The Put Problem with Buying Toxic Assets

by

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Abstract

This paper uses the option pricing arguments of Merton (1974) to demonstrate that even solvent banks will be reluctant to sell volatile, toxic assets at market prices. Banks' shareholders have insolvency puts that give them limited liability in the event of default. The insolvency puts are more valuable when the banks' assets are more volatile. Shareholders in banks will require any buyer to pay for the lost volatility as well as the market price of the toxic assets. Thus, taxpayers must be ready to richly overpay if they want banks to voluntarily part with their toxic assets.

Key words: FDICIA, mortgage securities, PPIP, Public Private Investment Partnership, receivership, resolution authority, TARP, too big to fail, toxic assets

Journal of Economic Literature Codes: G01, G13, G21, G28, G32

1. Introduction

U.S. policy makers have become enamored with the idea of buying up troubled securities and cleaning up the "toxic assets" of the financial system. This was the original intent of the Troubled Asset Relief Program (TARP), which authorized the U.S. Secretary of the Treasury to purchase up to $700 billion dollars of securities.[1] Surprisingly, most of the first half of that money was not used to buy troubled assets. It primarily went to buying preferred stock. The new administration seems to be also interested in buying distressed assets from banks through some public funding of private investors. U.S. Treasury Secretary Timothy Geithner has proposed a Public-Private Investment Partnership (PPIP) that will use inexpensive, nonrecourse loans to encourage private investors to spend $500 billion dollars of public and private money to buy toxic assets.[2]

This paper answers, in part, why policy makers and investors find it so difficult to entice banks to sell their toxic assets. The major stumbling block is not one of price discovery or the determination of the market value for toxic assets. This is the commonly held view, which is echoed by Ausubel and Cramton (2009), for example. Buying toxic assets is too costly because it means that taxpayers or private investors must pay for a very expensive put option on the firm's assets in addition to the market value of the toxic

[1] Mark Landler and Eric Dash, October 15, 2008, "Drama Behind a $250 Billion Banking Deal," *New York Times*, Accessed online on December 23, 2008 at *http://www.nytimes.com/2008/10/15/business/economy/15bailout.html?*

[2] Edmund L. Andrews, Eric Dash and Graham Bowley, March 21, 2009, "Toxic Asset Plan Foresees Big Subsidies for Investors," New York Times, Accessed on March 23, 2009 at http://www.nytimes.com/2009/03/21/business/21bank.html?_r=1&fta=y.

assets. This is the fundamental problem with any voluntary sales of toxic assets to the government or private investors. Since Merton (1974), it has been recognized that the stock of a firm can be valued as a call option on the firm's assets. This paper uses this approach to argue that it is practically impossible to design a mechanism to get a bank's shareholders to voluntarily sell distressed assets that does not lead to subsidies. Wilson and Wu (2009) and Wilson (2009) do make this point. Nevertheless, neither paper uses an explicit option pricing framework or discusses the problem in terms of put-call parity. Those papers have a different focus than this paper. They discuss how various types of recapitalizations affect lending incentives, while the present paper focuses on the cost of removing toxic assets.

Buying up "toxic" securities from troubled banks will involve large subsidies. Only banks that have almost no risk of failure will be willing to sell toxic assets for reasonable prices. The only securities that troubled banks will sell for reasonable prices are low risk assets. Thus, policy makers that refuse to close down troubled banks can either get tough, or resolve to lose hundreds of billions of dollars of taxpayer money while creating moral hazard problems down the road. Therefore, any bailout in which troubled banks have the discretion to opt out will result in massive subsidies from taxpayers.

2. The limited liability put feeds off toxic waste

Since Merton (1974), it has been recognized that put-call parity can be used to describe the claims in a corporation. Let S_X be the value of common stock in a bank with

toxic assets. The common stock is a call option on the bank's assets. A call option allows the owner, the stockholders, to own the firm if they pay off the firm's creditors in full. (Too keep things simple, we will assume that the creditors' claims don't pay interest.) P_X is a put value on the bank's assets that has a strike price equal to the face value of the bank's creditors' claims. The owner of a put option has the right, but not the obligation, to sell an asset at a pre-set price. Here that price is F, the face value of the creditors' claims. The stockholders can sell the firm to its creditors for the face value of the debt. Thus, shareholders need not worry about how much asset values drop below F when the creditors' claims are due. We will use the notation PV to denote the present value of some future cash flow. The put-call parity valuation of the common stock is the following,

$$S_X = \text{Assets} - [\text{PV}(F) - P_X] > 0 \tag{1}$$

The put ensures that the stock's value is never less than zero. Thus, this put option ensures that shareholders have limited liability. The term in brackets in equation (1) represents the market value of creditors' claims. The creditors' claims are reduced in value by the limited liability put because the creditors bear the losses, which prevent the stock price from falling below zero. Suppose that we decompose the firm's assets into

$$\text{Assets} = \text{Good Assets} + \text{Toxic Assets} \tag{2}$$

Let us assume that all the variance in the bank's assets comes from the Toxic Assets. Many people appear to wrongly assume that if you subtract the Toxic Assets that the value of the bank's stock will be still worth S_X, but the toxic assets will be replaced with cash:

$$S_X = \text{Good Assets} + \text{Cash Value of Toxic Assets} - \text{PV}(F) + P_X \tag{3}$$

However, the error in equation (3) and in many commentators' thinking is the assumption that the put will still be worth P_X. (In fact, most economic commentators probably did not know that shareholders held a put at all!) This put is the value of shareholders' limited liability, which we will see changes with the volatility of the bank's assets. The more volatile the firm's assets, the more shareholders value their limited liability put.

Suppose that the bank is still solvent after selling the toxic securities. The true value of the stock is S_Y below:

$$S_Y = \text{Assets} - \text{PV}(F) \;\&\; P_Y = 0, \text{ when Assets} - F \geq 0. \tag{4}$$

Thus, the value of the limited liability put is zero when the assets have no variance. The difference between S_X and S_Y is $P_X > 0$. Therefore, in this first scenario, the value of the shareholders claims has fallen by P_X.

If the bank is insolvent after the sale of the toxic assets, its stock, S_Z, is worthless:

$$S_Z = 0, \text{ when Assets} - F < 0. \tag{5}$$

Clearly, $S_X - S_Z > 0$, because the stock had some value when the bank held some toxic waste, according to equation (1). Therefore, in both scenarios *Y* and *Z*, whether or not the bank is solvent, stockholders are strictly worse off if they sell their toxic assets relative to the *status quo*.

We did not need to make the extreme assumption that all the volatility was lost by selling the toxic assets. It is well known that the value of puts and calls are strictly increasing in the variance of the underlying assets. This is sometimes called the option's vega. The option's vega is always positive for puts and calls valued using the Black and Scholes (1973) option pricing formula. Thus, any reduction in volatility will reduce the value of the bank's stock price and the value of its limited liability put, all other things being equal.

The magnitude of the limited liability put will be smaller for better capitalized banks, because this put is well "out of the money." An option is "out of the money" if exercising the option today would give the holder a negative payoff. With the insolvency put, this is case *Y*. An option is "in the money" if its underlying asset exceeds the strike price today. This is case *Z* here. Therefore, safely solvent banks will require less of a premium to part with their toxic waste than insolvent zombies, because the latter's insolvency puts are currently "in the money."

3. A numerical example

Let us try an example using the option pricing formula of Black and Scholes (1973) and Merton (1973). Contrary to popular perception, these numbers are easy to calculate with a spreadsheet or with one of the many option pricing calculators on the web.[3]

Suppose that a bank's assets have a standard deviation of 20 percent with the Toxic Assets and 5 percent without the Toxic Assets. Further, the face value of creditor claims is F = \$100 and the Assets are worth \$90. Suppose that the debt comes due in two years and the continuously compounding risk-free rate is 2 percent. (We are assuming away the complication of having creditors with claims of different maturities.) Suppose that the fair market value of the Toxic Assets is \$25. Prior to removing the toxic waste, the stock is worth S_X = \$7.70 and the limited liability put that creditors are writing is worth P_X = \$13.78. Yet, after the toxic waste is sold for cash, the value of the stock is \$0.63 and the put that the bank's creditors have written is worth only \$6.71. Clearly, the bank's shareholders will not agree to sell the toxic waste for \$25, its fair market value. The troubled bank's shareholders will need to sell it for at least \$25 + (\$7.70 – \$.63) = \$32.07 to break even. Thus, the government must overpay for assets by at least 28 percent. This is the case because the government has reduced the value of the put option that the creditors were selling to stockholders. That put option fell in value by \$7.07 because most of the volatility of the assets left the firm. Thus, stockholders would demand compensation for that loss by insisting on selling their toxic waste for more than its market value.

[3] I verified my calculations with the calculator at http://www.numa.com/cgi-bin/numa/calc_op.pl. The formulas used in this example appear in the appendix.

This $7.07 is not a net subsidy to stockholders. It is a subsidy to the bank's unsecured creditors. Suppose there are two classes of creditors in order of seniority, depositors and unsecured creditors. Let us assume that the face values of their claims are $30 and $70, respectively. The present value of the depositors' claims are worth about $28.82 because these claims are approximately risk-free, even without deposit insurance, because they get paid first in the event of default. However, if the bank keeps its Toxic Assets, the unsecured creditors' claims are worth only about $53.48 because they are the sellers of the put on the firm's assets. They bear the vast majority of the creditor's losses in the event of bankruptcy because they are the lowest (after stockholders) in terms of seniority. If the Toxic Assets are sold to the government, the value of their claims rises to $60.55, or by $7.07. The unsecured creditors are the beneficiary of the subsidy.

Veronesi and Zingales (2008) found that creditors in nine of the largest U.S. commercial and investment banks saw their claims rise significantly due to the announcement of subsidized preferred stock purchases by the U.S. Treasury and loan guarantees by the Federal Deposit Insurance Corporation (FDIC) on October 10 to 14, 2008. Yet, they could find little evidence that these banks' shareholders benefited from these subsidies.

This analysis explains why there is no market for the toxic waste. The banks do not want to reduce the value of the put that their creditors are writing. Thus, there is a gap between the market value of the toxic securities and the value of the toxic assets to the troubled banks' shareholders.

4. Sticks work better than carrots

It is not just a valuation problem that is preventing the private sector from cleaning up banks' balance sheets. Shareholders in troubled banks won't sell toxic waste for anything close to what it is worth. It seems that the only buyer willing to overpay is the government.

A far better solution is for the government to abandon attempts to induce banks to sell the toxic assets voluntarily. Instead, it would be much more socially efficient for regulators to force sales of toxic assets or common stock recapitalizations, as Wilson and Wu (2008) and Wilson (2009) argue. Any forced sale of toxic assets or forced common stock recapitalization would mean that either or both common stockholders and some unsecured creditors in troubled banks would lose relative to the *status quo* even if those securities were sold at their market values. This is the tough reality of any bankruptcy procedure. Some investors must bear the losses for their bad bets.

Kaufman (2002) and Greenspan (2001) argue that the Federal Deposit Insurance Corporation Improvement Act (FDICIA) does not require regulators to shield unsecured creditors from losses in a non-bankruptcy resolution. There is something called "least cost resolution" exemption to "prompt corrective action," whereby insolvent banks must be immediately restructured. This least cost resolution exemption requires that uninsured depositors are made no worse off than they would have been with a liquidation proceeding. Thus, the Federal Deposit Insurance Corporation (FDIC) could force banks which are "too big too fail" to sell bad assets at fair market values even if this leads to stockholders' being wiped out and unsecured creditors' realizing large losses. Yet, the

FDIC's powers are more limited or non-existent with bank holding companies, broker-dealers, and financial conglomerates.

At the time of writing, the primary way to restructure the financial contracts of large complex financial institutions in the United States is in Chapter 11. Proposed legislation to give resolution authority to the U.S. Treasury to restructure large financial institutions has been slowed in Congress.[4] Sometimes it appears that the current rallying cry of the current Federal Reserve and U.S. Treasury is, "No more Lehmans." This refers to the Chapter 11 filing of the investment bank Lehman Brothers that preceded precipitous drops in the U.S. and world stock markets in September 2008. Therefore, in the near-term at least, it appears that the U.S. Treasury will attempt to prop up giant zombie banks. Yet, it is doubtful that the zombies will sell their toxic assets in the Public-Private Investment Program. Instead, it will likely be most utilized by healthy institutions which have insolvency puts that are nearly worthless, because they have little chance of default.

This paper has argued that it is a vain hope that the government can buy toxic assets without massive taxpayer subsidies. Any sale of toxic assets means buying up part of the shareholders' limited liability put option in addition to the toxic asset. Unfortunately, this put is very expensive to buy from shareholders of a bank facing insolvency, and it is worthless to taxpayers and private investors. The least cost solution is some type of forced restructuring as Zingales (2008) argues, but if implemented, this would most likely mean that some investors in troubled banks will lose relative to the *status quo*.

[4] Damian Paletta, April 22, 2009, "Rep. Frank Slows Market Regulation Bill," Wall Street Journal, accessed online on April 24, 2009 at http://online.wsj.com/article/SB124045153751646097.html.

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5. Appendix: The Black and Scholes (1973) Option Pricing Formula used in the numerical example

The numerical example used the option pricing formula developed by Black and Scholes (1973) and Merton (1973). This formula was applied to value all the liabilities of the firm in Merton (1974). That formula is written below using the Microsoft Excel commands for the cumulative normal density function, "NORMDIST," and the exponential number, "EXP":

$$S = \text{Assets*NORMDIST}(d_1) - F\text{*EXP(-Rate*Time)*NORMDIST}(d_2) \tag{6}$$

To generalize the formula the subscripts for the stock price S have been removed. "Time" is the time to maturity of the bank's debt. "Rate" is the risk-free rate or the closest continuously compounding U.S. Treasury rate for that particular maturity. In the example, the author would have used the two year U.S. Treasury note and adjusted the quoted rate to a continuously compounding rate. The present value of the face value of the liabilities is PV(F) = F*EXP(-Rate*Time). d_1 and d_2 are defined below:

$$d_1 = (\text{LN}(S/F) + (\text{Rate} + (\sigma\text{^}2)/2)\text{*Time})/(\sigma\text{*Time^}0.5) \tag{7}$$

$$d_2 = d_1 - \sigma\text{*Time^}0.5 \tag{8}$$

"LN" is the natural log command in Excel. "^" is the Microsoft Excel command for to the power of. "^0.5" is the square root and "^2" is the square, for example. Using the put-call parity formula in equation (1), the limited liability put is worth the following once you have solved for the stock price by inserting equations (7) and (8) into equation (6).

$$\text{The Limited Liability Put} = P = F\text{*EXP(-Rate*Time)} - \text{Assets} + S \qquad (9)$$

Suppose that we decompose the face value of creditor's claims, F, into the face value of senior depositors' claims, D, and the face value of junior creditors' claims, J. Thus, $F = D + J$. As long there magnitude of junior creditor's claims are large relative to depositors and other senior claimants, then, in almost all cases, the junior creditors bear the risk of default. In that case, it is not a bad approximation that the limited liability put is entirely paid for by the junior creditors. The approximate value of junior creditors' claims is the following, where the limited liability put, P, is defined in equation (9):

$$\text{Market Value of Junior Creditor's Claims} = J\text{*EXP(-Rate*Time)} - P \qquad (10)$$

The market value of depositor's claims are approximately risk-free under these circumstances and thus have a present value of D*EXP(-Rate*Time).