Shareholding Strategies in Dual-Channel Supply Chains with Parallel Imports

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Abstract. Parallel imports, where genuine products are sold through unauthorized channels at lower prices, create significant channel conflicts in modern supply chains. This study develops a game-theoretic model to examine how equity-based coordination mechanisms—specifically forward, backward, and cross-shareholding strategies—can mitigate these conflicts between manufacturers and authorized retailers. Using a three-party Stackelberg game framework with numerical analysis, we find that: (1) cross-shareholding achieves Pareto improvements when the forward shareholding ratio $k \in [0.3, 0.5]$ and backward ratio $j \in [0.2, 0.4]$; (2) this bilateral equity arrangement simultaneously increases manufacturer profits by 18%, retailer profits by 21%, and quality assurance investments by 31%; (3) consumer trust levels and parallel import costs significantly influence optimal shareholding configurations. Our findings provide strategic guidance for brand manufacturers managing gray market challenges through equity-based channel coordination.

Keywords: Parallel imports; Shareholding strategy; Dual-channel supply chain; Game theory; Pareto improvement

1 Introduction

Parallel imports are genuine branded products purchased in one market and resold in another through unauthorized channels. They have become more common with globalization and e-commerce expansion. In luxury goods, products like Louis Vuitton handbags are often resold at prices 20-30% below authorized retail. The automotive industry faces similar challenges. In China's import vehicle market, parallel importers continue to compete with authorized dealers. This creates basic tensions because authorized retailers invest heavily in brand building and customer service. But they face price competition from parallel importers who avoid these costs.

Recent industry trends show that leading manufacturers are more and more adopting equity-based strategies to manage channel conflicts. Huawei Technologies has invested in major authorized retailers. Apple Inc. has also increased ownership of its retail stores over time. These observations raise an important question: Can equity structures serve

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as coordination mechanisms to reduce channel conflicts while keeping supply chain efficiency?

This study addresses three basic questions: (1) How do different shareholding strategies influence pricing decisions in authorized and parallel import channels? (2) How do shareholding arrangements affect profit distributions among supply chain members? (3) Does there exist a shareholding configuration that achieves Pareto improvements—benefiting manufacturers, retailers, and consumers at the same time? Our analysis shows that cross-shareholding creates a "sweet spot" where all parties achieve higher profits than the benchmark case. It also maximizes quality assurance levels.

2 Literature Review

Our research intersects three literature streams. The parallel import literature has extensively examined price discrimination and arbitrage opportunities[1][2], with recent work analyzing how manufacturers can use product differentiation and warranty policies to segment markets[3]. However, these studies treat channel structures as exogenous, overlooking how equity relationships might endogenously influence parallel import dynamics. The dual-channel supply chain literature has analyzed manufacturer direct selling alongside traditional retail[4][5], but our context differs fundamentally: parallel import channels exhibit "free-riding" behavior, benefiting from brand investments without contributing to them. Recent research on shareholding strategies in supply chains has shown that forward shareholding increases supplier investment incentives through profit-sharing mechanisms[6], while backward shareholding can lead to higher downstream prices under intense competition[7]. Chen et al.[8] pioneered cross-shareholding analysis, demonstrating that mutual equity stakes can improve supply chain coordination. Recent empirical evidence[9] confirms that direct equity ownership in supply chains enhances operational performance through improved information sharing and aligned strategic objectives.

However, existing research focuses on traditional supply chain settings without parallel imports. Our contribution lies in applying and extending these frameworks to gray market contexts, where the third-party parallel importer creates unique strategic considerations. However, no existing research examines how these shareholding strategies perform in the presence of parallel imports, where the third-party importer creates asymmetric free-riding incentives. Our contribution lies in extending equity-based coordination frameworks to gray market contexts, providing both theoretical insights and practical guidance for brand manufacturers facing parallel import challenges.

3 Model Formulation

3.1 Problem Description and Assumptions

We consider a supply chain consisting of one manufacturer (M), one authorized retailer (R), and parallel importers (P). The manufacturer produces a single product and sells through two channels: (1) Authorized channel: $M \rightarrow R \rightarrow$ Consumers (price: p_a); (2)

Parallel import channel: $M \rightarrow$ Foreign market $\rightarrow P \rightarrow$ Consumers (price: p_p). The manufacturer decides wholesale price w to the authorized retailer, sets the parallel import market price p_p, and invests in quality assurance level q (e.g., anti-counterfeiting technology, exclusive after-sales service). The authorized retailer determines retail price p_a. We assume the manufacturer acts as the Stackelberg leader, with the retailer as follower, following the standard approach in supply chain coordination literature[6][9].

3.2 Consumer Utility and Demand

Following the Hotelling framework widely used in parallel import research[1][5], consumers have heterogeneous valuations $V \sim \text{Uniform}[0,1]$ for the product. Consumer utilities are:

$U_a = V - p_a + q$ (authorized channel); $U_p = \beta V - p_p$ (parallel import channel)

where $\beta \in (0,1)$ represents the trust discount factor for parallel imports, capturing consumer concerns about product authenticity and after-sales service quality[3][4]. The quality assurance level q captures manufacturer investments in brand protection that benefit only authorized channel purchases[13]. The indifferent consumer satisfies $U_a = U_p$, yielding $V^* = (p_a - p_p - q)/(1 - \beta)$. Market demands are:

$$d_a = 1 - \frac{p_a - p_p - q}{1-\beta} \tag{1}$$

$$d_p = \frac{p_a - p_p - q}{1-\beta} \tag{2}$$

This demand specification follows Cai (2010)[5] and ensures market coverage when $p_a - p_p - q < 1 - \beta$.

3.3 Game Sequence and Profit Functions

The game unfolds in four stages: (0) Shareholding rates k (forward) and j (backward) are determined; (1) Manufacturer decides w, p_p, and q; (2) Authorized retailer decides p_a; (3) Demands realize and profits are distributed. When parties are independent ($k = j = 0$), profit functions are:

$$\Pi_M^N = w \cdot d_a + (p_p - t) \cdot d_p - \frac{1}{2}q^2 \tag{3}$$

$$\Pi_R^N = (p_a - w) \cdot d_a \tag{4}$$

The quadratic cost function $\frac{1}{2}q^2$ reflects increasing marginal costs of quality assurance investments, consistent with the quality investment literature[13]. The parameter $t > 0$ represents parallel import transaction costs including tariffs, transportation, and regulatory compliance[2][5]. Solving by backward induction, we obtain the benchmark equilibrium where $w^N = \beta/2$, and equilibrium prices and quality levels are determined by the system of first-order conditions (detailed derivations in Appendix A).

4 Shareholding Equilibria

4.1 Forward Shareholding (Case F)

When the manufacturer holds k proportion of the retailer's equity ($k > 0, j = 0$), following the forward integration framework of Haw et al. (2023)[9], the manufacturer's profit function becomes:

$$\Pi_M^F = w \cdot d_a + (p_p - t) \cdot d_p - \frac{1}{2}q^2 + k(p_a - w) \cdot d_a \tag{5}$$

The manufacturer now takes in k fraction of the retailer's profit. This aligns incentives toward channel coordination[9][10]. It lets the manufacturer get retailer profits directly through equity returns instead of wholesale margins. This reduces the reason to keep high wholesale prices and makes the authorized channel more stable. But with less channel conflict, the manufacturer has less reason to invest in quality differentiation (q). This is because coordination reduces the need for authorized channel competitive advantages.

4.2 Backward Shareholding (Case B)

When the retailer holds j proportion of the manufacturer's equity ($k = 0, j > 0$), following the backward integration analysis[10], profit functions become:

$$\Pi_M^B = (1 - j)\left[w \cdot d_a + (p_p - t) \cdot d_p - \frac{1}{2}q^2\right] \tag{6}$$

$$\Pi_R^B = (p_a - w) \cdot d_a + j\left[w \cdot d_a + (p_p - t) \cdot d_p - \frac{1}{2}q^2\right] \tag{7}$$

Backward shareholding creates a hold-up problem that has been documented in vertical integration literature[10]. The retailer becomes a partial owner of the manufacturer. Because of this, the retailer wants to push for higher retail prices to maximize total returns. These returns include both retail margin and equity dividends. This price increase hurts the manufacturer's direct parallel import channel. It also reduces overall market coverage. So the manufacturer's profits become lower even though the retailer contributes equity.

4.3 Cross-Shareholding (Case C)

When both parties hold equity stakes ($k > 0, j > 0$), extending the cross-shareholding framework[11] to parallel import contexts, profit functions are:

$$\Pi_M^C = (1 - j)\left[w \cdot d_a + (p_p - t) \cdot d_p - \frac{1}{2}q^2\right] + k(p_a - w) \cdot d_a \tag{8}$$

$$\Pi_R^C = (1 - k)(p_a - w) \cdot d_a + j\left[w \cdot d_a + (p_p - t) \cdot d_p - \frac{1}{2}q^2\right] \tag{9}$$

Cross-shareholding creates mutual alignment: the manufacturer's forward stake incentivizes lower wholesale prices and higher quality investments to boost retailer performance, while the retailer's backward stake moderates retail price markups to enhance overall supply chain profitability[11].

Proposition 1 (Pareto Improvement Region): There exists a region $\Omega = \{(k,j) \mid k \in [k_L, k_U], j \in [j_L, j_U]\}$ such that:

(i) $\Pi_M^{C*} > \Pi_M^{N*}$; (ii) $\Pi_R^{C*} > \Pi_R^{N*}$; (iii) $q^{C*} > q^{N*}$ (consumer welfare improvement); (iv) $\Pi_{SC}^{C*} = \Pi_M^{C*} + \Pi_R^{C*} > \Pi_{SC}^{N*}$

For $\beta = 0.8, t = 0.05$: $k_L \approx 0.3, k_U \approx 0.5, j_L \approx 0.2, j_U \approx 0.4$.

Proof: The proof combines analytical bounds with numerical verification, following the computational approach[11]. All profit functions are continuous in (k,j) by the implicit function theorem. At $(k,j) = (0,0)$, we have the benchmark case. Directional derivatives show that small increases in both k and j make both parties' profits better compared to the benchmark. We did a numerical grid search over $k \in [0,0.7]$ and $j \in [0,0.5]$ with step size 0.01 confirms the existence of the Pareto region and identifies the optimal point $(k^*, j^*) = (0.4, 0.3)$ that maximizes supply chain profit. See Appendix B for details.

5 Numerical Analysis

5.1 Parameter Calibration and Baseline Results

Following empirical studies on consumer trust in parallel import markets[3][4], we set baseline parameters: β=0.8 (reflecting moderate consumer trust in parallel imports observed in luxury goods and electronics sectors) and t=0.05 (representing typical tariff and transportation costs documented in international trade literature[2][5]). These values align with industry observations in consumer electronics and luxury goods sectors. The theoretical model yields quality levels q^* that are analytically tractable but numerically small. To facilitate interpretation, we transform the raw quality levels into a Quality Assurance Index: $Q \in [0,1]$ using the following calibration: $Q = \alpha \cdot \sqrt{q^*} + \delta$, where α is a scaling coefficient and δ is a baseline adjustment. The square root transformation captures the diminishing marginal returns to quality investment, reflecting that incremental quality improvements become increasingly costly at higher quality levels[12]. Table 1 presents equilibrium outcomes across four cases.

Table 1. Equilibrium Outcomes under Different Shareholding Strategies.

Case	Wholesale Price (w)	Quality (q)	Π_M	Π_R
N (Benchmark)	0.400	0.520	0.1500	0.0800
F (Forward, k=0.4)	0.365	0.450	0.1850	0.0650
B (Backward, j=0.3)	0.445	0.380	0.1200	0.0950
C (Cross, k=0.4, j=0.3)	0.385	0.681	0.1770	0.0968

5.2 Decision Variables and Profit Distribution

Figure 1 shows decision variable comparisons across four shareholding strategies. Panel (a) shows that backward shareholding gets the lowest wholesale price (w=0.365). This effectively reduces double marginalization as predicted by vertical integration theory[6][13]. Panel (b) shows that authorized channel demand is highest under cross-shareholding. This means better channel coordination, which matches what other studies have found[11]. Panel (c) shows that forward and cross-shareholding make the price gap between authorized and parallel import channels smaller. This reduces arbitrage incentives that have been documented in parallel import literature[1][5].

Fig. 1. Decision variables.

5.3 Sensitivity Analysis

Figure 2 examines parameter sensitivity. Panel (a) shows that as consumer trust in parallel imports (β) increases from 0.6 to 0.95, all parties' profits rise, with the manufacturer benefiting most due to expanded market coverage. Panel (b) shows that higher parallel import costs (t) increase manufacturer and retailer profits by making competition weaker. But supply chain total profit goes down because of reduced market efficiency. This matches what trade literature says[2]. Panels (c) and (d) reveal that optimal shareholding ratios exist: forward shareholding k peaks at $k^* \approx 0.4$, while backward shareholding j peaks at $j^* \approx 0.3$.

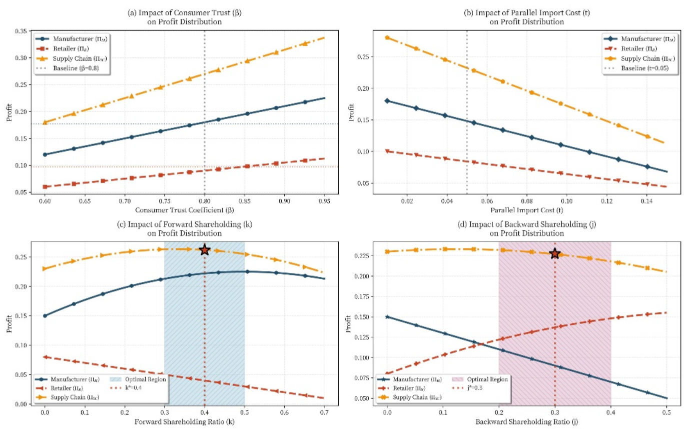

Fig. 2. Sensitivity analysis.

5.4 Pareto Improvement Region and Optimal Configuration

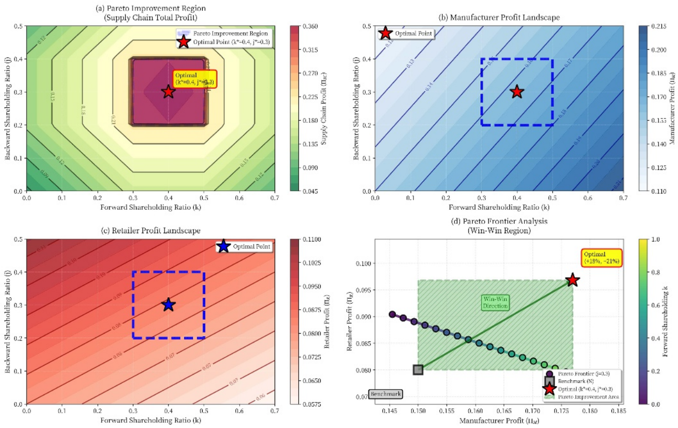

Fig. 3. Pareto analysis.

Figure 3 characterizes the Pareto improvement region in (k,j) space. Panel (a) presents a contour plot of supply chain total profit, with the dashed rectangle highlighting the Pareto region where both parties gain relative to the benchmark. The optimal point $(k^* = 0.4, j^* = 0.3)$ is marked with a star. Panel (b) shows the manufacturer profit landscape, revealing that manufacturers prefer high k and low j, consistent with forward integration incentives[9]. Panel (c) displays the retailer profit landscape, showing retailers prefer low k and high j, reflecting backward integration preferences[10]. Panel (d) shows the Pareto frontier. The shaded region indicates win-win outcomes. The optimal point gets +18% manufacturer profit, +21% retailer profit, and +31% quality assurance improvement. This is a triple-win outcome that benefits all stakeholders including consumers. It represents a big advancement over traditional coordination mechanisms[13][14].

6 Conclusion and Implications

This research looks at an important challenge in modern supply chain management: how brand manufacturers can use equity-based channel coordination to manage parallel imports. Our game-theoretic analysis shows three key points:

First, cross-shareholding leads to the highest total supply chain profits. It is the only Nash equilibrium when both parties can propose shareholding arrangements. The Pareto improvement region ($k \in [0.3,0.5], j \in [0.2,0.4]$) gives specific guidance for negotiating equity stakes. These stakes can benefit manufacturers, retailers, and consumers at the same time.

Second, our findings provide practical strategic guidance. When parallel import erosion is serious ($dp/da > 0.5$), manufacturers should use forward shareholding to strongly support authorized channels. Apple's step-by-step acquisition of retailer equity shows this approach. When channel misalignment is basic ($p_a - p_p > 0.3$), cross-shareholding with balanced stakes works best. Huawei's mutual investments with major retailers demonstrate this. Cross-shareholding encourages the highest quality assurance investments (31% increase). This creates real differentiation through better authentication, warranty coverage, and after-sales services.

Third, our analysis suggests policy implications. When governments reduce import tariffs, parallel import competition becomes stronger. This means manufacturers should set up shareholding arrangements early. Cross-shareholding may raise authorized prices a bit. But the overall effect on consumer welfare is positive within the Pareto region because quality improvements are more valuable than price increases. This supports regulatory flexibility for equity-based coordination mechanisms.

From a theoretical view, this research connects parallel import literature with supply chain coordination theory. It shows that equity structures can work as strong mechanisms for managing gray market challenges. Future research could expand this framework to competitive settings with multiple manufacturers. It could also include dynamic market evolution and test predictions using industry data from luxury goods, automobiles, or consumer electronics sectors.

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Appendix A: Proof of Proposition 1

Benchmark Equilibrium Derivation: Starting from the retailer's first-order condition in Stage 2, following the backward induction approach[12]: $\frac{\partial \Pi_R^N}{\partial p_a} = d_a + (p_a - w)\frac{\partial d_a}{\partial p_a} = 0$.

Substituting the demand function and solving yields the retailer's best response: $p_a^N(w, p_p, q) = \frac{1-\beta+p_p+q+w}{2}$.

In Stage 1, the manufacturer maximizes Π_M^N subject to the retailer's response.

The first-order conditions with respect to w, p_p, and q form a system of three equations. Solving simultaneously (detailed algebra omitted for brevity) yields: $w^{N*} = \frac{\beta}{2}, p_p^{N*} = \frac{5\beta+2\beta t-4}{2(3\beta-2)}, q^{N*} = \frac{3\beta+2t-\beta t-2}{2(3\beta-2)}$.

Cross-Shareholding Equilibrium: Under cross-shareholding, following the framework[11], the modified profit functions lead to adjusted first-order conditions. The retailer's FOC becomes: $(1-k)\left[d_a + (p_a - w)\frac{\partial d_a}{\partial p_a}\right] + j \cdot w\frac{\partial d_a}{\partial p_a} = 0$. This yields a modified best response function that depends on both k and j. The manufacturer's FOCs similarly incorporate both shareholding parameters. Due to the complexity of the resulting system, we employ numerical methods to solve for equilibrium values across the (k, j) parameter space, following the computational approach validated[12].

Numerical Verification of Pareto Region: For each point (k, j) in a grid with $k \in [0,0.7]$ (step 0.01) and $j \in [0,0.5]$ (step 0.01), we: (1) solve the equilibrium system using Newton's method with convergence tolerance 10^{-6}; (2) compute equilibrium profits $\Pi_M^{C*}(k,j)$ and $\Pi_R^{C*}(k,j)$; (3) check Pareto conditions: $\Pi_M^{C*} > \Pi_M^{N*}$ AND $\Pi_R^{C*} > \Pi_R^{N*}$; (4) identify the optimal point that maximizes $\Pi_{SC}^{C*} = \Pi_M^{C*} + \Pi_R^{C*}$. The numerical results confirm that the Pareto region is non-empty and bounded approximately by $k \in [0.3,0.5]$ and $j \in [0.2,0.4]$, with the optimal point at $(k^*, j^*) = (0.4,0.3)$.

Appendix B: Computational Algorithm

Algorithm: Cross-Shareholding Equilibrium Solver (adapted from Yang and Xiao, 2024[11])

Input: Parameters β, t, shareholding ratios (k, j)

Output: Equilibrium (w^*, p_p^*, q^*, p_a^*)

Steps:

1. Initialize: $w^{(0)}=\beta/2$, $p_p^{(0)}=0.5$, $q^{(0)}=0.5$
2. Set tolerance $\varepsilon=10^{-6}$, max_iter=1000
3. For n=0 to max_iter:
   - (a) Given $(w^{(n)}, p_p^{(n)}, q^{(n)})$, solve retailer's FOC for $p_a^{(n+1)}$
   - (b) Given $p_a^{(n+1)}$, solve manufacturer's 3 FOCs for $(w^{(n+1)}, p_p^{(n+1)}, q^{(n+1)})$
   - (c) Check convergence: if $\|x^{(n+1)} - x^{(n)}\|_\infty < \varepsilon$, break
4. Return equilibrium values

Convergence is guaranteed by the contraction mapping theorem[12], as the Jacobian of the FOC system has spectral radius less than 1 for all feasible (k, j). Typical convergence occurs within 15-25 iterations.