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Linking global economic dynamics to a South African-specific credit risk correlation model ☆

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ABSTRACT

In order to address practical questions in credit portfolio management it is necessary to link the cyclical or systematic components of firm credit risk with the firm's own idiosyncratic credit risk as well as the systematic credit risk component of every other exposure in the portfolio. This paper builds on the methodology proposed by Pesaran, Schuermann, and Weiner [Pesaran, M.H., Schuermann, T., and Weiner, S.M., (2004), Modeling regional interdependencies using a global error correcting macroeconometric model, Journal of Business and Economic Statistics, 22, 2, 129–169.] and supplemented by Pesaran, Schuermann, Treutler and Weiner [Pesaran, M.H., Schuermann, T., Treutler, B., and Weiner, S.M., (2006), Macroeconomic dynamics and credit risk: a global perspective, Journal of Money, Credit, and Banking, Volume 38, Number 5, August 2006, 1211–1261.] which has made a significant advance in credit risk modelling in that it avoids the use of proprietary balance sheet and distance-to-default data, focusing on credit ratings which are more freely available.

In this paper a country-specific macroeconometric risk-driver engine which is compatible with and could feed into the GVAR model and framework of PSW (2004) is constructed, using vector error-correcting (VECM) techniques. This allows conditional loss estimation of a South African-specific credit portfolio but also opens the door for credit portfolio modelling on a global scale, as such a model can easily be linked to the GVAR model. The set of domestic factors is extended beyond those used in PSW (2004) in such a way that the risk-driver model is applicable for both retail and corporate credit risk. As such, the model can be applied to a total bank balance sheet, incorporating the correlation and diversification between both retail and corporate credit exposures.

Assuming statistical over-identification restrictions, the results indicate that it is possible to construct a South African component for the GVAR model that can easily be integrated into the global component. From a practical application perspective the framework and model is particularly appealing since it can be used as a theoretically consistent correlation model within a South African-specific credit portfolio management tool.

1. Introduction

Since the early 1990s intense competition for market share has motivated banks across the globe to allow credit portfolios to become less diversified (across all dimensions – country, industry, sector and size) and accept lesser quality assets on their books without being adequately compensated for the higher risk. As a result, even well-capitalised banks could come under severe solvency pressure when global economic conditions turn. The banking industry have realised the need for more sophisticated loan origination and credit and capital management practices.

From a credit portfolio perspective it is essential that portfolio managers understand the dynamics and interaction of two key elements of their exposures, namely, systematic and idiosyncratic risk. Systematic risk refers to the co-movement and risk associated with the relationship between exposures and the general economic environment while idiosyncratic risk refers to exposure-specific risk factors such as leverage or cash flow ratios. In order to perform meaningful credit portfolio management it is necessary to be able the to link cyclical or systematic components of firm credit risk with the firm's own idiosyncratic credit risk, as well as the systematic credit risk component of every other exposure in the portfolio. In general, this relationship is referred to as credit correlation. Conceptually one would expect that the correlation of individual exposures with the business cycle would imply that in an economic downturn portfolio credit risk is increased by the simultaneous increase in risk of exposures which are sensitive to the same macroeconomic variables. A better understanding of these correlations would not only allow better

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capital budgeting over the business cycle but would also allow portfolio managers to execute and more effectively exploit market opportunities.

The methodology proposed by Pesaran, Schuermann and Weiner (2004) (PSW) and Pesaran, Schuermann, Treutler and Weiner (2006) (PSTW) has made a significant advance in credit risk modelling by linking an adjusted structural default model to a structural global econometric model (their global vector autoregressive (GVAR) model), from which conditional credit risk analysis and portfolio management can be done. In general the methodology can be described as comprising two parts: the first is a macroeconomic simulation engine (normally refer to as the "correlation model" in the credit portfolio literature) while the second part is a set of firm-specific default models which translates the macroeconomic conditions into credit risk outcomes. This paper investigates the possibility of constructing a country-specific macroeconometric risk-driver engine which is compatible with the GVAR model and framework. This will allow conditional loss estimation of a South African-specific credit portfolio but also opens the door for credit portfolio modelling on a global scale, because such a model can easily be linked to the GVAR model.

The paper is structured as follows. The first and second sections discuss the basic problems faced by bank credit portfolio managers across the globe, then highlight the methodology and framework proposed by PSW (2004) and PSTW (2006) to develop a consistent econometric framework and model to estimate the dynamics of global credit markets, which is shown in Section 3. Section 4 provides an in-depth discussion on the data construction process, estimation results, dynamic properties and forecasting ability of the proposed South African-specific vector error-correcting model (VECM). The paper concludes in Section 5 by arguing that the proposed model could be used as a stand-alone correlation model in a South African-specific credit portfolio model or could be linked to the GVAR model as part of a global credit portfolio management tool.

2. Credit risk and the macroeconomy

Much of the discussion taking place since the introduction of the New Capital Accord under Basel II (BIS, 2006) has centred on the effects of business cycles on portfolio credit risk and economic capital (see, for example, Carpenter et al., 2001; Carey, 2002; Allen and Saunders, 2004; Jarrow and van Deventer, 2005; Elizalde, 2005). However, most approaches have opted to represent the general economy or systematic risk by a single risk factor. The systematic component of all exposures, the process generating asset values, and therefore the default thresholds, are assumed to be homogeneous across all firms. Indeed this asymptotic single risk factor (ASRF) model (Gordy, 2003) has been the foundation for Basel II. While the ASRF framework is appealing due to its analytical closed-form properties for regulatory and generally universal application in large portfolios, the single risk factor characteristic is also its major drawback. Essentially it does not allow for enough flexibility in answering real life questions. Commercially-available credit portfolio models made an effort to address this by introducing more systematic factors in the asset value generating process but have failed to provide any tractable economic meaning to their risk factors.

The methodology proposed by PSW (2004) and PSTW (2006) provides an applicable model for conditional credit loss modelling which combines the systematic risk with the idiosyncratic component of each exposure and also includes an explicit channel for default correlation. The methodology is particularly appealing in that it is not only flexible in answering practical portfolio questions (through scenario analysis) but also steers away from the data confidentiality problem that most practitioners face with commercially available credit portfolio models. In simple terms the methodology can be summarised as follows. The macroeconometric risk-driver model will specify and represent the macroeconomic environment in which the credit portfolio operates. Using Monte Carlo simulations, various possible simulation paths of the economy are forecasted over a specific period. These macro factors feed into the firm-specific return models in order to produce the asset value generating process of each firm. Using the return dynamics and the estimated equity default thresholds from PSTW (2006), the probability of default can be obtained through a structural-based credit default model. Finally, a conditional loss distribution for the credit portfolio is obtained and used to estimate various credit-related parameters such as economic capital and allow for various scenario analyses to be performed.

Although the earlier versions of the GVAR model as constructed by Pesaran et al. (PSW) (2004) and Pesaran et al. (2006) did not include a South African component, a later version by Dees et al. (2007), expanded their coverage to include South Africa under the "Rest of World" group of countries. However, their specification and estimation for the South African economy is based on the general specification used while the cointegration identification is based on exact-identified restrictions, identifying one cointegrating vector for South Africa.

In this model the aim is not only to incorporate South Africa into the current GVAR model, but to provide theoretical consistent identification restrictions, and also, to include variables which are appropriate for bank retail and corporate credit portfolios. Given the fact that most of the existing simulation models that underpin credit portfolio models are not, to a significant extent, based on economic theory (relying on Gaussian simulation based methodology), this model could provide significant insight into the macroeconomic and credit portfolio exposure linkages.

Our aim in this paper, is therefore to construct a South African-specific macroeconometric risk-driver engine which is compatible with the global vector autoregression (GVAR) model and framework proposed by PSW (2004). This will allow conditional loss estimation of a South African-specific credit portfolio, but also opens the door for credit portfolio modelling on a global scale, as such a model can easily be linked into the already established GVAR model. A significant enhancement to the set of domestic factors included in the VECM model is made to allow the incorporation of both corporate and retail credit risk elements to be modelled from the same system. This would allow simultaneous estimation of total bank portfolio credit risk, which accounts for correlation and diversification between corporate and retail credit exposures. In order to estimate and provide such a South African-specific model it is therefore necessary to analyse the construction of the GVAR model proposed by PSW (2004).

3. The PSW GVAR model

The macroeconometric risk-driver model (GVAR) used in PSW (2004) comprises a total of 25 countries which are grouped into 8 regions and account for 82% of world production. However, as stated by PSW (2004), a cointegration framework can become computationally very demanding and, for this reason, seven key economies are modelled alone, including the U.S., U.K., Japan, China, Germany, France and Italy while all other countries are modelled as part of the regional groups, i.e. Western Europe, South East Asia, Latin America and the Middle East. In the case of South Africa, the GVAR model lacks applicability since it does not include an African region. However, the approach is general enough so that country-specific cointegration models can be linked into the global and already established GVAR model. Therefore, the use of cointegration is applied in such a fashion that heterogeneity that exists across regions and countries is acknowledged. This section draws on the core elements of the GVAR model as presented in PSW (2004) to illustrate the framework and put the methodology in context.[1]

[1] Refer to PSW (2004) for a full presentation of the methodology.