Alternative Approaches to Unwinding the Discount

- with Particular Focus on Determining Interest Cost under US-GAAP and IFRS Accounting Standards as they apply to Defined Benefit Pension Plans -

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1. Introduction

Probably one of the most basic tools applied in actuarial work for centuries is that of discounting future payments to obtain a present value as of today or any other point in time. Apart from simplifying a stream of cashflows into a single value, this also allows us to take account of the time value of money of each of those future payments. Computing power and academic work [1] have given us the means of translating available market data on bond prices into a series of spot rates on a yield curve that perfectly match the payment dates of the future cashflows we generate from actuarial calculations. The present value thus obtained together with the cashflows can then be used to solve for the single weighted average discount rate ($\boldsymbol{i_{wa}}$) which, when applied to the cashflows yields the same present value.

The process of accumulation rather than discounting is also commonly applied, i.e. that of accumulating present values or the underlying cashflows into a single amount at some future date. The understanding of the principles underlying these calculations is engrained in the training of every actuary and is often applied as a matter of course.

A special application of accumulation is the process generally required under pension accounting standards for unwinding the discount, i.e. that of reversing the discount, for the year following the balance sheet date in order to separate this cost from other components of total annual Pension Expense for a particular accounting period. Interestingly, until fairly recently, not much appears to have been written in actuarial literature about unwinding the discount of present values under pension accounting i.e. how the present value is adjusted by the time value of money from the beginning of a time period to its end. One reason is most probably the apparent triviality of the issue. However, when it comes to unwinding a present value computed by the application of the entire spot rate curve under the principles laid out in US-GAAP and IFRS for pension accounting purposes there is disagreement about its unwinding.

While there appears to be little if any controversy around discounting, the existing different views on unwinding the discount can lead to significantly diverging results. Not surprisingly, there is some controversy around the validity of these different methods.

The aim of this paper is to systematically (re-)consider the issue of discounting and its unwinding. First, the theory underlying discounting is very briefly summarized in Section 2 together with a description of the issues that have arisen in practice. In Section 3 an analysis of the three main approaches to unwinding including a discussion on their validity under US-GAAP and IFRS accounting standards is performed. Section 4 reviews the central question of the predictive quality of the *Expectations Theory* on the term structure of interest rates. In Section 5 the practical implications of each approach under the accounting standards are compared in a numerical example. In Section 6, finally, a conclusion is drawn.

[1] *McCulloch,* “Measuring the term structure of interest rates“, Journal of Business (1971) Vol. 4 (1); *McCulloch,* “The Tax-Adjusted Yield Curve“, Journal of Finance 30 (1975); *Nelson/Siegel,* “Parsimonious modeling of the Yield Curve“, Journal of Business (1987); *Svensson,* IMF Working Paper 114, (1994); *Diebold and Li,* “Forecasting the term structure of government bond yields”, Journal of Econometrics (2006); *De Pooter,* “Examining the Nelson-Siegel Class of Term Structure Models”, Econometric Institute, Erasmus University, Rotterdam (2007).

2. Outline of the underlying theory and practical issues

2.1 Basics

Probably the best starting point on discounting is the concept of accumulation at a rate of interest. The rate of interest, *i*, as defined in an actuarial textbook by Donald [2] and generally accepted is

the amount contracted to be paid in one unit interval of time for each unit of capital invested

From this is derived the function $\boldsymbol{f(t)}$, representing the accumulation of said unit of capital invested at the rate of interest *i* over a period of time *t*:

$$f(t) = (1+i)^t \tag{1}$$

The instantaneous rate of interest $\boldsymbol{\partial_t}$, can hence be expressed as:

$$\begin{aligned} \partial_t &= \lim_{h \to 0} \frac{f(t+h) - f(t)}{hf(t)} \\ &= \frac{1}{f(t)} \frac{d}{dt} f(t) \\ &= \frac{d}{dt} \ln f(t) \end{aligned} \tag{2}$$

Integrating $\boldsymbol{\partial_t}$ between the limits *0* and *t* we can state:

$$\ln f(t) = \int_0^t \partial_t \, dt + \ln f(0)$$

or

$$f(t) = f(0) \exp\left[\int_0^t \partial_t \, dt\right] \tag{3}$$

setting $f(0) = 1$:

$$f(t) = \exp\left[\int_0^t \partial_t \, dt\right] \tag{4}$$

Donald continues to develop formulae for determining $\boldsymbol{f(t)}$ on the basis of a force of interest varying continuously with finite limits, i.e. a force of interest with a limiting value, by which a typical spot rate curve can be described.

2.2 Spot Rates of Interest

In practice, an effective annual rate of interest over a given period of time *t* rather than a force of interest is typically agreed upon either explicitly or implicitly (the latter, for example, through the price of a financial instrument). Hence the focus in the following is on effective rates of annual interest $\boldsymbol{i_t}$ over a period of time *t*, typically expressed in years.

While effective rates of interest to maturity for bonds with fixed or variable coupons can be determined from the price, their exact effective yield at maturity can only be determined retrospectively, namely once the effective yields achieved on the (re-)investment on each of the contractually agreed interest payments received are known. To avoid this problem of (re-)investment, academic work performed [3] has allowed the transformation of market pricing data for coupon bonds to be converted into so-called spot (or effective interest) rates on theoretical zero-coupon bonds. Thus, effective rates of interest for any required periods of time can readily be determined. A zero-coupon bond purchased at

[2] *Donald*, Compound Interest and Annuities-Certain, William Heinemann Ltd., (1975).
[3] See footnote 1

time *0* at price $\boldsymbol{P_0}$ and returning the principal with interest, $\boldsymbol{B_t}$, at a single future point in time *t* produces an annual spot rate of $\boldsymbol{i_t}$ according to the following formula:

$$\boldsymbol{P_0} = \frac{\boldsymbol{B_t}}{(\boldsymbol{1} + \boldsymbol{i_t})^{t}}$$

Extending this to the US-GAAP and IAS 19 accounting standards as they apply to the accrued defined benefit liability, the future benefit payments $\boldsymbol{B_t}$ are those attributable to service completed as at the relevant balance sheet date (*bsd*). Assuming that a single average weighted discount rate $\boldsymbol{i_{wa}}$ can be used to discount all future benefit payments $\boldsymbol{B_t}$ and the projected annual payments are due on average in the middle of each future year, the above formula can be extended to represent the PBO (Projected Benefit Obligation under US-GAAP) or the DBO (Defined Benefit Obligation under IAS 19) as follows:

$$\boldsymbol{P/DBO_{bsd}} = \sum_{t=0}^{t=99} \frac{\boldsymbol{B}_{t+\frac{1}{2}}}{(\boldsymbol{1} + \boldsymbol{i_{wa}})^{t+\frac{1}{2}}} \qquad (5)$$

Although the accounting standards require the interest – or discount – rate $\boldsymbol{i_{wa}}$ to be consistent with the estimated term of the benefit payments being valued, this was originally interpreted as having only to be true “on average”. Thus, until fairly recently, a single rate of interest was chosen by practitioners and then applied to all calculations required under the accounting standards. In doing so, the weighted average term of the benefit payments was typically taken into account by approximation or, more precisely, by ancillary calculations. One reason for doing so was that the estimated probability-weighted future cashflows $\boldsymbol{B_t}$ were, as such, not normally determined. Rather, only the benefit payments due as per the pension plan formula were projected to each future point in time at which such payment could commence. To these gross amounts so-called commutation factors were then applied to take account of both the discount and the probability weightings on the gross payments in order to compute the *P/DBO*. The commutation factors used were typically computed using a single discount rate $\boldsymbol{i_{wa}}$.

With the increasing power of computer systems, it became ever more feasible to compute the *P/DBO* from first principles according to the formula:

$$\boldsymbol{P/DBO_{bsd}} = \sum_{t=0}^{t=99} \frac{\boldsymbol{B}_{t+\frac{1}{2}}}{(\boldsymbol{1} + \boldsymbol{i}_{t+\frac{1}{2}})^{t+\frac{1}{2}}} \qquad (6)$$

Even though the *P/DBO* was calculated in this way, the single weighted average interest rate $\boldsymbol{i_{wa}}$ was often computed in addition for the purpose of disclosure and/or for ease of communication with the user(s) of financial statements. The single weighted average discount rate is that which, when applied to the same benefit payments, results in the same $\boldsymbol{P/DBO_{bsd}}$:

$$\sum_{t=0}^{t=99} \frac{\boldsymbol{B}_{t+\frac{1}{2}}}{(\boldsymbol{1} + \boldsymbol{i}_{t+\frac{1}{2}})^{t+\frac{1}{2}}} = \sum_{t=0}^{t=99} \frac{\boldsymbol{B}_{t+\frac{1}{2}}}{(\boldsymbol{1} + \boldsymbol{i_{wa}})^{t+\frac{1}{2}}} \qquad (7)$$

With what is today referred to as the “*Traditional Approach*” the single $\boldsymbol{i_{wa}}$ was used to determine three important results required under the accounting standards. These were the “*Service Cost*”, the *“Interest Cost”* and the *P/DBO*. These can be expressed as:

$$\boldsymbol{Service\ Cost_{bsd+1}} = \left\{ \sum_{t=0}^{t=99} \frac{\boldsymbol{BSC}_{t+\frac{1}{2}}}{(\boldsymbol{1} + \boldsymbol{i_{wa}})^{t+\frac{1}{2}}} \right\} (\boldsymbol{1} + \boldsymbol{i_{wa}}) - \frac{\boldsymbol{1}}{\boldsymbol{2}} \boldsymbol{BSC}_{\frac{1}{2}} \boldsymbol{i_{wa}} \qquad (8)$$

Where $\boldsymbol{BSC_t}$ represents the future expected benefit payments payable at time *t* and attributable to service by active employees in the year following the balance sheet date.

$$\boldsymbol{Interest\ Cost_{bsd+1}} = \left\{\boldsymbol{P/DBO_{bsd}} - \frac{\mathbf{1}}{\mathbf{2}}\,\boldsymbol{B_{\frac{1}{2}}}\right\}\boldsymbol{i_{wa}} \tag{9}$$

The formula for $\boldsymbol{P/DBO_{bsd}}$ is given by equation (5).

Note also that throughout this paper it is assumed (as shown in formula (8)) that the *Interest Cost* on the *Service Cost* is expressed as part of the *Service Cost*. This is in line with generally accepted actuarial practice.

2.3 The issue in general

Ever since accounting for pensions under US-GAAP was fundamentally reformed in the mid-1980s, the idea of using “more sophisticated” approaches than the *Traditional Approach* using a single $\boldsymbol{i_{wa}}$ in determining Pension Expense was raised repeatedly. However, the question has only really gained momentum over the past five years or so.

The initial idea (referred to as Step 1 in the following), first put forward around 2013, was attractive and logical. Was the weighted-average interest rate $\boldsymbol{i_{wa}}$ applicable for determining the *P/DBO* really also appropriate for computing the *Service Cost* component of Pension Expense, when the latter typically had a much longer duration (i.e. average time to payment) than the former? If not, then assuming a “normally shaped” term structure of interest rates (or spot rate curve) in the capital market, i.e. one increasing with duration, an effective rate higher than $\boldsymbol{i_{wa}}$ was more appropriate to be used for determining the *Service Cost*. Now a higher discount rate would logically result in a lower *Service Cost*. This last effect was clearly something that defined benefit plan sponsors welcomed, in particular because of significantly increased Pension Expense that had to be recognized during the period of sustained reduction in market interest rates across all bond qualities since about 2011/12. There is general consensus amongst practitioners that the theory underlying this Step 1 is sound and in line with the requirements of the US-GAAP and IFRS accounting standards.

A little later a further idea (Step 2) developed out of Step 1. If the full spot rate curve could be used to determine both the *P/DBO* and the *Service Cost*, should the same curve not also be used to determine the *Interest Cost*? If so, then each present value of each expected future cashflow, having been discounted using the spot rate corresponding to its own particular duration, could be multiplied by the same rate to determine the *Interest Cost*. A summation over all durations would represent the *Interest Cost* for the plan. This approach, generally referred to as the *Spot Rate Approach*, or SRA, had a number of reasons put forward to justify it, one of which was its apparent far greater precision than the use of a single $\boldsymbol{i_{wa}}$ for the computation of all three relevant results required for accounting purposes, namely the *P/DBO*, *Service Cost* and *Interest Cost*. Furthermore, as a practical consequence, the total Pension Expense was normally reduced significantly by this Step 2 (see Section 5 for a quantification).

Note that both Steps 1 and 2 do not result in a *P/DBO* that is different from that derived under the *Traditional Approach* since the $\boldsymbol{i_{wa}}$ is calibrated to result in the same *P/DBO* that is determined by using the full spot rate curve. The SRA modifies only the two Pension Expense components *Service Cost* and *Interest Cost*.

In early 2014 an approach different from the SRA had been suggested as being the logical way forward if the *Traditional Approach* was to be abandoned [4]. This was the *Forward Rate Approach* (FRA) which is explained in more detail below in Section 3.3.

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[4] *Fodor/Gohdes*, „Reduzierung des Dienstzeitaufwandes mittels eines abweichenden Rechnungszinses“ („Reducing Service Cost by using an alternative discount rate“), BetrAV 2/2014 p. 137.

2.4 The issue under US-GAAP

Much publicized in 2015, the SEC staff indicated to the four large audit firms, that it would not object to preparers applying the SRA. What effect did the SRA have on the amounts previously determined by the *Traditional Approach*? As will be shown in Section 5 and based on typical populations of pension fund members, the SRA results in a noticeable reduction of the *Service Cost*, a significant reduction in the *Interest Cost* and a reduction in Pension Expense under US-GAAP that can, in certain circumstances, be described as staggering.

Since the SEC's blessing and the approval by the four large auditors, the SRA has enjoyed soaring popularity among preparers to the extent that well over half of all preparers of financial statements have moved to using the SRA under US-GAAP today.

2.5 The issue under IFRS

With regard to IAS 19, the IASB and its Interpretation Committee, IFRS IC, have not yet formally commented on the SRA, possibly because the relinquishment of the *Traditional Approach* has been much less prevalent in practice than under US-GAAP preparers.

Since, for all intents and purposes, the *Service Cost* and *Interest Cost* elements of Pension Expense are calculated identically under the two accounting standards, the same issues and effects on these two expense items arise under IFRS as those described above for US-GAAP.

In contrast to US-GAAP, however, IAS 19 requires the rate of expected return on plan assets to be the same as the discount rate. Without a clear maturity profile for payments from plan assets, it is unclear how the SRA or FRA should be applied to determine the expected return on assets. Also, in contrast to US-GAAP, actuarial gains and losses are never "recycled" through the income statement under IFRS, which possibly also presents a hurdle as explained in the following Section 3.

For these reasons the application of the SRA for determining total Pension Expense under IAS 19 is fraught with more difficulties than under US-GAAP. Therefore, this paper only considers the effects on total Pension Expense as applicable under US-GAAP.

3. Description and discussion of the main approaches

3.1 The Traditional Approach

Some hold the opinion that the *Traditional Approach* was followed simply because it made practical sense in times when IT-systems used by actuaries didn't allow for a more sophisticated approach and that there was no theoretical justification for its use. The latter argument must be roundly rejected since there is indeed a robust theoretical justification underlying it*:* If the population being valued is in a so-called stationary state, i.e. the accrued expected future cashflows remain unchanged from one year to the next, then the *Traditional Approach* leads to an expected *P/DBO* at the end of the year that is identical with the actual *P/DBO*, if the spot rate curve at the end of the year is unchanged from that at the beginning of the year (referred to in the following as the *Neutral Assumption*).

In practice, the assumption that the future cashflows of a population of a pension fund is in a stationary state may be considered as very unlikely i.e. that this condition will practically never be fulfilled. This is because pension plans of single employers will only very rarely have stable active populations, unchanged pension plan rules and experience largely the same economic conditions over time periods that span many decades. This can safely also be said to hold true for multi-employer, industry-wide or even nation-wide funds.

In real life, populations of pension fund members will be either in a run-down or in a growth mode. As stated above, the *Traditional Approach* assumes an unchanging remaining duration, i.e. the weighted average time to benefit payment, which, together with the *Neutral Assumption*, will systematically lead to actuarial losses for populations in a run-down mode, because the remaining duration will be continuously decreasing over time. The reverse is true of the population that is in a state of growth.

The *Traditional Approach* can thus be described as fulfilling the principles of the accounting standards, albeit only under very specific circumstances. It is not systematically biased, however, and thus can be accepted as a practical expedient.

3.2 The Spot Rate Approach

Under the SRA the *Service* and *Interest Cost* are calculated, in contrast to (8) and (9), as follows:

$$\boldsymbol{Service\ Cost_{bsd+1}} = \left\{ \sum_{t=0}^{t=99} \frac{\boldsymbol{BSC}_{t+\frac{1}{2}}}{\left(\boldsymbol{1} + \boldsymbol{i}_{t+\frac{1}{2}}\right)^{t+\frac{1}{2}}} \ (\boldsymbol{1} + \boldsymbol{i}_t) \right\} - \frac{\boldsymbol{1}}{\boldsymbol{2}} \boldsymbol{BSC}_{\frac{1}{2}} \boldsymbol{i}_0 \qquad (\boldsymbol{10})$$

$$\boldsymbol{Interest\ Cost_{bsd+1}} = \sum_{t=0}^{t=99} \left\{ \frac{\boldsymbol{B}_{t+\frac{1}{2}}}{\left(\boldsymbol{1} + \boldsymbol{i}_{t+\frac{1}{2}}\right)^{t+\frac{1}{2}}} \right\} \boldsymbol{i}_t - \frac{\boldsymbol{1}}{\boldsymbol{2}} \boldsymbol{B}_{\frac{1}{2}} \boldsymbol{i}_0 \qquad (\boldsymbol{11})$$

As for the *Traditional Approach* the *P/DBO* is calculated as per (6).

As already mentioned, one justification given in support of the SRA is that it apparently increases precision, since it does not use the same $\boldsymbol{i_{wa}}$ for all three relevant calculations but rather applies the full spot rate curve to each calculation.

A further justification is that since it treats each year of expected cashflow as a separate plan, thus conceptually breaking down a pension plan into as many as 100 individual plans, it is complying with the wording of the US-GAAP and IAS 19 standards, namely that “the discount rate” used for discounting should also be used for unwinding.

A third justification often given is that the *Expectations Theory* on the term structure of interest rates applies: This states that under the premise of the full spot rate curve being shaped normally, there is an inherent expectation in the capital market that the yield curve as at the end of the year will be higher than that as at the beginning of the year. In other words, it is expected that, from the beginning to the end of the accounting period, the spot rate curve “shifts upwards” by one period. It follows that if the yield curve does not actually do so, but remains unchanged or drops, that the ensuing actuarial losses are a natural and legitimate consequence.

The first justification for the SRA essentially argues that a more complicated measurement is necessarily superior to a less complicated one. This can surely not be a valid argument; complexity is quite obviously not a merit in itself. Having said that, there is little if any controversy surrounding the calculation of the *Service Cost* with the full spot rate curve rather than the weighted average discount rate $\boldsymbol{i_{wa}}$. This agreement is not shared in relation to the *Interest Cost*, though.

The next justification for the SRA rests on the argument that it follows the wording in the standards. However, as already mentioned above, the standard setting boards contemplating the standards at the time of their writing did not consider the notion of unwinding a full yield curve, but rather a single weighted average discount rate. The use of the full yield curve was very unusual at the time. Moreover, since the boards understood that the *Interest Cost* was a significant element of the liabilities expected at the end of the year, i.e. the benchmark for determining actuarial gains or losses at the end of the year, it is highly unlikely that they would have allowed an approach that systematically produces significant actuarial losses i.e. that was not a best estimate i.e. that was in fact systematically biased. In terms of carrying greater weight, the best estimate principle itself ("substance") must surely stand above wording ("form"), in particular if that wording was constructed when the recently emerged approaches were not in use.

As to the third justification: As already mentioned, assuming the full spot rate curve is normally shaped, the SRA bets on rising interest rates at the end of the accounting period. However, data from decades in the Eurozone, UK, US (all 58 years of data) and Japan (29 years) show that AAA- and AA-yield curves in those currency areas, although almost always normally shaped, were more or less equally likely to rise as they were to drop over the following 12-month period. In fact, it was slightly more likely for the yield curve to drop over 12 months throughout the periods mentioned. So if it is true that the yield curve at the end of the year is equally likely to rise as it is to drop, then clearly only the *Neutral Assumption* of an expected unchanged yield curve at the end of an accounting period can fulfil the requirement of a best estimate. This is the central argument against the use of the SRA: assuming a normally shaped spot rate curve it will systematically generate actuarial losses because the SRA assumes a rising spot rate curve at year-end. This is contrary to the standards' requirement to choose best-estimate assumptions i.e. assumptions that do not systematically generate actuarial gains or losses.

If the *Neutral Assumption* regarding the spot rate curve is accepted as appropriate, the SRA will therefore systematically lead to actuarial losses for populations in a stationary state. This will apply even more so for populations in a run-down mode and similarly for populations that are in a state of growth.

3.3 The Forward Rate Approach (FRA)

In contrast to equations (10) and (11) the *Service* and *Interest Cost* under the FRA are calculated as follows:

$$\boldsymbol{Service\ Cost_{bsd+1}} = \sum_{t=0}^{t=99} \left\{ \frac{BSC_{t+\frac{1}{2}}}{\left(1+i_{t+\frac{1}{2}}\right)^{t+\frac{1}{2}}} (1+f_t) \right\} - \frac{1}{2} BSC_{\frac{1}{2}} f_0 \qquad (12)$$

$$\boldsymbol{Interest\ Cost_{bsd+1}} = \sum_{t=0}^{t=99} \left\{ \frac{B_{t+\frac{1}{2}}}{\left(1+i_{t+\frac{1}{2}}\right)^{t+\frac{1}{2}}} \right\} f_t - \frac{1}{2} B_{\frac{1}{2}} f_0 \qquad (13)$$

where f_t is the one year forward rate commencing at *t* and as determined by:

$$\frac{(1+f_t)}{(1+i_{t+1})^{t+1}} = \frac{1}{(1+i_t)^t}$$

$i.e.$

$$\boldsymbol{f_t} = \frac{(\mathbf{1} + \boldsymbol{i_{t+1}})^{t+1}}{(\mathbf{1} + \boldsymbol{i_t})^{t}} - \mathbf{1}$$

The one year forward rate $\boldsymbol{f_t}$ is thus the interest rate by which the discounted present value at the balance sheet date, *bsd,* of the benefit payment $\boldsymbol{B_{t+1}}$ must be "unwound" in order to satisfy the *Neutral Assumption* for the present value of that same payment at the end of the year being discounted for one year less than at the beginning of the year.

As for the *Traditional Approach* the *P/DBO* is calculated as per (6).

As mentioned under Section 3.2 disagreements surrounding the effects on *Interest Cost* exist. But there is little if any controversy surrounding the calculation of the *Service Cost,* as can be seen by comparing formulae (10) and (12).

Some believe that the *Neutral Assumption* made by the FRA regarding the development of the spot rate curve over the year is no more valid than assuming the *Expectations Theory* to hold true in part. Moreover, the wording of the US-GAAP and IFRS standards require the *Interest Cost* to be determined by applying "the discount rate" also used for discounting the relevant cashflows. It follows that there is no requirement for using best estimate assumptions in determining the *Interest Cost* and that it is perfectly legitimate to hold the view that, given a normal spot rate curve at the beginning of the year, an increase in the spot rate curve at the end of the year can be expected.

As already mentioned above the process of unwinding the discount to determine the *Interest Cost* is an essential element to determine the expected *P/DBO* at the end of the year. Since this is the benchmark for determining actuarial gains or losses at that point in time, it follows that the benchmark itself must follow the best estimate requirement, i.e. the assumptions used to determine it must satisfy the best estimate requirement.

3.4 Other Approaches

The three methods described above are not the only ones in use. Some pick different elements of the approaches described or apply the principles of one method to different groups of the member population. Two such approaches may be described as follows:

- In an adaptation of the *Traditional Approach* separate $\boldsymbol{i_{wa}}$ are determined for each group of plan members e.g. for actives, vested leavers and pensioners. This is essentially a step towards a rough approximation for the SRA. Since there is a departure from the *Traditional Approach*, its justifications do not apply here. Rather, the discussion under Section 3.2 applies to this approach too. Also, suppose that the calculation of the *P/DBO* is performed with separate $\boldsymbol{i_{wa}}$ for actives and pensioners, then clearly under the *Neutral Asssumption* and a normal yield curve actuarial losses will systematically arise when actives transfer to the pensioner population.
- Also in an adaptation of the *Traditional Approach* the *Service Cost* is determined by applying the spot rate curve. However, the *Interest Cost* is calculated by applying the $\boldsymbol{i_{wa}}$ for the entire population. Here, an increased precision is applied to only one component of Pension Expense, another is chosen from the Traditional Approach. This method fails to take account of the (very) different theoretical justifications underlying each of the approaches thus creating a hotchpotch with little theoretical rationalization.

Since the three methods outlined and discussed in Sections 3.1, 3.2 and 3.3 form the basis of most other approaches followed, further analysis will concentrate on these only.

4. The *Expectations Theory* on the term structure of interest rates

The *Expectations Theory* on the term structure of interest rates states that long-term interest rates contain a prediction for successive short-term interest rates in the future. For example, the *Expectations Theory* postulates that one investor will earn exactly the same amount of interest by purchasing a one-year bond at the beginning of the first year and reinvesting the entire proceeds at the end of that year into another one-year bond as another investor that purchases a two-year bond at the beginning of the first year. The theory has been rejected for practical applications [5].

Nevertheless, at least one actuarial practitioner supports an extreme view of the pure *Expectations Theory*, namely that the *Interest Cost* should be determined using the first year's spot rate [6]. This view is only rarely encountered in practice.

Some observers do not explicitly take position on what approaches satisfy the best estimate principle. If referred to at all, they are equally reticent on the relative "supportability or reasonableness of various capital market views" and their inherent biases. Nevertheless, these observers generally lend their explicit or implicit support to the SRA by describing it as a "more refined" approach to calculating *Service* and *Interest Cost* [7], at least in comparison with the *Traditional Approach*.

Other observers have explicitly taken position on all approaches more granular than the *Traditional Approach*, pointing out that the FRA is the only approach without bias and that the SRA and approaches related to it fail to comply with US-GAAP, IFRS and generally accepted actuarial principles in terms of the *Interest Cost* produce by their use [8].

As most observers have stated directly or indirectly, the central issue around the controversy surrounding the determination of the *Interest Cost* is that some assumption must be made on the capital market at year end i.e. specifically, the expected spot rate curve at year-end. Whereas the FRA is neutral in this respect, the SRA assumes a systematic rising if the sport rate curve at the beginning of the year is normally shaped. The SRA thus assumes that the *Expectations Theory* will hold true, at least in part. Note that the *Traditional Approach* does not contain this inherent bias regarding the expected spot rate curve at the end of the year.

Not surprisingly, academic literature on the topic of the *Expectations Theory* is very extensive, since if true (even in part), the future course of spot rate curves could be predicted. There would also be other practical applications around other financial instruments. Based on observations of the short-term U.S. Treasury bill market over the period 1959 to 1982, Fama postulated that there was indeed evidence, if only weak, that the forward premium has some predictive power at least over certain periods of the past. More

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[5] See, for example, Brearley & Myers, "Principles of Corporate Finance", Mc Graw Hill, 8th Edition, 2010.

[6] *Olivieri/Fersini*, "The interest cost calculation under IAS 19 when discounting with a yield curve", International Journal of Accounting and Financial Reporting, Vol. 4, No. 2.

[7] *Ernst & Young LLP,* "To the Point - Potential alternative to develop discount rates used to measure defined benefit plan costs", No. 2015-63, 2015. *KPMG LLP*, "Alternative Approaches to Calculating Service and Interest Cost under FASB ASC Topic 715", 2016. *American Academy of Actuaries*, "Alternatives for Pension Cost Recognition— Issues and Implications", Issue Brief, 2015.

[8] *A. Gohdes*, "Accounting: Are Pension Costs 'faked'?", Investment & Pensions Europe, 2017.

recent research, however, tends to reach the conclusion that forward rates contain effectively no predictive power regarding future interest rates. This is probably not that surprising, since consistent predictions of the future remains beyond human reach [9].

Apart from contributions made by academia, typically analyzing bonds with periods to maturity not exceeding six months, a very simple but nevertheless convincing argument can be made by analyzing historical data on the spot rate curve over a 12-month period, i.e. the term most relevant for purposes of pension accounting. As already mentioned, data from many decades in the Eurozone, UK, US and Japan show that AAA- and AA-corporate spot rate curves, almost always normally shaped, were no more likely to rise than they were to drop over a 12-month period. This does not mean that over specific, generally brief, periods of time a tendency for the spot rate curve to rise or drop after a 12-month period did not occur.

The above discussion on the applicability of the *Expectations Theory* on the term structure of interest rates should give evidence that it is of little if any practical relevance for employers accounting for pensions. Also, the belief that substance should prevail over form, i.e. that the best estimate principle should prevail over wording (crafted when the issue at hand did not exist), the *Neutral Assumption* on the development of the spot rate curve over a period of 12 months is used as the benchmark in the following numerical examples.

5. Numerical examples for the main approaches

5.1 Input Data used for calculations

Appendix A shows selected relevant input data used for the calculations performed. Three of the eight spot rate curves, as applicable under Willis Towers Watson's RATE:Link methodology for determining discount rates for the Eurozone under the international accounting standards for pensions, are displayed for each duration from 0.5 to 99.5 years. Also, for each duration, the annual expected future cashflows used for a population of pensioners and one for actives are exhibited. These cashflows were derived from own calculations as well as from data extracted from the national and international defined benefit retirement arrangements run by the 30 companies comprising the DAX share index as reported in their year-end IFRS financial statements 2016 and as summarized by Willis Towers Watson, Germany [10].

The cashflows used for determining the *Service Cost* were taken to be a given percentage of the total cashflow attributable to actives. For the average (slightly declining) population of those companies underlying the DAX this percentage was determined to be 6% ("*Typical Population*"), for one in a growing mode 12% ("*Growing Population*") and for one in a more strongly declining mode 3% ("*Shrinking Population*"). The percentages for the latter two were picked more or less at random; they can be varied as desired in any subsequent calculations by using the data disclosed in Appendix A. The *Typical Population* represents the current slightly declining population that should be comparable with the

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[9] *E. F. Fama,* „The Information in the Term Structure", Journal of Financial Economics 13 (December 1984). *S. Ross*, "How accurate is the forward rate in predicting interest rates?", Investopedia, downloaded February, 2018: https://www.investopedia.com/ask/answers/043015/how-accurate-forward-rate-predicting-interest-rates.asp. *Afanasenko/Gischer/Reichling*, "The predictive power of forward rates: a re-examination for Germany", Investment Management and Financial Innovations, Volume 8, Issue 1, 2011. *Afanasenko*, "Forward Rates: Predictive Power and Trading Strategies", PhD Thesis at Otto-von-Guericke University, Magdeburg (2012). *Sarno/Valente/ Leon*, "Nonlinearity in Deviations from Uncovered Interest Parity: An Explanation of the Forward Bias Puzzle", International Monetary Fund Working Paper, 2006. *J.C. Hull*, "Options, Futures and other Derivatives", Prentice Hall, 2012. *Buser/Karolyi/Sanders*, "Adjusted Forward Rates as Predictors of Future Spot Rates", 1996.

[10] *WillisTowersWatson*; „DAX Pensionswerke 2016" (Pensions Data of the 30 companies in the German share index DAX as reported at year end 2016), (2017).

situation in most developed nations with long traditions of defined benefit pension plans. This situation epitomizes the global decline in defined benefit plans with progressively less active participants or progressively lower benefits for new entrants, or a combination of both. The *Growing Population* exemplifies a mature plan with a strongly growing active population while the *Shrinking Population* represents a population that is declining more rapidly than the *Typical Population*. For convenience the benefits accrued at the beginning of the year are identical for each of the three populations.

As discussed above, the assumption of choice for the development of the spot rate curve over the following 12-month period is the *Neutral Assumption*. And since, of the three main approaches outlined in Section 3, only the FRA leads to neither actuarial gains nor losses systematically on the basis of any underlying population, the FRA is used as a benchmark with which the results of the other two approaches are compared. Hence the results of the *Traditional Approach* and the SRA are shown as percentage deviations from the results under the FRA.

For purposes of estimating the effect that a methodology has on total Pension Expense the average funding level amongst the Fortune 1,000 Group of companies over the seven- year period 2010 to 2016 was used as a basis for estimating the amount of expected return on plan assets. This was done because the application of the SRA and FRA on the Net Pension Liability or Asset did not appear to make any sense under IFRS.

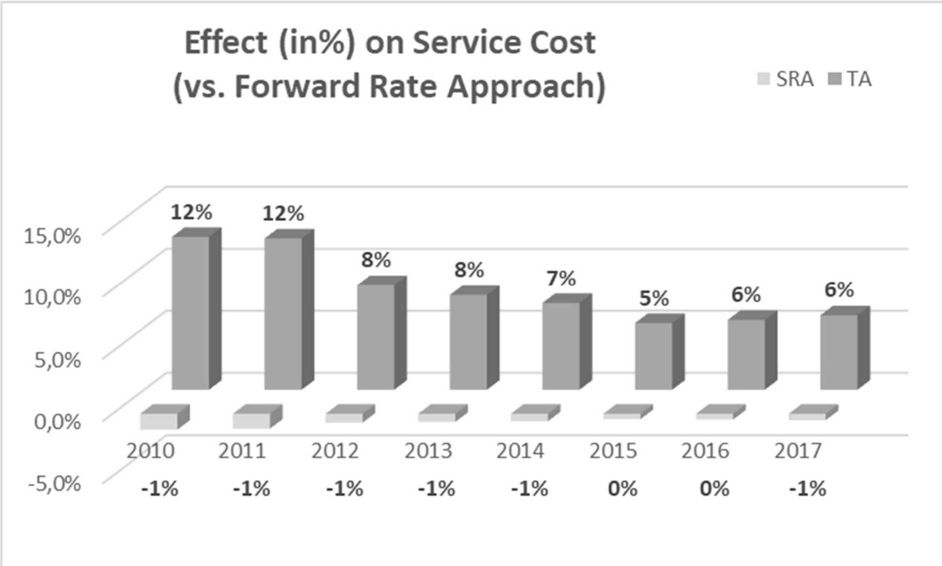
5.2 Results: Effect on Service Cost

For purposes of this paper the results for *Service Cost* are independent of the population type assumed. This is because the *Service Cost* cashflow was chosen for each population to be a percentage of the actives' cashflow attributable to past service.

As shown in Graph 1 below, the *Traditional Approach* results in *Service Cost* that are greater than those calculated under both the SRA and FRA to the tune of between 5 and 12%. This was to be expected since, under a normally shaped spot rate curve (as was the case for all of the eight year-end curves in the Eurozone), the longer duration of the *Service Cost* cashflow in comparison with the total benefit cashflow results in a higher weighted average discount rate for a population of actives than that for the entire population. Since the only difference between the SRA and the FRA is in respect of the *Interest Cost* element of *Service Cost*, these differ by amounts of the order of only about 1%.

During the eight-year period the average weighted discount rate for the entire population decreased from 5.1% to 1.8% p.a. Note that the variation from the FRA-benchmark tends to diminish with decreasing weighted average discount rate.

Graph 1: Effect of the *Spot Rate* and the *Traditional Approaches* on *Service Cost* in comparison with the *Forward Rate Approach* (in %)



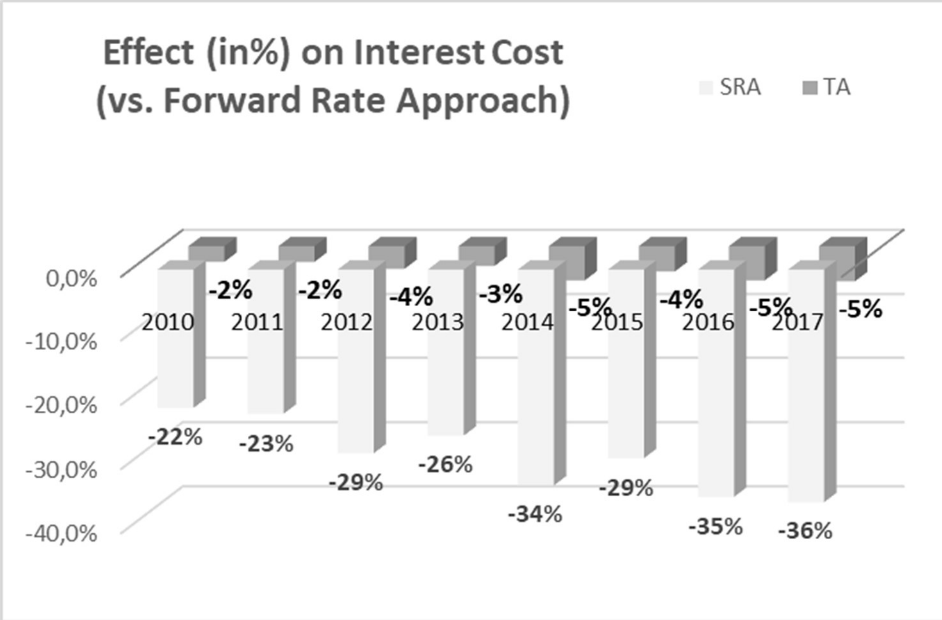
5.3 Results: Effect on Interest Cost

As is the case for *Service Cost* the results for *Interest Cost* for the pruposes of this paper are independent of the population type assumed because, by assumption, the benefits accrued at the beginning of the year are identical for all three populations.

Graph 2 below illustrates the effect that the SRA and *Traditional Approach* have on the *Interest Cost* in comparison with the FRA for each of the eight year-ends 2010 to 2017. The results for the *Traditional Approach* are between 2 and 5% lower than the FRA-benchmark whereas the effect under the SRA are more significant: they range from 20 to over 35% lower than the benchmark.

Although the *Traditional Approach*, as is the case for the FRA, is also based on the *Neutral Assumption*, it requires the additional condition of a population in stationary state to systematically produce neither actuarial losses nor actuarial gains. Note also that the variation from the FRA-benchmark increases with decreasing weighted average discount rate.

<u>Graph 2: Effect of the Spot Rate and the Traditional Approaches on Interest Cost in comparison with the Forward Rate Approach (in %)</u>



5.4 <u>Results: Effect on Pension Expense under US-GAAP</u>

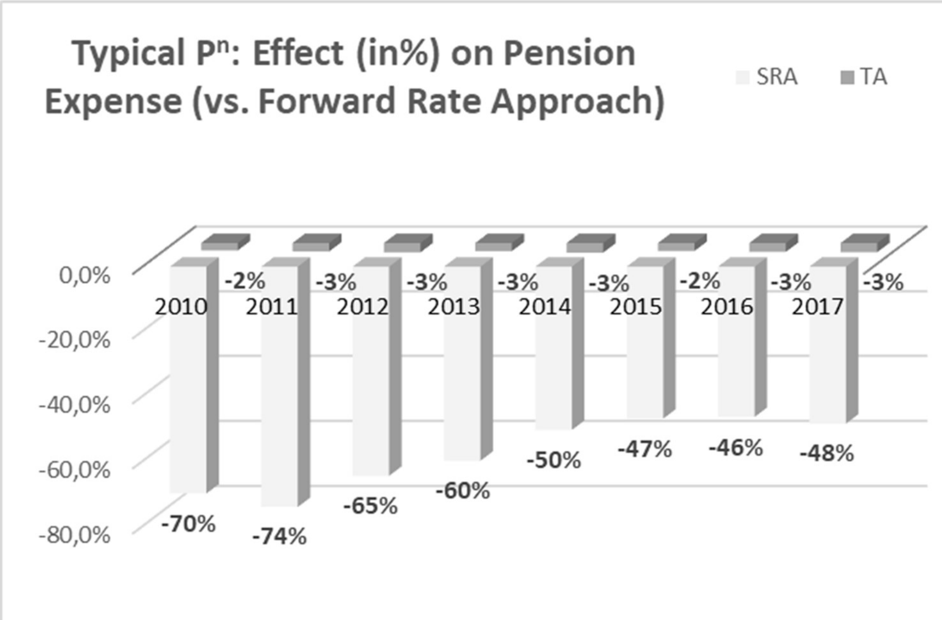
In contrast to the situation for *Service* and *Interest Cost* the results for Pension Expense are dependent of the population type assumed because of the interaction of *Service* and *Interest Cost* on the one hand and the effect of the expected return on plan assets on the other. As already mentioned above, the Pension Expense applies only to the situation under US-GAAP because of the difficulties surrounding the determination of the expected return on plan assets based on a spot rate curve under IFRS. For convenience, Pension Expense was assumed to consist only of the three components *Service Cost*, *Interest Cost* and expected return on assets.

In determining the expected rate of return on plan assets under US-GAAP, the average funding level – represented by the ratio of plan assets to *PBO* – as at the last eight year-ends for the defined benefit plans of companies included in the Fortune 1,000 index as reported under US-GAAP seemed to be a reasonable assumption to make. This was determined to be 81%. Since the expected rate of long-term return on plan assets is typically set at a rate higher than the weighted average discount rate the expected rate of return was estimated to be 85% of the Interest Cost as measured by the *Traditional Approach*. Both assumptions are admittedly rather rough-and-ready.

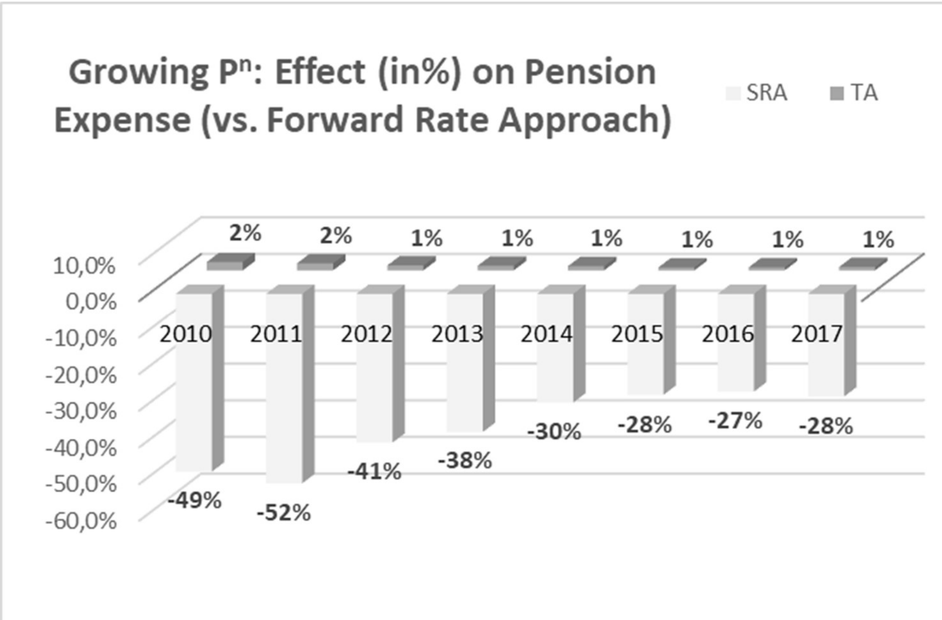
Graphs 3 to 5 below demonstrate the effect that the SRA and *Traditional Approach* have on the Pension Expense in comparison with the FRA for each of the eight year-ends 2010 to 2017. Graph 3 applies to the *Typical Population*, Graph 4 to a *Growing Population* and Graph 5 to a *Shrinking Population.*

Note also that the variation from the FRA-benchmark decreases with decreasing weighted average discount rate and increases significantly for increasingly shrinking populations. The results for the *Traditional Approach* range from around 1% higher for the *Growing Population* to around 7% lower for the *Shrinking Population*. For the SRA the results range from between 30 to 50% less for the *Growing Population* to between 70 and 95% less for the *Shrinking Population.* This latter result was described as staggering in Section 2.4.

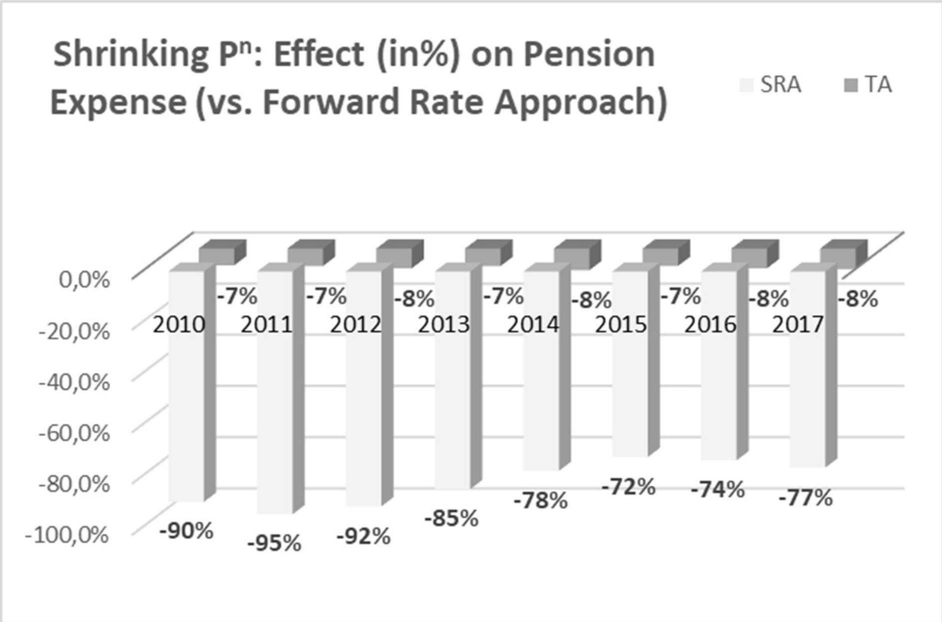
<u>Graph 3:</u> ***Typical Population*: Effect of the *Spot Rate* and the *Traditional Approaches* on Pension Expense in comparison with the *Forward Rate Approach (in %)***



<u>Graph 4:</u> ***Growing Population*: Effect of the *Spot Rate* and the *Traditional Approaches* on Pension Expense in comparison with the *Forward Rate* Approach (in %)**



Graph 5: ***Shrinking Population*: Effect of the *Spot Rate* and the *Traditional Approaches* on Pension Expense in comparison with the *Forward Rate Approach (in %)***



6. Conclusions

In this paper the issues of discounting and its unwinding under the US-GAAP and IFRS accounting standards for employers' accounting for defined pension plans have been systematically (re-)considered. In Section 2 above the theory underlying discounting was summarized and an outline given on the practical issues that have arisen in practice. In Section 3, an analysis of the three main approaches to unwinding including a discussion on their validity under the accounting standards is performed. Section 4 reviews the central theoretical arguments surrounding the issues that have arisen, in particular a discussion of the practical relevance of the *Expectations Theory*. In Section 5 the practical implications of each approach are compared in numerical examples.

The view is expressed that of the three main approaches used in modern practice, namely the *Traditional Approach*, the *Spot Rate Approach* (SRA) and the *Forward Rate Approach* (FRA), the FRA is closest to fulfilling the best estimate requirements of US-GAAP and IFRS. If it is accepted that the *Expectations Theory* on the term structure of interest rates is of little or no practical relevance, the SRA is the only approach that systematically fails to fulfil the best estimate requirements under both US-GAAP and IFRS because it is systematically biased. Although one assumption underlying the *Traditional Approach*, namely that the expected future benefit cashflows to pension fund members are in a stationary state, is unlikely to be fulfilled, the approach can be continued to serve as a practical expedient because it is not systematically biased.

The actuary providing actuarial services is often instructed to use assumptions and methods prescribed by the principal. If the actuary considers one or more of these to be outliers, then professional standards normally require the actuary to consider stating as much in the actuarial report. This paper concludes that usage of the SRA falls into this category.

APPENDIX A

Year	Spot Rate RATE:Link y/e 2010	Spot Rate RATE:Link y/e 2013	Spot Rate RATE:Link y/e 2016	Cashflow Pensioner BoY	Cashflow Actives BoY	Year	Spot Rate RATE:Link y/e 2010	Spot Rate RATE:Link y/e 2013	Spot Rate RATE:Link y/e 2016	Cashflow Pensioner BoY	Cashflow Actives BoY
0,5	1,36%	0,26%	-0,29%	7.884	0	50,5	6,31%	3,85%	2,09%	1	1.695
1,5	2,03%	0,56%	-0,20%	7.669	173	51,5	6,31%	3,85%	2,09%	0	1.601
2,5	2,50%	0,86%	-0,09%	7.449	325	52,5	6,31%	3,85%	2,09%	0	1.508
3,5	2,86%	1,16%	0,03%	7.225	475	53,5	6,31%	3,85%	2,09%	0	1.417
4,5	3,18%	1,46%	0,18%	6.997	624	54,5	6,31%	3,85%	2,09%	0	1.328
5,5	3,48%	1,78%	0,34%	6.764	771	55,5	6,31%	3,85%	2,09%	0	1.240
6,5	3,73%	2,06%	0,50%	6.526	914	56,5	6,31%	3,85%	2,09%	0	1.155
7,5	3,95%	2,29%	0,67%	6.283	1.054	57,5	6,31%	3,85%	2,09%	0	1.072
8,5	4,15%	2,50%	0,84%	6.035	1.191	58,5	6,31%	3,85%	2,09%	0	992
9,5	4,30%	2,67%	0,99%	5.781	1.325	59,5	6,31%	3,85%	2,09%	0	914
10,5	4,40%	2,81%	1,14%	5.523	1.456	60,5	6,31%	3,85%	2,09%	0	839
11,5	4,48%	2,93%	1,27%	5.260	1.584	61,5	6,31%	3,85%	2,09%	0	767
12,5	4,56%	3,03%	1,39%	4.992	1.710	62,5	6,31%	3,85%	2,09%	0	698
13,5	4,64%	3,13%	1,49%	4.721	1.832	63,5	6,31%	3,85%	2,09%	0	631
14,5	4,73%	3,21%	1,57%	4.446	1.951	64,5	6,31%	3,85%	2,09%	0	569
15,5	4,82%	3,29%	1,65%	4.168	2.067	65,5	6,31%	3,85%	2,09%	0	509
16,5	4,91%	3,36%	1,71%	3.888	2.178	66,5	6,31%	3,85%	2,09%	0	454
17,5	5,00%	3,42%	1,76%	3.608	2.286	67,5	6,31%	3,85%	2,09%	0	401
18,5	5,10%	3,48%	1,80%	3.329	2.388	68,5	6,31%	3,85%	2,09%	0	353
19,5	5,19%	3,54%	1,84%	3.052	2.486	69,5	6,31%	3,85%	2,09%	0	308
20,5	5,30%	3,61%	1,87%	2.779	2.578	70,5	6,31%	3,85%	2,09%	0	267
21,5	5,41%	3,66%	1,90%	2.512	2.663	71,5	6,31%	3,85%	2,09%	0	229
22,5	5,52%	3,71%	1,92%	2.252	2.741	72,5	6,31%	3,85%	2,09%	0	196
23,5	5,65%	3,75%	1,95%	2.002	2.812	73,5	6,31%	3,85%	2,09%	0	166
24,5	5,77%	3,78%	1,97%	1.763	2.875	74,5	6,31%	3,85%	2,09%	0	139
25,5	5,89%	3,80%	2,00%	1.538	2.929	75,5	6,31%	3,85%	2,09%	0	116
26,5	6,01%	3,81%	2,02%	1.327	2.974	76,5	6,31%	3,85%	2,09%	0	95
27,5	6,12%	3,83%	2,04%	1.133	3.010	77,5	6,31%	3,85%	2,09%	0	78
28,5	6,22%	3,84%	2,06%	956	3.035	78,5	6,31%	3,85%	2,09%	0	63
29,5	6,29%	3,85%	2,08%	797	3.050	79,5	6,31%	3,85%	2,09%	0	51
30,5	6,31%	3,85%	2,09%	656	3.056	80,5	6,31%	3,85%	2,09%	0	41
31,5	6,31%	3,85%	2,09%	534	3.051	81,5	6,31%	3,85%	2,09%	0	32
32,5	6,31%	3,85%	2,09%	428	3.036	82,5	6,31%	3,85%	2,09%	0	25
33,5	6,31%	3,85%	2,09%	339	3.012	83,5	6,31%	3,85%	2,09%	0	19
34,5	6,31%	3,85%	2,09%	265	2.979	84,5	6,31%	3,85%	2,09%	0	15
35,5	6,31%	3,85%	2,09%	203	2.938	85,5	6,31%	3,85%	2,09%	0	11
36,5	6,31%	3,85%	2,09%	154	2.889	86,5	6,31%	3,85%	2,09%	0	9
37,5	6,31%	3,85%	2,09%	115	2.833	87,5	6,31%	3,85%	2,09%	0	6
38,5	6,31%	3,85%	2,09%	85	2.770	88,5	6,31%	3,85%	2,09%	0	5
39,5	6,31%	3,85%	2,09%	62	2.701	89,5	6,31%	3,85%	2,09%	0	3
40,5	6,31%	3,85%	2,09%	44	2.627	90,5	6,31%	3,85%	2,09%	0	2
41,5	6,31%	3,85%	2,09%	31	2.547	91,5	6,31%	3,85%	2,09%	0	2
42,5	6,31%	3,85%	2,09%	22	2.463	92,5	6,31%	3,85%	2,09%	0	1
43,5	6,31%	3,85%	2,09%	15	2.375	93,5	6,31%	3,85%	2,09%	0	1
44,5	6,31%	3,85%	2,09%	10	2.282	94,5	6,31%	3,85%	2,09%	0	1
45,5	6,31%	3,85%	2,09%	7	2.186	95,5	6,31%	3,85%	2,09%	0	0
46,5	6,31%	3,85%	2,09%	5	2.086	96,5	6,31%	3,85%	2,09%	0	0
47,5	6,31%	3,85%	2,09%	3	1.987	97,5	6,31%	3,85%	2,09%	0	0
48,5	6,31%	3,85%	2,09%	2	1.888	98,5	6,31%	3,85%	2,09%	0	0
49,5	6,31%	3,85%	2,09%	1	1.791	99,5	6,31%	3,85%	2,09%	0	0