

Deep Temporal Graph Networks for Behavioural Scoring Prediction in Revolving Credit Lines

Kamesh Korangi, María Óskarsdóttir, Christophe Mues, Cristián Bravo

Abstract

Credit lines are borrowing facilities that firms can draw from up to an agreed limit. They are used primarily for liquidity management by firms as they offer flexibility within a set credit agreement. For banks, these lines of credit, in addition to the exposure to standard credit risk, also create procyclical risk, where the exposure increases during challenging conditions. Individually, credit lines also offer important behavioural patterns that could signal systemic deterioration in the general market environment, impacting other firms. However, due to data limitations, they are often less widely studied than other debt instruments, such as bonds or loans. This paper uses credit line data from a large portfolio of Small and Medium-sized Enterprises (SMEs), provided by a large European bank. We generate a vast set of behavioural features on credit line usage from temporal data on credit lines. We also create a dynamic directed network of all firms using explicit inter-firm transaction data, reflecting the supply chain between firms. The latter allows us to capture how default risk may propagate between firms. We also use financial information and credit agreement terms as further inputs to our model. For the behavioural and financial information, we create panel data for each firm and use it as input for temporal deep learning models. The network information serves as input to Graph Attention models. Using a multimodal architecture, we combine the data modalities of temporal and graph models to produce a one-year probability of default for a given firm. We compare this model with logistic regression, traditional machine learning models, and baseline deep learning models to gauge the performance. We also seek to understand the predictive power of behavioural data by comparing it with other data sources and draw portfolio-level conclusions from the network data.