

2 Is the standard micro portfolio approach to sovereign debt management still appropriate? A critical analysis of the underlying analytical framework

Joint with Hans J. Blommestein *This paper examines the analytical underpinnings of the standard micro portfolio approach to public debt management (PDM) that aims at minimizing longer-term cash flow-based borrowing costs at an acceptable level of risk. The study concludes that two technical key assumptions need to hold for the standard micro portfolio approach to yield optimal (i.e. cost-minimizing) results. We argue that these assumptions do not hold in the current borrowing environment characterized by fiscal dominance with complex links between PDM and monetary policy. By using the principles of portfolio theory, we demonstrate that in this borrowing environment cost-risk optimality requires the use of a broader cost concept than employed in the standard micro portfolio approach. This new concept incorporates not only the cash flows of the debt portfolio itself, but also those related to primary borrowing requirements. Therefore, the resulting broader cost measure includes the interactions with the budget. Finally, the paper demonstrates that the standard cost-risk framework of the micro portfolio approach is nested within this new, broader cost concept.*

2.1 Introduction

There is a consensus among OECD debt managers that the primary strategic objectives or functions of government debt management are⁶³: (a) securing continuous (and easy) access to markets, while (b) minimizing longer-term borrowing costs at an acceptable level of risk. These strategic cost-risk objectives constitute the basis of the so-called standard micro portfolio approach to public debt management (PDM). The recent global financial and economic crises, however, have triggered a growing debate on the need for making possible changes in this standard strategic mandate of PDM. This policy debate is also informed by the (potential) implications of new and complex interactions between PDM, monetary policy and financial instability in the face of serious fiscal vulnerabilities, a perceived increase in sovereign risk and considerable uncertainty about future interest rates (denoted as *fiscal dominance* in Turner [2011, pp. 7 f.] and [Blommestein and Turner 2012, p. 6], a situation that is likely to last for the foreseeable future).

Although both these interactions and fiscal dominance are the result of (or were revealed during) the global financial crisis and its aftermath, structural changes in (or features of) the new financial (and business) landscape may be additional structural reasons why some of these new complex links are likely to persist, see Blommestein and Turner [2012, p. 6]. These developments, in turn, have significantly changed the policy environment for debt management offices (DMOs), central banks (CBs) and fiscal authorities. The size of the balance sheets of CBs has been expanded significantly while their composition has been

⁶³For further details, see Blommestein [2002], Kreiner [2002] and other contributors in “Debt Management and Government Securities Markets in the 21st Century”, OECD.

radically changed⁶⁴. The use of unconventional monetary policy has created (potential) conflicts and new interactions between monetary policy, PDM and fiscal policy.

Several analysts and policy makers have argued that government debt managers should be more aware of, and/or take explicitly into account, the broader (macro) impact of their policy decisions on the economic policy mix and the financial system as a whole. Some authors have used this perspective as a basis for suggesting a revision of the conventional (micro portfolio) mandate to PDM, including Blommestein and Turner [2012], Turner [2011], Hoogduin et al. [2010], Surti et al. [2010] and Goodhart [2010]. Against this complex, multi-faceted borrowing background, the paper will address the core question as to what extent a conceptual reformulation of the standard micro portfolio approach to PDM is needed. In particular, we will focus on the following specific questions related to the underlying technical assumptions of the micro portfolio approach:

- (i.) Under which technical conditions or assumptions is the standard micro portfolio approach to PDM an optimal one in the sense that effective borrowing costs are indeed minimized subject to a stated preferred level of risk?
- (ii.) Do these technical (optimality) conditions remain valid in a situation of sustained fiscal dominance, imperfect asset substitutability, and the (partial) loss of risk-free assets?

Our analysis identifies two key technical assumptions for the standard micro portfolio approach to public liability management to yield optimal (i.e. cost-minimizing) results.

In this context we also demonstrate that the standard cost-risk framework of the micro portfolio approach represents a special case of a general framework associated with an alternative (i.e. broader) cost measure based on portfolio theory. The underlying reasoning demonstrates under which conditions it may be desirable to take a broader view of cost and risk than the measure implied by the standard micro portfolio approach to sovereign liability management. We shall refer to this broader measure as *effective sovereign borrowing costs*. In essence, we show how the use of this broader measure of sovereign borrowing costs (that explicitly encompasses interactions with the budget) may be a potentially effective response to the complications associated with situations of fiscal dominance.

The paper is structured as follows. Section 2.2 provides a detailed analysis of the analytical underpinning of the standard micro portfolio approach, thereby demonstrating that this approach has important similarities with the behavior of private financial institutions guided by micro-finance principles. By comparing, in section 2.3, the micro portfolio approach with well-established asset management practices, we are in the position to deduce two technical assumptions that are instrumental for the standard micro portfolio approach to generate optimal cost-risk values. In section 2.4, we compare the analytical features of the standard cost measure (associated with the micro portfolio approach) with a newly introduced superior cost concept.

Subsequently, in section 2.5, we examine the empirical validity of each of these two technical conditions supporting the standard micro portfolio approach. In doing so, we evaluate the implications of the financial-cum-sovereign debt crisis for this standard approach. To that end, we are making an explicit distinction between normal ('non-crisis') periods and more challenging crisis situations. Our analysis shows that in a situation

⁶⁴See Ben S. Bernanke, The Federal Reserve's Balance Sheet: An Update, Speech at the Federal Reserve Board Conference on Key Developments in Monetary Policy, Washington, D.C. October 8, 2009.

of fiscal dominance, the standard micro portfolio approach does not yield optimal cost-risk results. The final section 2.6 concludes and outlines the next steps in our research program.

2.2 The analytical roots of the standard micro portfolio approach

The micro portfolio approach currently pursued by most government debt managers is reflected in the basic functions of PDM (securing market-based financing at the lowest cost subject to risk preferences). The organization of PDM underwent major changes in the 1990s, reflecting the move to a micro portfolio approach to PDM.⁶⁵ Debt management operations have been delegated to separate operationally autonomous units, referred to as Debt Management Offices (DMOs), sometimes outside the Ministry of Finance⁶⁶ (MoF), albeit subject to the policy responsibility of the MoF. A crucial feature of this institutional set-up is the separation between PDM and fiscal policy on the one hand, and monetary policy (for which independent central banks are responsible) on the other, see IMF and Worldbank [2001*b*, p. 13]. DMOs operate as professional and predictable market players sticking to widely agreed-upon market rules, thereby supporting a liquid and transparent market for government securities.

As a result of this new institutional set-up, an active support by PDM for broader macroeconomic objectives, such as was common in the 1950s and 1960s (see Simons [1944], Musgrave [1959], Rolph [1957], Tobin [1963]) and which entailed an active use of the debt portfolio structure in the conduct of macroeconomic policies, has lost ground. Instead, the adoption of a micro portfolio approach entails a narrow focus on cost and risk targets directly linked to the sovereign debt portfolio. This implies that DMOs execute issuance and funding strategies based on a clear set of rules guided by micro-economic (or finance) principles. These principles are summarized as the strategic or functional objective to ‘minimize longer-term borrowing costs at an acceptable level of risk’.

Naturally, the objectives ‘minimizing borrowing costs’ and ‘managing the associated risks’ cannot be seen in isolation from each other. Maturities are the main components or features to manage the cost and (interest-rate) risk profile of the sovereign debt portfolio. The shorter the average term to maturity of the debt portfolio, the more frequently refinancing at new market conditions will be necessary. Thus, portfolios with a larger share of short-term financing instruments are subject to a higher level of interest-rate risk than those with a larger share of longer-term instruments. On the other hand, considering the commonly observed upward-sloping yield curve, longer-maturity securities provide on average higher yields than shorter-term securities. In other words, the basic PDM strategy is focused on managing the cost-risk trade-off so as to achieve the optimal debt portfolio⁶⁷.

In this context, we will refer to the underlying conceptual framework as the *standard micro portfolio approach to sovereign liability management* and argue that there are important analytical similarities with (private) asset management (allocation) concepts. Specif-

⁶⁵A more comprehensive treatment of the transformation process, including the changing role and structure of DMOs, is given by Kalderen and Blommestein [2002, pp. 109 - 133].

⁶⁶The term ‘Ministry of Finance’ applicable to Germany, France, Denmark, Sweden, Italy, Spain, Japan, China, Russia, India, South Africa, Brazil and many more countries is used synonymously with ‘Department of the Treasury’ adapted by the USA and ‘Her Majesty’s Treasury’ used in the United Kingdom.

⁶⁷See also Risbjerg and Holmlund [2005, p. 41] and Bolder [2003, p. 4]. The UK DMO provides an insightful analysis of the Principles and Trade-Offs When Making Issuance Choices; see OECD [2011].

ically, both the micro portfolio management of sovereign liabilities and private asset (or investment) management entail making decisions under conditions of uncertainty regarding:

- (a) the (optimal) structure of a debt (or investment) portfolio, which involves
 - (a1) the optimization of the micro cost (or return)/risk relationship, by taking into account
 - (a2) the existing portfolio (with liabilities or assets) and nothing else.

Point (a2) implies that the primary budget balance is treated as an *exogenous* variable in the standard micro portfolio approach. Hence, the level of debt is largely determined by changes in the primary budget balance.

The budgetary balance, reflecting the stance of fiscal policy, constitutes therefore exogenous input for simulations associated with the sovereign debt strategy (*while payments for servicing the debt are endogenous*). Hence, within the context of the analytical framework of the standard micro portfolio strategy, there is a clear functional separation between PDM and fiscal policy (while the PDM strategy is also functionally separated from monetary policy). Consequently, such an institutional set-up implies that PDM is in principle *not* integrated into the conventional macro-economic framework. In section 2.4, we will discuss whether this is an appropriate approach.

2.3 Technical conditions underlying the micro portfolio strategy

In order to identify the key technical assumptions associated with the current cost and risk framework of PDM, we will take a closer look at the underlying micro portfolio management strategy. In essence, a long-term debt management strategy is *broadly similar* to passive private investment or asset management strategies (based on the principles of portfolio theory for managing the risk-return relationship⁶⁸). Instead of replicating a broad market bond index (as in a passive asset management strategy), the approach used in strategic government debt management is to follow as closely as possible a predefined benchmark portfolio (reflecting long-term cost and risk preferences). The PDM strategy is characterized by risk-aversion and diversification, thereby mirroring the spirit of risk optimization in passive bond portfolio strategies. This usually involves the implementation of a buy-and-hold strategy⁶⁹.

There are, however, also substantial differences between strategic government debt management and a private asset or investment management strategy. In particular, a PDM strategy:

- (a) focuses on medium- to long-term borrowing costs vs. short-term market value considerations of private asset or investment management;

⁶⁸The principles of portfolio theory, introduced by Markowitz [1952, 1959], were further developed by Sharpe [1964], Lintner [1965] and Mossin [1966] into the Capital Asset Pricing Model (CAPM), which became the simplest standard for measuring risk and return.

⁶⁹A passive investment strategy implies that active trading on market views will not take place. The counter-part of a ‘buy-and-hold’ strategy in debt management can be viewed as holding debt to maturity, although these strategies might include (tactical) buy-back operations and the use of swaps to achieve and maintain the desired risk profile [see, for example, Risbjerg and Holmlund [2005, p. 50] and Jensen and Risbjerg [2005, p. 64]].

- (b) cannot maintain a risk-free position (a sovereign debt portfolio is always exposed to changes in interest rates due to the need to undertake refinancing activities);
- (c) contradicts the concept of an efficient and well-diversified portfolio⁷⁰ (i.e. the market portfolio);
- (d) requires the formulation of expectations about the evolution of interest rates (not implicit in current market prices) over a longer-term horizon⁷¹.

Consequently, DMOs need to tailor the analytical basis of passive private investment or asset management strategies to their specific situation. In short, DMOs use sophisticated portfolio and risk management techniques, in particular simulations of debt strategies based on a stochastic framework for the development of key risk measures (especially interest rates).

Nevertheless, strategic debt management can, to an important degree, be considered as the mirror image of an extended or adapted form of passive portfolio management. For this reason, strategic PDM is firmly based on the principles of portfolio theory, being primarily concerned with the micro-optimization of the portfolio structure based on the cost (return)/risk relationship. Portfolio theory is associated with the following two core assumptions, see Fama and Miller [1972, esp. p. 21 and pp. 189 - 214]:

- Core assumption 1: Rational financial decision makers that act as risk-averse expected utility (or wealth) maximizers.
- Core assumption 2: Perfect or efficient capital markets implying perfectly competitive markets that are frictionless.

We will use this perspective to identify the key technical assumptions of the standard micro portfolio approach to PDM.

Clearly, the first assumption can easily be applied to public sector decisions such as those relating to PDM since they also involve the allocation of scarce resources, including, rationally weighing costs against benefits, see also Fuguitt and Wilcox [1999, esp. pp. 35 - 42]. However, the second assumption cannot so easily be justified in the public sector. Governments have considerable market power, especially in the market for government securities. This means that the price-taker assumption needs to be further scrutinized. We will return to this particular point in section 2.5.

In addition to these two core assumptions, there is another, specific feature of the standard micro portfolio approach to PDM. As noted, PDM treats the ‘primary budget balance’ as exogenous since in most countries fiscal policy is institutionally separated from PDM. In this context, the OECD Borrowing Outlook makes a policy distinction between *funding strategy* and *borrowing requirements*. Accordingly, the total central government marketable gross borrowing requirements are calculated on the basis of budget deficits (the outcome of fiscal policy decisions that determine the primary borrowing needs) and

⁷⁰By definition, the government itself holds the market portfolio in its own instruments. Due to the high correlation between neighboring maturity segments, the ‘efficient frontier’ can be replicated with very few instruments.

⁷¹It is not possible to define or formulate an optimal long-term financing strategy using only the information implicit in current market prices. This feature substantially distinguishes debt management from passive investment or asset management strategies because the latter do not require the formulation of market expectations regarding the actual development of interest rates.

redemptions. On the other hand, the funding strategy of DMOs entails decisions on how total borrowing needs are going to be financed using different instruments (e.g. long-term, short-term, nominal, indexed, etc.) and distribution channels.

Thus, total borrowing requirements, and the associated funding strategy, are in part independently driven by the fiscal strategy of the government. This even applies, for example, to the funding strategy of DMOs, which may be informed by the central government's preferences to enhance fiscal resilience by seeking to mitigate refinancing and rollover risk, see Annex A of OECD Sovereign Borrowing Outlook 2012. As a matter of fact, total gross borrowing needs are in part exogenous for DMOs. By treating the 'primary budget balance' as exogenous, however, the use of the standard micro portfolio approach to PDM implies that the interactions between the debt portfolio on the one hand, and the *budgetary position*⁷² on the other, are irrelevant for the optimization framework associated with the standard micro portfolio approach. Therefore, the key optimization parameters refer only to the debt portfolio (comprising the outstanding stock and securities that are expected to be issued over the planning horizon).

As a result, we have identified the following two (related) key technical assumptions that drive the optimality results of the standard micro portfolio approach to public liability management:

- Technical assumption 1: the actions of the government (in particular planning and executing the funding strategy) have no impact on the market prices of government securities and the term structure of interest rates derived from them (price-taker assumption).
- Technical assumption 2: the budgetary position and the debt portfolio are statistically independent from each other (zero dependency or correlation).

These two assumptions or conditions are related to each other and need to be satisfied in order for the micro portfolio approach to PDM to yield optimal cost-risk choices. If they do not hold, decisions based on the associated cash flow cost measures do *not* lead to the same result as decisions taken on the basis of present value (or market value) considerations derived from portfolio theory, see the following section for details.

2.4 An extended analytical financing framework and associated cost measures

To gain a better understanding of the limitations associated with the standard micro portfolio approach, we will closely examine (a) the analytical features of the standard micro portfolio approach; and (b) compare the cash flow-based *standard cost measure* with an present value-based alternative *broader cost measure* (consistent with portfolio theory). To that end, we will introduce an extended analytical financing framework based on the projection of *all* future cash flows associated with the 'life time' (planning horizon) of the debt portfolio. This implies that we also take into account the cash flows associated with the primary borrowing requirements of the sovereign, which comprise all public expenditures and revenues, excluding debt servicing payments. This extended analytical

⁷²The budgetary position encompasses all public expenditures and revenues minus the debt servicing payments, as measured by the primary budget balance (or primary borrowing requirements).

framework⁷³ gives us a more precise insight into the limitations of the standard portfolio approach as well as the (cash flow-based) standard cost measure. In view of these limitations, we will introduce and propose an alternative (i.e. broader) cost measure for sovereign issuers based on present values.

2.4.1 Terms and definitions

Within our extended framework we assume (a) a finite time or planning horizon $[t_0, t_T]$ for the debt portfolio with (b) a starting date of the debt portfolio that coincides with the beginning of the evaluation date (t_0); this implies that there are no cash flows to be taken into account before the evaluation date. Key variables will be defined as follows:

- t = evaluation date
- t_0 = start date of the debt portfolio (equals evaluation date t)
- t_T = end of the ‘lifetime’ of the debt portfolio (represents the point in time where all government debt has been completely repaid)
- NPV_t = net present value (NPV) of the debt portfolio at time t
- NFV_T = net future value (NFV) of the debt portfolio at the end of the horizon at time t_T
- C = borrowing costs accumulated over the time interval $[t_0, t_T]$
- $\{Cf_0, \dots, Cf_T\}$ = cash flows of the debt securities portfolio in the time interval $[t_0, t_T]$; comprise cash flows from primary and secondary market operations (payments received through issuing or selling government securities, payments made for purchasing or redeeming securities and interest payments on securities) as well as interest payments on swaps
- $\{B_0, \dots, B_{T-1}\}$ = cash flows associated with primary borrowing requirements; this represents the difference between revenues and public expenditures (excluding debt servicing payments) in the time interval $[t_0, t_{T-1}]$. When the cash flow is positive the balance can be used to repay debt and when it is negative the balance indicates new borrowing. Note that only the cash flows associated with the borrowing requirement up to one period before the end of the horizon (that is, up to time t_{T-1}) are relevant for our analysis.
- R_T = final debt repayment cash flow (including principle plus accumulated interest) at the end of the horizon at time t_T
- $Z_i = Z(t, t_i - t)$ = the *deterministic* rate of return (for the time period $[t, t_i]$) expected by the market on a default-free zero-coupon bond held until maturity (at time t_i), also known as the spot rate

⁷³This analytical financing framework is very similar to the one used for the evaluation of financing decisions in long-term investment projects of corporations such as the financing of new machinery or a new plant, industrial projects, environmental projects, etc. This framework is also referred to as ‘capital budgeting’ (i.e. the allocation of internal and external resources among potential investment projects with a long-term time-horizon).

- $z_i = z(t_i, t_j - t_i) = \text{stochastic future zero-coupon interest rate for the time period } [t_i, t_j]$ (usually referred to as the forward interest rate $F_{i,j} = F(t_i, t_j - t_i)$)
- $r_s(t) = \text{instantaneous interest rate (annualized stochastic rate over an infinitesimal time period } dt)$
- $E_t(\dots) = \text{expectation operator conditional to the information set available at time } t$

2.4.2 Decisions under certainty

Presuming conditions of perfect certainty means operating within a very restricted environment, where the outcomes of all decisions are known ex-ante.⁷⁴ Under such a scenario all cash flows, including the cash flows of the debt securities portfolio Cf_i (with $i = 0, 1, \dots, T$) and the borrowing requirement cash flows B_i (with $i = 0, 1, \dots, T - 1$) are known from the beginning. The same applies to the related interest rates, used for discounting (to time t) to obtain the present value of the sum of all cash flows, on which basis risk-return measures associated with the modern portfolio theory can be calculated. In this respect, we adopt the well-established terminology of the corporate finance theory, and therefore refer to this discounted value as the net present value (NPV) of the debt portfolio. The certainty assumption combined with the presumption of a constant short-term rate implies a constant risk-free discount rate r_f , which the traditional capital theory refers to as the cost of capital, the given rate at which a firm can freely borrow, or alternatively invest, see Gordon [1966, pp. 14f.].⁷⁵

Assuming continuous compounding, the *net present value* NPV_t of the debt portfolio at time t is given by:

$$NPV_t = \sum_{i=0}^T Cf_i e^{-r_f(t_i-t)} + \sum_{i=0}^{T-1} B_i e^{-r_f(t_i-t)} \quad (2.1)$$

Equation (2.1) represents the *net fiscal position of the government*, being equal to the NPV of *all* cash flows. This means that we take into account the cash flows associated with both the sovereign debt portfolio *and* the primary borrowing requirements. In this context, the portfolio of government liabilities does not only include the stock with already issued securities, but also those that are expected to be issued in the future (i.e. over the entire planning horizon $[t, t_T]$ of the portfolio of a sovereign). Given the risk-free discount rate r_f , which remains constant over the whole time interval $[t, t_T]$, future securities prices and thus the future cash flows of the debt securities portfolio (for a predefined financing strategy) can directly be calculated.

The constant discount rate implies a perfectly flat yield curve, where all interest rates for all maturities are exactly the same. Indeed, under certainty in a perfect capital market with a constant short-term rate we would observe such a yield curve. Under this scenario

⁷⁴The certainty assumption represents one of the central cornerstones of the neoclassical capital theory. See for further details Gordon [1966, pp. 14 - 28], who discusses and reviews the neoclassical theory on the subject with a special emphasis on the certainty assumption.

⁷⁵This general assumption can be found in Lutz and Lutz [1951, p. 12], albeit they discuss a situation under conditions of certainty, in which the lending and the borrowing rate are not equal, see p. 22. Hirshleifer [1970, p. 48] makes it particularly clear, that a constant risk-free interest rate is a simplifying assumption often used as a starting point to explain the present-value rule under certainty.

the return from holding a long bond until maturity will be the same as the return from rolling over a series of short bonds with a total maturity equal to that of the long bond. No matter what their time horizon, rational acting investors will select the security that gives them the highest return. Hence, prices of securities will adjust until the return from different investment strategies with the same time horizon (e.g. rolling over a series of short-term bonds vs. holding a longer-term bond) will exactly be the same, see, for example, Elton et al. [2007, p. 519] and Fama and Miller [1972, pp. 36 f.]. It should be emphasized, that the adjustment process will only result in a flat yield curve, if the short-term rate is assumed to remain constant. If this condition is relaxed, the interest rates among different maturities do not necessarily need to be the same.⁷⁶

While a company is mostly interested in the additional value (measured by the NPV) a project contributes to the value of its equity (shareholders wealth) today, a key concern of government debt management is the financial burden (or cost) of the debt portfolio for future generations.⁷⁷ For that reason, the net future value (NFV) at the end of the horizon of the debt portfolio at time t_T is of crucial importance for funding decisions. Using continuous compounding, the *net future value* NFV_T of the debt portfolio is obtained by compounding the net present value NPV_t of this portfolio over the time interval $[t, t_T]$ at the appropriate discount rate (under certainty the cost of capital represented by the risk-free rate r_f), as expressed by the following equation⁷⁸:

$$NFV_T = NPV_t e^{r_f(t_T-t)} \quad (2.2)$$

It is evident from equation (2.2), that the decision criteria NPV and NFV are equivalent under certainty. The net future value NFV_T represents the amount of cash needed at time t_T to repay the debt (including principal plus accumulated interest). This will be referred to as the *final debt repayment cash flow*, denoted by R_T . Now we are in the position to deduce the following key debt sustainability condition:

$$0 = NFV_T + R_T \quad \Rightarrow \quad -R_T = NFV_T = NPV_t e^{r_f(t_T-t)} \quad (2.3)$$

Equation (2.3) reflects the key debt sustainability condition that the present value of liabilities is not greater than the present value of assets (i.e., the value of cash flows available to pay down the debt), see, for example, Giammarioli et al. [2007, p. 5].

We shall use the NFV of the debt portfolio to formulate a cash flow based cost measure. As a first step, the NFV is decomposed into two components, see Bierman and Smidt [1988, p. 19]:

$$NFV_T = \underbrace{\text{Principal}}_{\text{sum of the borrowing requirements}} + \underbrace{\text{Accumulated Interest}}_{\text{borrowing costs}} \quad (2.4)$$

⁷⁶In this case only the expected return from holding a longer-term bond (e.g. one-year bond) will be exactly the same as the expected return from rolling over a series of short-term bonds (e.g. two six-month bonds). As explained by Elton et al. [2007, p. 519] the expected return of the short-term bonds can differ from period to period.

⁷⁷This is comparable to the evaluation of efforts to improve the distant future, e.g. in the field of climate change or the preservation of natural resources, as examined, for example, by Gollier [2009], Hepburn and Groom [2007] and Stern [2007].

⁷⁸In the classical literature on capital budgeting the NFV of an investment is usually referred to as the future (or terminal) value of this investment, see, for example, Solomon [1969, p. 134], Hirshleifer [1970, p. 57] and Bierman and Smidt [1988, p. 19]. See also Hansen and Moven [2007, pp. 589 f.].

Secondly, the interest of the debt portfolio accumulated over the period $[t, t_T]$ will be referred to as (standard) borrowing costs and denoted by C . These purely cash flow-based borrowing costs comprise all coupon payments, accrued interest, inflationary adjustment and premium/discount as well as interest payments for borrowing (or alternatively lending) in the money market.⁷⁹ *Borrowing costs* can then be expressed as:

$$C = NFV_T - \sum_{i=0}^{T-1} B_i = NPV_t e^{r_f(t_T-t)} - \sum_{i=0}^{T-1} B_i \quad (2.5)$$

Given the certainty assumption, the borrowing requirement cash flows B_i are completely independent from the financing strategy chosen by the government. Thus, as a main result, it can be noted, that under certainty minimizing the NPV and with it the NFV of the debt portfolio (see equation 2.2) is equivalent to minimizing the borrowing costs.

2.4.3 Decisions under uncertainty and risk

So far the highly simplifying assumption of perfect certainty has been in place. No optimization is needed here, because only one outcome is possible in this case. Yet, the real world is characterized by uncertainty and risk. In specific, the cash flows Cf_i and B_i depend on the future development of macroeconomic variables (such as inflation, gross domestic product) and market risk factors (especially interest rates), which are uncertain and therefore subject to variability. For that reason, the optimal structure of the debt portfolio, which results in the lowest possible borrowing costs could only be identified in retrospect when the prices, interest rates and corresponding cash flows have become known, see Daube [2009, p. 79]. Therefore, the optimization of the debt portfolio as of date can only aim to identify the optimal long-term portfolio structure with respect to expected values and corresponding risk.

Under conditions of uncertainty we have to account for the fact that the forecasting process for cash flows is imperfect (subject to error). Future variables are therefore characterized by a probability distribution of possible outcomes.⁸⁰ According to Jorion [2007, p. 75] the amount of dispersion (or variability) of unexpected outcomes is a measure of the risk (or forecasting error) associated with it. The concept of the risk-adjusted discount rate is accepted as the general method for appraising projects under uncertainty. In this respect, Fama [1977] and Fama and French [1996] discuss the conditions, under which discounting the expected future payoffs with risk-adjusted discount rates is a theoretically correct procedure. It is also the method most frequently employed by practitioners in the corporate sector.⁸¹

In capital budgeting the risk-adjusted discount rate reflects the rate of return offered by a comparable investment opportunity in the capital market (known as the opportunity

⁷⁹Thus unrealized changes in the market value of the debt are not taken into account, see Risbjerg and Holmlund [2005, p. 50].

⁸⁰However, situations exist in which the probabilities of outcomes are not known. Therefore the economic literature distinguishes between unmeasurable uncertainty and measurable uncertainty, which is referred to as risk. As we only consider situations of measurable uncertainty, this separation of ‘uncertainty’ and ‘risk’, established by Knight [1921], is not of relevance in this context.

⁸¹Dayananda et al. [2002, pp. 114 - 181] provide a thorough overview on the capital budgeting methodology under uncertainty. See also Brealey et al. [2009, pp. 238 - 294], Ross et al. [2010, pp. 392 - 427] and Atrill and McLaney [1994, pp. 102 - 120].

Introduction of a New Conceptual Framework for
Government Debt Management
With a Special Emphasis on Modeling the Term
Structure Dynamics

Hubig, A.

2013, XXIV, 213 p. 45 illus., Softcover

ISBN: 978-3-658-00917-5