INCOMPLETE MARKETS AND COMMODITY-LINKED FINANCE IN DEVELOPING COUNTRIES

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This article provides a framework for appraising new financial instruments and evaluating the extent to which they can help alleviate problems of incomplete credit markets and contingent claims markets in developing countries. Although the issues involved apply to any new financial instrument, we give particular attention to commodity-linked securities because many developing countries specialize in producing a handful of primary commodities and are therefore exposed to substantial commodity price risks. The article looks at the supply of, demand for, and pricing of commodity-linked securities and discusses some issues that affect their use by developing countries: their special legal status as sovereign debt; their feasibility (since to become truly effective they will require liquid secondary markets); and the construction of an optimal portfolio of external debt obligations. It also discusses the potential for new financial instruments—particularly commodity-linked securities—as a tool for risk management in developing countries.

Over the years economists and policymakers have suggested a number of ways to reduce and manage the commodity price risks facing developing countries. Schemes to stabilize commodity prices—buffer stocks, buffer funds, quotas, and variable export taxes—have been the most common remedy because when credit and contingent claims markets are incomplete, stabilization schemes can reduce and redistribute risks and thereby increase economic efficiency (Newbery and Stiglitz 1981). But economists have become disillusioned with price stabilization schemes. For one thing, they force everyone to accept the same degree of stability. There is no way for farmers...
and traders to choose a level of participation that is consistent with their individual circumstances and preferences. For another, buffer stock schemes are open to speculative attack (Salant 1983) and tend to become instruments of income redistribution rather than of stabilization. Newbery and Stiglitz, in fact, suggest that the main effects of price stabilization schemes come from income redistribution, and that gains in economic efficiency, if any, tend to be very small.

One of the alternatives that has been suggested is to expand the use of market mechanisms for risk management, such as crop insurance and futures markets. These instruments allow individuals to participate at whatever level they choose and, it is argued, are more effective and efficient forms of risk management. But market mechanisms are not without problems either. Kenneth Arrow (1974) argues that a variety of factors, including poor economic infrastructure, informational asymmetries, and high transaction costs, make insurance and other intertemporal markets (for instance, futures markets and credit and capital markets) notoriously incomplete and imperfect in developing countries. Thus efforts to introduce new markets must be capable of overcoming these frictions.

One possibility would be to design a single market-based instrument that combines financing and hedging functions. Examples of such instruments include swaps; indexed variable-rate loans; caps, floors, and collars; and commodity-linked bonds. Because these instruments can improve risk management without relying directly on specialized futures and crop insurance markets, they can help overcome the problems inherent in incomplete markets by reallocating risk among individuals and easing access to credit. Despite the potential advantages of these financial instruments, however, relatively little use has been made of them by developing countries.

This article provides a framework for appraising new financial instruments and evaluating the extent to which they can help alleviate problems of incomplete credit and contingent claims markets in developing countries. While the issues involved apply to any new financial instrument, we give particular attention to commodity-linked securities because many developing countries specialize in producing a handful of primary commodities and are therefore exposed to substantial commodity price risks.

The appeal of commodity-linked securities is that their return is linked to the value of a commodity (or basket of commodities). Thus a bond linked to the price of copper, for example, might pay as principal the value of a specific quantity of copper priced in a designated copper market on the date that the bond matures. Coupon payments may also be linked to the price of copper at intermediate dates between issue and maturity. This means that the issuer of a commodity-linked security has debt service obligations that rise and fall with the prices of commodities; debt service payments are highest when commodity prices are high and commodity producers can best afford to pay. Conversely, when commodity prices are low and producers are strapped for funds, debt ser-
vice falls. These securities therefore allow developing countries to raise funds and hedge commodity price risks using a single financial instrument.

This article looks at the supply of, demand for, and pricing of new financial instruments and discusses some issues that affect their use by developing countries: their special legal status as sovereign debt; their feasibility (since to become truly effective they will require liquid secondary markets); and the construction of an optimal portfolio of external debt obligations. It also discusses the potential for new financial instruments—particularly commodity-linked securities—as a tool for risk management in developing countries.

Supply

Innovative financial instruments come in a variety of forms. A simple example is a swap, whereby two parties agree to exchange cash flows calculated to reflect fluctuations in a designated price or interest rate index. Consider a developing country that borrows from a bank at a fixed interest rate to expand coffee production. The country then negotiates a swap with a coffee-roasting firm. Under the swap, the firm agrees to make the fixed interest payments to the bank in exchange for payments based on the price of coffee. The country has gained downside price protection because its payment obligations now decline with coffee prices; the coffee roaster has hedged against price increases in coffee because it will receive higher payments when coffee prices rise. Thus both parties are better off. These transactions (including currency swaps to hedge exchange rate risks and interest rate swaps to hedge interest rate fluctuations) are still relatively new, but their use is growing rapidly (Smith, Smithson, and Wakeman 1986).

Commodity-Linked Bonds

An early example of commodity-linked finance was the decision by the Confederate States of America in 1863 to issue cotton bonds. The economy of the Confederacy relied heavily on cotton. To finance the war effort, the government issued a bond with payoffs linked to cotton prices. Commodity-linked finance in industrial countries expanded rapidly throughout the 1980s, and commodity bond issues now total between $3 billion and $4 billion (Priovolos and Duncan 1991). To date, however, most of the action has been heavily concentrated in gold, silver, and oil-linked securities issued by industrial countries (including the French government’s 1973 issue of gold bonds, Sunshine Mining’s issues of silver bonds in 1980 and 1985, and the oil-linked notes issued in 1981 by Denver-based Petro-Lewis Corporation); Mexico’s “petro” bonds are an exception to this trend.

There are two principal types of commodity-linked bonds: indexed bonds and option (or warrant) bonds. Principal and interest payments on an indexed
bond are linked (indexed) to the price of the underlying commodity; payments rise and fall according to a predetermined schedule as the price of the commodity fluctuates. Option bonds, in contrast, have conventional principal and interest payments but, at maturity, the holder has an option to buy (a call option) or sell (a put option) a predetermined quantity of a specified commodity at a predetermined price (the strike price). Because this option is valuable, option bonds either sell at a premium to conventional bonds or have lower coupon rates.

Why would a developing country issue a commodity-linked bond? The primary motivation is to hedge price risks and raise investment capital with a single financial instrument. If a commodity producer wants to expand production capacity (a risky investment because future commodity prices are unknown), it can, of course, take out a conventional loan at flexible interest rates. But interest payments on the loan are unrelated to the profitability of the enterprise, and the producer is exposed to considerable risk because debt service obligations can remain stagnant or even rise when commodity prices and profits are falling.

Indexed Bonds. In the case of commodity-linked indexed bonds, however, both coupon and principal payments are linked to future commodity prices. Coupon payments rise and fall in tandem with commodity prices. Similarly, when the bond matures and new production comes on line, principal payments will also parallel commodity prices. Thus debt service obligations are positively correlated with commodity prices, reducing the overall risk to the producer. Note that producer cash flows are a function of commodity prices under both conventional loans and commodity-linked indexed bonds. But with the indexed bond, net cash flows become less sensitive to commodity prices, so overall risk has been reduced.

Option Bonds. Commodity-linked bonds can also help alleviate cash flow problems by lowering interest payments below the level required by a conventional loan. Consider the same commodity producer who now finances new production capacity with an option bond. The option bond has conventional coupon and principal payments as well as an option to buy a certain amount of the commodity at maturity at a specified strike price. Because the option is valuable, even if the bond carries a lower coupon, the issue can raise the same amount of capital as a conventional bond with a higher coupon—much the same as convertible bonds used by corporations. The producer has lowered the cost of servicing debt until the bond matures. At maturity, the option may or may not be valuable; if the price of the commodity is below the strike price, the call option will expire worthless and the producer will have benefited from the lower coupon payments without having to service the option. If commodity prices are above the strike price, the call option will be exercised and the producer will have to pay the difference between the commodity price and the strike price. This payment occurs, however, at a time when commodity prices
are high and the producer can best afford to pay. The producer has forgone the opportunity to reap the gains above the strike price in exchange for lower interest payments.

The payment schedule from issuing commodity-linked bonds could, in principle, be replicated by issuing conventional bonds and taking out a portfolio of forward positions and options in the particular commodity. For zero coupon bonds this procedure is straightforward: an indexed bond is replicated by issuing a conventional bond and taking a short position in a forward contract to deliver the commodity at maturity; an option bond is replicated by issuing a conventional bond and selling an option to buy or sell the commodity at the strike price. Replicating the payment schedule for coupon-bearing commodity bonds is more difficult but can be accomplished using conventional bonds plus a portfolio of forward contracts and options with different maturities (Richard and Sundaresan 1981).

This raises the question of why developing countries need to issue commodity-linked bonds. For one thing, because forward, futures, and options markets are incomplete in developing countries, replication is theoretically possible but not feasible in practice. For another, even when these markets do exist, maturities are short—usually no more than a year. Commodity-linked bonds could provide finance and hedging opportunities over much longer periods. And finally, there may also be advantages (lower transaction costs, for one) to combining financial and hedging activities into a single financial instrument rather than separating them into several instruments.

Findings from Economic Models

O'Hara (1987) and Ball and Myers (1991) have examined economic models of the decision to issue commodity-linked bonds to finance production activities. They find that risk-averse producers prefer to issue commodity-linked bonds rather than take out conventional loans, provided that the commodity-linked bonds have no risk premium (that is, they do not carry a higher rate than conventional bonds to compensate for the increase in risk). (Default risk is ignored for the moment but is explored below.) If there is no risk premium, the commodity issues will be priced at the same level as conventional bonds with the same expected return. In this case, the reduction in risk (stemming from the hedging feature of the commodity issue) makes commodity-linked securities more desirable than conventional loans. If there is a risk premium, commodity issues will be priced at a discount to conventional bonds that yield the same expected return. As the risk premium increases, so does the price discount, and producers become less willing to issue commodity-linked bonds and instead revert to conventional forms of finance. If the risk premium gets too high, no commodity-linked bonds will be issued.

These results are exactly what we would expect. The risk premium can be considered a cost paid by producers to entice investors to accept part of the
price risk. If the cost is too high, producers will choose to bear the risk rather than pay the cost. The high cost of the risk premium resulting from the inherent commodity price risk, as well as the risk of default, could explain why developing countries have made little use of commodity-linked finance to date.

So far we have described securities that are linked to commodity prices. But hedging performance might be improved by linking debt service to commodity revenue instead. For example, suppose the price of a commodity is high because of a crop failure and the developing country actually is experiencing a shortfall in production and revenue. (This could easily occur if there were a single large exporter, but the situation might also arise if many countries share production shocks, perhaps because of common weather patterns.) If securities are linked to commodity prices, debt service would be high at precisely the time when commodity revenue, and hence the ability to service debt, is low. In theory, this difficulty could be avoided by indexing the securities to revenues rather than to prices. The problem, of course, is one of moral hazard: the country has a disincentive to increase (and an incentive to underreport) production levels. In practice, the only viable commodity-linked finance involves links to widely observed prices on liquid world markets (Lessard and Williamson 1985). It is important to recognize, though, that a negative correlation between the price of a commodity and the output of an individual country might discourage issues of securities linked to that commodity price.

Demand

The modern theory of finance suggests three reasons individuals invest in financial assets: to store wealth so that consumption can be smoothed over a lifetime; to accumulate wealth so that it can be passed on to heirs; and to reduce risks to the investor’s portfolio of assets. Assets are chosen for a portfolio because of their individual risk and return characteristics, and because of the way they interact to determine the aggregate risk and reward of the whole portfolio. From this perspective, the demand for new financial instruments depends on the distribution of returns from investing in the securities and on the extent to which the intrinsic risk from holding the instrument can be diversified by positioning it in the portfolio.

Risk Management

O’Hara (1984) and Fall (1991) use standard models of portfolio selection to investigate the potential demand for commodity-linked bonds. Because such investments are risky (the investor is subject to low returns when commodity prices drop), risk-averse investors might be expected to drop these issues from their portfolios unless there is a risk premium pushing the expected return on commodity issues above that of conventional bonds. But commodity-linked bonds
can provide a form of insurance to some investors. Suppose the commodity prices
to which the bonds are linked are positively correlated with the prices of goods
consumed by the investor. By investing in commodity issues, the investor will
get high returns precisely when they are needed most to pay for high-priced
consumption goods. In this sense commodity-linked securities act as an inflation
hedge (O'Hara 1984). In some instances the return may be negatively correlated
with returns on other assets in the investor's portfolio, providing a form of in-
surance through portfolio diversification. Although these insurance attributes
serve as an incentive to hold commodity-linked securities, a risk premium still
may be necessary to induce serious demand for these instruments.

The extent to which risks from holding commodity-linked securities can be
diversified depends on the set of asset markets and investment opportunities
available to investors. The opportunity for diversification is greatest when in-
vestors have access to futures and options markets for the same (or a closely
related) commodity. When futures and options are available, investors can
use them to manage overall risk exposure. For this reason, we might expect
investors to be more willing to hold commodity-linked securities where well-
developed futures and options markets operate.

The strength of the demand for new financial instruments will also depend
on how risk averse investors are. Investors who are highly risk averse will not
hold commodity issues unless they can either hedge the risk or obtain a return
at a substantial premium over the return on risk-free securities. The decisions
of less risk-averse investors will be dominated by the expected return on dif-
ferent securities, and only a small premium may be required to induce their
participation. As Fall (1991) points out, however, the aggregate demand will
depend on the market's risk aversion, which is a function of the degree of risk
aversion of all investors.

In the real world, these securities will be purchased—at least initially—by
businesses and financial intermediaries, not by individual investors. This may
increase the demand beyond what might be expected from individual investors
and reduce the premium required to induce participation. For example, the
commodity to which the security is linked could be an important production
input for a firm considering investment. Thus the returns to this firm from in-
vesting in commodity-linked securities would have a strong negative correlation
with firm profits, and the hedging potential therefore would be much higher
than for an individual investor. Furthermore, firms may be less risk averse than
individuals because there is a separation between ownership and control.

The question of who invests in commodity-linked securities—and why—is
crucial to developing countries. Demand has a hedging component, driven by
the risk of inflation and the desire for diversifying the portfolio, and a specu-
lative component, driven by any risk premium that places a wedge between the
expected return on commodity issues and the risk-free rate. Total demand de-
pends on the existing market structure, the insurance provided, the risk aver-
sion of investors, and the equilibrium risk premium in the market. Another
important factor influencing the demand for commodity-linked securities is whether a liquid secondary market exists for these assets.

**Pricing**

The most direct way of pricing securities is to build a model of supply and demand for all securities and define the equilibrium price based on the principle that markets clear. This is a daunting task, however, because a general equilibrium asset pricing model depends on interactions among many markets and is sensitive to the individual preferences of investors and issuers (about which we know little).

An alternative is to value securities based on an arbitrage principle. Arbitrage involves a transaction that results in a sure profit without an initial cash outlay. If an arbitrage opportunity exists, profit-seeking individuals would be expected to exploit it as soon as it arises and to continue exploiting it until it is eliminated. Thus equilibrium in well-developed, efficient markets should be devoid of arbitrage opportunities. This fact can be used to characterize the properties of equilibrium asset prices, and the resulting models are called arbitrage pricing models. Such models have become very popular since Black and Scholes (1973) applied them to option pricing. One advantage is that these models lead to a valuation formula that generally does not depend on individual preferences, in contrast to a general equilibrium approach.

A commodity-linked security is a derivative asset in the sense that its payoff is determined by the price of other assets (the underlying commodities). The key to valuing a derivative asset with the arbitrage pricing model is to find a trading strategy in the underlying assets that exactly replicates the payoff from a trading strategy in the derivative asset. To eliminate arbitrage opportunities, the current cost of establishing the positions in the underlying assets must then equal the current value of the derivative asset (Rubinstein 1987).

For example, consider the strategy of buying and holding a zero coupon bond that entitles the investor to receive the value of one barrel of oil at maturity, valued at the market price for oil on that date. Assuming no storage costs for the oil and no transaction costs on the bond, this trading strategy has exactly the same payoff as buying a barrel of oil and holding it until the maturity date. Thus to eliminate arbitrage opportunities, the current price of the bond must equal the current price of a barrel of oil. This establishes the price of the derivative asset (the commodity-linked bond) in terms of the probability distribution of prices for the underlying assets, without the need to resort to models of supply and demand that depend on the preferences of individual investors (Varian 1987).

Schwartz (1982) was one of the first to apply this approach to pricing commodity-linked bonds using the now standard assumptions of the Black-Scholes model:
1. Markets are frictionless (no penalties for short sales, no transaction costs, no taxes, infinitely divisible assets).

2. Markets for all assets are continuously traded.

3. Returns on the underlying asset are normally distributed with constant mean and instantaneous variance.

4. The risk-free rate of interest is known and constant.¹

Using these assumptions, Schwartz was able to replicate the return from investing in a risk-free bond by continuously adjusting a portfolio consisting of commodity-linked bonds, the underlying commodity, and the risk-free bond. Using the “no arbitrage” condition, Schwartz obtained an expression for the price of the commodity-linked bond in terms of the underlying commodity price, its instantaneous variance, and certain characteristics of the commodity-linked bond (time to maturity, strike price, and so on).

Solving the Black-Scholes model requires analyzing a complicated set of partial differential equations. A simplified arbitrage pricing model has been developed by Cox, Ross, and Rubinstein (1979) and applied to the pricing of commodity-linked bonds by Rajan (1991). Using this model,² Rajan estimates prices for hypothetical commodity-linked bonds and finds that results are very similar to those from the Black-Scholes model. Both rely on arbitrage arguments and are not sensitive to individual investor preferences. This means that securities are essentially priced as if they were risk free, with a current price equal to the expected value of the income stream generated by the security, discounted at the risk-free rate (Smith 1976). This is a strength in that the models are easy to understand and implement, but it is also a weakness because it implies that the security being priced has no risk premium (continuous trading allows the replicating portfolio to be continuously adjusted so that it remains risk free). Because the commodity-linked bonds can be made part of a risk-free portfolio, they have no risk premium in equilibrium.

All of this would be fine if the securities involved actually could be traded continuously; in fact, this is not the case. It is also worth noting that because of the customized nature of these securities, and because transactions would be international, transaction costs and tax considerations may also be important. These problems are compounded when valuing commodity-linked bonds with coupon payments, since most of the results so far have been derived for zero coupon bonds. For these reasons, many economists are skeptical of the assumptions of the Black-Scholes model when applied to the problem of pricing commodity-linked securities issued by developing countries.

Without continuous trading, any simplified approach to pricing based on risk neutrality may be quite misleading; actual prices may well have a risk premium in equilibrium. Indeed, it might be argued that the risk premium is currently so high that it precludes trade, which is why we see so few commodity-linked issues from developing countries. In this sense, markets for commodity linked securities are incomplete, and any innovation that could reduce risk premia (and other trade barriers), might encourage an expansion of trade.

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Sovereign Risk

So far, we have ignored default risk and assumed that all the risk from investing in securities involved the uncertainty of the income stream. In fact, however, securities issued by sovereign governments carry a different risk from those issued by private corporations. The additional risk faced by investors in this situation is usually called sovereign risk (Eaton and Gersovitz 1981). Not only is collateral generally unavailable, but, in the event of default, there is no distribution of assets to investors. The most creditors can do is seize assets held outside the country and cut off future financial dealings. In this sense, debt service by sovereign governments is voluntary, and investors are continually exposed to the risk of default—or the threat of default (the investor can hope that the government will try to reschedule the debt at more favorable terms).

A developing country presumably would threaten to default whenever the benefits from doing so (termination or rescheduling of principal and interest payments) exceed the costs (restricted access to international capital markets). Knowing this, investors will limit their loans to foreign governments to reduce their exposure to sovereign risk. The higher the perceived risk that a country will default, the more restricted its access to international capital markets, and the more limited its ability to finance domestic investment and smooth out fluctuations in aggregate consumption.

For example, Wright and Newbery (1989) analyze attempts to smooth domestic consumption using conventional external loans. They find that if sovereign risk induces investors to put any upper bound at all on the amount they are willing to lend, complete consumption smoothing cannot occur. The other problem with conventional debt (at least this was the case in the 1980s) is that the ability to pay is negatively correlated with debt service obligations. Thus the probability of default is high, and access to funds is restricted.

Would commodity-linked securities help developing countries overcome the restrictions on lending arising from sovereign risk? Investors still would be vulnerable in case of default, after all. What does change, however, is the probability of default. Because commodity-linked securities provide a hedge against movements of commodity prices, debt service is positively correlated with the ability to pay, in contrast to the zero or negative correlation that has characterized conventional loans.

For these reasons, a given amount of capital from commodity-linked securities provides a degree of consumption smoothing superior to the same amount raised via conventional loans, provided risk premia and transaction costs on the commodity-linked securities are not too high. Perhaps more important, investors will support more commodity-linked issues than conventional loans, other things being equal, because there is less risk of default. The degree to which the probability of default declines with commodity-linked issues depends on the magnitude of commodity price risk, the importance of the commodity
to the country’s export earnings and aggregate consumption levels, and the extent to which the country views stable consumption levels as desirable (Wright and Newbery 1989).

A number of developing countries today seem on the brink of default. Indeed, one might argue that some countries are in default already, protected only by the unwillingness of investors to make a formal declaration (and thereby reduce the prospects of recovering their funds). Sovereign risk is a barrier to participation in international capital markets, particularly at present, when lofty debt levels and low commodity prices mean that the probability of default is high. Investors demand a premium to compensate them for the risk of default, but if the premium is too high, countries may simply choose not to participate. By reducing the risk of default and lowering the premium a country must pay to get access to international capital markets, commodity-linked securities have the potential to generate improved access to funds.

Securitization

Securitization—the creation of liquid secondary markets for trading debt instruments—is one of the most important issues in the use of financial instruments by developing countries. Active secondary markets provide a number of advantages to issuers and investors. First, there are benefits from liquidity. Investors are much more willing to supply funds when they can trade into and out of the security any time they need to react to new information and circumstances. The flexibility can be valuable, enabling debt to be more widely distributed and inducing additional investment on better terms. Second, prices quoted in an active secondary market will aggregate and reflect information about the value of securities in a changing economic environment. The market’s valuation of the securities provides useful information to all participants, in much the same way an active futures exchange aggregates information about future commodity prices. Third, any actions taken by a developing country to reduce (or increase) the value of its debt would immediately be reflected in the price of its securities on secondary markets. This would allow an immediate adjustment in investors’ portfolios, and at the same time provide a strong incentive for officials to use funds wisely.

There are several barriers to securitization of such debt, but sovereign risk is the most important. Because of sovereign risk, the probability of default on external debt varies significantly from country to country. Debt issued by Brazil is a very different investment from debt issued by Indonesia, even when the terms are identical. This diversity presents a natural barrier to securitization. If debt from different countries cannot be packaged into securities with standard features, including standard default risks, then transaction costs from trade in secondary markets will be high and the development of liquid secondary markets will be problematic. The fact that most developing country debt
has been issued in the form of general obligation bank loans is testimony to
these obstacles.

Anderson, Gilbert, and Powell (1989) suggest a two-pronged attack for dea-
ling with sovereign risk. First, the risk of default would be split off from re-
main ing risks via a third-party guarantee on the performance of the developing
country. This guarantee would create securities that essentially have no default
risk and are therefore more suitable for standardization and securitization. The
third party providing the guarantee could be a new or existing international
agency that pools default risks from many different countries and types of se-
curities and insures the default risk. (Each developing country would pay a pre-
mium tied to the size of its debt and assessed probability of default.) In the
case of nonperformance by the debtor, the agency would make scheduled pay-
ments to the investor and assume the nonperforming security into its portfolio.
The agency might then reschedule or negotiate partial payment—or both. If
the default insurance is provided at actuarially fair rates, the operation could
be self-financing.

The same approach has been used by the U.S. Government National Mort-
gage Association, which performs similar activities by bundling standardized
securities and insuring default risks in order to facilitate liquid secondary mar-
kets for mortgage loans. Although an international agency operating in many
different countries would face considerable problems, there appear to be signif-
icant benefits to securitizing developing country debt, and national precedents
for this approach have been successful.

The main problem with the third-party guarantee, of course, is that it does
not eliminate default risk but merely transfers it from those investing in secu-
rities to the agency providing the guarantee. The agency, in turn, transfers the
cost of this risk back to the developing countries in the form of an insurance
premium. In many cases the insurance premium is likely to be so high that de-
veloping countries will have little incentive to participate. The second compo-
nent of Anderson, Gilbert, and Powell's plan therefore is to find a way to reduce
the probability of default. They would introduce commodity price contingency
into the debt obligations. They show that commodity-linked financial instru-
ments have many of the attributes desirable for a security design that minimizes
default risk.

The interesting practical question is whether commodity-linked financial in-
struments can lower the default risk enough to make debt service guarantees a
viable approach to securitization of developing country debt. This is a difficult
empirical issue about which little is known. There is no doubt, however, that
the introduction of liquid secondary markets would expand trade and improve
risk management opportunities for investors and issuers alike, expanding the
set of credit and contingent claims markets available and helping to overcome
the effects of incomplete markets. One of the most important policy issues for
developing countries is whether it is possible to develop liquid secondary mar-
kets for commodity-contingent debt.

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Optimal Portfolios of External Debt

Assuming that markets for new financial instruments will evolve, there are two key questions about their use by developing countries. First, how does a country determine the optimal currency composition of external debt (that is, in what currencies should the debt be denominated?), and second, how does the government choose an optimal portfolio of debt instruments to issue? Questions such as these must be answered on a case-by-case basis.

The optimal currency composition of external debt has been investigated by Claessens (1991). He assumes that no commodity-linked securities are available to the country but that it can issue conventional debt in several alternative currencies. At the same time the country faces risk from currency exchange rate movements and trades in commodities whose prices are subject to shocks over time. In this situation, unanticipated fluctuations in commodity prices cause fluctuations in domestic consumption that can be smoothed via external borrowing. Thus by issuing debt in currencies whose exchange rates are highly correlated with particular commodity price movements, an optimal currency composition of external debt provides a hedge against unanticipated fluctuations in domestic consumption. As an example, Claessens estimates the optimal currency composition of external debt for Indonesia and Turkey and finds a substantial reduction in risk as a result of a move from actual to optimal currency compositions during the sample period.

Optimal portfolios of commodity-linked bonds have been studied by Myers and Thompson (1989). They assume that all external debt is denominated in a single currency but that the country can issue bonds linked to its major export commodities. If there is no risk premium on the commodity-linked issues, a risk-minimizing portfolio of external debt depends on the relative strength of the correlations between unanticipated shocks to export revenues and unanticipated shocks to particular commodity prices. If export revenues are strongly positively correlated with the price of a commodity, bonds linked to this commodity price play a major role in the optimal debt portfolio. On the other hand, if this correlation is weak or negative, few—or no—bonds linked to that commodity price should be issued. (In the case of negative correlation, the country may want to invest in commodity-linked bonds rather than issue them.) This is exactly as expected because a strong positive correlation (where debt service obligations increase and decrease with commodity prices) reduces the risk that the country will be able to import to maintain consumption levels. The authors offer a method for estimating optimal portfolios of commodity-linked bonds showing that in the case of Costa Rica, bonds linked to the price of coffee could play an important role in reducing the country’s commodity risks.

Several unanswered questions concern the risk management dimension of new instruments, and existing studies have assumed the objective is to minimize—or eliminate—risk. Under more general preference assumptions and the

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existence of risk premia, the demand and supply of securities would have a speculative as well as a hedging component that could influence the composition of optimal external debt. Moreover, if risk premia do exist and are large enough, they would act as disincentives to developing countries, in spite of the risk reduction that could be achieved. There is also the question of whether commodity-linked securities issued in different currencies can be used to hedge exchange rate risk as well as commodity price risks. This could be particularly important for developing countries because they typically lack forward or futures markets for their currencies.

Concluding Comments

Incomplete credit markets and contingent claims markets are a persistent feature of the economies of many developing countries, and this persistence is testimony to the many barriers to the successful introduction of new markets. But markets are dynamic and flexible; new financial instruments are continually being developed, and new markets constantly emerge to take advantage of gaps in present markets and lower the costs of international finance.

Despite the potential advantages of commodity-linked securities, developing countries have made little use of these instruments to date. The reason could be a lack of familiarity with the characteristics of these new instruments and a lack of experience in using them. In this case we might expect use to expand over time as their benefits become known and countries acquire more experience with them. However, the reason could also be that transaction costs are too high. Or perhaps the risk premia required by investors are higher than developing countries are willing to pay. These problems may prevent the emergence of viable market institutions for commodity-linked securities. It therefore remains to be seen whether commodity-linked securities have a significant role to play in developing countries.

Notes

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1. Schwartz also generalizes the framework by allowing for default risk or interest rate risk (but not both) in some of his models. Carr (1987) provides a valuation formula when commodity price risk, interest rate risk, and default risk are all present.

2. The binomial option pricing model features trading at discrete time intervals, but price changes from period to period are limited to be one of only two possible values. This seems like a fairly severe restriction on the stochastic process governing commodity prices. However, it can be shown that as the time interval between trades approaches zero, the binomial option pricing model converges to the Black-Scholes option pricing model.
3. Wright and Newbery find that optimal consumption smoothing generates an accumulated debt path that follows a random walk. But because of the properties of a random walk, any upper limit on the amount of debt a country could accumulate would eventually be reached in finite time, and at that point the optimal consumption-smoothing plan would fall apart.

References

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