The Impact of Intellectual Property Rights on Labor Productivity: Do Constitutions Matter?*

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Abstract
Focusing on 22 OECD countries we estimate the impact of constitutional provisions and of lower-rank norms aimed at protecting intellectual property rights (IPR) on labor productivity at industry level.
Our analysis allows us to answer the following questions: Are IPR more likely to be enforced if they are envisaged in the constitution rather than provided for in ordinary legislation? And if constitutional protection implies an accrued defense or enforcement of those principles, is this difference relevant enough to translate into a higher impact on firms' outcome?
By using IV techniques and controlling for a full set of year-, industry- and country fixed effects (and their interactions), we show that constitutional provisions protecting IPR positively affect the differential in labor productivity between high and low R&D intensive sectors. This effect is driven by the impact of IPR protection on R&D investment of the highly innovative sectors. Our results hold after controlling for lower-rank norms. Furthermore, the interaction between constitutional norms and lower legislation is negative, suggesting that the two are substitutes: the impact of constitutions is stronger in those countries where IPR protection by lower norms is weaker. On turn, in those countries where IPR are protected by constitutional norms, lower norms do not have a significant effect on the productivity of high R&D intensive sectors.

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1 - Introduction

In this article we assess the impact that the legal protection of intellectual property rights (IPR) exerts on industry productivity and whether granting constitutional protection to IPR intensifies their economic effect.

In recent years, an increasing attention has been devoted to the study of the influence of constitutional principles and rules on economic outcomes (Persson and Tabellini, 2003; Blume et al., 2009a and 2009b). Of particular interest are the constitutional rules regarding the economic management of a country, the so called "economic constitution". It consists, *stricto sensu*, of constitutional norms concerning the economic relations and includes the provisions pertaining to the government's direct economic management of a country, the protection of individual rights, the promotion and strengthening of the rule of law and, more generally, the establishment of an institutional setting favoring markets and economic activity (Cassese, 2019; Prosser, 2014).[1] The idea is: if constitutional norms establishing voting systems and forms of government have economic impact (as Persson and Tabellini, 2003, 2006; Blume et al., 2009a and 2009b have thoroughly proven), norms directly regulating economic activities should exert an even greater effect on economic outcomes. A first test of such claim has proven a positive correlation between the constitutional protection of some economic rights (among which, the right to establish a business, the right to strike, anti-corruption provisions) and entrepreneurship (Carbonara et al., 2016). Constitutional provisions regarding IPR definitely fall within the economic constitution.

The main questions we want to investigate here are: 1) Does constitutional protection of IPR enhance firms' (labor) productivity and is this effect related to innovation effort? 2) Is the impact of constitutions larger or smaller when IPR are also protected by lower-rank norms? The latter question could also be reversed: does adding constitutional protection to rights already enforced by ordinary laws increase their (positive) impact? Productivity is an important source of economic growth and country development. As such, issues related to efficient resource allocation, technological development, spillovers,

[1] A broader and more precise definition of economic constitutions is provided in section 2.1.

R&D, as well as the institutional determinants of productivity are at the heart of the scholarly debate. In this paper we reconcile two distinct lines of research which, in our view, should go hand in hand in explaining the relationship between institutional settings and productivity. The first line of research focuses on the impact of constitutions on economic activity (as represented, among others, by the previously cited studies), the second one regards the relationship between productivity dynamics and R&D intensity (for a survey, cf. Syverson, 2011).

R&D is a key driver of economic growth (Aghion and Howitt, 1996) and its direct link to productivity has been proven extensively (Griliches, 1984). The implicit assumption in our analysis is that the impact of institutions on productivity (hence growth) is mediated by R&D. Specifically, the institutional environment in which firms operate shapes their attitude toward the undertaking of innovative activities and their likelihood to successfully translate R&D investment into enhanced labor productivity.[2] We want to test whether the constitutional protection has a greater impact on the performance and on the long-run labor productivity dynamics of high R&D intensive industries and, ultimately, of the countries in which such industries are based.[3] The underlying intuition is that, by stating the fundamental rights that a society wants to protect, constitutions provide positive incentives to the individuals and the firms who value those rights most.

Most of the previous studies on the economic effects of constitutional norms are based on cross-country regressions and suffer from reverse causality as well omitted variable problems. One way to make progress on causality is to focus on the mechanisms through which IPR protection affects productivity. According to the theory, IPR protection helps firms to internalize the positive spillovers of their innovative activity and protect them from opportunistic behavior, thus incentivizing firms to increase their R&D effort. So IPR protection should help more firms (or industries) typically more innovative and whose performance is more dependent on R&D investment.

[2] We test this assumption in section 5.2, proving it for our dataset.
[3] In the definition we adopt, high R&D intensive industries are those industries whose performance intrinsically relies more on innovation effort and innovative output.

Following Rajan and Zingales (1998) methodology, we construct the test as follows. First we identify an indicator for R&D dependence at industry level and then we test whether industries that are more dependent on R&D investment have relatively larger benefits in term of productivity in countries where legal IPR protection is stricter.

The original contribution of our study is twofold: first we identify the impact of constitutional provisions concerning the protection of intellectual property rights on cross-country and cross-industry differences in labor productivity, and, second, we control for the moderating effect of ordinary legislation protecting IPR on the relationship between constitutions and productivity.[4] We do that explicitly dealing with endogeneity issues, by means of both instrumental variables and fixed effects. We also control for *de facto* enforcement of IPR protection.

We test our conjecture that constitutional protection of IPR results in a greater propensity to innovate and enhance productivity more in R&D dependent industries than in low R&D ones. Controlling for legislative, and a full set of country-specific and time-variant dummies and industry dummies, we assess whether rules with a constitutional status and lower-rank legal instruments have a different impact on productivity.

We estimate the effect of constitutional and lower rank norms regarding IPR on labor productivity in a sample of 22 industries and 22 OECD countries over the period 2000 to 2013. We find that constitutional protection of IPR positively affects labor productivity (and innovative effort) in those industries where the R&D dependence is higher. Our results hold after controlling for the presence of lower legislation protecting IPR.

Interestingly, we also find that the impact of constitutions decreases as the extent of legal protection by lower norms increases, until it vanishes for very high levels of protection by lower norms. Similarly, in those countries where IPR are protected by constitutional norms, lower-rank norms have no significant impact on the labor

[4] Which is the best measure of productivity in cross-country studies is a matter of long-standing debate. While total factor productivity would represent a more comprehensive assessment, when used at the sectoral level it is laden with measurement problems (Caliendo et al., 2018). One of the major issues is, in fact, to gauge capital stocks (cf. Hölzl and Janger, 2014). The recourse to labor productivity allows a less fragmented measure, as it is more homogeneous across sectors and across countries.

productivity differential between high and low R&D intensive industries. Both results suggest a substitutability between constitutions and ordinary law.

The paper is organized as follows. Section 2 surveys the relevant literature. Section 3 presents the main research hypotheses and outlines the econometric strategy. Section 4 describes the dataset. Section 5 presents the main results. Section 6 proposes some robustness checks. Finally, Section 7 concludes, discussing our results, highlighting possible policy recommendations and directions for future research.

2 - Literature review

2.1 – The economic constitution

Constitutions are a source of higher-rank norms, permitting the creation of other norms and statutes, hierarchically subordinate and that cannot oppose constitutional norms (Kelsen, 1967). It follows that "economic constitutions" exert a strong impact on the institutional arrangements regulating the economic activity in a country. But how are economic constitutions defined? The term "economic constitution" has a number of accepted meanings (Prosser, 2014). In the broadest sense, it denotes the set of constitutional provisions playing a key role in the management of a country's economy. In a narrower sense, within the context of the overall process of political decision-making, a constitution can be seen as the fundamental source of the principles which underlay and constrain governmental decisions. Accordingly, economic constitutions include the economic principles that should be subtracted to the fluctuations determined by political change, such as economic freedom, competition, price stability, monetary policy. Finally, following the 'new constitutionalist' approach, economic constitutions represent the outcome of a process aimed at protecting private investors from adverse events by promoting business confidence and creating a climate favorable for investment and capital accumulation (Prosser, 2014; Gill, 2005).

Of utmost importance in modern economic constitutions are the provisions concerning the government's direct economic management of a country, the protection of individual rights, the promotion and strengthening of the rule of law and, more

generally, the establishment of an institutional setting favoring markets and economic activity.[5]

2.2 The economic effects of constitutions

Economic analysis of the link between some of the provisions contained in its constitution and the economic performance of a country extends the tradition of the public choice literature, that focused its attention on the impact of different constitutional settings on the size of government and on the composition of public expenditure (see Buchanan and Tullock, 1962; Brennan and Buchanan, 1980; Olson, 1982; North and Weingast, 1989; and, for a general overview, Mueller, 2003; and Voigt, 1999). Starting from the assumption that a strong constitutional structure is the institutional arrangement that better allows markets to operate freely, Buchanan (1987; as cited in Prosser, 2014, p. 10) encouraged economists to study the constitutional principles and rules that affect economic agents, thus singling out the economic constitution.[6]

The analysis put forward in the public choice literature is however theoretical in nature and does not provide empirical support to the idea that economic constitutions introduce effective (and possibly efficient) principles of economic conduct in the institutional framework of a country. As a matter of fact, it was not until the early 2000s, when Persson and Tabellini's (2003) study on the economic impact of constitutions on economic and fiscal indicators was published, that the gap between theory and empirical evidence started to be filled by scholars interested in the causal links between the constitutional characteristics of a country and its economic performance.

Persson and Tabellini (2003 and 2006) focus mainly on the constitutional principles regulating the organization of a state and the exercise of power. They study how different forms of government (presidential and parliamentary system) and different electoral

[5] The role played by constitutional arrangements in allowing governments to commit credibly to upholding property rights has been stressed also by North and Weingast (1989).

[6] Chilton and Versteeg (2016) find that constitutional protection is not always effective, meaning that not all constitutional rights are respected *de facto* by governments. In particular, they find that "organizational rights" are respected whereas other individual rights are not. They claim this happens because organizational rights (they consider the right to unionize and form political parties) create the very same organizations that will protect these rights. Similarly, Chilton and Versteeg (2015) prove empirically that constitutional torture prohibition, which is becoming more and more frequent worldwide, has not produced a statistically significant reduction in the diffusion of torture. The economic constitution thus represents yet another set of constitutional rights resulting in a *de facto* protection.

systems (majoritarian and proportional) affect fiscal policy, rent extraction (perceived corruption of executive), and economic productivity (measured by both labor and total factor productivity). Results indicate that presidential systems and majoritarian electoral rules result in much lower government expenditure than parliamentary and proportional systems. Furthermore, public expenditure is lower for presidential majoritarian systems than for parliamentary proportional ones. Finally, democratization promotes growth, especially when it goes hand in hand with economic liberalization. Their studies have been extended and partially confirmed by Kolscheen (2007) and Blume et al. (2009a and 2009b).[7]

Considering the role of constitutions and the legal system in a way that is consistent with the path traced by Persson and Tabellini's contributions, Melton et al. (2013) observe that certain features of constitutions, including their degree of specificity and the number of rights for which they provide protection, play a role in shaping the patterns of institutional development exhibited by different countries at different times. Eicher et al. (2018) consider how constitutions impact on social infrastructure, which is typically seen as one of the drivers of economic growth. They find that the extent to which a constitution constrains the decision-making powers of chief executives together with the electoral system are the main determinants of good-quality social infrastructure, which is also positively impacted by basic human rights.

The first to study the causal relationship between the economic constitution and economic variables are Carbonara et al. (2016 and 2018). Dealing with the constitutional determinants of entrepreneurship, Carbonara et al. (2016) show that some of the provisions contained in national constitutions – including right to conduct/establish a business, right to strike, consumer protection, anti-corruption, and compulsory education - are positively and significantly associated to a standard measure of entrepreneurial dynamics such as the rate of new business density. They also find that other constitutional provisions which may be likely to impose a burden on or just to limit entrepreneurial

[7] Persson and Tabellini's analysis indirectly strengthens the intuitions of the public choice literature, by confirming North and Weingast's (1989) arguments on the differences in the likelihood of parliamentary and presidential democracies to prevent default on external debt repayments.

freedom – such as IPR protection - are negatively and statistically significantly associated to new business density. In light of this somewhat puzzling finding on the relationship between constitutional protection of IPR and entrepreneurial activities, it is therefore of particular interest to explore the direct or indirect effect of such constitutional provisions on innovative activity.

Carbonara et al. (2018) find that cross-country differences in new business density are explained by constitutional principles protecting economic activity (like the right to own property, the right to conduct/establish a business, the right to free/competitive markets, and the independence of the judiciary) and by a population's psychological characteristics (in this case, a country's endowment of agency culture). They prove that both factors are important predictors of new business density and that the positive impact of agency culture is moderated by the economic constitution, becoming stronger as the constitutional protection of economic rights increases.

2.3 Institutions, IPR protection, and productivity

A conspicuous literature studies the causal links between the quality of institutions and the productivity outcomes and the growth rate of an economy. Of particular interest for our purposes are the studies looking at the impact of institutions (including - but not limited to - IPR protection), on productivity. Dreher et al. (2014), Della Malva and Santarelli (2016), Gianfreda and Vallanti (2017), Eicher and Kuenzel (2017) considerably extend the test of the impact of institutions and the law on tangible and intangible investments that are likely to increase productivity and economic growth.

Correcting for the size of the shadow economy, Dreher et al. (2014) find a significant although weak relation between the quality of institutions aimed at protecting property rights and total factor productivity for a group of OECD countries. Using a sample consisting of 28 transition countries in Eastern Europe and Central Asia over the 2002–2009 period, Della Malva and Santarelli (2016) find that differences in the strength of IPR protection systems - measured along various dimensions, including *de facto* enforcement and *de jure* patent and copyright protection - affect a firm's propensity to engage in R&D

activities. Eicher and Kuenzel (2017) propose the adoption of European constitutional features as a proxy for measuring the European influence on development and economic growth.

2.3 R&D investment, and productivity

Since the publication of the papers presented in the Fall of 1981 at the NBER conference on *R&D, Patents, and Productivity* (Griliches, 1984; see also Griliches, 1979), many studies have analyzed the relationship between innovative activities and productivity dynamics at the firm, industry, and country level. The papers collected in that book present clear empirical evidence of the relationship between R&D investment and standard indicators of economic performance such as productivity, both at the firm and at industry level. Coe and Helpman (1995) contribute to this literature by showing that domestic productivity is also explained by international R&D spillovers. Crepon, Duguet and Mairesse (1998) correct for selectivity and endogeneity by explaining productivity by innovation output and innovation output by R&D expenditure within a structural model (see also Lööl et al., 2017). Corroborating the Schumpeterian quality ladder model idea of R&D as a key driver of economic growth (Aghion and Howitt, 1996), almost all the evidence originating from this tradition shows that the elasticity of productivity with respect to the intensity and the structure of R&D expenditures is positive and statistically significant in both the manufacturing and the service sectors and in both advanced and developing countries.[8] Venturini (2015) finds for OECD countries that R&D performed to produce Information and Communication Technology (ICT)-related goods displays a positive and statistically significant impact on the long-term dynamics of total factor productivity. Raymond et al. (2015) find unidirectional causality from R&D-to-innovation and from innovation-to- productivity using firm-level data from France and the Netherlands. Surveying 65 studies on R&D and productivity at both firm and industry level, Ugur et al. (2016) report a systematically positive and significant empirical relationship. Kogan et al. (2017) find that medium-run fluctuations in total factor

[8] See, among others, Hall and Mairesse, 1995; Mairesse et al., 2005; Chudnovsky et al., 2006; Griffith et al., 2006; Parisi et al., 2006; Criscuolo, 2009; Savona and Steinmueller, 2013; Coad et al., 2016; Hall and Sena, 2017; Castellani et al., 2019.

productivity are mostly driven by technological innovation, whereas Battisti et al. (2018) find that 46% of labor productivity growth is originated by growth of technological productivity.

2.4 IPR and R&D

In the last two decades, light has been shed on the relevance of intellectual property rights protection (patents, trademarks and copyright) for the economic performance of countries. Kumar et al. (1999) find a positive relationship between patents and firm size in R&D intensive industries. Png (2017) proves the positive impact of the Uniform Trade Secrets Act (USTA) on R&D. Brown et al. (2017) use data on IPR, tax incentives and financial market to study for a broad sample of OECD countries the impact of domestic policies and institutions on country-level measures of R&D investment. Findings show that financial market rules that improve accounting standards and strengthen contract enforcement, along with strong IPR protection exhibit a positive relation with R&D.

3 - The identification strategy

3.1 - The basic specification

Focusing on 22 OECD countries, we assess the impact of constitutional IPR protection on labor productivity measured as output per hour worked. On the one side, following the 'economic constitutions' approach introduced in Section 2, we assume that the effectiveness of an institutional setting in providing incentives to conduct R&D activities exerts a positive impact on productivity. On the other side, following a well-established literature on cross-industry differences,[9] we assume that the effect of such institutional setting may be greater for more innovative industries whose performance is more dependent on R&D investment.

We draw the data on the constitutional norms protecting IPR from the Comparative Constitutions Project dataset (Elkins et al., 2009). The Project contains information on

[9] For example, comparing 14 European countries industries with significant differences in productivity, Subramanian and Megginson (2018) find that the effect of employment protection laws on privatization is disproportionately greater in less productive industries.

"nearly every active national constitution in the world".[10] It provides data on form and content of constitutions and tracks their main revisions over time. In particular, we find indication on which constitutions protect trademarks, patents and copyrights and on the year in which protection was introduced. The three main types of IPR protection - patents, trademarks, and copyright - have been shown to represent important drivers of innovativeness. Accordingly, and consistent with the findings of the literature *á la* Griliches outlined in Section 2 above, their full protection increases the likelihood that firms and industries with a high R&D intensity turn their innovative performance into increased competitiveness and productivity.

Our identification strategy exploits industry specificities under the assumption that protection of intellectual property rights may foster firms' productivity to an extent that is sector specific. Following the approach set forth by Kumar et al (2000), we use industries' R&D intensity to identify the effect of IPR on firms' outcome. The assumption is that the constitutional protection of intellectual property and human capital has a stronger effect in those industries in which R&D dependence is higher.[11] Following this approach implies estimating a standard diff-in-diff specification, exploiting cross-country/cross-industry data. Therefore, the model specification is the following:

$$y_{cst} = \beta_1(const_c \; x \; innov_s) + \boldsymbol{D}_{cst} + u_{cst} \qquad (1)$$

where y_{cst} is value added per hour worked (in log) in country c, industry s at time t, $const_c$ is a dummy for the presence of constitutional provisions in country c, $innov_s$ is an index of R&D dependence of industry s, and $\boldsymbol{D}_{cst}$ is a matrix of dummies which includes industry and country-by-year dummies. Country-by-year fixed effects "absorb" any unobservable attributes (both time variant and time invariant) at the country level (including the non-interacted main effect of the dummy for the presence of constitutional provisions *const*$_c$). Finally, u_{cst} is the error term.

Equation (1) estimates the average effect of constitutional provisions exploiting variability at the country-sector-time level. The coefficient β_1 in Equation (1) captures the

[10] See http://comparativeconstitutionsproject.org/about-constitute/.

[11] Consistent with Cozzi and Galli (2014), we remain in a quality ladder framework where basic and applied research co-exist and jointly determine economic growth within a process of endogenous skill acquisition.

effect of constitutional protection on productivity. Typically, there is a difference in productivity between two industries characterized by high and low R&D intensity. Then, the coefficient β_1 is the difference in such differential between countries with constitutional protection of IPR and countries without protection.

The main advantage of our specification is that we make predictions about within-country differences between industries based on the interaction between country and industry characteristics. Therefore, we can control for country (time-variant) and industry fixed effects and we will be less subject to criticism about an omitted variable bias or model misspecification.

3.2 Industry R&D dependence

In order to estimate the model in equation (1), we need appropriate measures of the extent of R&D dependence at industry level. Data on the actual R&D at industry level cannot be used as a proxy for R&D dependence since the latter is one potential channel through which constitutional provisions affect productivity. We then postulate that there are technological differences across industries and that such differences in technology explain why some industries rely more on R&D investment than others. We also assume that these cross-industry technological differences are the same across countries. Accordingly, we construct our baseline measure of R&D dependence at industry level using the new OECD Taxonomy of Economic Activities, which clusters manufacturing and non-manufacturing activities according to their level of R&D intensity, defined as the ratio of R&D expenditure to value added (Galindo-Rueda and Verger, 2016). Using data from 27 countries and 2011 as the reference year, Galindo-Rueda and Verger (2016, henceforth GV) identify 5 groups, i.e. high, medium-high, medium, medium-low, and low R&D intensity industries.

One major problem of matching our data on labor productivity with the GV classification is the level of aggregation at industry level. Even using the GV classification at two digit-level (which comprises 34 industries and is the closer to our data on

productivity, which includes 24 industries),[12] it is not always possible to unambiguously assign the GV index to all the industries considered in our sample. To avoid measurement errors, we take a conservative stance and include among high R&D industries only those falling entirely in the "high-or-medium-high" R&D intensity group in the GV taxonomy. For example, GV classify Pharmaceuticals (21) among high R&D intensity sectors and Chemical products (20) among the medium-high; our aggregate industry (20-21) then falls in the "high and medium/high sectors". Therefore, we define the index $innov_s$ as a dummy taking value 1 for industries having a high ("high or medium-high" in the GV taxonomy) R&D intensity and 0 for all the other industries ("medium", "medium-low" and "low" in the GV taxonomy).[13]

In Table 1 we report the correspondence between the GV classification (column 1) and our broader classification (column 2) for 24 industries as defined in the dataset from which we draw our sample. As shown in the table, we end up with six high R&D intensive sectors: Chemicals and chemical products (10-21), Other manufacturing; repair and installation of machinery and equipment (31-33), Transport equipment (29-30); Electrical and optical equipment (26-27); Machinery and equipment n.e.c (28), IT and other information services (62-63).

[TABLE 1 AROUND HERE]

We check the robustness of our results to the classification of R&D intensive industries and construct an alternative measure of R&D dependence by applying the Ciccone and Papaioannou methodology (2006, 2007). Following their approach, we estimate an index of R&D intensity that does not reflect idiosyncratic factors specific to a country or to a

[12] Data on productivity at industry level are drawn from the EUKLEMS database, which provides information on value added and hours worked for 34 industries and 8 aggregates according to the ISIC Rev. 4 (NACE Rev. 2) industry classification. Our final sample includes 24 industries for 22 countries over the period 2000-2013. The level of aggregation for each industry has been chosen in order to have consistent data across all countries over the sample period.

[13] Even classifying each sector either in the high or low group, the correspondence between GV classification and our broader classification is not always clear-cut. In a few cases, the broader category comprises sectors having a very different R&D intensity. This is the case of Publishing, audiovisual and broadcasting activities (58-60) and Professional, scientific, technical, administrative and support services activities (M-N). For example, GV classify Publishing activities (58) as a medium-high R&D intensive sector, while "Audiovisual and broadcasting activities" (59-60) as a low R&D intensive sector. As a consequence, the broader sector "Publishing, audiovisual and broadcasting activities" (58-60) is assigned neither to the high/medium-high nor to low/medium-low R&D group. For similar reasons, also the sector "Professional, scientific, technical, administrative and support services activities" (M-N) is not assigned. Both sectors are dropped when performing estimates. Robustness checks assigning the two sectors to the "low" group have also been performed. Results do not change.

constitutional/legislative environment.[14] Based on data from the OECD ANBERD database, we first calculate R&D intensity (as the ratio of R&D expenditure over value added) for 23 industries in an (unbalanced) sample of 18 countries from 1998 to 2013 and then estimate the following regression

$$RD_{cst} = \alpha_s + \gamma_{ct} + \delta_j const_c + \theta_j law_c + \omega_{cjt} \quad (2)$$

where RD_{cst} is industry and country specific R&D intensity at time t, α_s are sector dummies, γ_{ct} are country x year dummies, $\delta_j const_c$ are industry dummies interacted with the constitution indicator (and $\theta_j law_c$ are industry dummies interacted with an index of legal IPR protection - which is not at the constitutional level – as specified in the next section). The estimated vector $\widehat{\alpha_s}$ reports a measure of the extent of R&D intensity which is industry specific and exogenous with respect to country specific institutions protecting IPR. We then use $\widehat{\alpha_s}$ in our empirical model as an alternative measure of R&D dependence at industry level.

Column 3 in Table 1 tabulates the value of the estimated R&D intensity index for each of the 23 industries, as resulting from the estimation of equation 2, where the value corresponding to the base sector in regression (2) - Accommodation and Food Service Activities- is normalized to 0.

The same aggregation problems which prevent us to use the GV taxonomy directly in our estimation also affect the comparison between our R&D indicator and the GV one, making it not very clear cut in some cases. Nevertheless, the correspondence between the GV classification and our estimated index appears to be quite good. The five industries classified by GV as high or medium-high R&D intensive are among the first seven industries according to our estimated index.[15]

[14] See also Cingano et al. (2010) for an application of this methodology to the construction of a job reallocation index.

[15] Notice that "Publishing activities" and "IT and other information services", which are classified by GV as medium-high, have assigned no R&D index since data on R&D used in regression (2) are available at a higher level of aggregation The broader category Information and communication (J) for which the R&D index is available also includes sectors which are classified by GV as medium low and low.

3.3 Legal IPR protection indexes

Intellectual property right protection may be enforced by ordinary laws or by other sources of legislation (e.g., international treaties), irrespective of the presence of specific constitutional norms. In this case we need to exclude that our results are driven by the presence of legal rules other than the countries' constitution.

Based on the same identification strategy illustrated above, in order to capture the differential effect of protecting IPR at the constitutional level rather than through different sources of legislation, we augment our baseline specification (1) by including an index of legal protection different from constitutional norms (i.e., *lower-rank* norms protecting IPR) interacted with the index of R&D dependence, which is intended to assess the relevance of the constitutional norms in those countries in which IPR are also protected by other laws and regulations.[16]

We then estimate the following specification:

$$y_{cst} = \beta_1(const_c \; x \; innov_s) + \beta_2(law_c \; x \; innov_s) + \beta_3(const_c \; x \; law_c \; x \; innov_s) + \boldsymbol{D}_{cst} + u_{cst} \quad (3)$$

where law_c is the index measuring IPR protection by lower-rank norms in country *c* and $\boldsymbol{D}_{cst}$ is the matrix of industry and country-by-year dummies, to control for omitted country specific-time variant factors that could bias our coefficients.[17]

The coefficient β_3 of the third-level interaction term captures the effect of constitutional provisions on productivity in industries with different R&D intensity in countries with different degrees of patent protection. A positive interaction term would imply *complementarity* between constitutional and lower-rank legal norms, while a negative coefficient indicates *substitutability* between the two sources of legal protection.

3.4 Endogeneity and Instrumental Variables

For all the OECD countries included in our sample constitutional provisions concerning IPR protection have been introduced decades before the period under

[16] The IPR-protection indexes that we use in our model will be described in section 4.2 below.

[17] We also include the log of the pre-sample values of the dependent variable calculated for the year 1998 to account for initial conditions and the potential bias from omitted industry-country specific factors. Estimated coefficients reported in Table A1 in Appendix are remarkably similar to main results.

investigation. **Table 2** shows the year in which constitutional provisions protecting IPR have been introduced, as well as the year in which the constitution was enacted or modified.

[TABLE 2 AROUND HERE]

Among the countries in our sample, six have included IPR protection in their constitution *ab origine*. The most recent example is Portugal, whose constitution dates back to 1976. In two countries (Austria and Bulgaria), IPR protection was included also in the previous charter, so it even predates the present constitution.

Therefore, given the time span considered in our estimates (namely, from 2000 to 2013), we can rule out the possibility of reverse causality between the constitutional protection of IPR and labor productivity. Reverse causality might represent a problem for studies dealing with developing and transition countries that have recently introduced such provisions in their constitution. Moreover, in the empirical analysis we include country specific-time variant fixed effects which control for any omitted variable at country level that could potentially bias our results. Therefore, we can exclude that constitutional protection of IPR and changes in labor productivity are driven by common unobserved factors at the country level.[18]

However, this argument does not necessarily apply to the protection of IPR resulting from lower-rank legislation, as current values of the index of IPR protection may be determined by the productivity dynamics of R&D intensive sectors, so that the exclusion restriction would not hold in this case. In order to tackle a possible reverse causality or omitted variable bias in specification (2), we instrument the IPR index (and its interaction with constitutional norms) with a set of instruments that are widely known and used in the literature, namely an indicator of a country institutionalized democracy (*democ*), an indicator of regime durability (*durable*), and the distance from the equator (*latitude*).

[18] The exogeneity of constitutional provisions is also supported by a standard test on endogeneity. In specification (1) the null hypothesis of exogeneity of the interaction term ($const_c$ x $innov_s$) cannot be rejected after controlling for other (lower rank) legal protections of IPR and country-by-year fixed effects. Moreover, results are qualitatively similar to those presented in Table 6 (column 6) in which constitutional norms are treated as exogenous. Results are available upon request.

The first two variables (*democ* and *durable*) are indicators of political institutions and are both taken from the Polity IV dataset. *Democ* is an eleven-point indicator derived from the coding of variables such as the competitiveness of political participation, the openness and competitiveness of executive recruitment and the constraints on the chief executive; *durable* refers to the number of years since the most recent regime change or since the end of a transition period defined by the lack of stable political institutions. The choice of political variables as instruments for laws protecting IPR is based on the "hierarchy of institutions" hypothesis, according to which constitutional/political rules set the stage for economic institutions (Acemoglu et al. 2005). Political institutions change slowly, exhibit persistence over time and have a negligible direct impact on output; as a result, they have been shown to be particularly suited to instrument institutional characteristics of developed economies (Eicher and Leukert, 2009).

Latitude is a geographical characteristic intended to measure the extent to which an economy is influenced by Western Europe, the first region of the world to implement broadly an institutional setting that favors economic growth (Hall and Jones, 1999).

As a robustness check, we also instrument the endogenous variable(s) with the average values of both the Polity IV instruments across the 2000-2013 period. Our main results are remarkably robust (see Section 6).

4 – Data and descriptive statistics

4.1 Productivity data

Labor productivity is calculated as industry value added per hour worked. Data at industry level are drawn from the EUKLEMS database, which provides information on value added and hours worked for 34 industries and 8 aggregates according to the ISIC Rev. 4 (NACE Rev. 2) industry classification. Our final sample includes 22 industries for 22 countries over the period 2000-2013.[19] The level of aggregation for each industry has

[19] As specified in footnote 13, we start from a sample of 24 industries (according to the classification employed by EUKLEMS) and we drop the broad sectors "Publishing, audiovisual and broadcasting activities" and "Professional, scientific, technical, administrative and support services activities" (M-N), as they do not fit neither in our "High" nor in our "Low" R&D intensity classifications.

been chosen in order to guarantee the consistency of data across all countries over the sample period (2000 to 2013).

Table 3 shows descriptive statistics for labor productivity for both the whole sample and for the high and the medium-low R&D intensity subsamples, as defined according to the GV classification and obtained as described in section 3.2 above.

[TABLE 3 AROUND HERE]

4.2 Constitutional provisions and legal protections of IPR

Information on the characteristics of constitutions is drawn from the Comparative Constitutions Project: A Cross-National Historical Dataset of Written Constitutions (Elkins et al. 2009), a repository of valuable data on the formal characteristics of written constitutions for most independent countries since 1789. Among other things, the database provides information on the presence of constitutional norms protecting trademarks, patents and copyrights and on the year of their introduction.

Column 1 in Table 4 reports the type of protection of IPR from constitutional provisions for the countries in our sample.

[TABLE 4 AROUND HERE]

In the period under analysis (2000-2013) and for the countries in our sample 6 constitutions (Austria, Bulgaria, Germany, Lithuania, Portugal, United States) protect copyrights, 4 constitutions protect patents (Austria, Bulgaria, Lithuania, United States) while only Austria protects trademarks.

We use two indicators to capture the overall legal protection of IPR: the updated values of the Ginarte and Park index (Park, 2008) and the IPRI index by Property Rights Alliance (respectively, columns 2 and 3 in Table 4). The Ginarte and Park indicator captures the degree of patent protection granted by laws and regulations enforced in a country. The index is the unweighted sum of five separate scores for: i) coverage (inventions that are patentable); ii) membership in international treaties; iii) duration of protection; iv) enforcement mechanisms; and v) restrictions (e.g., compulsory licensing in the event that a patented invention is not sufficiently exploited). The index has been originally calculated

for the 1960–1990 period, broken down into 5-year intervals, and is updated on a quinquennial basis. Consistently with the time span covered by our estimation, we use the average of the index over the 2000-2010 period (thus excluding the value of the index for 2015, which falls outside our reference interval) as a measure of IPR protection resulting from legislative sources other than constitutional norms.

In order to test the robustness of our results and to control for *de facto* protection, we re-estimate our model using a different index of IPR strength, i.e., the International Property Right Index (IPRI, developed by the Property Rights Alliance). The IPRI is an indicator of property rights protection across the world. The overall score consists of three core components: i) legal and political environment; ii) physical property rights; iii) intellectual property rights. Given that we are interested in intellectual property exclusively, we take only the third component. Differently from the Ginarte and Park index, in measuring physical and intellectual property rights, the IPRI accounts for both *de jure* and *de facto* outcomes. In fact, in the assessment of the protection of IPR, the IPRI includes the Ginarte and Park index (*de jure*) as well as two *de facto* components: i) an opinion-based measure of the protection of intellectual property (drawn from the World Economic Forum's 2016-2017 Global Competitiveness Index) and ii) the level of piracy in the IP sector (based on the BSA Global Software Survey, "The Compliance Gap"). The latter estimates the volume and value of unlicensed software installed on personal computers, and reveals attitudes and behaviors related to software licensing, intellectual property and emerging technologies. The IPRI is available from 2007. As for the Ginarte and Park index, we use the average of the indicator (in this case, considering the years from 2007 to 2013).

Table 5 displays descriptive statistics for the variables used to instrument the IPR index. The values of *democ* and *durable* as reported in column 1 and 2 are averaged over the sample period.

[TABLE 5 AROUND HERE]

5 – Empirical results

5.1 Main results

Table 6 shows the results of regressing labor productivity on the constitutional dummy and IPR index as discussed in the previous sections.

[TABLE 6 AROUND HERE]

Columns 1-4 present OLS estimates and columns 5-7 IV estimates. As discussed in the previous session, in the IV estimates the term $law_c \; x \; innov_s$ is instrumented with the political variables *democ* and *durable* (both interacted with $innov_s$). In order to run the over-ID test, we added the instrument *latitude* in the full specification (column 7).

In both OLS and IV regressions the impact of constitutional norms protecting IPR on labor productivity in high-dependent R&D industries is positive and significant, also when the IPR index is accounted for.

The triple interaction term is negative in all cases (column 4 and 7). This result suggests a substitution effect between constitutional norms and lower-rank sources of legislation, as the presence of ordinary law reduces the differential impact of constitutions on high R&D intensive industries (and, vice-versa, constitutional protection dampens the effect of ordinary law).

Turning to the goodness of the instruments, in all specifications (columns 5 to 7), the over-ID test is accepted. The first stage results are reported in Table A2 in the appendix. It shows that instruments are all highly statistically significant and the F statistic for the relevance of instruments is well above the `rule of thumb' threshold of 10 in all specifications.

Based on the results in column 7 (the fully interacted model), we can assess, on the one side, the effect of constitutional norms on sector productivity depending on IPR protection and, on the other side, the effect of the IPR index depending on the presence of constitutional norms.

Let us focus on the effect of the IPR index first. Taking the first derivative of (3) with respect to *law* we obtain:

$$\frac{\partial y_{cst}}{\partial law_c} = (\beta_2 + \beta_3 const_c) \times innov_s \quad (4)$$

which shows that the effect of ordinary law on the productivity differential between high and low R&D sectors depends on the presence of constitutions. Therefore, $\widehat{\beta_2}$ is the estimated effect in countries with no constitutional protection, while $\widehat{\beta_2} + \widehat{\beta_3}$ is the effect when constitutional norms are present.

To this respect, two conclusions can be drawn from the findings in column 7. First, in those countries where IPR are also protected by the constitution, the IPR index has no significant impact on the labor productivity differential between R&D high and low intensive industries, as the effect of *law* on the dependent variable (i.e. $\widehat{\beta_2} + \widehat{\beta_3}$) is quantitatively small (-0.039) and not statistically significant. On the other hand, the effect turns out to be positive and quantitatively relevant in countries without constitutional protection, $\widehat{\beta_2}$ being equal to 0.47. Quantitatively, the effect of increasing IPR protection by ordinary law by one standard deviation (which is 0.42, around 10% of the average value) would be an increase of labor productivity in high R&D intensive sectors relative to low R&D intensive sectors of about 20% in the absence of constitutional IPR protection.

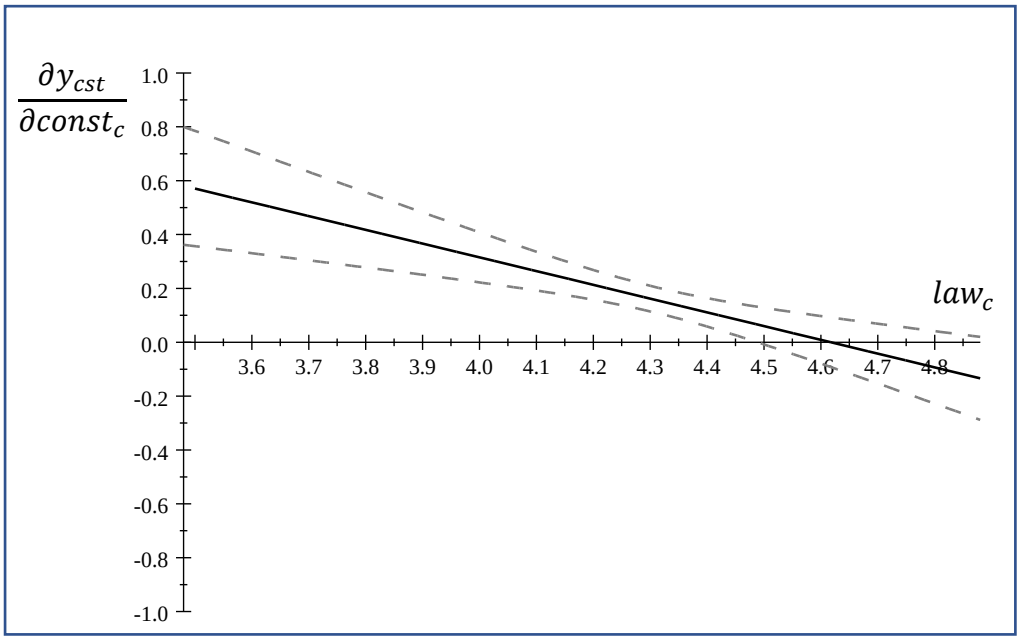
In a similar way, we can quantify the effect of constitutional provisions by taking the first derivative of (3) with respect to *const* and obtain:

$$\frac{\partial y_{cst}}{\partial const_c} = (\beta_1 + \beta_3 law_c) \times innov_s \quad (5)$$

According to the first derivative in (5), the marginal effect of the presence of constitutional norms protecting innovation depends on the IPR index. Since the IPR index assumes continuous values, we can graphically represent the estimated effects (and statistical significance) of constitutional provisions on labor productivity in R&D intensive sectors for different values of the IPR index distribution.

Results are displayed in Figure 1, which shows clearly that constitutional and ordinary legal norms are substitutes, the marginal effect of constitution being positive and statistically significant for an IPR index lower than 4.5 (that is for half of the countries in our sample). The differential impact of the constitutional norms for labor productivity in high- dependent R&D sectors is on average around 18%.

Figure 1: The effect of constitutional provisions protecting IPR on labor productivity in R&D intensive sectors for different levels of the IPR index (table 6, column 7 - 95% IC)



5.2 IPR legal protection and R&D investment

The results reported in Table 6 suggest that high innovative industries are relatively more productive in countries with a strong protection of intellectual property derived either from constitutional provisions or lower-rank laws. In this section we want to explore the channel through which the IPR protection affect industry productivity. To this aim we test whether and to what extent legal protection creates favorable conditions for undertaking research on and developing innovative ideas.

Based on the same identification strategy illustrated above, we estimate specification (2) by using the log of R&D intensity at industry level as a dependent variable.

Results are reported in Table 7.

[TABLE 7 AROUND HERE]

Column (2) shows that both constitutional provisions and lower-rank laws' IPR protection have a significant positive effect on R&D intensity. The presence of constitutional provision enhances R&D intensity and, hence innovation effort, by around

28% in those industries which have a higher R&D dependence. Similarly, if we increase the index of IPR legal protection by 1 standard deviation, R&D intensity grows by around 12 percent. The triple interaction term (column 3) is negative as in the productivity specification although less precisely estimated; this result seems to suggest once again a substitution effect between constitutional norms and lower-rank sources of legislation in stimulating innovation.

6 - Robustness

To check the robustness of our results, we run our main regressions using an alternative specification of R&D intensity, the IPRI (International Property Rights) Index, and a different specification of the instruments.

6.1 - Robustness to a different R&D dependence index

In this section we refine our identification of R&D dependent sectors by constructing an indicator which does not reflect idiosyncratic factors specific to a country or to a constitutional/legislative environment, as resulting from the estimation of equation (1).

We then estimate our model interacting *law* and *const* with the new R&D intensity indicator as reported in Table 1 (column 3). The results shown in **Table 8** are remarkably similar to those presented in Table 6. Considering the full specification (column 3), the average effect of the constitutional norms protecting IPR on labor productivity is around 13%. The effect of increasing the IPR index by one-standard deviation is around 17% in countries with no constitutional protection, and the effect turns out to be very small and statistically not significant in the countries with IPR protection.

[TABLE 8 AROUND HERE]

6.2 - Robustness to the International Property Rights Index

The Ginarte and Park index captures the degree of patent protection resulting by various types of norms (legislations, international treaties, and so on). However, the actual level of IPR protection in a country may also be the result of de facto situations which are related to the legal environment or to the quality of the enforcement, but which are not immediately encompassed in official rules.

We check the robustness of our findings using an alternative IPR index, the IPR component of the International Property Rights Index (IPRI). The IPRI is a composite indicator which is based on the Ginarte and Park measure of IPR strength, but it also includes two measures of *the facto* IPR protection, an opinion-based measure of the protection of intellectual property and the level of piracy in the IP sector. Therefore, differently from the IPR index used in the main regressions, the IPRI captures the level of actual protection (*de jure* as well as *de facto* protection) which is granted in a country as a result of the institutional settings at large.

The IPRI is published by the Property Rights Alliance on an annual basis since 2007. We calculate the average of the indicator over the year 2007-2013 and use it to re-estimate our model in equation (3). Here again, the results reported in **Table 9** are remarkably similar to those shown in Table 6.

[TABLE 9 AROUND HERE]

6.3 - Robustness to an alternative instrument specification

Lastly, we estimate our IV model replacing the (time variant) instruments *democ* and *durable* by their average along the 1998-2013 period; **Table 10** shows the results of our estimation, thus confirming also in this case the robustness of our findings.

[TABLE 10 *AROUND* HERE]

7 – Discussion

Taking hints from the strands of literature focusing on the impact of constitutions on economic activity and on the relationship between R&D intensity and productivity dynamics, this paper contributes to the scientific and policy debate in the broad interdisciplinary area of research on the impact of legislation, legislative processes, and regulation on various measures of economic performance. It shows that, in countries where intellectual property rights receive constitutional protection, R&D dependent industries exhibit higher productivity levels than the other industries. According to our findings, in those countries already endowed with a constitution containing provisions in support of IPR protection, legal norms hierarchically subordinate to constitutional norms do not necessarily strengthen the impact of higher-rank norms. We find that constitutional

protection of IPR has a positive impact on productivity which is relative larger for high-dependent R&D industry.

Constitutions delineate the pillars of the legal and the institutional systems that govern organizations and entities in a country. Typically, they embody values and principles that are considered of the utmost importance for a country and whose protection is prioritized. As such, constitutional status represents a signal, to both citizens and foreigners, that the principles behind those rules are granted the utmost protection. Insomuch as the provisions playing a crucial role for economic activity are enshrined in a country's constitution and not simply set for by lower-rank legislation, we should expect a stronger impact on productivity. Such impact should be more pronounced in those industries that benefit most from IPR protection, namely high R&D intensive ones.

A second, interesting result that we prove is that constitutions and lower-rank laws are substitutes.

Our findings show that constitutions seem to play a role in the absence of a specific law. In other words, constitutional law seems to play, in the application of IPR, a "supplementary" or "residual" role. The constitutional provisions regarding IPR protection acquire importance and exert a distinctive impact on labor productivity in the absence of specific ordinary law or standing a limited protection by ordinary law. Constitutional provisions thus fill the gap left by the lack of specific legal rules applicable to IPR protection, possibly through judicial revision procedures.

These results are interesting and raise questions on a) the mechanisms that might justify them; b) their generality. Substitutability between constitutional and lower-rank norm might, in fact, characterize some rights, whereas complementarity might be the distinctive feature of others.

Generally speaking, legal norms have the double function of 1) including principles and norms that reflect commonly shared values and social norms, to legitimate them and, 2) include principles that do not reflect shared values, to signal the political intention to change the common practice, aligning it to the new principles, and to commit to their enforcement (Carbonara, 2017).

Constitutions are a particularly powerful way to achieve the above results. They are special laws, with a special rank and a special force. Principles protected by constitutions are preserved from change by supermajority rules or aggravated procedures. By giving a law constitutional status, lawmakers make a strong commitment to their enforcement and give their statement a substantial weight.

When constitutions embody principles that diverge from current social values, conformity is particularly difficult and strong enforcement may be required to achieve it (Carbonara et al., 2012). Thus, higher- and lower-ranked rules are likely to be complements in this case, insofar as ordinary law strengthens the protection of constitutional rights by adding to the available remedies.

When constitutions include principles reflecting generally shared values, on the other hand, such values are already represented in common practice and conformity is likely to be guaranteed by social norms (Carbonara, 2017). Whereas including those principles in the constitution might have the symbolic value of legitimating both the principles and the social norms on which they are founded, a special force is not needed for their enforcement and lower-rank norms are sufficient. In this case, lower and higher-rank norms are substitutes and the presence of ordinary laws protecting IPR reduces the positive impact of constitutional provisions.

It is highly likely that the countries included in our sample fall within this latter case. Most of the OECD countries in our sample are developed countries that have a long-lasting tradition of pro-market commercial practices and that have helped designing the current methods of investment protection and appropriability of research results that form modern protection of intellectual property rights.

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TABLES

Table 1: R&D intensity index and GV classification (two-digit level)

Industries	GV classification	Authors' classification $innov_s$	Estimated R&D intensity index
	(1)	(2)	(3)
20-21 Chemicals and chemical products	High; Medium-high	**High**	2.793
31-33 Other manufacturing; repair and installation of machinery and equipment	Medium-high	**High**	2.134
19 Coke and refined petroleum products	Medium-low	Low	2.016
29-30 Transport equipment	Medium-high	**High**	2.000
26-27 Electrical and optical equipment	Medium-high	**High**	1.978
M-N PROFESSIONAL, SCIENTIFIC, TECHNICAL, ADMINISTRATIVE AND SUPPORT SERVICE ACTIVITIES	High; Medium-low	n.c.	1.940
28 Machinery and equipment n.e.c.	Medium-high	**High**	1.876
K FINANCIAL AND INSURANCE ACTIVITIES	Low	Low	1.787
22-23 Rubber and plastics products, and other non-metallic mineral products	Medium	Low	1.540
24-25 Basic metals and fabricated metal products, except machinery and equipment	Medium; Medium-low	Low	1.068
J INFORMATION AND COMMUNICATION			1.062
58-60 Publishing	High; Medium-low	n.c.	
61 Telecommunications	Medium-low	Low	
62-63 ICT services	Medium-high	**High**	
10-12 Food products, beverages and tobacco	Medium-low	Low	0.837
A AGRICULTURE, FORESTRY AND FISHING	Low	Low	0.816
16-18 Wood and paper products; printing and reproduction of recorded media	Medium-low	Low	0.779
13-15 Textiles, wearing apparel, leather and related products	Medium-low	Low	0.714
F CONSTRUCTION	Low	Low	0.663
G WHOLESALE AND RETAIL TRADE; REPAIR OF MOTOR VEHICLES AND MOTORCYCLES	Low	Low	0.637
L REAL ESTATE ACTIVITIES	Low	Low	0.357
H TRANSPORTATION AND STORAGE	Low	Low	0.164
D-E ELECTRICITY, GAS AND WATER SUPPLY	Low	Low	0.106
B MINING AND QUARRYING	Medium-low	Low	0.041
I ACCOMMODATION AND FOOD SERVICE ACTIVITIES (base)	Low	Low	0.000

Note: n.c. is for "not classified"

Table 2: Constitutional provisions protecting IPR and year of introduction

	Constitutional provisions protecting IPR			Constitution
Country	Patent	Copyright	Trademark	Year
Austria	1920	1920	1920	1945
Belgium				1831
Bulgaria	1970	1970		1991
Cyprus				1960
Czech Republic				1993
Denmark				1953
Finland				1999
France				1958
Germany		1949		1949
Greece				1975
Ireland				1937
Italy				1947
Lithuania	1992	1992		1992
Luxembourg				1868
Netherlands				1815
Poland				1992
Portugal		1976		1976
Slovak Republic				1992
Spain				1978
Sweden				1809
United Kingdom				1789
United States	1789	1789		1789

Table 3: Descriptive statistics for labor productivity (log)

Labor productivity (output per hour worked)				
Mean	Std. Dev.	Min	Max	Observations
All industries				
3.85	1.52	-2.05	10.38	7461 (24 sectors)
High R&D intensive industries				
3.75	1.35	-0.41	7.15	3261 (5 sectors)
Medium and Low R&D intensive industries				
3.87	1.55	-2.05	10.38	5992 (19 sectors)

Table 4: *Constitutional* and *legislative* protection of IPR

	IPR Constitutional Protection	IPR legal Protection	
		Ginarte and Park Index	IPRI Index
Austria	p, c, t	4.33	8.25
Belgium		4.67	8.06
Bulgaria	p,c	3.83	4.85
Cyprus		3.48	6.10
Czech Republic		3.96	6.41
Denmark		4.63	8.33
Finland		4.63	8.55
France		4.67	8.02
Germany	c	4.67	8.40
Greece		4.36	5.78
Ireland		4.67	7.81
Italy		4.56	6.74
Lithuania	p,c	3.70	5.18
Luxembourg		4.14	7.67
Netherlands		4.67	8.25
Poland		3.88	5.88
Portugal	c	4.21	6.84
Slovak Republic		3.68	6.42
Spain		4.33	6.87
Sweden		4.54	8.06
United Kingdom		4.54	8.22
United States	p,c	4.88	8.30
average		4.26	7.25
sd		*0.42*	*1.21*

p = patent; c = copyright; t = trademark.

Table 5: The instruments (2000-2013)

Country	democ	durable	latitude
Austria	10	60.5	47.5
Belgium	9	62.5	50.5
Bulgaria	8.93	16.5	42.7
Cyprus	10	32.5	35.1
Czech Republic	9.43	13.5	49.8
Denmark	10	61.5	56.2
Finland	10	62.5	61.9
France	9	37.5	46.2
Germany	10	16.5	51.1
Greece	10	31.5	39.1
Ireland	10	85.5	53.4
Italy	10	58.5	41.8
Lithuania	10	15.5	55.1
Luxembourg	10	61.5	49.8
Netherlands	10	61.5	52.1
Poland	9.9	15.5	51.9
Portugal	10	30.5	39.3
Slovak Republic	9.6	13.5	48
Spain	10	28.5	40.4
Sweden	10	89.5	60.1
United Kingdom	10	126.5	55.3
United States	10	197.5	37
mean	9.80	53.59	48.35
sd overall	*0.45*	*42.89*	*7.30*
between	*0.36*	*43.63*	
within	*0.28*	*4.04*	

Table 6: The effect of constitutional norms protecting IPR on labor productivity

	OLS				IV		
	1	**2**	**3**	**4**	**5**	**6**	**7**
Const x innov	0.14*		0.16**	0.615		0.157***	2.358***
	(0.075)		*(0.061)*	*(0.681)*		*(0.024)*	*(0.566)*
Law x innov		0.241***	0.258***	0.292***	0.221***	0.212***	0.472***
		(0.084)	*(0.074)*	*(0.092)*	*(0.048)*	*(0.047)*	*(0.069)*
Const x law x innov				-0.106			-0.511***
				(0.153)			*(0.131)*
r2	0.642	0.643	0.644	0.645	0.643	0.644	0.643
Industries	22	22	22	22	22	22	22
Countries	22	22	22	22	22	22	22
Obs.	7461	7461	7461	7461	7461	7461	7461
Industry FE	YES	YES	YES	YES	YES	YES	YES
Country × Year FE	YES	YES	YES	YES	YES	YES	YES
Underid					585.409	528.914	372.917
Chi-sq(2) P-val					0	0	0
Overid					0.004	0	1.304
Chi-sq(1) P-val					0.9525	0.9864	0.2534

Notes: Robust standard errors in parentheses; ***significant at 1%, **significant at 5%, *significant at 10%. Law: Ginarte and Park patent protection index (average 2000-2013). Instruments for *Law*: democ and durable (5, 6, 7), latitude (7). All instruments are interacted for *innov*

Table 7: The effect of constitutional norms protecting IPR on R&D intensity

		IV	
	1	**2**	**3**
Const x innov		0.275***	1.261
		(0.062)	*(4.290)*
Law x innov	0.403***	0.262**	0.346
	(0.127)	*(0.132)*	*(0.424)*
Const x law x innov			-0.220
			(0.960)
r2	0.823	0.824	0.824
Industries	20	20	20
Countries	18	18	18
Obs.	3261	3261	3261
Industries FE	YES	YES	YES
Country × Year FE	YES	YES	YES
Underid	280.131	408.323	64.953
Chi-sq(2) P-val	0	0	0
Overid	0.248	0.694	0.622
Chi-sq(1) P-val	0.619	0.405	0.430

Notes: Robust standard errors in parentheses; ***significant at 1%, **significant at 5%, *significant at 10%. Law: Ginarte and Park patent protection index (average 2000-2013).
Instruments for *Law*: democ and durable (5, 6, 7), latitude (7).
All instruments are interacted for *innov*

Table 8: Robustness to R&D dependence index

		IV	
	1	**2**	**3**
const x innov1		0.101***	1.982***
		(0.016)	(0.406)
law x innov1	0.2***	0.191***	0.412***
	(0.031)	(0.03)	(0.053)
const x law x innov1			-0.436***
			(0.094)
r2	0.669	0.671	0.664
Industries	20	20	20
Countries	22	22	22
Obs.	5992	5992	5992
Industry FE	YES	YES	YES
Country × Year FE	YES	YES	YES
underid	738.248	679.913	488.594
Chi-sq(2) P-val	0	0	0
overid	0.619	0.693	0.125
Chi-sq(1) P-val	0.4314	0.4052	0.7241

Notes: Robust standard errors in parentheses; ***significant at 1%, **significant at 5%, *significant at 10%. Law: Ginarte and Park patent protection index (average 2000-2013). Instruments: democ and durable (5, 6, 7), latitude (7). All instruments are interacted for *innov*.

Table 9: Robustness to the facto IPR protection (IPRI 2007-2013)

	IV		
	1	**2**	**3**
const x innov		0.167***	0.936***
		(0.024)	(0.3)
law1 x innov	0.081***	0.077***	0.135***
	(0.018)	(0.017)	(0.019)
const x law1 x innov			-0.107***
			(0.042)
r2	0.644	0.645	0.645
Industries	22	22	22
Countries	22	22	22
Obs.	7461	7461	7461
Industry FE	YES	YES	YES
Country × Year FE	YES	YES	YES
underid	757.002	641.78	253.335
Chi-sq(2) P-val	0	0	0
overid	0.156	0.205	0.563
Chi-sq(1) P-val	0.6925	0.6504	0.453

Notes: Robust standard errors in parentheses; ***significant at 1%, **significant at 5%, *significant at 10%. Law: Ginarte and Park patent protection index (average 2000-2013).
Instruments: democ and durable (5, 6, 7), latitude (7). All instruments are interacted for *innov*.

Table 10: Robustness to alternative instrument specification (*democ* and *durable*: average 2000-2013)

	IV		
	1	**2**	**3**
const x innov		0.154***	2.451***
		(0.024)	(0.541)
law x innov	0.187***	0.177***	0.448***
	(0.047)	(0.047)	(0.067)
const x law x innov			-0.533***
			(0.125)
r2	0.643	0.644	0.643
Industry	22	22	22
Countries	22	22	22
Obs.	7461	7461	7461
Industry FE	YES	YES	YES
Country × Year FE	YES	YES	YES
underid	590.233	533.500	402.542
Chi-sq(2) P-val	0	0	0
overid	0.008	0.060	2.003
Chi-sq(1) P-val	0.9296	0.8057	0.1569

Notes: Robust standard errors in parentheses; ***significant at 1%, **significant at 5%, *significant at 10%. Law: Ginarte and Park patent protection index (average 2000-2013). *Instruments*: democ and durable (average 2000-2013, columns 1, 2 3), latitude (3). All instruments are interacted for *innov*.

Appendix

Table A1: The effect of constitutional norms protecting IPR on labor productivity controlling for the log of pre-sample industry productivity

		IV	
	1	**2**	**3**
productivity (log) 1998	0.606***	0.631***	0.626***
	(0.022)	(0.021)	(0.021)
const x innov		0.08***	2.229***
		(0.017)	(0.431)
law x innov	0.290***	0.283***	0.527***
	(0.037)	(0.036)	(0.055)
const x law x innov			-0.491***
			(0.098)
r2	0.849	0.849	0.846
Industries	22	22	22
Countries	22	22	22
Obs.	7606	7606	7606
Industry FE	YES	YES	YES
Country × Year FE	YES	YES	YES
underid	759.206	732.400	516.334
Chi-sq(2) P-val	0	0	0
overid	2.474	0.357	0.335
Chi-sq(1) P-val	0.1158	0.5504	0.5629

Notes: Robust standard errors in parentheses; ***significant at 1%, **significant at 5%, *significant at 10%. Law: Ginarte and Park patent protection index (average 2000-2013). Instruments for *Law*: democ and durable (5, 6, 7), latitude (7). All instruments are interacted for *innov*

Table A2: First stage regressions

	First stage 1	First stage 2	First stage 3	
	law x sector	*law x sector*	*law x sector*	*cons x law x sector*
democ x sector	-0.0321**	-0.0307**	-0.0429***	0.0628***
	0.0144	0.0135	0.0131	0.0076
durable x sector	0.0006***	0.0057***	0.0056***	0.0027***
	0.0001	0.0001	0.0001	0.0001
latitude x sector			0.0116***	-0.0072***
			0.0010	0.0005
F test	816.56	954.01	772.38	323.69
Prob > F	0.00	0.00	0.00	0.00