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Using Economic Experiments to Improve Contingent Convertible Capital Bonds

*Douglas Davis and Edward Simpson Prescott**

This *Commentary* describes experiments conducted to study alternative designs for a new type of financial security, CoCo bonds, that is being used in some European countries to manage the risk of financial crises. CoCo bonds are bank-issued debt that converts to equity when a trigger is breached. The conversion into equity serves to recapitalize a bank during financial distress, precisely when it is hardest to raise capital. The types of trigger used for all CoCos issued thus far are defined in terms of book capital. The experiments we conducted explore the effects of using triggers that are based on market prices.

Traditionally, economics has been considered an observational science, that is, a science in which the only empirical evidence comes from interactions that cannot be directly controlled by the scientist. During the last 40 years, however, laboratory methods have become an increasingly accepted and used part of the economist's toolkit. In the laboratory, economists evaluate the decisions of financially motivated participants within a controlled environment. Experiments have proved particularly useful for studying market institutions and have been used to improve trading rules in diverse markets such as those for gastroenterology fellowships (Niederle and Roth, 2005), pollution emission trading schemes (e.g., Cason, Gangadharan, and Duke, 2003), and water irrigation rights (Cummings, Holt, and Laury, 2004). They have also been used to design auctions such as those for allocating the radio spectrum (Plott and Salmon, 2004).

This *Commentary* describes experiments the authors have run to study the design of contingent convertible capital (CoCo) bonds, an important new financial security. CoCo bonds are bank-issued debt that converts to equity when a trigger is breached. Their purpose is to recapitalize a bank during financial distress, precisely when it is hardest for a bank to raise capital.

We investigate the use of price triggers, which rely on market prices. Price triggers have an advantage in being forward looking, but they may reduce the informativeness of prices when a bank is in distress and thus be less useful as a trigger. Using laboratory experiments, we model the performance of two types of price triggers. One type is a fixed trigger in which conversion occurs automatically when a price threshold is crossed. The other type is a discretionary trigger in which a regulator decides on conversion based on prices that he observes. Our experiments suggest that price triggers do reduce the informativeness of prices and that the preferred price trigger depends on the conversion rule.

*Douglas Davis is a professor of economics at Virginia Commonwealth University and the director of the Experimental Laboratory for Economics and Business Research. Edward Simpson Prescott is a senior professional economist at the Federal Reserve Bank of Cleveland. The views authors express in *Economic Commentary* are theirs and not necessarily those of the Federal Reserve Bank of Cleveland or the Board of Governors of the Federal Reserve System or its staff.

CoCo Bonds Background

One advantage of CoCo bonds is that they reduce the "debt overhang" problem, that is, the difficulty a weak bank faces to raise funds to finance new profitable loans because the existing debt holders, with seniority to new debt and equity, would receive most of the return from the new project. Another advantage of these instruments is that they provide a way to recapitalize a financially distressed bank precisely when it is hardest for the bank to do so via the sale of equity. In this way, such a tool would conceivably reduce the chance that the bank would fail. In important respects, the conversion of CoCo bonds into equity resembles a prepackaged bankruptcy procedure that has the advantage of automatically and quickly changing a bank's capital structure when the bank is in financial trouble.

Since the financial crisis, European bank regulators have allowed banks to count CoCo bonds toward regulatory capital requirements, and, as a consequence, European banks have issued a sizable quantity of CoCo debt.[1] All of the existing issuances, however, use book capital as the trigger, a method that is problematic because evidence indicates that when a bank is in trouble, book accounting numbers lag economic value.[2] This means that CoCo debt with an accounting trigger will not be able to proactively recapitalize a bank. To fix this problem, one idea is to replace the accounting trigger in CoCo bonds with a price trigger, such as the price of bank equity.[3] The appeal of using a price trigger is that unlike accounting numbers, market prices are forward looking, and they incorporate information held by market participants.[4] Furthermore, as has been well documented, market prices contain information about bank quality that is not contained in supervisory reports.[5]

A conceptual problem arises, however, with using market prices to trigger CoCo conversions. Over a range of fundamental values close to the trigger threshold, economic models that base conversion on a price trigger generate multiple solutions or even the absence of a solution altogether.[6] The problem in these models comes from the feedback between prices and the conversion decision. Traders will anticipate a conversion decision, their anticipation of the conversion decision gets reflected in the price, and the new price in turn affects the conversion decision. For the types of conversion effects that we care about, such as conversion causing a distinct jump or drop in equity prices, this feedback loop makes the prices much less useful for making decisions.

Unfortunately, no empirical evidence exists that would allow an assessment of these modeling concerns about CoCo bonds with market prices, as all the issuances so far have, as noted previously, used book accounting triggers. For this reason, we conducted laboratory experiments in which feedback between prices and conversion decisions could occur, and then we measured the accuracy of conversion decisions. The primary focus of our experiments was on the relative performance of a fixed trigger to make a conversion decision versus that of a regulator who uses price information to make a conversion decision.

The Experiments

To evaluate the usefulness of price-based triggering mechanisms, we conducted two experiments.[7] The first experiment, conducted in 2010 and 2011, consisted of a series of 34 laboratory-controlled market sessions with 424 volunteers. The second experiment, conducted in 2014 and 2015, consisted of 18 market sessions with 234 volunteers. Both experiments were conducted at the Virginia Commonwealth University (VCU) Experimental Laboratory for Economics and Business Research. Participants were undergraduate students in math, science, business, or engineering at VCU.

Market sessions in the first experiment proceeded as follows. At the outset of each session, student volunteers were randomly seated at visually isolated computer terminals. In all sessions, 10 participants were randomly assigned the role of "trader." In sessions during which a regulator made conversion decisions, an additional three participants were assigned the role of "regulator."

Each session was divided into a series of 20 to 25 trading periods. At the beginning of each period, each trader was provided a portfolio consisting of two units of an abstract asset and a working capital loan, the latter of which they could use to buy assets from other traders. Each asset had a "market" fundamental value in the range of $2 to $8, which was the same for each asset, and this fundamental value differed unpredictably each period. To induce trade, the asset value for a subset of participants was $0.60 below the market fundamental. Once endowed, traders had 110 seconds to trade assets, a process they performed using a standard, open-book double auction, similar to the rules used on the New York Stock Exchange. At the end of trading, the median price of the trades was calculated and then either presented to "regulators," who made a conversion decision, or directly used to determine whether or not a conversion would occur as with a fixed price trigger.

In the event of a conversion, the value of each asset to each trader would change by $2. In some sessions, each asset increased in value by $2; in others, each asset decreased in value by $2. The value-increasing sessions correspond to a debt-to-equity conversion that raises the value to incumbent equity holders. The value-decreasing sessions correspond to a conversion that heavily diluted incumbent equity holders, thus lowering the value of the asset.[8]

In sessions during which the triggering condition was a fixed price, the conversion would occur mechanically if the median price fell below $5. In sessions during which a price-informed regulator made the conversion decision, each of the three regulators would look at the median price following the close of trade and independently decide whether to complete a conversion. The regulators did not know the fundamental value of each asset, but each regulator was rewarded if he correctly converted (or didn't convert) the asset. A correct conversion was identified as converting when the fundamental value (before conversion) was below a trigger value. A correct nonconversion was identified as not converting when the fundamental value (before conversion) was above a trigger value. In effect, regulators were rewarded when they correctly determined fundamental values based on market prices. Because there were three regulators, in each period we randomly chose which regulator's decision mattered for the result.[9] Traders were rewarded by their trading profits and the fundamental value they received from any assets they held at the end of the trading period.

The second experiment built on the first by changing the environment along several dimensions in order to see if we could improve the performance of the regulators. In one treatment, we altered the regulators' payoffs by imposing penalties for making an incorrect decision to convert. This treatment was motivated by the observation of forbearance by regulators in some past banking crises such as the Savings and Loan Crisis of the 1980s. In a second treatment, we added nonmarket information by probabilistically providing regulators with their own signal about the fundamental value.[10] This treatment was motivated by the observation that regulators examine banks and have access to information that the market does not have. In a final treatment, we gave the regulator the option to delay the conversion decision, but at some cost, in order to get better information. This treatment was motivated by a desire to examine a tradeoff between acting proactively under uncertainty and waiting to get more information.

In both experiments, sessions lasted 90 minutes to 120 minutes. The participants were paid based on how much they made during the experiments.[11] Earnings ranged from $14 to $32.25, which included a $6 payment for participating in the experiment.

The Results

The results of the first experiment, which are reported in Davis, Korenok, and Prescott (2014), established that, as the economic models suggest, the feedback from the possibility of conversion into prices affects the price's informational content. In a large percentage of instances, prices deviated from the final value of assets, a consequence that undermined the flow of assets from low- to high-value traders and caused frequent conversion errors for both fixed-price triggers and price-informed-regulator triggers. These problems arose with particular frequency when market fundamental values were close to the trigger. For fundamental realizations further removed from the trigger threshold, both fixed-trigger and price-informed-regulator mechanisms worked quite well.

The second experiment, reported in Davis and Prescott (2017), was conducted to more carefully compare the performance of fixed-trigger and regulator-based alternatives and to determine if we could improve the performance of these mechanisms. In this second experiment, we focused our analysis explicitly on the conversion error criterion, and we observed problems similar to those identified in the first, though we did find some insightful new treatment-specific results. For example, in the treatment in which we probabilistically presented the regulators with their own signal about the fundamental value, we observed that the traders tended to assume that the regulators always knew the fundamental value even though traders knew that the information was provided to the regulators only occasionally; as a consequence, there were frequent conversion errors.[12] In the value-increasing conversion, these errors were so frequent that they outweighed the absence of conversion errors when the regulators did receive the signal, so that overall the fixed-trigger treatment performed better. Finally, we also observed that giving regulators the opportunity to incur a cost to wait for better information resulted in a high incidence of socially costly waiting decisions by regulators interested in avoiding the chance of making an incorrect conversion.

In comparing the performance of the fixed-price trigger versus the regulator, we found a pattern that was robust across treatments: The better-performing mechanism varied with the effect of the conversion on the asset value. In the case of a value-decreasing conversion, which corresponds in practice to a heavy dilution of incumbent equity, the regulator-based mechanism generated fewer conversion errors. This was true for all the treatments, including those in the first experiment, except for the regulatory-delay treatment, for which both mechanisms performed similarly. In the case of the value-increasing conversion, which corresponds to a debt write down and small dilution of equity, the fixed-price trigger outperformed the regulators in all treatments.

Conclusion

Although the laboratory environments examined are very streamlined relative to richer, naturally occurring markets, such experiments are appealing in that they are a low-cost way to evaluate the properties of alternative forms of market structures and regulations.

In our experiments, we were able to provide evidence that supports the concerns about market price triggers raised in theoretical analyses. We were further able to use the experiments to broadly compare two ways of using market prices as a triggering mechanism, relying on price-informed regulators or using a fixed-price trigger. Our findings suggest that the mechanism to be preferred depends on the extent to which conversion dilutes equity, information that should be useful to those who design these securities.

Footnotes

1. See Avdjiev et al. (2015).

2. Since 1992, US bank regulators have been required to order banks to restrict their activities as bank book capital declines, and they can even shut down a bank with positive capital. Despite these prompt corrective-action requirements, average losses on failed commercial banks in the recent financial crisis were around 25 percent of failed bank assets

even though on average the banks had positive capital when they were closed. For details and an analysis of why book capital can lag economic value, see Balla, Mazur, Prescott, and Walter (2017).

3. See, for example, Calomiris and Herring (2013); Flannery (2009); McDonald (2013); Pennacchi (2011); Pennachi, Vermaelen, and Wolff (2013); and Raviv (2004).

4. For a classic example that uses the orange juice futures market, see Roll (1984).

5. See the survey in Flannery (1998).

6. For models in which a regulator makes the conversion decision based on observed prices, see Birchler and Facchinneti (2007) and Bond, Goldstein, and Prescott (2010). For a model in which the trigger is a fixed price, see Sundaresan and Wang (2015). For a summary of these models, see Prescott (2012). For more recent work, see Siemroth (2015) and Glasserman and Nouri (2016).

7. There are two papers that report our results. The first one is Davis, Korenok, and Prescott (2014). The second one is Davis and Prescott (2017), available at http://www.ijcb.org/journal/ijcb17q2a2.pdf.

8. It is possible to increase the value of equity from debt-to-equity conversion. The elimination of debt frees up the cash that can be paid to equity holders and if the conversion ratio is low enough then incumbent equity holders will benefit. Along these lines, Avdjiev et al. (2015) report that 55 percent of CoCo issues in their sample either partially or completely write down the principal of the CoCo debt if there is conversion.

9. We used three regulators in each period in order to generate more observations about regulator behavior.

10. We did this by giving each regulator a 50 percent chance that they would see a signal that told them what the fundamental value was.

11. The sessions were played in terms of "lab" dollars. At the end of a session, each participant's earnings in lab dollars were converted to US dollars in a ratio of 12 to 1.

12. In this treatment, the traders did not know whether the regulators received the signal.

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Federal Reserve Bank of Cleveland
Research Department
P.O. Box 6387
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