Lessons for the TARP Warrants
from 1983 Chrysler Auction

Linus Wilson [d]
Assistant Professor of Finance
University of Louisiana at Lafayette
B. I. Moody III College of Business
Department of Economics & Finance
214 Hebrard Boulevard, Moody Hall 253
P. O. Box 44570
Lafayette, LA 70504-4570
Phone: (337) 482-6209
Fax: (337) 482-6675
E-mail: linuswilson [at] louisiana [dot] edu
Web: http://www.linuswilson.com

First Draft: July 20, 2009
This Draft: December 31, 2009

Lessons for the TARP Warrants
from 1983 Chrysler Auction

Abstract

The U.S. Treasury began auctioning its warrant holdings in December 2009. Nevertheless, this was not the first large auction of warrants. The U.S. Treasury auctioned its holdings of warrants from the bailout of Chrysler Motors in 1983. That warrant auction resulted in an implied volatility of less than zero, but it generated higher price than the management of Chrysler was willing to pay in negotiations. The similarities and differences between this auction and the more recent auction of the JP Morgan Chase warrants, which were issued as part of the Troubled Asset Relief Program (TARP), are discussed.

1.   Introduction

Over twenty-six years ago the U.S. Treasury held an auction for an obscure financial instrument that has implications for whether taxpayers break even on their investments in the banking sector. The precedent set by this auction for the right to buy shares in Chrysler Motors in 1983 helped the U.S. Treasury collect over $4 billion in proceeds from its negotiations and auctions of bank warrants through the end of 2009. Warrants are call options issued by companies that increase the number of shares outstanding upon exercise. The holder of a warrant can purchase shares at a preset price prior to or on the contract's expiration date. By the end of 2009, U.S. taxpayers have realized over $2.6 billion in losses from the failures of recipients of government-funded capital injections, since the capital was passed out beginning in October 2008.[1] Thus the warrant proceeds have helped compensate taxpayers for the risks they continue to bear from their investments in the financial sector. The warrant program is currently so popular in Congress that the House of Representatives, which passed financial reform legislation on December 11, 2009, has included a provision in section 1110 of The Wall Street Reform and Consumer Protection Act (H.R. 4173), requiring that any future loan guarantee, loan, or capital injection extended to systemically important institutions will include a grant of warrants to U.S. taxpayers.[2]

---

[1] See U.S. Treasury, December 28, 2009, "Transaction Report on the Troubled Asset Relief Program" accessed online on December 31, 2009, at http://financialstability.gov/docs/transaction-reports/12-28-09%20Transactions%20Report%20as%20of%2012-23-09.pdf and David Goldman, December 24, 2009, "Bailout's Big Mistake: Loans to Small Banks" *CNN Money*, accessed online on December 31, 2009, at http://money.cnn.com/2009/12/24/news/economy/bailout_payback/index.htm.

[2] See Brady Dennis, December 12, 2009, "House Votes to Reform Financial Regulations," *Washington Post*, accessed online on December 31, 2009, at http://www.washingtonpost.com/wp-dyn/content/article/2009/12/11/AR2009121102754.html. By the end of 2009, the Senate version of the legislation was still being debated. The entire bill could be found on December 31, 2009, at

On September 12, 1983, Chrysler won the right to buy back the 14.4 million warrants that it issued to U.S. taxpayers for a price of $311 million. (That was about $675 million in 2009 dollars.) This auction was the largest warrant auction in U.S. history prior to December 10, 2009. On that day, the 88.4 million warrants of JP Morgan Chase were auctioned for approximately $950 million or $10.75 each, according to Wilson (2010). Those warrants were issued to the U.S. Treasury by the second largest bank holding company by assets because of its participation in the financial sector rescue known as the Troubled Asset Relief Program (TARP). The 1983 warrant auction presents some anomalous results. Nevertheless, the auction led to a higher price than managers at Chrysler were willing to pay in negotiations. At the time of writing, the U.S. Treasury owns warrants in over two hundred publicly traded banks, with various expiration dates in 2018 and 2019, as part of the Troubled Asset Relief Program.[3] It will likely continue to auction its warrant holdings in the coming months and years. The publicly traded warrant market roughly doubled in December 2009, according to Wilson (2010), and it should multiply further in the subsequent months and years as these warrant auctions continue.[4]

2. The 1983 auction of the Chrysler warrants

The 1983 auction is one of the few data points we have of large warrant auctions. The description here is drawn from the news accounts[5] and the case study of Bruner (1986). In the

---

http://financialservices.house.gov/Key_Issues/Financial_Regulatory_Reform/FinancialRegulatoryReform/111_hr_finsrv_4173_full.pdf.

[3] See the U.S. Treasury, Office of Financial Stability transaction report on December 22, 2009, accessed online on December 24, 2009, at http://financialstability.gov/docs/transaction-reports/12-24-09%20Transactions%20Report%20as%20of%2012-22-09.pdf.

[4] Steve D. Jones, December 21, 2009, "Banking on Warrants", *Wall Street Journal*, C10, accessed online on December 31, 2009, at http://online.wsj.com/article/SB10001424052748704247504574604554003752902.html.

[5] Brooks, John, (1985), "The Kicker," *The New Yorker*, accessed online on July 17, 2009, at http://www.newyorker.com/archive/1985/01/07/1985_01_07_044_TNY_CARDS_000342367.; Lueck, Thomas J.,

summer of 1983, Chrysler was well on its way to retiring the taxpayers' loan guarantees that prevented an almost certain bankruptcy in 1979 or 1980. That summer Chrysler tried and failed to get Congress or the Treasury to forgive the warrants. After much public scorn in Congress for asking for the warrants to be forgiven, Chrysler under Lee Iacocca offered to repurchase the warrants from the U.S. Treasury for roughly their intrinsic value of $250 million.[6] The intrinsic value of an option is its value if it had to be exercised today. Long-dated options are usually much more valuable than their intrinsic value. This extra value above their intrinsic value is often referred to as the time value of the option. On September 1, 1983, the U.S. Treasury set the deadline for bids on the warrants, which had a strike price of $13 and expired on December 31, 1990. The auction was a first-price, sealed-bid auction. Chrysler won the bidding at $311 million or $21.602 per warrant. The next closest bidder was a consortium led by Goldman Sachs and Prudential Bache Securities at $20.668 a warrant. There were only five total bids submitted. All bids had to be for the entire lot of 14.4 million warrants.[7]

I used the Black and Scholes (1973) model adjusted for dividends, which was developed by Merton (1973). In addition, I used the adjustments for dilution proposed by Galai and Schneller (1978). I assumed that warrant exercise would lead to percent ownership dilution of 12 percent. The closing price of Chrysler's stock on the day the bids were due was $28.375. The 7-year and 10-year T-notes were yielding 11.93 and 11.94 percent, respectively, on September 1, 1983. Chrysler was not paying a dividend at the time of the auction. The volatility in an option pricing model is the expected standard deviation of the stock price over the life of

September 13, 1983, "Chrysler Top Bids To Buy Back Stock Rights," New York Times, accessed online on July 17, 2009, at http://www.nytimes.com/1983/09/13/business/chrysler-top-bids-to-buy-back-stock-rights.html.; Eckblad, Marshall, June 25, 2009, "Tussle Over Bank Warrants Echoes Early '80s Chrysler Fight," *Dow Jones Newswires*, accessed online on July 17, 2009, at http://online.wsj.com/article/BT-CO-20090625-711470.html.
[6] Steven D. Jones, August 21, 2009, "It's an Auction Conundrum at J.P. Morgan," *Wall Street Journal*, C10, accessed online at http://online.wsj.com/article/SB125080277461547531.html.
[7] Warren Brown, September 13, 1983, "Chrysler Outbids Competitors for Warrants on Its Stock," *Washington Post*, D7.

the option. I adjusted interest rates, dividends and volatility for continuous compounding.

Plugging in a volatility approaching zero, I obtained a price per warrant based on September 1,

1983, closing prices of $22.82. That is, the minimum possible Black-Scholes value of warrants

was $1.22 more than the maximum bid at the auction! This also means that the implied volatility

of the auction price was less than zero. Clearly, standard deviations cannot be less than zero.

This price seems to present arbitrage opportunities. Nevertheless, my estimates of fair market

value below show that these arbitrage opportunities are not large.

Perhaps investors were expecting Chrysler to pay some large dividends over the next

seven years. They could have projected the dividends of the third largest U.S. automaker over

the next seven-plus years by looking at the dividends paid by the 2nd largest U.S. automaker,

Ford, over the previous six-or-so years. The average dividend yield of Ford Motor Company

from January 2, 1977, to September 1, 1983, was 0.5 percent when annualized and adjusted for

continuous compounding. (Yahoo! Finance, the source of the data, only has historic prices for

Ford back to the start of 1977.) I obtained a warrant price of $21.73, which is still 13 cents

above the price Chrysler paid when I used a dividend yield of 0.5 percent. Thus, dividend

expectations alone cannot explain away the low implied volatilities.

An option is in the money if it can be exercised immediately at a profit. I think the low

implied volatility anomaly stems from the fact that the Chrysler warrants were deeply in the

money. Deeply in the money options are relatively insensitive to changes in volatility. Thus, a

small discount from the Black-Scholes value for these warrants led to the anomalous implied

volatilities. Hull (2002, p. 251) advises when projecting implied volatilities to only use options

that are close to being at the money. At the money options have a strike or exercise price equal

to the stock price. At the money options are also the most sensitive to changes in volatility

expectations. In other words, the Chrysler warrants had a low sensitivity to volatility. An option's sensitivity to volatility is often referred to as its *vega*.

My estimates of fair market value of those warrants indicate that the Chrysler auction price was close to fair market value. Ford's historic volatility from the start of 1977 to the start of September 1983 was 30.8 percent. Bruner (1986) calculates the trailing 30-day historic volatility of Chrysler's stock price at 65.3 percent. Plus the implied volatility of a three month warrant with a strike price of $13 dollars and price of $16.38 traded on September 1, 2009, was a whopping 135 percent. It appears that there was little reason for the bidders to believe that Chrysler's stock volatility over the next seven years was zero! To estimate the fair market value of the Chrysler warrants, I plugged in a dividend yield and volatility of 31 and 0.5 percent, 65 and 0.25 percent, and 135 and 0 percent into my low, middle, and high estimates, respectively. Thus the Chrysler warrants should have been worth in total between $314, $343, and $397 million in each scenario. Per warrant values in the low, middle, and high scenarios were $21.79, $23.85, and $27.55. Thus, the auction generated between 99 and 78 percent of fair market value by my estimates.

3. Comparison with the JP Morgan Chase warrant auction

The JP Morgan Chase auction topped the Chrysler auction in terms of the real (or nominal) price paid. The former generated gross proceeds of $950 million versus $675 million (or $311 million) in the case of Chrysler. To estimate implied volatilities, you need option prices, stock prices, risk-free rates, times to expiration, and dividend yield projections. These

parameters and estimates are summarized in table 1. According to the preliminary prospectus,[8] the JP Morgan Chase auction was held on December 10, 2009, from 8:30 A.M. to 6:30 P.M. New York City time. The close of trading on the New York Stock Exchange (NYSE) was 4:00 P.M. New York City time on that day. The author used the closing prices on the auction day, because those were the last regular trade prices.

The JP Morgan warrants were almost at-the-money because the strike price was $42.42 and the closing stock price was $41.27.   Thus, investor's valuations of the JP Morgan Chase warrants were much more sensitive to volatility expectations of investors than was the case in the 1983 Chrysler warrant auction. The implied volatility of the JP Morgan Chase warrant auction was about 23.1 percent. This was about 800 basis points lower, or about 25.7 percent lower, than the 31.1 percent annualized implied volatility of an average of two-year options that expired in January 21. 2012, with strike prices between $40 and $45.[9] 23.1 percent is also lower than the 10-year historic volatility from November 25, 2009, to November 24, 2009, of 49.8 percent or the GARCH(1,1) average projected volatility of 35.4 percent over the life of the warrant estimated in Wilson (2010). (GARCH is an acronym for generalized autoregressive conditional heteroskedasticity model. This popular method for estimating volatility based on historic stock returns was developed by Bollerslev (1986).) Since higher implied volatilities are associated with higher option premiums, investors at both the Chrysler and JP Morgan auctions were not willing to pay for nearly as much volatility as other historic and implied volatility metrics would suggest.

---

[8] The preliminary prospectus was accessed online on December 9, 2009, at
http://www.sec.gov/Archives/edgar/data/19617/000119312509249391/d424b7.htm.
[9] Similar calculations by the author appeared in Matthew Monks, December 14, 2009, "Cheap Price of Warrants Helps Banks," *American Banker*, 1.

Like the Chrysler warrant sale where management rejected a lower price than the auction price, the JP Morgan warrant auction generated a higher price than was rejected in negotiations. According to some unnamed source, JP Morgan's offer in July 2009 was less than $900 million[10] and the U.S. Treasury confirmed that the auction's net proceeds of $936 million was higher than JP Morgan Chase offered. Unlike the Chrysler auction, JP Morgan Chase confirmed that it did not bid for its own warrants.[11]

4.   Importance of auction design

Bulow *et al.* (1999) argue that bidders who have advantages over their rivals can significantly drive down the prices of common value auctions. The value of an object depends on its perceptions by other bidders in a so called "common value auction." In such situations, small differences in bidders' information can lead to significant differences in auction prices. Clearly, management at JP Morgan has better information than external bidders about the value of the TARP warrants, because they have more up-to-date and complete information about JP Morgan's prospects than can be found from public disclosures alone. A better informed bidder can scare away less informed bidders.

Bulow *et al.* (1999) suggest handicapping the stronger bidder and advantaging other bidders. One handicapping mechanism would have bidders that are not the issuing bank to pay a price that is slightly less than the issuing bank and be able to win the auction. Alternatively, the

---

[10] See Eric Dash, "In JPMorgan Auction, U.S. Made the Right Choice," *New York Times* accessed online on December 24, 2009, at http://dealbook.blogs.nytimes.com/2009/12/14/in-jpmorgan-auction-us-made-the-right-choice-hfo/.

[11] Peter Eichenbaum and Joshua Fineman, "JPMorgan TARP Warrants Sold by Treasury Fetch $10.75 (Update2)," Bloomberg.com, accessed online on December 24, 2009, at http://www.bloomberg.com/apps/news?pid=newsarchive&sid=azxUif3PvCo8.

issuing bank could be excluded from bidding on all or some of the warrants in the primary auction, but it would be free to buy the warrants in secondary market trades. Bulow *et al.* (1999) also suggest first-price, sealed-bid auctions. The sealed bids hide the aggressiveness or lack of aggressiveness of the better informed issuer, JP Morgan. Moreover, in this situation, the bidders with the most optimistic beliefs are more likely to pay for their optimism by offering a higher price for the warrants in a first-price versus a second price auction. Yet, the disadvantage of all these approaches is that they may seem "unfair" or that they discriminate against different bidders. Some bidders will pay higher prices than other bidders under these approaches; and thus, these alternatives may be politically unattractive even if they maximize taxpayer's revenues from such a sale.

The 1983 Chrysler warrant auction was a first-price, sealed-bid auction just as Bulow *et al.* (1999) recommend. Yet, I'm not sure that paper is entirely well suited for an item that is easily divisible in 88.4 million pieces. Binmore and Klemperer (2002) argue that auction consultants are far cheaper than investment bankers, and that paper argues that good auction design can make a big difference in how much revenue an auction generates. The JP Morgan Chase, Capital One Financial, and TCF Financial warrant auctions in December 2009 were modified Dutch auctions with a minimum bid size of 100 warrants according to Wilson (2010). All investors paid the uniform price that sold all the warrants. The issuing company was allowed to bid on the same terms as other bidders, but in JP Morgan's case its managers chose to not bid at auction. In Capital One's case, they disclosed in a Securities and Exchanges Commission (SEC) form 8-K filing that they won no warrants at auction.[12] Investors bidding above the

---

[12] JP Morgan's failure to bid was reported on in Peter Eichenbaum and Joshua Fineman, December 11, 2009, "JPMorgan TARP Warrants Sold by Treasury Fetch $10.75 (Update2)," accessed online on December 20, 2009, at http://www.bloomberg.com/apps/news?pid=newsarchive&sid=azxUif3PvCo8. The 8-K on December 7, 2009, at

auction price received all the warrants they requested. Interestingly, the bids had to be in $0.25 cent increments in both the JP Morgan Chase and Capital One Financial, which had eventual auction prices of $10.75 and $11.75, respectively.[13] Thus, it is conceivable for small amounts of asymmetric information that the issuer could not over or underbid, less well informed investors, because of the $.25 bid increment in those two auctions. Yet, for asymmetric information that accounts for more than a couple of percent of the stock price, it seems likely that the bid increments may have protected less informed bidders from management's information advantage.

5.   Conclusion

This note has looked at the U.S. Treasury's 1983 auction of its warrants issued by Chrysler Motors. That auction like the JP Morgan Chase auction that followed it 26 years later produced implied volatilities much lower than other traded options and historic volatility metrics. (The Black-Scholes-Merton implied volatility of the Chrysler auction was less than zero.) Both auctions employed very different auction designs. The Chrysler auction was a first-price, sealed-bid auction in which bidders had to submit bids for the entire lot of 14.4 million warrants. In contrast, the JP Morgan auction was a second-price, sealed bid auction in which bidders could submit bids for as little as 100 warrants. The Chrysler auction is the only large example of the effectiveness of a different auction design than the one used in the Troubled Asset Relief

---

http://www.sec.gov/Archives/edgar/data/927628/000119312509248044/d8k.htm disclosed that Capital One bought no warrants at the December 3, 2009, auction.

[13] Meena Thiruvengadam And Robin Sidel, December 12, 2009, "Treasury Earns $936 Million From J.P. Morgan Warrants," *Wall Street Journal*, accessed online on December 24, 2009, at http://online.wsj.com/article/SB10001424052748704517504574589890146911428.html.; Darrell A. Hughes And Marshall Eckblad, December 5, 2009 , "Treasury to Unload Capital One Warrants ," *Wall Street Journal*, online on December 24, 2009, at http://online.wsj.com/article/SB10001424052748704342404574575941836962438.html.

Program (TARP) warrant auctions in December 2009. The low implied volatility of the Chrysler

auction indicates that it is an example of auction design that probably should not repeated.

Nevertheless, both the Chrysler and JP Morgan auctions appeared to generate higher prices for

the U.S. Treasury than could have been obtained by negotiations alone.

References

Binmore, Ken, and Paul Klemperer, (2002), "The Biggest Auction Ever: the Sale of the British
3G Telecom Licences," *Economic Journal*, *112*, C74-C96.

Bollerslev, Tim, (1986), "Generalized Autoregressive Conditional Heteroscedasticity," *Journal
of Econometrics*, *31*, 307-327.

Black, Fischer, and Myron Scholes, (1973), "The Pricing of Options and Corporate Liabilities,"
Journal of Political Economy, *81*, 637–654.

Bruner, Robert F., (1986), "Chrysler's Warrants: September 1983," *Darden Business Publishing,
University of Virginia*, case study UVA-F-0682.

Bulow, Jeremy, Ming Huang, and Paul Klemperer, (1999), "Toeholds and Takeovers," *Journal
of Political Economy*, *107*, 427-454.

Bulow, Jeremy, and Paul Klemperer, (1996), "Auctions Versus Negotiations," *American Economic Review*, *86*, 180-194.

Galai, Dan, and Meir I. Schneller, (1978), "Pricing of Warrants and the Valuation of the Firm," *Journal of Finance*, *33*, 1333-1342.

Hull, John, Options, (2002), *Futures and Other Derivatives*, 5th edition, Upper Saddle River, New Jersey: Pearson Hall.

Merton, Robert C., (1973), "Theory of Rational Option Pricing," *Bell Journal of Economics and Management Science*, *4*, 141–183.

Wilson, Linus, (2010), "The Biggest Warrant Auction in U.S. History," *forthcoming Research in Business and Economics Journal.*

Table 1: Implied Volatility Calculations for the JP Morgan Warrant Auction and Two-Year Call Options on Dec. 10, 2009

Option Contract	Ticker	Option Price at Close	Strike Price	Expiration Date	Closing Price Date	Continously Compunding Risk-Free Rate	Dividend Yield	Closing Stock Price	Time to Expiration in Years	Implied Volatility
JP Morgan Chase Warrant Auction	JPM-WS	$ 10.75	$ 42.42	10/28/2018	12/10/2009	3.26%	1.83%	$41.27	8.8877	**23.07%**
JP Morgan Chase's January 2012 $40 Call Option	WJPAH	$8.05	$40.00	1/21/2012	12/10/2009	0.78%	0.48%	$41.27	2.1151	**31.55%**
JP Morgan Chase's January 2012 $45 Call Option	WJPAL	$5.93	$45.00	1/21/2012	12/10/2009	0.78%	0.48%	$41.27	2.1151	**30.71%**

These are the inputs and implied volatility calculations used to estimate the annualized implied volatility of the long-dated call options and the warrant auction on December 10, 2009, based on closing prices on that day. For the warrant, the dividend yield is a simple average of both the continuously compounded ten-year average dividend yield and the current dividend yield. The historic dividend yield is defined as the average dividend divided by the average daily closing prices from November 25, 1999, to November 24, 2009. The current dividend yield is the most recent dividend divided by the stock price, which is then converted to annual compounding because dividends are paid quarterly. The risk-free rate for the warrant is a weighted average of the 7-year and 10-year U.S. Treasury rates adjusted for continuous compounding. The 7-year U.S. Treasury rate had a 1/3 weight and the 10-year rate had a 2/3 weight. For the options expiring in 2012, the 2-year U.S. Treasury rate was adjusted for continuous compounding, and the dividend yield was the continuously compounded current dividend yield. The warrant price was taken from NASDAQ.com and the option prices were from MSN Money. Treasury rates were reported by the U.S. Treasury, and JP Morgan's (unadjusted) closing prices and dividends were taken from Yahoo! Finance. Warrant contract terms are from the preliminary prospectus. Option contract features are from MSN Money.