of GDP growth, GDP-indexed loans would be a valuable hedge for many IDA countries. The optimal share, γ^*, is positive in 29 out of 40 countries at both horizons considered, and greater than one in 25 and 28 countries at the 5- and 10-year horizon, respectively. In these countries, GDP indexation does not only help to stabilize the debt ratio against output fluctuations, but provides additional insurance. The reason is that GDP growth is lower than expected when the real exchange rate depreciates and thus when capital losses occur because of foreign currency denomination. In fact, equation (1) shows that the optimal share of GDP-indexed debt is greater than one if GDP growth either displays a negative covariance with exchange-rate depreciation or a positive covariance with net exports. A closer look at the estimated covariances clearly points to the negative relation between output growth and the exchange rate as the main reason for the additional insurance that GDP indexation provides (see Tables C2 and C3). In particular, at the 10-year horizon, the real exchange rate appreciates with GDP growth in 27 of the 29 countries where indexed debt is preferred to conventional debt (in 27 out of 28 countries at the shorter horizon), while this happens in only four of the remaining 11 countries. This evidence is consistent with the Balassa–Samuelson effect, where productivity shocks lead to higher growth and unexpected real appreciations. Sudden stops and capital outflows also lead to output contractions and large real depreciations. Hence, in bad times, GDP indexation can provide insurance against valuation effects, a benefit not yet considered in the literature.

However, GDP-indexed loans are not always the best instrument; loans should not be indexed to GDP in one-quarter of the countries in our sample. The reason for this result is a significant positive covariance of GDP growth with real depreciation (eight out of 11 countries) and/or a negative covariance with net exports (seven out of 11 countries). In the latter case, as GDP increases with imports, higher payments on indexed loans add to the accumulation of external debt.

Export indexation is a valid alternative to GDP indexation. Tables 2 and 3 show that some export-indexed debt would help to stabilize the debt ratio in 34 IDA countries at both horizons considered. As exports affect debt accumulation only indirectly, export-indexed debt is not a perfect hedge against a specific shock to the debt ratio (see equation (2)). The reason why indexation provides valuable insurance is that exports are both positively related to GDP and negatively related to real exchange depreciation. Indeed, exports and GDP move in the same direction in 30 of the 34 countries where export indexation is desirable, while real depreciations are associated with export contractions in 31 of the same 34 countries. The positive relation between exports and GDP may derive from either productivity improvements or export diversification or foreign demand. Interestingly, export indexation, if optimal, also provides a hedge against valuation effects due to real depreciations. Though consistent with the effects of productivity improvements, this result more likely reflects the impact of terms-of-trade shocks on the value of exports and the real exchange rate. It suggests that export-indexed loans

could provide an alternative to commodity price indexation, especially to those countries that do not depend on a single commodity export.

On the other hand, we find six countries that would not benefit from export indexation at both the 5- and 10-year horizon. In the other 10 countries export-indexed debt should not exceed 50 per cent, which suggests a stabilizing role no greater than conventional loans. In general, a low or negative share of indexed debt is due to the positive covariance between export growth and exchange-rate depreciation (see Tables C2 and C3). For instance, at the 10-year horizon, this happens in eight of the 10 countries where the optimal share of export-indexed debt does not exceed 50 per cent and, more importantly, in four of the six countries that do not benefit from export indexation. The remaining two countries show a significant negative covariance between export growth and the ratio of net exports to GDP. Though surprising, this can be explained by the positive relation characterizing the dynamics of exports, GDP, and the demand for foreign goods.

The last instrument that we consider is inflation-indexed debt denominated in the borrower's currency. Local currency loans provide full protection against real exchange-rate risk and appear to stabilize the debt ratio in a large number of countries. The last columns of Tables 2 and 3 show that 36 countries would benefit from having at least a fraction of their debts denominated in the local currency and indexed to inflation. More importantly, such a share exceeds 50 per cent in 34 and 31 countries at the 5- and 10-year horizon, respectively. In 26 of these countries the covariance between exchange-rate depreciation and GDP is negative (see Tables C2 and C3). This implies an additional insurance role for domestic currency debt; it avoids the capital loss from currency depreciation when this is most valuable, i.e. when output growth is lower than expected. Indeed, real exchange-rate depreciations due to productivity shocks and capital outflows are a major source of debt vulnerability, which calls for either indexing the debt to GDP or denominating it in local currency. In about half of the sample, real depreciations are also associated with lower-than-expected net exports which makes an even stronger case for local currency denomination. Such a relation is shown by all the 21 and 20 countries (at the 5- and 10-year horizon) where the optimal share of local currency debt is greater than one. Hence, in these countries, local currency debt does not only offer protection against exchange rate volatility, but also against unexpected falls in net exports that are associated with real depreciations. On the other hand, when net exports are positively correlated to exchange-rate depreciations, which happens in the other half of the sample, some exposure to exchange-rate risk may be useful. This explains why in 11 and 15 countries at the 5- and 10-year horizon, respectively, only a fraction of the debt should be denominated in local currency, and why in two and five countries, respectively, such a fraction does not exceed 50 per cent.

The optimal share of domestic currency debt is negative in only five countries, either at the 5- or 10-year horizon: Djibouti, Malawi, Mongolia, Solomon Islands, and Vanuatu. In all these countries exposure to currency risk allows the hedging of changes in net exports because the latter are positively related and particularly sensitive to exchange-rate depreciation. Interestingly, conventional loans are the best instruments for Djibouti and Vanuatu, where no indexation scheme appears to enhance debt sustainability.

Summing up, we find strong evidence in favour of inflation-indexed loans denominated in local currency in that such debt would benefit the largest number of countries

in our sample. The analysis also makes a strong case for GDP-indexed loans that provide valuable insurance to the majority of IDA countries in our sample. In particular, over the 10-year horizon, GDP-indexed debt should exceed 50 per cent and be preferred to conventional debt in 29 countries, slightly less than the 31 countries where debt in local currency dominates conventional debt.

V. The cost of insurance

In this section we assess the feasibility of extending indexed loans at the same interest rate as that on conventional loans by studying whether portfolio diversification can limit the risk exposure of multilateral lenders. To this end we examine the risk-return characteristics of a portfolio of indexed loans to the same group of IDA countries considered in the previous section. First, we provide evidence on 10-year returns that arise because of forecast errors in setting the baseline levels of the reference variables. Second, we compare the return volatility of the MDBs' portfolio to the volatility of individual country loans. Finally, we derive the risk premium (over conventional loans) of indexed-loan portfolios through CAPM beta coefficients estimated using the covariances of the forecast errors of individual-country VAR models of indexed loan returns.

(i) Risk diversification; return and volatility of a portfolio of indexed loans

Indexed loans offer borrowers valuable insurance in case long-run GDP, exports, or the real exchange rate turn out to be lower than expected. Indeed, payments on indexed loans would be linked to deviations of real GDP, exports, and the real exchange rate from their baseline expected levels.[11] If the trends of such variables were perfectly foreseen, indexed loans would still offer a hedge against cyclical or exchange-rate fluctuations, and help stabilize the budget, but, as the ability to pay in the long run remains the same, the need for protection would be limited. As forecast errors of long-term GDP, exports, and the real exchange rate are usually large, so is the scope for insurance and likewise large are the potential gains and losses that MDBs would experience on individual country loans. Then, the relevant issue is whether there is enough heterogeneity across LICs that positive and negative returns would average out in the MDBs' portfolio.

To address this issue we simulate the performance of a portfolio of indexed loans to IDA countries over the period 2000–10, where the country weights in the portfolio are equal to their fraction of multilateral debt at the end of 2000. We first compute the returns on individual country loans and, then, the MBDs' portfolio returns for the three types of indexation. Returns depend on the realization of real GDP (or exports, or the real exchange rate) in 2010 relative to its baseline level in the same year as expected and set in 2000. To this end, we assume that expectations would be half based on historical

[11] Inflation-indexed loans in local currency may not feature a baseline real exchange rate, but it is reasonable to assume that their degree of concessionality would be adjusted to compensate LICs for the expected real appreciation of their exchange rates.

values and half based on perfect foresight, and simply set the expected growth rates of each reference variable equal to the mean of the growth rates in the two periods 1990–2000 and 2000–10 shown in Table C1. Then, we compute the unexpected 10-year return on each country loan as the difference between the cumulative growth of GDP (or exports, or the real exchange rate) and the cumulative growth of baseline GDP over the period 2000–10. Finally, we estimate (for each type of indexation) the 10-year return on the MDBs' portfolio by taking the weighted average of the 10-year returns on individual country loans.

Figure 1 shows the 10-year returns (relative to conventional loans) for GDP-indexed, export-indexed, and inflation-indexed local-currency loans, from the top to the bottom panel. The continuous line displays, in increasing order, the returns on the individual country loans that arise because of forecast errors in setting the baseline trends of real GDP, exports, and the real exchange rate. The horizontal continuous line reports the 10-year return on the MDBs' portfolio, while the horizontal dashed line indicates the sample average of individual returns.

The return on the MDBs' portfolio is positive for all types of indexation considered. This reflects the improved performance of IDA countries over the last 10 years relative to the previous decade; on average GDP and exports grew faster and real appreciation was stronger. Individual loans with negative returns are suggestive of the insurance that countries would obtain from indexed debt, while returns on the MDBs' portfolios provide evidence on the potential gains or losses that multilateral lenders would obtain from indexation.

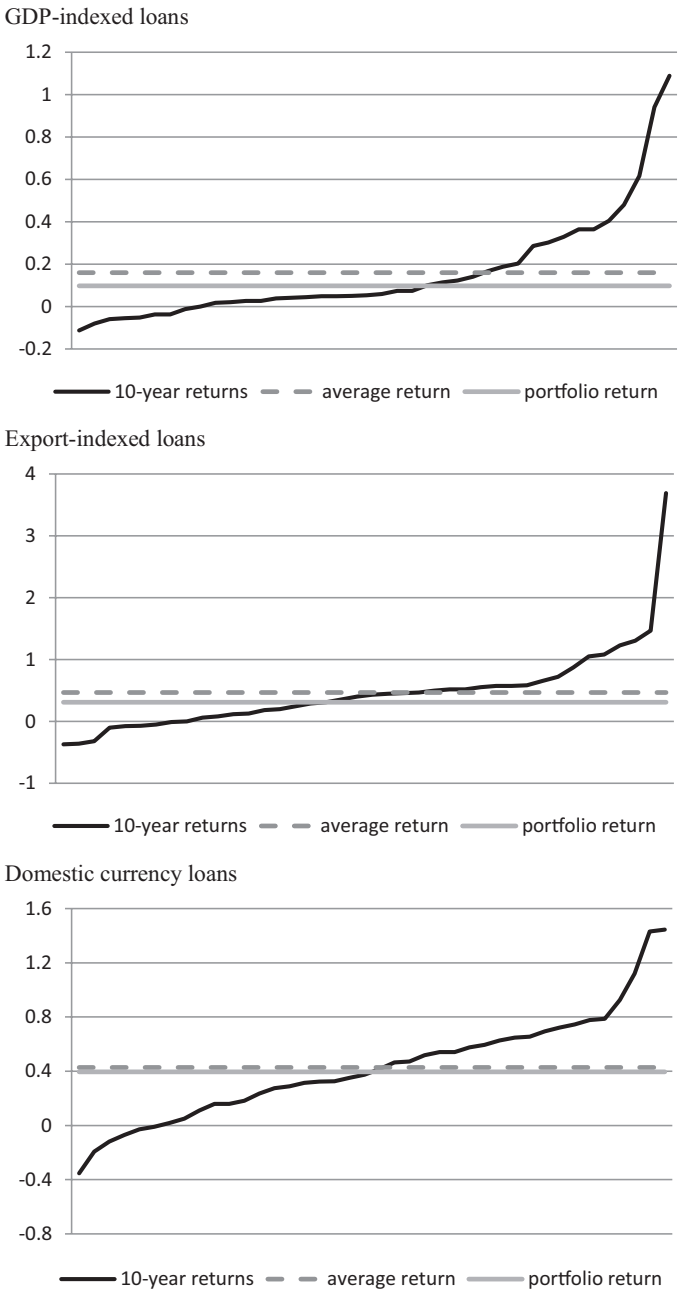
Table 4 shows that the 10-year return on the portfolio of GDP-indexed loans is 9.7 per cent, i.e. less than 1 per cent a year, while the returns on individual loans vary from a minimum of –11.2 per cent to a maximum of 108.9 per cent. By contrast, export-indexed loans show a much higher volatility as errors in forecasting exports, and thus 10-year returns, range from –37.1 per cent to an astonishing 369.4 per cent. The 10-year return on the MDBs' portfolio is as high as 31.1 per cent, while the 10-year dollar return on the portfolio of inflation-indexed loans in local currencies is also high at 39.6 per cent, i.e. almost 4 per cent a year, even though the variation in individual loan returns is lower, from –35.2 to 144.6 per cent.

This evidence suggests that GDP-indexed loans are less risky than export-indexed loans and local currency loans; the 10-year return on the portfolio of GDP-indexed loans is small which offers little support to the argument that such loans would have to pay a premium over conventional loans.

To further examine the scope for risk diversification we look at the volatility of annual returns on the same portfolios of indexed loans over the period 2000–10. In particular, we investigate whether the MDBs' portfolio would be less volatile than the individual country loans, as would be the case if GDP (or exports, or the real exchange rate) were uncorrelated across countries.

For each IDA country in our sample we compute the series of yearly returns as the difference between the actual rates of GDP growth (or export growth, or real appreciation) and the corresponding expected growth rates as previously estimated by the mean of the growth rates observed in the two decades. Then, for each year, we compute the return on the MDBs' portfolio as the weighted average of the returns on the 40 country loans and take the standard deviation of the resulting series as the volatility of the MDBs' portfolio.

Figure 1: Unexpected 10-year returns



The results are reported in Figure 2 for GDP-indexed, export-indexed, and domestic-currency inflation-indexed loans, from the top to the bottom panel. The continuous line displays, in increasing order, the standard deviations of returns on individual country loans. The average standard deviation in the sample is indicated by

Table 4: Risk diversification: portfolio returns and volatilities

	GDP-indexed	Export-indexed	Domestic-currency inflation-indexed
	10-year returns (%)		
Portfolio return	9.7	31.1	39.6
Individual loan returns			
Min.	–11.2	–37.1	–35.2
Max.	108.9	369.4	144.6
Mean	16.0	46.9	42.7
St. dev.	25.5	67.4	39.3
25° percentile	1.8	6.7	16.0
50° percentile	5.6	41.8	39.5
75° percentile	26.5	58.4	65.4
90° percentile	47.3	121.3	91.2
	Volatility (%)		
Portfolio risk	1.0	8.8	4.6
Individual loan risk			
Min.	0.5	5.6	2.3
Max.	27.8	33.1	21.7
Mean	3.4	15.1	9.6
St. dev.	4.3	6.7	4.6
10° percentile	0.7	8.4	3.7
25° percentile	1.4	9.6	6.6
50° percentile	2.5	13.3	8.8
75° percentile	3.7	19.7	12.2
90° percentile	6.8	26.3	17.8

the horizontal dashed line, while the horizontal continuous line reports the standard deviation of returns on the MDBs' portfolio. The visual impression is that the extent of risk diversification by lending to IDA countries is enormous whatever the type of indexation. Indeed, the volatility of the MDBs' portfolio is not only significantly lower than the sample average of the volatilities of the 40 IDA loans, but very few countries display a return volatility lower than the MDBs' portfolio: just five for each type of indexation.

(ii) A capital asset pricing model of indexed loans

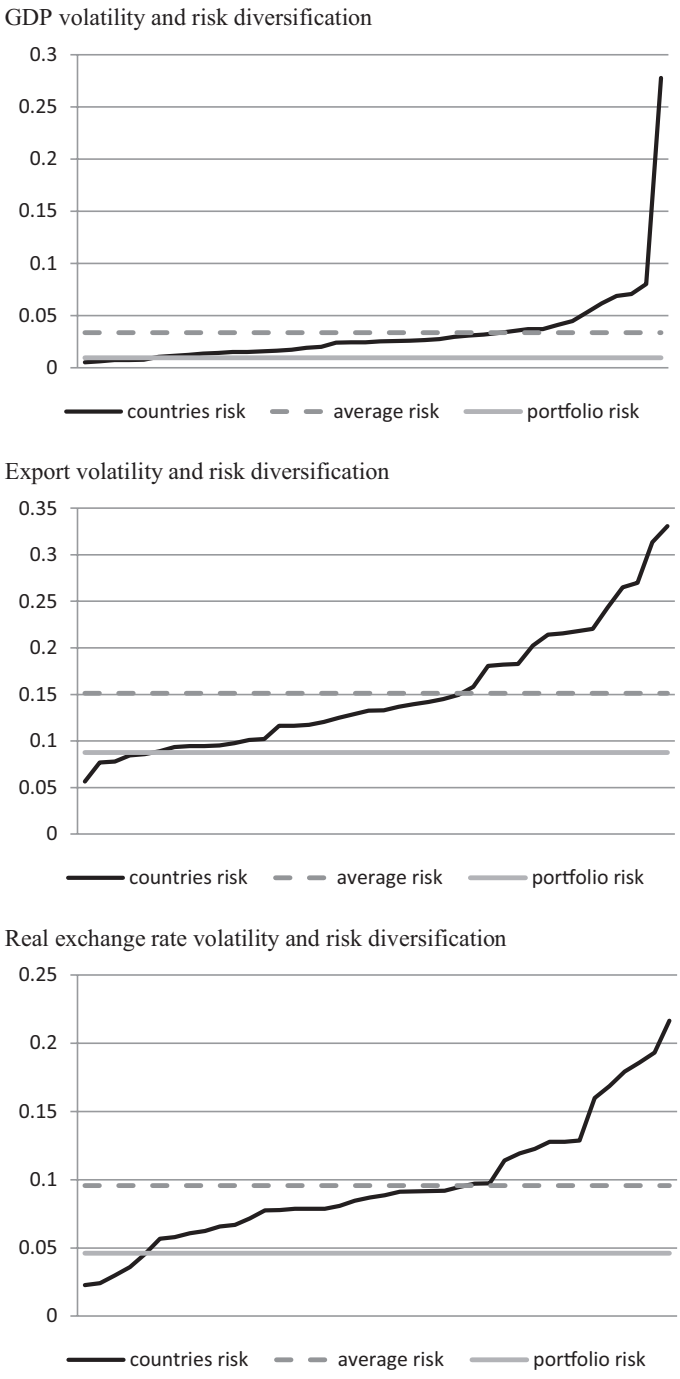
We use the CAPM to estimate the risk premium that lenders would require to index their loans. The CAPM implies an expected return on an indexed loan equal to

$$E_t R_{i,t+1} = R_{F,t+1} + \left[E_t R_{M,t+1} - R_{F,t+1} \right] \frac{Cov_t \left(R_{i,t+1}; R_{M,t+1} \right)}{Var_t \left(R_{M,t+1} \right)} \quad (4)$$

where $R_{i,t}$ is the return on the indexed loan, $R_{F,t}$ is the risk-free rate, and $R_{M,t}$ is the return on the market portfolio (see Borensztein and Mauro, 2004).

Hence, the risk premium depends on the systematic component of GDP risk (or export risk, or real exchange-rate risk) that is captured by the conditional correlation of the loan return with the return on the market portfolio; i.e. the beta coefficient. The latter conveys information on whether the risk of the loan can be diversified away; the lower the beta coefficient the lower the premium.

Figure 2: Risk diversification opportunities



As multilateral lenders do not hold other financial assets than country loans, to estimate the beta coefficients we take the GDP growth of OECD countries as the relevant market-portfolio return. This choice is justified by the fact that multilateral lenders, such as the IDA window of the World Bank, are mainly funded through the contributions provided by their wealthier member states. The higher the correlation of the return on the indexed loan with GDP growth in OECD countries —i.e. the higher the beta coefficients— the greater the risk that loan repayments may fall at times when fiscal resources for multilateral funding are scarce.

Denoting with I_t the variable to which loan payments are indexed, and abstracting from valuation effects, the return on an indexed loan can be approximated by $r^j + i_{t+1} - i^*_{t+1}$, where r^j is the fixed-rate component of the return (with $j = \gamma, x, h$), while i_{t+1} is the log of I_{t+1} and i^*_{t+1} is the log of its baseline level. Then, defining with w_t the log of GDP in OECD countries, and noting that r^j, i^*_{t+1} and w_t and are known at time t, the beta coefficient is equal to

$$\beta_{CAPM} = \frac{Cov_t\left[\left(r^i + i_{t+1} - i^*_{t+1}\right);\left(w_{t+1} - w_t\right)\right]}{Var_t\left[w_{t+1} - w_t\right]} = \frac{Cov_t\left[i_{t+1}; w_{t+1}\right]}{Var_t\left[w_{t+1}\right]} \tag{5}$$

To estimate the beta coefficients we use the variances and covariances of the forecast errors of the VAR model presented in section IV(i).[12] This allows us to derive beta coefficients over investment horizons of 5 and 10 years, which are particularly relevant because of the long maturity of multilateral loans.

Table 5 reports beta coefficients for: GDP-indexed loans; export-indexed loans; inflation-indexed loans denominated in local currency. They are computed as the covariances of the forecast errors of the log of GDP, exports, and the real exchange rate, with the log of GDP in the OECD area divided by the variance of the forecast error of the latter variable. The last rows of Table 5 also display beta coefficients for two MDBs' portfolios of indexed loans to IDA countries, along with their annual risk premium; the first portfolio, 'Multilateral Debt', uses as country weights the fraction of multilateral debt at the end of 2010; the second portfolio, 'Disbursement', takes as country weights the fraction of multilateral loan disbursements at the end of 2010.

In the case of GDP-indexed loans, beta coefficients are generally low for all countries at both horizons considered; indeed, a value greater than 0.5 is found only in 11 countries. The average of beta coefficients is 0.20, while the median is slightly higher at 0.28 for the 5-year horizon, but decreases to 0.19 as the horizon extends to 10 years. This result clearly suggests that unanticipated GDP growth and thus the payments on indexed loans are, on average, very weakly correlated with OECD growth and thus with the fiscal resources of multilateral lenders.

The risk premium on GDP-indexed loans can be computed using equation (4). Taking the average growth rate of nominal GDP in the OECD area over the sample period, 4.6 per cent, as the annual expected return on the market portfolio, and 0.75 per cent as the risk-free interest rate on conventional IDA loans, the difference between their 10-year compounded returns is 0.49 (= 0.568–0.078) and the 10-year compounded risk premium for the IDA country with the average beta, 0.20, is equal to 0.98 (= 0.49*0.20) which implies an annual

[12] The VAR model is extended to include an equation for the log of GDP of OECD countries.

Table 5: Beta coefficients of indexed debt

	5-year horizon			10-year horizon		
Countries	**GDP**	**Export**	**Local currency**	**GDP**	**Export**	**Local currency**
Angola	0.3	6.7	1.5	0.4	8.5	2.9
Bangladesh	0.3	4.2	–0.2	0.3	4.0	–0.4
Benin	0.6	–5.4	–3.9	0.2	–2.8	–2.0
Burundi	0.1	2.9	–2.1	–0.4	–3.1	–4.7
Cambodia	1.5	2.2	–0.2	1.6	3.1	–0.7
Cameroon	0.3	2.6	–0.5	0.5	2.6	–0.8
Congo, Rep.	–1.2	5.3	6.9	–1.9	0.2	0.7
Côte d'Ivoire	–1.4	–1.3	1.6	0.5	–4.5	–2.7
Djibouti	0.1	–2.5	0	0.2	–1.7	0.3
Ethiopia	–0.9	2.2	–1.7	0.1	7.3	–1.4
Ghana	–0.2	0	–1.7	0.1	1.3	–2.6
Guinea	0.5	2.5	–0.9	0.5	0.4	–0.9
Guyana	0.5	1.2	1.1	0	0.4	3.1
Haiti	0.2	3.6	–1.6	0.2	2.8	–2.7
Honduras	0.1	4.4	0.3	0	4.7	0.6
Kenya	0.5	4.3	0.1	0.6	11.9	–1.8
Kyrgyz Republic	–0.1	0.1	–0.3	–0.2	–0.5	–0.6
Lao PDR	–0.2	–0.4	–3.5	–0.2	2.8	–1.4
Lesotho	–0.6	4.1	–1.5	–0.3	6.1	–1.7
Madagascar	2.1	4.4	–6.5	2.1	4.4	–3.9
Malawi	–1.6	–6.4	–1.4	–1.8	–6.4	–1.3
Maldives	0.7	0.3	–1.0	1.6	3.1	–0.9
Mali	1.2	2.8	0	1.5	3.2	–0.5
Moldova	1.2	2.7	–0.2	1.1	2.3	0.1
Mongolia	0.9	6.9	2.9	0.8	8.2	3.4
Mozambique	–0.3	3.6	1.1	–0.6	4.4	1.7
Nepal	0.3	–0.7	0	0.2	–3.0	–0.8
Nicaragua	0.7	–0.9	–1.1	0.1	–3.5	–1.3
Niger	0.6	–2.0	–0.8	1.0	0	0.4
Nigeria	–0.4	6.1	4.0	–0.9	3.5	2.8
Rwanda	1.8	0.9	–1.2	–1.7	–12.7	–11.7
Senegal	0.4	0.3	0.9	0.3	–0.3	1.5
Sierra Leone	–2.1	–2.9	1.2	–2.2	1.4	1.7
Solomon Islands	0.5	0.9	–0.4	1.8	9.7	–0.4
Sudan	–0.3	8.3	2.3	–0.1	5.7	–4.0
Tanzania	0.1	0.5	–0.1	0	0.7	–0.6
Togo	–0.8	0.4	–0.6	–1.5	2.7	1.0
Uganda	–0.4	–1.7	–0.4	0.1	1.4	1.6
Vanuatu	3.1	7.6	–3.4	3.5	8.6	–2.5
Yemen, Rep.	0	6.0	4.7	0.6	2.9	2.1
N. obs Beta > 0.5	11	24	11	11	26	12
Mean	0.21	1.85	–0.16	0.20	2.00	–0.71
Median	0.27	2.23	–0.27	0.19	2.61	–0.63
Portfolio Multilateral Debt	0.14	2.70	0.13	0.19	2.83	–0.54
Risk premium (%)	0.67	8.80	0.62	0.89	9.09	–3.03
Portfolio Disbursement	0.04	2.40	0.31	0.07	2.74	–0.14
Risk premium (%)	0.19	8.09	1.43	0.34	8.89	–0.71

risk premium lower than 1 per cent. Even lower risk premia are shown in Table 5 for the two MDBs' portfolios; 67 and 89 basis points for the 'Multilateral Debt' portfolio and 19 and 34 basis points for the 'Disbursement' portfolio at the 5-year and 10-year horizon, respectively.

In fact, beta coefficients, and thus output growth, vary considerably across countries, which suggests large opportunities for risk diversification and risk sharing.

Export-indexed loans expose multilateral lenders to much greater risk. As shown in Table 5, beta coefficients are positive and large with an average around 2.0 at both horizons considered. This finding cannot be attributed to a few outliers, since there are 24 countries with a coefficient greater than 0.5. This evidence suggests that export growth is fairly correlated with OECD growth and thus with the fiscal resources of multilateral lenders. As a result, export-indexed loans would expose multilateral lenders to the risk of lower reflows at times when their funding needs are highest because of the weak performance of OECD donors. Table 5 shows that the annual risk premium for the two MDBs' portfolios would be very high; 880 and 909 basis points for the 'Multilateral Debt' portfolio and 809 and 889 basis points for the 'Disbursement' portfolio at the 5-year and 10-year horizon, respectively. As an 8 per cent interest rate on multilateral loans is hard to imagine, we should conclude that export indexation is not a feasible option.

A different conclusion is reached for inflation-indexed loans denominated in local currencies. Table 5 shows that the dollar return on domestic currency loans tends to be negatively correlated with OECD growth, as shown by the negative average and median beta coefficients at both horizons considered. The beta coefficient for the median IDA country is –0.27 at the 5-year horizon and decreases to –0.63 at the 10-year horizon. Since the real exchange rate of IDA countries tends to appreciate when OECD growth is lower than expected, the capital gains on local currency loans may stabilize donors' resources. This is the case for 24 countries in our sample for which the risk premium implied by the CAPM is even negative. When the two portfolios are considered, a positive risk premium of 62 and 143 basis points for the 'Multilateral debt' and 'Disbursement' portfolio, respectively, is found at the 5-year horizon, but disappears at the 10-year horizon over which the risk exposure of multilateral lenders should be evaluated. Therefore, it appears that no premium over conventional loans should be asked on domestic-currency loans, a result that is consistent with the findings of Hausmann and Rigobon (2003).

The analysis suggests that the individual country risk could be easily diversified in the MDBs' portfolio in the case of GDP-indexed and local currency loans, while the risk of export-indexed loans would be difficult to manage. Summing up, there are ample opportunities for risk-sharing among IDA countries, making it feasible for MDBs to provide loans either indexed to GDP or to inflation and denominated in local currencies. Such loans could be extended at current interest rates, since the estimated risk premium is either less than 1 per cent or non-existent.

Although it appears that multilateral lenders could easily diversify GDP and exchange-rate risks, this result hinges on the assumption that GDP indexation or domestic currency lending would not eventually alter the behaviour or the policies of debtor countries. We turn to this issue in the next section.

VI. Policy issues and a proposal for indexing multilateral loans

Indexation to variables that are partly under the borrower's control may give rise to adverse incentives and moral hazard. In the case of GDP indexation, a debtor

government may behave opportunistically along three dimensions. First, debt linked to GDP, by reducing the risk of distress and the probability of default, may favour irresponsible fiscal policies and delay fiscal adjustment. Second, the government may lack the incentives to adopt policies that promote growth. Finally, the debtor country might be tempted to manipulate GDP data in order to pay less on its debt.

Insurance strategies naturally involve a trade-off between the benefits of insurance and the risk of moral hazard whose seriousness is difficult to assess. However, in the case of GDP indexation the risk of moral hazard seems exaggerated (see, for example, Griffith-Jones and Sharma (2006), UN (2005, 2006)). In particular, it is unlikely that debtor governments would ever take deliberate actions to forestall growth that is an important policy objective and crucial to attract foreign investments and other capital flows. If anything, conventional fixed-rate debt does not seem to be effective as a disciplinary device, as shown by the long history of debt defaults, restructuring, and relief. Moreover, disincentive effects may also emerge with conventional debt because of 'debt overhang'; a heavy debt burden may act as an implicit tax on future income, and reduce incentives for investment and policy reforms.

The low quality of LICs' national accounts is instead a serious issue for GDP indexation, whether or not it leads to misreporting. Despite the continuous improvement of measurement standards and the substantial efforts by international institutions in checking for data consistency, an indexation programme would require further advances in the reliability and verification of national accounts.

In light of the data requirements for GDP indexation, one may wonder whether inflation-indexed lending in local currencies would not provide a simpler solution to protect IDA countries from output contractions that are often associated with strong real depreciations. Unfortunately, local currency debt creates adverse incentives that cannot be eliminated by price indexation. For instance, indexation may not remove the temptation for monetary expansion and currency depreciation if such policies do not lead to higher inflation, as would be the case in the presence of price controls. Moreover, while price inflation takes time to build up, the exchange rate usually moves fast and overshoots its long-run level. To the extent that nominal exchange-rate depreciation exceeds inflation, multilateral lenders are not protected against debtors' deliberate actions to depreciate their currencies. This may explain why MDBs have so far been reluctant to denominate their loans in local currencies. In addition, the lack of reliable price indices is a practical obstacle to price indexation as much as the low quality of GDP data is a problem for GDP indexation.

To conclude, while GDP-indexed debt is unlikely to affect LICs' incentives, local currency debt may twist their policy in favour of currency depreciation and a lax monetary stance. In light of the incentive problems raised by local currency denomination, arguments in favour of GDP indexation gain strength; although local currency debt seems to appeal to a greater number of countries, GDP-indexed debt still provides insurance benefits to three-quarters of IDA countries and it would not reduce incentives for growth.

As regards the practical implementation of the indexation scheme, it is worth noting that arguments against GDP-indexed bonds, that they are difficult to price, illiquid, and a costly financial innovation, do not apply to multilateral loans, which are not traded and need not be priced. On the other hand, for GDP indexation to work, the loan contract must specify the baseline GDP trend that is used to discount the realizations of

GDP to which payments are linked (see Appendix A(iv)). As this baseline trend scales down all future payments, its design is important in that it determines the degree of concessionality of the loan. If the baseline trend were too low, indexed loans would attract only countries with poor growth prospects. A similar problem arises in the case of loans denominated in local currency since the real exchange rate of LICs tends to appreciate in the long run. For LICs to borrow at the same expected cost as conventional debt, either the amount of transferred resources or their concessionality has to be adjusted to reflect the expected real appreciation.[13]

In the empirical analysis we took the estimated conditional mean of GDP (or the real exchange rate) of each IDA country to be equal to its baseline GDP trend (or exchange rate trend), which amounts to assuming a different baseline for each country. In practice, however, the same loan contract, with a common baseline GDP trend, would have to be offered to all LICs. This is because issuing loans with country-specific baselines would require the LIC and the MDB to agree upon an expected GDP trend, an outcome that would be difficult to achieve because of conflicting interests. On the one hand, the borrower country would have an incentive to claim that its growth prospects are strong in order to set the highest possible baseline trend for GDP and thus reduce future debt payments. On the other hand, the MDB would want to ensure itself an expected level of reflows comparable to those on conventional loans.

The solution to this problem is to make only indexed loans, and offer a standard contract with a common baseline GDP trend that is high enough to ensure the participation of all LICs. This task could be easily accomplished by tuning the baseline GDP trend to the average LIC, since the high concessionality of MDB loans make them a dominant funding strategy for borrowing countries.

It is worth noting that the baseline GDP trend is just a deterministic component of the loan; it changes the expected value but it does not otherwise affect the stochastic distribution of returns. Setting a different baseline changes the expected cost of the loan, i.e. its concessionality, but leaves its insurance properties unaffected. As the common trend should reflect the average expected GDP growth of LICs, the *ex ante* cost of funding for countries with better growth prospects should increase relative to conventional loans for the benefit of countries with a weaker growth potential. Eventually, a cap on total payments could be set to limit the cost of indexation for over-performing countries. However, making the *ex ante* concessionality of indexed loans decrease with expected GDP is certainly a desirable feature of any risk-sharing scheme and part of the cooperative nature of multilateral lending. In fact, the current IDA system of giving only grants or loans is consistent with this principle. But, differently from the existing system, with GDP-indexed debt the actual concessionality of the loans would be determined *ex post*, depending on the realized country performance as opposed to its uncertain projection. As low growth would reduce payments on GDP-indexed loans and make them similar to grants *ex post*, there would be no need to decide in advance which countries should receive loans or grants; all countries would have access to indexed loans.

The empirical analysis of the previous sections shows that a programme of indexed lending would provide substantial benefits to a majority of IDA countries and could

[13] The principal of the loan could be linked to the price index divided by a baseline index, say, I^{*}_{t+1}, equal to the expected trend for the real exchange rate, i.e. $I^{*}_{t+1} = E_0(P_{t+1} / S_{t+1})$. This design would reduce amortization payments according to the evolution of the expected real exchange rate.

be introduced at relatively minor costs for multilateral lenders. The present discussion suggests that GDP-indexed loans should not reduce incentives for growth and that such loans can be designed to ensure full participation and make risk-sharing more effective.

VII. Conclusion

We have evaluated the benefits and costs of indexing MDB loans to variables related to the LICs' ability to pay, and thus whether a reform of multilateral lending is feasible and economically justified. The analysis covers 40 IDA countries over the period from 1990 to 2010, and focuses on three types of debt: GDP-indexed loans; export-indexed loans; and inflation-indexed loans denominated in local currency.

Portfolio risk analysis points to a weak correlation of the returns on loans indexed to GDP or denominated in local currency with OECD growth and thus with the fiscal resources of multilateral lenders. Evidence from a CAPM shows that multilateral lenders could extend such loans at current interest rates, since the estimated risk premium is less than 1 per cent and the additional return-risk would be more than offset by a lower frequency of debt crises. By contrast, export indexation does not appear a viable option since the positive correlation of IDA countries' exports with the GDP of OECD countries would expose multilateral lenders to significant systematic risk.

The analysis also shows that individual country risk can be easily diversified away in the MDBs' portfolio and thus suggests ample opportunities for risk-sharing among IDA countries. This conclusion holds true whether beta coefficients from a CAPM are compared across countries or the volatility of the MDBs' portfolio is compared to the risk of individual countries' loans.

The role of indexed loans in reducing IDA countries' vulnerability to adverse macroeconomic shocks clearly emerges from the estimation of the shares of indexed debt needed to stabilize the debt ratio. We find strong evidence in favour of both inflation-indexed local-currency loans and GDP-indexed loans. Lending in the borrower's currency helps to stabilize the debt ratio against exchange-rate fluctuations which are a main cause of debt vulnerability. Likewise, GDP indexation would stabilize the debt ratio against output shortfalls and would also provide insurance against real depreciations to most IDA countries where depreciations are associated with output contractions. Although local-currency debt seems to benefit a greater number of countries, it affects policy incentives in favour of currency depreciation and greater laxity in monetary policy. In light of incentive problems, we argue in favour of GDP-indexed debt that still provides valuable insurance to three-quarters of IDA countries and is unlikely to reduce incentives for growth.

Multilateral loans are immune from the pricing difficulties and liquidity problems of indexed bonds but are sensitive to contract design. For GDP-indexed loans to attract countries with a high growth potential, amortization payments must be linked to the realization of GDP relative to a baseline GDP trend specified in the contract. If the expected cost/concessionality of indexed loans had to be the same across countries (and equal to conventional loans), then the baseline GDP trend should be equal to each country's expected GDP trend. However, agreeing on country-specific GDP trends would be impossible due to conflicting interests. We propose that multilateral lenders

make only GDP-indexed loans and offer a standard contract with a common baseline GDP trend that is high enough to ensure full participation. This should be an easy task to accomplish, since MDB loans are highly concessional and thus a dominant borrowing strategy for LICs.

As the common trend should reflect the average expected GDP growth of LICs, the *ex ante* cost of funding for countries with better growth prospects should increase relative to conventional loans for the benefit of countries with weaker growth potential. Making the *ex ante* concessionality of indexed loans decrease with expected GDP would be desirable for redistribution and consistent with the cooperative nature of multilateral lending. In fact, the current IDA system of giving only grants or loans is also based on LICs' ability to pay and thus on their expected GDP growth. But, differently from the existing system, GDP indexation would determine the concessionality of the loans *ex post*, depending on the realized country performance. As low growth would make GDP-indexed loans similar to grants, there would be no need to decide in advance which countries are worth receiving loans and which should instead obtain only grants.

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