

# Money Calculus

We take it for granted that quantities from physics are simply 'scalable'.

$$3,600 \text{ km / h} = 60 \text{ km / min.} = 1,000 \text{ m / sec.}$$

For an important quantity used so much in everyday life i.e. the interest rate, why should that not be the case?

Using the equation  $i_c \cdot \Delta t = \ln(1 + i_d \cdot \Delta t)$  wherein  $\Delta t = 1 \text{ year}$

a (discrete) annual rate  $i_d$  is simple to convert into the continuous interest  $i_c$  per year and vice versa.

This conversion is always true, and yet the right outcome in many exercises is exclusively available through the continuous interest. A discrete rate, any discrete rate can never be effective. The word 'effective' means real, true, truly, i.e. there can be only one effective rate. The continuous interest is always effective as well as efficient under all circumstances. Calculating with continuous interest is actually much easier. Discrete interest should be abolished worldwide in favor of continuous interest.

On January 15, 1998 (WARNING - Bug in financial functions of Microsoft Excel) a press release was issued, also internationally for the attention of the New York Times and the International Herald Tribune.

Mobilizing press people and science is necessary because both the statements of prof. dr. ir. P.J. Zandbergen, formerly attached to the 'Faculteit der Toegepaste Wiskunde' at the University of Twente and nota bene president of the KNAW, following the public scientific debate about the dissertation of Van der Boom / Van der Grift and in particular also the purely bad teaching in interest calculation at many colleges and universities; bad textbooks and bad software.

Money Calculus is a piece of applied mathematics, unambiguous and simple.

Easy for students to learn and then in practice one can easily perform all calculations.

Prof. Zandbergen told me to know that sociologists and economists often declare something in their books and papers which mathematicians know is not good. A wide opinion. I do not know that. I know just one concrete example, the fact that Van der Boom / Van der Grift's dissertation is at odds with something basic from Mathematical Analysis, and to prof. Zandbergen, I have provided this example. Then this mathematician fell silent and the entire 'Faculteit der Toegepaste Wiskunde' of the University of Twente fell silent.

In the US it is common practice (there is no reason to adopt nor sustain that common practice) to speak of an 8 % nominal rate when the so-called effective rate (APR) is 8.30 (what is called by definition 'the effective rate' in the US). The US Congress attempted to remedy the situation with the passage of "Truth-in-Lending" in 1967. There are detailed regulations ("Regulation Z") that explicitly set forth the formulas to be used and what items are to be considered in calculating interest. In general, results are stated as an APR (Annual Percentage Rate).

Lay it down asap in constitutions all over the world to make it crystal-clear to everybody forever. To make calculations short and easy. To minimize costs. To improve capital budgeting decisions.

The man in the street has only to push the e-key on any simple pocket-calculator to defeat the entire financial community that is clinging to old traditions. Who is afraid of the e-power? Busy with all kinds of financial tools. Neither effective (not doing the right things) nor efficient (not doing things right). How many keys we all are pushing all the time? Not knowing what. Only be interested in the outcome. There is no reason NOT to use the continuous i. The e-key leads us all directly to Rome. The continuous i is a fraction. Grade school arithmetical concepts are enough to handle the continuous i, yes indeed, and not PPR (Period Percentage Rate, any period). One can easily switch from discrete calculations to continuous calculations and vice versa without actually changing anything. If everything is considered accurate enough, there will be no difference at all.

The growth of money i in percentages per unit of time  $[T^{-1}]$  has been defined (see the Mathematical Analysis, the differential quotient) by means of  $i = (dB_t / B_t) / dt$

$$\text{So } d \ln (B_t / B_0) = i dt$$

because, a primitive is next to  $\ln B_t$  (a term with a dimension problem) also  $\ln (B_t / B_0)$ .

After integration follows  $\ln(B_t / B_0) = it$

$$\text{So } B_t = B_0 \cdot e^{it}$$

This continuous function holds for any value of t.

All real points (t,  $B_t$ ) actually exist.

As we, people in the cosmos, face multiplicative growth then that applies with the function  $y = e^x$  of which  $B_t = B_0 \cdot e^{it}$  is only one of the applications.

"Practice counts down on the fingers, chops something that is essentially continuous. Only at certain times (in that practice) does interest accrue, changes 'the state of the system', this is the amount in money. Between discrete points in time, 'the system' is in a fixed, well-defined state, with an unchanged, constant amount of money in between (Jacobs, 1994, p. 38)."

Money growth happens over time. Time passes continuously. Postulated that said e-power function, it would be just a model of the actual money growth, then it is indeed a comprehensive model because it does not describe only the continuous interest (CI) but also includes all of the points (combinations of amounts of money and time points) defined by simple interest (SI) as well as discrete compound interest (DCI). Even all points that one needs to see using the discrete SI and DCI formulas are easy to find using the CI function. DCI is repeated SI. Anyone who criticizes SI can express the same criticism onto DCI. Wesseling criticizes in his thesis rightly SI after which he proposes DCI. Too crazy for words. Where Van der Boom / Van der Grift do not sharply distinguish their discrete so-called rate v from i, for example on p. 280, p. 282 and p. 327 of their dissertation, they draw wrong conclusions. That thesis should never have been approved in my opinion. In 1998, the authors employed by the Erasmus University Rotterdam proclaim to the students their wrong ideas. I told them myself all about this. They had no defense. Yet they continue as if nothing had happened. In front of everyone. The rector has been informed by me. And the university magazine. Even the editors of Vrij Nederland. Still, everyone is silent.

The e-power function perfectly portrays the only real reality.

"Which has already been presented by Bremmers / Karman in TBA no. 1119, June 1990. (Jacobs, 1994, p. 36)." It should be noted that in the preface of my book 'GELD kost GELD' is stated that there is nothing new under the sun. Not really anything new about the effective

interest rate. My book is just presenting the latest Money Calculus theory in short (so already in 1994!). I have shown that only a few simple formulas are needed to solve all kinds of financial arithmetic exercises.

Yet in 1996, the thesis of Van der Boom / Van der Grift was published and they were completely informed (see above, they and I, we have discussed the whole matter and they had no response!), still in 1999, in the journal TBA, a paper by their hand was published. In response, I published the following open letter.

## Open letter

Enschede, February 12, 1999

### Send to:

The Editor-in-Chief of TBA, prof. J.L. Bouma  
The rector magnificus of Erasmus University Rotterdam, prof. dr. P.W.C. Akkermans  
Editors Erasmus Magazine  
Editor MAB, prof. dr. Ph. Wallage  
The Editor-in-Chief of Het Financieele Dagblad, drs. A. Bakker  
Editors ESB  
The Executive Board of the University of Twente, chairman A. van der Hek  
The Editor-in-Chief of De Twentsche Courant Tubantia, drs. G.T.M. Driehuis  
The president of the KNAW, prof. dr. ir. P.J. Zandbergen  
The Editor-in-Chief of NRC Handelsblad, mr. F.E. Jensma  
Prof. dr. V. Icke

You all know what is being propagated by the authors of an article in TBA ("Economics and the use of numbers and units in formulas" by dr. A.H. van der Boom and prof. dr. F. van der Grift, TBA, January / February 1999, no. 1219, pp. 17-27. For many years now.

In a series of articles in TBA, published in 1991/1992, a discord was revealed between Erasmus University Rotterdam on the one hand and the University of Amsterdam on the other. Unworthy of science. See the deadlock in TBA no. 1148.

Given the social importance of interest calculations, it could not stay with broken discussions in a professional journal and in 1994 therefore the book 'GELD kost GELD' ISBN 9073397065 has been published. Essence: there had long been a much better formula ( $y = e^x$  of which  $B_t = B_0 \cdot e^{it}$  is only one of the applications) than the so-called Van der Boom / Van der Grift formula.