

***ICT impact on entrepreneurship: econometric estimates to the panel of countries***

**Banco de la República: SEMINARIO DE ECONOMIA**

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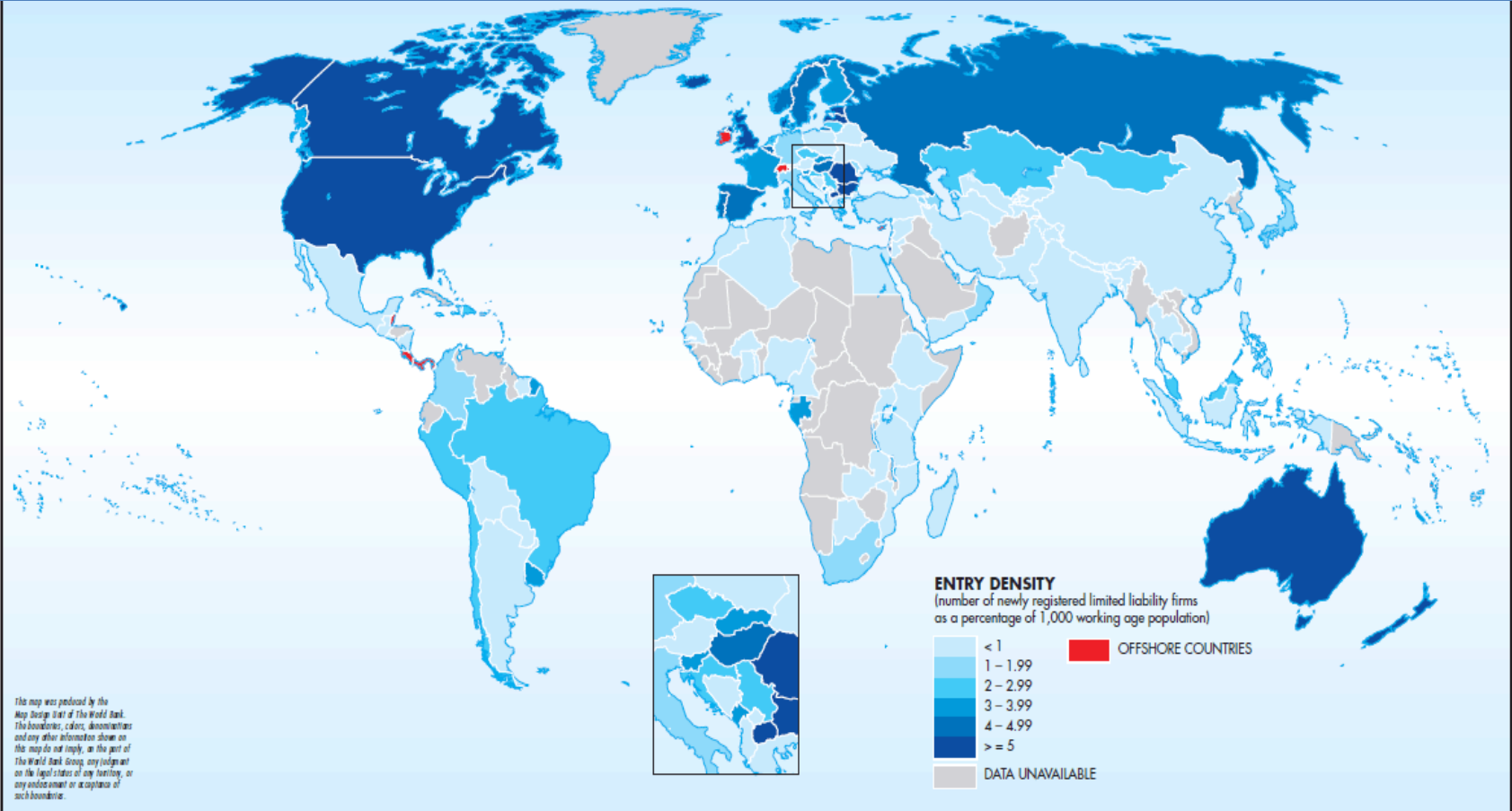
# Outline

1. Motivation
2. Theoretical Approaches
  - 2.1 Entrepreneurship theoretical approaches
  - 2.2 Empirical Evidence: Main works
3. The Model
4. Stylized Facts
5. Results and Conclusions

# Goal of the Paper

- Approach the study of causal relationships between ICT and entrepreneurship.
- Make some initial econometric estimates of this relationship.

# Entrepreneurship Snapshots



**Data profile:** Years: 2004-2009; Economies: 109 Objective: Benchmark entrepreneurship and private sector development

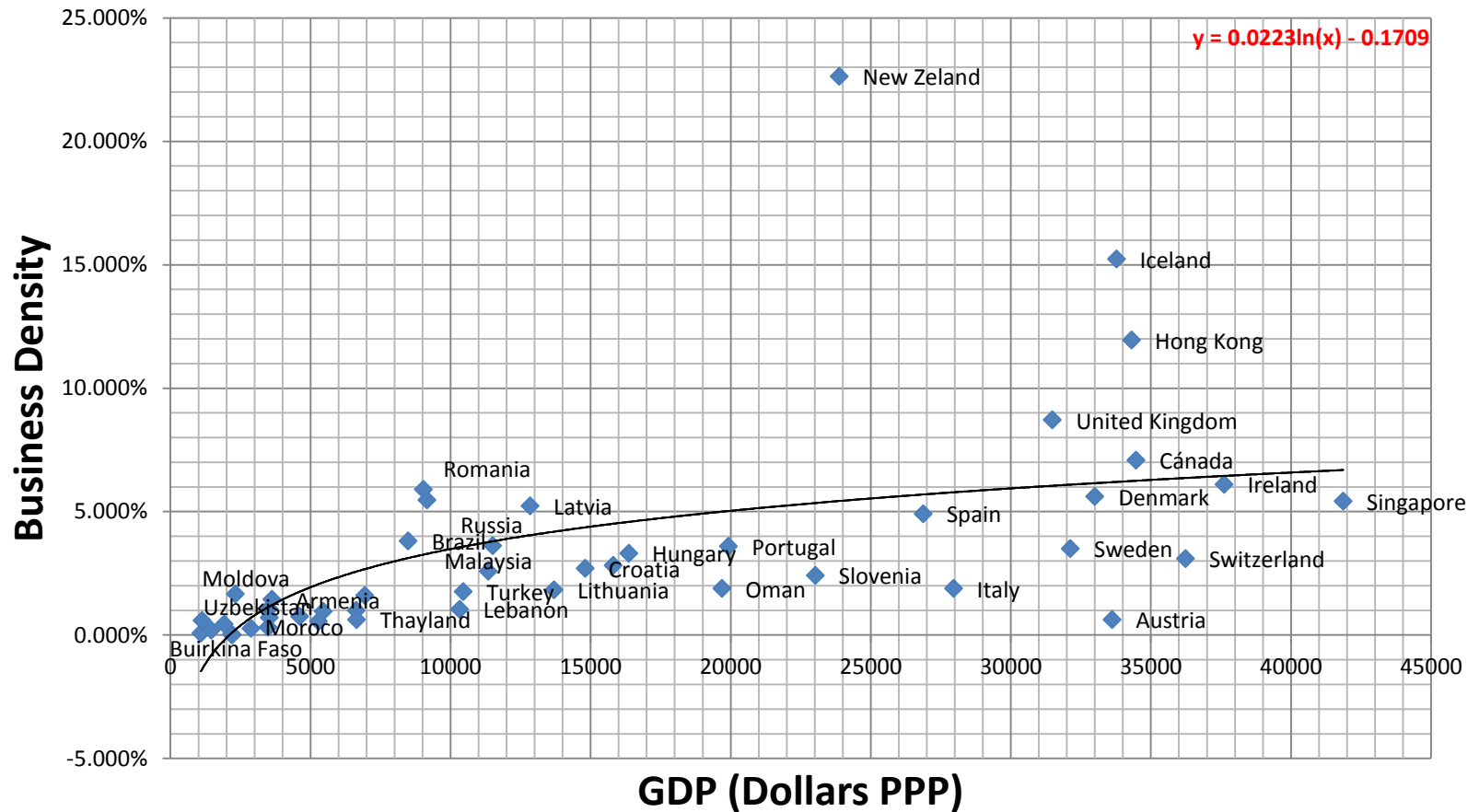
Source: [World Bank Group Entrepreneurship Database](#)

ICT impact on entrepreneurship

# Motivation

- One of the variables which stimulates economic growth of countries is the level of entrepreneurship as demonstrated by the work of Morris (2001), Carree and Thurik (2003), Stel (2005)
- Also address the growing concerns about economic growth and competitiveness in world markets, governments have responded to this new evidence policies encouraging entrepreneurship (Audretsch and Thurik, 2001, OECD, 1998).
- Several studies (eg Audretsch and Thurik (2001), Thurow (2003)) stressed the need to study the role of ICT in generating new business.
- The typical features of the entrepreneurial process, its environment and innovative potential has the following characteristics:
  - The intensive information content and knowledge (Role of decisions)
  - The fundamental role of human resources as a factor of systemic competitiveness.
  - The importance of learning curves and channels for technology transfer.
  - The level of economic and institutional development and technological environment has special features on the entrepreneurial process.

## Business Density and its relationship with GDP per capita (Average for the Panel, period 2002 - 2006)

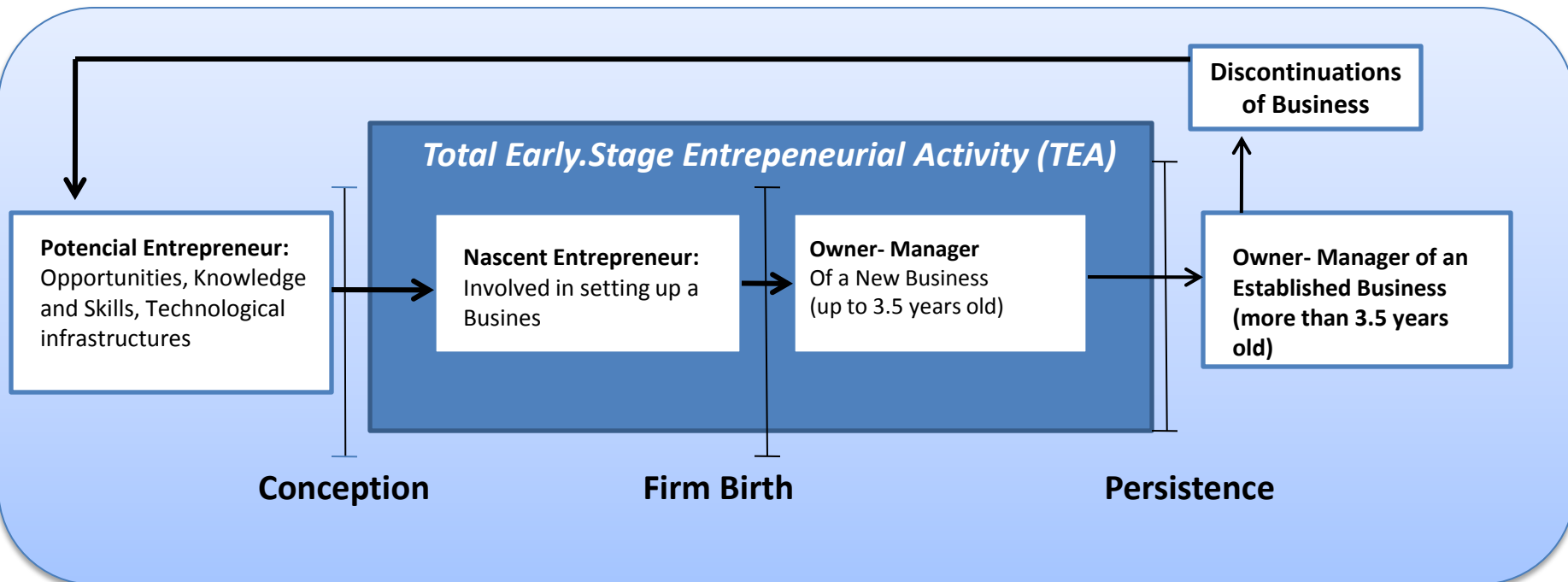


Source: GAuthor's calculation based *Global Entrepreneurship Monitor (GEM and IMF)*

## 2.1 Concept of Entrepreneurship

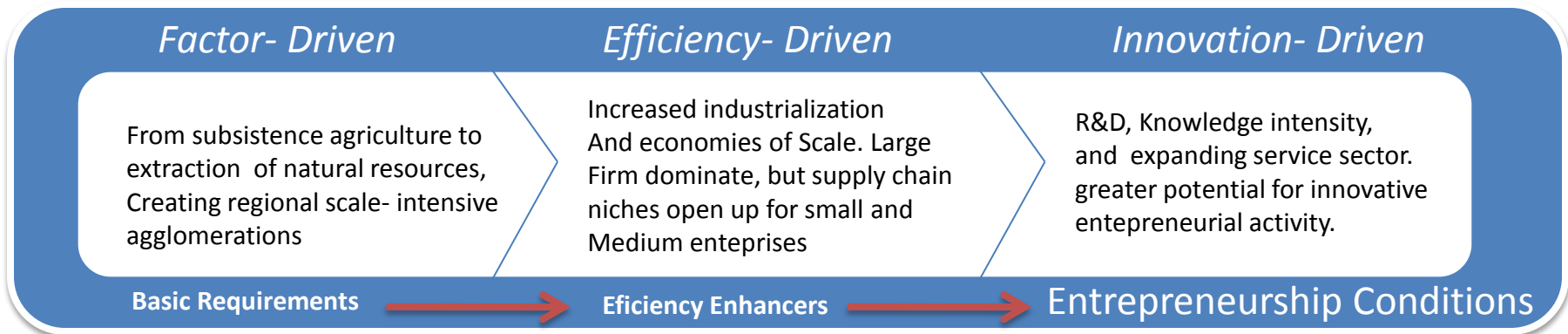
- One of the variables which stimulates economic growth of countries is the level of entrepreneurship Morris (2001); Carrée y Thurik (2003); Stel (2005).
- The work of Kline and Rosenberg (1986) define the limits of the level of entrepreneurship:  
"It's not a linear process, automatic and systematic, but a system of interactions and feedbacks between different functions and participants whose experiences and knowledge are iterated and intertwine each other and in turn build up. "
- The enterprise is defined from a multidimensional, and relates to the behavior of individuals to carry out new risks or business. Entrepreneurship is synonymous with innovation, self-employment or own business (Webster's Third New International Dictionary of the Inglés Language, unabridged (1976), Encyclopedia

# Entrepreneurial Process

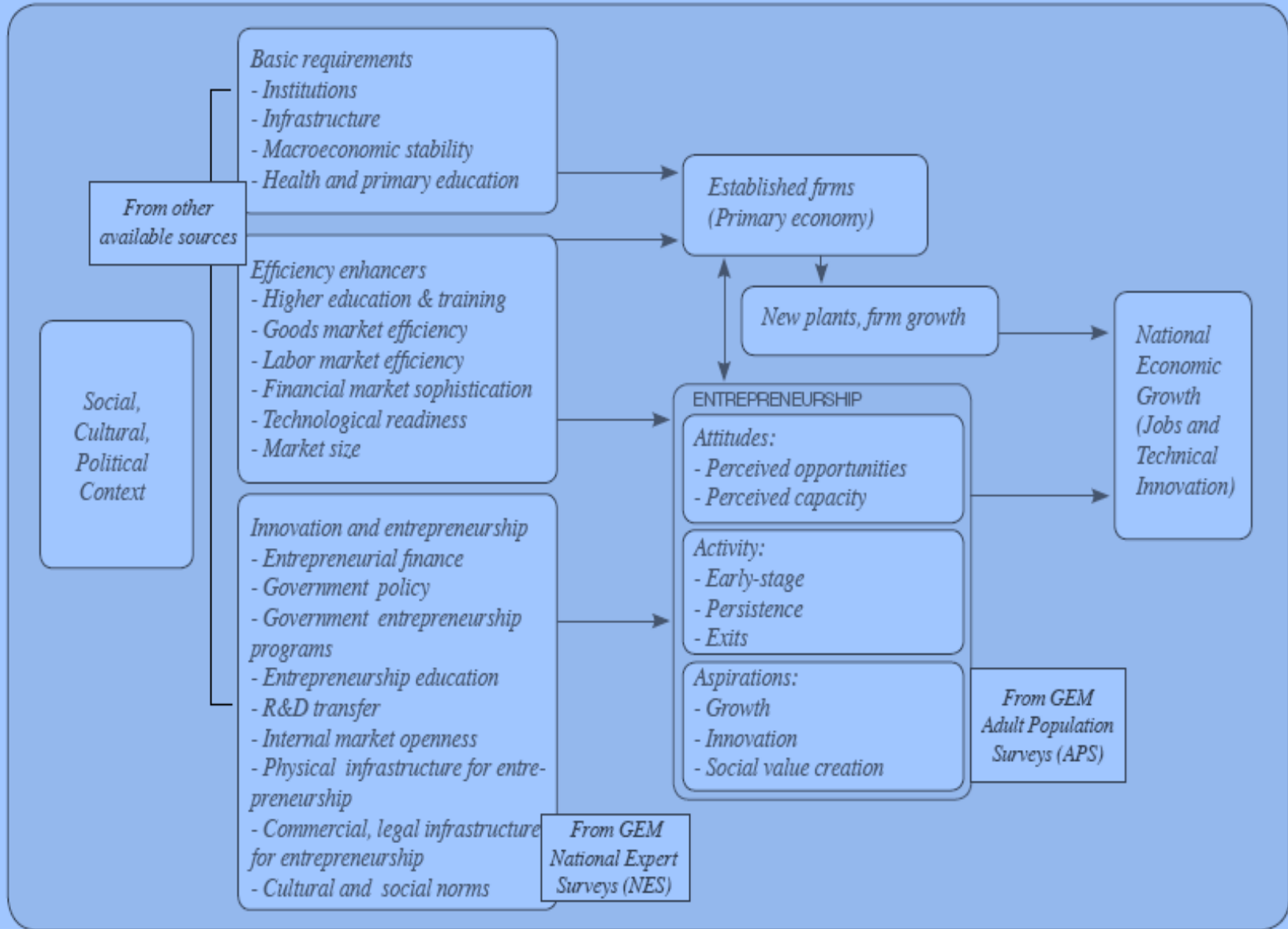




# Entrepreneurial Process



# Entrepreneurship Environment




## 2.2 Theoretical Approaches (1)

### 1. Entrepreneurship like Innovation process

**Line 1:** (Solow, 1956; Swan, 1956; Harrod 1949): Total Factor Productivity (TFP)

**Line 2:** Romer, 1986 y 1990; Mankiw, Romer y Weil, 1992; Grossman y Helpman (1991).

**Line 3:** Tebaldi y Elmslie (2007), Engerman y Sokoloff (1997), Acemoglu y otros (2001) y (2004), Easterly y Levine (2003).

$$Y = H_B^Y \int_0^{F(A,T)} (X(i)^\alpha di$$


$$\left[ Y - \left[ H_Y^\beta X i^{\alpha+1} \right]_0^{F(A,T)} \right] = \theta$$

$H$  = Human Capital

$Xi$  = Intermediate inputs

$A$  = Knowledge

$T$  = Institutional Quality (Sala-i-Martin (2002))

$$\forall \alpha : 0 \leq \alpha \leq 1$$

$$\forall \beta : 0 \leq \beta \leq 1$$

$$\alpha + \beta = 1$$

$\theta$  = Technical Progress Indicator: New Processes and businesses. Exogenous

Hall (1988) believes that innovation, in the sense of productivity can not be conceived as the "Solow residual"

Imperfect competition in the innovation function is different to that related to this waste:

1) Difficult to test the substitutability of factors in the short term.

2) No normal data with which models are implemented.

## 2.2 Theoretical Approaches (2)

1. Prior knowledge (prior accumulation of technological capabilities, Lall, 1992). The incorporation of learning curves. (Pavitt, 1997, Nelson and Sampat, 2001).
2. The environment in which the entrepreneurial process develops (Thomas, 1993).
3. Type of qualification of the workforce. Nelson y Winter (1982); Pavitt (1997); Dosi (1988a, 1988b y 1997).
4. Specificity of the level of entrepreneurship (Incremental or radical processes. (Afuah, 1999).
5. Also address the growing concerns about economic growth and competitiveness in world markets, governments have responded to this new evidence policies encouraging entrepreneurship (Audretsch and Thurik, 2001, OECD, 1998).
6. Porter and Stern., (2002). Thurow (2003) and Audretsch and Thurik (2001) the degree of economic development of each country plays a role when ponderarte entrepreneurial behavior observed over time, because for low-income countries and half the level of entrepreneurship is different from high-income countries, this because for the first, the process of enterprise creation is crucial to the extent that streamlines in the long run their economies.

Papers	Methodological characteristics	Scenario
Carree and Thurik (2003); Geroski and Jacquemin (1985); OECD (1998).	<ul style="list-style-type: none"> <li>Econometric estimates where the output enterprise depends on the level of income, unemployment, education levels, cost of capital, and demographic variables.</li> </ul>	<u>Macroeconomics Variables</u>
Wennekers et al (1999)	<ul style="list-style-type: none"> <li>Analyze cultural and institutional factors that determine the level of entrepreneurship.</li> </ul>	Qualitative analysis
Jensen (1993), Freeman and Pérez (1988)	<ul style="list-style-type: none"> <li>Study the impact of ict level of entrepreneurship on the industry. Panel Data Analysis</li> <li>Have shown that ICT has reduced transaction costs and allowed efficient scaling of the industries, which has opened doors for many small businesses either new or existing industries initiate plans for productive investments in various areas of the economy</li> </ul>	<u>ICT and Industry</u>
Audretsch and Thurik (2001); Thurow (2003)	<ul style="list-style-type: none"> <li>Have shown that ICT has reduced the importance of economies of scale in many sectors which has spurred the creation of small and new businesses.</li> </ul>	<u>ICT and Industry</u>
(Lopez, 1996).	<ul style="list-style-type: none"> <li>Study the relationship between investment in technology, human resources and entrepreneurship OLS</li> <li>Positive relationship</li> </ul>	Spain
Berman et al (1998), Caroli and Van Reenen (1998), Berndt et al (1992), Katz and Murphy (1992), Bell (1996), Acemoglu (1998), Goldin and Katz (1998), Caroli and Van Reenen (2001).	<ul style="list-style-type: none"> <li>Skill biased technical Change</li> <li>The introduction of new technologies increases the demand for workers with better qualifications</li> </ul>	Microeconomics

# The model

## Panel Data Specification: ICT impact on entrepreneurship

$$E = \alpha' NT + X\beta + u = Z\delta + u$$

where

$$u' = (u_{11}, \dots, u_{1T}, u_{21}, \dots, u_{2T}, u_{N1}, \dots, u_{NT})$$

$$Z_{\mu} = I_N \otimes l_t$$

$I_N$  = Identity Matrix Dimensión N

$l_t$  = Ones Vector de dimensión T

$\otimes$  = Kronecker Q

$Z_{\mu}$  = selector Matrix (1 y 0)

$$E_{i,t} = \alpha + X'_{i,t}\beta + u_{i,t}$$

$$\{i = 1, 2, 3 \dots 49\}$$

$$\{t = 1, 2, 3 \dots 49\}$$

$$u_{i,t} = \mu_i + v_{i,t}$$

$$u_{i,t} \sim \mathbf{N}(\mathbf{0}, \sigma^2)$$

$$E_{i,t} = \alpha + X'_{i,t}\beta + \mu_i + v_{i,t}$$

$$\bar{E}_{i,t} = \alpha + \bar{X}'_{i,t}\beta + \mu_i + \bar{v}_{i,t}$$

Where :

$$\bar{E}_{i,t} = \sum_{i=1}^n E_{i,t} / NT$$

define :

$$\tilde{E} = (E_{i,t} - \bar{E})$$

$$\tilde{X} = (X_{i,t} - \bar{X})$$

$$\rightarrow (E_{i,t} - \bar{E}) = \beta(X_{i,t} - \bar{X}) + (v_{i,t} - \bar{v})$$

$$\tilde{E}_{i,t} = \beta\tilde{X}_{i,t} + \tilde{v}_{i,t}$$

## The Model

### Panel Data Specification: ICT impact on entrepreneurship

$$\tilde{E}_{i,t} = \alpha + \sum_{k=1}^K \beta_{k,i,t} ICT_{k,i,t} + \sum_{k=1}^K \rho_{k,i,t} F_{k,i,t} + v_{i,t}$$

$$\{i = 1, 2, 3 \dots 49\}$$

$$\{t = 1, 2, 3 \dots 49\}$$

$$u_{i,t} = \mu_i + v_{i,t}$$

$$u_{i,t} \sim N(0, \sigma^2)$$

$$\mu_i \neq 0 \rightarrow \text{FixedE}$$

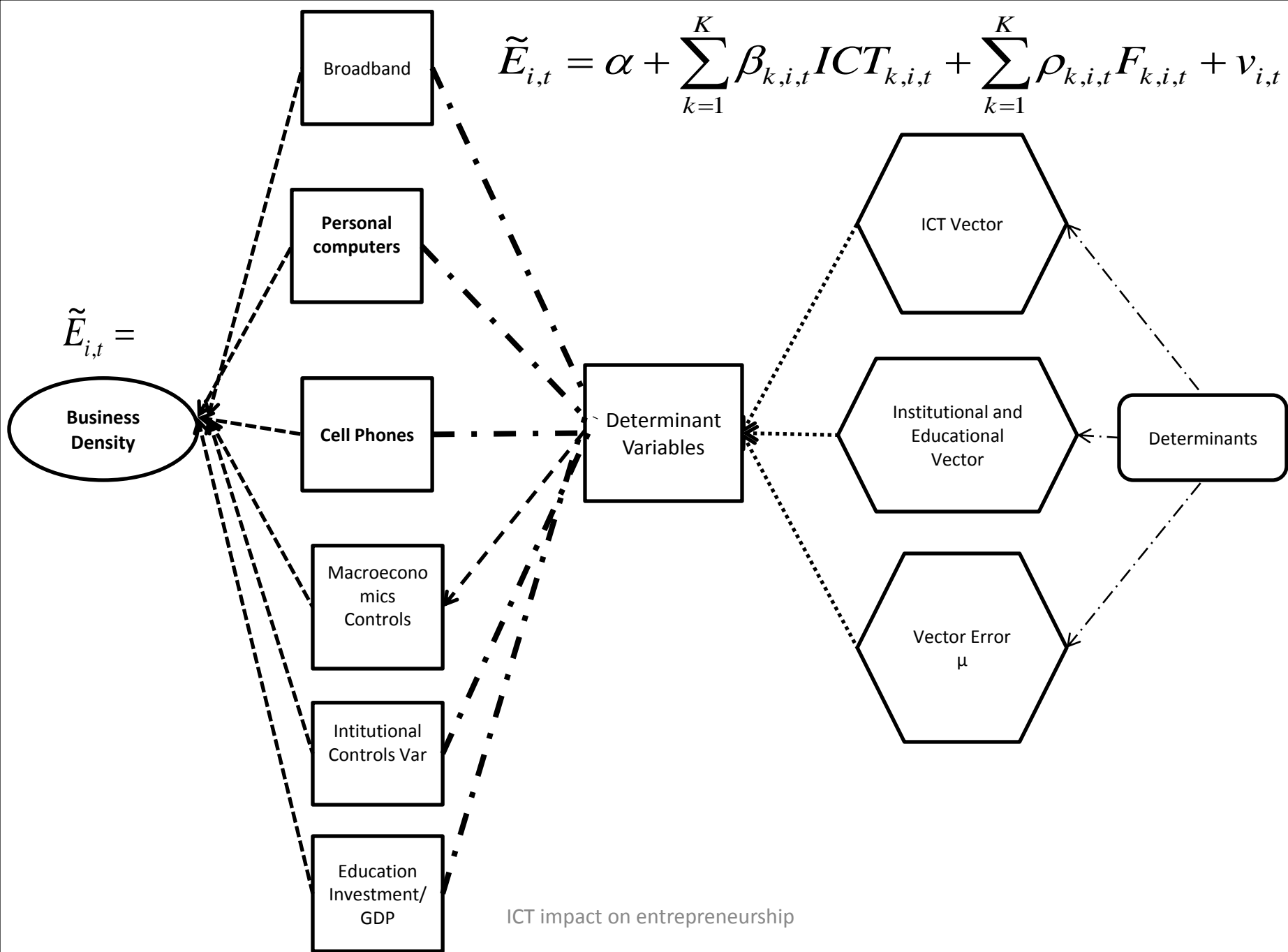
$\tilde{E}_{i,t}$  = Business Density

$ICT_{k,i,t}$  = ICT Vectors

$F_{k,i,t}$  = Control Variables

$\beta_{k,i,t}$  and  $\rho_{k,i,t}$  = Within Estimators

$$\tilde{E}_{i,t} = \alpha + \sum_{k=1}^K \beta_{k,i,t} ICT_{k,i,t} + \sum_{k=1}^K \rho_{k,i,t} F_{k,i,t} + v_{i,t}$$





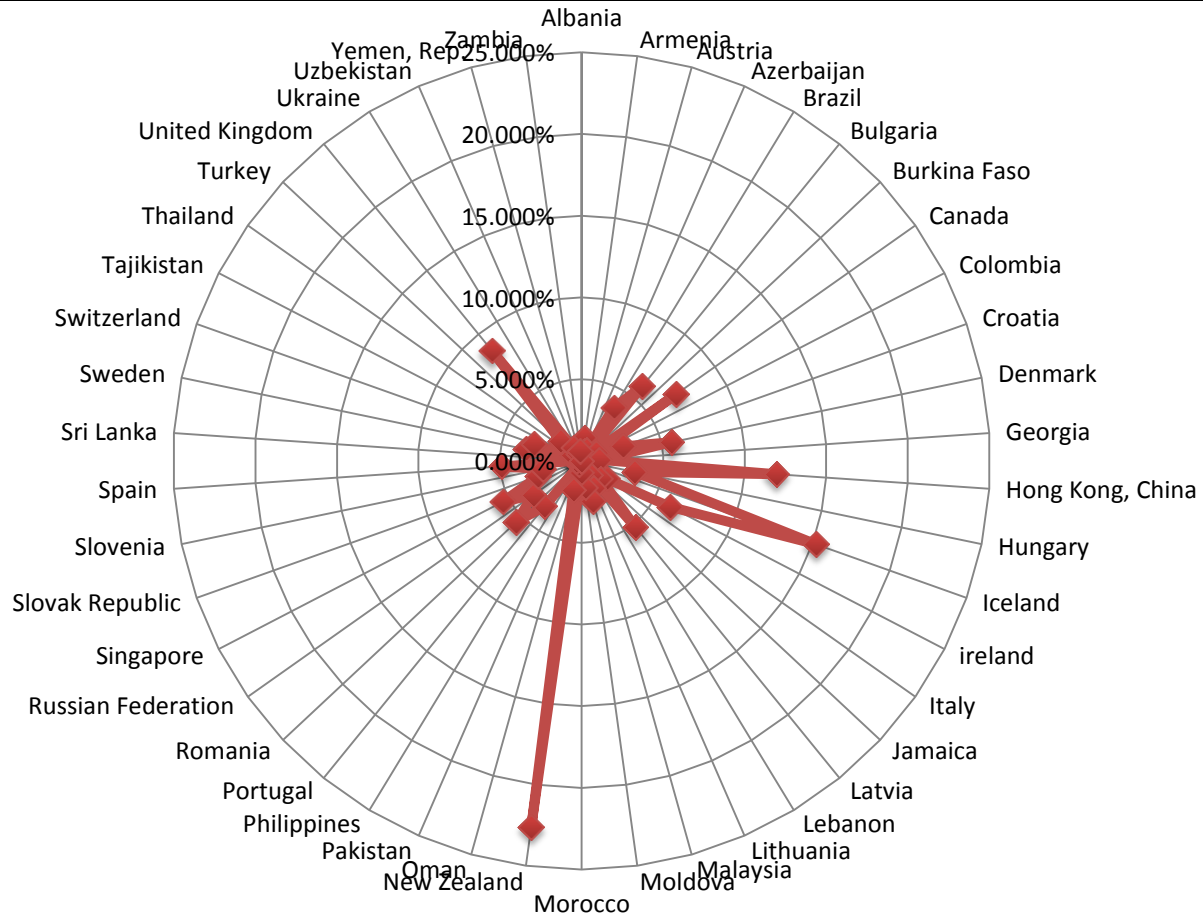
		VARIABLES	DESCRIPTION	SOURCE	
				<b>Business Density</b> $\tilde{E}_{i,t}$	Business Density as percent of WAL.
Model Variables	Independent Variables	ICT environment	<b>Broadband subscribers (per 100 people)</b> $ICT_{1,i,t}$	Broadband subscribers are the total number of broadband subscribers with a digital subscriber line, cable modem, or other high-speed technologies, although definitions may vary from country to country.	World Development Indicators Online. 2008. World Bank
			<b>Personal computers (per 100 people)</b> $ICT_{2,i,t}$	Personal computers (per 100 people)	Millennium Development Goals Database. United Nations Statistics Division
			<b>Cell phones (per 100 people)</b> $ICT_{3,i,t}$	The number of subscribers per 100 people to a service providing acces to the telephone network using cellular technology.	World Development Indicators Online. 2008. World Bank

Control Variables

Control Variables	Human Capital	<b>Investment in education as share of GDP</b> $F_{1,i,t}$	Public investment in education as a percentage of gross domestic product	UNESCO
	Institutional Environment	<b>Regulatory quality interacted with the ease of doing business</b> $F_{2,i,t}$	Government's ability to formulate and implement policies and regulations that stimulate and promote private sector development. Indicator constructed in standard deviations ranging from -2.5 to 2.5 deviations. This index is constructed indexed to the global average, where -2.5 indicates that the worst and 2.5 the best performance. (It is an ascending scale). For more details on the construction of this index is recommended to see the paper of Kaufmann et al (2010)	The Worldwide Governance Indicators (WGI) Project.
		<b>Property Rights</b> $F_{3,i,t}$	The property rights index measures the degree to which a country's laws protect private property rights and the extent to which the government enforces the law that protects such protection. It also assesses the likelihood that private property is expropriated.  Index ranges from 0 to 100 where 0 indicates that private property is illegal and 100 indicates that the government fully guarantees freedom of privacy.	The Index of Economic Freedom, Heritage Foundation
		<b>Ease of Doing Business</b>	Rigorous quantitative measure, quantity and cost of requirements to start, operate and close a deal. The index is based on 10 factors, all weighted equally using data from the World Bank Doing Business.	The Index of Economic Freedom, Heritage Foundation
	Macroeconomic Environment	<b>Unemployment</b> $F_{4,i,t}$	Percentage of total unemployed as a percentage of the workforce	World Economic Outlook Database The International Monetary Fund.
		<b>Income per person (GDP/capita, PPP\$ inflation-adjusted)</b>	Gross domestic product per person adjusted for differences in purchasing power (in international dollars, fixed 2005 prices, PPP based on 2005 ICP).	World Economic Outlook Database The International Monetary Fund.

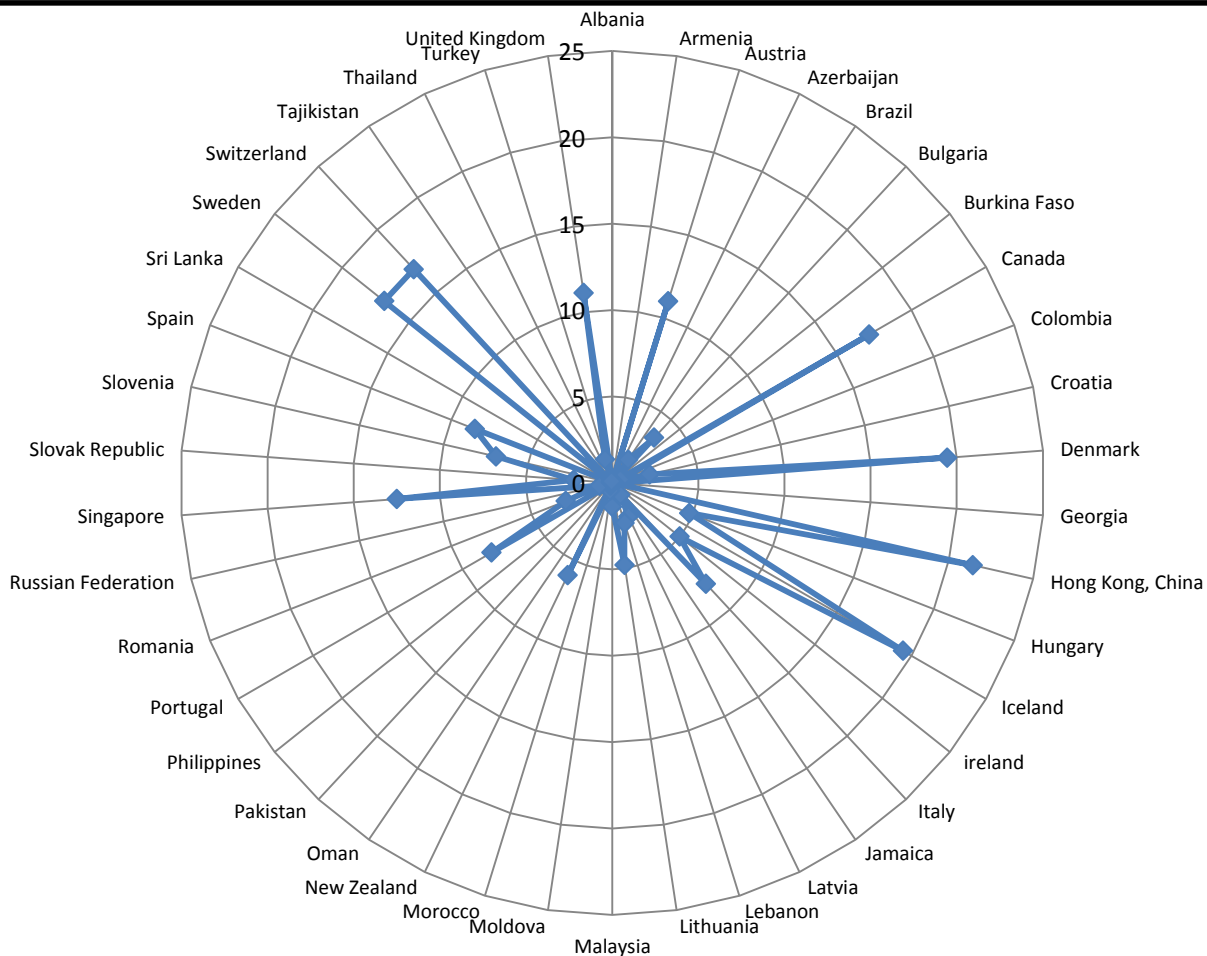
## Stylized Facts

# Business Density Radial Chart by Country



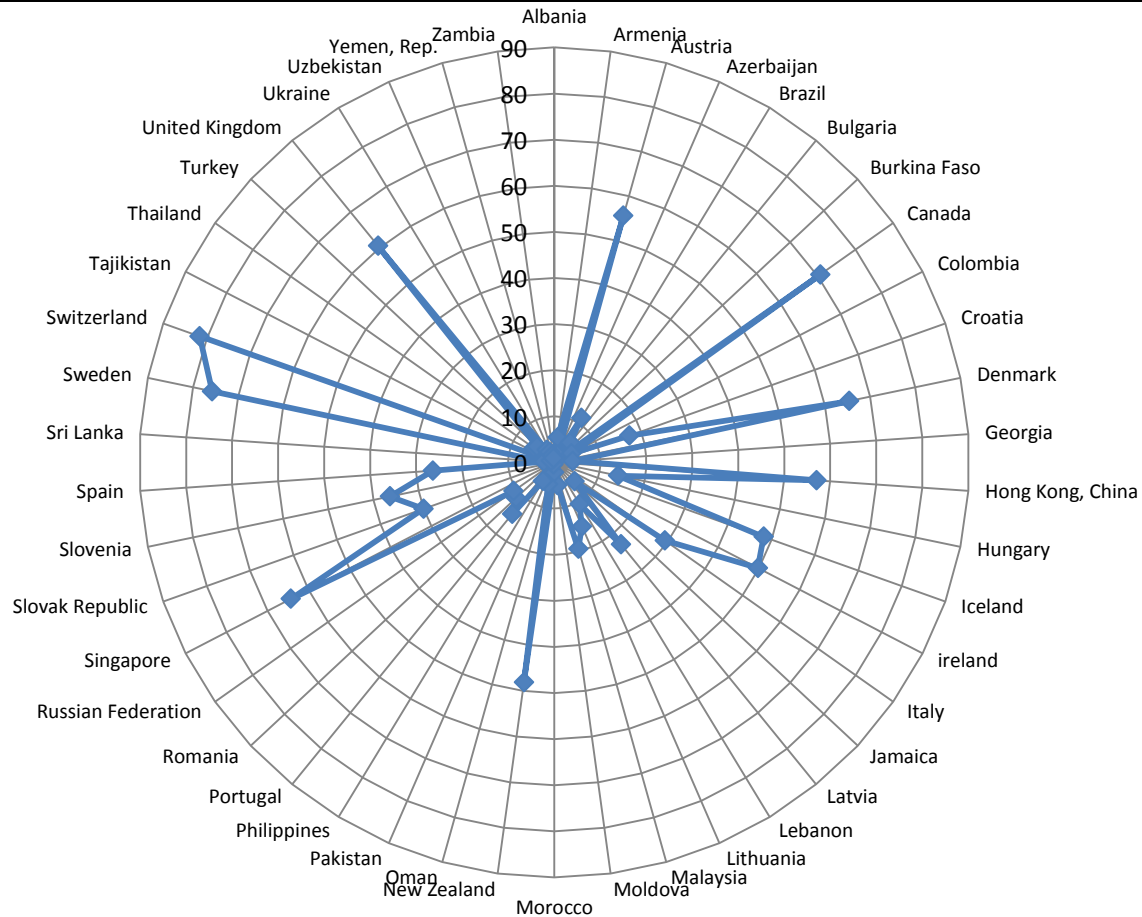
Source: Author's calculation ON *Global Entrepreneurship Monitor (GEM and World Bank Group Entrepreneurship Survey 2008)*

## Broadband subscribers (per 100 people) Radial chart by Country



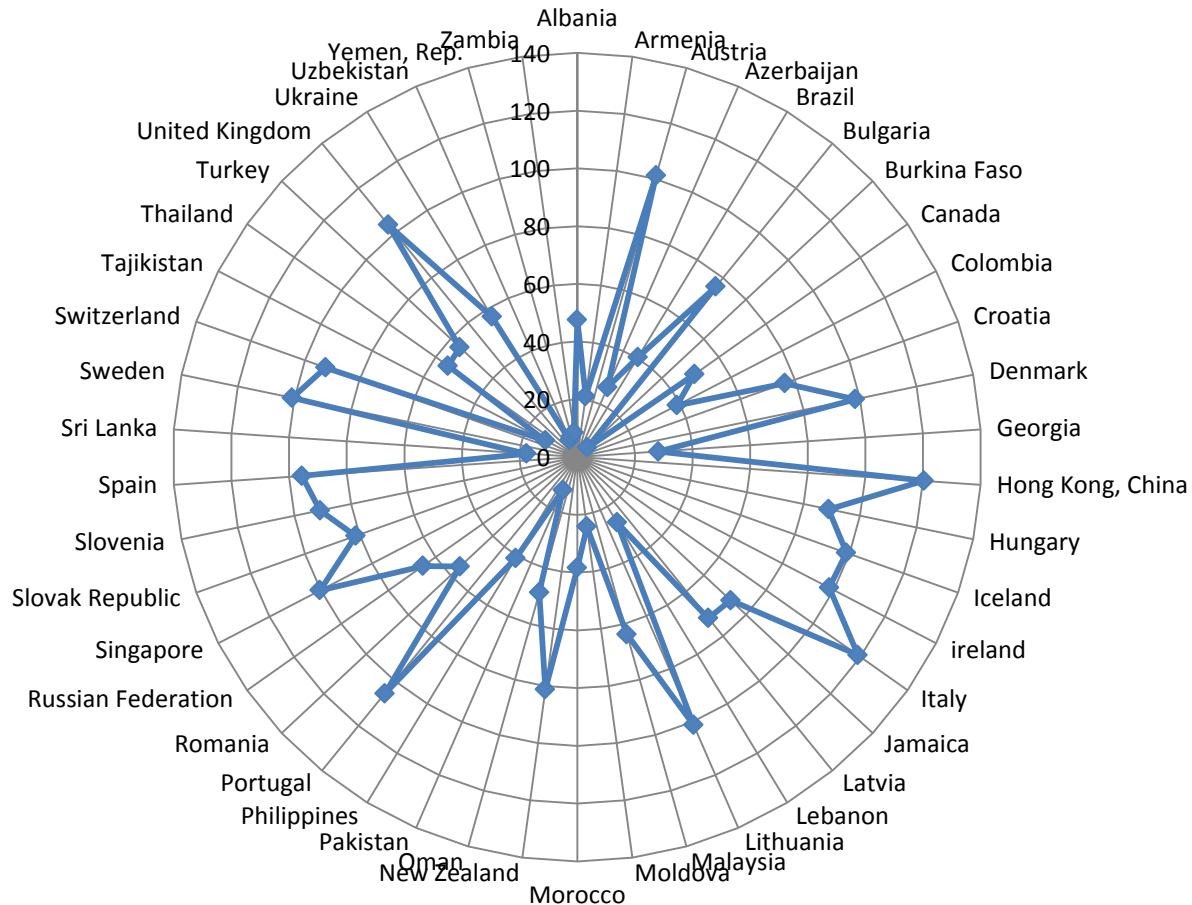
Source: Author's calculation on World Development Indicators Online. 2008. World Bank

## Personal computers (per 100 people) Radial Chart by country



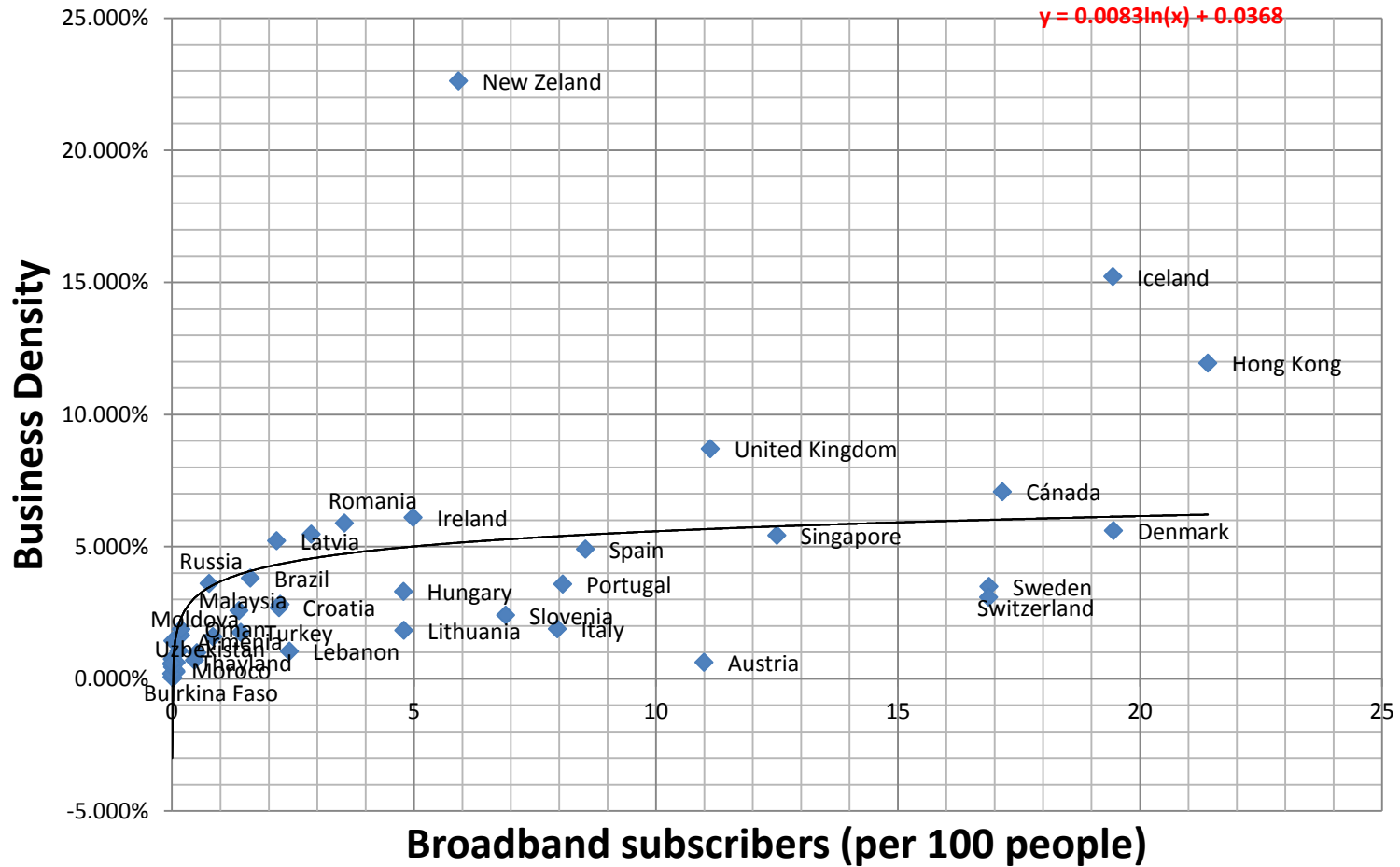
Source: Author's calculation on Millennium Development Goals Database. United Nations Statistics Division

## Cell phones (per 100 people) Radial Chart by Country



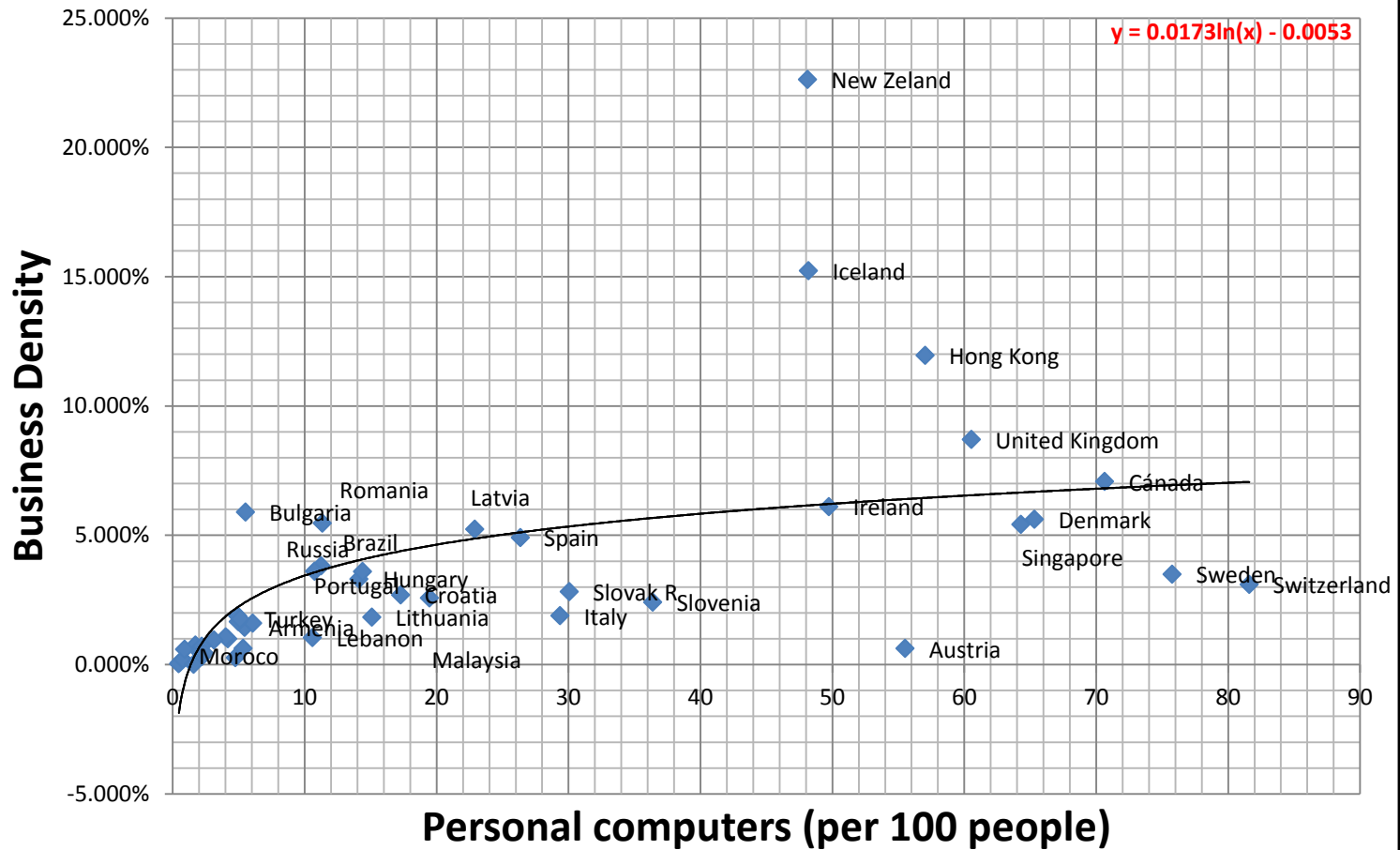
Source: Author's calculation on World Development Indicators Online. 2008. World Bank

## Relations between Business density and broadband



Source: Author's calculation on World Development Indicators Online. 2008. World Bank, *Global Entrepreneurship Monitor (GEM and World Bank Group Entrepreneurship Survey 2008)*

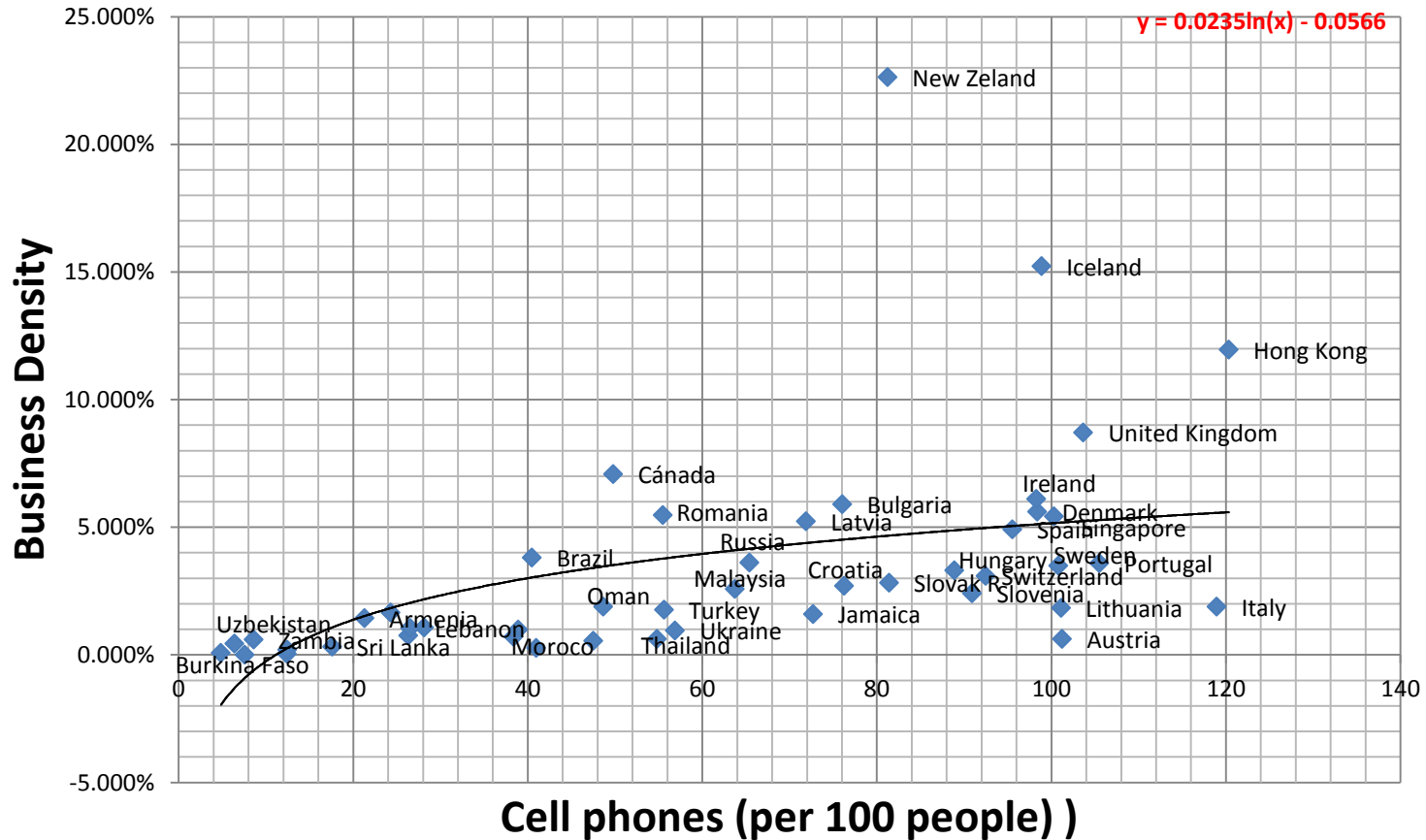
## Relations between Business Density and Personal Computer



Source: Author's calculation on World Development Indicators Online. 2008. World Bank, *Global Entrepreneurship Monitor (GEM and World Bank Group Entrepreneurship Survey 2008)*

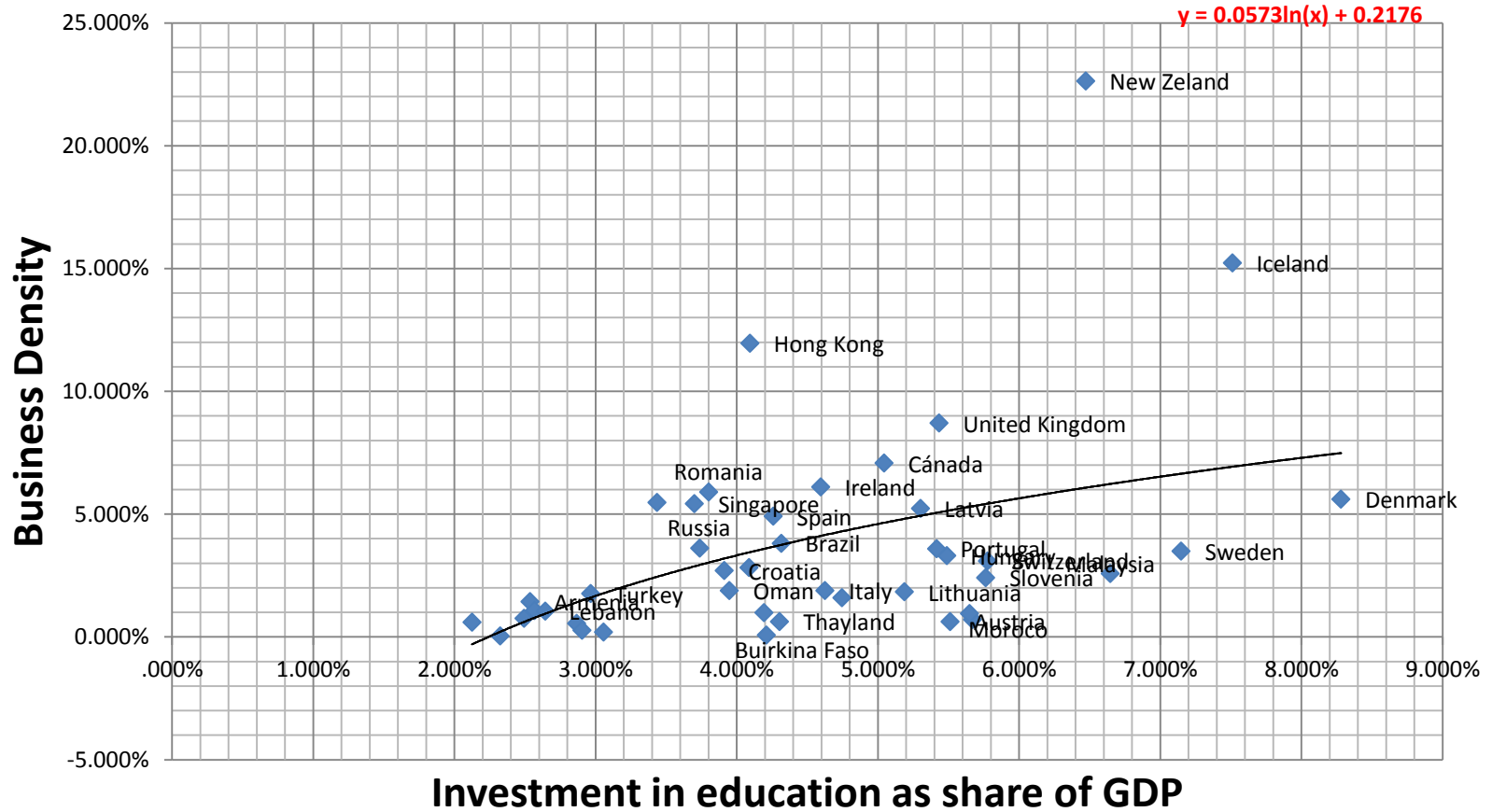


## Relations between Business Density and Cell Phones



Source: Author's calculation on World Development Indicators Online. 2008. World Bank, *Global Entrepreneurship Monitor (GEM and World Bank Group Entrepreneurship Survey 2008)*

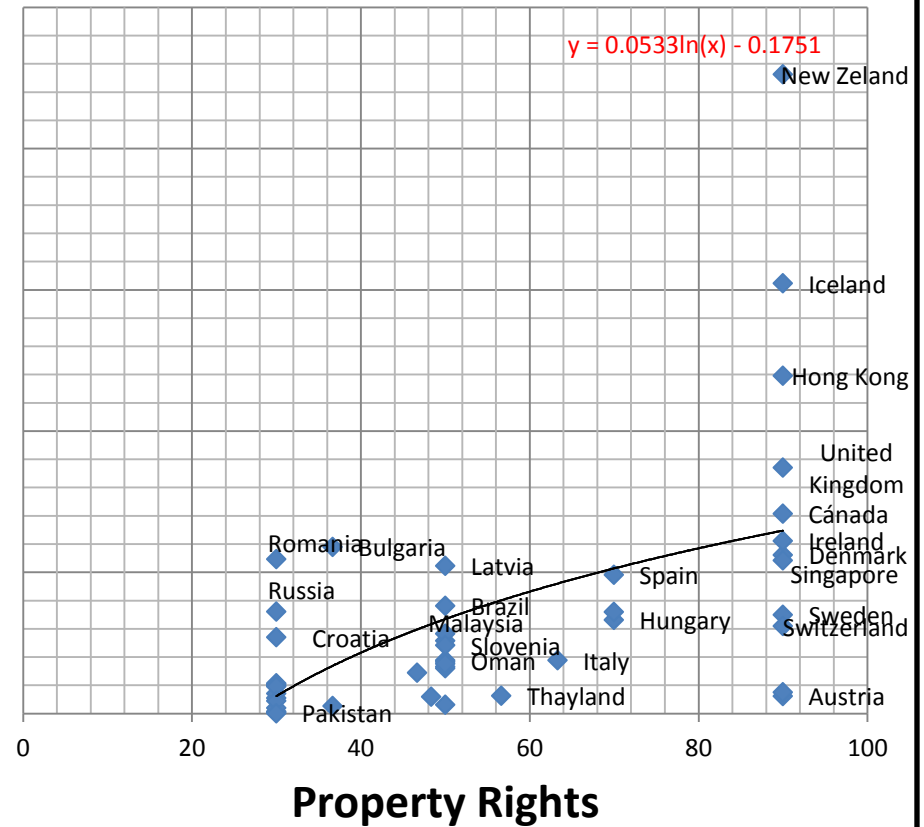
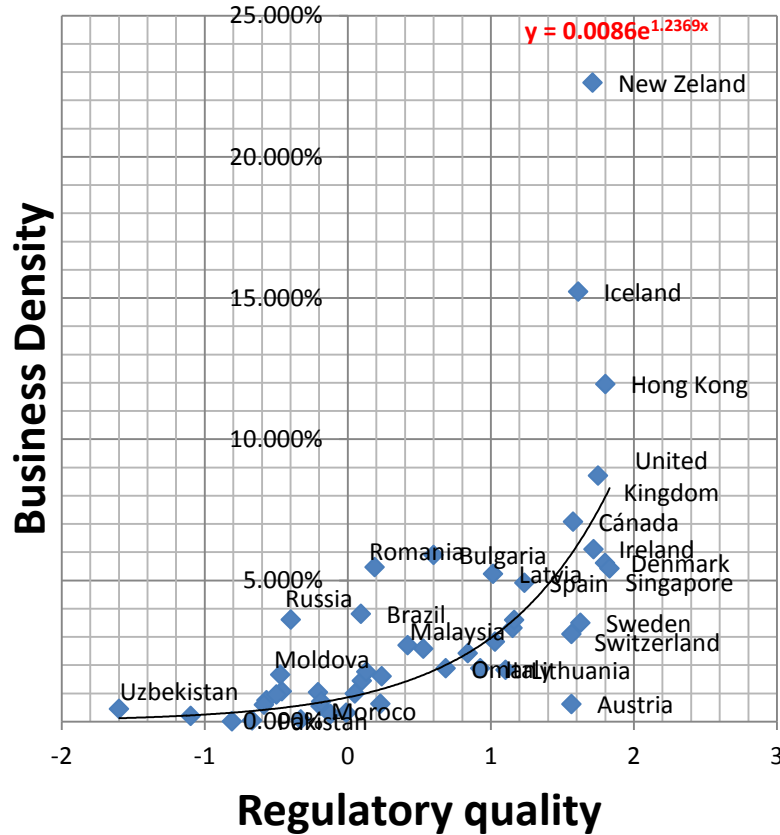
## Relation between Business Density and Education



Source: Author's calculation on World Development Indicators Online. 2008. UNESCO

## Stylized Facts

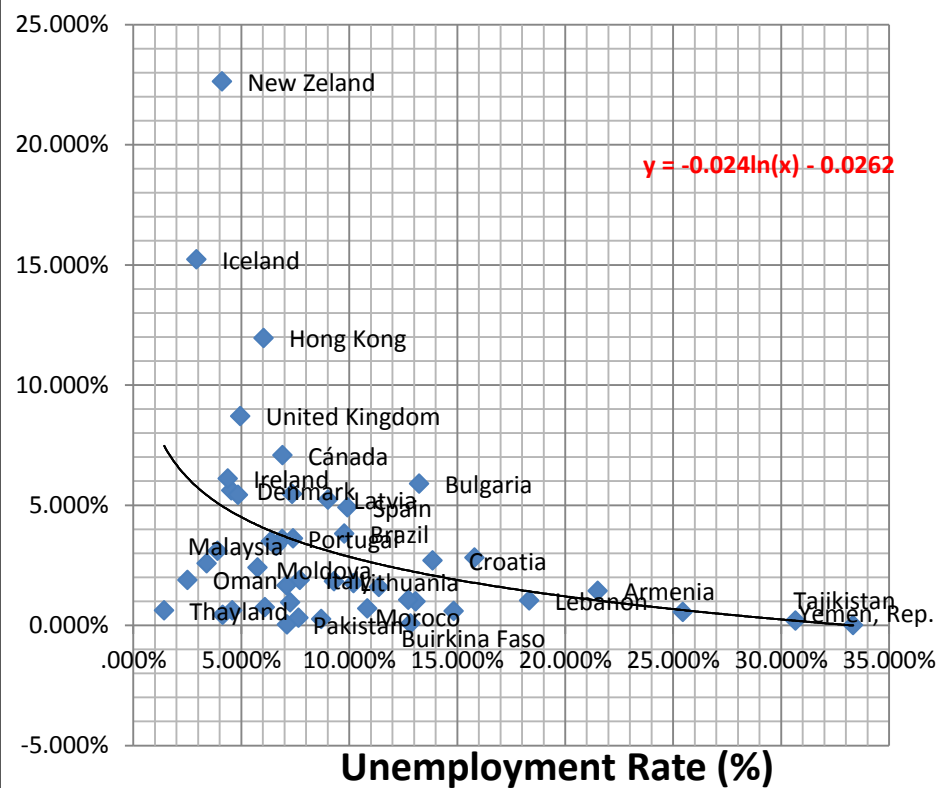
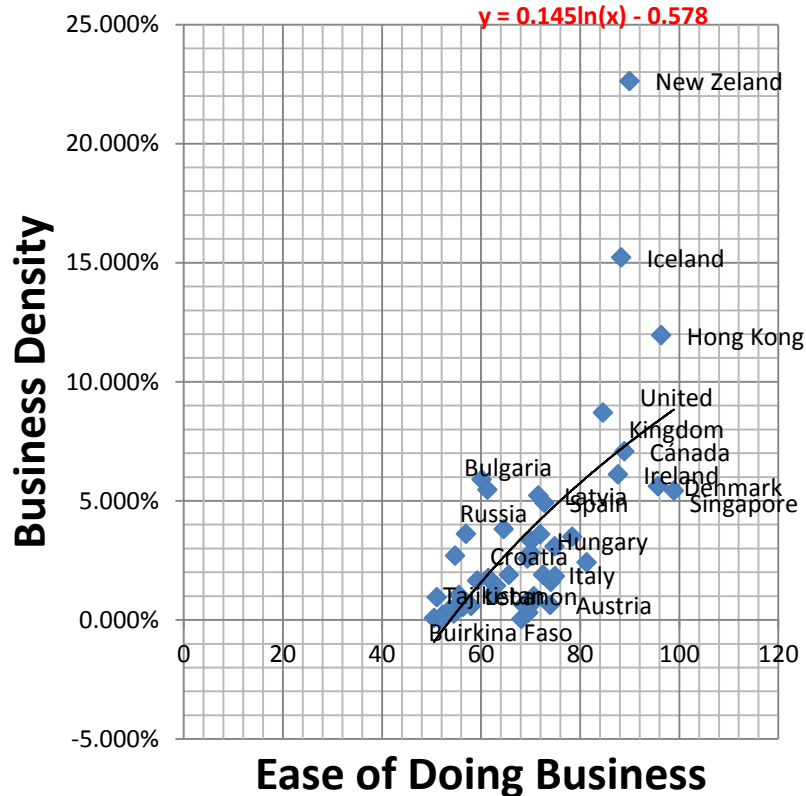
### Relations between Business Density and Regulatory quality (a) and property rights (b)



Source: Author's calculation on The Worldwide Governance Indicators (WGI) Project. And *Global Entrepreneurship Monitor (GEM and World Bank Group Entrepreneurship Survey 2008)*

## Stylized Facts

### Relations between Business Density and (a) Ease of doing Business and (b) Unemployment Rate



Source: Author's calculation on Heritage Foundation. IMF : World economic Outlook. And *Global Entrepreneurship Monitor (GEM and World Bank Group Entrepreneurship Survey 2008)*

## Model Results

<b>Business Density VARIABLES</b>	<b>ICT Model (1)</b>	<b>Model with Education Control (2)</b>	<b>Model with Macro and institutional controls (3)</b>
<b>Broadband</b>	0.5925512** (0.3271388)	0.5646527* (0.3542261)	0.5877704* (0.3303379)
<b>Personal Computers</b>	0.4273719*** (0.1607487)	0.4033949** (0.2120301)	0.3925539*** (0.1592026)
<b>Cell-Phones</b>	0.1441682** (0.0681971)	0.1535694** (0.0721085)	0.1152283* (0.0704763)
<b>Education Investment</b>	-	1.134693 (7.430632)	-
<b>Regulatory quality *doing business</b>	-	-	0.0110152*** (0.0045987)
<b>Property Righths</b>	-	-	0.1599177*** (0.0684771)
<b>Unemployment</b>	-	-	-0.4866222* (0.29132969)
<b>GDPP (PPP)</b>	-	-	0.0001457 (0.0007039)
<b>Constant</b>	12.82066 (4.573563)***	10.09484 (27.49356)	4.598046 (7.576365)
<b>Observations</b>	185	152	177
<b>Number of groups</b>	42	38	42
<b>R-Square: Withing</b>	0.3861	0.3485	0.4090
<b>    Between</b>	0.3337	0.2963	0.3850
<b>    Overall</b>	0.3149	0.2673	0.3641
<b>F</b>	14.09	7.45	39.87
<b>(Prob &gt;F)</b>	(0.000)	(0.000)	(0.000)

Robust Standard errors in parentheses \*\*\*p<0.01, \*\*p<0.05, \*p<0.1.

# Conclusions

- Results from the model to conclude that awareness of entrepreneurship to the impact of ICT indicators is a major way for access to broadband, then the number of personal computers and mobile phones per 100 inhabitants.
- On the other hand, the regulatory environment, the ease of doing business and establishing effective property rights positively impact the creation of new businesses.
- This would indicate that the density of new firms is significantly related to better governance. Regarding the level of unemployment, this is significant and reduces the density of business creation.

**GRACIAS...**