

The Bounded Utilization Regime: Reconciling Revenue Efficiency and Residual-Value Risk in Vehicle-as-Income-Stream Models

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Abstract

The claim that a privately owned motor vehicle constitutes a viable income-generating asset once matched to platform demand rests on a boundary condition: the utilization rate at which telematics-enabled efficiency gains offset the accelerated depreciation and resale-value volatility that intensive use produces. Studies quantifying the revenue benefits of higher utilization stop short of pricing in the residual-value discount that the same mileage generates in the secondary market. Studies quantifying that discount rarely connect it back to the utilization decision that produced it. This article formalizes the floor and ceiling conditions that bound viable operation as a conceptual model, collects the underlying cost and utilization parameters from the transportation-economics literature and compares them with independent data, and proposes that the vehicle-as-income-stream thesis is viable within a bounded interior range, provisionally the sixty-five to eighty-five percent utilization band. Below the floor, fixed costs remain unrecovered. Above the ceiling, mileage-driven depreciation and resale discounting are expected to erode the marginal revenue that higher utilization was meant to secure. The analysis frames utilization as a two-sided constraint: a specific band to be held, with candidate implications for financing terms, replacement schedules, and commission design.

Keywords: vehicle utilization, residual value risk, asset-based transportation, depreciation, platform economics, fleet economics

1. Introduction

A parked vehicle generates zero revenue, and this simple fact has organized platform-economics research around one variable: how many hours per week the asset spends in revenue-generating service. The floor condition can be written formally as

$$U^* = FC/(r(1 - c)) \quad (1)$$

where U^* is the minimum weekly platform-connection time required to recover cost, FC is the weekly fixed cost of depreciation, insurance, and financing, r is the average gross fare rate per hour of platform connection, and c is the platform's commission rate. For a reference sedan, Karazhekov (2026b) reports that this condition holds above approximately thirty-five hours of weekly connection time (twenty-six hours of passenger-carrying time once deadheading and positioning are netted out), and that U^* itself moves with contract terms the platform sets unilaterally: each five-percentage-point increase in c raises U^* by approximately four hours per week. Below U^* , insurance and depreciation accrue on a fixed schedule regardless of how the vehicle is used, so an owner who falls short earns a blended return that a passive financial instrument would beat at lower risk. The studies that established this threshold read it as a floor. It functions, this article argues, as one half of a boundary condition, and the omission matters because the same mileage that clears the floor drives the vehicle toward a ceiling those studies leave unexamined.

This split follows directly from how the two relevant bodies of work divide the object of study. Profitability research frames the vehicle as a revenue-generating capacity unit and stops at the point where gross earnings are established; the resale price those same kilometers set in the used-vehicle market falls outside its scope. Residual-value research frames the vehicle as a depreciating balance-sheet item and stops at the point where a discount rate is estimated; the utilization pattern that produced the discount falls outside its scope too. Each literature holds on its own terms and stays silent on the interval in which the other's finding starts to dominate. This article takes that silence as the object of analysis and proposes that a utilization ceiling exists, with residual-value dynamics, distinct from revenue economics, setting its location. The proposal places that ceiling relative to the utilization floor the profitability literature already established.

2. Literature Review

2.1 Utilization and Owner Income: The Floor Literature

Four studies, taken together, establish utilization as a measured, validated driver of owner income. Chen, Chevalier, Rossi, and Oehlsen (2019) exploited scheduling-flexibility variation among Uber drivers to show that the value drivers place on control over their own hours forms a component of the return, separate from fare revenue itself; this establishes utilization as a joint product of hours worked and the discretion over when they are worked. Henao and Marshall (2019) built a cost-revenue accounting for individual ride-hailing drivers that isolates the fixed-cost burden, insurance and depreciation charged regardless of hours driven, carried by low-utilization owners; this accounting supplies the mechanism, distinct from any single break-even figure, behind the utilization floor, and it is the same accounting

that later yields the resale-discount estimate discussed below. González, Wilby, Vinagre Díaz, Fernández Pozo, and Sánchez Ávila (2023) then supplied the metric itself, proposing utilization rate as a standardized fleet-performance indicator to formalize a concept prior work had used informally; their contribution is methodological, and it is what allows the cost-revenue findings above to be compared across markets and vehicle types on a common scale. Young, Farber, and Rahman (2025) applied that metric to driver-level data in Toronto and found that earnings inequality among drivers is closely tied to utilization variance across the driver population, a finding that closes the loop on this group by showing utilization functions as an explanatory variable for income outcomes. These four studies, addressing separate questions about earnings, stop at the point of income generation; the mileage that generates that income continues on into the vehicle's eventual disposal, a step the next literature takes up.

2.2 Residual-Value Risk: The Ceiling Literature

A separate literature addresses the same mileage from the disposal side. It begins from a different limiting condition: depreciation and resale price function as variables of usage intensity during the holding period. Nau (2011) modeled residual-value risk in automotive lease contracts as a function of usage intensity alongside vehicle age, handling the difference between contracted and realized end-of-term value as a usage-monitoring problem. Henao and Marshall's (2019) driver-economics data, read from the disposal side, supplies the transmission mechanism connecting the two literatures: their estimate that platform-history vehicles sell at an eight to fourteen percent discount relative to comparable private-use vehicles, documented in the Denver metropolitan area, is the resale-market price of the same mileage the first group of studies counts as pure upside. That estimate aligns in direction with the fifteen-to-twenty-five percent first-two-year liquidity discount Karazhekov (2026b) reports for intensively platform-operated vehicles generally; the difference between the two figures plausibly reflects a narrower, reputation-specific component in the Henao and Marshall estimate set against the broader liquidity effect Karazhekov's estimate also captures. Zhu, Zhao, and He (2025) confirmed the pattern at firm scale, tracing automobile-leasing losses in China to lease-price structures built on residual-value assumptions the market subsequently invalidated; this scales the individual-owner discount Henao and Marshall documented up into portfolio losses across many similarly utilized vehicles. Independent mileage-price evidence points the same way. Lacetera, Pope, and Sydnor (2012), analyzing more than 22 million wholesale used-car transactions, found discontinuous price drops of roughly 150 to 200 USD at each 10,000-mile odometer threshold, so a vehicle driven 50,000-70,000 km a year passes between three and five such steps annually. For New York's high-volume for-hire fleet, Parrott (2025) reports that full-time drivers log 32,500 miles a year and that a sample of 2,722 internal-combustion vehicles of model years 2015 to 2019 carried a weighted average odometer reading of 196,816 miles and a weighted average trade-in value of 7,200 USD. This group establishes, with reinforcing evidence at the contract, driver, and firm level, that utilization intensity and resale value move together, at a rate the first group's studies were built to leave aside.

2.3 Access-Based Consumption and Servitization

Access-based consumption research supplies the premise that vehicle access can be separated from ownership. Ride-hailing, carsharing, and subscription fall into the use-oriented class of Tukker's (2004, 2015) product-service taxonomy, and Bilgin, Mattioli, Morgan, and Wadud (2023) found that ridesourcing availability reduced household vehicle ownership in Great Britain, an effect their systematic review (Bilgin et al., 2025) confirmed across the wider evidence base. Kim, Park, and Ko (2019) identified the factors behind ownership reduction among carsharing users, and Lagadic, Verloes, and Louvet (2019) tested carsharing profitability once fleet-replacement costs were included. These studies price the service flow and leave the terminal value of the underlying asset outside the model, so the exposure an owner carries into the used-vehicle market goes unpriced.

2.4 Institutional Assetization and Asset-Light Business Models

Institutional assetization and asset-light research extends income-stream logic to financialized assets. Gupta and Sharma (2022) and O'Neill (2013) document how infrastructure acquired the categorization that made it investable, and McArthur (2024) follows the process into infrastructure debt funds; in each setting, professionally underwritten discounted cash-flow models set resale value. Asset-light firms outperform asset-heavy ones in tourism and hospitality (Seo, Woo, Mun, & Soh, 2021; Liang, Yu, Liu, Wang, Wu, & Hu, 2023), and Münzel, Boon, Frenken, and Vaskelainen (2018) and Nansubuga and Kowalkowski (2021) carried the logic into carsharing, where fleet utilization becomes the central performance lever and resale value stays fixed as utilization rises. That advantage depends on a counterparty to negotiate against. An individual owner selling into the retail used-car market has none: the buyer and the discount applied to platform-history mileage are given, and the owner remains the counterparty of last resort for the vehicle's residual risk.

2.5 Synthesis of the Four Literature Groups

Table 1 summarizes the evidentiary contribution and the specific boundary left open by each of the four groups reviewed above. Read across rows, the table makes the case for utilization as a two-sided variable directly: each row supplies one mechanism, generating value or eroding it, and the two mechanisms sit in separate rows throughout.

Table 1. Evidentiary contribution and unaddressed boundary by literature group

Group	Representative sources	Evidentiary contribution	Boundary left open
Utilization-profitability (floor)	Chen et al. (2019); Henao & Marshall (2019); González et al. (2023); Young et al. (2025)	Establishes utilization as a measured driver of owner income; supplies the fixed-cost accounting behind Eq. (1)	Stops at the point of income generation, before the mileage reaches the used-vehicle market
Residual-value risk (ceiling)	Nau (2011); Henao & Marshall (2019); Zhu, Zhao & He (2025); Lacetera et al. (2012); Parrott (2025)	Shows depreciation and resale price are functions of usage intensity; supplies the 8-14% platform-history discount behind Eq. (3)	Treats the discount as a fact about the vehicle, separate from the utilization decision that produced it
Access-based consumption / servitization	Tukker (2004, 2015); Bilgin et al. (2023, 2025); Kim et al. (2019); Lagadic et al. (2019)	Licenses viewing vehicle access as separable from ownership; documents ownership-reduction effects	Regards the ownership/use separation as sufficient for value regardless of residual-value path
Institutional assetization / business-model literature	Gupta & Sharma (2022); O'Neill (2013); McArthur (2024); Seo et al. (2021); Liang et al. (2023); Münzel et al. (2018); Nansubuga & Kowalkowski (2021)	Generalizes income-stream logic to financialized capital assets and asset-light business models	Assumes an informed institutional counterparty prices residual value

3. Methods

3.1 Parameter Sources and Owner-Level Cash Flow

This analysis draws its parameters from the broader literature synthesized in Table 1: the floor-side cost and revenue parameters come from Karazhekov's (2026b) worked reference-vehicle case, while the ceiling-side parameters come from the resale-discount estimates reported by Henao and Marshall (2019), Nau (2011), and Zhu, Zhao, and He (2025). The owner-level economics behind the floor condition in equation (1) are traceable in the worked reference case Karazhekov (2026b) uses to illustrate the calculation. The owner's net monthly cash flow, NI, decomposes as

$$NI = R(1 - c) - (Fu + In + Ma + Ms) \quad (2)$$

where R is gross monthly platform revenue, c is the commission rate, and Fu, In, Ma, and Ms are monthly fuel, insurance, maintenance, and miscellaneous costs respectively.

3.2 Two-Sided Utilization Bound and Expected Net-Value Function

The utilization variable the profitability literature positions as a target to be maximized

functions, in this model, as a two-sided bound. Below the floor established by equation (1), fixed costs remain unrecovered and the vehicle underperforms a passive financial instrument. A ceiling operates above this floor, set by the point at which the marginal kilometer's contribution to resale discount exceeds its contribution to gross fare; here the same mechanism reverses, and the owner earns fare revenue with one hand while giving up an increasing share of the vehicle's terminal value with the other. This trade is represented schematically as a resale discount $\text{Disc}(K)$ anchored at two values the cited sources report directly,

$$\text{Disc}(K) \approx 0 \text{ for } K \text{ at private-use annual mileage, and } \text{Disc}(K) \in [8\%, 14\%] \text{ for } K \text{ at platform-typical annual mileage of } 50,000\text{-}70,000 \text{ km} \quad (3)$$

with the severity of the trade growing, following Nau's (2011) usage-intensity approach to lease-contract residual value, as annual mileage departs further from the private-use range. Combining the floor and ceiling mechanisms into a single expected net-value function gives

$$V(U) = R(U) - C(U) - L(U) \quad (4)$$

where $R(U)$ is fare revenue as an increasing function of utilization U , $C(U)$ is total operating cost, and $L(U)$ is the expected resale-value loss implied by $\text{Disc}(K(U))$.

3.3 Status of Equation (4) and the Interior Band

Equation (4) is a proposed specification. The structure yields conditions that data can test. Let $\pi(U) = R(U) - C(U)$ denote operating margin, so that the floor in equation (1) is the utilization U^* at which $\pi(U^*) = 0$, and let the ceiling U^c be the utilization at which $V(U)$ peaks. The ceiling then satisfies the first-order condition

$$R'(U^c) - C'(U^c) = L'(U^c) \quad (5)$$

which equates the marginal operating margin of an additional hour in service with the marginal expected resale loss. If π is increasing and weakly concave, for example because added hours fall into lower-demand periods, and L is increasing and convex in mileage, V is strictly concave and U^c is unique. It lies above the floor whenever $\pi'(U^*) > L'(U^*)$, that is, whenever the marginal margin at the floor still exceeds the marginal resale loss. Because $L(U)$ is nonnegative, $V(U) \geq 0$ requires $\pi(U) \geq 0$, which makes the floor a necessary condition for net viability. The first-order condition applies to a smoothed $\text{Disc}(K)$, since the mileage-price schedule documented by Lacetera, Pope, and Sydnor (2012) contains discrete steps at 10,000-mile thresholds.

The edges of the band are proposed values. The lower edge of sixty-five percent is adopted from the aggregate utilization that Karazhekov (2026b) reports for two-asset operation, and the upper edge of eighty-five percent is the proposed location of U^c . Independent operating data supply a reference point for the upper edge: Hertz Global Holdings (2025) reports utilization, measured as rental days over available car days, of 80 percent in 2024 and 81 percent in 2023 for its Americas rental fleet, so a sustained eighty-five percent would sit above the level of a professionally managed fleet and is best read as an upper limit.

4. Results

4.1 Reference-Vehicle Worked Example

At the reported parameter values, $NI = 5,200(0.75) - 1,400 = 2,500$ USD per month. Karazhekov (2026b) reports a fourteen-month simple payback and a 78,200 USD five-year net present value at an eight percent discount rate against a total cost of ownership of 119,000 USD, figures generated by this same underlying calculation.

Table 2. Reference-vehicle worked example (Karazhekov, 2026b)

Parameter	Value	Note
Acquisition cost, P	USD 35,000	Financed at 5.9% APR over 60 months
Gross monthly revenue, R	USD 5,200	Mid-density urban ride-hailing market
Fuel	USD 650 / month	
Insurance	USD 280 / month	
Maintenance	USD 320 / month	
Miscellaneous	USD 150 / month	
Platform commission, c	25% of gross fare (USD 1,300)	
Net monthly cash flow, NI (Eq. 2)	USD 2,500	$R(1-c) - (Fu+In+Ma+Ms) = 5,200(0.75)-1,400$
Simple payback period	14 months	
NPV-adjusted payback (8% discount)	~16 months	
Five-year net present value	USD 78,200	
Total cost of ownership (5 yr)	USD 119,000	Acquisition plus cumulative operating costs

4.2 Net-Value Curve Across the Utilization Range

$V(U)$ stays negative below the floor because $R(U) - C(U) < 0$, rises through the interior range as $R(U) - C(U)$ grows faster than $L(U)$, and falls again once $L(U)$ grows faster than $R(U) - C(U)$. Figure 1 sketches this relationship schematically, drawing the shape equation (4) implies from the anchor points in equation (3) and Table 2. Section 3.3 states the conditions under which this shape obtains.

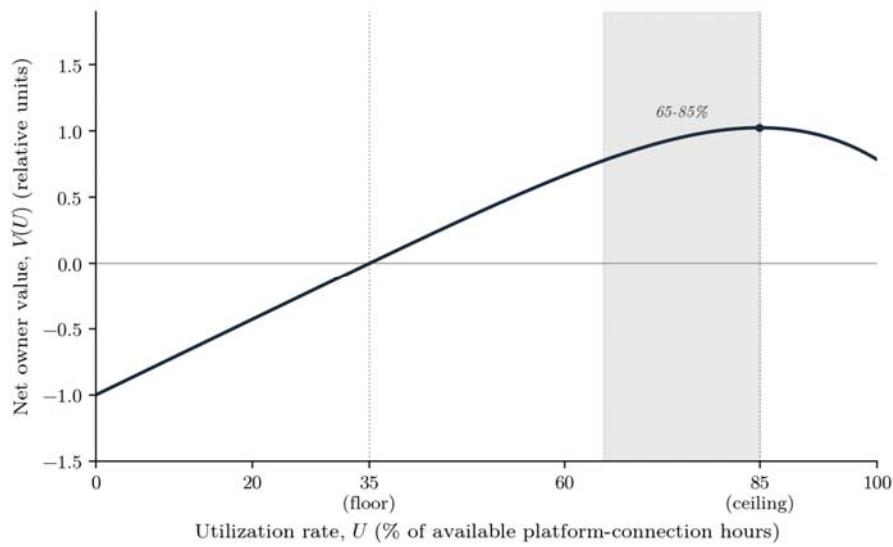


Figure 1. Schematic net-value curve $V(U)$ across the utilization range (Eq. 4)

4.3 Interior Utilization Band and Diversification Effect

Table 3 collects the parameter values behind Figure 1's three regions. The interior band, roughly sixty-five to eighty-five percent of available operating hours, is proposed in this analysis by joining the floor mechanism from the first literature group to the ceiling mechanism from the second. The range stands as a working value awaiting estimation. It matches in magnitude Karazhekov's (2026b) finding, illustrated in Figure 2, that owners diversifying across two appropriately positioned vehicles sustain aggregate utilization above sixty-five percent, a figure that stands well clear of the forty-to-fifty-five-percent ceiling achievable on a single asset.

Table 3. Parameters underlying the floor, ceiling, and interior band in Figure 1

Parameter	Reported value
Floor: weekly passenger-carrying time	~26 h/week
Floor: weekly platform-connection time	~35 h/week
Break-even sensitivity to commission	+4 h/week per +5 pp in c
Single-asset achievable utilization	40-55% of available hours
Diversified (2-asset) achievable utilization	>65% of available hours
Interior band (proposed working range)	65-85% of available hours
Platform-history resale discount	8-14%
First-two-year liquidity discount	15-25% of acquisition cost
Platform-use annual mileage	50,000-70,000 km (2-3x private use)
Demand volatility (coefficient of variation)	0.15-0.35 of monthly gross revenue
Risk premium above baseline ROI	300-500 basis points

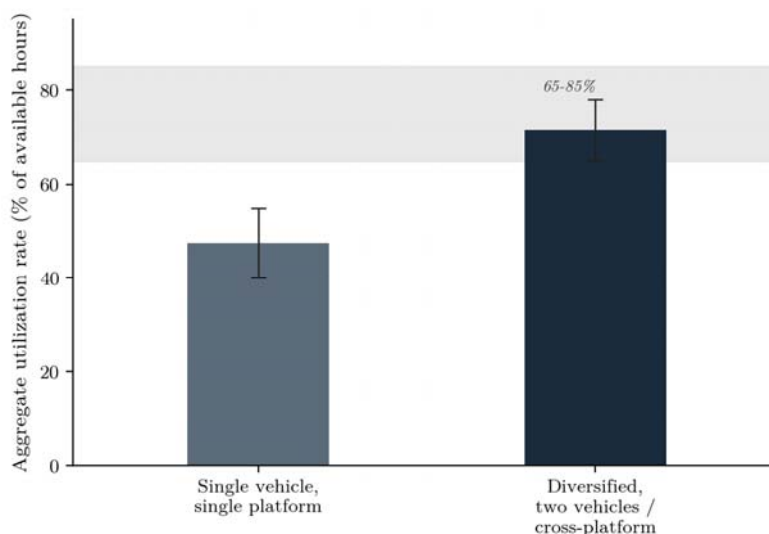


Figure 2. Achievable utilization: single asset vs. diversified operation (Karazhekov, 2026b)

4.4 Independent Cross-Checks of the Reference Parameters

The reference parameters of Karazhekov (2026b) come from one source, so Table 4 sets them against independent data. The cost side agrees within about 8 percent. Fuel, insurance, maintenance, and miscellaneous costs total 1,400 USD per month in the reference case, against about 1,300 USD per month for comparable items (fuel, insurance, maintenance, cleaning, and licensing) in the expense model that Parrott (2025) built for New York's high-volume for-hire fleet, and the vehicle payment of about 675 USD implied by the financing terms in Table 2 compares with 735 USD in that model. The platform mileage of 50,000-70,000 km in equation (3) brackets the 32,500 miles, about 52,300 km, that full-time drivers log each year in the New York data. On the utilization side, Hertz Global Holdings (2025) reports 80 percent for its Americas rental fleet in 2024, below the 85 percent upper edge of the proposed band. Revenue is specific to a market, and the risk premium has no independent estimate of this kind. Henao and Marshall (2019) put gross driver earnings in Denver at 15.57 USD per hour and net wages at 5.72 to 10.46 USD per hour before taxes across three expense scenarios, and since U^* in equation (1) rises as $r(1 - c)$ falls, the 35-hour floor of the reference case should be read as market-specific.

Table 4. Independent cross-checks of the reference parameters

Parameter	Reference case (Karazhekov, 2026b)	Independent source	Independent value
Annual platform mileage	50,000-70,000 km	Parrott (2025), New York for-hire drivers	32,500 miles (about 52,300 km) for full-time drivers
Monthly operating costs excluding vehicle payment	1,400 USD (fuel, insurance, maintenance, miscellaneous)	Parrott (2025)	About 1,300 USD (15,582 USD per year: fuel, insurance, maintenance, cleaning, licensing)
Monthly vehicle payment	About 675 USD (35,000 USD at 5.9% APR over 60 months; computed)	Parrott (2025)	735 USD (owned internal-combustion vehicle)
Residual value after intensive use	8-14% platform-history discount; 15-25% first-two-year liquidity discount	Parrott (2025)	7,200 USD weighted trade-in value at 196,816 miles (2,722 sampled vehicles, model years 2015-2019)
Fleet utilization	65-85% proposed interior band	Hertz Global Holdings (2025)	80% in 2024 and 81% in 2023 (Americas rental fleet)

5. Discussion

5.1 Floor and Ceiling as Two Ends of One Variable

The reference-vehicle calculation in Section 4.1 is the one that produces the floor in equation (1). It stops at the point of sale: what happens to the 35,000 USD acquisition cost once the vehicle changes hands is the exact question the residual-value literature exists to answer.

Fixed costs unrecovered below a floor, and resale value eroded above a ceiling, express the same variable, hours in service, at opposite ends of its range; the generalized assetization literature assumes the ceiling away by representing residual value as a parameter set by an informed counterparty, in place of a function of the very utilization the model maximizes. The assetization literature represented by Gupta and Sharma (2022) and McArthur (2024) describes an institutional counterparty pricing residual value against a discounted cash-flow model. An individually owned platform vehicle faces a different counterparty: a consumer used-vehicle buyer applying a stigma discount to mileage, and that discount, measured by Henao and Marshall (2019) at eight to fourteen percent and confirmed as a portfolio-level loss driver by Zhu, Zhao, and He (2025), moves with the utilization the owner chose in pursuit of the floor threshold.

5.2 Diversification and Telematics: Asymmetric Effects on Revenue and Resale Loss

The diversification finding in Section 4.3 fits the band: it solves the floor problem in equation (1), and this article's contribution is locating the ceiling problem in equation (3), a task the diversification argument leaves for this analysis to take up.

Karazhekov's (2026a) operational account of telematics-driven efficiency gains,

fault-prognostics recall improvements and deadhead-distance reduction among them, calls for a qualification this analysis supplies. Those gains raise effective utilization, and hence $R(U)$ in equation (4), through deadheading reduction alone; this is exactly the mechanism that widens the interior band by pushing the floor U^* downward through a lower effective FC per productive hour. Telematics adoption simultaneously increases connection-time visibility to the platform and, through the same continuous monitoring that produces the fault-prognostics benefit, increases the granularity of mileage and usage-pattern data available to used-vehicle appraisers and insurers, a channel through which operational efficiency could just as plausibly raise $L(U)$ by sharpening the resale market's stigma discount in equation (3). Diversifying across vehicle types raises aggregate utilization by distributing the added mileage across two assets, raising $R(U)$ for each while holding each asset's $L(U)$ at its original level. A telematics-driven reduction in deadheading concentrates its $R(U)$ benefit on a single asset, the same asset whose $L(U)$ exposure it documents in ever finer detail through that same telematics data.

5.3 Risk Premium as Evidence of Hidden Residual-Value Risk

Karazhekov's (2026b) risk-premium estimate offers one further piece of evidence for this asymmetry: the 300-to-500-basis-point premium he reports above the baseline ROI calculation, justified by demand volatility (coefficient of variation 0.15-0.35 in monthly gross revenue), regulatory reclassification risk, and technology-obsolescence risk, is consistent with a premium the market demands because $L(U)$ stays hidden at the point of purchase. Parrott (2025) argues that an expense study prepared for Uber significantly understated depreciation costs, and his expense model for New York's for-hire fleet records a weighted average trade-in value of 7,200 USD at 196,816 miles of odometer wear. Zhu, Zhao, and He (2025) report the same hidden-risk pattern at portfolio scale, for institutional lessors holding many similarly utilized vehicles.

6. Conclusion

The practical implication for owners, lessors, and platform designers holds utilization as a band with two enforceable edges, bounded below by equation (1) and above by equation (3), a range to be held steady. Financing terms that reward early payoff at the low end of the band, replacement schedules that retire a vehicle before its usage intensity crosses into the discount-accelerating range implied by equation (3), and commission structures that keep U^* in equation (1) within an owner's realistic connection time. Locating that ceiling precisely, as a function of vehicle class, platform type, and secondary-market structure, calls for a specific kind of data: panel records that pair individual vehicles' utilization histories, $U(t)$, with their eventual resale prices at disposal, in place of the cross-sectional earnings snapshots the profitability literature has relied on and the aggregate lease-portfolio losses the residual-value literature has relied on separately. That pairing, matched by vehicle class and platform, converts the interior band proposed here from a working range into an empirically estimated one.

The same logic applies to how platforms design dispatch and commission schedules. A schedule that rewards utilization alone pushes drivers toward exactly the range that erodes

their own asset base, working against the platform's stated interest in a stable, engaged driver pool. Dispatch algorithms already optimize for utilization; adding the resale-value term in equation (4) as a second objective would route drivers toward the interior band directly, replacing the practice of treating utilization as a single number to push upward.

The framework also carries over to owners holding several vehicles at once. There, the ceiling in equation (3) applies to each asset separately, so a fleet's aggregate utilization can sit inside the interior band while individual vehicles sit above it, a distinction fleet-level reporting typically obscures. Electric vehicles add a further channel: battery degradation feeds into $L(U)$ alongside the mileage-driven resale discount modeled here.

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