

Debt Dilution: When It Is a Major Problem and How to Deal with It

BY BURCU EYIGUNGOR

In light of the ongoing European debt crisis, the potential problems faced by countries in servicing their national or sovereign debt have attracted renewed attention. We had come to believe that sovereign debt crises were exclusively a phenomenon of developing countries, as all defaulters since World War II had been developing countries.¹ Recent developments, however, show that default is an important concern for all countries, threatening the stability of world markets.

Episodes of sovereign default are typically very costly, not only for the lenders but also for the defaulting country itself. Defaults — in fact, the mere possibility of default — lead to substantial losses in output, high unemployment, and often political upheaval.² Furthermore, not only are default episodes costly, they are also surprisingly frequent. For instance,

¹ Currently, sovereign debt usually takes the form of bonds issued by a national government. Sovereign default occurs when a government fails to repay its debts.

² Measuring the costs of sovereign default is somewhat challenging because defaults usually happen when a country has a low capacity to repay its debt and its output would probably be low regardless of its default decision. Still, recent studies have tried to correct for this factor and have found substantial default costs. Eduardo Borensztein and Ugo Panizza estimate that default is associated with a decrease in growth of around 1 percentage point per year

between 1981 and 2004 there have been 114 episodes of sovereign default in the world.

Given that these episodes are so costly, why do we see so much borrowing and so many countries defaulting? In this article, I will argue that a phenomenon called *debt dilution* is a major reason countries are prone to debt crises. To be more specific, the

during the time the country is in default. Davide Furceri and Aleksandra Zdzienicka find that eight years after the occurrence of a debt crisis, output is lower by 10 percent compared with its output trend. Sturzenegger finds that countries that have defaulted grow about 0.6 percent less per year than those that do not. For the period of 1974 to 1999, this implies that defaulters lag nondefaulters by about 14 percent. Bianca De Paoli, Glenn Hoggarth, and Victoria Saporta estimate an even larger number for the costs of default: Output falls 5 percent per annum during the crisis, which on average lasts for about 10 years.

possibility that countries can issue new debt before their existing debt comes due gives them an incentive to borrow heavily. This is because when a country is contemplating issuing new bonds, it need not care about the loss it inflicts on existing creditors who hold bonds the country issued in the past. As a result, the country borrows heavily and defaults frequently. As I will discuss, this incentive to issue a lot of debt ultimately hurts the country itself because it pays higher interest rates on its debt up front and suffers the costs when default happens.

To proceed, I will first look at the case of Argentina during its 2001 default, which will highlight the costs associated with default. Then I will give a simple example that will show how long-term debt and the possibility of diluting its value leads a country to borrow and default excessively, hurting the country itself. Finally, I will analyze various proposals that have been brought up to deal with the debt dilution problem.

COSTS OF DEFAULT: THE CASE OF ARGENTINA

Argentina has defaulted six times since it gained independence in 1820. But it is not the only “serial defaulter.” Carmen Reinhart and Kenneth Rogoff note that Mexico and Uruguay have defaulted eight times since 1800, and Germany and Spain defaulted seven times between 1800 and the start of World War II. When we look at what happened in Argentina around the time of its most recent default in 2001, we can get an idea of the costs associated with sovereign default episodes.



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Before defaulting in 2001, Argentina survived three and a half years of recession, starting in mid-1998. Although there was a primary federal budget surplus (i.e., a budget surplus excluding interest payments on debt), Argentina was having a difficult time paying the interest payments on the high levels of debt it had accumulated. Its debt reached 50 percent of its yearly GDP in 1999, and investors became less confident about Argentina's ability to pay back its debt. The perception of a higher likelihood of default meant that Argentina had to borrow at increasingly higher interest rates, ultimately paying 16 percent more than the U.S. on debt of comparable maturity in 2000. The International Monetary Fund and the U.S. government extended loans to Argentina at interest rates much lower than market rates to ease Argentina's debt repayment woes. Despite international help, increasing social unrest made it impossible for Argentina to implement the contractionary policies that would have generated the budget surpluses needed to lower its debt burden. There were eight general strikes during 2001, and by the time of the default in December 2001, the unemployment rate had increased to 20 percent from 13.5 percent in 1999.

The default episode was accompanied by runs on banks, typical of countries suffering from elevated risks of default. Runs like these arise from the fact that as investors become apprehensive, they liquidate their investments (this is known as capital flight), which leads to sharp depreciations of the currency. Banks in these countries typically hold debt denominated in foreign currency but assets denominated in the home country's currency. When the home country currency depreciates, this creates losses for the banks. In addition, the fear of sovereign default makes the banks that hold government bonds look

vulnerable. All of this makes depositors rightfully apprehensive and results in large-scale withdrawals of deposits from banks. The collapse of the banks, in turn, affects their ability to provide credit to domestic market participants, leading to a further contraction of the domestic economy. In Argentina, as a response to the bank runs, the government restricted individuals' withdrawals to no more than 250 pesos per day, which resulted in shortages of cash. In addition, the government also decreed that domestic debt and deposits denominated in U.S. dollars were to be converted into pesos at the pre-crisis exchange rate of 1 peso per dollar, when the post-default exchange rate was almost 3.5 pesos per dollar. This resulted in a huge redistribution of wealth from savers to borrowers.³ Finally, firms that had a direct connection to foreign lenders defaulted on their foreign debts because their foreign currency liabilities were fixed in dollars and the amount of pesos needed to fulfill these obligations had risen more than three-fold.

From Argentina's experience we can see that both the risk of default and default itself lead to substantial economic dislocation. Thus, frequent episodes of default are, in the end, very costly for the country.

How does debt dilution — that is, issuing new debt on top of existing debt, thereby diluting the value of existing debt — help us understand the excessive borrowing that led to debt crises in Argentina? Two recent studies have proposed the debt dilution problem as a major reason that developing countries borrow too much, default too frequently, and pay high interest rates. In my article with Satyajit Chatterjee, we estimate that Argentina

³ One might argue that this decreased the overall default rate in the private sector and prevented further contraction of the domestic economy.

has paid, on average, an extra 8 percentage points in higher interest rates and increased its yearly probability of default by 6 percentage points because of the excessive borrowing resulting from its debt dilution problem. In another study, Juan Carlos Hatchondo and Leonardo Martinez estimate these numbers to be 7 and 3 percentage points, respectively. Both studies show that without the debt dilution problem, Argentina's probability of default would be negligible, and it would be better off if it could solve this problem in some way.

EXPLAINING THE DEBT DILUTION PROBLEM

A debt dilution problem arises if a country has the opportunity to take out new loans before existing loans have matured and been paid off. When a country takes out a new loan and adds to its existing debt burden, the likelihood that the country will default on its obligations goes up. This happens because as debt levels increase, the probability that the country will have enough resources to repay outstanding debt decreases. New borrowing, then, reduces the value of the country's existing debt. This loss in the value of existing debt (because of a higher probability of default) is called a dilution in the value of existing debt. This is where the problem of debt dilution arises.

There is an externality imposed by the issuance of new debt on existing debt holders that the country does not take into account when deciding whether to issue new debt or not. Thus, the country ends up borrowing excessively, and defaulting excessively as well.

A simple example. To give more insight, let's examine a simple example of a country that has a three-year time frame. The country issues some long-term debt in the first year that is due in the third year. In the second year, it has the option to issue additional debt that also matures in the third year.

Note that this debt has a shorter maturity than the debt issued in the first year. In the third year, the country knows it will have to pay back whatever it borrowed in the first and second years or else default on its borrowings.

The country's expected income determines the probability of default. The country's income in the third year is uncertain. With a probability of 50 percent, the country will have an income of \$50; otherwise, it will have an income of \$100. Obviously, the country's income in the third year will determine its capacity to pay back its debt. To make the calculations simple, I assume that the country pays back its debt in full as long as its income exceeds its debt. If its income is lower than its outstanding debt, it will default and transfer all of its income to its lenders. The lenders share the income in proportion to their holdings of debt and are treated equally, independent of when the debt was issued.

The price of debt depends on the probability of default. For simplicity, let's assume that the interest rate on safe assets is zero. This means that if lenders know for sure that the debt will be paid back in full when it matures, they are willing to provide \$1 for debt that promises to pay \$1 at maturity. For example, if the total debt is \$30, the country will not default whether its income turns out to be \$50 or \$100. In either case, its income will be enough to pay back all of its obligations. Given this, the price of \$1 of debt at the end of the second year will be \$1. In contrast, if they think the country might default, they take that into account in pricing the debt. In that case, they would be willing to advance less than a dollar for debt that promises to pay \$1 at maturity. For example, if the total debt is \$60, the country will not default when its income is \$100, but it will default if its income is \$50. When it defaults, the \$50 will be shared among lenders, and the holder

of each \$1 of debt will be entitled to $50/60 = \$0.83$. Since the probability of the country's income being \$50 is half and the probability of the country's income being \$100 is half, in this case the price of \$1 of debt will be \$0.92 ($=0.5 \times \$0.83 + 0.5 \times \1).⁴ Figure 1 gives the price of \$1 of debt at the end of the second year, and Figure 2 gives the probability of default for different values of the country's debt at the end of the second year.⁵

⁴ A holder of \$1 of debt will get \$1 if income turns out to be \$100 (which happens with 50 percent probability) and will get \$0.83 if income turns out to be \$50 (again with 50 percent probability), and in expectation the holder receives $0.5 \times 1 + 0.5 \times 0.83 = 0.916$ in the third year. This implies that the price of each \$1 of debt will be \$0.92 in the second year.

⁵ The price of the debt depends only on the country's total obligations at the end of the second year and not on the composition of the debt at origination. This is because all debt, regardless of when it is originated, is treated equally and all obligations are due in the third year.

When we look at Figure 2, we see that the probability of default increases to 50 percent once the debt rises above \$50. This is because once the debt is above \$50, the country's income will not be enough to fulfill its obligations if its income turns out to be \$50. If the country's obligations exceed \$100, the country defaults for sure in the third year, since neither realization of income is enough to cover its debt payments.

From Figure 1, it is clear that the price of debt goes down as the country issues more debt. The creditors get back the face value of the debt if the country does not default, but if it defaults, creditors share the country's income. In the case of default, the larger the obligations are, the less money the holder of each unit of debt gets.

Additional borrowing dilutes the value of existing debt. Given that the price of each dollar of debt depends on the country's total obligations (and not on

FIGURE 1

Price of Debt Falls as More Debt Is Issued in Second Year

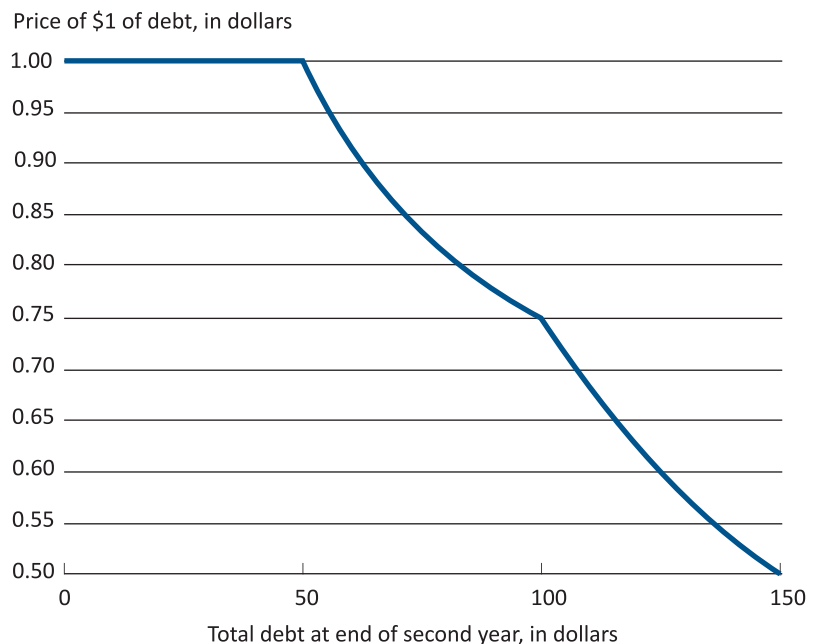
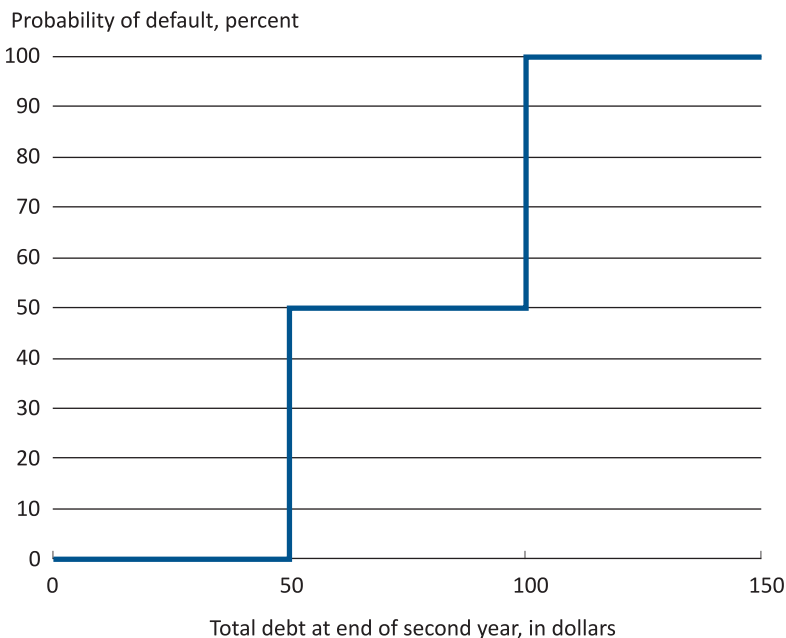


FIGURE 2**Probability of Default Increases as More Debt Is Issued in Second Year**

when the debt is issued), using Table 1, it is easy to see how more borrowing dilutes the value of the existing debt issued in the first year. Suppose that \$20 of long-term debt were issued in the first year. If no additional borrowing is done, its value will be \$1; if \$40 of additional (short-term) debt is issued in the second year (making the country's total obligation \$60), its value will go down to \$0.92; if \$60 of debt is issued, the value of the outstanding debt decreases to \$0.81.

Now we come to the heart of the debt dilution problem. Does the borrowing country care about the decline in the value of the \$20 of existing debt when it issues additional debt in the second year? The answer is no. The country received money from investors when it issued debt in the first year. Now banks or other investors hold this debt, and they, rather than the country, suffer the loss in the market value

of the debt as the country takes on additional debt.

This is in contrast to the case in which the country does not have any outstanding debt. When the country first borrows, the pricing of that initial debt will depend on its probability of default. Higher issuance will result in lower prices, that is, less revenue from issuing debt, and the country will take that into account in deciding how much debt to issue. This is where the costs due to debt dilution come from. Because the country does not care about the capital loss that the existing holders of debt incur, it will end up borrowing and defaulting excessively.⁶

⁶ Some people have thought that countries might act more responsibly in order to maintain or establish a good reputation. In my simple example, I am ignoring these reputational concerns.

COSTS OF DEBT DILUTION

An important question to ask is: Who bears the cost of debt dilution? One answer, as we've already seen, would be that the country's lenders bear the costs, since the debt they hold loses value when the country issues additional debt. But, in fact, what happens is that lenders realize that the country may borrow more in the future and that this additional borrowing will dilute the value of the debt they currently hold. Depending on how much lenders think the country will borrow in the future, the debt will be priced accordingly. For instance, if the country issues \$20 of debt in the first year and lenders know with certainty that the country will not issue additional debt in the second year, they will advance \$1 for each \$1 of debt. On the other hand, if they think that the country will issue \$40 more in debt in the second year, they will be willing to pay only \$0.92 for each \$1 of the \$20 of debt issued in the first year. Obviously, the country is worse off in the first year when its lenders think that it will borrow more in the second year.

So investors need to estimate how much the country can be expected to borrow in each year. Let's return to our example. For simplicity, let's suppose that the country issues \$50 of long-term debt in the first year and will either issue zero or \$50 of debt in the second year. With this simple setup we can show that the country will be better off if it can commit not to borrow more in the second year.

Column 1 of Table 2 shows what happens if no additional debt is issued in the second year. The country gets no net revenue in the third year when its income is \$50 (all the income goes to pay back first-year lenders), and it gets \$50 of net revenue in the third year when its income is \$100. In total then, net revenue in the second year plus average expected net revenue in the third year is \$25.

Compare this to the case, shown in Column 2, when the country issues \$50 of new debt in the second year. The price at which this new debt can be sold is \$0.75 per \$1 of debt (as seen in Table 1, for a total debt level of \$100), so net revenue in the second year will be \$37.50 (= \$0.75 × \$50 of debt).⁷ In the third year, if the country's income is \$50, it defaults, since its total debt exceeds its income and it gets no net revenue. Even if the country's income is \$100, it gets no net revenue in the third year because it has promised to pay

⁷ The new debt can be sold for \$0.75 per \$1 of debt only because there is now a 50 percent chance that second year lenders will get half the country's income when it is \$50 and a 50 percent chance they will get half of the country's income when it is \$100. So, on average, they expect to get \$0.75 for each \$1 of debt.

back a total of \$100 to lenders. In this case, net revenue in the second year plus average net revenue in the third year is \$37.50. This is higher than the \$25 of expected net revenue the country would get if it didn't issue new debt in the second year. So far, it looks like the country is better off by issuing the additional debt in the second year.⁸

⁸ It is worth noting that the additional net revenue permitted by the new borrowing comes from the fact that, by way of dilution, the country diverts resources from existing creditors to new creditors. With the new borrowing, the payment that creditors who lent to the country in the first year expect to get goes down. That's why the price of their debt goes down. The payment that would have gone to these existing creditors goes instead to the new creditors. In return, the new creditors lend the country money in the second year, which allows the country to have more net revenue in the second year.

While this dilution in the value of outstanding debt seems to be in the interests of the country issuing the debt, one must also take into account the country's net revenue in the first year. The important point here is that this amount will depend on what lenders believe the country will do in the second year. If the country could commit to not borrow in the second year, the \$50 of long-term debt issued in the first year would be fully paid back in the third year, and therefore, each \$1 of debt would have a value of \$1. This means that the country would have \$50 of net revenue in the first year. However, lenders know that once the second year arrives, it will be in the country's best interest to issue \$50 more of debt. That is, the country cannot commit not to issue that

TABLE 1

Pricing of Debt for Different Debt Levels

Total level of debt at end of second year	\$20	\$30	\$40	\$50	\$60	\$70	\$80	\$90	\$100
Debt payment when income is \$50	\$20	\$30	\$40	\$50	\$50	\$50	\$50	\$50	\$0
Debt payment when income is \$100	\$20	\$30	\$40	\$50	\$60	\$70	\$80	\$90	\$100
Probability of default	0%	0%	0%	0%	50%	50%	50%	50%	50%
Price of \$1 of debt at end of second year	\$1	\$1	\$1	\$1	\$0.92	\$0.86	\$0.81	\$0.78	\$0.75

TABLE 2

Effects of Additional Borrowing in Second Year

Debt issued in second year	\$0	\$50
Net revenue in second year	\$0	\$37.50
Net revenue in third year if output is \$50	\$0	\$0
Net revenue in third year if output is \$100	\$50	\$0
Net revenue in second year plus average net revenue in third year	\$25	\$37.50
Price of debt in second year	\$1	\$0.75
Probability of default	0%	50%

debt. Consequently, lenders will price the first-year debt with the expectation that the country will issue \$50 more of debt in the second year, which means that the value of each \$1 of debt issued in the first year will be only \$0.75. Thus, the country will have net revenue of only \$37.5 ($= \$0.75 \times \50 of debt) in the first year.

One of the fundamental reasons countries (or people for that matter) borrow is that they would rather have money sooner rather than later. If this is the case, our example shows that the country would be better off if it could commit to not borrow in the second year. To see this, notice that the net return to the country in the three

PROPOSED REMEDIES FOR THE DEBT DILUTION PROBLEM

Given the vulnerability of countries to the debt dilution problem, remedies have been proposed to solve it.¹⁰

Seniority of Existing Debt and Debt Dilution. One solution to debt dilution is to make existing creditors senior claimants to the debt. A seniority clause implies that whatever is recovered following default is distributed to the bondholders in the order in which the bonds were issued. That is, bonds issued earlier must receive distribution before bonds issued later can receive any distribution. The seniority clause makes a debt dilution problem less severe because, with seniority,

since then, many other economists have worked on the problem. Patrick Bolton and Olivier Jeanne suggest that seniority may be one way to resolve the debt dilution problem in the sovereign debt market. In my working paper with Satyajit Chatterjee, we estimate that if Argentina used the seniority clause in its sovereign debt, it would experience a gain that is worth around 2 percent of its annual consumption per year.

Although imposing seniority would be a good solution to the debt dilution problem, it does require a major institutional change in the way sovereign debt contracts are structured. Almost no sovereign bonds carry seniority clauses, except for loans from the International Monetary Fund and World Bank, which typically have higher seniority relative to other types of loans. Since imposing seniority might be costly to accomplish, other mechanisms have also been suggested.

Avoiding Long-Term Debt.

Another proposed remedy is to use short-term debt instead of long-term debt. By short term I mean that the country does not do any new borrowing until its existing debt matures. For example, the average maturity of debt for Argentina is around five years, and it borrows at a frequency of around once a month. If Argentina borrowed in bonds that matured in one month and paid off its maturing debt at the time it issued new debt, it would get rid of its debt dilution problem.

How does short-term debt solve the debt dilution problem? As the country issues more debt, the price for both the existing bonds and the bonds that are up for sale will decrease (because of the higher default risk resulting from the new issuance). The country, of course, cares about the fall in the value of the new issuances and would limit the supply of new issuances (and the default probability) accordingly, but it does not care about the negative effect that new issuances have

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years is \$50, 0, and \$25, respectively. When the country, instead, borrows \$50 more in the second year, its net revenues across the three years are \$37.50, \$37.50, and \$0. So long as the country prefers to have net revenues earlier rather than later, it would prefer the net revenues it would receive if it could commit not to borrow in the second year.⁹

⁹ To see this, suppose that the country values net revenues in the first year twice as much as it values net revenues in the second and third years. Then the value of the net revenue stream if it can refrain from borrowing in the second year is $\$50 \times 2 + \$0 + \$25 = \125 . And the value of the net revenue stream if it borrows an additional \$50 in the second year is $\$37.50 \times 2 + 37.50 + \$0 = \$112.50$. There is nothing magical about valuing first-year revenues twice as much as later-year revenues. One can show that as long as the country values earlier net revenues even slightly more than later net revenues, then the country would prefer the net revenue stream under commitment of no borrowing in the second year.

issuances of new debt have a smaller impact on the price of outstanding debt. New debt has the lowest value among all existing debt because in the case of default, the last issued (most junior) bond will recover something only if all of the more senior bondholders are paid in full. The fact that the more senior debt either does not suffer from capital losses or suffers to a more limited degree reduces the extent to which the debt is diluted and mitigates losses to the country. One of the first studies to show the effect of seniority on debt dilution was by Eugene Fama and Merton Miller in 1972, and

¹⁰ It is worth noting that we do see countries in a position to dilute the value of their existing debt. For instance, between 1994 and 2001, Argentina issued debt with an average maturity of five years, and it issued debt around once a month. Thus, at each point at which it issued new debt, it had the opportunity to dilute the value of existing debt.

on the value of existing debt. However, when the debt is short term (zero outstanding debt), all debt is new debt. Thus, the country bears the full cost of issuing more debt. This would be good for the country, as it would borrow less and have a lower default probability and, therefore, pay a lower interest rate on its debt.

This raises a second question: If short-term debt is better for the country (because it solves the debt dilution problem), why do countries borrow using long-term debt? The answer proposed by Harold Cole and Timothy Kehoe is related to the possibility of a *rollover crisis*. A rollover crisis occurs if the country is willing to pay back its maturing debt only if it can issue enough new debt, but it will default if lenders refuse to buy the new debt, that is, it cannot roll over its current debt into new debt. This can happen if paying off the maturing debt without engaging in new borrowing drastically decreases the country's current consumption. Faced with the prospect of low consumption, the country may prefer default if lenders refuse to buy its new debt. This creates a problem when the country is borrowing from a large number of lenders, each of whom is supplying only a small portion of the country's total borrowing. Then each lender will need to keep an eye on what other lenders are doing, since no lender on its own can meet the borrowing needs of the country.

To see why the country is now vulnerable to a rollover crisis, we can consider a simple example. Imagine that if the country is able to issue \$100 more of debt, it will not default, but for any lesser amount, it will choose to default. If each lender is able to lend a maximum of only \$10, each will be on the lookout for whether other lenders will choose to lend. Any one lender will not want to lend if there aren't enough other lenders to prevent the country from defaulting. A rollover cri-

sis occurs when new lenders lose confidence that other new lenders will step up and lend to the country. Thus, they stop lending and the country defaults.

The article by Harold Cole and Timothy Kehoe and my article with Satyajit Chatterjee show that a country is more vulnerable to a rollover

Faced with the prospect of low consumption, the country may prefer default if lenders refuse to buy its new debt.

crisis when it is borrowing short term because, with short-term debt, each period a much bigger portion of debt matures that has to be rolled over, for which new borrowing has to be made. For example, let's say that each quarter a country borrows using bonds that mature at the end of the quarter. If for some reason lenders lose confidence and will not lend further to the country, then it will not be able to pay back its obligations. This has a self-fulfilling aspect to it. Since lenders know that the country would default if it cannot issue enough new bonds, lenders may become hesitant to make new loans, and their lack of confidence is vindicated by the country's subsequent default.

In contrast, if the country's outstanding debt is long term, it will be much less susceptible to rollover crises. If the country issues and holds only five-year bonds, on average, only 5 percent ($1/5 \text{ years} \times 4 \text{ quarters}$) of its debt will be maturing each quarter, and the country would be paying back its debt much more easily than when it has to roll over 100 percent of its debt, even if it is unable to get new loans. If the country is able and willing to pay back its debt even without the issuance of new bonds, it will avoid a rollover crisis because each lender would be willing to lend (roll over) even if other lenders do not.

In summary, although short-term bonds get rid of the debt dilution problem, the country is left vulnerable to another type of problem, namely, rollover crises.

Taxing New Debt. Juan Carlos Hatchondo and Leonardo Martinez propose another solution. They pro-

pose that whenever a country issues new debt, a predetermined portion of the revenue be distributed to existing creditors. This "tax" on the revenue from new bond sales serves as compensation to existing bondholders for the capital loss they suffer because of the new borrowing. This leads the country to recognize the cost its new borrowing imposes on existing creditors. The mechanism resembles a tax imposed on activities that create negative side effects so that the activities are undertaken less intensively (a well-known example is a pollution tax). However, it is important to note that the negative side effects fall on foreigners, while the tax is collected on residents. Even though the country benefits in terms of a lower interest rate on its debt, it may be politically challenging to implement such a tax and adhere to it over time.

CONCLUSION

Sovereign debt problems are looming in many countries. The debt dilution problem has contributed to the very high levels of debt countries have taken on. When countries issue new debt without internalizing the costs that existing creditors bear, they tend to take on excessive levels of debt. Imposing seniority on debt or taxing issuances of new debt are possible solutions to make debt crises less frequent.

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