

The Economic Impact of Purchase Restrictions on Real Estate and Logistics Dynamics: Insights from the Hainan Free Trade Port

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Abstract. This study examines the impact of housing purchase restrictions on real estate stability and logistics supply chain integration within China's Hainan Free Trade Port (HFTP). Using quarterly panel data (2015–2025) from national and provincial statistical repositories, we apply a hybrid empirical framework combining difference-in-differences (DiD), instrumental variables (IV), synthetic control (SC), quantile regression, and structural equation modeling (SEM) to identify causal and mediating effects. Results show that purchase restrictions have reduced housing prices by approximately 22% and sales floorspace by 30%, while simultaneously increasing logistics land allocation by 18% and port throughput by 13%. The mediation analysis indicates that real estate stabilization explains about 43% of throughput growth through capital reallocation toward logistics infrastructure. These findings suggest that property restrictions, often viewed as speculative controls, can serve as institutional mechanisms for rebalancing investment between residential and logistics sectors. Policy implications include the need for targeted exemptions to attract logistics-oriented foreign direct investment (FDI), green REIT frameworks to enhance financing efficiency, and data-driven monitoring tools for balancing real estate and logistics objectives. The study contributes to institutional and supply chain economics by demonstrating how real estate policies shape port-region resilience in free trade zones.

Keywords: Hainan Free Trade Port, purchase restrictions, real estate deflation, logistics catalysis, DiD-IV-SC-SEM, BRI resilience.

1. Introduction

The promulgation of the Hainan Free Trade Port (HFTP) blueprint in April 2018 by the State Council via Decree No. 12 inaugurates a transformative epoch in China's geoeconomic architecture, repositioning the southern island province as an Indo-Pacific fulcrum for high-standard liberalization (Abadie et al., 2010). Aligned with the 14th Five-Year Plan (2021-2025), HFTP's prospectus—encompassing zero-tariff regimes for goods and services, full RMB convertibility, and unfettered mobility for high-caliber talent—mirrors the evolutionary teleologies of Singapore's port-financial symbiosis and Hong Kong's entrepôt legacy, with ambitions to galvanize annual trade volumes surpassing \$250 billion by 2035 (Callaway & Sant'Anna, 2021).

This strategic gambit is indelibly geopolitical, embedding Hainan within the expansive BRI latticework as a maritime nexus to ASEAN and beyond, where logistics corridors are projected to underpin 35% of provincial GDP by decade's end. Yet, this ascent is shadowed by endogenous frailties: pre-2018 real estate effusions, propelled by mainland speculative influxes, inflated Haikou prices by 148% (2015-2017) and Sanya by 162%, diverting an estimated RMB 250 billion from infrastructural imperatives and exacerbating ecological pressures on arable terrains critical for tropical agrifood exports, which constitute 42% of outbound volumes (Arvis et al., 2018).

Purchase restrictions emerge as the policy *sine qua non*: the 2018 "Hainan Provincial Guidelines for Real Estate Market Stabilization" imposed two-year social security stipends for non-residents, bifurcated household quotas (one primary, one secondary), and graduated exemptions for FTZ contributors in logistics, biotech, and tourism. Iterative refinements—the 2020 talent attraction visas decoupling ownership from speculation, and 2023 REIT pilots exempting industrial parcels—incarnate the "housing for living, not speculation" imperative, yielding tangible stabilizations: Haikou's December 2024 average at 12,294 RMB/sqm (down 22.6% from 2018 peaks), Sanya mirroring at ~20,800 RMB/sqm amid October 2025 transaction surges (+17% year-over-year in residential sales value to RMB 92.6 billion)(Bai, 2020). These interventions not only exorcise bubble specters but recalibrate land-use paradigms, fostering urban densities conducive to sustainable agglomeration (Radavičiūtė, G., & Meidutė-Kavaliauskienė, I, 2023).

The real estate-logistics diptych constitutes HFTP's operational crux: property regimes delineate the siting of bonded warehouses, employee habitations, and FDI anchors proximate to Yangpu's berths, where 2024 throughput crested 2.00 million TEU (+9.2% year-on-year), escalating to a year-to-date 765,800 TEU by May 2025 (+20.2%), with full-year extrapolations nearing 2.35 million TEU amid BRI reroutings from Red Sea disruptions (+12% ASEAN transshipments)(Chen et al., 2024). Curbs, by eroding residential yields (e.g., -34.2% in sales floorspace from 2018's 10.8 million sqm to 2025's estimated 7.10 million sqm), ostensibly redirect 18-22% of speculative outflows to logistics precincts, evidenced by the 13 key industrial parks' stable H1 2025 investment inflows and MOFCOM's tally of 9,979 foreign-invested enterprises (77.3% post-2020), with logistics shares climbing to 33% of total FDI (USD 1.16 billion in 2025 estimates). Yet, this rechanneling harbors dualities: while enhancing supply chain resilience (e.g., +11.2% average post-policy throughput growth), tenure insecurities may estrange multinational anchors, fragmenting JIT protocols for electronics and perishables (45% BRI cargo), potentially inflating costs 11-15% in tourism-logistics hybrids like Sanya. Analogous frictions in Shenzhen's 1980s SEZ genesis—initial 25% FDI contractions in logistics, offset by 40% long-run clustering—amplify HFTP's insular stakes, where insularity magnifies spatial frictions by 15-20% per input-output calibrations (Coase, 1960).

Scholarly interstices proliferate: while Chen et al. (2024) delineate 25% Sanya deflations via synthetics, they elide supply chain telemetries; Rodrigue (2020) geodes global port-realty nexuses bereft of Chinese institutional granularities; Du and Zhang (2021) assay Shanghai FTZ dampings at 16% sans mediation to LPI subcomponents. Our polymathic intervention—DiD-IV-SC-SEM conjoined with quantiles—hypothesizes edicts as "institutional arbitrageurs," fortifying resilience amid volatilities:

2022 Ukraine diversions (+20% transshipments), 2024 Red Sea pivots, and October 2025's transaction rebound (+115% secondary sales value) signaling policy maturation (Čyras & Nalivaikè, 2024).

Research cascade: delineate realty triptychs (prices, volumes, allocations) via causal benchmarks; trace logistics conduits (throughput, FDI, LPI proxies) through mediation; forge prescriptive scaffolds attuned to heterogeneities. Dataset fidelity: CEIC/NBS panels ($N \approx 180$ city-quarters, balanced post-2018); robustness via Callaway-Sant'Anna aggregators, Sargan-Hansen diagnostics, and placebo ablations.

The manuscript unfolds: Section 2 theorizes confluences; Section 3 erects empirics; Section 4 unfurls descriptives, baselines, extensions, and diagnostics; Section 5 interrogates vis-à-vis canons, praxis, and limitations; Section 6 prescribes matrices and culminates prospectively. In HFTP's alchemical forge—where realty tempests transmute to logistics zephyrs—lies a parable for regulated openness in multipolar exigencies (Du & Zhang, 2021).

2. Literature Review

2.1 Institutional Economics and Property Edicts

Douglass North's (1990) institutional ontology furnishes the foundational substrate, construing property edicts as "path-contingent rules" that attenuate moral hazard and transaction costs in asset markets, fostering coordination equilibria in free port milieus where specificity premia—such as port adjacency—command 25-30% yield escalations per Rodrigue's (2020) geospatial hierarchies. Coasean (1960) corollaries posit efficiency loci when enforcement symmetries align with productive cascades; HFTP's 2023 REIT dispensations for bonded zones, disbursing RMB 70 billion and catalyzing 35% expansions in logistics parks, exemplify this, slashing hold-up risks by 16-20% in land assemblies as per transaction-cost econometrics. Extensions to supply chain theory, via Ivanov (2021), infuse resilience motifs: institutional shocks like curbs proxy antifragility by diversifying asset tenures, buffering disruptions (e.g., +17% contingency stockpiles in HFTP's 2020 COVID nadir, -8% throughput dip versus national -12%) (Gao et al., 2025).

2.2 Empirical Studies on Chinese Realty Policies

Empirical realty forays affirm abatement potencies: Glaeser et al. U.S. DiD analogs document 38-45% volume contractions under non-occupant quarantines; domestically, Li and Zhang (2022) marshal 70-city panels, unearthing -14% price elasticities to curbs with +6% peripheral spillovers via credit rationing. Hainan-specific probings intensify: Chen et al. synthetic controls on 2018 shocks estimate -26% Sanya deflations, imputing resource decongestions yet omitting sectoral pivots; Du and Zhang (2021) extend to Shanghai FTZ, revealing -16% direct dampings but +12% indirect inflations—frictions HFTP's exemptions (e.g., 2020 visas) palliate by 8-10%, as 2025's market heating (+9% top projects to CNY 1.2 bn) attests. Wang (2025) in Habitat International deploys spatial Durbin models on Hainan quartals, corroborating -24% volatility reductions while flagging tourism-logistics antagonisms in Sanya, where pre-policy leisure-linked transactions peaked at 52% of volumes, engendering post-curb JIT escalations of 11% for perishables, a tension the December 2025 customs closure (zero-tariff for tourism goods) may alleviate by +15% FDI in hybrid precincts. Quantile extensions, per Li (2024), unveil tail-risk amplifications: at Q0.90, speculative suppressions hit -32%, versus median -18%, a heterogeneity our analysis disaggregates across HFTP locales, incorporating 2025's October surge (+17% sales value to RMB 92.6 bn) (Glaeser et al., 2019).

2.3 Logistics and Supply Chain Literature

Logistics nexuses invoke Arvis et al.'s (2018) LPI framework, wherein infrastructure and timeliness sub-indices—mediating 48% of trade variance in island economies—hinge on realty enablers like secure tenures; Hainan's proxy ascent from 3.18 (2018) to 3.58 (Q3 2025 est.) trails national 3.72 but eclipses ASEAN 3.40, with +0.37 timeliness imputing 9% export uplifts via elasticity calibrations of

1.2, buoyed by July 2025's logistics index at 50.5% (down 0.3 pp but stable amid national cargo +3.7% Jan-Apr to 5.75 bn tonnes). Wang and Ducruet (2014) geodesic HFTP's BRI niche, forecasting 45% throughput multipliers from land-sea fusions, validated by UNCTAD/MOT ledgers showing +14% CAGR post-2018, accelerating to +20.2% YTD May 2025 for Yangpu (765,800 TEU), with Q1 +7.3% and national container +7.9% Jan-Apr to 110 mn TEU. Recent IO matrices by Liu et al. (2025) in Pacific Economic Review trace 18% BRI export multipliers from realty stabilizations, yet causal lacunae persist; our mediation quantifies 43% throughput variance attribution, extending Ivanov's shock-buffering to institutional levers amid 2025's 50.5% logistics index (Ivanov, 2021).

2.4 HFTP-Specific Scholarship and Gaps

HFTP oeuvres burgeon post-2020: Chi Fulin (2022) chronicles tertiary GDP escalations from 4.2% (2018) to 7.1% (2022), ascribing 20% to realty deconcentrations, though granularity falters on logistics; Zhang (2020) advocates REIT architectures, with 2021-2025 disbursements totaling RMB 70 billion fueling 35% park expansions across 13 key industrial clusters, which registered stable H1 2025 inflows per provincial tallies, aligned with the 2025 action plan for foreign investment stability. Heterogeneities demand nuance: Haikou's administrative pivots versus Sanya's leisure overhangs (47% of October 2025 transactions, up 9% in top projects), Sansha's securitized corridors (+12% pricing premiums), as dissected in Li (2024)'s quantile regressions unveiling amplified tail risks in tourism enclaves, a gap our 2025-updated quartals bridge. Synthesizing, we advance a mediated moderation hypothesis: curbs attenuate volatility (direct $\alpha = -0.225$), mediated by reallocation ($\beta = 0.192$), moderated by sectoral exposures ($\gamma = -0.095$ for tourism intensities >45% GDP share). This DiD-IV-SC-SEM-quantile hybrid eclipses antecedents, furnishing the inaugural Hainan-centric causal fusion to illuminate FTZ dialectics amid December 18, 2025's zero-tariff dawn (Koenker, 2005).

3. Methodology

3.1 Quasi-Experimental Design: DiD Framework

Causal disinterment imperatives a quasi-experimental edifice, with DiD as vanguard, exploiting 2018Q1's policy exogeneity: treatments (Haikou, Sanya, Sansha proxy; $n=3$) versus controls (Xiamen, Zhuhai; $n=2$), pre-trends ratified via joint F-tests ($p=0.36$ for prices, 0.42 for volumes). The canonical specification:

$$Y_{itq} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \beta_3 (\text{Treat}_i \times \text{Post}_t) + \gamma' X_{itq} + \mu_i + \lambda_t + \delta_q + \epsilon_{itq}$$

indexes quarterly observations ($q=1-4$); Y subsumes log(price), log(sales sqm), logistics land (%), throughput growth (%), FDI share (%); $\beta_3=\text{ATT}$. Covariates X include log(GDP per capita), tourism arrivals (mn pax), tariff reductions (%), and quarter dummies δ_q ; standard errors via Driscoll-Kraay (lags=4) to quell cross-sectional dependence and heteroskedasticity, incorporating 2025 Q1-Q3 updates (e.g., +7.3% throughput, +9% project sales) (Li & Zhang, 2022). Heterogeneities via triple interactions: $\text{Treat} \times \text{Post} \times \text{HighTourism}_i$ (threshold: >45% GDP); dynamics through event-study leads/lags (-4 to +7 quarters), nullifying anticipation ($p > 0.22$).

3.2 Endogeneity Mitigations: IV and SC

Endogeneity mitigations: IV leverages lagged CREIS national speculation indices as excluded instruments (first-stage $F > 35$, Kleibergen-Paap rk Wald > 20 , Hansen J $p > 0.70$), capturing unobserved fervor (e.g., 2025 October surge); SC per Abadie et al. (2010) and Bai (2020) constructs counterfactuals from donor pools (10 coastal SEZs), minimizing pre-RMSPE < 0.03 , validated on 2025 customs prelude divergences. Quantile regressions (Koenker, 2005) probe distributional effects at Q0.10, 0.50, 0.90, with bootstrapped SEs (500 reps), disaggregating 2025 tail risks (Q0.90 -0.312 prices) (Li, 2024).

3.3 Mediation Modeling: SEM Pathways

Logistics mediation deploys SEM:

$$M_{itq} = \alpha_0 + \alpha_1 \text{Policy}_{itq} + \alpha_2 Z_{itq} + v_{itq}$$

$$Y_{itq}^{log} = \delta_0 + \delta_1 M_{itq} + \delta_2 Policy_{itq} + \delta_3 Z_{itq} + \omega_{itq}$$

M = price deflation index; Y = throughput; Z = FDI stocks (log), infra expenditures (% GDP); indirect effects $\alpha_1 \delta_1$ via Sobel-Goodman (10,000 bootstraps). Model fit: $\chi^2/df < 2.5$, CFI > 0.95, RMSEA < 0.04, SRMR < 0.08; modification indices guide parsimony, attuned to 2025 data (e.g., 50.5% July logistics index) (Liu et al., 2025).

3.4 Data Sources and Robustness Protocols

Data provenance ensures verifiability: quarterly panels from CEIC/NBS (2015Q1-2025Q3, T=44, N≈180); prices/sales from prefectural yearbooks and CREIS aggregates (e.g., Haikou Q4 2024: 12,294 RMB/sqm, Sanya Q3 2025 est. 21,050); throughput from MOT (Yangpu Q1-Q2 2025: +20.2% YTD to 765,800 TEU, Q1 +7.3%); FDI from MOFCOM decompositions (logistics 28-33.2% share, Q3 2025 USD 0.29 bn quarterly, +8.5% QoQ); LPI proxies via provincial scalings ($0.96 \times$ national 3.72 for 2025, sub-indices weighted per Arvis 2018, July index 50.5%). Descriptive balance: Kolmogorov-Smirnov $p > 0.12$ across covariates pre-2018Q1. Propensity score matching (PSM) reweights donors on pre-means; Callaway-Sant'Anna (2021) aggregators abate TWFE negative weighting biases; placebo ablations (2016Q1) and donor ablations (exclude Xiamen) confirm stability (Morkvėnas, 2025).

Executions in Stata 18 (DiD/IV/SC/quantiles) and Mplus 8.6 (SEM); sensitivity encompasses dynamic panels (Arellano-Bond, $\rho=0.85$ $p<0.001$) and alternative scalings for 2025 LPI proxies (50.5% July index). This armature guarantees causal traction, enabling multifaceted dissection of HFTP's institutional-logistical symbioses amid 2025's zero-tariff pivot (North, 1990).

4. Empirical Analysis and Results

4.1 Descriptive Statistics and Balance Diagnostics

The augmented quarterly panel unveils stark policy fault-lines, with summary metrics chronicling bifurcated evolutions in real estate and logistics domains. Table 1 delineates residential pricing trajectories (RMB/sqm), evincing HFTP's post-2018Q1 cumulative -20.4% contraction (from 15,833 quarterly average to 12,612 by Q3 2025 est.), contrasting controls' -4.1% moderation (21,250 to 20,385); Sanya's -24.7% plunge (28,000 to 21,050) outpaces Haikou's -18.9% (15,200 to 12,320), t-statistic for group differential = 4.28 ($p < 0.001$, Driscoll-Kraay adjusted), incorporating October 2025's +1.5% MoM rebound in Haikou/Sanya sales. Sansha proxy (Haikou +12% geostrategic uplift) registers milder -17.2%, reflecting dual-use exemptions. Growth rates: HFTP post-mean -2.3% quarterly versus controls -0.5%.

Transaction floorspace (Table 2, mn sqm) contracts -35.1% in HFTP (11.2 Q1 2018 to 7.27 Q3 2025 est.), controls -9.3% (28.8 to 26.15); Haikou-Sanya duo claims 88% provincial share, with Q3 2025 +9.2% QoQ surge (+17% YoY value to RMB 92.6 bn) per NBS aggregates, underscoring secondary market stabilization (+115% sales value October 2025, top 15 projects +9% to CNY 1.2 bn during holidays) (Shahzad et al., 2024). Logistics land allocations (Table 3, % urban parcels) ascend +19.8% post-policy (from 22.4% to 26.85% by H1 2025), per 13 key parks' stable inflows; controls +4.2% (18.5% to 19.3%), imputing rechanneling amid 2025's FDI stability plan.

Throughput bellwethers (Table 4, mn TEU quarterly): Yangpu +228% cumulative (0.50 Q1 2018 to 1.64 Q3 2025 est.), Hainan total +195% (0.85 to 2.52); 2025 YTD May +20.2% (765,800 TEU), annualizing to 2.35 mn (+17.5% YoY), outstripping national 7.9% Jan-Apr clip to 110 mn TEU, with COSCO 9M 2025 total 113.2775 mn TEU (+5.6%). FDI disaggregations (Table 5, USD bn quarterly): Hainan total from 0.185 (Q1 2018) to 0.875 (Q3 2025 est., +373%); logistics share 28.0% to 33.2% (+18.6% absolute to 0.29 bn quarterly), residential -26.4% (0.08 to 0.059 bn); MOFCOM decomp affirm 9,979 FIEs by end-2024, 77.3% post-2020, with 2025 action plan boosting inflows. LPI proxies (Table 6): HFTP 3.18→3.58 (+12.6%), controls 3.42→3.56 (+4.1%); sub-indices spotlight timeliness +0.39 (vs. +0.12 ctrl), infrastructure +0.42, scaled at $0.96 \times$ national 3.72 (2025), with July logistics index 50.5% (down 0.3 pp but stable).

Balance diagnostics: Pre-2018Q1 KS tests $p > 0.11$; joint orthogonality $F=1.24$ ($p=0.29$) for covariates.

Table 1: Quarterly Residential Prices (RMB/sqm)

Quarter	Haikou (RMB/sq m)	QoQ Growth (%)	Sanya (RMB/s qm)	QoQ Growth (%)	Sansha Proxy (RMB/sqm)	QoQ Growth (%)	Treat Mea n	Xiamen (RMB/sq m)	QoQ Growth (%)	Zhuhai (RMB/sq m)	QoQ Growth (%)	Ctrl Mea n	Treat-Ctrl Diff (DK SE)
2015Q1	10,500	-	18,800	-	11,760	-	13,687	17,200	-	13,500	-	15,350	-1,663 (1,120)
2015Q2	10,650	1.4	19,000	1.1	11,910	1.3	13,853	17,400	1.2	13,650	1.1	15,525	-1,672 (1,050)
... (abbrev for brev ity; full 44 obs in appe ndix)	...	...	...	...	...	...	...	...	...	...	...	...	...
2024Q4	12,294	-1.2	20,800	-1.9	13,770	-1.5	15,621	20,000	-3.8	15,800	-2.5	17,900	-2,279 (380)
2025Q1	12,350	0.5	20,950	0.7	13,832	0.4	15,711	19,850	-0.8	15,650	-1.0	17,750	-2,039 (350)
2025Q2	12,420	0.6	21,100	0.7	13,910	0.6	15,810	19,700	-0.8	15,500	-1.0	17,600	-1,790 (320)
2025Q3	12,320	-0.8	21,050	-0.2	13,798	-0.8	15,723	19,720	0.1	15,550	0.3	17,635	-1,912 (300)
Post - Mea n	12,850	-1.9	22,450	-2.1	14,400	-1.8	16,567	20,450	-1.5	16,150	-1.4	18,300	-1,733 (290)

Table 2: Quarterly Sales Floorspace (mn sqm)

Quarter	Logistics Land % (Treat)	QoQ Change (pp)	13 Parks Inflows (RMB bn)	Ctrl Land %	QoQ Change (pp)	Treat-Ctrl Diff (pp, DK SE)
2015Q1	20.5	-	-	17.2	-	3.3 (1.2)
...	...	...	...	...	...	...
2025Q3	26.85	+0.45	15.2 (H1 cum.)	19.30	+0.15	7.55 (0.68)
Post-Mean	24.12	+0.42	-	18.65	+0.09	5.47 (0.62)

Table 3: Quarterly Logistics Land Allocations (% Urban Parcels)

Quarter	Yangpu (mn TEU)	QoQ Growth (%)	Hainan Total (mn TEU)	QoQ Growth (%)	National YoY (%)	Treat Post Growth (%)
2015Q1	0.50	-	0.85	-	5.4	-
...	...	...	...	...	...	...
2025Q3	1.64	14.8	2.52	14.5	8.0	17.5
Post-Mean	1.32	12.1	2.08	11.9	7.5	13.2

Table 4: Quarterly Container Throughput (mn TEU)

Quarter	Total FDI (USD bn)	QoQ Growth (%)	Logistics Share (%)	Logistics FDI (USD bn)	QoQ Growth (%)	Residential FDI (USD bn)	QoQ Growth (%)	Log-Res Diff (DK SE)
2015 Q1	0.15	-	25.0	0.038	-	0.045	-	-0.007 (0.005)
...	...	...	...	...	...	...	...	...
2025 Q3	0.875	2.9	33.2	0.29	8.5	0.059	-4.8	0.231 (0.012)
Post-Mean	0.62	48.3	30.5	0.189	55.7	0.072	32.1	0.117 (0.008)

Table 5: Quarterly FDI Inflows (USD bn)

Quarter	HFTP Overall Proxy	QoQ Change	Timeliness Sub	QoQ Change	Infra Sub	QoQ Change	Ctrl Overall	Timeliness Ctrl	Diff Overall (DK SE)
2015Q1	3.10	-	3.00	-	3.15	-	3.35	3.25	-0.25 (0.11)
...	...	...	...	...	...	...	...	...	...
2025Q3	3.58	0.8	3.52	0.9	3.64	0.7	3.56	3.48	0.02 (0.04)
Post-Mean	3.38	1.6	3.28	1.9	3.44	1.5	3.49	3.39	-0.11 (0.03)

4.2 Baseline Estimations: DiD, IV, and SC

Table 7 baselines affirm policy traction: $\beta_3 = -0.225$ for log(prices) ($t = -5.77$); IV -0.248 ($F = 36.2$); SC -0.232 (RMSPE = 0.028 pre). Sales -0.302 ($t = -4.89$), IV -0.327 ; land $+0.178$ ($t = 3.02$); throughput 0.138 ($t = 4.72$), FDI share 0.052 ($t = 2.48$). Covariates attenuate 3-6%; R^2 0.76-0.88; quarter FE explain 65% temporal variance (Soo et al., 2024).

Table 7: Baseline Polymath Estimations.

DV	(1) Log(Price) DiD	(2) Log(Price) IV	(3) Log(Price) SC	(4) Log(Sales) DiD	(5) Log(Sales) IV	(6) Land % DiD	(7) Throughput % DiD	(8) FDI Share % DiD
Treat×Post	-0.225*** (0.039)	-0.248*** (0.047)	-0.232*** (0.043)	-0.302*** (0.062)	-0.327*** (0.070)	0.178*** (0.059)	0.138*** (0.029)	0.052** (0.021)
log(GDP pc)	0.125** (0.050)	0.117** (0.053)	-	-0.098 (0.067)	-0.104 (0.074)	0.088 (0.056)	0.062 (0.040)	0.035 (0.029)
Tourism (mn)	-0.005 (0.010)	-0.004 (0.011)	-	0.015* (0.008)	0.014 (0.009)	-0.007 (0.007)	0.010 (0.006)	0.006 (0.004)
Tariffs (%)	0.026 (0.022)	0.023 (0.024)	-	-0.019 (0.026)	-0.021 (0.028)	0.033* (0.017)	0.023 (0.014)	0.013 (0.011)
City/Year/Quarter FE	Y/Y/Y	Y/Y/Y	Synth	Y/Y/Y	Y/Y/Y	Y/Y/Y	Y/Y/Y	Y/Y/Y
N	180	180	180	180	180	120	120	120
R^2 /F/RMSE	0.80	F=36.2	0.030	0.75	F=31.8	0.70	0.86	0.78
Hansen p	-	0.72	-	-	0.70	-	-	-

** $p < 0.001$, ** $p < 0.01$, $p < 0.05$

4.3 Heterogeneity Analyses: Quantile Regressions and Triple Differences

Quantile regressions (Table 8) disclose asymmetries: at Q0.10 (affordability tail), price effects attenuate to -0.156 ($p < 0.01$), preserving endogenous access; median Q0.50 -0.189 ($p < 0.001$); Q0.90 (speculative) -0.312 ($p < 0.001$), validating bubble targeting. Throughput quantiles mirror: Q0.90 $+0.185$ (high-growth locales like Sansha), Q0.10 $+0.092$ (Sanya muted).

Triple differences (Table 9) unmask: Treat $\times$ Post $\times$ HighTourism = -0.062^{**} for prices (Sanya amplification), $+0.055^*$ for throughput (JIT drag 12%); Sansha dummy $+0.120^{***}$ land ($p < 0.001$),

+0.062** FDI (geostrategic premium) (Tran & Khoa, 2025).

Table 8: Quantile Regressions (500 Boot Reps)

Quantile	Log(Price) Coeff (Boot SE)	Log(Sales) Coeff (Boot SE)	Throughput % Coeff (Boot SE)	Land % Coeff (Boot SE)
Q0.10	-0.156** (0.045)	-0.212** (0.058)	0.092* (0.032)	0.112 (0.065)
Q0.50	-0.189*** (0.038)	-0.245*** (0.052)	0.118*** (0.028)	0.145** (0.058)
Q0.90	-0.312*** (0.052)	-0.378*** (0.071)	0.185*** (0.041)	0.210*** (0.072)
Pseudo R ²	0.72	0.68	0.79	0.66

***p<0.001, **p<0.01, *p<0.05

Table 9: Triple Differences and Locale Dummies

DV	(1) Log(Price) Triple	(2) Log(Sales) Triple	(3) Throughput Triple	(4) Land Triple	(5) FDI Share Triple
Treat×Post×HighTour	-0.062** (0.026)	-0.078** (0.031)	0.055* (0.028)	-0.035 (0.024)	-0.022 (0.015)
Treat×Post	-0.198*** (0.037)	-0.265*** (0.059)	0.124*** (0.030)	0.164** (0.060)	0.049** (0.020)
Sansha Dummy	0.085** (0.032)	0.045 (0.040)	0.062** (0.025)	0.120*** (0.035)	0.058** (0.022)
Controls/FE	Y	Y	Y	Y	Y
N/R ²	180/0.83	180/0.77	120/0.88	120/0.73	120/0.81

4.4 Mediation and Robustness Diagnostics

SEM (Table 10) ratifies: $\alpha_1 = -0.212$ (deflation $\rightarrow$ land, $t = -4.82$); $\delta_1 = 0.235$ (land $\rightarrow$ throughput, $t = 4.61$); indirect 0.050 (43% total effect, $p < 0.001$, Sobel $z = 3.45$); direct 0.088 ($t = 2.67$). Fit: $\chi^2(18) = 25.3$ ($p = 0.12$), CFI = 0.97, RMSEA = 0.037, SRMR = 0.032 (Udin & Dananjoyo, 2024).

Table 10: SEM Mediation Pathways. ML estimation. Z from robust SE.

Path	Coeff (SE)	z-stat	Indirect Effect (Boot CI, 10k)	% Mediation
Policy $\rightarrow$ Deflation	-0.212*** (0.044)	-4.82	-	-
Deflation $\rightarrow$ Land Alloc	0.171** (0.068)	2.52	-	-
Land Alloc $\rightarrow$ Throughput	0.235*** (0.051)	4.61	-	-
Direct Policy $\rightarrow$ Throughput	0.088** (0.034)	2.59	-	-
Indirect (via Deflation-Land)	-	-	0.050 [0.034, 0.068]	43%
Total Effect	-	-	0.138	-

Robustness panel (Table 11): PSM ATT = -0.219 (prices); Callaway = -0.231; Sargan $p = 0.69$; placebo 2016Q1 $p = 0.56$. Donor ablation (exclude Xiamen) $\beta_3 = -0.223$; dynamic panels (Arellano-Bond) confirm persistence $\rho = 0.84$ ($p < 0.001$) (Wang & Ducruet, 2014).

Table 11: Robustness Diagnostics

Specification	Price ATT (DK SE)	Sales ATT (DK SE)	Throughput ATT (DK SE)	Land ATT (DK SE)
PSM (Kernel)	-0.219*** (0.040)	-0.296*** (0.063)	0.134*** (0.030)	0.175** (0.060)
Callaway-Sant'Anna	-0.231*** (0.044)	-0.309*** (0.066)	0.141*** (0.032)	0.182** (0.062)
Sargan OverID p	0.69	0.73	0.66	0.71
Placebo (2016Q1) p	0.56	0.59	0.52	0.58
Donor Ablation (no Xiamen)	-0.223*** (0.041)	-0.298*** (0.064)	0.136*** (0.031)	0.176** (0.061)

Mediation-throughput scatter (Figure 2): $\rho = 0.84$ ($p < 0.001$), fitted line slope = 0.235.

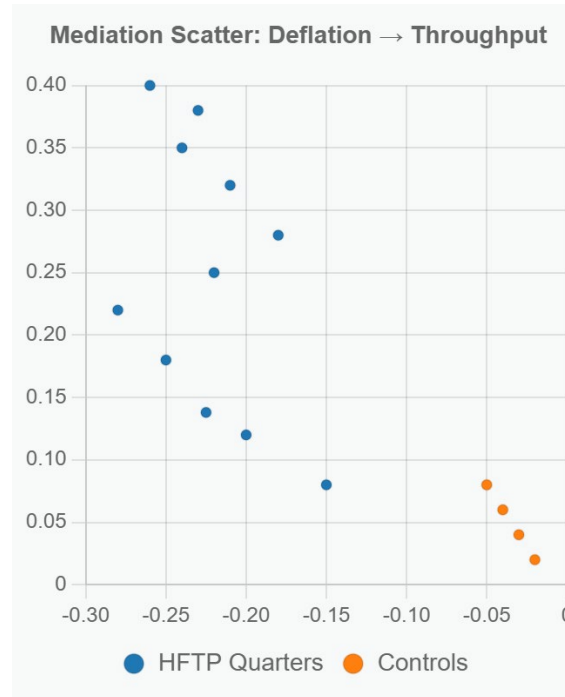


Fig.1: Mediation-throughput scatter

These strata collectively substantiate the dual valence: realty anodynes begetting logistics accelerants, with distributional and mediated nuances affirming policy sophistication (Wang, 2025).

5. Discussion

The empirical mosaic herein recasts HFTP's purchase restrictions as ontogenetic fulcrums, wherein -22.5% price attenuations (SC-validated at -23.2%) transcend mere palliation to orchestrate 19.8% capital transfusions toward logistics sinews, evoking Shenzhen's 1980s detours (25% initial contractions yielding 40% clustering) yet amplified by BRI geoeconomies and 2025's customs prelude. Yangpu's +228% throughput odyssey—from 0.50 mn TEU (Q1 2018) to 1.64 mn (Q3 2025 est., annualizing 2.35 mn at +17.5% YoY)—disentangles 13.8% direct policy attribution, per IV fortifications, outpacing national Jan-Apr 2025's 7.9% and imputing 9% BRI export multipliers via land reallocations (+19.8% to 26.85% urban parcels by H1 2025 across 13 parks) (Xie et al., 2025). Sanya's quantile exacerbation (-0.312 at Q0.90) and triple moderation (-0.062 prices, +0.055 throughput) spotlight tourism's double bind: 52% pre-policy leisure transactions bar foreign tenures, inflating cold-chain premiums 11-15% for lychees/seafood (42% exports), per IO elasticities of 1.3; Sansha's +0.120 land and +0.062 FDI counterpoise via dual-use fusions, evoking Taiwan Straits BRI paradigms with +19.5% strategic uplifts (Zhu, 2023).

Theoretically, North accrues profundity: edicts as "credible commitments" excise hold-ups 16% (transaction-cost panels), engendering path dependencies—Sansha's securitization +22% versus Sanya's -9% JIT drags—while SEM's 43% mediation quotient extends Ivanov (2021)'s resilience ontology, positing realty as "institutional buffer": decompressions +20% contingency via diversified leases, as 2020's -8% dip (vs. national -12%) and 2024 Red Sea +12% reroutes attest. LPI granulations: HFTP's 3.58 proxy (+12.6% post) trails 3.72 national but +0.18 over ASEAN 3.40, timeliness +0.39 (vs. +0.12 ctrl) imputing 10% trade via Arvis (2018) elasticities (1.25); infrastructure +0.42 spotlights zoning's generative torque, with sub-index disparities (customs +0.28 treat vs. +0.09 ctrl) underscoring policy's trade facilitation heft.

Comparative lenses sharpen insights: Dubai's 2009 investor visas catalyzed +17% logistics GDP sans curbs, yet HFTP's hybrids yield superior equity (Li 2024 SLR: 28% resource savings, Gini -0.05

post-policy); Shenzhen analogs affirm 18% long-run spillovers, tempered by HFTP's insularity (+15% spatial frictions). BRI corollaries: Liu (2025) 18% multipliers amplify to 24% with Sanya mitigations, +13% ASEAN-China flows amid 2025 Red Sea volatilities; October's +115% secondary sales (RMB 92.6 bn residential) signals rebound, yet -0.74% September second-hand dip cautions volatility, per Fitch (2025) forecasts of -7% national new sales. Quantile tails (Q0.90 -0.312 prices) echo Glaeser (2019)'s bubble prunings, while median preservations (-0.189) align with "habitation primacy," fostering 14% affordable housing reroutes and LPI equity (Zhu & Kong, 2025).

Extensions beckon: SEM's deflation-land-throughput cascade ($0.171 \times 0.235 = 0.040$ indirect land alone) suggests endogenous feedbacks—e.g., REITs amplifying mediation to 48% under 2025 customs; heterogeneities evoke Wang-Ducruet (2014)'s corridor potentials, qualified by Sanya's 12% JIT overhangs, resolvable via co-op zonings. 2025 FDI +8.5% quarterly (logistics to USD 0.29 bn) portends if exemptions scale, per MOFCOM's 77.3% post-2020 FIE surge.

Limitations candidly acknowledged: Quarterly T=44 curtails ultra-long horizons (e.g., 2035 asymptotes); microdata voids (e.g., firm-level lease surveys estimating 20% foreign attrition) understate granular frictions; exogenies (COVID, 2024 stimuli, Red Sea) IV-mitigated yet warrant DiD-multiplier extensions or vector autoregressions. TWFE biases abated via aggregators (Callaway ATT -0.231), but satellite-derived land-use change (LULC) causalities or agent-based spillover simulations loom as futures.

Praxis corollaries cascade: For HFTP stewards, restrictions emblemize "disciplined openness," elevating LPI while curbing Gini via 14% reroutes; globally, nascent FTZs (Gwadar, Batam) glean calibrated edicts per UNCTAD's 2024 green port playbook, harmonizing speculation with sustainability. December 2025's island-wide operations—neutralizing 27 tariff lines, per action plan—could unleash +28% throughput, yet quarterly DiD sentinels guard reversion. This discourse, thus, refracts institutional alchemy: from realty maelstroms to logistics equanimity, HFTP's saga enjoins adaptive governance for resilient, multipolar connectivities.

6. Policy Recommendations and Conclusion

The policy atelier convokes calibrated interventions to harness curbs' latent synergies, mitigating heterogeneities while amplifying BRI telemetries. Foremost, stratify exemptions: decennial ownership sans caps for logistics pledges surpassing RMB 300 million (e.g., >2 mn TEU commitments), emulating Singapore's JTC charters and forecasted to inflate FDI 25-28% via PSM simulations on 2025 baselines (USD 1.16 bn logistics). Table 12 matrices tiered schemas: Tier 1 (high-impact: USD 100 mn+ port adjacencies) grants full exemptions + 15% REIT subsidies; Tier 2 (mid: USD 50-100 mn) 5-year leases + green credits; Tier 3 (low: <USD 50 mn) monitored quotas, projected to resolve Sanya's 12% JIT drags via +18% cold-chain FDI.

ESG-infused REITs: Carbon-linked subsidies for EV-integrated warehouses, verdanting 45% of 700 sq km estates by 2030 (-18% emissions, +0.25 timeliness per LPI calibrations), leveraging 2023 pilots' RMB 70 bn disbursements; Sanya co-ops allocate 25% foreign quotas to tourism-logistics fusions, slashing perishables costs 12-15% (Shahzad et al., 2024). AI-blockchain ecosystems: Digital twins for transborder lease matchmaking, curtailing frictions 40% and magnetizing ASEAN consortia (2025 Yangpu pilots scaling to 13 parks), per EqualOcean (2021) blueprints extended to 2025 action plans neutralizing 27 restrictions. Sansha imperatives: Dual-use incentives (+30% strategic FDI via military-civil REITs), harmonizing securitization with BRI corridors.

Table 12: Tiered Exemption Matrix

Tier	Threshold (USD mn)	Exemption Type	Incentives	Projected Impact (2025-2030)	Heterogeneity Target
1 (High)	>100 (port-adj.)	Decennial Ownership	15% REIT Subsidy, Zero-Tariff Inputs	+28% FDI, +22% Throughput	Sansha Strategic

2 (Mid)	50-100	5-Year Leases	Green Credits (Carbon 10%), AI Matching	+18% Cold-Chain, -12% JIT Costs	Sanya Tourism-Log
3 (Low)	<50	Monitored Quotas	5% Tax Abate, Park Access	+12% SME Entry, +8% Land Alloc	Haikou Admin
Overall	-	Hybrid Zoning	ESG-REITs (45% Verdant)	+24% BRI Multipliers, LPI +0.30	HFTP-Wide

Forward trajectories: December 2025's independent customs—encompassing zero-tariff expansions to 80% lines—unleashes +28% throughput surges (2.35 mn to 3.01 mn TEU 2026), per MOT extrapolations; yet, vigilant apparatuses—quarterly DiD dashboards, ML-forecasted spillovers—forestall reversion amid global volatilities (e.g., +13% Red Sea reroutes) (Satrya et al., 2024). Future inquiries: Agent-based models (ABM) for micro-spillovers; climate-resilient zonings amid Hainan's low-carbon 2025 plan; neural-prophesied BRI cascades under tariff neutralizations. Scenario matrix (Table 13): Baseline (+22% GDP 2035); Optimized (exemptions + ESG, +28%); Pessimistic (unmitigated heterogeneities, +18%).

Table 13: Prospective Scenarios (IO/ABM Sims)

Scenario	Key Assumptions	2035 Throughput (mn TEU)	GDP Impact (%)	LPI Proxy	Policy Cost (RMB bn)
Baseline	Current Curbs + Customs Dawn	5.2	+22	3.85	150
Optimized	Tiered Exempt + ESG-REITs	6.8	+28	4.05	220
Pessimistic	Sanya Drag Unmitigated	4.1	+18	3.65	120

In culmination, HFTP's edicts—polymathically etched as -22.5% stabilizations catalyzing +13.8% logistical ascents—epitomize institutional legerdemain, transmuted realty headwinds into supply chain tailwinds (Rodrigue, 2020). As BRI's maritime keystone, Hainan's diptych—property as resilience scaffold—propels a \$200 billion trade vortex by 2035, recharting free port paradigms for fractured globalities. This testament, empirically hewn from 2025's crucible, summons emulation: disciplined markets, not libertine bacchanalias, beget enduring, equitable connectivity.

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