

# Quantifying Adaptive Strategies in Regulated and Unregulated Simulated Housing Markets

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## Extended Abstract

**Motivation.** Housing markets are not just price mechanisms; they are adaptive social systems in which scarcity, expectations, and regulation interact. Because individual decisions and institutional rules couple nonlinearly, the effects of regulation are difficult to anticipate through equilibrium approaches alone [2, 3, 4]. This work asks two related questions: how do regulated and unregulated rental markets reshape strategic behavior in a simplified competitive setting, and can their effective behavioral complexity be reduced to a small set of recurring heuristics without losing fidelity to empirical observations? These questions matter for rent-regulation debates, where rule changes may reorganize incentives and strategic timing rather than simply shift prices.

**Approach and Methodology.** We analyze data from *Jocs per l’Habitatge* (“Housing Games”), a citizen-science experiment developed by OpenSystems at the University of Barcelona [1]. In each session, six participants compete for a hypothetical apartment over twelve rounds, privately deciding whether to rent at the current price or wait. Prices evolve through a simple demand rule: if all participants wait, the next price decreases by 5%; if more than one participant attempts to rent, the apartment is assigned to the first bidder and the next price increases by 5%. The game was implemented under two regimes: an unregulated market and a regulated market with a price ceiling and floor. These empirical traces inform an agent-based model in which each simulated agent, or *mind*, is composed of two deterministic finite-memory strategies mapping the previous two market outcomes to a rent/wait decision. Figure 1 gives a clear picture of one representative mind. This construction yields 136 unique minds, of which 135 were retained in simulations. Agents adapt by switching between their two strategies according to past performance, while economic success is measured through an Agent Price Efficiency (APE) ranking. Model fidelity is evaluated by comparing empirical and simulated renting-price and exit-round distributions with the Kullback–Leibler divergence [5].

**Results.** The empirical games display three characteristic phases: an impulsive opening with rapid renting and price increases, a middle phase with more calculated timing, and an endgame where waiting becomes dominant. Simulations reproduce this structure while revealing a strong regime effect. Regulation does not simply rescale outcomes; it reorganizes the strategic landscape. In the unregulated regime, the best-performing minds tend to rent early. Under regulation, a behavioral niche of patient minds emerges, delaying

action and capturing lower prices within the bounded interval. This reordering is substantial: Spearman’s rank correlation between regulated and unregulated APE rankings is only  $\rho_S = 0.248$ . At the aggregate level, regulated simulations approximate empirical behavior more closely than unregulated ones. For the full ensemble, KL divergences are  $D_{KL}^{\text{price}} = 0.115$  and  $D_{KL}^{\text{exit}} = 0.193$  under regulation, versus 0.797 and 0.383 in the unregulated case. An information-theoretic filtering criterion further reduces the strategic space by about an order of magnitude, from 135 behavioral types to a compact subset that still reproduces the main price and timing distributions. In the unregulated regime, price and exit-round divergences fall from 0.797 to 0.120 and from 0.383 to 0.085; under regulation they fall to 0.022 and 0.017. Observable market dynamics therefore emerge from a small set of recurring behavioral archetypes rather than from the full combinatorial strategy space.

**Conclusions and Outlook.** Two conclusions follow. First, regulation does not affect all strategies uniformly; it selects and amplifies a niche of patient agents who benefit from delayed action within bounded prices. Second, despite the large theoretical strategy space, the effective complexity of the market is modest and can be captured by a reduced subset of behavioral types identified through an information-theoretic filter. Ongoing work examines the robustness of this reduction criterion and further characterizes the regime-dependent behavioral niches emerging in regulated and unregulated environments.

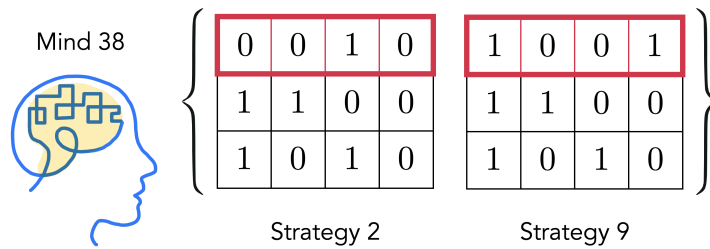


Figure 1: Mind 38 is composed of strategies 2 and 9. The bottom rows encode the four possible market histories from the previous two rounds, and the top row gives the corresponding rent/wait decision.

## References

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