A Critical Analysis of the Technical Assumptions of the Standard Micro Portfolio Approach to Sovereign Debt Management

Hans J. Blommestein,

Anja Hubig

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Abstract

A CRITICAL ANALYSIS OF THE TECHNICAL ASSUMPTIONS OF THE STANDARD MICRO PORTFOLIO APPROACH TO SOVEREIGN DEBT MANAGEMENT

This paper examines the analytical underpinnings of the standard micro portfolio approach to public debt management (PDM) that aims at minimising 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-minimising) 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 (MP). 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 (referred to as effective borrowing costs) incorporates not only the cash flows of the debt portfolio itself, but also those related to primary borrowing requirements. The resulting broader cost measure includes therefore 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.

A CRITICAL ANALYSIS OF THE TECHNICAL ASSUMPTIONS OF THE STANDARD MICRO PORTFOLIO APPROACH TO SOVEREIGN DEBT MANAGEMENT

By Hans Blommestein[1] and Anja Hubig[2]

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[1]   Hans J. Blommestein is Head of the Public Debt Management and Bond Market Unit, OECD. The views expressed are personal ones and do not represent those of the institutions with which the author is affiliated. *Email address; hans.blommestein@oecd.org*

[2]   Corresponding author. *Email address:* anja.hubig@gmx.de. Anja Hubig is a Doctoral candidate at the School of Business and Economics at the Humboldt University of Berlin (Institute for Banking and Asset Markets).

A CRITICAL ANALYSIS OF THE TECHNICAL ASSUMPTIONS OF THE STANDARD MICRO PORTFOLIO APPROACH TO SOVEREIGN DEBT MANAGEMENT

1. Introduction

There is a consensus among OECD debt managers that the primary strategic objectives or functions of government debt management are[3]: (a) securing continuous (and easy) access to markets, while (b) minimising 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 public debt management (PDM), monetary policy (MP) 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), Blommestein and Turner (2011), 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. These developments, in turn, have changed significantly the policy environment for debt management offices (DMOs), central banks (CBs) and fiscal authorities (FA) [4]. The size of the balance sheets of CBs has been expanded significantly while their composition has been radically changed[5]. The use of unconventional monetary policy has created (potential) conflicts and new interactions between MP, PDM and fiscal policy (FP). 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. Several authors have used this perspective as basis for suggesting a revision of the conventional (micro portfolio) mandate to PDM, including Turner (2011), Hoogduin et al. (2011), 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 this context, 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[6] are indeed minimised subject to a stated preferred level of risk?

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[3] See for further details Blommestein (2002), Kreiner (2002) and other contributors in "Debt Management and Government Securities Markets in the 21st Century", OECD.

[4] PDM and fiscal policy are closely linked, both from an institutional point-of-view and from a policy perspective and [Blommestein and Turner (2011)].

[5] See 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.

[6] The concept of the cash-flow measure based on the standard borrowing costs of the sovereign liability portfolio associated with the standard micro portfolio approach differs from a wider measure referred to in this paper as *effective sovereign borrowing costs*. The latter concept is further explained in section 3 and the annex.

(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 technical key assumptions for the standard micro portfolio approach to public liability management to yield optimal (i.e. cost-minimising) 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[7].

The paper is structured as follows. Section 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 behaviour of private financial institutions guided by micro-economic principles. By comparing the micro portfolio approach to well-established asset management practices in section 3, we are in the position to deduce the two key technical assumptions of the cost and risk framework associated with the standard micro portfolio approach. In section 4, we closely examine each of these technical conditions. In doing so, we evaluate the implications of the financial-cum-sovereign debt crisis for the standard micro portfolio 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 of fiscal dominance[8] the standard micro portfolio approach does not yield optimal, cost-risk results. The final section 5 concludes and outlines the next steps in our research programme.

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 lowest cost subject to risk preferences). The organisation of public debt management has undergone major changes in the 1990s, reflecting the move to a micro portfolio approach to PDM.[9] Debt management operations have been delegated to separate operationally autonomous units (DMOs[10] -- Debt Management Offices) sometimes outside the

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[7]   As noted, this reflects a situation with challenges and tensions in sovereign debt markets, where policy makers are facing serious fiscal vulnerabilities, a rapid increase in sovereign risk and considerable uncertainty about future interest rates.

[8]   Characterised by critical public debt ratios, perceptions that the risk-free asset condition has been weakened as well as imperfect asset substitutability along the yield curve

[9]   The transformation process was accompanied by broad financial sector deregulation, product innovations (esp. derivatives) and growing demands by investors as well as rapidly increasing debt levels combined with a growing volatility in interest and exchanges rates, calling for a sophisticated portfolio based risk management, as explained by Blommestein and Turner (2011, pp. 8 - 11). See also Wheeler (2004, pp. 2 - 9).

Ministry of Finance (MoF), albeit subject to the policy responsibility of the MoF.[11] 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[12]. DMOs operate as professional and predictable market players sticking to basic market rules, thereby supporting liquid and transparent market for government securities.

As a result of this institutional set-up, an active support by PDM for broader macroeconomic objectives, such as was common in the 1950s and '60s and which entailed an active use of the debt portfolio structure in the conduct of macroeconomic policies, has lost ground.[13] 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 principles[14]. These principles are summarized as the strategic objective to "minimise longer-term borrowing costs at an acceptable level of risk".

It should be noted that the objectives "minimising 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.[15] 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 entails the need to manage a cost/risk trade-off in structuring the (optimal) debt portfolio.[16]

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

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[10]   The generic term DMO includes not only debt management entities that operate outside the MoF, but also debt management units which are a part of the MoF or a central bank, as noted by Kalderen and Blommestein (2002, p. 101).

[11]   A more comprehensive treatment of the transformation process, and also of the role and structure of DMOs is given by Kalderen and Blommestein (2002, pp. 109 - 133).

[12]   After all, this was one of the reasons for the change in the institutional set-up in the 1990s. See Kalderen and Blommestein (2002, p. 110) with further references.

[13]   Hain (2004, pp. 113 - 131) provides a historical overview of macroeconomic approaches to PDM (mostly in the 1950s and 1960s), which in particular involved the use of the maturity structure of government debt to influence market interest rates and the level of economic activity. Most notable are the studies of Simons (1944), Musgrave (1959), Rolph (1957) and Tobin (1963). See also Wolswijk and de Haan (2005, pp. 7 f.) with additional remarks on conventional macroeconomic debt management objectives (such as macroeconomic and deficit stabilisation as well as tax smoothing).

[14]   This is also reflected in the organisational structure of the DMO, resembling that of a private sector financial institution, including a front office and a back office and a middle office (in particular for the formulation of the debt strategy and risk management functions).

[15]   In altering the cost/risk profile of debt portfolios, DMOs also make use of interest rate swaps. These derivative instruments enable the government to optimise the risk structure of the debt portfolio structure, while simultaneously proceeding with a demand-driven issuance strategy focused on lowest possible borrowing costs [see, for example, Daube (2009, p. 79)].

[16]   See 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).

similarities with asset management (allocation) concepts.[17] Specifically, both the micro portfolio management of sovereign liabilities and the private asset (or investment) management require making decisions under conditions of uncertainty regarding:

(a) the (optimal) structure of a debt (or investment) portfolio, which involves

(b) the optimisation of the micro cost (or return)/risk relationship, by taking into account

(c) the existing portfolio (with liabilities or assets) and nothing else.

Point (c) 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 public debt management and fiscal policy, while the public debt management strategy is also functionally separated from monetary policy. Consequently, such an institutional set-up implies that public debt management is in principle *not* integrated into the conventional macro-economic framework. In section 4 we will discuss whether this is an appropriate approach.

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 public debt management, 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 relationship[18]). 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 a predefined benchmark portfolio[19] (reflecting the long-term cost and risk preference) as closely as possible. The PDM strategy is characterised by risk-aversion and diversification, thereby mirroring the spirit of risk optimisation in passive bond portfolio strategies. This usually involves also the implementation of a buy-and-hold strategy[20].

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

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[17] However, we will also show that there are fundamental *differences* between sovereign liability management and asset management.

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

[19] Most governments with well-developed financial markets, establish strategic portfolio benchmarks to guide the long-term management of their debt portfolio [Jensen and Risbjerg (2005, pp. 64 f.) and IMF and Worldbank (2001, p. 129)].

[20] A 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 [see, for example, Risbjerg and Holmlund (2005, p. 50) and Jensen and Risbjerg (2005, p. 64)].

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

(b) cannot maintain a risk-free position (a sovereign debt portfolio is always exposed to changes in interest rates[21] due to the need to undertake refinancing activities);

(c) requires the formulation of expectations about the evolution of interest rates (not implicit in current market prices) over a longer-term horizon.[22]

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).[23]

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, firmly based on the principles of portfolio theory[24], is primarily concerned with the micro optimisation of the portfolio structure based on the cost (return)/risk relationship. We will use this insight to identify the key technical assumptions of the standard micro portfolio approach to PDM.

Portfolio theory is associated with the following core assumptions:[25]

- Core assumption 1: Rational financial decision makers that act as risk-averse expected utility (or wealth) maximisers.

- Core assumption 2: Perfect or efficient capital markets implying perfectly competitive markets[26] that are frictionless[27].

Clearly, the first assumption can easily be applied to public sector decisions such as public debt management since they are also concerned with the allocation of scarce resources, thereby rationally weighing costs against benefits[28]. However, the second assumption cannot so easily be justified in the

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[21]   The possible implications of a more critical perception of sovereign risk by market participants and its impact on interest rates is excluded here. However, we come back to this particular point in section 4.2.

[22]   Otherwise it would not be possible to define or formulate an optimal long-term financing strategy (based on information from observed 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.

[23]   See for a comprehensive treatment of debt strategy simulations Risbjerg and Holmlund (2005). These authors discuss also the standard analytical framework for government debt and risk management.

[24]   See for a similar view Jensen and Risbjerg (2005, p. 66).

[25]   For a rigorous treatment of these assumptions, see Fama, 1972, esp. pp. 189 – 214 (expected utility maximization) and p. 21 (notion of perfect or efficient capital markets).

[26]   Where the prices of securities contain all available information while they are taken as given by buyers, sellers and issuers of securities.

[27]   This in turn implies infinitely divisible securities, no transaction costs or taxes, while information is costless and available to everybody.

[28]   See, for example, Fuguitt and Wilcox (1999, esp. pp. 35 - 42) who provide a comprehensive treatment of cost-benefit analysis for public sector decision makers.

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 the next section.

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 fiscal policy is functionally separated from public debt management. This implies that the key optimisation parameters only refer to the outstanding debt portfolio. The OECD Borrowing Outlook[29] makes a policy distinction between *funding strategy* and *borrowing requirements*. The total central government marketable gross borrowing needs are calculated on the basis of budget deficits (the outcome of fiscal policy decisions that determine the primary borrowing needs) and redemptions. 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.

In sum, total borrowing requirements, and the associated funding strategy, are in part independently determined via the fiscal strategy of the government. In other words, they are in part exogenous for DMOs. For example, the funding strategy of DMOs may be informed by the central government's preferences to enhance fiscal resilience by seeking to mitigate refinancing and rollover risk[30]. However, in particular by treating the 'primary budget balance' as exogenous, the standard micro portfolio approach to PDM implies that the interactions between the debt portfolio on the one hand, and the *budgetary position*[31] on the other, are irrelevant for the standard micro portfolio optimisation framework.

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

(1) 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).

(2) Technical assumption 2: the budgetary position and the debt portfolio are statistically independent from each other (zero dependency or correlation).

These 2 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, as explained in detail in the annex. 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.

More specifically, our analysis implies that cost-risk optimality (in the portfolio theoretical sense) can only be achieved if we broaden the cost-risk perspective of the standard micro portfolio approach by including not only the cash flows associated with the debt portfolio itself, *but also those related to primary borrowing requirements*. In this way, a direct link is established between the debt portfolio (with its composition determined by the underlying funding strategy) and the government's capacity to service it via

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[29] See OECD Sovereign Borrowing Outlook 2012 (forthcoming).
[30] See Annex A of OECD Sovereign Borrowing Outlook 2012.

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

future budget surpluses. The main objective can then be formulated as *'to minimise the net burden of the debt portfolio'* (as measured by the present value of the net fiscal position[32]) given a desired level of risk, via the choice of the funding strategy of DMOs. This adjusted funding perspective corresponds to the *'minimisation of the effective interest costs'* associated with the government's net fiscal position.[33] Clearly, this total effective borrowing cost measure is broader than the standard borrowing cost measure[34] because, as explained, it also captures the (potential) impact of the DMO funding strategy on the primary borrowing requirements of the budgetary position over the planning horizon. This in turn implies that the standard micro portfolio approach represents a special case of a more general framework based on the total effective borrowing costs associated with the inter-temporal fiscal position.

4. Empirical validity of technical assumptions of the standard micro portfolio approach

After having identified the two key technical conditions supporting the standard micro portfolio approach, we will analyse in this section their empirical validity. To that end, two general situations will be explored. In *world situation one* (**World 1** for short) we have in mind the 'normal'[35] circumstances such as those that existed in the two decades or so prior to the 2008-2009 crisis: low volatility and strong liquidity in financial markets (including government securities markets), primary dealers with strong balance sheets and excellent capacity to make markets, relatively low borrowing costs, moderate government borrowing requirements, low sovereign risk[36], perfect or high asset substitutability across maturities, and low or moderate government debt levels. The first key question can then be formulated as follows: constitutes the standard portfolio approach with its criterion of "minimising the long-term borrowing costs subject to risk" (using the cash flows associated with the portfolio of existing and planned government liabilities) an adequate basis for the sovereign debt and funding strategy in World 1? Special attention will be paid in this context to the practical implications for DMOs of the assumption of exogenous *primary* borrowing requirements.

World situation two (**World 2** for short) represents crisis conditions, in particular serious fiscal vulnerabilities, a perceived increase in sovereign risk and considerable uncertainty about future interest rates.[37] Another feature of the current crisis situation are the (potential) implications (for the underpinning

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[32]   The *net fiscal position of the government* equals the net present value (NPV) of *all* cash flows. This means that we take into account the cash flows of both the existing (and the planned or expected) future sovereign debt portfolio and those associated with the primary borrowing requirements. Note that the portfolio of government liabilities does not only include the stock with already issued securities, but also those that will be issued in the future (i.e. over the "life time" of this portfolio). See for further details the annex.

[33]   The mathematical derivation of this and also the standard cost measure is given in the annex.

[34]   As noted, this is the measure associated with the standard micro portfolio approach (based on the cash flows of the debt portfolio itself).

[35]   This statement is not as straightforward as it seems. It has been argued that these circumstances were 'not normal' (therefore the use of expressions such as the Great Moderation) and that, indeed, they laid the basis for asset bubbles and macroeconomic imbalances that ultimately triggered the Great Crash [see Blommestein, Hoogduin and Peeters (2009); Blommestein (2010)]. We will ignore this complication and simply assume that the two decades or so prior to the crisis represent the normal conditions for PDM.

[36]   We refer here to perceptions of low (or high) sovereign risk without going into the complications associated with the fact that there are quite different views on what exactly sovereign risk is (see Blommestein, H. J., Guzzo, V., Holland, A., Mu, Y., 2010).

[37]   Denoted as *fiscal dominance* in Turner (2011), Blommestein and Turner (2011).

of the standard micro portfolio approach) of new and complex interactions between public debt management (PDM), fiscal policy, monetary policy (MP) and financial instability with (ultra-)high borrowing costs.

4.1 Evaluation of assumptions under normal (non-crisis) conditions (World 1)

The normal conditions of World 1 are characterised by low or moderate government deficits and debt levels (implying sustainable debt levels and perceptions of low sovereign risk) and well-functioning liquid debt markets with efficient access by DMOs to borrow funds at 'normal' ('risk free') costs. Under World 1 conditions public debt managers – although they (and central bankers) have potentially substantial market power – can be treated as price-takers. However, this presupposes a specific institutional set-up of DMOs and central banks. In many countries, the core of this institutional arrangement consists of institutionally independent central banks with strong anti-inflation mandates and operationally autonomous DMOs.

It was further assumed that potential policy conflicts between monetary policy and sovereign debt management could be avoided by following two "separability principles"[38]:

- Central banks should not operate in the markets for long-dated government debt, but should limit their operations to the bills market.

- Government debt managers should be guided by a micro portfolio approach based on cost-minimisation mandates, while keeping the issuance of short-dated debt to a prudent level.

In World 1, these institutional arrangements and principles conveniently simplified the lives of policymakers in central banks and debt management offices. More importantly, central banks and DMOs were judged as being fairly successful in executing their respective mandates. Moreover, they allowed each institution to be held accountable for their distinct mandates. And they provided considerable insulation from short-term political pressures. In such an environment, government debt managers do not (need to) mobilise their power to move markets. Instead, DMOs act as professional and fair market players (largely by following the market rules of private financial institutions). In addition, the direct interactions between DMOs and central banks (setting monetary policy conditions and controlling interest rates[39]), are minimal.

Hence, in the non-crisis conditions of World 1, public debt management activities can be expected to have a minimal impact on market prices (and, hence, on the yield curve derived from them). Moreover, given exogenous primary budget balances (known with certainty), the first technical precondition that actions of the government have no impact on the yield curve, is certainly met in the standard micro portfolio approach. The dependence between technical conditions 1 and 2 implies that also the second condition of zero correlation between the budgetary and the debt position is valid[40]. Hence, in World 1, the standard portfolio approach minimises longer-term borrowing costs (being equivalent to minimising the NPV[41] of the debt portfolio) and therefore provides in principle an appropriate basis for the sovereign funding strategy.

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[38] See Blommestein and Turner (2011) for a comprehensive discussion

[39] In World 1, short-dated and long-dated instruments are close substitutes and control of the overnight interest rate is sufficient for CBs to affect the near end of the yield curve (Blommestein and Turner, 2011).

[40] This feature follows directly from treating the primary borrowing requirements as an exogenous variable in the strategic framework for funding and debt management.

[41] NPV = net present value.

4.2 Evaluation of technical assumptions under crisis conditions (World 2)

The previous section shows that in normal circumstances the interactions between the budgetary and the debt positions are assumed to be negligible. This assumption is clearly not valid in crisis periods with highly volatile government securities markets with fiscal dominance periods and sovereign balance sheets very vulnerable for shocks. In that case, a sovereign asset-liability management (SALM) approach becomes more important. Put differently, the more likely that the structure of the government debt portfolio may help in providing an effective protection of the sovereign balance sheet against possible shocks, the more important an integrated management of sovereign assets and liabilities becomes. Moreover, SALM[42] is closely related to (the macro-economic objectives of) tax smoothing and budget stabilisation[43]. But even outside the framework of an integrated management of the balance sheet it has to be acknowledged that both the budget and sovereign debt position are basically driven by the same macroeconomic variables (inflation, GDP and economic growth). This perspective put pressure on maintaining the zero-correlation assumption even in periods that cannot be classified as extreme crisis periods[44].

World 2 conditions are associated with a structurally reshaped monetary, financial and fiscal environment, notably fiscal dominance characterised by high debt levels, a more critical perception of the underlying sovereign risk (leading to a weakening / loss of the risk free rate assumption) and, associated with these features, greater uncertainty about the (future) development of interest rates. In World 2, the actions of government debt managers may become a critical element in the overall conduct of macro-economic policy[45]. For these reasons we will take a closer look how World 2 conditions might affect the key technical assumptions underlying the standard micro portfolio approach.

First, the price-taker assumption is unlikely to hold in World 2, although price-making may not be the intention of debt managers. However, under less liquid and highly volatile market conditions, market operations by the DMO (a very large player vis-à-vis the market) may lead to *de facto* shifts in markets[46]. Moreover, also strategic decisions (in particular about the portion of short-term vs. long-term borrowing amounts) may have a significant impact on relative market prices of government securities and,

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[42]   SALM is concerned with the management of the overall risk exposure of the entire sovereign   balance sheet, comprising financial assets (mainly tax-paying capacities) and financial liabilities   (government debt portfolio). See also Risbjerg and Holmlund (2005, pp. 42 f.) and Blommestein   and Koc (2007).

[43]   These theories are focused on lowering the variability of the budget balance, thereby avoiding fluctuations in tax rates in responses to economic developments. Such a policy framework is   welfare-improving because changes in tax rates may create economic distortions. See the early   contributions   by   Barro (1979) and Missale (1997). More recent contributions include Missale   (2011), Bernaschi et al. (2009), Faraglia et al. (2008,2010), Lustig et al. (2008), Nosbusch (2008),   Bacchiocci   and   Missale   (2005), Buera and Nicolini (2004), Barro (2003), Angeletos (2002).

[44]   Nevertheless, treating the primary budget balance as an exogenous variable known with certainty may be a good starting point for debt strategy simulations under fairly normal market conditions. As noted by Risbjerg und Holmlund (2005, p. 48), a general lesson from building simulations models is to start out simple and gradually expand the model (e.g. allowing for the stochastic modelling of the budget balance). Such an approach, however, is certainly not appropriate in World 2.

[45]   This is the reason why several authors suggest a revision of the conventional or standard micro portfolio approach, including Hoogduin et al. (2011), Surti et al. (2010), Goodhart (2010) and Blommestein   and Turner (2011).

[46]   Also the accumulated (borrowing) effects of DMOs are likely to contribute to at times significant market moves.

as a result, influence the shape of the yield curve[47]. This also applies to debt levels having reached a critical limit (e. g. 90% of GDP and above[48]), which could put an upward pressure on interest rates (due to increased supply and crowding-out effects) and a downward pressure on economic growth.

In such an environment – and in spite of the separation of mandates – public debt management and monetary policy may start to have a direct influence on each other.[49] The main reasons are decreased substitutability along the yield curve and the existence of illiquid and dysfunctional market segments, which may hamper the monetary transmission process. As a consequence, the central bank's use of the overnight rate to control the shape of the yield curve in order to influence economic activity becomes less effective.[50] At the same time, purchases and sales of government bonds by CBs become more effective. However, by shifting their emphasis from the short end to the longer-term segment of the yield curve, the monetary authorities inevitably interact directly with government debt management decisions. These operations also change the maturity of government bonds in the hands of the public.[51] DMOs (and the fiscal authorities) need therefore to have greater awareness that their operations may also affect economic activity through new and at times complex interdependencies with monetary policy measures.[52]

Finally, the perception that sovereign risk has increased and the associated weakening of the 'safe (or risk free) asset' assumption has resulted at times in a significant credit risk premium implicit in the yield curve for government securities. Through this new channel, actual and expected changes in sovereign liabilities (or changes in fiscal policy) can directly affect the term structure of interest rates. This may also entail contagion to third countries, in particular among countries within a monetary union[53]. Furthermore, changes in perceptions about sovereign risk may be transferred to the holders of the government debt within and across borders (in particular by affecting the balance sheets of financial institutions[54]).

This implies that the interactions between the debt portfolio and the budgetary position need to be incorporated in the analytical framework of public debt management. Put differently, the second technical assumption needs to be dropped. The previously described link between fiscal policy (reflected in the primary budget balance) and the development of interest rates needs to be taken into consideration within the simulation framework of the debt strategy (for example, via specific macro-economic /fiscal scenarios). Moreover, high debt levels (e.g. above the critical level of 90%) directly feed back into the government's

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[47]   See Blommestein and Turner (2011, pp. 16).

[48]   Based on an empirical study, incorporating data on 44 countries and covering the time period 1946 to 2009, Reinhart and Rogoff (2010, p. 577) demonstrate that across both advanced countries and emerging markets, high debt/GDP levels (90% and above) are associated with considerably lower growth. See also the more recent BIS study by Cecchetti et al. (2011).

[49]   See Blommestein and Turner Turner (2011, pp. 19 - 30) and also Hoogduin et al. (2010, pp. 15 - 17) for additional detail.

[50]   For the same reasons, public debt management operations become more effective. In this context, the increasing use of short-term borrowing by government debt managers to secure additional funding during the global financial crisis is viewed critically. See, for example, Blommestein and Turner (2011, pp. 26 f.) and Hoogduin et al. (2010, p. 2). Short-term issuance has the same effect as monetary expansion, and therefore might complicate the control of the policy rate by the monetary authorities.

[51]   As argued by Turner (2011, pp. 5 f).

[52]   See Blommestein and Turner (2011, pp. 28 - 30).

[53]   For example, rating changes in country X may have a systemic impact on other countries, even when the latter countries are not formally downgraded; for example, in the form of higher funding rates.

[54]   See also Hoogduin et al. (2010, pp. 14 f).

fiscal position due to increasing debt servicing costs. In extreme cases, this chain of events may lead to a negative debt-deficit spiral. To prevent these negative feedback situations, the government needs to maintain control over the risks associated with the entire balance sheet. This can be accomplished by using a SALM approach, because, as noted, in this way policies can be identified to insulate in part or fully the fiscal position against supply and demand shocks.

In sum, the two key technical assumptions underpinning the standard micro portfolio approach to public debt management do not hold in World 2. Micro-optimisation of cost and risk using the standard approach would result in funding decisions that are suboptimal. We believe that the following World 2 conditions will remain in force for a considerable period of time: (a) high debt ratios, (b) perceptions of elevated sovereign risk levels, and related to this, (c) greater uncertainty about future interest rates, accompanied by critical interactions between public debt management and monetary policy.

5. Concluding remarks

Although the standard micro portfolio approach to public debt management has worked well for a long time, rapidly changing conditions associated with the current period of fiscal dominance has prompted a major re-think of the underlying framework. Our paper draws the following main conclusions:

a) The widespread use of the standard micro portfolio approach is associated with government debt management having become a distinct discipline, operationally independent, and guided by transparent micro-economic principles and rules, which seeks to ensure that the government is able to secure the required funding at lowest possible costs subject to a preferred or acceptable level of risk. The standard approach is well-anchored in the principles of portfolio theory.

b) The underlying core objective to "minimise longer-term (cash-flow based) borrowing costs at an acceptable level of risk" leads to optimal financing decisions, provided the following two key technical assumptions hold:

  1. Actions by the government (including the execution of its borrowing and funding programme) have no impact on market prices of government securities and the term structure of interest rates derived from them (price-taker assumption) and

  2. The budgetary and debt positions are statistically independent from each other (zero dependence or correlation)

c) The identification of these two key technical assumptions allows us to make a distinction between:

World 1: Normal (non-crisis) period. Minimising standard cost measures (i.e. cash-flows based on the borrowing costs of the sovereign liability portfolio as in the standard micro portfolio approach) yields optimal results.

World 2: Crisis period (fiscal dominance). Minimising standard cost measures leads to sub-optimal results. More specifically, violations of assumptions 1 and 2 are caused by critical public debt ratios, perceptions that the risk-free asset condition has been weakened as well as imperfect substitutability along the yield curve. Especially the weakening and (partial) loss of the risk-free asset condition has profound

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implications. In reponse, we suggest to minimise a broader cost measure so as to achieve optimal results during crisis periods.

What are the practical implications of these conclusions for PDM? The answer is less straightforward than one would perhaps think. On the one hand, it can be noted that the standard borrowing cost measure can be directly influenced by the debt manager through the choice of the funding strategy. On the other hand, we have shown that when World 2 conditions determine the borrowing environment, then we may need a broader cost objective for ensuring optimal funding decisions[55]. However, the adoption of a broader borrowing framework may also have implications for the current institutional set-up. Clearly, the pros and cons of any institutional change need to be carefully examined so as to avoid implementation decisions that may carry too much risk. We will assess carefully these institutional issues in follow-up research.

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[55]   It was also shown that the cost/risk objective of the standard micro portfolio approach is nested within this broader borrowing framework that uses a cost concept that ensures optimal funding decisions in World 2.

Annex: Deduction of the key technical assumptions that underpin the standard micro portfolio approach

Terms and definitions

Our analytical framework is based on the projection of *all* future cash flows associated with the debt portfolio over the "life time" of this portfolio[56]. This implies that we do not only include the cash flows of the government debt securities portfolio itself, but also take into account the related cash flows of primary borrowing requirements of the sovereign (which comprise all other public expenditures and revenues (excluding debt servicing payments)[57]. We assume (a) a finite time horizon or interval $[t_0, t_T]$ for the debt portfolio and (b) a starting date of the debt portfolio that coincides with the beginning of the evaluation date (t_0); this means that there are no cash flows to be taken into account before the evaluation date. Key variables will be defined as follows:

- t_0 = starting date of the debt portfolio

- t_T = end of the "lifetime" of the debt portfolio (represents the point in time where 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 time horizon at time t_T

- C = accumulated borrowing costs over the time interval $[t_0, t_T]$

- $\{Cf_0, \ldots, Cf_T\}$ = cash flows of the debt securities portfolio over the time interval $[t_0, t_T]$, including 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.

- $\{B_0, \ldots, B_{T-1}\}$ = 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[58].

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[56]   This assumption implies that all government debt will be completely repaid. This assumption can be relaxed by allowing for a constant debt level from some point of time in the future.

[57]   This analytical 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 financing framework is also referred to as *capital budgeting* and deals with the allocation of internal and external resources among potential investment projects with a long-term time-horizon.

[58]   Note that only the borrowing requirement cash flows 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 principal and accumulated interest) at the end of the horizon t_T

- r_f = *deterministic* 'risk-free' discount rate; only applicable under conditions of certainty (the given rate at which an entity can freely borrow or, alternatively, invest)

- $z_i = z(t, t_i - t)$ = *stochastic* interest rate for the time period $[t, t_i]$ comparable in its risk characteristics to the corresponding zero-coupon interest rate Z_i for that time period

- $E_t(\ )$ = expectation operator conditional to the information set available at time t.

Decisions under uncertainty and 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 characterised by a probability distribution with possible outcomes. In this framework the dispersion (or variability) of unexpected outcomes functions as a measure of risk (forecasting error)[59]. Assuming that the underlying *rate of return* z_i[60] evolves in a stochastic (non-deterministic) fashion through time, the expected net present value (**NPV**) can then be written as:

$$E_t(NPV_t) = E_t\left(\sum_{i=0}^{T} Cf_i\ e^{-z_i(t_i - t)} + \sum_{i=0}^{T-1} B_i\ e^{-z_i(t_i - t)}\right)$$

(1)

Government debt management is basically concerned with the financial burden (or cost) of the debt portfolio for future generations. For this 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 government debt policy decisions. The **NFV** can be obtained by compounding the **NPV** of this portfolio over the time interval $[t, t_T]$ at the appropriate discount rate (that is, the stochastic interest rate z_T over the time interval $[t, t_T]$). The expected **NFV** can then be expressed as follows[61]:

$$E_t(NFV_T) = E_t\left(NPV_t\ e^{z_T(t_T - t)}\right)$$

(2)

The expected net future value $E_t(NFV_T)$ represents the expected amount of cash needed at time t_T to repay the debt (including principal plus accumulated interest). This will be referred to as the *expected*

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[59]   See Jorion (2007, p. 75).

[60]   This rate of return will be denoted as the interest rate z_i for the time period $[t, t_i]$ (with $z_i = z(t, \tau_i)$ and $\tau_i = t_i - t$). It essentially reflects the concept of the yield curve, which captures the relationship between the rate of return $Z_i = Z(t, \tau_i)$ (i.e. expected by the market on a zero-coupon bond held until maturity) and its related time to maturity τ_i.

[61]   In the corporate finance 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.).

final debt repayment cash flow, denoted by $E_t(R_T)$. Now we are in the position to deduce the following key *debt sustainability condition*[62]:

$$0 = E_t(NFV_T) + E_t(R_T) \quad \Rightarrow \quad -E_t(R_T) = E_t(NFV_T) = E_t\left(NPV_t \; e^{r_f(t_T - t)}\right) \tag{3}$$

We shall use the NFV of the debt portfolio to formulate a cash-flow based cost measure. First, the NFV is decomposed into two components[63]:

$$NFV_T = \underbrace{\text{Principal}}_{\text{sum of borrowing requirements}} + \underbrace{\text{Accumulated Interest}}_{\text{borrowing costs}} \tag{4}$$

Second, the interest of the debt portfolio accumulated over the period $[t, t_T]$ will be referred to as borrowing costs and denoted by $C(.)$. *Expected borrowing costs* can then be expressed as:

$$E_t(C) = E_t\left(NFV_T - \sum_{i=0}^{T-1} B_i\right) = E_t\left(NPV_t \; e^{z_T(t_T - t)} - \sum_{i=0}^{T-1} B_i\right) \tag{5}$$

We can conclude from the equations (1), (2) and (5) that the **NPV**, the **NFV** and expected borrowing cost criterion C(.) do *not* necessarily yield the same results. The implications of this conclusion for the conceptual underpinning of the standard cost concept associated with the standard micro portfolio approach are further explored below.

Limitations of the standard micro portfolio approach

As explained in section 3, the standard micro portfolio approach is based on a straightforward application of cost (return in the case of assets) and risk measures from portfolio theory. These measures, however, are calculated from present value figures and do *not* represent cash-flow based costs (or revenues). Since the standard micro portfolio approach to PDM involves the minimisation of cash-flow based borrowing costs (subject to risk constraints), **NPV** (equation 1) and the standard cost criterion needs to be equivalent in order for the sovereign debt strategy to be entirely consistent with the underpinnings of portfolio theory. For this to be the case, we need, first, to place the expectations operator E_t before each variable. Secondly, the cash flows Cf_i of the debt securities portfolio and the borrowing requirement cash flows B_i have to be statistically independent from each other (zero dependence or correlation). Equation (2) can then be rewritten as:

$$E_t(NFV_T) = E_t\left(NPV_t \; e^{\tilde{z}_T(t_T - t)}\right) \quad \text{with } e^{\tilde{z}_T(t_T - t)} = E_t\left(e^{z_T(t_T - t)}\right) \tag{6}$$

Equation (6) implies that the expected **NFV** equals the expected **NPV** compounded at the deterministic interest rate $\tilde{z}_T$ for the time period $[t, t_T]$ (with $\tilde{z}_T = \tilde{z}(t, \tau_T)$ and $\tau_T = t_T - t$). This implies that the decision measures **NPV** and **NFV** are also equivalent under uncertainty. It should be emphasised, though, that this condition only holds if the expected compound factor $E_t\left(e^{z_T(t_T - t)}\right)$ depends solely on the

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[62] Equation (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).

[63] See, for example, Bierman und Smidt, (1988, p. 19).

expectations for the term structure of the (stochastic) interest rates z_i and therefore becomes statistically conditional on that information. This in turn implies also that the budgetary and tax decisions of the sovereign (fiscal policy for short) have no impact on the term structure of interest rates. Fiscal policy decisions act as exogenous input for the public debt manager in the form of both cash flow- based borrowing requirements B_i and cash flows Cf_i of the debt securities portfolio (determined by the funding strategy). In other words, it is assumed that B_i and Cf_i have no impact on the term structure of interest rates (i.e. technical assumption 1 in section 3). Only in that case, the expected compound factor behaves deterministically with respect to that conditional expectation, so that $E_t\left(e^{z_T(t_T-t)}\right)=e^{\bar{z}_T(t_T-t)}$.

A similar reasoning applies with respect to the expected borrowing costs $E_t(C)$ in equation (5). The *expected borrowing costs* equation (5) can then be rewritten as:

$$E_t(C)= E_t(NPV_t)\, e^{\bar{z}_T(t_T-t)} - \underbrace{\sum_{i=0}^{T-1} E_t(B_i)}_{\text{independent of the funding strategy}} \tag{7}$$

Provided that the cash flows B_i and Cf_i (determined by the funding strategy) are statistically independent from each other (zero correlation, see technical assumption 2 in section 3), the second term $\sum_{i=0}^{T-1} E_t(B_i)$ in (9) is equal for all funding strategies.

In sum, when both technical assumptions hold, min expected **NPV** and min expected **NFV** are equivalent to minimising the expected cash-flow based borrowing costs of the standard micro portfolio approach.

Effective borrowing costs

We concluded that in **World 2** (a crisis period with fiscal dominance), the minimisation of standard cost measures (i.e. cash-flows solely based on the borrowing costs of the sovereign liability portfolio) leads to sub-optimal results. Instead, we suggest to minimise a broader cost measure so as to achieve optimal results. This means that not only the cash flows of the debt portfolio itself are incorporated, but also the related cash flow-based borrowing requirements associated with all other public expenditures and revenues (summed up in the primary budget balance). The resulting broadened cost measure – referred to as *effective borrowing costs* – is equivalent to the **NPV** measure (see equation (1)) and can then be expressed as follows:

$$E_t\left(C^{eff}\right)= E_t\left(\underbrace{NPV_t\, e^{z_T(t_T-t)}}_{NFV_T} - NPV_t \right) \tag{8}$$

Where $E_t\left(C^{eff}\right)$ denotes the expected effective borrowing costs accumulated over the time period $[t,t_T]$. It can be seen from equation (8), that our broadened borrowing cost measure represents the effective interest costs associated with the net fiscal position (i.e., the net debt position as measured by the **NPV**). Hence, the proposed new cost measure captures also the impact of the funding strategy on the budget. In other words, by focusing on the net fiscal position, we establish a direct link between the debt portfolio and the budget.

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