The Impact of the Time Value of Money on Valuation Practice

Malvern TIPPING, United Kingdom

Key words: annuity, history, valuation practice

SUMMARY

Real estate valuers rely upon standard valuation tables without giving too much thought to their construction. Valuers of previous generations have also relied upon tables based upon the prevailing assumptions of their age. These assumptions have often been in conflict with market reality. Originally, only very limited regard was paid to the time value of money. Annuity tables have in the main been calculated on an annual basis. At first, these were always calculated in arrears. Sometimes the discount rate was based upon compounded interest, but very early practice often favoured simple interest. Moreover, early writers ignored the time value of money. By the early nineteenth century, some writers had become more aware of the time value of money. Nonetheless, this still did not become fully reflected in professional practice. Eventually, during the twentieth century the frequency of rental income did become reflected in the tables. Generally, these still treated income as receivable in arrears, whereas most rent was receivable in advance. However, the greater use of the True Equivalent Yield does help to compensate for this. At the beginning of the twenty-first century, United Kingdom valuers have access to True Equivalent Yield tables based upon the assumption of rental income being receivable quarterly in advance. Increasing numbers of United Kingdom commercial tenants have recently been seeking monthly in advance payment patterns. Other countries already have a tradition of such monthly payments. Real estate valuers should be equipped adequately in order to be able to apply professional practice to market reality. The tables and their application continue to evolve in order to equip valuers to offer best professional practice and to reflect changing circumstances. This paper will seek to illustrate how professional practice has had to adapt to keep pace with theory and how it might change in the future.

The Impact of the Time Value of Money on Valuation Practice

Malvern TIPPING, United Kingdom

1. INTRODUCTION

Interests in real estate bearing income are valued on the basis of the capitalization of that income. This is the fundamental aspect of the valuation method normally known as the *investment method*. Current valuation theory recognizes the importance of the pattern of the income-flow. Sometimes, valuation practice follows theory. On other occasions, the two are at variance. Although the Time Value of Money has not always been recognized, its roots are traced far back in history.

This paper traces the history of the Time Value of Money from its first application through to present practices. The appropriateness of current applications is examined and changes to practice are suggested.

1.1 Engagement with the literature

The research is based upon published material to build knowledge of the subject. Published research on the origins of concepts of the Time Value of Money, especially with respect to the application of compounded interest, is reviewed. This paper places emphasis on the development of valuation tables and valuation approaches in the United Kingdom from the time of the emergence of the chartered trading companies. Such an emphasis relies heavily upon an hermeneutic methodology.

The literature on both current theory and current practice is reviewed. Current theory and current practice are considered in conjunction with the history of the Time Value of Money.

1.2 Outcome of the paper

Appropriate theory on the Time Value of Money is highlighted. However, practical applications are also discussed. Sometimes, the real world requires divergence between practice and theory. This paper also seeks to highlight some change to valuation practice necessitated by true adherence to the Time Value of Money concept within the constraints of everyday practice

2. CURRENT VALUATION PRACTICE

The current approach to the valuation of real estate investment income has evolved over the course of the last four centuries. It is based upon the summation of the capitalization of both the present rental income and the reversion. Some valuation processes require the discounting of income receivable at some point in the future in order to arrive at a present value. Valuers generally think of these functions as arising from valuation tables. Such tables have

traditionally existed in printed format. However, it has been possible to calculate values through the application of the formulae from which the tables have been devised. Equally, computers have more recently made it possible to apply the tables in a digital format.

The common thread running through the valuation tables in their different guises is a recognition of the Time Value of Money. Interest receivable on principal has long since been the corner-stone of this recognition. The tables are now applied on the assumption that interest should be compounded. However, the pattern of such compounding does not always reflect the pattern of rental receipts. This has been true not only of the frequency of rental income, but also of the timing of receipts.

Economists and accountants had sought to address the issue of the timing of payments and receipts through the adoption of discounted cash-flow (DCF) techniques (Enever, 1984). The application of DCF techniques to property valuation and analysis arose as a consequence of the Greenwell Report. DCF attaches a value to each component of income. It values investment property through the summation of the value of each component of income (Baum & Crosby, 1995). It does so through adding up the present values of all the components of income. As a consequence, DCF techniques consider the Time Value of Money at every point.

Although DCF techniques do make full allowance for the Time Value of Money, they are not fully incorporated into professional practice. It is at this point that theory is not fully reflected within professional practice. Most valuers still do not use DCF techniques in all their valuations. There may be cultural reasons for this. Moreover, the use of DCF techniques is not always practicable. For example, it would not be practicable for an investor to use DCF techniques to analyze property lots as they are sold in the auction room. Such investors might seek a more user-friendly approach even if it is less precise.

Due to their resistance to use DCF techniques, many investors and valuers rely on tables produced in the traditional printed format. In the main, the tables relied upon are *Parry's Valuation & Investment Tables* (Davidson, 2002). When first published in 1913, these were forward-thinking and up-to-date. However, these tables were based upon nominal yields, which assume that rental income is receivable annually in arrear. The assumption underlying such tables has drawn criticism that they do not reflect market reality (Banfield, 2006). In several jurisdictions, including the United Kingdom, rents on most classes of property investment are actually receivable quarterly in advance. The latest edition of *Parry's Valuation & Investment Tables* (Davidson, 2002) does give some recognition to this by providing additional tables. It provides Years' Purchase tables based upon the assumption of rent being receivable quarterly in advance. It also provides Yield Conversion tables to facilitate conversion between nominal and effective yields, the latter otherwise known as true equivalent yields (TEYs).

In some jurisdictions the norm is for rents to be receivable monthly in advance. Although this pattern is not yet the norm for commercial investment property in the United Kingdom, an increasing number of retailers there are seeking to adopt a monthly rental payment pattern.

This will have some impact upon capital values of the properties concerned, and the property market should be aware of that.

3. THE HISTORY AND EVOLUTION OF THE ANNUITY TABLES

3.1 The first use of interest

Since the property valuation tables are in essence annuity tables based upon value arising from the application of interest to capital, it is necessary to trace the origins of interest.

The application of interest has not always been accepted by society. Islamic Shariah law prohibits *riba,* which includes the receipt or payment of interest (Qazi, 2006). Similarly, the charging of interest was generally prohibited in western society until the Reformation, although there were a few notable exceptions to the rule. Therefore, the annuity tables, with their reliance upon the input of interest, did not develop in the modern western world until after the Reformation. However, the history of interest can still be traced back to the earliest times (Kopf, 1927 and Hudson, 2000).

During the third millennium B.C., banking certainly existed in Babylonia (Hudson, 2000). It is thought to be highly probable that banking had also existed beforehand in Ancient Egypt. The concept of compound interest did exist from the outset of banking. The Babylonians were very conscious of the exponential growth of debt through the process of compounding and its capacity to overwhelm borrowers. As a result, provision was made to cancel such debts periodically or in given circumstances. Thus from an early stage there was some aversion to what later became known as usury.

There is evidence that the Romans applied discount and interest. There is also evidence that they had created crude annuity tables. The Romans used such tables to calculate the value of life annuities bequeathed to beneficiaries of wills. The best known such table is that attributed to the Praetorian Prefect Ulpianus and dated around 225 A.D.

3.2 The treatment of interest by the medieval Church

The medieval Church frowned upon the charging of interest. Indeed, it condemned the practice as usurious. In the main, banking and a monetary economy had disappeared in Europe with the fall of the Roman Empire (Kopf, 1927). The Church cited biblical texts to support a ban on the payment and receipt of interest. In particular, Exodus 22:25, Leviticus 25:35, 37, and Deuteronomy 23:19 were cited (International Standard Bible Encyclopedia). The principal motive behind the Church's opposition to interest was to protect the poor and destitute who borrowed in times of need. However, the Church did at times permit interest to be charged on some forms of loan (Kopf, 1927).

On the return of a monetary economy, the Church modified its stance towards interest. Although it remained opposed to the extraction of interest from the poor and destitute on

consumptive loans, it did start to support the charging of interest on loans associated with commercial risk.

A number of medieval monarchs outlawed the charging of interest. In England, Richard I introduced anti-usury laws in 1197. Later, since Edward I had already expelled the Jews in 1290, Edward III had to turn to Florentine bankers, who had set up in London, to finance his wars (Trevelyan, 1949-52). One of the reasons that leasehold tenure evolved at that time was to circumvent such new laws. However, it was the Church that re-awakened an interest in the Time Value of Money. This first arose through single life annuities. For several centuries from the eighth century, the Church granted lands in return for life annuities. Eventually, the Papacy entered into interest-bearing debt with the *Monte Fede* in 1526. This was at a rate of 10% per annum and was used to finance the Holy League's wars. However, subsequent *monti* increasingly provided for finance of a civic nature (Boone et al, 2003).

3.3 The development of the modern annuity

Large-scale development of the modern annuity occurred in the Low Countries. There is archival evidence extant of annuities, or *renten*, granted by the municipalities in Flanders and Brabant dating back to 1228 (Kopf, 1927). Documents relating to annuities granted in subsequent years show that annuities in the Low Countries were increasingly tailored to meet individual needs. For example, a contract from Bruges dated 1265 provided for a survivorship annuity that contained a built-in hedge against currency fluctuation (Kopf, 1927).

By the sixteenth century, annuities had become widespread throughout much of Europe. This coincided with a decline in the Low Countries' indebtedness to annuitants. However, the cost of the Dutch Revolt and the need for the subsequent Dutch Republic to finance a succession of wars necessitated renewed growth in annuities in the Netherlands. Johan de Witt was a lawyer and distinguished mathematician (O'Connor and Robertson, 1996), who became prime minister of the Dutch Republic between 1653 and 1672. According to Webb (2000), de Witt was:

> "The first person to make actuarial calculations combining compound interest and mortality rates".

Whilst in office, de Witt wrote *The worth of life annuities compared to redemption bonds*, in which he developed the theory of probability. A short while later, another Dutchman adept at mathematics, Johan Hudde, served as mayor of Amsterdam for thirty years. He, too, developed annuity tables. However, whereas de Witt's tables had been based upon theory, Hudde's tables were based upon the mortality rates of previous annuitants (Webb, 2000).

4. THE DEVELOPMENT OF THE PROPERTY VALUATION TABLES IN BRITAIN

4.1 The appearance of the property valuation tables

Just as some parts of the world such as China and the former Soviet Union are presently finding a need to develop techniques for the valuation of real estate interests, the same applied to post-medieval Europe. Communist economies in which all real estate interests are vested in the state have no need to value those interests. Similarly, feudal economies in medieval Europe had little need for property valuation. In those feudal economies real estate was either vested in the Church or the Crown and was occupied by vassals.

The Reformation saw a great deal of political, economic and social upheaval. The writings of Luther, Calvin and Zwingli may have condemned usurious practices, but the protestant Reformation, which they unleashed, also diminished the Church's power and influence. This paved the way for the secularization of society. Marital problems and the need to produce a male heir for the Tudor dynasty caused Europe's arguably most Catholic monarch, Henry VIII, to break with Rome. Coupled with the need to raise revenues to pay for Henry VIII's extravagancies, money was required to finance wars. As a result, the assets of the Church came under increased threat from the English state. Matters came to a head with the dissolution of the monasteries between 1536 and 1539. The assets of the religious houses were expropriated by the state. Many of their real estate assets were then sold off to emerging landed interests that had become independent of the feudal system (Mainwaring, 1961). Real estate had become an asset capable of being traded. It had therefore acquired tangible value. The need for techniques to value interests in real estate had become apparent.

The financial pressures of Henry VIII's reign had also led to the lifting of the taboo on interest. As a result, the Interest Act 1545 gave legal recognition to the charging of interest, but restricted the rate to 10 percent. The legislation was repealed in 1552 by an act that described all interest as "a vice most odious and detestable", but in 1571 the charging of interest at ten percent was again permitted (Trevelyan, 1949-1952)). The rate was reduced to eight percent in 1625 (Lewin, 1981) and to six percent in 1651 (Kopf, 1927). However, by the end of the sixteenth century the precedent for interest had been established.

At the time of the dissolution of the monasteries, the task of selling the former monastic lands on behalf of the Crown was given to the Court of Augmentations, which was charged with selling these and other Crown lands at twenty years' purchase (Scorgie, 1996). Thus, an essential element of real estate valuation, the application of years' purchase on rental values to ascertain capital values, was clearly established by the mid-sixteenth century. Expressed in another way, this was a recognition that real estate was capable of delivering a yield based upon an annual percentage.

4.2 The tables through the seventeenth and eighteenth centuries

The real breakthrough for the valuation tables in Britain came in 1613 with the publication of Richard Witt's *Arithmeticall Questions*. The full title of Witt's definitive book was: *Arithmeticall Questions, touching The Buying or Exchange of Annuities; Taking Leases for Fines, or yearly Rent; Purchase of Fee Simples; Dealing for present of future Possessions; and other Bargaines and Accounts, wherein allowance for disbursing or forebearance of money is intended; Briefly resolved by means of certain Breviats* (Lewin, 1970).

Richard Witt's work was revolutionary for two reasons. Firstly, it produced the first recorded property annuity tables. Secondly, it provided formulae, which still form the basis of tables in use today. This arose at a time when there was an increasing interest in the application of mathematics to business matters in general. It was at a time when a new spirit of commerce was being encouraged with the founding of a number of chartered mercantile companies (Canny, 1998). The age of interest had arrived. Witt's tables were based upon both simple and compound interest. The exponential growth of capital through the application of the compound interest element of these tables was not lost on the commentators of the day. For example, William Shakespeare, a man who kept abreast of contemporary developments, alluded to changing business practices in his plays. In 1611 he met Adventurers in the Mermaid Inn, close to his London home, where he heard tales of shipwreck around Bermuda, which he subsequently wrote into *The Tempest*. Shakespeare was also very aware of the exponential nature of compound interest, which he wrote about in *A Winter's Tale*, probably after 1610, around the time of the publication of Richard Witt's work.

One of the largest obstacles to the formulation of valuation and other tables had been the difficulty of undertaking complex calculations in the absence of computers. This difficulty was overcome by the invention of logarithms by John Napier (O'Connor and Robertson, 1998). These first appeared in Napier's work, *Mirifici logarithmorum canonis descripto*, in Latin format in 1614. An English translation was produced by Edward Wright two years later (O'Connor and Robertson). At the time, the invention of logarithms was seen as making a major contribution to astronomy. However, it can now be seen as a major breakthrough in the context of property valuation tables.

It was Henry Brigges, who through his *Arithmetica Logarithmica* published in 1624, demonstrated how logarithms could be used to calculate compound interest at nominal rates of interest whatever that rate of interest might be. Although, Brigges demonstrated how the yield on an invested amount over a number of years could be accurately calculated, he did not show how the yield of successive payments might be calculated (Lewin, 1981). Nevertheless, several different annuity valuation tables appeared during the following century. The first edition of William Webster's simple and compound interest tables in the form of *The True Valuation of Annuities, Leases, Fines and Reversions* had already been published in 1620 (Kopf, 1927). A second, much expanded edition appeared in 1629 entitled *Tables of Compound Interest* (Lewin, 1981). An abundance of interest tables and new editions of Witt's and Webster's works respectively appeared until the onset of the English Civil War.

It was not until the Restoration in 1660 that renewed interest in property annuity tables appeared. No doubt this renewal arose out of increased trade following the Restoration and out of an increase in transactions of property interests and the need to re-develop destroyed property in London in the aftermath of the Great Fire of 1666 (Scorgie, 1996). the first extant property valuation tables of this period were Sir William Morland's tables (1679), which give the first part of the lengthy title on their title page as:

> "The Doctrine of Interest, Both Simple & Compound: Explained In a more exact and satisfactory Method then has hitherto been Published. Discovering The Errors of the Ordinary Tables of Rebate for Annuities at Simple Interest. And Containing…."

A few years later, John Collins' tables were published posthumously in 1685. These give their title as:

> "The doctrine of Decimal Arithmetick, Simple Interest, &c. as also of Compound Interest and Annuities".

Also, Lewin (1981) states that John Newton provided tables in 1668 at increments of one percent between the rates of five and fourteen percent.

During the eighteenth century, several annuity tables capable of being applied to the valuation of real estate interests appeared. A number of these specifically applied themselves to property valuation. John Smart's tables, first published in 1707, were an important milestone. They appeared in new editions several times during the eighteenth century and later formed the basis of William Inwood's famous tables, which appeared just over a century later. Smart's tables were extensive. They gave alternatives in simple and compound interest at many rates. They provided the fundamentals used in good valuation practice. The function of Smart's tables were expressed as follows in the title:

> " 'Tables of Simple interest and discount at 3, 4, 5, 6, 7, 8, 9 and 10 l. per Cent. Per Ann.' Also 'Tables of Compound Interest at the same Rates, WHEREBY the Amount or Present Value of any Sum of Money, or any Annuity, or other Yearly Payment, &c, for any number of Years not exceeding One Hundred, is readily found'."

4.3 The role of the mathematicians

From their earliest origins, the property valuation tables in Europe owe their roots to mathematicians. It was mathematicians who devised the first theories of the compounding of interest. As far back as 1566, Jean Trenchant's *L'Arithmetique* was published in Lyons. A chapter in that work dealt with both simple and compound interest from a mathematician's point of view (Lewin, 1970). In 1585 Simon Stevin from Bruges dealt with the subject, giving worked examples, in his book, *La Practique d'Arithmetique.*

Richard Witt, author of the 1613 tables, was a well-known mathematician in London. In 1610 he and a number of other London mathematicians had combined to commend William Colson's new book on accountancy and arithmetic (Lewin, 1981). The roles of Napier and Brigges have already been covered in this paper. Other names can be cited. However, it was

from the time of the end of the seventeenth century that the better known mathematicians became involved.

Edmond Halley and Sir Isaac Newton are perhaps two of the most famous mathematicians who contributed to the annuity tables. Their mathematical applications were better known in the fields of astronomy and scientific investigation. However, they were possibly influenced by Abraham De Moivre, a refugee from France, who frequently came into contact with them. De Moivre had taken refuge in London shortly after the 1685 Revocation of the Edict of Nantes (Kopf, 1927)) and met Halley, the famous astronomer, in 1692. Whereas Halley prepared life mortality tables for Breslau, the capital of Silesia, a year later in 1693, De Moivre subsequently produced similar tables for London, for which he produced theorems. These tables were to be used for the purpose of valuing life annuities. The publication of these life mortality tables may have influenced Sir Isaac Newton. It was in 1731 that tables for the valuation of annuities, reversions and leasehold estates, attributed to Sir Isaac Newton, were published. It is true that *Tables for Renewing and Purchasing of the Leases of Cathedral-Churches and Colleges*, which was a booklet published in Cambridge in 1686, included a commendation from Sir Isaac Newton (Lewin, 1981). However, it cannot be conclusively proved that Newton was the author of these tables. Kopf (1927) states that a treatise and tables relating to life annuities and leases originally ascribed to Newton were actually written by Mabbot. Tables continued to be published during the eighteenth century under the title *Sir Isaac Newton's Tables*. Rouse (1816) infers that these tables were most unlikely to have been compiled by Newton due to a number of mathematical inconsistencies.

4.4 Comprehending the value of time

Possibly, the greatest advance in Britain since Richard Witt's *Arithmeticall Questions* (1613) came with the publication of William Rouse's book in 1816. This was entitled:

> "An investigation of the errors of all writers on annuities, in their valuation of half-yearly and quarterly payments, including those of Sir Isaac Newton, Demoivre, Dr. Price, Mr. Morgan, Dr. Hutton, &c. &c. With tables showing the correct values when payments are made in less periods than yearly, and a specimen of a set of tables on a new principle (now in the press) for the valuation of leases, estates, annuities, church livings or any income whatever."

Rouse (1816) demonstrates in his treatise a very clear understanding of the implication of the timing and frequency of annuity payments. Rouse states that although by the time of his writing there was an appreciation that payment patterns were material in the case of annuities for a limited number of years, no such consideration was being made for perpetuities. He reiterates the point in the tables that appear in middle of his text. His tables for *Amounts and Values of Half-Yearly Payments, at what is called* [a given] *per Cent. Per Annum* graphically make the point. These two tables are what valuers normally refer to respectively as *Amount of £1 per annum* and *Years' Purchase* tables. Rouse's computations calculate the tables on the assumption of monies being receivable in arrears, whereas rents are normally receivable in advance. However, Rouse still makes a major contribution in bringing payment patterns to the fore.

5. THE APPLICATION OF THE TABLES TODAY

5.1 True equivalent yields

The tables that are primarily used today are those first produced by Richard Parry in 1913. The use of dual rate Years' Purchase tables was highly controversial when Parry's tables were first published (Davidson, 2002). However, their adoption in Parry's first edition paved the way for their subsequent wide use by the valuation profession. Valuation practice now considers the appropriate use of dual rate tables the norm, since these make allowance for a built-in sinking fund to replace a capital investment that is finite rather than a perpetuity.

Rose (1975) possessed a great mathematical mind in the tradition of the great mathematicians who contributed to valuation theory during the seventeenth and eighteenth centuries. His tables are built upon the tradition of Inwood (1811) as acknowledged on Rose's title page:

> "Rose's Property Valuation Tables Constituting the 34th Edition of INWOOD'S TABLES of Interest and Mortality for the Purchasing of Estates and the Valuation of Property Reconstructed and Expanded."

Inwood's 1811 tables were in turn based upon those of John Smart, which were first published in London in 1707 (Inwood, 1880). Smart's tables, as incorporated into Inwood's work, would be very familiar to today's practitioner. The terminologies of *The amount of one pound* and *The present value of one pound* appear prominently. However, Rose's version of the tables addresses two hitherto shortcomings. Firstly, they paid regard to the effect of tax on the sinking funds in some tables. Since the Inland Revenue in the United Kingdom did not allow sinking funds as a deductible expense, taxation was eating into those sinking funds. Therefore, Rose addressed this issue by providing tables that made allowance for such tax. Partly due to lower rates of direct taxation, less thought is given to this innovation at present. Secondly, Rose devised tables that better reflected the reality of rental payment patterns. It was in this area that he contributed most to the time value of money concept. Whereas all previous tables had treated rent as being receivable in arrears, usually on an annual basis, Rose devised additional tables based upon the assumption of rents being receivable quarterly in advance. Yields based upon rents receivable annually in arrears are generally described as *nominal*. Those calculated for other payment patterns have been described by Rose and others as *effective yields*. However, the term *True equivalent yield* is now often used instead of *effective yield*. Rose produced effective yield tables for rents receivable quarterly in advance. That is beginning to have some lasting influence on valuation practice. The 2002 edition of Parry's tables (Davidson, 2002) have added some Years' Purchase Quarterly in Advance tables together with some conversion tables to and from nominal yields.

5.2 Formulae presently being applied

In *Parry's Valuation & Investment Tables*, Davidson (2002) gives examples of the application of formulae with respect to nominal and effective yields.

First, Davidson (2002) states that the following conversion formulae should be used with respect to nominal yields and effective yields for rental income receivable quarterly in advance.

Conversion from the effective yield based upon rents receivable quarterly in advance to the nominal yield:

$$i = 4\left[1 - (1 + r)^{-\frac{1}{4}}\right]$$

Conversion from the nominal yield to the effective yield based upon rents receivable quarterly in advance:

$$r = \left[\frac{1}{\left(1 - \frac{i}{4}\right)^{4}} - 1\right]$$

Where i = Nominal yield
r = Effective yield

Then Davidson's (2002) formulae are capable of being used for the conversion of nominal yields to effective yields, and vice versa, for application to rental income receivable on any given regular payment patterns in advance as:

Conversion from the effective yield based upon rents receivable at a given frequency in advance to the nominal yield:

$$i = p\left[1 - (1 + r)^{-1/p}\right]$$

Conversion from the nominal yield to the effective yield based upon rents receivable at a given frequency in advance:

$$r = \left[\frac{1}{\left(1 - \frac{i}{p}\right)^{p}} - 1 \right]$$

Where i = Nominal yield
r = Effective yield
p = Number of times the income is received and compounded per annum

It should be noted that the formulae are different where the rent is received and compounded in arrear.

5.3 Monthly rental payments

Residential tenancy reform during the 1980s and 1990s did result in some growth in the private residential lettings sector in the United Kingdom. Whereas prior to this reform, most residential rents had been paid on a weekly basis, subsequently the sector saw a move towards a monthly rental payment pattern. Generally, these rents are now contracted to be paid in advance. However, the way in which the Housing Benefit system operates ensures that many of these are paid late and hence in arrears.

There is a growing trend in the United Kingdom for many retailers to seek monthly in advance patterns from their landlords (Chesters, 2006). Sometimes, this is being done in the negotiation of new leases. In other cases, struggling tenants are seeking to ease their cash-flows by asking their landlords to switch them from quarterly in advance to monthly in advance rental payment patterns. Such a change does have an advantage to one party, whilst being disadvantageous to the other. The capitalization of rent receivable monthly in advance is worth less than the capitalization of rent receivable quarterly in advance. Therefore, a switch to a monthly in advance payment pattern favours the tenant. This is because those monies paid at the beginning of the second and third months of any given quarter have less time to accumulate from compound interest. In many countries throughout the world, the norm is for rents of all types of real property to be receivable monthly in advance. In such circumstances, there is a case for valuation practice to reflect market reality. Failure to do so may obscure transparency, distort the market and put some parties at a disadvantage.

From Davidson's (2002) approach, it is possible to deduce the formulae for calculating nominal and effective yields with respect to monthly in advance rental patterns to be as follows:

Conversion from the effective yield based upon rents receivable monthly in advance to the nominal yield:

$$i = 12\left[1 - (1 + r)^{-1/12}\right]$$

Conversion from the nominal yield to the effective yield based upon rents receivable monthly in advance:

$$r = \left[\frac{1}{\left(1 - \frac{i}{12}\right)^{12}} - 1\right]$$

Where i = Nominal yield
r = Effective yield

The impact of the frequency of rental payments will be greater for some types of investment than for others. It will have a greater impact in the case of high yielding properties than it would for those that are lower yielding.

6. CONCLUSIONS

The time value of money is especially appreciated following Rose's work. Mathematical theory has provided the formulae to enable the time value of money to be reflected in valuation practice. In the United Kingdom, this process has evolved over the last four centuries. To some extent, this has now brought theory to reflect the appreciation that sixteenth century mathematicians had of the time value of money. Trenchant's *L'Arithmetique*, which was published in Lyons in 1566, showed an appreciation of the effects of interest compounded over months rather than years. Originally, logarithms facilitated the compilation of appropriate tables. Today, computers make the task easier.

Real comparison can be made where yields for differing rental payment patterns are converted into effective or true equivalent yields. Valuation practice should apply the formulae to facilitate the calculation of True Equivalent (Effective) Yields. It is possible to apply the formulae individually to each calculation. Where appropriate tables do not exist, practitioners ought to consider the use of computer technology for the application of the TEY formulae to their valuations.

Valuation practice needs to reflect market reality to facilitate greater transparency. This holds true in all countries irrespective of the norm in those countries. Appropriate application of TEY formulae needs to be incorporated in all jurisdictions. Furthermore, even in those

jurisdictions where quarterly payments are the norm, consideration should be given to the application of specific TEY techniques for those property investments producing rents payable monthly in advance.

REFERENCES

Banfield, A. 2006, Valuation on Quarterly in Advance Basis and True Equivalent Yield, College of Estate Management

Baum, A. & Crosby, N. 1995, Property Investment Appraisal, Routledge, London

Boone, K; Davids, P & Janssens, P. 2003, Urban Public Debts: Urban Government and the Market for Annuities in Western Europe (14^{th}-18^{th} centuries), Brepolis, Turnhout

Canny, N. 1998, The Oxford History of the British Empire: The Origins of Empire, Oxford University Press, Oxford

Chesters, L. Dixons owner leads retailers in monthly payment revolt
http://www.property-week.co.uk/story.asp?storycode=3061087&sectioncode=36

Collins, J. 1685, The Doctrine of Decimal Arithmetick, Simple Interest &c, and also of Compound Interest and Annuities, Nath Ponder, London

Davidson, A.W. 2002, Parry's Valuation & Investment Tables, pp xi-xix, 1-38, Estates Gazette, London

Enever, N. 1984, The Valuation of Property Investments, pp 79-86, 96-104, Estates Gazette, London

Hudson, M. 2000, The Mathematical Economics of Compound Interest: A 4,000-year old overview, Journal of Economic Studies, 27(45), pp 344-362

Inwood, W. 1880, Tables for the Purchasing of Estates, Freehold, Copyhold, or Leasehold; Annuities, Advowsons, &c, 21^{st} ed, Crosby, Lockwood & Co, London

Kopf, E.W. 1927, The Early History of the Annuity, xiii, pp 225-266

Lewin, C.G. 1981, Compound Interest in the Early Seventeenth Century, Journal of the Institute of Actuaries, 108, pp 423-442

Lewin, C.G. 1970, An Early Book on Compound Interest: Richard Witt's Arithmeticall Questions, Journal of the Institute of Actuaries, 96, pp 121-132

Mainwaring, J. 1961, The New Educational Library Series, British Social History, vol 1, From Earliest Times to the Sixteenth Century, pp 294-298 Odhams Press, London, c1961

O'Connor, J.J. & Robertson, 1996, E.F, Johan de Witt,
http://www-history.mcs.st-andrews.ac.uk/Mathematicians/De_Witt.html Accessed Dec 2005

O'Connor, J.J. & Robertson, E.F, 1998, John Napier,
http://www-history.mcs.st-andrews.ac.uk/Mathematicians/Napier.html Accessed Dec 2005

Qazi, Imam. 2006, Jumping the Shariah Hurdle, Estates Gazette, p 171, Reed Business Information, London, 8th April 2006

Rose, J.J. 1975, Rose's Property Valuation Tables, Freeland Press, Oxford

Rouse, W. 1816, An Investigation of the Errors of all Writers on Annuities, in their Valuation of Half-yearly and Quarterly Payments, Lackington, Allen & Co

Scorgie, M.E. 1996, Evolution of the Application of Present Value to Valuation of Non-monetary Resources, Accounting and Business Research, 26(3), pp 237-248

Trevelyan, G.M. 1949-1952, Illustrated English Social History, vol 1, Chaucer's England and the Early Tudors, pp 30-31, 113, Longmans, London

Webb, J. 2000, Death and Statistics, http://pass.maths.org/issue12/features/annuities/

BIOGRAPHICAL NOTES

Academic experience: B.Sc. Urban Land Administration, Portsmouth Polytechnic
Presently, part-time professional doctorate research student, Anglia Ruskin University

Current position: Director, Tipping Estates Limited and other companies

Practical experience: valuation, property investment and development

Professional membership: Royal Institution of Chartered Surveyors

CONTACTS

Mr. Malvern Tipping
Tipping Estates Limited
Uggeshall
Beccles NR34 8BE
UNITED KINGDOM
Tel. + 44 1502 578784
Fax + 44 1502 578784
Email: admin@tipping-estates.co.uk