

Asset Price Movements and Derivatives: Implications for Monetary Policy in Nigeria

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I. Introduction

Accurate asset pricing is one of the fundamental and most pressing problems confronting modern finance practitioners. The risk of overvaluing ones assets needs to be carefully balanced against the threat of undervaluing them. This is because either situation could trigger arbitrageurs' and/or speculators' intervention to restore equilibrium at the expense of assets owners. In markets where information efficiency holds, erratic price movements should be at their minimum level.

On the premise that Nigeria's financial market is virtually accelerating towards global integration, this paper argues from the perspective of a wide group of stakeholders and highlights the importance of maintaining accurate market value for a wide variety of asset classes. From the perspective of speculators, the author discusses the methodology for identifying undervalued or overvalued assets for the purpose of taking appropriate bet on such assets. From analysts, hedgers or investors perspective, this paper discusses how financial instruments derivative could be used to protect financial assets and return on such assets against volatility. The author highlights application of the same set of derivative instruments for speculative, regulatory arbitrageurs and other purposes. For the same group, this paper identifies fundamental variables that determine assets' prices in a free market economy. The author specifically identifies interest rates, exchange rates, rates of inflation as well as monetary and macroeconomic policies as the main asset-price determinants.

This paper offers a set of mathematical models for pricing different categories of financial assets. The author maintains that financial engineering has ushered in a new set of financial assets, such as catastrophe bonds and collateralized debt obligations

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(CDOs), which are inherently difficult to price. At every opportunity, the author elucidates the roles of monetary policy makers in fostering efficient financial market system in an emerging economy like Nigeria.

According to Fabozzi (2006) and Martellini et al. (2004), asset pricing is a process by which the market value of a financial asset is determined. While the process relies heavily on accounting figures, it essentially incorporates the value of other intangible elements of the reference asset.

To the extent that the figure incorporates anticipated value of the reference asset, the price of any financial asset is essentially the outcome of the present value of its future receivables discounted at a reference rate or yield plus present value of the asset's par value, Hull (2005). The market worth of financial assets is constantly changing as they adjust to fundamental variables that apply to them. In a free market economy like Nigeria, market-sensitive information plays important role in determining the market worth of an asset. Ryan (2007) finds that the purpose of conducting pricing exercise on a reference asset includes, but not limited to, identifying the market worth of such asset at a point in time with the intention of taking speculative, hedging or arbitraging position as the condition may warrant, and depending on the identity of the reference entity. Agrawal et al (1992) holds that determining the price of a financial asset is a continuous process. Usually, it ends with the liquidation of the asset or, in case of a debt instrument, it coincides with its maturity date.

The issue of asset pricing is used by different entities and for different purposes. Regardless of the purpose, however, accurate asset pricing is one of the fundamental responsibilities of financial practitioners. By virtue of their roles, financial institutions in Nigeria and the Central Bank in particular, impliedly assume responsibility for providing essential inputs - including discounting interest rates, inflation targets and anticipated exchange rate - with which to calibrate market value for various categories of financial assets. Those who rely on, and use asset pricing in their daily activities include: analysts, investors, rating agencies, market makers, speculators, arbitrageurs and a host of other stakeholders. These market participants and intermediaries need to evaluate the price of their reference assets in order to make appropriate decisions in their financial activities.

Motivation and Context

Asset valuation, derivatives and exchange rates have received reasonable level of attention amongst front line researchers of modern times. The author divides these

researchers' areas of attention into different strands and discusses their contributions separately. Prominent works in the field of assets valuation are those of Barker (2001), Damodaran (2001) and Schwartz (2001). These authors offer a comprehensive analysis of valuation models using accounting figures for dot.com companies as their case studies. Examples from a number of old tech and new tech companies are included in their sample. Another author Hand et al (2003) - looks at a systematic approach to evaluation of intangible assets and the risks involved.

Agrawal et al (1992), Franks et al (1996), and Gorton et al. (2005) consider valuation for hostile takeovers and other forms of mergers and acquisitions. These authors share the view that post-merger value-added contribution for acquiring firms is as important as acquisition premiums for target companies when it comes to asset valuation for the purpose of mergers and acquisition. Jensen (1998) and Ryan (2007) hold the same view as Agrawal (1992), Franks et al (1996) and Gorton et al. (2005) on the issue of mergers and acquisition. Jensen (1998) and Ryan (2007) went further to explore causes of Mergers and Acquisition and their consequences for acquiring firms.

Another work, by Hull (2005), investigates foreign exchange and their effects on stock bonds. Other works in similar strand are that of Martellini et al (2004) and Fabozzi (2006). These two outstanding researchers and authors extensively explore fixed-income securities and their mathematics. Martellini et al (2004) and Fabozzi (2006) mathematically contend that the price of a reference financial asset is equivalent to the summation of the present values of all future receivables for the reference asset and present worth of such assets' par value. Fabozzi, in particular, applies an annuity formula to further illuminate the mathematics of assets pricing. His attention was mainly directed at evaluating fixed-income financial products. Another author in this category Hull (2005) critically explores the concept of options, futures and other derivatives and their applications to risk analysis and speculation on various financial asset groups. Hull's areas of attention include interest rate derivatives, credit derivatives and derivatives of exotic financial products including weather and energy products.

A large subset of academic investigations examines the issue of exchange rate, interest rates and other macroeconomic fundamentals that determine assets' prices. In this category Lucas (1982), explores the effects of interest rates and foreign exchange on financial assets' pricing. Lucas contends that positive correlation exists between interest rates and exchange rates. He also opines that the two indicators can be highly effective tools in monetary policy analysis. Another author, Jorion et al (1990),

considers the concept of purchasing power parity and its influence in optimal exchange rates determination.

In all, this paper seeks not to contradict, but rather to complement existing academic materials regarding the importance and applications of derivatives and exchange rate volatility in asset price determination. In addition, the paper attempts to highlight the roles of monetary policy practitioners in fostering effective asset-pricing mechanism in an emerging economy like Nigeria. In its contribution, this paper maintains that effective and coherent asset-pricing policies will place Nigeria in good stead. The author contends that failure to achieve this is to provoke frenzied attacks on under/over valued assets from speculators and arbitrageurs seeking to restore market equilibrium.

Problems of Asset Pricing

According to Schnitzer (1996) and Schwartz et al (2000) one of the fundamental challenges that confronts quantitative analysts and other specialists involved in asset pricing is the need to forecast the future value of financial assets with reasonable accuracy. Cash-flow modeling that is widely being used is not without its flaws as it relies overwhelmingly on subjective probability figures with which analysts extrapolate assets' expected future values. What compounds this problem is the fact that there are different categories of assets, and each of the categories requires fundamentally different valuation methodology according to Scherer (1988).

Another problem associated with asset pricing, especially with financial assets, is the fact that cash flow of most of these assets are notoriously volatile. This necessitates application of dynamic stochastic modeling techniques that require specialist knowledge including **GARCH** and other advanced quantitative techniques.

While most of the problems identified so far can be categorized as challenging, there are some which are simply daunting. To this category, according to Fabozzi (2006), belongs the difficulty associated with identifying appropriate discount rate with which to evaluate present value of a future stream of receivables. While it is normal to use a reference benchmark such as *Libor*, *Euribor*, *federal bonds spread (USA)*, *local discount/open market rate (Nigeria)*, there is no guarantee that such benchmark adequately reflects the appropriate market risk that best applies. It can be argued that the limits of the differentials that may result from such discount rate anomaly will tend towards zero and will eventually be corrected by the influence of arbitrageurs as number of such anomalies increases. While this argument holds in deep, broad and

highly efficient financial market regions; such argument can not be supported in less sophisticated markets including Nigeria which are characterized by relatively shallow capital base and less efficient financial system that is saddled with legal and other infrastructural impediments.

In the light of the above, it is imperative that monetary policy authorities in Nigeria devote adequate attention and resources to modeling interest rate and its volatility in a manner that best capture cost of capital. As Nigeria accelerates towards global financial integration, her interest and exchange rates, should adequately reflect regional and global purchasing power parity. This is necessary to stem speculative attacks which any anomaly might provoke.

The global financial markets are fast becoming borderless and highly integrated. This globalization phenomenon is genuinely abated by advancements in information technology and cohesion between advanced modeling technique and financial engineering. As a result of these factors, a new wave of financial instruments, which are sophisticated and complex to evaluate is now emerging according to Martellini et al (2004) and Hull (2005).

This new category of assets includes weather derivatives and associated catastrophe bonds. Other financial instruments that are considered very advanced and, hence, difficult to price include CDO of CDOs as well as other exotic over the counter (OTC) instruments. One other factor that poses problem when it comes to financial assets' pricing is the fact that the prices of most financial assets are closely related to and stubbornly mirror rating values attached to such assets.

To the extent that such rating values are not static and merely express probability of default, one can comfortably query the veracity of such rating-induced pricing technique. Monetary policy makers need to ensure transparency and consistency in rating mechanism available to stakeholders in Nigeria and that all stakeholders are knowledgeable about such mechanism. The stride being made towards global financial integration suggests that Agosto rating services alone might not be able to cope with speed and magnitude of prospective transactions that will soon follow. It is equally imperative that users of rating figures are monitored in a manner that precludes misconception of expression of probability to honor a debt obligation with willingness to actually honor it. The recent sub-prime mortgage crisis in the United States of America and the global contagion effects that followed lend credibility to this view (Financial Times 19th, 22nd, and 23rd October, 2007).

When Price Does Not Reflect Value

Investors, analysts and other market makers are constantly reviewing assets prices as they seek to identify undervalued or overvalued assets to take position on or against. To achieve this goal, these professionals employ a number of techniques prominent amongst which are the following:

By comparing the accounting value against the market value of reference assets

By comparing actual value of assets against their expected value

By separating the effects of macroeconomic indicators such as interest rate, exchange rate, inflation and taxation.

Another potent tool being used to identify overvalued or undervalued assets is by analyzing effects of global-specific shocks such as the Asian flu, Russian crisis and, more recently, the American sub-prime mortgage crisis. The degree of exposure of individual assets or countries to a global contagion is dependent on coefficient of correlation that exists between financial indicators of regions or assets under investigation.

Benchmarking and arbitrageurs' barometer are other common empirical methods being used.

According to Baker (2001) and Damodaran (2001), while arbitrageurs and speculative opportunities might add depth and breadth to a financial market and, hence, help ensure its efficiency, extreme shocks and erratic volatilities are considered unhealthy by market participants. Monetary policy makers need to ensure timely disclosure of market-sensitive information at corporate and at national levels in a manner that disadvantages no one in the market. This will enable market participants to adjust their asset valuation techniques accordingly and to avoid erratic volatility or shocks. Monetary policy makers, in addition, need to explicitly discourage abuse of "inside knowledge". This will ensure level playing fields and heighten investors' confidence.

Motivations for Asset Valuation

Assets valuation is performed for a variety of reasons and purposes. The following are the prominent reasons behind assets valuation:

Valuation for liquidation: Here the emphasis is on residual value of assets and net income, if any. The value of outstanding debt is equally important in this circumstance.

Valuation of a going concern: Here the accounting value is considered along with the market value of other intangible assets such as goodwill and ranking amongst competitors.

Valuation for Initial Public Offer (IPO): The value here depends on accounting value of operating assets and market assessment of future stream of income receivables. Unique position of a new company, such as patent rights or license to a new technology can substantially affect its market value during a road show for an IPO.

Valuation for Mergers and Acquisition: Here the key determinants of value are the accounting value of operating assets of the target company, goodwill and other intangible assets of the company and post-acquisition magnitude of future receivables of acquiring firm. In this case, the size of the control premium and post-acquisition value added need to be attended to by experts (Franks et al. 1996, Gorton et al. 2005, and Schnitzer 1996). Market perception of post-acquisition value of risk to be inherited by acquiring firm equally influences asset pricing for mergers and acquisition. In case of a hostile takeover, valuation process can be stifled and deliberately influenced due to information asymmetry and effects of bounded rationality.

Monetary policy makers in Nigeria need to ensure that information disclosure in company brochures and public domain are adequate, reliable and provided in a manner that is transparent and consistent. Malicious falsification of market-related information should be acutely discouraged.

Valuation of Financial Assets and Securities

According to Sholarin (2005), financial assets and securities are fundamentally different from other forms of physical assets in the sense that they can command far higher prices than their accounting values, depending on their rating, market expectation regarding their future value and magnitude and volatility of their future cash flow.

The following are examples of financial assets or securities for which effective pricing methodologies already exist globally:

- Equity
- Bonds
 - o Zero-coupon or bullet bonds
 - o Coupon-paying bonds

- o Plain vanilla bonds
- o Exotic bonds [puttable bonds, callable bonds, convertible bonds, and warrants].

Financial derivative products

- o Futures
- o Swaps
- o Options
- o Swaptions

In addition to these, there are other OTC products for which prices can be computed.

Lucas (1982) argues that the role of inflation, interest rate and exchange rate in determining market values of financial assets can not be overemphasized especially where future receivables are meant to be considered. As such, he further contends that it is the duty of monetary policy makers to ensure that these indicators are regularly available and that their future values are fairly predictable.

Mathematics of Debt-Instrument Pricing

The mathematics required for pricing financial securities are highly developed and have matured over the last two decades. With advancements in computational technology and modeling skills, the frontier continues to shift and, as yet, remains undefined. While fundamental differences may remain in areas of usage and applications, Hull (2005) and Fabozzi (2006) postulate that financial securities are priced on the basis of the present value of their future stream of receivables, as well as the present value of their future par values. As an example, this paper will focus on pricing of coupon-paying bonds, as well as zero-coupon bonds. Other categories of assets mentioned above can be priced with modifications to the mathematical equations offered.

Pricing Coupon Paying Bonds:

For a bond that makes semiannual coupon payments of $C/2$, and has a semiannual yield of $y/2$, the market price could be determined by:

$$P = \frac{C/2}{1 + \frac{y}{2}} \frac{1}{d/d'} + \frac{C/2}{1 + \frac{y}{2}} \frac{1}{1+d/d'} + \frac{C/2}{1 + \frac{y}{2}} \frac{1}{2+d/d'} + \dots + \frac{C/2}{1 + \frac{y}{2}} \frac{1}{n-1+d/d'} + \frac{M}{1 + \frac{y}{2}} \frac{1}{n-1+d/d'} \dots \dots \dots (1)$$

Using summation notation, it follows that:

$$P = \sum_{t=1}^n \frac{C/2}{1 + \frac{y}{2} t} + \frac{M}{1 + \frac{y}{2} n} \tag{2}$$

From equation (2) it can be concluded that the price of a coupon paying-bond is a combination of the following two elements:

1. The present value of coupon payments
2. The present value of the par value or maturity value

This will enable us to separate coupon payments, and interest from its re-investments, from the present value of the par value of a bond.

In this case:

The present value of all coupon payments and return on their reinvestments which is:

$$P = \frac{C/2}{1 + \frac{y}{2} d} + \frac{C/2}{1 + \frac{y}{2} 1+d} + \frac{C/2}{1 + \frac{y}{2} 2+d} + \dots + \frac{C/2}{1 + \frac{y}{2} n-1+d}$$

Will become:

$$C \frac{1 - \frac{1}{1+i}^N}{i} \tag{3}$$

The mathematical expression (3) is the same as the present value of an annuity (**C**) in which first payment commences at time [t+1], which in this case represents coupon, payable over (**N**) years and discounted at the rate of (**i**)

And the present value of the par value will be:

$$\frac{M}{1 + \frac{y}{2} N}$$

This will enable us to rewrite equation (2) thus:

$$C \left[1 - \frac{1}{(1+i)^n} \right] + \frac{M}{(1+\frac{y}{2})^N} \dots\dots\dots (4)$$

It is assumed that settlement date for [C] does not fall between coupon periods. As such, exponent [n-1+d/d] is replaced with [N].

Alternatively, Equation (2) can be rewritten as:

$$P = \frac{1}{1+\frac{y}{2}} \left[C/2 + \frac{C/2}{\frac{y}{2}} \left[1 - \frac{1}{(1+\frac{y}{2})^{n-1}} \right] + \frac{M}{(1+\frac{y}{2})^{n-1}} \right] \dots\dots\dots (5)$$

Pricing Zero-Coupon Bonds

Equations (1, 2, 3 and 5) assume that coupon payments are paid at irregular intervals and settlement date falls between coupon periods. Where no coupons are paid, and maturity period of (N) years are uninterrupted, this will be regarded as zero-coupon bonds. The price of such bonds will simply be:

$$P = M \frac{1}{(1+i)^N} \dots\dots\dots (6)$$

This is equivalent to the price of principal amount only in a mortgage bond where no foreclosures are assumed, and that interest payments are considered separately. This has further applications in pricing Residential Mortgage-Backed Securities [RMBS] under Asset-Backed Securitization [ABS] transactions. The same equation is applicable in valuing non-interest deposits. The equation can also be used in pricing treasury bills in discount markets.

More advanced [Black-Scholes] model enables analysts to price derivative products including bond options, interest rate swaps and swap options. According to Fabozzi (2006), Hull (2005) and Martellini et al (2004), Black-Scholes model assumes

lognormal distribution of asset price at maturity.

Key to equations:

$C/2$	=	Semiannual coupon payment;
$Y/2$	=	Semiannual coupon yield;
d	=	The actual number of days between settlement and the next coupon Payment;
d'	=	The number of days in the coupon period
n	=	Number of coupon payments remaining till maturity
N	=	Number of years remaining till maturity
M	=	Maturity value.

Asset Pricing and Financial Derivatives

According to Hull (2005), a derivative is a financial instrument, the price of which is derived from the price of another financial product called underlying instrument. The role of financial derivatives in pricing financial instruments is of unique importance to financial intermediaries and other stakeholders. Financial derivatives are now available on a vast number of financial securities including equity, fixed-income products, currency, commodities and market indices.

While equity and currency derivatives have seen a moderate growth over the past two decades, fixed income and commodity derivatives have seen the most pronounced transformation. Transformation of fixed income derivatives has ushered in a new set of financial assets with varying degrees of pricing difficulties according to Hull (2005). These new assets class or financial securities include: CDO, collateralized loan obligations (CLO), collateralized bond obligations (CBO), CSO, and CDO of CDOs. More traditional fixed-income derivative assets include interest rate swaps, options, futures and swaptions. Other category of similar assets belongs to Credit Derivative financial securities. These include: Total Return Swaps, Credit Return Swaps and Credit-Linked Notes. Black-Scholes mathematical equations and their modified versions are being used extensively in pricing a vast majority of these financial instruments derivative.

It must be emphasized that some of the financial securities highlighted above are not yet being traded in Nigeria due to legal and other infrastructural impediments. It is therefore imperative for monetary policy makers in Nigeria to either set up financial derivatives department or provide adequate incentives for private financial houses to facilitate their introduction. The need to monitor derivatives practitioners is

overwhelming. This is because of the high-risk nature that derivatives instruments connote. Representations should be made to law makers with the intention of removing legal barriers that impede application of derivatives in Nigeria's financial markets.

The very nature of Nigeria's economy - gas, oil, cocoa, cassava, rubber and others actually provides ample and genuine opportunities for futures, options, swaps and other derivative instruments to be actively traded in Nigeria's financial markets. Such move would further widen and deepen Nigeria's financial sector and create a new breed of high-caliber professionals with which to take future challenges. If properly taken, such move will ensure that Nigerian financial markets are adequately and quickly integrated within the global financial system. This is in line with vision 2020 currently being embarked upon by the present administration and its entire team.

According to Hull (2005) and Fabozzi (2006), while derivative products are financial assets in themselves, they are often acquired for specific purposes in a financial circle. Motivations for acquiring financial derivative products vary significantly and include the following:

Motivations for Financial Derivatives:

- Risk management
- Speculation
- Reduced transaction costs
- Regulatory arbitrage
- Financial engineering
- Enhancement of OTC transactions

Each of these motivations occupies separate areas of research and study in financial circle. Monetary policy makers need to ensure that these risks are identifiable and manageable by finance practitioners. The extent to which the risk factors are manageable depends on availability and nature of derivative instruments that the Nigerian financial system offers and supports.

This is because, as indicated above, derivatives serve as effective risk mitigating measures, and they are indispensable in modern financial markets.

Expectation Theory, Exchange Rate Volatility and Financial Asset Pricing

As indicated earlier, one of the fundamental macro-economic indicators that influence the price of a financial asset, apart from interest rate, inflation and taxation, is the relative value of a national currency in relation to other major international currencies. This, technically, is referred to as exchange rate. Like the price of any financial asset, exchange rate is subject to immense volatility and (according to Levich (1985), its value is influenced by the mechanism of fundamental market indicators in a market economy. In a market where exchange rate is determined by market forces, the effect of expectation in shaping future direction of exchange rate can be severe. Where financial sector occupies a significant position in the composition of major economic activities as is the case in modern Nigeria, then the influence of exchange rate expectation in determining the value of assets can even be more severe according to Blanchard et al. (1982).

When the value of a currency depends on its expected rate of change as well as on the market fundamentals, its behavior will fundamentally be different. In such a situation, the current level of exchange rate will relate to a weighted sum of current and expected future values of the fundamental variables. The weights will decline geometrically as we go forward in time starting with a weight of unity on the current value of fundamentals according to Copeland (2005), and Muth (1961).

As the Nigerian economy becomes increasingly integrated with the global economy, the value of its currency will depend crucially on the prospective capital gains or losses that the financial market anticipates. This in turn will determine how assets' values are perceived in relation to other market regions. This concept underlies the purchasing power parity which forms one of the fundamental principles that help shape international exchange rates. Monetary policy makers in Nigeria will need to devote substantial attention to ensuring that exchange rate policy connotes a healthy macro-economic outlook for the country. Exchange rate plays a very important and crucial role in categorizing a country as being investable or non-investable in investors' communities.

Copeland (2005), and Blanchard et al. (1982) argue that one key effect of exchange rate policy on financial assets is the fact that, because exchange rate expectation can add to, or drain value from net worth of an asset, its valuation is capable of triggering frenzied attacks on financial assets by speculators and/or arbitrageurs looking to make money in short-selling or long-buying of vulnerable assets in a series of derivative maneuverings. In this regard, the need to prevent anticipation of erratic movements in exchange rate of the Naira needs to be maintained at all times by the authorities concerned.

As a result of the on-going banking consolidation and reforms, Nigerian financial institutions are becoming increasingly integrated with the global financial markets. As such, the role of the Central Bank of Nigeria in determining monetary injections and/or withdrawals will gradually start to diminish. This will be replaced by the need to ensure a coherent and highly integrated network of monetary and macroeconomic policies that guarantee a balanced and prudent financial-economic system for Nigeria within the global economic and financial system.

Conclusion

The issue of asset pricing is of tremendous importance particularly for an economy like Nigeria that is accelerating towards global financial integration. Asset pricing efficiency needs to be maintained by the monetary policy makers. This is because overvalued assets are likely to keep foreign investors at bay and local ones will be encouraged to seek shelter abroad for their assets. In the same vein, assets that are undervalued are likely to cause long-run macroeconomic distortions in the market. In a free market economy, any anomaly in asset pricing will be corrected by market participants as the market seeks to equilibrate itself.

Financial derivatives have the potential to mitigate against asset-pricing volatility. As such they play very crucial roles in correcting anomalies in asset pricing mechanism. Interest rates, rates of inflation and exchange rates are fundamental macroeconomic indicators that actively influence market value of financial assets. The role of monetary policy makers in ensuring that these economic indicators are synchronized, integrated and carefully balanced is overwhelming. Again for an emerging economy like Nigeria, attending to the issue of asset pricing and its volatility can not be less relevant and timely.

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