# Democratization is the determinant of technological change

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ABSTRACT: The purpose of this paper is to analyze the relationship between democracy and technological innovation. The primary findings are that most free countries, measured with liberal, participatory, and constitutional democracy index, have higher technological innovation than less free and more autocratic countries, so that the former have a higher interaction among social, economic and innovation systems with fruitful effects on economic growth and the wealth of nations. In fact "democracy richness" in these countries displays a higher rate of technological innovation. In addition, democratization is an antecedent process (cause) to technological innovation (effect), which is a major well-known determinant of economic growth. These findings lead to the conclusion that policy makers need to be cognizant of positive association between democratization and technological innovation to sustain modern economic growth and future technological progress in view of the accelerating globalization.

KEYWORDS: Democratization, Technological Innovation, Patents, Royalty Licenses Fee, Economic Growth

JEL-CODES: F00, O33, O34, O57, P00

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CONTENTS

The Constitution of the Italian Republic (1948) states:

*Art. 2.*
*The Republic recognises and guarantees the inviolable human rights, be it as an individual or in social groups expressing their personality, and it ensures the performance of the unalterable duty to political, economic, and social solidarity.*
*Art. 3.*
*All citizens have equal social status and are equal before the law, without regard to their sex, race, language, religion, political opinions, and personal or social conditions. It is the duty of the Republic to remove all economic and social obstacles that, by limiting the freedom and equality of citizens, prevent full individual development and the participation of all workers in the political, economic, and social organisation of the Country.*
*Art. 4.*
*The Republic recognises the right of all citizens to work and promotes conditions to fulfill this right. According to capability and choice, every citizen has the duty to undertake an activity or a function that will contribute to the material and moral progress of society.*

## INTRODUCTION

Nowadays the best opportunities to improve living standards and reduce poverty come from technological innovation, which is one of the main factors underlying the productivity growth (Coccia, 2008). As a matter of fact, science and technology will play, more and more, a growing role in the next long waves to support future patterns of economic growth and improve the world's economic perspectives (Linstone, 2004). Although several works have provided many valuable insights into the role of technological innovation within the economic system, there are also unresolved issues, such as analyzing the best environment and political regime in which technology can originate, develop and diffuse. This environment transforms today's luxury goods into tomorrow's cheaper and widespread goods and services that lead to longer, better and healthier living.

To find this environment the fundamental questions for economic philosophy are: what is the relationship between innovation and democracy? Does democracy depend upon innovation? (Huebner, 2005).

My aim in this research is to investigate this relationship in order to understand this main issue of economic and political literature, which can provide findings to forecast patterns of technological innovation as well as of economic growth of countries.

In particular, the purpose is to determine if democratization as a "process" affects technological innovation, since this relationship has main political economy implications to create fruitful socio-economic interactions that fertilize the economic system and underpin the future development of societies.

The thesis of this paper is:

*Let democratization be a process antecedent to technological change.*

*Then, there is higher technological innovation when the countries have more democratization.*

The purpose of this paper is proving this fundamental proposition. Before I analyze the proposition and its proof by empirical analysis, let me first introduce the theoretical framework and method of research to achieve this main objective which is important, very important for the future technological and economic progress of countries and societies.

## 1. THEORETICAL FRAMEWORK

The debate over the definition of democracy has been ongoing since 400 B.C. Democracy can be seen as a set of practices and principles that institutionalize and protect freedom. Even if a consensus on precise definitions has proved elusive, most scholars today would agree that, at a minimum, the fundamental features of a democracy include a government based on the

majority rule and the consent of the governed, the existence of free and fair elections, the protection of minorities and respect for basic human rights. The Schumpeterian minimalist conception of democracy is a political system based on elections (Schumpeter, 1942)[1]. Przeworski *et al.* (2000) consider democracy the political system in which key government offices are filled through contested elections. Democracy presupposes equality before the law, due processes and political pluralism. Studies on democracy are a main topic for social and economic progress and for this reason have been carried out by several scholars since Greek philosophers. The economic debate has not examined how democratization of countries as a process can affect the origins of technological regimes and patterns of technological diffusion, in the face of accelerating technical change and the globalization of the knowledge era (Stiglitz, 2001).

A first aspect in the analysis of this main relationship for future socio-economic growth is the measurement and evaluation of democracies that have received special attention and have had a long tradition in political science since Aristotle and Machiavelli. Classical philosophy applies several criteria to define democracy such as: Aristotle uses the rule of number of governors[2], Machiavelli and Kelsen use the criterion of production of legal and political systems (bottom-down and vice versa), Montesquieu uses the criterion of "ressorts" (springs that induce individuals to obey), etc. (Bobbio, 1980). Modern studies in comparative political science and in democracy research apply a large number of indices of democracy to measure democratization of countries. The most widely used indices to measure the quality of democracy in comparative political science are: the Vanhanen-Index of participatory democracy, the Polity-IV Index for the assessment of constitutional democracy, and the Freedom House-Index of liberal democracy. These cover over 150 countries and in part go back to the 19th century (for details see Bogaards, 2007). They represent the most widely-cited standard indicators commonly used by scholars in democracy research.

The Freedom House Index of liberal democracy was launched by Raymond Gastil of the University of Washington in Seattle. Gastil developed a methodology which assigned ratings of political rights and civil liberties for each independent nation. Today it includes 192 countries and 18 independent territories. The index of political rights consists of ten criteria which are grouped into three parts: electoral process, political pluralism and participation, and government functioning; the index of civil liberties includes 15 criteria which are divided into four groups: freedom of speech, associational and organizational rights, rule of law, and autonomy. Then two more indices are created, with values ranging from 1 (*best value*) to 7 (*worst value*). In many publications the mean of the two indices is shown on a rotated scale whereby democracies with values between 1 and 2.2 are considered "free", those between 3 – 5 as "partly free", and those between 5.5 and 7 as "not free". The index monitors the existence of political rights in terms of electoral processes, political pluralism, and the functioning of the government. It has been employed by many scholars such as Diamond (1996), Barro (1999), Inglehart and Welzel (2005). Despite its virtues, the index has been subject to criticism on a number of methodological grounds (see Munck and Verkuilen, 2002).

The Polity-Index IV of constitutional democracy was developed by Ted Robert Gurr in the 1970s and is now connected to the University of Maryland and Colorado State University. The Polity-Index includes 150 countries which have been integrated at different times. For all practical purposes the index is two-dimensional even if its description lists three dimensions (free and competitive elections, horizontal power limitation, and liberty rights). The Polity-Index is based on the subtraction of a value on the autocracy scale from a value on the democracy scale. Thus it results in values ranging from –10 (*very autocratic*) to +10 (*very democratic*). The Polity IV Index was originally conceived by Gurr for

[1] *"The democratic method is that institutional arrangement for arriving at political decisions in which individuals acquire the power to decide by means of a competitive struggle for the people's vote"* (Schumpeter, 1942, p. 269).

[2] Aristotle (384 BC – 322 BC), a Greek philosopher and a student of Plato, argued that democracy was the rule of many.

different purposes: to monitor notions of political stability and regime change. It also has some limits (Munck and Verkuilen, 2002).

The Vanhanen-Index of participatory democracy was developed in 1984 by Vanhanen (2003), professor at Helsinki University, in cooperation with the International Peace Research Institute in Oslo. The data include 187 countries and cover the period 1810–1998. Because of its proximity to Dahl's theory of democracy, the Vanhanen-index is also informally known as the "polyarchy data set". Two dimensions are recorded - competition and participation - and aggregated over the following formula: *Competition×Participation / 100*, from 0 to 100.

Despite all differences in the construction of democratic indices, it is striking that their measures most commonly correlate strongly with each other (Elkins, 2000). No single approach is entirely satisfactory but a combination of methodologies holds great promise for adopting the best features and avoiding the limitations of each. Norris (2008) and other scholars confirm that each measure of democracy is significantly and positively associated with wealth and economic growth. This hypothesis has been confirmed by Barro (1999), Przeworski *et al.* (2000), as well as the more recent work by Lipset and Lakin (2004).

*The second term of the relationship that is analyzed here is technology*. It has numerous connotations, ranging from an object to the pool of applied scientific knowledge. The formal concepts of technology follow two categorical viewpoints: *a)* there is the neoclassical conception of technology in the form of production function; *b)* there is what might be termed as the Pythagorean concept of technology in terms of patent statistics (Sahal, 1981). I apply this second viewpoint that has a distinctly interdisciplinary origin. It is based on contributions from fields as diverse as economics, sociology, scientometrics, and so on. Technological change is conceived in terms of the number of inventions patented and a potentially broad range of other variables as appropriate measures of technological and scientific activity: number of articles published, number of researchers and technicians, etc. As a matter of fact, for economists that want to analyze patterns of innovations a common approach is to measure patents, which offer an indicator of innovative outputs (Steil *et al.*, 2002).

For this reason the economic literature gives particular attention to how innovators can appropriate returns by patents and intellectual property rights that have an increasingly important role in the innovation and economic performance of countries. The increasing use of patents to protect inventions by businesses and public research organizations is closely connected to recent evolutions in innovation processes that have become increasingly competitive, co-operative, global and more reliant on new entrants and technology–based firms (OECD, 2004). Growth in patenting corresponds to a new organization of research that is less centred on firms and more based on knowledge networks and markets. Patents aim at fostering innovation in the countries by allowing inventors to profit from their inventions. Cohen *et al.* (2001) demonstrate that patent protection is the central means for investors to reap returns in some industries such as pharmaceutical, fine chemical products, agricultural chemicals, etc. As there is a vast economic literature that converges towards patents as measures of innovation, I apply this indicator of innovative output of countries (OECD, 2004). More specifically, the paper does not use overall patents of countries since, for instance, about half of the patent applications to the U.S. patent office are filed by residents in countries other than the United States of America. To avoid this problem I use the patents of residents. However, patents as sources of innovation can have some limits, for instance transaction costs and disclosure rules vary among countries. Moreover, patented inventions give no information on innovation and the process of development of technology involving the translation of a blueprint into a working device suitable for mass production. On this basis, to increase the robustness of the analysis, patent statistics are integrated with payments of royalty and licenses fees within the country (Howenstine, 2008) and other indicators of innovative output according to the Pythagorean concept of technology, such as scientific and technical journal articles, researchers and

technicians in R&D, R&D expenditures (Torres-Salinas and Moed, 2007).

Przeworski *et al.* (2000) confirm that wealthier countries are more likely to sustain democracy; however, despite establishing the strong correlation between wealth and democracy, several scholars remain agnostic about the precise causal mechanism underlying this relationship, as well as its policy implications (Norris, 2008). The next sections show some results to shed light on this issue.

## 2. METHODOLOGY OF RESEARCH

Data concerning the measurement of democratization across countries and over time are from the democracy time series dataset developed by Norris (2008) from Harvard University. This dataset contains data on the social, economic and political characteristics of 191 nations, with over 600 variables, from 1972 to 2005. In particular, from this dataset, I use the Vanhanen, Polity IV and Freedom House indexes.

Instead, data of technological innovation outputs are from World Development Indicators developed by the World Bank (2008); the best indicator of production of technological innovation is the number of patent applications filed by residents. They are applications filed with a national patent office for exclusive rights to inventions – a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides a protection for the invention to the owner of the patent for a limited period, generally 20 years (OECD, 2004; Hall and Ziedonis, 2001; Hall, 2007). As patent statistics may suffer from a number of well-know drawbacks, they are integrated with other measures of innovative output which increase the robustness of statistics and econometric modelling. These control variables are:

1. Royalty and license fees are payments between residents and non residents for the authorized use of intangible, non produced, non financial assets and proprietary rights and for the use of produced originals of prototypes, through licensing agreements.
2. Scientific and technical journal articles include those published in a stable set of about 5,000 of the world's most influential scientific and technical journals, tracked since 1985 by the Institute of Scientific information's Science Citation Index and Social Science Citation Index.
3. Researchers and technicians in R&D are people engaged in professional R&D activities who have received vocational and technical training in any branch of knowledge or technology.
4. Expenditures for R&D are current and capital expenditures on the creative, systematic activity that increases the stock of knowledge. This includes fundamental, applied research and experimental development work leading to new devices, products, or processes.

The variables are described in Table 1.

These dimensions are a good proxy of technical change according to the Pythagorean concept of technology (Sahal, 1981). In addition to this dimension of technical change, there is the diffusion of technological innovation; to analyze this aspect within the relationship between innovation and democratization, I use the adopters of mobile phones per 1,000 people. Adopters of mobile phones refer to portable telephone subscribers to an automatic public mobile telephone service using cellular technology that provides access to the public switched telephone network per 1,000 people.

The data undergo a preliminary process of horizontal and vertical cleaning. The normal distribution of data is checked by statistics based on arithmetic mean, standard deviation, skewness, and kurtosis, normal Q-Q plot, Kolmogorov-Smirnov and Shapiro-Wilk tests of normality, using the SPSS statistics software. After that, the correlation and regression analysis are applied. The correlation applied is the partial correlation with control variable either GDP per capita or population.

The econometric modelling is based on the conceptual model as follow:

*Assumption*: Democratization is the cause of technological innovation.

TABLE 1: VARIABLES

| | | *Description and period* |
|---|---|---|
| *Index of democratization* | □ | Freedom House 7-pt rating 1990-1996: reversed scale 1 least free, 7 most free countries (1990-1996 period) |
| | □ | Polity Combined democracy-autocracy score from –10 to +10 annual (1990-1996 period) |
| | □ | Vanhanen index (1990-1996 period) |
| *Production of technological innovation* | ▪ | Patents of residents per 1,000,000 people (1995-2001 period) |
| | | Royalty and licenses fees-payments (current US$) (1995-2001 period) |
| | ▪ | Scientific and technical journal articles per 1,000 people-(1995-2001 period) |
| | ▪ | Researchers in R&D per million people (1995-2001 period) |
| | ▪ | Technicians in R&D per million people (1995-2001 period) |
| | ▪ | R&D expenditure as % of GDP (1995-2001 period) |
| *Diffusion of technological innovation* | ● | Adopters of mobile phones per 1,000 people (1995-2001 period) |
| *Other variables used in correlation analysis* | – | GDP per capita current prices, US$ (UNI) (1995-2001 period) |
| | | Gross domestic product (GDP) is a measure for the economic activity. It is defined as the value of all goods and services produced minus the value of any goods or services used in their creation |
| | – | Population (1995-2001 period) |

The logic relationship is:

*Technological innovation production and diffusion = f (level of democratization of countries).*

The general specification of the model is:

$$Technological\ innovation_{i,t} = \beta_0 + \beta_1\ index\ of\ democratization_{i,t-5} + \varepsilon_{i,t} \quad [1]$$

Where *i* subscripts denote countries, *t* subscripts denote time. The production of technological innovation is measured by the number of patents filed by residents per 1,000,000 people and other indicators described above, whereas the diffusion of technological innovation is measured by adopters of mobile phones per 1,000 people within the countries.

I apply the leading indicator model that is a special case of the dynamic linear regression model (Spanos, 1986):

$$y_{i,t} = \beta_0 + \beta_1 x_{i,t-5} + \varepsilon_{i,t} \quad [2]$$

Moreover, since Democratization is inherently a dynamic process and countries will adjust in the medium-long run, which is necessary to legislate and apply democratic laws, a lag of 5 year of the Democratization index is included in the specification [1].

In addition, the following dynamic linear model is also applied:

$$y_{i,t} = \beta_0 + \beta_1 x_{i,t-5} + \beta_2 y_{i,t-1} + \varepsilon_{i,t} \quad [3]$$

The long run impact of democratization on technological innovation is $\hat{\beta}/1-\hat{\alpha}$ (Verbeek, 2008).

The equations are estimated by the Ordinary Least Squares (OLS) method and the Prais-Winsten estimation method, by the au regression estimate procedure from time series with first-order autocorrelated errors; this method eliminates the problems of serial correlation.

The estimation of the parameters and the statistical analysis are performed using the SPSS statistics software.

## 3. FINDINGS

Above all, it is necessary to prove the following proposition:

PROPOSITION: Let democratization be a process antecedent to technological change.

*Then, there is higher technological innovation when the countries have more democratization.*

This proposition is important; hence I will suggest different ways of proving it, as they show different results:

*A*) Descriptive Statistics; *B*) Partial Correlation; *C*) Econometric modelling.

First of all, some variables have been transformed into logarithmic values to have normal distribution and to correctly apply the correlation and econometric modelling by regression analysis.

In fact, the statistic of Kolmogorov-Smirnov and Shapiro-Wilk test the normality of the variables, so that it is possible to apply the statistics and econometric modelling correctly.

### PROOF

A) Descriptive Statistics. Table 2 (in Annex A) shows that "most free" and "high democracy" countries have higher arithmetic mean of technical change indicators than "least free" and "high autocracy" countries.

REMARK: The Vanhanen index of participatory democracy confirms these results.

More specifically, the descriptive statistics based on Freedom House show that most free countries have a higher level of patents per 1,000,000 people than least free countries (about 375 vs. 7 per million people). These results are confirmed by the Policy score that shows greater values in high democracy countries than in autocracy countries (roughly 394 vs. 2) as well as by the Vanhanen-index. Control variables of technological innovation confirm these results, in particular: royalty and licence fees payments, scientific and technical journal articles, R&D expenditures, researchers and technicians in R&D have higher figures in most free and high democracy countries than in least free and high autocracy ones. If the indicator of diffusion of technological innovation is used, *i.e.* adopters of mobile phones, least free and high autocracy countries have a lower number of adopters of mobile phones per 1,000 people than most free and high democracy countries (see Table 2).

B) Correlations. Table 3 and 1A (in Annex A) display that *the indices of democratization have high positive associations with technical change indicators (coeteris paribus, GDP per capita or population).*

On the *whole*, the partial correlations analysis shows that the number of Patents by residents per 1,000,000 people has a high positive correlation with Democratic indices: in particular Patents / Freedom House has *r=0.53*, Patents of resident / Polity has *r=0.38*, Patents of resident / Vanhanen has *r=0.58*, control variable GDP PPP current international. If we use the population as control variable, we have Patents/ Freedom House *r=0.63*, Patents of resident / Polity *r=0.57*, Patents of resident / Vanhanen *r=0.40*. These results are confirmed by other indicators of technological change; in addition, the diffusion of mobile phones per 1,000 people has high positive partial correlation: over than 40 per cent, between adopters of mobile phones and the Vanhanen Index, and over 60 per cent between adopters of mobile phones and Freedom House and Polity (*coeteris paribus*, population or GDP PPP current international $ 1994-2000).

TABLE 2: CENTRAL TENDENCY AND DISPERSION

| *Level of democracy-index* | | *Arithmetic mean* | *Std. Error* |
|---|---|---|---|
| *Freedom house 1990-1996* | | | |
| 1: LEAST FREE | Patents per 1,000,000 people (1995-2001) | 6.72 | 1.35 |
| | Royalty and license fees payments Bop current US$ (1995-2001) | 126.62 | 125.92 |
| | Scientific and technical journal articles per million people (1995-2001) | 13.80 | 8.07 |
| | R&D Expenditure as % of GDP (1995-2001) | 0.64 | 0.15 |
| | Researchers and Technicians in R&D per million people (1995-2001) | 1,294.35 | 310.61 |
| | Mobil Phone per 1,000 people (1995-2001) | 14.83 | 4.25 |
| | GDP PPP current international $ per capita (1994-2000) | 2,590.31 | 478.67 |
| | Population (1995-2001) | 217,722,181.82 | 67,921,074.40 |
| 7: MOST FREE | Patents per 1,000,000 people (1995-2001) | 375.79 | 25.85 |
| | Royalty and license fees payments Bop current US$ (1995-2001) | 165.23 | 43.84 |
| | Scientific and technical journal articles per million people (1995-2001) | 545.55 | 30.12 |
| | R&D Expenditure as % of GDP (1995-2001) | 1.81 | 0.16 |
| | Researchers and Technicians in R&D per million people (1995-2001) | 3,496.90 | 366.92 |
| | Mobil Phone per 1,000 people (1995-2001) | 320.75 | 21.44 |
| | GDP PPP current international $ per capita (1994-2000) | 23,397.03 | 661.99 |
| | Population (1995-2001) | 23,122,591.30 | 5,650,438.93 |
| *Polity 1990-1996* | | | |
| –10: HIGH AUTOCRACY | Patents per 1,000,000 people (1995-2001) | 2.07 | 0.51 |
| | Royalty and license fees payments Bop current US$ (1995-2001) | 24.64 | 8.15 |
| | Scientific and technical journal articles per million people (1995-2001) | 22.63 | 5.01 |
| | R&D Expenditure as % of GDP (1995-2001) | 1.22 | 0.03 |
| | Researchers and Technicians in R&D per million people (1995-2001) | 1,197.46 | 301.70 |
| | Mobil Phone per 1,000 people (1995-2001) | 39.44 | 14.60 |
| | GDP PPP current international $ per capita (1994-2000) | 10,323.20 | 1,321.95 |
| | Population (1995-2001) | 16,666,166.67 | 3,162,370.83 |
| +10: HIGH DEMOCRACY | Patents per 1,000,000 people (1995-2001) | 393.86 | 41.79 |
| | Royalty and license fees payments Bop current US$ (1995-2001) | 139.35 | 31.42 |
| | Scientific and technical journal articles per million people (1995-2001) | 434.46 | 24.24 |
| | R&D Expenditure as % of GDP (1995-2001) | 1.74 | 0.11 |
| | Researchers and Technicians in R&D per million people (1995-2001) | 3,025.36 | 198.92 |
| | Mobil Phone per 1,000 people (1995-2001) | 298.72 | 17.61 |
| | GDP PPP current international $ per capita (1994-2000) | 20,026.21 | 506.70 |
| | Population (1995-2001) | 29,213,634.29 | 4,133,590.09 |

TABLE 3: PARTIAL CORRELATION

| *Control Variables* | | *Freedom House 1990-1996* | *Polity 1990-1996* | *Vanhanen 1990-1996* |
|---|---|---|---|---|
| LN GDP PPP current international $ 1994-2000 | *LN Patents per 1,000,000 people (1995-2001)* | 0.53 | 0.38 | 0.58 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 467 | 467 | 467 |
| LN Population 1995-2001 | *LN Patents per 1,000,000 people (1995-2001)* | 0.57 | 0.40 | 0.63 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 481 | 481 | 481 |
| LN GDP PPP current international $ 1994-2000 | *LN Royalty and license fees payments Bop current US$ (1995-2001)* | 0.62 | 0.38 | 0.54 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 329 | 329 | 329 |
| LN Population 1995-2001 | *LN Royalty and license fees payments Bop current US$ (1995-2001)* | 0.64 | 0.45 | 0.55 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 336 | 336 | 336 |

In short, most free and high democracy countries have higher positive coefficients of correlation with indicators of technology than least free and high autocracy countries. This confirms that most free countries, measured with liberal, participatory and constitutional democracy indicators, have a higher interaction with technical change than least free ones, generating fruitful effects on economic growth and the wealth of the nations over time (see Table 3 and 1A).

*C*) The econometric modelling by the Prais-Winsten estimation method has provided robustness estimates by significant parameters and *F* test significant at the level of 0.00, though the goodness of fit through $R^2$ adjusted values (the coefficient of determination adjusted) has low figures. The result of the Durbin-Watson test (Table 4), after the correction with the Prais-Winsten estimation method, is no serial correlation (5% significance level).

Regression analysis. *The coefficients of the econometric modelling have positive values, i.e. positive impact of democratization on technical change over time and across countries.*

Strictly speaking, econometric modelling shows that if the level of democratization, measured by the Freedom House index of liberal democracy, increases by 1 unit, the production of technological innovation per million of people (measured by patents statistics) increases by 1.75, whereas technology increases by 1.12 with the Polity IV-constitutional democracy, and it increases by 1.04 units if the democratization is measured by the Vanhanen-participatory democratization (Table 4).

TABLE 4: OLS RESULTS – PATENTS AND MOBILE PHONES EQUATIONS

| | Models and dependent variables | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Leading Indicator Dynamic Model* | | | *Dynamic Model* | | | *Leading Indicator Dynamic Model* | | |
| *Explanatory variables* | Ln $y_{i,t}$ = Patents by residents per 1,000,000 people 1995-2001 | | | Ln $y_{i,t}$ = Patents by residents per 1,000,000 people 1995-2001 | | | Ln $t_{i,t}$ = Mobile phones per 1,000 people 1995-2001 | | |
| *Freedom House 1990 -1996* | 0.557*** (0.063) | - | - | 0.062** (0.030) | - | - | 0.797*** (0.051) | - | - |
| *Polity 1990-1996* | - | 0.114*** (0.019) | - | - | 0.014* (0.009) | - | - | 0.198*** (0.015) | - |
| *Vanhanen 1990-1996* | - | - | 0.044*** (0.004) | - | - | 0.004* (0.002) | - | - | 0.063*** (0.004) |
| Constant | 0.603 (0.415) | 2.824*** (0.308) | 1.586*** (0.310) | –0.126 (0.142) | 0.070 (0.088) | 0.003 (0.103) | –0.688** (0.277) | 2.194*** (0.176) | 0.816*** (0.193) |
| Ln $y_{i,t-1}$ | - | - | - | 0.094*** (0.022) | 0.959*** (0.020) | 0.949*** (0.022) | - | - | - |
| $R^2$ adjusted | 0.155 | 0.077 | 0.188 | 0.889 | 0.888 | 0.889 | 0.267 | 0.208 | 0.300 |
| Durbin-Watson | 2.042 | 2.001 | 2.045 | 2.572 | 2.581 | 2.590 | 1.852 | 1.871 | 1.881 |
| F test sign. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| N. cases | 410 | 415 | 415 | 327 | 327 | 327 | 657 | 657 | 655 |

*** Parameter is Significant at 0.001; ** Parameter is Significant at 0.05; * Parameter is Significant at 0.1

*Note:* The Prais-Winsten estimation method based on the autoregression procedure estimates true regression coefficients from time series with first-order autocorrelated errors. Standard errors are in parenthesis. Moreover, *i* subscripts denote countries, *t* subscripts denote time.

These findings based on the positive impact of democratization on technological innovation are confirmed by the other indicators, such as royalty and licence fees (Table 1B in Annex B), scientific and technical journal articles (Table 2B), R&D expenditures (Table 3B), as well as researchers and technicians in R&D (Table 4B). In addition, if the diffusion of technological change is measured by adopters of mobile phones per 1,000 people, the econometric modelling shows that an increase of 1 unit of the democratic index raises the adopters of mobile phones by 2.2 per 1,000 people (in case democracy is measured by the Freedom House index), by 1.22 (with the Polity IV index) and 1.07 with the Vanhanen index.

The impact of democratization on the generation of technological innovation in the *long run* shows higher values because of a fertilization effect within economic, socio and institutional systems. In particular, in case the Freedom House Index is used, the long run impact of democratization on technological innovation production is 3.3, 1.41 with Polity IV and 1.08 in case of the Vanhanen Index. These results are also confirmed when other control variables are used, such as royalty and licence fees, scientific and technical journal articles, R&D expenditures, as well as researchers and technicians in R&D (see Tables 1B-4B in Annex B).

SYNTHESIS of this analysis carried out in three different ways: *More democratization generates higher technological innovation.*

## 4. DEMOCRATIZATION AS A DETERMINANT OF TECHNOLOGICAL INNOVATION AND ECONOMIC GROWTH

The primary finding of this paper is that democratization generates greater production, diffusion and utilization of technology, *i.e.* technical change.

In addition, this paper considers a main insight: democratization as a process is a

determinant of technological change, *i.e.* democratization is an antecedent process (cause) to technological innovation (effect), which is also a major well-known determinant of economic growth (Grossman and Helpman, 1991; Aghion and Howitt, 1998; Gulbranson and Audretsch, 2008). This result is important, very important in the modern era to sustain future economic growth in view of the accelerating globalization.

Since the proposition already demonstrated by empirical analysis provides fundamental findings, I will also reinforce its proof and theoretical structure by means of a historical approach.

The first industrial revolution originated in England and the background for its diffusion in the English economic system and society was the civil war in 1688 that established parliamentary monarchy and a more democratic government. After that, the French Revolution of 1789–1799 generated radical changes to government forms based on the Enlightenment principles of nationalism, citizenship, and inalienable rights. This social and cultural revolution, based on the Enlightenment, created a more democratic political system in France and several European countries. New democratic laws in France, as well as the United States constitution of 1791, are antecedent events and can be considered the foundations for the diffusion of the first and second industrial revolutions (Figure 1). They were based on several technological innovations (steam engine, spinning jenny, etc.) that changed the socio-economic structure of European and North-American economies, generating exceptional increases in employment, wealth and economic growth (Rae, 1834).

Mokyr (2002) argues that the second industrial revolution (since 1860) brought technological progress to the advantage of consumers. In 1853, Greeley stated that "we have democratized the means and appliances of higher life". These effects are due to a democratization process of countries that became stable and represented the background of higher technological innovation production and diffusion, generating higher productivity and economic growth as well as higher well being for the people (Acemoglu *et al*., 2008). Persson and Tabellini (2003) argue that constitutional arrangements have the capacity to influence economic policies and economic performance, and thus patterns of socio-economic development.

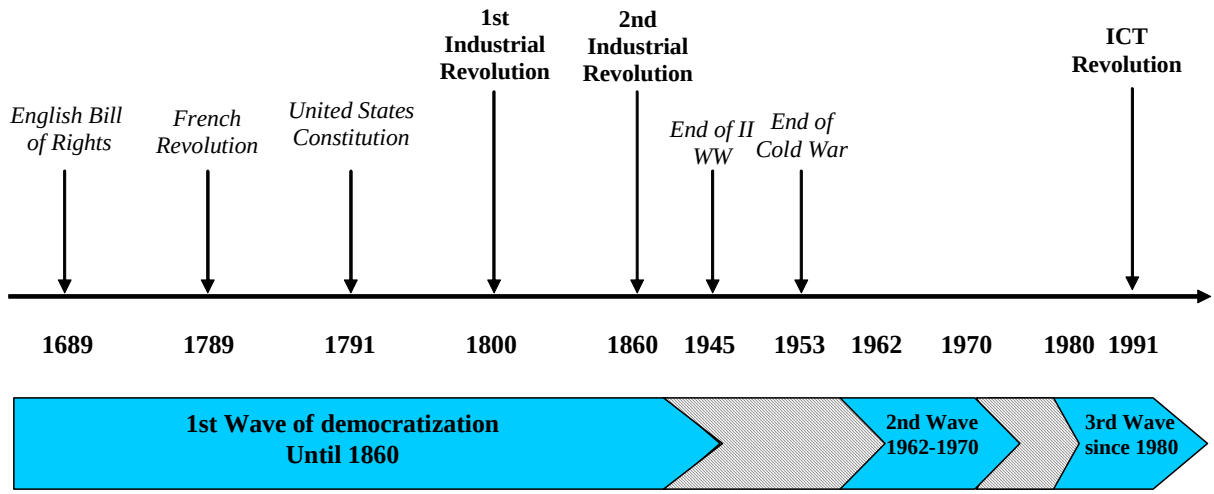


FIGURE 1: WAVES OF DEMOCRATIZATION ANTECEDENT TO THE TECHNOLOGICAL REVOLUTIONS

Mokyr (2002) points out that income growth in the twentieth century would not have taken place without technological changes, which are underpinned within more democratic countries. Kuznets (1965) writes that modern economic growth is based on the growth of the stock of useful or tested knowledge. Moreover, Mokyr (2002) claims that the failure of technological progress in the pre-1750 environment to generate sustained economic growth is due to institutional negative feedback. In fact, before the civil war in England, the French revolution and democratization wave diffusion (Kurzman, 1998), the social and environmental conditions to sustain worldwide technological progress are not present. The civil war in England (1688), the revolution of the American colonies (between 1775 and 1783) and the French revolution (1789–1799) generated a variety of social and political forces that led to the exploiting of several techniques (since 1800s) based on path-breaking classical inventions such as the steam engine. Mokyr (2002) also argues that scientific revolution and the Enlightenment [within most free and high democracy countries] helped expand the epistemic base of techniques in use and thus created the conditions for more sustainable technological progress. In order to support this process, the Industrial Revolution requires not just new knowledge but the ability of society to access this knowledge, use it, improve it, and find new applications and combinations for it. As Headrick (2000) emphasizes, the age of industrial revolution through a variety of technological as well as institutional innovations did exactly that, thanks to a new political and social climate within more democratic counties. Had the institutional feedback been negative, as it had been before 1750, technological progress would have been on the whole short-lived. Yet the feedback between institutions and technology was and is positive. As a matter of fact, the years after 1815 were more and more subjugated by the free market liberal ideology which provides incentives for scientific and entrepreneurial behaviour within more democratic countries.

Moreover, since the democracy of European countries as well as of the United States of America was, before 1815, at an early stage, innovations had minor effects on economic growth, real wages and living standards. When the democratization processes of countries entered a steadier state, another wave of innovations created – in a more global and democratic Europe – a new economic wind which, after the 1850s, increased productivity growth, income per capita and real wages. *This was a period of unprecedented growth, and achieved triumphs ... equal, if not superior, to all centuries combined* (Smith, 1994). The co-evolution of democratization and technical change has been assuming new forms in the current economy and the most important development is the Information and Communication Technologies Revolution (Devezas *et al.*, 2005). As a matter of fact, the Third wave of democratization (1980s-1990s) generated a receptive political and economic environment to absorb a new techno-economic paradigm and the benefits of converging technologies (Freeman and Louçã, 2001).

This historical discussion confirms that the democratization process underpins technical change and is prior to technological progress as well as economic growth (Figure 2).

Marchetti (1979) and Ayres (2005) consider the importance of energy as a driving force of economic growth and of Kondratieff waves (K-Waves or long wave dynamics). I actually assign a fundamental role to democratization, which is also an antecedent process to the use of energy resources and energy conversion as well as technology, economic growth and K-wave dynamics. For instance, some countries in Eurasia, which have the majority of the world's known energy resources, without democratization cannot research and develop technology, absorb it and follow economic growth patterns.

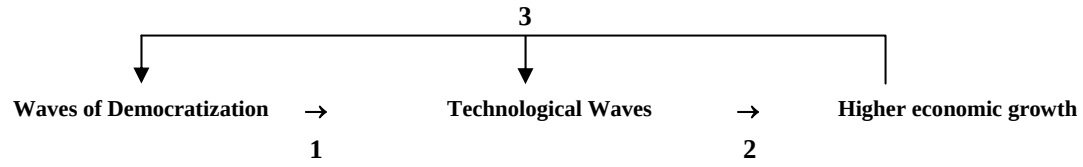


FIGURE 2: INTERACTION AMONG DEMOCRATIZATION, TECHNOLOGICAL WAVES AND ECONOMIC GROWTH BOOST

The political regime, like all social bodies, is a living entity, adaptive and responsive to external environment changes. Several researches have showed that political regimes based on democracy have been increasing over time (Modelski and Perry III, 2002; Norris, 2008). In fact, by a Darwinian process of natural selection, democracy is the best political regime suited to absorb socio-economic-technological changes in face of an accelerating environmental turbulence (Kauffman, 1995; 2001)[3]. Modelski and Perry III (2002) consider the democratization as a long-run process of social innovation that has taken 120 years to travel from 10% saturation to 50% (roughly in year 2000), whereas 90% of institutional democratization will be achieved in the 2110s or thereabouts. Linstone (2007) argues that although the number of electoral democracies is increasing, such democracies may elect on authoritarian leadership that undermines democratic institutions. Democratization is not a continuous, smooth process but rather it moves forward in discrete increments that could be subject to shocks due to, for instance, terrorist, nuclear and spatial warfare (Linstone, 2007).

Although there is a heated debate concerning the relationship between wealth and democratization, this research shows that democracy is the determinant of technical change as well as of technological progress.

An essential aspect of democratization must be considered:

*Why does democratization have positive effects on technological innovation? Which are the underlying elements within democratic countries that boost the technological innovation production and diffusion?*

The determinant of this effect of democratization on technological innovation and in general technical change is due to higher levels of literacy, schooling, education and media access, broadening the middle classes and reducing the extremes of poverty, as theorized by Lipset (1959). As a matter of fact, Lipset emphasizes that more egalitarian conditions, and in particular the expansion of the educated middle class, facilitate mass participation. Norris (2008) states that wealth is positively associated with each measure of democracy. This hypothesis is confirmed by Barro (1999), Przeworski *et al.* (2000) as well as by Lipset and Lakin (2004). To sum up, the underlying causes of this relationship can be based on the hypothesis by Lipset who places considerable emphasis on the role of human capital in the democratization process. In fact, democratization and technological innovation have a common denominator represented by growing levels of literacy, schooling and education. Norris (2008) suggests that each of these factors proves a significant predictor of democratization and – I add – of technological change. Several studies confirm that societies that invest in the human capital of their population are more likely to sustain democratization because literacy and education help generate access to information. Furthermore, these factors are important determinants of technological innovation and economic growth. In fact, the new growth theory in the Romer (1990) version introduces endogenous technological change (as a function of the level of human capital) into the Solow model.

Therefore, what is needed now for countries to improve democratization is to increase the education of human capital and, as a consequence, the intangible capital

[3] *"Dictatorship naturally arises out of democracy, and the most aggravated form of tyranny and slavery out of the most extreme liberty"* Plato, Greek Philosopher 427BC-347 BC.

accumulation, based on knowledge that has a greater and greater influence on technology production and on the competitive advantage of firms and countries (Griffith *et al.*, 2006).

## 5. DISCUSSION AND CONCLUDING REMARKS

The Copernican revolution in the development of the democratic state means the granting of human and citizens' rights through the declaration of rights and the acknowledgement of the natural equality of all individuals. The state is considered *ex parte populi*. In favour of democracy there is the idea that people cannot abuse power against themselves: *Vox populi vox dei*. After the French revolution, Rousseau's beliefs state that without democracy there is autocracy, while Kant says that human beings are no longer underage and, since they are of age, they can make decisions about their individual and collective freedom. According to Hobbes, Spinoza, Rousseau, and Hegel, democracy allows humans to achieve their role of beings of reason by means of an orderly life in common leading to personal fulfilment (Bobbio, 1980). The creation of big states with a large population leads to the modern concept of democracy based on representative governments, which are the only possible democracy in certain situations linked to territory and population. In relation to this, the US representative government after the revolution of the 13 colonies is of great interest[4]. Alexis de Tocqueville recognises modern democracy in the New World, opposed to that of the ancient populations. The idea of representative states originates in England with the constitutional movement of the early 19th century and then spreads to the rest of Europe, laying the foundations of the first and second industrial revolutions, characterised – as said above – by high levels of technological development, wealth, and wellbeing. Modelski and Perry III (2002) argue that the main advantage of democracy lies in its capacity to enhance cooperation and manage conflict. People increasingly prefer to live in democracies that are contagious and continuously spreading (as long as there is no world turbulence due to terrorism and wars)[5].

The primary findings of this research concerning the benefits of democracies are: higher democratization generates more technological innovation; in addition, democratization is the cause of higher technological progress and economic growth over time. In fact, "democracy richness" in the countries shows a higher rate of technological innovation.

However democracy has some drawbacks.

Pareto (1946) defines democracy as that form of government in which the power to make laws is given to the not so large "governing class", which keeps the power by force and thanks to the support of the "governed class", which includes the vast majority of citizens. Pareto also points out that democracy can turn into plutocratic demagogy: the governing class is made up of people who try to govern in their own interest, arousing support through cunning and deceit. Mosca (1933) notices that democracy can lead to the danger that the interests of a class which is given a defined social functions might be conflicting with public interests. Moreover, he claims that the political class actually holds power and it is characterised by the so-called *power elites* which, according to Schumpeter, compete in order to gain access to the government. In fact, new democracies are often characterised by a set of parties which are organised on the *basis of presumptively general interests* and decide by means of compromising

[4] The Preamble to the United States Constitution states: *We the People of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquillity, provide for the common defence, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America*.

In fact, the United States Bill of Rights consists of the ten amendments, added to the Constitution in 1791, inspired by the English Bill of Rights (1689): *An Act Declaring the Rights and Liberties of the Subject and Settling the Succession of the Crown*.

[5] Within this process of development of democracy, what Hegel (1934) said about the historical course of mankind should not be forgotten: *In general, Oriental culture sees only one man as free and, as a result, despotism rather than democracy could be more suited to some Oriental peoples*.

among themselves rather than according to the majority rule[6].

In short, democracy based on *power elites* deciding by means of compromise can be subject to a crisis when it no longer manages to dominate the power of the large interest groups competing with each other, thus slowing down and/or stopping the technological, economic, and social development of the nations.

Moreover, the recent terrorism wave (1970s to 2020s), especially by Islamic fundamentalists, is a form of warfare that is a continuous threat against freedom and democracies (Linstone, 2007). In fact, the effects of terrorist attacks have a strong social impact creating political, economic and financial instability, which affects economic growth in a negative way. The stability of modern democracy is based on security, however the balance between security and freedom is a difficult choice and not always compatible (Linstone, 2007a).

When democracy spreads throughout the populations of the world – as claimed by Modelski and Perry III (2002) –, how will it transform? The answer to this question is not simple because, if a philosophy of progressive history is applied, such as that of the philosopher Vico, the next step will be the perfecting of democracy. On the other hand, according to a cyclic-regressive view of history like that of Polybius, democracy is the last step in a cycle which starts with monarchy, has as its second form aristocracy and as its third and last form that of democracy, then starts over again.

I believe that the future process of sustainable development of democracy (Lijphart, 1999), in a condition of political and economic stability, should extend from the sphere of politics to that of society, in which every individual is considered in relation to the multiplicity of his/her status: entrepreneur, consumer, etc. In addition, democratization depends on the country's level of economic development, its level of available resources and its long-term national objectives. Hence, the traditional concept of democracy, based on the extension of political rights, should be applied in developing countries, whereas more developed countries should strengthen and broaden legal, economic and social equality for a future sustainable technological and economic development. All this should occur within a framework of supranational economic and social cooperation, in order to create one economic system aiming at the progress of civilization and at overcoming future challenge. In other words, future democracies should foster human qualities, which are at the basis of knowledge, through the progress of *civil society.* Furthermore, their administration should be based on the theory of the *balance of powers*, in which each body can hamper the others and/or collaborate with the others and none of the parties can go beyond their scopes. In fact, Cicero believes that the best form of government is *Moderatum et premixtum.* Mosca (1933) states that the systems that have enjoyed a longer duration and have the merit of stability are based on mixed governments, which in modern economies should support the development of knowledge and the balanced growth of countries. Democracy has a spontaneous rationality that, in the opinion of Adam Smith, influences several decisions regarding the economy and guarantees the free circulation of ideas and goods, which increase the happiness of citizens as well as economic wealth (Bobbio, 1980; 2005; 2006). According to J. S. Mill (1859), future democracies should be based on the idea of a free domestic and international market in order to increase technological progress and economic development[7]. These democratic systems should

[6] In fact, in terms of game theory, if in democratic countries there were a full majority rule, the result would be a zero sum game: what the majority wins the minority loses. The balance in this system is re-established by the fact that the minority can become the majority. On the other hand, compromise is a positive sum game: both parties win something and the negotiation procedure preserves the balance of the social system.

[7] In contrast, socialist systems operate on different principles in comparison with liberal systems. However, for instance in the Soviet Union, the most representative socialist system, it was envisaged that the establishment of the new socialist system after the revolution of the 1917 would release industry from the tyranny of the market and lead to flowering of technological progress. Bukharin and Preobrazhenskii (1969) argued that in communist society... every technical advance will be immediately adopted. But subsequent development of Soviet industry, particularly during the drive for industrialization which started in the late 1920s, created an environment basically hostile to endogenous technological change (Lewis, 1984).

involve minimal intervention by the State (Rawls, 1971; Nozick, 1974) and their role should be limited to the coordination of functional, economic, and cultural groups. Therefore, in today's age of knowledge and information technology, in which scientists and entrepreneurs play a more and more crucial role, democracies should simply coordinate the economic and scientific subsystems in order to increase the future technological and social progress of the world.

Although democracy can have some drawbacks and threats that may generate political and economic crisis, in the course of economic history the democratic structures have showed several advantages, in comparison to other political regimes, for generating technological progress and economic growth. However, sustainable democracy should be much more diffused across countries and improved where already applied.

The findings of the paper lead to the conclusion that policy makers need to be cognizant that democratization as a process triggers the origin, diffusion and utilization of technology within the economic system. As a matter of fact, the effects of technological innovations driven by the democratization process are an increase in factor productivity and purchasing power, due to cost and price reductions that boost the aggregate demand and, as a consequence, modern economic growth (Coccia, 2008). These insights are important, very important for economists, policy makers and politicians, since in the future they will have to focus much more on encouraging a sustainable democratization that, as proven, supports technological progress, economic growth of countries, and therefore global wealth and wellbeing.

## ANNEX A: PARTIAL CORRELATIONS

### TABLE 1A: PARTIAL CORRELATION WITH OTHER INDICATORS

| *Control Variables* | | *Freedom House 1990-1996* | *Polity 1990-1996* | *Vanhanen 1990-1996* |
|---|---|---|---|---|
| LN GDP PPP current international $ 1994-2000 | *Scientific and technical journal articles per million people (1995-2001)* | 0.68 | 0.54 | 0.73 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 459 | 459 | 459 |
| LN Population 1995-2001 | *Scientific and technical journal articles per million people (1995-2001)* | 0.70 | 0.58 | 0.77 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 479 | 479 | 479 |
| LN GDP PPP current international $ 1994-2000 | *R&D Expenditure as % of GDP (1995-2001)* | 0.36 | 0.32 | 0.29 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 155 | 155 | 155 |
| LN Population 1995-2001 | *R&D Expenditure as % of GDP (1995-2001)* | 0.38 | 0.29 | 0.34 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 167 | 167 | 167 |
| LN GDP PPP current international $ 1994-2000 | *Researchers and Technicians in R&D per million people (1995-2001)* | 0.43 | 0.34 | 0.47 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 173 | 173 | 173 |
| LN Population 1995-2001 | *Researchers and Technicians in R&D per million people (1995-2001)* | 0.36 | 0.26 | 0.45 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 183 | 183 | 183 |
| GDP PPP current international $ 1994-2000 | *LN Mobile Phones per 1,000 people (1995-2001)* | 0.62 | 0.40 | 0.65 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 640 | 640 | 640 |
| Population 1995-2001 | *LN Mobile Phones per 1,000 people (1995-2001)* | 0.64 | 0.40 | 0.66 |
| | Significance (2-tailed) | 0.00 | 0.00 | 0.00 |
| | *df* | 660 | 660 | 660 |

## ANNEX B: ECONOMETRIC MODELLING

### TABLE 1B: OLS RESULTS - ROYALTY AND LICENSE FEES PAYMENTS EQUATIONS

| | Models and dependent variable: Ln $s_{i,t}$ = *Royalty and license fees payments Bop current US$ 1995-2001* | | | | | |
|---|---|---|---|---|---|---|
| *Explanatory variables* | Leading Indicator Dynamic Model | | | Dynamic Model | | |
| *Freedom House 1990 -1996* | 0.756*** (0.064) | - | - | 0.041** (0.020) | - | - |
| *Polity 1990-1996* | - | 0.131*** (0.020) | - | - | 0.008 (0.005) | - |
| *Vanhanen 1990-1996* | - | - | 0.022*** (0.003) | - | - | 0.003** (0.001) |
| Constant | –1.766*** (0.405) | 1.495*** (0.298) | 1.292*** (0.296) | 0.050 (0.093) | 0.202*** (0.038) | 0.143*** (0.052) |
| Ln $s_{i,t-1}$ | - | - | - | 0.932*** (0.014) | 0.942*** (0.012) | 0.935*** (0.013) |
| $R^2$ adjusted | 0.287 | 0.113 | 0.159 | 0.959 | 0.959 | 0.959 |
| Durbin-Watson | 2.015 | 1.998 | 2.029 | 1.907 | 1.913 | 1.907 |
| F test sign. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| N. cases | 339 | 339 | 339 | 338 | 338 | 338 |

*** Parameter is Significant at 0.001; ** Parameter is Significant at 0.05; * Parameter is Significant at 0.1

*Note:* The Prais-Winsten estimation method based on the autoregression procedure estimates true regression coefficients from time series with first-order autocorrelated errors. Standard errors are in parenthesis. Moreover, *i* subscripts denote countries, *t* subscripts denote time.

### TABLE 2B: OLS RESULTS - SCIENTIFIC AND TECHNICAL JOURNAL ARTICLES EQUATIONS

| | Models and dependent variable: $z_{i,t}$ = *Scientific and technical journal articles per million people (1995-2001)* | | | | | |
|---|---|---|---|---|---|---|
| *Explanatory variables* | *Leading Indicator Dynamic Model* | | | *Dynamic Model* | | |
| *Freedom House 1990 -1996* | 52.005*** (4.213) | - | - | 0.742** (0.335) | - | - |
| *Polity 1990-1996* | - | 11.073*** (1.252) | - | - | 0.098 (0.085) | - |
| *Vanhanen 1990-1996* | - | - | 4.453*** (0.334) | - | - | 0.061** (0.025) |
| Constant | –83.888** (34.415) | 112.163*** (32.688) | 8.055 (31.944) | –1.537 (1.449) | 1.175* (0.634) | –0.099 (0.855) |
| $z_{i,t-1}$ | - | - | - | 1.003*** (0.003) | 1.005*** (0.002) | 1.003*** (0.003) |
| $R^2$ adjusted | 0.234 | 0.134 | 0.276 | 0.998 | 0.998 | 0.998 |
| Durbin-Watson | 1.853 | 1.869 | 1.880 | 1.924 | 1.921 | 1.934 |
| F test sign. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| N. cases | 493 | 493 | 463 | 462 | 462 | 462 |

*** Parameter is Significant at 0.001; ** Parameter is Significant at 0.05; * Parameter is Significant at 0.1

TABLE 3B: OLS RESULTS - R&D EXPENDITURE AS % OF GDP EQUATIONS

| | Models and dependent variable: $u_{i,t}$ = *R&D Expenditure as % of GDP 1995-2001* | | | | | |
|---|---|---|---|---|---|---|
| *Explanatory variables* | *Leading Indicator Dynamic Model* | | | *Dynamic Model* | | |
| *Freedom House 1990 -1996* | 0.201*** (0.040) | - | - | 0.004 (0.005) | - | - |
| *Polity 1990-1996* | - | 0.049*** (0.014) | - | - | 0.000 (0.001) | - |
| *Vanhanen 1990-1996* | - | - | 0.013*** (0.003) | - | - | 0.000 (0.000) |
| Constant | 0.122 (0.247) | 0.870*** (0.160) | 0.590** (0.185) | –0.026 (0.025) | –0.012 (0.015) | –0.012 (0.018) |
| $u_{i,t-1}$ | - | - | - | 1.039*** (0.010) | 1.041*** (0.010) | 1.042*** (0.010) |
| $R^2$ adjusted | 0.121 | 0.059 | 0.099 | 0.987 | 0.987 | 0.987 |
| Durbin-Watson | 2.071 | 2.094 | 2.097 | 1.766 | 1.772 | 1.773 |
| F test sign. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| N. cases | 170.0 | 170.0 | 170.0 | 169.0 | 169.0 | 169.0 |

*** Parameter is Significant at 0.001; ** Parameter is Significant at 0.05; * Parameter is Significant at 0.1

TABLE 4B: OLS RESULTS - RESEARCHERS AND TECHNICIANS IN R&D EQUATIONS

| | Models and dependent variable: $r_{i,t}$ = *Researchers and Technicians in R&D per million people 1995-2001* | | | | | |
|---|---|---|---|---|---|---|
| *Explanatory variables* | *Leading Indicator Dynamic Model* | | | *Dynamic Model* | | |
| *Freedom House 1990 -1996* | 386.030*** (77.542) | - | - | 16.252 (28.989) | - | - |
| *Polity 1990-1996* | - | 85.112*** (24.485) | - | - | –0.203 (8.957) | - |
| *Vanhanen 1990-1996* | - | - | 27.901*** (5.044) | - | - | 1.009 (2.135) |
| Constant | –71.220 (453.313) | 1406.416*** (263.467) | 662.918** (297.738) | 64.159 (146.759) | 136.464 (82.531) | 103.980 (98.889) |
| $r_{i,t-1}$ | - | - | - | 0.913*** (0.031) | 0.919*** (0.030) | 0.912*** (0.033) |
| $R^2$ adjusted | 0.110 | 0.052 | 0.134 | 0.844 | 0.844 | 0.844 |
| Durbin-Watson | 2.085 | 2.097 | 2.071 | 2.118 | 2.128 | 2.119 |
| F test sign. | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| N. cases | 186.0 | 186.0 | 186.0 | 185.0 | 185.0 | 185.0 |

*** Parameter is Significant at 0.001; ** Parameter is Significant at 0.05; * Parameter is Significant at 0.1

REFERENCES


Acemoglu D., Johnson S., Robinson J.A, Yared P. (2008), "Income and Democracy", *The American Economic Review*, vol. 98, n. 3, pp. 808–842.

Aghion P., Howitt P. (1998), *Endogenous Growth Theory*, MIT Press, Cambridge (USA).

Barro R. J. (1999), "Determinants of democracy", *Journal of Political Economy*, vol. 107, n. 6, pp. 158–183.

Bobbio N. (1980), *Stato, Governo e Società*, Einaudi, Torino.

Bobbio N. (2005), *Il futuro della democrazia*, Einaudi, Torino.

Bobbio N. (2006), *Liberalismo e democrazia*, Simonelli, Milano.

Bogaards M. (2007), "Measuring Democracy through Election Outcomes", *Comparative Political Studies*, vol. 40, n. 10, pp. 1211-1237.

Bukharin N., Preobrazhenskii, E. (1969), *The ABC of Communism,* Penguin, Harmondsworth.

Coccia M. (2008) "What is the optimal rate of R&D investment to maximize productivity growth?", *Technological Forecasting and Social Change*, on line since 24 April.

Cohen J., Dickens W.T., Posen A. (2001), "Have the New Human-Resource Management Practices Lowered the Sustainable Unemployment Rate", in A.B. Krueger and R. Solow (Eds), *The Roaring Nineties: Can Full Employment Be Sustained?*, Russell Sage, New York, pp. 219-259.

Devezas T. C., Linstone H. A., Santos H. J. S. (2005), "The growth dynamics of the Internet and the long wave theory", *Technological Forecasting and Social Change*, vol. 72, n. 8, pp. 913-935.

Diamond L. (1996), Developing Democracy: Toward Consolidation, Johns Hopkins University Press, Baltimore.

Elkins Z. (2000), "Gradations of democracy? Empirical tests of alternative conceptualizations", *American Journal of Political Science*, vol. 44, n. 2, pp. 293-300.

Freeman C., Louçã F. (2001), *As times goes by: from the Industrial Revolutions to the Information Revolution*, Oxford University Press, Oxford.

Griffith R., Huergo E., Mairesse J., Peters B. (2006), "Innovation and productivity across four European countries", *Oxford Review of Economic Policy*, vol. 22, n. 4, pp. 483-498.

Grossman M., Helpman E. (1991), *Innovation and Growth in the Global Economy*, The MIT Press, Cambridge (USA).

Gulbranson C. A., Audretsch D.B. (2008) "Proof of Concept Centers: Accelerating the Commercialization of University Innovation", *The Journal of technology transfer*, vol. 33, n. 3, pp. 249-258.

Hall B.H. (2007), "Patents and patent policy", *Oxford Review of Economic Policy*, vol. 23, n. 4, pp. 568-587.

Hall B.H., Ziedonis R.H. (2001), "The patent paradox revised: an empirical study of patenting in the U.S. Semiconductor industry, 1979-1995", *Rand Journal of Economics*, vol. 32, n. 1, pp. 101-128.

Headrick D.R. (2000), *When information came of age*, Oxford University Press, Oxford (UK).

Hegel G.W.F. (1934), *Vorlesungen über die Philosophie der Geschichte*, Frommann, Stuttgart.

Howenstine N. (2008), "Innovation-related data in bureau of economic analysis international economic survey", *Journal of Technology Transfer*, vol. 33, n. 2, pp. 141-152.

Huebner J. (2005), "A Possible Declining Trend for Worldwide Innovation", *Technological Forecasting & Social Change*, vol. 72, n. 8, pp. 980-986.

Inglehart R., Welzel C. (2005), *Modernization, Cultural Change, and Democracy: The Human Development Sequence*, Cambridge University Press, Cambridge (UK).

Kauffman S. (1995), *At Home in the Universe*, Oxford University Press, Oxford (UK).

Kaufman S. (2001), *Modern Hatreds: The Symbolic Politics of Ethnic Wars*, Cornell University Press, Ithaca (USA).

Kurzman C. (1998), "Waves of democratization", *Studies in Comparative International Development*, vol. 33, n. 1, pp. 42-64.

Kuznets S. (1965), *Economic Growth and Structure*, Norton, New York.

Lewis R. (1984), "Hierarchy and technological innovation in Soviet industry: The science-production associations", *Minerva*, vol. 22, n. 2, pp. 129-159.

Lijphart A. (1999), *Patterns of Democracy: Government Forms & Performance in Thirty-six Countries*, Yale University Press, New Haven (USA).

Linstone H. A. (2004), "From information age to molecular age", *Technological Forecasting and Social Change*, vol. 71, n. 1-2, pp. 187-196.

Linstone H. A. (2007), "Kondratieff Waves, Warfare and World Security. Tessaleno C. Devezas, Editor, IOS Press, Amsterdam (2006)", *Technological Forecasting and Social Change*, vol. 74, n. 1, pp. 113-116.

Linstone H.A. (2007a), "From my perspective. Science and Technology: Questions of control", *Technological Forecasting and Social Change*, vol. 74, n. 2, pp. 230-237.

Lipset Seymour M. (1959), "Some social requisites of democracy: Economic development and political legitimacy", *American Political Science Review*, vol. 53, n. 1, pp. 69-105.

Lipset Seymour M., Lakin J.M. (2004), *The Democratic Century*, The University of Oklahoma Press, Oklahoma (USA).

Marchetti C. (1979), "Energy systems: the broader context", *Technological Forecasting and Social Change*, vol. 14, n. 3, pp. 191-203.

Mill J.S. (1859), *On Liberty*, Library of Liberal Arts, Indianapolis (USA).

Modelski G., Perry III G. (2002), "Democratization in long perspective revisited", *Technological Forecasting and Social Change*, vol. 69, n. 4, pp. 359-376.

Mokyr J. (2002), "Innovation in an Historical Perspective: tales of technology and evolution", in Steil B., Victor D.G., Nelson R.R. (Eds), *Technological Innovation and Economic Performance*, Princeton University Press, Princeton (USA).

Mosca G. (1933), *Storia delle dottrine politiche*, Laterza, Bari.

Munck G. L., Verkuilen J. (2002), "Conceptualizing and measuring democracy: Evaluating alternative indices", *Comparative Political Studies*, vol. 35, n. 1, pp. 5-34.

Norris P. (2008), *Driving Democracy: do power-sharing regimes work?*, Cambridge University Press, Cambridge (UK).

Nozick R. (1974), *Anarchy, State and Utopia*, Basic Books, New York.

OECD (2004), *Patents and innovation: trends and policy challenges*, OECD Publications, Paris.

Pareto V. (1946), *Trasformazioni della democrazia*, Guanda editore, Modena.

Persson T., Tabellini G. (2003), *The Economic Effects of Constitutions*, MIT Press, Cambridge (USA).

Przeworski A., Alvarez M. E., Cheibub J. A., Limongi F. (2000), *Democracy and Development: Political Institutions and Well-Being in the World, 1950-1990*, Cambridge University Press, Cambridge (UK).

Rae J., (1834), *Statement of Some New Principles on the Subject of Political Economy, Exposing the Fallacies of the System of Free Trade, And of some other Doctrines maintained in the "Wealth of Nations"*, Boston: Hilliard, Gray. Reprinted (1964), New York: Kelley; and (1965), in R. W. James (ed.), John Rae, Political Economist, vol. 2, Aylesbury, University of Toronto Press, Toronto.

Rawls J. (1971), *A Theory of Justice*, The Belknap Press of Harvard University Press, Cambridge (USA).

Romer P. M. (1990), "Endogenous technological change", *Journal of Political Economy*, vol. 98, n. 5, pp. S71-S102.

Sahal D. (1981), *Patterns of Technological Innovation*, Addison Wesley, New York.

Schumpeter J.A. (1942), *Capitalism, Socialism and Democracy*, Harper, New York.

Smith M. R. (1994), "Technological Determinism in American Culture", in M. R. Smith and L. Marx (Eds), *Does Technology Drive History?*, MIT Press, Cambridge (USA), pp. 1-35.

Spanos A. (1986), *Statistical foundations of econometric modelling*, Cambridge University Press, Cambridge (UK).

Steil B., Victor D.G., Nelson R.R. (2002), (Eds) *Technological Innovation and Economic Performance*, Princeton University Press, Princeton (USA).

Stiglitz J. E. (2001), *In un mondo imperfetto: Stato, mercato e democrazia nell'era della globalizzazione*, Donzelli, Roma.

Torres-Salinas D., Moed H.F. (2007), *Proceedings of ISSI*, CINDOC-CSIC, Graesal, Madrid.

Vanhanen T. (2003), *Democratization. A comparative analysis of 170 countries*, Routledge, London.

Verbeek M. (2008), *A Guide to Modern Econometrics*, John Wiley & Sons, Ltd., Chichester, England.

World Bank (2008), *World Development Indicators on CD-ROM*, The World Bank, Washington D.C.

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