Game Theory and Behavioral Economics: A Comprehensive Analysis of Firm Strategies Amid Tariff Uncertainties

Ameri Emmanuel

May 2025

1 Introduction

You ever try to keep track of all these shifting tariffs and political spats? It's like trying to play chess during an earthquake. Seriously, companies here are sweating bullets, juggling strategy with gut feeling, all while the governments from different parts of the globe decide to issue a fee on imports because, well, politics. Leaving companies to think strategical, well in game theory and behavioral economics basically the science of 'what makes people tick' plus 'how to outmaneuver the competition' you get a fuller picture of why businesses act the way they do when the rules keep changing.

This paper gives an in-depth analysis of how game theory and behavioral economics collectively shed light on firm behavior in the context of tariff uncertainty. It determines the interplay role of rational strategic factors and psychological factors, such as loss aversion and social preferences, in the formulation of firm strategies. Through the combination of these perspectives with the application of game theory models, the analysis offers robust insights for policymakers and business managers who aim to formulate appropriate trade policies and robust firm strategies.

2 Game Theory and Strategic Interactions in Market Competition

Game theory, the study of strategic decision making among rational agents, is a fundamental analytical device for outlining firms' responses to tariff uncertainty. Players in such situations are abstracted as players with given strategies and pay-off functions attempting to maximize utility given constraints of action from rivals. Nash equilibrium, wherein no player can gain from unilateral change in his strategy in view of others' actions, is most applicable in explaining tariff related interactions (Nash, 1950).

Firms operating under tariff systems are often faced with strategic decisions akin to the Prisoner's Dilemma: to 'defect' is to impose tariffs or protectionism, while cooperation is to adhere to free trade. Although cooperation results in the greatest sum of economic welfare, the individual temptation to defect via short-term gain or strategic advantage is likely to dominate, thus producing a suboptimal outcome such as trade wars (Tullock, 1980).

More advanced oligopoly models build on this understanding by modeling different competitive forces in the face of tariffs. Cournot competition models include quantity setting firms moving simultaneously, whose aggregate production sets market price and thus generates market power for them. Bertrand competition, on the other hand, includes price setting competition in which firms try to reduce prices and thus undercut rivals, often with prices being driven down to marginal costs; this proves most challenging when tariff driven cost increases constrict firm margins (Dixit and Stiglitz, 1977). Stackelberg competition introduces sequential action, where a leader forms strategy and followers respond in consequence, a relevant analogy to firms' preemptive tariff setting and capacity decisions.

Firms' conflict in such environments is the trade-off between offensive price or quantity strategies to sustain market share and the risks involved in tariff uncertainty. For instance, in Bertrand competition, firms experiencing rising input costs due to tariffs may be hesitant to increase prices in the event that they lose market share, leading to margin squeezes. Timing decisions, whether to pass tariffs through prices or absorb costs, impose a strategic richness encompassing signaling and commitment in sequential games influencing rivals' and consumers' expectations and ultimately equilibrium results.

Repeated game models also illuminate the evolution of cooperative or retaliatory behavior over many rounds. Tit-for-tat strategies copying opponents' past cooperation or defection can stabilize cooperation even if short-term defection would be optimal. This model points to the role of reputation, market history, and expectations of the future in determining firms' tariff choices (Axelrod, 1984).

3 Behavioral Economics and Psychological Influences on Firm Decision-Making

Classical game theory's assumption of full rationality often falls short in capturing real world decision making, which involves cognitive limitations and behavioral biases. Behavioral economics, suggests adding psychological knowledge to economic models based on the assumption that bounded rationality, heuristics, and social preferences are what drive decisions (Kahneman and Tversky, 1979). Loss aversion the tendency to view losses as larger than commensurate gains dominates the firm's pricing and investment responses to tariffs. Firms will be risk-averse in their behavior, i.e., delaying price increases or offsetting tariffs partially to minimize perceived losses and preserve customer relationships, even at the expense of short run profits. Loss-averse behaviors explain partial pass through of tariffs and reluctance to pass costs entirely during consumer sensitivity (Thaler, 1980).

Social preferences further modulate firm strategy. Firms do not exist as isolated profit maximizer but as firms immersed in networks of relationships that are characterized by reciprocity, altruism, and fairness. For example, firms with cooperative supply chain relationships may sacrifice salient tariff retaliation in order to maintain trust, maintaining cooperative equilibrium despite exogenous tariff pressures. Experimental economic games such as the Ultimatum and Dictator Games provide empirical evidence for these social incentives motivating economic decisions (Güth et al., 1982).

In practice, firms react to tariff uncertainty by testing price mechanisms and communication. Surcharges on tariffs that are transparent and delineated from base prices allow firms to maintain value-based price perception while overtly recovering costs, making consumer acceptance and brand loyalty easier. Subscription and bundled products allow firms to smooth tariff cost shocks across product lines, balancing firm profitability and customer retention.

4 Interaction of Game Theory and Behavioral Economics in Navigating Tariff Uncertainty

The combination of game theory and behavioral economics provides a full toolkit to analyze firm behavior under tariff uncertainty, involving both structural incentives and behavioral deviations from rationality. Whereas game theory develops equilibrium conditions and incentive structures, behavioral economics encompasses bounded cognition, emotions, and social considerations that affect real strategic reactions.

The U.S.-China tariff war is one such example of integration. Delineated as an iterated Prisoner's Dilemma with signaling, commitment, and retaliation game theory captures the strategic imposition of tariffs as leverage and credible threats. Yet, continuous escalation despite economic inefficiency is illuminated by considerations of national pride, political pressure, and loss aversion over choice beyond maximizing pure payoffs (Bown, 2020).

At the company level, tariff surcharge pricing choices reflect competitive action expectations and psychological response of customers. Clear transparency of tariff-driven changes in prices, as external factors, is more socially desirable in fostering customer trust and stability of demand versus competitive risk compared to it.

5 Applying Behavioral Economics Insights in Designing Effective Trade Policies

Policy makers need to understand that economic agents fall short of classical rationality owing to cognitive biases and social pressures. Embedding behavioral insights into trade policy design will improve effectiveness and stakeholder acceptability.

5.1 Understanding Behavioral Barriers and Cognitive Biases

Loss aversion would generate opposition to trade liberalization reforms or tariff reductions due to asymmetrical fear of loss over gain and calls for phasing or compensation. Confirmation bias enhances biased arguments through selective processing, and status quo bias generates resistance even where there are net benefits from reforms. Counteracting these biases with objective facts and compassionate messages facilitates policy acceptance (Thaler and Sunstein, 2008).

5.2 Utilizing Choice Architecture and Nudges

Behavioral 'nudges' such as default sign-ups in compliance regimes, simplified customs procedures, and instant feedback reduce cognitive burdens and encourage compliance without constraining freedom of choice. These tools enhance the effectiveness of policy implementation and lower enforcement expenses (Sunstein, 2013).

5.3 Leveraging Social Preferences and Norms

Having policies of trade based on leveraging social preferences—fairness, reciprocity, norms conformity—fosters cooperation and partnership-based trust between trade partners. Ensuring openness, mutual monitoring, and equitable benefit sharing lessens enforcement frictions and enhances sustainability. Consideration of population and cultural preference heterogeneities also enhances policy legitimacy (Falk and Fischbacher, 2006).

5.4 Framing Effects and Communication Strategies

Presentation of trade information has significant effects on business and public support. Positive emphasis on job creation, consumer savings, and innovation fosters supportive attitudes, while negative emphasis on job loss discourages support. The use of understandable imagery, credible endorsements, and behavioral signals such as reminders improves message effect and compliance (Tversky and

Kahneman, 1981).

6 A Mathematical Framework to Model Firm Strategies Under Tariff Uncertainty and Behavioral Modifications

To model the tariff uncertainty-induced strategic interactions and adjustment behaviors of firms in a well-developed way, an expanded non-cooperative game-theory framework taking account of behavioral dimensions is needed.

6.1 Model Setup

Let there be N firms indexed by $i = 1, \ldots, N$, each choosing strategy s_i from a feasible set S_i. Strategies may represent pricing levels, production quantities, or tariff pass-through rates. The joint strategy profile is $s = (s_1, \ldots, s_N)$.

6.2 Payoff Functions

Each firm's payoff function incorporates revenue, operational costs, and tariff-related costs dependent on uncertain tariff parameter τ with known probability distribution:

$$U_i(s_i, s_{-i}; \tau) = R_i(s_i, s_{-i}) - C_i(s_i, s_{-i}) - T_i(s_i, s_{-i}; \tau)$$

6.3 Behavioral Utilities

Accounting for loss aversion, firms evaluate payoffs relative to a reference π_i^0, with utility:

$$\tilde{U}_i(s_i, s_{-i}; \tau) = \begin{cases} U_i - \lambda_i(\pi_i^0 - U_i), & U_i < \pi_i^0 \\ U_i, & U_i \geq \pi_i^0 \end{cases}$$

where $\lambda_i > 1$ quantifies loss aversion.

6.4 Equilibrium Concept

We seek a Generalized Nash Equilibrium (GNE) s^* such that:

$$s_i^* \in \arg \max_{s_i \in S_i(s_{-i}^*)} \mathbb{E}_\tau[\tilde{U}_i(s_i, s_{-i}^*; \tau)]$$

where $S_i(s_{-i}^*)$ incorporates competitive and regulatory constraints.

6.5 Solution Techniques

Using variational inequality (VI) formulations, with operator $F(s) = -\nabla_s \mathbb{E}_\tau[\tilde{U}(s; \tau)]$, equilibrium solutions satisfy:

$$\langle F(s^*), s - s^* \rangle \geq 0, \quad \forall s \in K$$

Solving via projection or extragradient algorithms iteratively approximates s^*. Sensitivity analyses on λ_i reveal behavioral impacts on price pass-through and output decisions.

6.6 Illustrative Example

Consider two firms competing in a Bertrand pricing game under uncertain tariff τ. Profits are given by:

$$U_i(p_i, p_j; \tau) = (p_i - c_0 - \tau) D_i(p_i, p_j),$$

with behavioral utility as described above. Equilibrium prices satisfy:

$$p_i^* \in \arg\max_{p_i} \mathbb{E}_\tau[\tilde{U}_i(p_i, p_j^*; \tau)]$$

reflecting strategic anticipation and behavioral biases.

7 Case Study: Honda's Production Shift Amid Tariff Uncertainty

To illustrate the application of the above mathematical framework, consider the recent case of Honda's decision to shift production of its CR-V SUVs from Canada to the United States, prompted by U.S. tariffs on Canadian autos.

7.1 Model Setup

Let N represent the number of firms in the automotive industry, including Honda and its competitors such as Stellantis, General Motors, and Ford. Each firm i selects strategy s_i encompassing production location, pricing, and investment decisions in electric vehicle technology.

7.2 Payoff Function

Honda's payoff function can be modeled as:

$$U_H(s_H, s_{-H}; \tau) = R_H(s_H, s_{-H}) - C_H(s_H, s_{-H}) - T_H(s_H, s_{-H}; \tau)$$

where R_H denotes revenue from vehicle sales, C_H includes operational costs dependent on production location, and T_H represents tariff-related costs accentuated by the 25% tariff on Canadian autos.

8 Behavioral Utility Model

The behavioral utility model for Honda, considering loss aversion, is expressed as:

$$\tilde{U}_H(s_H, s_{-H}; \tau) = \begin{cases} U_H(s_H, s_{-H}; \tau) - \lambda_H \left(\pi_H^0 - U_H(s_H, s_{-H}; \tau)\right), & \text{if } U_H(s_H, s_{-H}; \tau) < \pi_H^0 \\ U_H(s_H, s_{-H}; \tau), & \text{if } U_H(s_H, s_{-H}; \tau) \geq \pi_H^0 \end{cases}$$

where:

- $U_H(s_H, s_{-H}; \tau)$ is Honda's operating profit under strategy s_H, competitors' strategies s_{-H}, and tariff rate τ.

- π_H^0 is the reference profit, representing the expected profit without tariff-induced losses, e.g., the prior fiscal year's operating profit.

- $\lambda_H > 1$ is Honda's loss aversion coefficient.

9 Step 1: Define Reference Profit

From empirical data, Honda's reference operating profit (without tariff impacts) for fiscal year (FY) 2025 is approximately (Honda Stock Drops on Fears of $3 Billion Tariff Hit - Yahoo Finance, 2025).

$$\pi_H^0 = 1.21 \text{ trillion yen (or \$8.2 billion approx.)}$$

Honda projects its operating profit for FY 2026 under tariff impacts between 500 billion yen ($3.38 billion) and a loss of 650 billion yen due to tariffs and costs, with mitigation efforts reducing the effective tariff hit to approximately 450-500 billion yen.(Honda Stock Drops on Fears of $3 Billion Tariff Hit - Yahoo Finance, 2025).

Thus, for a given tariff τ (expressed as a percent rate impacting costs and profit), the operating profit can be modeled as:

$$U_H(\tau) = \pi_H^0 - L(\tau)$$

where $L(\tau)$ is the loss in profit caused by tariff rate τ. For simplicity, assume the loss is proportional to τ, reflecting higher tariffs causing greater profit reductions.

10 Step 2: Model the Distribution of Tariff Rates

Tariff τ can be treated as a random variable representing uncertainty in trade policies. Assume τ follows a discrete probability distribution over plausible scenarios:

Tariff Rate τ	Probability $p(\tau)$	Estimated Loss $L(\tau)$ (billion yen)	Profit $U_H(\tau)$ (billion yen)
0% (No tariff)	0.2	0	1210
10%	0.3	200	1010
25%	0.4	500	710
30%	0.1	650	560

Table 1: Distribution of Tariff Rates

These probabilities reflect uncertainty about tariff continuation or escalation, with a 25% tariff being the most likely scenario.

11 Step 3: Calculate the Behavioral Utility for Each Tariff Scenario

Using the loss aversion formula with $\lambda_H = 2$:

11.1 Calculations

For $U_H(\tau) \geq \pi_H^0 = 1210$:

- For $\tau = 0\%$:

$$U_H = 1210 \geq 1210 \implies \tilde{U}_H = 1210$$

For $U_H(\tau) < \pi_H^0$:

- For $\tau = 10\%$:

$$U_H = 1010 < 1210 \implies \text{loss} = 200$$

$$\tilde{U}_H = 1010 - 2 \times (1210 - 1010) = 1010 - 400 = 610$$

- For $\tau = 25\%$:

$$U_H = 710 < 1210 \implies \text{loss} = 500$$

$$\tilde{U}_H = 710 - 2 \times (1210 - 710) = 710 - 1000 = -290$$

- For $\tau = 30\%$:

$$U_H = 560 < 1210 \implies \text{loss} = 650$$

$$\tilde{U}_H = 560 - 2 \times (1210 - 560) = 560 - 1300 = -740$$

12 Step 4: Compute the Expected Behavioral Utility

The expected behavioral utility is calculated as follows:

$$\mathbb{E}_\tau[\tilde{U}_H] = \sum_\tau p(\tau) \times \tilde{U}_H(\tau) = 0.2 \times 1210 + 0.3 \times 610 + 0.4 \times (-290) + 0.1 \times (-740)$$

Calculating each term:

$$= 242 + 183 - 116 - 74 = 235 \text{ billion yen}$$

13 Step 5: Interpretation

The expected behavioral utility considering loss aversion is significantly lower than the average expected profit without behavioral adjustment:

$$\mathbb{E}_\tau[U_H] = \sum_\tau p(\tau) U_H(\tau) = 0.2 \times 1210 + 0.3 \times 1010 + 0.4 \times 710 + 0.1 \times 560 = 886 \text{ billion yen}$$

Thus, loss aversion markedly lowers Honda's evaluated expected payoffs due to the amplified negative impact of tariff-induced profit declines relative to the reference profit.

14 Step 6: Conclusion

Using the behavioral utility model with data-based tariff impact estimates, Honda's expected utility under tariff uncertainty and loss aversion is approximately 235 billion yen, much lower than the average expected profit of 886 billion yen. This captures the psychological weight Honda places on tariff-induced losses and underscores strategic incentives to shift production to mitigate tariffs.

This quantitative framework aids decision-making by discerning not just expected financial outcomes but also behavioral responses to tariff risk, enabling a more accurate assessment of strategic shifts like production relocation.

15 Behavioral Insights

The Honda strategic production realignment case illustrates the noteworthy influence of behavioral economic principles on firm decision-making in the face of tariff uncertainty. Honda's loss aversion, as articulated using the behavioral utility model, reflects intense psychological risk aversion toward losses relative to anticipated gains. This loss aversion induces a conservative approach, as Honda holds off on spending $11 billion to produce electric vehicles in Canada and moves manufacturing elsewhere to spare tariff cost. The caution manifests the pragmatic outworking of bounded rationality and uncertainty avoidance as firms choose the financial stability that comes with conservation over risky growth in uncertain policy circumstances. Besides, Honda's public promises to maintain Canadian production and employment reflect social preference considerations such as reciprocity and stakeholder trust. They suggest firms weigh profit incentives against long-term relational capital in strategic decisions beyond profit maximization. Such social promises function to maintain cooperative equilibrium in governments, suppliers, and local citizens during trade wars, as it builds reputational resilience and suggests reliability in spite of changing operations.

This fusion of loss aversion and social preferences demonstrates the way that psychological motivations based on firm culture and strategy strongly affect reactions to tariff regimes, often resulting in conservative investment behavior even when long-term growth prospects are plentiful. These results prompt policymakers and business leaders to incorporate behavioral insights in forecasting trade-induced corporate adjustments and structuring more advanced support and communication systems that acknowledge firms' cognitive and social realities.

16 Conclusion

The combination of behavioral economics and game-theoretic model gives more comprehensive and realistic analysis of firm strategic behavior in the widespread uncertainties produced by tariff policy. While game theory provides analysts with precise-cut equilibrium concepts and models of strategic interaction, behavioral economics brings these instruments to life by taking into account bounded rationality, loss aversion, and social choices that strongly influence firm decision and market process.

The Honda production relocation case shows that firms do not merely maximize financial returns in a vacuum but are situated in psychologically dense contexts driven by risk perception, cognitive heuristics, and stakeholder dynamics. The much lower expected behavioral utility than average expected profits shows how loss aversion increases perceived risks, which drive firms towards risk-averse actions such as investment delay and geographic production relocation to avoid tariff-related losses.

For policy-makers, understanding these behavioral dimensions is crucial to designing effective trade policies and interventions. Interventions based on nudges, choice architecture, open communication, and stakeholder engagement can neutralize cognitive biases and build cooperative trade environments even in the presence of adverse tariff conditions. Furthermore, firms guided by these integrated perspectives can predict competitor behavior, effectively navigate consumer sentiments, and employ adaptive strategies that balance risk and opportunity in fluid global markets.

Lastly, the synthesis of game theory and behavioral economics into one methodology demonstrates how good responses to tariff risk take more than skillful strategy but also deep understanding of human and organizational psychology. Both are promoted by this fused approach for robust, cooperative, and strategically viable decision-making better suiting the complexity of contemporary international trade, companies' viability, sustainability, and economic welfare amidst ongoing geopolitical and policy shifts.

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