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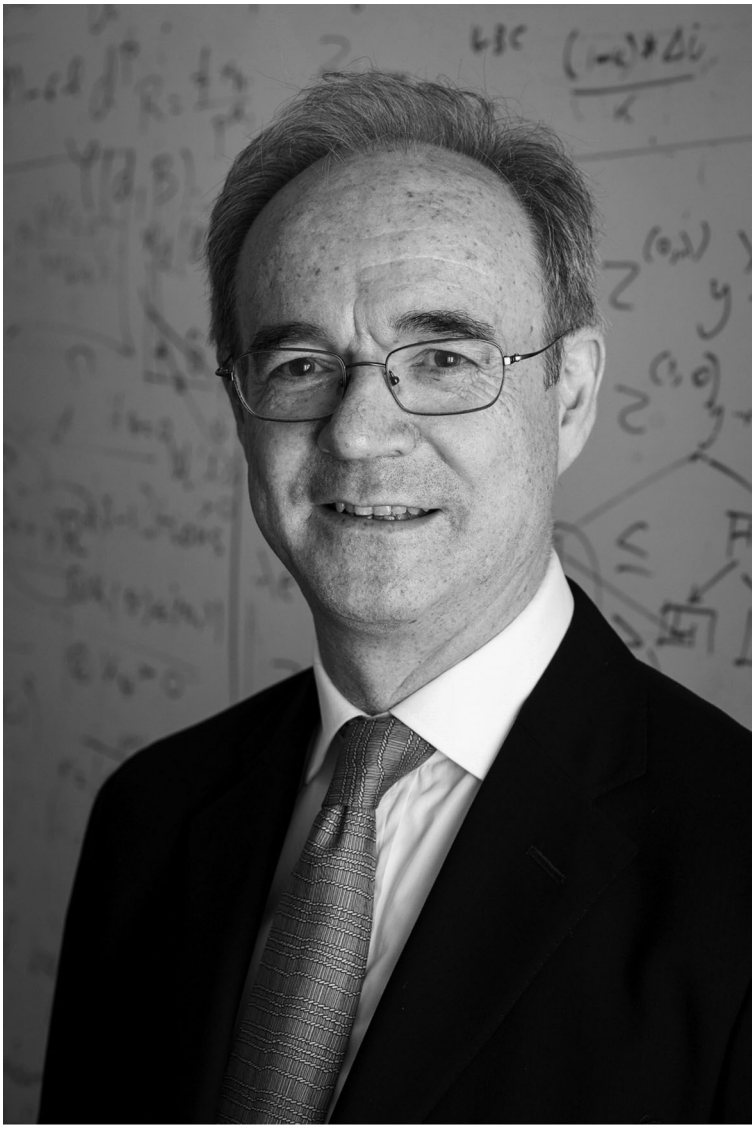

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President of the American Finance Association 2015

Presidential Address: Debt and Money: Financial Constraints and Sovereign Finance

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ABSTRACT

Economic analyses of corporate finance, money, and sovereign debt are largely considered separately. I introduce a novel corporate finance framing of sovereign finance based on the analogy between fiat liabilities for sovereigns and equity for corporations. The analysis focuses on financial constraints at the country level, making explicit the trade-offs involved in relying on domestic versus foreign-currency debt to finance investments or government expenditures. This framing provides new insights into issues ranging from the costs and benefits of inflation, optimal foreign exchange reserves, and sovereign debt restructuring.

FINANCE HAS TAKEN A BEATING lately. It is not just that the financial services industry has lost its luster with the public at large, as Zingales (2015) has distressingly reminded us. It is also that recent research calls into question the empirical validity and pertinence of classic theories of corporate finance. Yet, while criticism is clearly warranted, we should be careful not to throw away the baby with the bath water. In this address, I focus on the positive and highlight some valuable insights that a corporate finance perspective can bring when applied to a particular economic problem.

Myers (1984, p.575) famously began his presidential address by asking "How do firms choose their capital structures?," to which he promptly answered "We don't know." More than 20 years later, Lemmon, Roberts, and Zender (2007, p.1575–96) similarly began with the question ". . . after decades of research, how much do we really know [about corporate capital structures]?" and found that "The adjusted R-squares from traditional leverage regressions using previously identified determinants range from 18% to 29%, depending on the specification. In contrast, the adjusted R-square from a regression of leverage on firm fixed effects (statistical 'stand-ins' for the permanent component of leverage) is 60%, implying that the majority of variation in leverage in a panel of firms is time invariant and is largely unexplained by previously identified determinants." Last year, DeAngelo and Roll (2015, p.373) further complicated the picture by

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finding that leverage is actually far from time invariant and that "leverage cross sections more than a few years apart differ markedly." This finding poses an even greater challenge to existing theories. Not only is most of the variation in the cross section unexplained, but the factors that drive the time-series variation are poorly understood.

Does this mean that existing corporate finance theory should be discarded? My reading of the theory is that, while, admittedly, it needs to say more about the determinants of corporate leverage, it is much more pertinent for understanding how financial constraints shape corporate investment and financial decisions. The general, robust principle that has endured since Myers (1984) is that corporations should tap the cheapest marginal sources of funds for their investments. In other words, corporations should pledge the cash flows that are the most favorably priced by the market at any moment in time.

Taking this principle to the extreme, by recognizing that, sometimes, the market may overvalue some claims on the corporation, another robust precept is that firms can profit by timing capital markets and issuing claims that are temporarily overpriced. A remarkable finding of Baker and Wurgler (2002) is that such market timing of equity issuance has long-run effects on a firm's capital structure: to a large extent, the history-dependent succession of investment and market-timing opportunities is what shapes a firm's capital structure at any moment in time. No wonder then that firm fixed effects and firm-decade interaction effects have such strong explanatory power, as each firm has its idiosyncratic investment and/or market-timing opportunities.

But corporate finance theory is not limited to the study of corporate leverage. It is also, and perhaps mainly, interested in understanding financial constraints that prevent corporations from making efficient investments. If there is one deep, general, lesson from the global financial crisis of 2007 to 2009, it is that financial constraints matter—they bite a little most of the time, a lot some of the time, and are deadly in extreme crises. What is more, when they bite, a lot of the stagnation they engender persists for long stretches of time. Those who are tempted to purchase model simplicity and elegance at the price of suppressing financial constraints do so at their own peril.

So what makes corporate finance relevant is the universal presence of financial constraints. At the margin, most economic decisions are affected by financial constraints. Understanding these constraints therefore helps us better understand economic decision-making. And understanding how to relax financial constraints helps us achieve more efficient resource allocation.

To illustrate the powerful insights that can be obtained from corporate finance theory, I apply a corporate finance framing to sovereign finance and in doing so suggest new insights for monetary theory and sovereign debt. I build the discussion around a companion paper that lays out the formal analysis (Bolton and Huang (2016)), my previous research on sovereign debt (Bolton (2003), Bolton and Skeel (2004, 2005), Bolton and Jeanne (2007, 2009, 2011)), and related literature in international finance.

I. The Capital Structure of Nations

As others have done before, one can think about nations as corporations. While obviously highly reductive, consolidating all of a nation's agents into a single representative decision-maker has the advantage of bringing out in a simple way the economic objectives of a nation and the constraints that it faces, particularly its financial constraints. The main drawback, as with corporations, is that such consolidation buries all inside agency and governance issues. Consolidation also poses difficult empirical challenges.

If one thinks about a nation as a corporation it is natural to ask what is the analog of a corporation's capital structure for a nation. For instance, what is a nation's debt-equity ratio? Indeed, how does one capture the equity capital of a nation? In Bolton and Huang (2016), we suggest that the nation-level analog to equity is fiat money. Of course, dollar bills do not come with voting rights, but in effect money entitles the holder to a share of a nation's output just like a share of common stock entitles the holder to a pro-rata share of residual cash flow. That is the analogy we focus on. Much of finance theory models equity as a claim on residual cash flow, disregarding voting rights. The analogy between money and equity, as it is modeled in finance theory, is thus quite close.

Note that, in addition to fiat money, I also treat domestic-currency debt as equity. This is again not so far-fetched. A domestic-currency sovereign bond is in effect a pay-in-kind (PIK) note. When corporations issue such notes, they are treated as close substitutes for equity by the tax authorities, and corporations typically cannot freely deduct any interest payments in kind from corporate taxable income (see Bulow, Summers, and Summers, 1990). Similarly, Treasury bills are held as money-like reserves by many institutions, and repurchase agreements (repos) backed by Treasury bonds are widely perceived as money-like instruments, just as money-market mutual funds are seen as close substitutes for demand deposits.

What do we learn from making an analogy between fiat money and equity? Mainly, that we can apply classical trade-offs between equity and debt financing from corporate finance to sovereign finance. The theories of Myers (1977), Myers and Majluf (1984), Stein (1996), and Baker, Stein, and Wurgler (2003), which trade off the costs of debt-overhang, or the costs of default, against the potential dilution costs of equity issuance, are particularly relevant. A nation with high foreign-currency debt outstanding, or with highly volatile GDP, could be better off issuing money or domestic-currency debt to finance its investments, even if this gives rise to some inflation.

In short, there is an interesting parallel between dilution costs and inflation costs. Incumbent shareholders in a company see their ownership diluted when the company issues stock to new shareholders at a price below its intrinsic value. This does not mean that any stock issue necessarily involves dilution. As Stein (1996) and Baker, Stein, and Wurgler (2003) argue, there are situations in which corporations are able to issue new shares when the company's stock is overvalued. In such cases, the equity issue is value-increasing for incumbent shareholders. Similarly, printing more money can result in inflation and loss

of purchasing power for domestic residents if the increase in money supply is larger than the increase in output. But, as with new stock issues and dilution, printing more money does not *necessarily* lead to inflation and a debasement of the currency.

Another important observation that follows from this analogy is that the cost of inflation, like the cost of dilution, is ultimately a wealth redistribution cost. The cost of inflation (if there is any) is the transfer of wealth from the old to the new holders of money. We know from Myers and Majluf (1984) that a rights issue that is taken up by all existing shareholders cannot involve any dilution cost, for all old shareholders receive the same pro-rata share increase at the same price, so that, in the end, they hold the same pro-rata share in the company. Similarly, if new money were issued to all holders in proportion to their holdings, then there would be no cost of inflation. Another way of making the same point is that a change in currency denomination should not affect the value of a nation's real GDP, just as a stock split should not affect firm value.

Interestingly, the analogy between corporate equity and fiat money (or domestic-currency debt) was first made in the macroeconomics literature on the fiscal theory of the price level (Sims (2001), Cochrane (2005)).[1] But the implications of this analogy for the optimal financing of government expenditures are not explored in this literature. Another related literature is the extensive international finance literature on the risks associated with foreign-currency sovereign debt issues. Much of the literature following Eichengreen, Hausmann, and Panizza (2003) takes for granted that all but the most economically advanced countries can issue only foreign-currency debt. These studies use the term *original sin* to refer to situations in which emerging market countries have little choice but to finance themselves with foreign currency debt.

Such extreme situations are not unlike the constraints faced by many start-up firms, whose only source of external finance is debt. However, as economies and firms grow and establish a reputation for creditworthiness, their financial options expand to the point where the classical trade-off described above between debt and equity financing becomes meaningful. It is worth pointing out in this respect that, in recent years, many emerging market countries have successfully issued domestic-currency debt in international markets, so much so that the original sin state is less descriptive of the financial reality they currently face.

To gain better appreciation for what a corporate finance framing of sovereign finance can deliver, I now turn to a brief description of the model developed in Bolton and Huang (2016) and its key results. I then discuss its empirical implications and limitations, before considering the lessons from corporate finance for sovereign debt restructuring.

[1] Cochrane (2005, p.502) clearly identifies the connection when he writes that: "The fiscal theory of the price level recognizes that nominal debt, including the monetary base, is a residual claim to government primary surpluses, just as Microsoft stock is a residual claim to Microsoft's earnings."

II. The Bolton and Huang (2016) Model

The basic model structure is a classical three-period corporate finance framework, but applied to a small open economy. At date 0, the nation may undertake an infrastructure investment of size $k > 0$. At date 1, the initial endowment of goods $w > 0$ is divided between consumption c_1 and inputs for production. At date 2, output is realized and consumed. The investment at date 0 can be financed with either debt or money.

A representative risk-neutral household maximizes her lifetime utility of consumption,

$$U(c_1, c_2) = \beta c_1 + c_2, \tag{1}$$

where $c_t \geq 0$ for $t = 1, 2$ and $\beta < 1$. Households can store their initial endowment or sell it to firms. Storage results in some depreciation, so that one unit stored from dates 1 to 2 depreciates to $\delta < 1$. The economy comprises a continuum of identical households and firms operating in perfectly competitive markets.

Production at date 1 requires the endowment (consumption good) as an input: if a firm obtains x in inputs at date 1, its output at date 2 is $y \equiv \theta Q(k) f(x)$, where $f' > 0$, $f'' < 0$, and θ is a productivity shock with p.d.f. $h(\cdot)$ and c.d.f. $H(\cdot)$ on the support $[\theta_L, \theta_H]$. The factor $Q(k)$ reflects the increase in productivity from infrastructure investments k at date 0. By investing k, productivity is boosted by the factor $Q(k)$, where $Q(0) = 1$, $Q' > 0$, and $Q'' < 0$. To streamline the notation, whenever possible we denote

$$\Omega(k, x) \equiv Q(k) f(x).$$

At date 1, households start out holding their endowment w and firms hold money m. Inputs are purchased from households with money in a competitive market at date 1, and consumers use their money savings to purchase firms' output at date 2, so that money plays the dual role of a *means of exchange* and a *store of value*.

Firms are owned by entrepreneurs who maximize date 2 output (their consumption is a fraction of final output) and the continuation value of the firm $V(m_2)$, which is strictly increasing in m_2, the representative firm's holdings of cash at the end of period 2.[2] At date 0, the representative household of the nation can issue claims against date 2 output to finance investment k.

Quantity Theory of Money. The model is set up so that the quantity theory of money holds. Under the sufficient conditions that $f'(w) > 1$ and $\bar{\theta} \geq 1$, it is optimal for households to sell their entire endowment at date 1 as inputs for

[2] The value $V(m_2)$ is the value of future inputs for production that can be bought with m_2 (see Bolton and Huang (2016)). Money has value at date 2 if firms value end-of-period money holdings, solving the Hahn (1965) problem.

production to firms, so that $x = w$, the competitive price of inputs is $p_1 = \frac{m}{w}$, and the price of goods at date 2 is

$$p_2(\theta) = \frac{m}{\theta f(w)}.$$

We show that households cannot do better than sell their entire endowment for a price p_1 at date 1, and firms cannot do better than sell their production for $p_2(\theta)$ at date 2. Given these expressions for equilibrium prices at dates 1 and 2, it is straightforward to see that a doubling of the quantity of money m simply doubles the price of goods at dates 1 and 2.

Modigliani-Miller Theorem for Nations. The model also delivers a Modigliani-Miller theorem for the frictionless economy. To see this, consider the situation of the nation at date 0, when it invests in a positive net present value infrastructure investment that raises the nation's productivity. The nation raises k from international capital markets at a world price of one. It can pay for k either by increasing its money supply by $(\Delta - 1)m$, where $\Delta > 0$ is such that the new money printed is worth k, or by issuing a foreign-currency denominated debt claim $D \geq k$ repayable out of period 2 output. In the frictionless economy, the nation can commit not to default and not to print more money. Under full commitment, we then have $D = k$ and

$$\frac{(\Delta - 1)m}{E[p_2(\theta)]} = k,$$

where

$$p_2(\theta) = \frac{\Delta m}{\theta Q(k) f(w)}.$$

That is, foreign sellers of capital at date 0 must be made whole and get a claim worth the same (in expectation) as the amount invested. When they exchange k for money $(\Delta - 1)m$, the total money supply at date 2 is Δm and total output for any productivity shock realization θ is $\theta Q(k) f(w)$, so that the price is $p_2(\theta)$ as given above. By spending their money holdings $(\Delta - 1)m$, foreign investors can then get output $(\Delta - 1)m/p_2(\theta)$. In expectation, the output obtained must be worth the same as the capital invested.

Modigliani-Miller equivalence obtains when the expected net increase in wealth under both forms of financing is the same:

$$\frac{\bar{\theta}\Omega(k, w)}{\Delta} = \bar{\theta}\Omega(k, w) - k.$$

The left-hand side is the expected consumption obtained at date 2 by residents under a money-financed investment, and the right-hand side is the expected consumption under a debt-financed investment. We show that this is the case under full commitment. The equivalence holds even with risky debt financing

as long as there are no deadweight costs of default, and for any combination of debt and money financing.

As in all corporate finance theories, a nation's capital structure only matters in the presence of frictions. In Bolton and Huang (2016), we introduce two frictions. First, there is a classic willingness-to-repay problem for foreign-currency debt: when date 2 realized output is too low relative to the nation's outstanding debt obligations, the nation strategically defaults even if it incurs costs in the form of output losses as a result of default. Second, the nation may not be able to perfectly commit to keep money issuance under check so as to keep inflation under control. The government (acting in the interest of the representative agent) then trades off the dilution costs of money against the expected default costs of debt to determine the optimal form of financing of investment.

A. Unwillingness to Repay versus Willingness to Inflate

The first friction—a nation's unwillingness to repay its debts when they are too high—is standard in the international finance literature (see, for example, Eaton and Gersovitz (1981) and Bulow and Rogoff (1989)). In our model, a nation that promises to repay D in foreign currency (i.e., output) at date 2 to foreign investors may choose to default if the cost of default is smaller than the cost of servicing the debt. When the nation defaults, it suffers a percentage loss in final output $\phi > 0$ and can only consume $(1 - \phi)\theta\Omega(k, w)$. The nation therefore defaults on its debt obligation D whenever $\theta\Omega(k, w) - D < (1 - \phi)\theta\Omega(k, w)$.

If

$$\theta_D = \frac{D}{\phi\Omega(k, w)}$$

denotes the cutoff at which the nation defaults, then the credit risk for the holders of the nation's debt is given by $\Pr(\theta < \theta_D)$. Should the nation decide to finance its investment through a foreign-currency debt issue, then to compensate foreign investors for holding credit risk, the face value of debt D must be set so that

$$\Pr(\theta \geq \theta_D)D = k.$$

The expected cost of default is then given by:

$$\Pr(\theta < \theta_D)E[\theta \mid \theta < \theta_D]\phi\Omega(k, w).$$

The second friction—the dilution or inflation costs that may follow from a money-financed investment—may be familiar to a corporate finance audience but is typically not modeled in the international finance literature. Even for a corporate finance audience, the way we model the potential costs associated with printing money may seem slightly unusual. Although the general idea of dilution costs is directly inspired by Myers and Majluf (1984), the way we model these costs is closer to Dittmar and Thakor (2007) and the "market-driven" corporate finance literature (Baker (2009)).

If the nation funds k by printing money (or issuing domestic currency debt), the costs it potentially faces relate to exaggerated inflation expectations of foreign investors, which result in an unwarranted debasement of the currency. More formally, it is not known at date 0 whether the future government at date 2 will be a *monetary dove* or a *monetary hawk*. A monetary-dove administration expands the money supply at date 2 for domestic residents by an extra amount $(\Delta_1 - 1)\Delta_0 m$, which results in a higher nominal price level, and thereby brings about a transfer of wealth from foreign investors to domestic residents. A monetary-hawk government does not expand the money supply at date 2.

Domestic residents believe that they will have a monetary-dove government at date 2 with probability $\lambda \in (0, 1)$. Foreign investors' beliefs may differ as in Scheinkman and Xiong (2003). Moreover, foreign investors' revised beliefs that they will face a monetary-dove administration at date 2, conditional on a money issue $(\Delta_0 - 1)$ at date 0, are increasing in Δ_0. In other words, denoting by $\mu(\Delta_0)$ foreign investors' conditional belief that a monetary-dove government will be in place at date 2, the model assumes that $\mu' \geq 0$. A simple functional form is $\mu(\Delta_0) = \underline{\mu} + \gamma\Delta_0$, with $\underline{\mu} < \lambda$ and $\mu(\Delta_0) > \lambda$ for a sufficiently large Δ_0.

The key trade-off can be illustrated for the special case in which $\mu' = 0$ and by contrasting 100% debt financing with 100% money financing. Under money financing, the nation issues money $(\Delta_0 - 1)m$ at date 0 to fund k, which results in a price level at date 2 of

$$E[\hat{p}_2(\theta)] = \frac{m\Delta_0\Delta_1}{\bar{\theta}\Omega(k, w)}$$

under a monetary-dove government, and

$$E[p_2(\theta)] = \frac{m\Delta_0}{\bar{\theta}\Omega(k, w)}$$

under a monetary-hawk government. Therefore, foreign investors require a payment in money $(\Delta_0 - 1)m$ in exchange for investment k such that

$$\left[\frac{\mu}{E[\hat{p}_2(\theta)]} + \frac{1-\mu}{E[p_2(\theta)]}\right](\Delta_0 - 1)m = k.$$

Substituting for $E[\hat{p}_2(\theta)]$ and $E[p_2(\theta)]$ in this equation, it is a matter of simple algebra to derive the required increase in money supply at date 0:

$$\Delta_0(k) = \frac{(\frac{\mu+(1-\mu)\Delta_1}{\Delta_1})\bar{\theta}\Omega(k, w)}{(\frac{\mu+(1-\mu)\Delta_1}{\Delta_1})\bar{\theta}\Omega(k, w) - k}. \tag{2}$$

Foreign investors assign a present value of k to $(\Delta_0(k) - 1)m$, but domestic residents value $(\Delta_0(k) - 1)m$ at

$$(\lambda + (1-\lambda)\Delta_1)\bar{\theta}\Omega(k, w)\left(\frac{\Delta_0(k) - 1}{\Delta_0(k)\Delta_1}\right).$$

Therefore, domestic residents perceive a cost from currency devaluation or a loss in purchasing power of

$$(\mu - \lambda)\bar{\theta}\Omega(k, w)\frac{(\Delta_1 - 1)(\Delta_0(k) - 1)}{\Delta_0(k)\Delta_1},$$

whenever $\mu > \lambda$. They compare this cost to the costs of default under foreign-currency debt financing.

Optimal Financing. When comparing these costs, the algebra is considerably simpler if one further assumes that θ only takes one of two values $\theta \in \{\theta_L, \theta_H\}$, with $\Pr(\theta = \theta_H) = \pi \in (0, 1)$. The trade-off between money and debt financing is then brought out most interestingly when debt financing exposes the nation to default in the low productivity state θ_L. In that case, the repayment promise the nation must make to be able to raise k through an external debt issue is given by $D = k/\pi$ and the nation incurs expected costs of default under debt financing of $(1 - \pi)\theta_L\phi\Omega(k, w)$. Under monetary financing, in contrast, expected dilution costs are

$$(\mu - \lambda)(\pi\theta_H + (1 - \pi)\theta_L)\Omega(k, w)\frac{(\Delta_1 - 1)(\Delta_0(k) - 1)}{\Delta_0(k)\Delta_1}.$$

Comparing these two expressions, one obtains the following condition that succinctly summarizes when monetary financing dominates debt financing:

$$(\mu - \lambda)(\pi\theta_H + (1 - \pi)\theta_L)\frac{(\Delta_1 - 1)(\Delta_0(k) - 1)}{\Delta_0(k)\Delta_1} < (1 - \pi)\theta_L\phi\Omega(k, w). \tag{3}$$

B. Implications and Caveats

The original sin notion of Eichengreen, Hausmann, and Panniza (2003) can be interpreted as a special case of the above framework. When $(\mu - \lambda)$ is very large, international investors do not trust an emerging market issuer to keep its inflation under control, and hence demand compensation for holding inflation risk that is so large that the nation is better off financing its investments with foreign-currency debt. But foreign-currency debt is no panacea, as the nation then exposes itself to the risk of a debt crisis and the cost of default.[3] Arguably, the framework outlined above underestimates the risk and cost of debt crises when the nation borrows in foreign-currency denominated debt. An obvious cost that is not in the analysis but that is considered in Bolton and Huang (2016) is the cost of *debt overhang*, which can depress growth even if there is no actual default. Another cost associated with foreign-currency debt, which has been emphasized in the international finance and macroeconomics literatures, is the cost of *self-fulfilling debt crises* (see Calvo (1988), Chang

[3] Current Credit Suisse CEO Tidjane Thiam recently declared "I did a lot of infrastructure development in my life. To fund them with foreign currency is madness. OK? Madness." (Thiam Criticizes Foreign Debt Reliance, Clark, Simon, *Wall Street Journal*, October 7, 2015.)

and Velasco (2000), Cole and Kehoe (2000), Burnside, Eichenbaum, and Rebelo (2001), Jeanne and Wyplosz (2001), and Jeanne (2009)). When a nation has to engage in costly fire-sales of assets in order to service its foreign-currency debt obligations, then the mere expectation of such fire-sales may trigger a debt crisis, even if the nation is perfectly willing and able to service its debt under more favorable expectations and interest rates. The Bolton and Huang (2016) framework does not allow for self-fulfilling crises and therefore arguably tilts the balance too much in favor of foreign-currency debt financing.

A simple but revealing insight from condition (3) is that countries with relatively high productivity even in crisis times (a high θ_L) and a large deadweight cost of default ϕ, for example, due to the risk of a banking crisis in the event of default (as in Bolton and Jeanne (2011)), could be better off financing their investments by printing money (or issuing domestic-currency debt).

A more general lesson for monetary theory is that the optimal quantity of money depends on a subtle trade-off between inflation and expected debt default costs. In general, there is no simple rule for the evolution of the optimal quantity of money in an economy with financial frictions. How much a nation should rely on printing money as opposed to foreign-currency debt financing depends on the value of investments to be funded, the evolution of differences of beliefs on the risk of inflation, and the expected risk of default on the nation's debt. As Baker and Wurgler (2002) show for corporate leverage, a nation's optimal quantity of money and ratio of domestic to foreign-currency debt can be understood as the history-dependent outcome of a succession of changes in inflation expectations, exchange rates, growth opportunities, and the evolving trade-offs the nation faces with respect to its best sources of funding over time.

A corporate finance framework can also deliver novel implications for countries' foreign-currency reserve management. There has been renewed focus on foreign exchange reserves in recent years as a result of the spectacular buildup in reserves by several Asian countries in the aftermath of the Asian financial crisis of 1997 to 1998. What accounts for this buildup, and what are the implications? Two leading hypotheses have been explored in the international finance literature, a "mercantilist" and a "precautionary savings" motive, but neither has found substantial empirical support (see Aizenman and Lee (2007) and Jeanne (2007)). The mercantilist view holds that foreign exchange reserve buildup reflects an attempt by the nation to lower its exchange rate, thereby increasing the competitiveness of its export industry and generating current account surpluses (Dooley, Folkerts-Landau, and Garber (2004)). The precautionary savings theory holds that countries build up reserves to be able to dampen negative terms of trade and "sudden stop" shocks, thereby achieving better consumption smoothing (see Jeanne (2007), Caballero and Panageas (2007), Durdu, Mendoza, and Terrones (2009), and Jeanne and Ranciere (2011)). There are also the special category or commodity exporting countries that build reserves in an effort to forestall the "Dutch disease" (van der Ploeg and Venables (2011)) or to soften fluctuations in commodity export revenues (Céspedes and Velasco (2012)).

A key conceptual difficulty for determining the optimal size of foreign exchange reserves is to decide what the opportunity cost of building and holding reserves is. A shortcut that a number of empirical studies rely on is to calculate the cost of building reserves as the difference between the promised interest rate on the nation's foreign-currency debt and the return on reserves (see Jeanne (2007)). The idea is that, to add a dollar to reserves, the nation must borrow the dollar at rate R and then invest that dollar in U.S. Treasuries at rate r, thus incurring a cost $(R - r)$. But as Jeanne (2007) points out and Summers (2007, p.69) emphasizes in his discussion of Jeanne, "In a perfect capital market, where all assets are perfect substitutes and reserves are financed by issuing domestic debt, holding reserves costs nothing at all."

A corporate finance framework can further illuminate this issue. Basically, the marginal cost of building reserves is the dilution cost associated with printing more money or issuing more domestic-currency debt. To the extent that foreign investors are more pessimistic than domestic residents about future expected inflation, they will undervalue the domestic currency to the point that purchases of foreign currency involve an opportunity cost. For some countries, this cost may be too large to make it worthwhile to accumulate substantial reserves. Importantly, however, this cost may be small for other countries (or even negative in special circumstances). This is the case for countries with low inflation (or possibly even deflation) expectations. Indeed, there may be a strictly positive return associated with purchases of foreign-currency assets through domestic-currency issuance for such countries.

Two prominent examples of countries that have been in this position are Japan and Switzerland. Japan's foreign exchange reserves increased from just over 7% of GDP in 2000 to 26% in 2014. During this period, Japan's inflation rate was in deflation territory, hovering around 0% (except for 2014, when its inflation rate peaked at 2.7%). Japan's buildup of reserves is mostly the result of cumulative current account surpluses, which have not been entirely offset by capital account deficits, as Figure 1 illustrates. Even more striking is Switzerland's buildup of reserves, which from 2007 to 2012 increased from 10% to 70% of GDP and now stand at 100% of GDP. While Switzerland also ran substantial current account surpluses, the rapid buildup of reserves is due to the fact that, in some years, both current and capital accounts were in surplus, as can be seen in Figure 1. This buildup against domestic-currency issuance has been achieved essentially for free, with Switzerland's inflation rate declining from 2.5% in 2007 to a negative value by 2014.

These two examples (along with Denmark), and those of other countries that have failed to take advantage of similar opportunities of favorable exchange rates to build reserves (particularly during episodes of massive "hot money" inflows), point to the importance of better understanding the dynamics of foreign currency reserve management. Indeed, the recent studies of Dominguez, Hashimoto, and Ito (2012) and Céspedes and Velasco (2012) provide compelling evidence of the important GDP advantages countries with substantial foreign currency reserves observed during the financial crisis of 2007 to 2009. Alas, our understanding of foreign-currency reserve management—what is a reasonable

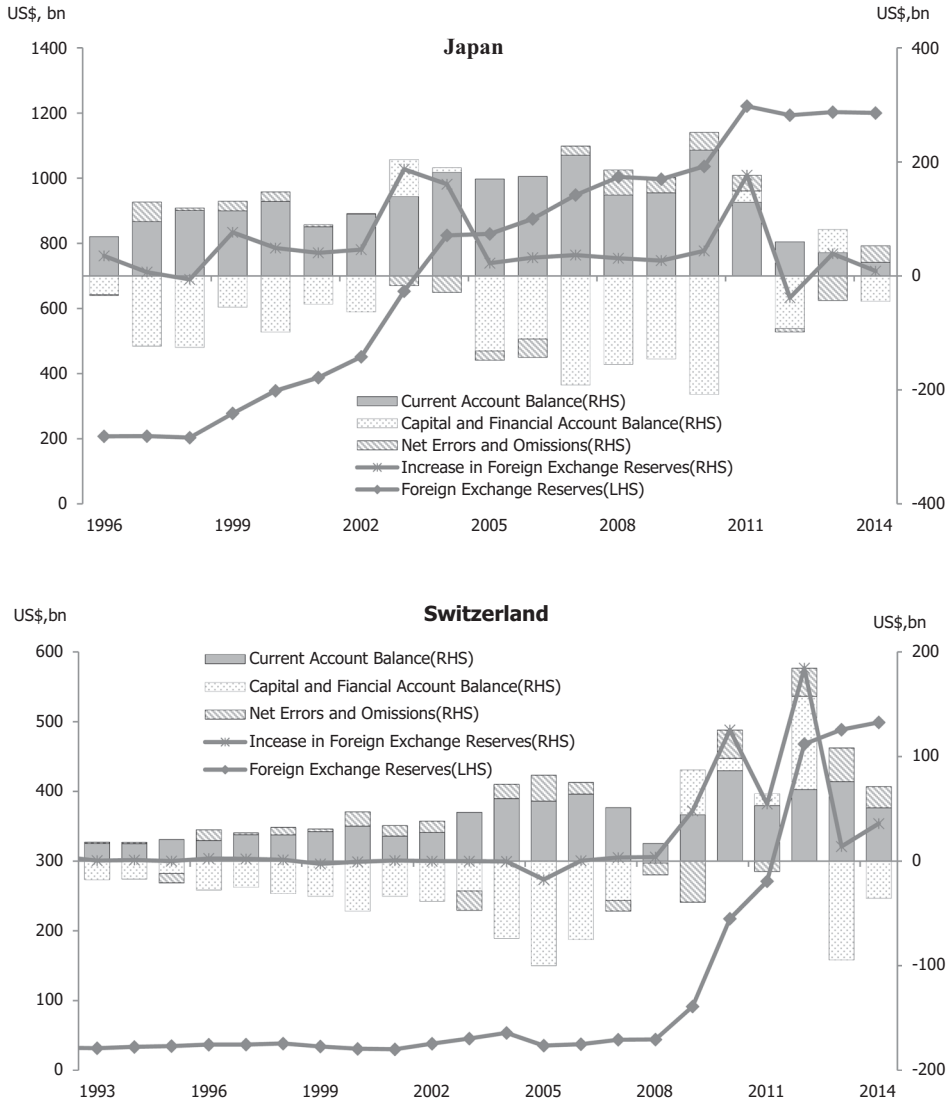

Figure 1. Foreign exchange reserves for Japan and Switzerland.

target reserves-to-GDP ratio, when to build up reserves, when to draw them down, how to combine reserves with foreign-currency debt liabilities—is still rather imprecise as the following quote from Summers (2007, p.67) illustrates:

> Soon after I arrived at the Treasury as undersecretary of international affairs in 1993, I was briefed about the Exchange Stabilization Fund. One of the first questions I asked was why this fund was the size that it was. Greenspan reported to me somewhat sheepishly their conclusion

> that, depending upon certain assumptions that were difficult to pin down, the optimal level [of reserves] was somewhere between $20 billion and $2 trillion.

Recent advances in the corporate finance literature on the dynamics of corporate savings and cash management can provide a helpful reference point for the analysis of a nation's foreign exchange reserves management (see Almeida et al. (2014) for a recent survey). But there is an important difference between corporate cash management and foreign exchange reserve management. When a corporation's cash holdings reach the point where the marginal corporate value of cash equals the after-tax value of cash to shareholders, it is optimal for the corporation to pay out a dividend (Bolton, Chen, and Wang (2011, 2013, 2014)). There is no exact analog for a dividend payout for the holders of a nation's currency, which raises the question of what a payout means for a nation that has accumulated excessively large foreign exchange reserves. Typically, in practice, foreign exchange reserve drawdown means foreign exchange intervention to support a falling exchange rate. This is analogous to a stock repurchase. Engaging in such repurchase operations makes sense when there is a risk that the value of the domestic currency depreciates excessively as a result of potentially self-fulfilling inflation expectations. Past experience with such interventions, however, is not encouraging, for countries in such situations have found that their foreign-currency reserves are insufficient to fund large enough interventions to have a long-lasting impact on the exchange rate. Also, note that for countries such as Switzerland, Japan, and Denmark, it does not make sense to spend their "excessive" reserves supporting an already overvalued exchange rate. So, how should these countries pay out their excess reserves? The obvious answer seems to be in the form of fiscal transfers. But this begs the question of what the criteria should be for when such transfers are justified.

Another important caveat to the analogy of fiat money and equity is that fiat money is not just a store of value, but also, and mainly, a means of exchange. As long as the velocity of circulation of money is constant, a relatively straightforward parallel can be made between the purchasing power of money and a stock's earnings per share. But, in practice, the velocity of circulation of money is endogenous and time-varying, which limits the suitability of the analogy.

As we mentioned before, treating a nation as a consolidated unit with a representative agent is another considerable oversimplification. In reality, a nation's capital structure, that is, the currency composition of its debt and its money supply (M2), is determined not solely by the nation's government, but also by private actors, corporations, banks, and households acting independently and imposing externalities on each other. One simple approach to disaggregating a nation into a government and a private sector with multiple agents is the dual-agency framework proposed by Tirole (2002, 2003), in which private firms move first by investing and financing their investments with a combination of domestic and foreign debt, and the government moves second by introducing policies that are friendly to domestic firms (see also Jeanne (2003)). The

dual-agency problem faced by international lenders is that they must deal with not only private sector borrowers, but also the government's strategic behavior. A central prediction that emerges from this framework is that private agents (borrowing firms and international lenders) choose to distort their debt contract in an effort to mitigate the agency problem with respect to the government. In particular, they engage in either more short-term debt financing (Tirole (2003)) or more foreign-currency debt financing (Jeanne (2003)) to reduce the government's ability to introduce policies that favor domestic borrowers at the expense of international lenders. Basically, the argument is that, by making their debt structures more fragile, borrowers and lenders are able to keep unwelcome ex-post government policies in check.

In a fully dynamic model, the timing of moves between the debt contracting parties and the government is blurred and the extent to which debt fragility is deliberately designed to discipline governments is less obvious. Recently, Du and Schreger (2015) consider such a dynamic model to study the interaction between the currency compositions of sovereign and corporate debts. In line with the dual-agency analysis of Tirole, they show that, when corporations rely more on foreign-currency debt, the government is more willing to reduce inflationary pressures so as to avoid a depreciation of the domestic currency, which could have potentially crippling consequences for corporate balance sheets. In a cross-country analysis of emerging market debt, they also find that, although governments have recently reduced their reliance on foreign-currency debt (thereby reducing the risk of default), corporations have not. Interestingly, they find that this gives rise to a higher risk of default on domestic-currency government debt because of governments' greater concern to keep inflation under control.

Externalities can also be present between private borrowers. Applying the classic notion of fire-sale externalities in corporate finance (see Shleifer and Vishny (2011)) to an international finance setting, Korinek (2010) shows that, when decentralized firms' borrowing constraints vary endogenously with the real exchange rate, they may rely excessively on foreign-currency debt. Indeed, a commonly observed pattern around financial crises is that a lending boom that precedes the crisis is increasingly funded with foreign-currency debt. What is more, reliance on this debt accelerates in response to monetary tightening shortly before the crisis, as interest rates on foreign debt are then relatively lower. Why they are lower is not entirely clear. Some authors have suggested that international lenders are far-sighted and rationally anticipate a bailout in the event of a crisis (see Schneider and Tornell (2004)). Whether this is true is difficult to ascertain, but more often than not distressed foreign-currency borrowers, in particular banks, are bailed out by their governments during a crisis, effectively consolidating private sector and government foreign-currency debt.

This is an important mechanism behind several countries' rapid buildup of foreign currency debt. For example, the government debt of Spain and Ireland shot up in the crisis of 2007 to 2009 as a result of bailouts of banks and the consolidation of private and government debt (see Acharya, Drechsler, and Schnabl (2014)). Such foreign-currency debt buildups are obviously not the

consequence of a carefully weighed capital structure decision, but the outcome of uncoordinated and poorly regulated private borrowing choices. The exposure of nations' balance sheets to such unplanned consolidation is a problem specific to sovereign debt and complicates the determination of the optimal capital structure of nations in situations in which debt can be accumulated in both the private and the public sectors.

As Bolton and Jeanne (2011) and Gennaioli, Martin, and Rossi (2014) show, a sovereign debt crisis then sparks a banking crisis largely for two main reasons. First, banks typically hold a significant fraction of sovereign debt on their balance sheet, and thus a sovereign default puts their solvency at risk. Second, an insolvent sovereign can no longer offer a backstop to banks, which puts them at risk of a run. Sovereign defaults that bring about a banking crisis, and the shutdown of the banking system, also result in exceptionally large output contractions, as the Argentina crisis of 2001 to 2002 and the Greek crises of 2007 to 2015 show. In light of the risk of economic devastation that countries face when their banking systems become hostage to a foreign-currency debt crisis, it is all the more important to rely on equity or domestic-currency debt financing (provided, of course, that the costs of such financing are not prohibitive) as an important advantage of domestic-currency debt financing is that it does not put the banking system at risk.

The core analysis outlined in the previous section oversimplifies the problem not only by considering a sovereign state as a single consolidated unit, but also by confining the analysis to a small open economy setting. As Gourinchas and Jeanne (2012) argue, global economic growth and the growing share of output from emerging market economies (with a high savings rate) could produce a global scarcity of safe assets. They refer to this development as the modern incarnation of Triffin's (1960) dilemma. The supply of domestic-currency debt issued by reserve-currency countries can tap into this global demand for safe assets and at the same time provide a cheap source of funding for investment in these countries. Thus, in a global context, the market-timing opportunities that countries like Switzerland and Japan have exploited to build large foreign-currency reserves may be related to this global scarcity of safe assets. In other words, the supply of safe assets by reserve-currency countries to the world economy is likely to be an important factor determining their capital structure. Which countries are more likely to be able to play this role of suppliers of safe assets has recently been analyzed by He, Krishnamurthy, and Milbradt (2015). They argue that, in periods of high global demand, countries with a large outstanding stock of debt can extract the convenience yield associated with reserve assets, even if they expose themselves to rollover risk in periods of lower global demand for safe assets.

From a general equilibrium perspective, a number of important questions arise concerning the demand and supply of reserve assets in the current environment. First, when Switzerland and Japan build up foreign exchange reserves by supplying Swiss Franc and Yen denominated reserve assets to the global economy, does this result in a net increase in the global supply of reserve assets? If these countries are buying U.S. dollar or Euro-denominated

bonds, arguably all they are doing is swapping one reserve asset for another. However, if Swiss Francs are printed to purchase stocks and build an equity portfolio, as the Swiss National Bank has done, this would amount to a net increase in global reserve assets. Second, if reserve-currency countries are net suppliers of reserve assets, this could mean that other countries are borrowers in foreign-currency denominated assets. If these borrowers are governments that fund their expenditures with foreign-currency denominated debt, then a perverse outcome of the increased supply of reserve assets could be greater fragility and default risk for the countries that borrow in foreign-currency debt. However, if the borrowers are primarily banks or corporations, then the greater global supply of reserve assets can improve the efficiency of global money markets and reduce global deflationary pressures. Third, if multiple reserve-currency countries supply reserve assets in a global decentralized market for reserve assets, will the equilibrium in this market result in an efficient allocation of reserve assets?

III. Reflections on Sovereign Debt Restructuring

The framework outlined above models the cost of default on sovereign debt as a percentage loss in output following default. The size of this loss in the year following the Argentina default in 2001 was 11% of GDP. Although Greece did not technically default on its debt, in the years following the Greek government's revelation in November 2009 that Greece was in financial distress, Greece's GDP shrank by over 25%. Such a large output loss following a default is driven first and foremost by the collapse of the banking system and the freezing-up of credit markets. In addition, trade sanctions and the withdrawal of trade credit result in a collapse of trade. Both the breakdown of credit markets and the collapse of trade result in enormous ex-post inefficiencies that cause a huge amount of suffering mostly for innocent bystanders. Is this a necessary and inevitable by-product of well-functioning sovereign debt markets? Is this "stick" needed to impose repayment discipline on sovereigns?

The IMF was created in 1944 with a core mission of helping forestall sovereign debt defaults and the economic devastation that may follow. Until the Russian debt crisis of 1998, the exclusive modus operandi of the IMF in sovereign debt crises had been to arrange bailouts (so-called IMF Stand-By Agreements) to avoid default at all cost. This bailout model reached its limits with the Russian default in 1998 and the subsequent default of Argentina in 2001, when moral hazard concerns became too evident to be ignored. Another more prosaic reason why the bailout model reached an impasse is that the IMF balance sheet became simply too small to carry increasingly large bailout packages.

With the return of sovereign debt defaults, the question of how to handle sovereign debt crises other than through bailouts, that is, how to facilitate debt restructuring and avoid the economic costs of an outright chaotic default, inevitably came to the forefront. Policy discussions culminated with the proposal in 2001 of a new sovereign debt restructuring mechanism (SDRM) by

the Deputy Managing Director of the IMF, Anne Krueger. The SDRM was seen as a bankruptcy procedure for sovereigns similar to corporate (chapter 11) or municipal (chapter 9) bankruptcy procedures. As with corporate bankruptcy, the main benefits of the SDRM were seen to be a stay on debt collection actions, an orderly and fair debt reduction process adjudicated by an independent court, and debtor-in-possession financing (mostly provided by the IMF) to sustain the distressed sovereign during the debt restructuring period.

Although there was considerable worldwide political support for the SDRM in 2002, the IMF ultimately failed to secure the backing of a few key member countries, in particular, the United States, Mexico, and Turkey. The proposal was eventually shelved and the only significant development from the debates around the SDRM was a push toward the systematic inclusion of collective action clauses (CACs) into sovereign debt contracts. These clauses make it easier for sovereign bondholders to renegotiate bonds in situations in which the sovereign is near default (typically CACs require a supermajority of bondholders to approve a haircut, which is better than a requirement of unanimity for corporate bond restructuring in the U.S. outside bankruptcy; see Gelpern and Gulati (2006)).

CACs can facilitate a bond restructuring, but they do little to stop individual creditor debt collection actions if there is no aggregation across different bond issues. The concern that there could be a proliferation of disruptive lawsuits by individual creditors following a sovereign debt default was a primary motivation for introducing the SDRM. This concern has taken unimaginable proportions in the case of Argentina's debt default. After defaulting on its debt in 2001, Argentina finally organized a debt exchange in 2005 that involved a major write-down. However, rather than accept this exchange offer, several major hold-out investors sued Argentina in New York. These lawsuits eventually resulted in an unprecedented disruption for Argentina and the holders of its 2005-restructured debt, when in October 2012, the Southern District Court of New York enjoined Argentina to stop servicing its restructured debt until it had met its obligations to the hold-out investors.[4] Without getting caught up in the legal technicalities of the case, the ruling prevented Argentina from continuing to service its restructured debt and in the end forced Argentina to also default on its restructured bonds in August 2014. The ruling of the Southern District Court of New York could have broader implications for the entire sovereign bond market. Unless sovereign issuers take care to avoid falling victim to the pari passu clauses that were the sources of the Southern District Court of New York's injunction, they may find themselves in the same position as Argentina—unable to service their restructured debt obligations (see Gulati and Scott (2012, 2016)). And if court injunctions preventing payment of debt obligations are anticipated, creditors may be more reluctant to agree to a debt restructuring in the first place.

[4] The court's ruling was later upheld by the United States Court of Appeals for the Second Circuit. The Supreme Court eventually refused to hear Argentina's final appeal.

While the Argentina saga has been unfolding, the other major development in the sovereign debt universe has been the Eurozone debt crisis of 2009 to 2015. Following an unsuccessful first bailout in May 2010, Greece was able to wipe out a debt obligation of over 100 billion Euro to its private creditors in an orderly debt restructuring in March 2012. This debt write-down, however, was accompanied by a second major bailout, followed by a third bailout in August 2015 after a dramatic but ultimately unsuccessful attempt by the new Greek administration to extract further debt write-offs from its creditors. Even though the debt write-off of 2012 represented around 50% of GDP, Greece's debt-to-GDP ratio now still stands at 180% of GDP.[5]

In sum, following nearly two decades of debate and several attempts at introducing a more orderly sovereign debt restructuring procedure, there has been virtually no progress in shaping a more efficient and fair debt restructuring regime, and this despite mounting evidence of the massive economic costs wrought by the disorderly resolution of sovereign debt crises. If anything, the costs of default are higher than ever, pushing overindebted sovereigns to desperately continue servicing unsustainable debt obligations.

That the move toward a bankruptcy regime for sovereigns is slow and contentious is not entirely surprising in light of the history of U.S. corporate bankruptcy reform. After all, it took over 100 years for the United States to perfect an efficient corporate bankruptcy law, which is increasingly seen as the model to follow around the world (see Skeel (2001)). The Bankruptcy Reform Act of 1978, although initially heavily criticized, is now well established. Four core principles underpinning corporate bankruptcy are widely accepted as essential: (1) an automatic stay of all individual debt collection actions to prevent an inefficient and disorderly run by creditors to the courthouse; (2) the debtor remains in possession of and continues to run the firm while debt restructuring proceedings are under way; (3) debtor-in-possession financing to preserve the going-concern value of the firm; and (4) enforcement of absolute priority rules.[6]

It took nearly as long to refine a resolution procedure for failed banks. Only after the savings and loan crisis of the 1980s and the passage of the Federal Deposit Insurance Corporation (FDIC) Improvement Act of 1991 has the modern bank resolution model around "prompt corrective action" and FDIC receivership taken shape. In Europe, a formal bank resolution procedure under the Single Resolution Mechanism was adopted in 2014 and will become operative in 2016. The model for the resolution of systemically important financial institutions (SIFIs) was only proposed for approval by the Financial Stability Board (FSB) this year, following years of protracted and complex negotiations between bank regulators. A critical difference between bank resolution and a

[5] The other widely covered debt restructuring episode occurred in Cyprus in 2012, where bank deposits in excess of 100.000 Euros were partially "bailed in" as a condition for a bailout package of around 10 billion Euros.

[6] This does not mean that bankruptcy is now free of controversy. Far from it, as the political battles around the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 have shown.

nonfinancial corporate bankruptcy is the greater need to resolve a failed financial institution without disrupting day-to-day operations, as any hint of disruption can trigger a bank run and, in turn, a banking panic, which would defeat any attempt to salvage the healthy parts of the financial system.

Unlike for nonfinancial corporations, it is difficult to implement a comprehensive automatic stay for banks while at the same time allowing banks to continue operating normally. The choice often ends up being between a pure bank holiday or business as usual. This is why the benchmark FDIC receivership intervention is to engineer, whenever feasible, a "purchase and assumption" takeover of a failed bank by a healthy bank over a weekend, so that the failed bank's operating affiliates can be open for business on the next Monday.[7] This surgically efficient intervention is typically not possible for a failed SIFI, however, since there may be no readily available healthy acquirer on hand, especially in a financial crisis. This is why the new resolution model proposed by the FSB for SIFIs is to engineer a long-term debt write-off at the holding company level, while ensuring that operating affiliates remain open for business. Resolution of an SIFI then essentially means that only long-term liabilities held by the holding company, which are part of the so-called required total loss-absorbing capacity (TLAC) of a SIFI can be written down.[8] All other liabilities, which may be essential for day-to-day operations, remain untouched so that normal banking operations can continue.

Why do I mention SIFI resolution in the context of sovereign debt restructuring? Because, to date, the main inspiration for the design of an SDRM has been corporate (chapter 11) or municipal (chapter 9) bankruptcy (see Krueger (2001), Bolton (2003), Bolton and Skeel (2004, 2005), Hagan (2005), Hagan and Krueger (2005), and Buchheit et al. (2013)). However, while in many ways, this is a relevant parallel to understand the benefits of a stay on debt collection, debtor-in-possession financing, and the importance of the absolute priority rule, it may miss the mark by underestimating the immediate economic disruptions that are likely to follow the activation of a sovereign debt restructuring procedure. As Bolton and Jeanne (2011) argue, a key difficulty for countries facing sovereign debt restructuring is that the banking system is put at risk, to the point that banks may no longer be able to operate normally. This difficulty became abundantly clear in the summer of 2015 in Greece, where an extended bank holiday had to be declared to forestall an imminent run caused by the very public and tense debt restructuring debates. The problem with the Greek precedent is that it has made the prospect of any form of debt restructuring even more remote. Sovereign debt relief is less politically feasible than ever, at least in the Eurozone, with the consequence that debt overhang will be a heavy and prolonged burden, possibly for decades to come.

[7] When the failed bank's liabilities are too large to be entirely assumed by the acquiring bank, the FDIC may also absorb some of the liabilities to facilitate the transaction. In the rare situation in which the failed bank has to be closed down, the FDIC liquidates the bank's assets and uses the proceeds as a priority to meet its deposit insurance obligations.

[8] Proposed TLAC requirements are in excess of 20% of bank assets.

So how can a sovereign debt restructuring be organized with minimal economic disruption? This is where the parallel with the proposed resolution procedure for SIFIs is pertinent. The key feature of the SIFI resolution model is the earmarking of a special category of debt that will be written down in the event of financial distress, and the requirement that SIFIs issue a fraction of their liabilities as "bail-in-able" debt. Under the intended resolution scenario, a distressed U.S. SIFI could be put under the resolution authority of the FDIC,[9] which would write down the long-term bail-in-able debt held by the bank holding company to make the SIFI solvent again but would leave other liabilities untouched, thereby allowing all SIFI affiliates to continue operating as usual. One can envision sovereigns being similarly required to issue a fraction of long-term bail-in-able bonds that cannot be held by banks and that can be written down under special circumstances of economic or financial distress. The write-down would immediately put the sovereign back on a sound financial footing and not create any disruptions to its banking system. The parallel with SIFIs can be pushed further and a multilateral agency like the IMF can be envisioned as having a similar authority to the FDIC in resolving a failed sovereign. Access to IMF emergency funding can be conditioned on fulfilling bail-in-able debt requirements, just as access of a SIFI to central bank emergency funding is conditioned on fulfilling TLAC requirements. Even simpler, the bail-in-able debt can be structured as a contingent convertible (CoCo) bond with a trigger, such as a debt-to-GDP ratio, which would activate a prespecified write-down of the bail-in-able debt if crossed.

Interestingly, the creation of two classes of sovereign debt—a junior and senior debt—has been at the center of a number of proposals to ease the Eurozone debt crisis, but for slightly different reasons. The first such proposal by Delpla and von Weizsäcker (2010) is to create two classes of Eurobonds, blue and red bonds. The blue bonds are senior and would be jointly backed by all Euro-member states, while the red bonds are junior and would be backed only by the issuing nation.[10] Only the red bonds would be bail-in-able and as such should not be held by banks. One key advantage of this scheme is to increase the attractiveness of blue bonds as global reserve assets, and, as such, to lower the cost of sovereign debt funding for the Eurozone as a whole. Another benefit of this proposal is to strengthen fiscal responsibility for Euro-member governments. The part of the proposal that has received the greatest attention, and generated most of the controversy, is the blue bond part, as it is seen as a step toward a fiscal union for Euro-member states, which some states are adamantly opposed to. Another proposal by Brunnermeier et al. (2011) is to create European safe bonds, what they refer to as ESBies. These are similar to blue bonds but do not entail fiscal union, since they are issued by an intermediary agency in the form of securities backed by Euro-member sovereign bonds. In other words, ESBies are created through securitization rather than

[9] The Orderly Liquidation Authority, or OLA, is a misnomer.

[10] The Eurobills proposal by Hellwig and Philippon (2011) proposes a variant of blue bonds in the form of short-term (joint liability) bonds to guarantee seniority.

through direct consolidation by Euro-member state fiscal authorities. As such, no explicit joint guarantee is involved.

Arguments over the desirability of a fiscal union, and the inevitable transfers from rich to poor member countries that it would entail, have distracted attention from the other part of the Delpla and von Weizsäcker (2010) proposal, namely, the red bonds, which is more relevant for sovereign debt resolution. It is important to note in this respect that a blue-and-red bond, that is, bail-in-able and non-bail-in-able debt, construction is possible without any fiscal mutualization. As with TLAC for SIFIs, each sovereign nation can issue both types of debt and implement a streamlined SDRM that would involve minimal economic disruptions. In effect, the red bonds offer a way of completing the debt markets for Eurozone member states, which cannot issue domestic-currency bonds. The ability to issue bonds with terms that can be changed in response to local conditions is an important substitute.

As hinted at above, this simple sovereign debt resolution scheme would, in effect, be similar to a CoCo for sovereigns. Alternatively, it can be seen as a coarse type of GDP-indexed debt instrument, where the debt write-down would be triggered if the nation's debt-to-GDP ratio exceeds a predetermined threshold. Admittedly, some regulation of the bail-in-able debt requirement may be necessary, and the conditions under which the bail-in-able debt can be written down need to be carefully calibered, but these institutional design challenges do not seem to be insurmountable. Rather, the main current obstacle to a more orderly sovereign debt restructuring model is a lack of political will. One example that is particularly revealing in this respect is the recent attempt by the IMF (2013) to rekindle discussions around the need for a more orderly sovereign debt restructuring regime, and the Brookings Institution report calling for 1) the introduction of aggregation CACs that allow for debt restructuring across all outstanding bond issues of a sovereign (subject to supermajority approval), and 2) the creation of a Sovereign Debt Adjustment Facility that aims to achieve the same goals as the SDRM but with a lighter touch (see Buchheit et al. (2013)).[11] This is the most ambitious recent proposal. It is hardly a radical manifesto, yet it has even less political support than the SDRM had in 2002.

An important reason for the change in political sentiment is that the Eurozone debt crisis of 2009 to 2015 has hardened the stance of many European central bankers and politicians, particularly following the October 19, 2010 agreement between Angela Merkel and Nicolas Sarkozy in Deauville to condition funding by the European Stability Mechanism to a member state on a partial bail-in of its debt. When Euro-periphery debt spreads shot up at the peak of the crisis in 2011, many prominent commentators blamed the Deauville agreement, and once it became a priority to "do whatever it takes" to smother

[11] Interestingly, the same report proposes a special sovereign debt restructuring procedure for the Eurozone on the grounds that "The Euro area differs from other integrated regions both in that its members have fewer instruments to deal with debt crises— *they cannot devalue or inflate* [emphasis added]—and because a crisis in one member can have catastrophic consequences for others (by threatening the common currency)." (See Buchheit et al. (2013, p.IV)).

the surge in periphery debt spreads and save the Euro, any allusion to debt restructuring or bail-in was unwelcome. Alas, the inevitable consequence is prolonged debt overhang in the Eurozone. We are now in the paradoxical situation where too-big-to-fail banks in Europe are subject to strict bail-in requirements, whether under the European Single Resolution Mechanism, the Dodd-Frank Act, or the FSB's proposed resolution regime for SIFIs, but no bail-in policy or conditions have been formulated for sovereign states.

IV. Conclusion

I hope that this discussion has shown that much can be learned by drawing an analogy between sovereign finance and corporate finance. Of course, the fact that nations, like corporations, can be severely financially constrained is not really a revelation. As such, this paper mostly revives old themes in light of new evidence or new research in corporate finance.

Early intellectual arbitrage between the two fields extended the notion of debt overhang, first explored in the context of corporations (Myers (1977)), to developing countries (Sachs (1984), Krugman (1988)). This analogy provided the conceptual foundations for the movement that led to the heavily indebted poor countries (HIPCs) debt relief initiative of 1996.

The parallel between corporate equity and a nation's currency explored in Bolton and Huang (2016) offers a way to complete the debt overhang analogy, by allowing for the articulation of a key trade-off in a nation's capital structure, and by capturing the redistributive costs of inflation associated with domestic-currency financing. That is, the inflation expectations associated with money issues involve a cost for domestic residents to the extent that they result in a transfer of wealth to foreign investors and a loss of purchasing power.

When should a nation borrow in foreign currency versus domestic currency, when should a nation build foreign exchange reserves, and how is debt overhang affected by the currency composition of a nation's debt? These are some of the questions that can be addressed using the above framework. The theory builds not only on core corporate finance notions from Myers (1977) and Myers and Majluf (1984), but also on insights from the more recent market-timing perspective of Baker and Wurgler (2002).

Optimal financing choices for a nation may change according to the nation's circumstances and changes in global financial markets. As a result, a nation's capital structure at any moment in time will be the sum of numerous history-dependent trade-offs, as Baker and Wurgler (2002) argue for corporations. A nation's financing choices at any given moment, however, are not necessarily optimal choices. They are as likely to reflect political and ideological constraints as a carefully balanced decision in the best interest of the nation. Therefore, compared to corporations, one should expect country fixed effects to explain an even greater fraction of cross-country variation in debt-to-GDP ratios or the composition of public debt than firm fixed effects for corporate leverage. Some evidence to this effect is given by Forslund, Lima, and Panizza (2011), who study the determinants of public debt composition for a sample of over 85

Table I

Explanatory Power of Country and Year Fixed Effects

This table reports adjusted R^2s for a regression of the ratio of domestic debt outstanding to GDP $(\text{Debt/GDP})_{jt}$, where countries are indexed by j and years are indexed by t, on country dummies (Model (1)), year fixed effects (Model (2)), with year dummies constant across countries, and both country and year dummies (Model (3)).

	Adjusted-R^2 for Model with:		
	Country Dummies (1)	Year Dummies (2)	Country Dummies and Year Dummies (3)
1980 to 2015	0.781	0.008	0.0798
1995 to 2015	0.778	0.024	0.802

Notes: Specifically, the regression equations for Models (1) to (3) are as follows:

$$(\text{Debt/GDP})_{jt} = \alpha + \theta_j + \varepsilon_{jt}, \quad (1)$$
$$(\text{Debt/GDP})_{jt} = \alpha + \delta_t + \varepsilon_{jt}, \quad (2)$$
$$(\text{Debt/GDP})_{jt} = \alpha + \theta_j + \delta_t + \varepsilon_{jt}, \quad (3)$$

where θ_j is country dummy, δ_t is year dummy, ε_{jt} is an error term, and α is constant. The full sample comprises 22 countries over the 1980 to 2015 period, which are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States. Due to some missing observations before 1995, we narrow our sample period to 1995–2015 and rerun the three tests. The results are similar. Country fixed effects explain 77.8% of the variation in debt-to-GDP, while year fixed effects only account for 2.4%. Country and year fixed effects together account for 80.2% of variation in debt-to-GDP.

developing countries for the period 1994 to 2006 and find that, when country fixed effects are added, standard explanatory variables such as inflation or the country's current account balance are statistically insignificant. The main significant variable positively associated with the domestic-currency debt share is GDP growth. In addition, Table I reports that the adjusted R^2 from a regression of debt-to-GDP on country fixed effects for 22 countries over the period 1980 to 2015 is 78%, implying even larger time-invariant, unexplained variation in countries' debt-to-GDP ratios than Lemmon, Roberts, and Zender (2007) found for corporate leverage in the United States.[12]

Obviously, the corporate finance framing of a nation's optimal capital structure outlined here is just a sketch meant to suggest questions for future research. One important question that I have not addressed is how the severity of debt overhang problems is related to the currency composition of the nation's debt. One would expect that if the government mostly funds public expenditures with domestic-currency debt, this would reduce debt overhang problems, as the government can always service the debt by printing money (and, if necessary, repurchase the debt by printing money). Other important avenues for

[12] The time-series variation in debt-to-GDP is negligible. In column (3), both country dummies and year dummies are included and the adjusted-R^2 is 0.798.

future research are capital structure dynamics and governance issues. What are the governance implications of debt relief? Some of the HIPC countries that have benefited from debt relief now find themselves again in a debt overhang situation. If debt relief may beget future overindebtedness and debt overhang, does this mean that debt relief is never warranted?

REFERENCES

Acharya, Viral, Itamar Drechsler, and Philipp Schnabl, 2014, A Pyrrhic victory? Bank bailouts and sovereign credit risk, *Journal of Finance* 69, 2689–2739.

Aizenman, Joshua, and Jaewoo Lee, 2007, International reserves: Precautionary versus mercantilist views, theory, and evidence, *Open Economies Review* 18, 191–214.

Almeida, Heitor, Murillo Campello, Igor Cunha, and Michael Weisbach, 2014, Corporate liquidity management: A conceptual framework and survey, *Annual Review of Financial Economics* 6, 135–162.

Baker, Malcolm, 2009, Capital market-driven corporate finance, *Annual Review of Financial Economics* 1, 181–205.

Baker, Malcolm, Jeremy Stein, and Jeffrey Wurgler, 2003, When does the market matter? Stock prices and the investment of equity dependent firms, *Quarterly Journal of Economics* 118, 969–1006.

Baker, Malcolm, and Jeffrey Wurgler, 2002, Market timing and capital structure, *Journal of Finance* 57, 1–32.

Bolton, Patrick, 2003, Towards a statutory approach to sovereign debt restructuring: Lessons from corporate bankruptcy practice around the world, *IMF Staff Papers* 50, 41–71.

Bolton, Patrick, Hui Chen, and Neng Wang, 2011, A unified theory of Tobin's q, corporate investment, financing, and risk management, *Journal of Finance* 66, 1545–1578.

Bolton, Patrick, Hui Chen, and Neng Wang, 2013, Market timing, investment, and risk management, *Journal of Financial Economics* 109, 40–62.

Bolton, Patrick, Hui Chen, and Neng Wang, 2014, Debt, taxes, and liquidity, NBER Working paper No. 20009.

Bolton, Patrick, and Haizhou Huang, 2016, The capital structure of nations, Working paper, Columbia University.

Bolton, Patrick, and Olivier Jeanne, 2007, Structuring and restructuring sovereign debt: The role of a bankruptcy regime, *Journal of Political Economy* 115, 901–924.

Bolton, Patrick, and Olivier Jeanne, 2009, Structuring and restructuring sovereign debt: The role of seniority, *Review of Economic Studies* 76, 879–902.

Bolton, Patrick, and Olivier Jeanne, 2011, Sovereign default risk in financially integrated economies, *IMF Economic Review* 59, 162–194.

Bolton, Patrick, and David Skeel, 2004, Inside the black box: How should a sovereign bankruptcy framework be structured?, *Emory Law Journal* 53, 763–822.

Bolton, Patrick, and David Skeel, 2005, Redesigning the international lender of last resort, *Chicago Journal of International Law* 6, 177–202.

Brunnermeier, Markus, Luis Garicano, Philip Lane, Marco Pagano, Ricardo Reis, Tano Santos, David Thesmar, Stijn Van Nieuwerburgh, and Dimitri Vayanos, 2011, ESBies: A realistic reform of Europe's financial architecture, in Thorsten Beck, ed.: *The Future of Banking* (VoxEU.org eBook, Centre for Economic Policy Research, London).

Buchheit, Lee, Anna Gelpern, Mitu Gulati, Ugo Panizza, Beatrice Weder di Mauro, and Jeromin Zettelmeyer, 2013, Revisiting sovereign bankruptcy, The Brookings Institution. Available at http://www. brookings.edu/research/reports/2013/10/soveoign-debt

Bulow, Jeremy, and Kenneth Rogoff, 1989, A constant recontracting model of sovereign debt, *Journal of Political Economy* 97, 155–178.

Bulow, Jeremy, Lawrence Summers, and Victoria Summers, 1990, Distinguishing debt from equity in the junk bond era, in: John Shoven and Joel Waldfogel, eds.: *Debt, Taxes, and Corporate Restructuring* (The Brookings Institution, Washington, DC).
Burnside, Craig, Martin Eichenbaum, and Sergio Rebelo, 2001, Prospective deficits and the Asian currency crisis, *Journal of Political Economy* 109, 1155–1198.
Caballero, Ricardo, and Stavros Panageas, 2007, A global equilibrium model of sudden stops and external liquidity management, Discussion Paper, MIT, Department of Economics.
Calvo, Guillermo, 1988, Servicing the public debt: The role of expectations, *American Economic Review* 78, 647–661.
Céspedes, Luis, and Andres Velasco, 2012, Macroeconomic performance during commodity price booms and busts, *IMF Economic Review* 60, 570–599.
Chang, Roberto, and Andres Velasco, 2000, Liquidity crises in emerging markets: Theory and policy, in Ben S. Bernanke and Julio Rotemberg, eds.: *NBER Macroeconomics Annual 1999* (MIT Press, Cambridge, MA).
Cochrane, John, 2005, Money as stock, *Journal of Monetary Economics* 52, 501–528.
Cole, Harold, and Timothy Kehoe, 2000, Self-fulfilling debt crises, *Review of Economic Studies* 67, 91–116.
DeAngelo, Harry, and Richard Roll, 2015, How stable are corporate capital structures?, *Journal of Finance* 70, 373–418.
Delpla, Jacques, and Jakob von Weizsäcker, 2010, The blue bond proposal, Bruegel Policy Brief 420. Available at http://bruege/.org/2010/05/the-band-proposal/
Dittmar, Amy, and Anjan Thakor, 2007, Why do firms issue equity?, *Journal of Finance* 62, 1–54.
Dominguez, Kathryn, Yuko Hashimoto, and Takatoshi Ito, 2012, International reserves and the global financial crisis, *Journal of International Economics* 88, 388–406.
Dooley, Michael, David Folkerts-Landau, and Peter Garber, 2004, The revived Bretton Woods system, *International Journal of Finance & Economics* 9, 307–313.
Du, Wenxin, and Jesse Schreger, 2015, Sovereign risk, currency risk, and corporate balance sheets, Working paper, Department of Economics, Harvard.
Durdu, Ceyhun, Enrique Mendoza, and Marco Terrones, 2009, Precautionary demand for foreign assets in emerging economies: An assessment of the new mercantilism, *Journal of Development Economics* 89, 194–209.
Eaton, Jonathan, and Mark Gersovitz, 1981, Debt with potential repudiation: Theoretical and empirical analysis, *Review of Economic Studies* 48, 289–309.
Eichengreen, Barry, Ricardo Hausmann, and Ugo Panizza, 2003, The pain of original sin, in Eichengreen et al., eds.: *Other People's Money: Debt Denomination and Financial Instability in Emerging Market Economies* (University of Chicago Press, Chicago and London).
Forslund, Kristine, Lycia Lima, and Ugo Panizza, 2011, The determinants of the composition of public debt in developing and emerging market countries, *Review of Development Finance* 1, 207–222.
Gelpern, Anna, and Mitu Gulati, 2006, Public symbol in private contract: A case study, *Washington University Law Review* 84, 1627–1716.
Gennaioli, Nicola, Alberto Martin, and Stefano Rossi, 2014, Sovereign default, domestic banks, and financial institutions, *Journal of Finance* 69, 819–866.
Gourinchas, Pierre-Olivier, and Olivier Jeanne, 2012, Global safe assets, BIS Working paper No. 399.
Gulati, Mitu, and Robert Scott, 2012, *The Three and a Half Minute Transaction: Boilerplate and the Limits of Contract Design* (The University of Chicago Press, chicago).
Gulati, Mitu, and Robert Scott, 2016, The costs of encrusted contract terms, Discussion paper, Duke Law School.
Hagan, Sean, 2005, Designing a legal framework to restructure sovereign debt, *Georgetown Journal of International Law* 36, 299–402.
Hagan, Sean, and Anne Krueger, 2005, Sovereign workouts: An IMF perspective, *Georgetown Journal of International Law* 36, 203–218.

Hahn, Frank, 1965, On some problems of proving the existence of an equilibrium in a monetary economy, in F.H. Hahn and F.P.R. Brechling, eds.: *The Theory of Interest Rates* (Macmillan, London).

He, Zhiguo, Arvind Krishnamurthy, and Konstantin Milbradt, 2015, A model of the reserve asset, Discussion paper, University of Chicago, Booth School of Business.

Hellwig, Christian, and Thomas Philippon, 2011, Eurobills, not Eurobonds, Vox (CEPR'S policy portal), December 2. Available at http://voxeu.org/article/eurebills-not-euro-bonds

International Monetary fund (IMF), 2013, Sovereign debt restructuring: Recent developments and implications for the Fund's legal and policy framework, staff paper. Available at http://www.imf.org/external/np/pp/eng/2013/042613.pdf

Jeanne, Olivier, 2003, Why do emerging economies borrow in foreign currency?, IMF Working paper 03/177.

Jeanne, Olivier, 2007 International reserves in emerging market countries: Too much of a good thing?, in W.C. Brainard and G.L. Perry, eds.: *Brookings Papers on Economic Activity* (The Brookings Institution, Washington, DC).

Jeanne, Olivier, 2009, Debt maturity and the international financial architecture, *American Economic Review* 99, 2135–2148.

Jeanne, Olivier, and Romain Ranciere, 2011, The optimal level of international reserves for emerging market countries: A new formula and some applications, *The Economic Journal* 121, 905–930.

Jeanne, Olivier, and Charles Wyplosz, 2001, The international lender of last resort: How large is large enough?, NBER Working paper No. 8381.

Jeanne, Olivier, and Jeromin Zettelmeyer, 2005, Original sin, balance-sheet crises, and the roles of international lending, in B. Eichengreen and R. Hausmann, eds.: *Other People's Money: Debt Denomination and Financial Instability in Emerging Market Economies* (University of Chicago Press, Chicago and London).

Korinek, Anton, 2010, Excessive dollar borrowing in emerging markets: Balance sheet effects and macroeconomic externalities, Discussion paper, University of Maryland, Department of Economics.

Krueger, Anne, 2001, A new approach to sovereign debt restructuring: Preliminary considerations, IMF Report

Krugman, Paul, 1988, Financing vs. forgiving a debt overhang, *Journal of Development Economics* 29, 253–268.

Lemmon, Michael, Michael Roberts, and Jamie Zender, 2007, Back to the beginning: Persistence and the cross-section of corporate capital structure, *Journal of Finance* 63, 1575–1608.

Myers, Stewart, 1977, The determinants of corporate borrowing, *Journal of Financial Economics* 5, 147–175.

Myers, Stewart, 1984, The capital structure puzzle, *Journal of Finance* 39, 575–592.

Myers, Stewart, and Nicholas Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13, 187–221.

Sachs, Jeffrey, 1984, Theoretical issues in international borrowing, *Princeton Studies in International Finance* 54, 1–41.

Scheinkman, José, and Wei Xiong, 2003, Overconfidence and speculative bubbles, *Journal of Political Economy* 111, 1183–1220.

Schneider, Martin, and Aaron Tornell, 2004, Balance sheet effects, bailout guarantees and financial crises, *Review of Economic Studies* 71, 883–913.

Shleifer, Andrei, and Robert Vishny, 2011, Fire sales in finance and macroeconomics, *Journal of Economic Perspectives* 25, 29–48.

Sims, Christopher, 2001, Fiscal consequences for Mexico of adopting the dollar, *Journal of Money, Credit, and Banking* 33, 597–616.

Skeel, David, 2001, *Debt's Dominion: A History of Bankruptcy Law in America* (Princeton University Press, Princeton, NJ).

Stein, Jeremy, 1996, Rational capital budgeting in an irrational world, *Journal of Business* 69, 429–455.

Summers, Lawrence, 2007, Discussion of *International Reserves in Emerging Market Countries: Too Much of a Good Thing?* by Olivier Jeanne in W.C. Brainard and G.L. Perry, eds.: *Brookings Papers on Economic Activity* (The Brookings Institution, Washington, DC).

Tirole, Jean, 2002, Financial crises, liquidity, and the international monetary system, *Paolo Baffi Lecture on Money and Finance* (Princeton University Press, Princeton, NJ)

Tirole, Jean, 2003, Inefficient foreign borrowing: A dual-and-common-agency perspective, *American Economic Review* 93, 1678–1702.

Triffin, Robert, 1960, *Gold and the Dollar Crisis: The Future of Convertibility* (Yale University Press, New Haven, CT).

van der Ploeg, Frederick, and Anthony Venables, 2011, Harnessing windfall revenues: Optimal policies for resource-rich developing economies, *The Economic Journal* 121, 1–30.

Zingales, Luigi, 2015, Does finance benefit society?, *Journal of Finance* 70, 1327–1363.