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Telecommunications –Connecting Egypt to Economic Growth

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Part IX: Sectoral and Industrial Vectors

Telecommunications – Connecting Egypt to Economic Growth

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Overview of Egypt's ICT Sector

- Egypt, pivotal in the MENA region, has experienced significant growth in its Information and Communications Technology (ICT) sector since its separation from the transportation sector in 2003/2004.
- Following the *World Trade Organization (WTO) agreement* in 2003, regulatory reforms were initiated in 2006. Law 15 of 2004 established *the Information Technology Industry Development Agency* (ITIDA) to promote e-business and develop an export-focused IT sector.
- The fixed-line telecommunications market remains under the monopoly of Telecom Egypt. In contrast, the mobile market is highly competitive with major providers such as Orange, Vodafone, Etisalat, and We (operated by Telecom Egypt), offering advanced connectivity options like third generation (3G) and fourth generation (4G) services.
- Recently, in October 2024, the National Telecom Regulatory Authority (NTRA) signed an agreement with the three leading telecom companies—Orange Egypt, Vodafone Egypt, and e& Egypt—granting them licenses for fifth-generation (5G) mobile services.
- An ***important challenge*** for the ICT sector is the dual role of the government as both an oversight authority, through the NTRA, and a service provider, through Telecom Egypt, creates conflicting interests, making it critical to enhance NTRA's independence to cultivate a competitive telecommunications sector in Egypt.

Economic Impact of Mobile Telephony and Fixed Broadband in Egypt

- The growth of mobile and broadband services directly contributes to innovation, job creation, and economic growth, helping to propel various sectors forward.
- Investments in advanced mobile and broadband technologies are enhancing service efficiency and quality, with significant spillover effects on the broader economy, aiding in modernization and global competitiveness.
- Given the inflation, fiscal pressures, and economic uncertainties, the robust telecommunications infrastructure, including mobile and broadband, plays a pivotal role in stabilizing and stimulating economic activities.
- With a growing population and significant poverty challenges, mobile and broadband technologies are instrumental in bridging digital divides and fostering socio-economic development.

Motivation

Globally, telecommunications is recognized as a key driver of economic growth, yet specific research, especially quantitative, on Egypt remains limited.

This scarcity highlights a critical gap, necessitating focused studies on how mobile telephony and fixed broadband specifically impact Egypt's economic development.

A detailed examination is essential to understand the specific contributions of telecommunications to Egypt's economy, providing insights that can guide effective policy-making and strategic investments in this sector.

With Egypt's unique economic landscape and rapid sector growth, localized insights are crucial to analyze telecommunications for national development and economic diversification.

Objectives

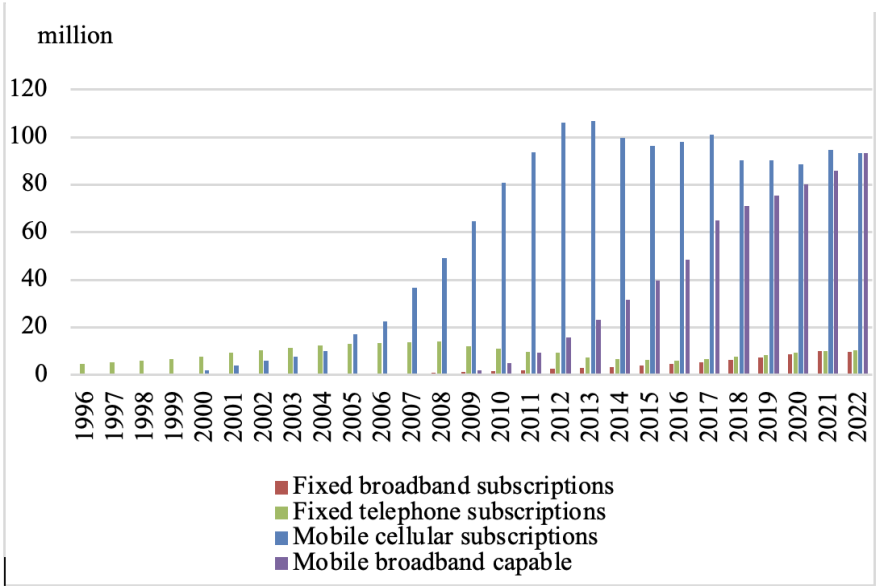
Assess how the **penetration** of mobile telephony and fixed broadband services has influenced GDP growth in Egypt from 2000 to 2022.

This study seeks to answer the following:

1. How does the penetration of unique mobile subscribers influence GDP growth in Egypt?
2. What is the impact of fixed broadband subscriptions on Egypt's GDP growth?
3. What are the broader implications of these patterns for the telecommunications industry in Egypt?

Mobile cellular, Fixed Broadband, and Fixed Telephone Subscribers in Egypt

The figure emphasizes the importance of the mobile industry within Egypt's telecommunications domain, as mobile cellular subscriptions serve as the predominant means of communication for most of the population.



Source: Authors: Based on WDI, 2023. Note: All variables are per 100 people.

Literature Review

▶Studies by Madden and Savage (2000) revealed a significant **positive** relationship between telecommunications and economic growth across various countries.

▶Markova (2009) found that investments in telecommunications infrastructure, like cell towers and fiber-optic cables, **stimulate economic growth** more effectively than investments solely in services or technologies.

▶Chakraborty and Nandi (2011) found a stronger correlation in less-developed countries, emphasizing the **critical role** of infrastructure in these regions.

▶Significant externalities that drive economic change and growth have been documented, such as job creation and improved business productivity (Kim et al., 2021; Wang et al., 2023)

Literature Review

- The deployment of 4G technology in the United States significantly increased both employment and output, as studied by Eisenach and Kulick (2020).
- Björkegren and Karaca's (2022) study found that subsidized handsets primarily remained in rural areas and were used at rates similar to purchased ones, leading to considerable interconnectedness among recipients and substantial spillover effects on nonrecipients.
- Katz and Callorda (2015a) revealed a causal link between *fixed broadband, wireless broadband, broadband penetration, and GDP growth*. Their findings also noted diminishing returns, indicating that the economic impact becomes less significant as broadband penetration increases.

Data

- Quarterly dataset over the period 2000-2022
- The data is sourced from:
  - World Development Indicators (WDI)
  - Global System for Mobile Communications Association Intelligence (GSMA)
  - International Telecommunication Union (ITU)
  - Penn World Tables (PWT)
  - Federal Reserve Economic Data (FRED)

Definition of Variables

Item	Variable	Comments	Abbreviation	Source
1	GDP	GDP is constant 2015 US$. Data converted to quarterly frequency by assuming CAGR within each year.	*GDP*	WDI
2	Gross fixed capital formation	Measured as percent of GDP. Data converted to quarterly frequency by assuming CAGR within each year.	*k*	WDI
3	Education	A composite index of the variable "Years of education" based on Barro Lee and "Years of enrollment in tertiary education" based on the UNESCO database. Both equal weights.	*edu*	Barro Lee[2] and UNESCO
4	Mobile unique subscribers	Total mobile unique subscribers, that is individuals, regardless of the number of SIM cards and thus mobile connections they have.	*mob*	GSMA
5	Fixed Broadband Subscriptions	Penetration of high-speed Internet access through a Transmission Control Protocol/Internet Protocol connection, with minimum downstream speeds of 256 kbit/s. This includes technologies such as cable modem, DSL, fiber-to-the-home/building, other wired broadband, satellite broadband, and terrestrial fixed wireless broadband.	*fbb*	WDI
6	Rural population	Data converted to quarterly frequency by assuming CAGR within each year.	*rural*	WDI
7	GDP per capita	GDP per capita (constant 2015 US$). Data converted to quarterly frequency by assuming CAGR within each year.	*GDPpc*	WDI
8	ARPU	Average Revenue Per User in dollars. Used as a proxy for mobile price.	*mob_arpu*	GSMA
9	Fixed Broadband Price	The price of a monthly subscription to an entry-level fixed-broadband plan offered by the carrier with largest market share	*fbb_price*	ITU
10	HHI mobile	Industrial concentration index for overall mobile services	*HHI_mob*	GSMA
11	HHI Fixed Broadband	Industrial concentration index for fixed broadband market	*HHI_fbb*	OVUM
12	Mobile revenue	Total revenue of Orange, Vodafone, and Etisalat.	*mob_rev*	GSMA
13	Fixed Broadband revenue	Calculated by multiplying fixed broadband subscriptions times fixed broadband price in US dollars.	*fbb_rev*	Authors' Calculation
14	Oil price	Global Price of Brent Crude.	*shock*	FRED
15	Fixed Telephone Subscriptions	The sum of active number of analogue fixed telephone lines, voice-over-IP (VoIP)	*ftel*	WDI

Methodological Approach

The variables are expressed in logarithms to account for exponential relationships and ensure that the model captures the proportional changes effectively. We ensured that all variables are stationary.

Each equation within the model is designed to control for potential reverse causality issues, thereby allowing for a more accurate estimation of the effects of independent variables on the dependent variable.

The model also includes quarter fixed effects to account for seasonal variations and potential cyclical trends that are not directly related to the variables of interest.

The Structural Model

The structural model comprises four key equations:

1. Aggregate production function,
2. Demand function,
3. Supply function, and
4. Infrastructure function

Each equation is designed to ***capture the dynamics and interdependencies*** within the telecommunication sector.

The aggregate production function estimates **overall economic performance**, while the other three equations mitigate potential reverse causality issues.

Empirical Model

Aggregate Production Function: Estimates overall economic performance, estimated twice, once with mobile unique subscriber penetration and once with fixed broadband penetration.

$$GDP_t = a_1 k_t + a_2 edu_t + a_3 pen_t + a_4 ftel_t + b_5 shock_t + \varepsilon_{1t}$$

Demand Function: Analyzes the factors influencing telecommunications penetration

$$pen_t = b_1 rural_t + b_2 GDPpc_t + b_3\, price_t + b_4 HHI_t + \varepsilon_{2t}$$

Empirical Model (contd.)

Supply Function: focuses on the factors influencing revenue generation in the telecommunications sector.

$$revenue_t = c_1\, price_t + c_2 GDPpc_t + c_3 HHI_t + \varepsilon_{3t}$$

Infrastructure Function: Provides insights into the role of infrastructure investment and its effect on the expansion of mobile telephony and fixed broadband penetration

$$\Delta\, pen_t = d_1 revenue_t + \varepsilon_{4t}$$

Estimation Results: Aggregate Production Function

Capital: Increased capital investment supports GDP growth in both models.

Education: Higher educational attainment drives GDP growth across both models.

Fixed Telephony : Increased fixed telephone subscriptions leads to a small reduction in GDP growth, suggesting a shift from traditional telephony to digital communication in the broadband model.

External Shocks: Rising oil prices lead to a slight decrease in GDP growth, highlighting the economy's sensitivity to external cost pressures in the mobile model.

Digital Connectivity

A 1% increase in mobile unique subscriber penetration leads to a **0.07% increase in GDP growth**, indicating that an increase in mobile subscriber penetration is associated with an increase in GDP growth

The impact of fixed broadband subscriptions on GDP growth is also positive but less pronounced compared to mobile unique subscribers, with a 1% increase in broadband device penetration leading to a **0.055% increase in GDP growth.**

	[I]	*[II]*
Aggregate production function Or Economic Growth	***GDP_t***	***GDP_t***
mob_t	0.070***	
	(0.011)	
fbb_t		0.055***
		(0.011)
k_t	0.011***	0.009*
	(0.002)	(0.003)
edu_t	0.013***	0.025***
	(0.003)	(0.002)
$ftel_t$		-0.0007*'
		(0.0005)
$shock_t$	-0.001***	
	(0.0001)	

Estimation Results: Demand Function

Demand function or Penetration	mob_t	fbb_t
$rural_t$	-0.128***	-0.183***
	(0.0005)	(0.048)
$GDPpc_t$	9.156***	6.926***
	(0.785)	(0.951)
mob_arpu_t	-0.0126***	
	(0.002)	
fbb_price_t		-0.017***
		(0.048)
HHI_mob_t	0.0437***	
	(0.002)	
HHI_fbb_t		-0.183 ***
		(0.006)

Impact of Rural Demographics: Growth in the rural population reduces mobile and fixed broadband subscriptions, with a larger effect on fixed broadband, which requires more extensive and costly infrastructure to reach remote areas.

Economic Influence: GDP growth substantially boosts demand for telecommunications services. Each 1% increase in GDP per capita leads to a 9.156% surge in mobile subscription demand and a 6.926% rise in fixed broadband adoption.

Price Sensitivity: Mobile users respond to price changes, showing sensitivity in subscription decisions. Fixed broadband users, however, exhibit even greater sensitivity, as price increases can significantly impact household budgets.

Market Competition Dynamics: Increased market concentration in mobile telephony positively affects subscriber growth. In contrast, higher market concentration in the fixed broadband sector has a negative impact on penetration, indicating less incentive for competitive pricing and innovation.

Estimation Results: Supply Function

Supply function or Revenue	mob_rev_t	fbb_rev_t
$GDPpc_t$	2.031*	3.540***
	(1.156)	(0.931)
mob_arpu_t	0.552***	
	(0.067)	
fbb_price_t		0.961***
		(0.024)
HHI_mob_t	0.133***	
	(0.028)	
HHI_fbb_t		-0.511***
		(0.173)

- Economic impact: A 1% increase in GDP results in a 2.031% increase in mobile revenue and a 3.540% rise in fixed broadband revenue, indicating strong growth in demand within Egypt.
- Price sensitivity: Higher ARPU positively impacts mobile revenue, indicating that price increases contribute to higher revenue despite potential effects on penetration. Similarly, in fixed broadband, price increases significantly boost revenue, reflecting demand resilience in Egypt's telecommunications market.
- Market concentration effects: In Egypt, increased concentration (but not too much) in the mobile sector—***still on the competitive side*** of the inverted U-curve—leads to higher revenue, suggesting that moderate competition elevates prices. Conversely, in the fixed broadband sector, which is ***past the peak of the curve***, higher concentration leads to reduced revenue, indicating that dominant firms may have less incentive to compete vigorously.

Estimation Results: Infrastructure Function

- An increase in revenue from either mobile or fixed broadband corresponds with a decrease in penetration growth, suggesting market saturation and indicating that revenue growth may be driven more by price increases than by an expanding customer base.

- This difference in the magnitude :
  - The mobile sector appears to be nearing its saturation, resulting in a sharper decline in the growth of penetration as revenue increases.
  - Conversely, the fixed broadband market shows a capacity for further growth, indicating that it has not yet reached the same level of market saturation as the mobile sector.

Infrastructure function or Adoption growth	Δmob_t	Δfbb_t
mob_rev_t	-0.033*** (0.005)	
fbb_rev_t		-0.016*** (0.003)
Observations	88	80
Quarter fixed effects	Yes	Yes
Years	2000q4-2022q4	2002q2-2022q4
R-squared first equation	0.9978	0.9997

In mature markets, rising revenue from existing users slows new subscription growth, highlighting the need to focus on customer retention and value-added services as market saturation limits new customer acquisition.

Conclusion

- Economic Impact: Telecommunications significantly boost Egypt's GDP growth, with mobile and fixed broadband subscriptions contributing to economic development.
- Growth Correlation: Each unit increase in mobile and fixed broadband penetration correlates with respective increases of 0.07% and 0.055% in GDP growth.
- Demand Influence: Higher GDP growth increases demand for telecommunications services, with mobile showing a stronger response, reflecting economic health's positive effect on telecom expansion.
- Rural Impact: Growth in rural populations reduces both mobile and broadband subscriptions, suggesting challenges in expanding telecommunications infrastructure in remote areas.
- Revenue Dynamics: Higher telecommunications revenue is inversely related to the growth of service subscriptions, suggesting potential barriers to further expansion at higher revenue levels.

Policy Implications

1. **Expand Rural Access**: Invest in telecommunications infrastructure in rural areas through subsidies, incentives, or partnerships to improve access and support economic inclusion.
2. **Enhance Competition**: Encourage competition, especially in fixed broadband, to improve service quality and affordability by reducing regulatory barriers and supporting new entrants.
3. **Regulate Pricing in Concentrated Markets**: Address high price sensitivity in broadband by considering pricing regulations to prevent excessive costs for consumers in less competitive markets.
4. **Incentivize High-Speed Network Investment**: Promote investment in high-speed broadband and 5G through tax breaks or grants to boost digital connectivity and economic growth.
5. **Encourage Sustainable Growth**: Address revenue saturation by fostering innovation, value-added services, and digital literacy programs to drive growth beyond price increases.