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# A quantitative model for structured microfinance

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ABSTRACT

We develop a quantitative model for structured microfinance instruments, which are regarded as an important means for refinancing microfinance institutions. The quantitative credit risk model presented takes into account the peculiarities of microfinance institutions and can be used for pricing purposes and analyzing the risk inherence in different tranches of a structured microfinance investment vehicle. Additionally, we introduce an innovative pricing methodology that abstains from using the martingale probability measure. This approach is more appropriate for illiquid securitized debt of microfinance institutions. In a realistic application we check the robustness and demonstrate the advantages of the model presented.



## 1. Introduction

While a few years ago microcredit was mainly seen as a means to reduce poverty and to boost the economies of developing countries, it has now become an increasingly attractive investment opportunity. As Lensink, Galema, and Spierdijk (2011) point out, adding microfinance funds to a portfolio consisting of international bonds and stocks yields diversification gains. Furthermore, investors might profit from an additional social return, like proposed by Tulchin (2003) and Ledgerwood (2000). The investment instruments at hand are stocks, bonds, microfinance investment funds (MFIFs) and microfinance collateralized debt obligations (MiCDOs) and other more general forms of structured investment products (see Dorfleitner, Leidl, & Priberny, 2011, for an overview). A prominent example for such a product is the European Fund for Southeast Europe (EFSE), which is an MFIF with applied structured elements, e.g. a hierarchical cash flow distributions scheme. This paper contributes to the methodology of pricing such instruments and analyzing their risk.

Taxonomies of structured microfinance vary: according to Byström (2007) structured microfinance is defined as direct and indirect securitization. Direct refers to the securitization of a microcredit portfolio by the microfinance institution (MFI) itself. An example, which is referred to by Hüttenrauch and Schneider (2008), is the “BRAC Micro Credit Securitization Series I Trust” by the Bangladeshian MFI BRAC. As opposed to this, indirect securitization means the securitization of a portfolio of debt instruments issued by MFIs. The indirect transactions are more frequent than the direct ones. One example for the indirect type is the “BlueOrchard Microfinance Securities I”, which was the first MiCDO ever issued. However, using the example of the EFSE, Glaubitt, Hagen, Feist, and Beck (2008) show how structured elements can also be applied to MFIFs. This supports the broader definition by Jobst (2011), who identifies three forms of structured microfinance, namely MFIFs, direct securitization or local issuance, and indirect securitization or external issuance. We adhere to this definition and incorporate the three forms in the term “structured microfinance investment vehicle” (SMIV). In any case the instrument has a CDO-type cash flow structure, implying that the SMIV holds a pool of debt instruments on the asset side of the balance sheet and several tranches on the liability side. The accruing cash flows of the pool are

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distributed to the investors, i.e. the holders of the tranches, according to an a priori fixed scheme with regard to the different seniorities of the tranches, ranging from the highest ranked senior tranche to equity at the bottom. The first losses in the asset pool affect the equity tranche. After this tranche is eliminated the other tranches are hit.

Structured microfinance entails several advantages often cited in the literature in the context of MiCDOs. According to Glaubitt et al. (2008) structured microfinance can reduce regulatory capital, as MFIs securitize parts of their loan portfolio. However, this holds true only for direct securitizations. Furthermore, MFIs can profit from improved access to capital markets. Compared to commercial bonds, the volume of MFI bond issues is considerably smaller, which makes it more difficult for MFIs to refinance themselves by utilizing the international capital markets. Pooling the smaller liabilities of MFIs is a means to reach a customary size. Another aspect mentioned by Glaubitt et al. (2008) is that MFIs are often rated lower than institutions of equal credit risk in developed countries due to higher country specific risks, which makes MFI bonds less interesting for institutional investors. By participating in a SMIV, the MFI can separate its credit risk from the country risk and thereby also attain improved access to capital markets. This improvement allows MFIs to diversify their founding resources (see Glaubitt et al., 2008). This is furthermore supported by Hartarska and Nadolnyak (2007) who ascertain that a higher number of funding sources contributes to the sustainability of MFIs. According to Watson (2009), MFIs were financed by middle- to long-term debt with an average share of 36.2% in 2009. If this part of the debt is refinanced only by a few lenders, the MFIs can be affected by serious financial distress if one of these is not willing to endure their engagement. Glaubitt et al. (2008) suggest that MFIs can acquire a good reputation on international capital markets by joining MiCDOs issued by recognized financial institutions. Due to the tranching process, different risk-return profiles can be created from a relatively homogeneous asset pool. This helps to attract new investors, whose individual risk preferences can be met more easily (see Byström, 2008). According to Byström (2008), structured microfinance also helps to overcome the asymmetric information problem introduced by Akerlof (1970) as the “lemon phenomenon”, which is particularly evident in microfinance. Since publicly available information is very limited for individual investors, they in turn demand additional premia for compensation. This problem can be mitigated if the better-informed issuer invests in the equity tranche and hence signals that he is willing to take the most risky part himself.

All of these advantages have contributed to the development that made structured products, in particular MiCDOs, the preferred investment vehicle in microfinance in the years 2006–2008 (see Jobst, 2008). While in commercial banking the issuing of CDOs did become impossible in the course of the financial crisis, Dorfleitner et al. (2011) reveal, in a survey addressed to relevant world-wide experts on investing in microfinance, that SMIVs (including structured MFIFs) are still regarded as a very important means for refinancing microcredit lending. Further evidence for this development can be found when examining four Indian MFI securitization deals in the year 2009 (see Matsukawa, 2010).

While the possible advantages of SMIVs have been widely discussed in the literature, it is yet to be examined, in which way credit risk models, which exist in commercial banking, can be adapted for analyzing SMIVs, which adoptions are necessary and how SMIV tranches can be priced explicitly. With this paper we fill this important gap.

In Section 2 we introduce a quantitative credit risk model for MFI debt instruments, which can be used for risk analysis of SMIV tranches by performing MC simulation. We furthermore introduce an innovative pricing approach for illiquid microfinance debt titles. Section 3 applies this model to a realistic SMIV, consisting of an MFI bond portfolio. Section 4 concludes the paper.

## 2. The model

Default risk modeling of a microloan portfolio should generally consider the peculiarities of microloans, namely the small nominal amounts for each loan, the aim of stimulating productive activities and the often-missing collateral. Further properties that are observed empirically are high interest rates, low default rates, a greater number of loans assigned to women than men and lower default rates for female borrowers. An empirical analysis of microfinance interest rates and their determinants has been conducted by Dorfleitner, Leidl, Priberny, and von Mosch (2012).

However, since most of the SMIVs like MFIFs and MiCDOs are indirect investment instruments, we restrict our quantitative model to a portfolio of debt instruments of MFIs. Therefore, the above-mentioned properties are only of indirect importance and we rather have to capture peculiarities of MFIs as obligors, namely the low correlation with worldwide stock markets (see Krauss & Walter, 2009), a large variety in profitability, and a possible geographical dependence of MFIs active in the same region induced for example by climatic risks (see Churchill & Frankiewicz, 2006). Furthermore, MFI debt titles are almost exclusively traded over the counter and therefore particularly illiquid. In contrast to commercial banks MFIs can vary in the legal status with different regulatory frameworks. Tchakoute-Tchuigoua (2010) perform an analysis of performance and social efficiency of MFIs regarding their legal status for an analysis of performance and social efficiency of MFIs regarding their legal status. In our model we capture these properties.

The model that we develop in this section serves the purpose of being the basis for Monte Carlo simulations, i.e. applying the model for risk analysis or the valuation of tranches is achieved through simulating cash flows of the structured instrument according to the model.

First we develop a model for the dependent default times of the SMIV's asset pool and then treat the structured instruments' cash flows in Section 2.2. In Section 2.3 we show how the model can be used for risk analysis of SMIV tranches via MC simulation. Based on this we introduce an innovative approach that uses risk analysis for pricing SMIV tranches instead of the risk-neutral pricing methodologies in Section 2.4, which are not suitable for illiquid MFI debt titles.

### 2.1. Modeling dependent default times

We start with a set of $n$ obligors (MFIs), whose debt instruments (loans or bonds), which we refer to as the asset pool, are held by the structured instrument. All cash flows originating from the asset pool are distributed to the tranche owners via an a priori fixed distribution scheme following the so-called waterfall principle. As the cash flows of the asset pool in turn depend only on the possible defaults of the obligors, the default times of the asset pool and their dependency structure are crucial for an exact description of cash flows received by the tranche owners.

The model can be summarized as follows. The obligor-specific PD term structure captures the probability of default over time. We denote the PD term structure of obligor $i$ by $t \mapsto PD_i(t)$ with $i = 1, \ldots, n$. This function captures the probability that obligor $i$ defaults within the given time interval $[0, t]$. To be exact, we define the probability space $(\Omega, \mathcal{A}, P)$, with $\Omega = ([0, \infty[ \times [0, 1])^n$ describing the default times and the losses given default (LGDs) of the $n$ obligors,