A STOCHASTIC PROGRAMMING FRAMEWORK FOR FINANCIAL INTERMEDIARIES LIQUIDITY MANAGEMENT IN SOUTH AFRICA

WILBERT CHAGWIZA

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ADVISORS:

PROFESSOR W. GARIRA

DOCTOR S. MOYO

DEPARTMENT OF MATHEMATICS AND APPLIED MATHEMATICS

SCHOOL OF MATHEMATICAL AND NATURAL SCIENCES

UNIVERSITY OF VENDA

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Abstract

We provide a thorough overview of the current liquidity problem, discussing what are considered to be state-of-the-art approaches in both industry and in academia, and clearly establish our motivation to depart from current liquidity management standards. We noted that during 2007 to 2009 financial crisis different countries throughout the whole world faced serious challenges that ranged from chronic liquidity problems, deep-rooted risk management deficiencies and poor corporate governance practices. The liquidity crisis, especially in the USA, was caused by low real interest rates stimulating an asset price bubble fuelled by new financial products that were not stress-tested and that failed in the downturn. Large depository institutions face the question of how to optimally utilise funds and manage liquidity problems. The existing liquidity models are not standardised, and do not take into consideration the complexity and the nature of the bank. As evidenced by the late 2000 financial crisis, it is evident that nowadays there is not a metric that seems to be completely adequate to prevent liquidity crises.

Our contribution is fourfold. First we investigate appropriate scenario generation methods and perform a rigorous investigation on how to generate multistage scenario trees. Further, we investigate the inclusion of all qualifying liquid asset instruments into the portfolio optimisation. We propose a novel multistage stochastic programming methodology for liquid asset control. Thus we define how to construct and solve stochastic programming models for liquidity needs-driven sub-portfolios. Our approach is based on scenario trees and makes no assumption on the distributions of random variables. Finally, we investigate the inclusion of liquidity needs-driven strategies which are core liquidity, cash cushion, operational cash and discretionary liquidity into the overall liquidity portfolio.

Stochastic programming is a multi-faceted problem, and even the most focused treatment necessarily incorporates techniques from a wide range of disciplines. Through the development of fully coherent models and a sufficiently robust solution methodology, we provide a thorough overview of the problem at hand, discussing approaches in both industry and in academia. We introduce practical and theoretical advances that are to our best knowledge unexplored in the current literature, and document the usefulness of these avenues through a systematic series of increasingly complex applications and experiments. The data used is from the South African Reserve Bank (SARB) and International Monetary Fund (IMF) from January 1988 to May 2014. Most corporations such as commercial banks generally hold a unitary liquidity portfolio and not necessarily segmented to focus on bank specific cash and liquidity needs. Banks do have different cash needs at different times. Financial intermediaries to manage liquidity efficiently and effectively, segmenting the optimal liquid asset portfolio is the best management strategy. We construct different stochastic programming models based on decision making under risk and provision of powerful paradigm for decision making under uncertainty. The stochastic programming models with recourse are clear, easy to implement, very efficient and provide the optimal solution according to future possible set of scenarios. In defining and constructing stochastic programming models with recourse, sensitivity analysis should be carried out to increase the decision maker's understanding of the problem and to show the effect of different assumptions. Constructing an SP model with more stages provides better approximations compared to a single-period model. We found that the use of the proposed models through segmenting the unitary liquidity portfolio improves the management of liquidity compared to current techniques which are based on simulation, experience and trial-and-error. Thus high quality liquidity buffers insure the bank against any adverse liquidity risk. We found that liquidity buffer is

best modelled as a stochastic process than deterministic. High net cash flow enhance effective and efficient liquidity management. Finally, excess reserves improve country monetary policy and broaden the scope of central bank lending programmes to address conditions in credit markets but on the other hand, may lead banks to loosen standards by weakening lending criteria in an attempt to increase returns.

In designing the sub-portfolios, liquidity determinants such as liquid asset returns, loan returns, payment flow, interest rates and gross income are uncertain, and to avoid liquidity problems caused by these variables, we need to include randomness on them. To effectively and efficiently manage liquidity, a bank may be required to follow certain key liquidity principles. The first is that the bank needs to understand and categorise its cash needs into at least four liquidity sub-portfolios as explained in the research. In this study, we strongly recommend that the banks' management should design the following sub-portfolios; liquidity buffer, cash cushion, operational cash and discretionary liquidity. The bank should clearly maintain the holdings of high quality liquid assets that can provide reliable reserves under all conditions. In addition, strict and relatively comprehensive disclosure practices in relation to liquidity risk management objectives should be submitted to central banks. Finally, there should be improvement on funding markets and public confidence by broadening the scope of bank guarantees to ensure future financial stability. We need to emphasise the point that bank liquidity is restricted by capital adequacy, required reserves, liability and deposit insurance defined by the central bank. Research can therefore be done on models that can be used to efficiently and accurately forecast future cash outflow taking into consideration the behavioural cash flows and estimating the discretionary and excess reserves. Further research can also be done on comparing the benefits of the calculated strategies in the stochastic program-

ming context to more traditional methods.