1 Corruption and sustainable development

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1. Introduction

Corruption in its various forms is generally believed to be an obstacle to economic development.¹ Anti-corruption reforms and policies consequently offer great promise to contribute to the well-being of millions of people. The seminal paper by Mauro (1995), which spurred a large empirical literature,² concluded that ‘if Bangladesh were to improve the integrity and efficiency of its bureaucracy to the level of that of Uruguay . . . its yearly GDP growth rate would rise by over half a percentage point’ (p. 683). Yet, in subsequent work on macroeconomic data, it has proved hard to find robust evidence that corruption, as opposed to general government inefficiency, has a sizable negative effect on growth in real GDP per capita (see, for example, Aidt, 2009).³ On the other hand, the evidence of a strong negative correlation between the level of GDP per capita and corruption is overwhelming, but a priori the direction of causality is unclear. Murphy et al. (1993), Ehrlich and Lui (1999), Lambsdorff (2007) and many others see the causality as running from high corruption to low income, while Treisman (2000) and Paldam (2002), among others, argue that a transition from a situation with high corruption to one with low corruption is a by-product of economic development. In a recent paper, Gundlach and Paldam (2009a) use deep prehistoric measures of biogeography as instruments for GDP per capita to demonstrate that the long-run causality runs from low levels of development to high corruption, thus suggesting that the reverse link between a high level of corruption and low national income is, at most, part of the short-run dynamics of development.

Although the insights from the research program on the GDP–corruption nexus are valuable and important for one’s understanding of the macroeconomics of corruption, there is a sense in which that research program is barking up the wrong tree. Policy advice should ideally be guided by considerations of social welfare. GDP per capita is a poor indicator of that concept. It measures current economic activity, but ignores many key determinants of human well-being (for example, social relations, health, and personal safety), the possible destruction of natural capital in the quest for higher incomes, the value of home production, and so on. In other words, research should be directed at questions related to *sustainable* development rather than *economic* development, narrowly defined.

Sustainable development relates to an economy's ability to maintain living standards through time; growth in GDP per capita is no guarantee for long-run sustainability.

In recent years, progress has been made in constructing empirical measures of social welfare and sustainable development. In a recent survey, Fleurbaey (2009) highlights three main approaches to the measurement of social welfare: adjusted GDP, happiness indices, and the Human Development Index based on A.K. Sen's capability approach.⁴ Each of these approaches has advantages and disadvantages. The happiness approach, which is based on survey evidence of subjective well-being, suffers from serious problems of comparability across time and space.⁵ The Human Development Index, which is an index of social welfare constructed from averages of GDP per capita and indicators of health and education outcomes, faces the so-called 'index problem': if a single index is defined that weights different aspects of life in the same way for all individuals, then these common weights do not respect the individuals' own valuations of these aspects. The adjusted GDP approach is based firmly on welfare economics and aims to derive indicators of the change in social welfare, rather than measures of the level of welfare as such. The most sophisticated indicators focus explicitly on the intertemporal dimension of social welfare and can, in contrast to the other measures, address issues related to sustainable development directly (Dasgupta, 2001: ch. 9; 2010). The basic insight is that an economy's capital stocks – broadly defined to include manufactured, human, social and natural capital, and the way in which these are managed – matter for the intertemporal well-being of individuals. Moreover, changes in intertemporal social welfare can be measured by variations in these stocks at current accounting prices or by variations in what is called 'genuine investment'. Although this approach also suffers from conceptual weaknesses (for example, it is based on the theory of revealed preference) and practical implementation problems (for example, the capability of one measurement to compare accounting prices across economies), these issues seem less of an obstacle for empirical research than those associated with the alternatives. For this reason, we argue that genuine investment, and the associated growth in genuine wealth per capita, is the best available indicator of sustainable development. We use such measures to revisit the macroeconomics of the corruption–development nexus, but with an emphasis on sustainable development, rather than on more narrowly defined economic development.

Development is, however, not the only concept that it is hard to quantify empirically. It is equally difficult to construct reliable and accurate measures of corruption (Jain, 2001, provides a good discussion). Most macroeconomic research explores cross-national differences in corruption

perceptions. It is well known that such perceptions may be biased and directly related to prevailing economic and social conditions, thus creating a spurious correlation between corruption and economic development. This suspicion was recently confirmed by Treisman (2007) and Aidt (2009). Treisman (2007) compares the determinants of corruption perceptions to the determinants of indicators of individuals' self-reported experiences with bribe giving ('experienced corruption'). He finds that many of the traditional determinants of corruption perceptions do not correlate well with indices of experienced corruption. Aidt (2009) reexamines the relationship between growth in GDP per capita and corruption and finds that the correlation between indices of experienced corruption and growth in GDP per capita is practically zero. This strongly suggests that neither the causes nor the consequences of perceived and experienced corruption are the same. However, survey-based indices of experienced corruption also suffer from many weaknesses (for example, related to selective non-response), and so neither of the two measures is perfect. To make progress one should study both types of indicators and, in that way, gauge the robustness of any relationship between corruption (measured by a variety of means) and sustainable development.

The contribution of this chapter is to revisit the classical macro-economic question of the impact of corruption on development, but from a new angle. First, we inquire into the effect of corruption on sustainable development, as opposed to more narrowly defined economic development. Second, we study the role of corruption perceptions as well as the role of individuals' self-reported experience with corruption. We find that corruption, by whatever means it is measured, is detrimental to sustainable development in a sample of up to 110 countries covering the period from 1996 to 2007. This correlation is robust across many different specifications, in contrast with the literature on GDP growth and corruption. Although, the World Bank has published estimates of genuine investment for a number of years, only a small number of studies⁶ have used them to study potential links between economic, social, and political factors and sustainable development.

The chapter is organized as follows. Section 2 discusses sustainable development in more detail and its links with corruption. Section 3 discusses the measurement problems associated with quantifying corruption. Section 4 takes a first look at the data and demonstrates a suggestive (negative) correlation between corruption and sustainable development. Section 5 sets out the estimation strategy while Section 6 presents the main results. We report results from a pooled ordinary least squares (OLS) estimator, from a Hausman–Taylor random effects estimator, and from an instrumental variables (IV) approach. Section 7 summarizes the robustness

checks implemented in the study, and Section 8 concludes the chapter with ideas for further research and thoughts on policy implications.

2. Sustainable development

Most of the empirical research on the consequences of corruption at the economy-wide level uses real GDP per capita to measure development. Ultimately, development is concerned with sustainable improvements in human welfare. It is widely recognized that GDP per capita is not necessarily a good measure of such improvements. In a nutshell, the problem is that GDP per capita is a flow variable. It records, at market prices, the value of the goods and services produced by an economy in a given year. This flow can, however, be increased over a period of time by running down an economy's capital stocks – for example, its reserves of renewable and non-renewable resources, or its stock of human capital – with the consequence that these stocks of capital are then partly lost for the future. It is, therefore, quite possible that an observed increase in the growth rate of GDP per capita over a period of time may correspond to a fall in intertemporal social welfare once the consequences for future generations are considered. This implies that we must look to other measures to assess the effects of corruption on sustainable development.

Framework and concepts

Sustainable development is loosely defined as present economic paths that do not compromise the well-being of future generations (World Commission, 1997). Arrow et al. (2004) propose a more precise definition, which we adopt for the purpose of our study. Their starting-point is an index of the intertemporal social welfare of an economy at a given time t . Intertemporal social welfare, denoted by V_t , is a measure of the present discounted value of social welfare attained at each future date along a given development path. An economy is, then, said to be on a sustainable development path if and only if V_t is not decreasing over time along that path. Clearly, this definition puts the emphasis on the change in social welfare, not on its level, and on the intertemporal aspect. One consequence of the intertemporal emphasis is that trade-offs are allowed, in the sense that social welfare may be lower at some future date than it is today so long as the discounted present value is not declining.⁷

It is useful to develop a simple theoretical framework to examine more clearly how corruption may influence the prospect of sustainable development. The framework builds on Dasgupta and Mäler (2000). They imagine a society populated by many identical individuals who live forever. Time (t) is continuous. For simplicity, we assume that the population size is fixed. The economy produces an all-purpose good (Y_t) from labor (L_t),

manufactured capital (K_t), and the flow of natural resources (R_t). The production technology is represented as:

$$Y_t = F(L_t, K_t, R_t), \quad (1.1)$$

where F increases in each of the three arguments and is continuously differentiable. It is important to stress that the production function need not be concave. As a consequence, our results regarding sustainable development and corruption apply to a wide class of economies with externalities and other market and government failures. Manufactured capital evolves over time according to the following law of motion:

$$\frac{dK_t}{dt} = F(L_t, K_t, R_t) - C_t \equiv I_t^K, \quad (1.2)$$

where C_t is aggregate consumption, I_t^K is investment in manufactured capital, and it is assumed that there is no depreciation. The natural resource base (S_t) evolves according to the following law of motion:

$$\frac{dS_t}{dt} = M(S_t) - R_t \equiv I_t^S, \quad (1.3)$$

where $M(S_t)$ is the natural rate of regeneration of the resource and I_t^S can be interpreted as the net investment in the resource base. For non-renewable resources, the regeneration rate is zero for all S_t , while for renewable resources it is positive. Individuals derive utility from consumption and disutility from labor supply. This is represented by a concave utility function, $U(C_t, L_t)$. Intertemporal social welfare at time t can, then, be defined by a utilitarian social welfare function:

$$V_t = \int_t^{\infty} U(C_{\tau}, L_{\tau}) e^{\delta(\tau-t)} d\tau, \quad (1.4)$$

where $\delta > 0$ is the (utility) discount factor. A development path P_{τ} starting at time τ is a projection into the future of all relevant economic quantities, that is, $P_{\tau} \equiv \{C_{\tau}, L_{\tau}, R_{\tau}, K_{\tau}, S_{\tau}\}_{\tau=\tau}^{\infty}$. The economy's institutions govern which of the infinitely many potential development paths is actually chosen. These include economic institutions, such as markets and trade regimes, legal institutions that govern the way disputes are settled, and political institutions that determine how the economy is governed, by whom, and regulate how power is contested, and so on. Particular institutions select particular development paths through the choices made by private individuals and public sector officials under those prevailing institutions.

There is no presumption that institutions are perfect. Economic institutions can be dysfunctional (distorted markets, unregulated monopolies, and so on) or not, rent-seeking may be kept in check or not, the society may be governed by a democratically elected leader or by a dictator, and corruption may or may not be controlled through monitoring or wage incentives. What is important for the arguments that follow is that the institutions can be taken as given; they can be affected by reform, but do not evolve organically over time.⁸ Society's institutions are formally defined as a function, α , that, given the state of the economy at each time t , $\{K_t, S_t\}$, selects a development path ($\dot{P}_t$) from the set of all feasible paths. We can then write intertemporal social welfare explicitly as a function of institutions and their stocks of capital: $V_t = V(\alpha, K_t, S_t)$.

The key question is how, in practice, we can judge whether the development path chosen by a society ($\dot{P}_t$) is sustainable or not. By definition, sustainability requires that intertemporal social welfare is not declining over time. Since intertemporal social welfare is not something that can be readily observed, this is, in itself, not very helpful for evaluating development paths empirically. Fortunately, Dasgupta and Mäler (2000) prove two important equivalence results which provide the fuzzy concept of sustainability with real empirical content.⁹ We shall focus on the most immediate of these as that suffices for our present purpose. The social scarcity of two capital assets can be measured by their accounting or shadow prices:

$$p_t(\alpha) \equiv \frac{\partial V(\alpha, K_t, S_t)}{\partial K_t}, \quad (1.5)$$

$$q_t(\alpha) \equiv \frac{\partial V(\alpha, K_t, S_t)}{\partial S_t}, \quad (1.6)$$

The shadow prices measure the change in intertemporal social welfare associated with a small increase in the relevant capital stock. Recall that intertemporal social welfare is a function of institutions and capital stocks, that is, $V_t = V(\alpha, K_t, S_t)$. Calculation of the total derivative, keeping institutions fixed, gives:

$$\frac{dV_t}{dt} = \frac{\partial V}{\partial K_t} \frac{dK_t}{dt} + \frac{\partial V}{\partial S_t} \frac{dS_t}{dt} \quad (1.7)$$

Using the definitions of the accounting prices from above (equations (1.5) and (1.6)), along with equations (1.2) and (1.3), we can rewrite equation (1.7) as:

$$\frac{dV_t}{dt} = p_t(\alpha) I_t^K + q_t(\alpha) I_t^S \equiv GI, \quad (1.8)$$

where GI is short-hand for genuine investment.¹⁰ Genuine investment reflects the change in society's genuine wealth (GW), that is, $GI_t \equiv (dGW/dt)$. Genuine investment is linked to the change in intertemporal social welfare through equation (1.8), which provides the fundamental link between theory and empirical implementation. This says that the change in intertemporal social welfare at time t in a society governed by institutions α is increasing if, and only if, the net investment in its genuine wealth is positive, that is, if, and only if, genuine investment is positive. In other words, the main determinant of intertemporal social welfare is an economy's productive base. This base consists of all the economy's capital assets, including manufactured and natural capital, as in the model, but, more generally, it also includes human and social capital. The change in the productive base can be expressed as the sum of the values of investment or disinvestment in the underlying capital assets, where the assets are priced at their social opportunity cost, that is, at shadow prices. From an empirical point of view, there is some hope that genuine investment (GI) can be estimated, while intertemporal social welfare itself is much harder, if not impossible, to measure objectively. We return to this below, but first we inquire into the effect of corruption on sustainability, as defined by the index of genuine investment.

Corruption has the potential to undermine sustainable development in many ways. The extent to which corruption actually does so is determined by an economy's institutions and its existing capital assets. This is because they control the opportunities and incentives for politicians and bureaucrats to engage in the 'sale of public assets for private gain' (Shleifer and Vishny, 1993). Returning to equation (1.8), sustainable development requires suitable investment in the economy's capital assets. A vast empirical literature strongly suggests that corruption is one reason why many societies do not make sufficient investments in their productive base. Take, for example, education, that is, investment in the stock of human capital. Since education is associated with positive externalities, the social value of these investments exceeds the private return, and public funding is justified from a social point of view, in particular for primary education. But do the funds committed always reach the schools? Expenditure tracking surveys undertaken by the World Bank in Africa suggest that the answer is no: corrupt officials manage to diverge the flow of funds to other purposes, most likely to private consumption or political patronage, somewhere along the way from the Treasury to the schools. The most extreme example of this is from Uganda in the mid-1990s, where about 80 percent of the funds intended for the surveyed schools disappeared (Reinikka and Svensson, 2004). On top of that, the macroeconomic evidence presented by Mauro (1998), Tanzi (1998) and many others shows how corruption

distorts the portfolio of public spending by shifting resources away from education and towards public consumption. In short, there are good reasons to believe that corruption undermines the accumulation of human capital and may thus be a cause of unsustainable development.

Another example is investment in manufactured capital. A large theoretical literature highlights different reasons why corruption reduces the incentive to invest.¹¹ The basic point is that corruption, through the sale of investment licenses or simply through creation of red tape and rent-seeking, serves as a tax on investment. The macroeconomic evidence strongly confirms that investment does not thrive in a corrupt environment. In fact, the most robust result of Mauro's (1995) seminal study is that perceived corruption and bureaucratic inefficiency are negatively related to investment in manufactured capital. This finding has been confirmed and elaborated on by many others since then.¹² Tanzi and Davoodi (1998), for example, show that corruption tends to increase public investment, but that it is associated with low operation and maintenance expenditures and with poor quality of infrastructure, that is, with investments of lower quality. Moreover, Wei (2000) demonstrates that corruption acts like a tax on international investments. He reports that an increase in the (perceived) corruption level from that of Singapore to that of Mexico would have the same negative effect on inward foreign direct investment as raising the tax rate on foreign investment by 50 percentage points.¹³ Along similar lines, Rose-Ackerman (1999, ch. 3) argues that corrupt politicians favor investment projects with inefficiently high capital intensity ('white elephants') because the stream of bribe income generated by such projects is front-loaded. As a consequence of this bias, too little investment is subsequently made in maintaining the capital. This effect is magnified by political instability which, in itself, reduces the time horizon of politicians.

The final example relates to the management of natural capital. Leite and Weidmann (2002) and many others provide macroeconomic evidence on the close association between extraction of natural resources, resource rents, and corruption. Anecdotal evidence linking the exploitation of natural resources to corruption is also abundant, ranging from kickbacks associated with logging concessions in Malaysia and Indonesia to oil concessions in Nigeria. (Rose-Ackerman, 1999, ch. 3, provides many more examples.) The consequence of these distortions is environmental degradation. This is directly related to a vast literature on the so-called 'resource curse'. Economic logic suggests that abundance of natural resources should be beneficial for economic development. After all, extraction of natural resources has a direct positive effect on GDP and the resource rent can, in principle, be taxed away without distorting economic decisions and invested in various capital assets, allowing a resource-abundant economy

to enjoy higher levels of consumption than a resource-scarce economy, not just in the short run but also in the long term. Yet, as first demonstrated by Sachs and Warner (1997), despite this apparent advantage, resource-rich countries tend to grow at a slower rate than other countries.¹⁴ One often-cited reason for this curse is that resource abundance fosters a ‘rentier’ economy with rampant corruption and poorly developed institutions (for example, Auty, 1993; Lane and Tornell, 1996; Hodler, 2006; Mehlum et al., 2006; Robinson et al., 2006). Such an environment not only encourages overuse of the natural resource base; it also crowds out investment in manufactured and human capital (Gylfason, 2001; Papyrakis and Gerlagh, 2006), misallocates talent away from innovative activities to rent-seeking (Acemoglu and Verdier, 1998) and encourages growth-harming increases in government consumption (Atkinson and Hamilton, 2003). Although natural resources used in this way can feed corruption, the adverse effect can, as demonstrated by Bhattacharyya and Hodler (2010), be mitigated by high-quality democratic institutions. Yet, the general message from this literature is that resource rents induce corruption where institutions are weak, and that corruption and weak institutions encourage overuse of natural capital. The implied net result is a significant fall in genuine investment.

These examples show that corruption can be a threat to sustainable development through the effect it has on investment in an economy’s productive base. However, they also demonstrate another basic point. The effect of corruption on economic growth, defined in terms of GDP per capita, is likely to be smaller than the corresponding effect of corruption on genuine investment and sustainability, at least over the medium term. To demonstrate this, equation (1.1) is used to calculate the rate of change of GDP (keeping labor input fixed for simplicity):

$$\frac{dY_t}{dt} = \frac{\partial F}{\partial K_t} I_t^K(\alpha) + \frac{\partial F}{\partial R_t} \frac{\partial R_t}{\partial t}(\alpha), \quad (1.9)$$

and the result is compared to that from equation (1.8), reproduced here for convenience:

$$\frac{dV_t}{dt} = p_t(\alpha) I_t^K + q_t(\alpha) I_t^S \equiv GI. \quad (1.8')$$

If we suppose that corruption has a negative effect on investment in manufactured capital (for one of the reasons discussed above), this would show up both as a reduction in the rate of change of GDP *and* as a reduction in genuine investment. However, if we suppose, instead, that corrupt politicians plunder a society’s natural resources by selling off mineral, fishing or oil rights for private gain, or by allowing developers, in exchange

for a bribe, to build on land that should, from a social point of view, have been protected because of the eco-services it provides, and that the proceeds from these transactions are directed at immediate consumption rather than at investment in other capital stocks,¹⁵ corruption then induces an immediate increase in the rate of change of GDP ($\partial R_t/\partial t$ in equation (1.9) increases) while genuine investment falls (I_t^S in equation (1.8) falls). This observation goes some way towards explaining why it is hard to find the effect of corruption on the growth rate of GDP: conflicting effects may cancel each other out. In contrast, the impact on genuine investment is unambiguously negative. Again, this line of reasoning has a parallel in literature on the resource curse. Atkinson and Hamilton (2003) argue that negative genuine investment tends to be associated with resource abundance. Along similar lines, Neumayer (2004), using cross-national data on GDP adjusted for depreciation of natural capital, demonstrates that the impact of resource abundance on adjusted GDP growth is smaller than the impact on unadjusted GDP growth. This is consistent with the notion that the effects of mismanagement of natural resources fall more directly on genuine investment than on the growth rate of GDP.

How should genuine investment be measured?

In order to study whether corruption is actually associated with, or perhaps even a cause of, unsustainable development, one needs empirical estimates of genuine investment across time and space. Although it is conceptually clear from equation (1.8) what needs to be measured, it is not a straightforward task to do so. One problem is to estimate the accounting prices. Another is how to take into account population and total factor productivity growth (factors which were ignored above, but obviously matter in practice). A third is how to define the relevant capital stocks and then to measure investment or disinvestment in them, and a fourth is to do all this in a way that makes international comparisons possible.

Fortunately, progress has been made in constructing rough empirical proxies for genuine investment. The World Bank, as part of the World Development Indicators, publishes an estimate of genuine investment on a yearly basis for a large number of countries, based on the work by Hamilton and Clemens (1999), Hamilton (2005) and others.¹⁶ Table 1.1 presents the figures for genuine investment from a selection of six countries and illustrates how they are calculated.

Genuine investment is estimated from gross national savings by making four adjustments that reflect investment or disinvestment in the economy's productive base.¹⁷ The first adjustment is to deduct an estimate of consumption of fixed capital to account for depreciation of manufactured capital. This represents the replacement value of capital consumed by the

Table 1.1 *Genuine investment in selected countries, average figures for 1996–2007*

Country	1	2	3	4	5	6	7	8	9	10	11
	Gross saving	Consumption of fixed capital	Education expenditure	Damage from CO ₂ emission	Particulate emission damage	Energy depletion	Mineral depletion	Forest depletion	Genuine investment	Growth rate of per capita genuine wealth	Growth rate of per capita GDP (1970–2000)
	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	%	%
India	28.43	9.33	3.93	1.41	0.68	3.10	0.50	0.78	16.56	0.88	2.79
Brazil	15.48	11.37	4.30	0.31	0.28	2.19	1.24	0.00	4.39	–0.74	2.07
Thailand	31.24	13.64	4.62	1.04	0.30	3.09	0.01	0.26	17.50	1.53	4.68
Nigeria	27.85	8.85	0.85	0.66	0.78	45.57	0.00	0.06	–27.22	–6.78	0.79
Kenya	14.08	9.54	5.82	0.41	0.18	0.00	0.05	1.35	8.37	–1.24	1.44
USA	15.00	11.84	4.79	0.34	0.25	0.85	0.04	0.00	6.46	0.49	1.76
UK	15.13	10.58	5.33	0.20	0.05	1.66	0.00	0.00	7.97	1.39	1.98

Note: Damage from CO₂ emissions is based on a marginal cost of \$30 per tonne.

Sources: World Development Indicators (various years), Hamilton (2005), Aidt et al. (2008) and the references listed in Table 1A.1 in the appendix.

process of production. The second adjustment is to add an estimate of investment in human capital. Public expenditure on education is used as a proxy for this.¹⁸ The third adjustment relates to the social cost of environmental pollution and has two parts. The first is designed to capture the cost of global warming. An estimate of the social cost of carbon dioxide emissions is subtracted from national savings, with the assumption that the average social cost of a tonne of carbon is US\$30. The second part is designed to capture the impact of local environmental degradation. The World Bank makes a financial deduction for an estimate of the health damages due to urban air pollution (particulate emissions) from gross savings. The fourth adjustment is also environmentally motivated. It seeks to account for energy depletion, mineral depletion, and net forest depletion by subtracting an estimate of the relevant resource rents from net national savings. These rents are calculated as the market price of the resource minus average extraction cost for the two non-renewable resources (energy and mineral depletion). For renewable forest resources, the rent is estimated as the market price per unit of harvest in excess of the natural regeneration rate.

The result of these adjustments on gross national savings provides a rough estimate of genuine investment in terms of the percentage of gross national income (GNI). The figures are reported in column 9 of Table 1.1 for the seven selected countries. We apply the method suggested by Arrow et al. (2003) to convert this into an estimate of growth in genuine wealth per capita. We start by converting the estimate of average genuine investment as a percentage of GNI into a growth rate of genuine wealth by multiplying by a presumed GNI–wealth ratio (v).¹⁹ Arrow et al. (2004) use a ratio of 0.2 for industrialized countries and a ratio of 0.15 for developing and oil-rich countries. Next, the population growth rate (n) is subtracted from this. In short, our empirical measure of sustainability is:

$$\frac{\frac{dgw}{dt}}{gw} = \frac{GI}{GNI}v - n, \quad (1.10)$$

where gw represents genuine wealth per capita. The net result for the seven countries is reported in column 10 of Table 1.1. Column 11 records the annual growth rates of GDP per capita for comparison. All seven countries experienced positive GDP growth during the period from 1970 to 2000. However, the estimates of growth in genuine wealth per capita suggest a bleaker picture: the current development paths of Brazil, Kenya, and Nigeria are unsustainable in the sense that they, on average, experienced negative growth in genuine wealth per capita over the period.

How reliable are these data? Clearly, they must be considered very rough indicators of sustainability as defined by equation (1.8). For example, market prices are used to value investment in human capital, but we know that this does not reflect the social value of such investment. The calculations of the resource rent associated with the various non-renewable and renewable resources are based on average costs, not on marginal costs as they should be. Moreover, they use uniform world market prices, thereby ignoring between-country quality differences in, say, minerals or wood. In addition, clearly not all capital assets have been counted. Most importantly, estimates of depletion of fish stocks, erosion of topsoil or depletion of water reserves are not included. Total factor productivity is also ignored.²⁰ The calculations are also sensitive to the choice of wealth to GNI ratios. The social cost of carbon emissions seems on the low side and, in any case, represents an average value rather than social marginal cost. Moreover, for global pollutants, such as CO₂, the citizens of a particular country will not benefit much from their own country's effort to reduce emissions unless it is part of a global effort to cut emissions. Yet the World Bank's calculations presume that the benefits of any emission reduction undertaken by a particular country are proportional to its emissions of CO₂. It is clear, therefore, that there is ample room for improvement and that these data are noisy. However, the trade-off between getting the details right for a few cases and getting a rough proxy for many cases is important. The trade-off comes down in favor of the latter for answering many interesting research questions, including the ones at hand here. In conclusion, for the purpose of our statistical analysis, we take these data at face value as the best available proxy for sustainable development. In Section 8, we discuss some concrete improvements that could be introduced in future research.

3. Corruption

Corruption is also an elusive concept to quantify, and a perfect index or ranking does not exist for the purpose of cross-national comparisons. The approach followed here is to emphasize robustness and make use of six different cross-national corruption indicators.²¹ These indicators fall into two groups. The first group includes cross-country indices of corruption perceptions. These are based on surveys of business consultants, local and international businesspeople, or of ordinary citizens. The two most commonly used indices of this type are the Corruption Perception Index, published by Transparency International (the '*TI index*'),²² and the Control of Corruption Index, published by the World Bank (the '*WB index*').²³ The original TI index measures corruption on a scale from 0 to 10, with 10 representing the lowest level of corruption. We have rescaled the index

such that 10 represents maximum perceived corruption. Likewise, we have normalized the *WB index* to be between 0 and 1, with 1 representing the country with the least control of corruption. We also make use of the country ranking published yearly in the International Country Risk Guide.²⁴ This rating, which we refer to as the '*ICRG index*', is based on evaluations made by a panel of experts, rather than on the aggregation of survey data from many different sources. The original ICRG index records these evaluations on a scale from 1 to 5. We have inverted the index so that 1 corresponds to low corruption and a value of 5 corresponds to high corruption. Data for the three indices are available from at least the 1990s. It is, however, debatable as to whether the variations in the data over time are informative or not. The problem with respect to the *TI index* and the *WB index* is that the underlying data sources are not the same from year to year, and this can account for as much as half of the variation over time (Kaufmann and Kraay, 2002, pp. 13–14). The *ICRG index* avoids this problem since it is based on *one* yearly survey by a panel of experts, but has its own problems. As pointed out by Lambsdorff (2005), the index is actually designed to measure the risk of political instability caused by corruption rather than corruption itself, and this seems to generate unexpected movements over time in the index for some countries. Nevertheless, we shall, with this caveat in mind, attempt to use the changes over time in the *ICRG index* in our estimations.

The *TI index*, the *WB index* and the *ICRG index* all measure perceptions concerning the level of corruption in different countries. This is problematic insofar as there is a gap between perceptions and facts on the ground. Treisman (2007) provides an illuminating discussion of this point. Equally troublesome for the purpose of estimating the impact of corruption on sustainable development, these perceptions may be informed partly by the economic conditions prevailing in the country at the time the perceptions were formed. As an alternative to the three corruption perception indices, we can draw upon surveys of self-reported experiences with corruption. The World Bank's World Business Environment Survey (the *WBES*)²⁵ interviewed managers in 80 countries in 1999 and 2000, and asked them to respond to the following statement: 'It is common for firms in my line of business to have to pay some irregular "additional" payment to get things done'. We have coded the *WBES index* based on the country averages, such that 1 corresponds to everyone answering 'never' and 6 corresponds to everyone responding with 'always'. Transparency International conducted a similar survey – the Global Corruption Barometer (GCB) – in 2004 and 2005. This survey recorded the percentage of citizens in different countries who answered 'Yes' to the question: 'In the past 12 months, have you or anyone living in your household paid a bribe in any form?'.

We refer to this as the '*GCB index*'. Finally, the Interregional Crime and Justice Research Institute (UNICRI),²⁶ under the United Nations, conducted a survey in the late 1990s that recorded the percentage of respondents who had been asked to pay a bribe by government officials during previous year. We refer to this as the '*UNICRI index*'. The merit of these three indices is that they are each targeted at eliciting information from first-hand experience with corruption. Yet, like the perception-based indices, they have their weaknesses. First, selective non-response is likely to be a problem as those surveyed may have an incentive to understate their experience with corruption. Second, it is also possible that individuals adjust their behavior to reflect past experiences with corruption. For example, they may stop engaging with certain public officials to avoid paying bribes. If so, when asked about bribe payments they might have made in the immediate past, they truthfully report that they have made none, but only because they have stopped interacting with those officials who demand bribes. Both of these effects suggest that self-reported experience with corruption may underestimate the true extent of bribery, and that the underestimate may be systematically larger in countries with high levels of corruption. In addition, country coverage for respondents is much more limited than for perception-based indices.

Nonetheless, by making use of all six proxies for corruption, we hope to gauge the robustness of our statistical findings. Another good reason for focusing both on perception- and experience-based indices of corruption is that they are likely to capture different aspects of corruption. The experience-based indices of corruption are clearly directed at measuring petty corruption. The perception-based indices may, in addition, pick up information concerning 'grand corruption' and 'government capture'.²⁷ So, by studying both, we might be able to say something about the impact of different types of corruption on sustainability.

4. A first look at the data

Perhaps the most instructive way to introduce the data is to split the sample of 110 countries into four groups. To do this, on the one hand, we divide the countries into those with positive and negative '*growth in genuine wealth per capita*' over the period from 1996 to 2007, and, on the other, we divide them into those with high and those with low corruption levels according to either the *WB index* or the *WBES Index*.²⁸

The resulting two-way tabulations are shown in Tables 1.2a and 1.2b. The tables report the names of the countries that fall into each of the four cells. Table 1.2a shows the cross-tabulation for the *WB index* and Table 1.2b shows the tabulation for the *WBES index*. The majority of countries fall on the left-right diagonal, that is, follow either a sustainable path

Table 1.2a Cross-tabulation of growth in genuine wealth per capita and the WB index

Low corruption		High corruption	
Sustainable			
Mongolia	France	Japan	Lithuania
Tunisia	Sweden	Norway	Panama
Latvia	Belgium	Ireland	Guyana
Morocco	Denmark	Singapore	Russia
Switzerland	Spain	Malaysia	Albania
Cyprus	Bahamas	Czech Rep.	
Hong Kong	Croatia	Portugal	
New Zealand	Canada	Luxembourg	
Netherlands	Uruguay	Austria	
Bulgaria	Turkey	Finland	
Thailand	Botswana	Germany	
Italy	Sri Lanka	Poland	
UK	Slovenia	Korea, Rep.	
USA	Estonia	Hungary	
Greece	Iceland		
		Indonesia	Jamaica
		Philippines	Honduras
		Vietnam	Bangladesh
		Mexico	Ukraine
		India	Moldova
		Belarus	Algeria
		Armenia	China
		El Salvador	
		Romania	
		Dominican Rep.	

with low corruption or an unsustainable path with high corruption, but a sizable minority manage to stay on a sustainable path, despite having high corruption. However, it is relatively rare that a country follows an unsustainable path while experiencing low corruption levels. All in all, these illustrations are suggestive of a negative correlation between sustainable development and corruption, but before we can draw firm conclusions, we need to subject the data to more thorough investigation.

5. Econometric specification

The theory, sketched in Section 2, suggests that *growth in genuine wealth per capita* is determined by three broad factors: the institutions that govern resource allocation (α), the productive base of the economy (the capital stocks), and the shadow prices of these resources along the chosen path. We shall use this as a guide to formulate our econometric model. However, in doing so, we must be careful not to explain *growth in genuine wealth per capita* with variables, such as the value of resource rents, government expenditure on education and so on, that are themselves part of the empirical definition of genuine investment. For the purpose of the statistical analysis, we have divided the sample of up to 110 countries into three cross-sections, covering the years 1996–99, 2000–03, and 2004–07, respectively. The dependent variable is *growth in genuine wealth per capita* (gw) and our baseline specification is the following panel model:²⁹

$$d \ln gw_{it} = \beta_0 CORRUPTION_{it} + \sum_{k=1}^{\bar{k}} \beta_{1k} INSTITUTIONS_{it}^k + \sum_{l=1}^{\bar{l}} \beta_{1l} STOCKS_{it}^l + \sum_{s=1}^{\bar{s}} \beta_{1s} SHADOW_{it}^s + \mu_i + \gamma_t + \varepsilon_{it}, \quad (1.11)$$

where i is a country index and $t = 1, 2, 3$ represent the three cross-sections. The error term has three subcomponents: μ_i represents unobserved country-specific determinants of sustainability that do not vary over time; γ_t represents common time-specific shocks to sustainability, and ε_{it} represents all unobserved determinants of sustainability that vary over time within a country. The variable *CORRUPTION* corresponds to one of the six corruption indices discussed above, while the variables *INSTITUTIONS*, *STOCKS* and *SHADOW* represent the three major categories of control variables suggested by theory, namely the proxies for political and legal institutions, for the capital stocks, and for the accounting or shadow prices (as discussed below).

Only one of the six corruption indices (the ICRG index) has potentially meaningful variation over time. So, for the bulk of the estimations, the variation used to estimate β_0 comes from the cross-section only. The theory refers to institutions, broadly defined. Corruption is clearly part of

this, but the underlying political and legal institutions also play a pivotal role. Conceptually, these may influence growth in their own right, that is, irrespective of the level of corruption. One possibility is that the variations in political accountability systematically affect the time horizon of politicians and thus their incentive to invest in the economy's capital assets (Aidt and Dutta, 2007). Another is that some legal environments make it hard to enforce intertemporal contracts. However, it is also clear that political and legal institutions are among the key determinants of corruption (Treisman, 2000; Paldam, 2002) and that they may affect the extent to which corruption adversely affects economic outcomes.³⁰ In fact, in our sample, the correlation between the various corruption indices and the other governance indicators in the World Bank's Governance Matters Database³¹ is higher than -0.75 , with the exception of the index of the rule of law (-0.15). In the baseline specifications, we include one proxy for the legal framework and one for the quality of political institutions. Our choice of proxy is guided by the desire to avoid too much multicollinearity. We use a dummy variable as a proxy for legal institutions (*common law*), to show whether the legal code of the country falls under common law or not (La Porta et al., 1997). The correlation between this variable and corruption is relatively low (less than -0.15). The variable is meant to capture systematic differences in the contracting environment, rather than variations in the rule of law as such. Thus, we do not take a stand a priori on the vexed debate over the relative efficiency of common law and civil law systems. We use two alternative measures as a proxy for the quality of political institutions. The first is the Freedom House Index of Political Freedom (*political freedom*).³² Freedom House rates countries according to the degree of political pluralism and participation, and the functioning of the government, based on the judgment of a panel of experts. We have adjusted the index such that higher values on the scale from 1 to 7 reflect institutions that function better. Because one of the categories used to construct this index refers to whether the government is free from pervasive corruption, it is directly related to corruption, yet its correlation with the corruption indices is lower than for the governance indicators from the Governance Matters Database. Moreover, the index has variation over time, which we shall explore in the estimations. The other indicator of the quality of political institutions is a measure of the durability of democracy (*democracy*), suggested by Treisman (2007). We record whether or not a country is a democracy as of the year in question (1996, 2000 or 2004) based on the classification of Beck et al. (2001). If it was a democracy at the relevant juncture,³³ the variable *democracy* then records the number of consecutive years since 1930 that the political system was democratic. In other words, we attempt to measure how consolidated a democracy is

in each country. If the country is not democratic at the relevant junction, *democracy* takes on the value of 0. The variable *democracy* includes time, as well as cross-national variation, and its correlation with the corruption indices is relatively high (around -0.67). It is important to stress that, by conditioning on these proxies for institutional quality, our estimate of the impact of corruption on sustainability (β_0 in equation (1.11)) captures the effect of corruption over and above that which can be explained by the checks on corruption induced by the institutional framework. In other words, if β_0 is estimated to be zero, it does not necessarily mean that corruption is irrelevant for sustainability; it may still exercise an influence through dysfunctional institutions. We shall return to this point in Section 6.

It is difficult to control for stocks of the various capital assets. As a result, we employ three imperfect proxies. One is the average years of schooling for the population aged 15 and over, lagged by five years (*human capital*).³⁴ This is only available for 69 of the 110 countries in the sample, but is the best available proxy for cross-national differences in the stock of human capital. The other proxy is PPP-adjusted real GDP per capita (from the World Development Indicators) suitably lagged (*GDP per capita*). This proxies for the stock of manufactured and human capital, but also picks up the flow of natural resources used in the production process, and so is, by construction, correlated with genuine investment. It is, therefore, a questionable proxy, a fact that should be kept in mind when interpreting the results.³⁵ The third proxy is for social capital. Bjørnskov (2007), among others, reports a strong negative correlation between survey measures of social capital and income inequality. This suggests that we can use the Gini coefficient³⁶ to proxy for social capital (*inequality*). A higher Gini coefficient corresponds to larger income inequality, and thus to a smaller stock of social capital. We have considered various proxies for the stock of natural capital, such as fuel exports relative to total manufacturing exports, or the World Bank's (2006) estimate of the stock of natural capital. The two main problems with these measures are that they relate directly to the extraction of natural resources (fuel exports), rather than to the stock, and that they are constructed from the same data on resources rents that are used to estimate genuine investment. For this reason, we do not include any of these measures in the baseline specifications, but consider them as part of the robustness analysis in Section 7.

It is even more difficult to find proxies for the relevant accounting or shadow prices. The best we can do is to note that world market prices can, in some cases, serve as shadow prices. The extent to which this is relevant depends on a country's involvement in international trade. This can, in turn, be measured by the variable *trade openness* which records spending

on imports of goods and services as a percentage of GDP (from the World Development Indicators). It is clear, however, that this is more related to whether local prices are linked to world market prices than to any specific values of the relevant shadow prices, and thus not a very accurate proxy. Appendix Table 1A.1 lists the sources used to construct the dataset and Appendix Table 1A.2 reports summary statistics for the variables used in the main statistical analysis.

6. Estimation results

The major statistical challenge is to obtain a robust and unbiased estimate of β_0 , the effect of corruption on *growth in genuine wealth per capita*. We rise to that challenge by estimating equation (1.11) in three different ways. First, we use a pooled OLS estimator with panel-corrected standard errors; second, we use the Hausman–Taylor random effects estimator; and, third, we use an IV estimator. We discuss the merits of these techniques and the results they yield in the following sub-sections.

Pooled OLS estimates

Our first estimation approach pools the three cross-sections and estimates the model with OLS. We allow for panel heteroskedasticity and for spatial correlations between the error terms across countries, and the reported standard errors of the parameter estimates are panel-corrected standard errors (PCSEs), as recommended by Beck and Katz (1995).

The results are presented in four tables. Tables 1.3 and 1.4 show estimations based on the three indices of perceived corruption, but differ with regard to how we control for political institutions (the specifications in Table 1.3 control for *democracy* while those in Table 1.4 control for *political freedom*). Tables 1.5 and 1.6 show a similar set of estimations, but these are based on the three indices of experienced corruption. All specifications control for *common law* and include a full set of regional dummy variables, and time-fixed effects (not reported in the tables). Moreover, for each combination of corruption index and institutional control variable, we show two specifications: one with the four control variables – *inequality*, *GDP per capita*, *human capital*, and *trade openness* – and one without. The main reasons for reporting both specifications are, first, that 30 observations are lost when we add the four additional control variables³⁷ and, second, that one can question the appropriateness of each of these control variables.

Taken together, the estimations reported in the four tables demonstrate that, conditional on the quality and type of political and legal institutions, corruption, however it is measured, is significantly negatively correlated with *growth in genuine wealth per capita*. This correlation is robust across many different specifications, with and without the extra control variables.

Table 1.3 Growth in genuine wealth per capita and perceived corruption, 1996–2007: Specification with democracy

Estimation technique: Pooled OLS with panel-corrected standard errors						
Dep. variable: <i>growth in genuine wealth per capita</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
TI index	−0.30*** [−4.42]	−0.20** [−2.16]				
WB index			−2.90*** [−4.70]	−2.10** [−2.45]		
ICRG index					−0.032 [−0.31]	0.13 [1.29]
Democracy	0.0073 [1.37]	0.0036 [0.73]	0.0066 [1.11]	0.0022 [0.43]	0.029*** [4.61]	0.0075 [1.52]
Common law	0.070 [0.29]	−0.49** [−1.97]	0.025 [0.11]	−0.42* [−1.70]	0.059 [0.24]	−0.42* [−1.68]
Inequality		0.012 [0.64]		0.013 [0.67]		0.0097 [0.48]
GDP per capita		−0.46** [−2.12]		−0.61*** [−2.58]		−0.17 [−0.87]
Human capital		0.18*** [2.66]		0.20*** [3.13]		0.27*** [3.93]
Trade openness		0.010*** [3.38]		0.0095*** [3.09]		0.011*** [3.56]
Observations	310	230	322	233	322	233
R-squared	0.54	0.57	0.56	0.58	0.52	0.57
Number of countries	106	78	110	79	110	79

Note: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust *z*-statistics are given in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The negative effect is particularly pronounced in the specifications based on individuals' self-reported experience with corruption (Tables 1.5 and 1.6). It is somewhat less robust in the specifications with perceived corruption. In particular, corruption is insignificant in the specifications based on the *ICRG index* (see columns (5) and (6) of Tables 1.3 and 1.4).³⁸ This suggests that petty corruption is at least as important as grand corruption.

To get a sense of the magnitude of the effect, consider the point estimate for the *TI index* reported in column (1) of Table 1.3 (−0.30). Take a country, Denmark, with one of the lowest average *TI index* scores over the period (0.40) and imagine that corruption in Denmark suddenly increased to the level perceived to prevail in a country with one of the

Table 1.4 Growth in genuine wealth per capita and perceived corruption, 1996–2007: Specification with political freedom

Estimation technique: Pooled OLS with panel-corrected standard errors						
Dep. variable: <i>growth in genuine wealth per capita</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
TI index	−0.30*** [−4.28]	−0.22** [−2.46]				
WB index			−2.83*** [−4.69]	−2.43*** [−2.87]		
ICRG index					−0.080 [−0.74]	0.11 [1.11]
Political freedom	0.11* [1.66]	−0.040 [−0.50]	0.089 [1.31]	−0.080 [−1.01]	0.27*** [3.46]	0.0072 [0.087]
Common law	0.11 [0.45]	−0.45* [−1.88]	0.065 [0.28]	−0.39 [−1.63]	0.25 [1.04]	−0.37 [−1.49]
Inequality		0.012 [0.64]		0.013 [0.65]		0.011 [0.52]
GDP per capita		−0.40* [−1.81]		−0.58** [−2.38]		−0.084 [−0.40]
Human capital		0.18*** [2.77]		0.21*** [3.27]		0.28*** [4.10]
Trade openness		0.010*** [3.29]		0.0097*** [3.01]		0.011*** [3.46]
Observations	310	230	322	233	322	233
R-squared	0.54	0.57	0.56	0.58	0.52	0.57
Number of countries	106	78	110	79	110	79

Note: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust z-statistics are given in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

highest average *TI index* scores, Nigeria (8.5). Then *growth in genuine wealth per capita* would fall from a healthy 2.37 percent to −0.06. In other words, the sharp increase in corruption would make the development path of Denmark unsustainable. Alternatively, consider the point estimate on the *GCB index* reported in column (3) of Table 1.6 (−0.034). In the OECD economies covered by the survey, fewer than 1 percent of the respondents claim that they were asked for a bribe during the past year. In the country with the highest score (Cameroon), 52 percent of respondents reported that they had paid a bribe. So, a country that went from the ‘OECD level’ of 1 percent to the ‘African level’ of 50 percent would, *ceteris paribus*, see

Table 1.5 Growth in genuine wealth per capita and experienced corruption, 1996–2007: Specification with democracy

Estimation technique: Pooled OLS with panel-corrected standard errors						
Dep. variable: <i>growth in genuine wealth per capita</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
WBES index	−0.90*** [−5.30]	−0.44** [−2.31]				
GCB index			−0.022** [−2.24]	−0.031*** [−3.33]		
UNICRI index					−0.061*** [−2.93]	−0.035* [−1.95]
Democracy	0.020*** [3.35]	0.015** [2.45]	0.022*** [4.45]	0.017*** [3.65]	0.015** [2.14]	0.018 [1.59]
Common law	−0.52** [−2.06]	−0.63** [−2.42]	−0.29 [−1.18]	−0.90*** [−4.61]	−1.28*** [−3.05]	−1.47*** [−2.95]
Inequality		0.028 [1.47]		−0.029*** [−3.13]		0.040 [1.41]
GDP per capita		0.19 [0.80]		−0.063 [−0.36]		−0.17 [−0.57]
Human capital		0.12* [1.84]		0.053 [1.03]		0.17** [1.98]
Trade openness		0.0061 [1.14]		0.0084*** [2.68]		0.0030 [0.47]
Observations	192	154	159	128	125	101
R-squared	0.58	0.58	0.69	0.79	0.54	0.57
Number of countries	65	52	55	44	42	34

Note: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust z-statistics are presented in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

its growth rate of genuine wealth per capita reduced by 1.73 percentage points. Of course, these examples are extreme in that they consider unrealistically big jumps in corruption. Yet, they serve the purpose of illustrating that the effect of corruption on *growth in genuine wealth per capita* is of economic, as well as statistical, significance.

Although corruption is robustly related to sustainability, it is harder to detect a consistent pattern with respect to political and legal institutions. The two measures of political institutions, *democracy* and *political freedom*, are mostly insignificant, but occasionally, we find a positive and significant effect, suggesting that established democratic institutions and political freedom may contribute to sustainable development (over

Table 1.6 Growth in genuine wealth per capita and experienced corruption, 1996–2007: Specification with political freedom

Estimation technique: Pooled OLS with panel-corrected standard errors						
Dep. variable: <i>growth in genuine wealth per capita</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
WBES index	−0.96*** [−5.47]	−0.41** [−2.21]				
GCB index			−0.034*** [−2.66]	−0.035*** [−3.37]		
UNICRI index					−0.075*** [−3.99]	−0.037** [−2.21]
Political freedom	0.16*** [2.70]	0.21** [2.42]	0.036 [0.50]	0.013 [0.21]	0.042 [0.72]	0.15 [1.06]
Common law	−0.36 [−1.47]	−0.52** [−2.06]	−0.073 [−0.29]	−0.76*** [−3.26]	−0.85** [−2.02]	−1.06** [−2.14]
Inequality		0.035* [1.84]		−0.022** [−2.36]		0.035 [1.20]
GDP per capita		0.26 [0.99]		0.14 [0.73]		−0.038 [−0.12]
Human capital		0.11 [1.48]		0.075 [1.31]		0.20** [2.22]
Trade openness		0.0041 [0.84]		0.0083** [2.29]		0.0045 [0.72]
Observations	192	154	159	128	125	101
R-squared	0.57	0.58	0.66	0.76	0.52	0.56
Number of countries	65	52	55	44	42	34

Note: All estimations include a full set of regional dummies, time-specific fixed effects and a constant term. Robust *z*-statistics are presented in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

and above the effect they may have on corruption). Our measure of legal institutions, *common law*, is significant in about half the specifications. The point estimate is negative. This suggests that countries with a common law system perform worse in terms of sustainable development than countries with a civil law (or some other legal) system. Past research has found that common law systems tend to promote *financial* development. This is because they offer better protection of private investors (La Porta et al., 1998). Our estimations suggest that while common law systems encourage financial development, this may happen at the expense of sustainable development. One reason for such a differential impact is that common

law systems protect private investors while civil law systems are better at promoting the type of socially valuable investments that are required to protect the capital base of an economy. Taken together, this suggests that financial development and sustainable development may not go hand in hand.

The economic control variables matter in some, but far from all, specifications. First, *gdp per capita* has a negative effect on sustainability, as one would expect if it proxies for the stocks of manufactured and human capital. Second, *inequality* has a negative effect, as one would expect if equality is associated with more social capital and trust. Third, *human capital* and *trade openness* both have positive effects on *growth in genuine wealth per capita*. The last effect is what one would expect if international trade brings domestic market prices closer to their accounting prices. The positive effect of our proxy for the stock of human capital is more puzzling as we would expect a negative effect. The most immediate explanation for this result is that there is persistence in school expenditures, so that the expenditures in the past are correlated with expenditures in the present and, therefore, with current education attainment levels. This would generate a positive correlation between current education attainment levels and *growth in genuine wealth per capita*.

Hausman–Taylor estimates

For a variety of reasons, the estimates presented in Tables 1.3–1.6 are unlikely to represent a causal effect. One major issue is that the six corruption indices are likely to be correlated with unobserved country-specific factors, such as culture, history, and unobserved institutional factors. In other words, it is possible that $Cov(CORRUPTION_i, \mu_i) \neq 0$. In principle, we could address this issue with a fixed effects estimator. The problem, however, is that five of the six corruption indices have little meaningful variation over time, and the variation that does occur over time in one – the *ICRG index* – is not strong enough to accommodate a fixed effects estimator. The standard random effects estimator is not appropriate either because corruption, as measured by the six indices, is almost surely correlated with the unobserved country-specific factors. The only way forward, then, is to employ the Hausman–Taylor estimator.³⁹ This estimator is designed to address the problem that corruption is endogenous in the sense of being correlated with unobserved country-specific factors, and has the advantage that we do not have to find external instruments. More specifically, the estimator is based on the assumption that, although the relevant corruption index and the relevant measure of political institutions may be correlated with unobserved country-specific effects, none of the other independent variables is so correlated. In addition, we must

assume that all the independent variables are uncorrelated with the time-varying country-specific error term (ϵ_{it}). Given these assumptions, we can use the time-averaged values of the exogenous time-varying variables as instruments for (a random effects transformation of) the corruption index and the deviation from the time average of the endogenous time-varying variable as an instrument for (a random effects transformation of) the measure of political institutions (Wooldridge, 2002). We can test the appropriateness of these instruments using a Hausman overidentification test. This test evaluates the Hausman–Taylor model against its fixed effects counterpart (where the effects of all the time-invariant variables are subsumed in the fixed effect). If the test statistic is insignificant, then the Hausman–Taylor estimator is consistent *and* more efficient than its fixed effects counterpart.

The estimation results are reported in Tables 1.7 and 1.8. We exclude *human capital* from all the specifications shown in order to maximize sample size, but doing so makes little difference to the results. The Hausman overidentification test reported at the bottom of Tables 1.7 and 1.8 supports, in each case, the choice of the Hausman–Taylor model. The picture remains clear with regard to the effect of corruption on *growth in genuine wealth per capita*: irrespective of the corruption index used, and irrespective of how we control for political institutions, corruption has a significant negative effect on sustainability. The magnitude of the effect is larger than that reported previously,⁴⁰ suggesting that once we take into account unobserved country-specific factors such as culture, geography, history, and so on, the effect of corruption is even more substantial than when we do not do so. On the other hand, it is clear from Tables 1.7 and 1.8 that the *direct* effect of political institutions is largely eliminated by the fixed effects, while *common law* occasionally has a significant negative effect on sustainability.

Instrumental variables estimates

The Hausman–Taylor estimator deals with one type of endogeneity, namely that related to unobserved country-specific determinants of sustainability, but not with others. In particular, the approach assumes that the corruption indices (and the other explanatory variables) are uncorrelated with all unobserved country-specific *time-varying* determinants of sustainability. This would not be the case if growth in genuine wealth affects corruption (reverse causality), if corruption is measured with error, or if our control variables do not pick up all aspects of the institutional and economic environment that might affect both corruption and sustainability (omitted variables).

These are real issues, and to address them, we need to find external

Table 1.7 Growth in genuine wealth per capita and corruption, 1996–2007: the Hausman–Taylor estimator with democracy

Estimation technique: Hausman–Taylor random effects estimator, treating corruption and democracy as endogenous						
Dep. variable: <i>growth in genuine wealth per capita</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
TI index	–1.04*** [–3.36]					
WB index		–10.4*** [–4.08]				
ICRG index			–0.17* [–1.72]			
WBES index				–2.98*** [–4.13]		
GCB index					–0.28*** [–3.07]	
UNICRI index						–0.21*** [–2.83]
Democracy	–0.011 [–0.38]	–0.032 [–1.12]	0.055*** [3.49]	0.010 [0.36]	–0.026 [–0.74]	–0.0079 [–0.25]
Common law	–0.84* [–1.96]	–0.44 [–0.94]	–1.01* [–1.78]	0.67 [0.92]	–0.75 [–0.97]	–1.00 [–1.43]
Inequality	–0.046** [–2.12]	–0.034 [–1.48]	–0.08*** [–3.21]	–0.11*** [–3.78]	–0.077** [–2.12]	–0.042* [–1.66]
GDP per capita	–1.24*** [–4.01]	–1.23*** [–3.84]	–0.99*** [–3.42]	–1.68*** [–3.58]	–1.26*** [–4.25]	–0.80* [–1.89]
Trade openness	0.0054 [0.88]	0.0060 [0.94]	0.0039 [0.58]	–0.0058 [–0.68]	0.012 [1.35]	–0.018 [–1.54]
Observations	279	285	285	187	150	125
Number of countries	95	97	97	63	52	42

Note: All estimations include time-specific fixed effects and a constant term. Robust z-statistics are presented in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

instruments for corruption, that is, we need to find variables that are correlated with corruption, but uncorrelated with all unobserved determinants of growth in genuine wealth. In other words, we need to find variables that affect sustainability only through their effect on corruption. This is a tall order. The best we can do is to follow the literature and pick instrumental variables that have proved useful in previous research on the economic consequence of corruption. Mauro (1995), La Porta et al. (1998), Hall and

Table 1.8 Growth in genuine wealth per capita and corruption, 1996–2007: the Hausman–Taylor estimator with political freedom

Estimation technique: Hausman–Taylor random effects estimator, treating corruption and <i>political freedom</i> as endogenous						
Dep. variable: <i>growth in genuine wealth per capita</i>						
	(1)	(2)	(3)	(4)	(5)	(6)
TI index	–0.93*** [–5.36]					
WB index		–7.94*** [–5.53]				
ICRG index			–0.17* [–1.74]			
WBES index				–3.20*** [–4.95]		
GCB index					–0.24*** [–5.33]	
UNICRI index						–0.20*** [–3.91]
Political freedom	0.02 [0.21]	0.01 [0.12]	0.11 [1.43]	–0.05 [–0.60]	–0.14 [–1.59]	–0.005 [–0.042]
Common law	–0.91** [–2.35]	–0.70* [–1.83]	–0.43 [–0.87]	0.82 [1.23]	–1.04* [–1.67]	–1.08* [–1.94]
Inequality	–0.050** [–2.56]	–0.045** [–2.33]	–0.083*** [–3.39]	–0.11*** [–3.65]	–0.087*** [–2.89]	–0.044** [–2.06]
GDP per capita	–1.26*** [–4.21]	–1.31*** [–4.28]	–0.27 [–1.28]	–1.60*** [–3.81]	–1.34*** [–4.77]	–0.87*** [–2.73]
Trade openness	0.0057 [0.96]	0.0077 [1.27]	0.0012 [0.18]	–0.0069 [–0.85]	0.015* [1.73]	–0.016* [–1.66]
Observations	279	285	285	187	150	125
Number of countries	95	97	97	63	52	42

Note: All estimations include time-specific time effects and a constant term. Robust z-statistics are presented in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Jones (1999), and Gupta et al. (2002), among others, have suggested that ethno-linguistic fractionalization (*ethnicity*),⁴¹ past corruption levels (the *initial ICRG index*), and distance from the equator (*latitude*) can all be used as instruments for corruption in GDP growth or income inequality regressions. It is not difficult to find objections to each of these instruments. Although the presence of many different ethnic groups may foster corruption because public officials favor their own group at the expense of others, or because this leads to less coordinated bribe taking, it is quite

possible that the degree of fractionalization is directly related to sustainable development. For example, Easterly and Levine (1997) show that ethno-linguistic fractionalization is related to economic growth and, as we discuss in more detail below, ethno-linguistic fractionalization is, in fact, strongly negatively correlated with *growth in genuine wealth per capita*. Lagged values are relevant instruments, but are only valid if there is no series correlation left in the error term of the outcome equation. Although Hall and Jones (1999) proposed a measure of distance from the equator as an instrument for social infrastructure – a composite index that includes, as one component, corruption – it is really an instrument for institutions, defined broadly, rather than for a specific aspect of governance, such as corruption. Moreover, Acemoglu (2005) questions the underlying rationale for focusing on the distance from the equator, namely that ‘good’ institutions spread from Europe to geographically similar regions. One problem is that the variable cannot explain the substantial differences in the quality of institutions among countries located in the same proximate distance to the equator.

With these significant caveats in mind, Table 1.9 reports IV estimations based on these three instruments. We have time-averaged the dependent variable *growth in genuine wealth per capita* and effectively treat the data as one cross-section. We only report specifications where we use *democracy* to control for political institutions and where we do not include any of the economic control variables.⁴² Statistically speaking, the three instruments work reasonably well for the *TI index* and the *WB index*. They are jointly significant in the first stage of the two stage estimation procedure and the *p*-value on the Hansen *J*-test for overidentification is large. For the *ICRG index* and the *WBES index*, however, the instruments fail the standard specification tests. Focusing, then, on the estimations for the *TI index* and the *WB index*, we see that the point estimates are somewhat larger in absolute value than the corresponding OLS estimates, reported at the bottom of the table, and are also statistically significant. This suggests that the OLS estimates might be biased towards zero. Such a bias is consistent both with measurement error and reverse causality.

Hierarchies of institutions

Our estimation strategy so far has been predicated on the assumption that political and legal institutions affect sustainability directly and that the effect of corruption can be estimated conditionally on the institutional context. However, it may be more instructive to think in terms of a hierarchy of institutions. At the top of the hierarchy, we find political and legal institutions. These determine the equilibrium level of corruption.

Table 1.9 Instrumental variables estimates (2SLS)

Endogenous variable: Corruption							
Instruments: latitude, initial ICRG index, and ethnicity							
Stage	(1)	(2)	(3)	(4)	(5)	(6)	(8)
	2nd	1st	2nd	1st	2nd	1st	1st
Dep. variable	Growth in genuine wealth	TI index	Growth in genuine wealth	WB index	Growth in genuine wealth	ICRG index	WBES index
TI index, instrumented	-0.47** [-2.57]						
WB index, instrumented			-3.93*** [-2.83]				
ICRG index, instrumented					-0.44 [-1.18]		
WBES index, instrumented						-2.72** [-2.10]	
Democracy	-0.0021 [-0.13]	-0.04*** [-4.50]	-0.0016 [-0.10]	-0.01*** [-5.33]	0.016 [0.95]	-0.02*** [-4.58]	-0.011** [-2.03]

Common law	0.099 [0.20]	-0.78** [-2.63]	0.30 [0.75]	-0.067** [-2.01]	0.38 [0.96]	0.045 [0.24]	0.075 [0.072]	-0.33 [-1.12]
Latitude		-0.035* [-1.76]		-0.0044* [-1.97]		-0.0067 [-0.93]		-0.0017 [-0.17]
Initial ICRG index		0.49** [2.18]		0.055** [2.40]		0.37*** [3.94]		0.11 [0.72]
Ethnicity		0.54 [0.66]		0.060 [0.61]		-0.35 [-0.79]		0.75 [1.05]
OLS estimate	-0.36*** [-3.20]		-3.40*** [-3.80]		-0.13 [-0.60]		-0.67* [-1.84]	
First stage F -statistics		12.11		14.79		12.1		2.19
Over-ID test (p -value)	0.33		0.12		0.03		0.63	
Observations	86	86	96	96	96	96	51	51
R -squared	0.43	0.75	0.51	0.76	0.44	0.65	0.36	0.41

Note: Robust z -statistics are presented in brackets; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$; all estimations contain regional dummy variables.

This, then, determines economic outcomes (here, sustainability). Another way to state the same point is to note that ‘corruption is a *symptom* that something has gone wrong in the management of the state. Institutions designed to govern the interrelationships between the citizens and the state are used instead for personal enrichment and the provision of benefits to the corrupt’ (Rose-Ackerman, 1999: 9, italics added). Persson (2004) and Eicher and Leukert (2009) also advocate this line of reasoning as a guide to empirical research. In our present context, the logic of a hierarchy of institutions implies that we should use our measures of political and legal institutions as instruments for corruption. That is, we should first estimate the impact of institutions on corruption, and then estimate the impact of corruption on sustainability.

Table 1.10 presents the results from a two-stage least squares (2SLS) estimation procedure based on this logic, in which we use *democracy* and *common law* as additional instruments for corruption (we also continue to use the three instruments introduced above). The estimates obtained in this way are highly statistically significant and suggest that corruption has a large negative effect on *growth in genuine wealth per capita*. Equally importantly, the new instruments perform well statistically: they can explain corruption in the first stage (that is, they are ‘relevant’ instruments) and they have no difficulty passing the Hansen *J*-test. Of course, this test can only tell us whether the new instruments are valid (that is, uncorrelated with the unobserved component of sustainability) *conditional* on at least one of the other instruments being valid (which may not be the case). Yet, the results are encouraging for the ‘hierarchies of institutions’ hypothesis. In particular, these results leave the door open for the interpretation that institutions may mainly exercise an influence on sustainable development because they control the extent of corruption.

7. Robustness analysis

We have undertaken a large number of robustness checks. In this section, we briefly comment on them. First, visual inspection of the data makes it clear that outliers could be an issue. In particular, Angola and the Democratic Republic of Congo stand out from the rest in that they experienced extremely high negative growth in genuine wealth during the late 1990s and early 2000s. We have re-estimated the various statistical models without those two countries and there is little difference to the results. We have also re-estimated the models presented in Tables 1.3–1.6 using an outlier robust estimator (the least-absolute-value estimator). This makes a difference in some specifications but, for the vast majority of specifications, we conclude that the correlations reported above are not driven by

outliers. Second, we have included a number of additional control variables. To begin with, sustainable development might be hindered by war and civil conflict. To control for this, we include a measure of the number of armed conflicts (external and internal) in which the government of each country was involved during the 1995–2000 period (*conflict*).⁴³ We also use the ethno-linguistic fractionalization index as a proxy for internal conflict (*ethnicity*). The variable *conflict* is mostly insignificant, and adding it to the various statistical models does not affect the conclusions regarding corruption. On the other hand, the variable *ethnicity* has a negative and significant effect on *growth in genuine wealth per capita* across the board, but, again, adding it to the statistical model does not affect the conclusions regarding corruption. This, however, casts doubt on the validity of *ethnicity* as an instrument for corruption. As a consequence, we re-estimated the IV regressions shown in Tables 1.9 and 1.10 without *ethnicity*. The results are very similar to those reported in the two tables. Third, in the main specifications, we did not control for the stock of natural capital. We could proxy for this variable by two different means, as discussed in Section 5: either by including a measure of the export value of mineral fuels as a percentage of manufacturing exports (sourced from the World Development Indicators), or by the World Bank's (2006) proxy for resource wealth. Both of these are, as noted, problematic because they are directly related to the calculation of genuine investment, however, we have tried to include them in the statistical model. As expected, both of these variables correlate negatively with *growth in genuine wealth per capita*, but adding them to the model does not affect the conclusions related to corruption.⁴⁴

8. Conclusion

The analysis presented in this chapter suggests that corruption is a major obstacle to sustainable development. We consistently find that cross-national measures of corruption perceptions, as well as measures of direct experience with corruption are negatively correlated with *growth in genuine wealth per capita* and that this correlation is robust after controlling for the quality and type of institutions, the stock of human capital, openness to trade, initial GDP per capita, inequality and many other observable determinants of sustainability. It is also robust to controlling for unobserved country-specific effects. Our IV estimates all point in the same direction, and they suggest that a causal effect may be at play and that political and legal institutions exercise their influence on sustainability through corruption. However, even if the thorny issue of causality has not been fully settled – and we acknowledge that it is unlikely to be resolved – the robustness of the correlation is itself remarkable, not least when our

Table 1.10 Instrumental variables estimates (2SLS): the ‘Hierarchies of Institutions’ hypothesis

Endogenous variables: Corruption							
Instruments: <i>democracy, common law, latitude, initial ICRG index and ethnicity</i>							
Stage	(1)	(2)	(3)	(4)	(5)	(6)	(8)
	2nd	1st	2nd	1st	2nd	1st	1st
Dep. variable	Growth in genuine wealth	TI index	Growth in genuine wealth	WB index	Growth in genuine wealth	ICRG index	WBES index
TI index, instrumented	-0.45*** [-5.25]						
WB Index, instrumented			-3.93*** [-5.75]				
ICRG index, instrumented					-0.84*** [-4.90]		
WBES index, instrumented						-1.60*** [-3.29]	
Democracy		-0.037*** [-4.50]		-0.0048*** [-5.33]		-0.020*** [-4.58]	-0.011** [-2.03]

Common law	-0.78** [-2.63]	-0.067** [-2.01]	0.045 [0.24]	-0.33 [-1.12]
Latitude	-0.035* [-1.76]	-0.0044* [-1.97]	-0.0067 [-0.93]	-0.0017 [-0.17]
Initial ICRG index	0.49** [2.18]	0.055** [2.40]	0.37*** [3.94]	0.11 [0.72]
Ethnicity	0.54 [0.66]	0.060 [0.61]	-0.35 [-0.79]	0.75 [1.05]
First stage <i>F</i> -statistics	46.32	58.77	21.47	5.21
Over-ID test	0.66	0.35	0.15	0.43
Observations	86	96	96	51
<i>R</i> -squared	0.43	0.50	0.38	0.19
			0.65	0.41

Note: Robust *z*-statistics are presented in brackets; ** $p < 0.01$, * $p < 0.05$, * $p < 0.1$; all estimations contain regional dummy variable.

results are contrasted with those that emerge from empirical studies of the effect of corruption on economic growth.

The data on genuine investment used in the analysis are, as pointed out above, problematic in many regards, and there is great scope for improvement. For example, instead of using public expenditure on education to approximate investment in human capital, it would be better to use information on the social return to education from country-specific surveys. Combined with data on educational attainment from, say, the Barro–Lee dataset (Barro and Lee, 2001), one could obtain a much better estimate for the social value of investment in the stock of human capital. It would also be desirable to collect country-specific information on total factor productivity growth and use that data to adjust measures of growth in genuine wealth. Better estimates of the environmental cost of carbon emission could also be obtained. Finally, the World Bank's estimate of genuine investment does not make any attempt to take into account distributional effects, either between individuals at a given point of time, or between different generations of individuals. The incidence of corruption appears to fall disproportionately on the poor (see Gupta et al., 2002): they rely more on public services (for example, schools and health facilities) than the rich and thus suffer more from the reduction in the quantity and quality of provision caused by corruption. This could be captured by introducing distributional weights in the calculation of genuine investment. All of these adjustments can, in principle, be made but are very labor intensive. However, they should be placed high on the future research agenda.

It is difficult to draw concrete policy conclusions from a macro-level study of the kind conducted here. Specific advice must come from micro-level evidence on the effects of particular policy measures. Nevertheless, some general insights of policy relevance emerge from the analysis. Most obviously, the message that the chapter sends to policy makers is that the issue is not so much what corruption does (or does not do) to the economic growth of a country; the real issue is that rampant corruption endangers sustainable development. As a consequence, reform effects, both in terms of concrete anti-corruption policies and in terms of governance reforms, should be directed at weeding out corrupt practices that reduce the incentive to protect and preserve the capital base, broadly understood. This includes control of corruption in relation to exploration of natural assets with high social value and in the enforcement of environmental regulation. It also includes policies aimed at preventing corruption and rent-seeking in the allocation of public funds for education, as well as policies that weed out, or reduce, the 'corruption tax' on domestic and international investment flows.

Notes

1. There is a dissenting view which contends that corruption can, in some restricted sense, be efficiency enhancing by allowing economic agents to overcome pre-existing, inefficient regulation and red tape (for example, Leff, 1964; Levy, 2007). Macro-level evidence consistent with this dissenting view is provided by for example, Egger and Winner (2005), Méndez and Sepúlveda (2006) and Méon and Weill (2010). But see the critical discussions of this view in Aidt (2009), and the surveys by Bardhan (1997) and Aidt (2003).
2. For example, Mo (2001) and the survey by Svensson (2005).
3. It is also possible that the causality runs from low growth to high levels of corruption as suggested by the theory of regulation and corruption proposed by Aidt and Dutta (2008).
4. He also considers a fourth approach, which is a synthesis of the others.
5. The approach has, nonetheless, been used to illuminate many important links between economic fundamentals, institutions, and human well-being (see, for example, Frey and Stutzer, 2002).
6. See Atkinson and Hamilton (2003) and Neumayer (2004).
7. See Arrow et al. (2004: 150) for further discussion of the implications of this definition.
8. This is a strong assumption but one which can be justified by the so-called 'critical junctions' theory of institutional development. According to this theory, institutional reform happens at critical junctions in history. Once the new institutions are in place, they persist for a long time – until the next critical junction. See Acemoglu et al. (2001) for an example of this with regard to political institutions and La Porta et al. (1997) with regard to legal institutions. This view is, however, challenged by modernization theory, according to which democratic institutions gradually emerge as a consequence of economic development (see, for example, Gundlach and Paldam, 2009b, and Guerriero, 2010 who show that legal institutions also evolve gradually in response to socio-economic factors).
9. See also Hamilton and Clemens (1999) and Dasgupta (2001: ch. 9).
10. The term 'genuine saving' is sometimes used in this context. Empirically, we cannot distinguish the two. In this study we follow Arrow et al. (2004) and refer to the change in an economy's genuine wealth as 'genuine investment'.
11. See, for example, Murphy et al. (1991, 1993), Krusell and Rios-Rull (1996), Blackburn et al. (2006, 2008), or Ellis and Fender (2006).
12. Most of this evidence relates to perceived corruption. A notable exception is Campos et al. (1999). They use data on self-reported experience with bribe giving from the World Bank's Business Enterprise Survey and demonstrate that experienced corruption, both the level and its predictability, is negatively related to investment in manufactured capital.
13. Others have, however, found that corruption attracts foreign direct investment (Egger and Winner, 2005; Sena and Martianova, 2008).
14. The most recent evidence on the resource curse (Brunnschweiler and Bulte, 2008; van der Ploeg and Poelhekke, 2010), which corrects for various endogeneity problems, however, casts some doubt on the simple proposition that resource abundance reduces economic growth unconditionally. For example, van der Ploeg and Poelhekke (2009) show that the effect works through economic instability and that only where economic instability is sufficiently large is resource abundance a curse.
15. Rodríguez and Sachs (1999) provide a similar argument with an application to the oil boom in Venezuela.
16. See World Development Indicators (World Bank, various years, Table 3.15). *The World Development Indicators* uses the term 'adjusted net saving' or 'genuine saving' to describe what we refer to as 'genuine investment'.
17. For details of how to estimate these deductions and the sources used to do so, see Bolt et al. (2002), or Arrow et al. (2004).
18. This includes current operating expenditures on wages and salaries but excludes capital investment in buildings and equipment.
19. See Hamilton (2005) for an alternative way of making this adjustment. Aidt (2009)

shows that it makes little difference which of the two methods are used for the statistical analysis of the link between corruption and sustainable development. In the interest of brevity, we focus on the one advocated by Arrow et al. (2004).

20. Conceptually, one could adjust for this if information on country-specific estimates of total factor productivity growth were available (Arrow et al., 2004). Without such data, however, we decided not to make any adjustments, rather than applying a one-size-fits-all adjustment based on a guesstimate.
21. At the national level several other measures of corruption are available. These include data on the number of officials convicted for corruption (see, for example, Alt and Lassen (2003) in a study of US states, and Del Monte and Papagni (2001) in a study of Italian regions) and data concerning the amount of leakage from infrastructure projects in Italian regions (Golden and Picci, 2005).
22. See <http://www.transparency.org/>.
23. See <http://info.worldbank.org/governance/wgi/index.asp>. The two indices include many of the same underlying sources and are highly correlated. However, there is not a perfect overlap, and the methods used to aggregate the information and the time and country coverage differ.
24. Unlike the other indexes, this index is not available for free. The index is used as one of the sources from which the *WB index* is constructed and it was included in some of Transparency International's early estimates of corruption.
25. See <http://info.worldbank.org/governance/wbes/>.
26. See <http://www.unicri.it/>.
27. Rose-Ackerman (1999, chs 3 and 5) discusses the distinction between petty and grand corruption in detail.
28. We use the median level of corruption to classify countries as being high or low corruption.
29. We prefer to use *growth in genuine wealth per capita* directly rather than a dichotomous classification into sustainable (positive growth) and unsustainable economies (negative growth), along the lines of Tables 1.2a and 1.2b. This is because sustainability is measured with a great deal of error and such a classification would inevitably allocate countries to the wrong category.
30. See, for example, Aidt et al. (2008) or Bhattacharyya and Hodler (2010).
31. See Kaufmann et al. (2005, 2006) or www.govindicators.org. The indicators are the index of Voice and Accountability, the index of Political Stability and Absence of Violence/Terrorism; the index of Government Effectiveness, and the index of Regulatory Quality.
32. See <http://www.freedomhouse.org>.
33. Democracies are those with a score of 6 or higher on Beck et al.'s (2001) measure of executive constraints.
34. The source for this is Barro and Lee (2001).
35. The main results are not affected if we exclude *GDP per capita* from the estimations.
36. The source for this is UNDP (2004).
37. The bottleneck is *human capital*.
38. Similar results emerge if we time-average the index (not reported here).
39. See Hausman and Taylor (1981).
40. Strictly speaking, we cannot directly compare these estimates to those reported in Tables 1.3–1.6 since these specifications include *human capital*. However, whether or not this variable is included makes little difference to the size of the point estimates (not reported), so no large error is introduced by making the comparison.
41. See Taylor and Hudson (1972).
42. The results when *political freedom* is used instead of *democracy* are very similar. The IV estimates of β_0 are not significant when the full set of economic control variables are included.
43. These data can be obtained from the Quality of Government Institute, Goteborg University at <http://www.qog.pol.gu.se/>.

44. Norman (2009) provides an estimate of the reserves of fuel and 35 non-fuel commodities in US\$ per capita in 1970. This must be considered as an exogenous determinant of growth in genuine wealth during the period from 1996 to 2007, and so could be used to control for initial resource stocks in future work.

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Appendix 1A*Table 1A.1 Definitions and sources of the variables used in the statistical analysis*

Name of variable	Brief description	Source
Growth in genuine wealth per capita	Average of genuine savings including particulate emissions damages across four-year periods (1996–2007), multiplying by GDP-wealth ratio, subtracting the average population growth rate	World Development Indicators (various years, Table 3.15) GDP-wealth ratios from Arrow et al. (2004) Population growth rates: World Development Indicators (various years)
Damage from CO ₂ emission	\$30 per tonne of CO ₂	Bolt et al. (2002) http://siteresources.worldbank.org/INTEEI/1105643-1115814965717/20486606/Savingsmanual2002.pdf
Particulate emission damage	An estimate of the health damages due to particulate emissions in urban areas	Bolt et al. (2002) http://siteresources.worldbank.org/INTEEI/1105643-1115814965717/20486606/Savingsmanual2002.pdf
Energy depletion	Resource rents are calculated as the market price of the resource minus average extraction cost	Bolt et al. (2002) http://siteresources.worldbank.org/INTEEI/1105643-1115814965717/20486606/Savingsmanual2002.pdf
Mineral depletion	Resource rents are calculated as the market price of the resource minus average extraction cost	Bolt et al. (2002) http://siteresources.worldbank.org/INTEEI/1105643-1115814965717/20486606/Savingsmanual2002.pdf
Forest depletion	Resource rent is estimated as the market price per unit of harvest in excess of the natural regeneration rate	Bolt et al. (2002) http://siteresources.worldbank.org/INTEEI/1105643-1115814965717/20486606/Savingsmanual2002.pdf

Table 1A.1 (continued)

Name of variable	Brief description	Source
ICRG index	Corruption perception index published in the International Country Risk Guide yearly	International Country Risk Guide (http://www.prsgroup.com/ICRG.aspx)
Democracy	Duration of democracy	Beck et al. (2001) and Treisman (2007)
Political freedom	The Freedom House Index of Political Rights	http://www.freedomhouse.org
GDP per capita	Gross domestic product per capita	World Development Indicators (various years)
Human capital	Average years of schooling for the population aged over 15	Barro and Lee (2001)
Trade openness	Imports of goods and services as percentage of GDP	World Development Indicators (various years)
TI index	Transparency International's Corruption Perception Index	http://www.transparency.org/
WB index	World Bank's Control of Corruption Index	http://info.worldbank.org/governance/wgi/index.asp
WBES index	The World Business Environment Survey index of experienced corruption	http://info.worldbank.org/governance/wbes/
GCB index	Global Corruption Barometer index of experienced corruption	http://www.transparency.org/
UNICRI index	The Interregional Crime and Justice Research Institute index of experienced corruption	http://www.unicri.it/

Table 1A.1 (continued)

Name of variable	Brief description	Source
Common law	Dummy variable equal to 1 if the legal code is common law	La Porta et al. (1997)
Inequality	The gini coefficient	UNDP (2004)
Latitude	Distance from the equator	Hall and Jones (1999)
Ethnicity	Index of ethno-linguistic fractionalization	Taylor and Hudson (1972)
Conflict	Number of armed conflicts 1995–2000	http://www.qog.pol.gu.se/
Resource dependency	Export value of mineral fuels as percentage of manufacturing exports	World Development Indicators (various years)
Resource wealth	Estimate of resource wealth	World Bank (2006)

Note: More detailed definitions of the variables are provided in the main text.

Table 1A.2 Summary statistics for the variables used in the main regression analysis

Variable	Years	Obs.	Mean	Std dev.	Min.	Max.
Growth in genuine wealth per capita	1996–1999	148	−0.16	2.56	−12.46	5.01
ICRG index	1996–1999	140	2.80	1.21	0.00	5.35
Democracy	1996–1999	132	17.56	22.20	0.00	65.00
Political freedom	1996–1999	133	3.51	2.19	0.00	6.00
GDP per capita	1996–1999	128	0.80	0.81	0.00	3.45
Human capital	1996–1999	100	6.17	2.78	0.76	11.89
Trade openness	1996–1999	125	39.68	22.22	1.96	147.65
Growth in genuine wealth per capita	2000–2003	146	−0.22	2.60	−13.57	5.49
ICRG index	2000–2003	140	3.31	1.13	0.00	5.69
Democracy	2000–2003	132	21.37	23.22	0.00	70.00
Political freedom	2000–2003	133	3.60	2.13	0.00	6.00
GDP per capita	2000–2003	129	0.93	0.97	0.00	4.87
Human capital	2000–2003	100	6.43	2.80	0.84	12.05
Trade openness	2000–2003	123	42.84	23.13	9.37	139.12
Growth in genuine wealth per capita	2004–2007	143	−0.14	2.83	−19.00	5.51
ICRG index	2004–2007	140	3.50	1.15	0.00	6.00
Democracy	2004–2007	132	25.24	24.30	0.00	75.00
Political freedom	2004–2007	133	3.61	2.14	0.00	6.00
GDP per capita	2004–2007	128	1.05	1.11	0.00	6.12
Human capital	2004–2007	100	6.43	2.80	0.84	12.05
Trade openness	2004–2007	123	42.84	23.13	9.37	139.12
TI index	1996–2007	128	5.72	2.26	0.40	8.55
WB index	1996–2007	135	0.64	0.28	0.00	1.06
WBES index	1996–2007	70	1.87	0.88	0.16	4.22
GCB index	1996–2007	59	12.08	11.72	0.00	52.00
UNICRI index	1996–2007	44	8.76	8.99	0.04	31.11
Common law	1996–2007	130	0.31	0.46	0.00	1.00
Inequality	1996–2007	106	40.12	9.78	24.00	63.00
Latitude	1996–2007	133	27.56	17.59	0.00	64.80
Ethnicity	1996–2007	114	0.45	0.28	0.00	0.91

Note: The definitions of the variables are provided in the main text.

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