

ETNO Regulatory Economics Task Force
Brussels, April 30, 2008

The economic and social impact of telecommunications output: empirical evidence in the US and Europe

Dr. Raul L. Katz

Director, Business Strategy Research, Columbia Institute for Tele-Information
President, Telecom Advisory Services, LLC

Contents

1. Theoretical framework
2. U.S. evidence
3. Spanish evidence
4. Implications

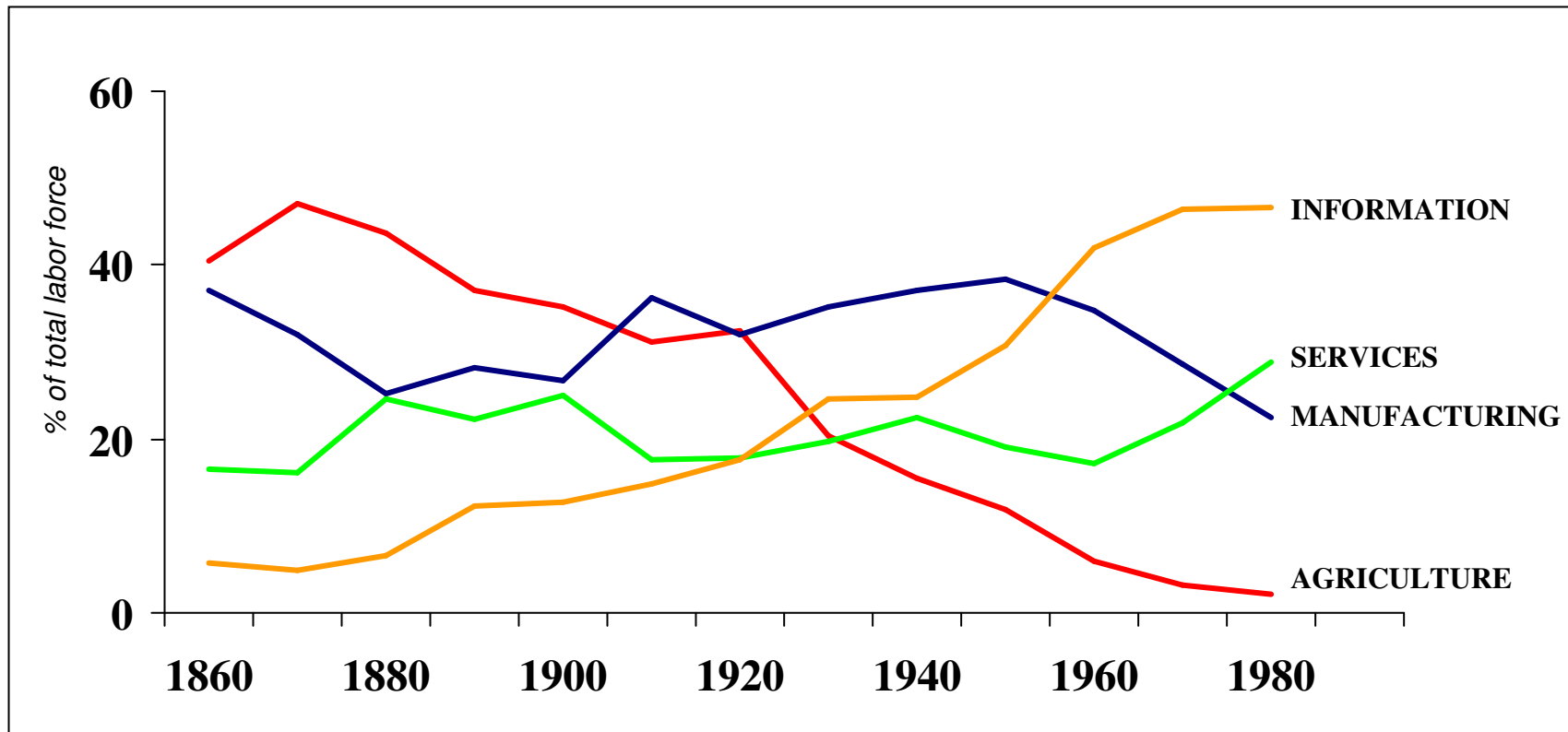
1. Theoretical framework

Our starting point: the information sector of the economy

- Machlup: knowledge industries (1962)
- Bell: knowledge workers (1973)
- Porat: information society (1976)
- OECD: information sector (1981)
- Jonscher: information workers (1982)

Growth in information workers signals the transition to an information economy

UNITED STATES: THE PROTOTYPE OF INFORMATION SOCIETY 1860 - 1980



Source: Porat (1977)

The growth of information workers is a worldwide trend

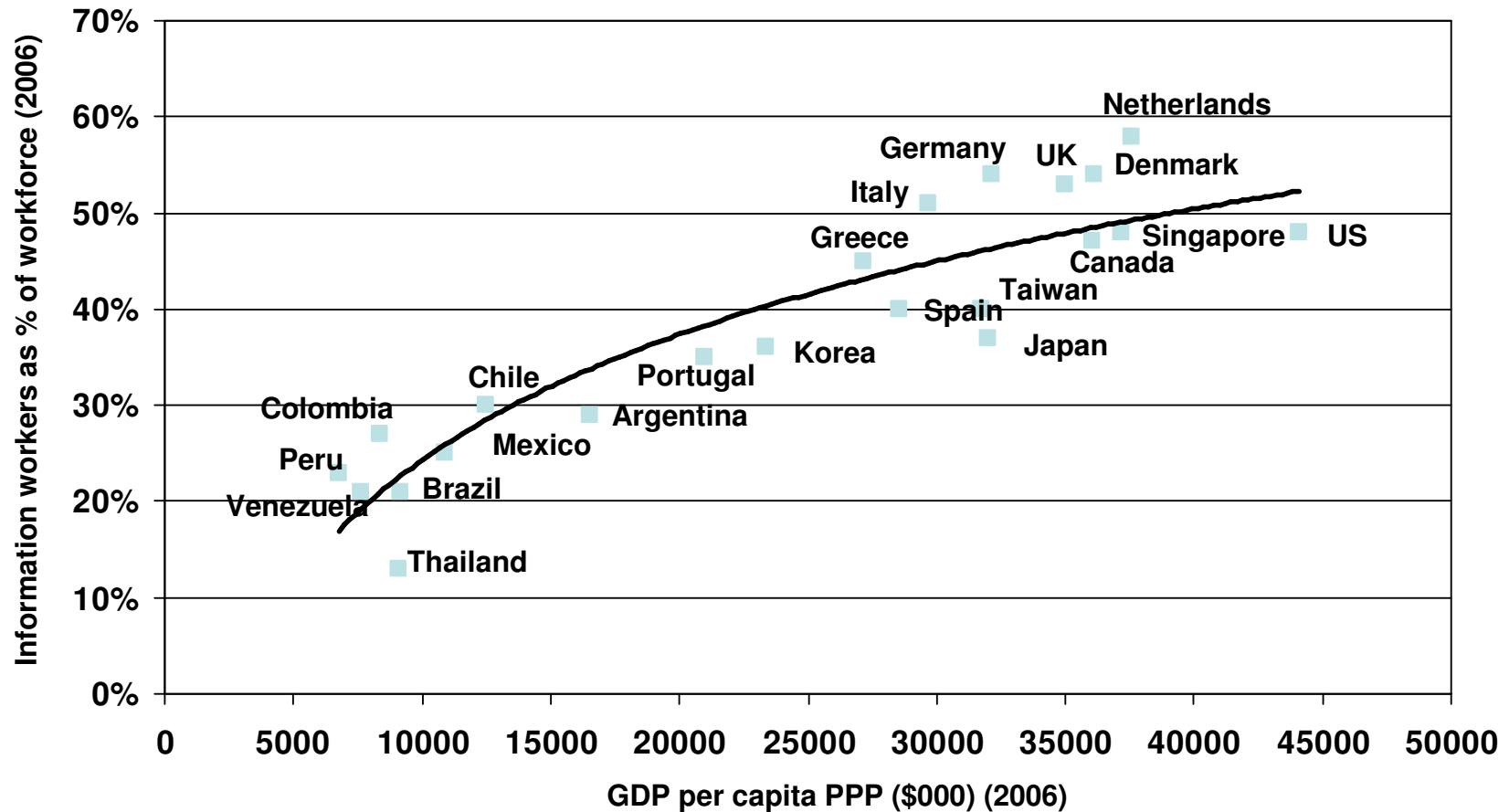
Country	Percent of Information Workers
Denmark	54 %
Germany	54 %
Greece	45 %
Italy	51 %
Netherlands	58 %
Portugal	35 %
Spain	40 %
United Kingdom	53 %
Average Europe	50 %
United States	48 %
Canada	47 %
Average North America	48 %

Country	Percent of Information Workers
Argentina	29 %
Brazil	21 %
Chile	30 %
Colombia	27 %
Mexico	25 %
Peru	23 %
Venezuela	21 %
Average Latam	24 %
Korea	36 %
Japan	37 %
Taiwan	40 %
Singapore	48 %
Thailand	13 %
Average Asia	31 %

Source: ILO (2007); analysis by the author

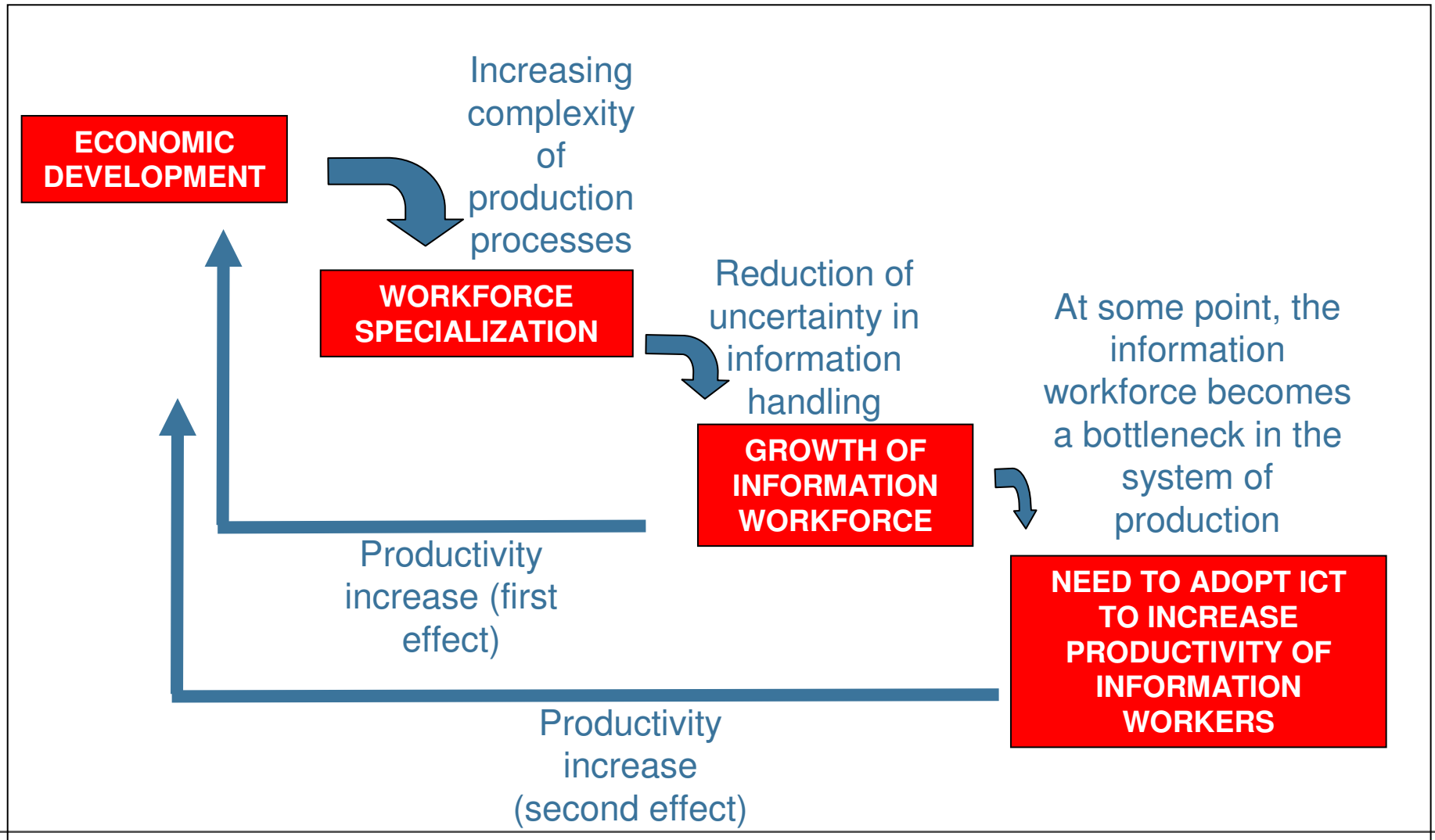
The growth of information workers is related to economic development

INFORMATION SOCIETY AND ECONOMIC GROWTH (2006)



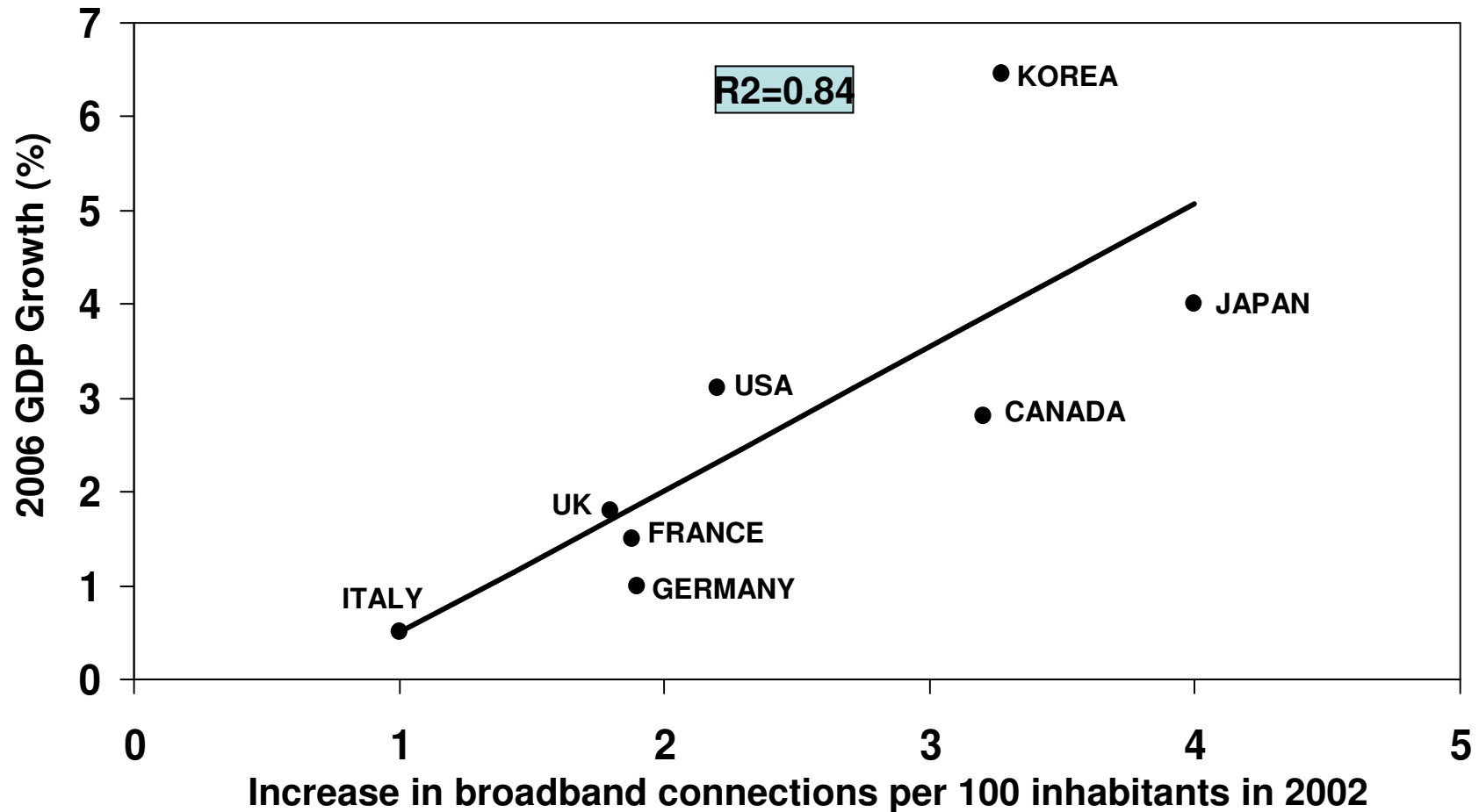
Source: *The Economist*; ILO; analysis by the author

First causality model: ICT innovation and diffusion is related to growth of information workforce



In particular, telecommunication networks have a direct influence on economic growth

BROADBAND PENETRATION AND GDP GROWTH



Source: Gentzoglani (2007)

Ultimately, networks enable the achievement of full potential of the information society

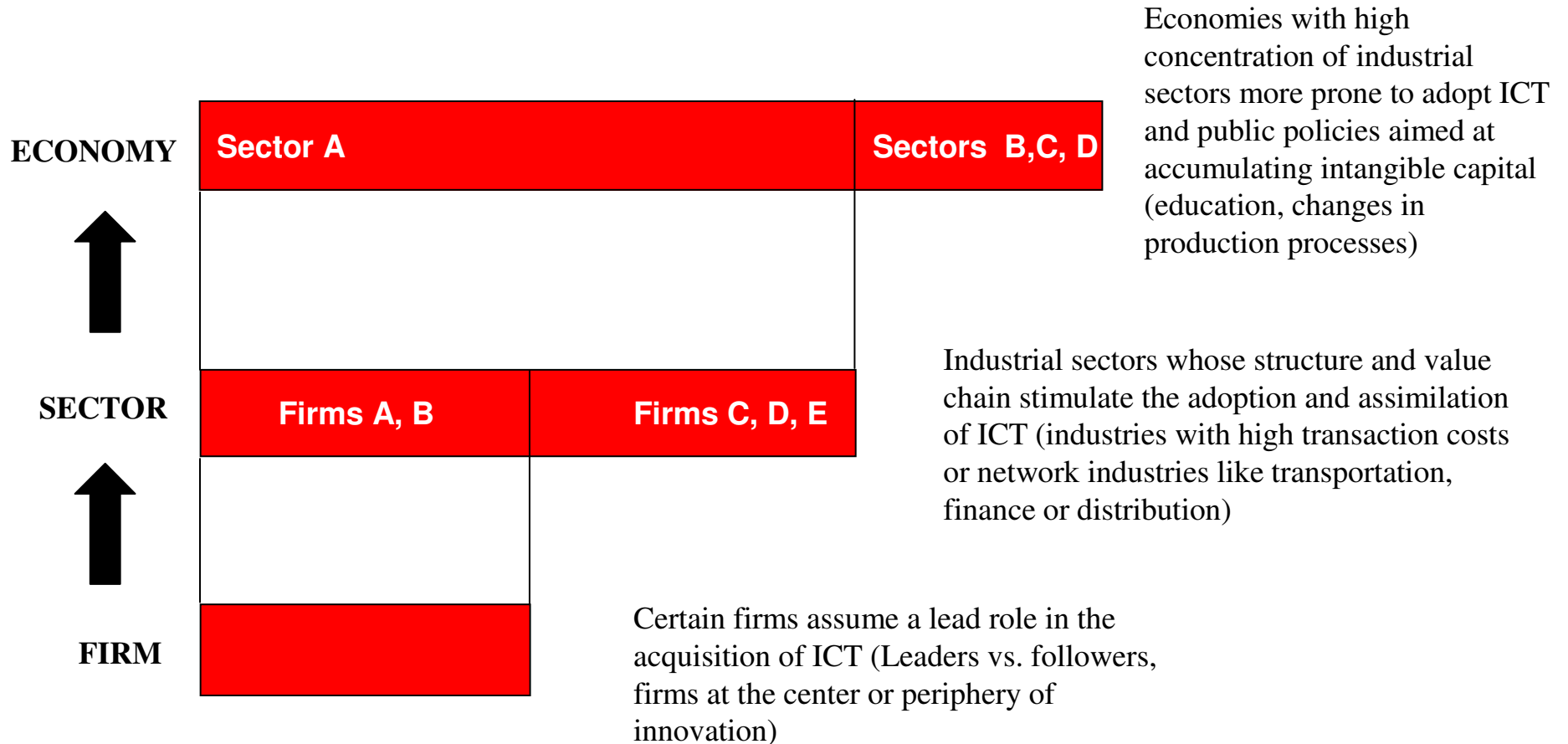
- **Tele-commuting: improvement in quality of life resulting from ability to work remotely**
- **Labor productivity: greater efficiency in processing of information-related tasks**
- **Transaction speed: faster completion of inter-firm transactions, with consequent reduction of costs**
- **Innovation capacity: innovation can be increased by streamlined collaboration among eco-system firms**
- **Modular and flexible production processes: Standardized optimized processes can only be achieved through flexible reconfiguration and simplification**

Theories and attempts to measure ICT impact on productivity

- **Information technology as an input in the production function (Braunstein)**
- **Information payoff (Strassman)**
- **Telecommunications and growth (Jipp, Parker, Wellenius)**
- **The productivity paradox (Solow, Krugman)**
- **Information technology and productivity (Jorgenson)**

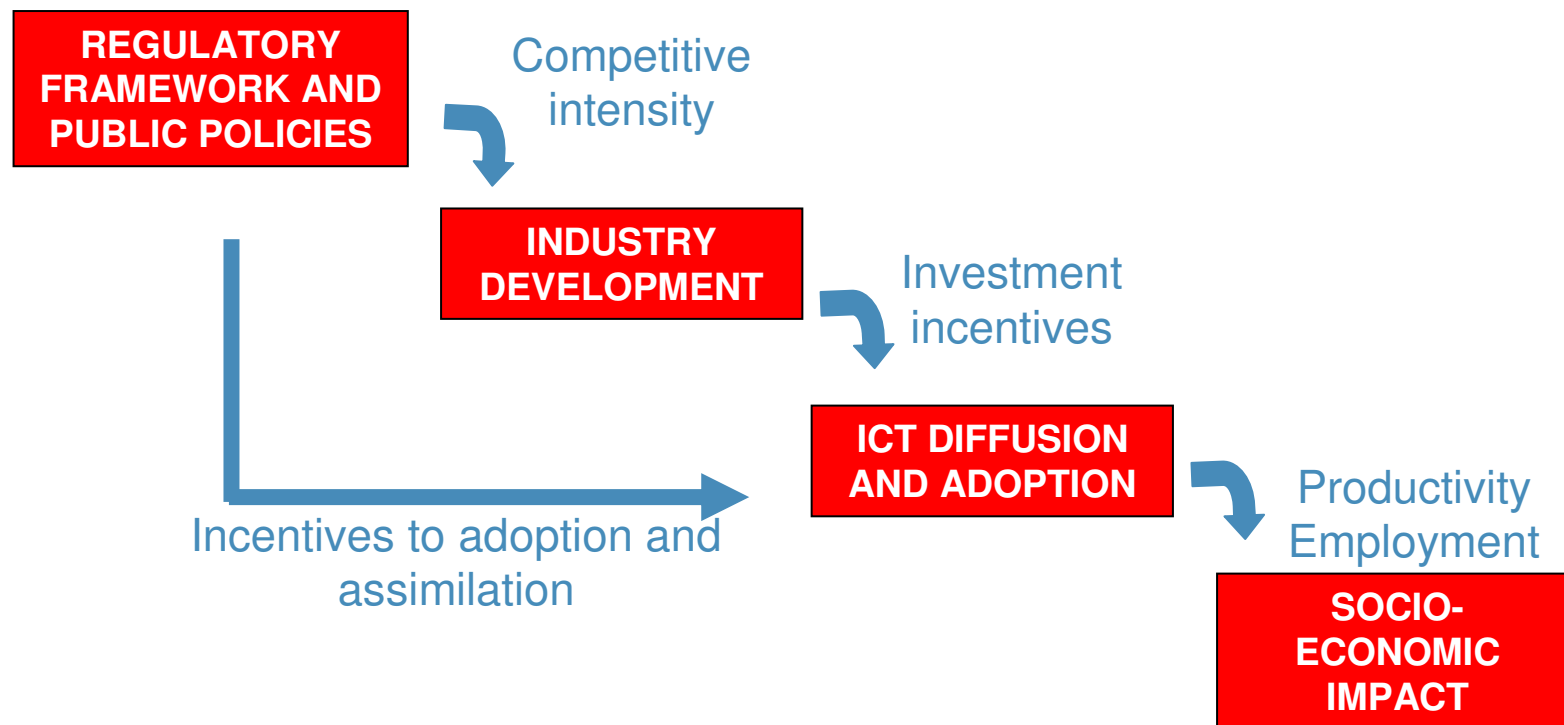
ICT and productivity: the lag effect

ICT-PRODUCTIVITY: THREE LEVELS OF CAUSALITY



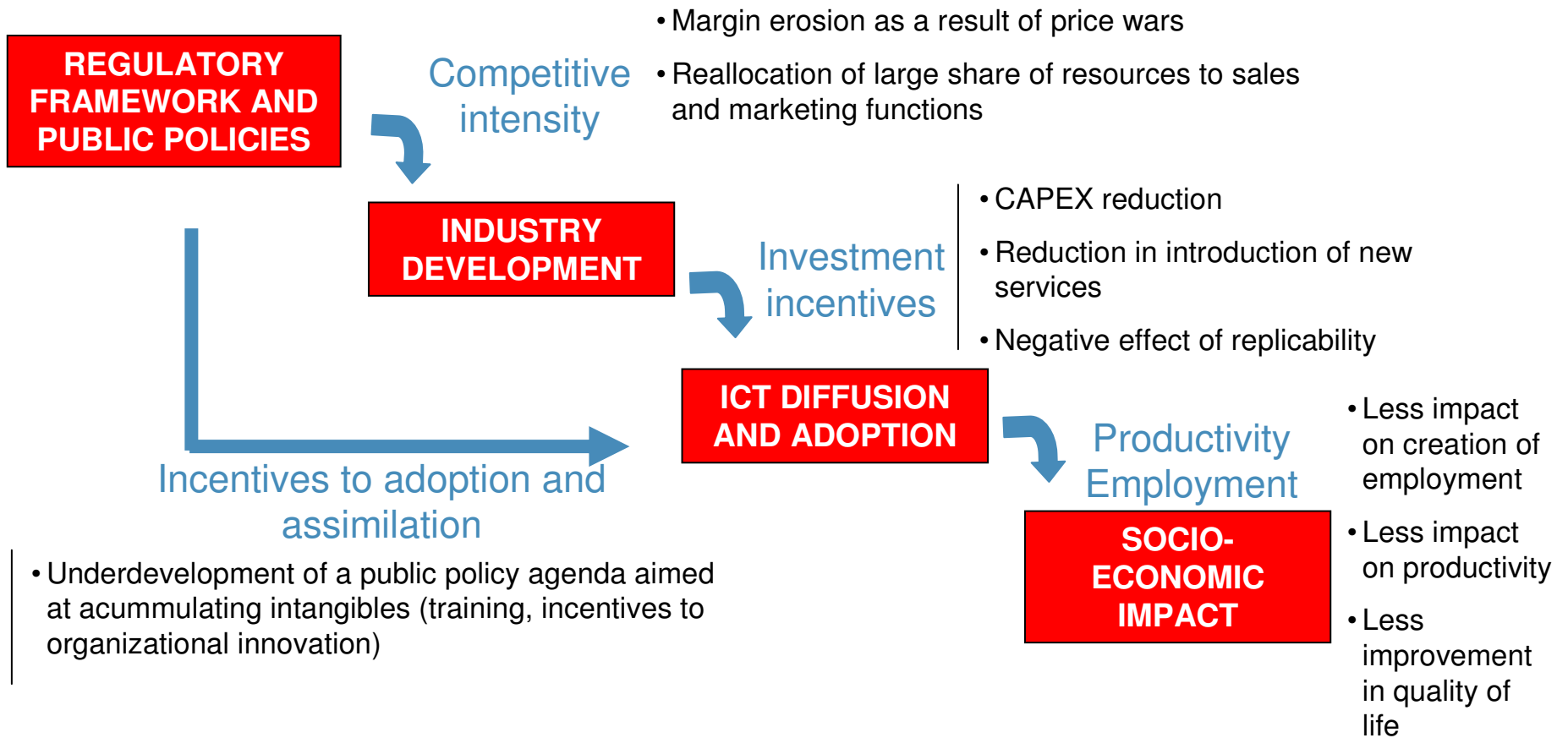
Second causality model: the impact of ICT public policies on ICT diffusion and socio-economic impact

IMPACT AND INTERRELATIONSHIPS OF VARIABLES



As a result, industry competitiveness has an impact on the degree with which ICT influences the economy

IMPACT AND INTERRELATIONSHIPS OF VARIABLES



2. US Evidence

US evidence of economic impact of ICT comprises four areas

AREAS OF IMPACT	BENEFITS
Productivity	<ul style="list-style-type: none"> • Total factor productivity in those industries that are ICT se intensive but also in those that are not
Creation/relocation of enterprises	<ul style="list-style-type: none"> • Relocation of enterprises based on the availability of high capacity telecommunications networks (as one of many infrastructure factors) and quality of life (driven by availability of networks in schools, hospitals, public administration, etc.)
Employment	<ul style="list-style-type: none"> • Creation of employment as a result of relocation of companies searching for labor cost arbitrage • Creation of qualified self-employment resulting from the availability of communication networks • Creation of employment in manufacturing and installation of telecommunications equipment
Economic growth	<ul style="list-style-type: none"> • Increase in efficiency of industries with high transaction costs (retail distribution, finance, etc.) • Consumer surplus generated by the availability of new telecommunications services, reduction of travel time and transportation, etc.

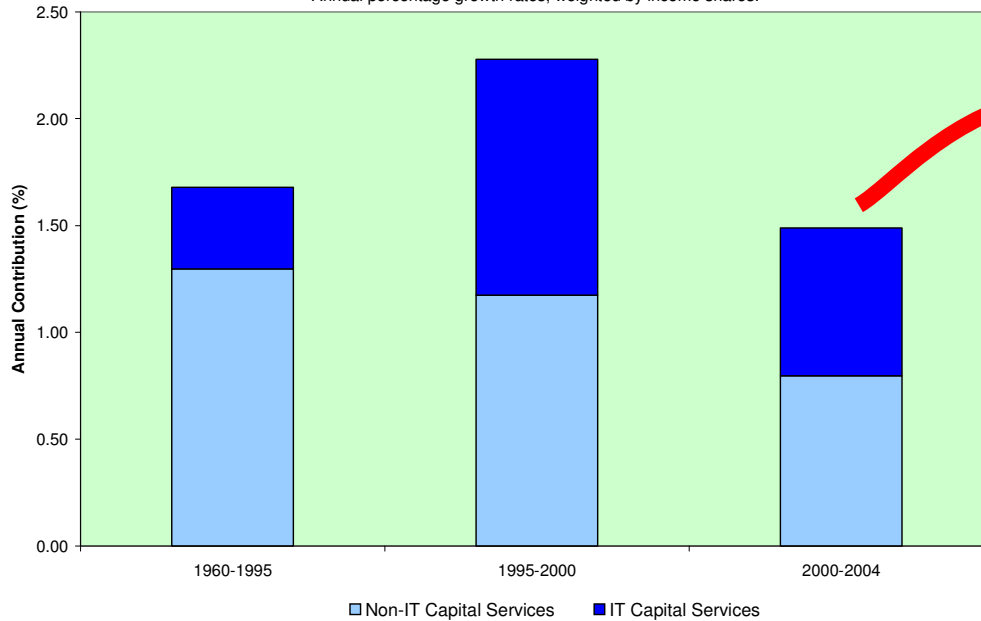
Jorgenson et al. have ascertained the impact of ICT on productivity

- **1995-2000: The rapid price declines in IT acted as a positive supply shock**
 - Fast decline in IT prices (memory chips declined 41% in 1974-96; logic chips 54 in 1985-96; computers declined less because chips are <50% of computer costs)
 - High rate of investment in IT, combined with more efficient combination of inputs
 - Increased productivity
- **2000-onwards: investment in IT has receded considerably, but labor productivity continued improving**
- **Rising productivity driven by a combination of structural and transitory factors (e.g. flexible labor markets)**

Jorgenson, Ho, Samuels and Stiroh's assesment of ICT impact on PTF

Capital Input Contribution of Information Technology

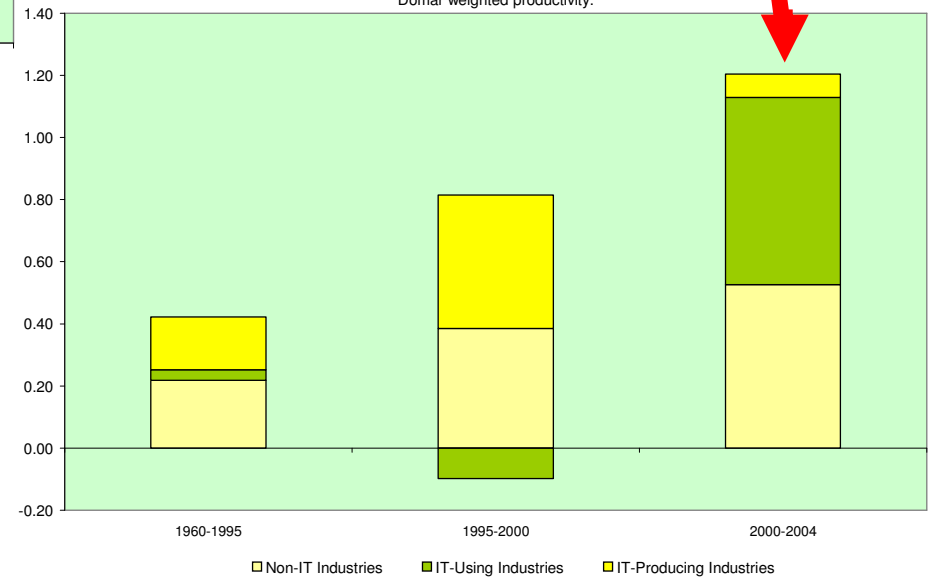
Annual percentage growth rates, weighted by income shares.



LAG EFFECT

Industry Contributions to Productivity Growth

Domar weighted productivity.



Source: Jorgenson et al. (2008)

Evidence of micro and macroeconomic impact of telecommunications on the economy

AREAS OF IMPACT	EVIDENCE
Impact of telecommunications on the economy	<ul style="list-style-type: none"> • Wireless communications improve productivity of supply chain and distribution processes (20% improvement) (Blackstone and Ware) • Total value of telecommunications input equals 1% of total output (Colpitts) • Telecommunications improves efficiency of suburban traffic up to 20% (Jones)
Impact of telecommunications on economic growth	<ul style="list-style-type: none"> • Growth in telecommunications density has an impact of economic development (Jipp, Parker, Hudson, Polischuk)
Telecommunications has an impact on economic efficiency of firms	<ul style="list-style-type: none"> • Improvement of supply chain (e.g. pricing, inventory management) (Jonscher and Tyler) • Reduction in amount of staff mobility • Improvement in distribution (e.g. better price signaling, better reach of distributors)

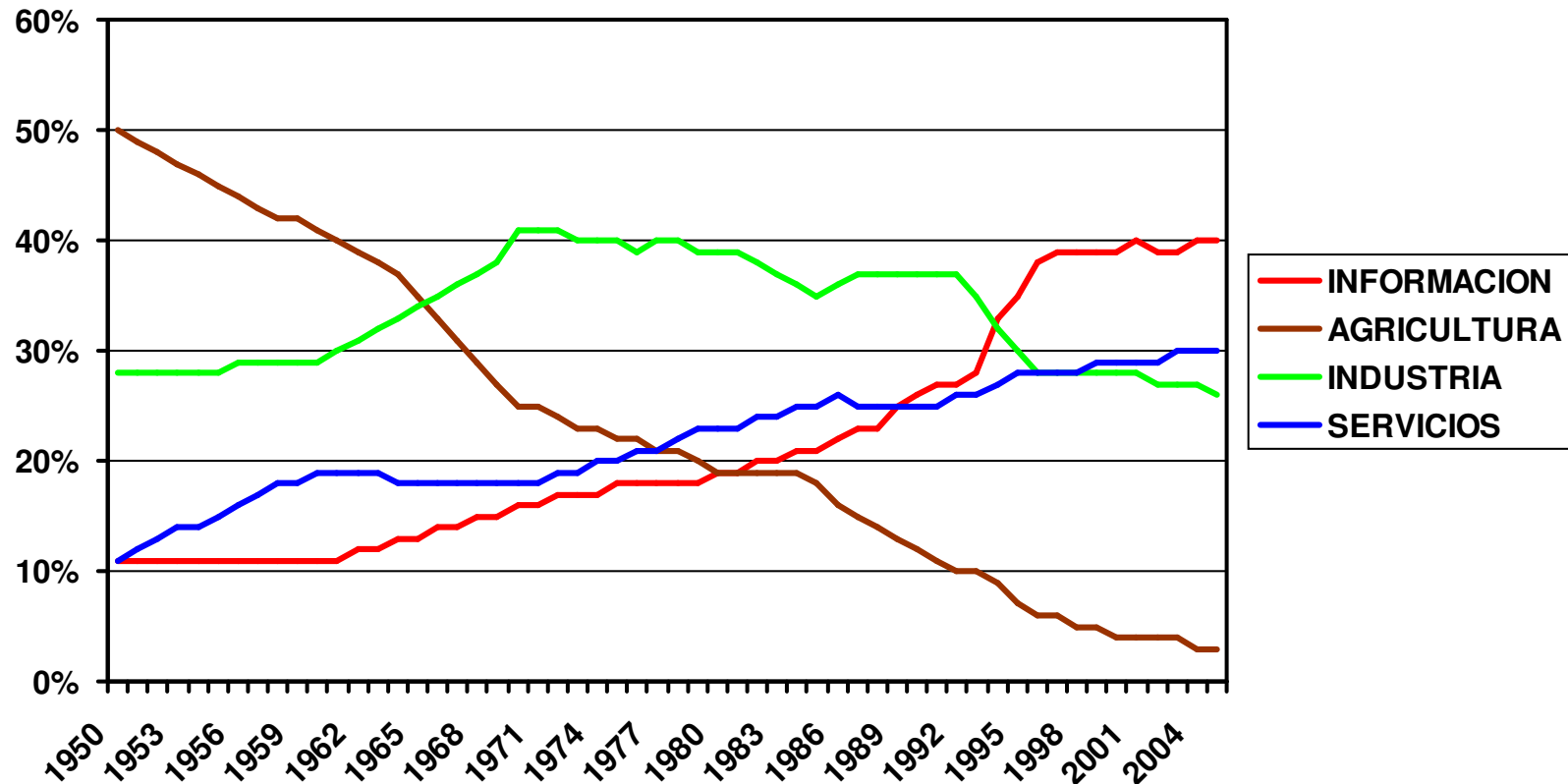
Impact of broadband investment on economic growth and employment creation

AREAS OF IMPACT	BENEFITS
Economic growth	<ul style="list-style-type: none"> • An investment in broadband of \$63 Billion in the US would achieve universal coverage, allowing the maximization of consumer surplus generated by new services, savings in transportation time and new computer applications; this would result in a cumulative increase to the GDP of \$ 179 Billion (Crandall) • A comparative analysis of similar cities where one is served by a broadband infrastructure leads to an improvement of economic growth of 28% (Ford)
Employment	<ul style="list-style-type: none"> • An investment leading to universal broadband coverage in the US results in an annual increase of 61,000 jobs (Crandall) • An investment in broadband in one of two adjacent cities attracts investment of 140 companies (versus 9 for the other city) generating 4,250 additional jobs (Kelly) • Broadband investment at the end of the last century in the US resulted in an increase in employment of around 1.5% at the aggregate level (Sirbu)

3. Spanish evidence

The Spanish economy has undergone a structural change over the last fifty years transitioning towards an information economy

SPAIN: BREAKDOWN OF ECONOMICALLY ACTIVE POPULATION (1950-2005)

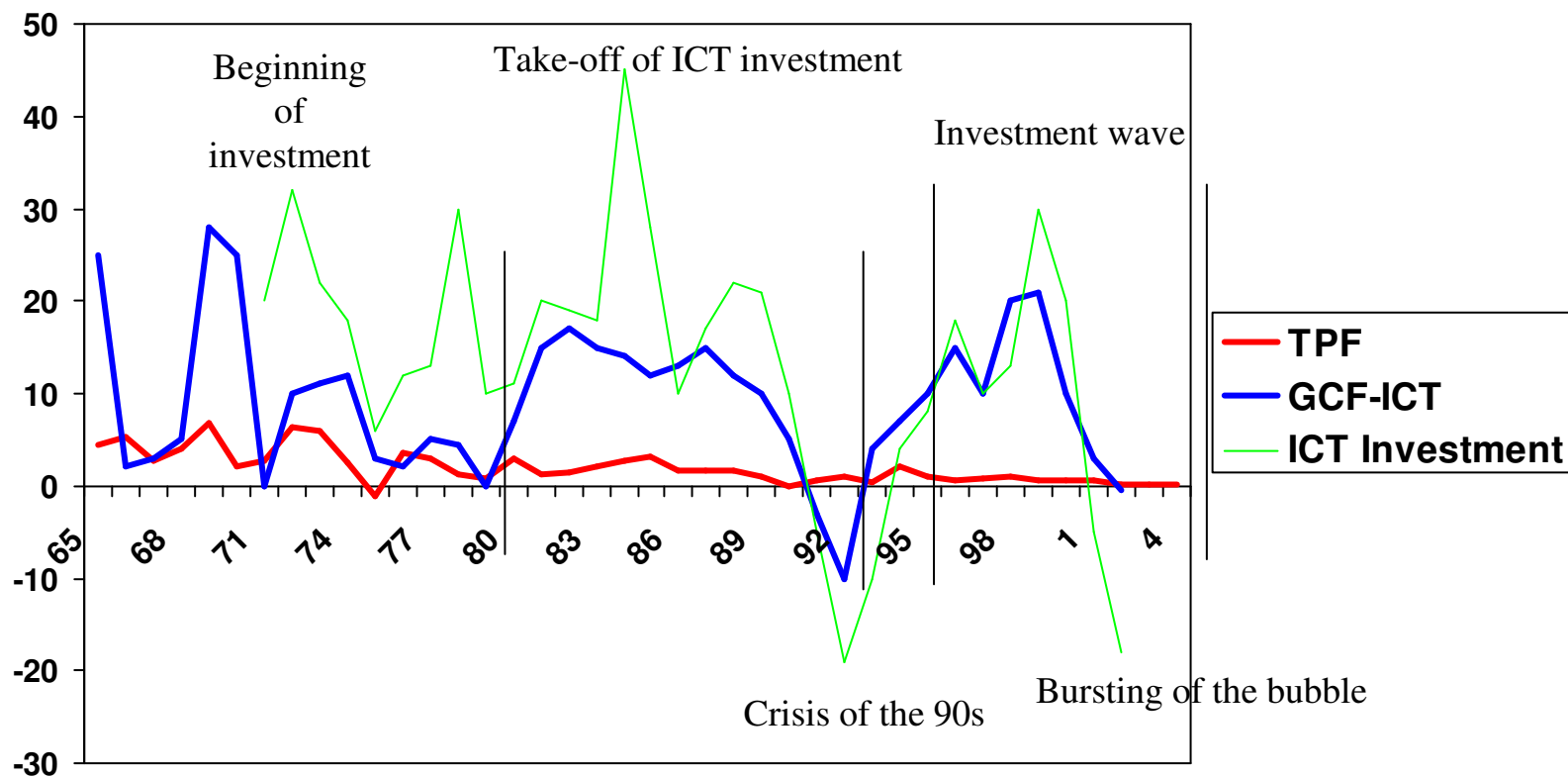


Nota: Los trabajadores de la informacion incluyen ejecutivos, administradores, profesionales, tecnicos y empleados administrativos

Fuentes: OIT; Análisis TAS

However, in the aggregate, the causal relationship between investment in ICT and productivity is not clear

SPAIN: Y-T-Y CHANGE IN ICT FIXED CAPITAL FORMATION AND TOTAL FACTOR PRODUCTIVITY



Note: ICT investment is calculated in current prices while ICT-Fixed Capital Formation is presented in real terms.

Sources: Gual, J. Et al. (2006); Quesada et al. (2006); Aniel

Two structural features of the Spanish economy explain the lack of impact of ICT on aggregate productivity

- **Employment growth:** the aggregate numbers are biased by the construction sector, which is a sector that has generated a large part of employment growth in the last decade
- The sectors that have benefitted more from the development of the telecommunications industry and the generalized investment in ICT are the ICT-intensive industries, which show an important increase in productivity

GROWTH IN LABOR PRODUCTIVITY

	1995-2000	2000-02	Change	Impact
Total	0,48%	0,71%	0,23%	
Not ICT intensive	-0,12%	0,30%	0,41%	
ICT intensive	0,67%	1,23%	0,57%	
Paper, print	0,25%	0,93%	0,68%	Impacto menor
Finance	1,22%	5,84%	4,63%	Accelerating
Energy	6,18%	5,89%	-0,29%	High constant impact
Transport and Commun.	2,52%	1,93%	-0,59%	Moderate impact

Source: Mas y Quesada (2006)

- **The structure of the Spanish economy shows a preponderance of Small and Medium Enterprises, a sector that is significantly slower than the rest of firms in adopting ICT**

Furthermore, emerging research regarding the impact of ICT on the Spanish economy is not yet conclusive

YES

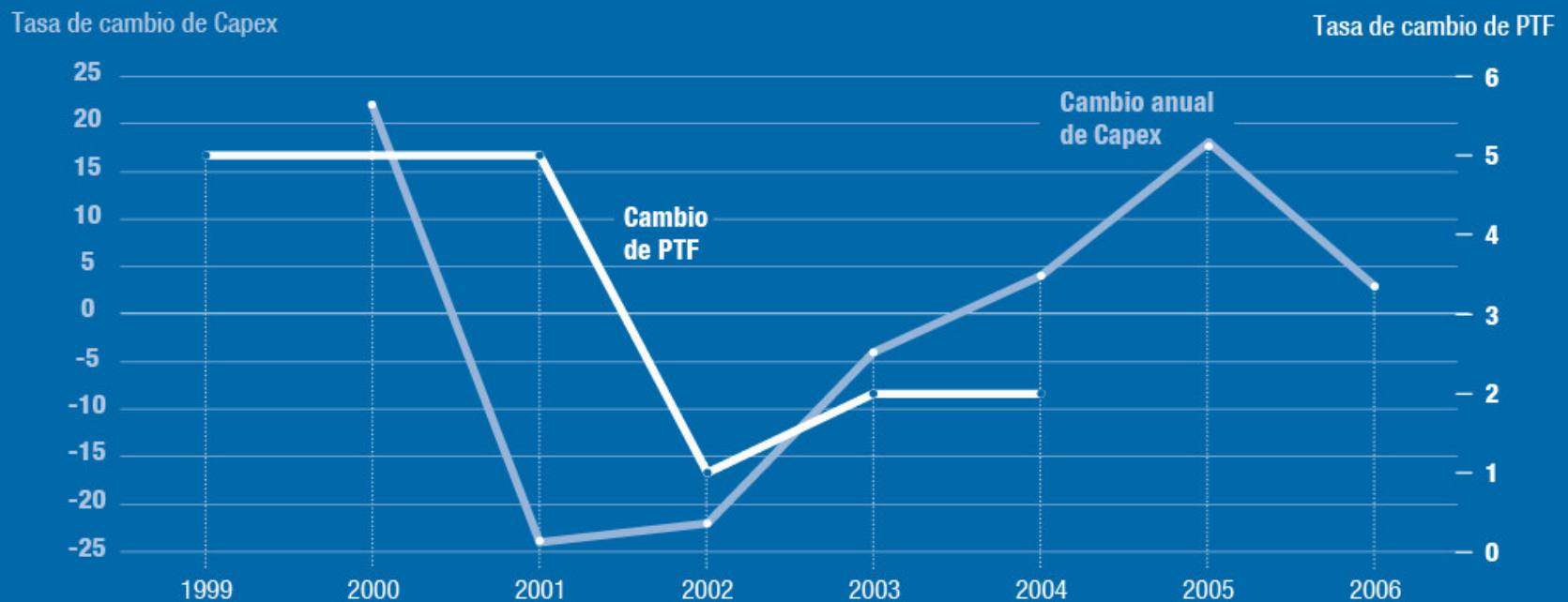
- Hernando and Nunez argue that ICT investment in 1990 had a positive impact on Spanish productivity
 - Study based on enterprise statistics aggregated at the sectorial and economy level
 - Concludes that ICT contribution to value-added increased from 0.29 pp in 1992-5 to 0.45 pp in 1996-00
 - In that sense, ICT contribution has been 0.10 for each percentage point of economic growth (compared to 0.25 in the US)

NO

- Gual, Rosello and Posino argue that given the slow-down in productivity growth in the 21st century, ICT is not having a positive impact on TFP
 - Productivity grew 2.18% between 1980 and 1994, dropping to 0.68% between 1995 and 2000
 - ICT capital stock as % of the GDP increased from 1.93% to 4.58%
 - Institutional and regulatory barriers are limiting the impact of ICT on the economy
- Mars and Quesada argue that the important ICT investment has not materialized in TFP improvement due to the lack of intangibles

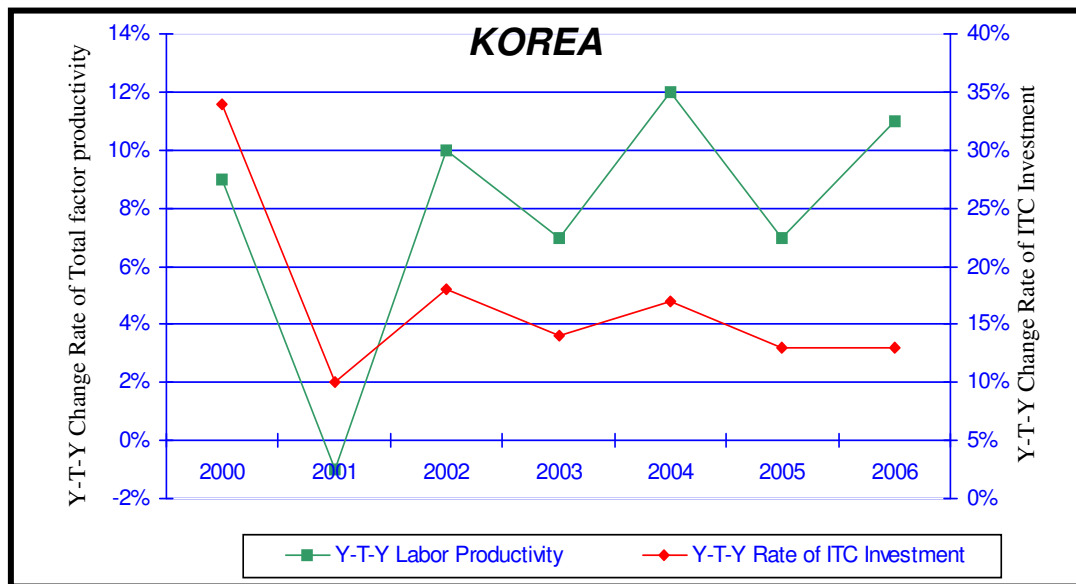
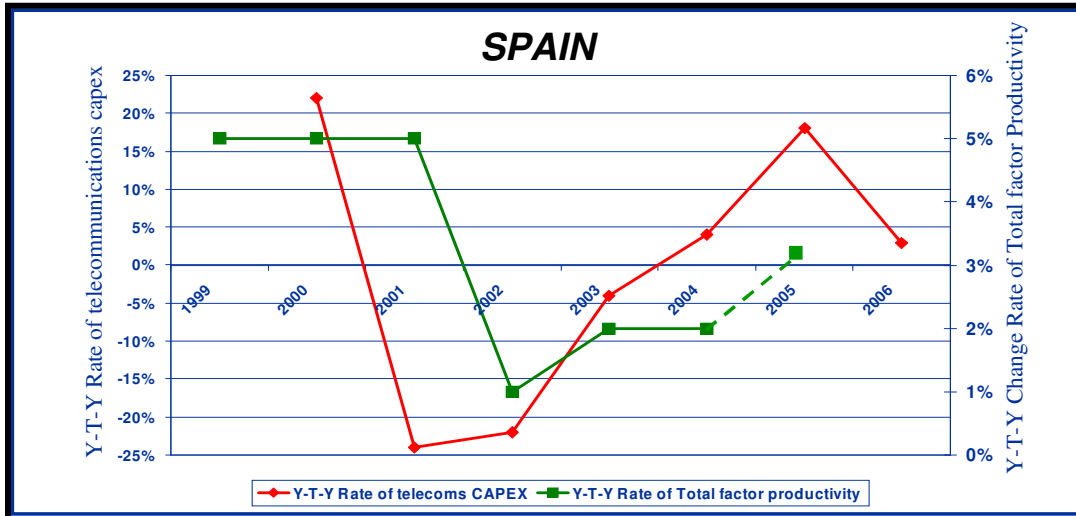
Our assessment of Y-t-Y change in telecommunications CAPEX and PTF indicates the presence of a direct relationship

2. Inversión de capital de telecomunicaciones y tasa de variación Interanual de la productividad en España. %



Fuente: CMT (2006); Gual et al. (2006); Análisis ENTER

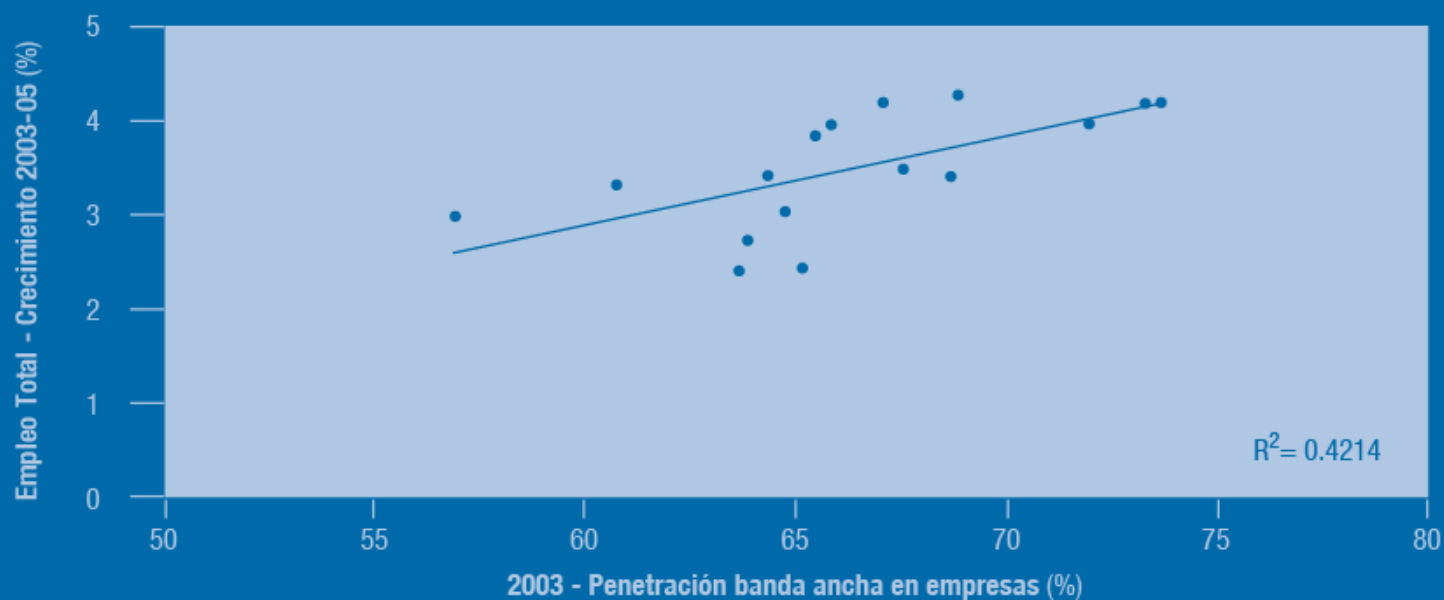
However, the relationship pattern between the two variables in Spain is different from the one in Korea



- The rate of change of ITC investment has been found to be directly linked to Total Factor Productivity change
- Impact can be achieved almost simultaneously or with a time lag
- Time lag has been found to be driven by an economy's ability to immediately assimilate the investment in ITC as a result of high level of human resource training and flexible production processes ("intangible capital")

In addition, consistent with the US evidence, broadband penetration in the business segment appears to have an impact in employment growth

4. Relación de causalidad entre banda ancha y empleo en España.

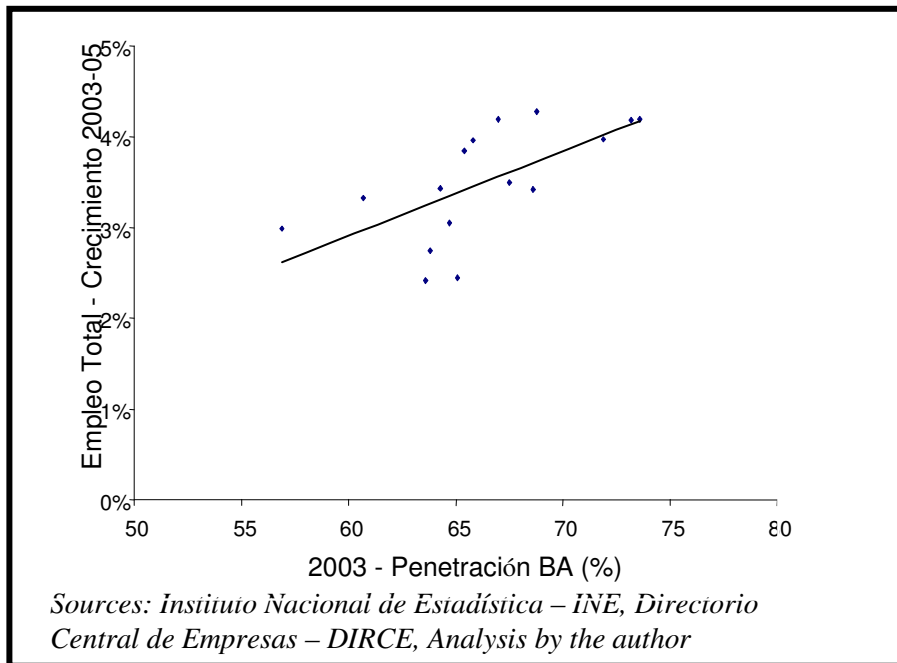


Fuente: CEPREDE (2007); INE; Análisis ENTER

The relationship between broadband and employment appears to be stronger in Spain than in South Korea

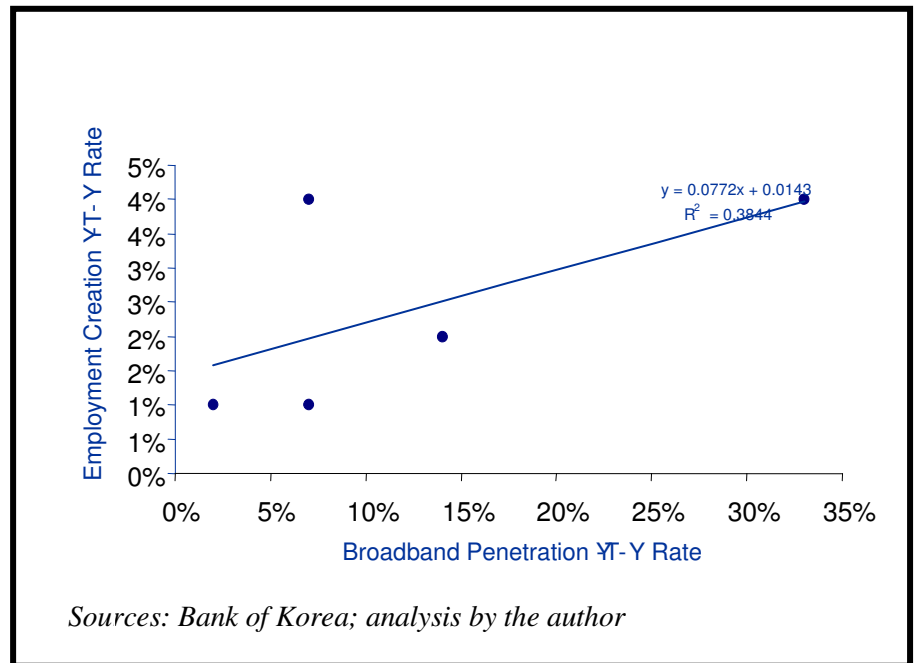
BROADBAND PENETRATION AND CREATION OF EMPLOYMENT

SPAIN



A 5% increase in broadband adoption by enterprises (SMEs included) results in a .6% of percentage point improvement in job creation

KOREA



A 5% increase in broadband adoption by enterprises (SMEs included) results in a 0.4% improvement in job creation

In sum, a positive relation between ICT investment and broadband penetration on one side, and productivity and employment growth

Structural transformation of the Spanish economy, indicating a transition toward an information society

Growing causal relation between diffusion and assimilation of ICT and economic growth

Positive relation between telecom Capex change and TFP change

A 5% increase in broadband adoption by enterprises results in a 0.6 % improvement in job creation

4. Implications

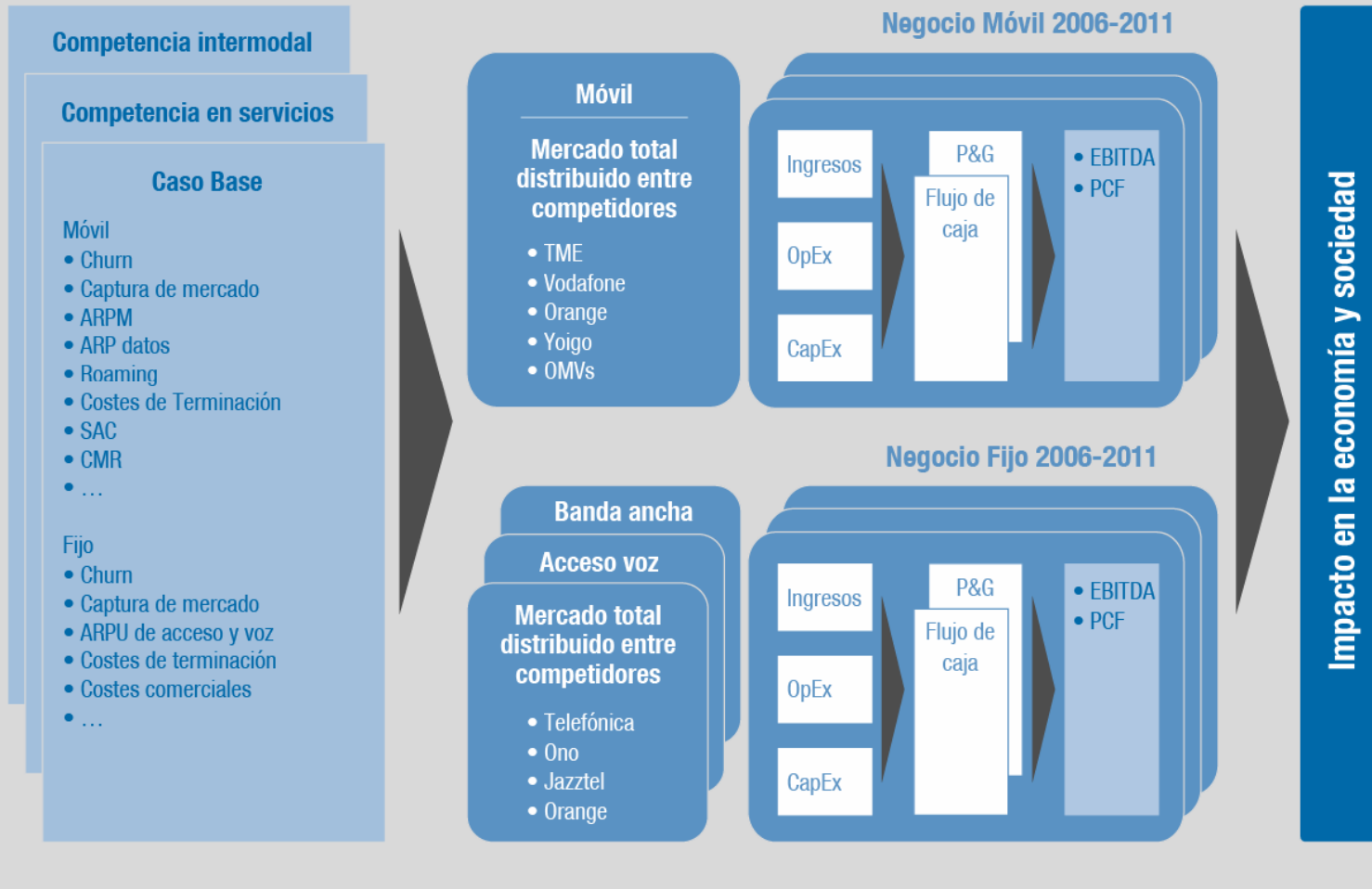
Hypothesis

If productivity growth and employment creation are driven partially by the level of investment in ICT and telecommunications, a decrease in Capex as a result of a certain regulatory framework could have an impact on the economy

- **A growing regulatory pressure resulting from service-based competition on carriers capable of investing in infrastructure could result on a reduction in CAPEX**
- **A decline in CAPEX, including broadband deployment, could have a negative impact on the productivity growth and employment generation**

An industry simulation model was built to determine the impact of alternative regulatory frameworks on level of investment

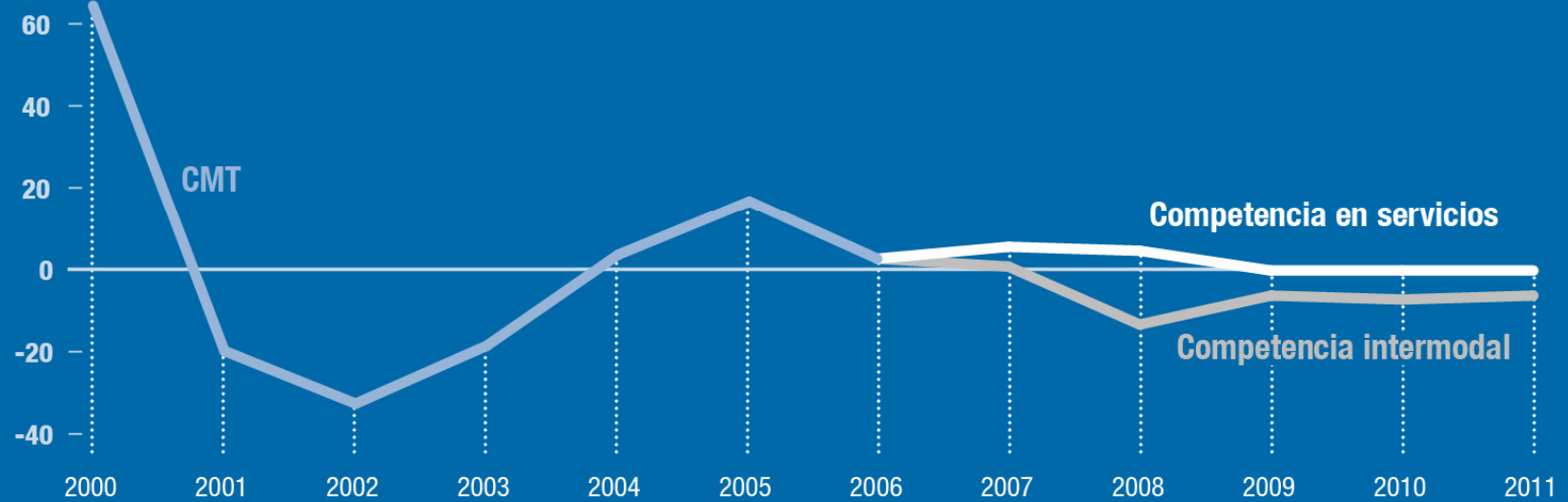
34. Modelo de simulación del mercado y el sector



We forecast two CAPEX scenarios

5. Evolución de la inversión de capital en telecomunicaciones en España.

2000-2011, tasa de variación interanual, %

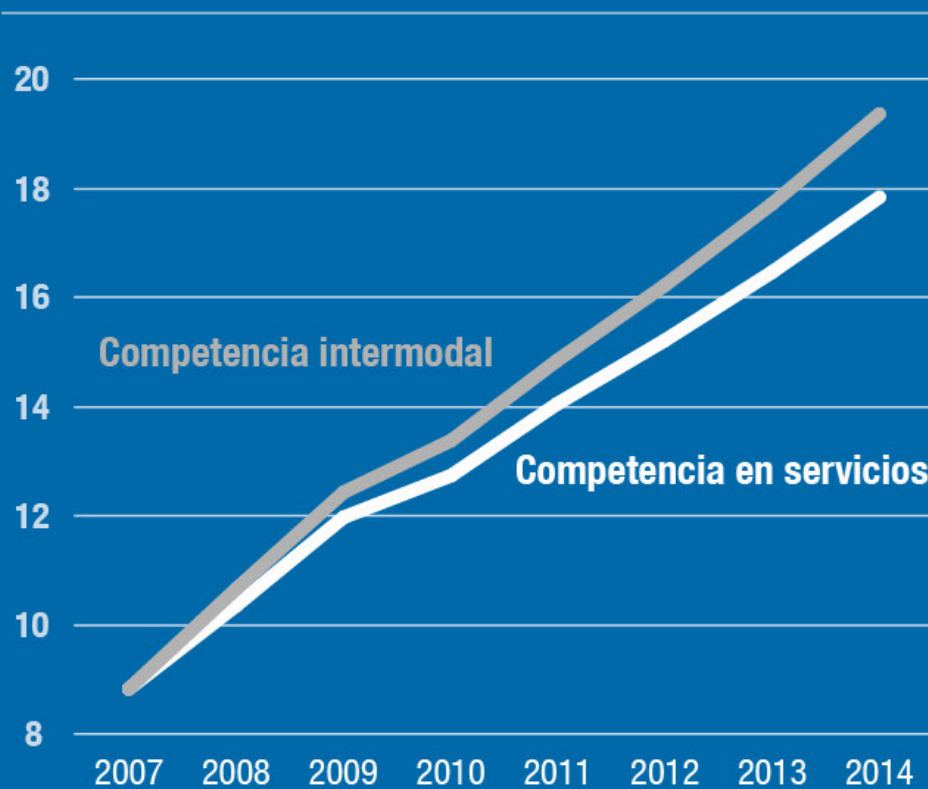


Fuente: CMT; Análisis ENTER

We also forecast two scenarios of broadband deployment, factoring in the deployment of fiber optics

45. Accesos totales de banda ancha

Millones

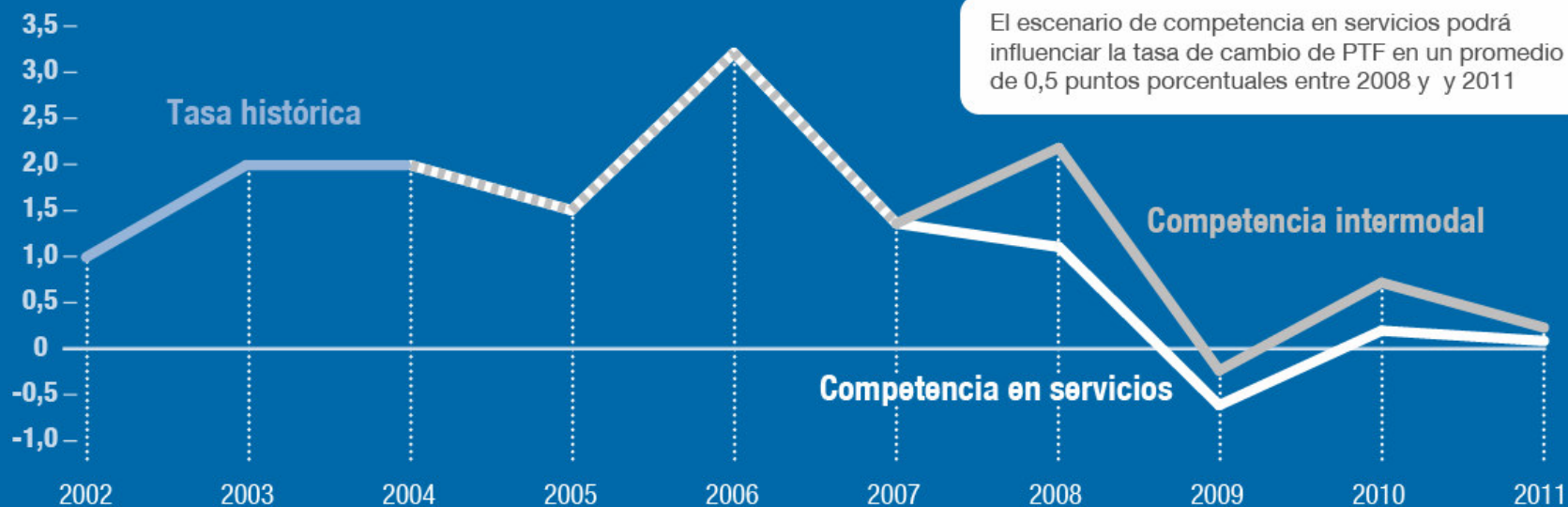


Fuente: *Análisis ENTER*

Industry scenarios yield different evolution in TFP Y-T-Y changes

6. Tasa de variación interanual en la PTF histórica y por escenario regulatorio.

2002-2011, tasa de variación interanual, %



Nota: La proyección de la tasa de cambio interanual de la PTF es hecha sobre la base de la influencia que puede tener la inversión de capital en telecomunicaciones. La reducción en 2009 se debe a la disminución de capital proyectado en móviles. Esto no significa que la PTF disminuirá, sino que la disminución de inversión en móviles afectará su tasa de cambio negativamente

Fuente: CMT; Análisis ENTER

A similar effect could be seen if incremental fiber were to be deployed

48. Impacto de los escenarios de banda ancha en la creación de empleo

Escenario	Accesos incrementales en 2011 (vs. 2007)			Accesos incrementales en 2014 (vs. 2007)				
	Número	Penetración incremental		Crecimiento empleo	Número	Penetración incremental		Crecimiento empleo
		Residencial	Empresas			Residencial	Empresas	
Extrapolación de tasa de despliegue actual	3.300.000	12%	47%	0,36%-1,41%	6.200.000	21%	78%	0,63%-2,34%
Plan de despliegue básico	5.400.000	21%	79%	0,63%-2,37%	9.200.000	31%	121%	0,93%-3,63%

Fuente: Análisis ENTER

Conclusions

Service-based competition could have a negative effect in the deployment of infrastructure and, consequently, on the Spanish economy

This negative effect could be accentuated if the public policy focus is put on the resolution of market failures, to the detriment of the creation of conditions favorable to the assimilation of ICT

Service-based competition could have a negative impact of productivity of around 0.50 percentage points in the next five years

Alternatively, fiber deployment stimulated by intermodal competition could yield an incremental growth of 21,000 to 35,000 jobs per year in the next five years