The U-Shaped Impact of FinTech Development on Urban Economic Growth

Evidence from 17 Korean Cities (2014–2023)

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Research Background & Motivation

Challenging the Linear Growth Assumption

Literature often assumes uniformly positive FinTech effects. However, early-stage "creative destruction" costs are significantly understudied in urban contexts.

Korea's Unique Policy Context

Following the 2015 "IT—Finance Integration Support Plan," Korea's rapid FinTech transformation provides an ideal natural setting for this study.

Rising Regional Disparities

Rapid sector growth has widened economic gaps between the Seoul metro area and other regions, emphasizing the urgency of spatial inequality issues.

Policy Relevance & Motivation

Universal promotion strategies may harm sub-threshold cities. Understanding nonlinear dynamics is crucial for designing targeted, stage-specific interventions.

Research Gap & Objectives

The Gap

Literature often assumes linear growth effects of fintech, overlooking early–stage dynamics.

Limited evidence on how early–stage disruption costs and threshold effects shape urban economic development.

Need to understand nonlinear dynamics to guide targeted policies.

Study Objectives

Nonlinear Relationship Analysis

Examine U–shaped relationship between fintech and per capita GRDP.

Rigorous Identification

Mitigate endogeneity via lags, fixed effects, and national trends.

Robustness & Causality

Verify findings via robustness checks and causal timing tests.

Heterogeneity Exploration

Analyze heterogeneity by region, fintech level, industry, and firm size.

Policy Implications

Derive policy recommendations tailored to fintech maturity levels.

Theoretical Framework: U-shaped Mechanism

HYPOTHESIS 1

FinTech development and urban economic growth exhibit a U-shaped relationship.

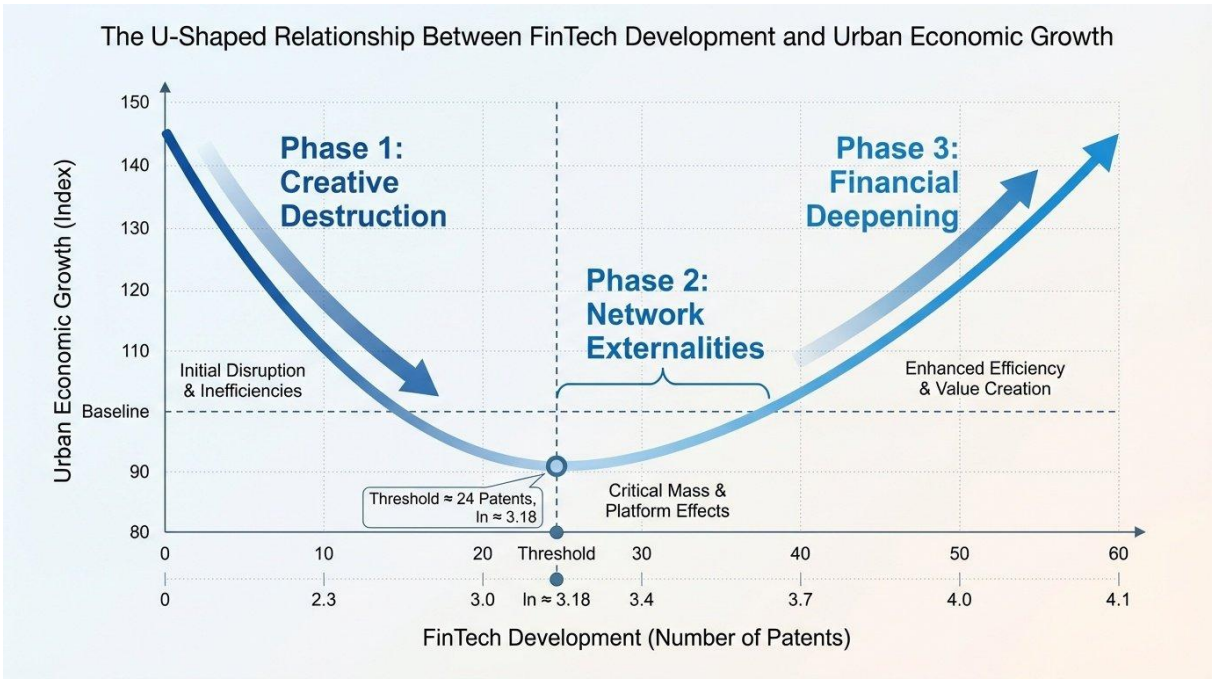


Figure 1: The Three Stages of FinTech's Impact on Urban Economic Growth

Stage 1: Creative Destruction

Early-stage fintech disrupts traditional financial sectors. Adjustment costs and employment losses in incumbent industries initially depress per capita GRDP.

Stage 2: Network Externalities

Critical Threshold: ≈ 24 patent applications (ln ≈ 3.18). Beyond this point, self-reinforcing network effects and knowledge spillovers begin to outweigh disruption costs.

Stage 3: Financial Deepening

Mature fintech ecosystems promote urban growth through improved credit access, lending efficiency, and greater financial inclusion.

Research Design & Variables

Variable Construction: Dependent, Independent, and Controls

Dependent Variable

$ln\_GRDP_{i,t}$

Natural logarithm of per capita Gross Regional Domestic Product (GRDP).

Proxy for urban economic growth level.

Independent Variable

$FinTech_{i,t-1}$

Lagged FinTech patent applications (IPC G06Q 20/30/40).

$$\ln(1 + \text{Patent\_Apps}_{i,t-1})$$

Squared term ($FinTech^2$) added to test U-shape.

Control Variables (PCA Analysis)

PC1 — 44.4% Var		PC2 — 25.3% Var		Retained Variables	
Urbanization & Econ. Dev.		Human Capital		Used Directly	
Tertiary (IS)	+.516	Human (ln_HUM)	+.807	**INT**: Internet Users/Pop	
Assets (ln_CAP)	+.496	Tertiary (IS)	+.431	**GOV**: Budget Exp./GRDP	
Urban (URB)	+.480	Assets (ln_CAP)	−.333	**OPE**: Export Growth	

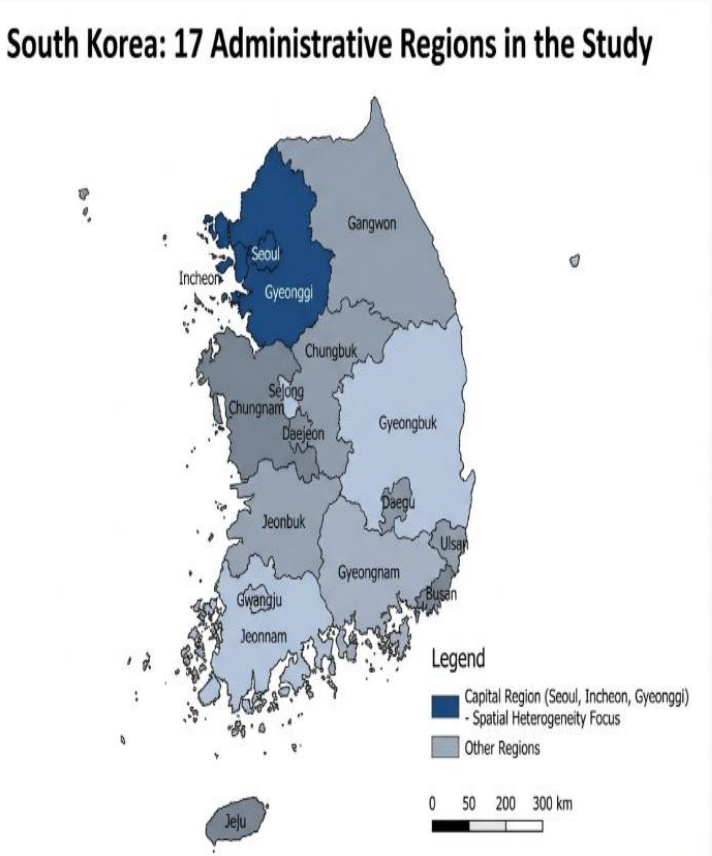
Other Variable

National FinTech Control

To control for nationwide common shocks & trends.

$$\text{FinTech\_Nat}_{t-1} = 1/17 \sum \ln(1 + \text{Patent}_{i,t-1})$$

Sample: 17 Korean Cities



Model Specification & Data Sources

Research Design Overview

Benchmark Fixed Effects Model

$$lnGRDPi,t = \alpha + \beta 1FinTechi,t-1 + \beta 2FinTech^2i,t-1 + \delta FinTech\_Nationalt-1 + \gamma Controlsi,t + \mu i + \varepsilon i,t$$

Where μi represents city fixed effects, and standard errors are clustered at the city level.

Data Sources

KOSIS Korean Statistical Information ServiceGRDP, population, and macroeconomic control variables.

KIPRIS Korea Intellectual Property Rights Info ServiceFinTech patent application data (2012–2024).

WRDS Wharton Research Data ServicesCorporate financial data (Total Assets) for listed firms.

Sample Construction

17 Cities & Provinces (Full Coverage)	**2014-23** Time Period (10 Years)
170 Total Observations (City–Year Panel)	**PCA** Control Method (Multicollinearity)

Descriptive Statistics

Summary of Key Variables (N=170)

Variables	Mean	Std. Dev	Min	Max
ln_GRDP Dependent	10.48407	0.293	9.890	11.305
fintech Key	3.599859	1.311	0.693	7.372
fintech² Key	14.66719	11.624	0.480	54.348
INT (Internet Users)	0.8561286	0.071	0.592	0.976
GOV (Local Budget)	0.1527606	0.060	0.047	0.322
OPE (Export Growth)	0.02803064	0.145	-0.323	0.580
PC1 (Urban/Dev)	2.35e-11	1.494	-2.902	4.189
PC2 (Human Cap)	-5.88e-12	1.127	-2.169	2.265
fintech_national	3.599859	0.419	2.902	4.157
IS (Tertiary Ind)	0.5450410	0.159	0.230	0.855
ln_CAP (Total Assets)	17.84202	1.771	13.987	22.793

Observation: The sample shows significant variation in fintech development (Min: 0.693, Max: 7.372), providing sufficient variability to test the U-shaped hypothesis. PC1 and PC2 are principal components extracted to handle multicollinearity among control variables.

Source: KOSIS, KIPRIS, WRDS (2014—2023)

Benchmark Results

Fixed Effects Panel Regression Estimates (Table 2)

Key Finding: U-Shaped Relationship Confirmed

The coefficients for FinTech are significantly negative, while FinTech^2 are significantly positive across all models, confirming the U-shaped hypothesis.

Variables	Model (1)No Controls	Model (2)With Controls	Model (3)With Controls + National
fintech	-0.1546(0.1029)	-0.2088***(0.0596)	-0.2105***(0.0608)
fintech^2	0.0397***(0.0135)	0.0299***(0.0082)	0.0331***(0.0070)
INT	-	0.7579**(0.3608)	0.8405**(0.3995)
GOV	-	3.1304***(0.9859)	3.2460***(0.9302)
OPE	-	0.0471(0.0305)	0.0587(0.0393)
PC1	-	0.0395(0.0842)	0.0355(0.0812)
PC2	-	0.1461(0.1166)	0.1418(0.1182)
R-squared	**0.205**	**0.541**	**0.543**

Notes:

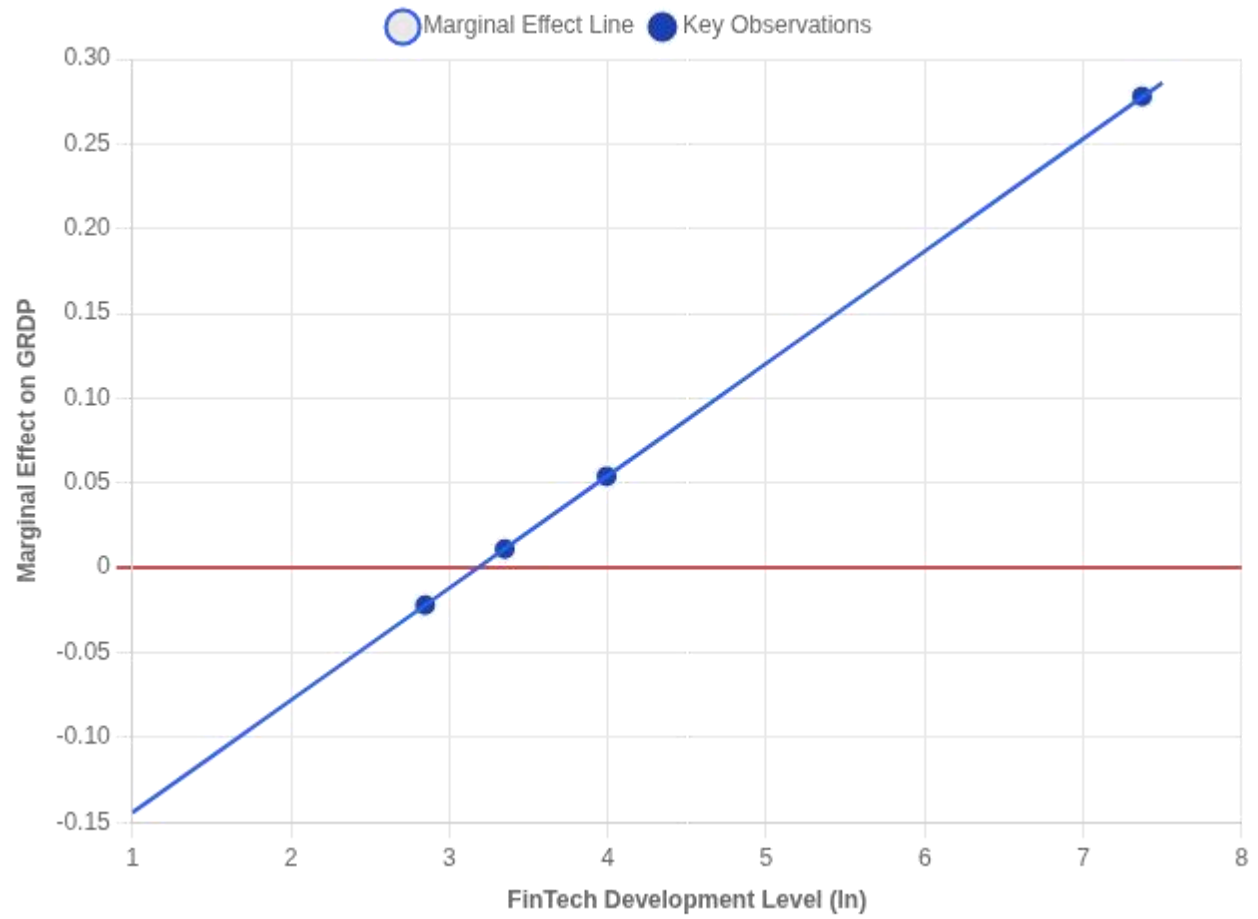
Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1. Model (3) is the most comprehensive specification. Controls, National Control, and Fixed Effects included in models as specified but omitted here for brevity.

Source: Empirical analysis results based on data from 17 Korean cities (2014—2023)

Marginal Effects Analysis

Marginal Effects at Representative FinTech Levels (Table 6)

Marginal Effect on GRDP



Relationship: Marginal Effect = −0.2105 + 0.0662 × FinTech Level

Statistical Evidence

Point	FinTech Level	Marginal Effect	t-stat
P25	2.848	**-0.022**	-0.598
P50 (Median)	3.350	0.011	0.319
P75	3.993	**0.054**	1.493
Max	7.372	**0.278*** **	**4.272**

Interpretation

Below Threshold (~3.18): The marginal effect is negative, reflecting "Creative Destruction" costs dominating early stages.

Transition Zone: Around the median (3.350), the effect turns positive but remains statistically insignificant.

High Intensity: At maximum levels (7.372), the effect becomes highly positive (0.278) and significant, confirming the strong benefits of mature FinTech ecosystems.

Source: Marginal effects calculated based on Model (3) coefficients.

Causal Identification

Timing Tests with Different Lag/Lead Specifications (Table 3)

Variable	(1) BaselineCurrent Period	(2) Laggedt−2 Period	(3) Leadt+1 Period	(4) Leadt+2 Period
fintech	−0.2105***(0.0608)			
fintech²	0.0331***(0.0070)			
fintech (t−2)		−0.1293***(0.0392)		
fintech² (t−2)		0.0355***(0.0052)		
fintech (t+1)			−0.1253***(0.0431)	
fintech² (t+1)			0.0221***(0.0054)	
fintech (t+2)				−0.0625*(0.0327)
fintech² (t+2)				0.0083**(0.0041)
R−squared	**0.543**	**0.581**	**0.546**	**0.531**

Interpretation: The U−shaped relationship remains robust across different timing specifications. The significant results for lagged terms (t−2) confirm the persistent effect of fintech development. All models include full controls, national fintech control, and city fixed effects. Standard errors clustered at city level.

Note: Dependent Variable: ln(per capita GRDP). Standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Robustness Checks

Excluding Influential Observations (Seoul) and Abnormal Periods (COVID-19)

Model Specification	Benchmark (1) Baseline	Outlier Check (2) Exclude Seoul	Period Check (3) Exclude COVID Years
fintech	-0.2105***(0.0608)	-0.2106**(0.0865)	-0.1953***(0.0694)
fintech^2	0.0331***(0.0070)	0.0335***(0.0114)	0.0321***(0.0092)
Controls	YES	YES	YES
Fixed Effects	YES	YES	YES
Observations (N)	170	160	136
R-squared	**0.543**	**0.523**	**0.616**

Robustness Findings:

The U-shaped relationship remains robust and statistically significant even after excluding Seoul (the capital with highest fintech concentration) and the COVID-19 pandemic years (2020-2022). This confirms that the results are not driven solely by the capital region or pandemic-induced digital acceleration.

Significance Levels:

*** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors clustered at the city level are reported in parentheses.

Heterogeneous Effects I

Comparisons by Regional Characteristics & Initial Development Levels (Table 5–1)

Panel A: Regional Heterogeneity

Variable	(1) CapitalRegion	(2) Non–capitalRegion
fintech	-0.3139***(0.0676)	-0.1848*(0.0953)
fintech^2	0.0465***(0.0050)	0.0294**(0.0130)
Controls & FE	YES	YES
Observations	30	140
R–squared	0.891	0.502

Insight: The U–shaped pattern is significantly stronger and more robust in the Capital region (Seoul, Incheon, Gyeonggi), explaining nearly 90% of variance (R^2=0.891).

Panel B: Initial FinTech Level

Variable	(3) HighFinTech	(4) LowFinTech
fintech	-0.2562***(0.0439)	-0.1074(0.1315)
fintech^2	0.0336***(0.0092)	0.0276(0.0209)
Controls & FE	YES	YES
Observations	90	80
R–squared	0.761	0.459

Insight: Cities with initially high fintech levels show a distinct U–shape. In low–level cities, coefficients are insignificant, suggesting they haven't reached the scale for impact.

Note: Standard errors in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1. Dependent Variable: ln(GRDP).

Heterogeneous Effects II

Comparisons by Industry Structure & Firm Size (Table 5–2)

Panel C: Industry Structure (Service Sector)

Variable	(5) HighService Share	(6) LowService Share
fintech	-0.2166***(0.0298)	-0.2290**(0.1055)
fintech^2	0.0319***(0.0076)	0.0434***(0.0145)
Controls & FE	YES	YES
Observations	90	80
R-squared	0.783	0.392

Insight: Service-oriented economies exhibit a much stronger fit (R^2=0.783) compared to manufacturing-heavy ones (R^2=0.392), confirming fintech complements service industries.

Panel D: Firm Size (Corporate Assets)

Variable	(7) LargeFirms	(8) SmallFirms
fintech	-0.2105***(0.0448)	-0.1619(0.1057)
fintech^2	0.0302***(0.0087)	0.0278*(0.0150)
Controls & FE	YES	YES
Observations	90	80
R-squared	0.828	0.355

Insight: Cities with larger firms show a highly robust U-shaped pattern (R^2=0.828). In contrast, small-firm cities show weaker effects, suggesting scale is crucial for fintech adoption.

Note: Standard errors in parentheses. Significance: *** p<0.01, ** p<0.05, * p<0.1. Dependent Variable: ln(GRDP).

Key Findings & Discussion

Core Insight

The relationship between FinTech and urban economic growth is not linear but clearly U–shaped.

Evidence from 17 Korean cities (2014—2023) confirms that initial disruption costs must be overcome before growth benefits materialize.

Robust across multiple specifications & contexts.

Empirical Evidence Summary

Confirmed U–Shaped Pattern

Fintech initially depresses per capita GRDP, but becomes growth–enhancing after surpassing a threshold of ~24 patent applications (ln≈3.18).

Robust Results

The U–shaped relationship holds across all specifications: including controls, national trends, lag/lead timing, and excluding Seoul or COVID years.

Significant Heterogeneity

Growth benefits are stronger in capital–region cities, high–service economies, and areas with larger corporate sectors.

Increasing Magnitude

Marginal effects analysis shows impact turns from negative/insignificant at low levels to highly significant and positive at high intensity.

Conclusions & Policy Implications

Summary and Recommendations for Korean Urban Development

Main Conclusions

Nonlinear U-Shaped Impact:

FinTech's impact on urban growth is nonlinear (U-shaped) in Korea (2014—2023).

Early-stage disruption costs dominate at low fintech levels, suppressing growth initially.

Positive spillovers and financial deepening prevail beyond the critical threshold.

KEY INSIGHT

The transition from "Creative Destruction" to "Network Externalities" occurs at approximately 24 patent applications (ln≈3.18).

Heterogeneity:

Growth effects are significantly stronger in capital regions and service-oriented economies.

Initial fintech maturity amplifies the positive impact.

Policy Implications

For Sub-Threshold Cities:

Provide targeted support to overcome coordination failures.

Focus on achieving initial scale to reach the inflection point.

For Above-Threshold Cities:

Maximize ecosystem advantages and foster spillovers.

Encourage cross-regional knowledge sharing.

Regional Strategy:

Support non-capital cities in building complementary strengths rather than simply replicating Seoul's model.

Limitations & Future Research

Data Constraints: Short panel (2014—2023) and Korea-only context limit generalizability.

Measurement: FinTech measured via patents only; future studies should use broader indices.

Mechanisms: More exhaustive testing of transmission channels needed.

Thank you for your attention. Q&A Session.