American Economic Review: Papers & Proceedings 2014, 104(5): 88–93
http://dx.doi.org/10.1257/aer.104.5.88

SOVEREIGN DEBT CRISIS[‡]

Is It Too Late to Bail Out the Troubled Countries in the Eurozone?[†]

By Juan Carlos Conesa and Timothy J. Kehoe*

Following its devaluation of the peso on December 20, 1994, the Mexican government experienced increasing difficulties in selling its dollar-indexed bonds, *tesobonos*, at weekly auctions, up until the point that a default seemed inevitable. On January 30, 1995, US President Bill Clinton organized a 48.8 billion USD loan package for Mexico with funds from the US Exchange Stabilization Fund, the International Monetary Fund, the Bank for International Settlements, and the Bank of Canada. The Clinton bailout of Mexico required the government to pay penalty interest rates on borrowing from this package and to pledge its oil export revenues as collateral. During 1995 and 1996, the Mexican government reduced spending and increased taxes. The government borrowed less than half of the loans offered, and, as it regained access to credit markets, paid back these loans by January 1997, three years ahead of schedule.

The Clinton bailout of Mexico suggests that, by following Bagehot's (1873) dictum of lending freely at a penalty interest rate and on good collateral, an outside party can put an end to a sovereign debt crisis. Starting in 2008, the governments of a number of countries in the eurozone—notably the PIIGS: Portugal, Ireland, Italy, Greece, and Spain—have had to pay high spreads over German yields on sales of sovereign bonds, as seen in Figure 1. So far, only Greece has defaulted on its debt. We ask whether the Troika—the European Commission, the European Central Bank, and the International Monetary Fund—can bail out the troubled countries in the eurozone as President Clinton bailed out Mexico in 1995. Our analysis suggests that debt levels among the PIIGS are so high that it may be too late for such bailouts to be successful in inducing these countries to reduce their debt.

I. Self-Fulfilling Debt Crises

Our paper builds on the analysis of the debt crises in the eurozone of Conesa and Kehoe (2012), which in turn builds on the analysis of the Mexican debt crisis of Cole and Kehoe (1996, 2000).

Conesa and Kehoe's (2012) model has three sets of actors—domestic households, international lenders, and the domestic government. The government chooses government spending and borrowing and whether or not to default to maximize the expected discounted utility of the households. The state of the economy in every period, $s = (B, z_{-1}, \zeta)$, is the level of government debt B, whether or not default has occurred in the past z_{-1}, and the value of the sunspot variable ζ. The country's GDP is

$$y(z) = Z^{1-z}\,\overline{y}, \tag{1}$$

[‡]*Discussants:* Andrew Atkeson, University of California-Los Angeles; Javier Bianchi, University of Wisconsin; Vincenzo Quadrini, University of Southern California.

*Conesa: Department of Economics, Stony Brook University, SBS Building, Office S-637, Stony Brook, NY 11794 (e-mail: juan.conesa@stonybrook.edu); Kehoe: Department of Economics, University of Minnesota, 1925 Fourth Street South, Minneapolis, MN 55455, Federal Reserve Bank of Minneapolis, and NBER (e-mail: tkehoe@umn.edu). We are grateful to participants at the Session on Sovereign Debt Crises, especially our discussant, Vincenzo Quadrini, for helpful comments. Kehoe thanks the National Science Foundation for support through SES-09-62865. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

[†] Go to http://dx.doi.org/10.1257/aer.104.5.88 to visit the article page for additional materials and author disclosure statement(s).

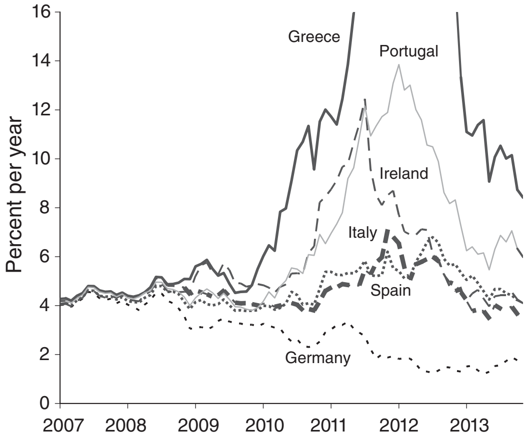

Figure 1. Yields on 10-year Sovereign Bonds in the Eurozone

where $1 > Z > 0$ and $1 - Z$ is the default penalty. To keep the model simple, we assume that this penalty is permanent. The government solves the dynamic programming problem

$$\text{(2)} \qquad V(s) = \max u(c, g) + \beta V(s')$$

$$\text{s.t. } c = (1 - \theta)y(z)$$

$$g + zB = \theta y(z) + q(B', s)B'$$

$$z = 0 \quad \text{if} \quad z_{-1} = 0.$$

Here $u(c, g)$ is the households' concave utility function, which depends on private consumption c and government spending g. The government is benevolent in that shares the same utility function as households. All actors in the model have the same discount factor β. To keep the model simple, we assume that the tax rate θ is constant and that there is no private investment.

Lenders are risk neutral and have deep pockets. In particular, they buy the bonds B' offered for a price $q(B', s)$ that implies the same expected yield $1/\beta - 1$ as risk-free bonds:

$$\text{(3)} \qquad q(B', s) = \beta E z(B'(s'), s', q(B'(s'), s')).$$

Let π be the probability that the sunspot variable ζ takes on a value that tells the international lenders to panic if a crisis would be self-fulfilling. Then,

$$\text{(4)} \qquad q(B', s) = \beta(1 - \pi)$$

if the amount borrowed B' leaves the government at the risk of a self-fulfilling debt crisis in the next period. That is, $z(B'(s'), s', q(B'(s'), s')) = (1 - \pi)$ is the probability that the government will repay the debt in the next period.

The possibility of self-fulfilling crises in the Cole-Kehoe and Conesa-Kehoe models depends on the timing of sovereign debt auctions and government decisions to default or not: the sunspot occurs first, then the government offers new bonds B' at auction, which the bankers buy at price $q(B', s)$, and then the government decides whether to default or not. The equilibrium outcome is that, if there is an unfavorable realization of the sunspot variable—some bad news that is irrelevant except for its impact on the equilibrium—lenders will not lend to the government if they know that this lack of lending will, in fact, cause the government to default. If, however, the realization of the sunspot variable is favorable, the lenders lend and no crisis occurs. In this sense, the crisis is self-fulfilling.

Two cutoff levels of debt are endogenous in the solution to the government's problem: a lower cutoff $\overline{b}$ and an upper cutoff $\overline{B}(q)$. If $B \leq \overline{b}$, the government repays even if lenders do not lend. If, however, $\overline{b} < B \leq \overline{B}(q)$, the government repays if bankers lend at price q. The government defaults whether or not lenders lend if $B > \overline{B}(q)$. The crisis zone is the set of debt levels for which $\overline{b} < B \leq \overline{B}(\beta(1 - \pi))$. For sufficiently low debt levels, $B \leq \overline{b}$, no self-fulfilling crisis is possible. For high enough debt levels, $B > \overline{B}(\beta(1 - \pi))$, no borrowing is possible. For debt levels in between these cutoffs, whether or not a crisis occurs depends on the realization of the sunspot variable. There are multiple equilibria in the model that depend on the probability π of an unfavorable realization of this sunspot variable. In fact, Conesa and Kehoe (2012) show that π itself can fluctuate over time, following a Markov process. The arbitrary nature of π—the arbitrary nature of exactly what constitutes bad news in the model—is how the model captures what finance ministers refer to when they complain about their country's sovereign bonds being at the mercy of the financial markets.

In the Cole-Kehoe model, the optimal policy for a government when its debt is in the crisis zone is, in general, to run surpluses to reduce the debt to the safe level $\overline{b}$—although, if the debt is sufficiently high and if π is sufficiently low, it

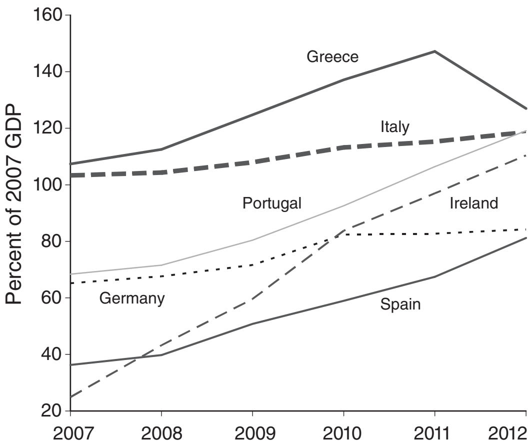

FIGURE 2. GOVERNMENT DEBT IN THE EUROZONE

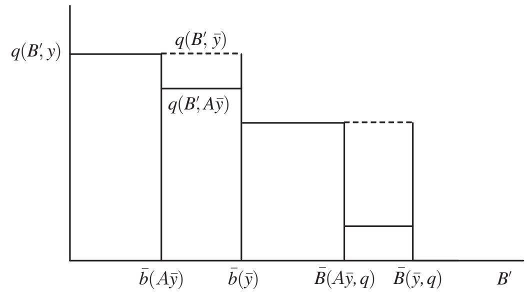

FIGURE 3. BOND PRICES

can be optimal for the government to keep debt constant. Unless the debt is sufficiently close to the safe level $\bar{b}$, it is optimal to reduce the debt in a number of steps because the concavity of $u(c,g)$ implies that the government wants to smooth its spending.

II. Gambling for Redemption

Since 2008, the governments of the PIIGS have run deficits and increased their levels of debt, as seen in Figure 2, even though they have faced high spreads on bond sales, which we interpret as having levels of debt in the crisis zone. To rationalize this behavior—which cannot be optimal in the Cole-Kehoe model—Conesa and Kehoe (2012) introduce recessions into the model. A government of a country that is in a recession has the incentive to borrow to smooth government spending, even though this borrowing puts the country at greater risk of a self-fulfilling crisis. We refer to this policy of borrowing as gambling for redemption.

The state of an economy in every period is now $s = (B, a, z_{-1}, \zeta)$, where $a = 1$ when the country is in normal times and $a = 0$ when it is in a recession. The country's GDP is now

$$y(a, z) = A^{1-a} Z^{1-z} \bar{y}, \tag{5}$$

where $1 > A > 0$ and $1 - A$ is the severity of the recession. Let p be the probability that a increases from 0 to 1. In other words, a country in a recession has a low level of GDP $A\bar{y}$ and faces a probability p of recovery to the high level of GDP $\bar{y}$ in the next period. To keep the model simple, we assume that, after a recovery from a recession, the country never enters another recession.

There are now four cutoffs: $\bar{b}(y)$ and $\bar{B}(y, q)$, where $y = \bar{y}$ or $y = A\bar{y}$ and $q = \beta(1 - \pi)$. The government faces a schedule of bond prices that depend on whether or not the country is in a recession and how much new debt B' it wants to sell at auction. As the government tries to auction off more new debt, the price it receives falls as this debt B' crosses cutoffs, as in Figure 3.

Consider the case in which

$$\bar{b}(A\bar{y}) < \bar{b}(\bar{y}) < \bar{B}(A\bar{y}, \beta(1 - \pi)) < \bar{B}(\bar{y}, \beta(1 - \pi)), \tag{6}$$

which holds for reasonable values of the parameters. (If the recession is very severe, that is, $1 - A$ is very large, it is possible that $\bar{B}(A\bar{y},\beta(1 - \pi)) \leq \bar{b}(\bar{y})$.) Suppose that the country is in a recession. For low enough debt offerings, $B' \leq \bar{b}(A\bar{y})$, the price is β; as B' crosses $\bar{b}(A\bar{y})$, the price falls to $\beta(p + (1 - p)(1 - \pi))$; and, as B' crosses $\bar{b}(\bar{y})$, the price falls to $\beta(1 - \pi)$. There is even the interesting possibility that the government will choose to sell debt at price $\beta p(1 - \pi)$ when it is in a recession, where $\bar{B}(A\bar{y}, \beta(1 - \pi)) < B' \leq \bar{B}(\bar{y}, \beta(1 - \pi))$; that is, it will sell so much debt that lenders know that the government will repay only if the country recovers and no crisis occurs.

To understand this price schedule, suppose, for example, that the government offers

$\overline{b}(A\overline{y}) < B' \leq \overline{b}(\overline{y})$ at auction. If the realization of the sunspot variable in the current period is favorable, then lenders will pay

$$q(B', s) = \beta(p + (1 - p)(1 - \pi)) \tag{7}$$

for the bonds: they know that the government will repay for sure if the country recovers, which occurs with probability p, and it will also repay even if the country is still in a recession, which occurs with probability $1 - p$, as long as there is no crisis, which occurs with probability $1 - \pi$. That is, $(p + (1 - p)(1 - \pi))$ is the probability that the government will repay B'.

When debt is in the crisis zone during a recession, the government has conflicting incentives. It can reduce its debt to escape the crisis zone so as to reduce the interest that it pays on its debt and eliminate the possibility of incurring the default penalty or it can increase its debt to smooth spending and gamble for redemption. Conesa and Kehoe (2012) find that the optimal government policy depends on the parameters of the model. In particular, the government runs down the debt if interest rates are high (π is large), the costs of default are high ($1 - Z$ is large), the recession is mild ($1 - A$ is small), and the probability of recovery is low (p is small). On the other hand, in the crisis zone, the government runs up the debt if interest rates are low, the costs of default are low, the recession is severe, and the probability of recovery is high. Furthermore, even for parameter values for which a government chooses to run down its debt if the initial debt is low enough, it can gamble for redemption and run up the debt if the initial debt is high enough. For high enough levels of initial debt, it is simply too costly to cut spending over a long period of time to try to reach the safe zone of debt.

III. Bailouts and the Role of Collateral

We now introduce a fourth actor, the Troika, into the model. Suppose that, with probability π_b, the Troika bails out the government in the event of a debt crisis. With probability π_d, the government is forced to default, $\pi_b + \pi_d = 1$. The country's GDP is now

$$y(a, z_b, z_d) = A^{1-a} Z_b^{1-z_b} Z_d^{1-z_d} \overline{y}, \tag{8}$$

where $1 > Z_b > Z_d > 0$. That is, the cost of a bailout, $1 - Z_b$, is less than the cost of a default, $1 - Z_d$. To simplify the analysis, we assume that there is either a bailout or a default, but not both, in the event of a self-fulfilling crisis. What is currently going on in Greece does not easily fit into our model.

The Troika buys the government bonds during the bailout at price $q_b \leq \beta$. In the event of a bailout, the relevant cutoffs are $\overline{b}(AZ_b\overline{y})$ for the upper limit of the safe zone during the recession and $\overline{b}(Z_b\overline{y})$ during normal times and $\overline{B}_b(AZ_b\overline{y}, q_b)$ for the upper limit of the crisis zone during the recession and $\overline{B}_b(Z_b\overline{y}, q_b)$ during normal times. If the government runs down its debt to reach $\overline{b}(AZ_b\overline{y})$ during the recession or $\overline{b}(Z_b\overline{y})$ during normal times, the government can resume sales of bonds to international lenders at price $q = \beta$. Once there is a bailout, a self-fulfilling crisis cannot occur. In other words, the spread $1/q_b - 1/\beta$ is a penalty, not a risk premium.

Our question is whether, in the event of a self-fulfilling crisis, the Troika can bail out the government and impose a high enough interest rate on its lending, a low enough price q_b, to induce the government to run surpluses and reduce its debt to $\overline{b}(AZ_b\overline{y})$ even if the recession persists. If the debt level B is high enough, because the government has been gambling for redemption and gambling for a bailout, the answer is no: a low price q_b for bonds lowers the upper limit of the crisis zone $\overline{B}_b(AZ_b\overline{y}, q_b)$ so much that

$$B > \overline{B}_b(AZ_b\overline{y}, q_b), \tag{9}$$

and the government prefers to default. Notice that, to compute $\overline{B}_b(AZ_b\overline{y}, q_b)$, we need to imagine the government choosing to default and incurring the full default penalty $1 - Z_d$ even though a bailout has occurred.

It is possible to increase the upper limit of the crisis zone by imposing collateral on borrowing during the bailout. The crucial question is: What happens if the government defaults even after it has been bailed out? The specification that we have discussed assumes that GDP drops from $AZ_b\overline{y}$ to $AZ_d\overline{y}$. Collateral increases the penalty for a default, lowering GDP even further, say, to $AZ_gZ_b\overline{y}$. Collateral serves as a commitment device for the government, allowing it to sell more debt. If its debt is high enough, however, a collateral requirement as part of a bailout is unattractive for the government because it commits the government to do something that it prefers not to do—pay a high interest rate on this debt.

IV. Numerical Experiments

We modify the numerical experiment in Conesa and Kehoe (2012) to provide some illustrations of the sorts of results that the model produces. A period is one year, and we model bonds having an average maturity of six years using the specification of Chatterjee and Eyigungor (2012):

$$(10)\quad q(B', s) = \beta E\big[z(B'(s'), s', q(B'(s'), s')) \times \big(\delta + (1-\delta)q(B'(s'), s')\big)\big];$$

that is, a fraction of bonds $\delta = 0.17$ needs to be paid every period. Fortunately, this change in the model does not change our basic analysis but makes it possible for the model to produce reasonable results in numerical experiments.

We assume that GDP in normal times is $\overline{y} = 100$. During the recession, GDP falls to $A\overline{y} = 90$. The bailout penalty is 5 percent of GDP, $Z_b = 0.95$, while the default penalty is 10 percent, $Z_d = 0.90$. The utility function is

$$(11)\quad u(c, g) = \log(c) + \gamma \log(g - \overline{g}),$$

where $\gamma = 0.25$ and $\overline{g} = 25$. The parameter $\overline{g}$ dictates how much government spending the households and government regard as essential; the results are sensitive to changes in this parameter. The discount factor is $\beta = 0.96$. The government collects 40 percent of GDP in taxes, $\theta = 0.40$. The probability of recovery from the recession is $p = 0.20$, so that the expected duration of a recession is five years, $1/p$. The probability of an unfavorable realization of the sunspot variable is $\pi = 0.03$, which implies a spread of about 3 percent. The households and the government assume that, if there is a crisis, the Troika will provide a bailout with probability $\pi_b = 0.50$.

Suppose that $q_b = 0.90$. Before the recession, that is, before 2008, the crisis zone is $\overline{b}(100) = 90.0 < B \leq \overline{B}(100{,}0.931) = 173.9$. Here, of course, $\beta(1 - \pi) = 0.931$. Then the recession hits unexpectedly in 2008 and the crisis zone drops to $\overline{b}(90) = 66.0 < B \leq \overline{B}(90{,}0.931) = 161.4$. Notice that, in this crisis zone, the price of bonds is $\beta(p + (1 - p) \times (1 - \pi)) = 0.936$ if $B' \leq \overline{b}(100)$ and it is $\beta(1 - \pi) = 0.931$ if $B' > \overline{b}(100)$. The government defaults or is bailed out if $161.0 < B \leq 173.9$. The government starts to run down its debt if $66.0 < B \leq 84.3$ or $90.0 < B \leq 117.1$. For debt levels $0 \leq B < 66.0$, $84.3 < B < 90.0$, and $126.8 < B < 161.4$, it gambles for redemption. For debt levels $B = 66.0$, $B = 90.0$, $B = 161.0$, and $117.1 \leq B \leq 126.8$, it keeps debt constant.

Suppose a crisis occurs and the Troika bails out the country, setting the price $q_b = 0.90$ for bonds. Notice that this implies a substantial penalty over the interest rate where $q = \beta = 0.96$, and still implies a penalty over the interest rate where $q = \beta(1 - \pi) = 0.931$ or the interest rate where $q = \beta(p + (1 - p)(1 - \pi)) = 0.936$. As a consequence, the government runs down the debt if it does not default and debt is in the crisis zone. The problem is that the upper debt limit $\overline{B}_b(85.5, 0.90)$ comes crashing down to 83.4, and the government would prefer to default rather than to make the interest payments dictated by the bailout.

Imposing a collateral requirement as part of this bailout changes the numbers. In particular, the upper debt limit during a recession becomes $\overline{B}(90, 0.931) = 154.4$. If there is a crisis and a bailout, the upper limit only drops to $\overline{B}_b(85.5, 0.90) = 117.8$. Now the problem is that the government runs down the debt only if $B < 86.2$. The government gambles for redemption and runs up its debt if $B > 102.9$. That is, the price $q_b = 0.90$ for new bonds sold is not low enough to induce the government to run down its debt.

Our experiments indicate that we need very large penalty interest rates to induce the government to run down its debt after a bailout, interest rates that correspond to bond prices like $q_b = 0.85$. The problem with such high interest rates is that they would make a bailout unattractive for the government. If the Troika cannot force the government to accept the collateral requirement when $q_b = 0.85$, then the government would prefer to default rather than to accept a bailout with the collateral requirement if $B > 79.6$ when the country is in a recession and if $B > 101.0$ if the country has recovered.

V. How Can the Eurozone Debt Crises End?

Our model is simplistic along many dimensions and includes simplifying assumptions that are worth relaxing. Nonetheless, using the model as a lens through which to compare the 1994–1995 Mexican crisis with the ongoing threat of crises in the eurozone suggests that there are four ways that the ongoing problems in each of these eurozone countries can end: First, and most obviously, vigorous economic growth in the country could resume. Second, the government could default and the country could leave the eurozone. This would allow the country to devalue its real exchange rate and perhaps induce the sort of growth that Mexico experienced after its crisis. Third, the Troika could take over the public finances of the country and force the government to run down the debt, ignoring the incentives to gamble for redemption and gamble for a bailout. Forcing the government to accept a bailout with a high penalty interest rate and a large collateral requirement would be an obvious way to do this. Fourth, the government and households of the country, in their role as voters, could realize that they are significantly poorer than they thought that they would be during the 2000–2008 boom, eliminating much of the incentive to gamble for redemption.

REFERENCES

Bagehot, Walter. 1873. *Lombard Street: A Description of the Money Market*. London: Henry S. King.

Chatterjee, Satyajit, and Burcu Eyigungor. 2012. "Maturity, Indebtedness, and Default Risk." *American Economic Review* 102 (6): 2674–99.

Cole, Harold L., and Timothy J. Kehoe. 1996. "A Self-Fulfilling Model of Mexico's 1994–95 Debt Crisis." *Journal of International Economics* 41 (3–4): 309–30.

Cole, Harold L., and Timothy J. Kehoe. 2000. "Self-Fulfilling Debt Crises." *Review of Economic Studies* 67 (10): 91–116.

Conesa, Juan Carlos, and Timothy J. Kehoe. 2012. "Gambling for Redemption and Self- Fulfilling Debt Crises." Federal Reserve Bank of Minneapolis Research Department Staff Report 465.