ON THE DYNAMICS OF CORRUPTION*

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Abstract. To examine the joint evolution of corruption and per capita GDP, we augment the standard lifecycle model of capital accumulation by three endogenous state variables that describe institutions and culture, and by three fixed parameters that proxy for personal morality and social interactions. Institutions that regulate economic incentives are decided by majority vote over a binary agenda that pits "strong" against 'weak" property rights. Culture consists of slow changing social conventions which generate behavioral norms in the public and private sectors. Norms spread consumption externalities that impact the occupational opportunities of current households, and become in turn a reflection of past household choices.

Our main theoretical finding is that societies with collectivist cultures and corruption-tolerant norms behave very differently from the individualistic ones of neoclassical growth theory. Collectivist society features include: (a) highly nonlinear GDP and corruption dynamics; (b) dominant roles for culture and social norms as engines of institutional quality, corruption and growth; and (c) majorities that favor diluted property rights, thus splitting the world economy into individualistic and collectivist convergence clubs with two distinct stable long-run states.

These hypotheses receive a fair amount of support from international data. Variations in social norms, culture and human capital typically explain more than half of the variance in per capita GDP across countries and time. Many alternative measures of culture seem to be highly significant determinants of corruption and institutional quality. The fact that we control for culture in many alternative ways supports our confidence in the largely favorable tests of our main hypotheses.

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1 Overview

1.1 Agenda

Corruption and rent-seeking, two antisocial activities with potentially grave collective side effects, command much attention in development economics because they suggest plausible answers to a fundamental question raised long ago by North and Thomas (1973) and Easterlin (1981): Why isn't the whole world developed? Responses to this question from the neoclassical growth theories of Solow (1956), Cass (1965), Diamond (1965) and Romer (1990) seem inadequate because they identify proximate growth causes with economic fundamentals alone (factor accumulation motivated by patience, new ideas and high rates of return), ignoring potentially deeper social forces (institutions and culture) favored by development economists, economic historians and other social scientists.

Models of neoclassical growth seem underequipped, and perhaps unsuited, for explaining why many nations go through long-lasting episodes of sub-par growth which keep them from catching up with wealthier economies. Is there a recipe for overcoming developmental hurdles or "barriers"?[1] Our paper takes a step to fix this deficiency: we add cultural and institutional proxies to the list of state variables used in neoclassical growth; we work out the hypotheses that emerge from the richer structure; and we test those hypotheses with international data.

Both anecdotal sources and empirical work[2] cite corruption and rent-seeking as major channels through which weak social institutions and permissive cultural traits[3] thwart economic growth, reducing welfare in countries at all stages of economic development. Closely related to each other, these two forms of illegal enrichment restrict rights to private property and undermine the enforcement of laws intended to protect those rights. Corruption and

[1]The evidence on convergence in per capita national income is explored by Durlauf and Johnson (1995), Liu and Stengos (2001), and reviewed most recently by Johnson and Papageorgiou (2020) who conclude that as, a group, developing economies have not closed the income per capita gap with advanced ones. See Parente and Prescott (2002) for the role of technology-adoption barriers in economic development.

[2]Cf among others Murphy, Shleifer and Vishny (1993), Mauro (1995), Gelfand *et al.* (2011a), Kyriacou (2016) and Gorodnichenko and Roland (2017).

[3]Guiso, Sapienza and Zingales (2006) and Alesina and Giuliano (2015) discuss modern definitions of the terms "institutions" and "culture" used in social science research.

rent-seeking are widely regarded as occupational choices that divert capital and labor from legitimate production and wealth creation into illegal, wasteful and inefficient activities like burglary, robbery, bribery and extortion. We call this diversion *rent-seeking* when it benefits someone in the private sector, and *corruption* when the gainer works in the public sector[4]. In terms of foregone national income or delayed development, the labor misallocation from such anti-social activities appears to outweigh by far the material benefits accruing to the perpetrators.[5].

How much and through what mechanisms do corruption and rent-seeking impede economic performance? Under what circumstances do societies allow anti-social activities to fester, thus trapping themselves into vicious cycles of weak institutions, habitual corruption and poverty? These are the central questions which we explore at first for an arbitrary and exogenous choice of the institutions that enforce property rights in a standard, off-the-shelf model of neoclassical growth; we later entrust the selection of those institutions to majority voting under a universal franchise. The paper seeks a tractable and testable description of the institutional and cultural mechanisms that appear most likely to drive corruption dynamics in an open economy, and to advance or retard economic progress.

Analytical tractability is hard to preserve in environments of complex interactions that span economics, politics and culture. To maintain it, we focus on the simplest and most intuitive patterns of demographics, technology, tastes, and social interplay that appear to illuminate the dynamics of corruption. Simple as they are, these patterns lead to plausible testable hypotheses that may well accord with more robust analyses that the one we are able to provide in this paper.

National and international equilibria for corruption, gross domestic product and institutions are examined in the light of behavioral assumptions that are considerably richer than those of neoclassical growth theory. In particular, we introduce group interactions, a form of interpersonal externalities that exposes households to social norms. Norms are collective

[4]This definition of rent-seeking differs somewhat from the usual one of earning monopoly income in factor markets or acquiring influence over regulatory processes. For richer definitions of what constitutes corrupt activity, see the surveys by Bardhan (1997) and Aidt (2003).

[5]Hsieh and Klenow (2009) report that improved within-industry factor reallocation in India and China through the 1990s could have raised total factor productivity by 40-60%

habits connected with past corruption and rent-seeking. We view norms and institutions as endogenous state variables in economic growth, on a par with human capital, physical capital and technology. Poor habits or social norms may hamper, and good ones may facilitate, institutional reform through majority voting. In either case, they vastly enrich the potential of growth theory to study institutional reform and its implications for economic development.

We start with four basic premises: one, the main function of institutions is to protect property rights from challenges originating in the private sector;[6] two, the public sector is uniquely responsible for the protection of those rights;[7] three, weak property rights may endure not because enforcement is expensive, but rather because society cannot commit to side payments or other transfers that enable the gainers from stronger enforcement to compensate the losers;[8] and four, strong social interactions between younger and older generations, in the form of consumption externalities, can lock in corruption-tolerant norms that encourage majority voting in favor of weak institutions.

Starting from these four premises, we analyze how the combined economic influence of institutions or property rights, and culture guides the occupational choices of young workers which, in turn, shape aggregate rent-seeking and corruption. We examine how corruption interacts with long-term income, and derive implications connecting the corruption/growth nexus with human capital, politics and socio-cultural factors.

Economic growth, institutional quality and corruption in this context are the equilibrium of a broad array of social forces, or growth "engines", emanating from the realms of economics, politics and culture, and operating at home and abroad. To gain a quantitative sense

[6]This assumption encapsulates evidence by Acemoglu, Johnson and Robinson (2005a; 2005b) who find that property rights protection has a first-order effect on economic performance. We ignore challenges emanating from the public sector, e.g., bribery of the type analyzed by Blackburn, Bose and Haque (2006) or the threat of outright expropriation by the government.

[7]Enforcement is purely private in the early literature on social conflict modelled as predator-prey games that pit "marauders" with offensive weapons against "producers" wielding defensive ones. Cf. Skaperdas (1992), and Grossman and Kim (1995).

[8]For example, Acemoglu and Robinson (2000a) attribute the non-existence of side payments to rogue households as a natural consequence of an inability to pledge credible transfers that may induce predators to give up activities in which they may have a substantial comparative advantage and considerable earning power.

of what those engines add to or subtract from national income, we test the main predictions of this paper by estimating dynamic regressions with international data. These tests typically treat national income, corruption and institutional quality as dependent variables; and culture, human capital and norms (or lagged corruption) as predetermined or independent ones.

1.2 Plan of the paper

Here is how the rest of the paper is organized: section 1.3 gives a verbal outline of the main model and data sources. Section 1.4 sums up key theoretical results and empirical tests of the hypotheses derived from those results. Section 1.5 connects our paper with the literatures on neoclassical growth, social conflict, corruption and development, especially with the conjecture that institutions and culture are "deep determinants" of economic performance. Sections 2 and 3 lay out our basic model, and describe the forces that shape household choices to select occupations and consumption-saving plans.

Section 4 is a simple example consisting of two household groups which illustrates how politics, culture and economics interact simultaneously (or sequentially) to choose institutions, social norms, corruption and income. Next we fix institutions in section 5 and 6, and study how corruption and income evolve for each institutional choice. Majority voting over a binary agenda endogenizes institutions in section 7, and provides useful insights into the joint dynamics of corruption and GDP. Sections 8–10 discuss empirical results, and the main body of the paper ends in section 11 with conclusions and extensions. Before the bibliography come technical appendices with mathematical proofs, and after it come tables with empirical details.

1.3 Model and data sources

To describe in a plausible manner the social forces that guide the evolution of corruption and income over the long run, we extend both the state space and the parameter space of Diamond's (1965) lifecycle model of capital accumulation. There is no public debt, population growth, technical change or aggregate uncertainty. Economic fundamentals are simple and time-invariant: the world is made up of a large finite number of economically identical small open economies, which operate under a common time-invariant vector consisting of the world wage rate, interest yield and capital-labor ratio. The world credit market settles the value of that vector. At the beginning of each time period, a young cohort of unit mass is born in each national economy. Cohorts contain two types of risk-neutral households with the usual two-period lifecycle: work one time unit, consume and save in youth, retire and consume in old age. Household types differ in their exogenous endowment of human skills: type one has a comparative advantage in production, type two in rent seeking. Technologies satisfy constant returns to scale and lifecycle utilities are homothetic.

Superimposed on this familiar overlapping generations edifice of consumption and investment is a less familiar array of occupational decisions made by each newly arrived cohort in response to the institutions and social norms that surround its members. In our framework, institutions are decided at the beginning of each period by majority voting from a simple binary agenda that pits a "strong" enforcement alternative against a "weak" one. The former choice completely eliminates predatory rent seeking; the latter one gives predators free reign but not the power to expropriate all earned income. Given the voting outcome, young agents are left with two options. One option is employment in the private sector. The alternative is enforcement work (i.e., policing or prosecuting) in the public sector for type-one persons, or predatory rent-seeking against their entire cohort for type-two persons.

All incomes and lifecycle utilities are proportional to the world wage rate which does not influence job choice. What does is the value of the expected after-tax lifecycle income earned in each alternative job, adjusted for negative interpersonal externalities, and for personal morality or scruples. Affecting all occupational choices, these income adjustments are equivalent to tax rates that are proportional to the difference of each person's occupational choice from the prevailing social norm, and also proportional to the distance between personal morality and moral "neutrality". Adjustments capture reduced enjoyment from current and future consumption due to personal scruples from antisocial acts, or to collective punishments ("shunning" or other forms of exclusion) meted out to those members of a conformist or traditional society who deviate from the behavioral codes set up by their elders.[9]

Unadjusted "cash" incomes are made and lost in meetings between workers, rent-seekers and enforcers. We model those meetings as two independent random search-and-matching processes under constant returns to scale. Each period, after honest workers have earned their after-tax income, rent seekers are initially matched with their victims (that is, all other young agents), and later with enforcers. Successful matches occur with probabilities that reflect the population ratio of the two sides or, equivalently, the intensity of enforcement. These probabilities are public knowledge and, in equilibrium, are consistent with economy-wide occupational choices.

Completed matches transfer all income from "prey" to "predator", that is, victim to rent-seeker. Honest enforcers return to the Treasury all income recovered from apprehended rent-seekers. Corrupt or rogue enforcers retain all confiscated loot for their own use at the risk of being themselves caught in the act by vigilant colleagues and forced to give up their government salary. To simplify matters, we assume that forfeiture of illegal income is the only loss from exposed antisocial acts, ignoring other punishments like incarceration or restrictions on future trading. Expected earnings from legitimate activity are proportional to the probability that the earner will avoid an undesired meeting with a predatory rent-seeker. By symmetry, predatory rent-seeker incomes are proportional to the product of two probabilities: predator finds victim, and predator avoids enforcers.

Social forces of this complexity call for a set of parameters and state variables beyond the usual economic fundamentals of population, endowments, tastes and technology. We need six such objects. One of them indexes institutions; five are proxies for broadly defined "culture". Specifically, we deploy three time-varying state variables to pin down institutions, and social norms in the private and public sectors; two fixed parameters describe how moral codes vary over the population; and one additional fixed parameter defines a social interactions index. This last parameter captures the extent of tolerance society shows for deviant occupational

[9] Gelfand et al. (2011) construct a "tightness-looseness" index that measures tolerance for deviant behavior. Low values of this index (below 5) describe "loose" or tolerant societies; high values above 8 denote "tight" or conformist ones.

choices.

The extreme values of the social interactions index (σ) define pure individualism and pure conformism, under which occupational choices ignore social norms altogether or follow them slavishly. Intermediate sigma values reflect degrees of individualism or the intensity of social interactions or the degree of tolerance toward deviant behavior or a host of related sociological concepts (rationalism, secularism, self-expression, "looseness"). This family of concepts was pioneered by Hofstede (1984) who collected international survey data on them. Each worker is also associated with a fixed individual moral code, which has a Pareto distribution across the population, measuring the intensity of remorse one feels when collecting income from antisocial activities. Low realizations of this code denote high morality or intense scruples. We may think of its opposite as defining a "remorse tax" equivalent: positive when this code is small, zero when it is neutral, and negative when it is is large, that is, when a perpetrator feels pride in his antisocial accomplishments.

Three time-varying variables (property rights enforcement intensity, the past share of the less-productive agents who choose to become rent-seekers, and the past share of more-productive agents who become corrupt enforcers) capture, respectively, the quality of institutions, social norms for rent-seeking, and social norms for official corruption. Norms are simply lagged values of equilibrium corruption in the private and public sector, that is, of the fraction of older agents who turned rogue when young. The institutional parameter (theta) equals the enforcer-to-rent-seeker ratio, and measures the quality of governance or the intensity of property rights. Zero property rights protection means thieves and extortionists are never forced to forfeit illegally obtained wealth; full protection means they always are.

Informative proxies for culture and corruption exist in the literature and in international survey data sources collected periodically by a number of institutions. Sections 9.1–9.5 of this paper lay out sources and data in detail. Nearly all sources provide cross sectional and time series data on official corruption, and many report information about aspects of institutional quality. Proxies for the intensity of conformism vs. individualism appear in the World Values Survey (WVS) and in the papers by Hofstede, Gelfand *et al.* and Falk *et al.* mentioned earlier. WVS and Fisman and Miguel (2007) report proxies for moral values, social norms, and related cultural concepts; Inglehart and Welzel (2017) sum up some of the WVS data in a "cultural map of the world" shown in Figure 2 below. As we discuss in greater detail below, proxies for institutions are strongly auto-correlated, and non-linearly correlated to per-capita GDP in the cross section.

Our theory also offers predictions about the role culture plays in the correlation between the quality of institutions and corruption. Specifically, both panels in Figure 1 show a clear negative correlation of corruption and institutional quality, where corruption is proxied by the Corruption Perception Index, `CPI`, and two proxies of institutional quality that are defined in sections 9.3 and 9.4, $\texttt{ICRG}_{ins}$ and $\texttt{WMO}_{ex}$. This is demonstrated by the negative slopes of the lines estimated through the scatter of time-averaged data in Figure 1. Both panels are consistent with our theoretical prediction that the negative correlation is stronger in more individualistic than in more conformist societies. The line through the scatter of the data points for the most individualistic societies is *steeper* than the one through those for the most collectivist, when we focus on countries with the lowest one-third and with the highest one-third of values of the Hofstede index, skipping the middle one-third.

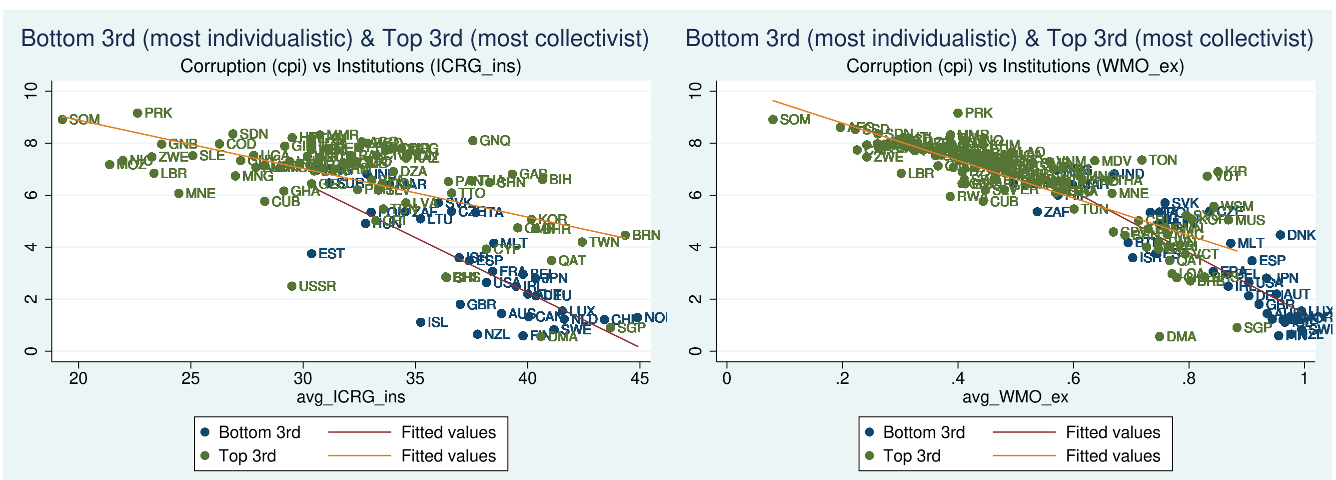

Figure 1: Culture (Hofstede) and Corruption vs. Institutions

Little information exists about the extent of private sector rent-seeking, much of which is criminal activity in the underground economy. All we have to go on are computations of

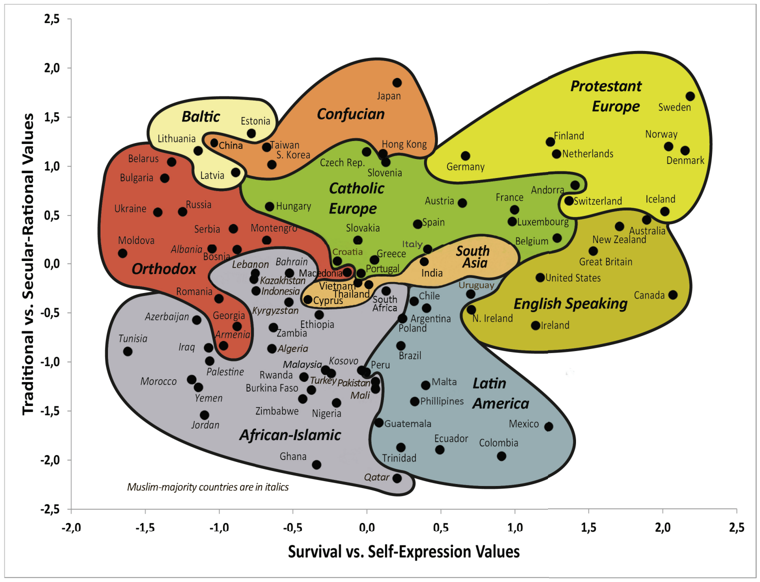

Figure 2: Cultural Map of the World (WVS)

underground economy size like those of Schneider (2005) for 110 OECD nations. We also have a theoretical result from section 7 asserting that, in a stationary equilibrium, a reduced-form equation connects the incidence of rent-seeking to official corruption and institutional quality: rent-seeking declines monotonically as institutions improve while corruption may go up at first and then drop.

1.4 Summary of Findings

1.4.1 Main results for exogenous institutions

How would corruption and national income respond to a permanent change in institutional quality? Result 2 in section 5 and eqs. (35) and (36) in section 6 provide answers to these basic questions. To start we choose an arbitrary value for the ratio of enforcers to predators in a finite interval, somewhere between no enforcement and fully secure property rights. Then we trace what happens in the longer and shorter runs for each possible choice of institutions. One key result is that, in individualist or ”’loose” societies with limited social interactions, antisocial behavior depends strongly on institutions and weakly on norms; the reverse is true in traditionalist or "tight" societies with intense social interactions. The reason for this dichotomy is that institutions provide economic incentives that translate into cash incomes. Those incomes are all important in individualist environments but matter less in conformist ones where social approbation can be significant for lifecycle utility.

Stronger property rights reduce rent seeking in both the short and long runs. Their impact on long-run corruption is subtler because, as societies begin to strengthen the quality of governance, public employment initially expands and incentives to misbehave abate in the public sector. The actual mass of rogue enforcers responds to this institutional improvement at both the extensive margin of (bigger) public employment and the intensive margin of (less frequent) misbehavior. The outcome of this interplay can be the inverse U-shaped curve shown in Figure 10: the extensive margin dominates at weak levels of enforcement but is overshadowed at higher values because of the sustained drop in rent-seeking activity which tempers the need to put cops on the street.

A similar balance of countervailing forces shapes the response of long-run output to property rights, also shown in Figure 10. Stronger enforcement will eventually raise GDP as it steers most less-productive households toward legitimate jobs. However, at low levels of human skills and enforcement, relatively minor institutional tinkering may not help national income because the number of repentant rent-seekers is below that of additional enforcers. In other words, steering unskilled type-two workers away from their comparative advantage in thieving, and into legitimate jobs, removes too many cops from production when institutions are relatively weak and income is low. In this situation, the long run correlation of institutional quality with national income is ambivalent in theory as it is in international data.

Contrary to what one may expect from recent empirical work[10], Result 2 our model suggests that individualist attitudes do not always correlate positively with good outcomes (higher income or lower anti-social activity), and conformism does not necessarily go hand in hand with poor results. Individualism simply minimizes the impact of social norms and magnifies the influence of institutions; conformism does the reverse. Good outcomes are in

[10]See, for example, the last three references in fn. 2.

principle achievable in a conformist society, even one with weak property rights, if norms are sufficiently good. This occurs because conformism and weak institutions generate two stable long-run equilibria: a good one and a bad one. Empirical work gives us evidence that conformist societies have the most to lose from bad habits; we think it is quite possible that they also have the most to gain from good ones.

1.4.2 Main results for endogenous institutions

To preserve tractability in our model, we narrow institutional choice to majority voting over the simplest binary agenda, that is, no enforcement vs. full enforcement, under a universal franchise. The advantage of this specification is that, for each policy choice, no enforcement takes place and no taxes are collected in equilibrium. No cops are hired when property rights remain unenforced; none are needed in equilibrium when the government signals a credible intention to wipe out all rent-seeking.

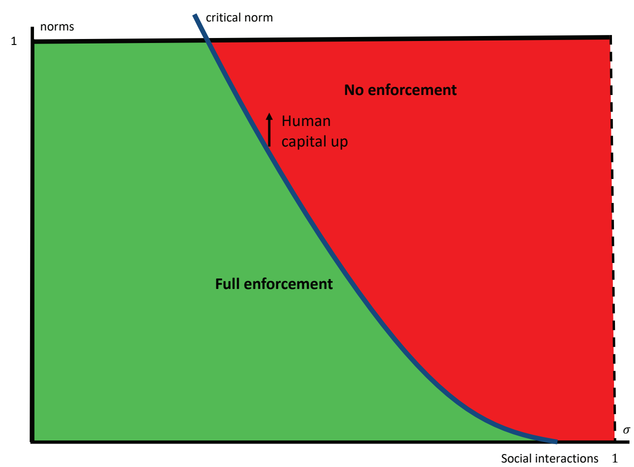

Figure 3: Majority Voting over Institutions

Result 3 in section 7 below and its illustration in Figure 3 show that the voting outcome in this simple society depends on several factors: human capital, culture, history, and the efficiency of the predator-victim matching process. Individualist societies vote for strong institutions if the productive skills of its corruptible members are not too low; if predators are not easily matched with prey; if social interactions are weak or unimportant; and if history shows little antisocial activity. Conformist societies, on the other hand, become prisoners of their past which shapes current institutions through prevailing norms. Majorities vote for no enforcement if norms tolerate corruption, for full enforcement otherwise. Strong social interactions also split economies into convergence clubs with two distinct, and locally stable, steady states. Conformist societies with a history of low corruption converge to a high-income state whereas those with a corruption-tolerant past head to a low-income state.

1.4.3 Empirical Findings

We take the key predictions of our theory to international country-level data on GDP per capita as well as several indices of institutional quality, corruption, and several measures of culture. Because our cultural indices are time-invariant, we correct for persistent country-specific heterogeneity by working with a stochastic structure that includes random effects. We also examine the robustness of our results against the restrictive assumptions of random effects. Accounting for country heterogeneity in the form of random effects is always statistically significant. Full details are provided in sections 8, 9 and 10, and therefore we merely preview them immediately below.

Among measures of culture, the Hofstede individualism index fits our theory and performs well: less individualism is associated with lower per capita GDP when we control for lagged human capital, lagged corruption (which proxies for social norms) and lagged institutions. Under these controls, more human capital and better current institutions help GDP while lagged corruption hurts it. The Falk *et al.* measure of negative reciprocity also performs well in this regard: higher GDP is associated with greater propensity to enforce norms and punish antisocial behavior.

The results confirm the key role that institutions and human capital play in our model. Since corruption and institutional quality are endogenous, it is variations in human capital over time that in effect drive all of the endogenous variables in the model. Specifically, lagged human capital alone gives an R^2 of 0.504, that is, it explains one-half of the total variance in GDP per capita across countries and time. Adding year dummies and random effects increases the respective R^2 to 0.643, implying that country-specific heterogeneity is important though not overwhelmingly so. Adding lagged institutions (specifically proxied by lagged $\texttt{ICRG}_{ins}$), and the Hofstede proxy for culture, increases that to 0.664. In that case, the within-R^2 is 0.654. Excluding lagged human capital reduces the overall R^2 to 0.547, which suggests that the additional explanatory variables predicted by our theory contribute an important part to the variance. These results are similar if instead we use lagged $\texttt{WMO}_{ex}$ and the Falk *et al.* proxies for culture: the respective R^2's for human capital alone are 0.671, which becomes 0.755 when adding year dummies and random effects, 0.861 when adding institutions and culture, and 0.745 when excluding human capital. Human capital is always important but so are culture, corruption, institutional quality and heterogeneity.

Regression results are similarly very consistent with our theory regarding the evolution of corruption and institutions. All alternative corruption indices we use are strongly and positively autocorrelated; lagged human capital reduces corruption, and so do better institutions, even when culture is controlled for. More collectivist societies are more conducive to corruption, even when human capital and institutions are controlled for as well as country-specific heterogeneity. Regarding institutions, they too are strongly and positively autocorrelated, lagged corruption reduces institutional quality and lagged human capital improves it, even when culture is controlled for.

Summing up the full details from section 10 below: Greater human capital and better institutions increase GDP per capita, and corruption reduces it when culture, human capital and institutions are controlled for. Better institutions reduce corruption. Corruption hampers institutional quality and human capital enhances it, when lagged institutions are controlled for. The totality of our empirical results demonstrate that many alternative measures of culture are typically very significant determinants of GDP per capita, institutions and corruption. The fact that we control for culture in a multitude of alternative ways, but for reasons of brevity do not report here, gives us confidence in the validity of our predictions: the impact of lagged institutional quality, culture, lagged corruption and lagged human capital on current institutions, current corruption and per capita GDP is similar across different proxies of culture.

1.5 Connections with the Literature

Our two main innovations are to nest corruption within a neoclassical growth framework, and to model culture as a consumption externality or social interaction between individual households and society at large. We use the Hofstede individualism index and alternative concepts to measure the intensity, or impact, of that externality which we take as a strictly exogenous parameter.

Deploying the Hofstede individualism index furnishes judgements about the relative importance of culture vs institutions as drivers of economic development. A key conclusion is that conformist or traditionalist societies, like those we often find among the world's poorer emerging economies, behave very differently from the individualist societies that are emblematic of the richer regions of Europe and of European offshoots. Figure 2 illustrates this pattern.

In the traditionalist societies of our model, cultural norms and social habits are powerful drivers of economic performance. These societies appear to be "prisoners" of their past: institutional quality and individual heterogeneity have little impact on economic decisions. If conformist nations happen to start with poor norms or a shortage of civic traditions, a potentially spurious correlation emerges between national income and individualism, or between national income and heterogeneity in population characteristics. In principle, sufficiently good habits lead conformist societies to good outcomes, even under fairly weak institutions or a highly diverse population.

Heterogeneity regarding property rights emerged in the early 1990s as an important parameter for the development/growth nexus. Skaperdas, Grossman and others (see fn. 7) worked out formal models of property rights and rent-seeking as one-shot non-cooperative games between two players: a predator investing in offensive weapons and endowed with comparative advantage in expropriation; and a victim investing in defensive weapons and possessing a comparative advantage in production. Nash equilibria of such games are typically wasteful, with too much conflict and too much spending on weapons if the players are very different in their comparative advantage. Efficiency is nearly achieved when player endowments are nearly identical and their interests are closely aligned.

Empirical work provisionally confirms this insight: Easterly and Levine (1997), Alesina and Giuliano (2015), and Spolaore and Wacziarg (2016a) report that ethnolinguistic diversity correlates negatively with both institutional quality and economic performance; Spolaore and Wacziarg (2016b) also find that genetic distance from the U.S. is a barrier impeding the adoption of better institutions. Section 7 in our model shows this result to be relevant only for individualist societies with modest or negligible group interactions. Voters in these circumstances favor strong property rights if the human capital of potential rent-seekers is close to that of producers. We find, however that heterogeneity by itself does not appear to be an important factor in conformist environments, like those of the poorest emerging economies, where voting patterns reflect civic conventions and social norms rather than narrow personal interests.

Another strand of the development literature examines the efficiency of corruption through its influence on economic development. Does corruption "grease" or "sand" the wheels of an emerging economy? "Greasing" involves bribes that ease the tasks of obtaining licenses, navigating labyrinthine bureaucracies, and ensuring favorable treatment from government officials, as in Lui (1985) and Murphy, Shleifer and Vishny (1991). "Sanding" happens when bureaucracies compromise property rights, reduce capital mobility, and repel investment. Empirical evidence from Mauro (1995), Aidt (2009), and our Figure 1 among others, favors the "sanding" viewpoint. Results in our section 7 validate that evidence, with a note of caution: corruption and GDP per capita can be uncorrelated or even positively correlated for middle income countries, as reported by Mendez and Sepulveda (2006) or Aidt, Dutta and Sena (2008). That may happen because, in combating private misbehavior, higher enforcement expands opportunities to misbehave in the public sector.

The most active strand of the literature, and the one closest to this paper, pursues the "Protestant ethic" conjecture made a long time ago by Weber(1930), extended more recently by North and Thomas (1973), Acemoglu et al. (2005a, 2005b), and explored since by many others. The gist of the Weber-North-Acemoglu conjecture, which we adopt in this paper, amounts to a claim that institutions and culture are the fundamental causes of economic performance. Culture and institutions are evocative names for social forces that sometimes work in tandem and occasionally oppose each other. Theory suggests, and empirical work provisionally confirms, that these forces are not easy to separate. In our model, for instance, feedback loops connect institutions and culture. Institutions are a scalar chosen by the median voter; culture is partly endogenous and time-varying (social norms or civic conventions), and partly exogenous and fixed (degree of individualism, personal morality index). One feedback loop binds culture with politics because voting outcomes generally depend on current social norms– less so in individualistic societies, and more so in conformist ones. Current voting, in turn, shapes today's occupational choices, thus feeding into future norms.

Richer and subtler definitions of these forces abound in the literature. Early work by North (1991) and Greif (1994, 2016) defines culture and institutions inclusively as humanly devised rules, that is, as the informal and formal constraints which regulate social interactions and shape our beliefs as to how people will act or react in various circumstances. Recent contributions by Guiso, Sapienza and Zingales (2006), Tabellini (2008a), Alesina and Giuliano (2015), and Gorodnichenko and Roland (2017) distinguish frequently changing institutions[11] from slowly evolving culture. Culture is presumed to embody norm-generating values;" trust", "respect" and other forms of civic habits; or, equivalently, customary beliefs which various social groups transmit fairly unchanged from one generation to the next. The consensus view, which we also adopt in this paper, seems to be that institutions are an endogenous political outcome acting as a constraint on individual behavior. Culture is, at least in part, an exogenous description of preferences and values,[12] and therefore a "deeper" force than institutions.

If we interpret culture as social norms alone, recent empirical work provides some sup-

[11] Acemoglu and Robinson (2000b and elsewhere) link institutional progress in 19th century Western Europe to the spread of voting rights which they model as an equilibrium outcome in a game between the "elite" and the "masses". Elites have decision-making power which they agree to share more widely when the probability of a mass revolt becomes sufficiently high.

[12] Recognizing that preferences may also evolve, albeit very slowly, Bisin and Verdier (2001), and Fernandez, Fogli and Olivetti (2013) explore possibilities of intergenerational change in cultural traits through parental investment or parental example. Fernandez et al. present evidence that parental example has a significant impact on female occupational choice in the U.S. among second-generation immigrants.

port for the primacy of it, even in the form of long-ago cultural indicators, over institutions. Tabellini (2008a, 2008b, 2010) reports that both GDP and institutional quality correlate positively with civic measures of trust, morality and respect. Guiso *et al.* (2016) uncover in Italian data an interesting connection between current regional measures of good civic habits and medieval status as a city state. Using data from former colonial African nations, Michalopoulos and Papaioannou (2014) find that ethnic groups sharing a common culture perform at about the same level, even when they live under different institutions and are separated by national borders. All these reports seem consistent with our description of conformist societies in section 7: norms replicate themselves as they exert decisive influence over institutional choice, corruption and GDP; individual attributes, like heterogeneity, human capital and others, are relatively unimportant. Long-run economic performance is also sensitive to initial norms: poor civic culture becomes a formidable development barrier.

Individualist societies turn out to behave quite differently. To proxy culture, Kyriacou (2016) and Gorodnichenko and Roland (2017) use genetic distance from the U.K. (and the U.S.) as an index for individualism which they regard as synonymous with meritocracy, propensity to innovate, and absence of small-group favors (nepotism and client-patron relationships). Under this definition, they find that (a) individualism is positively correlated with GDP, factor productivity, patents and the quality of governance; and (b) individualism causes growth even after controlling for institutions. Stronger individualism, i.e., closer genetic similarity to the United States, thus elicits better economic performance.

Working with the more neutral Hofstede index, our model offers a more guarded assessment of what individualism or conformism contribute to long-term income. Figure 3 sums up what we found: when individualism is already high, more of it weakens the influence of norms or social capital, and helps economic performance by improving institutions that are already strong. At the other extreme, when conformism is high, a small additional dose of individualism does not help because conformist societies simply do what their norms dictate. Lastly, at intermediate values of the Hofstede index, individualism becomes a substitute for good norms: each can improve economic performance independently of the other.

Much as the Hofstede index helps as a particular abstraction of culture, our empirical predictions are robust to alternative proxies. We next lay out an extended lifecycle growth model to help us understand the details of how culture and institutions interact with corruption and national income.

2 A Growth-theory Framework

2.1 Building blocks

The one-sector growth model of Diamond (1965) serves as the basic building block of this paper. There is no public debt, population growth or technology shocks. The world economy is made up of many similar open economies, $j = 1, \ldots, J$, each with two overlapping generations of unit size, whose members' two-period lifecycle completes the basic demographic structure. Economic fundamentals (preferences, endowment, technology) are common to all countries. Free capital mobility ensures that a common world capital-labor ratio prevails independently of any nation's institutional choices. In each economy, the savings of the young finance their old-age consumption when they are old. A neoclassical production technology with constant returns to scale is assumed for each country. What distinguishes our model from the standard one is preferences that exhibit consumption externalities, more precisely national-economy wide social interactions between young and old agents.

We assume that each generation consists of two types of people: type $i = 1$ agents, of mass $1 - \mu$, possess one efficiency unit of labor which they can apply to either production or enforcement; type $i = 2$, of mass μ, are less skilled and possess $\gamma < 1$, efficiency units of productive labor or one efficiency unit of rent-seeking labor. We define the ratio parameter n and assume that type $i = 2$ workers are more numerous than type $i = 1$ workers:

$$n := \mu / (1 - \mu) > 1. \tag{1}$$

We further assume that households are further differentiated via occupational choice. In other words, we suppose that agents of type $i = 2$ choose between rent-seeking (with 1 efficiency unit of labor each) and productive employment (with γ efficiency units of labor each); agents of type $i = 1$ choose between employment as enforcers of property rights or as productive workers (with 1 efficiency unit of labor each). Those who become enforcers also become vulnerable to corruption, as we specify in detail shortly. Rent-seekers ("predators") are matched randomly with their victims ("prey"), that is, with everyone else who are productive workers of either type; predators are in turn matched randomly with enforcers. Both matching technologies exhibit constant returns to scale. All agents are assumed to be risk-neutral, or equivalently to participate in complete financial markets against idiosyncratic risks which eliminate all uncertainty.

2.1.1 The State of the Economy

The state of the economy at time t is completely described by the following variables and parameters:

- Capital per person, k_t, an endogenous state variable whose determination and evolution are specified below.
- The share of type $i = 2$ persons who choose rent-seeking is $\rho_t \in [0, 1]$. In many of our applications, its lagged value serves to define the norm ρ_t^n for time period t rent-seekers; a mass of $\mu(1 - \rho_t)$ agents are employed as type-2 productive workers.
- D the mass of type $i = 1$ persons who become enforcers; the remainder $1 - \mu - D$ is the mass of type-1 producers.
- The share $x_t \in [0, 1]$ of type $i = 1$ persons who are employed as enforcers but decide to engage in corruption in dereliction of their duties. Its lagged value also serves as the period$-t$ norm, x_t^n, for rogue enforcers, or public-sector corruption.
- An institutional policy variable, $\theta_t \in [0, b]$, which defines the ratio of ratio of enforcement personnel to rent-seekers. This is a scalar, decided by a political process. Extreme values $\theta_t = 0$ and $\theta_t = b$ denote no enforcement and maximum enforcement,

respectively. This variable proxies for the strength of property rights enforcement, and will be referred to as "institutions" for short. For some of our applications, θ_t may also take discrete values in $\{0, b\}$.

- An invariant exogenous taste parameter $\sigma \in [0, 1]$ denoting culture. It expresses the impact of inherited norms or past history on lifetime utility, or, equivalently, on lifetime income or consumption. We associate pure individualism with the value $\sigma = 0$, when norms are irrelevant for individual decisions, and pure conformism with the value $\sigma = 1$, when individual decisions respond strongly to norms. As we discuss in detail below, the intensity of disapproval directed at those who do not conform works effectively as a "tax" imposed on the income of income of young rent-seekers.

2.1.2 Demography and Preferences

Both agent types have identical utility functions, for $i = 1, 2,\ j = 1, \cdots, J$:

$$u_{i,j,t} = (1 - \delta_{i,j,t}) c_{i,j,t}^{1-\beta} c_{i,j,t+1}^{\beta},\ \beta \in [0, 1], \tag{2}$$

where $(c_{i,j,t}, c_{i,j,t+1})$ denotes agent i's lifecycle consumption profile in cohort t and country j, and $\delta_{i,j,t}$ denotes an adjustment for social interactions between young and old that will be defined by combining culture and norms. $\delta_{i,j,t}$ is the implied "tax" on agents who deviate from social norms within their occupations, i.e. from the choices made by the preceding cohort.

Eq. (2) leads to an indirect lifetime utility

$$v_{i,j,t} = (1 - \delta_{i,j,t}) y_{i,j,t} R_{j,t+1}^{\beta} =: \hat{y}_{i,j,t} R_{t+1}^{\beta}, \tag{3}$$

where $y_{i,j,t}$ is the (after-tax) cash income for type$-i$ agent in country j and period t, R_t is 1 plus the world rate of interest, and $\hat{y}_{i,j,t}$ is income adjusted for social interactions. All agents share a common time-endowment profile $(1, 0)$, but efficiency units differ across agent types. Note that this specification of social interactions affects only utility and does not affect savings behavior.

The production technology is also common for all countries. The aggregate quantity, $Y_{j,t}$, of the single output that may be used for consumption and investment is given by

$$Y_{j,t} = K_{j,t}^{\alpha} N_{j,t}^{1-\alpha}, \ j = 1, \ldots, J, \tag{4}$$

where $K_{j,t}$ denotes aggregate physical capital and $N_{j,t}$ aggregate efficiency units of labor that are productively employed.

2.2 The World Economy without Corruption

As our simplest example, we consider first a utopian benchmark, namely a world where $\delta_{i,j,t} = 0$: people are not corruptible nor prone to rent-seeking, and no externalities exist across agents. With no resources allocated to enforcement, one aggregate unit of productive labor is employed in each period in every nation, which saves fraction β of the total wage bill. For world equilibrium, world capital next period must equal world saving this period: $K_{t+1} = \beta w_t J$, where J denotes the world mass of workers, and the world-wide pre-tax wage w_t in every period equals the marginal product of labor. The law of motion in intensive form becomes:

$$k_{t+1} = \beta(1-\alpha) k_t^{\alpha}, \tag{5}$$

where k_t denotes the world capital-labor ratio $k_t := K_t/J$.

Consequently, world factor prices for capital and labor are taken as given in each national economy. They are determined at the general equilibrium of the world economy as functions of k_t. The law of motion for the world income per capita, readily follows from (5) and looks exactly like the standard Solow model of economic growth. The upshot is that the world economy converges to a unique steady state with capital-labor ratio $\bar{k}$ and per capita income $\bar{y}$ common to all nations:

$$\bar{k} = [\beta(1-\alpha)]^{\frac{1}{1-\alpha}}, \ \bar{y} = [\beta(1-\alpha)]^{\frac{\alpha}{1-\alpha}}. \tag{6}$$

From now on we ignore the national index j unless it becomes necessary for clarity.

2.3 Economies with Rent-seeking and Corruption

2.3.1 Sequence of Events and Meetings

To grasp why rent-seeking and corruption cause deadweight losses in output and welfare, we focus on the occupational decisions of young households. How does society allocate its labor endowment among the activities of producing, rent-seeking and property-rights enforcement?

Answers depend on outcomes in a variety of political and economic arenas. To analyze how those interact, we assume that collective and individual decisions emerge sequentially in several stages, and that subsequent decisions fully reflect the outcomes of earlier stages. In particular, we suppose that:

i. World markets move first to set factor rentals (w, R) for labor and capital, as well as the world capital-labor ratio k.

ii. Voters in each country choose the institutional parameter $\theta_t \in [0, b]$, that is, the ratio of enforcers to rent-seekers, by majority vote.

iii. Young workers choose occupations. A mass $X_t = \mu\rho_t$ of type-2 households become rent-seekers, while the remaining mass $\mu(1-\rho_t)$ opts for legitimate production work. This means that the government will hire a mass of enforcers equal to:

$$D_t = \theta_t X_t, \tag{7}$$

from among type-1 households, and that the remaining mass $1 - \mu - D_t$ of those households will find work in the private sector.

iv. Type-2 workers who choose to become rent-seekers, with total efficiency units $X_t = \mu\rho_t$, are randomly matched with their potential victims, that is, all non-rent seeking young workers who add up to $V_t = 1 - \mu + \gamma\mu(1-\rho_t)$ efficiency units. Thus, the entire young generation may be victimized by rent-seekers. For simplicity we assume that retirees and capital income are immune from rent-seeking.

v. As production takes place, individuals receive total pre-tax wage income, $(1-\alpha)k_t^\alpha$, and pay income taxes at a given income tax rate $\phi \in [0,1]$. The government uses the tax revenue to pay enforcers, which renders the tax rate endogenous.

vi. Matched victims surrender all wage income to rent-seekers. For simplicity of modeling we assume that idiosyncratic risks to rent-seekers and victims are removed by actuarially fair pre-match insurance. And, in a manner to be specified in detail further below, all private decisions reflect expected income adjusted for social interactions.

vii. After rent-seeking is complete, rent-seekers are randomly matched with enforcers. Successful matches again transfer all income to enforcers who may opt to retain it for their own use, if they choose corruption, or turn it over to the Treasury if they prefer honesty.

viii. Rogue enforcers are exposed with exogenous probability $\pi \in [0,1]$; exposed rogues forfeit their government salaries but retain all looted income.

2.3.2 Matching of Rent-Seekers with Producers

The model relies critically on how rent-seekers come together with productive agents and how enforcers match with rent-seekers. Following the Diamond-Mortensen-Pissarides model we assume that rent-seekers with mass $X_t = \mu\rho_t$ match randomly with all producers with mass (in efficiency units), $V_t = 1-\mu+\gamma(1-\rho_t)\mu$, and loot victims of all after-tax income. Matching is defined in terms of a function $P(V_t, X_t)$ which enumerates the number of meetings between rent seekers and their victims. We assume that $P(V,X)$ is increasing, concave, homogeneous of degree one in (V,X) and such that:

$$P(0,X) = P(V,0) = 0, \forall (X,V), \quad P(V,X) \leq \min(V,X). \tag{8}$$

Under these assumptions, the probability that a victim meets a rent seeker is:

$$p(z_t) := \frac{P(V_t, X_t)}{V_t}, \tag{9}$$

where z_t, the intensity of rent seeking, that is, the predator-to-prey ratio X_t/V_t, of the number of rent seekers divided by the total efficiency units of productive agents. That means

$$z_t = z(\rho_t) := \frac{\mu\rho_t}{1-\mu+\gamma(1-\rho_t)\mu} = \frac{n\rho_t}{1+\gamma n(1-\rho_t)} \in [0,n],\ \rho_t \in [0,1], \tag{10}$$

where n is a parameter defined in (1) above. The probability that a victim meets a rent-seeker is P/X or simply $p(z)/z$. It is easy to see that $p(z)$ is increasing concave in z and $p(z)/z$ is decreasing and convex in z, as shown in Figure 4.

2.3.3 Enforcers with Rent-Seekers

To deter rent-seeking the government employs enforcers who receive the same wage as type $i = 1$ producers. Matching a mass D_t of enforcers with X_t rent-seekers generates probabilities that a rent seeker meet an enforcer, and vice versa, which depend on the property rights enforcement intensity, that is, on

$$\theta_t := \frac{D_t}{X_t}. \tag{11}$$

We define rent-seeker-to-enforcer matches by analogy with those of producers-to-rent seekers. Let $Q(X_t, D_t)$, the number of matches between rent seekers and enforcers, be a concave and homogeneous-of-degree-one function of its arguments, satisfying $Q(0, D) = Q(X, 0) = 0, \forall\ (X, D); Q(X, D) \leq \min(X, D)$. The probability that a rent seeker meets a cop, $q(\theta_t)$, follows immediately:

$$q(\theta_t) := \frac{Q(X_t, D_t)}{X_t},\ \theta \in [0, b],\ b \in (0, 1/n], \tag{12}$$

No rent-seekers can be apprehended if there are no enforcers. We introduce, for analytical simplicity, an upper bound, b, on the exogenous enforcement intensity at which all rent-seekers are apprehended. Succinctly, we have:

$$q(0) = 0 \leq q(\theta) \leq q(b) = 1, \theta \in [0, b],\ b \in (1, n^{-1}); q'(0) \leq 1. \tag{13}$$

Enforcer employment is a direct consequence of the collectively chosen institutions θ_t and the stock of rent-seekers X_t, and therefore reflects both individual and policy choices. See Figure 5.

3 Incomes and Occupational Choice

3.1 Production versus Rent-Seeking

Job choice in this paper boils down to a simple comparison of after-tax incomes in alternative occupations, adjusted for social interactions and personal morality. Type-2 households select between rent-seeking and productive work in the private sector. Type-1 households may choose to work in the private sector for a competitive wage rate, which we normalize to one for each efficiency unit of labor; or to enforce in the public sector for a salary also equal to one.

Keeping in mind that type-2 households are endowed with $\gamma < 1$ efficiency units of legitimate labor, we define adjusted period$-t$ incomes $\left(y_t^{HE}, \gamma y_t^{HE}\right)$ for legitimate work by types 1 and 2, where HE denotes "honest enforcement." We also define by $\left(y_t^{RE}(\varepsilon), y_t^{RS}(\varepsilon)\right)$ adjusted gross incomes for rogue enforcers (RE) and rent-seekers (RS) with moral code $\varepsilon \geq \bar{\varepsilon}$. Households take those incomes as exogenous and beyond their control. We assume that the moral code is a publicly known inverse index of social morality: the greater the value the weaker the scruples from engaging in anti-social behavior. This index is a random draw, revealed at the beginning of each agent's life cycle, from a Pareto distribution over

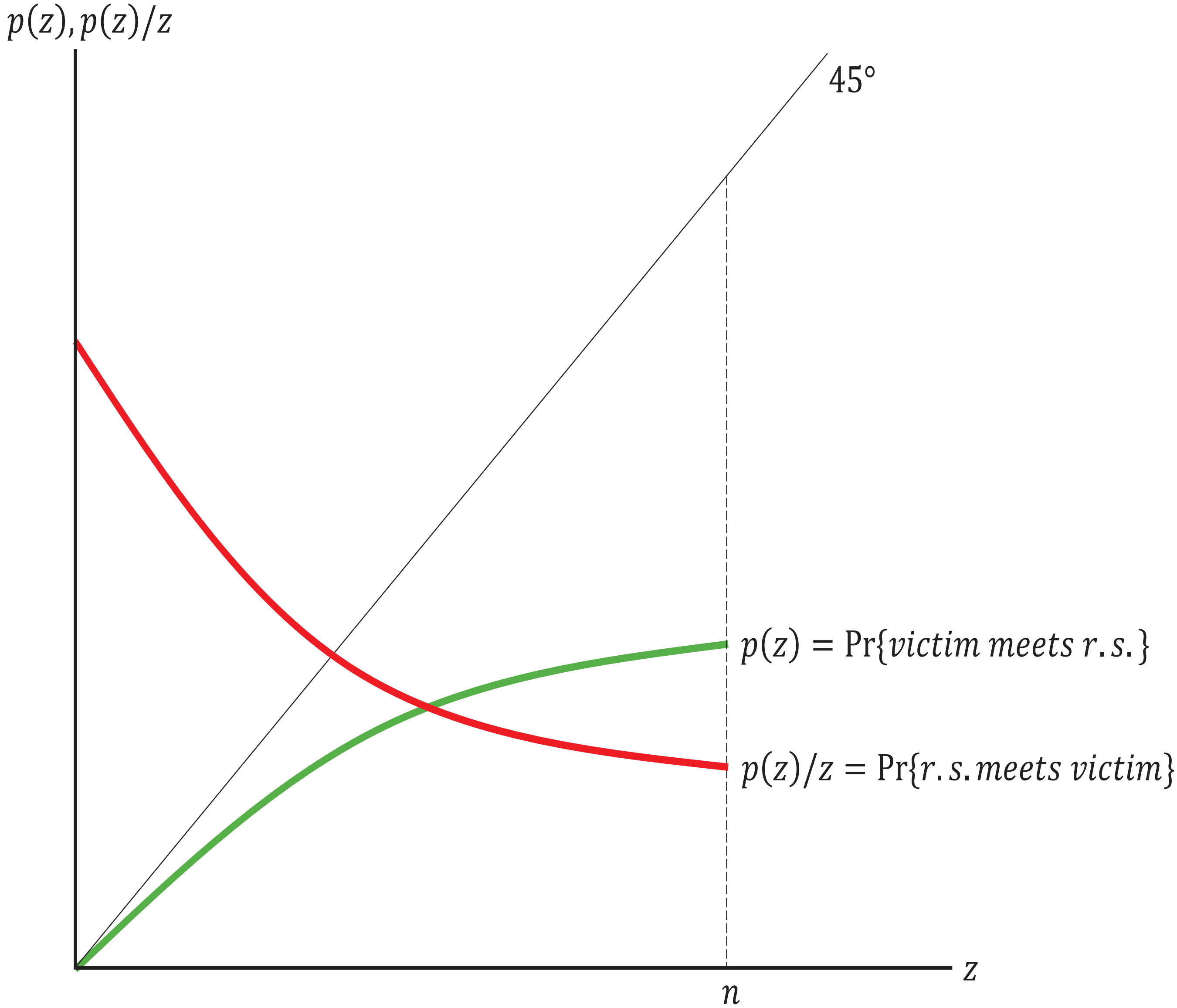

Figure 4: Rent-seeking Probabilities

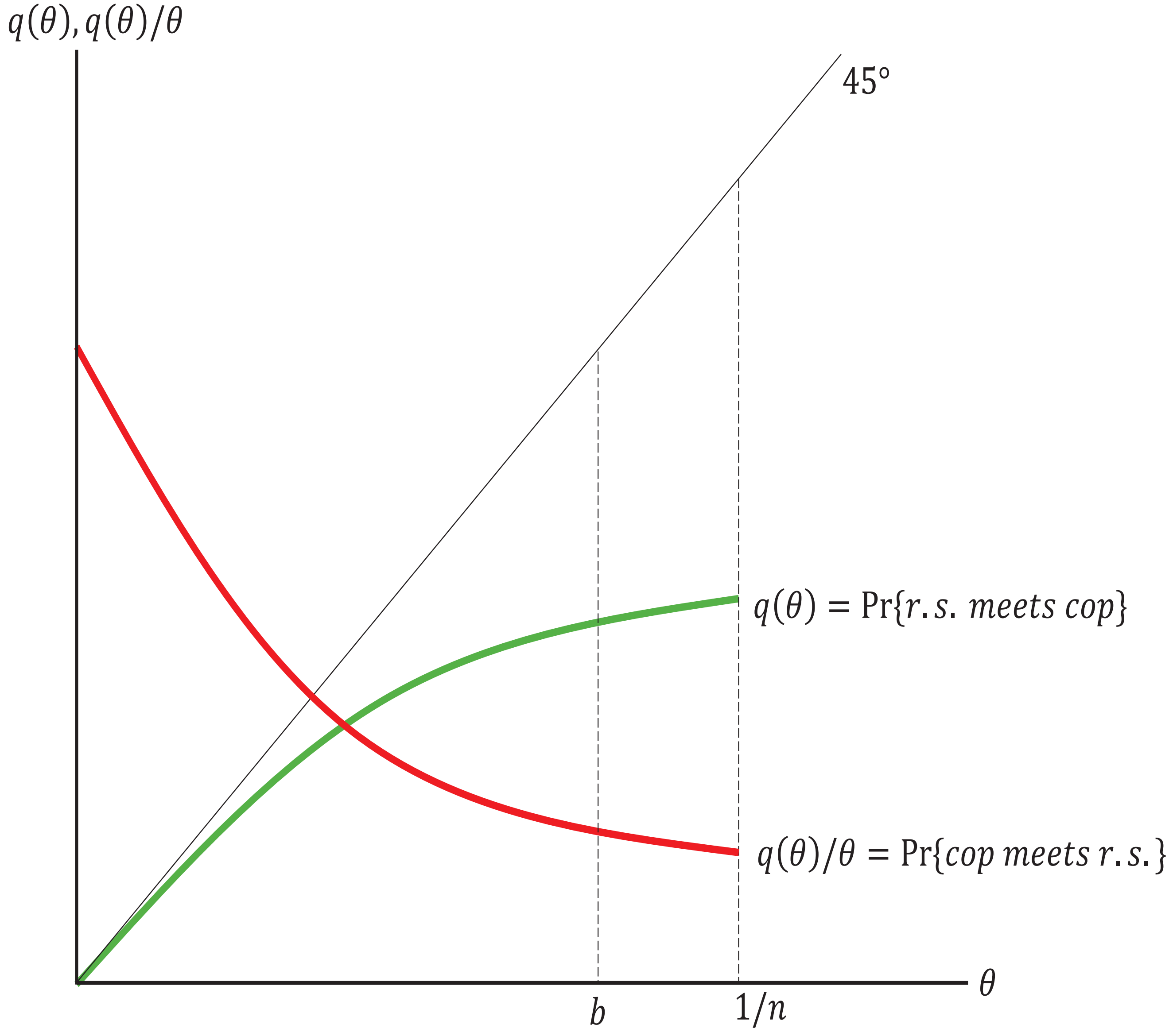

Figure 5: Apprehension Probabilities

the entire population with parameters $(\zeta, \overline{\varepsilon})$, that is:

$$\Pr\{\varepsilon \geq \overline{\varepsilon}\} := G(\varepsilon; \zeta, \overline{\varepsilon}) = 1 - \left(\frac{\overline{\varepsilon}}{\varepsilon}\right)^{\zeta}, \ \zeta \geq 2. \tag{14}$$

Individual moral codes affect all payoffs from anti-social activity.

Given the income array $\left(y_t^{HE}, y_t^{RE}(\varepsilon), y_t^{RS}(\varepsilon)\right)$ honest behavior prevails if and only if:

$$y_t^{HE} \geq y_t^{RE}; \tag{15a}$$

$$\gamma y_t^{HE} \geq y_t^{RS}. \tag{15b}$$

These conditions translate as follows in terms of ε :

$$\varepsilon \leq \hat{\varepsilon}_t^1, \ \varepsilon \leq \hat{\varepsilon}_t^2, \tag{16}$$

which mean that honest behavior obtains in each sector for all those with sufficiently high moral codes. "Morality bars" ε_t^1 and ε_t^2 depend on prevailing institutions and culture.

People with weak moral codes will engage in anti-social activity. We recall the definitions in 2.1.1 of ρ_t as the fraction of rent-seekers among type-2 households, and of x_t as the fraction of rogue enforcers among all enforcement personnel. Then, by (16) and Definition (14), we have:

$$1 - \rho_t = G(\hat{\varepsilon}_t^2; \zeta, \overline{\varepsilon}); \ \ 1 - x_t = G(\hat{\varepsilon}_t^1; \zeta, \overline{\varepsilon}), \tag{17}$$

or equivalently:

$$\rho_t = \left(\frac{\overline{\varepsilon}}{\hat{\varepsilon}_t^2}\right)^{\zeta}; x_t = \left(\frac{\overline{\varepsilon}}{\hat{\varepsilon}_t^1}\right)^{\zeta}. \tag{18}$$

We delve next into the factors that determine adjusted incomes and the critical values of the moral code.

3.2 Income Adjustments

Occupational choice in our environment depends on individual earnings, social interactions and an individual moral code. The code itself is realized as a multiplicative adjustment, or "correction" to the cash receipts each person collects from anti-social activity. Social interactions translate to a negative consumption externality arising from the disapproval felt by individuals who deviate from social norms, either because they are more honest or less honest than the norms prescribe. To simplify the exposition, we assume that social norms (ρ_t^n, x_t^n) in the private and public sector are identical and equal to the lagged value of public sector norms, that is

$$\rho_t^n = x_t^n = x_{t-1} \in [0, 1]. \tag{19}$$

We also assume that the negative consumption externality is equivalent to a tax rate proportional to each person's deviation from the social norm, i.e. to $\sigma(1 - x_t^n)$ for corrupt enforcers or rent-seekers. Once we adjust cash incomes fully for all cultural factors, equivalent lifetime expected incomes become

$$y_t^{HE} = (1 - \phi_t)[1 - p(z_t)](1 - \sigma x_{t-1}); \tag{20a}$$

$$y_t^{RS}(\varepsilon) = (1 - \phi_t)\,\frac{p(z_t)}{z_t}[1 - q(\theta_t)][1 - \sigma(1 - x_{t-1})]\varepsilon; \tag{20b}$$

$$y_t^{RE}(\varepsilon) = (1 - \phi_t)(1 - \pi)(1 - p(z_t))(1 - \sigma x_{t-1}) \tag{20c}$$

$$+ (1 - \phi_t)\frac{p(z_t)}{z_t}\frac{q(\theta_t)}{\theta_t}[1 - \sigma(1 - x_{t-1})]\varepsilon; \tag{20d}$$

where z_t is defined in (10).

In these expressions $(\phi, 1 - p, p/z, 1 - q, q/\theta)$ denote respectively, the wage tax rate collected by the government, the probability that an honest worker evades rent-seekers, the probability that a rent-seeker finds a victim, the probability that a rent-seeker evades law enforcement, and the probability that an enforcer catches a rent-seeker. Also, $(\sigma x, \sigma(1 - x))$ are implied tax rates on honest and anti-social agents, respectively, who deviate from the prevailing social norm $x \in [0,1]$ when they choose levels of honesty $(x_i, \rho_i) = (0,0)$, or corruption, $(x_i, \rho_i) = (1,1)$, which differ from the average choice of their elders. Corruption in this setting penalizes honest individuals and favors antisocial ones.[13]

Eq. (20a), in particular, summarizes several assumptions from section 2 and asserts that the adjusted income of honest workers per efficiency labor unit is the product of three terms: the after-tax cash wage, the probability of escaping predators, and a correction for deviating from social norms. A similar interpretation applies to eq. (20b) which reflects the probability of finding a victim, the probability of escaping law enforcement, and the personal morality code. Lastly, eq. (20c) combines its predecessor eqs. (20a) and (20b) to express the expected life cycle payoff of a rogue enforcer. The first term on the right-hand side of that equation is the honest- enforcer payoff adjusted downwards by the exogenous probability π of exposing rogues; the last term on the right-hand side is the expected amount of loot each enforcer recovers from captured rent-seekers.

3.3 Occupational Equilibria

We return to equations (19) through (20) to derive closed-form expressions for aggregate rent-seeking and corruption. Assuming that the random matching technology P between predators and victims displays constant elasticity of substitution with share parameter $A \geq 1$, we have the extensive and intensive form expressions

$$P(V, X) := (V^{-1} + AX^{-1})^{-1}, A \geq 1; \tag{21a}$$

$$p(z) = \frac{z}{z + A}, \; \forall z = \frac{X}{V} \in [0, n], \tag{21b}$$

For this matching technology, equations (15), (16) and (20) lead to:

Result 1: Under the matching technology (21a), critical values for the moral code ε are

[13] In the social interactions literature, the moral code ε denotes an individual social effect, z_t, the rent-seeking intensity, a contemporaneous endogenous social effect (via its dependence on ρ_t, the share of type-2 agents who become rent-seekers), and σx_{t-1} describes a lagged-endogenous social effect. In addition, eqs. (20a – 20d) capture contextual effects through the probability functions $p(z_t)$ and $q(\theta_t)$.

a. $\hat{\varepsilon}_t^1 = \max\left\{\bar{\varepsilon}, \frac{\pi A\theta_t}{q(\theta_t)} m(x_{t-1})\right\}$
$\hat{\varepsilon}_t^2 = \max\left\{\bar{\varepsilon}, \frac{\gamma A}{1-q(\theta_t)} m(x_{t-1})\right\}$.

b. The auxiliary function

$$m(x) := \frac{1-\sigma x}{1-\sigma(1-x)} \in [1-\sigma, 1/(1-\sigma)], \tag{23}$$

is decreasing and convex in x; increasing in σ if $x \leq 1/2$, decreasing in σ if $x \geq 1/2$.

c. For any constant $\theta \in [0, b]$ and $\lambda := \bar{\varepsilon}/\gamma A \leq 1$, the equilibrium values of corruption and rent-seeking intensities satisfy the following laws of motion in eqs. (17) or (18):

$$x_t = \mathcal{J}(x_{t-1}; \theta, \sigma) := \min\left\{1, \left[\frac{B_1(\theta)}{m(x_{t-1})}\right]^{\zeta}\right\}; \tag{24a}$$

$$\rho_t = \min\left\{1, \left[\frac{B_2(\theta)}{m(x_{t-1})}\right]^{\zeta}\right\}, \tag{24b}$$

where

$$B_1(\theta) := \lambda \frac{q(\theta)}{\theta}\frac{\gamma}{\pi}; \tag{25a}$$

$$B_2(\theta) := \lambda[1-q(\theta)] \leq 1, \ \forall \theta \in [0, b]. \tag{25b}$$

Equations (24a,b and (25a,b) provide a complete description of corruption dynamics: if $\bar{\varepsilon}$ is small enough, then aggregate corruption at any time $t = 0, 1, \ldots,$ is simply proportional to the square of corruption intensity, that is:

$$C_t(\theta) = x_t D_t = x_t \theta X_t = x_t \theta \mu \rho_t. \tag{26}$$

Before we delve into the mechanics of corruption, we take a quick look, in section 4 at how a joint political-economic equilibrium comes about in a simple economy with strong social interactions when all households face binary choices.

4 A Simple Binary Economy

We demonstrate the power of our approach and key ingredients of our theory via a greatly simplified economy in which all choices are binary: all type-2 agents are either rent-seekers or productive workers; the economy is at an equilibrium consistent with these choices; and institutional choice is discrete — either no enforcement of property rights at $\theta_t = 0$, or full enforcement at $\theta_t = b$ under a matching technology ensuring that rent-seekers are caught with probability one. Thus hiring of enforcers is unnecessary and so are income taxes, which means that all type-1 agents are productively employed. We arrive at this simplification by assuming away the individual moral code, $\varepsilon = 1$. We study the dynamic evolution of the economy under a cultural setting that is maximally sensitive to antisocial behavior: $\sigma = 1$, for which $m(\rho_{t-1}) = \frac{1-\rho_{t-1}}{\rho_{t-1}}$. In addition, we invoke Assumption (21a) for some $A \geq 1$, and $\lambda := \bar{\varepsilon}/\gamma A = 1$.

Under those assumptions, equations (20a,b,c) simplify to:

$$y_t^{HE} = \frac{A(1 - x_{t-1})}{A + z_t}; \tag{27a}$$

$$y_t^{RS}(1) = \frac{[1 - q(\theta_t)]x_{t-1}}{A + z_t}; \tag{27b}$$

$$y_t^{RE}(1) = \frac{1}{A + z_t}\left[(1 - \pi)A(1 - x_{t-1}) + \frac{q(\theta_t)}{\theta_t}x_{t-1}\right]; \tag{27c}$$

with $\theta_t \in \{0, b\}$ and z_t given by (10).

4.1 Individual Incomes

Since every agent chooses the occupation that maximizes adjusted income, our assumptions imply that agents of type$= 1, 2$, have payoffs

$$\begin{aligned} y_t^1 &= y_t^{HE}, && \text{if type-1 producer;} && (28a)\\ &= \max\{y_t^{HE}, y_t^{RE}(1)\}, && \text{if type-1 enforcer;} && (28b)\\ y_t^2 &= \max\{\gamma y_t^{HE}, y_t^{RS}(1)\}, && \text{if type-2.} && (28c) \end{aligned}$$

Full enforcement, $\theta_t = b$, eliminates all anti-social activity, generating adjusted incomes

$$\left\{y_t^1, y_t^2\right\} = \{1, \gamma\}, \tag{29}$$

when the wage rate is normalized to one. At the other extreme, no enforcement, $\theta_t = 0$, implies $q(0) = 0$, making rent-seeking feasible for agents of type-2, and also making agents of type-1 recognize that they may be looted. Therefore, from (28a,b,c) incomes become:

$$\left\{y_t^1, y_t^2\right\} = \frac{1}{A + z_t} \left\{A(1 - x_{t-1}), \max[\gamma A(1 - x_{t-1}), x_{t-1}]\right\}; \tag{30}$$

Comparing equations (29) and (30) shows that productive type−1 households prefer full enforcement to none, because they are completely unsuited to rent-seeking. If we define the critical value

$$\hat{x} := \frac{\gamma A}{1 + \gamma A}, \tag{31}$$

we conclude directly from (30) that all type−2 agents will choose legitimate labor under good norms, $x_{t-1} \leq \hat{x}$, which implies $z_t = 0$, and rent-seeking otherwise.

Figure 6 shows the law of motion for corruption activity when property rights are not enforced. The respective equilibrium values of income are:

$$y_t^2 = \gamma(1 - x_{t-1}), \qquad \text{if } x_{t-1} \leq \hat{x}; \tag{32a}$$

$$= \frac{x_{t-1}}{A + n}, \qquad \text{if } x_{t-1} \geq \hat{x}. \tag{32b}$$

4.2 Choosing Institutions under Conformism: $\sigma = 1$

For $\sigma = 1$, majority voting mirrors exactly the wishes of type−2 households, who are by assumption (1) the politically dominant group. Eqs. (29) and (32) assert that the majority choice will be

i. full enforcement, $\theta_t = b$, if norms are good, that is, $x_{t-1} < \widetilde{x} = \frac{\gamma(A+n)}{1+\gamma(A+n)}$;

ii. no-enforcement, $\theta_t = 0$, otherwise.

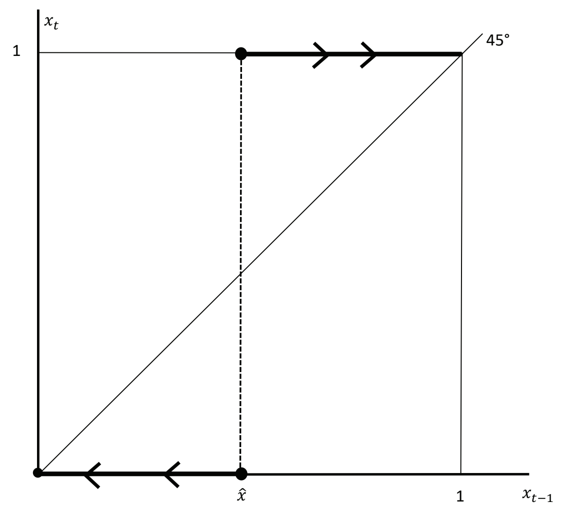

Figure 6: Corruption Dynamics for $(\theta, \sigma) = (0, 1)$

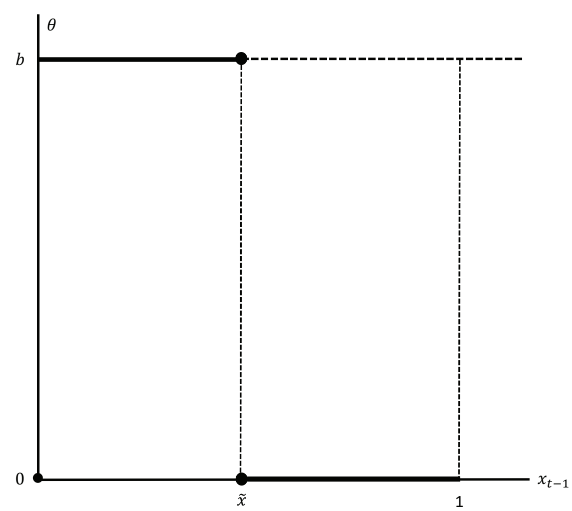

Figure 7: Binary Institutional Choice for $\sigma = 1$

The main takeaways from this example are that, as (γ, A) increase, a majority prefer strong institutions for a larger range of initial histories; and institutional choice mirrors history under a conformist culture ($\sigma = 1$). These possibilities are depicted in Figure 7.

5 Equilibrium Dynamics for Given Institutions

5.1 The Law of Motion for Corruption

This section explores laws of motion for a society in equilibrium when institutions are fixed at an exogenous value $\theta_t \in \{0, b\}$ while the intensity of social interactions is assumed to be time-invariant, $\sigma \in [0,1]$. With the full complement of social effects being present, we derive laws of motion for the fraction of corrupt ("rogue") enforcers in the total police force and for the fraction of rent-seekers in the total type-2 population, (ρ_t, x_t) If social norms equal the lagged value of of the share of corrupt enforcers, x_{t-1}, then the equilibrium is determinate and monotone, converging to a unique steady state that reflects institutional quality and individualism. Section 6 extends these laws of motion to aggregate corruption and GDP; section 7 describes what happens when institutions are endogenous.

Key results are proved in the Appendix and are summed up in

<u>Result 2</u>: Define the parameter $\nu := \frac{\bar{\varepsilon}}{\pi A} q'(0)$ and assume $\nu < 1, \zeta > 2$. Then:

a. If $\sigma \in [0, 1-\nu]$, that is, if society is sufficiently individualistic, the function $\mathcal{J}(x; \theta, \sigma)$ defined in eqs. (24a) and (25) is well behaved; it is smooth, increasing, and convex in x for each $(\theta, \sigma) \in [0, b] \times [0, 1-\nu]$. Eq. (24a) has a unique, stable fixed point $x^*(\theta, \sigma)$, which describes long-term corruption intensity and attracts all equilibrium sequences from any initial norm x_0 as shown in Figure 8.

b. The long-run corruption intensity x^* is decreasing in institutional quality for all $\sigma \in [0, 1-\nu]$. It is also decreasing in the individualism index σ, if $\sigma < \frac{1}{2}$, and increasing in σ if $\sigma > \frac{1}{2}$.

c. Long-run rent-seeking is decreasing in institutional quality, θ, and in the productive skills γ of type-2 agents.

d. If $\sigma \in [1-\nu, 1]$ we define $\theta = \hat{\theta} \in [0, b)$ to be the unique solution of the equation

$$\frac{q(\theta)}{\theta} = \frac{1-\sigma}{\nu} q'(0). \tag{33}$$

Then the law of motion is identical to the one in Figure 8 and part (a) above, if $\theta \in [\hat{\theta}, b]$, that is, if institutional quality is sufficiently high.

e. If $\sigma \in [1-\nu, 1]$ and $\theta \in [0, \hat{\theta}]$, that is, if society is sufficiently conformist and institutions are relatively weak, then the law of motion (24a) becomes sigmoid with three fixed points:[14] a low stable steady state $x^*(\theta, \sigma) < \frac{1}{2}$ described earlier; a high stable steady state $x = 1$, and an unstable intermediate steady state $\tilde{x}(\theta, \sigma) > \frac{1}{2}$. These are shown in Figure 9 which is a more general version of Figure 6.

5.2 Discussion

There is a notable similarity between the evolution of ρ_t and x_t. Both depend on the matching functions $(p(z), q(\theta))$, and on social norms through the function m. Greater enforcement hinders both corruption and rent-seeking intensities in the steady state, but not necessarily the aggregate amount of corruption. From an empirical vantage point, the behavioral similarity of rent-seeking to corruption is welcome because it appears that unobservable rent-seeking tracks observable corruption. We explore this similarity in our empirical work, reported in section 8.

In addition, we have club convergence for combined low values of individualism and institutional quality. In that situation, there is a critical value $\tilde{x}(\theta, \sigma)$ for social norms with the property that long-run equilibria converge to low corruption if social norms begin below $\tilde{x}$, and to universal corruption at $x = 1$, if norms begin above $\tilde{x}$. The basin of attraction to universal public corruption is larger for nations with weaker institutions and stronger collectivist values.

[14] Multiple steady states often occur in models of social interactions when externalities are strong. See Ioannides (2013), p.32, for more details.

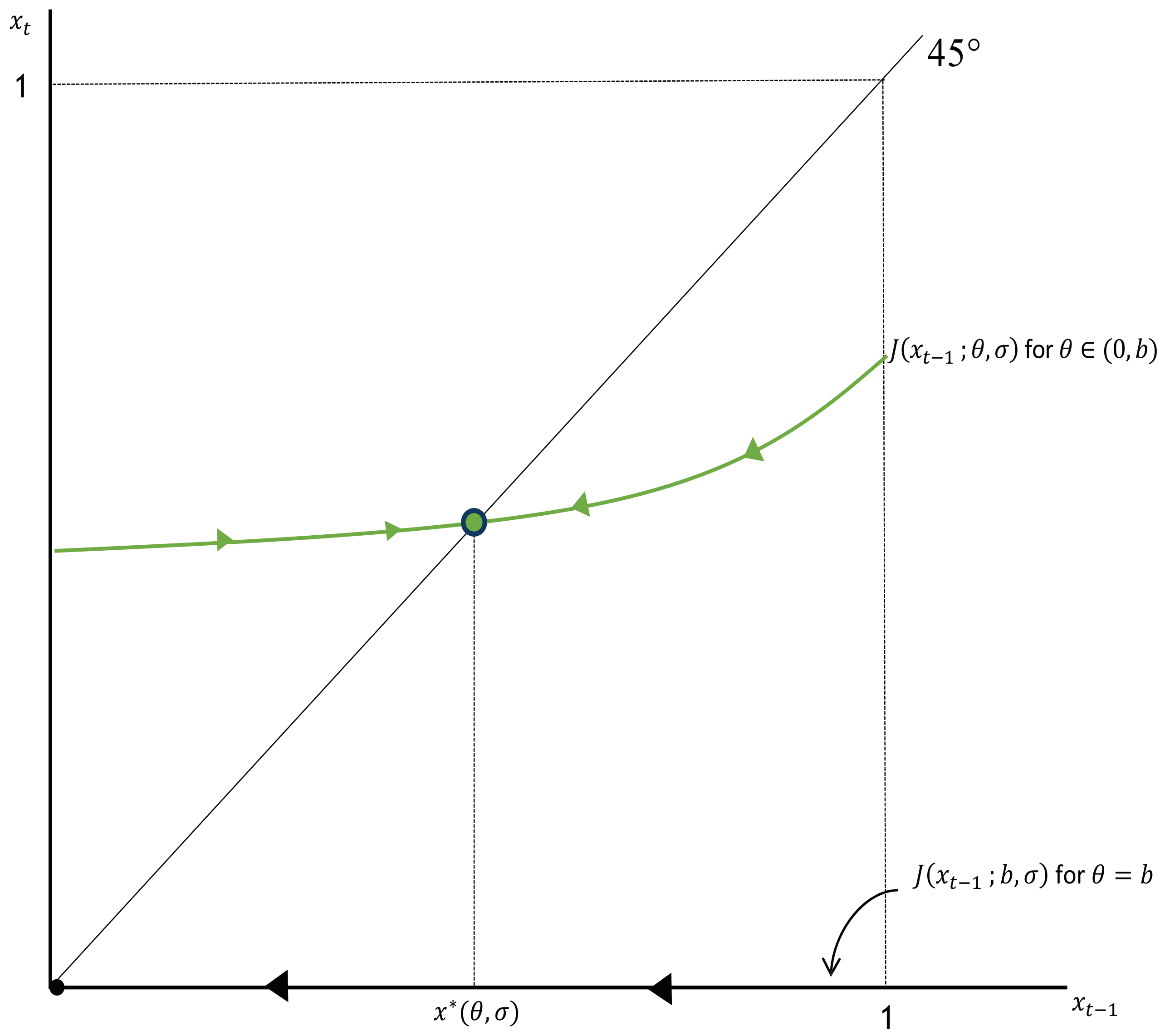

Figure 8: Corruption vs. Norms at Low σ

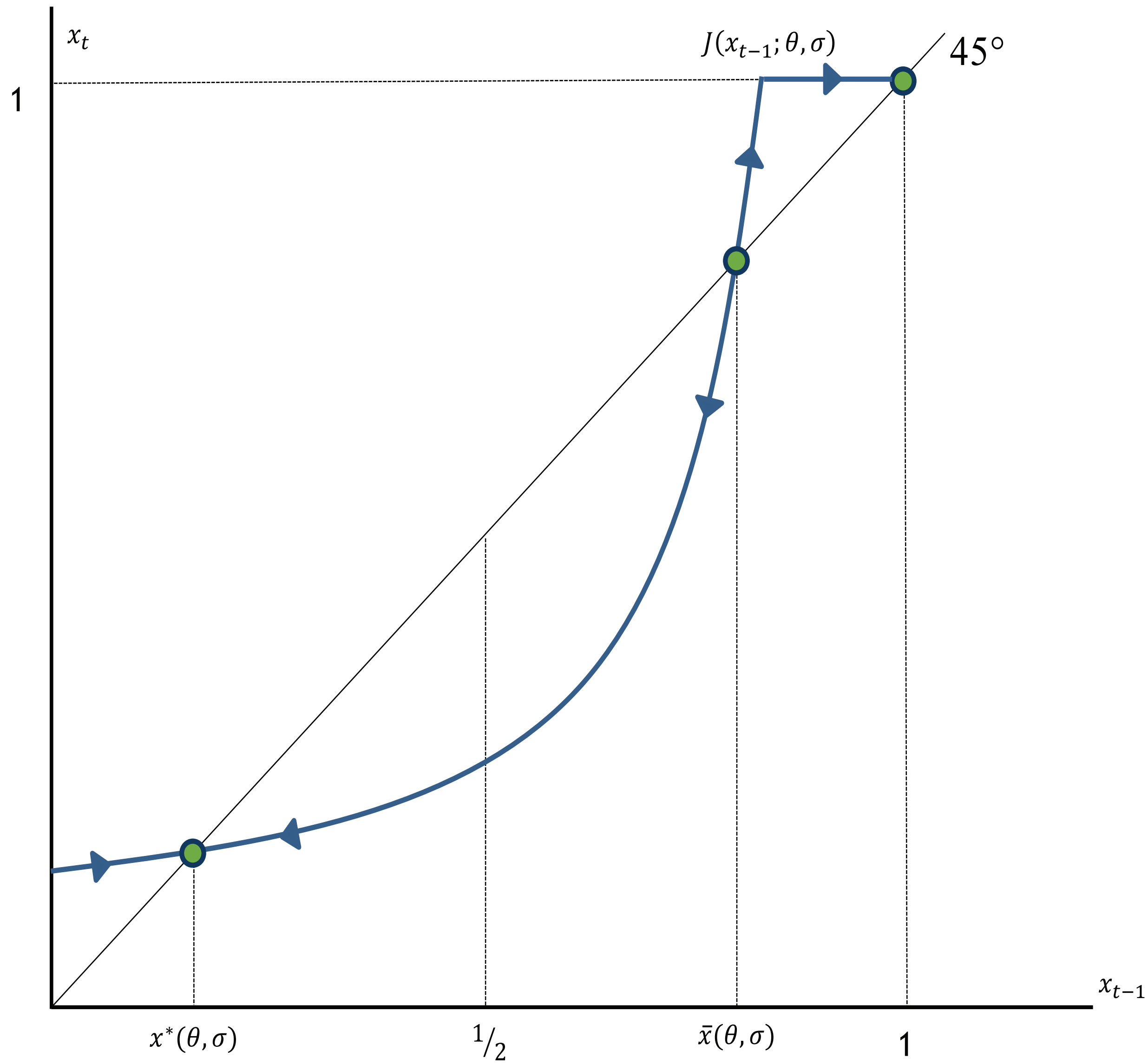

Figure 9: Corruption vs. Norms at High σ and Low θ

6 Corruption and GDP in the Long Run

In our highly simplified model, laid out in section 2 and 3, a good proxy for GDP is the mass of employment allocated to production. This section explores the relationship of corruption and GDP for exogenously given (but possibly time-varying) institutional quality in order to obtain predictions for the relationship between corruption and GDP as institutional quality varies over time. We obtain precise analytical predictions by assuming that the intensive-form matching function between enforcers and rent-seekers is $q(\theta) = \frac{\theta}{1+\theta}$.

We begin with aggregate corruption from eq. (26), then subtract employment in rent-seeking and enforcement from the maximal value of employment:

$$Y(\theta_t) = 1 - \mu + \gamma\mu - (\theta_t + \gamma)\mu\rho_t. \tag{34}$$

Next we insert the function $q(\theta) = \theta/(1+\theta)$ into eqs. (24a,b) to obtain expressions for aggregate corruption and GDP. These are given below.

6.1 The Joint Determination of Corruption and GDP

By expressing (C, Y) as direct functions of θ_t, we have aggregate corruption:

$$C(\theta_t, x_{t-1}) = b_1(x_{t-1}; \lambda, \sigma, \gamma)\tau(\theta_t), \tag{35}$$

where

$$b_1(x_{t-1}; \lambda, \sigma, \gamma) := \mu\left(\frac{\gamma}{\pi}\right)^{\zeta}\lambda^{2\zeta}\left[\frac{1-\sigma+\sigma\left(\frac{\pi}{\gamma}\right)^{\zeta}x_{t-1}}{1-\sigma\left(\frac{\pi}{\gamma}\right)^{\zeta}x_{t-1}}\right]^{2\zeta}\ ;\ \tau(\theta) := \frac{\theta}{(1+\theta)^{2\zeta}}.$$

We also have

$$Y(\theta_t, x_{t-1}) = 1 - \mu + \gamma\mu - b_2(x_{t-1}; \lambda, \sigma, \gamma)\psi(\theta_t) \tag{36}$$

where

$$b_2(x_{t-1};\lambda,\sigma,\gamma)=\mu\lambda^{\zeta}\left[\frac{1-\sigma+\sigma\left(\frac{\pi}{\gamma}\right)^{\zeta}x_{t-1}}{1-\sigma\left(\frac{\pi}{\gamma}\right)^{\zeta}x_{t-1}}\right]^{\zeta};\ \psi(\theta_t)=\frac{\theta_t+\gamma}{(1+\theta_t)^{\zeta}}.$$

It readily follows that $\tau(\theta)$ and $\psi(\theta)$ are concave functions of θ, with $\tau(0)=0,\psi(0)>0$; τ is increasing in θ iff $\theta<\hat{\theta}:=\frac{1}{2\zeta-1}$, and ψ is increasing iff $\theta<\widetilde{\theta}:=\frac{1-\zeta\gamma}{\zeta-1}$; and $\hat{\theta}>\widetilde{\theta}>0$ if $\gamma\zeta<1$.

These properties are shown in Figure 10. GDP is also decreasing in lagged corruption and in enforcement strength (via the probability that rogue cops are apprehended), and increasing in skills and in institutional quality.[15]

This example shows that, for low values of the human skills parameter γ, GDP may be decreasing in θ for small θ. GDP falls when an improvement in policing requires reallocating skilled labor away from production while freeing unskilled labor from rent-seeking. A positive correlation is consistent with the empirical observation that corruption and GDP sometimes move together, especially in emerging economies.

[15]For a fixed institutional quality θ, equations (35) and (36) imply, somewhat counterintuitively, that individualist societies are associated with higher GDP and lower corruption if corruption norms are not low, and with reverse outcomes if corruption tolerance is quite low. As we will find out in section 7, however, high tolerance for corruption typically biases political equilibria toward weak institutions and poor economic performance.

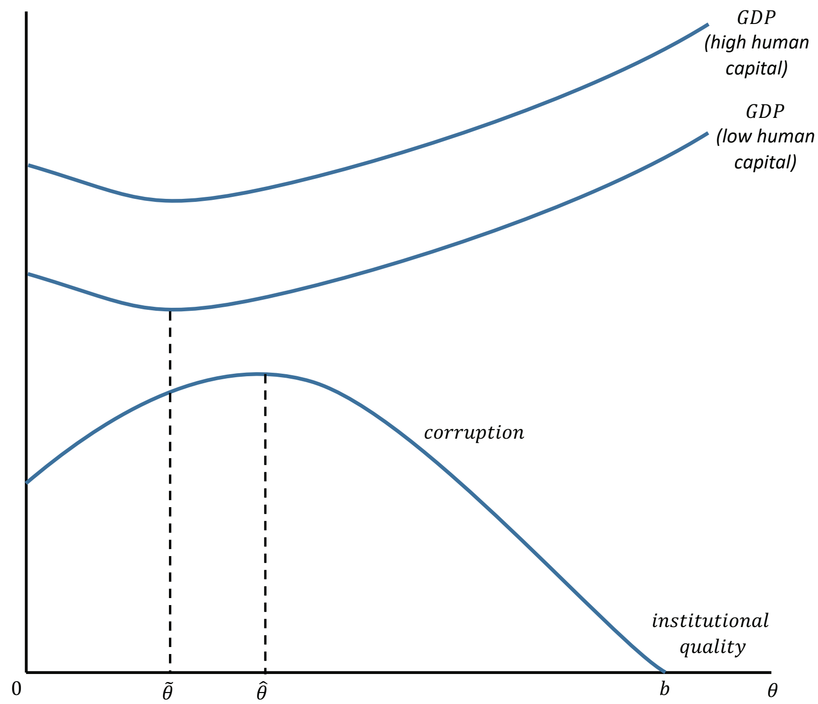

Figure 10: Corruption and GDP vs. Institutions

6.2 Discussion

We can interpret eq. (36) as a reduced form for the evolution of GDP. We note that the effect of institutional quality is separable from other factors. For any given path of institutional quality, $\{\theta_t\}$, GDP is increasing in the quality of institutions for sufficiently high θ_t, decreasing in the lagged incidence of corruption, x_{t-1}, and increasing in the skills of the lower skilled agents, γ, and therefore in the average skills of the population. GDP is also decreasing (increasing) in the conformity/anticonformity parameter σ, if $\left(\frac{\pi}{\gamma}\right)^{\zeta} x_{t-1} \leq (\geq) 1/2$. As the above analysis makes clear, enforcement is a key intermediary: stronger enforcement reallocates type-1 labor from production to policing. It also reduces after-tax earnings for rent-seekers, forcing some of them into productive activity; output declines initially as the number of added enforcers is below that of repentant rent-seekers, and rises eventually.

Eqs. (24, 25) directly trace the evolution of the incidence of corruption, which depends on several factors: institutional quality, the gain from anti-social behavior (via the lower bound of the support of the individual moral code $\bar{\varepsilon}$), the conformity parameter σ, and the efficiency of the processes matching rent-seekers with their victims and their pursuers.

We turn next to the determination of institutional quality, the key variable which seems — in both theoretical and empirical work — to power movements in corruption and national income.

7 Choosing Institutions by Majority

We have taken institutions as given so far, and studied their impact on the evolution and steady-state outcomes of corruption and rent-seeking. The impact of norms works through the economy's social interactions (or culture) parameter σ. Long-run outcomes depend strongly on norms when σ is high, and they do so through two distinct channels. One is that norms may reflect established social habits, that is, past corruption and rent-seeking in the manner exemplified in the corruption dynamics of eq. (24a). Here initial norms x_0 determine how long each society takes to approach the steady state $x^*(\theta, \sigma)$ which corresponds to a particular combination of institutions and culture.

A second channel operates through politics when institutions are endogenous. As we will see shortly, conformist societies tend to tailor their institutional choices to inherited habits: poor norms create majorities favoring weak property rights; strong norms lead in the opposite direction.

We explore the choice of institutions through majority voting over the binary agenda $\theta_t \in \{0, b\}$, that is, between no enforcement and full enforcement. We assume both to be costlessly signaled. In the case of no enforcement, the government hires no enforcers. In the case of full enforcement, $\theta = b$ the government signals a zero-tolerance policy, namely that rent-seekers will be caught with probability 1 which means the government hires no enforcers at equilibrium and raises no taxes: $\phi = 0$. There is no rent-seeking or corruption. Interestingly, working with a binary choice of institutions obviates the need for taxes and a public enforcement sector.

We note at the outset that only young households are affected by institutional quality because the accumulated savings of old households are, by assumption, exempt from rent-seeking or corruption. While young agents of type-1 unequivocally benefit from good institutions, those of type-2 face a consequential choice due to their comparative advantage in rent-seeking: they may rent-seek with one efficiency labor unit; or, they may work productively with $\gamma < 1$ efficiency units. Therefore, the occupational composition of the economy is critical to the choice of institutions, and vice versa.

The Technical Appendix shows that eq. (16), which guarantees honest behavior, holds for a simple majority of the population at time t when:

$$1 \geq \mathcal{H}\left(\frac{\lambda}{m}\right) := (2\mu)^{\frac{1}{\zeta}}(\frac{\lambda}{m}) - \frac{1}{A}\frac{n(\frac{\lambda}{m})^{\zeta}}{1+\gamma n\left[1-(\frac{\lambda}{m})^{\zeta}\right]}, \tag{37}$$

where we recall $\lambda := \frac{\bar{\varepsilon}}{\gamma A}$ and $m = m(x_{t-1})$ is as defined in (23). It is also easy to verify that, if the matching parameter A is large enough, then the function $\mathcal{H}\left(\frac{\lambda}{m}\right)$ is increasing and concave in $\frac{\lambda}{m}$, and the equation

$$\mathcal{H}(\lambda) = 1 \tag{38}$$

has a unique solution $\lambda^* \in (0, 1)$.

The main takeaway from this analysis is proved in the Technical Appendix and is summed up in

Result 3: Define critical values

$$\hat{A} := \frac{n\zeta(1+\gamma n)}{(2\mu)^{\frac{1}{\zeta}}} \text{ and } \widetilde{A} := \frac{n}{\left[(2\mu)^{\frac{1}{\zeta}} - 1\right]}$$

for the matching parameter A and suppose that $A \geq \max\{\hat{A}, \widetilde{A}\}$. Also define critical values $\hat{x}(\sigma, \lambda)$ for the norm x_{t-1}, and $(\tilde{\sigma}, \hat{\sigma})$ for the social interactions parameter σ such that

$$\hat{x}(\sigma, \lambda) := \frac{\lambda^* - \lambda(1-\sigma)}{\sigma(\lambda^* + \lambda)}; \tag{39a}$$

$$\hat{\sigma} := \frac{\lambda^*}{\lambda} - 1 > \tilde{\sigma} := 1 - \frac{\lambda}{\lambda^*} \tag{39b}$$

where $\lambda^* \in (0, 1)$ uniquely solves eq. (38). Then:

a. A majority votes for full enforcement if $x_{t-1} \leq \hat{x}(\sigma, \lambda)$, for no enforcement otherwise.

b. If the human skills parameter γ is sufficiently small, that is, $\lambda \in (\lambda^*, 1)$, then $\hat{x}(\sigma, \lambda) < 0,\ \forall(\sigma, \lambda)$, and the median voter opts for no enforcement for any social norm $x_{t-1} \in [0, 1]$.

c. If γ is not small, that is, if $\lambda \in (0, \lambda^*)$, then full enforcement prevails for all norms, provided that $\sigma \in (0, \tilde{\sigma})$; and regimes switch at $x_{t-1} = \hat{x}(\sigma, \lambda)$ if $\sigma \in (\tilde{\sigma}, \hat{\sigma})$, as shown in Figure 3.

Figure 3 shows the critical norm $\hat{x}(\sigma, \lambda)$ as a downward-sloped curve. It also explains why more human capital and stronger moral codes, that is, higher values of γ and lower values of $\bar{\varepsilon}$, shrink the area (σ, x_{t-1}) of culture and social norms which favors no enforcement: type-2 agents find legitimate work more attractive. On the other side, pairing weak social norms to a high degree of conformism encourages factor misallocation and perpetuates underdevelopment.

To get a quantitative sense of how much damage weak social norms can create, we compute the gap

$$g_t := Y^* - Y_t, \tag{40}$$

between maximum feasible national income,

$$Y^* = 1 - \mu + \gamma\mu$$

and actual income. Normalizing to one the output per efficiency labor unit supplied by each productive worker, we have:

$$g_t = \gamma\mu\rho_t, \tag{41}$$

which captures the loss of potential output due to rent-seeking alone, because enforcement vanishes in all equilibria with $\theta \in \{0, b\}$.

Assuming social norms for rent-seekers reflect past rent-seeking,

$$\rho_t^n = \rho_{t-1}, \tag{42}$$

Result 3 says that the output gap is zero unless:

i. the human skill parameter γ is small (or, equivalently, λ is large);

ii. (γ, σ) are large and norms are corruption-tolerant.

In both these cases, the gap at time t and its unique steady state satisfy:

$$g_t = \frac{\gamma\mu\lambda}{m(\rho_{t-1})}; \tag{43a}$$

$$g^* = \frac{\gamma\mu\lambda}{m[\rho^*(0,\sigma)]}. \tag{43b}$$

The asymptotic convergence to the steady state resembles that of Result 1(a) and Figure 8.

8 From Theoretical Predictions to the Data

Our most basic results, numbered 1 through 3, make specific predictions about the cross-section and time-series behavior of GDP per capita, corruption, and institutions, especially when institutions are endogenous and culture is fixed. The Hofstede index as a proxy for culture corresponds neatly to the taste parameter σ. However, for other culture proxies, our theory does not offer specific predictions. But using those allows us to examine the robustness of our results, regardless of how we proxy for culture. Below, we express these predictions in terms of regression equations. In taking the theory to the data we pursue broad implications of our predictions and ignore most of our nonlinear predictions, with one exception, nonlinear estimations for corruption dynamics. We plan to consider the full set of nonlinearities in a followup study.

8.1 GDP per Capita Regressions

From section 6 we expect that GDP per capita $y_{j,t}$ for country j at time t should decrease with weaker social norms, or, equivalently, the lagged incidence of corruption $x_{j,t-1}$; should increase with lagged human capital $\gamma_{j,t-1}$, and with lagged institutional quality, proxied by θ_t; be conditional on culture, σ_j,[16] and specifically should decrease with collectivism, provided that $2\left(\frac{\pi}{\gamma}\right)^{\zeta} x_{t-1} > 1$. The regression equation is:

$$y_{j,t} = b + b_{y,x} \cdot x_{j,t-1} + b_{y,\theta} \cdot \theta_{i,j,t-1} + \beta_{y,\sigma} \cdot \sigma_j + b_\gamma \cdot \gamma_{j,t-1} + D_t + \varepsilon^y_{j,t}, \tag{44}$$

where D_t denotes year dummies, and alternative specifications for the stochastic term $\epsilon^y_{j,t}$ may be iid shocks, random effects, or modified random effects since culture is time-invariant.

8.2 Corruption Regressions

Our Result 1c predicts, when institutions are given, that current corruption increases in its own lagged value; decreases in institutional quality; and increases in the degree of collectivism if norms are poor, decreases if norms are good. Regarding corruption in the long run, Result 2 predicts corruption decreases with the quality of institutions and is independent of the starting incidence of corruption (for low levels of conformism); increases with the quality of institutions for sufficiently strong levels of conformism. If conformism is high and the law of motion for corruption has two steady states, these properties are inherited by the stable (and lower) steady state. However, even in that case, corruption is increasing in lagged corruption. Although our theory predicts that the dynamics of corruption are independent of human capital, we think it is appropriate to allow for such an effect in our estimations.[17] In addition, recalling our Result 2(e), we note that if society is sufficiently conformist and institutions are relatively weak, then the law of motion (24a) becomes sigmoid with three

[16] Culture could be time-varying, but the Inglehart and Welzel (2017) variables, the only set of time-varying proxies for culture that are available and we worked with, did not perform well with our data. Specifically, they destroyed the effects of all other variables of interest. This disappointing performance of those time-varying proxies precludes, unfortunately, our use of fixed effects in the stochastic structure.

[17] We base such a conjecture on the fact that human capital raises skills, discourages rent-seeking, and shrinks opportunities for corruption. In addition, it can proxy for omitted variables.

fixed points. We heed this prediction of our theory regarding the dependence of $x_{j,t}$ on its lagged value by assuming the functional form $\tanh(x_{j,t-1})$. In addition, it is a function of culture, σ_j, of lagged institutions, $\theta_{j,t-1}$, and lagged human capital, $\gamma_{j,t-1}$:

$$x_{j,t} = b + b_{x,x} \cdot \tanh(x_{j,t-1}) + b_{x,\theta} \cdot \theta_{j,t-1} + \beta_{x,\sigma} \cdot \sigma_j + b_\gamma \cdot \gamma_{j,t-1} + D_t + \epsilon^x_{j,t}, \tag{45}$$

where the function $\tanh(bx) := \frac{e^{bx} - e^{-bx}}{e^{bx} + e^{-bx}}$ is a particularly flexible one-parameter expression that nests sigmoid functions similar to those suggested by the theory. Depending upon parameter values, a steady state version of (45) may admit three fixed points, exactly as the theory predicts.

8.3 Institutions Regressions

We summarize the predictions of Result 3, section 7, when the choice is restricted to either no enforcement or full enforcement.[18] Better institutions are more likely the lower is lagged corruption, the higher is human capital (provided that collectivism is not too strong), and the lower is collectivism. Although the theory does not explicitly predict an effect from lagged GDP per capita, we include it in the regressions as a proxy for omitted variables not captured by the other regressors. That will give us:

$$\theta_{i,j,t} = b + b_{i,x} \cdot x_{j,t-1} + b_{i,y} \cdot y_{j,t-1} + \beta_{,\sigma} \cdot \sigma_j + b_{i,\gamma} \cdot \gamma_{j,t-1} + D_t + \epsilon^\theta_{j,t}, \tag{46}$$

where, again, it is important to allow for alternative stochastic structure specifications that are appropriate given the available data.[19]

[18]Data on institutions is typically either categorical or continuous.

[19]A trivial extension of eq. (46) would include a vector of institutions rather than just one at a time, as a way to mitigate the lack of a single fiscal measure required by our theory. Although this is perfectly feasible, availability of data for many institutions greatly reduces the number of observations available for estimation as well as the information content of our estimates.

8.4 Empirical Strategy and Instruments

Income and institutions are simultaneously determined, given culture, and even though culture could be assumed to be slow varying and almost exogenous, we cannot ignore the simultaneity affecting income, corruption and institutions. The set of predictions that we take to the data is quite novel and, consequently, the existing empirical literature provides little specific guidance regarding valid instruments for endogenous regressors. Many researchers have sought valid instruments for culture and institutions, which is easier in a static context.

We do not instrument for the Hofstede Index by appealing to Gorodnichenko and Roland (2017), who provide robust evidence of its exogeneity. We appeal to the careful work of Falk *et al.* (2018) in constructing the GPS data and adopt their claim that they are exogenous.

We address the potential endogeneity of human capital by experimenting with alternative measures of the demographic composition of the population and settling with the five-year lag of the population share occupied by persons aged 15-64. We handle the potential endogeneity of measures of corruption, following Jha and Sarangi (2018), by means of the share of women in parliament [Inter-Parliamentary Union (2019)].[20] We address the potential endogeneity of lagged institutions by using formally as instruments the explanatory variables which our theory suggests are determinants of institutions in the manner described by eq. (46) above.

9 Data on GDP per capita, human capital, Culture, Corruption and Institutions

9.1 GDP per capita and Human Capital

Throughout this study, we employ annual data on real GDP per capita from Penn World Tables Version 9.0 (PWT9.0). Human capital, in particular, is the measure available in

[20] These authors provide robust evidence via a cross country analysis that women's presence in parliament has a causal and negative impact on corruption while other measures of female participation in economic activities are shown to have no effect.

PWT9.0, a human capital index based on schooling.[21] For the variables used as instruments, we obtain the share of women in parliament from the International Parliamentary Union (2019), and the age composition of the population from the World Development Indicators.[22]

9.2 Proxies for Culture

Many different measures of culture that economists use are borrowed from other social scientists. A proxy of *culture* that lends itself well to our model is a society's tendency towards conformism (or collectivism) versus its opposite, individualism. The former connotes a preference for uncritically or habitually adhering to the customs, rules, or styles of an in-group (a group broader than the family), in exchange for loyalty.[23] The Hofstede Individualism vs. Collectivism Index, which we employ, recognizes the continuum aspect of this dimension — societies do not necessarily belong to either extreme.

We establish robustness of the basic model predictions regarding the effects of the key explanatory variables, as expressed in eqs. (44)– (46), by also estimating them using several alternative measures of culture. For brevity, we report estimates based only on the Hofstede Index and the Falk *et al.* (2018) measures of culture drawn from their Global Preference Survey (GPS). This group of variables consist of measures of patience, risk-taking, positive reciprocity, negative reciprocity, altruism and trust.The GPS measures of culture are time-invariant, like the Hofstede index. To the best of our knowledge, the Falk *et al.* (2018) measures of culture are the only ones that have been produced by economists.[24]

9.3 Measures for Corruption

Several measures of the incidence of corruption across countries appear in the literature. We report estimations with the Perception of Corruption Index (`CPI`) (higher value means more

[21] https://www.rug.nl/ggdc/docs/human_capital_in_pwt_90.pdf

[22] https://data.worldbank.org/indicator/SP.POP.1564.TO.ZS

[23] A society's position on this dimension is sometimes reflected in whether self-image is defined in terms of "I" or "we."

[24] https://www.briq-institute.org/global-preferences/home

corruption), provided by Transparency International; the corruption index from the International Country Risk Guide ($\texttt{ICRG}_c$, greater value less corruption), provided by the PRS Group; and the Control of Corruption Index (`CCI`) (greater value means more corruption) from the World Bank. GDP per capita is typically lower when corruption is higher. Corruption enters as an explanatory variable in the GDP per capita and institutions regressions, and as a dependent variable in the corruption regressions. Summary statistics are available on Tables 1.1 and 1.2. Corruption indices are time-varying but positively and strongly autocorrelated over time.

9.4 Measures for Institutions

Lacking a fiscal measure of spending for institutions, and in an effort to augment the set of institutions typically used in the literature, we have explored numerous alternative measures which are either aggregated[25] into more commonly used indices or have been overlooked. For brevity, we report estimation results with the following set of institutions: First, $\texttt{ICRG}_{ins}$, which measures quality of institutions as it affects economic risk and is available from the PRS Group; it is positively correlated with GDP per capita. Second, $\texttt{ICRG}_{lo}$ measures the strength and impartiality of law and order and is also available from the PRS Group. Third, $\texttt{WMO}_{ex}$ which measures expropriation risk, is a component of the World Bank's [26] measure of rule of law, and pertains to the risk that the state or other sovereign political authority will deprive, expropriate, nationalize, or confiscate the assets of private businesses, whether domestic or foreign. Higher values imply lower risk of expropriation and are associated with higher values of GDP per capita.

As section 7 details, a key element of our approach is that institutions are deliberately designed in a political equilibrium setting, given human capital and culture. Naturally, human capital and institutions may not be treated as independent. As indicated above we

[25] A disadvantage of aggregated measures is that more likely to contain endogenous components, complicating the estimations.

[26] `http://info.worldbank.org/governance/wgi/pdf/rl.pdf`, downloadable from info.worldbank.org/governance/wgi/pdf/WMO.xlsx and comes from Global Insight Business Conditions and Risk Indicators.

employ instrumental variable estimators for all measures of institutions.

9.5 Descriptive Statistics and Features of the Data

Table 1.1 reports overall summary statistics for the principal variables we use in our regressions. Table 1.2 reports the overall pairwise correlations for those same variables. All institutional quality variables, namely $\mathtt{ICRG}_{ins}$, $\mathtt{WMO}_{ex}$, and $\mathtt{ICRG}_{ins}$, are positively correlated with GDP per capita and human capital, and negatively correlated with corruption. Corruption is negatively correlated with human capital and GDP per capita. Collectivism is positively correlated with corruption, negatively with GDP per capita and quality of institutions. The Global Preferences Survey (GPS) variables display a rich pattern of primarily weak correlations connecting preference indices. Among these, patience exhibits the strongest correlations with the other regressors: positive with GDP per capita, human capital and quality of institutions; and negative with corruption and collectivism. The share of women in parliament is quite strongly and positively correlated with human capital and GDP per capita; positively but not so strongly with institutions and patience (and weakly with the other GPS variables); and negatively with corruption and collectivism. Finally, the share of the population aged 15 to 64 years is strongly and positively correlated with GDP per capita, human capital and institutions, negatively correlated with corruption and collectivism.

9.6 Modified Random Effects with Time-invariant Proxies for Culture

To the best of our knowledge and except for the Ingelhart and Wenzel measures, the available measures of culture are time-invariant, which is appropriate in view of the consensus that culture is slow-varying. This precludes using fixed-effects estimators in our panel data setting, as they would not allow us to estimate the effect of culture, which is a critical parameter of our theory. This leaves us only random effects in the stochastic structure as a proxy for persistent heterogeneity. However, the standard random effects model assumes that, to maintain consistency, the country-specific time-invariant unobservable component of the stochastic structure be uncorrelated with the other regressors. This condition may, of course, be hard to satisfy.

We examine the consistency of our estimates by adopting the modified random effects approach,[27] as suggested by Hajivassiliou (2011). This procedure requires that the time averages of the time-varying regressors be included as separate regressors and then tested for the statistical significance of their exclusion from the regressions. If exclusion of the time averages is rejected and the estimates do differ from those obtained without those averages, then we must reject the assumption that the random effects are uncorrelated with the regressors in our model. The model without the time averages would be inconsistent and, hence, including the time means helps in soaking up such correlations and delivering consistent estimates. As we see shortly below, consistent estimates are obtained for many of the key parameters of interest. Exclusion is not rejected in only one of the regressions that we report, namely the one for institutions, proxied by $\mathtt{WMO}_{ex}$ and reported in Table 2, Columns 7 and 8. The Wald χ^2 rejects the exclusion of the time averages of the time-varying variables in all other regressions we report below and, for brevity, this statement will not be repeated.

10 Estimation

10.1 First-stage Regressions

We use two excluded instruments, namely the share of 15-64 year-olds in the population, lagged by 5 years, and the share of women in parliament. We instrument for lagged human capital, measured by the human capital index provided by Penn World Tables 9.0, that is

[27]See also Mundlak (1978) and Chamberlain (1984). This method assumes that the expectation of the idiosyncratic component of the error is a linear function of the time averages of the time-varying and of time-invariant regressors; the expectation depends only on the regressor data for the respective country and it does so in a time-invariant way. Under these assumptions, the modified random effects estimates are consistent and efficient.

based on years of schooling[28], and the various corruption indices. [29] The pairwise correlation coefficients (for the entire sample) for human capital with the lagged share of 15-64 year-old is 0.760; that with the share of women in parliament is 0.459 [Table 1.2]. The correlations for the first quartile of the collectivism variable are 0.487 and 0.463, respectively. The respective correlation coefficients, for the full sample (and for the first quartile of the collectivism variable, in parentheses) of the corruption indices (CPI, $\mathtt{ICRG}_c$, and CCI) we use are -0.488 and -0.324 (0.221 and -0.571), 0.324 and 0.254 (-0.188 and 0.386), and -0.509 and -0.362 (0.152 and -0.692).

We argue that the exclusion restriction for the two instruments is satisfied. For the case of corruption, we appeal to the overwhelming evidence provided by Jha and Sarangi (2018), namely that the share of women in parliament has a causal and negative impact on corruption while other measures of female participation in economic activities are shown to have no effect. There is no reason why the share of women in parliament should directly impact GDP per capita. It is certainly possible that years of schooling impact the share of women in parliament, but we use its lagged value. Regarding the effect of the five-year lag of the share of 15-64 year-olds in the population, it should directly affect neither GDP per capita nor corruption, when schooling is controlled for. As for its direct effect on schooling, individuals in those age groups would likely have completed their schooling. Regarding reverse causality, the pairwise correlations of GDP per capita with the share of women in parliament and the lagged share of the age composition are 0.355 and 0.747, respectively. The former is relatively small; the latter could reflect the high correlation of both those variables with schooling.

A comparison of all of our coefficient estimates obtained with and without instrumental variables typically show that the estimates are numerically larger and more significant when instruments are employed than when they are not. The estimated coefficients in the reduced-form regressions corresponding to Table 2, columns 1–6, for the lagged age composition are highly significant, though not those for the share of women in parliament. Reduced forms regressions generate joint $F-$ tests for the excluded instruments that are highly significant,

[28] https://www.rug.nl/ggdc/docs/human_capital_in_pwt_90.pdf

[29] This instrument performs much better than the dependency ratio.

and so are Sanderson-Windemeijer multivariate $F-$ tests. The Kleiberger–Paap rank LM for underidentification has a $p-$ value of 0.0011; the null hypothesis for weak identification is rejected by the Cragg-Donald Wald F test and the Kleiberger-Paap Wald rank test.

The first-stage regressions accord with economic intuition for lagged human capital, not so for CPI, but strongly so for the various institutions variables we use. Tests for the validity of instruments are generally satisfactory. However, since it is lagged institutions that enter on the right hand side of eq. (46), their second lags also enter when they are used as instruments for lagged institutions in eq. (44), which results in fewer years of available data for the estimations. Recognizing the importance of instrumental estimation we adopt that approach in the absence of other ways to instrument for institutions. Furthermore, our use of three alternative measures of corruption, several alternative measures of culture and several alternative measures of institutions, as discussed above (only few of which we report for reasons of brevity) serves in providing additional checks of robustness. The first-order regressions for our variables are all highly significant by means of the Wald χ^2 for all of our regressions, with the standard as well as the modified random effects.

10.2 GDP per capita Against Culture and Lagged Corruption, Human Capital, and Institutions

Although we report here a small part of the estimation results that we have obtained, the overall evidence we report provides fairly strong support for our theoretical predictions as summarized in equation (44). We work with three alternative measures of corruption, the corruption perception index, `CPI`, the control of corruption index, `CCI`, and the ICRG measure of corruption, $\texttt{ICRG}_c$, but in this section we report results with the first two only. We instrument corruption, when it enters as a lagged RHS variable, by means of the respective share of women in parliament, as we discussed earlier; see section 8.4.

Table 2, columns 1–6, report regressions relating to eq. (44), with culture proxied by the Hofstede index (`col`) in Columns 1 through 4, and by the GPS variables in Columns 5, and 6. In all those regressions, lagged corruption (proxied by `CPI` in Columns 1 and 2, and by `CCI` in Columns 3 through 6), has a negative and almost always significant effect. Lagged human capital always has a positive and significant effect on GDP per capita. Better institutions (as proxied by lagged institutions, specifically $\texttt{ICRG}_{ins}$ in Column 1, and $\texttt{WMO}_{ex}$ in Columns 2, 3 and 4) increase GDP per capita. Thus, a more favorable economic risk environment and a lower risk of expropriation increase GDP per capita. Conformism (or collectivism), as proxied by the Hofstede index in Columns 1 and 2, decreases GDP per capita, as predicted by our theory. The F test for the excluded instruments for Column 1 has a value of 722.91 and a $p-$ value of 0.0000, and the Sanderson-Windmeijer multivariate F test of excluded instruments has a value of 803.83 and a corresponding $p-$value of 0.0000. For Column 5, the F test for the excluded instruments has a value of 1052 and a $p-$ value of 0.0000, and the Sanderson-Windmeijer multivariate F test of excluded instruments has a value of 190 and a corresponding $p-$value of 0.0000.

We note that our estimation results continue to support the underlying theory, as it pertains to the effects of variables other than culture, when culture is alternatively proxied by means of the GPS variables, instead of the Hofstede index. We find that negative reciprocity is the only one of them to be highly significant with a positive effect in both Columns 3 and 4, while risk taking is negative and significant in Column 3 only.

Our results with modified random effects are as follows. The results in Column 2, Table 2, show that lagged institutions from $\texttt{ICRG}_{ins}$ continue to be significant, with a coefficient similar to the previous estimate, and its time average is also significant and positive. Lagged corruption (CPI) and its time average are not significant; human capital loses its significance but its time average is significant and with a positive coefficient; and the Hofstede index has a negative but not significant coefficient. The Wald χ^2 test rejects the exclusion of the time averages.

The results in Column 4, Table 2, show that lagged institutions, proxied by $\texttt{WMO}_{ex}$, are significant and similar to the reported one, and their time average is also significant and positive. Lagged corruption (CCI) and its time average are not significant; lagged human capital has a similar coefficient to the one reported above and its time average is also significant and positive; but the Hofstede index is not. The Wald χ^2 rejects the exclusion of the time averages.

The results with the GPS variables in Column 6, Table 2, are as follows. Columns 3 through 6 show that lagged corruption (`CCI`) has a negative and significant coefficient (which is similar to the one reported earlier) and so does its time average; lagged human capital has a positive and significant coefficient (also similar to the one reported earlier) and so does its time average, but institutions $\texttt{WMO}_{ex}$ and its time average are not statistically significant. The estimates for risk taking and negative reciprocity are very similar. The Wald χ^2 rejects the exclusion of the time averages. Column 5 shows that lagged corruption (`CPI`) comes with a negative and significant coefficient and so does its time average; lagged institutions ($\texttt{WMO}_{ex}$), in Column 6, again has a positive and significant coefficient (that is similar to the one reported) though not its time average; lagged human capital is not significant but its time average has a positive and significant coefficient. As with the estimates for the GPS variables, negative reciprocity is, but risk taking is not, significant with a positive coefficient similar to the one reported before.

We examine the robustness of these results by performing estimations with the `ivreg2` procedure in Stata with cluster-robust standard errors, which also affords us a great variety of diagnostic tests. This estimation procedure is different from the one employed above and differences in the estimated coefficients are to be expected. For example, in the regression reported by Column 1, Table 2, lagged human capital and institutions (proxied by ICRG_{ins}) are highly significant and have similar signs to the respective earlier ones, but the effect of lagged `CPI` while still negative is significant at 10% only. The F test of excluded instruments is 24.74 and the Sanderson-Windmeijer multivariate F test of excluded instruments is equal to 35.10, with both tests having $p-$values equal to 0.0000. The Hansen J statistic has a value of 10.339, with a corresponding $p-$value of 0.0159; the Kleiberger-Paap underidentifcation test based on the rk LM statistic is equal to 18.252, the corresponding χ^2 has $p-$value of 0.0011, and the Cragg-Donald Wald F statistic is equal to 59.86.

For the regression reported by Column 3, Table 2, lagged human capital is highly significant and with the same sign as before; lagged institutions (proxied by WMO_{ex}) has the same sign but is marginally significant at 8%; the effect of lagged `CCI` is negative and significant at 2.2%; but collectivism has a positive but statistically insignificant effect. The F test for the excluded instruments has a value of 6.47 and a $p-$ value of 0.0000, and the Sanderson-Windmeijer multivariate F test of excluded instruments has a value of 8.15 and a corresponding $p-$value of 0.0000. The Hansen J statistic has a value of 11.472, with a corresponding $p-$value of 0.0094; the Kleiberger-Paap underidentification test based on the rk LM statistic is equal to 18.8, and the corresponding $\chi^2(4)$ has $p-$value of 0.0009, and the Crag-Donald Wald F statistic is equal to 167.27.

For the regression reported on Column 5, Table 2, the estimated coefficients for lagged human capital and lagged corruption index `CCI` have the same signs as those reported earlier and are highly significant; the lagged value of institutions (proxied by WMO_{ex}) is not significant; and the GPS culture variables have estimated coefficients similar to those reported on Column 5, with negative reciprocity having a positive and very significant coefficient, and risk-taking having a negative one and also very significant. The F test for the excluded instruments has a value of 13.88 and a $p-$ value of 0.0000, and the Sanderson-Windmeijer multivariate F test of excluded instruments has a value of 11.58 and a corresponding $p-$value of 0.0000. The Hansen J statistic has a value of 19.960, with a corresponding $p-$value of 0.0002; the Kleiberger-Paap underidentification test based on the *rk LM* statistic equals 17.806; the corresponding $\chi^2(4)$ has $p-$value of 0.0013, and the Cragg-Donald Wald F statistic is equal to 119.267.

We consider these results as reasonably strong support for our theory: when culture is proxied for by several alternative measures, human capital and institutional quality increase GDP per capita and corruption decreases it.

10.3 Corruption against Lagged Corruption, Institutions, Human Capital, Culture

Our empirical investigation of eq. (45), section 8.2, is novel. Estimates of that equation are reported on Table 3, where Columns 1–4 report results with linear models and Columns 5 and 6 involve a nonlinear one. Specifically, the latter report estimates with a functional form for lagged corruption that encompasses the type of nonlinearity discussed in section 8.2. Corruption is proxied by $\texttt{ICRG}_c$ in Columns 1 and 2, and by CCI in Columns 3–6. The former index assigns higher values to less corruption and the latter higher values to more corruption. All regressions produce highly significant and numerically large autoregressive coefficients, but the null hypothesis of unit root is rejected for all indices. As with the GDP per capita regressions, the culture variables we use are time-invariant which rules out accounting for country heterogeneity by means of fixed effects. We account for persistent heterogeneity by carrying out our estimations with country-specific components of the shocks modeled as random effects. We test for the appropriateness of the specification by means of modified random effects.

Like the estimations of eq. (44), our aim here is to control for culture so as to examine the empirical relevance of our theoretical results regarding the impact of institutions and human capital on corruption. All our estimations include the lag of the respective corruption index, as predicted by our theory, while the lagged institution is instrumented by means of eq. (46). Unfortunately, instrumenting lagged human capital with the share of 15-64 year olds in the population does not work well here.

Our theoretical exposition suggests essential nonlinear effects for the dynamics of corruption. A simple nonlinear specification of the evolution of the corruption index $x_{i,j,t}$ that roughly fits the implications of the theoretical predictions, as discussed in section 8.2 above, is to model the term involving lagged corruption as $\tanh(b_0 + b_{x,x}x_{i,j,t-1})$. While in principle it is reasonable to include additional regressors as arguments of the tanh function, unfortunately, the maximum likelihood estimation did not converge. This finding is corroborated by specifying the right hand side as the $\tanh(\cdot)$ evaluated at alternative sets of regressors, as we discuss below. Instead, we estimate eq. (45) with alternative proxies for institutions $\theta_{j,t-1}$ included individually.

We estimate two versions of the dynamics of corruption along the lines of eq. (45). The first version, reported in Table 3, columns 1–4, includes $\tanh(x_{j,t-1})$ as an explanatory variable. It is thus a linear regression, and therefore amenable to straightforward IV and random effects estimation, and we do indeed report respective results. The second version, reported in Table 3, columns 5 and 6, is based on $\tanh\left(b_0 + b_{x,x}x_{j,t-1}\right)$, and is estimated with maximum likelihood, with the additional regressors entering linearly outside that function.[30]

Specifically, Table 3 reports regression results for the dynamics of corruption with culture being proxied by the Hofstede collectivism index. Predictions are generally confirmed. Greater collectivism increases corruption in all regressions we report. Better institutions, proxied by $\texttt{ICRG}_{lo}$, in columns 1, 2, 5 and 6, and $\texttt{WMO}_{ex}$, in column 3, respectively, reduce corruption and so does lagged human capital. The autoregressive terms for corruption are always very significant and positive. The same IV approach is adopted in the estimation reported in columns 5 and 6, where the corruption index used is `CCI` and its own lagged value is the argument of the hyperbolic tangent function (along with a constant), but the equation is estimated with maximum likelihood, with independent and identically distributed normal errors assumed. The lagged values of the corruption index, which enter as arguments of the hyperbolic tangent function, have highly significant and positive estimated coefficients $b_{x,x}$. They are displayed on the row corresponding to the lagged `CCI` with its associated constant b_0 immediately below. The group of numbers labeled $b2$ corresponds to the regressors that enter linearly. Greater collectivism increases corruption, and better institutions decrease it, when proxied by the law and order variable $\texttt{ICRG}_{lo}$. Columns 5 and 6 differ only with respect to how the lagged value of $\texttt{ICRG}_{lo}$ has been instrumented: in column 5 with random effects included and in column 6 with modified random effects included.

Exclusion of the time averages of the time-varying regressors is rejected in the regressions reported in Columns 2 and 4. Therefore, the results reported there, which are most often significant, are consistent. Better institutions reduce corruption. An anomaly in column 2 is that human capital and its time average have opposite signs, but the net effect is reduction in corruption. Regarding columns 3 and 4, the net effect of better institutions is also to reduce corruption.

We examine the robustness of these results by performing estimations again with the `ivreg2` procedure in Stata, while allowing for cluster-robust standard errors, which again

[30]Of course, it is in principle possible to include random effects in the maximum likelihood estimation, but we leave this for future work.

affords us a great variety of diagnostic tests. This estimation procedure is different from the one employed earlier, and differences in the estimated coefficients are to be expected. For example, in the counterpart of the regression reported by Column 1, Table 3, all regressors (lagged human capital, lagged institutions proxied by ICRG_{lo}, and collectivism) are highly significant and have the same signs as the respective earlier ones. The Hansen J statistic has a value of 36.123, with a corresponding $p-$value of 0.0000; the Kleiberger-Paap underidentification test based on the rk LM statistic is equal to 40.73, and the corresponding $\chi^2(4)$ has $p-$value of 0.0000. For the counterpart of the regression reported on Column 3, Table 3, lagged human capital has the wrong sign but is not statistically significant; collectivism has the right sign but is not statistically significant; lagged institutions (proxied by $\texttt{WMO}_{ex}$) has the right sign and is significant at 4%; and the lagged value of the endogenous variable has the right sign and is highly statistically significant. The Hansen J statistic has a value of 30.766, with a corresponding $p-$value of 0.0000; the Kleiberger-Paap underidentification test based on the rk LM statistic is equal to 27.421, and the corresponding $\chi^2(4)$ has $p-$value of 0.0000. For the counterpart of the regression reported on Column 5, Table 3, the Hansen J statistic has a value of 0.0000, that is, the equation is exactly identified; the Kleiberger-Paap underidentification test based on the rk LM statistic is equal to 1.402, and the corresponding $\chi^2(1)$ has $p-$value of 0.2364.

Therefore we conclude that these findings are mainly consistent with predictions from our model. All in all, the corruption regressions are highly significant, even when random effects are included in the specification of the stochastic shock in the linear part of the equation. Controlling for lagged institutions reduces the estimate of the key parameter $b_{x,x}$ (relative to a benchmark parsimonious case, which we do not report) and thus reduces the likelihood of multiple equilibria. Nonetheless, estimation of the predicted corruption model as in eq. (45) implies three equilibria, in principle, of which two are stable and the middle one unstable. Simulations with the estimated values suggest that the low one is approximately equal to 0.20 the high one to 0.80. Overall, the results with the corruption regressions provide strong support for the theory.

10.4 Individual Institutions against Lagged institutions, Corruption, GDP per capita, Human Capital

Regressions along the lines of eq. (46) involve a specific institution i in a specific country j at a specific point in time t, under alternative error structure specifications and while instrumenting for lagged human capital and lagged corruption. Our theory implies higher lagged corruption leads to weaker current institutions, without necessarily decreasing current GDP per capita. From the numerous estimations that we performed we report, in columns 7 and 8 of Table 2, results for the risk of expropriation $\mathtt{WMO}_{ex}$ (with higher values denoting lower risk) regressed against culture (proxied by the GPS variables), own lagged value, lagged corruption proxied by `CPI`, lagged GDP per capita, and lagged human capital, while using random effects. The excluded instruments in the first-stage regressions for human capital are very significant, and so so are all GPS culture variables. The first-stage regressions themselves are very significant by the Wald χ^2 test.

Results confirm the predicted negative effect of lagged corruption and positive effect of own lagged value, and positive and very significant effect of human capital on the current quality of governance. However, in the regression reported here, lagged GDP per capita has the wrong sign but is not significant, lagged GDP per capita has a strong positive effect when the institution's own lagged value is not included, and is also very significant in the first-stage regression for human capital. The F test of excluded instruments has a value of 8.50 and a $p-$value of 0.0050. From among the GPS variables controlling for culture here, negative reciprocity continues to be highly significant, but similar results are obtained with alternative culture variables. The panel stochastic structure is significant, with the between variation being much more important than within in explaining the total variation, as R^2 ranges between 0.846 and 0.971. Column 8 reports results with the time averages of the time-varying regressors included as additional regressors. Their inclusion is highly significant but only the lagged own effect remains statistically significant, with a coefficient not very different from the one reported on Column 1. The exclusion of the time averages of the time-varying regressors is not rejected by the Wald χ^2 test in this case. Therefore, the results reported in Column 7 are consistent.

We further examine the robustness of these results by performing estimations with the `ivreg2` procedure in Stata with cluster-robust standard errors, which again affords us a great variety of diagnostic tests. This estimation procedure is different from the one employed earlier and differences in the estimated coefficients are, once more, to be expected. For example, in the regression reported by Column 7, Table 2, lagged human capital has the same sign and is significant at 3.7%; the own lagged value of institutions (proxied by $\texttt{WMO}_{ex}$) has the same sign and is highly significant; the lagged value of GDP per capita has a similar estimated coefficient and is not significant; and the GPS culture variables have similar estimated coefficients to those reported on Column 7, with negative reciprocity being the only significant one. The Hansen J statistic has a value of 0.0000 (the equation is exactly identified), with a corresponding $p-$value of 0.0159; the Kleiberger-Paap underidentifcation test based on the rk LM statistic is equal to 5.392, and the corresponding $\chi^2(1)$ has $p-$value of 0.0202. The Cragg-Donald Wald F is 102.12. In a nutshell, most of our results confirm the predictions of the theory: bad norms tend to reproduce themselves and institutions regressions are fairly supportive.

11 Conclusions and Extensions

To understand why the whole world is not developed, we add private rent-seeking and official corruption as occupational choices in a growth-theoretic model of macroeconomic activity in which institutions are chosen by a citizen majority. Our main conclusion is that the road to prosperity can be blocked by poor social norms in conformist societies and by human capital inequality in individualist ones. Poor norms in a conformist environment allow the past to dominate the present: they raise the importance of history, diminish chances for meaningful reform and perpetuate underdevelopment for political reasons, by tying the present to the past. Differences in human skills among voters drive a wedge between the interests of the skilled minority who favor legitimate endeavors, and those of the unskilled majority who lean toward anti-social activities.

These results apply to a world consisting of many symmetric national economies with identical economic fundamentals, perfect capital mobility, and different cultural characteristics, operating under a common vector of worldwide factor prices. It is clear, however, that in closed economies corruption and institutions would affect wage and interest rates. In addition, occupational choice would respond to expectations of future changes in prices and policies. From an empirical standpoint, it would be interesting to find out how anti-social activity responds to additional types of penalties, such as incarceration or exclusion from asset markets, and how unobserved rent-seeking may be connected to more readily observable official corruption. Eq. (24b) suggests that there is a close link between private-sector and public sector corruption which we think is worth exploring. Another extension would come to grips with the strong positive autocorrelation in corruption statistics: one way to proceed is to replace the majority voting assumption with a supermajority one through interest groups as in Acemoglu and Robinson (2000a), or by bringing in veto power as in Tsebelis (2004). Similarly, we may easily identify aspects of our theory that deserve additional attention including, in particular, threshold effects and other nonlinear predictions for key endogenous variables of interest.

There are many additional challenges for future research that deserve attention. One is the total absence of observable aggregate measures of rent-seeking which stymies research on rent-seeking directly. Aggregating micro measures such as incidence of bribery, the size of the shadow economy and employment in public enforcement may be helpful here.

Perhaps the most important issue this paper can raise is one for economic policy: how does one deal with ingrained corruption? Since norms matter, initiatives like long-run propaganda campaigns via schools, churches and the media may be effective in changing preferences and moral codes by helping citizens identify public but also private corruption. Lessons may also be sought from countries like Singapore, which uprooted government corruption in the 1960s, and South Korea, which has made leaps and bounds in identifying and prosecuting corruption. Similarly, whistleblowers could become a useful means to enforcement, as could the draconian punishment of perpetrators, and elevated pay for civil servants.

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12 Appendix: Proofs of Main Results

This appendix provides proofs of Results 2 and 3 and eqs. (37) and (38).

A. 1 Result 2

Here we focus on parts (a), (d) and (e), which show that the function $\mathcal{J}(x;\theta,\sigma)$ is increasing and convex in x, possessing an asymptotically stable fixed point $x^*(\theta,\sigma)$ for all $(\theta,\sigma)\in[0,b]\times[0,1]$. The monotonicity and convexity of $\mathcal{J}$ follow from the fact that $\mathcal{J}$ is decreasing and convex in $m(x)$ while $m(x)$ itself is decreasing and convex in x.

Note also that

$$\mathcal{J}(0;\theta,\sigma)>0,\ \forall(\theta,\sigma);$$

$$\mathcal{J}(1;\theta,\sigma)<1,\ \forall(\theta)\text{ if }\sigma<1-\nu;$$

where $\theta=\hat{\theta}$ is the unique solution to eq. (32) in the main text.

Figure 9 graphs $\mathcal{J}$ against x for $\sigma\in[1-\nu,1]$ and $\theta\in[0,\hat{\theta}]$ while Figure 8 does the same for all $(\theta,\sigma)\in[0,\hat{\theta}]\times[1-\nu,1]$. In each case, there is one asymptotically stable fixed point $x^*(\theta,\sigma)$ which is a decreasing function of θ and decreasing (increasing) function of σ if $\sigma<\frac{1}{2}\left(\sigma>\frac{1}{2}\right)$. Figure 9 also shows that two additional steady states, a stable one at $x=1$ and an unstable one at $x=\tilde{x}(\theta,\sigma)$, exist when σ is large and θ is small. In that case, $(x^*,\tilde{x})$ straddle $x=\frac{1}{2}$ because $\mathcal{J}(1/2;0,\sigma)=[B_1(\theta)]^{\zeta}<[B_1(0)]^{\zeta}=\nu^{\zeta}<1$ by assumption.

A. 2 Equations (37) and (38)

Type-2 agents with moral code $\varepsilon\geq\bar{\varepsilon}$ have lifetime utility $V_2(\theta,\varepsilon)$ and a choice $\theta\in\{0,b\}$ between no enforcement and full enforcement. They will choose full enforcement if

$$V_2(0,\varepsilon)\leq V_2(b,\epsilon),$$

or equivalently if

$$\frac{1-\sigma+\sigma\rho_0}{A+z(\rho)}\max\{\varepsilon,\hat{\varepsilon}\}\leq\gamma(1-\sigma\rho_0), \tag{A.2.1}$$

where

$$(\rho_0, \rho) := (\rho_{t-1}, \rho_t), \tag{A.2.2}$$

$$\hat{\varepsilon} := \gamma A m(\rho_0)\bar{\varepsilon}, \tag{A.2.3}$$

as in Result 1(a).

From the definition of the predator-to-prey variable (the rent-seeking intensity) we have for any $\rho \in [0, 1]$:

$$z(\rho) := \frac{n\rho}{1 + \gamma n - \gamma n\rho}. \tag{A.2.4}$$

Continuing, we replace the state variable ρ_t with ρ and set the norm $x_{t-1} = \rho_0$ in eqs. (23a, b) to obtain

$$\rho = [\lambda/m(\rho_0)]^{\zeta} \tag{A.2.5}$$

when $\theta = 0$. Then eq. (A.2.1) reduces to

$$\max\{\varepsilon, \hat{\varepsilon}\} \le \gamma m(\rho_0)[A + z(\rho)], \tag{A.2.6}$$

or to

$$\varepsilon \le \gamma m(\rho_0)\left[A + z\left(\left[\frac{\lambda}{m(\rho_0)}\right]^{\zeta}\right)\right], \tag{A.2.7}$$

because $\hat{\varepsilon}$ is always less than the RHS of Eq. (A.2.7). The mass M of type-2 people favoring no enforcement are those with a moral code that violates eq. (A.2.7), that is,

$$M = \mu\left[\frac{\frac{\lambda}{m(\rho_0)}}{1 + A^{-1}z\left(\left[\frac{\lambda}{m(\rho_0)}\right]^{\zeta}\right)}\right]^{\zeta}. \tag{A.2.8}$$

Full enforcement is a majority outcome if $M \le 1/2$, that is, if for $\lambda(m) \in [0, 1]$ we have $1 \ge \mathcal{H}(\lambda/m)$. Here $\mathcal{H}$ is defined on the RHS of eq. (37) in the main text, with $\lambda := \frac{\bar{\varepsilon}}{\gamma A}$ and $m = m(x_{t-1})$. Finally, we show that, for sufficiently large values of the search inefficiency parameter A, the function $\mathcal{H}(\lambda/m)$ is increasing and convex in λ/m, and that eq. (38) has a unique solution $\lambda^* \in (0,1)$. To that end, we rewrite the function $\mathcal{H}$ in the form

$$\mathcal{H}(\lambda) = (2\mu)^{\frac{1}{\zeta}}\lambda - \psi(\lambda)/A, \tag{A.2.9}$$

where $\lambda \in [0,1]$ and

$$\psi(\lambda) := \frac{n\lambda^{\zeta}}{1 + \gamma n - \gamma n \lambda^{\zeta}} \tag{A.2.10}$$

is an increasing convex function of $\lambda : \psi$ is increasing convex in λ^{ζ} and λ^{ζ} is increasing in λ for any $\zeta \geq 1$. Therefore, $\mathcal{H}$ is a concave function defined as equal to a positive linear minus an increasing convex function of λ. The linear part of $\mathcal{H}$ dominates if $(2\mu)^{\frac{1}{\zeta}} > \frac{\psi'}{A}$, for all values of $\lambda \in [0,1]$, that is, if $A > \psi(1)/(2\mu)^{\frac{1}{\zeta}} := \hat{A}$, as assumed in the beginning of Result 3.

Lastly, we note that the increasing function $\mathcal{H}(\lambda/m)$ vanishes at $\lambda = 0$, and exceeds unity if $A > \tilde{A}$, as the parameter $\tilde{A}$ is defined in the beginning of Result 3.

A. 3 Result 3.

The proof follows directly from eqs. (37) and (38) which we can write out in detail as:

$$1 = \mathcal{H}[\lambda/m(x_{t-1})] \tag{A.3.1}$$

is an indifference condition for defining combinations of parameters (γ, A, σ), and of norms x_{t-1} that leave the median voter indifferent between the non-enforcement and full enforcement options. If $\lambda^* \in (0,1)$ solves eq. (38), then the indifference relationship takes the form

$$\frac{\lambda}{m(x_{t-1})} = \lambda^*, \tag{A.3.2}$$

with $\lambda := \bar{\varepsilon}/\gamma A$, and the entire Result 3 follows immediately.

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Table 1: Descriptive Statistics

	(1)															
	y	cpi	ICRG_c	CCI	hc	ICRG_ins	WMO_ex	ICRG_lo	col	patience	risktaking	posrecip	negrecip	altruism	trust	women_parliament	age_composition_15_64
mean	3.611503	5.763876	2.99066	.0285083	2.088969	33.66145	.5909382	3.671805	.6081188	-.0022495	.011673	-.0350362	.0103759	-.040126	-.0292031	13.06537	58.76528
sd	.5579965	2.154449	1.334268	1.006621	.6237891	6.994797	.225743	1.444894	.2196952	.3695583	.3017893	.341627	.2743532	.342644	.270924	10.35728	6.805124
count	8200	2665	4580	3499	6872	4560	3393	4254	6767	5025	5025	5025	5025	5025	5025	1669	9286

Table 2: Pairwise Correlations

	(1)																
	y	cpi	ICRG_c	CCI	hc	ICRG_ins	WMO_ex	ICRG_lo	col	patience	risktaking	posrecip	negrecip	altruism	trust	women_parliament	age_composition_15_64
y	1																
cpi	-0.727	1															
ICRG_c	0.495	-0.860	1														
CCI	-0.723	0.955	-0.835	1													
hc	0.740	-0.605	0.458	-0.621	1												
ICRG_ins	0.616	-0.564	0.312	-0.552	0.480	1											
WMO_ex	0.748	-0.849	0.731	-0.872	0.610	0.577	1										
ICRG_lo	0.643	-0.729	0.626	-0.741	0.552	0.513	0.756	1									
col	-0.576	0.656	-0.608	0.673	-0.524	-0.317	-0.634	-0.594	1								
patience	0.533	-0.741	0.574	-0.721	0.498	0.492	0.658	0.584	-0.647	1							
risktaking	-0.0607	0.0427	-0.127	0.0479	-0.0119	-0.0676	-0.101	-0.130	0.00256	0.231	1						
posrecip	0.0557	-0.0497	0.0947	-0.0426	0.0378	0.134	0.0717	0.143	0.0453	0.0166	-0.257	1					
negrecip	0.239	-0.0735	-0.0165	-0.0670	0.203	0.221	0.163	0.181	-0.150	0.262	0.191	-0.158	1				
altruism	-0.123	0.0800	-0.0350	0.0670	-0.118	0.0561	-0.1000	-0.0712	0.135	-0.00861	-0.0171	0.711	-0.139	1			
trust	0.255	-0.240	0.170	-0.212	0.153	0.206	0.174	0.263	-0.181	0.201	-0.0695	0.364	0.145	0.265	1		
women_parliament	0.355	-0.324	0.250	-0.362	0.459	0.264	0.281	0.296	-0.210	0.290	-0.0574	-0.0444	-0.0360	-0.139	0.132	1	
age_composition_15_64	0.747	-0.488	0.324	-0.509	0.760	0.528	0.553	0.568	-0.460	0.403	-0.262	0.240	0.217	0.0105	0.255	0.331	1

t statistics in parentheses
Pairwise Correlations

Table 3: GDP per capita 1. Culture: Hofstede Collectivism

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	y	y	y	y	y	y	WMO_ex	WMO_ex
L.cpi	-0.0254**	-0.0180					-0.00547***	0.0157
	(0.0124)	(0.0128)					(0.00206)	(0.0423)
L.hc	0.240**	0.0866	0.363***	0.200**	0.374***	0.199**	0.0248**	-1.143
	(0.0948)	(0.0963)	(0.0880)	(0.0862)	(0.0767)	(0.0834)	(0.0122)	(5.619)
L.ICRG_ins	0.00501***	0.00466***						
	(0.00139)	(0.00122)						
col	-0.958***	-0.235	-0.451*	0.242				
	(0.237)	(0.183)	(0.243)	(0.249)				
avg_cpi		0.00956						-0.0281
		(0.0290)						(0.0301)
avg_hc		0.374***		0.259**		0.240**		0.852
		(0.125)		(0.108)		(0.118)		(4.135)
avg_ICRG_ins		0.0472***						
		(0.0129)						
L.CCI			-0.0650*	-0.0245	-0.109***	-0.0697**		
			(0.0382)	(0.0401)	(0.0343)	(0.0321)		
L.WMO_ex			0.300**	0.212*	0.372*	0.326	0.916***	0.833***
			(0.129)	(0.115)	(0.192)	(0.201)	(0.0188)	(0.223)
avg_CCI				-0.0174		-0.253***		
				(0.102)		(0.0933)		
avg_WMO_ex				1.007*		-0.785		
				(0.576)		(0.512)		
patience					0.0694	-0.0924	-0.00654	-0.0203
					(0.116)	(0.130)	(0.00579)	(0.111)
risktaking					-0.250*	-0.247*	-0.00879	0.156
					(0.151)	(0.147)	(0.00804)	(0.786)
posrecip					0.0340	0.00755	-0.00179	-0.0243
					(0.207)	(0.213)	(0.00863)	(0.207)
negrecip					0.256***	0.352***	0.0141**	-0.0831
					(0.0970)	(0.110)	(0.00578)	(0.552)
altruism					-0.0440	0.0617	-0.00338	0.119
					(0.143)	(0.148)	(0.00621)	(0.660)
trust					0.147		0.00552	-0.155
					(0.128)		(0.00599)	(0.773)
L.y							-0.0159	0.611
							(0.0135)	(2.841)
avg_y								-0.287
								(1.243)
_cons	3.838***	1.238**	3.047***	1.889***	2.669***	3.092***	0.0811**	-0.0706
	(0.338)	(0.554)	(0.309)	(0.432)	(0.240)	(0.289)	(0.0367)	(1.344)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	219	219	179	179	133	133	595	595
Number of id	51	51	56	56	40	40	61	61
Wald Chi2	304.2662	405.3577	227.5384	271.0874	354.5237	437.9214	41893.92	338.0297
Wald test		34.521		22.014		15.946		1.334
R2 within	0.654	0.671	0.496	0.551	0.508	0.562	0.288	0.206
R2 between	0.649	0.796	0.696	0.747	0.850	0.861	0.998	0.615
R2 overall	0.664	0.779	0.731	0.765	0.861	0.864	0.971	0.594
Country random effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard error in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Institution instrumented by eq 79

Human capital instrumented by 5-year-lagged age composition

Corruption instrumented by share of women in parliament

Table 4: Corruption Autoregressions: linear

	(1) ICRG_c	(2) ICRG_c	(3) CCI	(4) CCI	(5) CCI	(6) CCI
main						
L.hc	0.568***	0.870**	-0.161**	0.0368		
	(0.210)	(0.408)	(0.0762)	(0.148)		
L.ICRG_lo	0.174***	0.147***				
	(0.0485)	(0.0518)				
col	-1.930***	-1.288***	0.863***	0.268		
	(0.458)	(0.436)	(0.250)	(0.215)		
L.tanh_ICRG_c	6.365***	6.364***				
	(0.856)	(0.865)				
avg_hc		-0.758*		0.0131		
		(0.416)		(0.150)		
avg_ICRG_lo		0.352***				
		(0.0955)				
L.WMO_ex			-0.559**	0.699**		
			(0.223)	(0.287)		
L.tanh_CCI			1.865***	1.689***		
			(0.164)	(0.150)		
avg_WMO_ex				-2.970***		
				(0.361)		
L.CCI					2.071***	2.111***
					(0.228)	(0.236)
_cons	-3.264***	-3.947***	-0.877**	0.166	1.445***	1.472***
	(1.004)	(1.047)	(0.353)	(0.364)	(0.209)	(0.215)
b2						
col					0.693***	0.730***
					(0.0924)	(0.0919)
L.hc					-0.336***	-0.324***
					(0.0377)	(0.0379)
L.p_CCI_col_ICRG_lo					-0.237***	
					(0.0140)	
L.p_CCI_col_ICRG_lo_mre						-0.229***
						(0.0137)
_cons					0.400***	0.312**
					(0.152)	(0.151)
sigma						
_cons					0.397***	0.399***
					(0.0101)	(0.0101)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1945	1945	720	720	779	779
Number of id	75	75	80	80		
Wald Chi2	756.1127	888.9588	740.1337	1580.758	82.57317	79.90359
Wald test		13.856		68.921		
R2 within	0.434	0.434	0.227	0.227		
R2 between	0.729	0.802	0.915	0.941		
R2 overall	0.656	0.704	0.907	0.932		
Country RE	Yes	Yes	Yes	Yes		

Robust standard error in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Institution instrumented by eq 79

Human capital instrumented by 5-year-lagged age composition

Corruption instrumented by share of women in parliament