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EU PATENT SYSTEM: TO BE OR NOT TO BE?

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ABSTRACT

This paper introduce a list of desirable efficiency properties that any a patent system should have in order to enhance innovation, trade competitiveness, employment mobility and economic growth. We briefly overview the literature on patents and discuss the advantages and disadvantages of the present and recent proposals for the future of the European Union Patents System. In particular, we discuss the cost-inefficiencies observed in the current design of the EU Patent System based in a double structure layer divided in a central European Patent Office (EPO) and several national-based patent offices. This paper analyzes the likely backlashes of creating a third layer for a sub-sample of EU countries. The paper suggests an alternative more efficient Patent System together with some policy implications.

JEL classification: O31, O34, D02, F15, L24

Key words: innovation, patents, knowledge spillovers, common European patent, welfare losses, patents' languages, cultural proximity, competitive trade.

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1. Introduction

Scholars from management and economics (Arora and Gambardella, 2010; Gans and Stern, 2010) have lengthily stressed how innovation is not only the base of a firm competitive advantage but also the engine of the growth of a region. Innovation anyway has its drawbacks and it is burdened by two sources of uncertainty: first, the time span between investments is realized and its financial return is obtained, and second because it could be easily copied without incurring in the cost of R&D.

In the R&D literature, a question that has generated long debates is how monopoly rights (patents, etc.) and competition affect innovation and productivity growth[3]. There are two clear opposite views: Innovation under competition reduces *innovations rents*, relative to the monopoly rents, but innovation is also a mechanism to escape competition (*competitive advantage*) and in that sense increases *innovation rents*. First, through a "*rent dissipation effect of competition*", tough competition *discourages innovation* and productivity growth by reducing the expected rents from innovation. By reducing the monopoly rents, competition discourage firms from doing R&D activities which lower the innovation rate and the long run growth. The initial endogenous growth models of technical change of Romer (1986, 1990), Aghion and Howitt (1992), Grossman and Helpman (1991), predict that competition (or the imitation rate) has a negative effect on entry and innovation and therefore on productivity growth. Therefore, patent protection that protects monopoly rents from innovation enhances further innovation and growth (Schumpeterian view). Second, the "*escape competition effect*", followed by most competition authorities, says that competition is a necessary input for innovation both because it *encourages new entry* and because it *forces incumbent firms to innovate* and reduce costs to survive and therefore competition is productivity and growth enhancing. Which of the two competition effects dominate is an empirical question.

Crépon et al (1998) study the relationship between productivity, innovation and research (R&D) at the firm level using a structural model. In particular, they find that firm´s innovation output (patents) raises by increasing research effort and other indicators that also transmit their effects through research (R&D) and increases firm´s

[3] Aghion and Griffith (2005) provide an interesting overview.

productivity. Aghion et al (2003) found an inverted-U relationship between innovation (citation-weighted patent count) and product market competition which is steeper for more neck-to-neck industries. In a recent empirical application, Blazsek and Escribano (2010) also obtain an inverted-U relationship between R&D (after controlling for patent citations) and innovation (measured by patent application counts).

Patents represent a solution to imitation and knowledge diffusion problems (Gallini, 2002) since from one side, patents *protect innovators from imitation*, and from the other *diffuse publicly the characteristics* of a discover. However, the particular patent design mechanism (patent system) affects how perfect the solution to the maladies of innovation is. Patent system aims to define neatly the intellectual propriety rights, to sustain the incentives to R&D investments, to create the base of a market for technologies, and to increase the efficiency of resource allocations (Arora and Gambardella, 1994).

Any biases that an ill-designed patent system introduces in the economy will compromise the fulfillment of its objectives. There is a long dated debate over the European Patent System (see Harhoff et al., 2010) and its level of efficiency especially compared to competitive systems like in US and Japan. European Patent System has to adapt to the peculiar European characteristics of being divided in countries with different languages and cultures. Actually, Europe has set in place a dual system of country-based and European-based patents that has generate significant higher costs for European inventors to accede to patenting (Pottelsberghe de la Potterie and Didier, 2009). Therefore, this paper will try to focus the debate over the Patent System in Europe.

In regional economic models, geographically localized innovation spillovers are important in explaining why firms and economic activity in general are densely concentrated in Space (Glaeser, 1999). In development models, localized spillovers are the cross country determinants of persistence productivity gaps.

The recent trade literature has emphasized the importance of firm heterogeneity in understanding *export* behaviour and foreign direct investment (*FDI) inflows*. Bernard and Jensen (1995, 1999), Clerides, Lach and Tybout (1998), and Aw, Chung and Roberts (2000) all find that the larger and more productive and innovative firms are more likely to export (see Bernard et al., 2007 and Lopez, 2005 for reviews). Therefore, firm´s innovation enhances trade competitiveness. This finding is consistent with theoretical predictions of heterogeneous-firm trade models, most notably those of Melitz (2003), Bernard et al. (2003) and Yeaple (2005). The more productive and innovative domestic firms are the ones that engage in exporting activities. On the other hand, firms entering more competitive export markets (*self-selection*) obtain significant productivity gains by *learning by exporting*.

Likewise, the conventional wisdom associates *foreign direct investment* (FDI) inflows with higher productivity and innovative firms. If multinationals possess knowledge based assets that are not available in the host country, it is reasonable to believe that some of their technological superiority may spill over domestic firms with direct implications on productivity gains (see e.g. Görg and Greenaway, 2003 and Kokko, 2002). Foreign firms through technology transfers improve the innovation activities and the productivity of the firms they acquire while simultaneously the foreign investors select the more productive and innovative firms to acquire *(foreign investors are picking winners and creating them*). These are important simultaneous aspects that affect the way firm's innovation diffusion (patent systems) is internationally transmitted to other firms (spill over) increasing, therefore, their trade competitiveness.

Clearly, *imitation* poses threats to the incentives to R&D investments. This is related to two facts. First, the imitator could exploit a cost advantage because it could frame a copy of an innovation, reaping the benefits without incur in the costs, especially fixed. Second, sometimes the innovator firm is not the best organization to generate profit from their innovation. Indeed, profiting from innovation depends from downstream assets of the firms that tend to be independent from the ability to innovate (Teece, 1986). These problems generate fewer incentives to be an innovator, and higher ones to be a first imitator. Second, innovators rely more and more on secrecy in order to protect their R&D investments. Unfortunately, secrecy generates social costs because innovation is a cumulative process that depends on the bulk of the past knowledge (Dosi, 1988).

The structure of the paper is the following: Section 2 introduces a list of desirable properties that any efficient patent system should share. Section 3, discusses recent empirical literature relating trade competitiveness, total factor productivity, patents and innovation. Section 4, reviews the cultural proximity effects (cultural distance) on international trade and R&D; in particular, it presents some evidence of the effects of cultural factors, such as languages, on international trade competitiveness. Section 5, includes a quick literature review and some stylized facts over the actual European Patent Systems. We then, in section 6, highlight important backlashes of a new common European patent proposal of 11 European countries to set German, English and French as official languages for the European Patent. Section 7, suggests a natural more efficient alternative the actual proposal of a common patent system for the EU. Finally, section 8 includes the main policy conclusions.

2. Desirable properties of any efficient patent system

According to a large *survey sponsored by the European Commission* based on 9,216 European Patent Inventors from France, Germany, Italy, the Netherlands, Spain and the United Kingdom, almost **60% of the inventors (58.87%) answered that the patent literature was important as a source of knowledge**. Among the 8 possible sources of knowledge, patent literature results the second most important, only beyond customers and suppliers (Gambardella et al., 2005).

Property 1: *Patent systems should* ***facilitate the circulation of the knowledge derived from the innovation*** *for all interested firms.*

Europe is investing in protecting innovations and the beneficial spillovers should not be biased en favor of some countries over the rest. It is worth to note that knowledge spillovers (Alcacer and Gittelman, 2006) are a fundamental part of the process of innovation creation. Knowledge spillovers, also fostered by patent literature, diffuse new inventions and knowledge across firms and countries, increasing the probability that novel inventions arrive. Indeed, innovation has been demonstrated to be a cumulative process (Dosi, 1988 and Blazsek and Escribano, 2010) in which the probability that a new innovation is discovered is a function of the past trajectories of research and patent applications. A patent system represents a welfare improvement for the society, if and only if, it represents an important channel to transfer knowledge

(Gallini, 2002). Barriers or a constraint to the transfer of knowledge generates social inefficiencies.

Property 2*: Patent systems should be* ***costs efficient*** *for applicants.*

Patent systems that are not cost efficient will reduce the rate of patenting for firms and inventors due to the high patenting costs. This could not only decrease the incentives to innovate (less R&D) but also could increase the incentives to keep the innovation secret (less patents) reducing the overall rate of knowledge spillovers. What is more important is that differences in cost efficiencies among patent offices could cast a significant competition advantage for firms located in different countries. Van Pottelsberghe and Francois (2009) estimate that an EU patent valid for 10 years in 13 countries will cost about 56k euros, compared to 12k for USA and 7k for Japan.

Property 3: *Patent systems should be* ***costs efficient*** *in terms of litigations.*

According to the European Commission (2006), in 2004 litigation costs in Europe were quite high. The total cost of patent litigation in Europe amounts of about 303 billions of Euros with an average costs per patent in force of about 215 Euros. Patent litigation is not only a private cost for innovative firms, but it represents also a public cost for the society that has to deal with an increasing number of trials (Arora and Gambardella, 2010). Ziedonis (2004) and Arora and Merges (2006) note that an cost efficient patent system reduces litigations among firms especially in case of complex and fragmented knowledge. Firms with an extensive protection of the knowledge base could easily reach cross-licensing agreements without recurring to courts. Patent litigation is a costly activity for the society in general and policy makers are well aware that an efficient patent system that saves the cost of ex-post litigations is a better equilibrium.

Finally, as correctly pointed out by Reitzig et al. (2010), inefficient patent systems give raise to the so-called patent trolls or sharks, that are non-innovative firms that use patents usually acquired from ceased companies to threat innovative firms into patent litigations.

Property 4**: Patent systems **should not give differential incentives for **small, medium size (*SMEs*)** *located in certain countries.*

It is not desirable to have a patent system that will increase the R&D incentives and the corresponding innovation protection to small, medium size (SMEs) firms located in certain competing countries.

Generally speaking, sustaining innovation for SMEs is usually part of the agenda of any government. Indeed, since small firms suffer problems of liquidity constraints policy interventions tend to help SMEs in financing their R&D activities. Anyway, one thing is to try to alleviate the problems of financing R&D project, another to introduce biases in the patentability of an innovation. Even more if the protection is only granted to particular groups of SMEs, i.e. in particular countries.

First of all, all other things equal, some countries with SMEs will have an additional strength compared to other SMEs derived from a patent system that has lower cost of patenting or that provides higher protection. Second, the possible competition between large firms and SMEs could be altered if the patent system favors certain SMEs that compete with large firms of other countries.

Property 5**: Patent systems should **promote R&D Collaborations.

Collaboration relationships in R&D, usually in the form of innovative division of labor between large and small firms (see Arora and Gambardella, 1994) should be promoted. Especially in technology sectors at the frontier (i.e. biotech, coating, lasers) innovation is a complex system carried on by a deep structure of innovative buyer-supplier relationships between large integrated firms and small innovative start-ups. Patents represent the common language that sustains this structure, also because the large firms use patent databases to find the precise small and young firm that could perform research in a particular field of analysis (Giarratana, 2004).

If collaborations in R&D are not promoted, this could not be detrimental only for the division of innovative labor inside Europe, but also for the cross border collaborations between European firms and Japanese and US innovators. Giarratana and Torrisi (2002) shows that in several sectors European firms are technology laggards that need to learn the state of the art technology from Japanese and US counterparts. R&D

alliances and joint-ventures are one of the best tools to achieve this aim and a good international patent portfolio is the necessary condition to achieve and sign these types of collaborations.

Property 6*: Patent systems* ***should enhance inventor´s mobility.***

Inventor mobility is one of the most important engines of innovation (Alemedia and Kogut, 1999; Palomeras and Melero, 2010). First, in terms of entrepreneurship; most successfully innovative start-ups were founded by inventors usually employed in large firms, who decide to perform innovative R&D trajectories with a spin-out. Usually these innovative entrepreneurs use patents to find funds to form the new firm since Venture Capitalists tend to put a premium on innovative start-up (Giarratana, 2004; Klepper and Thompson, 2010).

Second, an efficient labor market for inventors allows the best allocation between an inventor with some characteristics and a firm with determined assets. The canonical work of Saxenian (1994) shows that, one of the motives of, the success of the Silicon Valley was the high labor mobility of inventors and engineers inside the region. As Saxenian (1994) puts it, people perceive that they are employed “by the Valley” rather than by the individual firms. Patents represent the base of this labor market because it allows a high circulation of information on inventors (who I should hire?) and firms R&D characteristics (where should I go?) creating the ex-ante premises for a good match.

Moreover, an efficient patent system helps in defining what innovation an inventor could or could not use to base his mobility both in terms of being hired by a new company or founding a new start-up.

Also literature (Gambardella and Giarratana, 2010) has analyzed patent citations and inventor mobility and find a positive correlation. Finally, several scholars (see Kerr, 2008) point out how innovation and technology diffusion is related to the flows of high level human capital migration. Basically, in order to increase the competitive performance of an innovative system, it is important to attract high-quality human capital from outside (i.e. from outside Europe).

It is also worth noting that the Lisbon Agenda sets among the long-term strategic objectives of EU these following two interrelated aims: i) making lifelong learning and mobility a reality; ii) enhancing creativity and innovation, including entrepreneurship, at all levels of education and training.

Property 7: *Patent systems should* ***promote "open innovations".***

Large firms could have incentives to move their patent strategy from an international approach to a more local one. This could generate a trend of a consolidated fragmentation of the market of innovation that gives more strength to the role of patent as a protection and strategic tool and detriments the role of the patent as a knowledge broker directed to the diffusion of innovation. Alcacer (2006) shows that in the semiconductor industry, large companies manage a complex network of R&D research labs across different geographical areas in the world. All these research labs are connected and organized in order to maximize the absorption of knowledge (Escribano, Fosfuri and Tribo, 2008) from the external environment and to make more efficient the flow of this knowledge inside the company. Patents registered by the different subsidiaries all around the world are the common source of knowledge sharing in which English is usually the basic language. It is worth to note that this is harmful especially in light of the new "open innovation" approach to innovation (Laursen and Salter, 2006). Open innovation assumes that innovation production is a mix of external and internal knowledge in which the ability of firms of collaborate and exchange knowledge and patents are fundamental. Any additional barriers that slow down this flow exchange will seriously damage this approach.

Property 8: *Patent Offices should be internationally competitive and promote* **labor productivity.**

It is well known that the European Patent Office has a low productivity compared to US and Japanese ones. This could pose the European system in a worse position compared not only to Japan and US, but also to the raising R&D stars of Asia and South America. In terms of the functioning, patent offices should be organized based on efficient examiners. Patent systems should avoid generating language heterogeneity in patent applications that will; increase administrative costs of patent applications, create difficulties in the overall background of knowledge owned by examiners and slowdown the whole application process, making therefore examiners less precise and efficient.

For example Van Pottelsberghe and Francois (2009) show that EPO total staff is about 5k employees, compared to 7k of USPTO and 2.5k of JPO, but USPTO examines 340k patent applications, compared to 116k of EPO and 413k of JPO.

3. Trade competitiveness, productivity, patents and innovation

Innovation and the search for new ideas by researchers or firms interested in profiting from their inventions is the engine of economic growth following the endogenous growth models (Romer, 1986, Grossman and Helpman, 1991, Aghion and Howit, 1992 and Jones, 1995).

(Insert Table 1, 2 and 3 and Figure 1 and 2 around here)

Bernard and Jensen (1995, 1999), Clerides, Lach and Tybout (1998), and Aw, Chung and Roberts (2000) all find that the more productive (TFP) and innovative firms are more likely to export. In fact, the contribution of average TFP and innovation to the probability of firms to export is 20% and 2%, respectively (Table 1b and Figure 1b). On the other hand, firms entering more competitive export markets (*self-selection*) by *learning by exporting* they obtain significant productivity gains equal to 4% (Table 1b, Figure 1b). Innovation has also important direct partial net effects (net of human capital and financial aspects, labor regulations, competitive aspects that are not usually controlled for when measuring innovation effects) on total factor productivity (TFP) of the firms. This partial net innovation effect (without considering the spillovers) was evaluated as a 4% of average TFP by Escribano, Pena and Reis (2010) using firm level data from developing countries, (Table 1b and Figure 1b).

(Insert Table 4 around here)

Table 4 shows that two important EU countries (Spain and Italy) in terms of their gross domestic product (GDP) are at the lower tail of the productivity (labour productivity and TFP) distribution of selected competing countries. The main way to improve their productivity is by enhancing product innovation and by generalizing the use of best competitive practices (process innovation) of more efficient countries. If the two languages (Spanish and Italian) are left out of the diffusion of the innovations of the new EU patent system that will create an important discrimination and a significant barrier for the diffusion and creation of knowledge through the EU. The new EU patent system proposal of 11 countries will increase the cultural distance among EU countries (internal market) and will increase the cultural distance between EU countries, specially Spain, and Latin American countries as will be discussed in section 4 below.

Foreign investors select the more productive and innovative firms to acquire while simultaneously foreign firms through technology transfers, improve the innovation activities and the productivity of the firms they acquire *(foreign investors are picking winners and creating them*). The more productive and innovative firms are, the more foreign direct investment (FDI) they will attract. In particular, the contribution of average TFP and innovation on the probability of attracting FDI is 25% and 4% respectively while the contribution of FDI to average TFP is equal to 1.6% in developing countries (Table 1b and Figure 1b). Therefore, international trade (exports and FDI) are important aspects that simultaneously affect the way firm's TFP and innovation diffusion (patent systems) is internationally transmitted to other firms (spill over) affecting their international competitiveness.

Blazsek and Escribano (2010) introduced new econometric methods to control for firm-level observed and unobserved R&D spillovers when estimating the economic determinants of patent applications. They applied it to the U.S. economy over a long period of 22 years (1979-2000) by merging patent data sets from MicroPatents and from the National Bureau of Economic Research (NBER) data files. They incorporate latent (unobserved) innovation spillovers in their model since previous R&D literature realized that knowledge spillovers are partly observable and partly latent. Following Hall et al (2001) they used patent citation data, which is fully available for a very long time period for all U.S. firms, to measure observable knowledge spillovers with the citations published in patent documents (innovation information flows). They showed that patent propensity[4] increases exponentially with the R&D of the firms and that the spillovers from patent citations are much higher for the Hi-tech sectors than for the rest. In Hi-tech sectors the highest number of patent citations is first the intra-industry citations closely followed by self-citations. The number of inter-industry citations is only half of the previous type of citations. This is consistent with the prediction that firms are sorted by their absorptive capacity. Agglomerations attract firms with high absorptive capacity and more sparsely populated regions include firms that are more indifferent to spillovers. Absorptive capacity is an important source of competitive advantage (Escribano, Fosfuri and Tribo, 2009). Governments fostering the creation of industrial clusters must establish complementary policies to enhance firm's absorptive capacity. They obtained that absorptive capacity is relatively more important in turbulent knowledge sectors and in environments where intellectual property rights (IPR) are stronger (patents).

There are positive contemporaneous and dynamic effects between firm´s stock returns and patent intensity (Blazsek and Escribano, 2011). In their analysis they use a cluster of technologically related US firms, most of them from the pharmaceutical sector over a 22 year period, and found using a vector autoregressive panel (P-VAR) that patents have a much larger effect on firm´s returns than secret firm´s innovations. Therefore, inefficiencies in the design of the patent systems that will reduce the knowledge flow among firms will create important losses for the firms in terms of their market value.

4. The Role of Cultural Distances in International Trade and R&D

It is an old and well established stylized fact that international trade is affected by the cultural distances among nations. Even several recent works (see Guiso et al., 2009; Disdier and Head, 2008) reasserted this issue claiming that cultural aspects like language, religions and somatic similarities are main determinants of economic exchange across nations. This line of reasoning suggests that one could observe more bilateral trade, both in terms of goods and services exchange and FDI investments, between countries that are culturally near. Lychagin (2010) shows the gains from

[4] The *patent propensity* of a firm is equal to the firm´s number of patent applications divided by their R&D expenses.

spillovers will be shared by “neighbor” countries and the gains from spillovers decline with distance (geographical distances, cultural distances, etc.).

Innovation through the creation of new varieties and *diffusion*, through the adoption of new varieties through imports, can explain the relationship between trade and growth (Santacreu, 2010). She showed that diffusion in the last decade was particularly important in Asia and Eastern Europe and that they grew faster than average. As countries (say Italy and Spain) get closer to the technological frontier a policy that enhances innovation is appropriate in order to expand the technological frontier.

Table 4 shows a paradigmatic example. We present the ratio between the Export/GDP of Spain over Export/GDP of UK (i.e. [ES Export/ ES GDP] / [UK Export/ UK GDP]) towards two groups of countries related to Spanish or English speaking traditions. As one could easily observe, while Spain has a relative advantage towards the countries with a Spanish speaking tradition (Ratio>1), UK manifests this advantages towards the countries with an English based tradition (Ratio<1).

[INSERT TABLE 4 ABOUT HERE]

Especially Guiso et al. (2009) pointed out that the more a good is trust intensive and therefore bounded by transaction costs, the more the cultural dimensions will play a major role in determining the trade between nations. Transaction costs rise when a market of a particular good is bounded by uncertainty (for example over the good quality and characteristics of use) and the price is not a perfect mechanism to make demand and supply coinciding (Williamson, 2002).

One of the classical goods bounded by transaction cost that is trust intensive is technological knowledge (Gans and Stern, 2010). Indeed, technological knowledge markets are usually plagued by asymmetric information (one does not know how good is a technology until he uses it) and strategic considerations (the value of an innovation is not fixed, but changes according to the characteristics of the firm that uses it) (Arora and Gambardella, 2010).

Following this line, empirical evidence has already shown how a cultural factor as language could influence the internationalization of R&D. A recent work of Picci (2010:

1076) that analyzes patent activity in the European patent office has demonstrated that looking at inventor and applicant nationality in patent applications “a common language has a significantly positive effect on all type of international inventive collaboration”.

The basic mechanism of a patent system is a general agreement between the government and the inventor under which the inventor will disclose the basic features of an innovation while the government will provide protection against imitation. Literature (Gallini, 2002) agrees that from one side a patent system favors the diffusion of knowledge, increasing knowledge spillovers and productivity, and from the other, gives to inventors the incentives to invest in innovation because protection is granted. Finally, it reduces the transaction costs associated with technological knowledge increasing the specification on the intrinsic characteristics and potential applications of an innovation (Arora and Merges, 2004).

Anyway also patents have their maladies. The technical ability in writing a patent, and therefore the skills to write a patent in a particular language, could determined the level of defensibility, especially in courts, of an innovation, and therefore the real and perceived ability of the inventor to protect his investment (Reitzig et al., 2010). This is particular important in a period of market globalization in which companies are forced to compete in new foreign markets and to defend their own national market from new external competitors (Ghemawat, 2007). This increased competition clearly affects also the R&D processes and the related incentives to expand or defend a competitive advantage based on technological knowledge.

To give a general idea of the main languages actually spoken in the world, Table 5 shows the actualized data.

[INSERT TABLE 5 ABOUT HERE]

Table 6 shows the latest data in terms of GPD growth for the fastest growing countries that could represent both potential new markets and potential new competitors. AS one can easily note, Asia and South America play the major role.

[INSERT TABLE 6 ABOUT HERE]

Said that, moving again our lens toward the R&D field of analysis, the main question is whether language could affect the patent activities of the firms beyond their propensity to export in a particular country. To rapidly check this hypothesis, we also present in Table 7 the ratio between the number of patents and the exports with the applicant country defined as UK or Spain and a particular set of phase countries. The measure is similar to the previous one of Table 4 and formally is the ratio between the Patents/Exports of Spain over Patents/Export of UK (i.e. [ES Patents/ ES Export] / [UK Patents/ UK Export]) towards a particular country. If there is no bias in the patent system due to the language on top of the export propensity, the ratio should not show any strong variation among countries. As one can see the ratio different between Mexico and US or Australia is more than the double.

[INSERT TABLE 7 ABOUT HERE]

5. The EU Patent System

In 1973 the European Patent Convention signed the birth of the European Patent System that came into full effect in 1977. Since 1977 European Patent Office (EPO) became the executive arm of the European Patent Organization, and it is a centralized patent granting system on behalf of all the member states (Table 8). It is worth to note that the founding motivation EPO was "to support innovation, competitiveness and economic growth for the benefit of all citizens of Europe" (www. Epo.org). EPO works nowadays for the protection of innovation in 38 different countries and employs about 5900 employees.

[INSERT TABLE 8 ABOUT HERE]

EPO patent application should be submitted in one of the three procedural languages English, German or French. When the examination procedure that checks the novelty and industrial applicability of the patent is terminated, the EPO patent is granted and should be converted in national patent in each state for which protection is asked. This implies additional translation and national fee costs for each country in which the patent is enforced. Clearly, an EPO patent submitted in French (or English, or German) should not pay any additional costs in order to be enforced in France (or UK, or Germany). Accordingly, national renewal fees have to be paid in those states where the patent is valid (Harhoff et al., 2009). Table 9 shows the patent applications in the three main offices in the world in which USPTO plays the mayor role.

[INSERT TABLE 9 ABOUT HERE]

Table 10 shows the picture of main EPO patent applicants at 2005. The image that comes out is a high concentration of patent activity: the first two countries for patent granted already own 50% of overall patents. Note that Germany alone owns a large part of the EPO patents, about 42%. This concentration is also reflected by the importance of some large firms for the overall R&D in Europe; for example in 2005 the German firm Siemens and the Dutch firm Philips jointly accounts for 4759 EPO patents, equal to 9% patents of all European countries.

[INSERT TABLE 10 ABOUT HERE]

Data of Table 10 should be compared to more general R&D indicators for top countries provided in Table 11. One could note that while Germany invests on average 4.1 times more in R&D and has 3.3 times more researchers compared to the counties of comparisons, it applies 4.7 times patents.

It is particular striking the evidence also in terms of inventor mobility. Germany employs only 4.9% of foreign (non-German) researchers compared to 8.2% (non-English) of UK. This means that while UK is able to attract researchers from different countries, Germany employs mainly own formed inventors. Granted this, one could think that language is an important factor at work. Indeed, Spain, that speaks one of the most diffuse world languages, employs 9.5% of foreign (non-Spanish) researchers.

[INSERT TABLE 11 ABOUT HERE]

Several scientific articles criticize the actual structure of the EPO patent system. First of all, actual EPO patent system has introduced importance biases across European countries. Harhoff et al. (2010) highlight the existence of significant differences among countries in terms of costs to access to the EPO patent protection. Their work indicates that “validation fees, early renewal fees, and translation costs vary substantially across countries” (pag. 1433). One of the main results of the econometric study of Harhoff et al. (2009) is that there is significant empirical evidence that translation costs represent a cost barrier for acceding to the EPO patent protection.

Second, compared to the US and Japan, EPO system presents important different costs that create inefficiency. EPO at 2003 presents a ratio between patents applications and patent examiners of 34.65, compared to 96.87 of US and 366.86 of Japan (Von Pottelsberghe de la Potterie and Didier, 2009).

Interestingly, Von de la Potterie and Didier (2009: 341) propose an estimation of the cost of an EPO patent. To enforce a patent in one of the three countries of procedural language (France, Germany or UK) the costs amount to 20570 Euros, compared to the 9856 of US and 5541 for Japan. This means that to protect an innovation in one of the three procedural countries of Europe, a firm should invest 2 or 3 times as much as United Stated or Japan.

What is even more evident is the difference in the case of a patent protection extended to more European countries. The cost difference between a patent granted in the three procedural countries and a patent enforced also in Spain, Italy, Netherlands, Sweden, Switzerland, Belgium, Austria, Denmark, Ireland and Finland is about 32627 Euros. The authors (pag. 343) conclude that “a European patent designating 13 countries is about 11 more expensive than a US patent if process and translation costs are considered”.

This actual cost of patenting in Europe should also be confronted to the globalization trend that is taking place, especially for the so-called China effect. According to Thomson Reuters (2009) China’s overall patent filings grew by 26% a year between

2003 and 2009 compared to 6% in America, 5% in South Korea, 4% in Europe and 1% in Japan. What is more interesting is the penetration of Chinese patenting inside foreign systems; Table 12 shows the increase in Chinese patent activity in USA, Japan and Europe (27 members) compared to export statistics. It is worth to note that while the differences in terms of export growth are not so significant among the three geographical areas; the patent activity of China is growing 5 times more in Europe that in USA. This could suggest a general weakness of EPO compared to the other major system.

[INSERT TABLE 12 ABOUT HERE]

6. Evaluation of the European Patent System Reform Proposal

One of the main drawbacks of the innovation system in Europe is the lack of a uniform European Patent that homogenizes the rules (and also the language) among the partner countries (see also Nature, 2010) even if 80% of European patents are filed in English.

Up to date, given the impossibility to reach an agreement, especially on translation procedures, at the end of 2010, 11 member states address a formal request to the European Commission proposing a third system of patent protection, a sub-category of the actual European Patent, that should be a new option and that could coexist with the actual European and national systems. Inside this new system, the *three procedural languages will become official languages for patent applications*, no translations needed for the single states.

It does not seem that this new proposal that transform the three procedural languages (German, English and French) in official languages for patent procedures goes in the expected direction of creating a unified and stronger European patent system. It could indeed introduce some important bias in the actual market of innovation in Europe for the firms and the inventors that are located outside France and Germany.

The major threat that this system could generate is the creation of two separated European innovation markets that will represent a definitive shipwreck to the objective of a common European market for innovation. Moreover, adding a third layer to the actual two coexisting European patent systems could dangerously increase even more the cost of patenting in Europe. In the following we highlight several backlashes that the new system could originate.

Backlash number 1: Knowledge spillovers

The new system allows protection to innovations that will spill-out with a low rate outside France and Germany, undermining the very positive effect of patents to the European society. This means that Europe invests in protecting innovations but the beneficial spillovers would be more fruitfully exploited inside the French and German speaking countries. One of the main positive effects of a European Patent is to increase the circulation of knowledge among European inventors, while the system proposed seems to raise new barriers for countries with other native languages. A new system that gives larger protection to some languages compared to others could prevent the use of new protected innovations to build up new knowledge, increasing the concentration of R&D activities in particular States compared to others. This seems not only against the fundamental principle of equality among European states, but also a significant barrier for the welfare goals of a patent system.

Backlash number 2: Costs of patenting

The new system will clearly raise the cost of patenting. Nature (2010) points out that the new system will be “a third layer atop the current European and National patents” (pag. 395). European firms will probably face the additional burden of registering and paying for a third European patent to protect an innovation. Given the already cost difference compared to USA or Japan, this could be really problematic for the European innovation system. This means that the new systems will probably reduce the rate of patenting for firms and inventors due to the increasing patenting costs. For non France and German countries the system will probably cause a cost differential, accentuating the previous problems; for example, an inventor who does not understand German and French should contract out the patent review to external parties.

Backlash number 3: Costs of litigations

The new system will probably raise both the cost of patent litigation and the probability to generate a patent litigation. With the new system, a firm or an inventor will incur with higher probability in infringing some patents without any voluntary reasons only because it was too difficult and costly to scan all the relevant patent literature inside three different coexisting systems. Given that a third layer of patent system will add more uncertainty on the actual state of the art of the invention, more uncertainty usually generate more room to IPR conflicts. For no-German and French speaking countries, with higher probability the new system will raise these costs more proportionally compared to the three procedural States. This cost will tend to increase in the future giving that the number of patents in litigations are increasing exponentially see Figure 3.

[INSERT FIGURE 3 ABOUT HERE]

Backlash number 4: Competition among SMEs in Europe

It mostly probable that this new proposed system will increase R&D incentives and innovation protection to SMEs located in German and French countries. At any rate, the fact that the new system will probably award more protection to SMEs in French and German speaking countries could create important competitive biases especially in those European countries characterized by an industrial structure of SMEs.

Backlash number 5: R&D Collaborations

With the new system at work, collaboration relationships in R&D, usually in the form of innovative division of labor between large and small firms could be affected. A third new patent system on top of the two existing one could generate problems not only in the search process of a R&D partners but also in the process of sustaining the contractual relationships among parties. Especially for Europe this is a particular point of importance, given the large amount of EU public money invested in fostering R&D collaborations across EU countries (Miotti and Sachwald, 2003). Additionally, this could not be detrimental only for the division of innovative labor inside Europe, but also for the cross border collaborations between European firms and Japanese and US innovators. An even more fragmented and burocratized patent system could slow down this important catching up process of European firms.

Backlash number 6: Bias in the labor market for inventors

A third system of patenting in Europe could generate first of all two separated markets for inventors in Europe, reducing the labor mobility inside the European market. A part from the fact that this is against the basic principles of the European foundation on labor mobility, this will reduce globally the possibility to have a perfect match firm-employee across European countries that, in terms of R&D activity, would cause a reduction in the productivity. Moreover, most probably inventors with the ability to read and write in French or German will tend to earn higher returns, all other things equal. Therefore, there should be an increase in the demand for this type of inventors that lead to a raise in their wage that is independent from their underling R&D quality.

If the new system will reduce inventor mobility, it will reduce knowledge spillovers, and so R&D productivity. It is worth nothing that according to Eurostat data (2010) UK and Spain, native speaking countries for ones of the most diffuse languages in the world, account for a presence of foreign inventors that is about the double of Germany and France, for example. Therefore, policy makers should evaluated deeply how much barriers a third new system could pose to the ability of Europe to attract human capital that was formed outside its borders (for example from South America, India,…).

Backlash number 7: Bias in the patent strategy of large European firms

The new proposed system could also generate biases incentive to large international firms that usually adopt English as the innovation common language since according to Nature (2010) 80% of EPO applications are in English. What will happen to the European system of innovation if firm like Siemens or Saint Gobain, will start patenting massively in German and French at the European level? As previously pointed out, R&D in Europe tend to be concentrated around some big players like Philips and Siemens that base part of their success on an international approach to innovation.

Backlash number 8: Bias in European Patent Office

As already pointed out, European Patent Office has a low productivity compared to US and Japanese ones. Adding a third layer atop of the two systems already in place not only will lower even more the productivity statistics, but also it will create additional costs for the European Union without any clear beneficial counterpart. This could pose the all European system in a worse position compared not only to Japan and US, but also to the raising R&D stars of Asia and South America. In terms of the functioning of the patent office also the new system will probably generate a higher demand for examiners that are able to read and write in German and French, all other things held equal. This could generate biases due to the language in the overall background of knowledge owned by examiners, and so in the type of knowledge that EU office will protect.

7. A proposal for a more efficient system

Given the arguments expressed above, we think that the European system should be directed to soften the cultural barriers among the member countries. Cultural and language distances in innovation represent an important barrier to an efficient European patent system. We think that a long term policy should implement a series of interventions aimed to create a real common system of innovation that could exploit all the potentialities (economies of scale and scope) and the positive externalities (spillovers) among the different countries.

The approach should envisage a multi-target strategies aimed to a more coordinated structure of the R&D in Europe with from one side less barriers to the circulation of knowledge and inventors, from the other with a more planned division of innovative labor among countries. Inside this picture, the harmonization of a R&D common language represents a sort of necessary condition. A long term plan, with a series of incentives to help all the countries to converge towards this target is necessary. Clearly, a common European patent system should be part of this project.

This is why we think that Europe should bet for two simultaneous targets: a) making *English as the common EU language for patent applications*, since 80% of them are already filed in English at the EU, and b) for maximum dissemination of the invention, *once the patent is issued it should be translated to other languages of the EU*.

The main fear that European countries should have is not only that an inefficient system impedes the exploitation of EU innovative capabilities at a full effect, but also that non-European competitors could use these European inefficiencies to create "virtual" competitive advantages against European firms. Therefore, the economic rationality of each European country predicts a unanimous support of this more efficient proposal since it is "Pareto superior"; none of the countries is worse off and most of them are better off. The common efficient European Patent System is important to exploit all potential knowledge spillovers and to benefit from the economies of scale and scope in knowledge that could be created inside Europe.

8. Conclusions

The main conclusion of this work is in line with the finding of the literature (see Harhoff et al, 2010). The *actual EU patent system is inefficient*: it is more costly than other comparable systems and it creates important barriers at the diffusion of the innovation in Europe. This notwithstanding, the European firms have tried to use at best the European Patents because not only 80% of applications were submitted in English, but also the EPO patent applications have shown in the last ten years an average annual growth of 3.4%.

What seems obvious, from an efficient point of view, is to establish a *unique European Patent in which English is the only procedural language and the diffusion of the innovation must be translated to other EU languages*. This means a simplification of the actual double system (European and national) in which a European inventor could decide to file a European Patent in English (enforceable without translation in all the European countries) and a local patent in the specific country language.

If the desired proposal is not achieved, for political reasons, we think that the choice of procedural languages should show a broader view that would take into account the globalization trends of worldwide innovation and not only the actual state of R&D investments in Europe. At least language should be neither a barrier nor an external factor that biases the incentives to invest in R&D in Europe, the ability to profit from R&D investment and the probability of exporting and attracting FDI. Europe Patent

System should try to give to every potential European inventor the same ex-ante conditions and should not to generate cost differentials (discriminate) to firms and inventors located in different countries.

We have showed that the actual proposal of 11 member states of a third system of patent protection, a sub-category of the actual European Patent, setting the *three procedural languages* (English, German and French) as official languages *for patent applications* , create at least two significant orders of biases. Those biases generate important inefficiencies and welfare losses for all EU: the *first bias* generates *unfair competition* among state members; the *second biases* reduce the potentialities and the competitive advantages of the overall European system of innovation.

If the 11 Member states proposal will be actuated, as a third best solution, in order to avoid all the backlashes we have listed in this paper, a program of subsidies devoted to innovative firms located in non-German, English and French speaking countries should be set in motion. These subsidies should be particularly directed to innovative SMEs. Moreover, European antitrust should evaluate closely how competitive opportunities are biased inside the common market.

In summary, the actual 11 Member states *biased proposal for a common EU Patent System* creates at least four important inefficiencies in the internal market that discriminates among Members by *reducing*: 1) the knowledge and inventors' circulation and the corresponding spillovers; 2) the absorptive capacity of all firms and specially of the small and medium size firms of no GFNS countries; 3) the access to the basic inputs needed in innovative activities; and 4) the cooperation among firms of member states and non-member states.

We have discusses a natural alternative, for a common EU Patent System, which is easy to implement and represents a Pareto efficient improvement for the EU. A unique European Patent system in which English is the *only procedural language* and where, for maximum dissemination of the invention, once the patent is issued it is translated to other languages of the EU (all of them, only the main languages or at least few languages selected by the applicant).

If the EU wants to increase their competitiveness worldwide through enhancing firm´s innovation and productivity, it would be surprising that this more efficient alternative of EU patent system it is not unanimously selected by all EU countries.

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APPENDIX A:

Table 1: (a) Semi-Elastiticies and Linear Probability Coefficients in Developing Countries (b) Percentage Contributions of TFP, Exports and FDI in Developing Countries

(a) Semi-elasticities and Linear Probability Coefficients		
	Sample of developing countries (1)	**Sample of Latin American countries** (2)
Effects of TFP on the probability of exporting	0.17	0.16
Effects of TFP on the probability of receiving FDI	0.13	0.12
Effects of the propensity to export on TFP	0.19	0.11
Effects of the propensity of receiving FDI on TFP	0.23	0.28
(b) Percentage (%) Average Contributions		
	Sample of developing countries (1)	**Sample of Latin American countries** (2)
% Contribution of TFP on the probability of exporting	20.55	14.70
% Contribution of TFP on the probability of receiving FDI	25.48	18.79
% Contribution of the propensity to export on TFP	4.09	4.86
% Contribution of the probability of receiving FDI on TFP	1.57	0.89
% Contribution of innovation variables (3) on TFP	4.32	4.67
% Contribution of innovation variables (3) on the probability of exporting	7.51	7.09
% Contribution of innovation variables (3) on the probability of receiving FDI	6.44	8.31

(1) *Sample of 19 developing countries*: Brazil, Chile, Colombia, Costa Rica, Egypt, Guatemala, India, Kenya, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Senegal, South Africa, Tanzania, Turkey and Uganda.

(2) *Sample of 6 Latin American countries*: Chile, Colombia, Costa Rica, Guatemala, Mexico and Peru.

(3) *Innovation variables* include: Introduction of new technologies to the production process, outsourcing, R&D, use of information technologies (IT), joint venture, product and process innovation and use of foreign technologies.

Source: Escribano, Pena and Reis (2010).

Table 2: Input´s Cost Shares: labor, intermediate materials and capital stock and their % Contribution to average output (in logs) in Spain

Inputs and TFP (2)	**Cost shares** (1)	**% Contribution to average output** (1)
Labor	0.43	32.28
Materials	0.47	43.55
Capital	0.10	9.06
TFP	-	15.11

(1) Firm level data from Spain based on Business Enterprise Surveys (BEEPS).

(2) TFP = Total Factor Productivity.

Source: Escribano and Pena (2010).

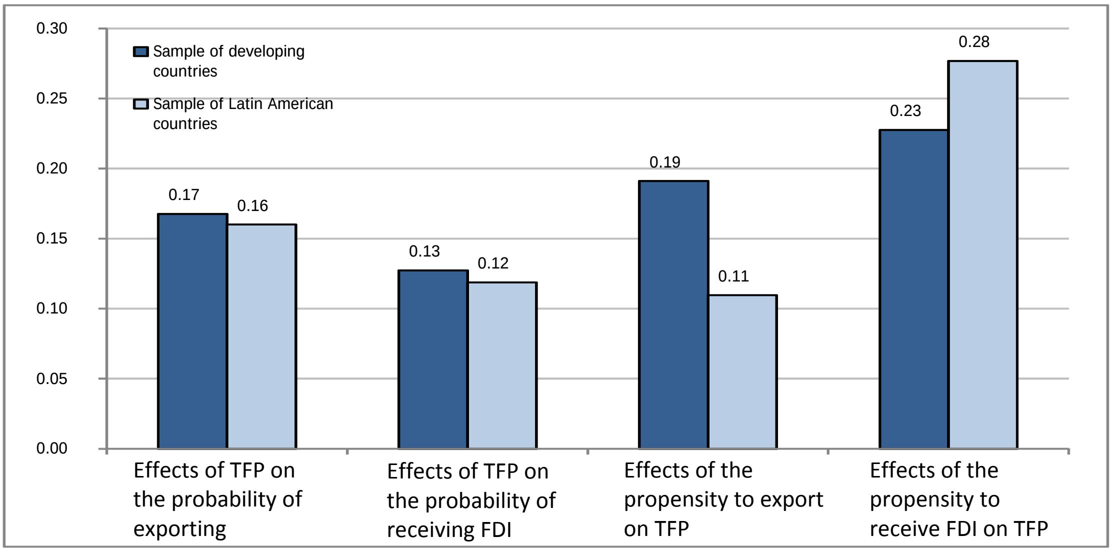
Table 3: (a) Semi-Elastiticies and Linear Probability Coefficients in Spain
(b) % Contributions of TFP, Exports and FDI in Spain and other Developed Countries

Semi-elasticities and Linear Probability Coefficients		
	Spain	
Effects of TFP on the probability of exporting	0.23	
Effects of TFP on the probability of receiving FDI	0.14	
Effects of the propensity of exporting on TFP	0.19	
Percentage (%) Average Contributions		
	Spain	**Sample of developed countries (1)**
% Contribution of TFP on the probability of exporting	69.89	
% Contribution of TFP on the probability of receiving FDI	87.18	
% Contribution of the propensity of exporting on TFP	34.15	
% Contribution of innovation variables (2) on TFP	24.51	17.79
% Contribution of innovation variables (2) on the probability of exporting	9.12	
% Contribution of innovation variables (2) on the probability of receiving FDI	3.83	

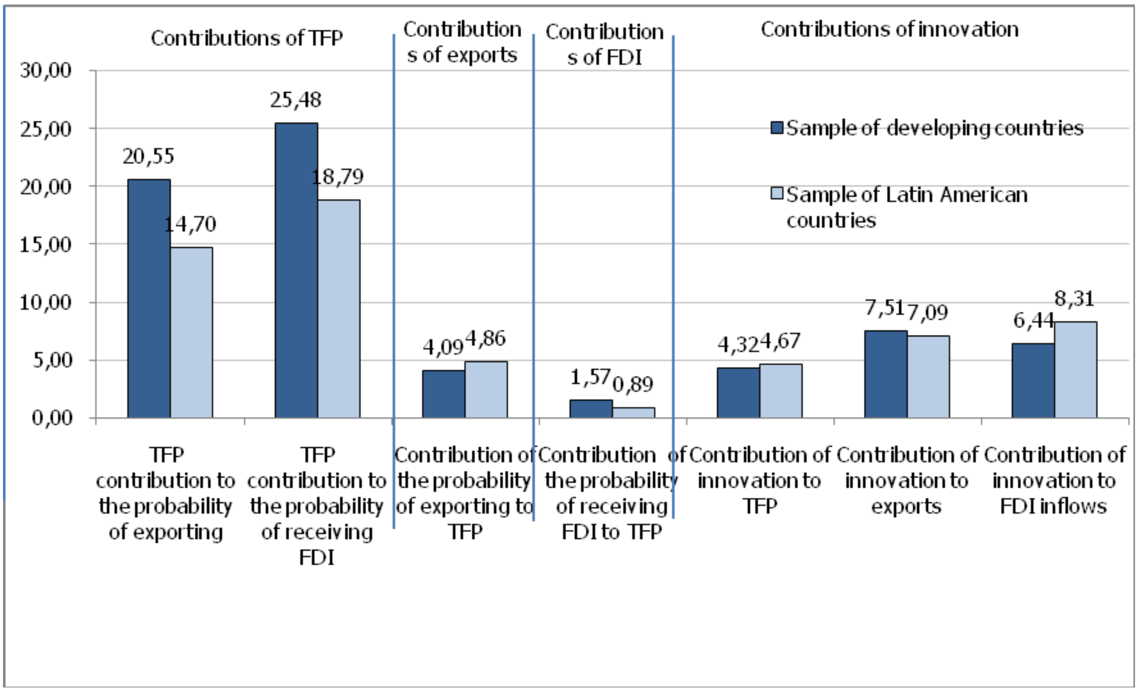
(1) *Sample of developed countries:* Firm level data based on Business Enterprise Surveys (BEEPS) from Spain, Germany, Korea, Ireland, Portugal and Greece.
(2) *Innovation includes:* Introduction of new technologies to the production process, outsourcing, R&D, use of information technologies (IT), joint venture, product and process innovation and use of foreign technologies.
Source: Escribano and Pena (2010).

Figure 1: Linear Probability Coefficients, Semi-elastiticies and Percentage Contributions of TFP, Exports and FDI in Developing Countries

a) Linear Probability Coefficients and Semi-elasticities



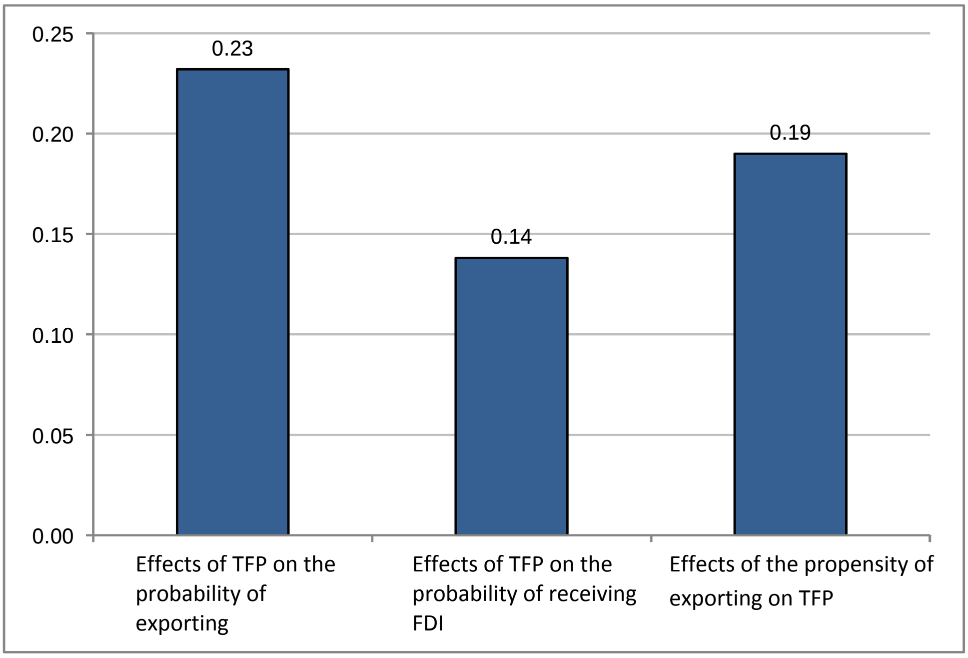
b) Percentage Contributions



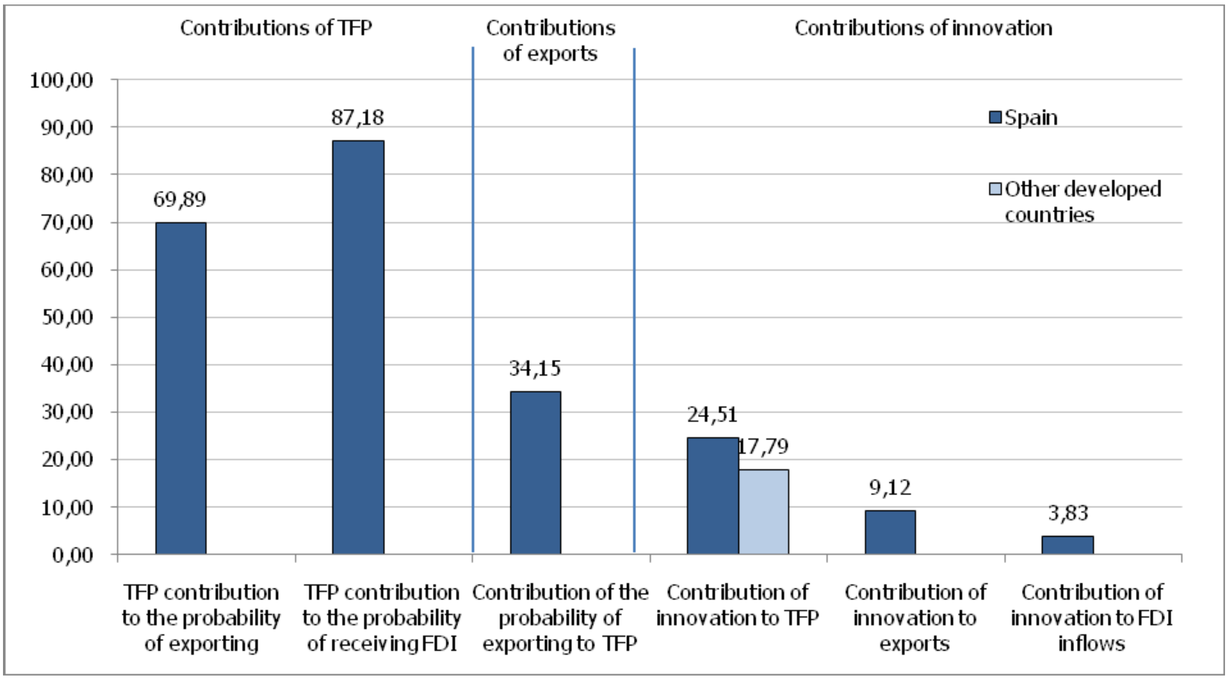
(i) Sample of developing countries: Firm level data from Brazil, Chile, Colombia, Costa Rica, Egypt, Guatemala, India, Kenya, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Senegal, South Africa, Tanzania, Turkey and Uganda. (ii) *Sample of Latin American countries*: Firm level data from Chile, Colombia, Costa Rica, Guatemala, Mexico and Peru. (iii) *Innovation variables include*: Introduction of new technologies to the production process, outsourcing, R&D, use of information technologies (IT), joint venture, product and process innovation and use of foreign technologies. *Source:* Escribano, Pena and Reis (2010).

Figure 2: Linear Probability Coefficients, Semi-elastiticies and Percentage Contributions of TFP, Exports and FDI in Developed Countries

a) Linear Probability Coefficients and Semi-elasticities: Spain



b) Percentage Contributions



(i) Sample of developed countries includes: Firm level data based on Business Enterprise Surveys (BEEPS) from Spain, Germany, Korea, Ireland, Portugal and Greece. (ii) *Innovation variables include:* Introduction of new technologies to the production process, outsourcing, R&D, use of information technologies (IT), joint venture, product and process innovation and use of foreign technologies. *Source:* Escribano, Pena and Reis (2010).

Figure 3: Number of Patents in litigation

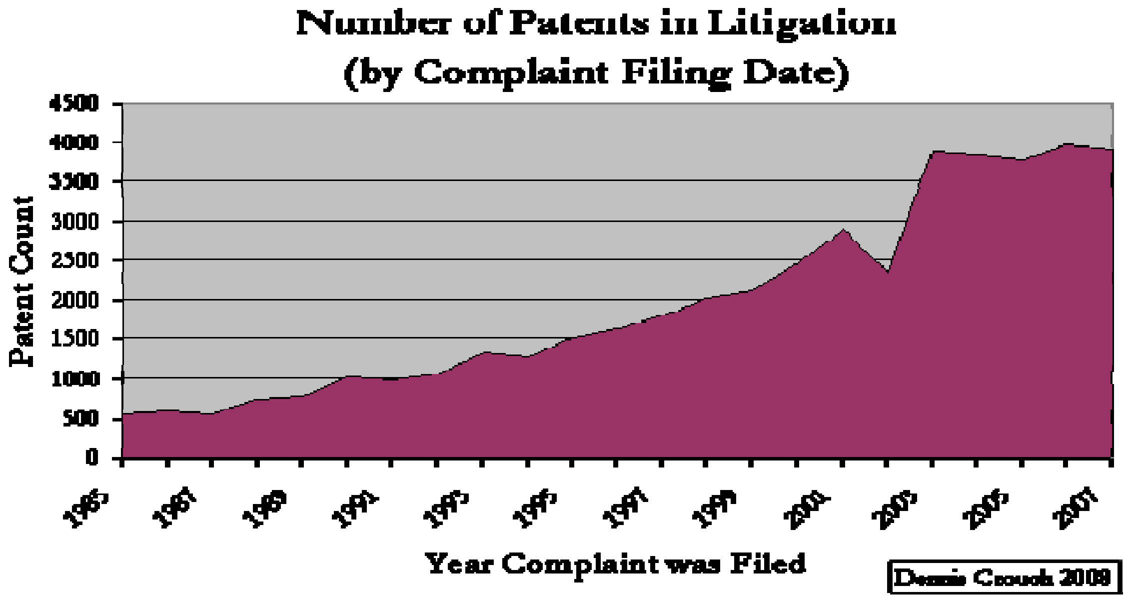
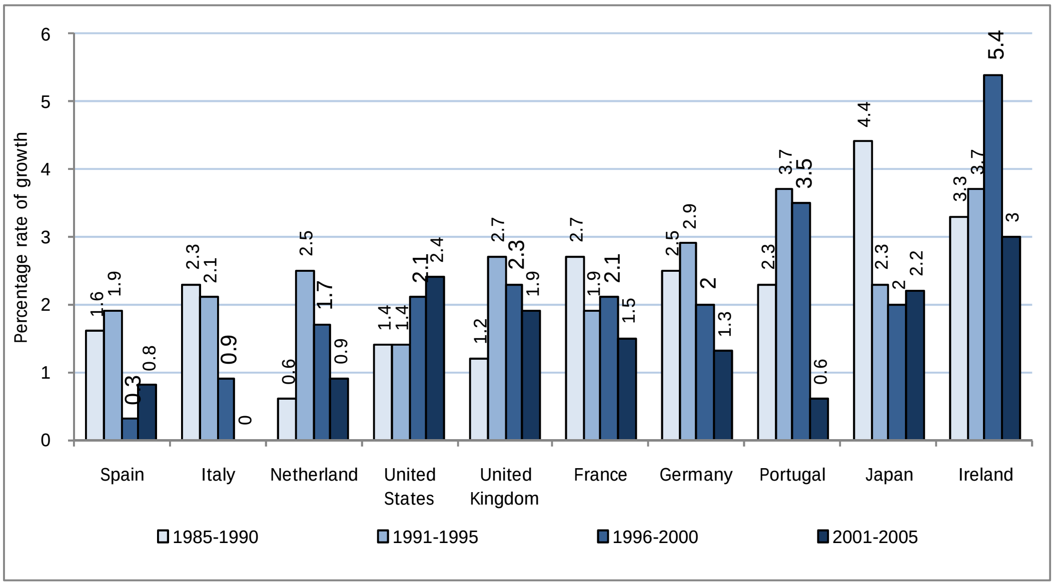
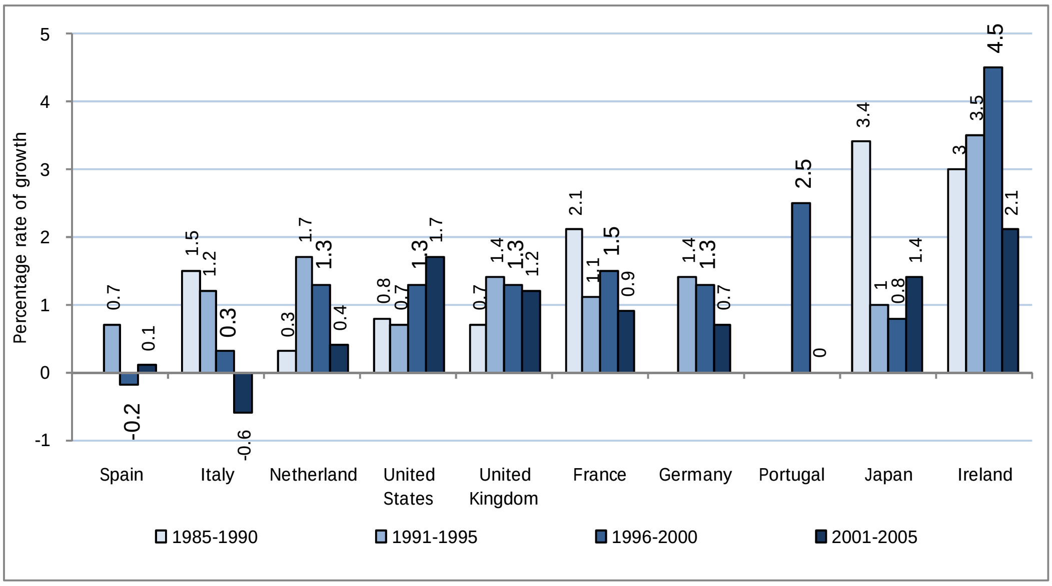


Figure 4. Evolution of Labor Productivity (Y/L) and Total Factor Productivity (TFP) in Spain and other selected countries, 1985-2005

A. Labor Productivity (Y/L)



B. Total Factor Productivity (TFP)



Source: Escribano et al. (2010) with data from OECD, Database of productivity and capital services, 2007. The numbers indicate the rates of growth (in percentage).

Table 4. Spain and UK exports ratio over GDP selected targeted countries

Country	Year	Language	Export Ratio[a]	Export/GDP[b]	Mean
Argentina	2005	Spanish	1.50	3.93	3.61
Argentina	2006	Spanish	1.51	3.41	
Argentina	2007	Spanish	1.76	4.11	
Argentina	2008	Spanish	2.82	3.18	
Argentina	2009	Spanish	2.30	3.42	
Mexico	2005	Spanish	2.41	5.73	5.15
Mexico	2006	Spanish	2.48	5.49	
Mexico	2007	Spanish	2.79	5.55	
Mexico	2008	Spanish	3.68	4.43	
Mexico	2009	Spanish	3.07	4.55	
India	2005	Hindi/English	0.14	0.28	0.30
India	2006	Hindi/English	0.12	0.27	
India	2007	Hindi/English	0.13	0.33	
India	2008	Hindi/English	0.25	0.25	
India	2009	Hindi/English	0.25	0.37	
USA	2005	English	0.14	0.28	0.28
USA	2006	English	0.15	0.32	
USA	2007	English	0.16	0.31	
USA	2008	English	0.21	0.29	
USA	2009	English	1.50	0.23	
Australia	2005	English	0.50	0.41	0.45
Australia	2006	English	0.50	0.42	
Australia	2007	English	0.51	0.55	
Australia	2008	English	0.60	0.47	
Australia	2009	English	0.67	0.40	

Source: United Nations Statistics.

[a] Export ES/Export UK;

[b][ES Export/ ES GDP]/[UK Export/ UK GDP]

Table 5. Main languages in terms of the number of speakers

Rank	Language	Estimated Speakers	% on world	Cumulative

		(Billion)	population	
1	Mandarin	1200 ca	17.4	17.4
2	**English**	**508**	**7.4**	**24.8**
3	Hindu	497	7.2	32.0
4	**Spanish**	**392**	**5.7**	**37.7**
5	Russian	277	4.0	41.7
6	Arabic	246	3.6	45.2
7	Bengali	211	3.1	48.3
8	**Portuguese**	**191**	**2.8**	**51.1**
9	Indonesian	159	2.3	53.4
10	**French**	**129**	**1.9**	**55.2**
Total World Population		6900 ca		

Source: UNESCO

Table 6. Top countries in terms of GDP growth in 2010

Country	GDP Growth (%) in 2010	Language	GDP (billion)
Singapore	**14.8**	**English/Malay**	**255**
China	10.2	Mandarin	10084
Taiwan	10.1	Taiwanese/Mandarin	423
India	**8.6**	**Hindi/English**	**4001**
Argentina	**8.3**	**Spanish**	**351**
Turkey	8	Turkish	956
Brazil	**7.7**	**Portuguese**	**2181**
Thailand	7	Thai	539
Russia	3.7	Russian	2219
Chile	**5.1**	**Spanish**	**222**
Mexico	**5**	**Spanish**	**1541**
Colombia	**4.4**	**Spanish**	**431**

Source: Economist, IMF

Table 7. Spanish (patents/exports) ratio relative to the UK for selected countries

Country	Year	Language	Patent/Export[5c]	Mean
Argentina	NA			
Mexico	2003	Spanish	0.307	0.322
Mexico	2004	Spanish	0.459	
Mexico	2005	Spanish	0.276	
Mexico	2006	Spanish	0.297	
Mexico	2007	Spanish	0.273	
India	NA			
USA	2003	English	0.855	0.995
USA	2004	English	0.847	
USA	2005	English	1.105	
USA	2006	English	1.016	
USA	2007	English	1.153	
Australia	2003	English	0.397	0.286
Australia	2004	English	0.283	
Australia	2005	English	0.285	
Australia	2006	English	0.254	
Australia	2007	English	0.211	

Source: United Nations Statistics, WIPO

[c] Patent/Export = [ES Patent/ ES Export]/[UK Patents/ UK Export]

[5] billion

Table 8. European Patent Office (EPO) Members

ID	Code	Country	First Year of participation
1	AL	Albania	2010
2	AT	Austria	1979
3	BE	Belgium	1977
4	BG	Bulgaria	2002
5	CH	Switzerland	1977
6	CY	Cyprus	1998
7	CZ	Czech Republic	2002
8	DE	Germany	1977
9	DK	Denmark	1990
10	EE	Estonia	2002
11	ES	Spain	1986
12	FI	Finland	1996
13	FR	France	1977
14	GB	United Kingdom	1977
15	GR	Greece	1986
16	HR	Croatia	2008
17	HU	Hungary	2003
18	IE	Ireland	1992
19	IS	Iceland	2004
20	IT	Italy	1978
21	LI	Liechtenstein	1980
22	LT	Lithuania	2004
23	LU	Luxembourg	1977
24	LV	Latvia	2005
25	MC	Monaco	1991
26	MK	Macedonia	2009
27	MT	Malta	2007
28	NL	Netherlands	1977
29	NO	Norway	2008
ID	**Code**	**Country**	**First Year of participation**
30	PL	Poland	2004
31	PT	Portugal	1992

32	RO	Romania	2003
33	RS	Serbia	2010
34	SE	Sweden	1978
35	SI	Slovenia	2002
36	SK	Slovakia	2002
37	SM	San Marino	2009
38	TR	Turkey	2000

Source: EPO

Table 9. Patent Applications by main Patent Office

Year	Europe	USA	Japan	Sum	Europe	USA	Japan
	# of patent applications				Percentage (%)		
2005	128,709	390,733	427,078	946,520	13.60%	41.28%	45.12%
2006	135,399	425,967	408,674	970,040	13.96%	43.91%	42.13%
2007	141,423	456154	396,291	993,868	14.23%	45.90%	39.87%
2008	148,844	456,321	391,002	996,167	14.94%	45.81%	39.25%
2009	134,542	456,106	348,596	939,244	14.32%	48.56%	37.11%

Source: EPO, USPTO, JPO

Table 10. Selected European Countries for EPO patents granted in 2005

	Patents	(%)of GDP	(%) of European Patent	Cumulative
Germany	23364	10.4	42%	42%
France	8191	4.8	15%	57%
UK	5258	2.9	10%	67%
Italy	4797	3.4	9%	76%
Netherland	3379	6.6	6%	82%
Spain	1331	1.1	2%	84%

Source: Eurostat (2010)

Table 11. Selected European Countries for R&D indicators in 2007

	R&D Researchers	R&D Expenditures	(%) of Foreign R&D Researchers
Germany	406253	61543	4.9%
France	262421	39369	4.4%
UK	105536	36728	8.2%
Italy	137163	16831	0.3%
Netherlands	49979	9666	3.4%
Spain	201108	11815	9.5%

Source: Eurostat (2010)

Table 12. Chinese Patent Activity

Country	Overseas Invention Applications by China in 2007	Increase from 2006 by China	Increase from 2006 by all Applications	Average Increase from 2006 of export
USA	4140	9.9%	6.0%	3.5%
Europe	1136	58.0%	3.7%	4.2%
Japan	656	29.9%	3.0%	3.1%

Source: Thomson Reuters, OECD, Eurostat.