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Print ISSN: [3006-2497](https://doi.org/10.5281/zenodo.23000481) Online ISSN: [3006-2500](https://doi.org/10.5281/zenodo.23000481)Platform & Workflow by: [Open Journal Systems](https://doi.org/10.5281/zenodo.23000481)<https://doi.org/10.5281/zenodo.23000481>**Cash on Delivery, at Last****Supply Chain Finance, SME Automation and the Financing Efficiency of Small Logistics Firms in the United States: A Resilience Perspective with a Business Action and Marketing Plan****Faizan Ahmed**

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fiza46755@gmail.com**Abstract**

A delivery, for a small carrier, is only half a transaction; the other half is getting paid. This paper examines how supply chain finance (SCF) and the automation of small and medium-sized enterprises (SMEs) can raise the financing efficiency of the United States logistics industry, where 95.5 per cent of motor carriers run ten trucks or fewer. Extending the evidence of Wu, Zhang and Zhang (2024) from Chinese listed SMEs to a sector of private, thinly capitalised firms, it develops a proof-to-cash framework in which automated, data-verified proof of delivery turns a load into a receivable that a financier can price on the credit of the shipper or broker rather than on that of the carrier. Five propositions are examined with public U.S. data and a calibrated Monte Carlo model (10,000 draws) of a representative ten-truck carrier. Converting deliveries into cash costs the baseline carrier a median 4.57 per cent of revenue and takes 18.8 revenue-weighted days. Automation alone lowers the cost to 3.27 per cent, SCF alone to 4.05 per cent, and the two together to 2.60 per cent, cutting the cycle to 7.4 days, releasing about \$67,000 of working capital and saving about \$43,000 a year. The combination is superadditive in 96 per cent of draws and absorbs a downturn shock with 41 per cent less deterioration. Per-load pricing removes the penalty that fixed fees would impose on owner-operators. The findings are translated into an explicit 36-month business action plan, a go-to-market and marketing strategy, an industry roadmap and a mapping to Sustainable Development Goals 8, 9 and 13.

Keywords: supply chain finance; reverse factoring; SME automation; U.S. logistics industry; trucking; financing efficiency; supply chain resilience; business action plan; B2B marketing; Sustainable Development Goals

JEL classification: G23; G32; L91; M31; O33; Q01

1. Introduction

Two of the best-known names in American finance began life in the freight business. In 1850 a group of express messengers, among them Henry Wells and William G. Fargo, merged their businesses as the American Express Company and built a network of offices that carried parcels, drafts and valuables from the East Coast into the Midwest. When the company's board declined to follow the Gold Rush west, Wells and Fargo founded Wells, Fargo & Co. in March 1852 to give California what it most lacked: reliable freight shipping and reliable payment, offered across the same counter (Wells Fargo, n.d.). Neither man saw anything odd in the combination. A delivery, to them, was a financial event. Goods moved one way, money moved the other, and whoever could vouch for both could charge for the certainty.

A century and three-quarters later, the two halves of that bargain have drifted apart. A small carrier in Ohio or Texas can deliver a load on a Monday and wait until the middle of the following month to be paid for it. Meanwhile it pays for diesel, drivers, insurance and truck instalments weekly, and sometimes daily. The gap is bridged by factoring companies, credit cards, merchant cash advances and the owner's savings, in roughly ascending order of cost and descending order of dignity. The freight is fast; the money is not.

The mismatch is not a curiosity at the edge of the American economy. U.S. business logistics costs reached \$2.4 trillion in 2023, or 8.7 per cent of gross domestic product (Council of Supply Chain Management Professionals [CSCMP], 2024). Trucking earned \$987 billion that year and hauled 11.18 billion tons of freight, yet it remains an industry of small firms: 95.5 per cent of carriers operate ten or fewer trucks and 99.6 per cent fewer than one hundred (American Trucking Associations [ATA], 2024). Across the wider economy, the Federal Reserve's Small Business Credit Survey found that 56 per cent of employer firms had difficulty paying operating expenses in 2024 and 51 per cent reported uneven cash flows; of those that applied for financing, only 41 per cent received all they sought (Federal Reserve Banks, 2025). The largest specialist lender to the freight sector called 2024 "the longest downturn in the freight market since trucking deregulation in 1980" and reported that its count of small-carrier clients continued to contract (Triumph Financial, 2025). The spring of 2025 has added its own uncertainty. Real GDP fell at an annual rate of 0.3 per cent in the first quarter, primarily reflecting an increase in imports (Bureau of Economic Analysis [BEA], 2025), and a new schedule of tariffs was announced on 2 April 2025 (Executive Order No. 14257, 2025). Uncertainty of this kind is paid for, first and most heavily, by firms without a cash buffer.

Two bodies of research offer remedies but seldom speak to each other. The literature on supply chain finance (SCF), in which a creditworthy buyer's approval of an invoice allows its supplier to borrow at the buyer's cost of credit, has concentrated on manufacturers, retailers and their larger suppliers (Gelsomino et al., 2016; Xu et al., 2018). The literature on digitalisation and automation, for its part, has mostly counted operational gains. Wu, Zhang and Zhang (2024) are a welcome exception. Exploiting China's 2018 supply chain innovation pilot in a difference-in-differences design, they report that supply chain digitalisation raised the financing efficiency of small and medium-sized enterprises (SMEs) listed in Shenzhen, and that the effect travelled through supply chain resilience. The result is suggestive, but it describes listed firms, a state-led pilot and a Chinese credit system. Whether anything like it holds for America's small, private and unlisted logistics firms, and what a business would have to do to make it hold, has not been examined.

This paper asks three questions. First (RQ1), through what mechanisms can SCF and SME automation raise the financing efficiency of small U.S. logistics firms? Second (RQ2), how large are the gains for a representative carrier, are the two levers complements or substitutes, and do they make carriers more resilient to a downturn? Third (RQ3), what explicit business action plan and marketing strategy would turn the gains into practice, and how do they align with the Sustainable Development Goals (SDGs)?

To answer them, the paper combines a review of the finance, operations and logistics literatures with public U.S. evidence dated no later than May 2025; a conceptual proof-to-cash framework with five propositions; and a transparent Monte Carlo model of the delivery-to-cash cycle, calibrated to published figures. It then translates the results into a 36-month action plan for a platform venture, set within an industry roadmap, together with a go-to-market strategy and an SDG map.

1.1 Novelty and value added

The paper makes five contributions that, to the author's knowledge, have not previously been brought together.

- (1) **Context.** It moves the digitalisation, finance and resilience question from listed Chinese SMEs to the U.S. logistics industry, where the typical firm is a private carrier with fewer than ten trucks and no published accounts.
- (2) **Mechanism.** It identifies proof of delivery, rather than digitalisation in general, as the hinge on which SCF and automation turn: a verified delivery is what converts a load into a receivable that a third party can safely finance. This extends the insight of Baker and Hubbard (2004), that on-board computers changed who owned the truck, to the question of who finances the load.
- (3) **Evidence.** It offers a calibrated simulation of a U.S. carrier's delivery-to-cash cycle that separates the effects of automation, SCF and their interaction, decomposes the interaction into its channels, and stress-tests all three against a freight downturn.
- (4) **Practice.** It converts the findings into an explicit, costed and time-bound business action plan with key performance indicators (KPIs), a risk register and a marketing strategy, rather than leaving the implications at the level of exhortation.
- (5) **Sustainability.** It maps each component of the plan to specific SDG targets and indicators, and proposes a green pricing tier that rewards verified fuel efficiency.

Section 2 reviews the literature and the base study. Section 3 presents the framework and propositions, and Section 4 the U.S. evidence. Section 5 describes the simulation and Section 6 its results. Sections 7 and 8 set out the business action plan and the marketing strategy, Section 9 the SDG alignment, Section 10 the discussion and Section 11 the conclusion.

2. Literature Review

2.1 An old idea in new clothes

Supply chain finance is older than its name. For centuries the hundi served South Asian merchants as a bill of exchange and a good deal more: an indigenous banking system whose central purpose was trade (Martin, 2009). Its European cousin, the bill of exchange, did similar work between Florence, Bruges and London. What is new is the coincidence of three conditions: large buyers whose credit is better than that of their suppliers, digital records that can prove an obligation exists, and financiers willing to lend against one party's promise to pay another. The Global Supply Chain Finance Forum (2016) defines SCF as the use of financing and risk-mitigation

techniques to optimise the working capital and liquidity invested in supply chain processes and transactions, and notes that it is typically triggered by supply chain events. The last phrase deserves emphasis. For a carrier the decisive event is the delivery; until it is proven, there is nothing to finance.

The toolkit includes payables finance (often called reverse factoring), receivables discounting, factoring, dynamic discounting and inventory finance (Global Supply Chain Finance Forum, 2016). Early conceptual work framed SCF as the optimisation of financial flows across company boundaries (Hofmann, 2005; Pfohl & Gomm, 2009). Reviews by Gelsomino et al. (2016) and Xu et al. (2018) chart a literature that grew quickly after 2010 but remained centred on programmes designed by large buyers. Empirical studies have examined financial supply chain management practices (Wuttke et al., 2013), adoption decisions (Caniato et al., 2016; Wuttke et al., 2016) and the cash-to-cash cycle as a shared rather than a single-firm measure (Hofmann & Kotzab, 2010; Randall & Farris, 2009).

Reverse factoring, the instrument at the centre of this paper, lets a supplier sell an invoice that its buyer has approved, at a discount priced on the buyer's credit. Its value to the supplier depends on the spread between the two parties' borrowing costs and on the payment term (van der Vliet et al., 2015). Theory suggests that buyer intermediation can raise efficiency (Tunca & Zhu, 2018), that reverse factoring can benefit both parties even without a rating advantage (Kouvelis & Xu, 2021), and that it can relieve the fraud problem that burdens conventional factoring (Zhu & Ou, 2023). Adoption nevertheless falters among small suppliers, for whom onboarding, know-your-customer checks and minimum volumes loom large (Dello Iacono et al., 2015; Lekakos & Serrano, 2016). Artificial intelligence has begun to lower those hurdles through automated credit assessment, fraud prevention and onboarding (Ronchini et al., 2024).

SCF has also had its cautionary tale. Greensill Capital, which had prospered by paying other companies' suppliers early, found in March 2021 that it could not pay its own creditors at all. A British parliamentary inquiry declined to recommend bringing SCF within the regulatory perimeter; it concluded instead that the underlying cause, late payment, should be addressed by paying suppliers sooner (House of Commons Treasury Committee, 2021). In the United States, buyers must now disclose the key terms and outstanding balances of their supplier finance programmes (Financial Accounting Standards Board [FASB], 2022), although S&P Global Ratings (2025) judges that transparency still has room to improve.

2.2 Small firms as unwilling lenders

Trade credit makes lenders of suppliers whether they like it or not. Petersen and Rajan (1997) show that firms extend and take trade credit for reasons that range from informational advantages to price discrimination. Klapper et al. (2012) find that large, creditworthy buyers obtain the longest payment terms, and that they obtain them from small suppliers. Murfin and Njoroge (2015) show that when large retailers pay slowly their smaller suppliers invest less, especially when bank credit is tight. The general theory of small-firm finance explains why. Information asymmetry leads lenders to ration credit rather than raise its price (Stiglitz & Weiss, 1981), and small firms, lacking audited accounts, depend on relationship lending or on lending against specific assets (Berger & Udell, 1998, 2006). Factoring is valuable precisely because it lends against the quality of the customer rather than that of the borrower (Klapper, 2006).

Trucking supplies unusually clean evidence. When France capped payment terms in road haulage in 2006, Barrot (2016) found that the default probability of affected trucking firms fell by about

a quarter, that the effect was strongest among firms with little access to liquidity, and that entry by small firms rose; long payment terms, he concluded, are a strong impediment to the entry and survival of liquidity-constrained firms. In the United States, Barrot and Nanda (2020) studied QuickPay, a reform that permanently accelerated federal payments to small business contractors, and found a strong direct effect on employment growth at the firm level, tempered by the crowding out of other firms' hiring in tight labour markets. Transparency helps too: after the United Kingdom required large firms to disclose their payment practices, the receivables of small suppliers fell by 8.3 per cent and their financial constraints eased (Grewal et al., 2024). The lesson of these studies is consistent. Faster payment is not a courtesy; for a small firm it is capital.

2.3 Automation, data and the contractibility of a delivery

If finance follows information, the question is what information a small carrier can offer. Baker and Hubbard (2004) showed that on-board computers, by making drivers' behaviour observable, changed the governance of U.S. trucking, including who owned the truck. The electronic logging device (ELD) rule has since made such data universal for interstate carriers: it was published in December 2015, compliance began on 18 December 2017 and the grandfathering of older recording devices ended on 16 December 2019 (Federal Motor Carrier Safety Administration [FMCSA], 2015). Every covered truck now produces time-stamped records of its location and duty status. The industry has also agreed a standard for electronic bills of lading (National Motor Freight Traffic Association [NMFTA], 2022), revised as eBol 2.1 in March 2024 (NMFTA, 2024). Data of this kind can do the work that collateral once did. In a study of more than two million Chinese firms, Gambacorta et al. (2023) find that big-tech credit, which relies on transaction data, responds to firm-specific characteristics rather than to house prices, the collateral signal on which bank lending leans. Berg et al. (2020) show that even simple digital footprints predict default, and Chod et al. (2020) demonstrate that supply chain transparency lowers financing costs by signalling operational quality. In the back office, robotic process automation and optical character recognition remove the manual steps between a document and a ledger (van der Aalst et al., 2018). Adoption, however, is slow: the share of U.S. firms using artificial intelligence rose only from 3.7 to 5.4 per cent between September 2023 and February 2024 (Bonney et al., 2024). Research on technology acceptance explains why. Perceived usefulness and ease of use, rather than technical capability, decide whether a small firm adopts a tool (Davis, 1989; Venkatesh et al., 2003).

2.4 Resilience and financing efficiency

Supply chain resilience is the capacity to prepare for disruption, respond to it and recover (Ponomarev & Holcomb, 2009), returning to the original state or to a better one (Christopher & Peck, 2004; Pettit et al., 2019; Sheffi & Rice, 2005). The concept has widened to viability, the ability to survive a long disruption (Ivanov & Dolgui, 2020), and digital technology is now seen as central to containing the ripple effects of a shock (Ivanov et al., 2019). The stakes are not abstract. The McKinsey Global Institute estimates that companies can expect disruptions lasting a month or longer every 3.7 years, and losses equal to almost 45 per cent of a year's profits over a decade (Lund et al., 2020). The collapse of Yellow Corporation, which closed in the summer of 2023 and left some 30,000 employees without work (CNN Business, 2023), showed how quickly a disruption at one carrier travels to its shippers and to the smaller carriers who absorb its freight. Wu et al. (2024) connect resilience to finance through dynamic capabilities (Teece et al., 1997), which they classify as proactive, reactive and quality capabilities, and they treat financing

efficiency as the ability to earn returns by allocating funds at the lowest cost with risk under control. For a private carrier with no published accounts, this paper adapts the idea to what can be observed: the cost and the time of converting a completed delivery into usable cash, in the tradition of cash-to-cash measures (Randall & Farris, 2009).

2.5 Logistics providers as financiers

The line between moving goods and financing them has been redrawn before. Chen and Cai (2011) model a third-party logistics (3PL) firm that offers both logistics and financial services and show that the combination can improve supply chain performance, and Hofmann (2009) describes logistics service providers acting as inventory financiers. In U.S. freight the payment infrastructure is already concentrated: the largest freight payment network reports that more than half of all brokered freight transactions touch it (Triumph Financial, 2025). Sustainability-linked programmes show how incentives can be layered on top; since 2019, Walmart suppliers that make progress in its sustainability programmes have been able to obtain cheaper financing through HSBC (PYMNTS, 2019).

Why, then, do small carriers still wait to be paid? Is it the anchors' indifference, the financiers' caution, or the carriers' own suspicion of anything that resembles a bank? Each plays a part. The more prosaic culprit is paper. What is missing is a mechanism that prices the small carrier's receivable on the strength of the party that owes it, triggered by a delivery that no one needs to take on trust.

2.6 The base study: what it establishes and what it leaves open

Wu et al. (2024) analyse 6,604 firm-year observations of SMEs listed on the Shenzhen SME and Growth Enterprise boards from 2015 to 2022. They measure financing efficiency by data envelopment analysis (DEA), treat firms designated as supply chain innovation pilots as the treatment group, and report that digitalisation raised financing efficiency by 0.082 in their full specification. Mechanism tests point to cost control, internal and external financing and collaborative innovation; heterogeneity tests favour state-owned firms and the eastern and central regions.

The study is a useful foundation, and its limits define the opportunity. First, resilience is named as the transmission path but is not measured directly; the mechanism tests use proxies for cost, financing and innovation. Second, DEA is applied to ratio indicators, including a growth rate that can be negative, which standard DEA does not accommodate without transformation. Third, several significance markers in the mechanism and heterogeneity tables do not match the reported t-statistics (a coefficient marked significant at the 1 per cent level sits beside a t-statistic of 0.91, for example), and the sub-samples in the heterogeneity analysis sum to far fewer than the 6,604 baseline observations; the results are therefore best read as indicative. Fourth, listed SMEs exclude the micro-firms that dominate logistics, and a state-selected pilot differs from market-led adoption. Table 1 summarises how the present study responds.

Table 1. What this study adds to the base study

Dimension	Wu, Zhang and Zhang (2024)	This study
Setting	China; SMEs listed in Shenzhen, 2015 to 2022	United States; logistics SMEs, chiefly private carriers and brokers; evidence to May 2025
Typical firm	Listed manufacturer or service firm	Carrier with ten or fewer trucks and no published accounts
Lever studied	Supply chain digitalisation (pilot designation)	SME automation and SCF, separately and together
Mechanism	Resilience, proxied by cost, financing and innovation	Verification, credit arbitrage and transaction costs; resilience measured as sensitivity to a shock
Method	Difference-in-differences; DEA efficiency	Calibrated Monte Carlo model (10,000 draws) with sensitivity and stress tests
Financing efficiency	DEA score built from ratio indicators	Cost of converting deliveries into cash; days from delivery to cash
Practical output	Policy implications	Costed 36-month action plan, KPIs, risk register and marketing strategy
Sustainability	Not addressed	Mapping to SDG targets 5.a, 8.3, 8.10, 9.1, 9.3, 9.4, 10.2, 12.6, 13.2 and 17.17
Data and code	Proprietary databases (CSMAR, Wind)	Public sources; every model parameter reported (Table 3)

Source: author's comparison.

3. Conceptual Framework and Propositions

Figure 1 sets out the proof-to-cash framework. It keeps the spine of the base study, in which better information raises financing efficiency and financing efficiency underwrites resilience, but it replaces digitalisation in general with two specific levers and names the hinge on which they turn: a delivery that is proven by data rather than by paper.

Financing efficiency is defined here as the cost and speed with which a firm converts completed work into usable cash, together with the breadth of its access to working capital. It is measured by two quantities. The **cash-conversion cost ratio** (CCR) is the sum of all costs incurred between delivery and cash (finance charges, the carrying cost of waiting, losses on disputed invoices, back-office labour and technology) expressed as a share of revenue. **Days-to-cash** (DTC) is the revenue-weighted number of days from delivery to the receipt of cash. **SME automation** means the digital tools that remove manual steps between the loading dock and the bank: electronic bills of lading and proofs of delivery (e-BOL and e-POD), telematics-verified delivery events from ELDs, optical character recognition (OCR) and robotic process automation (RPA) in invoicing, application programming interface (API) links to the systems of shippers, brokers and financiers, and instant payment rails. **SCF** means anchor-led reverse factoring, together with dynamic discounting and data-verified receivables finance.

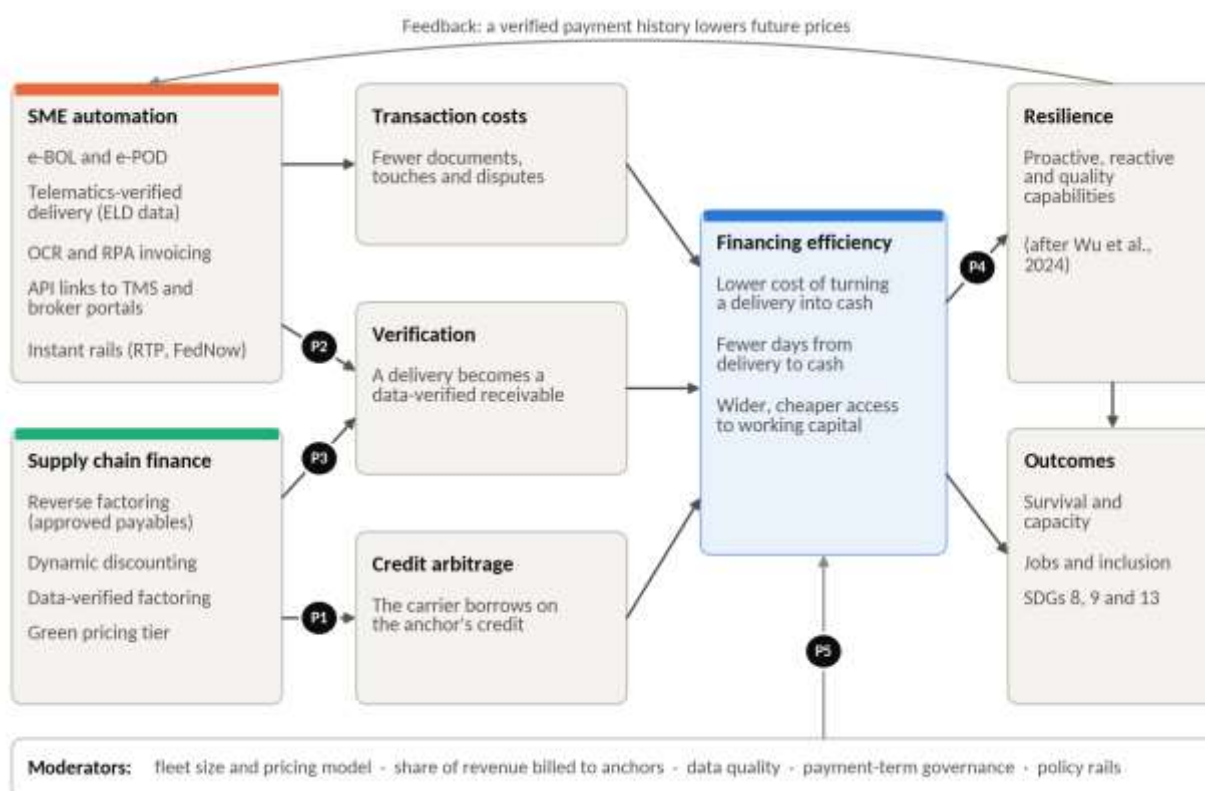


Figure 1. The proof-to-cash framework: how SME automation and supply chain finance raise financing efficiency and resilience

P1 to P5 denote the propositions in Section 3. The chain from information to financing efficiency to resilience follows Wu, Zhang and Zhang (2024); the levers, mechanisms and moderators are this study's extension. Source: author.

Proposition 1 (credit arbitrage). SCF raises the financing efficiency of small logistics firms by substituting the anchor's cost of credit for the carrier's on the invoices the anchor approves. The rationale is the spread documented in Section 4: a carrier paying factoring fees equivalent to 12 to 49 per cent a year can, through an approved-payables programme, borrow near the shipper's rate of 5 to 7 per cent (Klapper, 2006; van der Vliet et al., 2015).

Proposition 2 (verification and transaction costs). SME automation raises financing efficiency by shortening the interval between delivery and invoice, by reducing disputes and manual handling, and by lowering the cost of verifying conventional receivables. Paper is patient; creditors are not. Every day a proof of delivery spends in a cab or a mailbag is a day of finance that someone must pay for (Baker & Hubbard, 2004; Chod et al., 2020).

Proposition 3 (complementarity). SME automation and SCF are complements. Automated proof of delivery raises the share of invoices an anchor can approve within its programme window and the speed with which it approves them, so the combined effect exceeds the sum of the separate effects. Verification is the sine qua non of SCF for small carriers: without it, SCF waits for paper; without SCF, verification merely hastens an expensive form of credit.

Proposition 4 (resilience). By reducing the cost of cash and the time to cash, the combination lowers the sensitivity of financing efficiency to a downturn, strengthening the proactive, reactive

and quality capabilities that Wu et al. (2024) associate with resilience. A verified payment history, in turn, lowers future financing prices and closes a feedback loop.

Proposition 5 (heterogeneity). The gains are moderated by fleet size and the pricing of automation, by the share of revenue billed to programme anchors and by the carrier's alternative cost of capital. They are largest for credit-constrained carriers, and fixed-fee pricing of automation erodes them for owner-operators.

4. The U.S. Setting: Evidence from Public Data

4.1 A small-business industry in a large-business economy

The American economy is famous for its giants, but its freight is moved largely by small firms. The Small Business Administration counts 34.75 million small businesses, 99.9 per cent of all firms, employing 45.9 per cent of private-sector workers and producing 43.5 per cent of GDP (U.S. Small Business Administration Office of Advocacy [SBA Advocacy], 2024). In trucking the skew is extreme (Figure 2a). The industry employed 3.55 million professional drivers and 8.5 million people in industry-related jobs in 2023 (ATA, 2024); the carriers that employ them are overwhelmingly small, while their customers, the shippers and brokers, are frequently large and well rated. It is a textbook setting for the unwilling-lender problem described in Section 2.2.

4.2 Cash, not demand, is the binding constraint

The Small Business Credit Survey, fielded in 2024 and released on 27 March 2025, shows how widely cash strain is felt (Figure 2b). Three-quarters of employer firms cited rising costs of goods, services or wages; 56 per cent had difficulty paying operating expenses; 51 per cent reported uneven cash flows. Fifty-nine per cent sought new financing, most often to meet operating expenses (56 per cent of applicants), and 41 per cent of those denied were told they already carried too much debt, against 22 per cent in 2021 (Federal Reserve Banks, 2025). Trucking's own costs tell the same story. The American Transportation Research Institute (ATRI, 2024) put the marginal cost of operating a truck in 2023 at \$2.270 per mile; excluding fuel, costs rose 6.6 per cent, led by driver wages (\$0.779 per mile), truck and trailer payments (\$0.360, up 8.8 per cent) and insurance (\$0.099, up 12.5 per cent). Average operating margins were 6 per cent or lower in every fleet size and sector other than less-than-truckload. In such a business, a percentage point of revenue lost between delivery and cash is not a rounding error. It can be a sixth of the margin, or more.

Fraud adds a further premium. Cargo theft reached a record 3,625 reported incidents in 2024, up 27 per cent on 2023, with an average loss of \$202,364; Texas alone recorded a 39 per cent rise (Verisk CargoNet, 2025). A financier who cannot verify a delivery must price the risk that it never happened, or that the carrier is not who it claims to be.

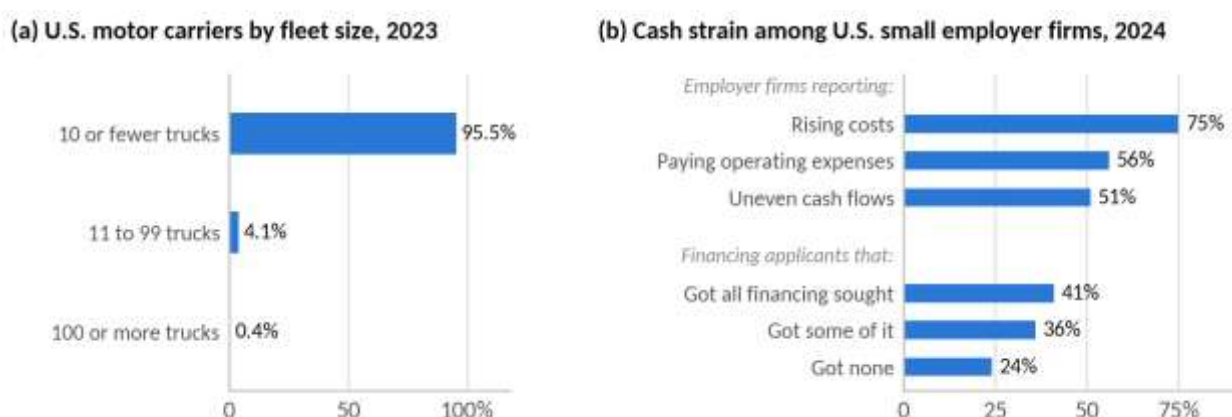


Figure 2. The U.S. setting: a small-firm industry under cash strain

(a) Shares of U.S. motor carriers by fleet size in 2023; the 11 to 99 band is derived as 99.6 minus 95.5 per cent. (b) Employer firms reporting each financial challenge, and financing outcomes among applicants, in the Small Business Credit Survey fielded in 2024. "Rising costs" covers goods, services and wages; outcomes sum to 101 per cent because of rounding. Sources: ATA (2024); Federal Reserve Banks (2025).

4.3 The price of waiting

Figure 3 arranges the prices at which a small carrier can bridge the gap between delivery and payment. At the bottom sit the rates available to large, well-rated firms. The Federal Reserve held its target range for the federal funds rate at 4.25 to 4.50 per cent on 7 May 2025 (Board of Governors of the Federal Reserve System [Federal Reserve], 2025c); the secured overnight financing rate (SOFR) stood near 4.3 per cent and the bank prime rate at 7.50 per cent (U.S. Bank, 2024). Transportation factoring, at the scale of the largest U.S. freight factor, earned an average yield of 13.36 per cent in the fourth quarter of 2024 (Triumph Financial, 2025). Credit card plans charged 21.76 per cent on all accounts and 23.37 per cent on accounts assessed interest (Federal Reserve, 2025a). A merchant cash advance advertised at a "factor rate" of 1.15 amounted, on one analysis, to an estimated annual percentage rate of about 70 per cent (Federal Reserve, 2025b). A small carrier paying 1.5 to 4.0 per cent to factor a 30- to 45-day invoice is paying, in simple annual terms, between 12 and 49 per cent. The distance between the top of this ladder and its bottom rung is the prize that SCF offers. The question is who can reach it.

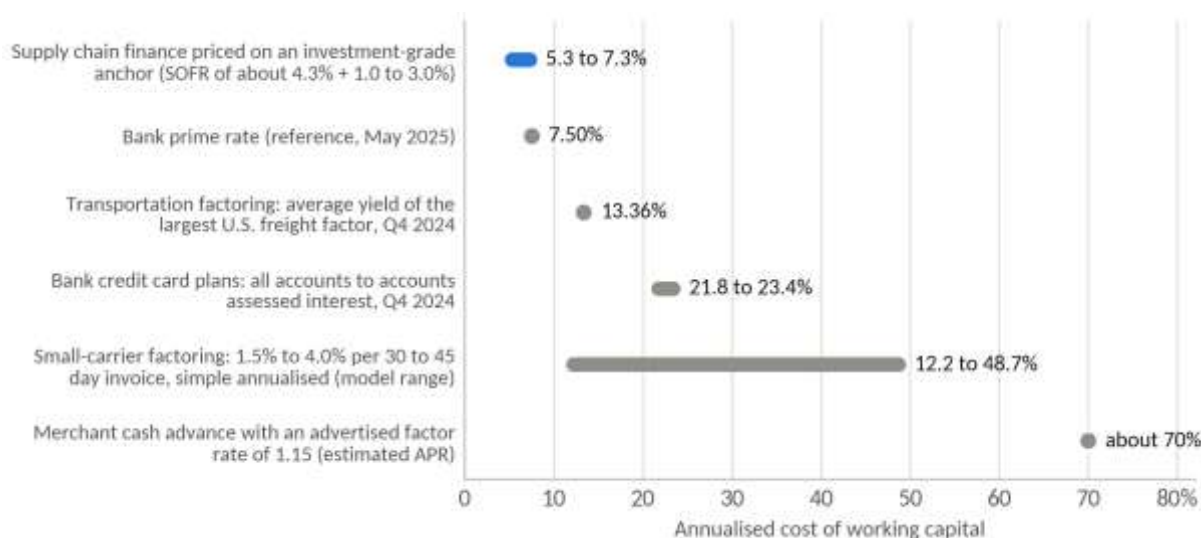


Figure 3. The cost-of-finance ladder facing a small U.S. carrier, spring 2025

Point estimates and ranges, annualised. The SCF range assumes SOFR of about 4.3 per cent plus a financier spread of 1.0 to 3.0 per cent; the small-carrier factoring range converts per-invoice fees of 1.5 to 4.0 per cent over 30 to 45 days into simple annual rates. Both ranges are this study's assumptions (Table 3). Sources: Federal Reserve (2025a, 2025b, 2025c); Triumph Financial (2025); U.S. Bank (2024).

4.4 The rails are already laid

Unusually, the institutional plumbing for proof-to-cash finance already exists in the United States, although it has not been connected (Table 2). The ELD rule supplies verified delivery events and the NMFTA standard a common electronic bill of lading. The RTP network raised its limit to \$10 million per transaction in February 2025 (The Clearing House, 2024), and the Federal Reserve's FedNow Service had enrolled more than 1,300 financial institutions in all fifty states by April 2025, most of them small and mid-sized, and processed about 1.3 million transactions in the first quarter (Payments Dive, 2025). Accounting standards now require buyers to disclose their supplier finance programmes (FASB, 2022). The FMCSA has proposed that brokers keep transaction records electronically and provide them within 48 hours of a carrier's request (FMCSA, 2024). The Department of Transportation's Freight Logistics Optimization Works (FLOW) initiative has operated a public-private exchange of freight data since March 2022 (Bureau of Transportation Statistics [BTS], n.d.), and the SBA has launched a pilot of transaction-based and asset-based working capital lines under its 7(a) programme (U.S. Small Business Administration [SBA], 2024). Each rail was laid for its own reason. Laid end to end, they reach from the loading dock to the bank.

Table 2. Institutional rails for proof-to-cash finance in the United States, as of May 2025

Rail	Date	What it provides	Role in the framework
ELD rule (FMCSA)	Published Dec. 2015; compliance 18 Dec. 2017; older devices phased out by 16 Dec. 2019	Time-stamped location and duty records for interstate trucks	Verified delivery events (P2, P3)
e-BOL standard (NMFTA Digital LTL Council)	Released Oct. 2022; eBOL 2.1 in Mar. 2024	Common API standard for electronic bills of lading	Machine-readable proof of shipment and delivery
RTP network (The Clearing House)	Limit raised to \$10 million, Feb. 2025	Instant, irrevocable business payments	Same-day payment to carriers
FedNow Service (Federal Reserve)	Launched July 2023; more than 1,300 institutions by Apr. 2025	Instant payments through community and regional banks	Payout rail to small carriers' own banks
ASU 2022-04 (FASB)	Fiscal years beginning after 15 Dec. 2022; roll-forward after 15 Dec. 2023	Buyer disclosure of supplier finance programme terms and balances	Guard against opaque term extension (Table 7)
Broker transparency proposal (FMCSA)	Proposed 20 Nov. 2024	Electronic broker records, provided within 48 hours of a request	Evidence in disputes; data access for carriers
FLOW initiative (DOT and BTS)	Launched Mar. 2022	Public-private exchange of freight data	Template for payment-timing data (P4)
7(a) Working Capital Pilot (SBA)	Announced June 2024	Guaranteed transaction-based and asset-based lines of credit	Funding for invoices outside anchor programmes
SmartWay (EPA)	Operating since 2004	Freight fuel and emissions measurement	Basis for a green pricing tier (Section 9)

Sources: FMCSA (2015, 2024); NMFTA (2022, 2024); The Clearing House (2024); Payments Dive (2025); FASB (2022); BTS (n.d.); SBA (2024); U.S. Environmental Protection Agency (n.d.).

5. Methodology: A Delivery-to-Cash Simulation

5.1 Why simulate?

No public dataset records the financing costs, payment times and back-office effort of America's private carriers, and the base study's design cannot simply be relabelled with U.S. data. This paper therefore follows the analytical-modelling tradition in operations and finance. It builds a transparent model of the delivery-to-cash cycle, calibrates it to published figures where they exist and to bounded assumptions where they do not, and propagates the uncertainty by Monte

Carlo simulation. The approach cannot establish causality, but it makes every mechanism and assumption explicit, and so exposes each of them to falsification by future data (Section 10.4).

5.2 Scenarios and the representative firm

The representative firm is a truckload carrier with ten power units, the upper edge of the fleet class that accounts for 95.5 per cent of U.S. carriers. Four scenarios are compared. In the baseline (B), documents are on paper, and the carrier either factors an invoice or waits for its customer to pay. In the automation scenario (A), e-POD, telematics-verified delivery and OCR or API invoicing replace paper. In the SCF scenario (S), the carrier joins programmes offered by anchors, shippers or brokers with investment-grade credit, but its documents remain on paper, so approval waits for the paperwork. In the combined scenario (AS), automated proof of delivery triggers approval and payment. Each of 10,000 draws samples every parameter from a triangular distribution (Table 3), and results are reported as medians with 5th and 95th percentiles. The random seed is fixed so that every figure in this paper can be reproduced.

5.3 The model

Consider an invoice of value L issued d days after delivery and paid by the customer T days after it is issued. With probability p it is disputed, which adds D days and loses a share w of its value. A carrier that factors the invoice receives cash the day after submission and pays a flat fee ϕ for the first 30 days, plus a surcharge ϕ_x for each further 15 days that the invoice remains unpaid; while it waits, it bears the annual cost r of its other working capital. As fractions of invoice value, the expected costs are:

$$c_F = \phi + \phi_x \cdot [(1 - p) \cdot \max(0, T - 30) + p \cdot \max(0, T + D - 30)] / 15 + r \cdot (d + 1) / 365 \quad (1)$$

$$c_U = r \cdot (d + T + p \cdot D) / 365 \quad (2)$$

$$c_C = f \cdot c_F + (1 - f) \cdot c_U + p \cdot w \quad (3)$$

where f is the share of conventional invoices that are factored and c_U is the cost of waiting for payment. An invoice financed through SCF is paid when the anchor approves it, a days after delivery ($a = d + g$ on paper, where g is the approval lag; $a = g'$ with automation), and the financier is repaid at maturity. Its cost is

$$c_S = (\text{SOFR} + s) \cdot (d + T - a) / 365 + \pi + r \cdot (a + p \cdot D) / 365 + p \cdot w \quad (4)$$

where s is the financier's spread and π a platform fee. Let σ denote the share of revenue financed through SCF (the anchors' share of revenue multiplied by the share of their invoices approved in time), $\bar{h}$ the expected back-office minutes per invoice, ω the loaded hourly wage and K the annual cost of technology. The scenario's cash-conversion cost ratio and days-to-cash are then

$$\text{CCR} = \sigma \cdot c_S + (1 - \sigma) \cdot c_C + (\bar{h} \cdot \omega / 60) / L + K / \text{Rev} \quad (5)$$

$$\text{DTC} = \sigma \cdot (a + p \cdot D) + (1 - \sigma) \cdot [f \cdot (d + 1) + (1 - f) \cdot (d + T + p \cdot D)] \quad (6)$$

Automation changes d , T , p , D , ϕ , $\bar{h}$ and K ; SCF changes σ , a and the price of finance. Working capital locked in receivables equals $\text{Rev} \cdot \text{DTC} / 365$, and the saving from a scenario is its fall in CCR relative to the baseline, multiplied by revenue.

5.4 Parameters

Table 3 reports every parameter with its low, modal and high values and its basis. Where a published figure exists it anchors the range; where none does, the range is the author's assumption and is labelled as such. All assumptions are varied in the sensitivity analysis of Section 6.5.

Table 3. Model parameters (triangular distributions: low, mode, high)

Parameter	Low / mode / high	Basis
Operations		
Revenue per truck per year (\$)	180,000 / 220,000 / 260,000	ATRI (2024) marginal cost of \$2.270 per mile at roughly 80,000 to 115,000 miles a year, with thin margins
Revenue per load, equal to invoice size (\$)	1,400 / 1,770 / 2,300	Average transportation invoice of \$1,767, Q4 2024 (Triumph Financial, 2025)
Baseline: paper documents and conventional finance		
Days from delivery to invoice	2 / 4 / 10	Assumption: collecting, scanning and sending paper proof of delivery
Days from invoice to customer payment	30 / 38 / 55	Assumption: net-30 terms plus slippage
Probability of dispute or short payment	4% / 8% / 15%	Assumption
Extra days for a disputed invoice	10 / 20 / 45	Assumption
Share of a disputed invoice never recovered	2% / 5% / 10%	Assumption
Share of conventional invoices factored	40% / 70% / 100%	Assumption; small carriers factor heavily
Flat factoring fee, first 30 days	1.5% / 2.5% / 4.0%	Floor near a 13.36% annual yield over about 40 days (Triumph Financial, 2025); top reflects spot and non-recourse pricing (assumption)
Ageing surcharge per 15 days beyond 30	0.25% / 0.5% / 0.75%	Assumption
Annual cost of other working capital	9% / 16% / 30%	Between prime-based bank credit (prime 7.50%) and card rates of 21.8% to 23.4% (Federal Reserve, 2025a); cash advances excluded
Back-office minutes per invoice; extra per dispute	15 / 25 / 45; 30 / 60 / 120	Assumption
Loaded wage (\$ per hour)	25 / 30 / 36	Median of \$22.81 for bookkeeping clerks, May 2023 (U.S. Bureau of Labor Statistics [BLS], 2024), plus benefits

Parameter	Low / mode / high	Basis
SME automation		
Days from delivery to invoice	0.1 / 0.5 / 1.0	Assumption: e-POD with OCR or API submission
Fewer customer payment days	0 / 2 / 5	Assumption: no document chasing
Fall in dispute probability; in dispute duration	30 / 50 / 70%; 20 / 40 / 60%	Assumption: time-stamped delivery evidence
Fall in factoring fee on data-verified invoices	0% / 15% / 30%	Direction from Chod et al. (2020) and Gambacorta et al. (2023); size assumed
Back-office minutes per invoice; extra per dispute	3 / 6 / 10; 15 / 30 / 60	Assumption
Subscription per truck-month (\$); onboarding per fleet (\$)	30 / 55 / 90; 1,500 / 3,000 / 6,000	Assumption; onboarding amortised over three years
Supply chain finance		
Share of revenue billed to programme anchors	30% / 50% / 70%	Assumption
Share of anchor invoices approved in time: paper; automated	60 / 75 / 90%; 88 / 95 / 100%	Assumption: approval requires proof of delivery
Approval lag: days after invoice (paper); days after delivery (automated)	3 / 7 / 15; 0.1 / 0.5 / 2	Assumption
Financier spread over SOFR (about 4.3%)	1.0% / 1.75% / 3.0%	Assumption: investment-grade anchor risk
Platform fee per financed invoice	0.10% / 0.25% / 0.50%	Assumption
Extra portal minutes per SCF invoice (paper only)	2 / 4 / 6	Assumption

Values separated by a slash are the low, modal and high points of a triangular distribution. Parameters are drawn independently; the random seed is 20250522. Source: author.

5.5 Stress and robustness tests

Resilience (P4) is assessed by applying a downturn shock to every draw: customer payment terms lengthen by 15 days, the dispute rate rises by half, factoring fees rise by 0.5 percentage points, the cost of other working capital by 3 points and the SCF spread by 0.5 points. Four robustness checks follow. Anchors extend payment terms by 30 days inside SCF programmes; automation brings no reduction in factoring fees; approval rates are held equal with and without automation,

which isolates the eligibility channel of complementarity; and fleet size varies from one to fifty trucks under two ways of pricing automation.

6. Results

6.1 What it costs to be paid

Table 4 and Figure 4 report the central results. Converting deliveries into cash costs the baseline carrier a median 4.57 per cent of revenue (5th to 95th percentile: 3.64 to 5.65 per cent) and takes 18.8 revenue-weighted days. On average, finance charges account for 2.17 percentage points of that cost, back-office labour for 0.97, the carrying cost of waiting for 0.95 and losses on disputed invoices for 0.51. More than a fifth of the cost of getting paid, in other words, is the cost of paperwork.

Automation alone lowers the ratio to 3.27 per cent, a saving of 1.28 percentage points, or about \$28,100 a year for a ten-truck carrier. Most of the gain comes from labour (0.75 points) and from fewer and shorter disputes (0.26), with smaller gains in finance charges (0.37) and carrying costs (0.30), set against technology costs of 0.37 points. Each dollar spent on automation returns a median \$4.50 in gross savings, and the onboarding fee is recovered in about five weeks.

SCF alone does less than one might expect. The ratio falls to 4.05 per cent, a saving of 0.49 points (about \$10,800), because finance charges fall by 0.50 points on average while approval waits for paper. The carrier receives an approved invoice's cash on about the eleventh day, against the fifth day for a factored one, and in 31 per cent of draws SCF alone actually lengthens the delivery-to-cash cycle. Without automation, SCF trades speed for price.

Together, the two levers cut the ratio to 2.60 per cent, a median saving of 1.96 percentage points (1.33 to 2.71), or about \$42,900 a year for the representative carrier and \$4,300 per truck. The cost of converting deliveries into cash falls by 43 per cent, days-to-cash fall by 11.2 days (60 per cent) to 7.4, and about \$67,200 of working capital is released. The saving is positive in every one of the 10,000 draws. Set against operating margins of 6 per cent or less (ATRI, 2024), it amounts to roughly a third of the best margin most small fleets can hope for. At the scale of the industry the arithmetic is simple: with trucking revenue of \$987 billion (ATA, 2024), every tenth of a percentage point of revenue saved is worth close to \$1 billion a year.

Table 4. Simulated delivery-to-cash performance of a representative ten-truck carrier

Measure	Baseline	Automation only	SCF only	Automation + SCF
Cost of converting deliveries into cash (% of revenue)	4.57 [3.64, 5.65]	3.27 [2.58, 4.10]	4.05 [3.28, 4.98]	2.60 [2.12, 3.19]
Days from delivery to cash	18.8 [9.9, 28.8]	12.8 [4.9, 21.7]	17.7 [11.4, 24.6]	7.4 [3.3, 12.5]
Working capital in receivables (\$ thousand)	112.8 [58.0, 176.9]	76.6 [29.4, 132.6]	106.1 [67.5, 152.2]	44.3 [19.5, 76.3]
Share of revenue financed through SCF (%)	0	0	37.5 [26.6, 49.2]	47.2 [34.1, 60.4]

Measure	Baseline	Automation only	SCF only	Automation + SCF
Saving against baseline (percentage points of revenue)	n/a	1.28 [0.80, 1.87]	0.49 [0.25, 0.87]	1.96 [1.33, 2.71]
Saving against baseline (\$ thousand a year)	n/a	28.1 [17.2, 42.3]	10.8 [5.4, 19.3]	42.9 [28.6, 61.1]
Working capital released (\$ thousand)	n/a	34.8 [19.6, 56.5]	6.5 [-14.7, 31.0]	67.2 [35.4, 107.2]
Draws with a positive saving (%)	n/a	100	100	100

Medians of 10,000 draws, with 5th and 95th percentiles in brackets. Revenue has a median of \$2.2 million. Source: author's delivery-to-cash model.

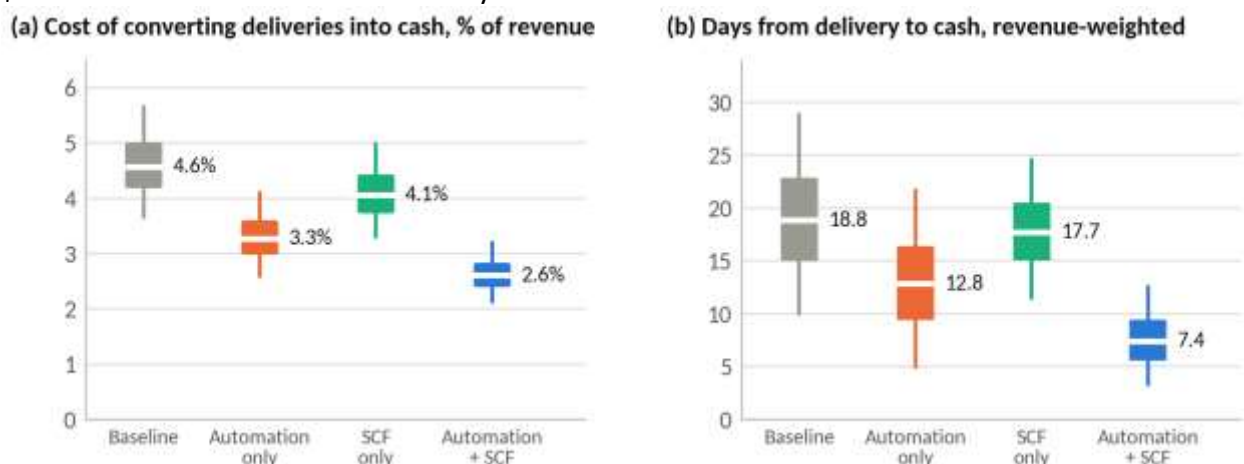


Figure 4. Simulated cost and speed of converting deliveries into cash, by scenario

Ten-truck carrier, 10,000 draws. Boxes span the interquartile range; the white bar and label mark the median; whiskers run from the 5th to the 95th percentile. Source: author's delivery-to-cash model.

6.2 One load, four ways

Figure 5 follows a single load through the four arrangements at the modal parameter values. Waiting for the customer brings cash on day 42, financed in the meantime at 9 to 30 per cent a year. Factoring brings it on day 5, at a price of 2.8 per cent of the invoice once the ageing surcharge is included. Paper-bound SCF brings it on day 11 at a discount of 0.76 per cent. Automated proof with SCF brings it within a day for 0.85 per cent; the slightly larger discount reflects the extra days financed and is more than repaid by ten fewer days of waiting.

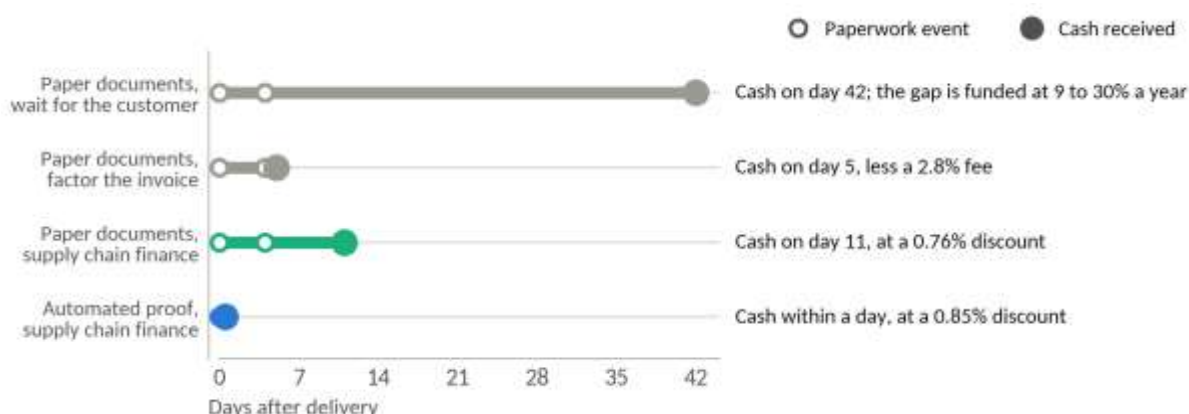


Figure 5. One load, four ways: the delivery-to-cash timeline of a typical carrier

Modal parameter values (Table 3). Fees include the ageing surcharge on invoices outstanding beyond 30 days; SCF discounts include the platform fee. Source: author's delivery-to-cash model.

6.3 Are the two levers complements? (P3)

The combined saving exceeds the sum of the separate savings in 96 per cent of draws, by a median 0.15 percentage points (0.01 to 0.35). The source of the surplus is instructive. Holding the approval rate at its paper level removes a median 0.13 points of it; the remainder, the net effect of faster approval and of the overlap between cheaper factoring and SCF, is small and can go either way (median 0.02; 5th to 95th percentile, -0.10 to 0.15). Complementarity is therefore real but conditional. It runs through eligibility: automation lets anchors approve more invoices within the programme window. Where approval is already quick and complete, the two levers are close to additive; where it is bound to documents, they are complements. P3 is supported in that qualified form.

6.4 Resilience under a downturn (P4)

Figure 6 applies the downturn shock. The baseline carrier's conversion cost rises by a median 1.50 percentage points and its delivery-to-cash cycle by 4.8 days. Under the combined scenario the cost rises by 0.88 points, 41 per cent less, and the cycle by 2.5 days, about half as much. The reasons are mechanical but important. Invoices financed through SCF are paid on approval, whatever the anchor's own payment stretch; automation limits disputes, which the shock multiplies; and the carrier leans less on factoring and card credit, whose prices rise in a downturn. Measured in this way, as the sensitivity of financing efficiency to a shock, resilience is observed directly rather than inferred, which answers the first limitation of the base study. P4 is supported.

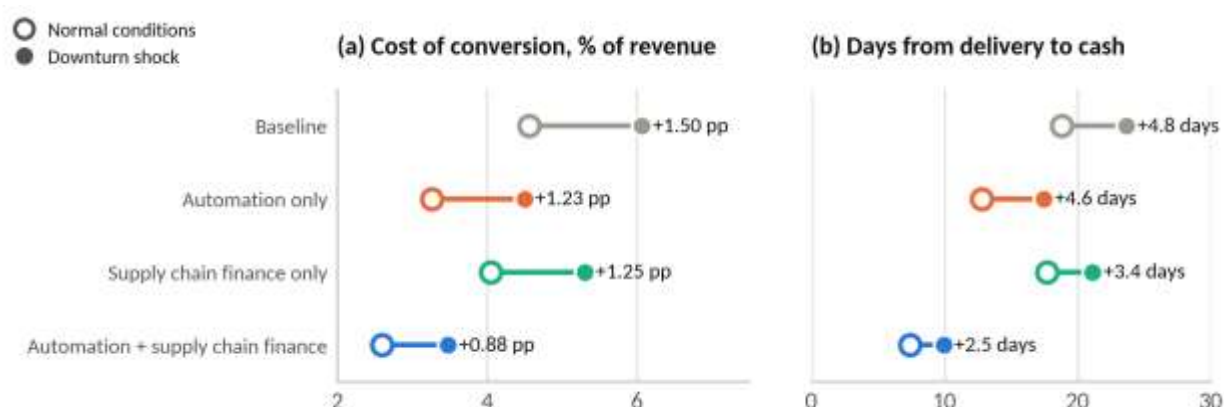


Figure 6. Stress test: how each scenario absorbs a freight downturn

Medians of 10,000 paired draws; labels give the median change. Shock: customer payment terms 15 days longer, dispute rate 1.5 times higher, factoring fee 0.5 percentage points higher, cost of other working capital 3 points higher, SCF spread 0.5 points higher. Source: author's delivery-to-cash model.

6.5 What drives the gains, and who receives them (P5)

Figure 7a ranks the parameters that move the combined saving most when each is varied across its range with the others held at modal values. The factoring fee matters most (the saving ranges from 1.24 to 2.21 points), followed by back-office minutes per paper invoice (1.35 to 2.20), the cost of other working capital (1.44 to 2.00) and the share of revenue billed to anchors (1.39 to 1.87). The typical carrier's saving at modal values, 1.63 points, lies below the Monte Carlo median because several distributions are skewed to the right. The pattern favours the credit-constrained. Carriers in the top quartile of alternative borrowing costs save a median 2.14 points against 1.79 for the bottom quartile, and those in the top quartile of factoring fees save 2.23 points against 1.71. The benefit flows towards those who need it most.

Figure 7b turns to fleet size. When automation is sold as a subscription with an onboarding fee, an owner-operator's combined saving falls to 1.48 points, against 1.96 for a ten-truck fleet and 2.00 for a fifty-truck fleet; for automation alone, the owner-operator saves 0.81 points against 1.28. Priced per load, at the same cost for a ten-truck fleet, the saving is 1.96 points for every fleet size. Fixed fees are a regressive tax on the smallest firms, and per-load pricing removes it. P5 is supported, and its practical corollary shapes the pricing strategy in Section 8.

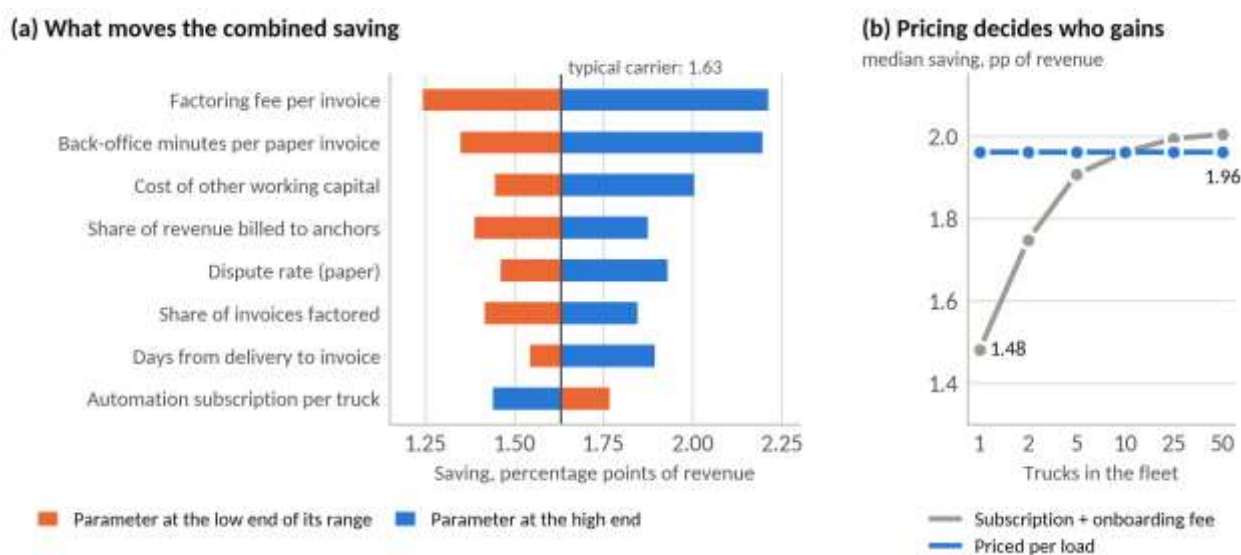


Figure 7. What drives the combined saving, and how pricing decides who gains

(a) Each parameter varied across its Table 3 range with the others at modal values; the eight largest swings are shown, and the vertical line marks the typical carrier's saving of 1.63 percentage points. (b) Median saving under automation plus SCF by fleet size, with automation priced as a subscription plus onboarding fee or per load (set to equal the subscription cost of a ten-truck fleet). Source: author's delivery-to-cash model.

6.6 Robustness

The results do not rest on a single generous assumption. If anchors use SCF to extend payment terms by 30 days, a common temptation, the combined saving falls to a median 1.72 points (1.11 to 2.46): smaller, but still large, because the carrier is paid on approval and the extra days are financed at the anchor's rate. If automation brings no reduction in factoring fees, the savings fall to 1.00 point for automation alone and 1.81 points for the combination. The model omits correlations among parameters, strategic responses by factors who may cut their prices, and the general-equilibrium effects that Barrot and Nanda (2020) observed in tight labour markets. It should be read as a disciplined estimate of what is at stake, not as a forecast.

7. An Explicit Business Action Plan

Findings that stop at implications tend to stay there. This section sets out an explicit plan for a venture that builds and markets a proof-to-cash platform for small U.S. logistics firms, and places it within an industry roadmap for the other parties whose cooperation it needs.

7.1 The venture and its business model

The venture's proposition fits in three words: delivered, proven, paid. For carriers it offers payment within hours of a verified delivery, at a price set by the anchor's credit, together with an automation app that captures e-POD through the carrier's existing ELD, builds and submits invoices, and assembles an evidence pack for disputes. For anchors (shippers, brokers and 3PLs) it offers carrier retention and loyal capacity, fewer disputes, programme reporting consistent with ASU 2022-04 and verified emissions data, without consuming their balance sheets, because the receivables are funded by third parties. For financiers, from banks and community development financial institutions (CDFIs) to credit funds, it offers short, self-liquidating assets backed by investment-grade obligors and verified delivery data.

The platform earns four kinds of revenue: a per-load automation fee, roughly \$6 to \$7 at ten-truck scale in the model; a platform fee of about 0.25 per cent on financed invoices; a programme fee from anchors; and, later, data services such as verified emissions reports. For the representative ten-truck carrier, the automation and platform fees together come to roughly \$10,500 a year, about half a per cent of revenue, and they are already netted from the \$42,900 saving in Table 4. The carrier therefore keeps roughly four dollars of every five that the arrangement creates. The division is deliberate. A platform that takes most of the surplus invites the suspicion that has long attended factoring.

The unit economics follow. At an acquisition cost of no more than \$1,500 per active fleet and a gross margin of about 70 per cent, a three-year relationship with a ten-truck carrier is worth about \$22,000 to the platform, a ratio of lifetime value to acquisition cost above ten. For an owner-operator, whose fees are about a tenth as large, acquisition must cost less than about \$700 to keep that ratio above three, and only anchor-led, digital onboarding can achieve it.

7.2 A 36-month roadmap

The plan runs for 36 months in four phases (Figure 8 and Table 5), each ending in a decision gate. The pilot corridor is the Texas Triangle of Dallas-Fort Worth, Houston and San Antonio-Austin, chosen for its freight density and for the value of verification in a state where cargo theft rose 39 per cent in 2024 (Verisk CargoNet, 2025).

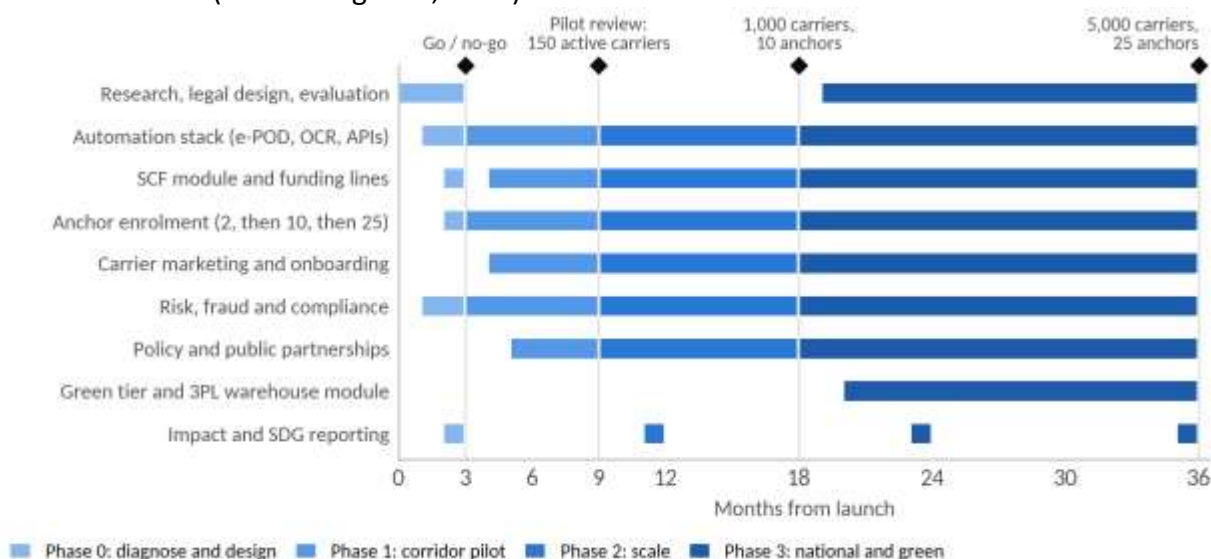


Figure 8. Thirty-six-month roadmap for the proof-to-cash venture

Bars show workstreams by phase; diamonds mark decision gates and milestone targets. Source: author.

Table 5. Business action plan: phases, actions, owners, targets and indicative budgets

Phase and months	Key actions	Owner	KPIs and targets	Budget (US\$)
0. Diagnose and design Months 0 to 3	Interview 40 carriers and 6 anchors; audit ELD and TMS integrations; measure baseline CCR and DTC; legal design (true-sale opinions, UCC filings, KYC and KYB checks); financier term sheet	Founders; legal counsel	Baseline measured for 30 carriers; 2 anchor letters of intent; 1 funding letter of intent; go or no-go at month 3	150,000 to 250,000
1. Corridor pilot Months 4 to 9	Launch the automation app and SCF module with 2 anchors in the Texas Triangle; \$10 million warehouse funding facility; fraud controls; bilingual support	Product; partnerships; risk	240 carriers onboarded, 150 active; SCF invoices paid within 24 hours of delivery; CCR down 30%; disputes down 40%; losses below 0.15% of volume; NPS of 40 or more	0.9 to 1.3 million
2. Scale Months 10 to 18	Expand to 10 anchors and three corridors; \$50 million of funding capacity with banks and CDFIs; partner an SBA Working Capital Pilot lender for non-anchor invoices; RTP and FedNow payouts	Commercial; capital markets	1,000 active carriers; \$400 million annualised financed volume; acquisition cost below \$1,500 per active fleet; 12-month retention of 75% or more	3 to 4 million
3. National and green Months 19 to 36	Expand to 25 anchors and national coverage; launch the green pricing tier and a 3PL warehouse (inventory finance) module; commission an independent impact evaluation; publish an SDG report	Leadership ; impact team	5,000 active carriers; \$1.5 billion annualised financed volume; emissions data for 60% of enrolled trucks; approval and price parity across owner groups; operating break-even by month 36	8 to 10 million

Budgets are indicative operating costs and exclude the receivables funded by financiers. CCR: cash-conversion cost ratio; DTC: days-to-cash; KYC and KYB: know your customer and know your business; NPS: net promoter score; UCC: Uniform Commercial Code. Source: author.

7.3 An industry roadmap

No platform can do this alone. Table 6 sets out what each party would need to do in the first year and thereafter. Most of the actions are modest; their value lies in their coincidence.

Table 6. Industry roadmap: actions by stakeholder

Stakeholder	First 12 months	Months 13 to 36
Small carriers and brokers	Measure the cost of getting paid; adopt e-POD and ELD-linked invoicing; clean rate and accessorial data	Join anchor programmes; negotiate per-load pricing; build a verified payment history
Anchor shippers and large brokers	Offer term-neutral SCF; approve invoices within 24 hours of a verified delivery	Publish payment practices; report programmes under ASU 2022-04; add green pricing
Banks, CDFIs and factors	Fund anchor programmes; price data-verified receivables	Use SBA working capital lines for non-anchor invoices; pay out over RTP and FedNow
ELD, TMS and load-board vendors	Open APIs for delivery events; adopt the NMFTA e-BOL standard	Offer carrier-controlled, consent-based data sharing
Public agencies	FMCSA: finalise electronic broker records. SBA: promote the Working Capital Pilot to carriers	DOT and BTS: extend FLOW to domestic trucking and payment timing. Consider payment-practice reporting by large buyers. Link EPA SmartWay data to green finance

Source: author, drawing on Sections 4 and 6.

7.4 Key performance indicators and governance

Governance rests on a small set of KPIs, reported quarterly to the board and annually in public: the days-to-cash and cash-conversion cost ratio of enrolled carriers, measured against their own baselines; dispute and loss rates; acquisition cost, activation and retention; and the SDG metrics in Table 9. Carriers own their data and share it by consent, and the financiers' credit rules and the platform's pricing rules are documented and audited. A plan that measures only volume will be tempted to grow at any price; one that measures the carrier's cost of getting paid will not.

7.5 Risks and their mitigation

Table 7 lists the principal risks. Two deserve comment. The first is that anchors may use a programme to stretch payment terms and so shift their own financing costs onto carriers; Greensill's collapse showed how opacity compounds such risks (House of Commons Treasury Committee, 2021). The venture's programmes are therefore term-neutral by contract, disclosed under ASU 2022-04 and open to carrier exit without penalty. The second is fraud. Verified delivery events, identity checks on carriers and brokers, and the hashing of documents make it far harder to finance a load that never moved, and these controls are built into the data layer rather than bolted on afterwards.

Table 7. Risk register

Risk	Likelihood	Impact	Mitigation
Anchors use SCF to stretch carriers' payment terms	Medium	High	Term-neutral contracts; ASU 2022-04 disclosure; caps on any term extension; free exit for carriers
Fraud: double brokering, identity theft, fictitious pickups	High	High	ELD-verified delivery events; carrier and broker identity checks; document hashing; anomaly detection
Concentration of exposure on a few anchors	Medium	High	Exposure limits per anchor; several financiers; credit insurance
Withdrawal of funding by financiers	Medium	High	Committed facilities; diversified funding; regular stress tests
Slow adoption or distrust among carriers	Medium	Medium	Anchor-led onboarding; transparent per-load pricing; bilingual support; no exit fees
Cyber-security and data privacy	Medium	High	SOC 2 controls; encryption; least-privilege access; consent-based sharing
Regulatory change, including state commercial-financing disclosure laws such as those of California and New York	Medium	Medium	Compliance by design; disclosure of annualised costs; legal opinions on true sale
Freight downturn and weaker anchor credit	Medium	Medium	Dynamic limits; shock testing as in Section 6.4; several corridors
Integration failure with ELD or TMS vendors	Medium	Medium	Integrations with several vendors; manual verification as a fallback

Source: author.

8. Marketing and Go-to-Market Strategy

8.1 Market and segments

A delivery-to-cash service is a two-sided product sold into a fragmented market, and its marketing must be designed accordingly. The addressable flow is large. Carriers earned \$987 billion in 2023 (ATA, 2024), and the brokered segment alone is estimated at about \$110 billion a year (Triumph Financial, 2025). The platform's 36-month target of \$1.5 billion in financed volume would amount to roughly 1.4 per cent of the brokered market: ambitious, but not grandiose.

Four carrier segments are distinguished: owner-operators with their own operating authority (one truck), micro-fleets (two to ten trucks), small fleets (eleven to ninety-nine trucks) and small brokers and 3PLs. Anchors fall into three segments: mid-sized and large shippers with carrier networks, large freight brokers and 3PL warehouses. The beachhead is the micro-fleet serving shipper and broker anchors in the Texas Triangle. Micro-fleets depend heavily on factoring, generate enough loads to spread onboarding costs and are numerous enough to matter, while the corridor's freight density and exposure to fraud make verification valuable.

8.2 Positioning and message

The positioning statement reads: for small carriers who deliver on time and are paid late, the platform is the cash-flow service that pays on verified delivery at the shipper's price of credit; unlike factoring, it does not price the carrier's own risk into every invoice, hold reserves or charge for leaving. The brand promise compresses this to three words, delivered, proven, paid, and the message is tailored to each side of the market: to carriers, "get paid on delivery, not on day 42"; to anchors, "keep your carriers without stretching them"; to financiers, "short, verified, self-liquidating assets".

8.3 The marketing mix

Table 8 sets out the extended marketing mix. Its guiding principle is that every element should reduce either the carrier's cost of adoption or its uncertainty about the result.

Table 8. Marketing mix (7Ps) for the proof-to-cash platform

Element	Strategy	Evidence or rationale
Product	Automation app (e-POD through the existing ELD, OCR or API invoicing, dispute evidence pack), SCF and a cash-flow dashboard	Automation delivers most of the stand-alone gain, and SCF needs verification (Table 4)
Price	Per-load automation fee; platform fee of about 0.25% on financed invoices; costs shown per load and as an annual rate; no onboarding, minimum or exit fees; green-tier discount	Fixed fees erode owner-operators' gains (Figure 7b); transparency builds trust (Morgan & Hunt, 1994)
Place	Embedded in ELD and TMS apps, broker portals and load boards; mobile first	Distribution where carriers already work lowers acquisition cost
Promotion	Anchor co-branded invitations; partnerships with OOIDA, state trucking associations and TIA; SBDC workshops; trade shows such as the Mid-America Trucking Show; a cost-of-getting-paid calculator; consented case studies; referral credits	Two-sided markets launch through the side that brings the other (Eisenmann et al., 2006; Rochet & Tirole, 2003)
People	Bilingual onboarding specialists; carrier success managers for fleets of five or more trucks	Ease of use and support drive adoption (Davis, 1989; Venkatesh et al., 2003)
Process	Onboarding in under 24 hours; first payment on the first verified delivery; automatic dispute evidence	An early, tangible benefit accelerates diffusion (Rogers, 2003)
Physical evidence	Time-stamped payment receipts; a monthly days-to-cash statement; a published fee schedule; a SOC 2 report	Makes an intangible service and its savings visible

OOIDA: Owner-Operator Independent Drivers Association; TIA: Transportation Intermediaries Association; SBDC: Small Business Development Center. Source: author.

8.4 Launch sequence, channels and trust

Two-sided platforms face a problem of chicken and egg; the answer here is to begin with the hen. An anchor that signs a programme invites its own carriers, which cuts acquisition cost to a fraction of that of cold outreach and assures carriers that the programme has the shipper's backing. As verified data accumulate, risk and prices fall, more financiers compete to fund the programme, and more anchors and carriers join (Figure 9). Carriers, the more price-sensitive side, are charged little and only when they gain; anchors and financiers, who capture durable value in capacity, data and assets, pay for the programme (Eisenmann et al., 2006; Rochet & Tirole, 2003).

Trust is the scarce resource. Many small carriers have met factoring contracts with reserves, minimums and termination fees, and they approach any new offer of finance with the suspicion of experience. The marketing therefore leads with arithmetic rather than adjectives: a calculator that shows a carrier its own cost of getting paid, a fee schedule that fits on a card, and testimonials from pilot carriers who have agreed to be named. Commitment follows trust (Morgan & Hunt, 1994), and trust follows the first payment that arrives when promised.

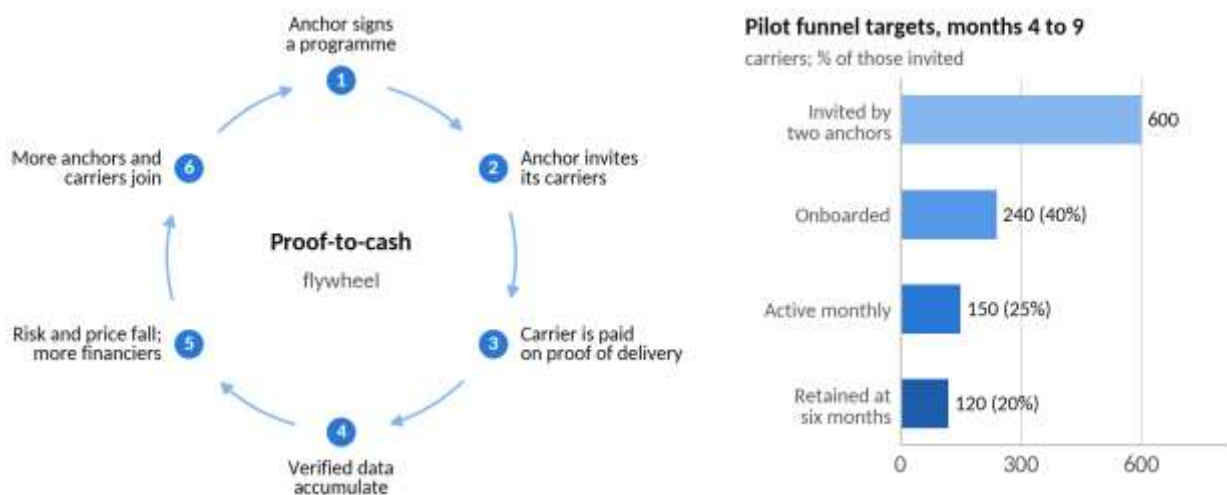


Figure 9. Go-to-market: the anchor-led proof-to-cash flywheel and pilot funnel targets

Funnel values are plan targets for months 4 to 9, not results; percentages are shares of carriers invited. Source: author.

8.5 Funnel targets and marketing metrics

The pilot funnel runs from 600 carriers invited by two anchors to 240 onboarded (40 per cent), 150 active each month (25 per cent) and 120 retained at six months (80 per cent of those active). Marketing is held to a short list of measures: acquisition cost below \$1,500 per active fleet and below \$700 per owner-operator; a ratio of lifetime value to acquisition cost of at least three, with a target of five; less than 48 hours from invitation to first payment; a net promoter score of 40 or more; and 60 per cent of eligible anchor invoices financed. About 15 per cent of Phase 1 operating spending, some \$150,000 to \$200,000, is allocated to marketing and partnerships.

9. Sustainability and the Sustainable Development Goals

The 2030 Agenda applies to every country, the United States included (United Nations, 2015). Table 9 maps the plan to specific targets and to the indicators by which progress would be judged, and Figure 10 summarises the strength of each link. The closest fit is target 9.3, which seeks to increase "the access of small-scale industrial and other enterprises ... to financial services, including affordable credit, and their integration into value chains and markets" (United Nations, 2015). Its indicator 9.3.2, the proportion of small-scale industries with a loan or line of credit, could be measured directly among enrolled carriers (United Nations, 2017). Target 8.3, which calls for policies that encourage the growth of micro, small and medium-sized enterprises, including through access to financial services, and target 8.10, on strengthening the capacity of domestic financial institutions to widen access, follow closely.

The environmental case rests on the weight of freight in national emissions. Transportation produced 28 per cent of U.S. greenhouse gas emissions in 2022, and medium- and heavy-duty trucks 23 per cent of that share (U.S. Environmental Protection Agency [EPA], 2024). The plan's green tier would lower the financing price by 10 to 25 basis points for carriers whose telematics show verified gains in fuel efficiency or who take part in EPA's SmartWay programme (EPA, n.d.), following the precedent of Walmart's sustainability-linked supplier finance with HSBC (PYMNTS, 2019). Because the data are verified rather than self-reported, the same records can feed anchors' Scope 3 reporting (target 12.6) and national climate planning (target 13.2).

Inclusion is pursued through per-load pricing, multilingual onboarding and credit decisions based on verified transactions rather than collateral, with approval and pricing parity across owners' gender and ethnicity monitored through voluntary self-identification (targets 5.a and 10.2). The usual caution applies. Claims of alignment with the SDGs are easy to make and hard to audit, and the plan therefore commits only to indicators it can measure and submits them to independent review.

Table 9. Alignment of the plan with SDG targets and indicators

Target	What the target seeks	Contribution of the plan	Indicator or plan metric (36 months)
8.3	Growth of micro, small and medium-sized enterprises, including through access to financial services	Cheaper and faster working capital for micro-fleets	Enrolled SMEs financed; median days-to-cash of two or fewer
8.10	Stronger domestic financial institutions and wider access to financial services	Community banks and CDFIs fund programmes; FedNow payouts	Community banks and CDFIs funding or paying out
9.1	Quality, reliable, sustainable and resilient infrastructure	Payment and data rails that keep cash moving in a downturn	Change in days-to-cash under stress (Section 6.4)

Target	What the target seeks	Contribution of the plan	Indicator or plan metric (36 months)
9.3	Small enterprises' access to affordable credit and integration into value chains	Anchor-priced credit on verified invoices	UN 9.3.2: share of enrolled carriers with a loan or line of credit; cost of credit
9.4	Upgraded, cleaner and more resource-efficient industry	Green tier rewards verified fuel efficiency	UN 9.4.1: CO2 per unit of value added; fuel per mile of the enrolled fleet
5.a	Women's equal access to economic resources and financial services	Data-based rather than collateral-based credit; inclusive onboarding	Share of women-owned carriers enrolled; approval and price parity
10.2	Social and economic inclusion of all	Multilingual onboarding; per-load pricing	Approval and price parity across owner groups
12.6	Sustainability reporting by companies	Verified emissions data for anchors' Scope 3 reports	UN 12.6.1: anchors receiving verified emissions reports
13.2	Climate measures in policies and planning	Emissions data and green pricing	UN 13.2.2: tonnes of CO2e avoided by the enrolled fleet
17.17	Effective public, public-private and civil-society partnerships	FLOW-style data sharing; SBA, association and bank partnerships	Number of active public-private partnerships

Targets and indicators from United Nations (2015, 2017). Source: author.

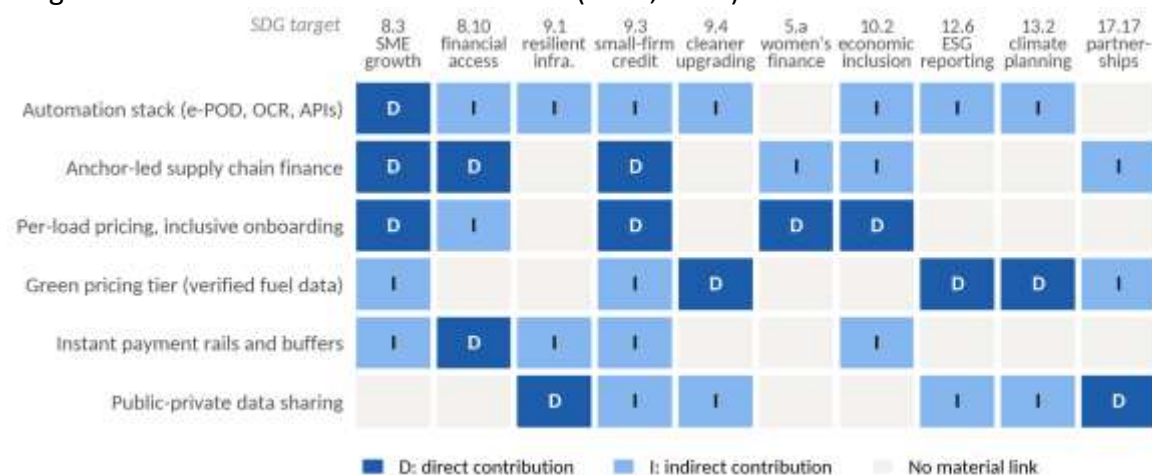


Figure 10. Alignment of the plan's components with SDG targets

D: direct contribution; I: indirect contribution. The author's assessment, based on Table 9.

10. Discussion

10.1 Implications for theory

Three implications follow for theory. First, the results sharpen the mechanism proposed by Wu et al. (2024). Digitalisation raises financing efficiency not in general but to the extent that it

makes a transaction verifiable to a third party, and in logistics the verifiable transaction is the delivery. Resilience, which the base study inferred, appears here directly, as a smaller deterioration of financing efficiency under stress.

Second, the paper joins the trade credit literature, in which small suppliers are unwilling lenders to large customers (Barrot, 2016; Klapper et al., 2012; Murfin & Njoroge, 2015), to the literatures on SCF and automation. SCF moves the burden of finance to the party best able to bear it, but only when the obligation can be verified cheaply, and automation is what makes verification cheap. The results also extend the argument that data can substitute for collateral (Gambacorta et al., 2023) from platform lending to trade: a verified delivery is a form of collateral that even the smallest firm already owns.

Third, complementarity between digital and financial innovation should be demonstrated rather than assumed. In the model it is conditional and flows through eligibility. That refinement invites empirical testing and cautions against the easy claim that any two modern technologies must reinforce each other.

10.2 Implications for managers

For carriers, the first step is to measure what is rarely measured: the cost of getting paid. Paperwork alone costs the representative carrier about one per cent of revenue, and automation repays its onboarding cost within weeks. For anchors, SCF without verification disappoints. Approval speed is a design choice, not an accident of the accounts-payable calendar, and programmes that do not stretch carriers' terms preserve the goodwill on which capacity depends. For financiers and platforms, the lessons are to price per load rather than per fleet, to seek out credit-constrained carriers rather than avoid them, and to build fraud controls into the data rather than around it.

10.3 Implications for policy

Public policy can connect rails that already exist. The FMCSA could finalise its proposal for electronic broker records (FMCSA, 2024), which would give carriers evidence in disputes and data for finance. Evidence from the United Kingdom suggests that requiring large firms to report their payment practices shortens small suppliers' collection times (Grewal et al., 2024), a measure worth considering in the United States. The QuickPay experience shows that faster payment by a large buyer raises small-firm employment, although its general-equilibrium effects counsel a gradual roll-out (Barrot & Nanda, 2020). The SBA could promote its Working Capital Pilot to carriers for invoices outside anchor programmes; the Department of Transportation could extend FLOW to domestic trucking and to anonymised statistics on payment timing; wider enrolment of community banks in FedNow would give small carriers instant payouts through the banks they already use; and EPA SmartWay data could anchor green supply chain finance. None of these measures requires a new agency or a large appropriation. They require that existing rails be joined.

10.4 Limitations and future research

The study's limitations are those of its method. The simulation is calibrated, not estimated; several parameters rest on bounded assumptions; parameters are drawn independently; and strategic responses, such as factors cutting their prices or anchors extending their terms, are treated only in robustness checks. The action plan's targets are plans, not results.

Future research can address each point. The staggered compliance dates of the ELD rule (December 2017 for most carriers and December 2019 for those grandfathered with older

devices) offer a quasi-natural experiment in the availability of verified data, well suited to the difference-in-differences design of the base study, provided that carrier-level financing data can be assembled from UCC filings, factoring records or platform data. A stepped-wedge roll-out of the pilot across carriers would permit causal estimates of the effects on days-to-cash, the cost of credit and survival. Surveys of carriers' payment terms and financing costs would replace assumptions with estimates, and the framework should apply, *mutatis mutandis*, to warehousing and last-mile delivery.

11. Conclusion

The Pony Express carried the mail from Missouri to California in about ten days and lasted eighteen months. It cost some \$700,000 to run and took in about \$500,000, losing, on one reckoning, as much as \$13 on every letter it carried (Encyclopaedia Britannica, n.d.). Speed, on its own, has never been a business model. Wells and Fargo understood what the Pony Express did not: the value of a delivery lies in the certainty that it will be paid for.

This paper has argued that the United States can restore that certainty for its smallest logistics firms by joining two levers that are usually studied apart. SME automation turns a delivery into verified data; supply chain finance turns verified data into cash at the shipper's price of credit. In a calibrated simulation of a ten-truck carrier, the combination lowers the cost of converting deliveries into cash from 4.57 to 2.60 per cent of revenue, shortens the delivery-to-cash cycle from about nineteen days to about seven, releases some \$67,000 of working capital and absorbs a downturn with 41 per cent less damage. SCF without automation trades speed for price; with automation, the carrier gets both. The gains are largest for the credit-constrained, and per-load pricing ensures that owner-operators share them. The explicit action plan, the marketing strategy and the SDG map set out how the gains could be realised, measured and shared.

Cash on delivery was once a promise of the frontier. With a verified delivery, a willing anchor and a sensible price, it can become the ordinary terms of trade for America's smallest carriers. That would be progress of the most old-fashioned kind.

Declarations

Funding: [To be completed by the author.]

Declaration of competing interest: [To be completed by the author.]

Data availability: All empirical figures are drawn from the public sources cited. Every parameter of the simulation is reported in Table 3, and the code is available from the corresponding author on request.

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