Political Institutions, Technology and Growth: a dynamic panel approach*

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Abstract

This paper investigates whether the effect of political institutions on sectoral economic performance is determined by the level of technological development of industries. Building on previous studies on the linkages among political institutions, technology and economic growth, we employ the dynamic panel Generalized Method of Moments (GMM) estimator for a sample of 4,134 country-industries from 61 industries and 89 countries over the 1990-2010 period. Our main findings suggest that changes of political institutions towards higher levels of democracy, political rights and civil liberties enhance economic growth in technologically developed industries. On the contrary, the same institutional changes might retard economic growth of those industries that are below a technological development threshold. Overall, these results give evidence of a technologically conditioned nature of political institutions to be growth-promoting.

Keywords: Political institutions, technological development, growth, dynamic panel data.

JEL classification: H70, O10, O43, P16, C23

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1 Introduction

This paper investigates the relationship between technological development and the effects that political institutions have on economic performance. Specifically, we focus on the effect that democracy, political rights and civil liberties –in their interaction with technological development –have on economic growth. We argue that the degree of technological development might be at work in the impact of political institutions on sectoral economic growth. Consequently, the same political institutions could exert both negative and positive effects on growth relying upon the tehcnological characteristics of industries.

Drawing on previous empirical studies on the interrelation among political institutions, technology and economic growth, we use highly disaggregated data and propose a dynamic panel data model, estimated by the system Generalized Method of Moments (sys-GMM) as developed by Blundell and Bond (1998). We extend in that way the analysis by Aghion, Alesina, and Trebbi (2008), who document that the degree of technological advance plays a crucial role in the relationship between political institutions and economic growth, using a static panel data estimated by the fixed-effects within-group estimator. These authors suggest that political institutions, such as democracy, political rights and civil liberties, impact differently on different sectors of the economy. This heterogenity of effects is determined by the degree of technological development of the industries. As they declare, the reasons for this diversity of impacts reside in that more democratic institutions are associated with fewer market entry barriers, driving to a higher level of competition and innovation. In this plausible scenario, only those industries technologically advanced are more capable to adapt to a higher degree of competition relative to backward industries. Therefore, advanced industries are likely to survive and eventually grow, whereas bakcard industries are forced to reduce or even exit the market. As a result, this particular channel conveys that more democratic institutions benefit technologically advanced industries and, to the contrary, grinds backward industries' growth. Arguably, these different effects of democracy on economic growth could explain the ambiguity of the aggregate results shown by the empirical literature on this field.

More recent attempts investigating the conditional nature of the effect that political institutions exter on economic growth do not support that political institutions, and particularly, democracy needs development to spur economic growth. That is the case of Acemoglu, Naidu, Restrepo, and Robinson (2014) , who study the impact of democracy on growth from the perspective of economic development and human capital[1]. They conclude that the effect of democracy on economic growth do not seem to vary because of different stages of economic development. Moreover, these authors affirm that democracy is growth-enhancing even for developing countries, contrary to a common claim in this field. However, they constrained their analysis to the effect of democracy interacted with economic development and human capital, but do not consider technological development. This fact definitely motivates our analysis of the technological precondition of political institutions to be growth-enhancing.

The analysis in Aghion et al. (2008) is here extended in three major directions, futher discussed in the text. Firstly, we use a higher level of data disaggregation on both output and value added growth rates of 61 International Statistics Industrial Classification (ISIC) manufacturing industries in a yearly basis, instead of the 28 industries employed in Aghion et al. (2008). While many studies focus on aggregate data, the use of higher levels of data disaggregation allows for a better insight by looking at how specific sectors perform depending on the levels of democracy and of technological development. Secondly, we examine whether the role of political institutions vary when controlling for market-entry regulation. To that end, we propose panel data models which include a proxy of economic regulation in terms of freedom of entry in the market.

Thridly, we specify a dynamic panel data model that includes lagged dependent variables as regressors to control for growth dynamics and employ the system Generalized Method of Moments (sys-GMM) to estimate

[1]They proxy the level of economic development by log GDP per capita, and human capital by the share of the population with Secondary schooling.

it. By doing so, we treat possible endogeneity bias and capture the long-run effect that political institutions might exert on sectoral growth rates. We believe that these departures from the previous literature might help to study a technologically constrained relationship between political institutions and economic performance.

The paper is organized as follows. Section 2 reviews the existing literature, frames our empirical research and explains in depth the departures we take from previous studies. Section 3 describes the data used in the analysis. Section 4 presents our baseline model, a country-industry fixed effects panel data model. Section 5 includes into the baseline model measures of market-entry regulation. Section 6 proposes a dynamic panel data model that solves for endogeneity issues and considers the inherent dynamics of economic growth. Section 7 concludes.

2 Literature review and Central Hypothesis

Political institutions[2] are a complex phenomenon. In the words of Fukuyama (2007), political institutions come as complex, interdependent packages. Efendic, Pugh and Adnett (2009) and Krieckhaus (2004) also emphasize this methodological challenge in studying and measuring political institutions. This complexity renders empirical research unable to capture simultaneously all the arenas that political institutions entail, and forces the simplification of the analyses. In this paper, we focus on three main institutional arenas of governments, such as democracy, political rights and civil liberties, and we employ widely used indicators to measure them.

A large body of literature in the politico-economic field makes the case that political institutions matter for economic growth. As of today, there are theoretical arguments and empirical findings suggesting that democracy and higher levels of political rights and civil liberties either foster or, to the contrary, grind economic growth. What follows summarizes the main views.

Theoretically, the effect of these three political institutional arenas on economic growth is ambiguous. There are plausible reasons why democracy may foster economic growth. Among others, the works of North (1990), Olson (1993) and Przeworski and Limongi (1993) hint that more democratic institutions constraint authoritarian elites which seek vested interest rather than efficient outcomes for the whole economy. Democracy is therefore needed to impulse economic performance and to periodically evict bad leaders. Analogously, democracy promotes efficiency and growth by reducing cronyism and other socially undesirable political features like corruption (Mesquita, Morrow, Siverson, and Smith 2001). The two other arenas we base our analysis on -political rights and civil liberties-, are also associated with higher efficiency and better economic outcomes. In this sense, Sirowy and Inkeles (1990) present microfoundations of the growth-enhancing effect of political rights and civil liberties. Civil liberties, they argue, could generate a safer business environment and promote entrepreneurs to enter the market and, in this way, foster economic growth. As regards political rights, political pluralism might break down political privileges of interest groups, ensuring therefore that political institutions act on behalf the public interest rather than serve vested interests. Contrary to these theoretical benefits of more democratic political institutions, Olson (1982) suggests that powerful interest groups in a democracy could influence state policy and damage the overall economy. In this line of thought, newly democracies could be associated with an increasing government spending and a reduction of the surplus to investments, and eventually they may have a negative effect on growth (Huntington, 1968) .

Looking at previous empirical works, there are econometric results that either support the growth-enhancing or growth-diminishing effect of political institutions. Barro (1996) finds a nonlinear effect of democracy on economic growth using repeated cross-section of countries. His findings point out that democracy enhances growth in low-democratic countries but retards growth in those which have already reached a certain demo-

[2] Gerring and Thacker (2001) define political institutions as enduring practices or organizations with an explicitly political orientation, and encompass the constitutional elements of a polity. They may be distinguished from public policies and political events, both of which are generally more evanescent.

cratic level.
Other studies, however, suggest that democracy could exert a null effect on growth. In this instance, Helliwell (1994) and latterly Gerring, Bond, Barndt, and Moreno (2005) argue that the growth-enhancing indirect effects of democracy via education, investments or greater stability and more property rights-, could be counterbalanced by growth-diminishing effects, and the net effect might eventually be null or even negative.
Counterposing the above empirical findings, Acemoglu et al. (2014) argue that democracy fosters investments and education, induces proper economic reforms and improves the provision of public goods. Using dynamic panel regressions, they estimate that democratization increases GDP per capita, and this effect is emphasized in the long-run, consistently with previous findings (Acemoglu, Robinson, Johnson, and Yared, 2005). Rivera-Batiz (2002) also evidences that stronger democratic institutions constraints corruption and inefficient features of governance. In turn, democracy stimulates technological change and spurs economic growth.

The ambiguity of the empirical results in the literature demonstrates that the linkages between political institutions and economic growth are puzzling and triggers our analysis of the effects of democracy, political rights and civil liberties on economic growth. We address a common claim in the politico-economic empirical studies: democracy needs development to be growth-enhancing. Specifically, we focus our analysis on that political institutions require a certain level of technological development to exert a positive effect on growth. Our work builds on the works of Aghion et al. (2008) and Acemoglu et al. (2014) since we believe that they complement each other in terms of methodology and the hypothesis they try out. Here we hypothesize that higher levels of democracy increases economic competition by reducing market-entry barriers. We expect that democracy, in turn, has a positive effect on those industries that are able to adapt to a higher competitive economic environment and a negative one on backwards industries, which are unable to survive in a more competitive and innovative economy. Using static panel data regressions and the within-group estimator, the results in Aghion et al. (2008) support the hypothesis of a technologically determined effect of democracy. We complement their analysis including some methodological differences that are employed in Acemoglu et al. (2014).
First, we use a higher level of data disaggregation and more recent data (1990-2010), which allow us both to look at additional industries and benefit from a greater number of observations. We also include control variables at a country-industry level to partial out possible effects of political institutions and of the whole manufacturing industry. In contrast to the specification in Aghion et al. (2008), we do not include additional interaction terms in order to avoid possible multicollinearity issues.
Second, we consider the number of procedures to start up a business[3] as an indicator of the strictness of the economic regulation in a country. The inclusion of this variable leads to the debate on the effect of regulation on sectoral growth rates, discussed in Section 5.
Finally, in Section 6 we model the dynamics of growth by including past values of output and value added growth in our regressions. We therefore specify a dynamic panel model and perform the system-GMM estimator. By doing so, we address one of the major empirical challenges in estimating the effect of political institutions on economic growth, that is to tackle the serially correlated dynamics of growth (Acemoglu et al. (2014).

3 Data

We use a short unbalanced three-way panel data to investigate the interrelation among political institutions, technology and growth. Notice that the unit of observation has a tridimensional nature related to a manufacturing sector, country and year. The data include 4,134 country-industries from 89 countries and 61 ISIC different manufacturing industries during the period 1990-2010. However, the number of observations varies

[3] The number of start-up procedures is provided by the *Doing Business Project* of the World Bank Group since 2004.

depending on both the different measures which serve for political institutions proxies and the two alternative dependent variables analyzed. Our dependent variable is the sectoral economic growth measured by either the output or the value added growth rates. We employ highly disaggregated data on manufacturing industries from the Industrial Statistics collected by the UNIDO (2010, revision 3), arranged at the 3 and 4 ISIC digit-level and presented in US dollar values at current prices. Thus, throughout the text we refer to output or value added growth rates specifically to a sectoral dimension.

The explanatory variables are distance to the world technological frontier, political institutions indices, the interaction between these two variables and a set of control variables. Regarding the technological development, we use an inverse measure that is the distance to the technological frontier, in the sense of Acemoglu, Aghion, and Zilibotti (2006). This variable is defined as one minus the logarithm of the value added per worker ratio of each sector divided by the logarithm of the maximum value of this ratio related to the same sector across all the countries included in the dataset in each year,

$$Distance_{ict} = 1 - \frac{\log(VA_{ict}/EMP_{ict})}{\log(max_{c'}(VA_{ic't}/EMP_{ic't}))}$$

$$i = industry; c = country; t = year$$

where VA_{ict} stands for the value added presented in US dollars at current prices for each country-industry and year, and EMP_{ict} denotes the number of employees in each country-industry and year. The variable could range theoretically from zero to one, although the actual maximum value of the distance in our sample is 0.82 [4]. A value close to zero means that the industry is close to the technological frontier, whereas values close to one reflect that the industry is far from the technological frontier and hence backward. More precisely, the country-industry which presents a value of distance equal to zero is the observation that sets the world technological frontier. The data show that the country which sets the technological frontier varies across industries and over time. On average, the United States, Japan and New Zealand are the countries which exhibit the maximum ratio of value added per employee. By contrast, Madagascar, Gambia and Mongolia systematically present the lowest average values of this ratio, meaning that they are the countries that are farthest from the technological frontier.

In characterizing the political institutions, we consider three well-known indices that are commonly used in the politico-economic literature, namely the Polity2 index from the Polity IV Project and the political rights and civil liberties indicators from the Freedom House. A few points are worth noticing regarding these indices, as the literature echoes a stern skepticism of the conceptual foundations of the construction of these indicators. One is the high volatility that these indicators exhibit, which could enter in conflict with the conceptual durability that political institutions should fulfil by definition. Another source of criticism is the high correlation between political institutions and per capita income. Finally, as pointed in Glaeser, La Porta, Lopez-de-Silanes and Shleifer (2004) these indicators might reflect political outcomes derived from non-evanescent institutions rather than political institutions themself. That said, we should strictely rely on the definition of democracy, political rights and civil liberties provided by the data sources of each indicator. The Polity IV Project measures political regimes using polity scores that are derived from an authority coding based on the competitiveness and openness of the executive recruitment, constraints of the chief executive, competitiveness and regulation of political participation. The Polity2 index is a combination of autocracy and democracy scores elaborated by the Polity IV Project in the basis of a democracy scale. The Polity2 index is computed by subtracting the autocracy score, ranging from -10 to 0, from a democracy score, ranging from 0 to 10 points. Therefore, this index ranges from -10 (high autocracy) and 10 (high democracy), and we do not include special political features coded as transitions, interruptions and interregnums. Polity IV Database is a conventional approach to assessing democracy scale and measures political regime using a polity score. We use it in order to get a characterization of political institutions in terms of democracy levels.

[4]This value is set by the observation referred to tobacco sector of the Arab Republic of Egypt in 1998.

The other two proxies of political institutions are the Political Rights and Civil Liberties indicators elaborated by the Freedom House. The methodology is inspired by the Universal Declaration of Human Rights (UN General Assembly 1948) and reviewed periodically. These indices analyze the degree of freedom in a country concerning three dimensions in the case of political rights and four dimensions in the case of civil liberties. Political Rights indicator considers the electoral process, political pluralism and participation and functioning of the government. As regards to Civil Liberties indicator, the Freedom House considers the freedom of expression and belief, associational and organizational rights, rule of law and personal autonomy and individual rights. Each of these indices ranges from 1 (greatest degree of freedom) to 7 (smallest degree of freedom). Nevertheless, we re-scale these indices for convenience and comparability with the polity2 index. Thus, a political rights or civil liberties score of 7 means the greatest degree of freedom, and conversely, a score of 1 means the lowest degree of freedom.

Aming at analyzing one essential pattern in the channel hypothesized in this investigation, we include the number of start-up procedures to enter the market in alternative models as a proxy of entry regulation. The number of procedures to start a business is one of the indicators collected by the World Bank Group *Doing Business* project and it has been used in previous studies (Djankov, La Porta, Lopez-de-Silanes, and Shleifer, 2002, and Aghion et al., 2008). However, this indicator is available from 2004, thus the number of observations is remarkably reduced when considering this variable into the model.

A set of control variables is considered in the models proposed along this research. Firstly, we include the log value of either output or value added of the total manufacturing industry so as to accounting for possible shocks that could specifically affect the manufactures at a country level. Secondly, we include the real GDP per capita in international dollars as reported in the Penn Worlds Tables (mark 7.1). Finally, our set of control variables include the log value of the total population, collected by the World Development Indicators database from the World Bank (version December 2014). The Appendix includes the mean values for each of the countries in our sample.

4 Political Institutions and Technology: baseline model

In this section, we propose a country-industry fixed effects model to analyze the effect of political institutions -in its interaction with technological development, on sectorial growth rates. Our baseline model is specified as follows.

$$\begin{aligned} Y_{ict} &= \beta_0 + \beta_1 DIST_{ict} + \beta_2 DIST_{ict} * POL_{ct} + \beta_3 POL_{ct} \\ &+ \beta_4 IND_{ct} + \beta_5 GDP_{ct} + \beta_6 POPlog_{ct} + u_{ict} \end{aligned} \tag{1}$$

$$Y_{ict} = \log y_{ict+1} - \log y_{ict}$$
$$u_{ict} = \alpha_i + \gamma_c + \delta_{ic} + \varepsilon_{ict}$$
$$i = industry; c = country; t = year$$

The left-hand-side variable (Y_{ict}) is either the log difference of output or value added at a country-industry level over year t, that is the growth rate from year t to t+1. The key set of explanatory variables are distance to the technological frontier ($DIST_{ict}$), the political institutions indices (POL_{ct})[5] and the interaction between these two variables ($DIST_{ict}*POL_{ct}$). Due to the conditional nature of the hypothesis we test, the interactive term is crucial to the model specification. We fulfil the indications proposed by Brambor, Clark, and Golder (2006) for a proper use of interactive models[6], such as the inclusion of all constitutive terms of the interaction and the conditional interpretation of the marginal effects of the coefficients. In contrast to additive models,

[5]The term POL stands for either Polity2, Political Rights or Civil Liberties indicators.
[6]Find a wide debate on interactive models in Friedrich (1982).

interactive models allow the effect of an explanatory variable on a dependent variable vary conditioned on the level of some other variable. The marginal effect of a change in an explanatory variable which is interacted with another is no longer equal to the estimated coefficient but the sum of the regressor coefficient and the interaction term. In our model, the interacted variables are political institutions and distance to the technological frontier. Consequently, the interpretation of their interaction term becomes essential for our analysis. Our specification lets the marginal effect of political institutions on disaggregated growth to vary with different degrees of technological development, and this variation is given by the interaction term. As control variables, we include the log value of either the output or value added of the total manufacturing industry (IND_{ct}), the real GDP per capita (GDP_{ct}) and the log value of the total polulation ($POPlog_{ct}$). As long as these control variables are not interacted with other variable, the interpretation is the same as an additive model.

Our model presents different sources of individual-specific effects due to the tridimensional nature of the observation units. More precisely, individual time-invariant effects may arise from the country idiosyncrasy (ϕ_c), industrial peculiarities (α_i) and country-industry characteristics (δ_{ic}). These variables capture the unobserved heterogeneity. Because the individual effects are unknown they cannot be consistently estimated in short panels. In order to consistently estimate the coefficients of the regressors, we use the within-group estimator. The within-group estimator demeans the original equation (1) to get rid of the individual fixed effects. As it name suggests, the within-group estimator uses the time variation within each cross-section.

$$Y_{ict} - \bar{Y}_{ic} = (X_{ict} - \bar{X}_{ic})'\beta + (u_{ict} - \bar{u}_{ic})$$

$$(u_{ict} - \bar{u}_{ic}) = \varepsilon_{ict} - \bar{\varepsilon}_{ic}$$

The within-group estimator uses an OLS regression to consistently estimate the above transformed model. In this sense, the fixed effects model allows the introduction of heterogeneity across country-industries in our model. We assume strong exogeneity of the regressors, assumption that will be relaxed in section 6, in which we specify a dynamic panel data model that includes lagged dependent variables in the set of explanatory variables.

Additional problems might arise when using the within estimator, such as serial correlation and heteroskedasticity. Wooldridge (2002) points out that nothing ensures in the fixed-effects model that serial correlation is wiped out. It could be true that the observed serial correlation in the composite error terms is dominated by the presence of individual fixed-effects, or it can also be serial correlation that dies out over time. In order to control for error correlation, we use the cluster-robust variance matrix estimator (White, 1980; Newey and West, 1987) . This estimator is valid in the presence of any kind of heteroskedasticity or serial correlation. By doing so, we assume zero correlation across groups as with fixed effects, but allow within-group correlation to be of any form. We identify groups in our data at a country-industry level. Cameron and Trivedi (2005) warn that if cluster-robust errors are not implemented, the OLS estimator is likely to underestimate standard errors and overestimates t statistics, invalidating statistical inference.

Table 1 shows the baseline estimation results, in which we employ the within-group estimator. Columns 1-3 use output growth rates as dependent variable, whereas columns 4-6 use value added growth rates. Both dependent variables are regressed against the three proxies of political institutions we consider in our analysis and its interaction with distance to the technological frontier. The first column of each alternative left-hand side variable uses the Polity2 index from Polity IV Project, and the other two columns uses respectively the Political Rights and the Civil Liberties indicators from the Freedom House.

The estimated coefficients of the three measures of political institutions are statistically significant, positive and robust to different specifications[7]. The interaction terms between distance and political institutions measures have a negative and significant coefficient. The estimated coefficients in Column 1 imply that

[7]Other specifications results such as frequency changes and alternative control variables available from the authors support these findings.

a unit point increase of the Polity2 scale of democracy has the effect of increasing 2.4 percentage points output growth rates of industries which operate with the most advanced technology. Considering however an industry operating with the sample average technology [8], the effect of the same increase of Polity2 is reduced to 0.99 percentage points.

Distance to the technological frontier regressor is associated with a positive and significant coefficient, and this finding is robust to the different specifications displayed in Table 1 and alternative specifications available from the author. Higher values of distance to the technological frontier are related to higher output and value added growth rates. One might consider that industries far from the world technological frontier have a higher potential for growth than those countries already developed in technological terms. Nevertheless, as countries become more democratic and exhibit higher values of political rights and civil liberties, this positive effect reduces due to the negative sign of the interaction between distance and political institutions coefficient. We interpret these positive coefficients as an evidence of the convergence theory of growth (Barro and Sala-i-Martin 1995, Bloom, Canning and Sevilla, 2002). The catch-up effect could be at work in the relation between distance and economic performance. Regarding the control variables, we find that the coefficients of the total output and value added of the total manufacturing industry are systematically negative and statistically significant. Real GDP per capita on the contrary, exhibits a positive coefficient that is statistically different from zero. The coefficient associated with the log value of total population is generally negative and statistically significant.

The results obtained in our baseline model underpin the hypothesis that the effect of political institutions on economic performance is interrelated with the technological development. We find that higher levels of democracy, political rights and civil liberties foster economic growth when industries are technologically advanced. However, when industries are backwards this growth-enhancing effect vanish. Furthermore, the effect of political institutions on growth turns out to be growth-diminishing when sectors are far enough from the technological frontier. In this context, we find that when industries are above a certain technological threshold, political institutions measured through democracy levels, political rights and civil liberties impact positively on growth. Otherwise, the effect becomes negative. Figures 1 to 3 plot respectively the marginal effect of Polity2, Political Rights and Civil Liberties indicators on output growth rate conditional upon different values of distance to the world technological frontier.

5 Political Institutions, Technology and Regulation

The idea of a technologically determined effect of political institutions on growth is based on the crucial assumption that institutional changes towards higher levels of democracy, political rights and civil liberties reduces entry regulation, and that ultimately increases the growth of those advanced industries. This section assesses directly this concern.

The hypothesis here at stake suggests that higher levels of democracy promote competition through lowering market-entry barriers. Some attention should be paid on this assumption which is directly related to economic regulation -the pattern of government intervention in the market (Posner 1973). There are two major theories explaining economic regulation which are widely applied to the market-entry context. The Public Interest theory of regulation (Pigou 1938) suggests that governments regulate in order to avoid market failures such a flight-by-nitgh operators, externalities and therefore provide minimum quality standards of the products or services. Thus, this view states that regulation serves the government to act on behalf the whole society and permits the public get higher outcomes. Therefore, this theory predicts that higher number of procedures should be posetively correlated with higher economic growth rates. Becker (1986) supports the Public Interest theory but restricts it to situations in which certain political conditions are met.

[8] The sample mean value of Distance to the World Technological Froniter is 0.16.

In cases in which publics awareness and voting participation are high, the general interest could be protected because legislators are self-interested in getting socially efficient outcomes in order to be re-elected. Contrary to this view, the Public Choice theory predicts that stricter regulation keeps out economic competition and is associated with flawed political institutions. Stigler‘s (1971) general hypothesis points out that industries with enough political power to utilize political institutions will seek to control market-entry and thus, regulatory policy. This view sees regulation as a sign of political institutions being *captured* by industry incumbents, and states that regulation may be actively sought by an industry, or it may be thrust upon it. Procedures are therefore designed and settled to benefit those industries, leading to a greater market power and lower benefits to consumers. The *tollbooth* version of the Public Choice theory (Shleifer and Vishny 2002) suggests that regulation is partially driven by politicians and bureaucrats to get bribes, emphasizing the rent-seeking role of the government officials. This theory then predicts that higher number of requirements to enter the market should be associated with poorer economic performance. Djankov et al. (2002) support both versions of the public choice theory. In their empirical work, they use cross-country data on the number of procedures to start up a business and study whether heavier regulation of entry is associated with better institutional quality. Their findings demonstrate that more democratic governments tend to have lower market-entry barriers, and therefore, a lower number of procedures.

We propose a specification that includes a measure of market-entry cost in the set of explanatory variables. Our analysis is now focused on whether the effect of political institutions on sectorial growth is affected by market-entry regulation. The goal of the inclusion of a market-entry regulation variable is twofold. On the one hand, this new setting acknowledges the possibility that the role played by democracy, political rights and civil liberties and their interaction with technology might differ when controlling for market-entry regulation. On the other hand, these specifications allow us to directly address the two main theories on economic regulation. A positive coefficient of the number of procedures may support the Public Interest view of regulation. Conversely, a negative estimated coefficient associated with this variable would reject the Public Interest view and underpin the Public Choice view.

$$\begin{aligned} Y_{ict} &= \beta_0 + \beta_1 DIST_{ict} + \beta_2 DIST_{ict} * POL_{ct} + \beta_3 POL_{ct} \\ &\quad + \beta_4 N^{\underline{o}}PROC_{ct} + \beta_5 IND_{ct} + \beta_6 GDP_{ct} + \beta_7 POPlog_{ct} + u_{ict} \end{aligned} \tag{2}$$

$$Y_{ict} = \log y_{ict+1} - \log y_{ict}$$
$$u_{ict} = \alpha_i + \gamma_c + \delta_{ic} + \varepsilon_{ict}$$
$$i = industry; c = country; t = year$$

Specification in equation (2) includes the number of procedures ($N^{\underline{o}}PROC_{ct}$) that firms face to enter the market. The number of start-up procedures directly assesses economic regulation matters and is closely related to the decision-making process of the political institutions. This regressor has been widely used in empirical research on economic regulation (Djankov et al. 2002). Since this variable is available at a country level, we assume that the number of procedures required to enter the market do not vary across industries within a country. Bearing that our dataset is an unbalance panel data, this proxy of economic regulation is preferred over other measures of market-entry regulation used in the economic regulation literature, such as the business regulation ranking (Djankov, McLiesh & Ramalho, 2006). A major difference between our specification and that of Aghion et al. (2008) is that they proxy market-entry regulation by using the number of establishments in industries. However, one might consider that the number of procedures permits a better insight of the policy-making process of economic regulation than the number of establishments. Note that due to data availability, some countries considered in the previous specification are now dropped. The dataset used in the following regressions are composed by 3,383 country-industries from 77 countries and 61 industries over the period 2004-2010[9].

Table 2 presents within-group estimates of the specification in (2), in which the number of procedures

[9]The appendix specifies those countries included in each analysis.

to enter the market is considered. Columns 1-3 use output growth rates as left-hand side variable, the rest of Table 2 reports estimations using value added growth rates as dependent variable. Column 1 regresses output growth rates against Polity2 index of democracy. Contrary to what we have obtained along the regressions above, the coefficients of both the democracy scale and its interaction with distance are not statistically significant. The same happens for the case of value added growth rate as dependent variable (Column 4). However, the coefficients have the expected signs –positive in the case of the Polity2 index and negative in the case of its interaction with distance. The results show that including the number of procedures in the model wipes out the effect of democracy on output growth rates. The correlation between these two variables is negative (see Table A4 in the Appendix), supporting the recurrent finding in the literature that higher levels of democracy are associated with a lower number of procedures.

There are no substantial changes on the estimated coefficients for Political Rights and Civil Liberties regressors once the number of start-up procedures is included in the model. The estimates of these two indicators are associated again with positive and statistically significant coefficients.

As regards the estimated coefficients associated with the number of start-up procedures, we find that one additional start-up procedure decreases output growth rates, and this effect is robust to the three different political arenas we are focused on. Based on the estimates in Table 2, one additional procedure to enter the market is associated with a decrease of around 1.5 percentage points of the sectoral output growth rate, and a decrease of value added growth rate of approximately 2.4 percentage points. This finding sheds light on the hypothesis that stricter regulatory policies, here measured through the number of procedures, could harm economic performance. The within-group estimate results suggest that stricter regulation harms economic performance, and thus, are consistent with the Public Choice theory.

6 Political Institutions and Technology: a dynamic approach

This section deals with endogeneity issues by addressing the economic growth dynamics in our analysis. The natural extension of the fixed effects static panel data models is to include lags of the dependent variable as additional explanatory variables, allowing for serial correlation of unknown form. The dynamic model we propose allows us to make a step forward in our analysis by considering that the effect of political institutions on growth will accumulate over time. To this respect, we re-examine the interrelation among political institutions, technology and sectorial growth including the past values of the growth rates and estimating this dynamic panel data model by GMM (Arellano-Bover 1995, Blundell-Bond 1998). Thus, we consider that the dynamic effect of democracy and technological advance on sectorial growth might be governed by the past values of sectorial growth.

We transform our static specifications (1) and (2) in previous sections into dynamic panel data models by including the lagged dependent variable in the set of explanatory variables. We consider the following dynamic panel data models.

$$\begin{aligned} Y_{ict} &= \phi Y_{ict-1} + \beta_0 + \beta_1 DIST_{ict} + \beta_2 DIST_{ict} * POL_{ct} + \beta_3 POL_{ct} \\ &+ \beta_4 IND_{ct} + \beta_5 GDP_{ct} + \beta_6 POPlog_{ct} + u_{ict} \end{aligned} \tag{3}$$

$$\begin{aligned} Y_{ict} &= \phi Y_{ict-1} + \beta_0 + \beta_1 DIST_{ict} + \beta_2 DIST_{ict} * POL_{ct} + \beta_3 POL_{ct} \\ &+ \beta_4 N^{\underline{o}} PROC_{ct} + \beta_5 IND_{ct} + \beta_6 GDP_{ct} + \beta_7 POPlog_{ct} + u_{ict} \end{aligned} \tag{4}$$

$$|\phi| < 1$$

$$u_{ict} = \alpha_i + \gamma_c + \delta_{ic} + \varepsilon_{ict}$$

$$i = industry; c = country; t = year$$

Again, we assume that the terms α_i, γ_c and δ_{ic} capture the unobserved country-industry specific effects, being ε_{ict} the error term. The coefficient of the lagged dependent variable reflects the persistence in the process of adjustment. The relationship between output and value added growths and regressors has to be dynamically stable, so we assume the parameter of the autoregressive lag to be lower than one in absolute terms ($|\phi| < 1$). The right-hand side variables ($DIST_{ict}, DIST_{ict}{*}POL_{ct}, POL_{ct}, IND_{ct}, GDP_{ct}, POPlog_{ct}$) are those of the previous section, and including when appropriated the proxy of entry cost ($N^{\underline{o}}PROC_{ct}$). This dynamic context allows us to distinguish between the effects on the output and value added growth rates of the variation of other regressors in our specifications and the persistence of the economic growth measured by the parameter ϕ. Additionally, we are able to infer both the short-run and long-run effects of political institutions on sectoral economic performance. In the presence of lagged dependent variables in the right-hand-side variables, the within-group estimator used before yields inconsistent estimates. To consistently estimate specifications (3) and (4), we exploit the special features of the system GMM estimator. In a nut-shell, this estimator instruments the lag of the dependent variable included as a regressor by using its longer lags, resulting in consistent estimations. This methodology is particular convenient for our purpose since the GMM estimator is designed to control for endogeneity in cases where the number of individuals (N) is large whilst the number of periods (T) is small, which is precisely our case.

As pointed in Cameron and Trivedi (2005), dynamic panel data models present three main sources for correlation in the dependent variables over time: true state dependence, due to the inclusion of preceding periods; observed heterogeneity directly through the explanatory variables; and unobserved heterogeneity –indirectly through time-invariant or fixed effects. The GMM estimator deals with these three potential sources of correlation. Initially developed by Holtz-Eakin, Newey and Rosen (1988), the GMM proceeds firstly by transforming equations (3) and (4) by taking first differences to eliminate the country-industry individual effects, and thus eliminate the potential source of bias caused by unobserved fixed-effects.

$$\triangle Y_{ict} = \phi \triangle Y_{ict-1} + \beta^{'} \triangle X_{ict} + \triangle \varepsilon_{ict}$$

where $\triangle = 1 - L$ for L the lag operator such that $\triangle Y_{ict} = Y_{ict} - Y_{ict-1}$. To control for observed heterogeneity, GMM imposes the following moment conditions that exploit the absence of correlation between lagged regressors and errors.

$$E(Y_{ict-s}, \triangle \varepsilon_{ict}) = 0 \text{for} s \geq 2; t = 3, ...T \tag{5}$$

$$E(Y_{ict-s}, \triangle X_{ict}) = 0 \text{for} s \geq 2; t = 3, ...T \tag{6}$$

Finally, to solve true state dependence issues, the GMM instruments the differenced predetermined and endogenous variables with their available lags. The exogenous variables are used as their own instruments. There are two GMM versions; the difference-GMM (diff-GMM) and the system-GMM (sys-GMM). The diff-GMM developed by Arellano and Bond (1991) uses past values of the regressor in levels as instruments of the differenced dependent variable. However, as warned in Roodman (2009), diff-GMM lagged levels may be poor instruments for first differences. More precisely, Blundell and Bond (1998) demonstrate that difference-GMM estimates poorly because past values convey little information about future changes when dependent variables are close to a random walk, so that untransformed lags are weak instruments for transformed variables. Arellano and Bover (1995) and Blundell and Bond (1998) propose the more efficient system-GMM estimator. This variant of the GMM estimator add the original equation in levels to the system. When first-differences of an explanatory variable are uncorrelated with the individual effect, first-differenced lagged values can be used as instruments in the equation in levels. Basically, the difference between these two alternative procedures is that diff-GMM uses only lagged levels whereas the sys-GMM also includes a set of suitable lagged first-differences to instrument equations in levels[10].

[10]See Bond, Hoeffler and Temple (2001) for further details in the advantages of sys-GMM over difference-GMM in empirical growth studies.

We use the sys-GMM, which is actually a common practice not only in the growth empirical studies since the work of Caselli, Esquivel, and Lefort (1996), but also in other empirical studies of the linkage between political institutions and macroeconomic variables, as we can see *inter alia* in Acemoglu et al., (2008), Acemoglu et al., (2014), Yang (2008) or Asien and Veiga (2013). We implement the collapse technique[11] in all our sys-GMM estimations to reduce instrumental proliferation. This option is suitable to avoid overfitting GMM estimates. We check the robustness and goodness of fit of our GMM estimates using the Arellano-Bond autocorrelation test for ensuring assumption in equation (5) holds, and the overidentification Hansen/Sargan test and the difference-in-Sargan/Hansen test of exogeneity of instruments, to check assumption in equation (6).

Table 3 presents results on output growth rates using the sys-GMM estimator. Columns 1-3 show estimates of a specification that includes to our baseline model the first lag of the dependent variable. Columns 4-6 also use output growth rates as left-hand side variable, but include the number of start-up procedures covariate. The coefficients of past values of output growth rates are negative and statistically significant. We interpret this negative effect as an evidence of the conditional convergence effect. Our preferred model is the dynamic specification over the static speficications shown in Section 4 and 5 since the lagged is statistically significant.

The three indicators for political institutions are generally associated with postive and statistically significant coefficients along the alternative speficications in Table 2. Column 1, however, shows that the Polity2 indicator is not statistically significant, although it is associated with an excepected sign –positive. Column 2 estimates that a unit point increase of the Political Rights indicator is associated with a short-run impact of increasing 1.6 percentage points the output growth rate when industries are technologically advanced. However, when industries get far from the technological frontier, this effect turns out to be negative. More accurately, when industries exhibit distance values higher than 0.17, the effect of an additional unit point of Political Rights has no effect on output growth rates. For industries operating with an industry above 0.17, the effect of Political Rights indicator is negative. Columns 3-6 show that one additional point in the score of Civil Liberties and Polity2 exert similiar effects that of the explained for Political Rights indicator.

The long-run effects[12] of political institutions on output growth rates are displayed in Table 3. Keeping in mind that we are analyzing a technologically conditioned effect, we compute the long-run effect of a change of political institutions on output growth in the case of two different stages of technological development. On the one hand, we compute the long-run effect when industries are in the world technological frontier, in other words, when the variable $DIST_{ict}$ is equal to zero. On the other, the long-run effect of one additional point of the political institutions indicators is evaluated at the sample mean of the distance to the technological frontier, that is, when $DIST_{ict}$ is equal to 0.16. Higher values of Polity2, Political Rights and Civil Liberties are associated with an increasing effect on output growth rates in the long-run. Again, these positive effects are restricted to certain levels of technological development, meaning that higher democracy levels exert a positive effect on advanced industries but a null or a negative effect on relatively backward industries. As a matter of fact, the long-run effects of one additional point of the scores of political institutions are negative when industries are at the sample mean distance of the world technological frontier (Columns 3 and 4).
It is widely claimed in the politico-economic literature that institutional changes have stronger impacts in the long-term because of among other factors, the cumulative effect of the democratic capital (Persson & Tabellini, 2006). Consequently, the analyses of institutional changes might be better assessed over longer periods of time. However, most of the variables crucial to our analysis are only available for recent decades, so we are bound to consider shorter periods than desired. Notice that we use a three-way panel data in order to exploit both across and within country-industry variation, which is highly informational demanding.

[11] Find a further insight in the command we use (xtabond2) in Stata that implements GMM method in Roodman (2009).

[12] The long-run effects are caculated using the general formula $\frac{\hat{\beta}}{1-\sum_{j=1}^{p}\hat{\phi_j}}$, where p stands for the number of lags included into the model.

Additionally, it is also commonly suugested in the literature that the relationship between institutions and growth might be nonlinear (Gerringet al. 2005, Barro 1996). In this respect, we do not find substantial differences between short and long-run effects, if any, long-run effects are slightly lower. These similarities among short and long-run effects might support the hypothesis of non-linearities in the realtion between political institutions and economic growth.

Columns 4-6 in Table 3 control for the cost that firms face when entering the market, measured throught the number of start-up procedures to legally operate a company. Overall, the effect of the political institutions indices and its interaction with technological development has the expected sign, and are generally statistically significant, except for the case in Column 1. The Polity2 index becomes statistically significant when including the number of start-up procedures (Column 4). The estimates for the Freedom House indicators state that one additional point of the Political Rights and the Civil Liberties have respectively a increasing effect of 2.2 and 2.4 percentage points of sectoral output growth rates. These positive effects again reduce and even turn out to be growth-diminishing as industries get far from the world technological frontier, consistently with our previous findings.

Our specifications in Table 3 yield a positive and statistically significant coefficient of the number of start-up procedures. This result is robust to the three alterantive political arenas under scrutiny, and valid for the two alternative left-hand side variables in our analysis (output and value added growth rates). One additional procedure is associated with an increasing effect of 0.5 percentage points on output growth rates. This finding is contrary to our static model results in Section 5, and thus, inconsistent with the Public Choice theory of economic regulation. Instead, our dynamic results –which are our preferred speficiations –support the Public Interest theory. This view states that regulation caters the public interest and thus, higher number of procedures affect positively economic performance. We might consider that once the dynamics of growth are specified, the negative effect of regulation vanishes. In this way, required procedures to enter the market on the one hand might serve to block low quality products entering the market, ensuring both public safety and minimum quality standards. On the other, they might reduce externalities such flight-by-night companies. As long as we analyze manufacturing data, we could expect that regulatory procedures in certain instances, such as minimum quality standards, are specially necessary to avoid market failures.

The dynamic estimates using output growth rates as dependent variable confirm the technological conditioned effect of political institutions on sectoral economic performance. In light of the dynamic results we have brought out, we do not find evidence on the growth-diminishing effect of stricter regulation. The positive coefficients associated with our proxy of economic regulation force us to think of other alternative patterns to what the central hypothesis here analyzed conveys. We reformulate in this way the channel proposed by Aghion et al. (2008), which state that democracy foster economic competition by reducing the number of start-up procedures. We argue that economic competition could be promoted by higher levels of democracy, political rights or civil liberties through other channels such as investor protection or higher consumer rights. Highly related to this argument, Perotti and Volpi (2007) point out that more political accountability, measured by a normalized PolityIV index, increases investor protection. Higher investor protection tends to foster firms entrance to market and, as a last resort, enhances economic competition.

We replicate the dynamic analysis using the value added growth rates as measure of sectoral economic growth. Table 4 presents the results with two lags of the dependent variable, which we found necessary for a correct specification. The Arellano-Bond post-estimation test of the specifications in (3) and (4) fails to reject second order autocorrelation when including only the first lag of the value added growth rate as a regressor. This motivates the inclusion of both first and second lags of the dependent variable as regressors. We therefore assume that the effects of political institutions on value added growth are governed by first and second lags and the dynamics of output and value added growth rates behave differently. Overall, the results displayed in Table 4 evidence the conditional effect of political institutions on economic growth, measured by the value added growth rate. Furthermore, they evidence a negative effect of higher values of democracy, political rights and civil liberties on value added growth when industries are far from the technological frontier. Estimates in Column 1 assocaites the Polity2 indicator with a 1.4 percentage point increase of value added growth rates when industries operate with the most advanced technology. This effects turns out to be negative for industries that exhibit a distance to the world technolgical frontier above 0.17. The long-run effects of one additional point of the three different indicators are slightly lower than the short-run effects. Our intutition is that this might be a consequence of plausible non-linearities in the political institutions' impact on growth.

Regarding the number of procedures, the estimated coefficients are positive, significant and robust to alternative measures of political institutions. One additional start-up procedure increasing 0.7 percentage points value added growth rates when the political institutions' index considered is Polity IV, and 0.8 percentage points in the case of Political Rights and Civil Liberties. This growth-enhancing effect on value added growth rate assocaited with stricter regulation is therefore consistent with the Public Interest theory.

7 Conclusion

This paper analyses whether the effect of political institutions on economic growth is determined by technological development. Using highly disaggregated data on manufacturing industries, we find that this effect changes depending on the level of technological development of the industries. We use several specifications and the system-GMM technique to estimate a dynamic panel data model which includes lagged dependent variables as regressors, which has become a common practice in the economic growth literature. Our results are robust to different political institutions characterization (Polity2, Political Rights and Civil Liberties) and alternative measures of economic performance (output and value added growth rates).

We specifically present evidence of a positive effect of democracy, political rights and civil liberties on economic growth in industries that are close to the world technological frontier, meaning that higher levels of democracy have a growth-enhancing impact on advance industries. However, as industries become less developed in technological terms, the effect of democracy turns out to be growth-diminishing. Thus, we support that political institutions affect differently depending on technological development, which is a common claim in the field. More precisely, we suggest that technology affects the institutional effect on growth on both short and long-terms. Our investigation, however, is bound to use shorter periods of time than desired, and we should interpret the strength of the long-run effects cautiously.

Consistently with the Public Interest theory, our results point that once we control for economic growth dynamics, the effect of additional start-up procedures do not seem to retard economic growth. Recall that we use data on official requirements, meaning that we do not control for possible extra requirements in the form of bribes. We find that official procedures might ensure minimum quality standards and reduce externalities and eventually avoid market failures. Notice also that we proxy entry cost through the number of official start-up procedures, but we do not consider other measures to assess entry barriers, -e.g. time or cost to fulfil each procedure. In a sense, the information given just by the number of procedures do not provide the whole shades of economic regulation and should be complemented with additional variables to get the full flavor of the real effect of regulation on growth. In the light of our results, we reformulate the channel proposed in Aghion et al. (2008) by opening up the possibility of different channels through which political institutions might increase economic competition, and therefore, exert a growth-enhancing effect on advanced industries. Democracy, political rights and civil liberties could foster economic competition through several channels, such as increasing investor protection, ensuring business safety or constraining vested regulatory policies.

To conclude, this paper lays at the empirical strand of the political economy literature that supports a development conditioned linkage between political institutions and economic performance. We have empirical evidence to believe that there is a technological determination of the effects of political institutions on economic performance. Additionally, we argue that the ambiguity shown in the empirical literature could be solved using highly disaggregated data, which leads to a greater insight in both across and within variation of the data. The natural steps following this investigation have two main directions. First, going further on the study of the channel through which democracy foster economic competition by using additional economic regulation variables time and cost of procedures-, and by modeling other features that could be at work e.g corruption and bribing. Second, expand this investigation to other economic activities apart from the manufacturing industries and the inclusion of other institutional arenas, such as the rule of law or government efficiency.

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Table 1: Political Institutions and Technology (Within-Group Estimations)

	(1) Output	(2) Output	(3) Output	(4) VA	(5) VA	(6) VA
Distance	2.373***	3.286***	3.501***	4.701***	6.359***	6.331***
	(0.240)	(0.454)	(0.476)	(0.229)	(0.420)	(0.440)
Distance*Polity2	-0.088***			-0.163***		
	(0.027)			(0.025)		
Polity2	0.024***			0.042***		
	(0.007)			(0.006)		
Distance*PR		-0.262***			-0.480***	
		(0.071)			(0.067)	
PR		0.114***			0.167***	
		(0.017)			(0.016)	
Distance*CL			-0.313***			-0.488***
			(0.077)			(0.073)
CL			0.076***			0.119***
			(0.016)			(0.015)
Ind. Output or VA (log)	-0.082***	-0.074***	-0.065***	-0.008	0.006	0.011
	(0.018)	(0.019)	(0.019)	(0.019)	(0.019)	(0.020)
GDP per capita	-0.000***	-0.000**	-0.000***	-0.000***	-0.000*	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pop(log)	-0.277***	-0.287***	-0.309***	-0.515***	-0.542***	-0.561***
	(0.070)	(0.070)	(0.073)	(0.081)	(0.079)	(0.081)
Year dummies	YES	YES	YES	YES	YES	YES
N of Obs.	38070	38486	38486	38527	38951	38951
N of Groups	3817	3909	3909	3839	3938	3938
Within-R^2	0.076	0.077	0.075	0.122	0.125	0.121

Dependent variable (1-3) Output growth rate and (4-6) Value Added growth rate

Clustered standard errors in parentheses (country-industry level)

* $p < .1$, ** $p < .05$, *** $p < .01$

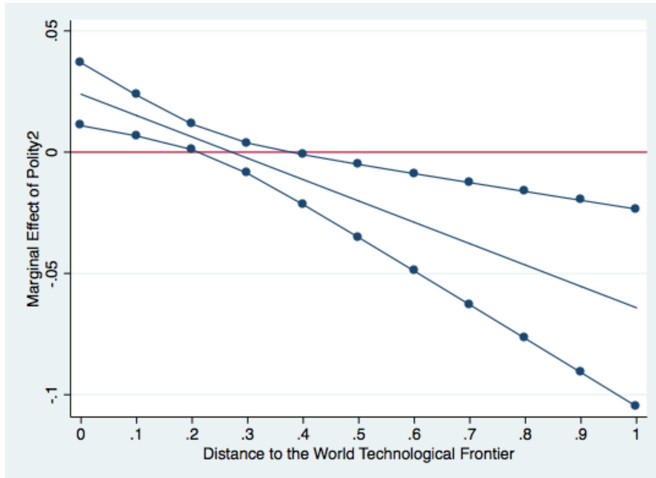

Figure 1: Conditional marginal effect of Polity2 on Distance

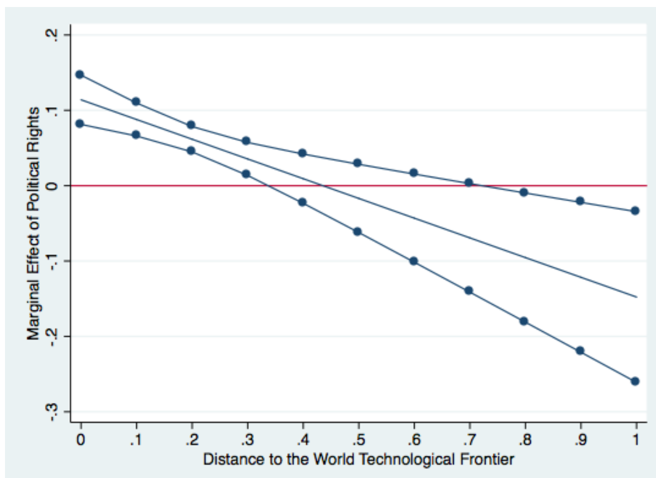

Figure 2: Conditional marginal effect of PR on Distance

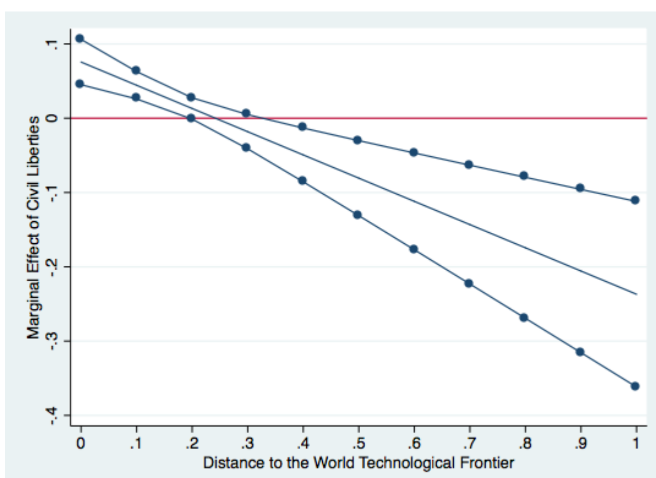

Figure 3: Conditional marginal effect of CL on Distance

Table 2: Political Institutions and Regulation (Within-Group Estimations)

	(1)	(2)	(3)	(4)	(5)	(6)
	Output	Output	Output	VA	VA	VA
Distance	4.335***	5.469***	6.527***	7.295***	8.384***	9.198***
	(0.419)	(0.814)	(0.947)	(0.450)	(0.904)	(1.076)
Dist*Polity2	-0.059			-0.032		
	(0.049)			(0.051)		
Polity2	0.015			-0.005		
	(0.015)			(0.017)		
Dist*PR		-0.303**			-0.272*	
		(0.149)			(0.163)	
PR		0.107**			0.075	
		(0.044)			(0.047)	
Dist*CL			-0.509***			-0.428**
			(0.173)			(0.194)
CL			0.125***			0.113***
			(0.040)			(0.044)
N of Proc.	-0.015***	-0.016***	-0.016***	-0.023***	-0.024***	-0.025***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Ind. Output or VA (log)	-0.183***	-0.185***	-0.183***	-0.012	-0.011	-0.010
	(0.041)	(0.040)	(0.040) (0.044)	(0.044)	(0.044)	
GDP per capita	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pop(log)	0.576**	0.603**	0.702***	1.017***	1.055***	1.124***
	(0.259)	(0.253)	(0.253)	(0.303)	(0.300)	(0.298)
Year dummies	YES	YES	YES	YES	YES	YES
N of Obs.	13393	13393	13393	13554	13554	13554
N of Groups	3134	3134	3134	3188	3188	3188
Within-R^2	0.105	0.107	0.108	0.188	0.189	0.189

Dependent variable (1-3) Output growth rate and (4-6) Value Added growth rate

Clustered standard errors in parentheses (country-industry level)

* $p < .1$, ** $p < .05$, *** $p < .01$

Table 3: Political Institutions on Output growth rates (GMM Estimations)

	(1) Output	(2) Output	(3) Output	(4) Output	(5) Output	(6) Output
L.Output	-0.079***	-0.073***	-0.074***	-0.114***	-0.114***	-0.115***
	(0.018)	(0.018)	(0.018)	(0.027)	(0.027)	(0.027)
Distance	1.129***	1.495***	1.699***	1.450***	1.854***	2.163***
	(0.111)	(0.189)	(0.201)	(0.211)	(0.353)	(0.399)
Dist*Polity2	-0.023**			-0.038**		
	(0.010)			(0.018)		
Polity2	0.003			0.007*		
	(0.002)			(0.004)		
Dist*PR		-0.093***			-0.118**	
		(0.028)			(0.048)	
PR		0.016***			0.022**	
		(0.005)			(0.011)	
Dist*CL			-0.137***			-0.179***
			(0.032)			(0.059)
CL			0.015***			0.024*
			(0.005)			(0.012)
N of Proc.				0.005***	0.005***	0.005***
				(0.002)	(0.002)	(0.002)
Ind. Output (log)	0.026***	0.024***	0.030***	0.036***	0.036***	0.043***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)
GDP	0.000***	0.000***	0.000***	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pop(log)	-0.017***	-0.016***	-0.023***	-0.024***	-0.024***	-0.034***
	(0.004)	(0.004)	(0.005)	(0.007)	(0.007)	(0.007)
Year dummies	YES	YES	YES	YES	YES	YES
Long-run effect (Dist = 0)	0.003	0.015	0.014	0.006	0.020	0.022
Long-run effect (Dist = 0.16)	-0.001	0.001	-0.006	0.001	0.003	-0.004
AR1	0.000	0.000	0.000	0.000	0.000	0.000
AR2	0.245	0.367	0.360	0.201	0.202	0.197
Hansen p-value	0.150	0.151	0.150	0.424	0.426	0.424
Diff-in-Hansen (excluding group)	0.110	0.110	0.108	0.374	0.375	0.377
Diff-in-Hansen (H_0=exogenous)	0.691	0.704	0.736	0.406	0.410	0.400
N of Instruments	36	36	36	19	19	19
N of Obs.	32496	32714	32714	12596	12596	12596
N of Groups	3464	3516	3516	2983	2983	2983

Dependent variable: Output growth rates

Arellano and Bond's GMM estimates of Political Institutions interacted with Technology

Period dummies and constant terms are not reported.

Long-run effects of Political Institutions interacted with zero Distance and at sample average.

AR rows report the p-value for the test of serial correlation in the residuals.

Hansen test for overidentifiation restrictions and exogeneity of instruments.

Clustered Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4: Political Institutions on Value Added growth rates (GMM Estimations)

	(1)	(2)	(3)	(4)	(5)	(6)
	VA	VA	VA	VA	VA	VA
L.ValueAdded	-0.150***	-0.145***	-0.147***	-0.146***	-0.143***	-0.146***
	(0.019)	(0.019)	(0.019)	(0.032)	(0.032)	(0.031)
L2.ValueAdded	-0.068***	-0.067***	-0.067***	-0.077***	-0.076***	-0.076***
	(0.015)	(0.015)	(0.015)	(0.026)	(0.026)	(0.026)
Distance	2.427***	3.349***	3.455***	2.650***	3.673***	3.844***
	(0.163)	(0.269)	(0.290)	(0.276)	(0.475)	(0.553)
Dist*Polity2	-0.082***			-0.069***		
	(0.014)			(0.023)		
Polity2	0.014***			0.013***		
	(0.003)			(0.005)		
Dist*PR		-0.260***			-0.266***	
		(0.037)			(0.064)	
PR		0.050***			0.055***	
		(0.007)			(0.014)	
Dist*CL			-0.292***			-0.298***
			(0.043)			(0.081)
CL			0.044***			0.052***
			(0.007)			(0.016)
N of Proc.				0.007***	0.008***	0.008***
				(0.002)	(0.002)	(0.002)
Ind. ValueAdded (log)	0.057***	0.056***	0.062***	0.058***	0.057***	0.064***
	(0.006)	(0.006)	(0.007)	(0.009)	(0.010)	(0.010)
GDP	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Pop(log)	-0.040***	-0.040***	-0.047***	-0.038***	-0.038***	-0.046***
	(0.006)	(0.006)	(0.007)	(0.010)	(0.010)	(0.010)
Year dummies	YES	YES	YES	YES	YES	YES
Long-run effect (Dist = 0)	0.011	0.041	0.036	0.011	0.045	0.043
Long-run effect (Dist = 0.16)	0.001	0.007	-0.002	0.002	0.010	0.004
AR1	0.000	0.000	0.000	0.000	0.000	0.000
AR2	0.444	0.382	0.390	0.342	0.344	0.356
AR3	0.959	0.958	0.988	0.901	0.887	0.887
Hansen p-value	0.205	0.238	0.229	0.357	0.360	0.370
Diff-in-Hansen (excluding group)	0.205	0.253	0.257	0.248	0.246	0.259
Diff-in-Hansen (H_0=exogenous)	0.144	0.230	0.192	0.616	0.646	0.617
N of Instruments	43	43	43	18	18	18
N of Obs.	28454	28620	28620	9812	9812	9812
N of Groups	3365	3411	3411	2822	2822	2822

Dependent variable: Value Added growth rate

Arellano and Bond's GMM estimates of Political Institutions interacted with Technology

Period dummies and constant terms are not reported.

Long-run effects of Political Institutions interacted with zero Distance and at sample average.

AR rows report the p-value for the test of serial correlation in the residuals.

Hansen test for overidentifiation restrictions and exogeneity of instruments.

Clustered Standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Appendix

Table A1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N
Output Growth rate	0.061	0.477	-8.638	10.142	39446
Value Added Growth rate	0.052	0.532	-8.423	8.532	39915
Distance World Tech. Frontier	0.16	0.112	0	0.822	44044
Polity2	6.726	5.358	-10	10	43548
Political Rights	5.715	1.803	1	7	43948
Civil Liberties	5.492	1.539	1	7	43948
Industrial Output (log)	24.725	2.249	16.555	29.332	43011
Industrial Value Added (log)	23.554	2.245	15.274	28.5	43161
GDP per capita	18514.07	14149.009	335.746	136311.008	44044
Population (log)	16.593	1.589	12.556	20.999	44044
N of Procedures	8.303	3.443	1	19	17181

Find a full description of the variables and their corresponding sources in the text.

Table A2: Countries in the Sample

	Polity2	PR	CL	Distance	N_Proc
Albania	7.72	4.90	4.71	0.29	9.56
Azerbaijan	-7.00	2.00	3.00	0.35	11.13
Argentina	7.39	5.80	5.10	0.12	
Australia	10.00	7.00	7.00	0.08	3.00
Austria	10.00	7.00	7.00	0.06	8.00
Bahamas		7.00	6.00	0.17	
Bangladesh	6.00	5.52	4.00	0.32	
Belgium	9.60	7.00	6.56	0.06	4.21
Bolivia	9.00	6.71	4.85	0.23	
Botswana	8.00	6.00	6.00	0.11	10.00
Brazil	8.00	5.66	5.12	0.15	16.03
Bulgaria	8.65	6.48	5.58	0.30	8.62
Cambodia	1.38	2.75	2.38	0.35	
Canada	10.00	7.00	7.00	0.05	1.79
Sri Lanka	5.63	3.81	4.00	0.27	7.15
Chile	8.84	6.35	6.49	0.14	9.00
China	-7.00	1.00	2.00	0.24	13.00
Taiwan	9.55	6.45	6.55	0.13	8.00
Colombia	7.00	4.55	4.27	0.14	11.71
Cyprus	10.00	7.00	7.00	0.13	6.00
Czech Republic	9.70	7.00	6.32	0.20	10.00
Denmark	10.00	7.00	7.00	0.08	4.33
Ecuador	6.94	5.29	4.93	0.21	14.00
Ethiopia	-0.54	2.91	3.00	0.30	9.17
Eritrea	-6.54	1.34	2.59	0.32	13.00
Estonia	9.00	7.00	6.64	0.20	5.58
Fiji	2.24	3.29	4.65	0.25	7.55
Finland	10.00	7.00	7.00	0.07	3.00
France	9.00	7.00	6.43	0.07	5.50
Georgia	5.88	4.27	4.27	0.36	6.30
Gambia	-5.80	2.80	3.20	0.38	
Germany	10.00	7.00	6.66	0.08	9.00
Greece	10.00	7.00	5.46	0.10	15.00
Hungary	10.00	7.00	6.38	0.21	5.67
India	9.00	6.00	5.00	0.27	11.64
Indonesia	6.14	5.11	4.44	0.26	12.00

Iran	-2.19	2.00	1.75	0.19	8.33
Ireland	10.00	7.00	6.88	0.06	4.00
Israel	9.74	7.00	5.40	0.10	5.00
Italy	10.00	7.00	6.28	0.08	8.53
Japan	10.00	6.94	6.00	0.03	9.32
South Korea	7.15	6.25	5.84	0.06	10.00
Kuwait	-7.00	4.00	3.66	0.17	
Kyrgyzstan	1.74	2.64	3.48	0.34	6.94
Lebanon	6.00	2.47	3.47	0.17	6.00
Latvia	8.00	6.45	6.21	0.25	5.00
Lithuania	10.00	6.91	6.55	0.24	7.43
Luxembourg	10.00	7.00	7.00	0.06	6.00
Madagascar	7.00	4.99	4.68	0.49	13.03
Malawi	5.70	4.39	4.40	0.32	10.00
Malaysia	3.80	3.64	3.73	0.19	10.00
Malta		7.00	7.00	0.15	
Mauritius	10.00	7.00	6.14	0.21	5.67
Mexico	6.25	5.05	4.62	0.15	8.34
Mongolia	9.76	5.94	5.50	0.37	7.11
Moldova	8.60	5.00	4.10	0.34	9.57
Morocco	-6.00	3.00	3.73	0.21	6.72
Oman	-8.50	2.00	2.62	0.16	8.79
Nepal	5.73	4.40	4.00	0.34	7.00
Netherlands	10.00	7.00	7.00	0.06	6.57
New Zealand	10.00	7.00	7.00	0.04	1.91
Norway	10.00	7.00	7.00	0.06	4.80
Panama	8.77	5.99	5.33	0.19	
Paraguay	7.00	4.00	5.00	0.21	
Peru	6.52	5.37	4.84	0.23	10.00
Philippines	8.00	5.50	5.00	0.22	17.00
Poland	9.47	6.92	6.41	0.19	10.00
Portugal	10.00	7.00	7.00	0.14	8.21
Qatar	-10.00	2.00	2.58	0.16	7.00
Romania	8.03	5.48	5.63	0.28	5.16
Russia	5.21	2.32	3.00	0.24	8.85
Senegal	4.42	4.81	4.20	0.25	
Singapore	-2.00	3.17	3.47	0.10	5.46
Slovak Republic	8.73	6.64	5.95	0.25	8.72
Vietnam	-7.00	1.00	2.43	0.32	11.00
Slovenia	10.00	7.00	6.54	0.15	7.73
South Africa	8.49	5.93	5.58	0.15	8.32
Spain	10.00	7.00	6.47	0.09	10.00
Sweden	10.00	7.00	7.00	0.07	3.00
Switzerland	10.00			0.05	
Thailand	5.50	4.52	4.75	0.23	8.00
Trinidad and Tobago	10.00	5.91	5.54	0.18	
Macedonia	8.60	4.92	4.97	0.25	9.81
Egypt	-4.72	2.00	2.57	0.28	10.73
United Kingdom	10.00	7.00	6.41	0.08	6.00
Tanzania	-1.00	4.08	5.00	0.29	10.72
United States	10.00	7.00	7.00	0.02	6.00
Uruguay	10.00	7.00	6.78	0.19	10.69
Yemen	-2.00	2.78	2.58	0.29	12.00

The table summarizes the countries' mean values over the period 1990-2010

Table A3: Subindustries in the Sample

	UNIDO Codes
Processed meat,fish,fruit,vegetables,fats	151
Dairy products	1520
Grain mill products; starches; animal feeds	153
Other food products	154
Beverages	155
Tobacco products	1600
Spinning, weaving and finishing of textiles	171
Other textiles	172
Knitted and crocheted fabrics and articles	1730
Wearing apparel, except fur apparel	1810
Dressing & dyeing of fur; processing of fur	1820
Tanning, dressing and processing of leather	191
Footwear	1920
Sawmilling and planing of wood	2010
Products of wood, cork, straw, etc.	202
Paper and paper products	210
Publishing	221
Printing and related service activities	222
Reproduction of recorded media	2230
Coke oven products	2310
Refined petroleum products	2320
Processing of nuclear fuel	2330
Basic chemicals	241
Other chemicals	242
Man-made fibres	2430
Rubber products	251
Plastic products	2520
Glass and glass products	2610
Non-metallic mineral products n.e.c.	269
Basic iron and steel	2710
Basic precious and non-ferrous metals	2720
Casting of metals	273
Struct.metal products;tanks;steam generators	281
Other metal products; metal working services	289
General purpose machinery	291
Special purpose machinery	292
Domestic appliances n.e.c.	2930
Office, accounting and computing machinery	3000
Electric motors, generators and transformers	3110
Electricity distribution & control apparatus	3120
Insulated wire and cable	3130
Accumulators, primary cells and batteries	3140
Lighting equipment and electric lamps	3150
Other electrical equipment n.e.c.	3190
Electronic valves, tubes, etc.	3210
TV/radio transmitters; line comm. apparatus	3220
TV and radio receivers and associated goods	3230
Medical, measuring, testing appliances, etc.	331
Optical instruments & photographic equipment	3320
Watches and clocks	3330
Motor vehicles	3410
Automobile bodies, trailers & semi-trailers	3420
Parts/accessories for automobiles	3430
Building and repairing of ships and boats	351
Railway/tramway locomotives & rolling stock	3520
Aircraft and spacecraft	3530
Transport equipment n.e.c.	359

Furniture	3610
Manufacturing n.e.c.	369
Recycling of metal waste and scrap	3710
Recycling of non-metal waste and scrap	3720

61 ISIC industries, UNIDO (3 and 4 digit-level 2010, rev.3)

Table A4: Cross-correlation table

Variables	Output	ValueAdded	Distance	Polity2	PR	CL	logIndOutput	logIndVA	GDP	Pop(log)	N_Proc
Output	1.000										
ValueAdded	0.849	1.000									
	(0.000)										
Distance	0.111	0.153	1.000								
	(0.000)	(0.000)									
Polity2	-0.057	-0.065	-0.354	1.000							
	(0.000)	(0.000)	(0.000)								
PR	-0.048	-0.054	-0.454	0.904	1.000						
	(0.000)	(0.000)	(0.000)	(0.000)							
CL	-0.051	-0.055	-0.477	0.828	0.917	1.000					
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)						
logIndOutput	-0.038	-0.036	-0.603	0.343	0.369	0.358	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)					
logIndVA	-0.040	-0.039	-0.616	0.332	0.353	0.344	0.994	1.000			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)				
GDP	-0.035	-0.036	-0.637	0.242	0.407	0.488	0.471	0.469	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
Pop(log)	0.007	0.012	-0.039	-0.014	-0.114	-0.189	0.633	0.640	-0.195	1.000	
	(0.163)	(0.021)	(0.000)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
N_Proc	0.080	0.083	0.331	-0.212	-0.278	-0.365	-0.050	-0.038	-0.480	0.385	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	

Significance of each correlation in parenthesis.