



Valuation in illiquid markets

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Abstract

What is the value of a financial instrument in an illiquid market? The classical valuation theory which is based on the law of one price assumes implicitly that market participants can trade freely in both directions at the same price. In the absence of perfect liquidity the law of one price should be replaced by a two price theory where the terms of trade depend on the direction of the trade. A static as well as a continuous time theory for two price economies is discussed. The two prices are termed bid and ask or lower and upper price but they should not be confused with the vast literature relating bid-ask spreads to transaction costs or other frictions involved in modeling financial markets. The bid price arises as the infimum of test valuations given by certain market scenarios whereas the ask price is the supremum of such valuations. The two prices correspond to nonlinear expectation operators. Specific dynamic models which are driven by purely discontinuous Lévy processes are considered.

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1. Introduction

Market liquidity may be loosely defined as the ease with which assets can be bought or sold. For a specific market, the degree of liquidity depends on a number of factors. One not so obvious but rather crucial factor is trust. When trust evaporates liquidity too will dry up. Changes in liquidity often occur as a result of a change in risk perception. The start of the 2007–2009 financial crisis illustrates this in a dramatic way. After a long period with plentiful trust and liquidity the market realized in July 2007 that there was a substantial default risk in portfolios underlying the tranches of Collateralized Debt Obligations (CDOs) in which a number of banks were heavily invested. These portfolios had been classified as subprime. The initially AAA rated CDO tranches became totally illiquid within a short period. Consequently the values of these assets had to be written down when the portfolios of these investors were revalued.

One can try to categorize markets according to their liquidity. A rough scale would start with those instruments, that are traded at organized exchanges, being considered the most liquid. Examples are the exchanges for equity shares and for derivatives. The next category in such a liquidity scale would be bonds. It is evident that there are big differences within this asset class. The rating, (by which we do not necessarily mean the ratings issued by rating agencies), typically has some influence on the liquidity of the instrument, but ratings do not take specific account of liquidity. Rather, ratings quantify credit risk. Liquidity risk is a second order risk and often reacts to changes in the credit standing of the bond. Sovereign bonds feature at the top of this asset class but there are many corporate bonds that outperform sovereign bonds issued by governments of countries with a fragile economy. In decreasing order of liquidity another category in the liquidity scale are structured products that are only Over-the-Counter traded.

Bespoke financial contracts which usually cannot be sold to a third party at all constitute a huge and even less liquid asset class. Insurance contracts would be typical examples of this kind, but note that there is a reinsurance market where some part of the risk can be traded. At the end of our liquidity scale one could place real estate. Real estate can be classified as a financial instrument since it is included within the portfolio of many institutional investors.

Among the many problems posed by a lack of liquidity is the question: What is the value of assets under these market conditions? We prefer here to use the word *value* instead of *price*. Pricing puts one primarily into the perspective of a trader who wants to buy or to sell a security. Valuation is a much broader notion. Investors often have a very long investment horizon. Nevertheless they need a value for each asset when they revalue their portfolio. This is necessary for active portfolio management on a daily, weekly or monthly basis or to produce a balance sheet even when they do not have any intention to sell. The same consideration applies to liabilities on the balance sheet of a financial institution.

The classical valuation theory which is based on the *law of one price* assumes implicitly that market participants can trade freely in both directions at the same price. This means in particular that the market is able to accept any amount of assets which are traded at the current market price whatever the direction of the trade is. In the absence of perfect liquidity the law of one price can no longer be justified. It should be replaced by a *two price theory* where the terms of trade depend on the direction of the trade. Let us illustrate this fundamental change of view by considering as an example sovereign bonds issued by a government that has already accumulated substantial debt and continues to produce a big budget deficit. At some point there will be a trigger whereby the market starts to worry about a possible default of the issuer and the partial or even total losses that could occur. As a consequence of the perception of an increased risk these bonds become less attractive for cautious investors and the price quotes will go down. Investors that hold these bonds on the asset side of their balance sheet will have to write the value of this position down. In fact the current mark to market accounting rules force them to do so even though they might not have the intention to sell the position at the reduced price which could afterwards recover again. Markets often overreact or even panic. A striking example where overreaction caused enormous financial damage was the situation of insurers – in their role as institutional investors – after the burst of the internet bubble in 2000. Stock quotes which had reached record levels in the internet rally fell sharply. In order to stimulate markets and economies interest rates were pushed down by monetary authorities and thus the discount factors applied to long term liabilities went up with the consequence that liabilities in the balance sheets of those insurers increased. At the same time they had to write down the investments in stock on the asset side of their balance sheet. In deed, it was reported that supervising agencies in some countries asked insurance companies in this situation to close the gap in their asset-liability relation. They did this by selling blue chips which were their most liquid assets. These sales contributed to drive stock markets down further. Billions of euros and dollars – wealth of investors in life insurance – were destroyed unnecessarily. The situation reached such a point that some insurance companies had to raise fresh capital. In this context it is worth recalling that the current mark to market accounting rule was inspired by the savings and loan crisis that had shaken the United States in the late 80s. According to the accounting principles at that time banks had been allowed to carry initial values of credits forward although, it was evident their debtors were already insolvent. Mark to market as an accounting principle represents the other extreme and may not be the optimal solution either.

Now let us turn to the balance sheet of the issuer of the government bond referred to above. The position is now on the liability side of the balance sheet. Following the mark to market accounting rule a lower market quote would reduce the debt and hence generates a profit for the issuer. These so-called “windfall” profits have been observed in 2008. Indeed, major US banks reported hundreds of millions US dollars of profits caused by a reduction of their debt positions when their ratings were downgraded in the crisis and price quotes for bonds fell. Pursuing this line of thought an issuer of bonds might even register record profits just prior to its own default. Does this make any sense? Certainly not, unless one is prepared to accept the idea that windfall profits help a distressed company to dress up its balance sheet. An issuer in distress cannot exploit the low price for its debt position. Funds to buy bonds back will not be available in such a situation. If the issuer could take advantage of the low price and reduce the debt, the market would certainly realize the new situation and the quote for the bond would jump up immediately. Thus the lower price at which the bonds are offered in the market has no practical relevance for the issuer. On the balance sheet the debt position should be reported essentially at the initial value which it had before the deterioration of the credit status. This is roughly the sum which the issuer in the event of survival will ultimately have to redeem at maturity. As a consequence we are led to a two price valuation for such a financial instrument. Figure 1 shows how the two values should evolve qualitatively as a function of the default probability of the issuer of the bond.

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