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Valuation of a Fintech Invoice Trading Platform: The Role of Managerial Flexibility

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Abstract:

Purpose: *The study investigates how managerial flexibility affects the financial viability of a staged fintech venture operating an invoice-trading platform. It evaluates the extent to which contingent strategic decisions-continuation, expansion, sale or termination - enhance project value in environments characterised by technological, market, and regulatory uncertainty.*
Design/Methodology/Approach: *A three-phase cash-flow model of a hypothetical invoice-trading platform is combined with Real Options Valuation (ROV) and the Financial Outcome of Managerial Flexibility (FOMF). The analysis integrates a multi-stage decision tree with 100,000-iteration Monte Carlo simulation, using Free Cash Flow to the Firm (FCFF) and a unified discount rate (WACC = 12%). The ROV quantifies the upper-bound value of flexibility through backward induction, while the FOMF captures the realised financial effect of path-dependent managerial decisions.*
Findings: *Results demonstrate that flexibility materially improves economic performance. The baseline rigid project exhibits a highly unfavourable risk–return profile, with a strongly negative median NPV. Incorporating flexibility substantially increases value: the median ROV is €5.60 million, while the mean FOMF equals €3.32 million, with a 93.95% probability of non-negative realised value. Expansion to the Polish market is executed in most paths, whereas CEE expansion occurs only when operational thresholds are met. ROV produces stable, non-negative values, while FOMF displays wider dispersion, reflecting realistic decision-making under uncertainty.*
Practical Implications: *The findings show that deterministic valuation approaches underestimate the economic potential of fintech platforms exposed to volatile transaction volumes, evolving risk analytics, and multi-jurisdictional compliance demands. For operators and investors, incorporating real options into financial evaluation improves strategic planning, capital allocation, and risk management in early-stage digital finance ventures.*
Originality/Value: *The study provides an integrated framework that links fintech platform architecture with real-options theory, offering one of the first applications of both ROV and FOMF to invoice-trading models. The dual-metric approach distinguishes between theoretical optimal value and realised managerial outcomes, generating actionable insights for fintech strategy, valuation, and regulatory-technology alignment.*

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1. Introduction

This study examines how managerial flexibility affects the financial viability of a staged fintech venture operating an invoice-trading platform. The research addresses a central question: to what extent do real options and sequential decision-making improve the economic value of fintech projects exposed to technological, market and regulatory uncertainty?

The problem is relevant because digital working-capital platforms function in environments where transaction volumes, API stability, scoring accuracy, and compliance conditions change dynamically, making rigid valuation methods insufficient.

The aim of the study is to quantify the value of flexibility using two complementary approaches-Real Options Valuation (ROV) and the Financial Outcome of Managerial Flexibility (FOMF) applied to a three-phase development model of a hypothetical Invoice Trading Platform (ITP). The methodological contribution lies in integrating a full financial model with Monte Carlo simulation and a multi-stage decision tree, allowing explicit comparison between optimal (ROV) and realistic, path-dependent decisions (FOMF).

The introductory analysis establishes the novelty and topicality of the research by linking real-options theory with the operational characteristics of fintech platforms, a domain where staged scaling, high uncertainty and regulatory constraints make flexibility a key determinant of value. Information sources include empirical studies on fintech architectures, risk analytics, and SME financing, as well as theoretical literature on real options and decision analysis. The study is delimited to the perspective of the platform operator and focuses on economic outcomes of strategic decisions across the development horizon.

2. Literature Review

The rise of financial technologies (Fintech) is transforming access to working capital for small and medium-sized enterprises (SMEs). Modern peer-to-peer (P2P) platforms, invoice-trading marketplaces, and smart-IT solutions based on artificial intelligence (AI), machine learning (ML), distributed ledger technology (DLT), and smart contracts enhance information exchange, risk assessment, and automation of financial flows (Kou *et al.,* 2025; Ioannou *et al.,* 2022). Increasingly, these systems adopt a hybrid model combining P2P decentralization with a controlled client–server infrastructure to balance innovation with regulatory oversight.

Research confirms that P2P platforms improve credit access in areas underserved by banks. Jagtiani and Lemieux (2018) show that LendingClub fills systemic gaps by offering credit in low-branch-density regions. Morse (2015) notes that while P2P reduces information asymmetry, it requires central control through credit scoring, KYC, and AML procedures. This leads to intermediary models, where the operator acts as a trusted broker while investor–borrower links remain P2P.

In this study's operational model, the platform serves as a market intermediary, not a financial institution. It functions as a digital factoring marketplace, connecting firms seeking liquidity with investors. The platform neither accepts deposits nor grants loans and thus remains outside the CRD/CRR banking regime.

It operates within a hybrid P2P client/server structure, providing compliance, scoring, and verification, while money flows through licensed banks and payment institutions. Polish research (Waliszewski *et al.,* 2024) suggests that linking LendTech with the traditional banking sector strengthens financial stability and SME credit access. The hybrid model integrates AI/ML risk analytics with centralized compliance, offering a practical alternative to full decentralization.

Digital factoring exchanges connect receivables sellers with investors using hybrid architectures-centralized transaction engines supported by P2P mechanisms. Dorfleitner *et al.* (2017) found that invoice-trading markets efficiently price payment risk; Corrales *et al.* (2024) and Esteva *et al.* (2023) proved that ML and the Kelly criterion optimize capital allocation. In Poland, Walkusz and Dziadek (2024) highlight increasing digitization and automation, stressing the growing role of online factoring platforms for SMEs.

Operationally, such platforms ensure AML/KYC compliance but do not perform banking functions. Receivables insurance from external partners covers debtor default, reducing systemic risk and protecting investors. Operating as compliant

Fintechs, these platforms rely on licensed banks and insurers for fund transfers. The operator manages compliance, assignment documentation, and reporting in line with the Anti–Money Laundering and Counter–Terrorism Financing Act.

Smart-IT technologies support the automation and auditability of financial processes. Ioannou *et al.* (2022) note that the application of distributed ledger technology (DLT) in supply chain finance (SCF) enhances transparency and mitigates fraud, although it requires interoperability between enterprise resource planning (ERP) systems.

In a hybrid model, smart contracts implemented on the DLT layer cooperate with the platform's central module, which is responsible for legal compliance and risk monitoring. The literature suggests that fully decentralized P2P architecture is impractical within regulated markets.

A hybrid model (P2P + client–server) allows for a balance between transparency, automation, supervision, and security. Studies by Polish researchers (Waliszewski *et al.,* 2024; Walkusz and Dziadek, 2024) confirm that this architecture most effectively supports the development of digital financial platforms for SMEs, integrating AI/ML algorithms, KYC/AML compliance procedures, and DLT technology into a coherent Fintech ecosystem.

The Polish market has seen the emergence of several information technology solutions that facilitate working capital financing. Platforms such as Finea, PragmaGO, and NFG combine peer-to-peer (P2P) mechanisms with a client–server infrastructure, employing AI/ML algorithms and credit scoring models. Meanwhile, corporate supply chain finance (SCF) systems-such as Aleo.com and Comarch SCF-operate within a client–server architecture enhanced by microservices and ERP–API integrations.

In the banking sector, smart-IT solutions like Comarch Loan Origination and Santander e-Factoring are being implemented, integrating robotic process automation (RPA) with pilot DLT (Distributed Ledger Technology) modules. The examples presented in the table illustrate that the market's development trajectory is moving toward integrated systems that combine process automation with regulatory oversight, reflecting a broader convergence of technological innovation and compliance in the Polish Fintech ecosystem.

Table 1. *Examples of IT-Based Solutions Supporting Working Capital Financing in Poland*

Type of solution	Examples	Model	Technologies
Factoring online platform (B2B/P2P)	Finea, PragmaGO, NFG	Hybrid P2P–client/server	AI/ML, credit scoring, API
SCF Corporate	Aleo.com, Comarch	Client–server,	ERP-API, cash flow

Type of solution	Examples	Model	Technologies
Platform	SCF	microservis	analytics
Smart-IT banking systems	Comarch Loan Origination, Santander e-Faktoring	Client–server	AI, RPA, DLT integrations (pilot implementation)

Source: *Own elaboration based on product specifications and market reports: Finea (Santander Bank Polska), PragmaGO, Aleo.com (ING Bank Śląski), NFG SA, Comarch SA.*

The literature on digital working-capital finance shows that Fintech invoice-trading platforms operate under high and multi-dimensional uncertainty. Their performance depends on the stability of data pipelines, accuracy of ML-based credit scoring, and the reliability of PSD2 banking integrations. Incomplete financial data, inconsistent API standards or temporary AIS/PIS interruptions can distort risk assessment and disrupt settlement processes, directly affecting liquidity and investor confidence (Kou *et al.,* 2025; Ioannou *et al.,* 2022).

These technological dependencies amplify exposure to cybersecurity incidents and regulatory compliance failures, which are particularly consequential in platforms handling short-term receivables.

Market and financial volatility further intensify uncertainty. Transaction volumes fluctuate with SME liquidity cycles and macroeconomic shocks, while early-stage platforms lack diversification and strong network effects, making them sensitive to downturns in debtor payment behaviour (Walkusz & Dziadek, 2024). Regulatory fragmentation across the EU adds another layer of unpredictability, influencing cross-border expansion strategies (EBA, 2022).

Together, these technological, market and regulatory uncertainties create a highly variable environment in which rigid, deterministic valuation approaches underestimate both risk and the adaptive capacity of management. For staged Fintech ventures such as the ITP-moving from pilot to national scaling, to regional expansion-decisions on whether to continue, expand, delay or terminate investment are central to navigating volatility and protecting economic value.

Real options analysis provides the appropriate framework for capturing this flexibility, quantifying how managerial discretion mitigates downside exposure and enables the platform to capitalise on favourable market and technological conditions.

3. Methodology

The valuation of the analysed ITP was conducted in two stages. First, a three-stage cash-flow model was constructed, comprising: the pilot phase (MVP in Poland), domestic commercialisation (scaling in Poland), and regional expansion (CEE). Second, the value of managerial flexibility was assessed using the real-options framework and Monte Carlo simulation. The point of departure follows the classical real-options view, in which project value depends not only on discounted cash flows but also on the manager's ability to defer, expand, or abandon the investment contingent on unfolding information (Dixit and Pindyck, 1994; Trigeorgis, 1996).

Literature reviews emphasise that this interpretation of flexibility is particularly relevant for high-uncertainty, staged and scalable ventures, consistent with the characteristics of fintech transaction platforms (Savolainen, 2016; Lamberts-Van Assche and Compernolle, 2022).

4. Real Options Valuation (ROV): Backward Induction Framework

Real Options Valuation (ROV) is defined as the incremental project value arising from the ability to take contingent investment decisions - continuation, expansion, sale or termination at specified decision nodes, under the assumption of rational and optimal behaviour. Formally:

$$ROV = E[V_{ext} - V_{base}], \tag{1}$$

where V_{ext} denotes the project value assuming flexibility and an optimal execution policy, while V_{base} represents the value in the baseline scenario in which all phases are automatically continued until the end of the horizon without adaptation. By definition, $ROV \geq 0$, as flexible decisions may, but need not, be exercised, which is consistent with the theoretical properties of real options (Trigeorgis 1996; Copeland and Antikarov 2001).

ROV was estimated using a decision-tree approach based on backward induction, consistent with the decision-analytic literature on real-options valuation (Brandão, Dyer and Hahn, 2005).

The backward induction method in real option valuation involves calculating the value of an option by working backwards from the final (terminal) time step to the present, using a lattice or tree structure to represent possible future states of the underlying asset or project. At each terminal node, the value is determined by the payoff of exercising the option, and at each preceding node, the value is computed as the risk-neutral expected value of future option values, discounted at the risk-free rate, and considering the optimal exercise strategy at each step.

This recursive process ensures that at every decision point, the value reflects the maximum expected benefit, accounting for the possibility of early exercise or abandonment, as appropriate for American-style or other types of complex real options (Kumar, 2016; Hwang and Kim, 2024).

Backward induction combined with Monte Carlo simulation generates multiple stochastic paths of project value and evaluates, at each decision point, whether immediate exercise yields a higher payoff than the expected continuation value, typically estimated using regression-based techniques such as Least Squares Monte Carlo (Rodrigues and Armada, 2007). This approach enables the valuation of American-style and path-dependent real options under multiple sources of uncertainty, making it suitable for complex investment projects where analytical or purely tree-based methods are insufficient.

A decision-state tree is constructed for key nodes (t = 12, 36, 72 months). The procedure consists of:

- At the terminal node (t = 72): comparing continuation value (terminal value TV_{72}), sale value to a strategic investor (LV), liquidation value (0), and selecting the maximum admissible decision.
- At t = 36: discounting the chosen value from t = 72 to t = 36 and comparing the discounted continuation value (entering the CEE phase), sale value at t = 36 and liquidation (0). Expansion becomes available only when the predefined activation criteria (volume threshold) are satisfied.
- At t = 12: comparing continuation (transition to the Polish commercialisation phase), sale after the pilot, and termination. Expansion is admissible only if predefined activation criteria (number of invoices and technological readiness) are met.

The maximum available option value is selected at each node and discounted back to t = 0, reflecting rational optimal decision-making under full foresight. The resulting "with-flexibility" value (V_{ext}) is subsequently compared with the baseline "no-flexibility" scenario (V_{base}), in which all phases are executed sequentially without the possibility of sale or termination.

This dynamic-programming procedure follows standard practice in the valuation of compound real options using decision trees (Brandão, Dyer and Hahn, 2005; Savolainen, 2016).

4.1 Financial Outcome of Managerial Flexibility (FOMF): Simulation on the Decision Tree

While ROV provides an upper-bound estimate based on fully optimal decision-making, real-world managers operate under imperfect and locally available information. To capture this behavioural realism, the study applies the FOMF, a forward-looking, scenario-based metric derived from conditional Monte Carlo simulation.

Unlike ROV, FOMF does not assume full ex-ante optimisation; instead, it reproduces the realised financial effect of sequential decisions made solely on the information available at each decision point. Methodologically, FOMF is obtained by integrating Monte Carlo simulation with the decision-tree structure:

- generating a large number of stochastic paths for key variables (volume, revenues, costs, default rate),
- taking decisions in each path at t = 12 and t = 36 continuation, expansion, sale, or termination, based on realised cash flows and indicators (e.g., average volume, number of invoices processed, or fulfilment of other activation thresholds),
- computing the value of each path under such sequential decisions and comparing it with the baseline scenario in which all phases are continued automatically.

FOMF is defined as:

$$FOMF = E[V_{ext}^{subopt} - V_{base}], \quad (2)$$

where V_{ext}^{subopt} is the path-wise project value under decisions based on local information without global optimisation. Unlike ROV, negative values are not truncated - the effect of flexibility may be positive or negative, reflecting the possibility that some decisions made under uncertainty prove unfavourable ex post.

The integration of Monte Carlo simulation with a multi-stage decision tree corresponds to recommended practice for projects characterised by multiple, interacting uncertainties (Liu *et al.,* 2017; Savolainen, 2016; Lamberts-Van Assche and Compernolle, 2022).

4.2 Relationship Between ROV and FOMF

Both metrics - ROV and FOMF use the same cash-flow model, the same stochastic assumptions, and identical activation criteria (volume thresholds, technological readiness, entry conditions for CEE markets). They differ only in their informational and behavioural assumptions.

ROV is calculated using backward induction and assumes full rationality and dynamic optimisation across the entire tree. ROV represents the upper bound of managerial flexibility value.

FOMF reflects sequential, path-dependent decisions under limited information. The value may be positive or negative because it captures the realised financial outcome of flexibility under an operational decision policy.

Together, ROV and FOMF provide a dual perspective: the theoretical upper bound of flexibility and its practical financial impact under realistic managerial behaviour. The article reports ROV and FOMF jointly, allowing comparison between the "theoretical" potential value of managerial flexibility (ROV) and its simulated financial effect (FOMF) under realistic decision rules.

5. Research Results

5.1 Business Model of Invoice Trading Platform

To illustrate how the methodological framework could be applied in practice, the valuation is conducted for a staged fintech venture, the ITP. The presented ITP business model is a theoretical construct whose underlying assumptions reflect the typical architecture and operating principles of comparable real-world fintech platforms.

The project constitutes a suitable empirical setting for real-options analysis, as its development unfolds through sequential phases (pilot, national scaling, regional expansion), each associated with explicit managerial choices regarding continuation, expansion or termination. Such a structure captures the essence of managerial flexibility in startup environments and enables a direct mapping between theoretical option concepts and the operational dynamics of a real-world digital platform.

The analysed fintech the ITP, represents an AI-driven peer-to-peer invoice trading platform, designed to provide instant, data-driven financing for SMEs while simultaneously offering institutional and private investors a secure, yield-generating alternative to short-term deposits. The platform functions as a digital marketplace where unpaid invoices are listed, priced, and financed in real time through algorithmic risk assessment and automated transaction settlement.

The business model is built upon the idea of disintermediation in short-term financing, replacing bank factoring, where the approval of working-capital credit typically takes 1–3 weeks, with a fully automated, low-cost online infrastructure. From an investor perspective, the platform opens access to a new digitised asset class - short-term trade receivables - characterised by predictable maturities, stable yields (typically, depending on risk 7–18% annualised), and lower volatility compared to unsecured lending.

The ITP functions as a two-sided digital marketplace that intermediates between two categories of users, the SMEs seeking liquidity and investors seeking yield. The platform connects these actors through a rule-based mechanism that replaces standard procedures of conventional bank factoring with real-time, data-driven transactions.

The process begins when an SME uploads an issued but unpaid invoice to the platform to accelerate its cash inflow. Once submitted, the platform's AI-based risk engine automatically retrieves and analyses firm-level and sectoral data, including payment history, financial ratios, trade references, and behavioural indicators, to generate a dynamic credit score and estimate the probability of default. Based on this assessment, the platform proposes a discount rate reflecting both the credit risk of the debtor and current market demand.

The operational core of the ITP consists of several integrated technological layers that enable automation, scalability, and real-time risk assessment. An AI and Machine Learning (ML) layer supports credit scoring, anomaly detection, and dynamic invoice pricing based on historical payment data, financial ratios, and sector-specific indicators.

An API-based architecture allows secure data exchange with banks, credit insurers, and enterprise resource planning (ERP) systems, ensuring interoperability and efficient verification of transaction participants. The system is hosted on cloud infrastructure, which provides scalability, operational continuity, and rapid deployment across different national markets.

Optionally, a blockchain-based audit trail can be used to maintain immutable transaction records and support regulatory traceability. These components together enable near real-time trading and settlement processes, allowing invoices to be uploaded, assessed, and funded within a very short operational cycle.

An investor registered on the platform can then purchase the receivable at its discounted price, effectively advancing liquidity to the SME. For example, an invoice with a nominal value of €20,000 may be sold for €19,600, representing a 2% discount that becomes the investor's return when the debtor pays the invoice at maturity.

The transaction is executed automatically via an escrow account: the investor transfers funds to the platform, which immediately disburses the payment to the SME (net of the platform's transaction fee, typically depending on risk 0.8–1.2%). Thus, three financial flows occur within each transaction:

- The SME receives immediate working capital equal to the invoice value minus the discount (investor's yield) and the platform's service fee;
- The investor earns the difference between the invoice face value and the discounted purchase price once the debtor settles the invoice, corresponding to an annualised yield of approximately 7–18%, depending on maturity and credit grade;
- The platform operator retains its transaction fee as revenue for providing infrastructure, risk analytics, and regulatory compliance, while ensuring that default probabilities remain below the acceptable threshold (typically under 4%).

The platform's financial model assumes that all transactions are structured as monthly rolled-over financing cycles, in which receivables are funded for approximately 30 days and reinvested upon repayment, forming a continuous sequence of short-term liquidity and capital allocation operations.

a.

b.

5.2 Revenues

The analysed fintech project operates as a non-bank peer-to-peer invoice trading platform, which intermediates short-term financing between small and medium-sized enterprises (SMEs) seeking working capital and investors seeking higher returns than traditional deposits. The revenue model of the ITP consists of several complementary income streams reflecting the platform's dual role as a financial intermediary and technology provider.

The primary component is a transaction fee, charged on each financed invoice, which is explicitly risk-adjusted: it ranges from 0.8% for low-risk invoices to approximately 1.2% for cases where the estimated probability of default approaches the upper bound of 4%. This fee is typically expressed as a percentage of the invoice value and is deducted upfront from the amount transferred to the SME.

It compensates the platform for technology infrastructure, credit risk assessment, compliance (KYC/AML), and settlement operations. The platform's fee is independent of the credit performance of the underlying receivable and is realized at the moment of financing. This ensures a stable revenue stream even in volatile market conditions.

A secondary stream includes subscription fees for premium access to enhanced analytics and portfolio dashboards, API connectivity for automated trading, integration with enterprise ERP systems, credit scoring reports or debtor monitoring tools. These subscriptions are billed monthly, stabilizes the revenue base, reducing dependency on transactional volume volatility.

The average subscription price is set at €50 per month, with approximately one in four active SME clients maintaining a subscription account. Statistically, a single SME holds around 2.5 invoices, each averaging €20,000 in value, implying that the number of subscriptions scales proportionally with total financed volume.

Additional operational revenues derive from risk analytics and data services, where each credit-scoring request via the AI risk API generates a fee of €0.10. On average, two scoring queries are performed per invoice, complemented by an additional verification per SME client. The platform also charges €0.10 per operation for payment integration, KYC verification, and factoring-as-a-service functions, corresponding to roughly two operations per financed invoice.

Income components include also financial income (float), a marginal source of revenue, interest earned on funds temporarily held in escrow accounts during payment settlement cycles. When investors deposit funds or debtors repay invoices, the platform may hold those funds for short periods (typically 1 day) before disbursement. One-day financial liabilities to investors represent the only component of net working capital.

The platform may also derive commission-based revenues from partnerships with credit insurers and data providers. Approximately 70% of invoice volume is insured, with an average insurance cost of 0.5% of the financed amount recorded as an operational expense. The platform receives a 25% commission rebate from partner insurers and credit risk guarantors for client acquisition and data integration.

It should be noted that the platform does not retain credit exposure arising from SME insolvency or from potential losses on investor positions. Around 70% of the financed volume is protected through external credit-insurance arrangements, which shift the default risk to the insurer, whereas the remaining uninsured share of risk is carried by the investors themselves.

The revenue model leverages platform network effects - as the transaction volume and number of participants grow, marginal operational costs per transaction decline, while revenues scale almost linearly with traded volume. This enables the platform to achieve effective operating leverage typical of SaaS–fintech hybrids.

5.3 Market Scaling and Cost Structure Across Development Phases

The business model of the ITP assumes a gradual three-phase development path aligned with both market maturity and operational capacity. Each phase is associated with distinct cost dynamics, fixed and variable, reflecting the scale of technological infrastructure, regulatory compliance, and geographic reach.

Phase I – Pilot Deployment in Poland (12 months). The initial stage focuses on developing a minimum viable product (MVP), establishing the legal and technical framework, and conducting pilot operations with a limited group of SMEs and institutional investors. The total operating expenditure (OPEX) at this stage amounts to approximately €30,000 per month, covering:

- *IT infrastructure and maintenance (€10,000): hosting, licensing, and cybersecurity;*
- *Administration and compliance (€8,000): legal, accounting, AML, and GDPRprocedures;*
- *Personnel (€10,000): project and operational staff;*
- *Marketing (€2,000): online campaigns and pilot client acquisition.*

Variable transaction costs represent 0.5% of invoice volume, including payment processing, credit scoring (API queries), and insurance verification. Capital expenditure (CAPEX) of around €300,000 finances platform development and initial integrations, depreciated over five years (€60,000 annually).

Phase II – National Scaling in Poland (24 months). The second phase extends operations to commercial scale across Poland. The focus shifts toward sustained client acquisition, diversification across industries, and deeper automation of credit assessment. Monthly OPEX rises to €55,000, primarily due to personnel expansion (€15,000), marketing and partnerships (€13,000 combined), and growing compliance costs. CAPEX of €650,000 covers advanced AI model refinement, integration with national banking systems, and full language and legal localisation. Depreciation expenses increase proportionally (€130,000 per year).

***Phase III* –** Regional Expansion in CEE (36 months). The final stage involves cross-border expansion to the Czech Republic, Slovakia, Hungary, Romania, and the Baltic States. This requires local adaptations of scoring models, multi-currency API connections, and partnerships with insurers and financial institutions.

Monthly OPEX is estimated at €160,000, driven by IT scalability (€40,000), staff and operational support (€60,000), marketing (€20,000), and compliance (€30,000). Variable transaction costs remain at 0.5% of financed volume, reflecting operational efficiency and economies of scale. CAPEX investment for this stage is projected at €1.5 million, primarily for infrastructure scaling, multi-jurisdictional compliance, and integration with alternative investment funds (AIFs). Depreciation amounts to €300,000 annually.

This staged cost trajectory aligns with the stochastic growth assumptions used in the Monte Carlo simulation of transaction volume and captures the incremental risk–return trade-offs associated with technological, regulatory, and geographic scaling of the platform.

5.4 Assumptions for Transactions Volume and its Risk Estimation

The projected transaction volume of the analysed fintech platform is modelled as a stochastic multiplicative process with monthly time steps, employing a lognormal distribution to capture asymmetric growth patterns and the realistic volatility associated with market adoption.

This modelling framework reflects the platform's progressive business development in three distinct stages. The pilot phase corresponds to product validation and early user acquisition; the scaling phase within the Polish market captures the transition toward operational stability, brand credibility, and improved unit economics; and the cross-border expansion phase represents a mature stage of growth driven by geographic diversification and partial market saturation across Poland, the Czech Republic, Slovakia, Hungary, Romania, and the Baltic States. The underlying quantitative assumptions for each stage are summarised in Table 1.

***Table 2.** Assumptions for the growth rate of the transaction volume in the ITP model*

Phase	Duration (months)	Mean	Std Dev	Shock probability	Shock multiplier
Pilot PL	12	1.10	0.25	15 %	0.80
Scaling PL	24	1.07	0.20	12 %	0.85
Expansion CEE	36	1.05	0.18	10 %	0.90

***Source:** Authors' assumptions.*

The simulation starts from an initial trading volume V_0= EUR 500,000, representing the assumed average cumulative value of financed invoices during the first pilot month. The monthly transaction volume evolves multiplicatively, with each period's volume determined by the previous month's level adjusted by a stochastic growth factor. This growth factor follows a lognormal distribution, ensuring non-negative dynamics and capturing the asymmetric variability typically observed in fintech transaction flows.

This choice ensures that all simulated values remain strictly positive and that growth shocks are multiplicative, consistent with empirical observations of early stage fintech's (where volume increases are driven by user adoption and network effects rather than linear trends). Each phase of development is defined by its duration, expected monthly growth rate (mean), volatility (std dev), and parameters describing rare negative shocks (shock probability and shock multiplier).

A binary market shock mechanism introduces the possibility of systemic or regulatory disruptions. In any given month, a shock occurs with a probability defined for each phase. If triggered, the growth factor is multiplied by a shock multiplier. This mechanism allows the Monte Carlo simulation to capture low-frequency, high-impact events such as regulatory tightening, data-breach incidents, or liquidity shortages.

The risk associated with the volume of invoices sourced by the platform is modelled as a triangular random variable drawn independently each month. The three scenarios: low, average and high-volume risk, that are linked to default-probability levels of 0.5%, 1.5% and 4.0%, respectively, reflecting the empirical tendency for greater sourcing uncertainty to coincide with weaker average invoice quality.

The upper bound of 4% represents the platform's risk-tolerance limit and directly affects the transaction fee and investors fee (0.5%-1.5%), which increases in line with the implied probability of default.

The capital structure of the ITP evolves along its development trajectory, reflecting the firm's access to external financing and its risk–return profile. In the pilot phase, the venture is assumed to be entirely equity-financed (D/V = 0%), as early-stage fintech projects typically rely on founder equity, public grants, or seed capital due to the absence of collateral and untested cash flows (OECD, 2022; EVCA, 2021).

Initial expenditures amount to EUR 600,000, of which EUR 300,000 is allocated to CAPEX and the remaining EUR 300,000 to operating costs during the pilot phase in Poland. During the national scaling phase, the company is expected to attract venture debt or partner-backed credit lines, increasing leverage to approximately D/V = 20%.

This level reflects partial creditworthiness, positive transaction history, and emerging profitability. In the regional expansion phase, the platform is assumed to secure bank or institutional financing through structured facilities or mezzanine instruments, with D/V = 40%, consistent with typical leverage for mature fintech service providers with diversified markets (EBA, 2022; World Bank, 2021). The cost of long-term debt, based on European Central Bank statistics, is set at 7.75% (see: ECB, 2025).

For valuation and simulation purposes, a constant discount rate (WACC = 12%) is applied across all phases. Although the theoretical WACC would decline with maturity, a unified rate allows comparability between conditional and unconditional scenarios in real-option valuation, isolating the financial outcome of managerial flexibility (FOMF) from changes in the cost of capital. he 12% WACC reflects the moderately higher end of the average cost of capital typically observed among early-stage non-bank fintech's in Central and Eastern Europe (Bank of Spain, 2023).

6. Managerial Flexibility

The investment project spans 72 months and progresses through three sequential development stages: a pilot phase (0–12 months), a national commercialisation phase in Poland (12–36 months), and a regional expansion phase across Central and Eastern Europe (36–72 months). At the end of each stage, the investor faces a discrete decision point at which continuation, expansion, sale, or termination of the project is possible. These nodes reflect the staged nature of fintech platform development and form the decision structure used both in the real-options model and in the simulation of managerial flexibility.

Initial Stage: t = 0 - Investment Commitment. The project begins with an initial decision on whether to commit funds to develop the minimum viable product and launch the pilot. At this point, no operational data exist, and uncertainty is maximal. The investor chooses between undertaking the initial capital expenditure and commencing the pilot or refraining from investment altogether. This first branching corresponds to a now-or-never option, typical for digital platform ventures, where early cash flows are deliberately negative and value depends on future scaling.

Pilot Completion: t = 12 - Validation and First Strategic Choice. After 12 months, the pilot phase provides the first substantial information set about the platform's technological maturity and early commercial traction. By this point, the system has undergone live testing with SMEs and investors, and data are available on operational stability and API readiness, performance of credit-scoring algorithms, number of uploaded invoices and their total value, compliance with KYC/AML processes, the speed and reliability of the settlement workflow. At this decision point, the investor may pursue one of three paths.

First, the project may transition into full commercialisation in Poland, but only if two pre-defined conditions are met: the platform must reach the technological readiness (what is a random variable with 90% of probability of success), and the pilot must generate a minimum operational scale equivalent to approximately 250 invoices, assuming an average invoice size of €20,000.

These thresholds represent standard "proof-of-concept" criteria indicating viable product–market fit and operational reliability. If these thresholds are not achieved, continuation is not advisable. The investor may instead exit the project, selling the developed technology and early-stage operational know-how. The expected sale price at this stage is modest and reflects the limited maturity of the asset; it is approximated as a fraction (0.8) of the last 12 months' revenues. Finally, if prospects are poor and the market value is negligible, the investor may terminate the project.

Commercialisation Completion: t = 36 - Scaling Decision. By month 36, the platform has completed two years of commercial operations within Poland. The investor now has access to performance data under real market conditions: average monthly transaction volumes, realised fee income, observed default rates, customer acquisition costs, and system scalability.

This phase is crucial because it reveals whether the underlying business model can sustain positive unit economics in a single, well-defined jurisdiction. At this point, the investor faces a second strategic choice. If the platform has reached sufficient operational scale defined as an average monthly traded invoice volume of at least €5 million in the preceding 12 months, the project may undertake expansion into the broader CEE region. This represents a major investment decision because cross-border deployment requires localisation of scoring models, additional regulatory compliance assessments, integration with regional data providers, and expansion of onboarding processes for SMEs and investors.

If the volume threshold is not met, or if the risk–return characteristics appear unfavourable, the investor may instead sell the business. At this stage, sale values are higher than in the pilot phase (1 x yearly revenues) because the platform is now a functioning financial infrastructure serving a real market. Conversely, if both continuation and sale prove unattractive, the investor retains the option to cease operations.

Final Horizon: t = 72 - Terminal Decision. The final stage occurs at month 72, after the platform has been operating across several CEE markets. By this point, most sources of operational uncertainty have materialised, and the business reaches a relatively mature, steady-state configuration. The investor must then choose the final course of action.

One option is to retain the platform, valuing it through a terminal value calculation based on normalised free cash flows from the last 12 months, assuming no long-term growth. This reflects the steady-state maturity typical for financial infrastructure providers operating in saturated regional markets.

Alternatively, the investor may sell the platform to a strategic acquirer, such as a payment provider, factoring firm, digital bank, or a financial infrastructure consolidator. Since the platform is now multi-jurisdictional and exhibits network externalities, typical acquisition premiums are higher than in earlier stages 1.5 x yearly revenues). The final option-termination-is usually dominated by the two preceding choices but remains embedded as a theoretical lower-bound payoff.

Managerial flexibility generates economic value by allowing the investment path to be adapted to new information revealed at each stage of the project's development. Unlike a rigid venture that must continue irrespective of performance, a flexible platform can be expanded when market and operational conditions are favourable, suspended or liquidated when results deteriorate, or sold when its market value exceeds the value of further continuation.

This asymmetry - limiting losses in adverse states while capturing upside potential in favourable ones, increases the expected project value relative to a scenario without flexibility. In the case of the ITP, the investment exhibits the properties of a real option to expand, as technological and regulatory validation in one market allows subsequent scale-up to multiple jurisdictions at relatively low marginal cost.

At each transition point, the project embeds two strategic choices: to expand if conditional cash flows justify further investment, or to exit when continuation becomes economically unjustified. The quantification of these strategic choices through ROV and FOMF is therefore essential. These measures capture, respectively, the theoretical upper bound of value attainable under optimal decision-making and the realised financial effect of sequential decisions under uncertainty, forming a necessary foundation for informed investment and managerial decision-making.

7. Financial Models – Base and Extended

To evaluate both the ROV and FOMF, two Monte Carlo–based NPV models were constructed, each operating on the same stochastic structure but differing in the treatment of managerial decisions. In both models, the key sources of uncertainty are represented by random variables capturing: 1) monthly transaction volume, modelled as a multiplicative lognormal process across the three development phases; 2) the monthly volume-risk parameter, drawn from a triangular distribution (low, average, high); and 3) the binary probability that the platform achieves technological readiness after the pilot phase (90% success, 10% failure). These stochastic inputs ensure that each simulated path reflects a realistic combination of operational and market variability affecting early-stage fintech platforms.

The first model constitutes the baseline NPV scenario without managerial flexibility. It assumes that the project progresses mechanically through all stages-pilot, national scale-up, and regional expansion-regardless of realised performance or risk conditions. Capital expenditures are incurred deterministically at predefined milestones, and the project is completed even in adverse scenarios.

At the end of the 72-month horizon, the terminal value is estimated as 0.8 × the sum of FCFF generated in months 61–72, assuming zero long-term growth. This conservative formulation reflects the expected stabilisation of revenues once regional scale has been achieved and incorporates a discount for competitive and regulatory risks characteristic of late-stage fintechs. The resulting NPV represents the economic benchmark (V_{base}) against which the value of flexibility is measured.

The second model incorporates managerial flexibility and forms the basis for calculating both ROV and FOMF. At each decision node ($t = 12, 36, 72$), the model evaluates the admissible strategic actions - continuation, expansion, sale, or termination - conditional on the information available in that node.

In the ROV framework, decisions follow the optimal strategy obtained through backward induction: the model selects the option that maximises project value under full rationality and perfect foresight. In the FOMF framework, decisions are path-dependent and based solely on realised local information, which may lead to non-optimal behaviour.

This distinction reproduces the economic difference between theoretical option value and the practical outcome of sequential decision-making under uncertainty. Options are executed only when predefined activation conditions-such as volume thresholds or technological readiness-are satisfied.

Across both models, project cash flows are calculated as Free Cash Flow to the Firm (FCFF). FCFF was selected because it isolates the underlying operating performance from financing decisions, which is essential when valuing real, stage-dependent managerial actions. Using FCFE would embed changes in leverage and net borrowing into the analysis and distort comparability between development stages, especially given the evolving debt-to-value ratio.

In accordance with standard practice in real options and Monte Carlo valuation, FCFF is discounted at the project-wide WACC of 12%, ensuring methodological consistency across all simulated strategic paths.

The financial model supporting the simulations comprises a full set of interlinked statements: the income statement, balance sheet, and cash-flow statement. A corporate income tax rate of 19% is applied. Long-term debt bears an interest rate of 7.75% (ECB, 2025), and short-term liquidity shortages are financed through revolving credit at 9.75%, repaid immediately when cash surpluses arise. Cash flows are therefore constructed strictly from the firm's perspective and discounted using a constant project-level rate, enabling an NPV-based evaluation of efficiency across scenarios.

Both simulation models were validated and verified prior to their use in the ROV and FOMF valuation. Validation was conducted through a series of standard stress-testing procedures, including the examination of extreme-value behaviour (very low and very high transaction volumes, boundary default probabilities, and zero-growth conditions) to ensure numerical stability and economic plausibility.

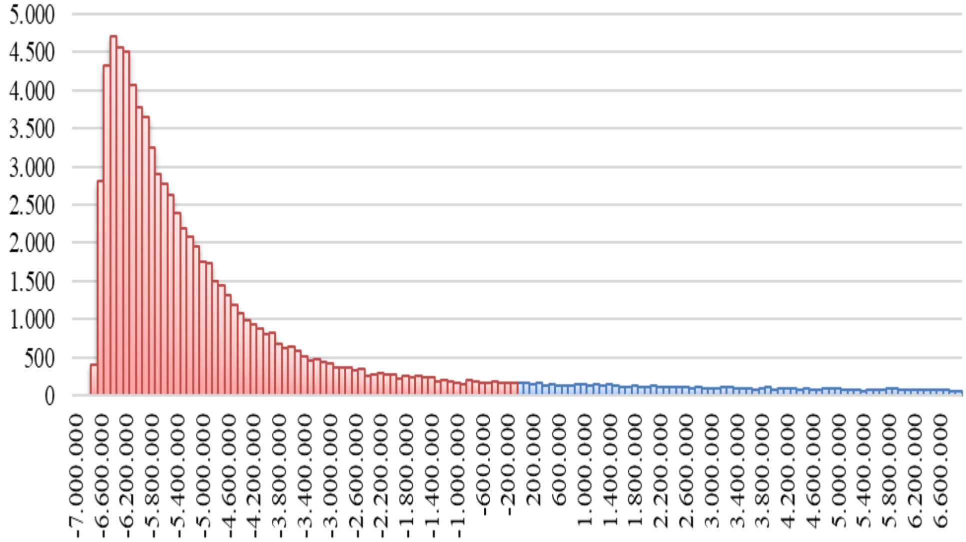
Under economically reasonable parameter settings, the models behaved as expected: higher volume volatility reduced expected NPV, credible activation thresholds determined the exercise of expansion options, and negative-shock scenarios systematically shifted the distribution of cash flows without producing pathological outcomes.

Verification also included internal consistency checks between the income statement, balance sheet and cash-flow modules, ensuring that FCFF, depreciation schedules, tax effects, and working-capital adjustments remained coherent across all simulated paths. Both the baseline and extended models were executed using 100,000 Monte Carlo iterations, which ensured convergence of the simulated NPV distributions. The resulting standard errors of simulated mean values remained within an acceptable range of 0.3%–0.8% of expected NPV across development phases, indicating sufficient numerical precision for comparative analysis.

Together, these two simulation models - one without flexibility, the other embedding contingent managerial actions (Figure 1. And Figure 2.) form the analytical foundation for estimating ROV and FOMF in accordance with the methodological framework outlined earlier. As established, the first stage involves modelling the project through three sequential development phases, while the second stage applies real-options logic and Monte Carlo simulation to quantify the economic value of managerial flexibility in a high-uncertainty, scalable fintech venture.

The Monte Carlo simulation (100,000 iterations) of the baseline, no-flexibility scenario generates a highly right-skewed NPV distribution, with skewness of 39.49 and extreme kurtosis (3,279). Although the mean NPV is positive (€2.63 million), the median is strongly negative (–€5.24 million), indicating that the majority of simulated paths result in economic loss, while the expected value is driven by a small number of rare high-growth outcomes.

***Figure 1.** Distribution of Base Project Value (NPV + Terminal Value)*



***Source:** Authors' calculation using Oracle Crystal Ball.*

The high standard deviation (€41.43 million) reflect the volatility typical of early-stage fintech ventures. The probability of achieving a non-negative NPV is only 20.7%, showing that a rigid, non-adaptive investment strategy produces an unfavourable risk–return profile.

This distributional pattern demonstrates that, without flexibility, the project is dominated by downside outcomes, which highlights the importance of managerial adaptability assessed later through the ROV and FOMF frameworks.

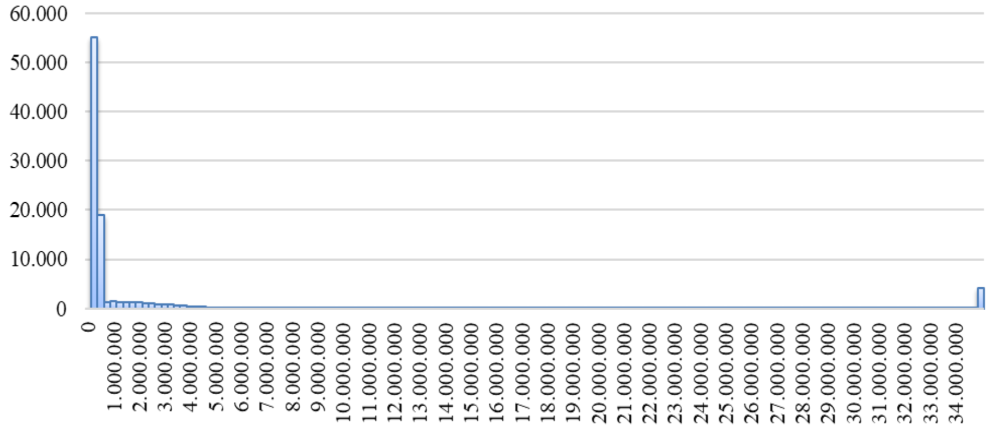
The simulation of the extended NPV model yields a highly right-skewed distribution, indicating the presence of rare but extremely high-value outcomes.

The mean NPV amounts to €5.95 million, while the median is only €207,410, showing that although the expected value is positive, most trajectories generate relatively modest economic gains, and the overall distribution is dominated by a small fraction of high-growth paths.

The high standard deviation: €39.4 million and range: €4,967 to €4.81 billion is reflecting the volatility inherent in multi-stage fintech expansion. This NPV distribution will serve as the basis for computing the FOMF, obtained by subtracting the baseline no-flexibility NPV for each iteration.

The resulting difference captures the realised financial effect of managerial flexibility under sequential decision-making.

Figure 2. *Distribution of Extended Project Value (conditional NPV + Terminal Value)*



Source: *Authors' calculation using Oracle Crystal Ball.*

8. Valuation of Managerial Flexibility

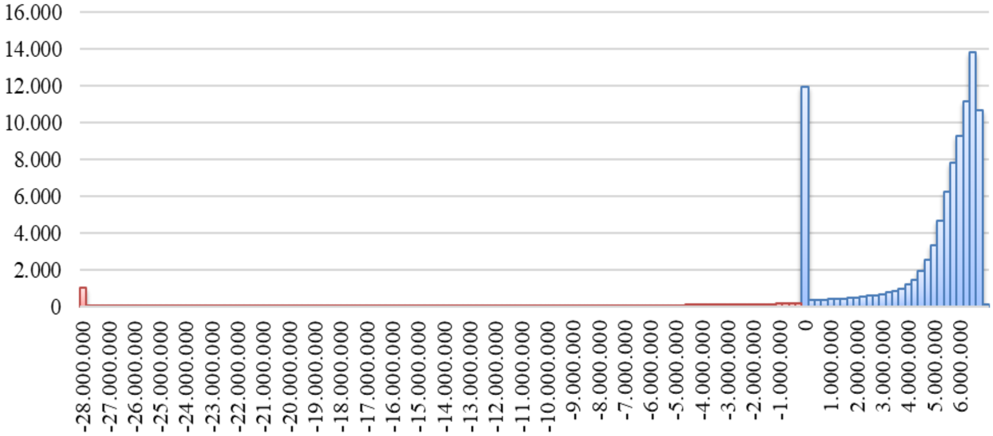
A direct comparison of the two simulated NPV distributions - baseline and extended - yields the FOMF, calculated for each Monte Carlo iteration as the difference between the conditional (flexibility-enabled) project value and the baseline no-flexibility value. This procedure follows the valuation framework specified in the methodological subsection, where the construction of both models and the principles of deriving ROV and FOMF were formally established.

In the simulation, the platform exercised its flexibility options with markedly asymmetric frequencies. The expansion to the Polish market was triggered in 72.5% of all paths, reflecting that the pilot phase typically generates sufficient volume and technological readiness to justify domestic scale-up.

The more demanding expansion to the CEE region occurred in 21.2% of paths, consistent with higher thresholds related to cross-border scalability and market maturity. Both expansion options were exercised jointly in 27.3% of cases, whereas 27.5% of trajectories did not justify any expansion. In 45.2% of paths only the Polish expansion option was exercised. The distribution of FOMF values is presented in Figure 3.

The FOMF distribution captures the realised financial effect of managerial flexibility under sequential, path-dependent decision-making. The results indicate that flexibility substantially improves the project's economic profile. The median FOMF equals €5.60 million, and the mean amounts to €3.32 million, showing that in the majority of scenarios managerial decisions based on locally available information generate additional economic value relative to a rigid, non-flexible investment path.

Figure 3. *Distribution of FOMF Value*



Source: *Authors' calculation using Oracle Crystal Ball.*

The probability of obtaining a non-negative FOMF is 93.95%, indicating that flexibility almost always improves financial performance for this type of fintech platform. The distribution remains wide (standard deviation: €11.2 million; range: –€0.75 million to €6.77 million), reflecting the volatility of early-stage, multi-phase fintech ventures.

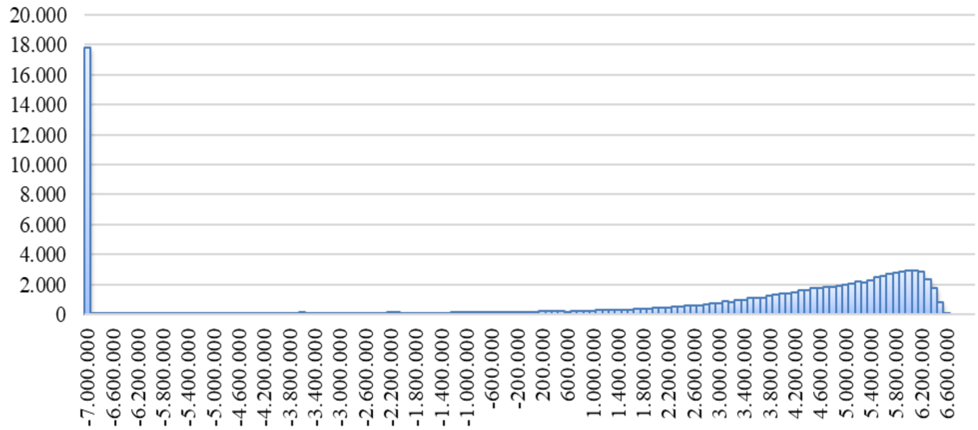
Negative outcomes, though rare, arise in paths where sequential decisions triggered by local information lead to premature expansion or delayed exit in adverse conditions. The left tail is limited, confirming that managerial missteps can reduce value but do so to a relatively small extent compared with the upside margin.

Overall, the FOMF results demonstrate that for an invoice-trading platform operating under technological, market and volume uncertainty, managerial flexibility is a critical driver of value creation, enabling adaptation to unfolding information and materially increasing expected project returns.

The ROV estimate is obtained using backward induction, following the methodology outlined earlier, where each decision node is evaluated under full rationality and perfect foresight. At every stage, the model selects the option-continuation, expansion, sale, or termination-that maximises expected project value, yielding the upper-bound measure of managerial flexibility for the analysed fintech platform.

In a venture characterised by technological uncertainty and volatile transaction volumes, this optimisation reflects the project's theoretical strategic potential. The option to expand is exercised only when predefined thresholds are met, while exit options prevent value destruction when continuation becomes unprofitable. By comparing this optimised value with the baseline no-flexibility scenario, the ROV quantifies the maximum economic gain attributable to flexible, state-contingent decision-making (Figure 4).

Figure 4. *Distribution of ROV Value*



Source: *Authors' calculation using Oracle Crystal Ball.*

The ROV distribution represents the upper-bound economic value of managerial flexibility for the analysed invoice-trading platform, obtained through backward induction under the assumption of fully optimal, perfectly informed decision-making. The results indicate a concentrated and strictly non-negative distribution, with a median ROV of €5.60 million and a mean of €4.48 million, reflecting the expected gain from exercising only value-maximising actions at each decision node.

The distribution exhibits low dispersion relative to other project components (standard deviation: €2.40 million), consistent with a model in which suboptimal decisions and negative outcomes are ruled out by construction. The left tail is truncated at zero, as real options cannot destroy value in the optimal-policy framework.

Compared with the FOMF distribution, the ROV results are more stable and more tightly clustered. While both metrics identify managerial flexibility as a major driver of value, their economic interpretations differ. ROV quantifies the theoretical maximum value attainable under idealised behaviour, where managers always choose the globally optimal continuation, expansion, or exit option.

FOMF, in contrast, reflects the realised effect of decisions made with limited, path-dependent information, allowing for delays, premature expansions, and occasional negative flexibility effects.

As a result, FOMF exhibits a wider distribution, includes negative values, and produces a lower mean than ROV, even though its median is similar due to the mass of positive outcomes.

9. Conclusions, Proposals, Recommendations

The analysis shows that managerial flexibility is a first-order driver of value creation in invoice-trading fintech platforms operating under high technological, market and regulatory uncertainty. In the baseline, no-flexibility scenario, the project exhibits a highly unfavourable risk–return profile: the probability of achieving a non-negative NPV is only 20.7%, and the distribution is dominated by downside outcomes despite a positive mean driven by a few extreme high-growth paths.

Once flexibility is introduced, both the ROV and FOMF metrics indicate a substantial uplift in economic value. The median FOMF of €5.60 million and a 93.95% probability of non-negative FOMF imply that, even under locally informed, path-dependent decisions, managerial discretion almost always improves outcomes relative to a rigid investment path.

The ROV measure, with a mean of €4.48 million and a non-negative, tightly clustered distribution, quantifies the theoretical upper bound of value attainable under fully optimal decision-making. Together, these results demonstrate that, for staged fintech ventures such as the ITP, expansion, exit and termination options are not marginal refinements but core determinants of viability.

A key methodological contribution lies in the integrated use of a three-phase FCFF model, a multi-node decision tree and Monte Carlo simulation to derive both ROV (via backward induction) and FOMF (via conditional, path-wise decisions) within a single, internally consistent framework.

The study shows that it is possible to keep the cash-flow and risk structure identical across models and isolate the pure effect of managerial flexibility, rather than changes in leverage or discount rates.

For practitioners, this dual perspective clarifies the gap between "strategic potential" and "operationally achievable" value and offers a quantitative basis for deciding whether to proceed with pilot deployment, national scaling or regional expansion.

The study is subject to several limitations: the ITP model is a calibrated theoretical construct rather than one estimated on historical platform data; key parameters (volume growth, risk distributions, WACC, option payoffs) are assumed; and managerial decision rules in the FOMF framework are stylised and do not capture richer behavioural or competitive dynamics.

Future research should empirically calibrate similar models using data from operating platforms, enrich decision rules with learning and updated risk parameters, and extend the analysis to other fintech business models and investor-level outcomes to test robustness and practical applicability of the proposed framework.

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