

# Mobile Phones and Economic Development in Africa



Jenny C. Aker

Center for Global Development

August 25, 2009

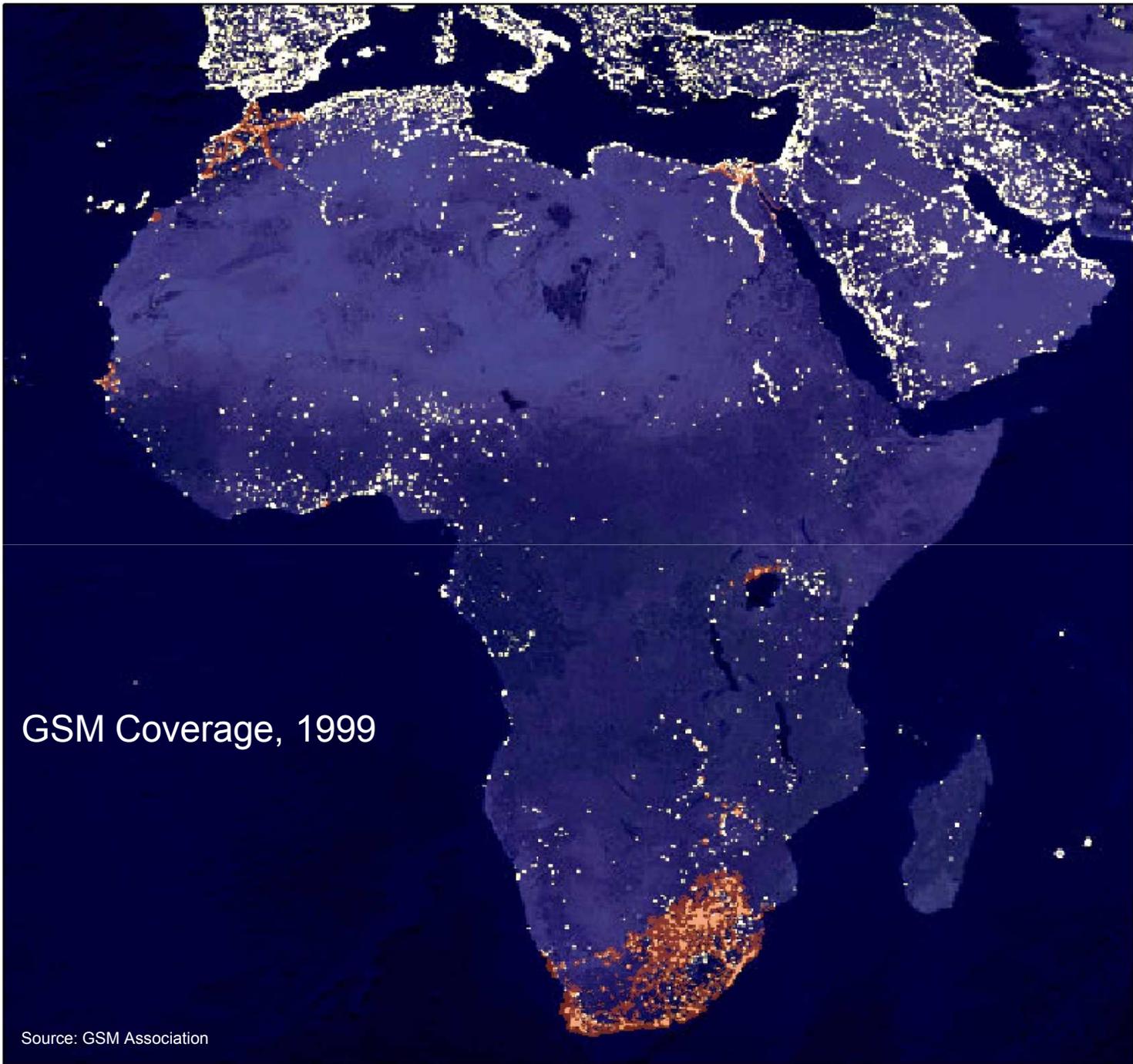
# Low Infrastructure Investment



# Low Infrastructure Investment

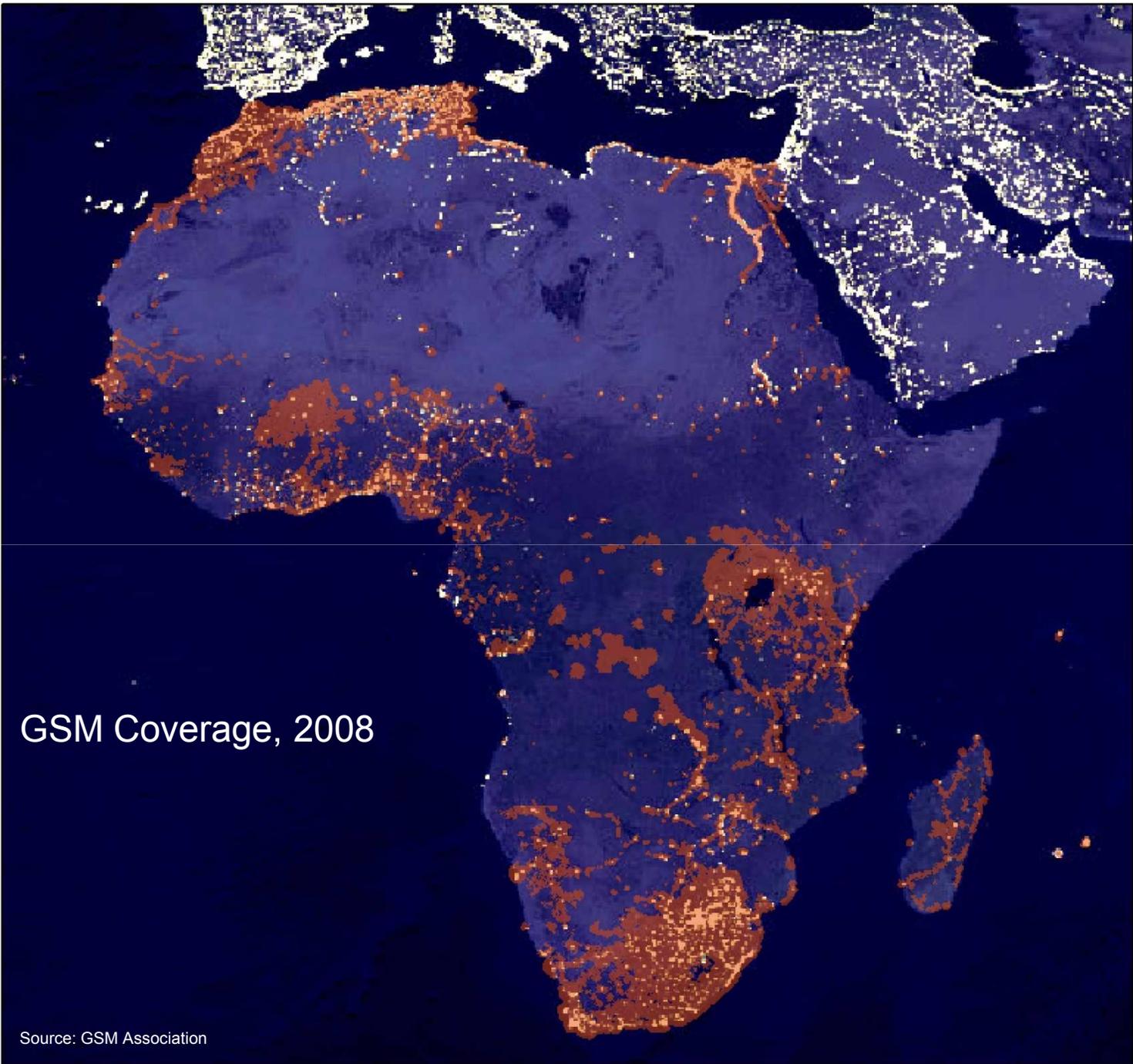
- Africa has only 4% of global electricity capacity
- Sub-Saharan Africa has only 1%
  - 80% of that is used by South Africa and North Africa





GSM Coverage, 1999

Source: GSM Association



GSM Coverage, 2008

Source: GSM Association

**“In 10 short years, what was once an object of luxury and privilege, the mobile phone, has become a basic necessity in Africa.”**

Paul Kagame, President of Rwanda, 2008

**A device that was a yuppie toy not so long ago has now become a potent force for economic development in the world's poorest countries.**

*The Economist, May 29, 2008*

**“[With a cell phone], in record time, I have all sorts of information from markets near and far...”**

Grain trader in Magaria, Niger



**“A Wonderful Life.”**



**“Together we can do more.”**



**vodafone**



**“Rule your World.”**

**“Tudo bom.”**

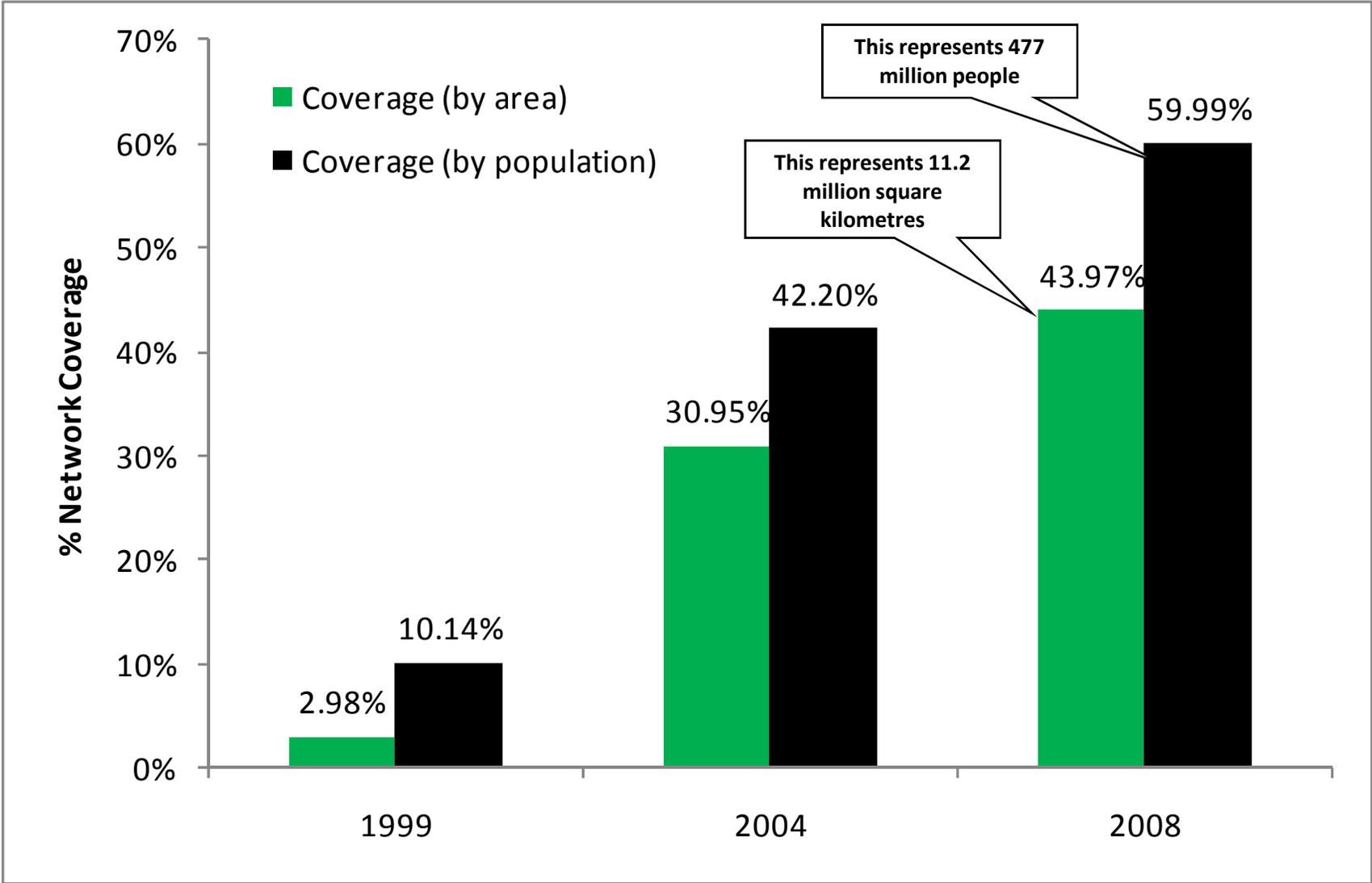
# Overview

- Cell phone coverage and the digital divide
- Buying a mobile phone on less than a dollar a day
- Cell phones... "Making Life Better"?
- Mobile phones and development
- A way forward

# Overview

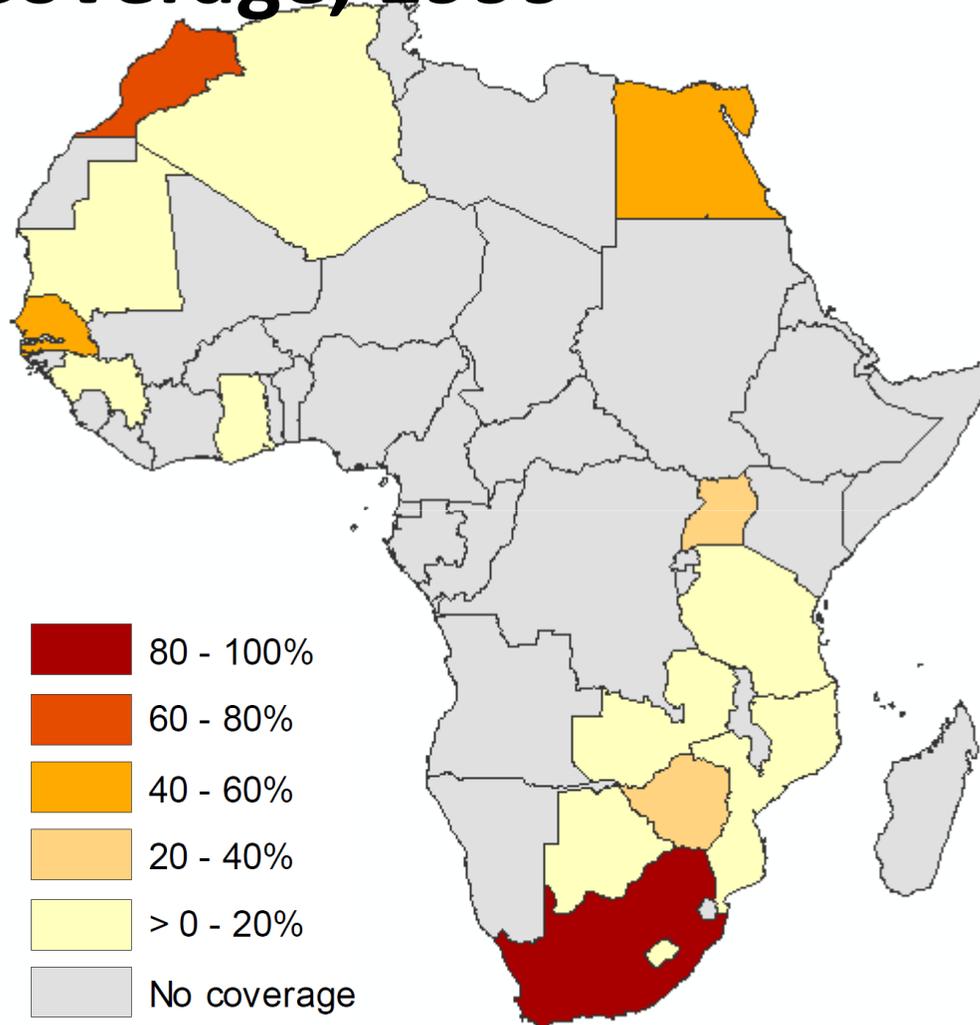
- Cell phone coverage and the digital divide
- Buying a mobile phone on less than a dollar a day
- Cell phones... "Making Life Better"?
- Mobile phones and development
- A way forward

# 477 million people covered by mobile



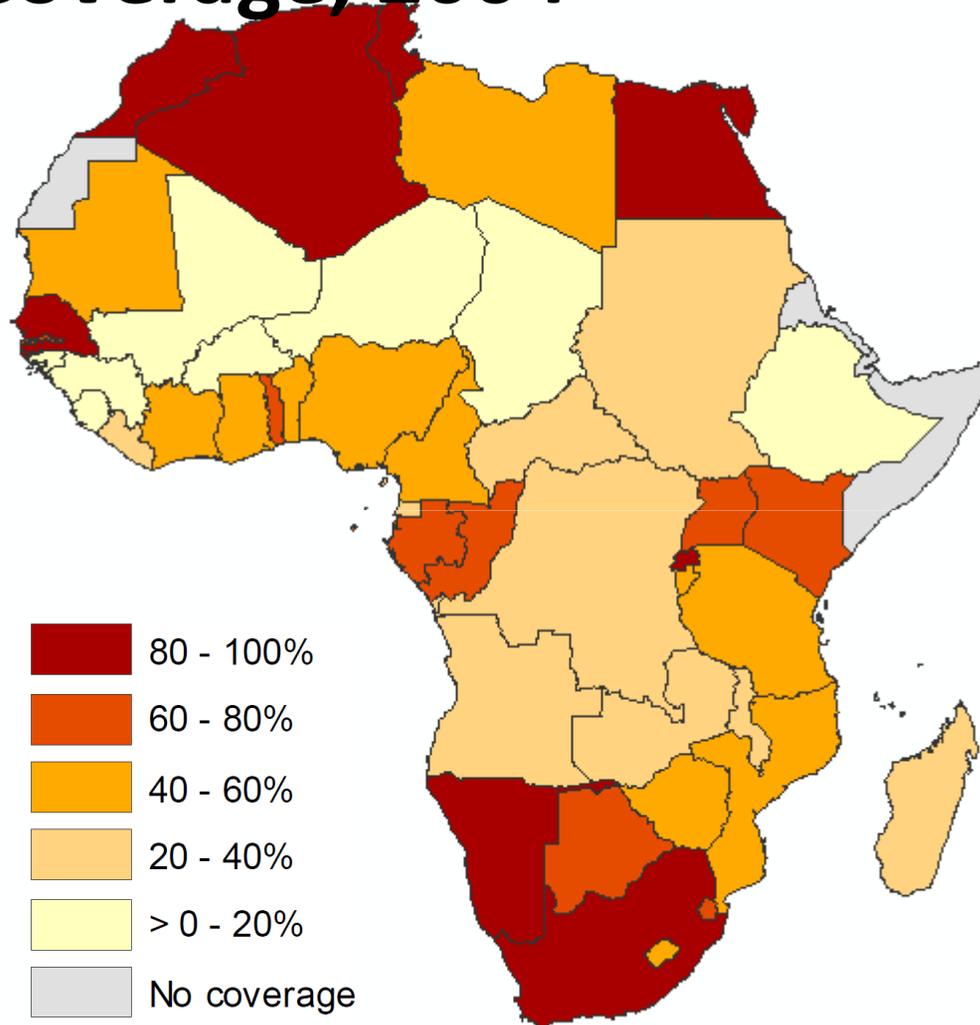
Source: GSMA 2009

# Mobile Coverage, 1999



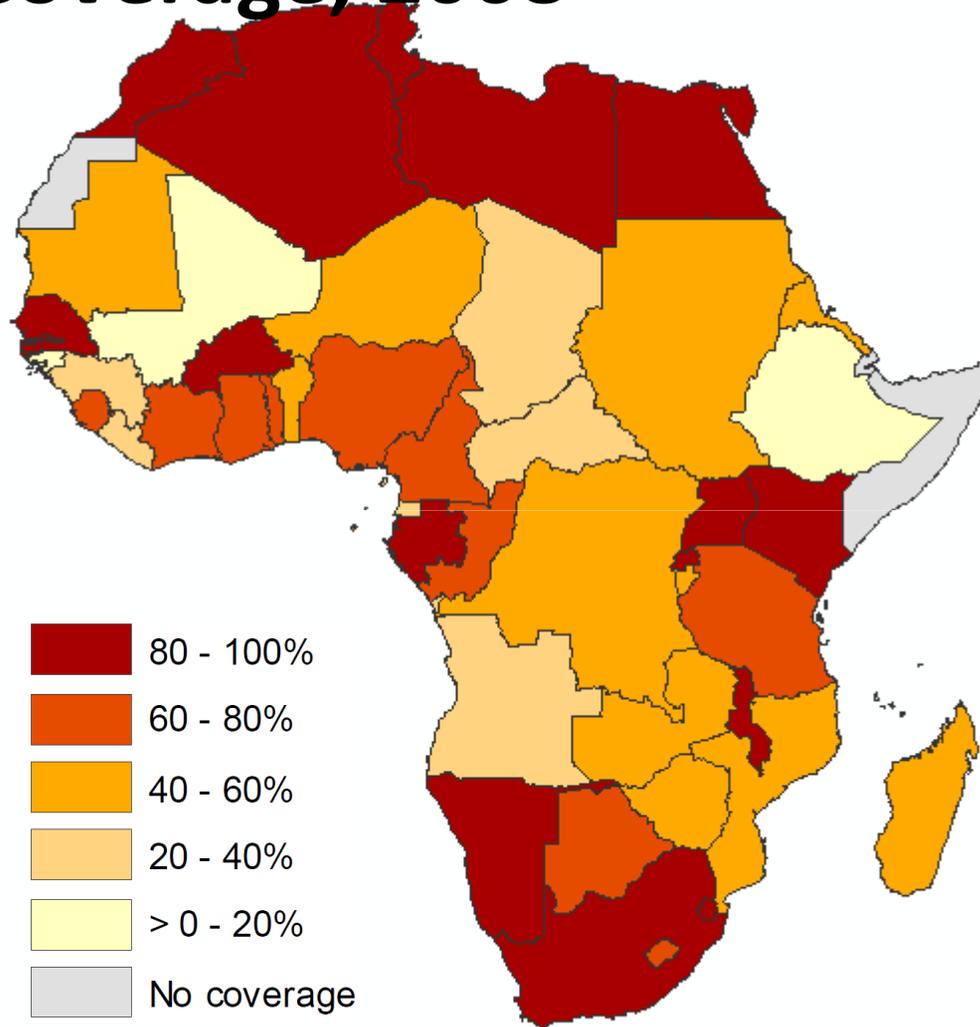
Source: GSMA 2009

# Mobile Coverage, 2004



Source: GSMA 2009

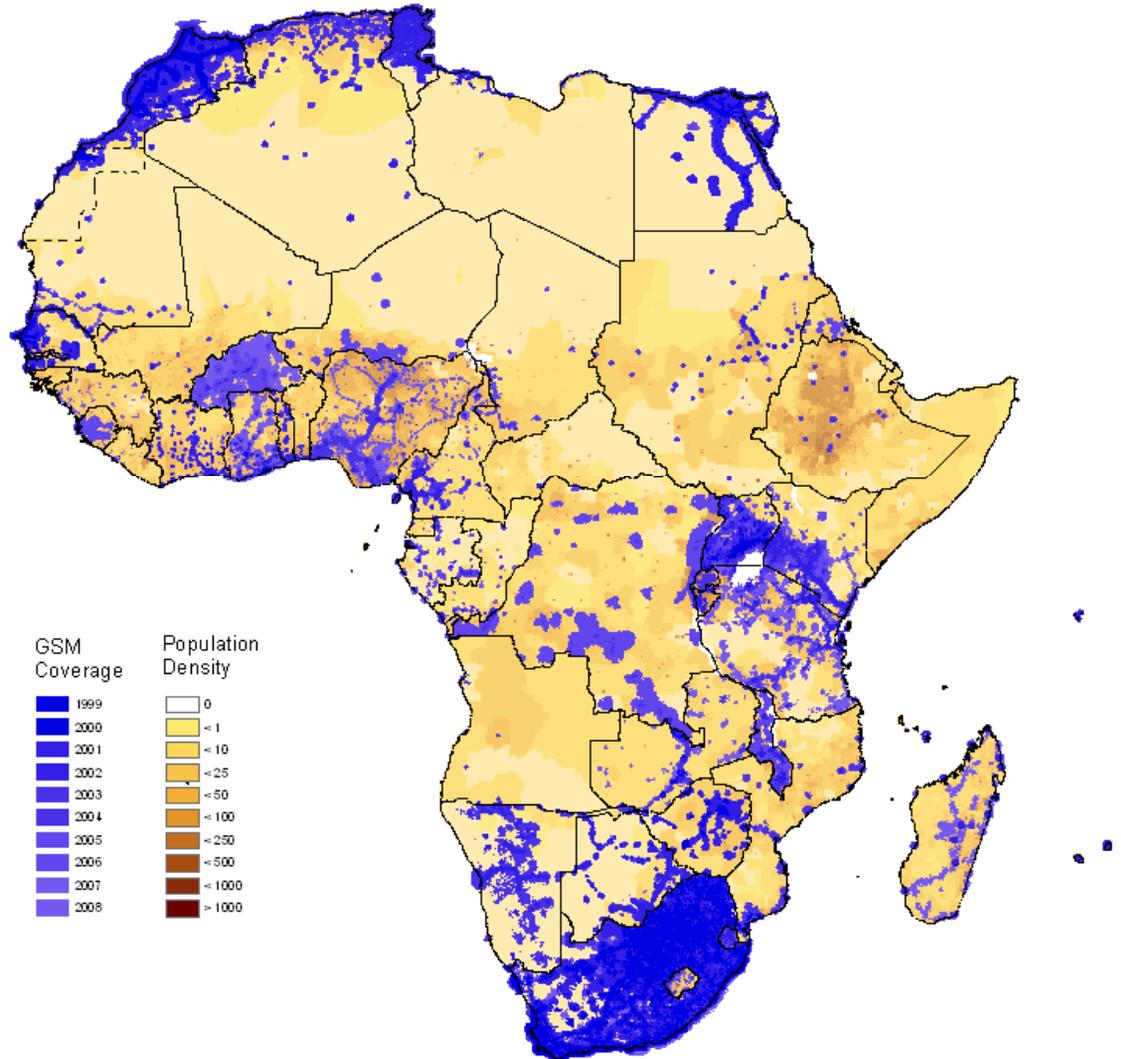
# Mobile Coverage, 2008



Source: GSMA 2009

# The Digital Divide

- Demand
- Supply
- Market structure



Source: GSM Association/ Europa Technologies. Population Density data source: Gridded Population of the World (GPW)/ Global Rural - Urban Mapping Project Alpha (GRUMP Alpha).

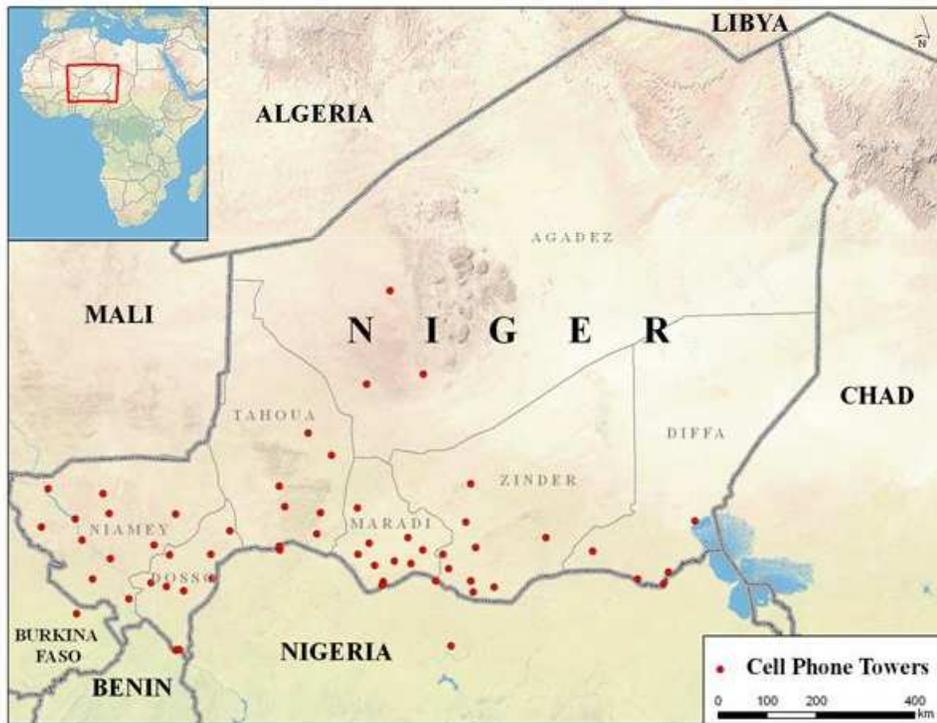
# Determinants of the Digital Divide

(Buys, Dasgupta, Thomas and Wheeler 2009)

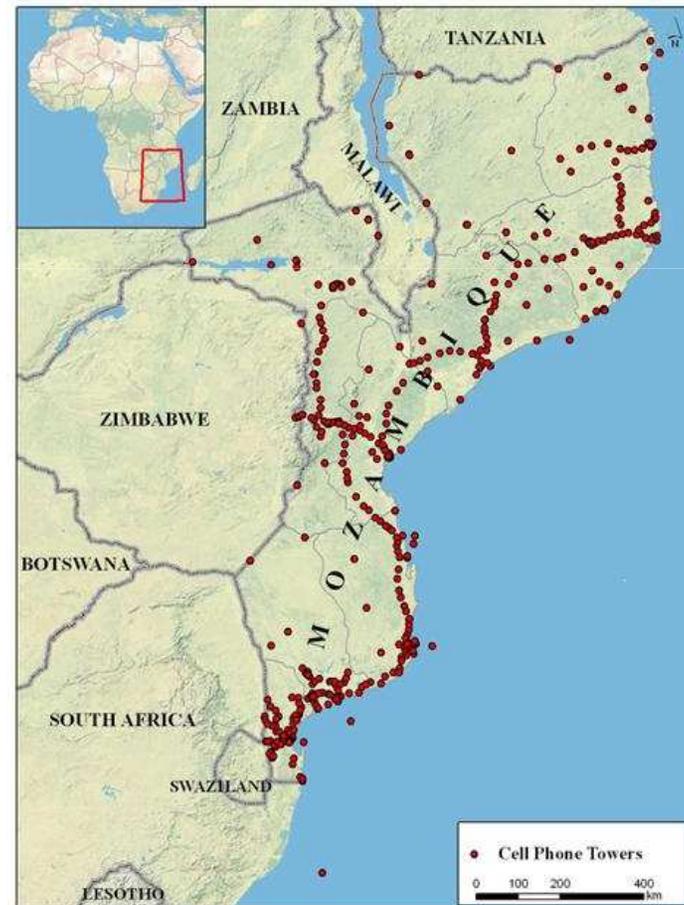
- The probability of cell phone coverage is:
  - Positively associated with potential demand – **population and per capita income**
  - Negatively associated with higher costs – namely, **higher elevation, steeper slopes, longer distance from the main road and from major cities**
  - Positively associated with a **competitive cell phone industry** (affecting costs, entrants and prices)

# Determinants of the Digital Divide

## Cell Phone Coverage in Niger



## Cell Phone Coverage in Mozambique



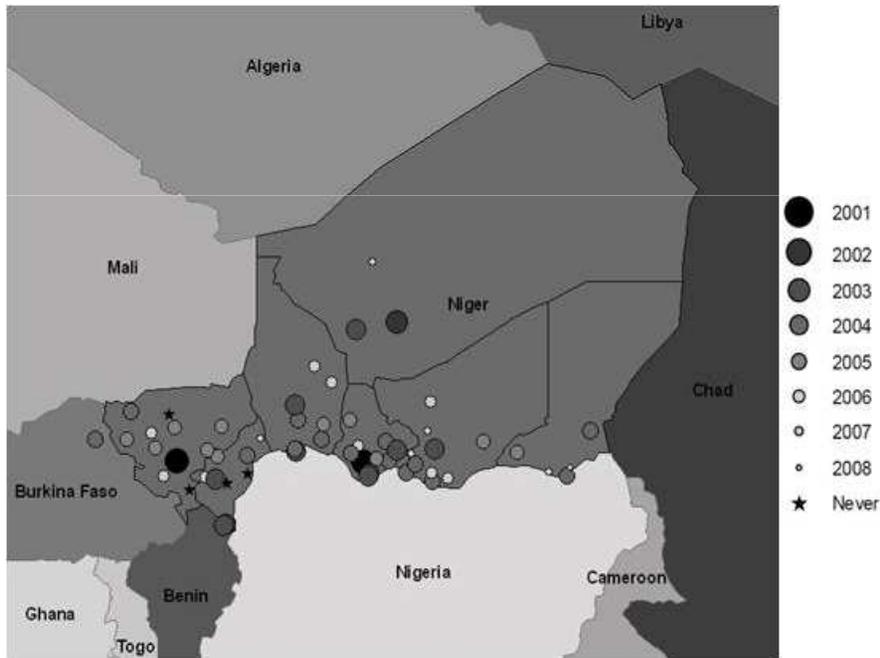
**Table 1. Estimates of GSM Coverage in Mozambique and Niger**

	Mozambique		Niger	
	(1)	(2)	(1)	(2)
Log(elevation)	-.017***(.005)	-.045***(.014)	-.011(.044)	-.041(.129)
Dummy slope	.055(.052)	.145(.136)	.019(.035)	.070(.107)
Urban center	.115***(.016)	.293***(.041)	.279***(.018)	.754***(.051)
Road quality	.115***(.035)	.316***(.103)	.036**(.017)	.121**(.055)
Latitude	-.004(.003)	-.009(.007)	-.012(.023)	-.027(.025)
Longitude	.003(.004)	.009(.010)	.010***(.004)	.031***(.011)
Constant	.158(.196)	-.912(.521)	.360(.272)	-.339(.515)
R <sup>2</sup>	0.024	0.0177	0.0852	0.0663
No obs	7020	7020	4032	4032

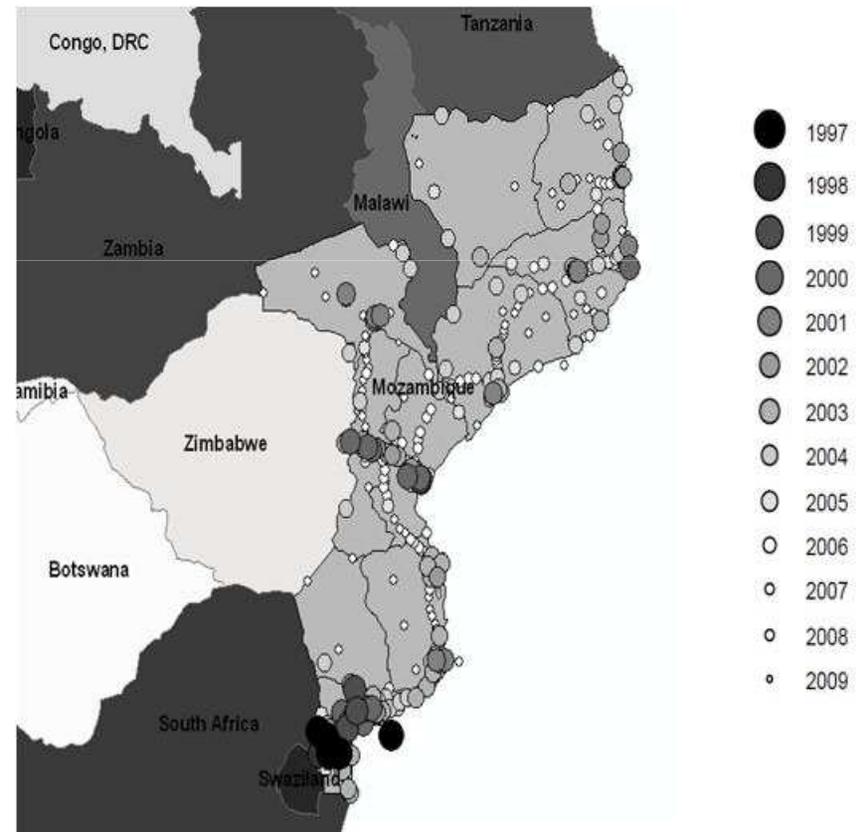
Notes: The slope dummy is equal to 1 if the location is steeply sloped, 0 otherwise. Urban center is equal to 1 if the location has a population greater than 35,000 people, 0 otherwise. Road quality is equal to 1 if the location has access to a paved road, 0 otherwise.

# Determinants of the Digital Divide

## Niger



## Mozambique

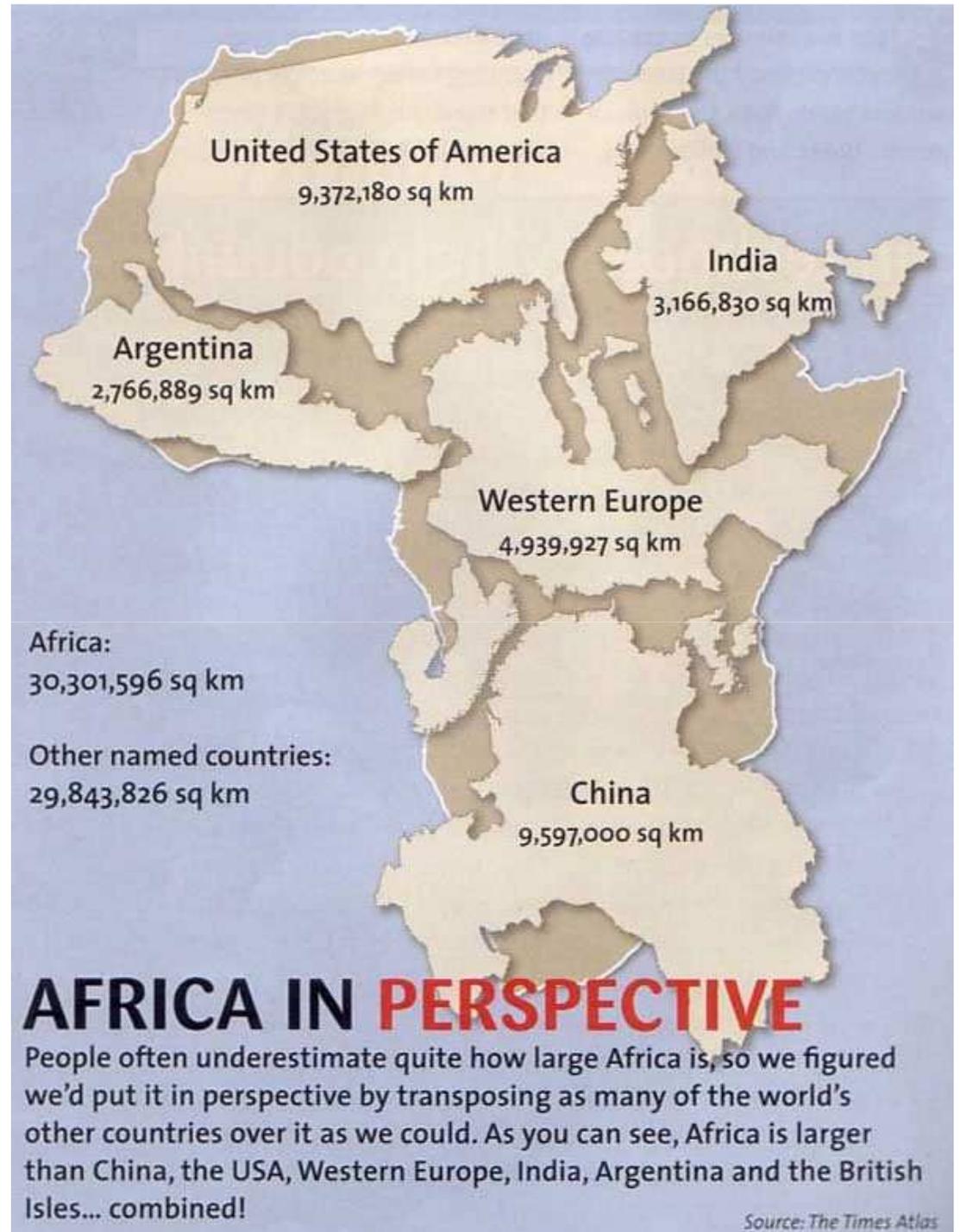
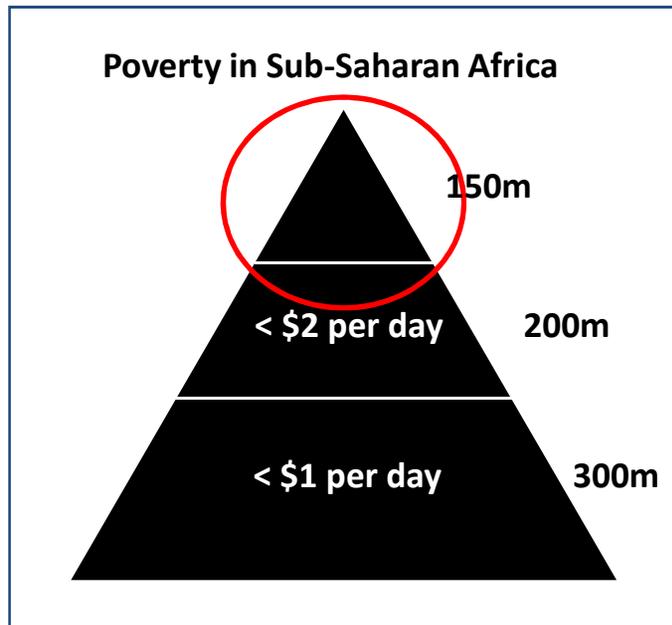


# Overview

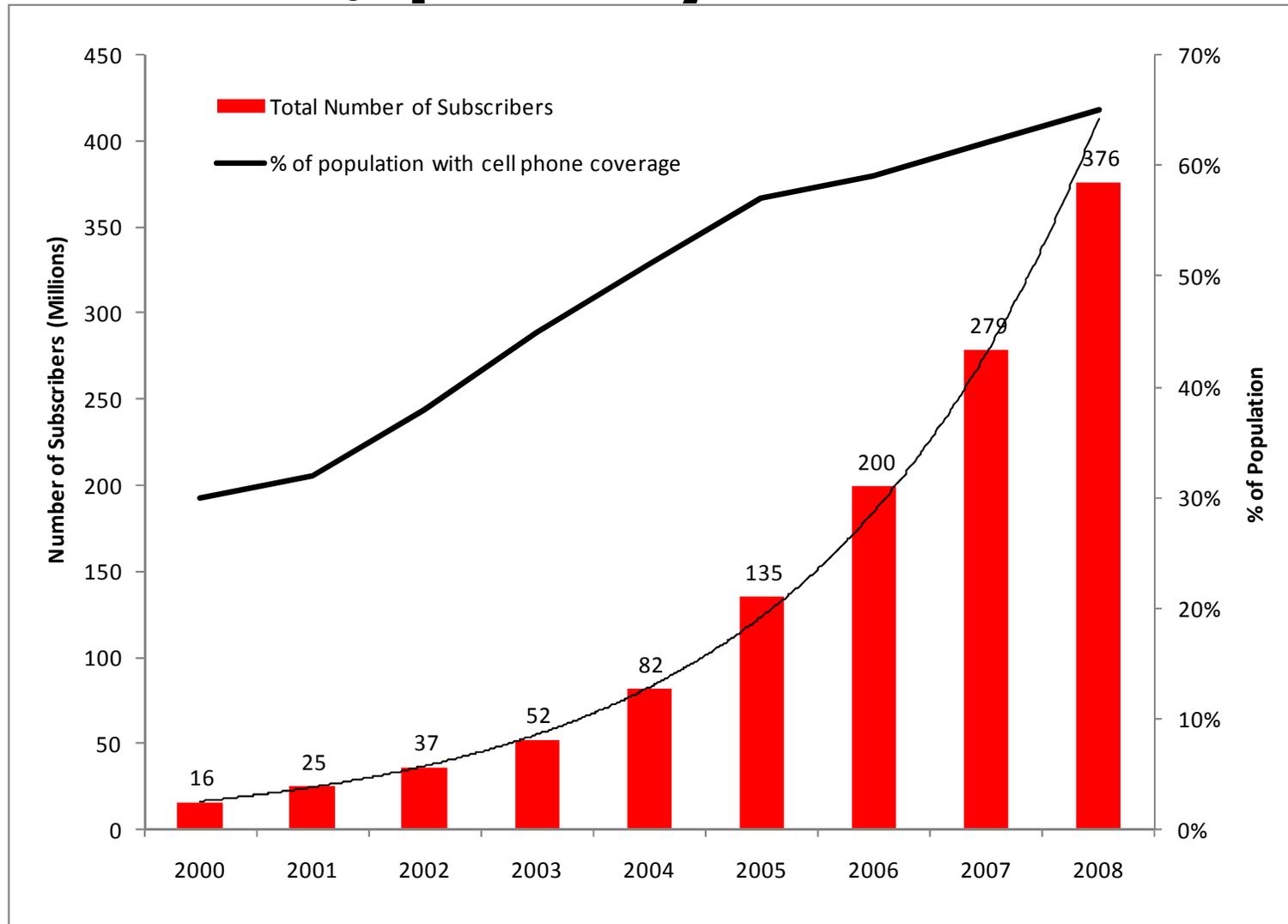
- Cell phone coverage and the digital divide
- Buying a mobile phone on less than a dollar a day
- Cell phones... "Making Life Better"?
- Mobile phones and development
- A way forward

# Cell Phones in Africa

- Africa has .9 bn consumers
- 30 percent live on less than \$US1 per day

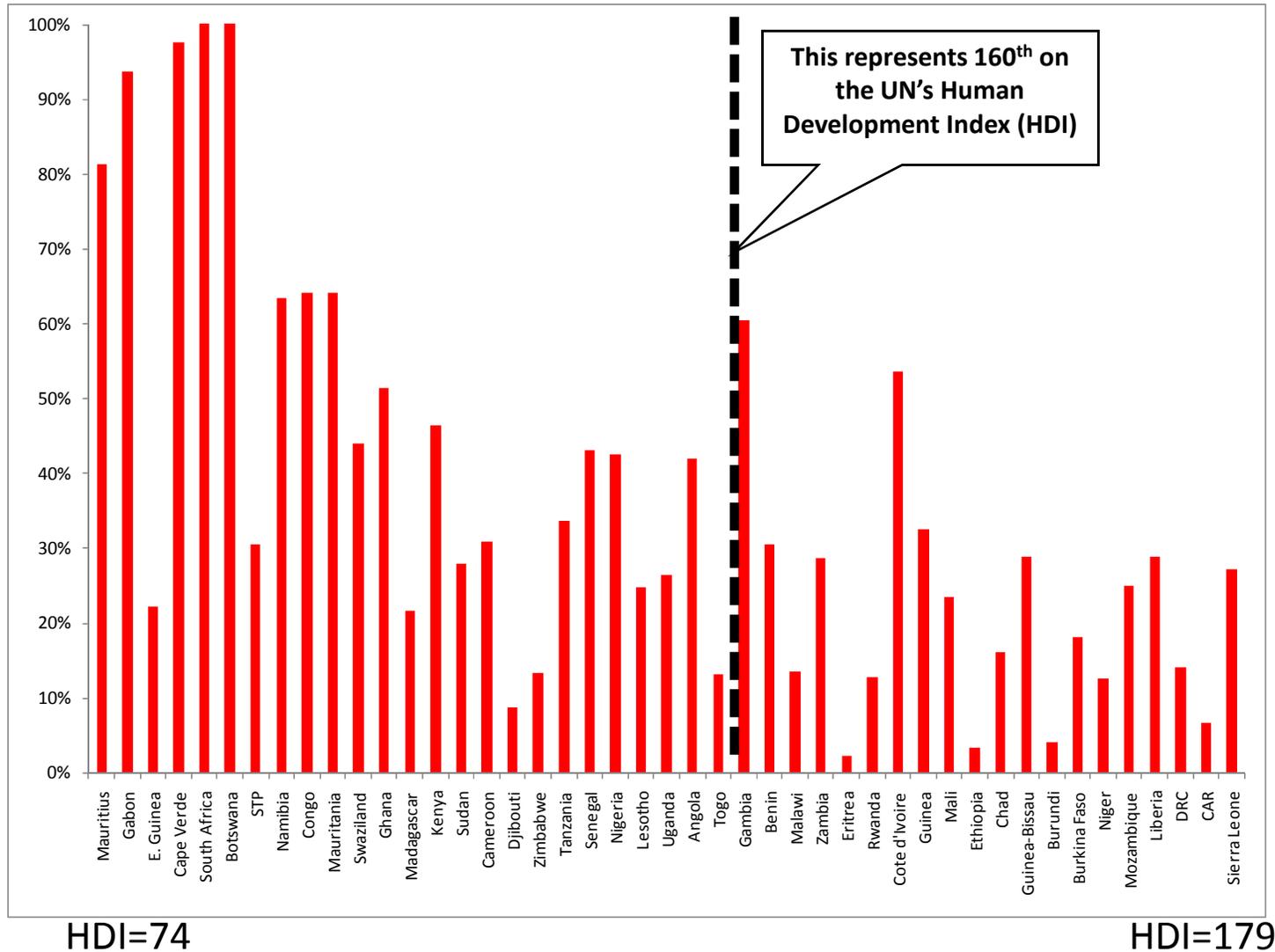


# Mobile Phone “Adoption” on Less than US1\$ per day



Source: Wireless Intelligence

# Mobile Phone “Adoption” by Country, 2008



Source:  
Wireless  
Intelligence

# Who adopts and why?

- Limited or inaccurate data (subscriptions rather than adoption)
- Endogeneity
  - Unobserved factors explaining adoption (ie, “entrepreneurial spirit” or “risk-taker”)
  - Simultaneity: Higher incomes lead to mobile phone adoption, which leads to higher incomes
- Multiple technological uses (agriculture, health, financial, social)
- Pseudo-private good (common property)
  - Somewhat excludable and somewhat rival

# Who adopts and why?

- Higher income levels
- Occupation (traders, firms)
- Geographic location (urban centers)
- Education (ambiguous)
- Learning by doing and learning from others
  - Lower levels of adoption (or later adoption) due to free-riding
- Main uses are voice and some SMS

# Overview

- Cell phone coverage and the digital divide
- Buying a mobile phone on less than a dollar a day
- Cell phones... "Making Life Better"?
- Mobile phones and development
- A way forward

# “God Sends Mobiles” (Schmitt 2002)

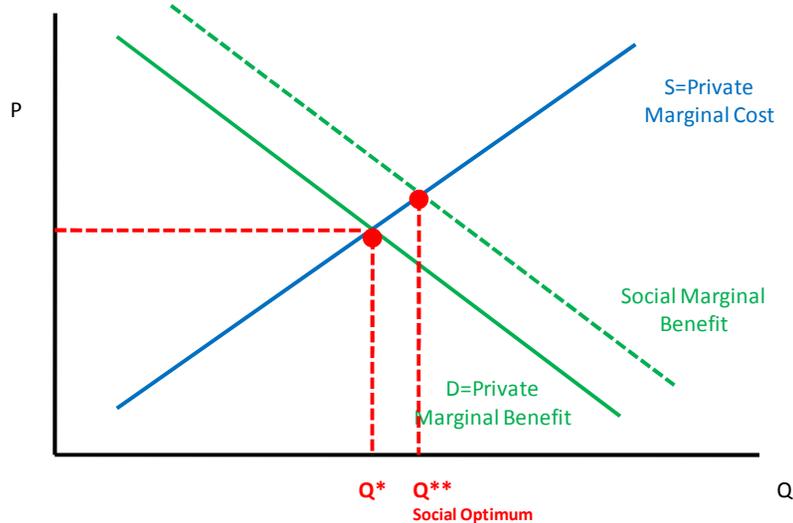
- “The cell phone is the single most transformative technology for development” (Jeffrey Sachs)
- “A 10% increase in mobile penetration boosts annual GDP by 1.2%” (Deloitte 2007)
- “Making lives better”

Is it true?

# Cell Phones...A Wonderful World?

(Positive) Externalities

Cell Phone Services and  
Development Projects



# The Hypotheses

- Costly information can make it difficult for market agents to engage in optimal arbitrage
- Excess price dispersion for homogeneous goods is a common occurrence in developed and developing countries (Stigler, *JPE* 1961, Brown and Goolsbee, *JPE* 2002, Jensen, *QJE* 2007)

# The Hypotheses

- Mobile phones offer a new technology to **reduce search costs**
  - In Niger, mobile phones reduced search costs by 50% as compared with personal travel
- Consumers, producers and firms obtain **more (and perhaps “better”) information**
- Market actors **change their behavior** to take advantage of new arbitrage opportunities
- This leads to more **efficient markets (Law of One Price)** and **improved (net) welfare**

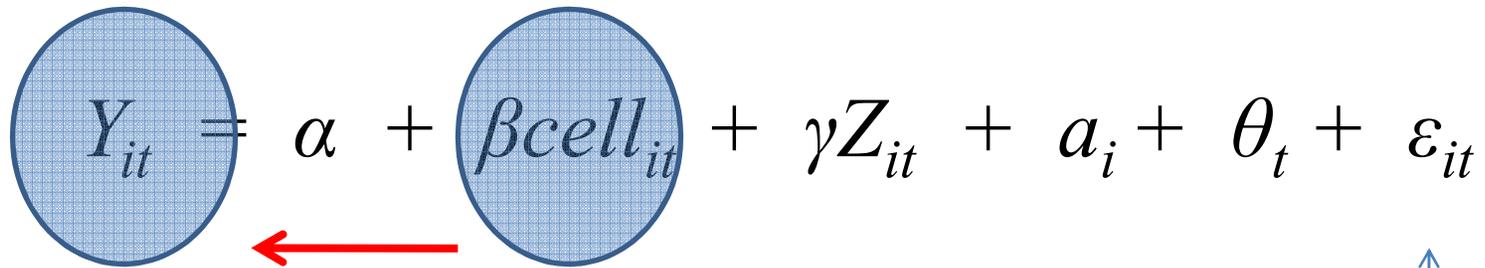
# Empirical Research on the Impact of Mobile Phones

- Fisheries in India (Abraham 2007, Jensen 2007)
- Grain markets in Niger (Aker 2008)
- Farmer participation in Uganda (Muto 2009)
- Internet kiosks and soybean prices in India (Goyal 2009)
- Labor markets in South Africa (Klonner and Nolen 2009)

# Empirical Research on the Impact of Mobile Phones

- Fisheries in India (Abraham 2007, Jensen 2007)
- Grain markets in Niger (Aker 2008)
- Farmer participation in Uganda (Muto 2009)
- Internet kiosks and soybean prices in India (Goyal 2009)
- Labor markets in South Africa (Klonner and Nolen 2009)

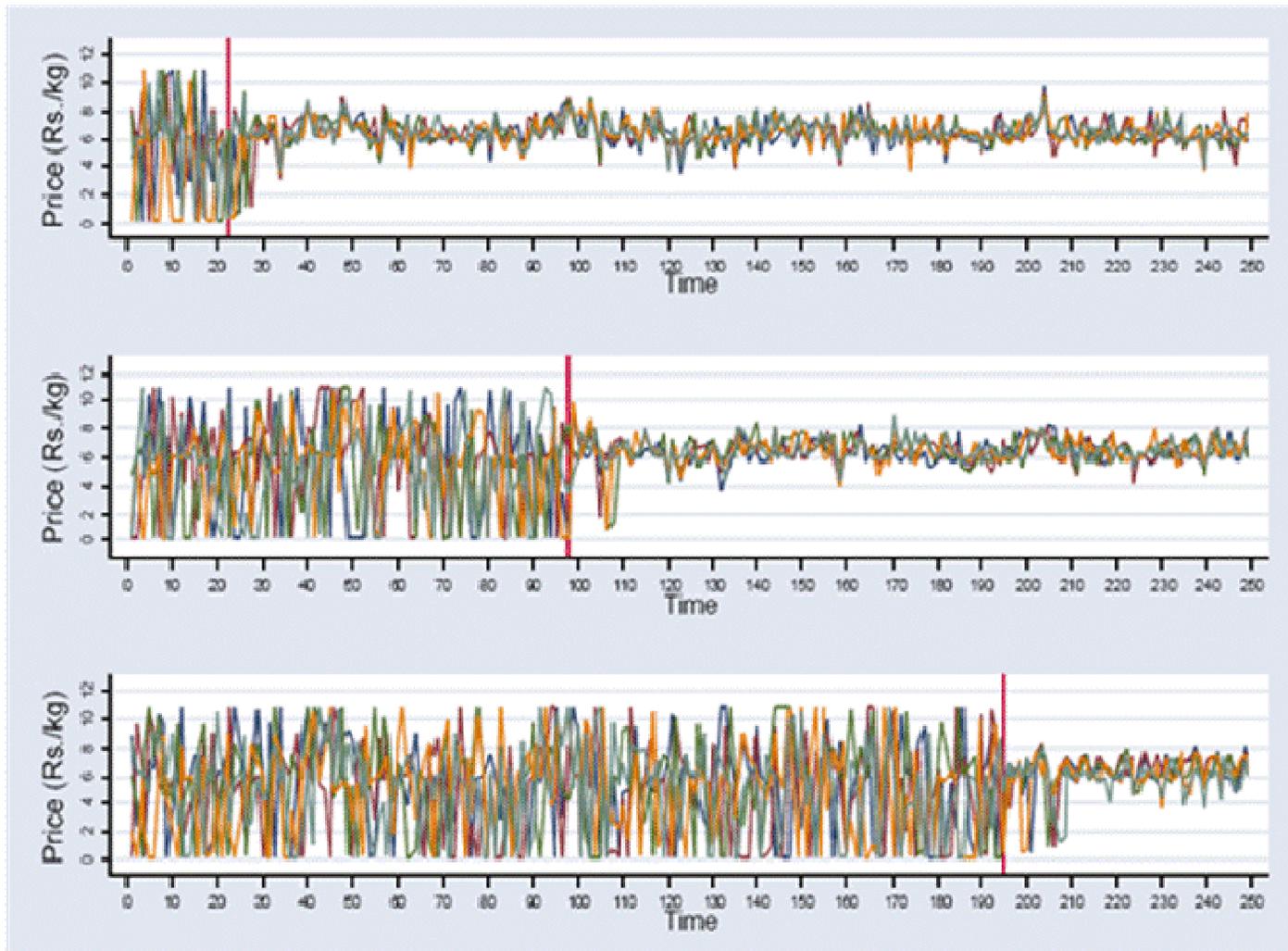
# The Impact of Cell Phones on Development Outcomes

$$Y_{it} = \alpha + \beta cell_{it} + \gamma Z_{it} + a_i + \theta_t + \varepsilon_{it}$$


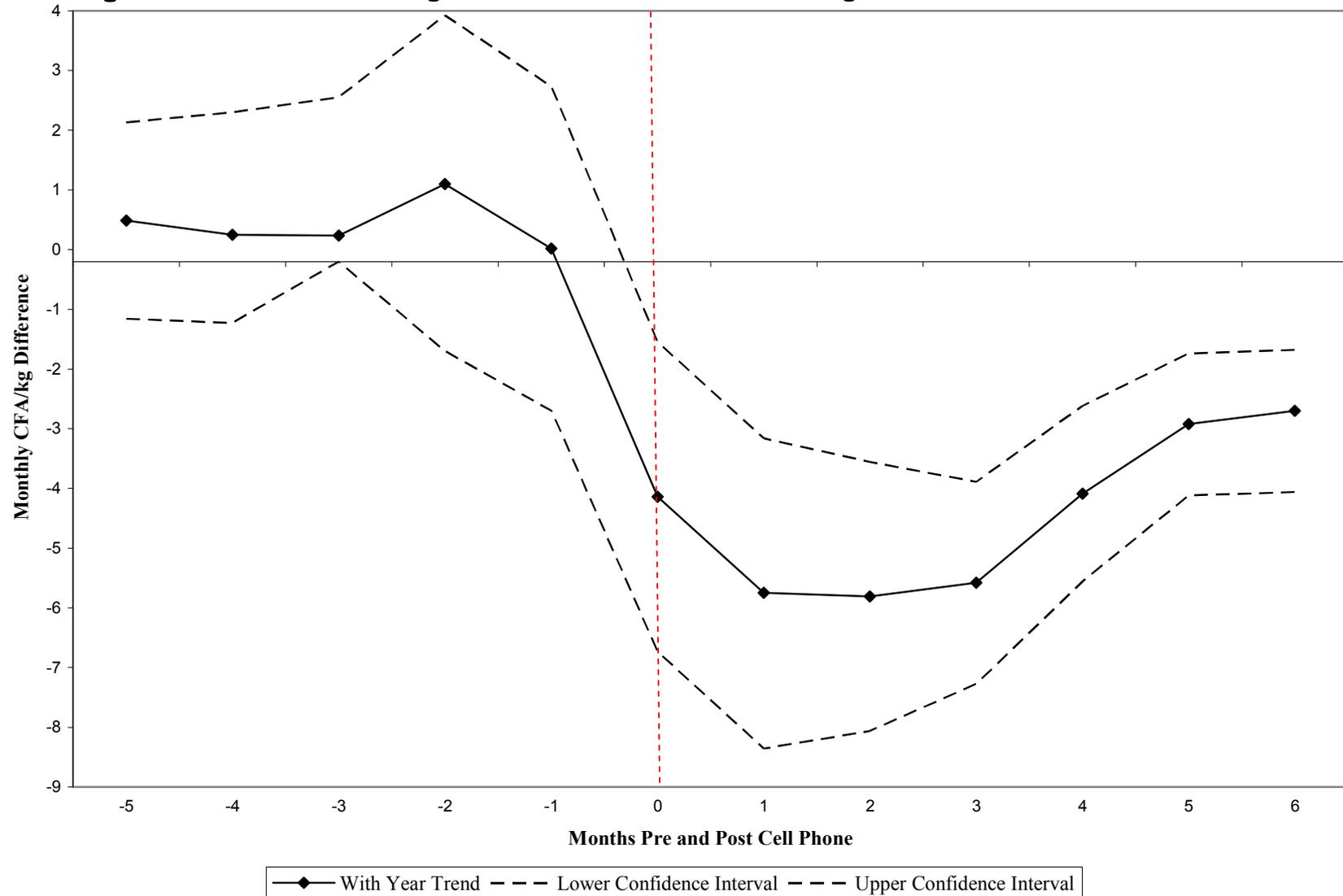
Price dispersion  
Price levels  
Agents' behavior  
Welfare measures

Omitted variables  
Reverse causality

# Mobile Phones and Fish Price Dispersion (Jensen 2007)



# Mobile Phones and Grain Price Dispersion (Aker 2008)



# Trader-Level Outcomes (Aker 2008)

Dependent variable:	OLS Estimate		Poisson Estimate		Probit Estimate	Nearest Neighbor	
	Coeff (s.e.)	%Δ	Coeff (s.e.)	Coeff (adj s.e.)	Coeff (df/dx) (s.e.)	Coeff (s.e.)	%Δ
# of Markets Searched	.91** (.46)	26.26%	.22** (.11)	.22** (.05)		.91** (.47)	26.49%
# of people consulted for market information	1.5*** (.50)	39.95%	.33*** (.11)	.33** (.08)		1.7*** (.71)	45.14%
Use personal contacts to obtain market information	.07*** (.02)	7.99%			.61*** (.09)	.07* (.04)	7.57%
Change sales markets (Yes=1, 0=No)	.08 (.06)	57.14%			.08* (.05)	.09* (.05)	64.29%
# of Sales Markets	1.02** (.71)	25.37%	.22** (.09)	.22*** (.02)		1.13* (.70)	28.04%

Search in .91 more markets

Sell in one more market

# Cell Phones and Welfare

- Welfare improves with market efficiency, but how welfare is distributed among consumers, producers and traders is ambiguous
- Increase in fisherman's profits and a reduction in waste (Jensen 2007)
- Traders' profits increase (higher prices) and consumer prices decrease (Aker 2008)
- Increase in monthly wholesale price of soybeans (Goyal 2008)

# Overview

- Cell phone coverage and the digital divide
- Buying a mobile phone on less than a dollar a day
- Cell phones... "Making Life Better"?
- **Mobile phones and development**
- A way forward

# Cell Phone-Based Services and Development Projects

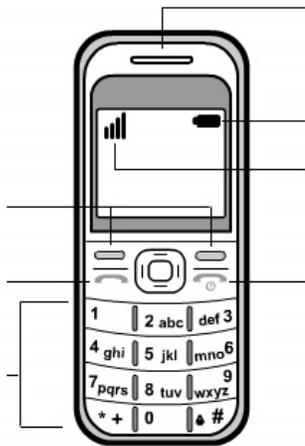
## Services

- Mobile banking (M-PESA, Zap, G-Cash)

## Development Projects

- Market information systems (Esoko Ghana, IMAC **Niger**)
- Health information systems (Satellife Mozambique)
- Early warning (Lake Victoria project, *Ushahidi*)
- Governance (PVT hotlines, voter education **Mozambique**)
- Village Phone (Bangladesh, Rwanda, Uganda)
- Literacy (**Niger**, Senegal)

# Cell Phones and Literacy: Project *Alphabétisation de Base par Cellulaire* (ABC)



ts	Ts	sh	Sh	gw	Gw	kw	Kw	kw	Kw	ky	Ky	Ky	Ky
tsuntsaye	shonu	gwiwa	kwando	kwai	kyankyaso	ryaure							

Aa Bb Bb Cc dD dD Ee  
 Ff Gg Hh Ii Jj Kk Kk  
 Ll Mm Nn Oo Rr Ss Tt  
 Uu Vv Yy Yy Zz

© Tous droits réservés  
 SIL International  
 B.P. 10151 Niamey, Niger  
 Imprimé par l'imprimerie Régionale  
 de Zinder

N° De référence HV 15 02  
 Première édition  
 Première impression  
 Décembre 2002

Illustrations:  
 Moussi Dawe Ernest (dessinateur)  
 Habaheba Aïdés (dessinateur)  
 Amadou Sani (dessinateur)  
 Haidara Ibrahim Sambou  
 (éditeur informatique)



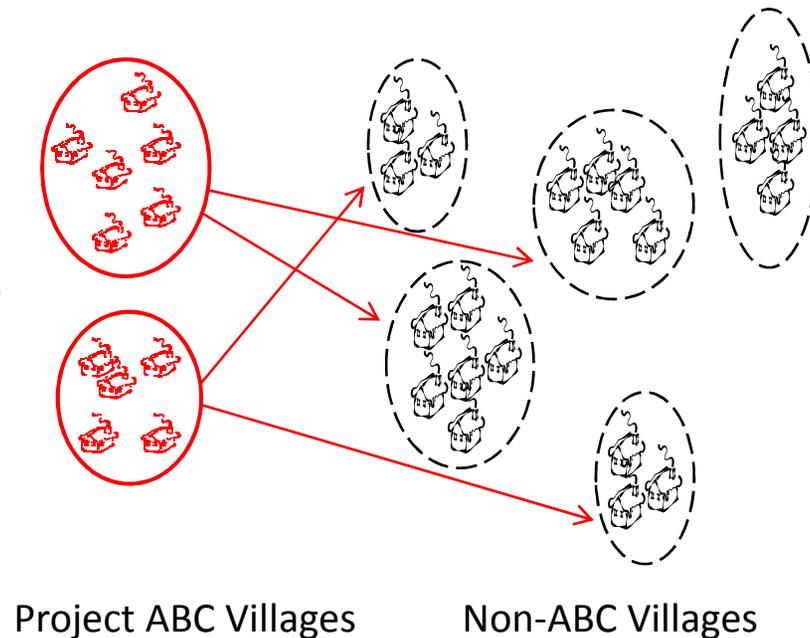
# Project ABC Approach

- Use “**simple**” cell phones as a learning tool to allow participants to practice reading and writing in their local languages (Hausa, Zarma) via SMS
- Reinforce the importance of **functional literacy** (and numeracy) by targeting producers’ groups with a common economic “function”
- Facilitate participants’ **access to market information** via cell phones (Frontline SMS)

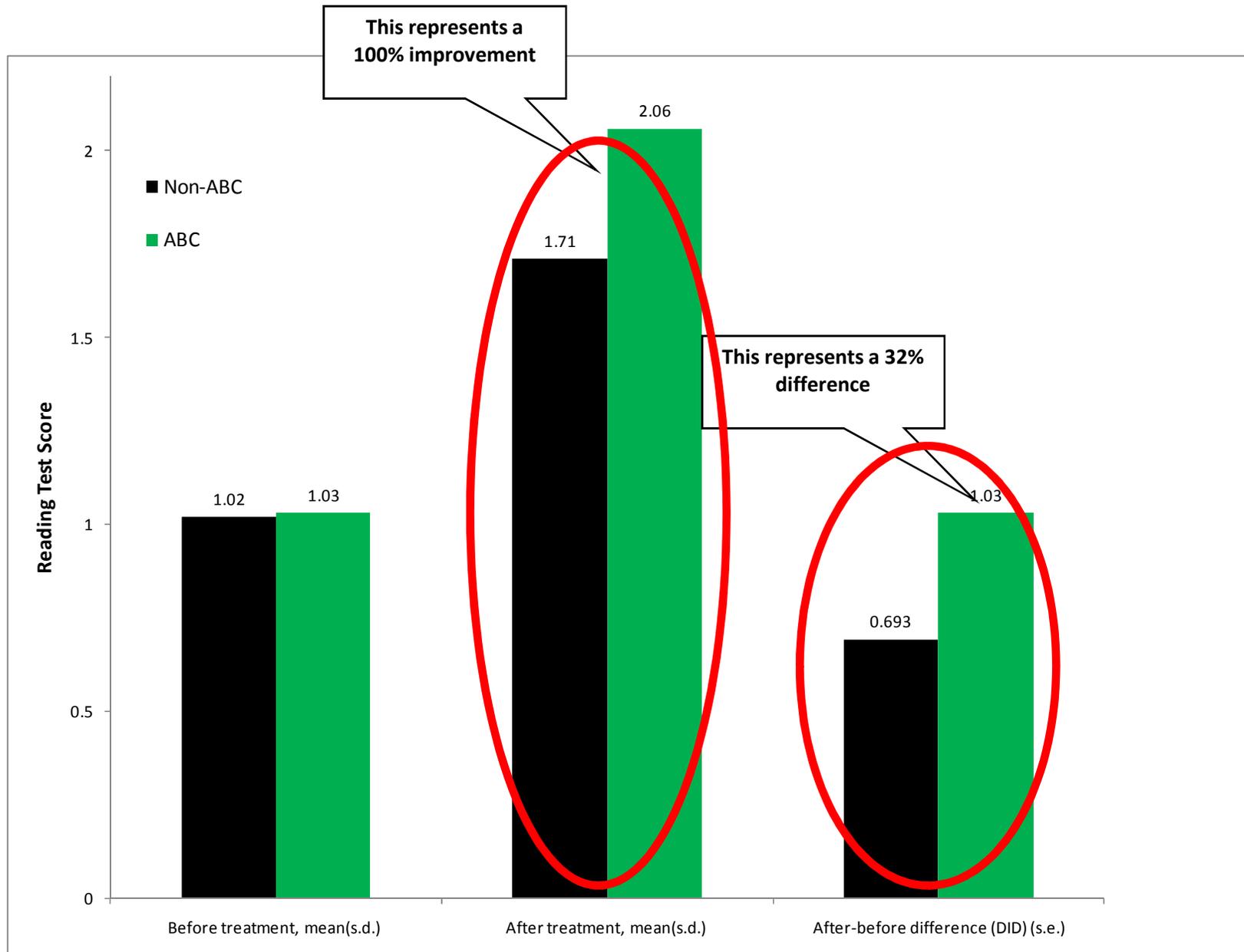
# Project ABC Evaluation Approach

- Compare cell-phone based literacy with traditional literacy
- Half of villages (70) were randomly selected to receive the interventions in 2009
- Half of the 2009 villages (35) receive “cell-phone “ literacy

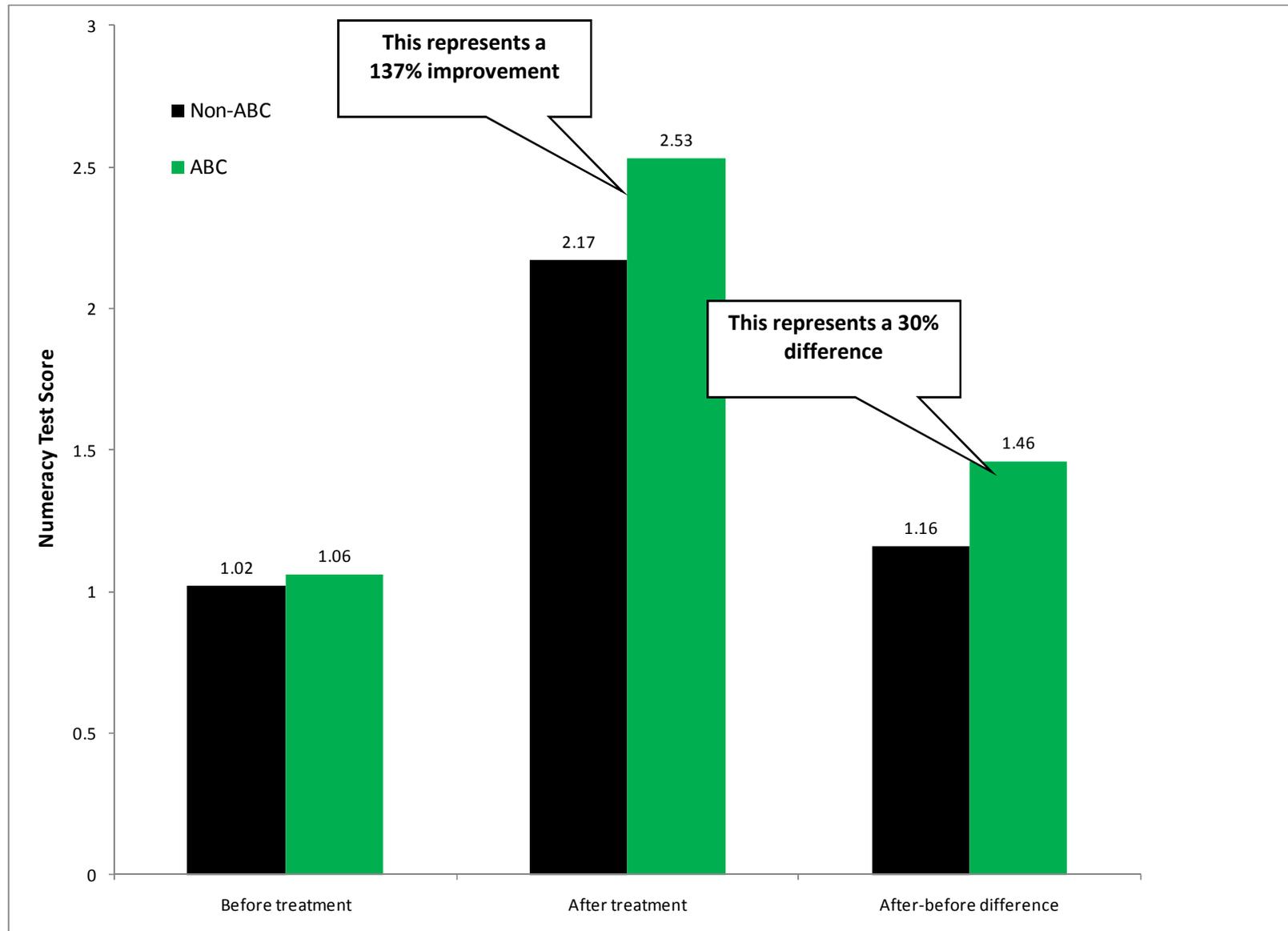
Compare impact on literacy rates and other outcomes in ABC and non-ABC villages



# Reading Tests Before and After



# Numeracy Tests Before and After



# Overview

- Cell phone coverage and the digital divide
- Buying a mobile phone on less than a dollar a day
- Cell phones... "Making Life Better"?
- Mobile phones and development
- **A Way Forward**

# A Way Forward

A device that was a yuppie toy not so long ago has now become a potent force for economic development in the world's poorest countries. **But more can be done to exploit it.** Most governments say they are in favor of economic growth and **broader access to communications.** By cutting back on mobile-specific taxes and tariffs, they can help to promote both of those things.

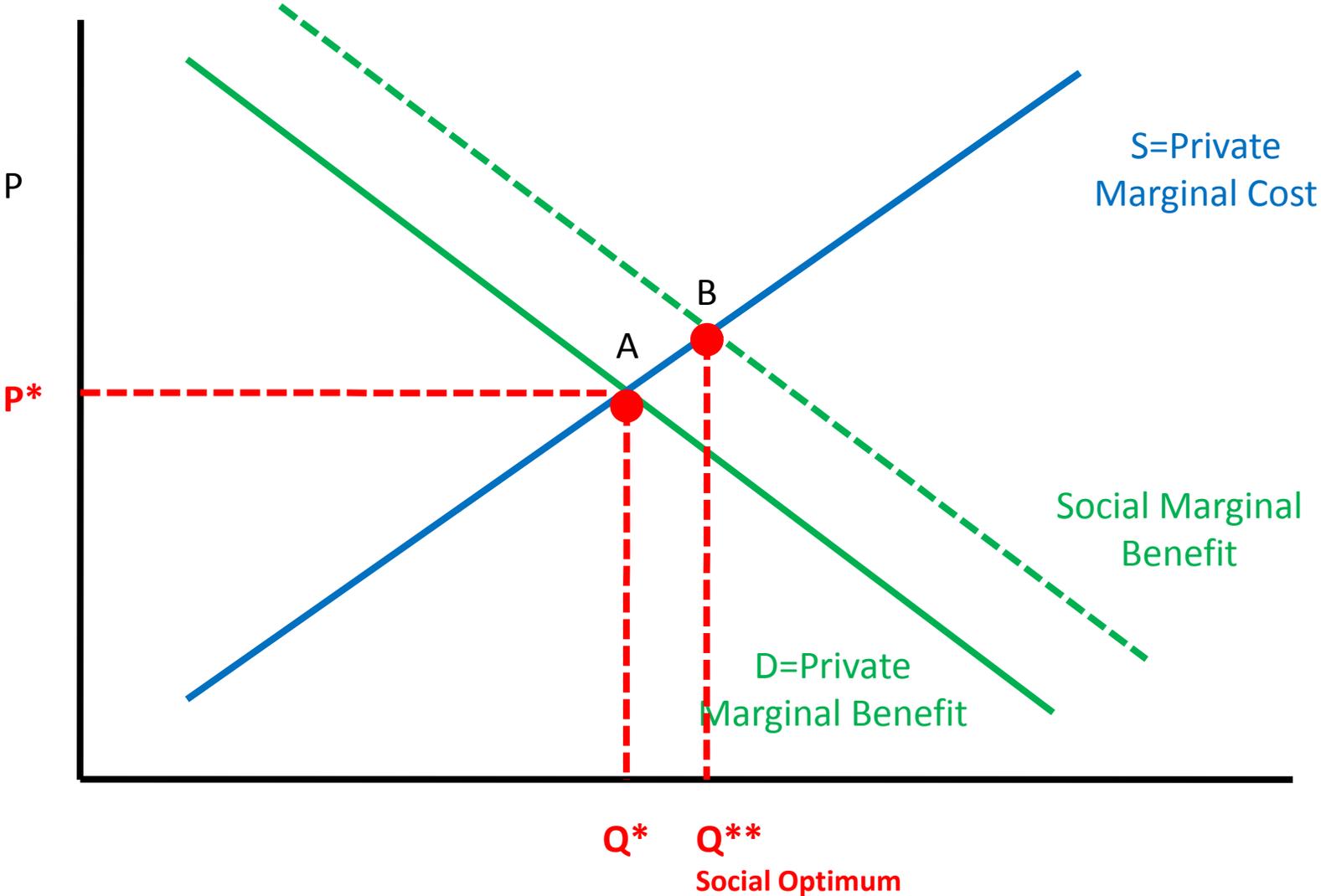
*(The Economist, May 29, 2008)*



# Three Issues for Affordable Access to Mobile Phones (“Fair Mobile”)

- Positive Externalities
- Market Structure and Government Policy
- Taxes and Regulatory Fees

# Positive Externalities of Telecommunications



# Market Structure

## Monopoly



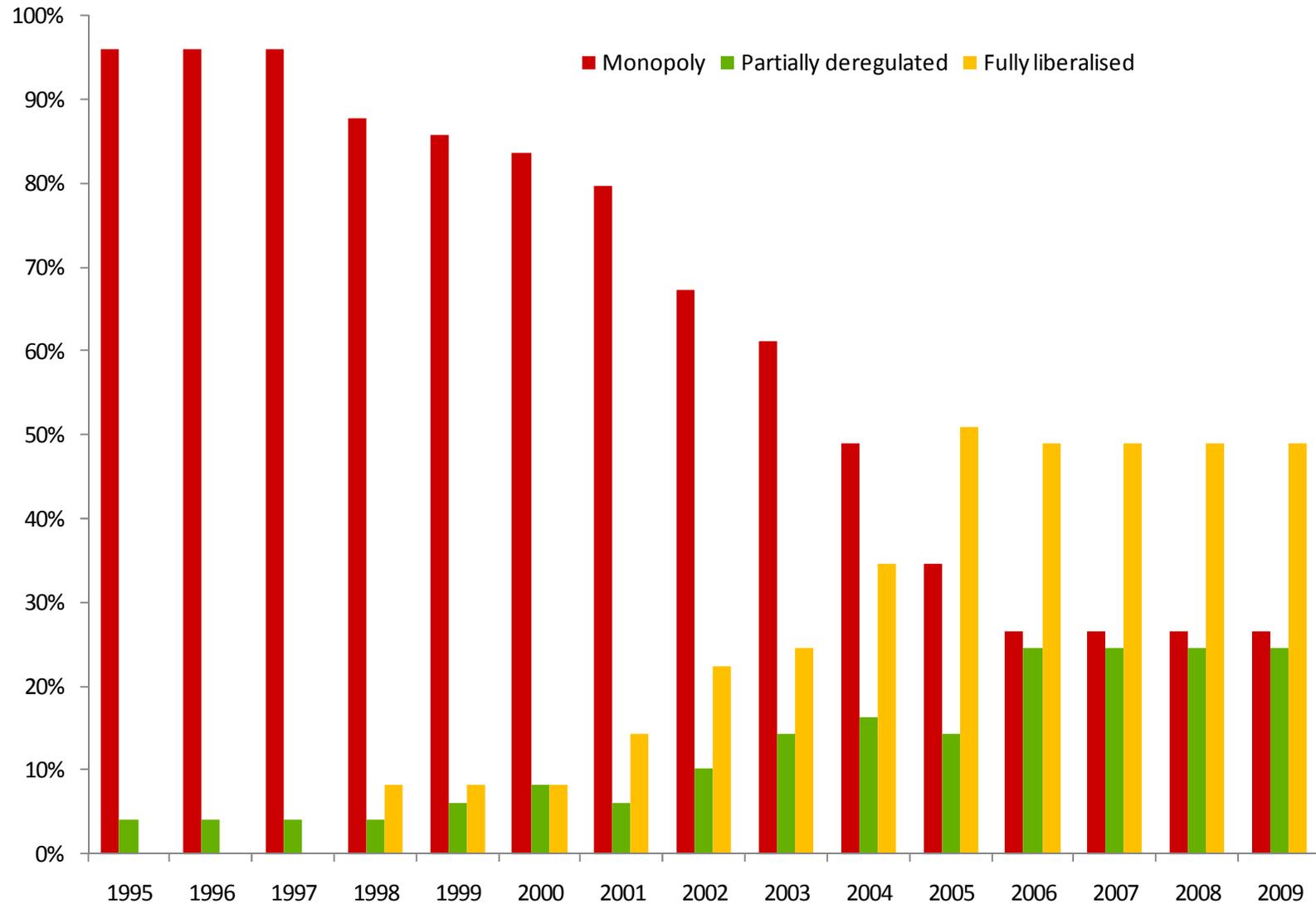
- One service provider
- Higher prices and lower volumes
- Fewer range of products, low-quality service

## Liberalized

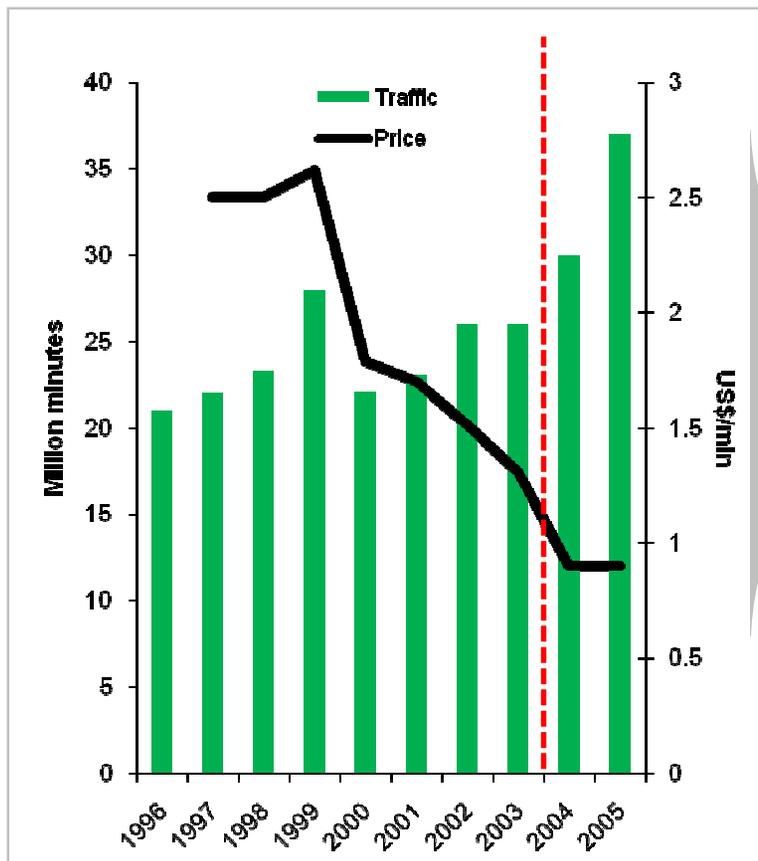


- Greater number of entrants
- Lower prices
- Greater range of products and services

# Telecommunications Structure in Africa, 1995-2009

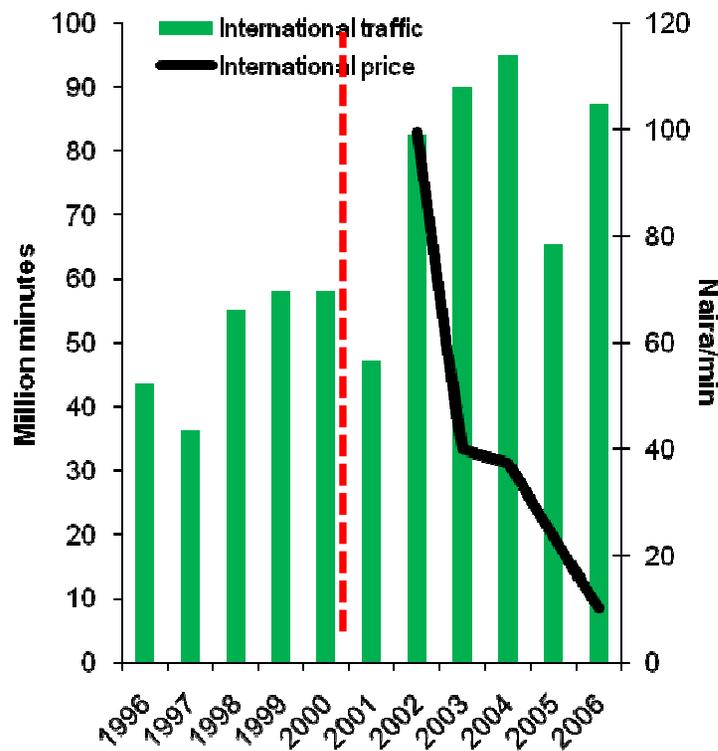


# Liberalization and Pricing in Kenya (GSMA 2006)



- Partial liberalization in 2004
- International call prices decreased by 31%
- Traffic increased by 40% by the end of 2005
- Four mobile operators as of 2009

# Liberalization and Pricing in Nigeria (GSMA 2006)



- Partial liberalization in 2001, full liberalization in 2006
- Price of international calls in 2005 is 10% of the price in 2002
- Average annual traffic in 5 years after partial liberalization is 65% higher than traffic in the five years prior
- Five mobile operators as of 2009

# Taxes and Regulatory Fees (GSMA 2006)

- 24 governments levy specific luxury taxes on mobile handsets
- 8 governments levy specific luxury taxes on mobile usage (air time)
- 25+ governments levy specific luxury taxes on ICT equipment

# Summary

- Mobile phone coverage and adoption is occurring at a staggering rate in sub-Saharan Africa
- Their primary use appears to be in facilitating access to and use of information (and services)
- There is strong evidence that mobile phones are having a (positive) economic impact on markets and individuals, but evidence on the impact of cell phone-based development projects is currently limited

# Recommendations for Development Actors and Donors

- Keep it simple
  - Handsets and products (services) need to be adapted to populations with low literacy rates.
- Encourage public-private partnerships
- Measure the impact of cell-phone based interventions to verify that it's better
- Don't forget about other infrastructure investments
  - Mobile phones can enhance delivery of and access to resources and information, but they cannot replace roads power credit

# Recommendations for Policy-Makers

- Create enabling environment for investors by:
  - Continuing the liberalization process
  - Maintaining fair and transparent regulation
  - Reconsidering ICT-specific taxation

# Recommendations for the Private Sector

- Continue partnerships with the public sector
- Develop appropriate products
- Recognize potential social benefits of cell phone technology
- Environmentally-friendly investment
  - Diesel generators and coltan (tantalum)
  - “Can you hear Congo Now? Cell Phones, Conflict Minerals and the Worst Sexual Violence in the World” (Pendergast 2009)



# Are there potential negative impacts?

- Disseminate hate speech
- Misinformation
- Election-rigging
- Blocking services
- Environmental impacts
  - Diesel generators, coltan in the Democratic Republic of Congo

