

# 3G internet diffusion and secondary education attainment: Evidence of opportunity cost in Viet Nam

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**SUSTAINABLE  
DEVELOPMENT  
GOALS**



# Structure



# Case



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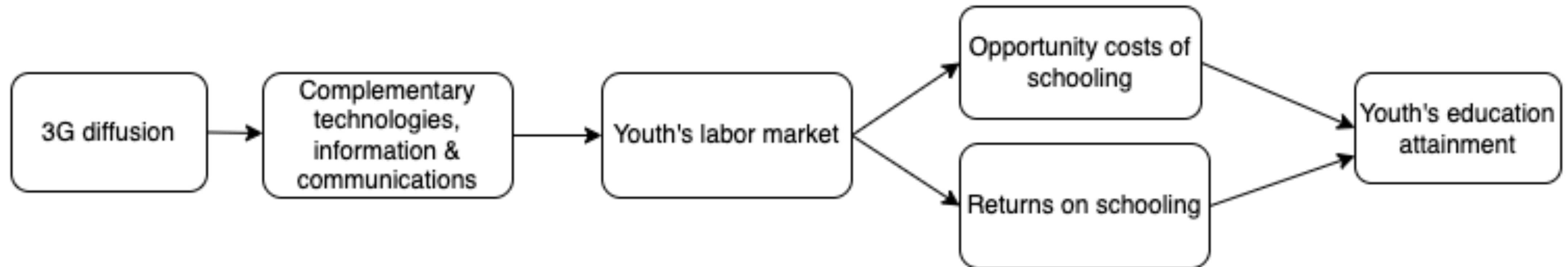
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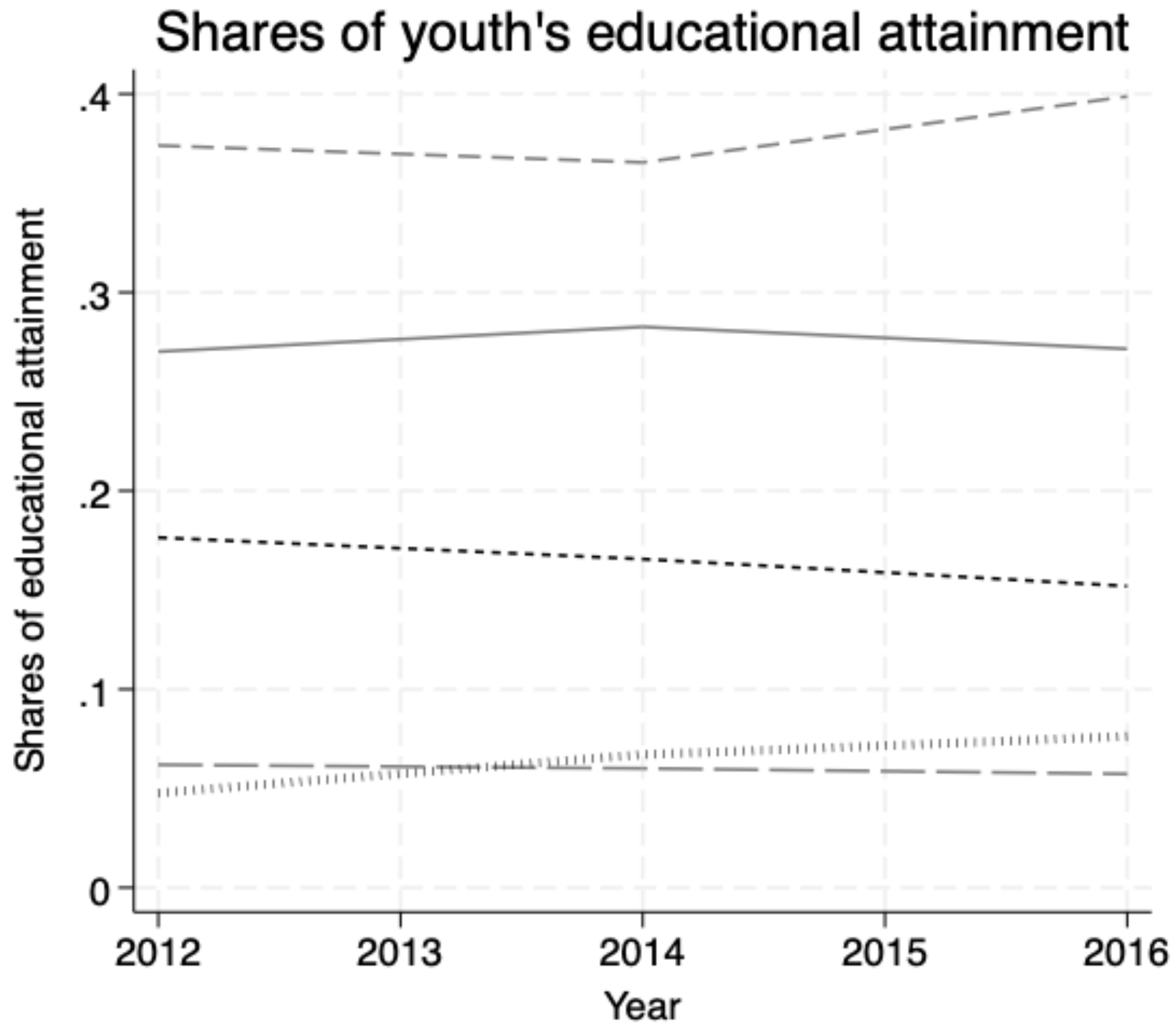
<https://restofworld.org/2023/samsung-female-factory-workers-beauty-industry/>

# Literature: development economics, ICT4D, M4D

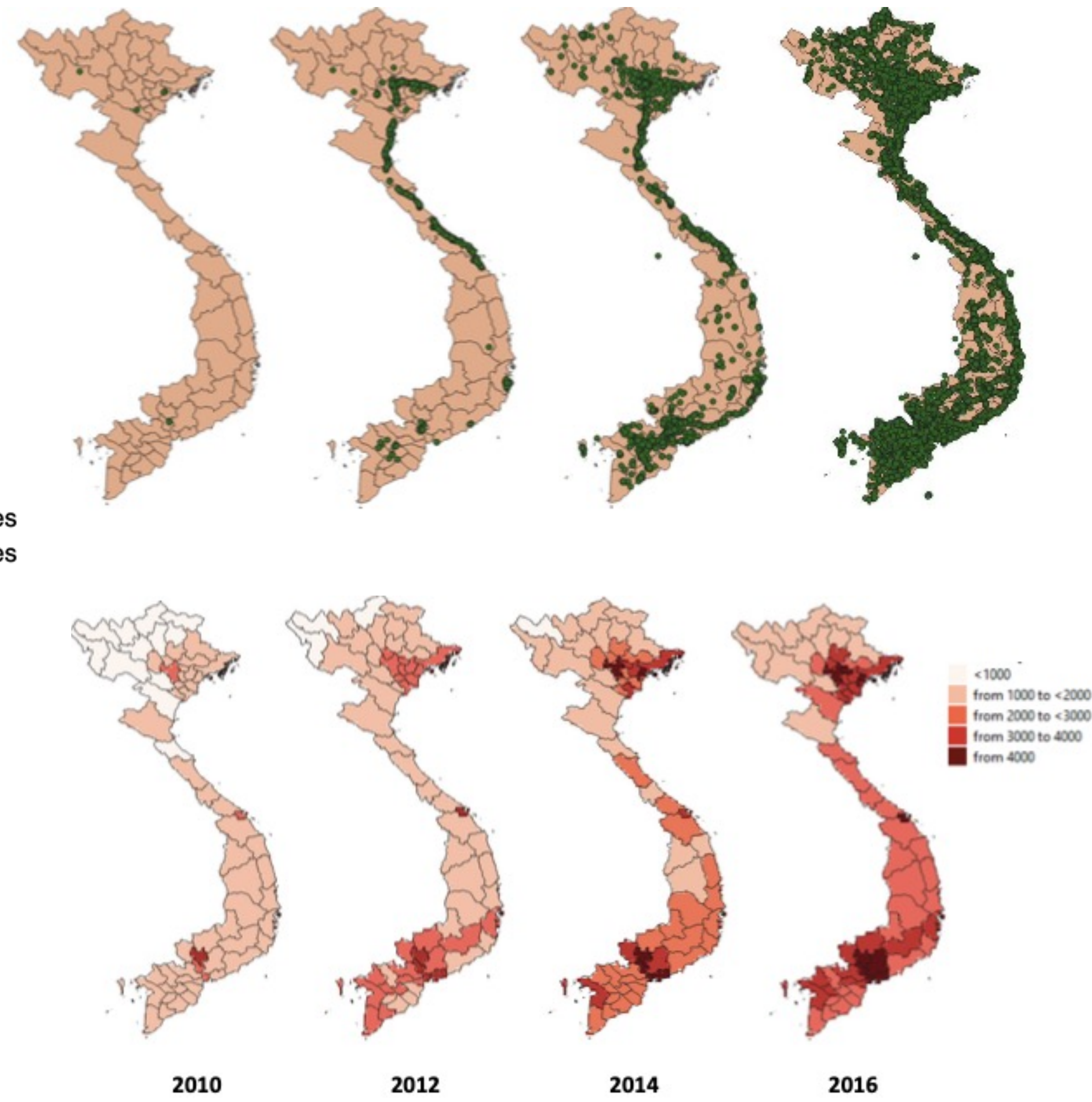
- ICT4D, M4D; ICT4E.
- Years of schooling, degree attainment, quality dimensions (skills, test scores, attitudes).
- Individual level vs. labor market outcomes.
- Different technologies within the ICT sector.
- General Purpose Technology (**GPT**) (Caldarola et al., 2023; Gaglio et al., 2022).
- **Inclusive** technology.
- Short-long-run dimension.



# Context



- Lower-secondary degrees
- Upper-secondary degrees
- - - Primary degrees
- Vocational degrees
- ⋯ Tertiary degrees



# Data & Methodology

## Province-level

- Vietnam Household Living Standard Survey (VHLSS)
  - Degree shares for 15-25yo.
  - 2010-2016.
  - Nationally and provincially representative.
- 3G cell towers coverage: GSMA and OpenCellID.
- Others: employment, wages.

## FE - IV

$$y_{it} = \beta_0 + \beta_1 Cov_{it} + X_{it} + f_i + \gamma_t + \epsilon_{it}$$

- Lightning strikes per capita as IV (Caldarola et al., 2023; Guriev et al., 2021; Manacorda & Tesei, 2020; Mensah, 2021).
- Seminal paper by Andersen et al. (2012).
- World Wide Lightning Location Network.

$$\widehat{Cov}_{it} = \gamma_0 + \gamma_1 Z_{it} + \gamma_2 X_{it} + f_i + \theta_t + \nu_{it}$$

# Findings

Upper-secondary school level

Lower-secondary school level

	FE		FE-IV				FE		FE-IV	
	(1) Non-weighted	(2) Weighted	(3) Non-weighted	(4) Weighted	(3) Non-weighted	(4) Weighted	(1) Non-weighted	(2) Weighted	(3) Non-weighted	(4) Weighted
Lag 1 3G	0.0599 (0.0566)	0.00680 (0.0577)	-0.296** (0.131)	-0.194** (0.0912)			-0.00256 (0.0501)	0.0659 (0.0469)	0.296** (0.148)	0.265*** (0.0753)
1st stage lightning strikes					-22.878*** (5.657)	-29.510*** (5.579)	0.152 (0.119)	0.243** (0.0920)	0.372** (0.141)	0.365*** (0.0777)
Lag 1 2G	0.123 (0.0793)	-0.0236 (0.102)	-0.138 (0.118)	-0.571*** (0.202)	-0.146 (0.105)	-0.527*** (0.177)	-0.0485 (0.298)	0.0613 (0.254)	-0.216 (0.296)	-0.0868 (0.230)
Share pop. 15-25	0.184 (0.265)	0.123 (0.239)	0.383 (0.311)	0.682* (0.378)	0.272 (0.273)	0.653* (0.361)	-0.00616 (0.0758)	-0.00675 (0.0632)	0.0150 (0.0809)	0.0104 (0.0624)
Average HH income ln	-0.00814 (0.0773)	-0.0380 (0.0792)	-0.0333 (0.0675)	-0.152* (.0927)	-0.0553 (0.0752)	-0.148 (0.0836)	0.0442 (0.0923)	0.0385 (0.0797)	-0.172 (0.137)	-0.105 (0.0879)
Road length ln	-0.0256 (0.0922)	0.0135 (0.103)	0.232 (0.139)	0.485*** (0.120)	0.157 (0.115)	0.418*** (0.114)	-0.288 (1.293)	-0.348 (0.997)		
Constant	0.514 (1.404)	0.414 (1.251)					Yes	Yes	Yes	Yes
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	0.451	0.569		
Adjusted $R^2$	0.783	0.789					0.379	0.379	0.379	0.379
Mean DV	0.275	0.275	0.275		0.275				16.36	27.97
Observations	189	189	189	189	189	189	189	189	189	189
Kleibergen-Paap Wald F-stat				16.36		27.97				



# Mechanisms

	Waged employment shares		Non-waged agri shares		Non-waged non-agri				
	(1) Non-weighted	(2) Weighted	(3) Non-weighted	(4) Weighted	(5) Non-weighted	(6) Weighted			
Lag 1 3G	0.0321** (0.0152)	0.0233* (0.0125)	-0.0440*** (0.0111)	-0.0306*** (0.00947)	-0.00257 (0.00628)	0.00170 (0.00607)			
Lag 1 2G	0.0470 (0.0749)	0.102 (0.072)	0.0201	0.0217	0.00604	0.0272			
			With lower-secondary degree		Upper-secondary		With tertiary degree		
			(1)	(2)	(3)	(4)	(5)	(6)	
Share pop. 15-25	-0.154 (0.347)	-0.27 (0.264)	Ln wages	Wage growth	Ln wages	Wage growth	Ln wages	Wage growth	
Road length ln	-0.117 (0.105)	-0.10 (0.093)	Lag 1 3G	0.563*** (0.141)	1.823*** (0.662)	0.450* (0.269)	0.555 (1.267)	0.787 (1.204)	0.321 (0.424)
Constant	1.856 (1.418)	1.636 (1.255)	Lag 1 2G	3.974* (2.366)	-2.066 (1.578)	2.231 (1.869)	-4.009 (4.096)	5.317 (4.690)	1.786 (1.965)
Province FE	Yes	Yes	Share pop. 15-25	-6.517* (3.395)	-25.46 (18.38)	-9.514 (6.271)	-59.86* (32.67)	37.74* (19.45)	0.273 (9.126)
Observations	189	189	Road length ln	-2.175 (1.353)	-2.785 (3.904)	-1.097 (1.766)	2.226 (5.308)	-0.720 (5.523)	1.768 (1.958)
Adjusted $R^2$	0.742	0.744	Constant	35.63** (16.74)	44.99 (54.90)	23.36 (24.14)	-11.79 (70.79)	5.355 (74.56)	-24.48 (26.25)
			Province FE	Yes	Yes	Yes	Yes	Yes	Yes
			Observations	189	180	189	162	189	138
			Adjusted $R^2$	0.664	0.683	0.422	0.849	0.345	0.312

# Mechanisms

	Agriculture		Manufacturing		Services					
	(1) Non-weighted	(2) Weighted	(3) Non-weighted	(4) Weighted	(5) Non-weighted	(6) Weighted				
Lag 1 3G	-0.0632*** (0.0159)	-0.0506*** (0.0139)	0.0353** (0.0169)	0.0277 (0.0169)	0.0318* (0.0176)	0.0249 (0.0180)				
Lag 1 2G	0.0612 (0.0715)	0.0813 (0.0864)	-0.200** (0.0777)	-0.159 (0.114)	0.138* (0.0752)	0.0874 (0.110)				
Share pop. 15-25	0.272 (0.397)	Manufacturing				Services				
		Textiles		Electronics, electrical		Hospitality		I&C		
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
Constant	0.369*** (0.101)	Lag 1 3G	0.0281** (0.0121)	0.0228** (0.00878)	0.0188** (0.00728)	0.0136 (0.0110)	0.0197* (0.0110)	0.0206** (0.00794)	0.0203* (0.0109)	0.0233*** (0.00845)
Province FE	Yes	Lag 1 2G	-0.0618* (0.0361)	-0.0406 (0.0456)	-0.0463** (0.0183)	-0.0335 (0.0336)	0.0583* (0.0345)	0.000349 (0.0910)	0.0581 (0.0381)	0.0101 (0.0878)
Observations	189	Pop. 15-25	-0.406 (0.314)	-0.481 (0.295)	-0.0819 (0.127)	-0.167 (0.167)	0.461* (0.237)	0.365* (0.197)	0.371* (0.214)	0.347* (0.178)
Adjusted $R^2$	0.912	Constant	0.214** (0.0808)	0.224*** (0.0837)	0.0716** (0.0327)	0.0803** (0.0314)	-0.104 (0.0666)	-0.0245 (0.110)	-0.0858 (0.0636)	-0.0279 (0.100)
		Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Observations	189	189	189	189	189	189	189	189
		Adjusted $R^2$	0.779	0.786	0.727	0.675	0.488	0.473	0.447	0.451

# Conclusions & Implications, Future research

- **Technology adoption & diffusion;** educational and labor market outcomes of youth.
- Improves lower-secondary school attainment but discourages upper-secondary achievement.
- **Education – employment trade-off:** more job opportunities (waged, manufacturing & services); and reduced returns to schooling during following fast diffusion (lower-secondary school level attained the highest returns relatively to upper-secondary and tertiary levels).
- Industrialization, increased manufacturing can increase child labor and reduce education attainment initially, but later on reduce child employment (Goldin & Katz, 2009; Hindman, 2002).
- Technical and vocational educational and training (TVET) uptakes & quality, alternative pathways to formal education especially for at-risk youth (work-study programs, apprenticeships, and internships).
- Development catching up: human capital development policies in the age of (mobile) digitalization.
- Tertiary degrees: program levels.

# Thank you!

## Selected literature

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