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

The Economics of Small Open Economies

Breaking the Ice: Government Interventions in Frozen Markets

Research Rap

INSIDE

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Today we recognize sovereign default, which was once largely confined to developing economies, as a threat not only to investors and to the defaulting country's economic and political stability but also to the global financial system. **Burcu Eyigungor** explains that a major reason that countries are prone to debt crises is a phenomenon called *debt dilution*.

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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

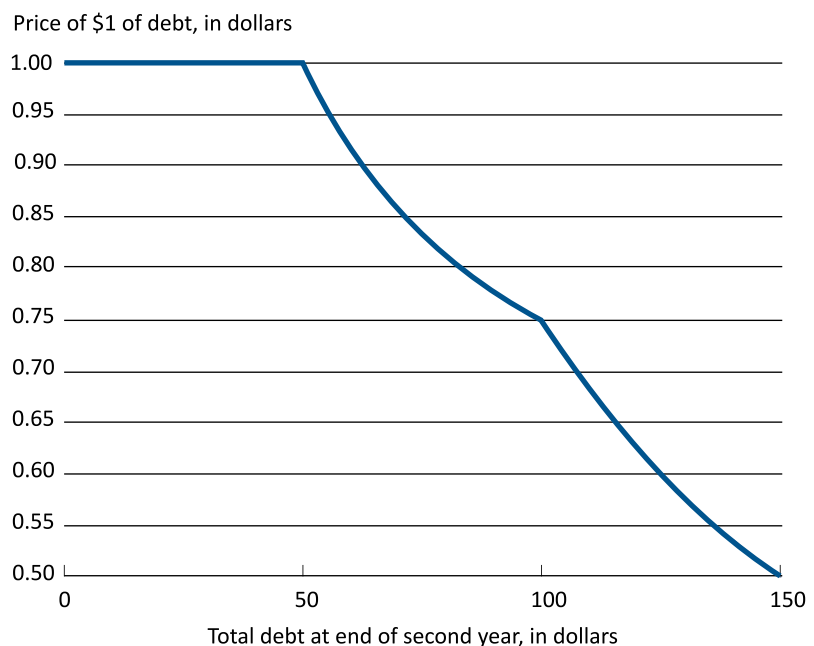
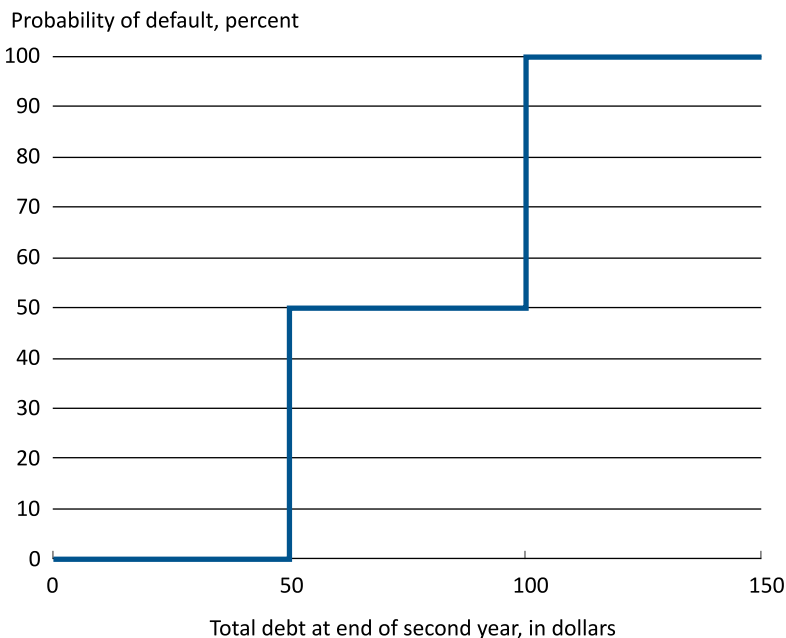


FIGURE 2**Probability of Default Increases as More Debt Is Issued in Second Year**

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

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.

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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The Economics of Small Open Economies

BY PABLO GUERRON-QUINTANA

Countries, like families, incur deficits when expenditures exceed income. Countries around the world finance their deficits by issuing debt. This debt is bought by either domestic or foreign investors. The United States, Canada, Chile, Mexico, and South Korea are a few examples of countries that borrow in international markets.¹ The difference between, say, the United States and Mexico is that the latter has little or no control over the premium it pays on its international debt. In contrast, the price of debt issued by the United States depends to a large degree on its own characteristics, such as its domestic wealth, households' preferences, and technology. This distinction between how much control a country has over the interest rate on its debt determines whether a country is called a small open economy. If, as in the case of Chile or South Korea, the price of debt is determined by international markets, then economists refer to these countries as small open economies. In the next few pages, the reader will be introduced to the main economic characteristics of this class of countries.

One of the defining features of small open economies is that households and firms in these countries can borrow and lend at an interest rate determined by international markets.² But not all small open economies are alike. Take, for example, our neighboring countries Canada and Mexico. Historically, economic fluctuations in Mexico have been more volatile than those in Canada. Furthermore, consumption

displays more variability than gross domestic product (GDP). That is, for each percentage point that production changes in Mexico, its consumption tends to move by more than 1 percent.

Small open economies that share Mexico's business cycle features described in the previous paragraph are often referred to as *developing* small open economies. Canada and other small open economies with similar aggregate fluctuation patterns are known as *developed* small open economies.

Another important difference between developing and developed small open economies is that whereas the former have defaulted in the past few decades on their international debt

obligations, the latter countries have consistently met their outstanding borrowing claims.

The recent developments in several European countries, such as Spain and Portugal, make studying small open economies timely. It is important to draw similarities with (and possibly learn lessons from) the experiences of countries traditionally considered to be developing small open economies.

DEVELOPED VERSUS DEVELOPING COUNTRIES

Economists usually discuss the problem of international indebtedness in terms of the interest rate on debt rather than the price.³ Roughly speaking, price and interest rates are inversely related. To understand this relationship, consider a 10-year Treasury bond.⁴ Holding this bond is attractive because it pays a fixed interest rate every six months plus its face value at maturity, that is, 10 years after issuance. Suppose you hold a bond that was issued last year that pays an interest rate of, say, 3 percent. If the government issues a new bond today with an interest rate of 4 percent, then your bond suddenly looks less attractive because it pays less. As a consequence, people prefer the new bond over yours, which leads to a decline in the demand for bonds issued last year. Less demand, in turn, implies that the price of the old bond has to decline.

¹ One reason countries borrow in international markets is to smooth consumption. For details, see the *Business Review* article by George Alesandria.

² See the lecture notes by Stephanie Schmitt-Grohe and Martin Uribe.

³ With international indebtedness, I refer to total international borrowing by a country, i.e., debt issued by the government and the private sector.

⁴ In the finance jargon, this bond is called a 10-year Treasury note.



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The interest rate that a country pays on its debt can be analyzed as the sum of a country-specific component and an international element. By definition, the former depends entirely on the country's (economic, political, and geographical) features. For instance, by limiting people's savings choices to domestic instruments, a government can influence the country-specific component of the interest rate on its debt.⁵ In contrast, the international element is determined by the collective borrowing and lending decisions of participants in international debt markets around the world. Examples of these players include, among others, individual investors, banks, multinationals, hedge funds, and pension funds.

To put it simply, a country is considered a small open economy when it takes as given the interest rate on its debt. In principle, the small open economy can issue as much debt as it desires as long as the country accepts the interest rate and its debt remains within the country's borrowing limits. Figure 1 plots the interest rate on debt on the vertical axis and the quantity of debt on the horizontal axis. In this figure, the supply of debt is decreasing because for each dollar the small open economy borrows from the world, it has to pay a higher interest rate on it.⁶

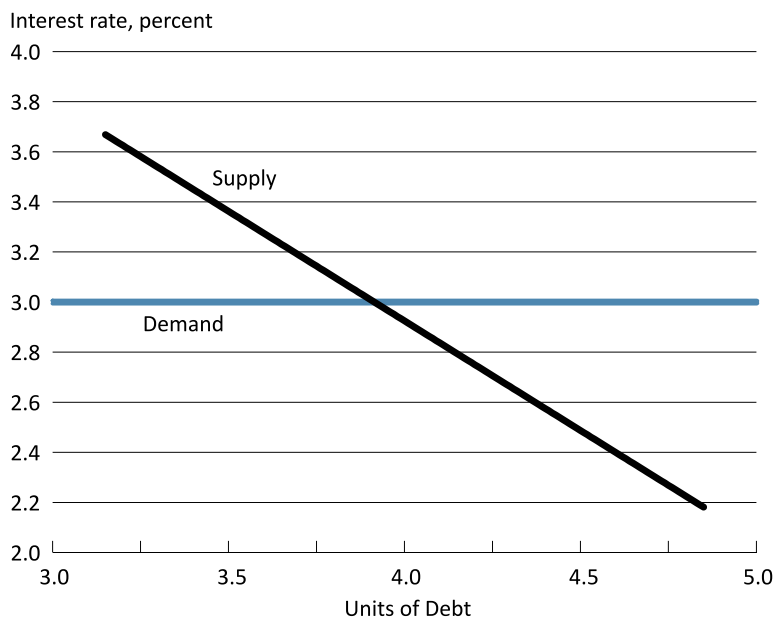
In the same figure, the demand for the country's debt is flat at some given interest rate. This means that international markets are willing to buy the small open economy's debt as long as they receive their desired interest payments. Equilibrium happens at the point at which supply equals demand. In our example, this equilibrium level dictates that the small open economy

⁵ This type of saving limitation was commonplace in the first part of the 20th century, but it has fallen out of favor since then.

⁶ Think about your credit card. The higher the monthly interest rate, the less attractive it is for you to borrow.

FIGURE 1

Supply and Demand in Debt Markets



issues about four units of debt and pays an interest rate of 3 percent.

To be precise, Figure 1 is a snapshot of the country's debt market. That the demand line is flat at 3 percent does not necessarily mean that it will be at that level next month. In fact, demand will most likely change over time. In small open economies, these fluctuations are, to a large extent, independent of the country's economic fundamentals, such as productivity or its labor market. This is because demand depends on foreign investors' view of not only the small open economy but also of international markets.

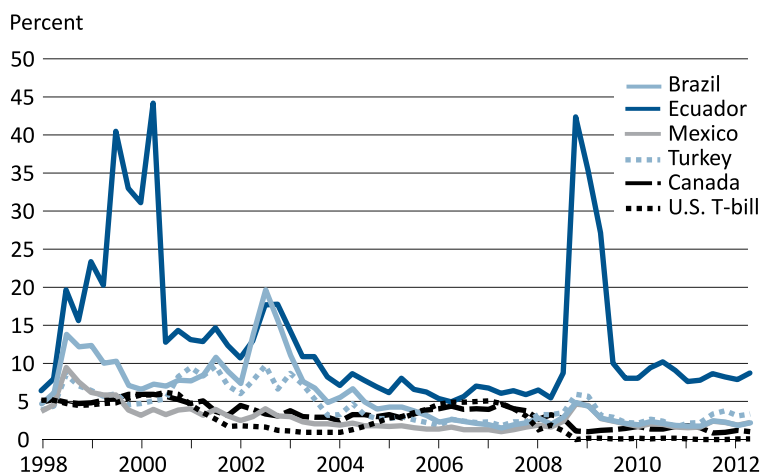
An important feature of debt markets in small open economies is that the demand schedule moves because of domestic as well as foreign considerations. For example, following the Asian crisis in 1998, international markets became more cautious and demanded less sovereign debt around the world.⁷ This means that Mexico, say, had to pay a larger interest rate to sell its debt. What is surprising about

this situation is that the spike in interest rates is unrelated to the Mexican economy. In Figure 1, this external component in Mexico's debt market would be reflected as an upward jump in the demand schedule.

Figure 2 displays the interest rate premiums paid by some developing small open economies (Brazil, Ecuador, Mexico, and Turkey). This premium corresponds to the Emerging Markets Bond Index (EMBI) calculated by J.P. Morgan and is expressed in annualized percentages. It is a rough measure of how much foreign lenders request on top of the prevailing international rate to lend to emerging countries.⁸ In January 1998, Brazil's EMBI was 5.82 and the three-month Treasury bill rate

⁷ Sovereign debt refers to bonds issued by a national government in order to finance its expenditures.

⁸ Two measures of the international interest rate typically used in the literature are the LIBOR (London interbank offered rate) or the three-month Treasury bill rate.

FIGURE 2**Interest Rate Premiums on Short-Term Debt**

was 5.00. Together, these numbers imply that international markets charged at least 10.82 percent for short-term (three months or less) loans to Brazil. We can observe that as the Asian crisis unraveled in 1998, the EMBIs for all countries in our sample moved up, even though these countries were located in different regions of the world (Brazil's EMBI reached 14.56 basis points in January 1999). This is a clear example of how spreads in emerging economies depend on external factors.

In contrast, interest rates in large-scale economies such as Japan and the United States are determined by their domestic markets. In other words, the demand curve for Japanese or U.S. debt is upward sloping. The higher the amount of debt in the market, the higher the interest rate international markets demand in exchange. More important, the interest rate is dictated by the country's fundamentals such as productivity, households' preferences, attitudes toward risk, and technology. This means that unless these factors change, the demand schedule does not change. To further visualize this effect, Figure 2 also plots the yields on short-

term sovereign debt in Canada and the U.S. during the last several years. In sharp contrast to the yields of some other countries' short-term debt, U.S. and Canadian yields barely moved during the Asian crisis or more recently during the 2008 financial crisis.

Another interesting feature of some large economies is that exports and imports play a small role in economic activity. A traditional measure of openness (how much a country trades with the rest of the world) is the ratio of exports plus imports to GDP. A higher number is usually interpreted as a sign of a more open (in the trade sense) country. This number is also a rough indicator of how much a country's finances rely on international trade. The more a country imports and exports, the more dependent the country is on international markets. By the end of 2011, this ratio was around 0.30 for the U.S. and 0.65 for Canada. These numbers indicate that the latter country traded more heavily with the rest of the world.

Table 1 presents our measure of trade openness for several countries around the world. Whereas Japan and

the U.S. are relatively closed economies, Sweden and Germany depend on international trade. Among large economies, Germany is the only one that is open. In contrast, economies considered small (Australia, Canada, Chile, Mexico, and Sweden) trade substantially with the rest of the world.

To further illustrate the distinction between small and large economies, Table 1 presents the ratio between the country's GDP and world GDP in 2011. One can see that while large economies like the U.S. and Japan each accounted for more than 10 percent of world GDP, small countries like Canada or Chile accounted for only a small share of the total world output in 2011.

Although small open economies share the feature of being price-takers in international bond markets — that is, they do not influence prices in the marketplace — they differ substantially in other dimensions. Consequently, economists sort these countries into two types: developed (or industrialized) economies and developing (or emerging) economies. This classification was originally proposed in the 1980s by World Bank economist Antoine van Agtmael. A country is considered to be developing or emerging if it is in the early stages of economic development characterized by lower income per capita and lower life expectancy compared with developed countries.⁹

In spite of this deceptively simple classification, there is no consensus about where the distinction between developed and developing vanishes. Indeed, there are many lists of emerging and developed economies compiled by institutions like the International

⁹ On average, emerging economies have one-fifth the income per capita of developed economies and a life expectancy that is at least eight years shorter than that in developed countries (World Bank's World Development Report 2000-01).

TABLE 1**Trade Openness and GDP in 2011**

	Australia	Canada	Chile	Germany	Japan	Mexico	Sweden	U.S.
Trade openness	0.42	0.65	0.73	0.84	0.31	0.65	0.94	0.30
GDP	0.013	0.021	0.003	0.05	0.119	0.017	0.007	0.276

Trade openness is defined as the ratio of exports plus imports to output; GDP is the country's output as a fraction of world output, both computed using constant 2000 U.S. dollars.

Source: International Financial Statistics

Monetary Fund (IMF), Columbia University's Emerging Market Global Project (EMGP), Standard and Poor's (S&P), and *The Economist*.¹⁰

To avoid these conflicting views about the definition of emerging countries, we rely on more concrete quantitative measures based on the business-cycle properties of these economies. To this end, one useful concept is the standard deviation (volatility) of GDP in a country. This statistical concept is typically expressed in percentage units and measures how much the variable in question fluctuates over time around its mean. Higher standard deviation translates into higher dispersion.

We also rely on a second concept: correlation. The correlation between, say, interest rates and output measures how much the two variables co-move over time. The correlation takes values between -1 and 1. A positive value means that the two variables (in our example, output and interest rates) move in the same direction over time. In contrast, a negative correlation indicates that they move in opposite directions: Output is increasing, and interest rates are declining.

¹⁰ To have an idea of the disagreement, whereas the IMF and EMCP classify Argentina as an emerging economy, *The Economist* and S&P exclude Argentina from their emerging markets lists.

With these definitions in place, we are ready to discuss developed and developing small open economies.

DEVELOPED SMALL OPEN ECONOMIES

Developed small open economies have several salient features. First, their business-cycle volatility (as measured by the standard deviation of their GDP growth) is usually comparable in size to that seen in large and wealthy nations such as Germany, Japan, and the U.S.

The second characteristic of developed small open economies is that their consumption follows paths that are smoother than those followed by output. In such cases, economists say that consumption is smoother than output. Consumption smoothing is possible in developed economies because people have access to financial markets. For example, suppose a person is laid off. Access to those markets implies that this person can, in principle, borrow to smooth out his decline in income. This means that consumption does not drop by as much as the contraction in income. By the same token, if this person's income increases, he will save part of the extra income for the future. Access to financial markets facilitates saving the additional income. Overall, consumption moves less than output.

Another interesting feature of developed small open economies is that interest rates are procyclical. This means that, for example, an increase in economic activity is usually associated with an increase in interest rates today and in the near future.

Table 2 lists some developed and some emerging small open economies. To facilitate comparison, the table also contains some features of the data for the U.S.¹¹

DEVELOPING SMALL OPEN ECONOMIES

In contrast to developed small open economies, emerging small open economies experience substantially more volatile business cycles. For example, the volatility of GDP in Mexico (an emerging small open economy) is around 3 percentage points. The volatility of Canada's GDP is about half of Mexico's.

Consumption in most emerging economies displays fluctuations that are larger than those of output. As a

¹¹ It should be noted that the proposed classification is not perfect, either. Norway is a rich and developed economy by any measure. For instance, its GDP per capita in 2011 was about 30 percent larger than that in the U.S. Yet, Norway has a consumption profile that is more volatile than its output. Hence, Norway meets one of the criteria to be classified as a developing economy.

TABLE 2

Business Cycles Around the World

	Small Open Economies						United States
	Emerging Economies			Developed Economies			
	Argentina	Mexico	Philippines	Australia	Canada	New Zealand	
Standard deviation of output	4.22	2.98	1.44	1.19	1.39	1.99	1.59
Standard deviation of consumption to standard deviation of output	1.08	1.21	0.93	0.84	0.74	0.82	0.77
Standard deviation of investment to standard deviation of output	2.95	3.83	4.44	4.13	2.91	3.32	4.10
Standard deviation of net exports to GDP	0.34	0.76	2.30	0.86	0.55	0.66	0.64
Correlation of output and net exports to GDP	-0.89	-0.87	-0.40	-0.59	-0.01	-0.06	-0.48
Correlation of output and interest rate	-0.63	-0.49	-0.53	0.37	0.25	0.07	0.18

Source: Neumeayer and Perri (2005) for Small Open Economies and Fernandez-Villaverde et al. (2012) and Corsetti et al. (2008) for the U.S.

consequence, the volatility of consumption is greater than the volatility of output. For instance, the volatility of consumption in Mexico is 1.21 times that of output. In contrast, this number is about 0.74 for Canada.

A third important characteristic of emerging countries is that the interest rate on their debt experiences abrupt movements over time. As shown in Figure 2, yields on Brazilian debt jumped about 5 percentage points in a matter of months during the 1997-98 Asian crisis. Most developed small open economies have never seen such an abrupt change in their interest rates (at least until the recent European crisis; I will get back to this in the final section).

Related to the previous point, interest rate hikes (arising, for example, from contagion in international markets) in emerging economies are typically followed by a contraction in economic activity; that is, output, consumption, and investment con-

tract. These opposing movements in output and the interest rate are captured by the negative correlations reported in Table 2 for our three emerging economies.¹²

Other features of emerging economies are also often emphasized. In their book, Paul Krugman and Maurice Obstfeld stress that, in addition to the characteristics discussed above, these countries tend to have high inflation and weak financial systems; their exchange rates are, to a large extent, influenced by their local government; and their economies rely heavily on commodities (natural and/or agricultural resources).

Finally, it seems that there is no

¹² The decline in fortune following the spike in interest rates is typically accompanied by a rise in imports and a collapse of exports. See the study by Guillermo Calvo, Alejandro Izquierdo, and Luis Mejia. An example of this behavior is the decline in production that Brazil experienced following the Asian crisis.

clear difference regarding the evolution of net exports. According to Table 2, net exports have been less volatile than output in both developing and developed economies. The exception is the Philippines, which displays more volatility in net exports. A closer look at the data, however, reveals that developing countries display on average a strong negative correlation between net exports and output. Furthermore, emerging economies tend to run large trade deficits (imports are larger than exports) prior to crises. Subsequently, the trade account turns into a surplus as the emerging economy reduces its imports from abroad and the weakening of its currency boosts exports. In contrast, developed countries have run persistently large trade deficits, e.g., Canada and the U.S.¹³

¹³ See the study by James Nason and John Rogers for a discussion of the trade account.

WHY ARE DEVELOPED AND DEVELOPING COUNTRIES SO DIFFERENT?

To explain the marked differences between emerging and developed small open countries, economists have advanced several theories.

One theory argues that international markets take a dimmer view of debt in emerging economies. As a

consequence, investors demand higher returns to hold debt from developing small open economies.¹⁴ Moreover, investors' risk appetite for these securities tends to change quickly as the small open economy's fundamentals such as technology and conditions in

¹⁴ See the study by Andy Neumeier and Fabrizio Perri.

other emerging countries also change. This changing attitude results in abrupt movements in interest rates that the emerging countries have to pay. To the extent that the country meets its debt obligations, a sudden increase in interest rates implies that fewer resources are available to consume and invest. If the labor supply cannot sufficiently adjust in response to the shock,

The Cost of Default

T

he decision to repay debt issued by both emerging and developed countries depends entirely on the country's willingness to do so. Default happens when the country decides to stop repaying its debt.^a

Historically, developing countries have tended to default on their international borrowing obligations. For instance, Chile, Brazil, and Ecuador have defaulted nine times since 1800. Over that same time span, Greece and Spain have defaulted five and 13 times. In contrast, Australia and Canada have dutifully paid their obligations during the same period.^b These observations raise the interesting question of why some countries default and others repay.

Intuitively, a country (like a household) might opt to default whenever its income is not sufficient to cover its outlays (one of which is debt repayment). However, if a country defaults, it is typically excluded from the international market, which means that it cannot borrow from abroad. As a consequence, defaulting is an intertemporal (dynamic) decision in which present and future considerations matter. This temporal aspect of default makes it an interesting (and difficult) problem to analyze.

More specifically, a country may choose to default during periods of low economic activity to redirect resources from foreign debt repayment to domestic consumption and investment. However, if a country stops repaying its foreign obligations, it will be excluded from international capital markets. This means that in the foreseeable future, it will not secure loans from foreigners. This exclusion is problematic during periods of high productivity when the small open economy wants to borrow to consume and invest more (to take advantage of the good times).

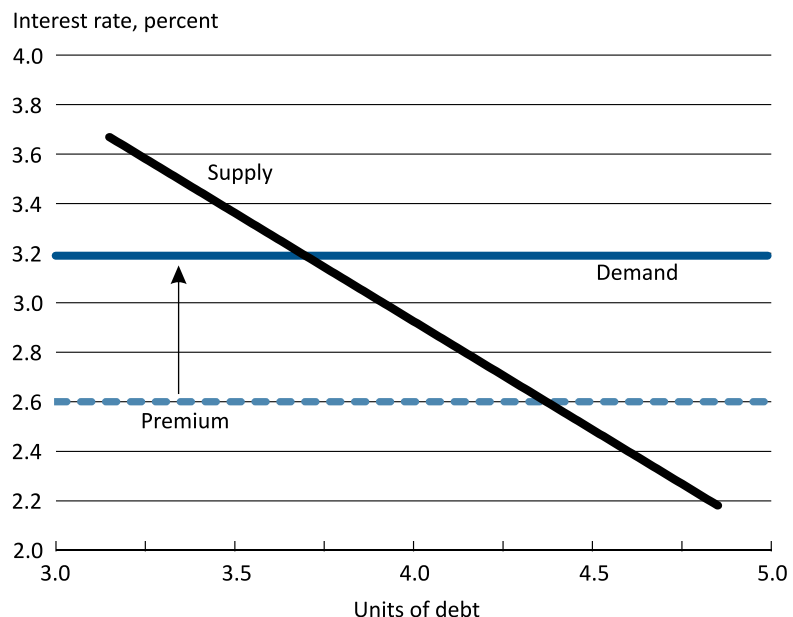
Economists have found that countries are more likely to default if 1) countries are impatient; that is, they care less about the future; 2) the burden of debt is large relative to the country's gross domestic product; and 3) the interest rate at which international markets willingly buy the country's debt is high; the likelihood of default also depends on how productive the country is in the period when it's considering default.^c

^a For additional details, the interested reader can consult the article by Burcu Eyigungor in this issue of the *Business Review*.

^b See the 2008 paper by Reinhart and Rogoff.

^c See the article by Cristina Arellano.

Figure A: An Increase in Demand for Bonds



consumption follows a more volatile pattern. Furthermore, the collapse of domestic demand (consumption plus investment) induces producers to cut production, which leads production and interest rates to move in opposite directions. That theory provides an explanation behind the negative correlation reported in Table 2.

A second theory proposes that the

disturbances buffeting developed and developing economies are different in nature.¹⁵ For the former countries, the argument goes, shocks tend to be predominantly short-lived; that is, their impact washes away after a few quarters. In contrast, shocks persist for sev-

¹⁵ See the study by Mark Aguiar and Gita Gopinath.

eral quarters or even years in emerging countries. As a result, households in these economies have to significantly adjust their consumption in response to these shocks. This is because households understand that the decline in income will be highly persistent and hence fewer resources will be available to consume in the future. The opposite arises in developed economies: Shocks

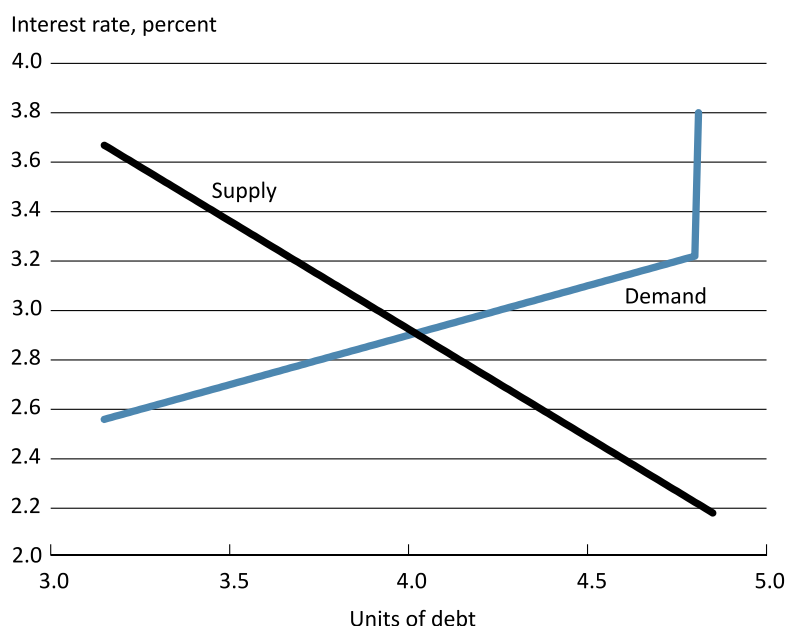
The risk of default changes the dynamics between borrowers and lenders in sovereign markets. International markets are no longer willing to take debt from the small open economy at the international interest rate. Indeed, when buying sovereign debt, foreign investors demand an interest rate that includes a premium that depends on how likely it is that the small open economy will default. In other words, this premium is a compensation that lenders demand, on top of the international risk-free rate, to cover the loss arising when the sovereign country reneges on its obligations. More pointedly, if a country experiences a downturn (perhaps due to a bad crop or the collapse of commodity prices) and suddenly there are fewer resources with which to repay debt, investors will likely charge a higher interest rate to purchase new debt issued by the small open country.

Let's consider the case in which foreign investors charge the small open economy a constant premium. Figure A shows the vertical displacement in the demand schedule for sovereign debt (the dotted line corresponds to the case in which there is no premium). Note that lenders happily buy debt as long as they receive their desired interest rate, which is 3.2 percent in our example. Since the interest rate is higher than before, the small open economy finds it more expensive to issue debt, and hence it sells only a small amount.

The more realistic situation corresponds to the one in which foreign markets charge a variable interest rate. In particular, let's consider the case in which investors demand interest rate payments that are increasing in relation to the amount of outstanding debt (see Figure B). Under this new situation, if the sovereign country wants to sell more

debt in foreign markets, it has to be ready to pay an increasing premium. As stressed before, the intuition is that foreign lenders worry that the country's ability to repay its obligations decreases with new debt issuance. Hence, lenders charge a higher premium to recover their loans more quickly. Eventually, debt issuance by the sovereign reaches a point that is beyond the country's ability to repay. Beyond this point, the interest rate is too high for the sovereign to sell debt. This is captured by the vertical line in Figure B for a debt level of 4.8.

Figure B: An Upward Sloping Demand for Bonds



have a short duration, so households can borrow resources from abroad to smooth out the impact of the changes in consumption resulting from the shocks. A drawback to this theory is that it is silent about the negative correlation between production and interest rates.

A third theory conjectures that information is less readily available in emerging economies.¹⁶ Hence, when a developing country is hit by a new disturbance, it is difficult to disentangle the nature of the shock, namely, whether it is temporary or persistent. Households tend to overreact to this lack of information by excessively contracting or expanding consumption. To see this point, let's suppose a worker is granted a wage increase this year. The increase is likely to be permanent, but it is not guaranteed. If the worker believes the increase in wages is permanent, she will borrow and consume more than the wage increase. This is because she believes more income will be available down the road. However, if the spike in wages turns out to be temporary, the worker will be forced to decrease her consumption. In fact, consumption will be lower than before the wage increase, since the worker has to repay the loans she took out to fund the extra consumption. Clearly, consumption is very volatile in this environment.

In contrast, information is more widespread in developed countries, which reduces the incentives to overreact. Going back to our example, if the worker knows that the increase in wages is permanent, she can plan accordingly. There is no excess consumption (when she receives the news about the increase) followed by a contraction (when she learns that the offer is temporary). Consumption follows a more stable pattern.

¹⁶ See the study by Emine Boz, Christian Daude, and Bora Durdu.

THE RECENT EUROPEAN CRISIS

Since the onset of the financial crisis in 2008, some European countries have run large deficits, and they pay large premiums on their debt. Hence, the lessons learned from the sovereign debt crises of developing economies will likely be relevant in the years to come.

Small open European economies are considered to be developed economies in the sense that they share business-cycle properties similar to those of Australia or Canada. Furthermore, small European economies enjoyed (until recently) easy access to international debt markets. As a consequence, demand for their debt involved relatively low premiums.

Yet, since the Great Recession (2007-09), public finances in countries such as Ireland, Spain, and Portugal have been under significant pressure. International markets are growing skeptical about the ability of those countries to repay their borrowing obligations.

Not surprisingly, the interest rate paid by those European countries spiked. Figure 3 displays the interest

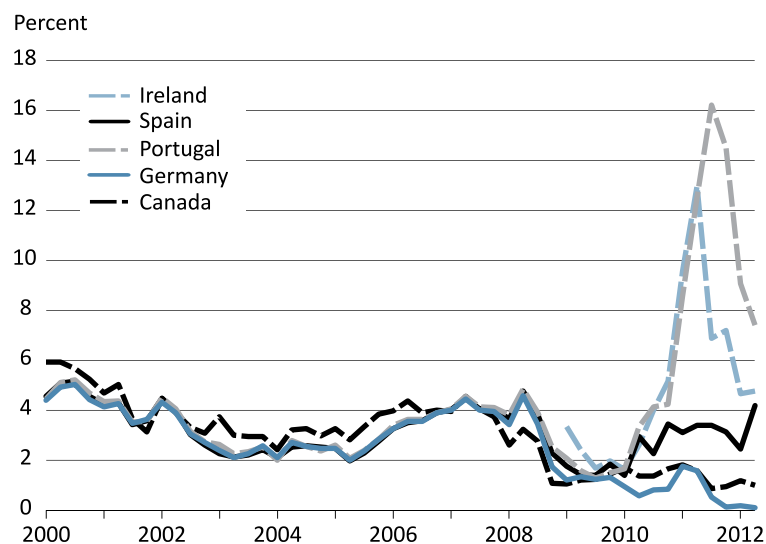
rates in annualized percentage points on two-year bonds in some European countries as well as Canada. It is immediately clear from this figure that the yields for Ireland and Portugal skyrocketed during the recent crisis. As an example, the interest rate on Portugal's debt shifted from 200 basis points in late 2009 to almost 1,700 basis points by mid-2011. This sudden spike is in sharp contrast to the declining interest rates in Germany and Canada. Ultimately, the already low economic activity in Ireland, Spain, and Portugal has been severely curtailed by the increasing burden of international debt.

It is surprising to see that unlike their European counterparts, small open economies in other regions, such as Latin America and Asia, have weathered the crisis quite well. For example, the country premiums in Brazil and Mexico have remained around 200 basis points over the last two years.

Interestingly, the recent events in European countries such as Portugal and Spain share many similarities with what happened during the Asian crisis

FIGURE 3

Interest Rate Premiums on Two-Year Bonds



in 1998 and the Latin American crisis of the early 1980s. As we noted above, premiums on sovereign debt in Portugal and Spain have reached levels not seen in recent history. The same spikes were seen in Latin America and Asia during their respective financial crises. The burden of debt in the small open European economies has been on the rise over the last five years. Emerging economies also faced an increasing burden from foreign obligations during periods of financial distress. Figure 4 displays the ratio of total public debt to output in different small open economies.¹⁷

¹⁷ Total public debt corresponds to debt issued at home and in international markets, as reported in the 2010 paper by Carmen Reinhart and Kenneth Rogoff.

A key difference between small open European economies and developing economies in previous crises is that some of the latter countries are commodity exporters. For instance, Chile (which defaulted in the 1980s) exports copper, and Ecuador (which defaulted in the late 1990s) exports oil. This is important because, upon default, the countries continued exporting commodities to mitigate the effects of being excluded from international capital markets. In contrast, since Greece does not export commodities, its attempts to repay its debt are more complicated.

A second important difference is that emerging economies have resorted to currency depreciations to make their exports cheaper in international

markets, albeit temporarily. The boost in exports partially alleviated the financial needs of these countries. Portugal and Spain use the euro as their official currency. Since the value of the euro is determined by an external and independent monetary authority (the European Central Bank), boosting exports via depreciations that lower real wages is a tool that is not available to those countries.

CONCLUSION

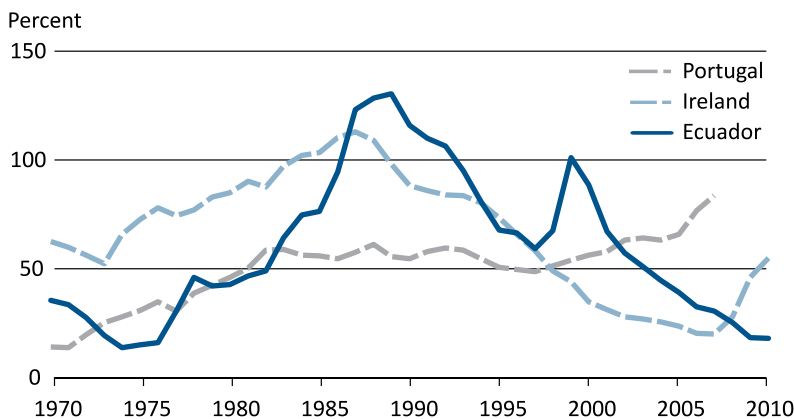
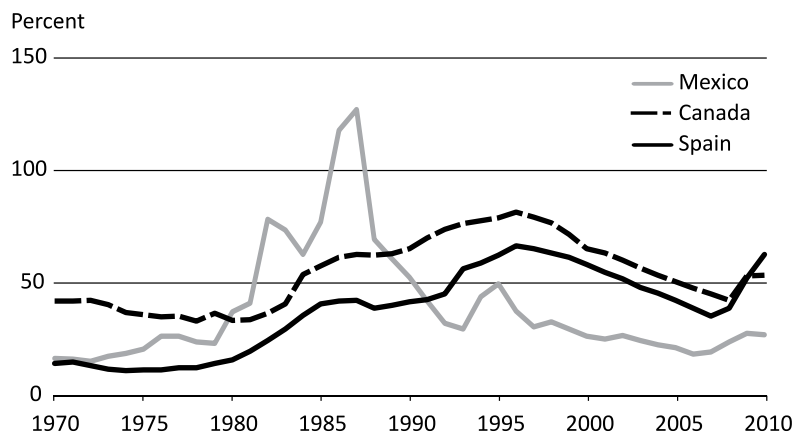
This article has introduced the reader to the concept of small open economies. It has done so by outlining the key differences between those countries that are considered emerging economies, such as Mexico and Turkey, versus those that are developed, such as Australia and Canada. Defaults and country premiums were also discussed.

Countries traditionally considered to be developing and default-prone (e.g., Brazil, Chile, and Mexico) weathered the 2007-09 international financial crises with surprising ease. Another important aspect in the recovery of these countries is that they had access to currency depreciations to boost their exports and hence improve their finances, at least in the short run.

In contrast, countries such as Greece, Ireland, Portugal, and Spain, once believed to pose very low or no risk of default, are now experiencing difficulties in meeting their debt obligations. The crises in these countries resemble, in part, episodes of financial distress in emerging economies. The situation is also different because the European economies do not have access to commodities and lack their own currencies, which have been crucial factors in the healing process post-crisis in several developing economies.

FIGURE 4

Debt-GDP Ratio in Small Open Economies



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Breaking the Ice: Government Interventions in Frozen Markets

BY BENJAMIN LESTER

T

he recent financial crisis began with a fall in housing prices in 2006, followed by an increase in delinquencies on subprime mortgages in early 2007.¹ As subprime borrowers began to default on their mortgages, the value of assets backed by these loans declined, resulting in substantial losses on the balance sheets of many financial institutions in the United States and across the globe. However, as many have noted, these losses were too small to account for the crisis that followed.² Therefore, a central challenge in the aftermath has been to understand how relatively small losses within the financial sector could be propagated and amplified to the rest of the economy.

A leading theory contends that after assets such as mortgage-backed securities (MBS) began to fall in value, what truly sparked the financial crisis was the inability of financial institutions to reduce their leverage, either by selling these assets and paying down their debt or by raising new equity. This freeze led to further declines in

¹ For a detailed description of this sequence of events, see the accounts by Gary Gorton or Markus Brunnermeier.

² For example, as Tobias Adrian and Hyun Shin argue, the total value of outstanding adjustable-rate subprime mortgages in 2008 was less than \$1 trillion. Therefore, even if an unprecedented number of households defaulted on these mortgages, total subprime losses would still have been equal to just a small fraction of the decline in the total market value of publicly traded companies that occurred between October 2007 and March 2009, which was about \$30 trillion.

asset values and ultimately reduced credit to households, firms, and even state and local governments. Without access to credit, households reduced their level of consumption, while firms and government agencies contracted by employing fewer workers and cutting back on capital investments. As a result, the economy plunged into a recession from which it has still not fully recovered.

Economists have proposed a variety of explanations for why financial institutions had difficulty selling assets and raising new capital. One prominent explanation for why banks had difficulty selling assets such as MBS is that the market for them was plagued by *asymmetric information*. When buyers cannot distinguish good assets from bad ones, the highest price they're will-

ing to pay is an average of the values they would normally attach to good and bad assets. However, if sellers know the quality of their own assets, then sellers with good assets will choose not to sell at this average price, leaving only bad assets for sale in the market. In this way, the market can unravel, and good assets simply won't trade.

A prominent explanation for why financial institutions had difficulty raising new capital is that they suffered from *debt overhang*. According to this explanation, a bank with large amounts of risky debt will find it expensive to issue new equity because the proceeds of any new investments would accrue first to the bank's bondholders rather than its shareholders. If this problem is sufficiently severe, existing shareholders will oppose issuing new equity even if doing so would generate profits (or reduce losses) for the bank.³

Although economists have explored a number of alternatives, asymmetric information and debt overhang offer two useful theories for understanding why banks found it so difficult to reduce their leverage.⁴ Using

³ To read more about the phenomenon of debt overhang and the role it can play in financial crises, see the *Business Review* articles by Satyajit Chatterjee and Burcu Eyigungor.

⁴ In his *Business Review* article, Yaron Leitner provides a nice summary of several alternative explanations for market freezes. For example, asset markets can freeze and prices can plummet if market participants face binding capital constraints. Alternatively, during times of crisis and unusually high uncertainty, investors sometimes behave as if they are extremely risk-averse, which can stall trade. Finally, banks might not want to sell assets for fear they would have to mark other assets on their balance sheets to the market price.



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these two theories, we can explore several forms of government intervention that were proposed or implemented to enable banks to reduce leverage and restore liquidity to crucial markets.

WHY FINANCIAL INSTITUTIONS COULD NOT SELL ASSETS

While there are many reasons that MBS and similar assets became very difficult to sell, there is consensus that a major factor was the presence of asymmetric information. As housing prices fell and delinquencies on mortgages rose, it became apparent that some MBS could be worth considerably less than had previously been claimed. In the language of Nobel laureate George Akerlof, these low-quality assets were “lemons.” Of course, not all MBS were lemons; many were of higher quality, with fundamental values at or near precrisis valuations. However, these assets are fairly complex, and to make things worse, they were combined to form even more complicated securities. This bundling made it very difficult for buyers to differentiate high-quality assets from low-quality assets. Sellers, on the other hand, typically had a better idea about the quality of the assets they owned. In many cases, the sellers had purchased the underlying assets (e.g., mortgages), worked closely with the rating agencies to bundle them into more opaque securities, and monitored their cash flows before attempting to sell them.

Hence, this market had many of the basic ingredients of Akerlof’s (1970) “market for lemons”: Assets were heterogeneous in quality, and sellers had better information about the quality of their assets than did prospective buyers. In his seminal paper, Akerlof shows that these ingredients can lead to a breakdown in trade. To illustrate, suppose that the market is composed of a large group of sellers, half of whom own lemons (such as

MBS with many loans that are likely to default) and half of whom own peaches (such as MBS with few loans that are likely to default). The owners of lemons are willing to sell for no less than \$100, while the owners of peaches are willing to sell for no less than \$200. Buyers are willing to pay no more than \$120 for a lemon and \$240 for a peach. There is potential for trade as long as the maximum price that buyers are willing to pay exceeds the minimum price that sellers are willing to accept.

While there are many reasons that MBS and similar assets became very difficult to sell, there is consensus that a major factor was the presence of asymmetric information.

However, whether trade will actually occur depends critically on what buyers and sellers know. If all market participants can distinguish lemons from peaches, then all assets will trade: Lemons will sell at some price between \$100 and \$120, and peaches will sell at some price between \$200 and \$240.

However, suppose instead that sellers know what type of assets they own, but buyers cannot distinguish lemons from peaches. It should be clear that the two types of assets could never sell at two different prices, as owners of lemons would always choose to pass off their assets as peaches in order to sell at the higher price.⁵ Therefore, at a given price, a buyer is willing to pay only a weighted average of his valuation across the two types of assets for sale. In this market, since there is an equal share of each type, the most

⁵ In the language of information economics, the only possible equilibrium outcome is a pooling equilibrium, in which lemons and peaches sell at the same price. If the two types of assets sold at different prices, economists would describe the outcome as a separating equilibrium.

a buyer would pay for a randomly selected asset would be $\$180 = (1/2) \times \$240 + (1/2) \times \$120$. However, note that owners of peaches aren’t willing to sell for \$180. As a result, owners of peaches would drop out of the market, leaving only lemons to trade (at some price between \$100 and \$120). In real-world markets, where there are many different asset qualities, this unraveling can be even more alarming, as only the very lowest-quality assets will trade; the rest of the market will be frozen.⁶

WHY BANKS COULD NOT RAISE CAPITAL

As an alternative to selling their assets, financial institutions could issue new equity to reduce leverage. Yet this, too, proved difficult during the financial crisis. Again, there are a number of potential reasons for why this was so, but a leading candidate is debt overhang, which was first analyzed by Stewart Myers. When a bank has risky outstanding debt — i.e., when investors believe the bank may default on its obligations to its bondholders — the bank’s existing shareholders may find it unprofitable to sell new shares, given that these shares must be priced at their fair market value. The reason

⁶ To see how unraveling works, note that all assets must sell at the same price, and this price must equal the average price for all qualities in the market. Therefore, all sellers who own assets that are more valuable than the average will drop out of the market. However, after these sellers withdraw, the only possible price is one equal to the average value of the assets remaining in the market. Again, all sellers with assets more valuable than the average will drop out. Following this logic to its conclusion, only the lowest-quality assets remain.

shareholders resist is that, should the bank default, a portion (or even all) of the proceeds from issuing new equity would be used to increase the payoffs to existing debt holders before any of the bank's shareholders would see a single cent. Existing shareholders incur the full cost of raising new capital, as the value of their shares is diluted, but they reap only a fraction of the benefit. As a result, these original shareholders may not support new issues even if it is common knowledge that the bank has investment opportunities that are sure to deliver a positive return.⁷

To illustrate this phenomenon, suppose a firm has \$80 in debt and a risky asset (e.g., a pool of MBS) that will yield either \$100 or \$0 with equal probability. If the asset yields \$100, the equity holders will repay the debt holders \$80 and keep \$20 for themselves. If the asset yields \$0, the firm will default on the debt, and the equity holders will have nothing. Hence, the expected value of existing equity is $\$10 = (1/2) \times (\$100 - \$80) + (1/2) \times \0 , while the expected value of the debt claim is $\$40 = (1/2) \times \$80 + (1/2) \times \$0$.

Now suppose the firm has an investment opportunity that will cost \$25 but will return \$40 with certainty. Would the existing equity holders choose to issue new equity — thereby giving up a share of the firm's profits — in exchange for the \$25 required to finance this project? The answer de-

pends on how large a share they would have to give up.

Table 1 can help us determine the share of the firm's equity that new investors would require in exchange for \$25. Suppose they received 1/6 of the firm's equity, which corresponds to the first row of the table. If the MBS yield \$0, the extra \$40 in revenue from the new investment is still not enough to prevent the firm from defaulting on its \$80 debt, and the equity holders (old and new) receive nothing. But if the MBS yield \$100, then the equity holders split the profit of $\$60 = \$100 + \$40 - \80 . Hence, the expected value of a 1/6 share of the firm's equity, reported in the second column, is $\$5 = (1/6) \times [(1/2) \times \$0 + (1/2) \times \$60]$. The new equity holders would be providing \$25 in exchange for an expected return of just \$5, resulting in an expected loss of \$20. Clearly they would never agree to such a deal. Instead, scanning down the third column, one can see that new equity holders would demand at least a 5/6 share in ex-

change for a \$25 investment.

However, whether the original equity holders would agree to such a deal depends on the expected value of their share of the firm after the new equity issue. If the original equity holders must give up 5/6 of the firm's profits in exchange for the \$25 investment, then their remaining 1/6 share is worth only \$5, as discussed above. Since the expected value of their equity was \$10 before the investment opportunity appeared, the original equity holders would lose \$5 by pursuing this investment; from the final column of Table 1, we see that the original equity holders would give up at most a 4/6 share of the firm in exchange for the \$25. Hence, the original equity holders would choose not to raise capital to invest in this project, even though it would earn the firm $\$15 = \$40 - \$25$.

Intuitively, the reason that debt overhang makes it so expensive for firms to raise money is that new investors know that their funds will be used to repay debt holders if the firm's MBS

TABLE 1

How Debt Overhang Can Impede New Equity Issuance

Share given to new equity holders	Expected value of new equity share	Expected payoff from investment	Remaining share for original equity holders	Change in value of original equity share
1/6	\$5	-\$20	5/6	\$15
2/6	\$10	-\$15	4/6	\$10
3/6	\$15	-\$10	3/6	\$5
4/6	\$20	-\$5	2/6	\$0
5/6	\$25	\$0	1/6	-\$5
1	\$30	\$5	0	-\$10

⁷ Note that the problem of debt overhang described below does not require any information asymmetries between the bank and its potential new equity holders. However, in the absence of asymmetric information, there must be a reason that the firm does not simply sell assets to finance an investment. As discussed in footnote 4, asset markets might freeze for a number of other reasons. Moreover, some assets are difficult to sell because their value depends on an existing relationship; for example, a bank may be able to enforce repayment of a loan because it has an ongoing relationship with the borrower, but this loan would be difficult to sell to a third party who lacks this relationship.

yield \$0, and they need to be compensated for this risk. Notice that this problem eases as the probability of default decreases: If the MBS yield \$100 with greater probability, it becomes less expensive for the firm to issue new equity, and the effects of debt overhang diminish.

POLICY OPTION: DIRECT ASSET PURCHASES

As we explained above, the presence of risky assets in the market can cause market activity to seize up. Moreover, the presence of risky assets on banks' balance sheets can make it too costly for them to raise additional capital by issuing new equity. One potential policy response is for the government to simply buy assets directly from these banks, thus removing them from both banks' balance sheets and the market at large.⁸

Although it is possible that bank regulators may have superior information about asset values through bank examinations, the more conservative assumption — and the one that most economic analyses make — is that the government has no better information than other potential buyers. However, even without an informational advantage, government purchases may be beneficial in several ways. When the government has no better information than other buyers in the market, the banks would likely sell their low-quality or “toxic” assets to the government. Once these assets have been purchased, the average quality of the assets remaining in the market

⁸ Indeed, the Troubled Asset Relief Program (TARP) was initially intended to support this type of policy. Signed into law on October 3, 2008, TARP authorized government purchases of up to \$700 billion of “troubled assets” such as mortgage-backed securities. Days later, however, Treasury Secretary Henry Paulson revised the TARP, opting instead to pursue some of the interventions described herein, including equity injections.

would increase. As a result, buyers would be willing to pay a higher price for a randomly selected asset, since the probability of receiving a lemon has declined. Therefore, if the government is able to remove a sufficiently large quantity of toxic assets from the market, it can alleviate the problem of asymmetric information and potentially rejuvenate trading among private investors. This idea has been formalized by Jean Tirole and by Thomas Philippon and Vasiliki Skreta.⁹ In addition to rejuvenating trade in private markets, direct asset purchases can also help banks issue new equity. By removing the most toxic assets from banks' balance sheets and replacing them with cash, the program makes existing debt less risky and hence reduces debt overhang. As a result, issuing new equity would be less costly, which could allow banks a better opportunity to raise capital. Therefore, for both of the reasons discussed above, banks could potentially use private markets to recapitalize after the initial purchases by the government, thus limiting the burden that would fall solely on the government.

Unfortunately, this type of program also has several disadvantages. For one, when the government is at an informational disadvantage (just like buyers in the private market), it will likely overpay for the assets, which is costly to taxpayers.¹⁰ Second, this type of government intervention will interfere with the process of price discovery. Private investors, such as hedge

⁹ Note that the timing of such programs is important. For example, if owners of lemons anticipate that prices will rise in the future, they may choose not to sell their assets to the government, and instead wait for the market to recover. But then, since lemons remain in the market, it doesn't recover! Braz Camargo and I study the importance of both the timing and duration of government interventions and show how policies that would seemingly speed up a market's recovery can inadvertently slow it down.

funds, spend valuable resources trying to figure out what an asset is worth, in the hopes of either buying an asset that is undervalued or selling an asset that is overvalued. As a result, the price at which an asset is bought and sold typically conveys information; at the very least, it provides some insight into what the buyer and seller believe the asset to be worth. This information can be valuable to other market participants who are trying to figure out what similar or even identical assets are worth. Government purchases may undermine the incentives for private investors to research an asset's value, making the ultimate price less informative. Finally, direct asset purchases will most likely allocate funds to the banks with the lowest-quality assets. Not only may this allocation be seen as unfair, but the funds may also be used poorly if these banks have other assets of similarly low quality or if these banks do not have strong investment opportunities.

POLICY OPTION: REDUCE THE RISKINESS OF ASSETS

As an alternative to buying assets directly, the government can help banks reduce leverage by making the assets they hold less risky and more attractive to potential buyers. There are a variety of ways to do this. For example, a mortgage modification program that encourages lenders to reduce

¹⁰ The government, of course, would try to limit the extent to which it overpays. In addition to carefully examining the assets before purchasing them, the government could try to determine a fair price through certain market mechanisms such as reverse auctions. Lawrence Ausubel and Peter Cramton describe one such mechanism. However, it is worth emphasizing that the government's ability to overpay is the fundamental reason it can play this role in thawing the market. Not only can the government bear losses that private investors are unwilling or unable to take; it can also take into account the benefits that are captured by other participants in the economy that no private investor would take into account.

either the principal amount of the loan or the interest payments may increase the value of MBS by improving the expected performance of the underlying loans — that is, by reducing the probability that homeowners will default. Alternatively, the government can make assets less risky by guaranteeing a minimum return, eliminating the possibility that the purchaser will suffer a large loss. Finally, the government can partner with private investors by assisting in the financing of asset purchases and assuming a portion of the downside risk. Since this last option is perhaps the least understood, let's explore it in greater depth.

Suppose the government offers a program in which a private investor who buys an asset is required to put up his or her own equity to pay a fraction of the purchase price and receives a nonrecourse loan from the government for the remainder in exchange for a share of the asset's returns.¹¹ When a private investor purchases an asset with a nonrecourse loan, the asset itself serves as collateral. Should the investor default, he can lose, at most, his equity investment, but he is not personally liable for any additional losses suffered by the lender; those are borne by the government. Therefore, this type of program essentially provides partial insurance to investors should they acquire a lemon, but the government also shares in the upside should the asset appreciate.

An advantage of this type of program is that private investors have an incentive to research and acquire information about the assets for sale because they have their own equity at risk, or "skin in the game." Although

¹¹ This hypothetical program captures the essential features of a program called the Public-Private Investment Program for Legacy Assets, which was introduced in March 2009 as a joint venture of the Treasury Department, the FDIC, and the Federal Reserve.

investors' losses are limited, they still lose money if they make poor, uninformed investment decisions. An immediate consequence is that prices are more informative, in that they more accurately reflect the true value of the assets. This information is valuable to other market participants. For example, once previously uninformed buyers observe the price and thus learn about

Given the severity of the information asymmetries during the crisis, raising any money to purchase MBS was challenging.

the market's assessment of one pool of MBS, they may be sufficiently informed to bid on similar pools of MBS, helping to unfreeze the market. In addition, since the purchase price is more likely to be closer to the true value of the asset, and the taxpayer shares in the gains should the asset appreciate in value, the total potential losses to the taxpayer are reduced.

However, it is important to note that the taxpayer is still exposed to risk under this type of program. Because buyers are partially insured against losses, they still have some incentive to gamble by purchasing risky assets; economists call this phenomenon *moral hazard*. When investors gamble and lose on a government-insured investment, the taxpayer ultimately covers some of the losses. Therefore, when designing a policy like this, there is a delicate balance between providing buyers with enough insurance to be willing to purchase the assets but not so much insurance that they bid recklessly. My coauthors, Braz Camargo and Kyungmin Kim, and I construct a theoretical model that captures this type of policy intervention, along with the inherent tradeoff that emerges, and we use this model to identify the optimal level of insurance.

An additional concern with this type of program is that it still requires private investors to raise some capital on their own. Given the severity of the information asymmetries during the crisis, raising any money to purchase MBS was challenging. As a result, the scope of a program of this type could be limited by the capital constraints being faced by private investors.

POLICY OPTION: EQUITY INJECTIONS

A different approach to recapitalizing highly leveraged financial institutions is for the government to simply provide them with cash in exchange for either shares of stock (often preferred shares) or warrants, which are options to buy shares of stock at a predetermined price.¹² This type of policy has the advantage of being quick and direct: Banks immediately receive capital, and their leverage ratios fall.¹³ In

¹² A large portion of the TARP funds were ultimately used for equity injections under the Capital Purchase Program, in which the government injected billions of dollars into the largest U.S. banks (and some smaller ones) in exchange for preferred shares and warrants. Preferred shares are senior to common shares, so that owners of preferred shares have priority for the distribution of dividends or other assets in the case of liquidation. However, preferred shareholders are subordinate to debt holders, who typically have the most senior claim when a firm is liquidated. The Treasury Department regularly updates the status of the money disbursed under TARP, including how much has been repaid and the return on these investments, at <http://www.treasury.gov/initiatives/financial-stability/reports/>.

¹³ In addition to helping banks reduce leverage, this type of program also eases concerns about the solvency of financial institutions, which was an important rationale for government intervention as well.

addition, equity injections can provide more protection to the taxpayer. Unlike asset purchases, equity injections leave the government with a claim on both the good and the bad assets that a bank owns. If bank shares ultimately appreciate after the crisis subsides, the taxpayer shares in the gains.

However, this type of policy has disadvantages, too. Since markets are not purged of toxic assets, they may remain frozen for quite some time. For this reason, Christopher House and Yusufcan Masatlioglu argue that asset purchases are more effective than equity injections. Under an asset purchase program, banks are “re-warded” with new equity only when they take an action that helps markets recover, i.e., when they sell their assets and allow the average quality of assets in the market to increase. Similarly, since toxic assets remain on banks’ balance sheets after equity injections, debt overhang persists as well. In fact, as Linus Wilson points out, the seniority of the government’s preferred shares could even magnify the problems associated with debt overhang, since preferred shares are ultimately very similar to debt.¹⁴ Therefore, with preferred equity injections alone, banks would still find it costly to sell

¹⁴ See Thomas Phillipon and Philipp Schnabl for a study of the most efficient way to recapitalize banks through equity injections.

their assets or to issue new equity.

Finally, even if it is desperate to deleverage, a bank may hesitate to accept equity injections from the government for fear it could be viewed by the market as a signal that the financial institution is in trouble. Such a perception could trigger withdrawals or raise its cost of funds even further. To avoid this outcome, the government may encourage *all* large financial institutions to accept equity injections by offering very attractive terms, although doing so could make it less likely that the taxpayer will ultimately be compensated for the investment.¹⁵

CONCLUSION

The financial crisis began when banks needed to deleverage and were unable to do so. Banks could not sell many of their assets at an acceptable price, and issuing new equity was not profitable. A prominent explanation for the former type of market failure is asymmetric information, and a prominent explanation for the latter is debt overhang.

¹⁵ As Philip Swagel puts it, the terms have “to be the opposite of the ‘Sopranos’ or the ‘Godfather’—not an attempt to intimidate banks, but instead a deal so attractive that banks would be unwise to refuse it.” Note that the stigma associated with accepting equity injections could also be a relevant concern for the other types of interventions discussed here. In general, accepting any form of government assistance could be interpreted by the market as a signal that the bank is in trouble.

There are many potential ways for the government to intervene in an attempt to restore liquidity in crucial markets and allow banks to reduce their leverage. We have outlined several leading candidates and discussed their advantages and disadvantages. Ultimately, the government used a combination of them, making a variety of alterations and special provisions in an attempt to ameliorate the potential risks associated with each type of intervention.

However, it is important to remember that *all* interventions carry some risk. Each program we have discussed can be costly to taxpayers, ultimately transferring resources from the broader economy to the financial sector. An inevitable consequence is that some of the institutions responsible for creating this crisis will not bear the full costs of their actions, which may encourage risk-taking if financial institutions expect a similar government response in the future.

In addition, interventions typically need to be recalibrated as market conditions unfold. These adjustments impose an additional layer of uncertainty because market participants need to anticipate not only what other participants will do but what the government will do as well! Uncertainty can actually increase incentives for buyers and sellers to stop trading and simply wait for it to be resolved, causing markets to freeze even more.

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Debt Dilution and Seniority in a Model of Defaultable Sovereign Debt

An important inefficiency in sovereign debt markets is debt dilution, wherein sovereigns ignore the adverse impact of new debt on the value of existing debt and, consequently, borrow too much and default too frequently. A widely proposed remedy is the inclusion of seniority clauses in sovereign debt contracts: Creditors who lent first have priority in any restructuring proceedings. The authors incorporate seniority in a quantitatively realistic model of sovereign debt and find that seniority is quite effective in mitigating the dilution problem. The authors also show theoretically that seniority cannot be fully effective unless the costs of debt restructuring are zero.

Working Paper 13-30. Satyajit Chatterjee, Federal Reserve Bank of Philadelphia; Burcu Eyingor, Federal Reserve Bank of Philadelphia.

Measuring the Performance of Banks: Theory, Practice, Evidence, and Some Policy Implications

The unique capital structure of commercial banking — funding production with demandable debt that participates in the economy's payments system — affects various aspects of banking. It shapes banks' comparative advantage in providing financial products and services to informationally opaque customers, their ability to diversify credit and liquidity risk, and how they are regulated, including the need to obtain a charter to operate and explicit and implicit federal guarantees of bank liabilities to reduce the probability

of bank runs. These aspects of banking affect a bank's choice of risk versus expected return, which, in turn, affects bank performance. Banks have an incentive to reduce risk to protect the valuable charter from episodes of financial distress, and they also have an incentive to increase risk to exploit the cost-of-funds subsidy of mispriced deposit insurance. These are contrasting incentives tied to bank size. Measuring the performance of banks and its relationship to size requires untangling cost and profit from decisions about risk versus expected-return because both cost and profit are functions of endogenous risk-taking. This chapter gives an overview of two general empirical approaches to measuring bank performance and discusses some of the applications of these approaches found in the literature. One application explains how better diversification available at a larger scale of operations generates scale economies that are obscured by higher levels of risk-taking. Studies of banking cost that ignore endogenous risk-taking find little evidence of scale economies at the largest banks, while those that control for this risk-taking find large scale economies at the largest banks — evidence with important implications for regulation.

Working Paper 13-31. Joseph P. Hughes, Rutgers University; Loretta J. Mester, Federal Reserve Bank of Philadelphia; The Wharton School, University of Pennsylvania.

On the Welfare Properties of Fractional Reserve Banking

Monetary economists have long recognized a tension between the benefits of fractional reserve banking, such as the ability to undertake more

profitable (long-term) investment opportunities, and the difficulties associated with fractional reserve banking, such as the risk of insolvency for each bank. The goal of this paper is to show that a specific form of private bank coalition (a joint-liability arrangement) allows the members of the banking system to engage in fractional reserve banking in such a way that the solvency of each member bank is completely guaranteed. Under this arrangement, the paper shows that a lower reserve ratio usually translates into a higher exchange value of bank liabilities, benefitting the consumers who use them as a means of payment.

Working Paper 13-32. Daniel Sanches, Federal Reserve Bank of Philadelphia.

Export Dynamics in Large Devaluations

The authors study the source and consequences of sluggish export dynamics in emerging markets following large devaluations. They document two main features of exports that are puzzling for standard trade models. First, given the change in relative prices, exports tend to grow gradually following a devaluation. Second, high interest rates tend to suppress exports. To address these features of export dynamics, the authors embed a model of endogenous export participation due to sunk and per period export costs into an otherwise standard small open economy. In response to shocks to productivity, the interest rate, and the discount factor, the authors find the model can capture the salient features of export dynamics documented. At the aggregate level, the features giving rise to sluggish exports lead to more gradual net export reversals, sharper contractions and recoveries in output, and endogenous stagnation in labor productivity.

Working Paper 13-33. George Alessandria, Federal Reserve Bank of Philadelphia; Sangeeta Prataap, Hunter College and Graduate Center, City University of New York; Vivian Yue, Board of Governors, Federal Reserve System.

Reverse Kalman Filtering U.S. Inflation with Sticky Professional Forecasts

The authors provide a new way to filter U.S. inflation into trend and cycle components, based on extracting long-run forecasts from the Survey of Professional Forecasters, by operating the Kalman filter in reverse, beginning with observed forecasts, then estimating parameters, and then extracting the stochastic trend in inflation. The trend-cycle model with unobserved components is consistent with numerous studies of U.S. inflation history and is of interest partly because the trend may be viewed as the Fed's evolving inflation target or long-horizon expected inflation. The sluggish reporting attributed to forecasters is consistent with evidence on mean forecast errors. There is considerable evidence of inflation-gap persistence and some evidence of

implicit sticky information. But statistical tests show these two widely used perspectives on U.S. inflation forecasts, the unobserved-components model and the sticky-information model, cannot be reconciled.

Working Paper 13-34. James M. Nason, Federal Reserve Bank of Philadelphia; Gregor W. Smith, Queen's University.

Inflation and Real Activity with Firm-Level Productivity Shocks

In the last ten years, there has been an explosion of empirical work examining price setting behavior at the micro level. The work has in turn challenged existing macro models that attempt to explain monetary nonneutrality, because these models are generally at odds with much of the micro price data. In response, economists have developed a second generation of sticky-price models that are state dependent and that include both fixed costs of price adjustment and idiosyncratic shocks. Nonetheless, some ambiguity remains about the extent of monetary nonneutrality that can be attributed to costly price adjustment. The authors' paper takes a step toward eliminating that ambiguity.

Working Paper 13-35. Michael Dotsey, Federal Reserve Bank of Philadelphia; Robert G. King, Boston University, Federal Reserve Bank of Richmond, National Bureau of Economic Research; Alexander L. Wolman, Federal Reserve Bank of Richmond.

House-Price Expectations, Alternative Mortgage Products, and Default

Rapid house-price depreciation and rising unemployment were the main drivers of the huge increase in mortgage default during the downturn years of 2007 to 2010. However, mortgage default was also partly driven by an increased reliance on alternative mortgage products such as pay-option ARMs and interest-only mortgages, which allow the borrower to defer principal amortization. The goal of this paper is to better understand the forces that spurred use of alternative mortgages during the housing boom and the resulting impact on default patterns, relying on a unifying conceptual framework to guide the empirical work. The conceptual framework allows borrowers to choose the extent of mortgage "backloading," the postponement of loan repayment through various mechanisms that constitutes a main feature of alternative mortgages. The model shows that, when future house-price expectations become more favorable, reducing default concerns, mortgage choices shift toward alternative contracts. This prediction is confirmed by empirical evidence showing that an increase in past house-price appreciation, which captures more favorable expectations for the future, raises the market share of alternative mortgages. In addition, using a proportional-hazard default model, the paper tests

the fundamental presumption that backloaded mortgages are more likely to default, finding support for this view.

Working Paper 13-36. Jan K. Brueckner, University of California, Irvine; Paul S. Calem, Federal Reserve Bank of Philadelphia; Leonard I. Nakamura, Federal Reserve Bank of Philadelphia.

Do Supply Restrictions Raise the Value of Urban Land? The (Neglected) Role of Production Externalities

Restriction on the supply of new urban land is commonly thought to raise the value of existing urban land. This paper questions this view. The authors develop a tractable production-externality-based circular city model in which firms and workers choose locations and intensity of land use. Consistent with evidence, the model implies exponentially decaying density and price gradients. For plausible parameter values, an increase in the demand for urban land can lead to a smaller increase in urban rents in cities that cannot expand physically because they are less able to exploit the positive external effect of greater employment density.

Working Paper 13-37. Supersedes Working Paper 12-25. Satyajit Chatterjee, Federal Reserve Bank of Philadelphia; Burcu Eyigungor, Federal Reserve Bank of Philadelphia.

Debt Collection Agencies and the Supply of Consumer Credit

The author examines contract enforcement in consumer credit markets by studying the role of third-party debt collectors. In order to identify the effect of debt collectors on credit supply, he constructs a state-level index of the tightness of debt collection laws. The author finds that stricter regulations of third-party debt collectors are associated with a lower number of third-party debt collectors per capita and with fewer openings of revolving lines of credit. One additional restriction on debt collection activity reduces the number of debt collectors per capita by 15.9% of the sample mean and lowers the number of new revolving lines of credit by 2.2% of the sample mean. At the same time, regulations of third-party debt collectors do not affect secured consumer credit, which is consistent with the fact that debt collectors are used to enforce unsecured debt contracts. Stricter regulations of debt collectors decrease credit card recovery rates (by 9% of the sample mean for each additional restriction on debt collection activity), which appears to be the transmission mechanism by which debt collectors affect credit supply. The effect of debt collection laws is significant even when average credit scores are controlled for, meaning that consumer credit risk is not the only driver of credit access. The author's results can help explain the existence of a large market for unsecured consumer credit and shed light on contract enforcement in this market.

Working Paper 13-38. Viktor Fedaseyev, Bocconi University, Federal Reserve Bank of Philadelphia Visiting Scholar.

Identifying Long-Run Risks: A Bayesian Mixed-Frequency Approach

The authors develop a nonlinear state-space model that captures the joint dynamics of consumption, dividend growth, and asset returns. Building on Bansal and Yaron (2004), their model consists of an economy containing a common predictable component for consumption and dividend growth and multiple stochastic volatility processes. The estimation is based on annual consumption data from 1929 to 1959, monthly consumption data after 1959, and monthly asset return data throughout. The authors maximize the span of the sample to recover the predictable component and use high-frequency data, whenever available, to efficiently identify the volatility processes. Their Bayesian estimation provides strong evidence for a small predictable component in consumption growth (even if asset return data are omitted from the estimation). Three independent volatility processes capture different frequency dynamics; their measurement error specification implies that consumption is measured much more precisely at an annual than monthly frequency; and the estimated model is able to capture key asset-pricing facts of the data.

Working Paper 13-39. Frank Schorfheide, University of Pennsylvania, National Bureau of Economic Research, Federal Reserve Bank of Philadelphia Visiting Scholar; Dongho Song, University of Pennsylvania; Amir Yaron, University of Pennsylvania, National Bureau of Economic Research.

Macro Fiscal Policy in Economic Unions: States as Agents

The American Recovery and Reinvestment Act (ARRA) was the U.S. government's fiscal response to the Great Recession. An important component of ARRA's \$796 billion proposed budget was \$318 billion in fiscal assistance to state and local governments. The authors examine the historical experience of federal government transfers to state and local governments and their impact on aggregate GDP growth, recognizing that lower-tier governments are their own fiscal agents. The SVAR analysis explicitly incorporates federal intergovernmental transfers, disaggregated into project (e.g., infrastructure) aid and welfare aid, as separate fiscal policies in addition to federal government purchases and federal net taxes on households and firms. A narrative analysis provides an alternative identification strategy. To better understand the estimated aggregate effects of aid on the economy, the authors also estimate a behavioral model of state responses to such assistance. The analysis reaches three conclusions. First, aggregate federal transfers to state

and local governments are less stimulative than are transfers to households and firms. It is important to evaluate the two policies separately. Second, within intergovernmental transfers, matching (price) transfers for welfare spending are more effective for stimulating GDP growth than are unconstrained (income) transfers for project spending. Matching aid is fully spent on welfare services or middle-class tax relief; half of project aid is saved and only slowly spent in future years. Third, simulations using the SVAR specification suggest ARRA assistance would have been 30 percent more effective in stimulating GDP growth had the share spent on government purchases and project aid been fully allocated to private sector tax relief and to matching aid to states for lower-income support.

Working Paper 13-40. Gerald Carlino, Federal Reserve Bank of Philadelphia; Robert P. Inman, The Wharton School, University of Pennsylvania.

The Political Polarization Index

American politics have become increasingly polarized in recent decades. To the extent that political polarization introduces uncertainty about economic policy, this pattern may have adversely affected the economy. According to existing theories, a rise in the volatility of fiscal shocks faced by individuals should result in a decline in economic activity. Moreover, if polarization is high around election dates, businesses and households may be induced to delay decisions that involve high reversibility costs (such as investment or hiring under search costs). Testing these theories has been challenging given the low frequency at which existing polarization measures have been computed (in most studies, the series is available only biannually). In this paper, the author provides a novel high-frequency measure of polarization, the political polarization index. The measure is constructed monthly for the period 1981–2013 using a search-based approach. The author documents that while the index fluctuates around a constant mean for most of the sample period prior to 2007, it has exhibited a steep increasing trend since the Great Recession. Evaluating the effects of this increase using a simple VAR, the author finds that an innovation to polarization significantly discourages investment, output, and employment. Moreover, these declines are persistent, which may help explain the slow recovery observed since the 2007 recession ended.

Working Paper 13-41. Marina Azzimonti, Federal Reserve Bank of Philadelphia.

Dynamic Market Participation and Endogenous Information Aggregation

This paper studies information aggregation in financial markets with recurrent investor exit and entry. A dynamic

general equilibrium model of asset trading with private information and collateral constraints is considered. Investors differ in their aversion to Knightian uncertainty: When uncertainty is high, some investors exit the market. Since exiting investors' information is not fully revealed by prices, conditional return volatility and risk premia both increase. Data on institutional investors' holdings of individual stocks show that investor exits indeed move negatively with price informativeness. The model also implies that exit is more likely when wealth is more concentrated in the hands of less uncertainty-averse investors. The model thus predicts less informative prices toward the end of a long boom, as seen in the data. Moreover, economies with looser collateral constraints should see more volatility due to exit and partial revelation. Higher capital requirements can improve welfare by inducing more information revelation by prices.

Working Paper 13-42. Edison G. Yu, Federal Reserve Bank of Philadelphia.

The Dynamics of Public Investment Under Persistent Electoral Advantage

This paper studies the effects of asymmetries in re-election probabilities across parties on public policy and their subsequent propagation to the economy. The struggle between groups that disagree on targeted public spending (e.g., pork) results in governments being endogenously short-sighted: Systematic underinvestment in infrastructure and overspending on targeted goods arise, above and beyond what is observed in symmetric environments. Because the party enjoying an electoral advantage is less short-sighted, it devotes a larger proportion of revenues to productive investment. Hence, political turnover induces economic fluctuations in an otherwise deterministic environment. The author characterizes analytically the long-run distribution of allocations and shows that output increases with electoral advantage, despite the fact that governments expand. Volatility is non-monotonic in electoral advantage and is an additional source of inefficiency. Using panel data from U.S. states, the author confirms these findings.

Working Paper 13-43. Marina Azzimonti, Federal Reserve Bank of Philadelphia.

Polarized Business Cycles

The authors are motivated by four stylized facts computed for emerging and developed economies: (i) business cycle movements are wider in emerging countries; (ii) economies in emerging countries experience greater economic policy uncertainty; (iii) emerging economies are more polarized and less politically stable; and (iv) economic policy uncertainty is positively related to political polarization. The authors show that a standard real business cycle (RBC) model augmented

to incorporate political polarization, a “polarized business cycle” (PBC) model, is consistent with these facts. The authors’ main hypothesis is that fluctuations in economic variables are not only caused by innovations to productivity, as traditionally assumed in macroeconomic models, but also by shifts in political ideology. Switches between left-wing and right-wing governments generate uncertainty about the returns to private investment, and this affects real economic outcomes. Since emerging economies are more polarized than developed ones, the effects of political turnover are more pronounced. This translates into higher economic policy uncertainty and amplifies business cycles. The authors derive their results analytically by fully characterizing the long-run distribution of economic and fiscal variables. They then analyze the effect of a permanent increase in polarization on PBCs.

Working Paper 13-44. by Marina Azzimonti, Federal Reserve Bank of Philadelphia; Matthew Talbert, University of Texas, Austin.

Entrepreneurial Tail Risk: Implications for Employment Dynamics

New businesses are important for job creation and have contributed more than proportionally to the expansion in the 1990s and the decline of employment after the 2007 recession. This paper provides a framework for analyzing determinants of business creation in a world where new business owners are exposed to idiosyncratic risk due to initial imperfect diversification. This paper uses this framework to analyze how entrepreneurial risk has changed over time and how this has affected employment in the U.S. Conditions are

provided under which entrepreneurial risk can be identified using micro data on the size distribution of new businesses and their exit rates. The baseline model considers both upside and downside risk. Applied to U.S. time series data, structural estimates suggest that higher upside risk explains much of the high job creation in the late 1990s. Time variation in risk explains around 40% of the variation in employment of new businesses. Reduced form results show that this relationship is strongest in IT-related industries. When restricting the model to a single risk factor, the explanatory power for employment drops by 25% to 50% compared to the baseline estimates.

Working Paper 13-45. Thorsten Drautzburg, Federal Reserve Bank of Philadelphia.

Fiscal Stimulus and Distortionary Taxation

The authors quantify the fiscal multipliers in response to the American Recovery and Reinvestment Act (ARRA) of 2009. They extend the benchmark Smets-Wouters (2007) New Keynesian model, allowing for credit-constrained households, the zero lower bound, government capital, and distortionary taxation. The posterior yields modestly positive short-run multipliers around 0.53 and modestly negative long-run multipliers around -0.36. The authors explain the central empirical findings with the help of a simple three equation New Keynesian model with sticky wages and credit-constrained households.

Working Paper 13-46. Thorsten Drautzburg, Federal Reserve Bank of Philadelphia; Harald Uhlig, University of Chicago.

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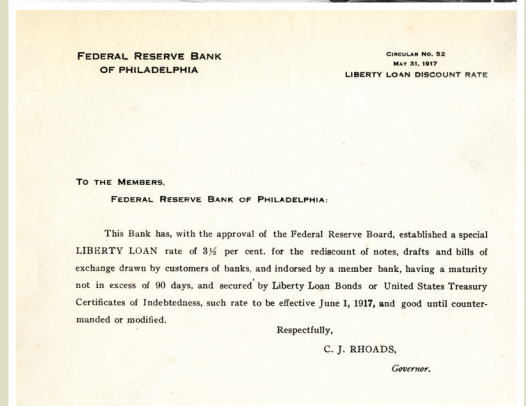
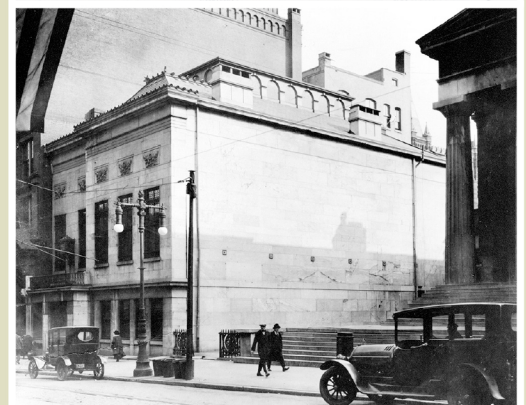
To mark the 100th anniversaries of the signing of the Federal Reserve Act in 1913 and the opening of the Federal Reserve Banks in 1914, the Fed is asking scholars, historians, and other members of the public to help compile an inventory of records, collections, and artifacts related to the history of the nation's central bank. Do you know of materials that should be included? Information may be submitted at <http://www.federalreserve.gov/apps/contactus/feedback.aspx>.

The inventory will give researchers, academics, and others interested in studying U.S. central banking a single point of electronic access to documents, photographs, and audio and video recordings from sources across the Federal Reserve System, universities, and private collections. Information is also being included about material not yet available online

On December 23, 1913, President Woodrow Wilson signed the Federal Reserve Act, establishing the Federal Reserve System as the U.S. central bank. Its mission is to conduct the nation's monetary policy; supervise and regulate banks; maintain the stability of the financial system; and provide financial services to depository institutions, the U.S. government, and foreign official institutions.

Congress designed the Fed with a decentralized structure. The Federal Reserve Bank of Philadelphia — serving eastern Pennsylvania, southern New Jersey, and Delaware — is one of 12 regional Reserve Banks that, together with the seven-member Board of Governors in Washington, D.C., make up the Federal Reserve System. The Board, appointed by the President of the United States and confirmed by the Senate, represents the public sector, while the Reserve Banks and the local citizens on their boards of directors represent the private sector.

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