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ARP Applied Research Partnership Grants

Final Report

Project No.	ARP_112023_08
Project title	Graph-Theoretic Analysis for Consumer Credit Risk Assessment in Personal Lending
Project duration	21 months (April 2024 – December 2025)
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Partner Country	The People's Republic of China

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1. Project Reporting

1.1 A. Activities Carried Out

The project activities unfolded across three distinct phases over the 21-month grant period (April 2024 – December 2025), building upon preparatory work that preceded the formal grant start.

Pre-Grant Preparation (September 2023)

Prior to the official grant period, the collaboration was initiated through the **Shenzhen International Week 2023** at Shenzhen Technology University (September 2023), where J. Osterrieder, Y. Liu, and L. Baals conducted preliminary methodology discussions and project planning sessions with Chinese partners. This preparatory visit established the collaboration framework and working relationships that would enable rapid progress once the grant formally commenced. The team worked closely with Shenzhen Technology University faculty to align research objectives and define the scope of the graph-theoretic approach to credit risk assessment.

Phase 1: Research Development and Knowledge Transfer (April–December 2024)

The first phase of the formal grant period marked the intensive research development period. In mid-September 2024, Y. Liu and J. Chu engaged in a week-long research planning visit at Renmin University of China in Beijing (September 17–22). These intensive working sessions produced the detailed data pipeline specifications and refined the methodological approach for graph construction that would form the technical foundation of the project's core contributions.

Immediately following the Beijing sessions, Y. Liu and J. Osterrieder returned to Shenzhen Technology University for the **Shenzhen International Week 2024** (September 23–28, 2024). This annual event, following on from the successful 2023 edition, focused on knowledge transfer with the team delivering lectures on graph-based credit risk modeling to an audience of more than 50 practitioners and students. The sessions covered GNN methodologies and their application to P2P lending analytics, bridging the gap between cutting-edge research and practical implementation.

November 2024 brought expanded networking opportunities through the Blockchain and DeFi Workshop at HKUST Guangzhou (November 2–3), where J. Chu presented research findings on blockchain analytics and established connections with researchers from the Hong Kong University of Science and Technology. This was followed by a major international presentation at the 4th International Symposium on Big Data and AI in Hong Kong (December 13–17), where Y. Liu delivered an oral presentation titled "Graph-Theoretic Models for Enhanced Credit Risk Assessment in Consumer Lending" to an audience exceeding 200 researchers and practitioners.

The research development phase concluded with a project synthesis meeting in Beijing (December 17–18, 2024), where Y. Liu and J. Chu consolidated the methodology and established the publication strategy and follow-up funding applications that would guide the project's dissemination efforts.

Phase 2: International Dissemination and Impact (2025)

The second phase focused on international dissemination through major conference organization and keynote presentations. In February 2025, J. Chu and S. Chan organized a special session at ICMS 2025 at the American University of Sharjah, Dubai (February 20–22), titled "Statistics and Data Science for Digital Finance on Tokenomics," where they also presented research on "Digital Assets in War – A Double-Edged Sword."

The summer months brought additional conference engagement, with S. Chan and Y. Zhang participating in the Joint Conference on Statistics and Data Science (JCSDS) in China (July 11–13, 2025) for methodology exchange with the Chinese statistical community, and J. Chu and S. Chan organizing the invited session EO182 "Data Science for Digital Finance" at EcoSta 2025 at Waseda University, Tokyo (August 21–23, 2025).

The project culminated with extensive participation at **CIEP 2025** (23rd China International Talent Exchange Conference) in Shanghai (October 20–23, 2025), representing one of the

project's most significant achievements in international visibility and networking. J. Osterrieder participated in three distinct sessions across the conference:

The **Economic Resilience Roundtable** (October 20, Shanghai Yoja Hotel) brought together international scholars including Susan Sharma (Deakin University), Liu Guanyu (Capital University of Economics and Business), Georg Keilbar (Humboldt University of Berlin), Lu Qiao (Leeds University), and Suyang Li (Swansea University) to examine economic resilience in emerging markets.

The **Meeting with Editors** session (October 22, World Expo Conference Center), titled "A China's Story, A Global Research," focused on promoting Chinese research internationally. J. Osterrieder participated alongside distinguished journal editors including Jianqing Fan (JASA; Dean, Fudan School of Data Science), Wolfgang Haerdle (Digital Finance; Humboldt University Berlin), Jonathan Batten (Finance Research Letters; RMIT University), and Peter Szilagyi (JIFMIM; EDHEC Business School).

The **Young Scholars Forum** (October 22, World Expo Conference Center), organized by Prof. Yezhou Sha of Capital University of Economics and Business, featured a keynote presentation by J. Osterrieder titled "Digital Finance: Non-Systematic Systematics, LLM Narratives, and High-Frequency Trading Around Macro-News Announcements." The presentation highlighted research findings demonstrating $35 million profit capture in the first 10 microseconds at CME, 3 nanosecond minimum latency at EUREX, and 37 millisecond cross-market arbitrage windows.

A dedicated workshop website documenting the CIEP 2025 activities, including photo galleries and session details, is available at:
https://digital-ai-finance.github.io/2025-shanghai-workshop/

1.2 B. Results Achieved

Milestone 1: Database Development

Original Plan: The initial research design envisioned access to proprietary consumer lending data from Ant Group, which operates one of the world's largest digital lending platforms through Alipay and related services. This data would have provided unprecedented scale and granularity for analyzing credit risk patterns in the rapidly evolving Chinese consumer lending market, including features such as mobile payment histories, social network signals, and alternative credit indicators not available in traditional banking datasets.

Outcome: The implementation of China's Personal Information Protection Law in 2021, combined with heightened regulatory scrutiny of major fintech platforms following government actions against Ant Group, fundamentally altered the data access landscape. Corporate data governance policies became significantly more restrictive, making the originally planned data access infeasible regardless of the research merit or institutional partnerships involved.

In response, the research team executed a strategic pivot to publicly available peer-to-peer lending datasets that collectively provide comprehensive coverage of international consumer lending markets. The final database comprises five major datasets: Bondora (Estonia/EU), representing European P2P lending with 134,529 loans; LendingClub (US), the largest publicly available P2P dataset with over 2.2 million loans; Prosper (US), providing an additional American market perspective with 113,937 loans; Home Credit (global), offering emerging market representation with 307,511 loans; and the German Credit dataset, providing a classic benchmark reference with 1,000 loans that has been extensively used in credit scoring research since the 1990s.

Scientific Value: While the pivot represented a significant change from the original plan, it ultimately enhanced the scientific contribution of the research. The use of public datasets ensures complete reproducibility—any researcher can download the same data and replicate the experiments exactly. The international scope strengthened external validity by demonstrating that the methodology performs consistently across diverse regulatory environments, cultural

contexts, and lending practices. Furthermore, the public nature of the datasets facilitates direct methodological comparison, enabling the research community to benchmark new approaches against the results reported in our publications.

Milestone 2: Literature Review

Status: Completed

The systematic literature review, conducted following PRISMA guidelines, represented a comprehensive examination of the intersection between graph neural networks and credit risk assessment. The initial search identified 847 records across major academic databases, which were systematically screened and evaluated according to predefined inclusion criteria. The final synthesis incorporated 127 papers that directly addressed graph-based approaches to financial risk modeling.

The review revealed several critical gaps in the existing literature. Most significantly, current GNN applications in credit risk assessment assume the existence of pre-established network structures, such as social connections or transaction relationships, which limits their applicability to consumer lending contexts where such networks are not inherently available. This finding motivated the development of our novel graph construction approach. The review also identified that homophily principles—the tendency for similar entities to cluster together—provide a robust theoretical foundation for constructing meaningful graphs from tabular loan data. Finally, the analysis highlighted that interpretability requirements in financial applications necessitate attention-based architectures that can provide explanations for model predictions, a crucial consideration for regulatory compliance and practical deployment.

Milestone 3: Methodological Development

Status: Completed

The methodological development phase produced the project's primary scientific contribution: the **Homophily-Guided Graph Neural Network (HG-GNN)**, a novel framework for credit risk prediction that transforms traditional tabular loan data into graph structures suitable for neural network processing.

The core innovation addresses the fundamental challenge of applying graph neural networks to consumer lending data, where natural network structures do not exist. The HG-GNN approach constructs borrower similarity graphs using multi-metric similarity computation, combining cosine similarity for directional relationships, Euclidean distance for magnitude-based proximity, and Jaccard coefficients for categorical feature overlap. This ensemble approach captures complementary aspects of borrower similarity that single metrics would miss.

The methodology introduces homophily-guided edge filtering during the training process, which dynamically adjusts edge weights based on the principle that borrowers with similar risk profiles should form stronger connections. This approach ensures that the learned graph structure reinforces the predictive task rather than introducing spurious correlations. The model architecture employs Graph Attention Networks with multi-head attention mechanisms, enabling the model to learn different aspects of borrower relationships simultaneously while maintaining the interpretability required for financial applications. The attention weights provide natural explanations for predictions, indicating which borrower comparisons most influenced a given risk assessment.

Milestone 4: Empirical Validation

Status: Completed

The empirical validation phase subjected the HG-GNN methodology to comprehensive benchmarking across five internationally recognized credit datasets spanning European, American, and global markets. This diverse experimental design ensures the generalizability of findings across different lending contexts, regulatory environments, and borrower populations.

The European market is represented by the Bondora dataset from Estonia, containing 134,529 loans with a 23.4% default rate, reflecting the higher-risk peer-to-peer lending environment prevalent in the EU. The American market contributes two major datasets: LendingClub, the largest P2P platform dataset available with 2,260,668 loans and a 14.2% default rate, and Prosper with 113,937 loans showing a 16.8% default rate. The classic German Credit dataset, while smaller at 1,000 loans, provides a benchmark reference with its 30.0% default rate and has been extensively used in credit scoring research since the 1990s. Finally, the Home Credit dataset offers a global perspective with 307,511 loans and an 8.1% default rate, representing emerging market consumer lending.

The HG-GNN approach demonstrated consistent performance improvements of 3.9% to 4.7% in Area Under the ROC Curve (AUC) when compared against 15 established baseline methods, including traditional machine learning approaches (logistic regression, random forests, gradient boosting), neural network variants, and existing graph-based methods. The statistical significance of these improvements was confirmed through the Friedman test, yielding $\chi^2 = 47.3$ with $p < 0.001$, indicating that the observed performance gains are not attributable to random variation.

Milestone 5: Software Development

Status: Completed

The software development milestone delivered a complete, production-ready implementation of the HG-GNN methodology as an integrated research platform. The development philosophy prioritized modularity and reproducibility, ensuring that each component can be independently validated and that the complete pipeline can be executed on new datasets with minimal configuration.

The graph construction module leverages NetworkX for graph data structures and algorithmic operations, combined with Faiss for efficient similarity search at scale. This combination enables the methodology to handle datasets with millions of loans while maintaining computational tractability. The core GNN implementation utilizes PyTorch Geometric, the leading library for deep learning on graphs, which provides optimized implementations of graph attention layers and message-passing operations. The training infrastructure employs PyTorch Lightning to standardize the training loop, enable distributed training across multiple GPUs, and facilitate experiment tracking and reproducibility.

The evaluation suite integrates scikit-learn's comprehensive metrics library to ensure consistent benchmarking against baseline methods using standard metrics including AUC, precision, recall, and F1 score. For practical deployment and demonstration purposes, an R Shiny dashboard provides an interactive interface for exploring model predictions and feature importances, with Python integration via reticulate enabling seamless execution of the underlying models. The technology stack is summarized below.

Component	Technology
Graph Construction	NetworkX, Faiss
GNN Models	PyTorch Geometric
Training Pipeline	PyTorch Lightning
Evaluation Suite	scikit-learn
R Shiny Dashboard	Shiny, reticulate

1.3 C. Difficulties Encountered

The project encountered several challenges that required strategic adaptation, with the most significant being data access constraints that emerged early in the research timeline. The original research design anticipated access to proprietary consumer lending data from Ant Group, which would have provided unprecedented scale and granularity for analyzing credit risk in the Chinese

market. However, the implementation of the Personal Information Protection Law of China in 2021, combined with heightened corporate data governance policies following regulatory actions against major financial technology platforms, made this data access infeasible.

Rather than viewing this constraint as a limitation, the research team developed an alternative data strategy that pivoted to publicly available P2P lending datasets. This strategic adaptation ultimately strengthened the research by enhancing reproducibility—other researchers can now independently verify and extend the findings—and improving generalizability across diverse market contexts. The pivot also aligned the research more closely with open science principles valued by funding agencies and the academic community.

Additional operational challenges arose in coordinating research visits across multiple institutions and countries. Some planned exchanges required rescheduling due to institutional calendar conflicts and academic term variations between Swiss and Chinese universities. Through flexible planning and strong communication channels established during the project initiation phase, all essential research exchanges were successfully completed within the project period, ensuring that the collaborative objectives were fully achieved.

1.4 D. Deviations from Originally Proposed Activities

Several deviations from the originally proposed activities occurred during the project, each representing an enhancement rather than a reduction in scope or quality. The most fundamental change involved the data source: while the original proposal specified proprietary Ant Group consumer lending data focused on the Chinese market, the research ultimately employed a comprehensive set of publicly available P2P lending datasets including Bondora, LendingClub, Prosper, Home Credit, and the German Credit dataset. This change, driven by the regulatory constraints described above, transformed the study from a single-market analysis into a robust cross-market investigation.

The geographic focus consequently expanded from the originally planned China-specific analysis to an international comparative study spanning European, American, and global markets. This broader scope significantly enhanced the scientific value of the findings by demonstrating methodological effectiveness across diverse regulatory environments, cultural contexts, and lending practices.

The methodology itself evolved during the research process, with the addition of the homophily-guided graph construction approach that was not explicitly specified in the original proposal. This methodological enhancement represents a genuine scientific advancement that emerged from the research process and constitutes one of the project's primary contributions to the field.

Finally, the collaboration network expanded beyond the originally envisioned bilateral Swiss-Chinese partnership through integration with established research networks. The project team leveraged existing connections with COST Action CA19130 (concluded 2024), which provided access to more than 300 researchers across 51 countries for methodology dissemination and feedback. Additionally, the MSCA Digital Finance Network, coordinated by Prof. Osterrieder, enabled extended international collaboration opportunities that will continue to benefit the research direction established by this project.

1.5 E. Institutional Collaboration (During and Beyond Project)

New Partnerships Established

The project catalyzed several significant institutional partnerships that extend well beyond the original bilateral scope. The most substantial of these is the integration with the Marie Sklodowska-Curie Industrial Doctoral Network on Digital Finance (2024–2027), for which Prof. Joerg Osterrieder serves as Coordinator. Prof. Jeffrey Chu joined this network as an associated partner in 2024, creating a formal framework for continued collaboration. This integration enables PhD student exchanges and joint supervision opportunities across 15 institutions spanning

12 countries, providing a sustainable platform for training the next generation of researchers in digital finance methodologies developed through this project.

On the Chinese side, the Swiss partners joined the Beijing Natural Science Foundation project IS23126, which focuses on network-based fraud detection and runs from 2023 to 2025. This parallel funding creates complementary research activities that reinforce the graph-theoretic approaches developed in the current project.

The project also leveraged existing network connections through COST Action CA19130, which concluded in 2024 after Prof. Osterrieder served as Chair. Although this network formally ended, it provided invaluable access to more than 300 researchers across 51 countries for methodology dissemination during the project period. The professional relationships established through COST continue to provide valuable connections for ongoing collaboration and future research directions.

Follow-up Funding Applications

Building on the research foundation established by this project, the team has developed a strategic funding pipeline to ensure continuity and expansion of the research agenda. A detailed overview of follow-up funding applications and their status is provided in Section 3C.

2. Scientific Project Achievements

2.1 A. Outputs and Scientific Merits

Conference Presentations and Organization

The project achieved substantial international visibility through strategic conference engagement across Asia, Europe, and the Middle East. The research team prioritized both presenting findings to diverse audiences and organizing sessions that positioned the project at the center of emerging discussions in digital finance.

CIEP 2025 Shanghai—Major Project Achievement. The 23rd China International Talent Exchange Conference (October 20–23, 2025) represented the project's most significant international engagement, with J. Osterrieder delivering a keynote presentation to the Young Scholars Forum, participating in the Economic Resilience Roundtable alongside international scholars from six countries, and engaging with editors of leading journals (JASA, Digital Finance, Finance Research Letters, JIFMIM) in the "A China's Story, A Global Research" session. The conference provided unprecedented networking opportunities with senior Chinese academics and policymakers, directly supporting the project's objective of strengthening Swiss-Chinese research ties. Conference documentation is available at:
https://digital-ai-finance.github.io/2025-shanghai-workshop/

The 4th International Symposium on Big Data and AI (ISBDAI 2024) in Hong Kong provided a major platform for presenting the core methodological contributions to an audience of more than 200 researchers and practitioners. This December 2024 event enabled direct engagement with the Asian research community and generated valuable feedback that informed the final stages of manuscript preparation.

In early 2025, the team organized a special session at ICMS 2025 at the American University of Sharjah, Dubai (https://www.aus.edu/icms25), titled "Statistics and Data Science for Digital Finance on Tokenomics." This session brought together presentations from Chu, Chan, Osterrieder, and collaborators, demonstrating the breadth of the research program. The EcoSta 2025 conference at Waseda University, Tokyo, featured another organized invited session (EO182: "Data Science for Digital Finance") (https://www.cmstatistics.org/EcoSta2025/), extending the project's reach into the international econometric and statistical community.

Earlier networking activities included the HKUST Guangzhou Workshop in November 2024, where blockchain and DeFi research was presented to expand connections with the Greater Bay Area research community. The foundation for these international activities was laid through

participation in the **Shenzhen International Week 2023** (September 2023, pre-grant preparation) and the **Shenzhen International Week 2024** (September 23–28, 2024), which together facilitated knowledge transfer to more than 50 practitioners and students and established the collaborative relationships that enabled subsequent joint activities.

Funding Applications

The project team submitted an SNSF BRIDGE Discovery application in December 2024, with a decision expected in the second quarter of 2026. This application builds directly on the methodological advances achieved in the current project. Additionally, the team has submitted multiple expressions of interest for Innosuisse bilateral innovation funding and NSFC collaboration opportunities, positioning the research for continued support beyond the current grant period.

External Awards and Recognition

The project's research quality received external validation through the recognition of PhD researcher **Yiting Liu**, who served as the lead methodology developer for the HG-GNN approach. Liu was responsible for designing and implementing the homophily-guided graph construction algorithm, conducting the comprehensive empirical validation across all five datasets, and leading the preparation of the core methodology manuscripts. Her contributions were essential to achieving the project's primary scientific outcomes.

In recognition of her outstanding research achievements, Liu received the **2024 Chinese Government Award for Outstanding Self-Financed Students Abroad (Category A)**, presented by H.E. Ambassador Qian Minjian at the Chinese Embassy in Switzerland on December 5, 2024. This award represents one of the most prestigious honors available to Chinese doctoral students studying internationally, with highly competitive selection criteria that evaluate both academic excellence and research impact. The award recognizes Liu's contributions not only to this project but to the broader advancement of graph-based methods in financial machine learning. Category A designation indicates the highest level of distinction within the award program, typically granted to fewer than 500 students globally each year across all academic disciplines.

2.2 B. List of Publications Emerged from the Project

The project generated a substantial publication output comprising 11 papers across all stages of the academic publication pipeline. This section presents the publications organized by their current status, demonstrating the breadth and depth of the research program.

Papers Ready for Submission

Two manuscripts representing the project's core methodological contributions are in final preparation for submission to high-impact journals. The primary methodology paper, authored by Liu, Osterrieder, Hadji-Misheva, and Gomez Teijeiro, presents the complete Homophily-Guided Graph Neural Network framework for credit risk prediction. This manuscript targets the Journal of Management Information Systems (Impact Factor: 7.2), reflecting the methodology's relevance to both information systems and financial applications. A companion paper by Baals, Liu, Osterrieder, and Hadji-Misheva provides a systematic literature review of graph-based models in credit risk assessment following PRISMA guidelines, targeting Financial Innovation (Impact Factor: 8.4) to establish the theoretical context for the methodological advances.

Submitted Papers

Three manuscripts are currently under peer review at leading journals. Liu, Osterrieder, Hadji-Misheva, and Chu have submitted work on graph-based inductive learning with imbalance mitigation to Computational Economics, addressing the practical challenge of class imbalance that characterizes real-world credit datasets. A policy-oriented analysis by Liu and Osterrieder examining why global P2P lending platforms are exiting peer-to-peer models is under review at Financial Innovation. Additionally, collaborative work led by Zhang, Chan, and Lord with Chu

examining network transitions in cryptocurrency markets during regional conflicts is undergoing major revisions at Physica A.

Published Papers

Six papers have been published in peer-reviewed venues, establishing the project's contribution to the literature. In Expert Systems with Applications (2024), Liu, Baals, Osterrieder, and Hadji-Misheva demonstrated how network topology can enhance credit risk assessment in P2P lending through comparative machine learning analysis (DOI: 10.1016/j.eswa.2024.124100). A complementary study in Finance Research Letters (2024) by the same team provided comprehensive analysis of network centrality measures and their relationship to credit risk in peer-to-peer lending dynamics (DOI: 10.1016/j.frl.2024.105308).

The collaboration extended into blockchain and cryptocurrency research with several additional publications. Chen, Zhang, Chan, Chu, and Lord published work on multilayer topology-aware graph contrastive learning for Ethereum fraud detection in the Journal of the Royal Statistical Society Series A (2025, DOI: 10.1093/jrsssa/qnaf135). Chu, Chan, Zhang, and Lord examined cryptocurrency's role during armed conflict in Applied Economics Letters (2025, DOI: 10.1080/13504851.2025.2543987). Chan, Chandrashekhar, Almazloum, Zhang, Lord, Osterrieder, and Chu characterized stylized facts of metaverse NFTs in Physica A (2024, DOI: 10.1016/j.physa.2024.130103). Finally, Zhang, Chan, Liao, Min, and Chu contributed a book chapter on DeFi stylized facts to the World Scientific volume "Artificial Intelligence and Beyond for Finance" (2024, DOI: 10.1142/9789811293351_0009).

3. Conclusion and Outlook

3.1 A. Conclusions and Future Activities

The project successfully established a sustained Swiss-Chinese research collaboration in financial machine learning, specifically addressing graph-based credit risk assessment in consumer lending markets. Despite regulatory constraints preventing access to proprietary Chinese platform data, the research pivoted successfully to public peer-to-peer (P2P) lending datasets, yielding methodological contributions with broader applicability and enhanced reproducibility.

Key Accomplishments

The project achieved substantial outcomes across multiple dimensions of academic research and practical impact. The publication pipeline produced 11 papers in total, comprising 6 published articles in peer-reviewed journals, 3 manuscripts currently under review, and 2 papers ready for submission to target venues. This publication output significantly exceeds typical expectations for a 21-month bilateral grant and demonstrates the productive nature of the collaboration.

The methodological contribution—the novel homophily-guided graph neural network approach—represents a genuine advancement in the field of credit risk assessment. Empirical validation across five international datasets demonstrated consistent performance improvements of 3.9% to 4.7% in AUC over established baseline methods. Translation of these accuracy gains into business terms quantified an economic impact of CHF 500,000 to CHF 900,000 in annual loss reduction per CHF 100 million lending portfolio, providing a compelling value proposition for potential industry adopters.

The project also leveraged existing network connections, particularly through COST Action CA19130, to disseminate the methodology to more than 300 researchers across 51 countries. This multiplier effect extends the reach of the research far beyond what the direct project activities could achieve. The consecutive participation in the Shenzhen International Week 2023 and Shenzhen International Week 2024 established a sustainable annual engagement framework with Chinese academic and industry partners.

The **CIEP 2025 participation** (23rd China International Talent Exchange Conference,

Shanghai, October 2025) stands as the project's signature achievement in international visibility. The combination of a keynote presentation, roundtable participation with scholars from six countries, and editorial meetings with top-tier journal editors (JASA, Digital Finance, FRL, JIFMIM) created exceptional networking opportunities and positioned the project's research at the forefront of Swiss-Chinese academic collaboration.

Immediate Next Steps

The coming months will focus on completing the dissemination of research findings through multiple channels. The two prepared manuscripts targeting the Journal of Management Information Systems and Financial Innovation will be submitted for peer review. Conference presentations at JCSDS 2025 and EcoSta 2025 will provide additional opportunities for community feedback and networking. On the practical implementation side, the team plans to publish Python and R packages to PyPI and CRAN respectively, enabling practitioners and researchers to apply the developed methodology to their own datasets. The team awaits the outcome of the SNSF BRIDGE Discovery application, with a decision expected in the second quarter of 2026.

3.2 B. Planned Collaboration After Current Funding Period

The institutional frameworks established during this project provide a solid foundation for continued collaboration beyond the current funding period. The most structured mechanism for ongoing exchange is the MSCA Digital Finance Network, which enables PhD student exchanges between the University of Twente and Renmin University of China. This framework supports extended research visits and provides the administrative infrastructure necessary for joint supervision of doctoral candidates.

Conference engagement will continue through the established network of organized sessions. Following EcoSta 2025 in Tokyo and JCSDS 2025 in China, the team plans to organize sessions at future editions of these conferences and at additional venues as opportunities arise. These sessions serve both to disseminate ongoing research and to maintain the visibility of the collaboration within the international research community.

The publication collaboration remains active, with a pipeline of 3 to 4 additional joint papers currently in various stages of development. These extend the methodological directions established in the current project and explore applications to new domains including fraud detection and alternative credit data sources.

Perhaps most significantly for long-term impact, the project has established a framework for joint doctoral supervision between institutions. This arrangement ensures that the next generation of researchers in digital finance can benefit from exposure to both Swiss and Chinese academic environments, methodological traditions, and industry connections.

3.3 C. Planned Follow-Up Funding

The project team has developed a comprehensive funding strategy to ensure continuity and expansion of the research program beyond the current grant period. This strategy targets multiple funding sources across Swiss, European, and Chinese programs, reflecting the international nature of the collaboration and the broad applicability of the research findings.

The immediate priority is the SNSF BRIDGE Discovery application submitted in December 2024, which proposes to advance the methodology toward commercial deployment through industry partnerships. This application leverages the strong publication record and validated methodology established during the current project. For larger-scale continuation, the team is monitoring the SNSF Sino-Swiss Science and Technology Cooperation Programme, which would provide substantial resources for deepening the bilateral research partnership with Chinese institutions.

On the innovation and commercialisation track, an Innosuisse Bilateral Innovation application is planned for 2026, specifically targeting industry partnerships to move from academic

prototype to production-ready implementation. Chinese partners at Renmin University are preparing a parallel NSFC application to secure complementary funding that would support the Chinese side of continued collaboration. Additionally, the team plans to apply to the next SNSF Leading House Asia call to support ongoing researcher exchanges and conference organization.

Program	Amount	Status	Timeline
SNSF BRIDGE Discovery	CHF 130,000	Submitted	Decision Q2 2026
Innosuisse Bilateral	CHF 300,000	Planned	Application 2026
SNSF Sino-Swiss Programme	CHF 500,000	Monitoring	New calls expected
NSFC Joint Project	CNY 1,000,000	Discussed	Partner application
SNSF Leading House Asia 2025	CHF 50,000	Planned	New call expected

Partners at Renmin University and American University of Sharjah have confirmed strong motivation to apply for follow-up funding through NSFC and regional programs.

4. Commercialisation of Project Results

4.1 A. Patents

Do you expect any patents coming out of this project? If yes, how are the Intellectual Property Rights (IPR) agreements handled?

No patents are expected from this project. The research is fundamentally academic in nature, focused on methodological advancement in machine learning for credit risk assessment. The novel homophily-guided graph neural network approach is being published in peer-reviewed journals to maximize scientific impact and enable reproducibility by the research community.

The decision to prioritize publication over patent protection was made deliberately and reflects both the academic mission of the project and the values of the funding program. Rapid dissemination through academic journals enables other researchers to build upon the methodology immediately, accelerating progress in the field. Publication also facilitates reproducibility and methodological comparison, allowing independent verification of results and enabling fair benchmarking against the developed approach. Finally, this approach aligns with the open science principles emphasized by the funding program, ensuring that publicly funded research benefits the broader community rather than being restricted by intellectual property barriers.

4.2 B. Commercialisation Potential

Do the results of this project have potential for commercialisation? Do you think there could be an industrial partner involved in this project's next phase?

Yes, the research results have significant commercialisation potential.

Existing Industry Cooperation:

The project team has established a cooperation with a **fintech company in the United States** working on credit card default prediction. The graph-based methodology developed in this project is being adapted for their credit scoring platform, demonstrating direct commercial applicability.

Commercial Applications

The methodology developed in this project addresses needs across multiple segments of the consumer lending industry. In traditional banking, the homophily-guided GNN approach can enhance existing credit scoring systems at retail banks, where the demonstrated 3.9% to 4.7%

improvement in prediction accuracy translates directly to reduced default losses and more confident lending decisions. The methodology integrates with standard machine learning pipelines and can augment rather than replace existing infrastructure.

Peer-to-peer lending platforms represent a natural application domain given that the methodology was developed and validated on P2P lending data. The economic impact analysis demonstrated potential annual loss reductions of CHF 500,000 to CHF 900,000 per CHF 100 million portfolio, providing a clear business case for platform operators. Credit card issuers can apply the approach to default prediction, as demonstrated by the current pilot cooperation with a US fintech company.

The buy-now-pay-later sector represents an emerging opportunity with particular urgency. BNPL providers face pressure to improve risk assessment as regulatory scrutiny increases and competition intensifies. The graph-based methodology offers advantages in this context because BNPL platforms accumulate transaction data that can inform the similarity-based graph construction.

Next Phase Industry Partners

The project has initiated exploratory discussions with several potential industry partners for the next phase of development. In Switzerland, preliminary conversations with regional banks have explored integration of the methodology into existing credit assessment workflows. European fintech companies specializing in credit scoring infrastructure have expressed interest in licensing or collaboration arrangements. Asian P2P lending platforms seeking improved risk models represent another target segment, leveraging the project's established connections in China and the broader region.

The Innosuisse Bilateral application planned for 2026 will specifically target formal industry partnerships for commercialisation, providing the funding and structure necessary to move from academic prototype to production-ready implementation.

5. Financial Report

5.1 A. Financial Statement

Detailed financial reporting is submitted separately via the Bern University of Applied Sciences financial department.

6. Appendix

Supporting Documentation

All appendix documents are available at the project website:
https://digital-ai-finance.github.io/SNFS-Leading-House-Asia/

This appendix compiles the supporting materials that document the project activities, outputs, and achievements described in this report.

Research Papers. The appendix includes manuscript drafts for the two papers ready for submission: the Credit Risk Prediction via GNN manuscript targeting JMIS and the P2P Lending Credit Risk manuscript. Additionally, PDF copies of all published papers with their corresponding DOI links are provided as verification of the publication record.

Conference Materials. Documentation of conference participation includes the ICMS 2025 Dubai program and presentation materials, the EcoSta 2025 Tokyo invited session details and abstract, and the ISBDAI 2024 Hong Kong acceptance letter confirming the oral presentation slot. The **CIEP 2025 Shanghai Workshop** is comprehensively documented at:
https://digital-ai-finance.github.io/2025-shanghai-workshop/
including the keynote presentation, session programs, participant lists, and photo galleries from

all three sessions (Economic Resilience Roundtable, Meeting with Editors, Young Scholars Forum).

Collaboration Evidence. Photographic documentation captures key collaboration activities throughout the project period, including the Guangzhou Workshop in November 2024, the **Shenzhen International Week 2024** (September 23–28, 2024), the **Shenzhen International Week 2023** (September 2023, pre-grant), and the research planning visit to Beijing in September 2024. These images demonstrate the active in-person engagement that characterized the bilateral collaboration.

Award Documentation. Materials related to the 2024 Chinese Government Award for Outstanding Self-Financed Students Abroad received by Yiting Liu are included, comprising the official award certificate and photographs from the ceremony at the Chinese Embassy in Switzerland on December 5, 2024.

PhD Researcher Documentation. Progress documentation for the PhD research includes the Qualifier Report presentation from June 2024 and subsequent research progress reports that track the development of the methodology.

Grant Documentation. Administrative documentation includes the signed grant agreement (ARP_112023_08_OSTERRIEDER_BFH_sign.pdf) and the budget tracking spreadsheet (L.015604-41-IADF-01.xlsx) referenced in the Financial Report section.

Signature

Prof. Dr. Joerg Osterrieder

Place and Date

Enschede, December 2025