Digital FDI and Smart Supply Chains in India

Exploring Pathways for Resilience in a Changing Global Environment

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Presentation structure

1

Economic problem

Why supply chains now need resilience, not only efficiency

2

Policy value

How the paper contributes to India's policy choices

3

Approach

Analytical framework, indices and methodology

4

Findings & gaps

Key empirical findings and limitations

5

Recommendations

Priorities for digital-resilience policy for India

The economic problem: fragile supply chains in a shock-prone world

Q1: Economic problem

Problem statement

Global production networks have become highly interconnected, but this has also made them exposed to vulnerabilities and shocks that spread across countries, sectors and logistics channels.

1	2	3	4
Pandemic disruptions	**Geopolitical tensions**	**Climate events**	**Rapid digitization , AI adoption and Cyber risks**
production breaks + logistics delays	trade restrictions + regional conflicts	Transport and inventory risk	new vulnerabilities in connected systems

Why this is an economic problem — and why policymakers should care



Within this broader discussion Foreign Direct Investment has gained renewed interest

- Over the years FDI has played a significant role in helping countries integrate into Global Value Chains
- However, the role of FDI in supporting resilience in terms of technological upgradation, digital technologies and stronger linkages across production networks is not much studied in literature
- In recent years, a growing share of global investments is directed towards digital technologies and related infrastructure.
- Investments in cloud computing, telecommunications, artificial intelligence, digital platforms, data centres and advanced logistics systems are becoming increasingly important
- World Investment Report 2025, 2026 suggest that about 80% of the digital sector greenfield projects has been in the global south, of which 10 are Asian countries.
- India provides an interesting case because not only investment inflows towards digitally enabled services has grown in India, digital public infrastructure has expanded very rapidly since 2016-17.

The paper's policy value lies in linking Digital FDI, Digital Public Infrastructure and readiness to adopt digital technologies to supply-chain resilience in India— a connection usually studied separately.

Review of Literature

1 FDI & GVC Integration

- FDI deepens GVC participation through technology, market access and production integration.
- Concentrated production networks can increase exposure to disruptions.
- **Evidence: Gereffi (2020); Chawla (2023).**

2 Supply Chain Resilience

- Resilience extends beyond recovery to preparation, adaptation and transformation.
- Diversified and connected supplier networks improve recovery from shocks.
- **Evidence: Durach & Wieland (2021); Todo et al. (2022); Ivanov (2023).**

3 Digital & Smart Supply Chains

- AI, analytics, IoT and digital twins strengthen visibility, forecasting and responsiveness.
- Core capabilities: visibility, agility, adaptability and recoverability.
- **Evidence: Sanders (2019); Le & Fan (2023); Ashraf et al. (2023).**

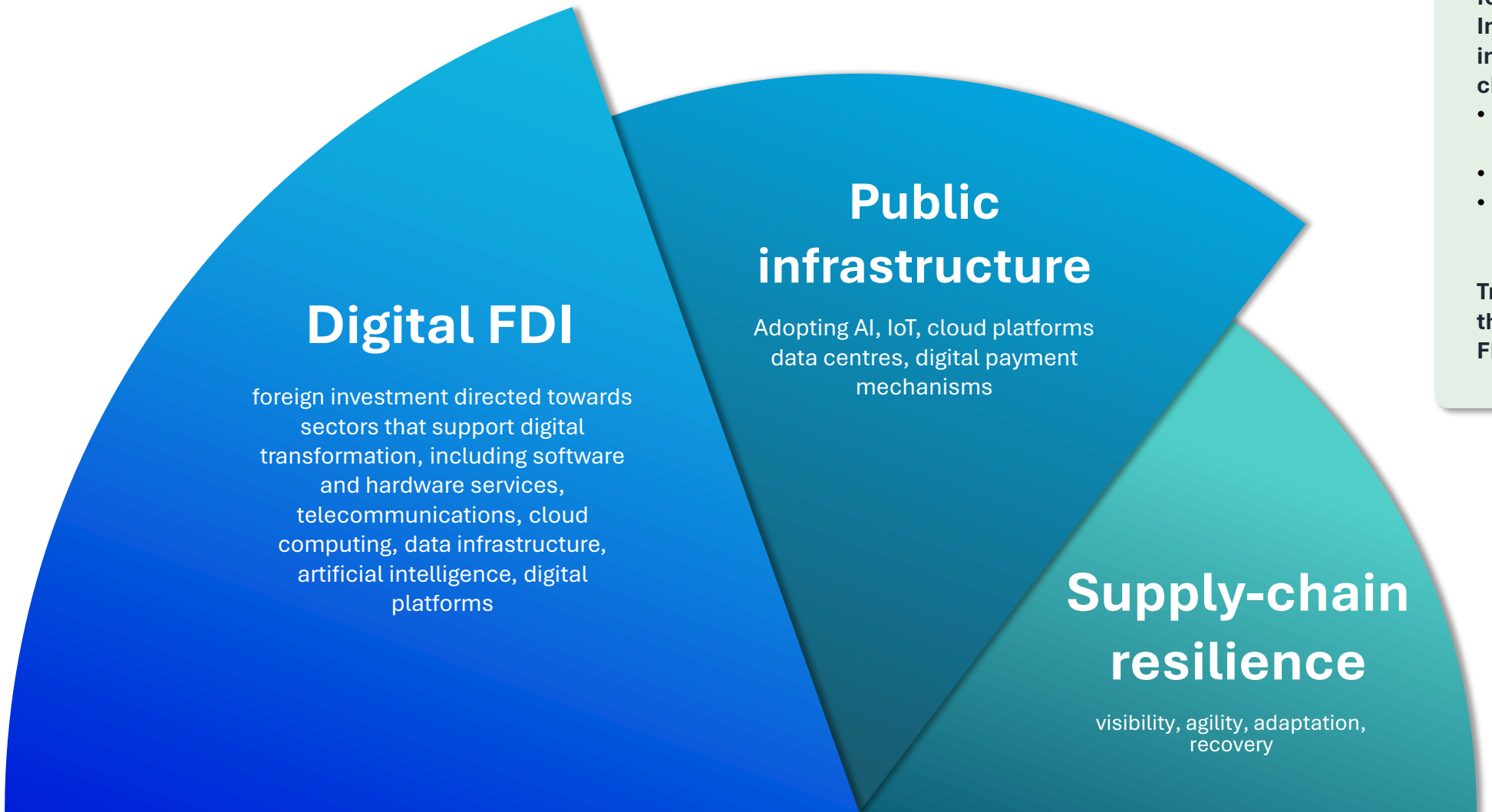
Gaps in literature

- Limited research on whether foreign investment directed towards digital-intensive sectors contributes to supply chain resilience
- Whether effectiveness of digital technologies depend on broader digital environment like public digital infrastructure is not studied.
- Whether penetration of AI technology has any impact on Supply side resilience is not found in literature

Contribution of the Study

Q2: Value addition

Existing literature often studies these in silos



Contribution

Develops an India-focused framework for Digital FDI and Digital Public Infrastructure (DPI) and digital innovative readiness → smart supply-chain capabilities → resilience.

- Builds three indices: Digital FDI Index (DFDII)
- Supply Chain Resilience Index (SCRI)
- Digital Innovation Readiness Index (DIRI)

Treats DPI as an enabling foundation that can amplify the impact of Digital FDI.

This study connects them

Objectives and hypotheses

Objectives

- Examine the relationship between Digital FDI and supply-chain resilience in India.
- Assess whether Digital Public Infrastructure complements Digital FDI.
- Assess whether digital technology adoption and readiness influence resilience.

Hypotheses

H1 Digital FDI is positively associated with SCRI.

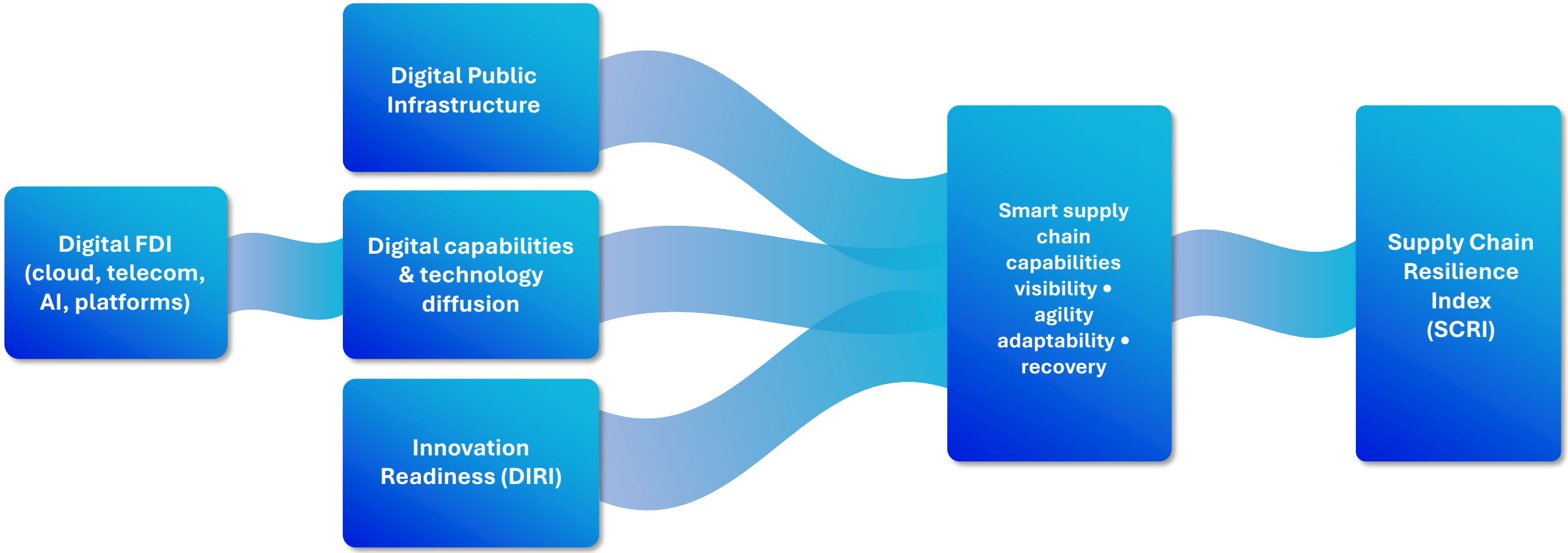
H2 DPI strengthens the Digital FDI–resilience relationship.

H3 Smart supply-chain capabilities positively influence resilience.

System view: DFDI, public digital foundations and innovation readiness operate as an interconnected ecosystem.

Conceptual framework: from Digital FDI to resilient supply chains

Q3: Framework



DPI reduces frictions, improves interoperability and strengthens the ecosystem in which Digital FDI operates.

Data Sources and Analytical Method

Secondary data from official national and international databases

FDI and macroeconomic indicators

- DPIIT: sector-wise FDI inflows
- Reserve Bank of India: FDI and macroeconomic indicators
- International Monetary Fund: control variables

Digital infrastructure and adoption

- TRAI: broadband and connectivity
- NPCI: digital payments
- MeitY: digital infrastructure and technology adoption
- World Bank World Development Indicators (WDI)

Trade and global integration

- Ministry of Commerce and Industry, Government of India
- DGCI&S: merchandise and sector-wise trade data
- UNCTAD Statistics Database

Innovation inputs for DIRI

- Dimensions AI: publications affiliated with Indian institutions, 2010–2024
- CGPDTM: patents granted

Logistics and supply chains

- World Bank Logistics Performance Index
- Ministry of Ports, Shipping and Waterways, Government of India
- National Logistics Policy reports

Index construction and analysis

- Min–Max normalization and aggregation to construct DIRI
- Python for data processing, index construction and empirical analysis

Construction of index

The empirical framework is built around the composite indicators developed specifically for this study:

Digital FDI Index (DFDII) | **Supply Chain Resilience Index (SCRI)** | **Digital Innovation Readiness Index (DIRI)**

$$DFDII = 0.40(SW) + 0.30(TEL) + 0.20(SERV) + 0.10(ELEC)$$

Higher values of DFDII indicate a greater concentration of foreign investment in sectors supporting digital transformation

Where:

- **SW = Share of FDI in Software and Hardware**
- **TEL = Share of FDI in Telecommunications**
- **SERV = Share of FDI in IT-enabled Services**
- **ELEC = Share of FDI in Electronics Manufacturing**

$$SCRI = 0.30(LC) + 0.30(TR) + 0.20(DC) + 0.20(DR)$$

Where:

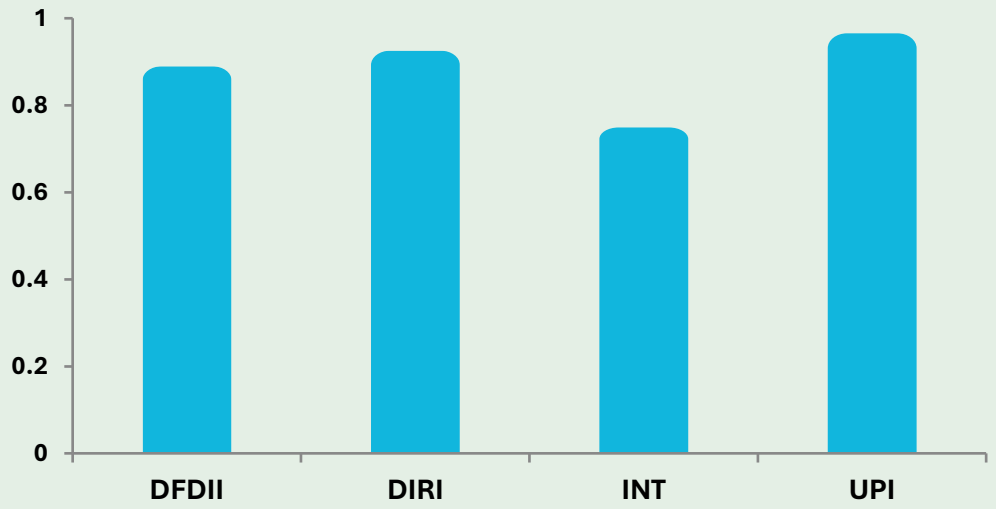
- **LC = Logistics Capability Score**
- **TR = Trade Recovery Capability Score**
- **DC = Diversification Capability Score**
- **DR = Digital Readiness Score**

$$DIRI = 0.30(BP) + 0.35(AIP) + 0.35(PAT)$$

Where:

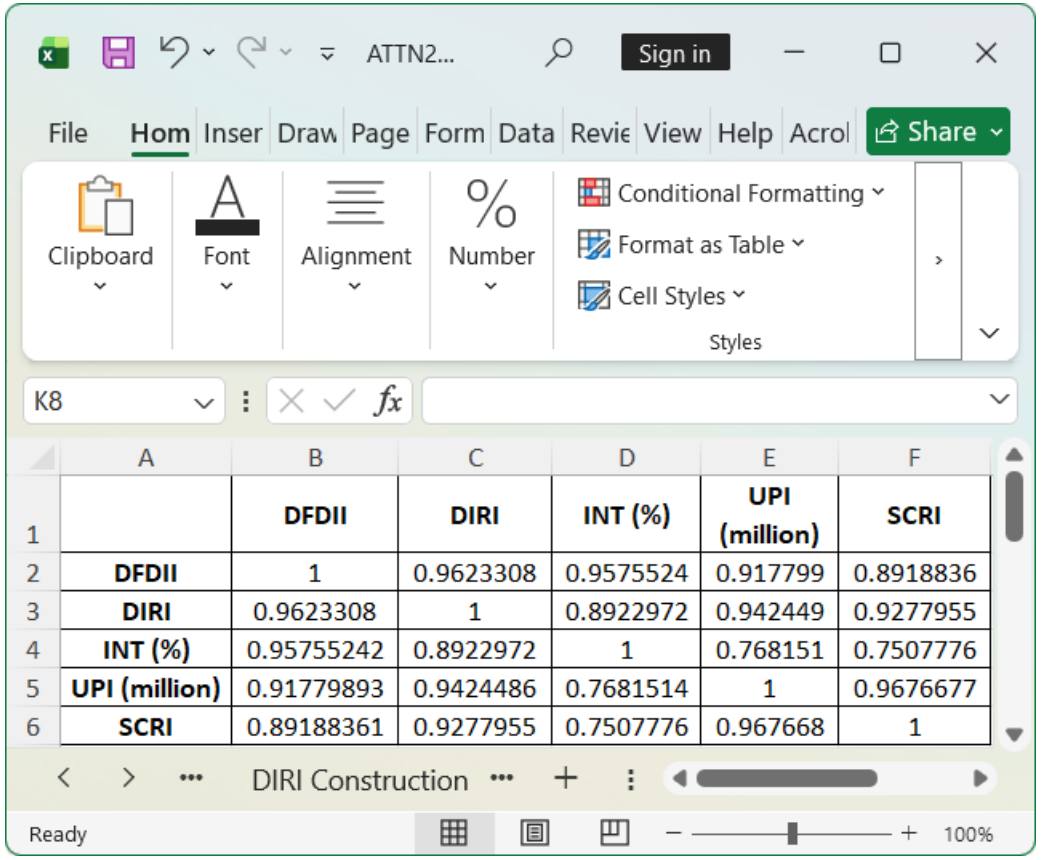
- **BP = Broadband Penetration**
- **AIP = AI Publications**
- **PAT = Patents Granted**

Correlation evidence: strong positive associations with SCRI



DFDII–SCRI: r = 0.892
DIRI–SCRI: r = 0.928
UPI–SCRI: r = 0.968
High correlation also warns against treating each driver as independently causal.

Signal: digital transformation is an interconnected system.



	A	B	C	D	E	F
1		DFDII	DIRI	INT (%)	UPI (million)	SCRI
2	DFDII	1	0.9623308	0.9575524	0.917799	0.8918836
3	DIRI	0.9623308	1	0.8922972	0.942449	0.9277955
4	INT (%)	0.95755242	0.8922972	1	0.768151	0.7507776
5	UPI (million)	0.91779893	0.9424486	0.7681514	1	0.9676677
6	SCRI	0.89188361	0.9277955	0.7507776	0.967668	1

Econometric approach: joint relationship, not isolated causality

Q3: Methodology

Mixed-method secondary-data design

Python used for analysis

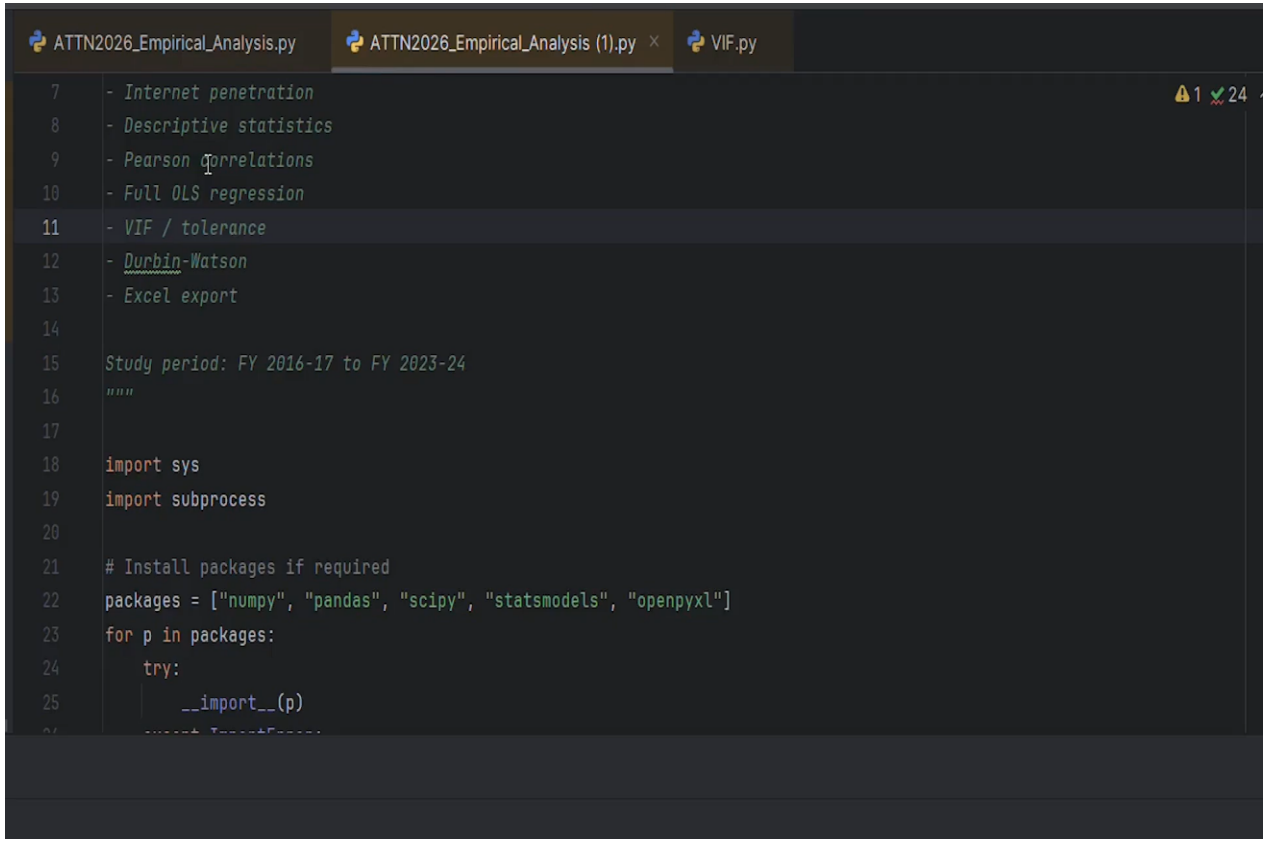
Cautious interpretation

Model specification

$$SCRIt = \beta 0 + \beta 1DFDIIt + \beta 2INTt + \beta 3UPIt + \beta_4 DIRI_t + \varepsilon_t(I)$$

Multiple Regression Results

Variable	Coefficient (B)	t-value	p-value
Intercept	53.865	1.288	0.288
DFDII	0.494	0.230	0.833
DIRI	23.178	0.481	0.663
INT	−0.782	−0.265	0.808
UPI	0.000084	0.107	0.922



Regression results: strong joint fit, cautious individual interpretation

Q4: Findings

R^2 0.941	0.863	p = 0.034	DW 2.272
Variation in SCRI explained	Adjusted fit	Overall model significance	Residual autocorrelation check

Interpretation

The model is statistically significant overall and explains a large share of observed SCRI variation.

Individual coefficients are not significant at 5%, mainly because the variables move together and sample size is small.

VIF values are very high: DFDII 898.85, DIRI 43.50, INT 419.06, UPI 271.95.

Interpretation: evidence of joint association within a digital-resilience ecosystem, not clean independent causal effects.

Key findings

1

Digital FDI and resilience are positively associated

DFDII shows a strong positive correlation with SCRI and a positive directional regression coefficient.

2

Innovation readiness matters

DIRI moves closely with SCRI, indicating the importance of knowledge creation, broadband and patents.

3

DPI and digital adoption are enabling conditions

UPI, connectivity and interoperable platforms are part of the environment in which resilience develops.

4

The ecosystem is the finding

Investment, connectivity, innovation and payments expanded together; their effects are difficult to isolate.

Main takeaway: supply-chain resilience appears to be built through a connected digital ecosystem rather than through any single standalone driver.

Gaps identified and scope for future research

Q4: Gaps

Data and method gaps

No dedicated official measure of Digital FDI; the paper uses a sectoral proxy index.
Supply-chain resilience is multidimensional and difficult to capture in one composite indicator.
Available annual data used in this study is only for 8 years.
Measurement overlap exists because digital readiness is also part of SCRI.

Research agenda

Longer time series and richer databases can enable robust econometric analysis e. a dynamic panel regression..
State-level and sector-specific studies.
Comparative research across Asia-Pacific economies.
Case studies in electronics, pharmaceuticals, automotive, agri-food and digital commerce.

Gap-to-policy bridge: better measurement is itself a policy need, because resilience must be tracked before it can be managed.

Concrete Policy Recommendations

Q5: Recommendations

1	**Attract quality Digital FDI**	Prioritize investments in cloud, data centres, telecom, AI-enabled logistics, platforms and technology-enabled services.
2	**Strengthen the enabling ecosystem**	Invest in digital infrastructure, cybersecurity, standards, digital skills and SME adoption.
3	**Deepen interoperability through DPI**	Enable secure data exchange among businesses, logistics providers, financial institutions and government agencies.
4	**Coordinate industrial, trade and logistics policy**	Link technology-intensive FDI with domestic capability development, digital logistics and supply-chain diversification.
5	**Measure resilience systematically**	Create consistent data systems to track digital investment, adoption, logistics capability and resilience outcomes.

Need to make India's digital transformation not only larger, but more connected, capable and resilient.

Thank You All