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Political Persistence, Connections and Economic Growth

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Keywords: Political Persistence, Growth, Innovation

JEL Classification: O43

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Abstract

Using data on a panel of 56 democratic countries in the period 1975-2004, we find evidence of a negative association between political stability and economic growth which is stronger and empirically more robust in countries with high bureaucratic costs. Motivated by these results, which contrast with previous contributions, we develop a model of growth with quality improvements where political connections with long-term politicians can be exploited by low-quality producers to defend their monopoly position and prevent innovation and entry of high-quality competitors. This requires that the incumbent politician remains in office and that the red-tape cost advantage granted by political connections is large relative to the quality upgrade related to innovation. Consistently with our empirical findings, the model delivers a negative association between the probability that the incumbent politician remains in office and average economic growth in the presence of high bureaucratic costs.

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1 Introduction

Low turnover of politicians is a feature of political systems in several countries. For example, in 2002, 398 US House members ran for re-election, and only 16 were defeated, while a mere 3 out of 26 senators running for re-election lost. A recent cross-country analysis of comparative turnover rates, based on lower house legislative elections from 1979 through 1994 for twenty-five countries, shows that the mean of incumbents returning rate is 67.7% (see Matland and Studlar [21]). For the US, Merlo et al. [22] report that re-election rate in the Congress between 1951 and 1994 was never below 80%. In Italy, re-election rate in Parliament between 1951 and 2008, though more volatile than in the US, never fell below 60% and was around 80% in several elections.[1]

In some countries, among which Italy is certainly a prominent example, the existence of long-lived political and economic elites is often blamed for the low rate of technological innovation, economic growth and social mobility. Politicians and major economic actors are perceived as an inaccessible and self-sufficient core that rules the country by means of long-lasting personal relations, contacts and acquaintances, preventing access to power by more dynamic (and young) individuals and creating a relationship-based system where economic outcomes tend to be driven by "knowing the right person in the right place" more than by the market.

In this paper we investigate the relationship between political persistence and growth by first performing an empirical analysis in a sample of 56 developing and developed countries, which are democratic according to the definition of the World Bank's Database of Political Institutions (Beck et al. [4]), for the period 1975-2004. Measuring political persistence with the percentage of main political entities ("veto players") who remain in place in the government in any given year (available from the same data set), we detect a *negative* association between political persistence and economic growth. Elaborating further on this first result, we find that the inverse relation between persistence and growth is driven by countries where red-tape costs are relatively high.

It is worth emphasizing that our empirical findings, which associate low persistence with high growth, are at odds with the conclusions of the existing literature on political instability and economic growth. In fact, almost all contributions use data on revolutions, coups and assassinations to construct a measure of political instability (see, for instance Alesina et al. [2] and the survey of the literature in Carmignani [10]). Not surprisingly,

[1] The lowest re-election rate (60.5%) occured in the 1994 election, after the "Mani Pulite" scandal which decimated previously ruling parties.

these studies find a *positive* effect of stability on growth. On the contrary, our findings suggest that, when government change occurs through democratic institutions, political turnover (i.e. instability) rather than political persistence (i.e. stability) is positively associated with growth in countries where red-tape costs are high, while no robust correlation emerges when red-tape costs are low.[2]

Our suggested interpretation of these results is that high political persistence may lead to low innovation and growth via the relationship between political connections and firms' competitiveness that may become crucial in highly regulated economies. We believe that, in the presence of high levels of regulation, personal relations and experience tend to become an important instrument for incumbent firms to maintain their leadership. Strong and long-established network with politicians helps connected firms to avoid, or at least alleviate, red-tape costs due to cumbersome bureaucratic and administrative requirements and/or inefficient bureaucracy, thereby gaining a competitive advantage over more innovative firms lacking connections, that may find it very difficult even to enter the market. Thus, political persistence may be detrimental to growth in countries with high levels of regulation (e.g. Italy), while it would be uninfluential (abstracting from other possible mechanisms that may imply a relationship between persistence and growth) in countries where regulation is low (e.g. the US).[3]

Motivated by our empirical evidence, in the second part of the paper we develop a theoretical analysis whose main novelty is to set up a model to illustrate a mechanism through which political persistence can indeed *hinder* economic growth. We introduce political networks in a model of growth with quality improvements à la Aghion and Howitt [1]. In the intermediate good sector, red-tape costs can be mitigated through political connections. Networks with politicians are established by producers and pay off with one period lag, so that only re-elected politicians can provide favors to firms. The incumbent

[2] An exception is the paper by Feng [15], who distinguishes between irregular and regular government changes and finds that stability enhances growth in the case of irregular changes, but is *negatively* associated with growth in the case of regular changes. Our empirical analysis, using a completely different dataset and exploiting the time dimension, shows that the negative relation between political persistence (stability) and growth is robust solely in countries that we classify as high red-tape costs.

[3] According to Doing Business 2008, Italy ranks 53 (out of 155 countries) in the ease of doing business, well below many emerging and less developed economies, while the US ranks 3. Dealing with licenses (in the construction industry) takes on average 257 days in Italy and 40 days in the US, with a cost of 138% of income per capita in Italy and 13.4% in the US. Starting a business requires a cost of 18.7% of income per capita in Italy compared to only 0.7% in the US. According to the executive opinion survey of the Global Competitiveness Report 2007-2008, the main problematic factor for doing business in Italy is inefficient government bureaucracy.

firm and the outside firm (which is endowed with the leading-edge technology) engage in Bertrand competition. Under certain conditions , the next-to-top-quality (incumbent) producer has the opportunity to keep her monopoly position and prevent innovation by exploiting her network advantage and the resulting cost reductions.

The main implications are two-fold. In the short-run, keeping the political status-quo leads to income maximization as it allows to exploit lower production costs and lower prices. In the long-run, however, the perpetuation of the network between incumbent politicians and firms blocks innovation and is detrimental to economic growth, leading to technological backwardness. Consistently with our empirical findings, this negative effect of political persistence emerges only when bureaucratic and administrative costs are large enough and/or the bureaucracy is sufficiently inefficient to make red-tape costs large relative to the quality upgrade related to innovation. When these costs are low, innovation cannot be blocked and political networks become irrelevant.

Besides the already mentioned literature on political instability and growth, our work is related to recent (mainly) empirical contributions that investigate the relevance of political connections on firms' performance. From a cross-country perspective, Faccio [13] documents the widespread existence of political connections and that these connections significantly add to company values. Faccio et al. [14] find that politically-connected firms are significantly more likely to be bailed out than similar non-connected firms. More importantly for our paper, Desai and Olofsgard [12] investigate the consequences of political connections on influential firms and find that they encounter fewer administrative and regulatory burdens and invest and innovate less.

Moreover, although the political network in our analysis does not involve any form of administrative or bureaucratic bribing, our work is related to the literature on the economics of corruption.[4] Recently, Harstad and Svensson [17] developed a theoretical model where firms, instead of complying with regulation, can either bribe or lobby the government and study under which conditions firms decide to bribe or lobby and the effects of this choice on economic growth. Blackburn and Sarmah [6] study a model where private agents can bribe bureaucrats in return for being freed from red-tape and bureaucrats choose optimally the amount of red-tape, as an instrument of rent extraction. None of these papers, however, analyze the relationship between red-tape, political persistence, innovation and economic growth, which is instead the focus of our research.

The paper is organized as follows. Section 2 presents empirical evidence on the relationship between political persistence and growth taking into account cross-country differences

[4] For a review of the literature on corruption, see Bardhan [3] and Svensson [24].

in red-tape costs. Section 3 develops the theoretical model and characterizes the static equilibrium, while Section 4 analyzes the dynamics of the model. Section 5 concludes.

2 Motivating evidence

The aim of this Section is to provide empirical evidence on the relationship between political persistence and growth. Our investigation is based on a sample of 56 countries over the 1975-2004 period. Following the Database of Political Institutions (DPI), we measure political persistence (*PERS*) as the percentage of main political entities (such as the prime minister, the larger parties in the government coalition, etc.) who remain in place in the government in any given year, relative to the previous one.[5] To capture political turnover that takes place through democratic institutions, we restrict our analysis to democracies. Using DPI definitions, we consider a country as democratic in year t if for that country legislative and executive competitiveness (*LIEC* and *EIEC,* respectively) both take their maximum value in year t.

As it is well known, the identification of exogenous source of variation of right-hand side variables in cross-country growth regressions is a difficult task, so that we will rely on panel data estimation in order to deal (at least partially) with sources of endogeneity bias that may be present in OLS estimation using cross-country data. In particular, the bias introduced by the omission of country-specific permanent effects that may be correlated with right-hand side variables is well known to be pervasive in cross-country OLS estimates of growth regressions (see, for example, the discussion in Temple [23]).

Thus, we begin our analysis estimating a growth regression by means of Least Square Dummy Variable (LSDV), including time and country fixed effects to eliminate any within country and within period common trends. To this end, we construct six 5-year periods between 1975 and 2004. To perform fixed effects estimation we need at least two observations for each country. Since we will regress growth on *lagged* persistence, observations are included only if a country is democratic for at least three consecutive periods between 1975 and 2004, giving rise to an unbalanced panel of 205 observations for 56 countries.

The dependent variable, *GROWTH*, is the average annual per capita GDP growth rate at constant 2005 PPP USD, over the 5-year periods between 1980 and 2004 and *PERS* is the (lagged) average persistence over the 5-year periods. In some specifications

[5] A more detailed explanation about the definition of PERS can be found in the Data Appendix. It is worth emphasizing that, differently from widely used definitions of political stability, our measure captures political changes not only in electoral years but also during the legislature.

we include standard controls, such as the log level of initial GDP per capita (GDP), the investment share of GDP (INV), the average schooling years in total population (EDU), the government expenditure share of GDP (GOV), and fertility rate ($FERT$). In order to alleviate estimation bias due to measurement error and reverse causation, all controls are taken at the beginning of each period, with the exception of EDU which is the average over the current and previous 5-year periods and $PERS$ which is the 5-year average over the previous period.

More specifically, we estimate the following equation:

$$GROWTH_{it} = \alpha + \beta_1 PERS_{it-1} + \gamma \mathbf{X}_{it} + \upsilon_i + \eta_t + \varepsilon_{it} \tag{1}$$

where i denotes country, t the time period, $\mathbf{X}_{it}$ is a vector of controls, υ_i are country fixed effects, η_t are time fixed effects and ε_{it} is the error term.

Column (1) in Table 1 reports estimation results for a baseline regression including only time and country fixed effects and $PERS$ as explanatory variables. The coefficient for $PERS$ is *negative* and significant (at 10% level). In column (2) we add all other controls and the previous result is confirmed with an increase in the significance of $PERS$. Notice that this negative association between political persistence and economic growth contrasts with the results of the existing literature on political instability and growth, as surveyed in Carmignani [10]. In fact, by using measures of political instability based on data on revolutions, coups and assassinations, these studies find a *positive* effect of stability on growth. On the contrary, our findings suggest that, when government change occurs through democratic institutions, political turnover (i.e. instability) is positively associated with growth.[6]

What could explain our results? Our interpretation is that high political persistence may hinder growth through the relationship between political connections and firms' competitiveness. More specifically, in the presence of high levels of regulation, strong and long-established networks with politicians may help connected firms to reduce the burden of administrative and bureaucratic costs. These connected firms would then enjoy a competitive advantage over more innovative firms that lack connections and may find it very difficult even to enter the market. As mentioned in the Introduction, Desai and Olofsgard [12] investigate the consequences of political connections on about 10.0000 firms surveyed

[6] In a recent paper, Besley, Persson and Sturm [5] investigate the relationship between political competition and economic growth. Using data on US states, they find evidence that political competition is positively associated with growth. Insofar as the lack of political competition could be related to our notion of political persistence, their empirical findings somehow confirm our results obtained in a panel of countries.

in 40 developing countries and find that influential firms face fewer administrative and regulatory burdens and invest and innovate less.

As this interpretation emphasizes the role of red-tape costs due to cumbersome regulation and bureaucratic inefficiency, we explore the possibility that the relationship between persistence and growth might be weak (and possibly negligible) in low-cost countries while negative in high-cost countries. Thus, we use the index of Bureaucratic Quality (BQ) constructed in the International Country Risk Guide ($ICRG$) to classify countries as low or high red-tape cost. In particular, we define a country as low (high) cost if BQ is above (below) a given threshold and specify the following equation:

$$GROWTH_{it} = \alpha + \beta_1 PERS_{it-1} + \beta_2 (d_i^H * PERS_{it-1}) + \gamma \mathbf{X}_{it} + v_i + \eta_t + \varepsilon_{it} \tag{2}$$

where d_i^H is a dummy for high red-tape costs, and $d_i^H * PERS_{it-1}$ is the interaction of this dummy with our measure of persistence. The dummy variable d^H takes value one (zero) when BQ is below (above) 3.5 (in 1984).[7,8] Following our previous argument, we will test the hypothesis that $\beta_1 = 0$ and $(\beta_1 + \beta_2) < 0$.

Column (3) in Table 1 replicates the baseline regression of column (1), limiting the sample to countries for which data on BQ are available. The coefficient for $PERS$ is again negative, slightly larger in absolute value and significant at 5% level. In columns (4) and (5) we split the sample into low and high-cost countries, respectively. Consistently with our interpretation, the negative correlation is present only in high-cost countries, while it disappears in low-cost countries. In column (6), we include the interaction term (d^H*$PERS$): our null hypothesis cannot be rejected at 5% level. In column (7) our set of controls is added. Results are basically unchanged; in particular $\widehat{\beta}_1 = 0$ and the sum $\widehat{\beta}_1 + \widehat{\beta}_2$ is negative and strongly significant.

In column (8) we introduce a proxy of corruption, $CORR$ from ICRG, which measures actual or potential corruption in the form of excessive patronage, nepotism, job reservation,

[7] The BQ index takes values between 0 and 4, with 0 denoting lowest quality. This variable captures one determinant of red-tape costs, that is a bureaucracy which is weak and inefficient (see the Data Appendix for the exact definition). We prefer this to alternative proxies of red-tape costs - such as, for example, measures of government effectiveness from the World Bank's Worldwide Governance Indicators (Kaufman et al.[19]) and indicators of the cost of setting up and operating a business (Doing Business: Measuring Business Regulations [25])- since it is available for a longer time span, allowing us to measure red-tape costs at the beginning of the period.

[8] Data appendix provides the list of high (low) cost countries according to our threshold. Notice that approximamtely 54% of the observations in our sample belong to high-cost countries. Moreover, we also performed our empirical anlaysis with threshold values ranging between 3.1 and 3.9 (notice that OECD average is 3.56). Results are qualitatively unchanged, as very few countries are affected by these changes.

"favors-for favors", secret party funding, etc.[9] Comparing results with those of column (7), notice that there are no changes whatsoever and that corruption is not significant. These findings suggest that formal corruption is not the main channel through which political persistence is related to growth and are in line with our argument which relies on personal acquaintances and connections, which are not necessarily a form of explicit and illegal corruption.

As it is well known (see, for instance, Caselli et al. [11]), estimation of the fixed effects version of equations (1) and (2) raises some concerns, as the model underlying the standard growth equation is intrinsically dynamic, automatically introducing a bias in our LSDV estimates in Table 1. Although the bias approaches zero as $T \to \infty$, LSDV estimates are inconsistent when T is small, as it is the case in our sample.

The procedure proposed for small samples by Kiviet [20] and developed, for the case of unbalanced panels, by Bruno [8], produces efficient estimates. To apply this procedure, we estimated the coefficients of the following equation:

$$GDP_{it} = \delta_0 + \delta_1 GDP_{it-1} + \delta_2 PERS_{it-1} + \delta_3 (d_i^H * PERS_{it-1}) + \upsilon_i + \eta_t + \varepsilon_{it} \quad (3)$$

by means of Anderson-Hsiao technique[10] and use them to correct the (inconsistent) coefficients obtained by LSDV estimation of the same equation.[11]

Table 2 reports LSDV (columns 1 and 3) and our corrected LSDV estimates (columns 2 and 4), henceforth LSDVC, obtained without and with the inclusion of the interaction term $d^H * PERS$ in equation (3). To save degrees of freedom, we include only time and country fixed effects as additional regressors, since the first step of the LSDVC procedure determines a substantial loss of observations. Notice that, as the original growth equation (2) was written in terms of average annual growth rates, the coefficients in Table 2 must be divided by five for comparison with Table 1.

Inspection of columns (2) and (4) shows that the LSDVC procedure corrects for the downward bias in the LSDV estimates of the *GDP* coefficient. With regard to political persistence, notice that $\widehat{\delta}_2$ in column (2) is significant at 10% level, while the sum $\widehat{\delta}_2 + \widehat{\delta}_3$ in

[9] $CORR$ takes values between 0 and 6, with low values indicating poor control of corruption. Like other controls, observations for $CORR$ are taken at the beginning of each 5-year period.

[10] This requires to first difference equation (3), to remove fixed effects, and instrument for $GDP_{it-1} - GDP_{it-2}$ with GDP_{it-2}. A complete description of the corrected LSDV procedure and of its Stata routine is provided by Bruno [9].

[11] As discussed by Judson and Owen [18], the use of Arellano-Bond and Anderson-Hsiao estimation techniques, generally employed in dynamic panel data, is not recommendable in our case, due to the large variance of these estimators in small samples.

column (4) is not significant although almost identical to the corresponding coefficients of column (1) and (3). A possible explanation for this loss of significance is that many high-cost countries have short time dimension (only 2 or 3 observations are available). Thus, the application of our procedure implies a loss of information which is concentrated among those countries (i.e. high-cost ones) that we expect to be responsible for the negative correlation between persistence and growth.

Overall, our fixed-effect estimates highlight a negative correlation between political persistence and growth in democratic countries with high red-tape costs. Our results do not necessarily identify a causal effect of persistence on growth because of the possible reverse effect of growth on persistence and because there may be other time-varying confounding factors such that $\mathrm{Cov}(PERS_{it-1}, \varepsilon_{it}) \neq 0$. To tackle these issues, we tried to perform an instrumental-variable estimation using dummies for proportional vs. majoritarian, closed vs. open list electoral systems, and the number of elections. Unfortunately, these variables turned out not to be valid instruments.

However it is worth noting that, according to the conventional wisdom, growth should have a *positive* effect on political persistence so that $\mathrm{Cov}(PERS_{it-1}, \varepsilon_{it}) \geq 0$. Thus, when inconsistent, our fixed-effect estimator will be biased upward, so that our estimation results could be viewed as upper bounds (in absolute terms) on the causal effect of persistence on growth. In other words, if we could control for reverse causation, the negative effect of persistence on growth should actually turn out to be even *stronger* than what we have found.[12]

Motivated by our empirical findings, in the next Section, we will present a theoretical model where exogenous political persistence affects growth and where red-tape costs play a crucial role in the presence of established relationships and networks between main economic actors and politicians.

3 The model

Consider an economy populated by a continuous mass of infinitely-lived agents. In each period, agents have one unit of time that can be supplied inelastically to production in

[12] From an empirical point of view, the idea that high economic growth should help incumbent politicians to be re-elected has been recently tested in a large cross-section of countries by Brender and Drazen [7]. They find that growth raises the probability of re-election only in less developed countries and new democracies and only insofar as it is not attributed to global growth.

the final good sector or in managing a firm in the intermediate good sector.[13] The utility function is linear in consumption in each period. Future consumption is discounted at the subjective discount factor $\beta = 1/(1+r)$ where r is the interest rate, which implies that in each period consumption is equal to income.

In each period t output in the final good sector is given by:

$$y_t = \widetilde{x}_t^{\alpha} {L_t}^{1-\alpha} \tag{4}$$

where L_t is labor, $\widetilde{x}_t = \sum_{q=0}^{Q(t)} \gamma^q x_q$ is a quality-adjusted intermediate input, with q denoting quality rung of intermediate good x_q that has quality γ^q. $K(t)$ denotes the highest quality level in use at time t. We will take the final good as numeraire and normalize its price to one. We assume no population growth and normalize $L = 1$. The final good sector is perfectly competitive. The intermediate good is produced using the final good by means of a linear technology.

To keep the economic side of the model simple and focus on the relationship between innovation, growth and political persistence, we abstract from endogenous innovation determined by R&D and from the potential catching up associated to distance to frontier. Specifically, we assume that in each period exogenous technological progress makes a higher quality version of the intermediate good available. Technological upgrade is limited to the next higher quality good (step-by-step innovation). For reasons that will become clear later, technology adoption occurs with a given probability that is related to political outcomes. Thus, if technology j is the highest quality adopted at $t-1$, only technology $j+1$ can be adopted at time t, although other superior technologies may be available.

Nature randomly chooses who has the monopoly right to produce the highest vintage of the intermediate good in each period. This power lasts for one period of time, after which the new vintage technology becomes freely available.

Operation in the intermediate good sector involves red-tape costs due to the requirement to abide by complex norms and regulations in order to undertake production (think of environmental regulation or industrial licensing where production is subject to administrative approval) that are more cumbersome in the presence of inefficient bureaucracy. These costs can be reduced by establishing a network with politicians in office. The working of the network does not require any illegal activity such as bribes and corruption. As we discussed in the Introduction, what is essential is to know the right person in the right place (a "rolodex effect"). The potential cost advantage of politically connected firms is

[13] We do not model the occupational choice of individuals between working or managing a firm. For the purpose of our analysis, the selection process can be considered as purely random.

thus related to extent of red-tape costs.

We denote with $\sigma > 1$ the marginal cost of production of firms with no political connections and normalize to 1 the marginal cost of production of politically connected firms. In other words, the parameter σ captures in a reduced form the cost advantage of politically connected firms.[14] A key feature of our model is that it takes one period for the network to pay off so that the network advantage can be exploited by producers *only if a politician remains in office for more than one period.*

In each period, elections are held with two candidates (parties): I (which stands for incumbent) and O (which stands for opponent). We denote with π the (exogenous) probability that in each period the incumbent politician is re-elected and assume that electoral results at t are independent of electoral results at any other $s \neq t$. Electoral results are relevant insofar as they affect the marginal cost of the incumbent producer. If I is reelected, the incumbent producer with technology j is politically connected and enjoys the cost advantage $\sigma - 1$ over competitors. Otherwise, if O is elected, no producer is politically connected and all firms face the same marginal cost σ. We assume that at time 0 there is an incumbent politician I who is connected with the owner of technology $\gamma^0 = 1$.[15]

3.1 The one-period equilibrium

A standard assumption in the literature on Schumpeterian models of growth (see Grossman and Helpman [16]) is that in the intermediate good sector owners of different vintages compete à la Bertrand. Since intermediate inputs are perfect substitutes in the production of the final good, if all producers faced the same marginal costs of production, the technological leader would enter the market in each period setting a limit price (slightly lower than) γ times the marginal cost of production of the incumbent producer.

In our framework, however, the incumbent producer may be politically connected and enjoy a cost advantage over the leader. In this case, the only active producer in each period may either be the incumbent, who owns vintage j or the new entrant, who owns vintage $j + 1$ and has no political connections.[16]

[14] Faccio [13] shows that politically connected firms tend to benefit from preferential access to credit and tax discounts. This type of benefits could also be captured by the difference $\sigma - 1$.

[15] Although it is natural to relate political persistence to electoral results, we can interpret π more generally as capturing the probability of an incumbent politician to remain in office in the current period, indipendently of whether it is an electoral period or not.

[16] Notice that although we assumed that, after one period, technology becomes freely available (which means that at time t everybody may produce with technology j), the existence of political networks implies

Notice that, in general, the incumbent firm can prevent entry of the more advanced competitor by setting a limit price equal to $p_{x_j} = c_{j+1}/\gamma$ where $c_{j+1} = \sigma$ is the marginal cost of production of the competitor. Conversely, the outside firm can enter the market by setting a limit price equal to $p_{x_{j+1}} = \gamma c_j$ where $c_j = \{1, \sigma\}$ is the marginal cost of production of the incumbent firm. Clearly, if $\gamma > \sigma$ the incumbent firm cannot make positive profits at the price which would keep the leading-edge firm out of the market, so that innovation would always occur. When $\gamma < \sigma$, if $c_j = 1$ the incumbent firm wins competition and prevents innovation; if $c_j = \sigma$ the leading-edge firm wins competition, enters the market and innovation takes place.

We can summarize this discussion in the following proposition which characterizes the economic equilibrium:

Proposition 1 (The one-period equilibrium) *Let $\alpha\sigma < \gamma < 1/\alpha$. Then:*

(i) If $1 < \sigma < \gamma$ the leading-edge producer enters the market setting a limit price $p_{x_{j+1}} = \sigma\gamma$ if and only if the next-to-leading edge (incumbent) producer is not politically connected. Otherwise, the leading-edge producer wins competition setting a limit price $p_{x_{j+1}} = \gamma$.

(ii) If $\sigma > \gamma$ the leading-edge producer enters the market setting a limit price $p_{x_{j+1}} = \sigma\gamma$ if and only if the next-to-leading edge (incumbent) producer is not politically connected. Otherwise, the next-to-leading edge (incumbent) producer wins competition setting a limit price $p_{x_j} = \sigma/\gamma$.

Proof. The leading-edge producer (new entrant) has a monopoly price equal to σ/α while the incumbent has monopoly price $1/\alpha$ if connected and σ/α if unconnected. If the incumbent is unconnected, the leading-edge producer can drive her out of the market by setting the monopoly price σ/α, when $\gamma > 1/\alpha$, or the limit price $\sigma\gamma$, when $\gamma < 1/\alpha$. In fact the next-to-leading edge producer (incumbent) can at most set a price $1/\gamma$ times that of the leader. If the incumbent is connected, she drives the leader out of the market by setting her monopoly price $1/\alpha$, when $\alpha\sigma > \gamma$, or the limit price σ/γ, when $\alpha\sigma < \gamma$ and $\sigma > \gamma$. If $\sigma < \gamma$ the next-to-leading edge producer makes negative profits at price σ/γ and the leader acts as constrained monopolist setting a limit price equal to γ (if the incumbent is connected) or $\sigma\gamma$ (if the incumbent is not connected). ■

The last result shows that when regulatory costs σ are low with respect to quality improvement γ political networks cannot prevent entry of the innovator and have no

that the firm endowed with the new technology $j+1$ is the **only one** that can win competition with current producer.

influence on the economic equilibrium in terms of which firm produces. However, political connections still influence prices and income as they limit the monopoly power of new entrants and drive prices down. On the contrary, when $\sigma > \gamma$ political connections become *crucial* for the possibility of innovation, as the owner of quality γ^j is able to prevent entry of the innovator by exploiting the political connections that she established in the previous period. Clearly, this requires that the incumbent politician is reelected at time t.

We can explicitly link our economic equilibrium to electoral results by means of the following:

Corollary 1 *Whenever the opponent politician O wins elections, innovation takes place and the equilibrium price of the intermediate good is $\sigma\gamma$. If the incumbent politician I wins the elections and $1 < \sigma < \gamma$, innovation takes place and the equilibrium price of the intermediate good is γ. Otherwise, there is no innovation and the equilibrium price of the intermediate good is σ/γ.*

To conclude this section, we investigate the efficiency properties of the equilibrium.

First of all, we can write GDP at time t as the sum of wages and profits, that is:

$$\begin{aligned} \Omega_t &= w_t + (p_{x_s} - c)x_t = (1-\alpha)\alpha^{\frac{\alpha}{1-\alpha}}\gamma^{\frac{\alpha s}{1-\alpha}}p_{x_s}^{\frac{\alpha}{\alpha-1}} + \alpha^{\frac{1}{1-\alpha}}\gamma^{\frac{\alpha s}{1-\alpha}}p_{x_s}^{\frac{1}{\alpha-1}}(p_{x_s} - c) \\ &= \gamma^{\frac{\alpha s}{1-\alpha}}\left[\left(\frac{\alpha}{p_{x_s}}\right)^{\frac{\alpha}{1-\alpha}} - c\left(\frac{\alpha}{p_{x_s}}\right)^{\frac{1}{1-\alpha}}\right] \end{aligned} \tag{5}$$

where $c = \{1, \sigma\}$ if the producer is incumbent or new entrant respectively and $s = \{j, j+1\}$.

As established in Proposition 1, the price of the intermediate good and the level of GDP at time t depend on who wins the election at t and on the relative magnitude of σ and γ.

Let us denote with σ_L, σ_H choices of σ such that $\sigma_L \in [1, \gamma)$ and $\sigma_H \in (\gamma, \infty)$, respectively. Then , when $\sigma = \sigma_L$, the GDP at time t is given by:

$$\Omega^I_{\sigma_L,t} = \left[\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}\frac{\sigma_L}{\gamma}\right]\gamma^{\frac{\alpha j}{1-\alpha}} = \Omega^I_{\sigma_L}\gamma^{\frac{\alpha j}{1-\alpha}} \tag{6}$$

if the incumbent politician wins the election, and to:

$$\Omega^O_{\sigma_L,t} = \sigma_L^{\frac{\alpha}{\alpha-1}}\left[\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}}\gamma^{-1}\right]\gamma^{\frac{\alpha j}{1-\alpha}} = \Omega^O_{\sigma_L}\gamma^{\frac{\alpha j}{1-\alpha}} \tag{7}$$

if the opponent wins the election. Notice that, in this case, as established in Corollary 1, innovation occurs at each point in time so that the level of technology j at the beginning of period t is equal to t.

Similarly, when $\sigma = \sigma_H$, the GDP at time t is given by:

$$\Omega^I_{\sigma_H,t} = \sigma_H^{\frac{\alpha}{\alpha-1}} \left[\alpha^{\frac{\alpha}{1-\alpha}} \gamma^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}} \sigma_H^{-1} \gamma^{\frac{1}{1-\alpha}}\right] \gamma^{\frac{\alpha j}{1-\alpha}} = \Omega^I_{\sigma_H} \gamma^{\frac{\alpha j}{1-\alpha}} \tag{8}$$

if the incumbent politician wins the elections or to:

$$\Omega^O_{\sigma_H,t} = \sigma_H^{\frac{\alpha}{\alpha-1}} \left[\alpha^{\frac{\alpha}{1-\alpha}} - \alpha^{\frac{1}{1-\alpha}} \gamma^{-1}\right] \gamma^{\frac{\alpha j}{1-\alpha}} = \Omega^O_{\sigma_H} \gamma^{\frac{\alpha j}{1-\alpha}} \tag{9}$$

if the opponent wins the election. In this case, innovation occurs only in periods when the opponent politician is elected, so that $j \leq t$.

Comparing these levels of GDP, we can write the following proposition:

Proposition 2 (Static efficiency of the network) *In each period and for any possible level of σ, the price of the intermediate good is lower and the level of GDP is higher if the incumbent politician is re-elected.*

Proof. 1) $\Omega^I_{\sigma_H,t} > \Omega^O_{\sigma_H,t}$. It is easy to verify that if the leading-edge technology firm entered the market (when the opponent politician is elected) setting a price $p_{x_{j+1}} = \gamma p_{x_j}$ we would get:

$$\Omega^I_{\sigma_H,t} > \Omega^O_{\sigma_H,t} \Leftrightarrow \alpha^{\frac{1}{1-\alpha}} \gamma^{\frac{\alpha j}{1-\alpha}} p_{x_j}^{\frac{1}{\alpha-1}} < \alpha^{\frac{1}{1-\alpha}} \gamma^{\frac{\alpha(j+1)}{1-\alpha}} p_{x_j}^{\frac{1}{\alpha-1}} \gamma^{\frac{1}{\alpha-1}} \sigma$$

which holds as long as $\gamma < \sigma$. By Proposition 1 we know that $p_{x_{j+1}}$ is actually equal to $\gamma^2 p_{x_j}$ so that a fortiori $\Omega^I_{\sigma_H,t} > \Omega^O_{\sigma_H,t}$.

2) $\Omega^I_{\sigma_L,t} > \Omega^O_{\sigma_L,t}$. Here it is enough to notice that technology is the same regardless of which politician is elected and that p_x would be higher when the opponent politician is elected. ■

As the last proposition show, from a static point of view, in all cases the highest level of *GDP* is achieved when the incumbent politician is re-elected. This is due to the fact that, given the level of technology j achieved at the beginning of period t, the incumbent producer is more efficient when she can exploit her political network, that is when the incumbent politician wins. When $\sigma < \gamma$, this implies that the innovator faces a more efficient competitor and is forced to set a lower price when the incumbent politician is elected. When $\sigma > \gamma$, the innovator cannot enter the market when the incumbent politician is elected as the incumbent producer can set a lower (quality-adjusted price) by exploiting her connections.

4 Dynamics and welfare analysis

In the previous section we analyzed the properties of the one-period equilibrium of our economy and emphasized the static efficiency of the network, which reduces the production costs of the incumbent firm and brings about a reduction in the level of prices.

Here we extend the analysis to take into account the dynamic implications of the network between firms and politicians. As we have seen in the previous section, when regulatory costs are high ($\sigma > \gamma$), innovation can be blocked by the incumbent firm which exploits political connections at the expense of the technological leader. Thus, politicians' re-election entails a short-run benefit in terms of lower current prices and a long-run cost in terms of technological upgrades and future productivity.

To highlight the dynamic costs of network, let us compute the expected value at the beginning of time t of GDP at time $t+k$ with $k \geq 1$, which we denote as $E_t\left(\Omega_{t+k}\right)$.[17] Notice that $E_t\left(\Omega_{\sigma,t+k}\right) = E_t\left(\gamma^{\frac{\alpha(j+z)}{1-\alpha}} \cdot \Omega_\sigma^P\right)$ where $P = \{I, O\}$, $\sigma = \{\sigma_L, \sigma_H\}$, j is the given level of technology at the beginning of time t and z denotes the number of times that innovation takes place between t and $t+k-1$.[18] Clearly, $E_t\left(\Omega_{\sigma,t}\right) = \gamma^{\frac{\alpha j}{1-\alpha}} E_t\left(\Omega_\sigma^P\right)$.

When $\sigma < \gamma$, we know from Proposition 1 that innovation always occurs, so that $z = k$ and we can write:

$$E_t\left(\Omega_{\sigma_L,t+k}\right) = \gamma^{\frac{\alpha(j+k)}{1-\alpha}} E_t\left(\Omega_\sigma^P\right) = \gamma^{\frac{\alpha(j+k)}{1-\alpha}}\left[\pi\Omega_{\sigma_L}^I + (1-\pi)\Omega_{\sigma_L}^O\right] = \gamma^{\frac{\alpha k}{1-\alpha}} E_t\left(\Omega_{\sigma_L,t}\right) \quad (10)$$

When $\sigma > \gamma$, in each period innovation depends on electoral results and z becomes a random variable with binomial distribution $b(k, 1-\pi)$ where the probability of success (i.e. innovation) in each of the k trials is equal to the probability that the opponent is elected, that is $1-\pi$. Using the fact that each electoral result is independent of the others so that $\gamma^{\frac{\alpha(j+k)}{1-\alpha}}$ and Ω_σ^P are independent, we can write:

$$\begin{aligned} E_t\left(\Omega_{\sigma_H,t+k}\right) &= E_t\left(\gamma^{\frac{\alpha(j+z)}{1-\alpha}}\right) E_t\left(\Omega_\sigma^P\right) = \gamma^{\frac{\alpha j}{1-\alpha}}\left[(1-\pi)\gamma^{\frac{\alpha}{1-\alpha}} + \pi\right]^k \left[\pi\Omega_{\sigma_H}^I + (1-\pi)\Omega_{\sigma_H}^O\right] \\ &= \left[(1-\pi)\gamma^{\frac{\alpha}{1-\alpha}} + \pi\right]^k E_t\left(\Omega_{\sigma_H,t}\right) \quad (11) \end{aligned}$$

Consider the second equality in each equation. In both cases, the expected level of future GDP is the product of two terms. The first is a "growth effect" and measures the expected quality of technology after the $t+k$ elections which is equal to $\gamma^{\frac{\alpha(j+k)}{1-\alpha}}$ when

[17] To make it clear, from now on $E_t(x)$ denotes the expected value of x where expectation is taken *before* the election at t.

[18] In other words, here we are looking at the expected value of GDP after $k+1$ elections, from t to $t+k$.

$\sigma < \gamma$, and equal to $\gamma^{\frac{\alpha j}{1-\alpha}}\left[(1-\pi)\gamma^{\frac{\alpha}{1-\alpha}}+\pi\right]^k$ when $\sigma > \gamma$.[19] The second is a "level effect" equal to $\left[\pi\Omega_\sigma^I+(1-\pi)\Omega_\sigma^O\right]$ which is related to the static consequences of the network and depends only on the electoral result at time $t+k$.

We can now use our previous results to derive welfare implications. More specifically, we can try to rank in welfare terms the two alternative technological trajectories associated with σ_L and σ_H. In so doing, we consider the point of view of an infinite-horizon benevolent planner who compares the corresponding discounted sums of aggregate GDP from time 0 to infinity. When $\sigma = \sigma_L$ the discounted sums of future is given by:

$$W_{\sigma_L} \equiv \left[\pi\Omega_{\sigma_L}^I+(1-\pi)\Omega_{\sigma_L}^O\right]\sum_{t=0}^{\infty}\beta^t\gamma^{\frac{\alpha t}{1-\alpha}} \tag{12}$$

while when $\sigma = \sigma_H$ it is:

$$W_{\sigma_H} \equiv \left[\pi\Omega_{\sigma_H}^I+(1-\pi)\Omega_{\sigma_H}^O\right]\sum_{t=0}^{\infty}\beta^t\left[(1-\pi)\gamma^{\frac{\alpha}{1-\alpha}}+\pi\right]^t \tag{13}$$

Assuming convergence of the two series,[20] we get

$$W_{\sigma_L} = \frac{\left[\pi\Omega_{\sigma_L}^I+(1-\pi)\Omega_{\sigma_L}^O\right]}{1-\beta\gamma^{\frac{\alpha}{1-\alpha}}} \tag{14}$$

and

$$W_{\sigma_H} = \frac{\left[\pi\Omega_{\sigma_H}^I+(1-\pi)\Omega_{\sigma_H}^O\right]}{1-\beta\left[(1-\pi)\gamma^{\frac{\alpha}{1-\alpha}}+\pi\right]} \tag{15}$$

so that we can write the following:

Proposition 3 (Welfare) *The trajectory with σ_L is superior in terms of welfare to the trajectory with σ_H.*

Proof. First of all, we need to prove that $\left[\pi\Omega_{\sigma_L}^I+(1-\pi)\Omega_{\sigma_L}^O\right] > \left[\pi\Omega_{\sigma_H}^I+(1-\pi)\Omega_{\sigma_H}^O\right]$. For this, it is sufficient to prove that $\Omega_{\sigma_L,t}^I > \Omega_{\sigma_H,t}^I$, that is:

$$\alpha^{\frac{\alpha}{1-\alpha}}-\alpha^{\frac{1}{1-\alpha}}\frac{\sigma_L}{\gamma} > \left[\alpha^{\frac{\alpha}{1-\alpha}}\gamma^{\frac{\alpha}{1-\alpha}}\sigma_H^{\frac{\alpha}{\alpha-1}}-\alpha^{\frac{1}{1-\alpha}}\gamma^{\frac{1}{1-\alpha}}\sigma_H^{\frac{1}{\alpha-1}}\right] \tag{16}$$

$$\alpha^{\frac{\alpha}{1-\alpha}}-\alpha^{\frac{1}{1-\alpha}}\frac{\sigma_L}{\gamma} > \alpha^{\frac{\alpha}{1-\alpha}}\left(\frac{\sigma_H}{\gamma}\right)^{\frac{\alpha}{\alpha-1}}-\alpha^{\frac{1}{1-\alpha}}\left(\frac{\sigma_H}{\gamma}\right)^{\frac{1}{\alpha-1}} \tag{17}$$

[19] Notice that when $\sigma < \gamma$ the expected quality of technology is also the *actual* quality, as innnovation always occurs.

[20] This requires assuming $\beta\gamma^{\frac{\alpha}{1-\alpha}} < 1$.

which is equivalent to comparing two levels of GDP in equation (5), the one on the LHS with $p_x = 1$ and $c = \sigma_L/\gamma$ and the one on the RHS with $p_x = \sigma_H/\gamma$ and $c = 1$. Clearly, the LHS is larger than the RHS ■

Finally, let us compute the expected rate of growth of the economy, defined as $E_t(g_{t+1}) = E_t(\ln \Omega_{t+1} - \ln \Omega_t)$. Given equations (6) - (9), we can write the following proposition:

Proposition 4 (The average growth rate) *At any time t, the average growth rate of GDP between t and t + 1 is constant. This growth rate is equal to* $E(g_{\sigma_L}) = \frac{\alpha}{1-\alpha} \ln \gamma$ *if* $\sigma = \sigma_L$ *and to* $E(g_{\sigma_H}) = (1-\pi)\frac{\alpha}{1-\alpha} \ln \gamma$ *if* $\sigma = \sigma_H$.

Proof. 1) Consider the case $\sigma = \sigma_L$. The expected growth rate is equal to:

$$\begin{aligned} & \pi^2[\ln \Omega^I_{\sigma_L,t+1} - \ln \Omega^I_{\sigma_L,t}] + \pi(1-\pi)[\ln \Omega^O_{\sigma_L,t+1} - \ln \Omega^I_{\sigma_L,t}] + \\ & +(1-\pi)\pi[\ln \Omega^I_{\sigma_L,t+1} - \ln \Omega^O_{\sigma_L,t}] + (1-\pi)^2[\ln \Omega^O_{\sigma_L,t+1} - \ln \Omega^O_{\sigma_L,t}] \\ = \; & \pi[\ln \Omega^I_{\sigma_L,t+1} - \ln \Omega^I_{\sigma_L,t}] + (1-\pi)[\ln \Omega^O_{\sigma_L,t+1} - \ln \Omega^O_{\sigma_L,t}] = \ln \gamma^{\frac{\alpha}{1-\alpha}}. \end{aligned}$$

2) Consider the case $\sigma = \sigma_H$. Here the expected growth rate is:

$$\begin{aligned} & \pi(1-\pi)[\ln \Omega^O_{\sigma_H,t} - \ln \Omega^I_{\sigma_H,t}] + (1-\pi)\pi[\ln \Omega^I_{\sigma_H,t+1} - \ln \Omega^O_{\sigma_H,t}] + \\ & +(1-\pi)^2[\ln \Omega^O_{\sigma_H,t+1} - \ln \Omega^O_{\sigma_H,t}] \\ = \; & \pi(1-\pi)[\ln \Omega^I_{\sigma_H,t+1} - \ln \Omega^I_{\sigma_H,t}] + (1-\pi)^2[\ln \Omega^O_{\sigma_H,t+1} - \ln \Omega^O_{\sigma_H,t}] = (1-\pi) \ln \gamma^{\frac{\alpha}{1-\alpha}} \end{aligned}$$

Q.E.D. ■

With regard to the relationship between growth and probability of re-election, notice that when the network advantage of the politically connected producer is not so strong to allow him to prevent entry of competitors with leading-edge technology, innovation takes place irrespective of electoral results and the expected growth rate of income is not affected by the probability that the incumbent politician is re-elected. Instead, when the next-to-leading edge producer can prevent entry of competitors with more advanced technology by exploiting her political connections, innovation will not take place whenever the incumbent politician is re-elected, implying that the expected growth rate is decreasing with the probability that the incumbent politician is re-elected.

5 Conclusions

Excessive regulatory and administrative burdens due to cumbersome regulatory and administrative requirements and/or inefficient bureaucracy are often pointed out as a major hindrance to growth as they subtract resources to investment and innovation and represent a barrier to entry for new firms and superior technologies.

In this paper, we consider red-tape as a production cost for firms that can be mitigated through political connections in a relationship-based system ("knowing the right person in the right place"). As establishing connections requires time but no extra resources, operating firms face lower marginal costs than potential competitors. Thus, incumbent firms may be able to prevent entry of competitors with superior technology if they can exploit their political connections, that is, if politicians do not change too frequently. For the society as a whole, this creates a trade-off between short-run benefits of keeping the status quo and enjoying low prices and long-run costs of retarding technological upgrade.

Our theoretical analysis suggests that the magnitude of red-tape costs plays a crucial role in determining whether we should expect a relationship between the frequency of political change and economic growth. When red-tape costs are high, the advantage granted by political connections allows the incumbent to maintain her dominant position and prevent technological innovation, implying a negative relationship between political persistence and economic growth. Instead, when red-tape costs are low, political connections become irrelevant, innovation takes place irrespective of political turnouts and political persistence and economic growth are unrelated.

The results of our model provide a possible explanation for the empirical evidence of a negative association between political persistence and economic growth in presence of high red-tape costs, that we documented in the first part of the paper. This correlation turned out to be robust to the inclusion of dummies for country fixed effects and time effects and of standard control variables, such as initial GDP, investment ratio, education levels, etc. Although we could not establish a causal link between persistence and growth, we argued that reverse causation should not alter our main results.

Our theoretical analysis could be extended in different ways. In particular, it could be interesting to incorporate political economy considerations in order to endogenize the probability of being re-elected. Although potentially complicated by the dynamic nature of our model, this extension might shed light on the effects of bureaucratic (in)efficiency on the persistence of politicians, and on the reasons why politicians are often reluctant to reform the bureaucracy. Moreover, this extension could highlight political and economic conflicts between short-sighted and long-sighted agents, which in an overlapping generations set-up would give rise to intergenerational conflicts between the young (more inclined to political turnover and economic change) and the old (supporting the status quo).

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6 Data Appendix

In this Appendix we provide information about data used in Section 2.

6.1 List of variables and data sources

In the following we present the list of variables, organized by data source.

World Bank's World Development Indicators (WDI)

FERT: log of total fertility rate (births per woman)

GDP: log of gross domestic product per capita, PPP (constant 2005 PPP USD)

GROWTH: average annual growth rate of gross domestic product per capita (constant 2005 PPP USD)

World Bank's Database of Political Institution (DPI)

DEMO: dummy indicating fully democratic countries. *DEMO* =1 if both *LIEC* = 7 and *EIEC* = 7, the former indicating fully competitive legislative elections and the latter indicating fully competitive executive elections

EXELEC: dummy indicating that an executive election took place in a given year

LEGELEC: dummy indicating that a legislative election took place in a given year

PERS: *PERS = 1- STABS*

STABS: share of veto players that drop from the government in any given year. In fully democratic countries, veto players are defined as the chief executive (counted twice if she's competitively elected) and the opposition if it controls the legislature. In addition, each chamber (unless the chief executive controls the lower house through a closed list system) and each of the party allied with the president is a veto player in presidential systems. In parliamentary systems, veto players are those parties that are necessary for the winning coalition to keep the absolute majority in the government and those parties in the government coalition that are ideologically nearer to opposition parties.

Penn World Table 6.1. (PWT)

GOV: government expenditure as share of *GDP*

INV: investment as share of *GDP*.

Barro and Lee

EDU: average schooling years in total population

International Country Risk Guide (ICRG)

BQ: bureaucratic quality (0-4 scale) in 1984. High values are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. In these low-risk countries, the bureaucracy tends to be somewhat autonomous from political pressure and to have an established mechanism for recruitment and training. Countries that lack the cushioning effect of a strong bureaucracy receive low points because a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions

d^H: dummy variable taking value one (zero) when BQ is below (above) a certain threshold (see Section 2)

CORR: control of corruption (0-6 scale). Low values correspond to a very poor control of corruption (or very high level of corruption). The variable measures mainly actual or potential corruption in the form of excessive patronage, nepotism, job reservations, favor exchange, secret party funding, and suspiciously close ties between politics and business

6.2 Countries

Our sample includes 56 countries for which DEMO=1 in the 1975-2004 period and data are available for *PERS* and *GROWTH*. Countries are listed below, together with the number of observations available for each country in the period 1980-2004 (in parentheses). For 51 countries we have information also on *BQ*. There are 18 low-cost countries with an average of 4.78 observations each, while there are 33 high-cost countries with an average of 3.06 observations per country.

Low red-tape costs countries: Australia (5), Austria (5), Belgium (5), Canada (5), Denmark (5), Finland (5), France (5), Iceland (5), Ireland (5), Japan (4), Netherlands (5), New Zealand (5), Norway (5), South Africa (2), Sweden (5), Switzerland (5), UK (5), USA (5).

High red-tape costs countries: Argentina (3), Bolivia (2), Brazil (3), Chile (2), Colombia (5), Costa Rica (5), Cyprus (2), Ecuador (4), El Salvador (3), Greece (4), Guatemala (2), Honduras (3), India (3), Israel (5), Italy (4), Korea (3), Malaysia (2), Mexico (3), Nicaragua (3), Panama (3), Paraguay (2), Peru (3), Poland (2), Portugal (4), Senegal (2), Spain (4), Sri Lanka (3), Thailand (2), Trinidad and Tobago (2), Turkey (3), Uruguay (3), Venezuela (4).

Remaining countries for which no data on BQ are available are: Bahamas (3), Germany (5), Luxembourg (5), Madagascar (2), Malta (5).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LSDV	LSDV	LSDV	LSDV	LSDV	LSDV	LSDV	LSDV
Country Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Time Dummies	YES	YES	YES	YES	YES	YES	YES	YES
PERS_{t-1}	-0.024*	-0.028**	-0.032**	-0.001	-0.054**	-0.017	-0.009	-0.012
	[0.014]	[0.013]	[0.015]	[0.015]	[0.022]	[0.023]	[0.019]	[0.020]
$d^H * \text{PERS}_{t-1}$						-0.026	-0.032	-0.023
						[0.030]	[0.026]	[0.026]
GDP		-0.078***					-0.099***	-0.097***
		[0.014]					[0.015]	[0.016]
EDU		0.002					0.003	0.003
		[0.004]					[0.003]	[0.003]
GOV		-0.001***					-0.001***	-0.0001**
		-0.0003]					[0.0003]	[0.0003]
INV		-0.002***					-0.00121***	-0.001**
		[0.0004]					[0.000427]	[0.0004]
FERT		-0.042***					-0.0431***	-0.038***
		[0.013]					[0.0131]	[0.014]
CORR								-0.002
								[0.002]
Observations	205	187	187	86	101	187	185	179
Countries	56	53	51	18	33	51	51	51
R^2	0.138	0.464	0.128	0.363	0.293	0.133	0.509	0.410
$\widehat{\beta}_1+\widehat{\beta}_2$						-0.043**	-0.040***	-0.035**
						[0.020]	[0.015]	[0.016]

*** p<0.01, ** p<0.05, * p<0.10. Standard errors in parenthesis

Table 1. Dependent variable: 5-year average annual growth rate of per capita GDP (constant 2005 PPP USD)

	(1)	(2)	(3)	(4)
	LSDV	LSDVC	LSDV	LSDVC
Country dummies	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES
PERS_{t-1}	-0.125**	-0.132*	-0.040	-0.076
	[0.062]	[0.077]	[0.114]	[0.184]
$\text{d}^{H}*\text{PERS}_{t-1}$			-0.119	-0.079
			[0.134]	[0.209]
GDP_{t-1}	0.548***	0.759***	0.546***	0.761***
	[0.075]	[0.160]	[0.075]	[0.178]
Observations	165	83	165	83
Number of countries	51	48	51	48
R^2	0.786		0.788	
$\widehat{\delta}_2+\widehat{\delta}_3$			-0.160**	-0.156
			[0.0740]	[0.101]

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parenthesis.

Table 2. Dependent variable: 5-year average log of per capita GDP (constant 2005 PPP USD)

6.3 Descriptive Statistics

Tables 3 and 4 report descriptive statistics and pairwise correlations.

	Full Sample			Low Cost Countries			High Cost Countries		
Variable	Obs.	Mean	Std.Dev.	Obs.	Mean	Std.Dev.	Obs.	Mean	Std.Dev.
$PERS$	187	0.84	0.12	86	0.85	0.12	101	0.83	0.12
$GROWTH$	187	1.88	2.00	86	1.84	1.45	101	1.91	2.37
GDP	187	9.43	0.87	86	10.10	0.28	101	8.87	0.81
EDU	187	7.54	2.47	86	9.44	1.37	101	5.92	2.01
GOV	185	15.34	8.01	86	11.91	6.10	99	18.32	8.31
INV	187	20.14	6.65	86	23.37	4.49	99	17.34	6.97
$FERT$	187	0.79	0.38	86	0.58	0.16	101	0.98	0.41
$CORR$	181	4.61	1.92	83	5.98	1.81	98	3.45	1.05
BQ	187	2.83	1.28	86	3.94	0.16	101	1.89	1.04

Table 3: Descriptive statistics

	$PERS$	$GROWTH$	GDP	EDU	GOV	INV	$FERT$	$CORR$
$GROWTH$	-0.06	1.00						
GDP	0.10	-0.06	1.00					
EDU	0.20**	0.07	0.80**	1.00				
GOV	-0.20**	-0.11	-0.54**	-0.41**	1.00			
INV	0.04	-0.04	0.69**	0.58**	-0.41**	1.00		
$FERT$	-0.06	-0.18*	-0.82**	-0.65**	0.52**	-0.64**	1.00	
$CORR$	-0.01	-0.05	0.51**	0.50**	-0.11	0.37**	-0.43**	1.00
BQ	0.06	0.01	0.73**	0.63**	-0.39**	0.54**	-0.63**	0.59**

Table 4. Pairwise correlations; * significant at 5% level; ** significant at 1% level

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