Social Orders and Growth Fragility*

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Abstract

We construct empirical measures of a novel institutional concept recently proposed by North, Wallis and Weingast (NWW) and investigate links with the stability of countries' growth. NWW define "social orders" as politico-economic equilibria in which societies generate and distribute economic rents in particular ways. In "limited access social orders" entry to the means of rent creation is limited. This places a constraint on organisational development and economic specialisation, and therefore on overall economic activity. In "open access social orders" entry barriers are absent. NWW argue that open access orders are associated with the transition to modern economic growth and with the emergence of an advanced level of development. More specifically, they claim that open access societies have more stable patterns of growth. We build empirical measures of access and social orders. We then test for an association between social orders and "growth fragility", an important performance characteristic given that low income levels may be the result of countries' failure to sustain growth rather than to achieve it at all. Using dynamic panel estimation techniques we find some evidence that over the 19th and 20th centuries, countries that made the transition to the open access social order tended to achieve more stable, modern patterns of growth.

Keywords: Growth and fluctuations; development; economic transition; institutions

JEL Classification: N10, O11, O43, 047

1 Introduction

Douglass North, John Wallis and Barry Weingast (NWW) recently proposed a novel theory of institutions and development based on the idea of "social orders" (North *et al.*, 2009).

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Social orders delimit societies differing in the extent of "access" in their economic and political systems. NWW argue that advanced development is driven by "open access" and that countries at earlier stages of development have lower levels of access. NWW draw on detailed qualitative historical analysis of European development. There has been little quantitative investigation of NWW's approach. This paper makes a start in that direction. It constructs measures of access. These measures are used to test a conjecture made by NWW, that open access is associated with more stable forms of growth.

We begin in Section 2 by discussing NWW's notions of social orders and access, focusing on aspects of most relevance to post-war development and to the emergence of modern economic growth over the last couple of centuries. Section 3 outlines our empirical strategy: we describe our approach to measuring social orders and our method for linking them to patterns of growth instability.

Section 4 presents our empirical measures of social orders, a historical, narrowly focused measure which we use in our growth stability estimations, and a broader indicator which gives a contemporary context to the historical indicator. The purpose of these measures is to draw a link between growth fragility and social orders. A by-product of their construction is that we can assess basic conjectures made by NWW about links between development status and levels of access. In Section 5 we discuss econometric implementation, outlining the multiple structural break and panel approaches needed to estimate our empirical fragility model, and paying particular attention to robustness issues surrounding the use of panel models in dynamic settings. Section 6 presents the growth fragility and access results, and Section 7 draws overall conclusions.

2 Social orders and historical economic transition

2.1 Politico-economic equilibria

Under NWW's schema, social orders are politico-economic equilibria in which agents' payoffs are economic rents. NWW define types of social order, the transition between which forms a model of development from primitive societies to advanced industrial polities. In societies with pervasive rent creation and rent-seeking, the maintenance of rent-supported equilibria prevents polities from disintegrating into violent anarchy. In this way, rents come to have an important social function.

NWW's approach is different from an influential strand of development analysis which views persistent rents and rent-seeking as indicating undesirable market distortions, frequently created by the actions of an overbearing state (Krueger, 1974; Bhagwati, 1982). These imperfections are seen as exogenous deviations from perfect competition to be removed through policy

actions. Under NWW's framework rent-seeking is given a rational logic by being modelled as a central endogenous component of equilibria.

2.1.1 From the primitive to the limited access social order

A starting point of the NWW schema is to consider a primitive kind of human existence, perhaps Hobbes's natural state in which life is "nasty, brutish and short". Here no formal institutions exist and the basic economic unit is the extended family. No complex types of production take place with people largely living off natural endowments. One might imagine this to be a state in which Olson's myopic roving bandits freely pillage, completely expropriating the fruits of labour (Olson, 1993; McGuire and Olson, 1996). There is little incentive for raising output beyond subsistence needs. An equilibrium strategy of agents is to be violent: agents expect others to be violent and therefore continue to be violent themselves, so confirming beliefs and cementing actions. NWW call this the "primitive social order".

Roving bandits (or "warlords") are good at carrying out violence and are therefore able to control resources through coercion. This opens up the possibility of another equilibrium. These specialists in violence may realise that by controlling parts of the economic system, they can generate rents. If they control an area they can simply extract resources from the population. When the resulting rents are high enough it may be profitable for warlords to cease attacking each other, agreeing instead on spheres of influence from which each gathers rents. This generates an equilibrium in which violence is placed off the equilibrium path and warlords allow more economic activity to take place. The equilibrium is supported by the threat of violence, so warlords need to maintain their military capacities. In Olsonian terms, roving bandits become stationary ones. This politico-economic equilibrium forms the basis of the "limited access social order".

The requirement for limited access is that there are restrictions on entry to rent gathering: if there were free entry, rents would be competed down to too low a level to make non-violence the equilibrium outcome and society would revert to the primitive social order. The limited access mechanism can be manifested through a variety of more or less complex institutional forms. A typical limited access society today does not generate rents through warlords but through competing elite factions who together constitute a dominant coalition, in Olsonian terms a collective of sophisticated stationary bandits. These elites get rents through privileged access to a variety of institutions. This access is frequently facilitated by the state, itself sustained by the support of the dominant coalition. Elites also gain political support from groups who align themselves with factions of the dominant coalition in return for a share of rents. A form of this is the patron-client network. Thus in limited access societies politics and economics are overtly intertwined: "economics is politics by other means" (North *et al.*, 2009, p. 42).

2.1.2 The open access social order

In the "open access social order" there is free entry to the institutions of rent creation on the basis of impersonally defined criteria. Rents are now generated not by restricted access but by Schumpeterian competition and innovation. This generates different incentives: because access is open, the possibility of earning rents, even transitory ones, brings more economic actors into the cycle of innovation and competition. Open access spawns a variety of organisational forms such as corporations, guilds, and trade associations. The division of labour and specialisation are then more fully reaped than under the limited access order. NWW argue that this heralds the sustained economic growth seen in modern capitalist societies.

Open political access and open economic access go together. Open access economic institutions tend to share private wealth through the supply of public goods and publicly funded goods which then enhance the potential for market-generated wealth. At the same time political life is competitive which constrains the ability of rulers to limit access. A ruling group which attempted to shore up its power through rent-seeking and the limitation of access would trigger economic contraction and a shrinking tax base.

Organisations exist in both the limited access and open access orders, but with different effects and under different constraints. In limited access orders private sector organisations such as corporations or guilds are tied to the rent creation and distribution functions of the dominant coalition and are part of personalised, patron-client networks. In advanced limited access societies there are many sophisticated organisations. However, the logic of the limited access order—the need to limit access to protect the rents needed to glue together the dominant coalition through personalised economic interactions—acts as a constraint on the number and complexity of organisations. Under open access there are no limits to the establishment of organisations, and impersonality means that these can be widely dispersed and highly complex.

An important type of organisation is the state. In limited access orders, the state, the top layer of the dominant coalition of elites, distributes private goods to its clients as a form of rent distribution to maintain the politico-economic settlement. When political and economic access is open, proper electoral competition induces the state to provide goods and services, including public goods, to non-elites as well as to elites. The narrow privileges previously enjoyed by elites and their clients are converted into rights for the broader population. This is related to the rise of impersonality in the sense that a privilege can be thought of as a personally defined entitlement, a right as an impersonal one. Furthermore, provision of classic public goods is connected to the emergence of impersonality because of these goods' properties of non-excludability and non-rivalry.

The realignment of the state to a provider of mass goods and services under open access implies a larger, more complex set of government organisations. Lindert has linked growth of

the public sector since the eighteenth century with economic development (Lindert, 2004); his findings are useful to think about in terms of Europe's graduation to the open access social order. Lindert asks why today's social programmes came so late in history: by the end of the eighteenth century no country spent even three percent of its national income on such programmes (Lindert, 2004, p. 4). From the NWW perspective, the provision of public goods, including redistributive goods, was negligible by the end of the eighteenth century because no country had achieved open access; the most advanced countries were at best limited access orders on the cusp of transition. The subsequent rapid growth of social spending in some countries came with the advent of open access: electorally disciplined governments began to respond to citizens' growing demands for publicly provided goods and services.

Lindert contends that the rise of social spending in Europe was growth enhancing. Firstly, democracies with large welfare states designed taxes and transfers to minimise distortions, for example through the levying of indirect taxes. Secondly, the universalism of taxes and entitlements seen in developed welfare states—the impersonal rights highlighted in NWW's theory—supported growth more effectively than "low budget countries' preference for strict means testing and complicated tax compromises", these compromises in a limited access polity having the function of stabilising the intra-elite bargain which sustains the dominant coalition. Thirdly, social spending in countries with large welfare states includes components which are productivity enhancing, notably public education and health programmes.

Thus, through the development of complex organisations, open access societies attain more advanced levels of development than limited access ones. Limited access societies may also be more vulnerable to shocks than open access societies. Rodrik has argued that countries with high levels of social conflict are less able to carry out macroeconomic adjustments following external shocks (Rodrik, 1999, 2000). Social conflict may involve situations in which the rents that need to be distributed to different groups to achieve politico-economic equilibrium make up a large share of national income; one would expect this share to be large when a society contains many mutually antagonistic groups engaging in a zero-sum rent-seeking game. Maintenance of the limited access political equilibrium is a constraint on policy actions such as fiscal retrenchment, and might prevent adjustment if this would overly disrupt the flow of rents. If so, the macroeconomies of limited access societies are more vulnerable to external shocks than those of open access societies. More broadly, sustained growth may only be achievable once countries have exited the limited access order. As NWW put it: "Modern societies that made the transition to open access, and subsequently became wealthier than any other society in human history, did so because they greatly reduced the episodes of negative growth" (North *et al.*, 2009, p.4). Thus NWW pose the key question of this paper. Are limited access societies more prone to growth instability than open access ones?

2.2 Transition from the limited to the open access social order

The majority of societies have contained elites who generate and sustain rents through privileged access to institutions; they are limited access polities. Only a handful have made the transition to open access but most have escaped the unfettered Hobbesian brutality of the primitive social order. Thus the default position of societies is that of the limited access order.[1] Today, more countries have joined the open access club including late movers such as Southern Europe and parts of South-East Asia. At the same time there are very few contemporary societies which can still be classified as primitive social orders. Even the most seemingly chaotic countries, such as Somalia or Iraq, have nodes of rent creation and distribution controlled by competing elites; viewed from within this framework there is a method to the apparent madness prevailing in these societies. Mainstream development questions are therefore to do with the transition from the limited to the open access social order. Discussion of how Ghana might attain a standard of living closer to that of Belgium relates to how it might achieve this kind of transition; even in Ghana the primitive social order is long gone. This is why the analysis of this paper focuses on transition to the open access order.

How, then, do societies move from limited access to the open access order? In particular, how do elites come to give up their privileges by allowing these to become socially dispersed rights? Theories of transition, such as the related one proposed in Acemoglu and Robinson (2006), grapple with the problem of how transformations occur even in the presence of blocking coalitions. Acemoglu and Robinson model the transition from dictatorship to democracy, which in their framework happens when the cost to the elite of holding onto their privileges becomes too high. What is the analogous motor of transformation in NWW's theory? How and why do elites in limited access societies reform themselves?

Limited access social orders face a trade-off. Specialisation and the division of labour are likely to increase rents but this requires easier entry to rent-creation structures, that is, more openness in the NWW sense. This opening may have a tendency to reduce rents and so to threaten the politico-economic equilibrium, raising the possibility of a descent into violence. At some point the trade-off may dissolve and it will be optimal for elites to allow an opening of access. NWW argue that this is possible when impersonal economic relationships develop within elites. Transition to open access then occurs when incentive-compatible opening is possible, that is, when it is optimal for elites to incrementally open access to organisations where impersonal economic relationships have developed.

The emergence of impersonal economic relations within elites puts society at the threshold of transition. NWW define three "doorstep conditions" for the achievement of impersonality:

[1] To emphasise this NWW also call the limited access order the "natural state".This is not to be confused with Hobbes's natural state which might be thought of as corresponding to NWW's primitive social order.

- *Doorstep One: rule of law.* This must exist for elites. This requires a judicial system or other mechanism for arbitration; this must deliver both *de facto* and *de jure* results.
- *Doorstep Two: perpetual organisational forms.* These must be available to elites. These might include corporations existing independently of named individuals. Agreements can then be made with organisations, not just with people, and can be honoured beyond the lifespans of particular individuals.
- *Doorstep Three: political control of the military.* There must be an organisation (such as the state) with control over all military resources; there should be credible conventions for the use of force.

How the emergence of these doorsteps is sequenced may differ across countries and epochs. When the doorstep conditions are satisfied and impersonal economic relations within elites have arisen, transition may happen but is not automatic. Further analysis of how transition takes place is required. NWW define three general principles, termed transition conditions. Firstly, behaviour at the beginning of the transition must be consistent with behaviour in the limited access order. Secondly, changes must arise out of intentional behaviour consistent with interests of the dominant coalition, but the outcomes do not have to be consistent with these original intentions. Thus, the dominant coalition do not have to knowingly initiate a transition. Thirdly, incremental increases in access must be sustained and reinforced by the political and economic system at each step.

A "transition mechanism" then comes into play when impersonal exchange among elites creates incentives at the margin to extend access to the institutions supporting impersonal exchange. These mechanisms could include fiscal, regulatory, electoral and other dimensions. The mechanisms may be self sustaining: marginal changes lead to further changes sparking a full transition to open access. Because social orders are politico-economic equilibria, the move from limited to open access has to happen both politically and economically, as stated in the third of the transition conditions. NWW term this the "double balance": a limited access political system cannot support an open access economic system and an open access political system cannot be sustained alongside a limited access economic system.

This model of transition consists of two broad components: achievement of the doorstep conditions, and contingent upon these, eventual transition to the open access order. The latter of these one may term "transition proper". This distinction is useful for conceptually breaking down a drawn-out historical process, and for categorising the existing historical literature.

The limited access order encompasses many economies with varied development outcomes. NWW define three types of limited access social orders: "fragile", "basic" and "mature". Mature limited access societies are those which have achieved the doorstep conditions; they then stand

at the threshold of transition to the open access social order. A vast historical literature is concerned with aspects of these doorstep conditions the achievement of which may take centuries. For example, in economic history a prominent theme is the problem of achieving impersonal exchange when there are incentives for economic agents to renege on contracts (Greif, 2000).

Viewed through the NWW lens, these analyses are concerned with how societies create the conditions for reaching the threshold to transition. They do not directly address how societies push through into the open access order from the threshold. There is nothing automatic about transition once the threshold is arrived at; one can think of societies which achieved the doorstep conditions but which then failed to make the transition. Between the eleventh and sixteenth centuries, the Italian city states were the most economically advanced countries in Europe displaying a high degree of institutional development of kinds relevant to the doorstep conditions. However, these states did not at that time make the transition to open access. Impersonal exchange of the kind modelled by Greif, even if restricted to elites, existed well before transition.[2] In a sense, then, the stories told by existing literatures about the development of the rule of law, trade and the emergence of the state end before the advent of full transition.

3 Empirical approach

Our empirical approach has two planks. First we construct measures of social orders and access, drawing on different kinds of historic and contemporary data. We describe the general approach in Section 3.1. We then use one of our measures to analyse growth fragility over time. In Section 3.2 we describe a way of conceptualising growth fragility that will be used as the basis for our estimations.

3.1 Operationalising the social order concept

The politico-economic equilibria that underlie different social orders are multifaceted and richly characterised in NWW's description. Empirically pinning down the concept of a social order and tracing its links with economic performance therefore presents a challenge. For earlier eras there is progressively less data, both for measuring social orders, and any economic outcome

[2]Indeed, Greif's discussion of how societies solved the fundamental problem of exchange focuses on late medieval Europe, well before transition. Similarly, property rights may have been a necessary but not sufficient condition for growth and transition, and may have been related to the achievement of some of the doorstep conditions. Clark has criticised North and Weingast's view that the Glorious Revolution, by securing property rights, led to transition in Britain. Clark argues instead that stable property rights existed well before this with meagre results in terms of economic growth (Clark, 1996, 2001).

that one wished to test for. In this kind of analysis there is a trade-off between data richness and historical depth. One empirical approach would be to narrow in on a limited, historically measurable aspect of social orders. An alternative would be to exploit the more plentiful contemporary data and carry out an analysis of today's countries, ignoring the historical dimension.

In Section 4 we present a historic measure of social orders based on a narrow aspect of open access. This measure is constructed from information contained in Polity IV, a long-run institutional dataset. We discuss how the concepts used to construct the Polity IV data relate to the political component of social orders, and then present a variable which captures this. We use this variable to test NWW's conjecture that open access is associated with more stable patterns of growth: these tests are the basis of the results presented in Section 6. This historic measure is useful in that it can be employed in time-series analysis but is limited in that it only captures certain features of open access. In Section 4 we present an alternative cross-country measure of social orders based on a range of contemporary data. This measure, having no time-series component, cannot be used in growth fragility tests. Its advantage is that it encompasses a broader range of social order characteristics. In order to place the historic measure in a broader data context we show how it relates to this more comprehensive measure.

3.2 Growth instability analysis

To test for a link between open access and growth stability we build on the existing literature on growth episodes, which examines medium-term growth performance across countries, typically after World War II (Pritchett, 2000; Rodrik, 1999; Jones and Olken, 2008; Hausmann *et al.*, 2006; Cuberes and Jerzmanowski, 2009). These studies avoid the simplifications of long-run mean growth analyses, which smooth away economically significant, shorter-run growth rate variation. At the same time they attempt to uncover growth properties which are longer run than volatility or the business cycle. This literature considers growth episodes—growth above (or below) a bound for some minimum, medium-run time period—relating these growth "miracles" or "disasters" to explanatory variables.

We employ an approach similar to those used by Jones and Olken, and Cuberes and Jerzmanowski. In particular, Cuberes and Jerzmanowski define "growth reversals" as situations in which positive trend growth over a medium-run timespan is associated with negative trend growth in an adjoining timespan. This is in contrast to reversion to mean growth rates where a high, positive growth rate is followed by a lower, positive growth rate, generating reversion to a steady state. Under growth reversals, medium-term trend growth is spiky: growth miracles tend to be followed by growth disasters. This is pertinent to developing economies which suffer

not so much from an inability to achieve high rates of trend growth but a limited capacity to sustain these for very long. Less fragile growth is connected with the advent of modern economic growth: countries achieve sustained intensive growth and higher living standards when positive growth episodes are less likely to be interrupted by growth contractions.

The concept of a reversal can be made precise by defining coefficient ranges in the following model:

$$g_{i,s+1} = \beta_0 + \beta_1 g_{i,s} + \epsilon_{i,s+1} \tag{3.1}$$

where $g_{i,s}$ is trend growth of country i in growth regime s, where s refers to one of $m+1$ growth regimes separated by m breakpoints. Growth regime s starts at $t = t_{s-1}$ (e.g. 1921) and ends at $t = t_s$ (e.g. 1935). So between 1921 and 1935 trend growth is $g_{i,s}$. From $t = t_s$ (after 1935) the economy moves into regime $s+1$ with trend growth $g_{i,s+1}$.

The economy may show no memory across breaks, reversion to mean dynamics, or growth cycling (reversals) as follows:

- No memory across breaks: $\beta_1 = 0$
- Reversion to mean: $0 < \beta_1 < 1$
- Cycling/reversals: $-1 < \beta_1 < 0$

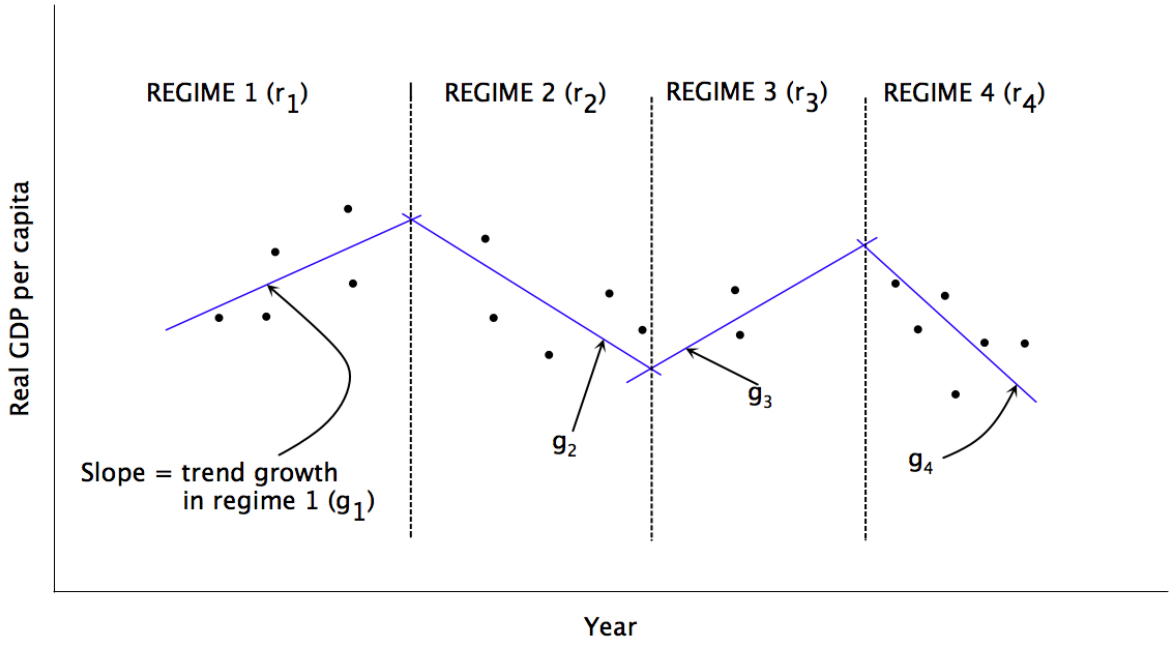
A pattern of growth reversals is depicted in Figure 3.1. Here positive trend growth in the first regime is followed by negative growth in the second regime, positive growth in the third regime, and so on.

In order to link reversal characteristics with appropriate covariates an expanded version of equation (3.1) can be estimated:

$$g_{r+1} = \beta_0 + \beta_{11} g_r + \beta_{12} A_{r+1} g_r + \beta_{13} y_{r+1} g_r + \beta_2 y_{r+1} + \beta_3 A_{r+1} + \epsilon_{r+1} \tag{3.2}$$

Here, A_r is the average value of a covariate prior to entry into growth regime r and y_r is average output prior to entry to growth regime r. A negative β_{11}would indicate a general tendency towards growth reversals. The main coefficient of interest is β_{12}, a positive value of which indicates that reversal dynamics tend to be weaker with higher values of the covariate. Thus, if A_r represents open access, a positive value of β_{12} would indicate that open access dampens growth reversals. Estimating this type of model using a post-1950 panel, Cuberes and Jerzmanowski (2009) find that democracy dampens growth reversals.

Figure 3.1: Growth reversals



In our estimations we use a measure of GDP relative to the leading country (the UK before 1900 and the US after). This allows us to abstract from common shocks affecting all countries which would show up in absolute GDP. In this way the model focuses on specific domestic aspects of economic performance and institutions, rather than on external common shocks. A secondary aim of this paper is to extend the historical perspective, linking the literatures on growth fragility and transition by encompassing periods when today's industrial economies were at earlier stages of development.

4 Measuring social orders

In this section we construct a narrow, historic measure of access suitable for time-series analysis. Our historic measure is based on political aspects of social orders. Analytically, this separation between political and economic aspects of access is misleading because of the intimate entanglement of politics and economics in the NWW world view. Nevertheless, to make empirical progress we now pragmatically make this division.

A crucial marker of open political access is the presence of proper political competition. Formal institutions such as elections do not guarantee open political access. Elections may be under the control of a narrow elite and used as a vehicle for rent gathering and distribution. True political competition can play out at the level of political organisations such as political parties and in the extent to which non-elites can participate in politics. Open politics ensures access

to rents which are then competed away by entry; in this situation parties compete to offer public goods to the populace instead of private goods to political clients. Thus two aspects of political competition are of interest: the level of competition between political organisations such as parties, and the extent to which non-elite groups have a say in the political process. In the following sub-sections we describe the contents of Polity IV, a long-run dataset which codes institutions and politics for a large number of countries. We show how these data relate to concepts of political competition. We then draw up a measure of political access based on information contained in this dataset. In Section 4.4 we present an alternative indicator based on a broader range of contemporary data. We show how our narrow measure is related to the broader one.

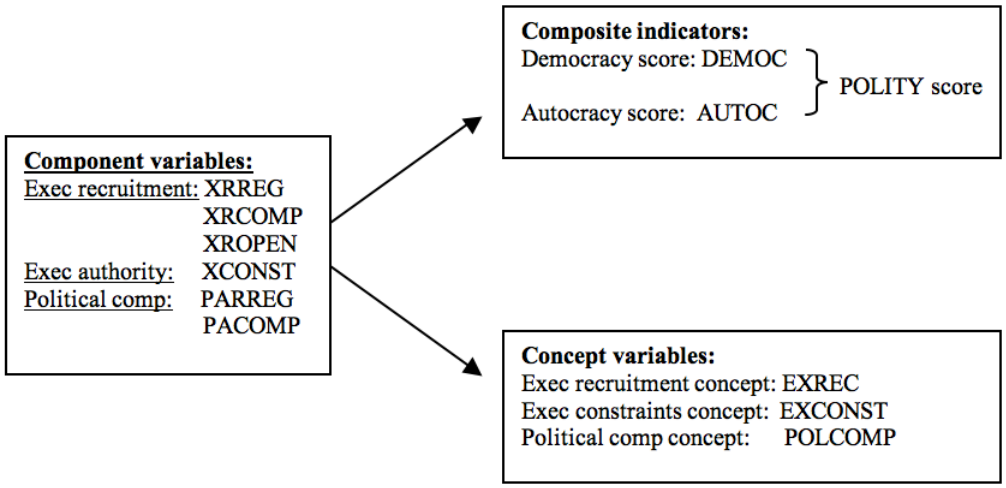
4.1 The Polity IV dataset

The theoretical basis of the Polity IV data are "political authority" patterns defined as relationships between "subordinates" and "superordinates" (Eckstein and Gurr, 1975). The concept of "executive recruitment" is about how superordinates come to occupy their positions. "Constraints on the executive" refer to the extent to which superordinates are obliged to incorporate subordinates' preferences into decisions, not just to consider them. "Political competition" relates to ways in which subordinates attempt to influence superordinates. The dataset covers 163 countries from 1800 to 2008, although only a few countries have data reaching back to 1800 (Marshall and Jaggers, 2007).

These concepts of authority motivate six "component variables" which are the basic data. Three of these relate to recruitment of the executive, one to constraints on the executive, and two to political competition. The information contained in the component variables is used to derive three "concept variables" which define alternative types of society. From the component variables composite indicators are also constructed. The principal ones are a democracy indicator and an autocracy indicator. From these two is derived the unified *POLITY* scale, a variable widely used in empirical work. Figure 4.1 illustrates the content of the dataset and how the different types of variables relate to each other. Table 4.1 lists the component variables and their value ranges.

The concept variables set up types of societies under each of the three broad categories, executive recruitment, executive independence and political competition, defining polity types as certain combinations of scores in the underlying component variables. The executive recruitment and political competition categories contain three and two variables respectively, generating corresponding concept variables defined in three and two dimensional space, *EXREC* and *POLCOMP*. Because the executive independence category contains only one variable, the concept variable corresponding to that category, *EXCONST*, is trivially identified with the

Figure 4.1: Variables in the Polity IV dataset



single variable itself, *XCONST*. The *EXREC* and *POLCOMP* concept categories are defined in Tables 4.2 and 4.3. Table 4.2 shows, for example, that a country with an *XRREG* value of 3, an *XRCOMP* value of 1 and an *XROPEN* value of 1, for example, would be designated as having "ascription" characteristics under the executive recruitment concept.

4.2 Conditions for open access and the Polity IV concepts

In Section 4.1 we highlighted two aspects of political competition, the key ingredient of political access: competition between political organisations such as parties, and the extent to which non-elites can influence the political process. Subsets of the Polity IV data are related to these ideas.

4.2.1 Competition between political groups

The component variables The political competition component variables, *PARREG* and *PARCOMP*, are highly relevant to the measurement of competition between political organisations in the open access sense. *PARCOMP* deals with the competitiveness of participation between political groups. The "repressed" form (coded 1) indicates that no opposition is allowed outside of the ruling regime. In the NWW framework the "ruling regime" would be conceptualised not as a single actor but as a dominant coalition of elites. Repressed competition refers to a situation in which the dominant coalition is all powerful and stable as in certain kinds of limited access societies. However, this is not always the case under limited access: the

Table 4.1: Polity IV component variables

Broad category	Variable		Value
Executive recruitment	*XRREG*	Regulation of executive recruitment	1 (Unregulated) 2 (Designational) 3 (Regulated)
	XRCOMP	Competitiveness of executive recruitment	1 (Selection) 2 (Transitional) 3 (Election)
	XROPEN	Openness of executive recruitment	1 (Closed) 2 (Dual/designation) 3 (Dual/election) 4 (Election)
Executive independence	*XCONST*	Executive constraints	1 (Unlimited authority) 2 (Intermediate value) 3 (Some limitations) 4 (Intermediate value) 5 (Big limits) 6 (Intermediate value) 7 (Executive parity)
Political competition	*PARREG*	Regulation of participation	1 (Unregulated) 2 (Multiple identity) 3 (Sectarian) 4 (Restricted) 5 (Regulated)
	PARCOMP	Competitiveness of participation	1 (Repressed) 2 (Suppressed) 3 (Factional) 4 (Transitional) 5 (Competitive)

Source: (Marshall and Jaggers, 2007)

Table 4.2: The executive recruitment concept variable (*EXREC*)

EXREC value	*XRREG*	*XRCOMP*	*XROPEN*
I.Ascription Hereditary sucession	3	1	1
II.Dual executive: ascription + designation Hereditary sucession and designation	3	1	2
III.Designation Chosen by elites without competition	2	1	4
IV.Self-selection Forceful seizure by elites	1	0	0
V.Transition from IV Transition to a more regulated method	2	0	0
VI.Dual executive: ascription + election Hereditary sucession and election	3	2	3
VII.Transitional or restricted election Free but not fair elections	2	2	4
VIII.Competitive election Free and fair elections	3	3	4

Source: (Marshall and Jaggers, 2007)

Table 4.3: The political competition concept variable (*POLCOMP*)

POLCOMP value	*PARREG*	*PARCOMP*
I.Suppressed No politics outside ruling regime	4	1
II.Restricted Limited politics outside ruling regime	4	2
III.Imposed transition Transition to or from more competition	3	2
IV.Uninstitutionalised Personality-based politics	1	0
V.Gradual transformation from IV Transition to more regulated politics	2	0
VI.Factional/restricted Favouritism by faction in power	3	3
VII.Factional Groups promote particularist agendas	2	3
VIII.Electoral transition/conflict Coerced transition between VI and X	3	4
IX.Electoral transition/limited conflict Peaceful transition to or from X	2	4
X. Institutionalised open electoral Stable competition without coercion	5	5

Source: (Marshall and Jaggers, 2007)

politico-economic equilibrium on which the dominant coalition rests may be fragile and subject to reconfiguration in the event of shocks. If this happens, groups overtly jockey for position as a new equilibrium emerges. Society becomes factional, captured in *PARCOMP*'s "factional" value (coded 3). *PARCOMP* also defines a "suppressed" form of competition (coded 2) in which there is competition alongside the systematic exclusion of groups, again a pervasive feature of limited access polities. Finally, the "competitive" value (coded 5) relates to important features of open political access: alternative policy preferences can be pursued through stable, enduring and competing groups between which there are regular, voluntary transfers of power.

PARREG deals with the regulation of political participation by groups. "Unregulated" (coded 1) refers to fluid types of participation in which there are no lasting organisations, and under which activity forms around particular clans or groups of fluctuating importance. This captures characteristics of immature limited access societies which have yet to develop the capacity to sustain the stable organisational forms seen in advanced limited access orders. "Sectarian" (coded 3), refers to a situation of multiple identity groups with incompatible interests, possibly driving intense factionalism. This is an important feature of many limited access societies as groups compete for access to rents through the manipulation of the political system. The "restricted" value (coded 4) describes types of mature limited access polities in which there is organised participation without intense factionalism but in which some groups or issues are excluded. Finally, the "regulated" form of participation (coded 5) refers to an environment in which the expression of political preferences takes place through stable, regularly competing groups with little coercion or exclusion of groups or issues. This seems akin to the open access environment in which competition takes place without entry barriers.

PARREG's values (ranging from 1 to 5) appear to monotonically represent societies' development from basic limited access orders, to more developed limited access orders and then to the open access order. This is not the case for *PARCOMP*: values 1 to 4, although capturing features of limited access societies, do not represent an obvious sequence of development from undeveloped to advanced limited access societies. As the "competitive" value (coded 5) seems to closely represent aspects of open access *PARCOMP* could be used as part of a dichotomous indicator variable, as discussed below.

***POLCOMP* Concept X: "Institutionalised electoral"** The political competition concept variable, *POLCOMP*, brings these two component variables together. Again, this concept variable does not obviously correspond to a monotonically increasing scale from fragile limited access to mature limited access orders through to the open access order. However, values I-IX all seem to describe features of limited access societies.

Under "Institutionalised open electoral participation" (*POLCOMP* value X)—made up of a *PARREG* score of 5 ("regulated" participation) and a *PARCOMP* score of 5 ("competitive"

participation)—stable political groups regularly compete with little coercion and no major groups or issues are excluded from politics. The government does not use its institutional powers to interfere with election processes. This category seems closely related to features of the open access social order, suggesting a dichotomous variable approach. This variable is particularly useful for our purposes because it captures the idea that formal institutions such as elections can exist in limited access settings and so do not themselves indicate open access. For example "factional/restricted competition" (coded VI) is defined as a situation in which the faction in power uses its position to favour its own group interests while restricting the political access of other groups; this is not inconsistent with a democratic electoral system. Similarly, "restricted competition" (coded II) codes settings in which the dominant coalition systematically excludes major groups such that the polity is institutionally closed *de facto*, not necessarily *de jure*.

In NWW terms, the *POLCOMP* concept X classification is useful in that *de facto* features are stressed. Domination of the political arena by a single party for long periods of time may be a sign of restricted competition even if elections are held, although the appearance of domination does not necessarily disqualify a polity from being coded X if opposition groups can effectively challenge the incumbent's policies. Finally, countries are excluded from scoring X if political groups are highly personalistic, sectarian and exclusionary rather than being based around broad issues or ideologies. In open access societies parties are durable and have mass constituencies; this would be less likely to be so for organisations deriving their strength from the personality of an individual.

4.2.2 Non-elite influence

The component variables Polity IV's executive recruitment category variables are relevant to measurement of citizens' opportunities for *de facto* influence. In the "open" mode of executive recruitment openness ($XROPEN$=4), any member of the politically active population could become the head of government: there is no hereditary component to succession with recruitment taking place through elite designation, competitive elections, or some combination of these. This contrasts with "closed" forms of recruitment ($XROPEN$=1) as under hereditary succession seen in some limited access societies. In the "election" mode of executive recruitment competitiveness ($XRCOMP$=3) governments are chosen in elections with two or more parties or candidates, a feature often associated with open access polities. In contrast, the executive may simply be designated by elites, often the case under limited access ($XRCOMP$=1). The distinction between $XRCOMP$, capturing competition in executive recruitment, and $XROPEN$, capturing openness in executive recruitment, is subtle. The latter captures the extent to which any member of the population could become the executive through some institutionalised process. Thus an open recruitment system could be consistent

with the elite designating the executive as long as this designation was not tied to a hereditary criterion. Both *XRCOMP* and *XROPEN* monotonically capture a move to greater access in influence on government choice.

XRREG is aimed at capturing the concept of institutionalisation. The key difference between "regulated" (*XRREG*=3) and "unregulated" (*XRREG*=1) or "designational" (*XRREG*=2) is that regulated forms involve institutionalised types of recruitment, whether through elections or hereditary succession. Institutionalisation means that executive recruitment is not dependent on a particular party or group in power. This may not be the case in a designational system where the executive may be chosen by an elite group (whether through a one-party system or rigged elections), or in an unregulated system where this may happen through the forceful seizure of power. Institutionalisation relates to two important aspects of the NWW framework: the extent of impersonalisation and the existence of perpetual organisational forms in the political sphere.

***EXREC* Concept VIII: "Competitive elections"** The *EXREC* concept variable ties these variables together. The *EXREC* category of "competitive elections" (coded VIII) is defined as an *XRREG* score of 3 ("regulated" recruitment), an *XRCOMP* score of 3 ("election"-based recruitment) and an *XROPEN* score of 4 ("open" recruitment). This concept category captures the electoral features of open access societies, competitive elections which are not significantly influenced by the incumbent. In concept-VIII societies the *de facto* head of government is chosen through competitive elections with two or more candidates from at least two parties, rather than through power-sharing arrangements between elites. Elections may be popular or by a freely elected assembly. Crucially, the electoral process is transparent and the outcomes are institutionally uncertain: results must not be significantly influenced by the incumbent or non-elected individuals such as members of the military. The VIII classification requires that major opposition parties participate vigorously in the electoral process: there must be no boycotts by the opposition and there must be no significant restrictions on the ability of opposition parties to field candidates, mobilise their supporters or access the media. Countries are not coded VIII if elections are held during civil war, in conditions of secessionism or under the military supervision of the United Nations or other peacekeeping forces—all of these indications that the state does not hold a monopoly of violence. Such polities have not achieved the third of the doorstep conditions, a prerequisite for transition to the open access social order.

In contrast, other categories, such as "restricted elections" (coded VII) capture aspects of elections in limited access societies, in particular that they may be free but not fair. As with the political competition concept variable, *EXREC* may be useful for defining a dichotomous condition for open access, with open access being associated with a score of VIII. The other

categories describe aspects of limited access societies but without an obvious sequencing from immature to advanced limited access orders.

4.3 Construction of a historical measure of social orders

We have seen that the Polity IV data contain much information of relevance to classifying social orders. The most useful variables are the concept variables *POLCOMP* and *EXREC*. The highest values of them occur when the highest values of the political competition component variables and of the executive recruitment component variables hold simultaneously, and we linked top values of these component variables to various open access characteristics. Using these conditions for open access, let us now define a measure of "political access", PAC:

$$PAC = \begin{cases} 1(open) & POLCOMP = X \\ & EXREC = VIII \\ 0(limited) & Otherwise \end{cases} \tag{4.1}$$

Relative to the complexity of the access concept described by NWW this is a parsimonious measure. It reduces access to a single dummy variable and it contains no information on economic aspects of access. The advantage of PAC is that it is computable for many countries over long timespans.

Some of the results which will be discussed in Section 6 focus on a core set of 23 countries, mainly drawn from today's developing countries. Figure 4.2 shows the dates at which these core countries are first classified as open access under the PAC dummy. The income axis shows GDP per person when countries first achieve $PAC = 1$. The first year of $PAC = 1$ is indicated by black dots. A number of countries achieve a score of open access, then revert back to $PAC = 0$. Years of reversion are indicated by hollow grey dots and dotted grey lines. Returns to $PAC = 1$ after such breaks are indicated by solid grey dots.

The broad patterns shown by PAC are in line with priors. All of today's developed countries in the sample make a transition to open access after 1840; two of today's developing countries, Sri Lanka and Brazil never achieve open access. Eleven countries achieve "stable" open access in the sense that once they first achieve it they never regress. These are Australia, Austria, Canada, Italy, Japan, Portugal, Spain, Sweden, Switzerland and the UK, with Chile being classified as open access from 2006. Six countries—Belgium, Denmark, Finland, France, the Netherlands and Norway—achieve open access before World War II, but revert temporarily to $PAC = 0$ during the war years before reverting permanently to $PAC = 1$. Three other countries—the US, New Zealand and Uruguay—achieve open access but experience decades-long reversions. The US first achieves open access in 1845, then experiences two decades of

interruption (1850-1870) before reverting to open access in 1871. Many of today's industrialised countries seem to achieve open access relatively late. Under this criterion the UK only achieves open access in 1922, later than one might expect, with 10 countries achieving the open access score earlier. PAC appears to capture political aspects of highly consolidated open access societies well beyond the early transition from the mature limited access social order.

4.4 A broader contemporary measure of social orders

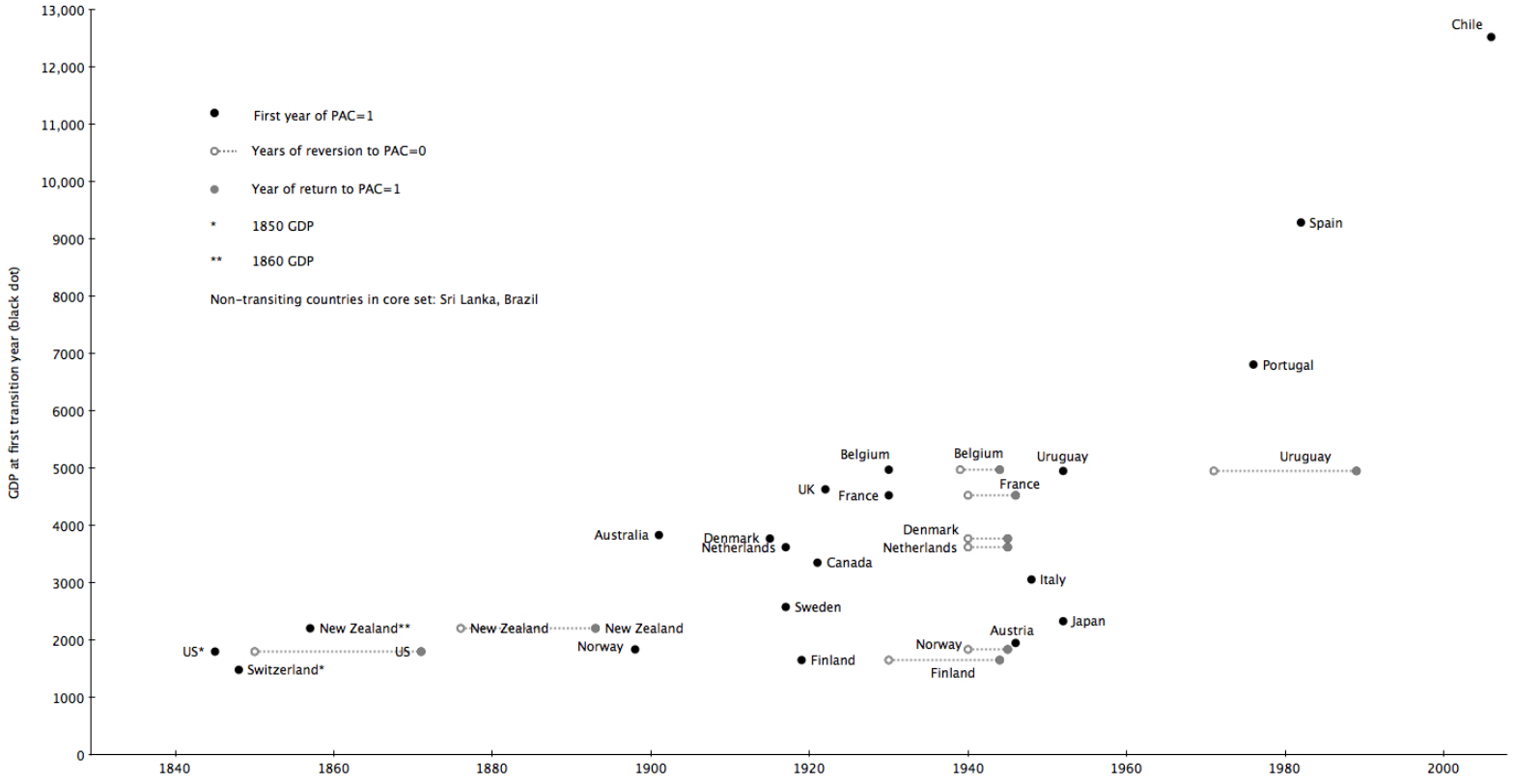
The historic indicator of access has the disadvantage that it is narrow and may be an overly strict measure of political components of access. To set the measure in a broader context we present an alternative, more comprehensive measure of access and relate it to our narrower one. Although this purely cross-country measure will play no role in the time-series analysis it helps to ground the narrower measure in a data-rich context.

Our entry point for this broader measure is NWW's analysis of the doorstep conditions (see Section 2). The doorstep conditions come into play when countries arrive at the mature limited access state. As countries transit into open access the institutional arrangements defined in the conditions expand to non-elite groups, propelling the growth of impersonal contracting over the entire economic space. NWW advocate achievement of the doorstep conditions as the marker of mature limited access societies on the cusp of open access. NWW do not present them as the fundamental definition of social orders, and their fulfilment are necessary but not sufficient conditions for open access. They are, however, important components of social orders. Countries far from them will be more basic limited access polities. Open access societies more than fulfil the conditions in the sense that the rule of law and organisational perpetuality exist beyond elite groups. By measuring the doorstep conditions we are going quite some way towards measuring access itself. The data that we use to do this sits well with this. Standard institutional indices give higher scores to countries in which the measured characteristic exists in a wide segment of the population than to those in which it exists in the elite only. Thus the idea is to construct indices which measure degrees of the fulfilment of the doorstep conditions and degrees of access, an infinite number of which exist within a single social order. This will allow us to rank countries according to their levels of access, if not to define precise boundaries between different social orders.

To construct our broader indicator we use factor analysis, a latent variable approach useful for constructing indices of unobservable characteristics. The underlying variable which we seek to measure is access (or social orders)[3], a complex concept which is not immediately

[3]For the purposes of this part of the analysis we consider measuring social orders and measuring access to be equivalent.

Figure 4.2: *PAC* - first open access against income at first classification

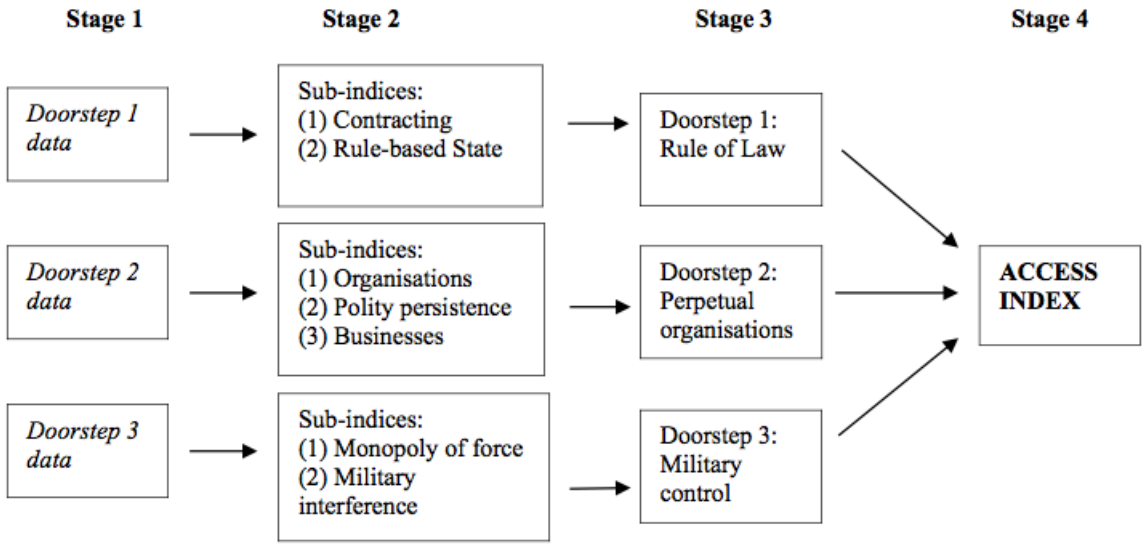


observable. Factor analysis provides a way of constructing indices of unobservables by making use of observables which are likely to be related to them. We construct measures of each of the three doorstep indices and then use these to build an overall access indicator for over 100 countries. The doorstep conditions are themselves wide concepts and in building indices for them factor analysis allows us to define more detailed institutional characteristics that contribute to them. Thus the approach is to build successively "higher-level", more aggregated indicators on the basis of "lower-level" ones.

We apply factor analysis according to a nested structure suggested by NWW's theory. In Stage 1 we draw up three subsets of data corresponding to each of the doorstep conditions. This division of data corresponds to the prior of there being three important, distinct institutional characteristics, the doorstep conditions. For each set of data corresponding to a doorstep condition we then carry out the factor analysis (Stage 2). In this stage we are agnostic about what factors might emerge within each doorstep, letting the data speak for themselves. The analysis groups clusters of variables—factors—which have a large share of variance in common. These can then be interpreted on the basis of prior theory, in this case the NWW framework. So using the variables for Doorstep One (rule of law), factor analysis might yield a number of factors which if the approach is successful will each have something to do with an aspect of the rule of law. In Stage 3 the factor scores of the factors found in Stage 2 are calculated and then aggregated with variance weights to make overall doorstep indices. Thus for Doorstep One the factor scores of each factor are found and these scores are then aggregated to make an index for Doorstep One. In Stage 4 these doorstep indices are themselves used as inputs into a final stage of factor analysis where the underlying factor of interest is now access and the doorstep indices are used as the observables. The factor scores of the access factor is the overall access index. Details of the datasets and variables used for construction of the doorstep indices are given in Appendix B (and described in more detail in Kishtainy (2011))

Applying factor analysis to our contemporary datasets uncovered multiple factors corresponding to each doorstep condition. These factors were aggregated to produce three doorstep indices. The Doorstep One (rule of law) index is made up of two factors. *Contracting* measures an important aspect of the rule of law: private economic agents' access to the rule of law. The *rule-based state* captures a macro-level feature: the extent to which the state's behaviour is in line with the rule of law. The Doorstep Two (perpetual organisational form) index consisted of three factors. The *organisational creation* factor measures how easy it is for people to establish organisations such as firms or political parties. *Polity persistence* concerns the stability of state institutions, and *business start-up* captures *de facto* aspects of organisational establishment, in particular, firm creation. The index for Doorstep Three (military control) was based on two factors. *Monopoly of violence* measures the state's control over the means of war and *military interference* the extent to which the military influences political life including

Figure 4.3: Structure of doorstep and access indices, and derived sub-indices



through the mounting of coups. The individual doorstep indices were combined into an overall access index, *ACCESS*. The structure of these factors and indices is shown in Figure 4.3.

Figure 4.4 and Table 4.4 show the rankings, distribution and ordinal country ranks of the *ACCESS* index. The ordinal rankings shown in the table begin from the left with the lowest-ranked countries. The countries are divided into quartiles by rank with lowest-ranked countries in Group One and countries listed in ascending order of ranks in each group; thus the Democratic Republic of Congo is the lowest ranked country, Switzerland the highest.

The distribution shows some high-ranked countries, some low-ranked countries and a large set of intermediate countries. The *ACCESS* country rankings show a positive relationship between development levels and access, as argued for by NWW. Most of the countries in Group One are categorised by the World Bank as being of low development status. 28 percent qualify for World Bank IDA loans, highly concessionary loans for the poorest countries. A further 45 percent of countries are IDA countries also classified as highly indebted poor countries (HIPCs). Thus HIPC and IDA countries make up 73 percent of this group. No countries in Group One are non-borrowers, high-income or OECD economies.

The share of IDA and HIPC countries falls in Groups Two, Three and Four. Group Four countries are overwhelmingly dominated by OECD, high-income and non-borrowing countries: the 24 top-ranked countries are all high-income or OECD countries. There are no low, lower-middle-income or IDA countries in this group. Figure 4.5 shows explicitly the positive relationship between income and *ACCESS*. The figure highlights certain low-scoring countries such as Uganda, some intermediate countries in transition such as China and India, and a high-

scoring country, Britain. Formal tests presented in Kishtainy (2011) confirm econometrically the positive relationship between development levels and access.[4]

How does *PAC* relate to the broader *ACCESS* measure? *PAC* is likely to be a strict criterion of access. It measures stringent all-or-nothing features of advanced open access orders while *ACCESS* captures a spectrum of varying characteristics that encompass limited access orders, polities going through transition and those that have emerged into open access. It would be easier for a country to score highly on the broader *ACCESS* variable, because that measure synthesises different institutional characteristics, of which higher values of some could compensate for lower values of others. Relative to the broader, continuous measure of access, the *PAC* variable may under-classify countries as open access; Figure 4.2 showed that leading countries achieved *PAC* scores of 1 relatively late. Table 4.5 shows the results of probit models run across 80 countries in which the dependent variable is the *PAC* dummy and the main independent variable of interest is *ACCESS*. This shows that larger values of *ACCESS* lead to highly statistically significant increases in the probability of countries being classed as open access using *PAC*. This is robust to the inclusion of standard controls and the income level. Thus, the narrower *PAC* criterion can be thought of as being nested in the broader, continuous *ACCESS* measure.

5 Fragility estimation methods

In Section 3 we described our implementation of growth fragility using the concept of growth reversal. Testing for reversals begins with the following model:

$$y_t = a_r + g_r t + \epsilon_t \tag{5.1}$$

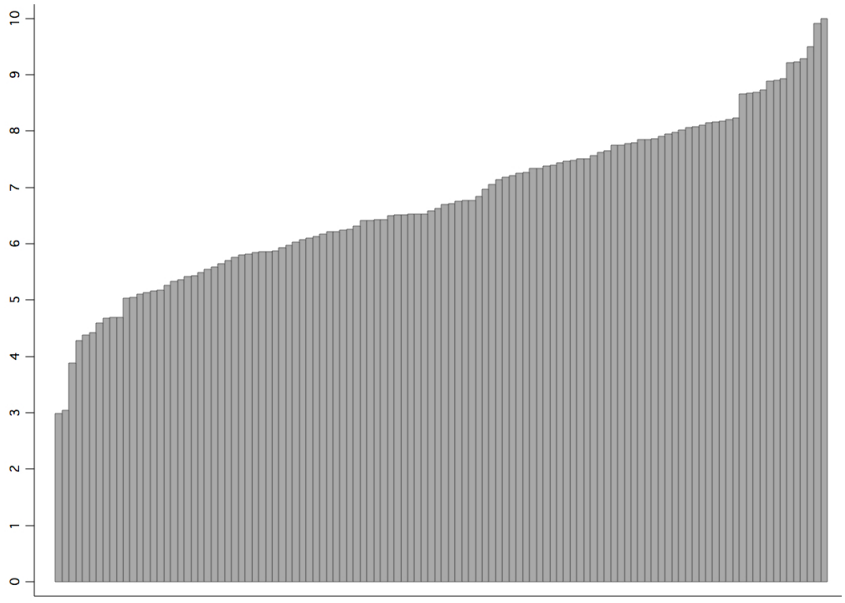
where $t_{r-1} < t < t_r$ for $t = 1, ..., T$ and where y_t is real GDP per person. Thus a particular value of r represents an episode in the process with a certain growth trend starting at time t_{r-1} and ending at t_r when an episode with a different trend growth begins.

The first step is to find the breakpoints (t_r's) and growth trends (g_r's) for each country by estimating equation (5.1). The second step is to use the estimated g_r's to estimate the reversal equations presented in Section 3. These steps are described in Sections 5.1 and 5.2.

[4]Detailed results for the individual doorstep indices are presented in Kishtainy (2011); these suggest similar positive relationships between individual doorstep scores and development, although many countries show varying performance across the doorsteps.

Figure 4.4: *ACCESS* index

(a) Country scores in rank order



(b) Score frequencies

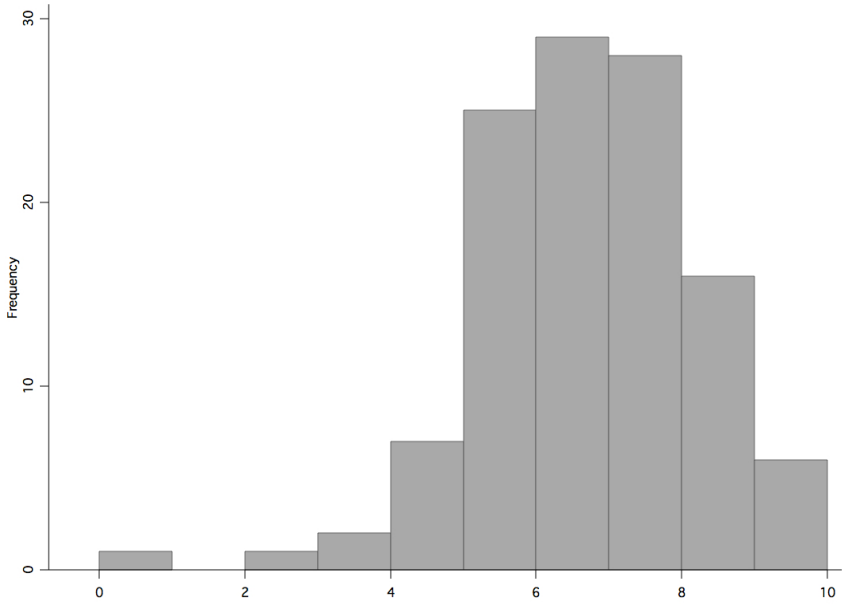


Table 4.4: *ACCESS* rankings

Group 1	Type	Debt	Group 2	Type	Debt	Group 3	Type	Debt	Group 4	Type	Debt
Congo (DRC)	L	IDA*	Paraguay	LM	IBRD	South Africa	UM	IBRD	Singapore	H	-
C. Afr. Rep.	L	IDA*	Colombia	UM	BL	Gabon	UM	BL	South Korea	H	IBRD
Zimbabwe	L	BL	Philippines	LM	IBRD	Ghana	L	IDA*	Mauritius	UM	IBRD
Chad	L	IDA*	Guatemala	LM	IBRD	Senegal	LM	IDA*	Uruguay	UM	IBRD
Indonesia	LM	BL	Benin	L	IDA*	Vietnam	LM	BL	Slovenia	OECD	-
Cambodia	L	IDA	Nepal	L	IDA	Tanzania	L	IDA*	Greece	OECD	-
Sudan	LM	IDA	Mali	L	IDA*	Mongolia	LM	IDA	Spain	OECD	-
Congo (ROC)	L	IDA*	Turkey	UM	IBRD	Botswana	UM	IBRD	Hungary	OECD	-
Nigeria	LM	IDA	Ethiopia	L	IDA*	Qatar	H	-	Cyprus	H	-
Mozambique	L	IDA*	Mexico	UM	IBRD	Oman	H	-	Italy	OECD	-
Togo	L	IDA*	Syria	LM	IBRD	Saudi Arabia	H	-	Portugal	OECD	-
Haiti	L	IDA*	Azerbaijan	UM	BL	Malaysia	UM	IBRD	Japan	OECD	-
Venezuela	UM	BL	Dom. Rep.	UM	BL	Romania	UM	IBRD	France	OECD	-
Angola	LM	IDA	Zambia	L	IDA*	China	LM	IBRD	Germany	OECD	-
Burkina Faso	L	IDA*	Ecuador	LM	IBRD	UAE	H	-	Belgium	OECD	-
Uganda	L	IDA*	Peru	UM	IBRD	Israel	H	-	Netherlands	OECD	-
Niger	L	IDA*	Ukraine	LM	BL	Chile	UM	IBRD	Austria	OECD	-
Mauritania	UM	IDA*	Honduras	LM	IDA*	Kuwait	H	-	Ireland	OECD	-
Pakistan	LM	BL	Tunisia	LM	IBRD	Bahrain	H	-	Denmark	OECD	-
Bangladesh	L	IDA	Iran	UM	IBRD	Bulgaria	UM	IBRD	Finland	OECD	-
Yemen	LM	IDA	Nicaragua	LM	IDA*	Czech Rep	OECD	-	Sweden	OECD	-
Lebanon	UM	IBRD	Kazakhstan	UM	IBRD	Argentina	UM	IBRD	Norway	OECD	-
Cameroon	LM	IDA*	Uzbekistan	LM	BL	Latvia	H	-	Canada	OECD	-
Kenya	L	IDA	Sri Lanka	LM	IDA	Slovak Rep.	OECD	-	UK	OECD	-
Laos	L	IDA	India	LM	BL	Brazil	UM	IBRD	Australia	OECD	-
Egypt	LM	IBRD	Bolivia	LM	BL	Taiwan	H	-	New Zealand	OECD	-
Thailand	LM	IBRD	Russia	UM	IBRD	Estonia	H	-	US	OECD	-
Algeria	UM	IBRD	Namibia	UM	IBRD	Lithuania	UM	-	Switzerland	OECD	-
Madagascar	L	IDA*	Jordan	LM	IBRD	Poland	OECD	-			
% low	55	-		17	-		7	-		0	-
% lower-middle	31	-		48	-		14	-		0	-
% upper-middle	14	-		34	-		34	-		7	-
% high	0	-		0	-		34	-		11	-
% OECD	0	-		0	-		10	-		82	-
% IBRD	-	13		-	48		-	31		-	11
% IDA (non-HIPC)	-	28		-	7		-	3		-	0
% IDA (HIPC)	-	45		-	21		-	10		-	0
% Blended lending	-	14		-	24		-	7		-	0
% non-borrowers	-	0		-	0		-	45		-	89

Notes: Income and lending groups: L=Lower, LM=Lower-middle, UM=Upper-middle, H=High; BL=Blended lending, IDA*=IDA and HIPC

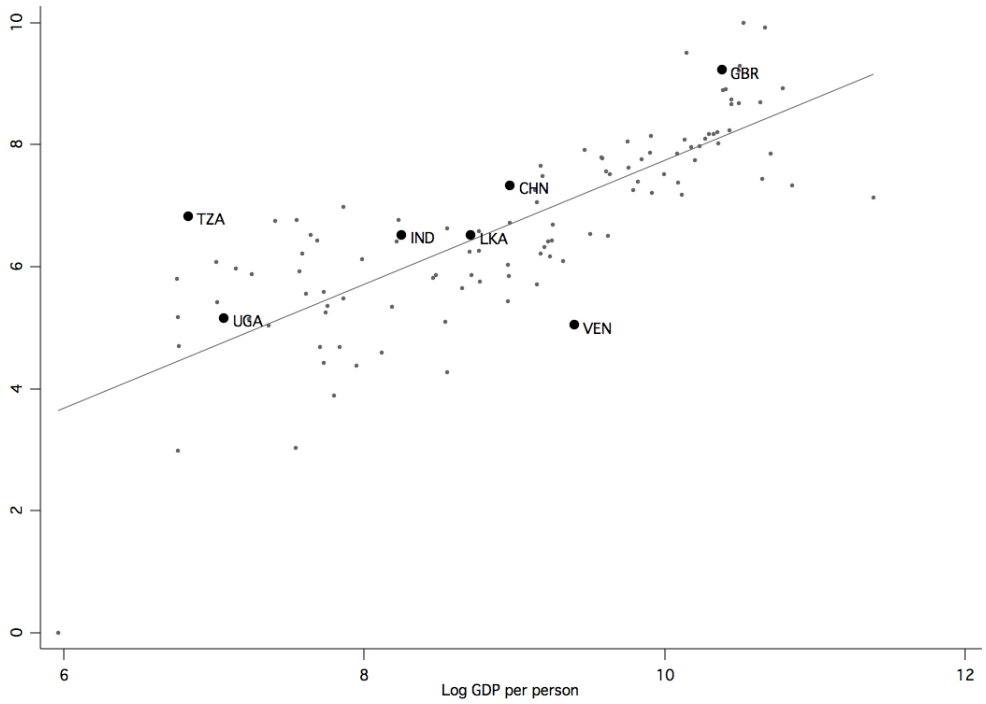
Table 4.5: *PAC* and the full access measure

	(1) *PAC*	(2) *PAC*	(3) *PAC*
ACCESS	2.325***	2.618**	2.533*
	(0.531)	(1.078)	(1.348)
Secondary enrolment		0.0343	0.00327
		(0.0478)	(0.0640)
Primary enrolment		-0.0906	-0.0812
		(0.0562)	(0.0581)
Population growth		0.120	-0.0121
		(0.458)	(0.485)
Government growth		-0.160	-0.172
		(0.139)	(0.136)
Government consumption		-0.0966	-0.103
		(0.105)	(0.111)
Gross fixed capital formation		-0.181*	-0.181*
		(0.100)	(0.104)
Export share		-0.0289	-0.0351*
		(0.0197)	(0.0211)
Domestic credit growth		-0.290	-0.208
		(0.718)	(0.607)
Per person income			1.103
			(1.253)
Constant	-17.84***	-5.869	-13.48
	(4.059)	(7.595)	(11.97)
N	115	80	80

Standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

Figure 4.5: Access and income



5.1 Step 1: multiple break tests by estimation of equation (5.1)

One approach to detecting structural breaks involves testing a prior break timing. This would be impractical for a panel analysis involving many countries of the kind that we are undertaking. Our approach is to let the data speak for themselves by using tests of break timing without priors. We require a method that allows for more than one breakpoint, otherwise countries would have at most two growth regimes which would not allow for estimation of the reversal equations. Thus break tests need to satisfy two requirements: break timings, t_r, should not be imposed, and the number of breaks, m, must be able to exceed one.

Bai and Perron (1998) present a test of multiple structural breaks that satisfies both requirements. The m breakpoints $(t_1...t_m)$ and the $m+1$ a_r and g_r coefficients are treated as parameters to be estimated. This has been used in the literature to analyse growth breaks by applying the technique to log GDP series to detect intercept and trend shifts. Monte Carlo simulation and robustness checking using alternative Bayesian approaches have found that the technique works fairly well in growth contexts (Jones and Olken, 2008; Cuberes and Jerzmanowski, 2009). We impose a minimum break length of 10 years in order to abstract from short-term cycles in economic activity. This is implemented using a dynamic programming algorithm (Bai and Perron, 2003). Details on the algorithm are given in Appendix A.

5.2 Step 2: estimating the reversal model, equation (3.2)

From Step 1 we obtain a set of breakpoints, and regime trend growth coefficients for a certain number of regimes. Thus for country i we have n regimes, $1, \ldots, n$, where n may vary across countries. Our model seeks to test for the relationship between regime coefficients in adjacent regimes. While countries represent the dimension of cross-sectional variation, it is the number of the regime that takes the second dimension of variation in our panel estimation as in Cuberes and Jerzmanowski (2009).

Our reversal model, equation (3.1), containing a lagged dependent variable, is a dynamic panel model. The strong exogeneity assumption needed for consistent estimation using standard static panel estimators is violated in dynamic settings. Consistent estimators for dynamic models are based on the use of lagged variables as "internal" instruments. Holtz-Eakin and Newey (1988) and Arellano and Bond (1991) propose a GMM estimator based on a difference transformation, sometimes termed the difference GMM estimator. The large number of instruments used brings gains in precision, and the possibility of testing overidentifying restrictions. With more than three time periods the restrictions can be tested using the Hansen and Sargan tests. These tests are based on the null that the restrictions are correct; correct specification requires acceptance of this null. These two tests are equivalent under spherical errors but under heteroskedasticity the Sargan test becomes inconsistent.

Sometimes the lagged variables used as instruments in the difference GMM estimator are weak instruments for differenced variables, particularly if series are persistent. If a variable is close to being a random walk then its differences are close to being white noise errors and will not purge endogeneity in levels. Differences are also weak instruments when the variance of the individual specific effects are large relative to that of the error term. In these cases the difference GMM estimator can suffer from finite sample bias. To address the problems Blundell and Bond (1998) propose an extended GMM estimator, the system GMM estimator in which are used lagged differences as instruments in a levels equation, as well as level instruments in a differenced equation. We make use of both the difference GMM and system GMM estimators.

The instruments used to form the difference GMM estimator are used under the assumption of no serial correlation in the error terms, u_{it}. If there is serial correlation then instruments become endogenous and the instrument set has to be restricted to longer lags depending on the precise pattern of correlation. Arellano and Bond (1991) derive tests for these correlation properties. Under no serial correlation in u_{it}, there will be first order serial correlation in $\triangle u_{it} = u_{it} - u_{i,t-1}$ because of the one-lag overlap in successive differences ($\triangle u_{it}$ is correlated with $\triangle u_{i,t-1}$ through the common term, $u_{i,t-1}$), but have no second order serial correlation ($\triangle u_{it}$ is uncorrelated with $\triangle u_{i,t-2}$). A correctly specified model should reject the test's null of no first order serial correlation, accept the null of no second order serial correlation.

A disadvantage of the difference transformation is that it expands gaps when panel are unbalanced. If a variable, x_{it} is missing then following transformation, so will be $\triangle x_{it}$ and $\triangle x_{i,t+1}$. In this situation an alternative transformation which preserves the sample size is the forward orthogonal deviation transform, so called because it uses future observations and preserves *iid* errors (Arellano and Bover, 1995). Under this transformation one subtracts the average of future observation which are in the sample. This can be calculated for all observations apart from the last ones. This transformation can be written as:

$$\widetilde{x_{it}} = \sqrt{T_{it}/\left(T_{it}+1\right)}\left(x_{it} - \frac{1}{T_{it}}\sum_{s>t} x_{is}\right) \tag{5.2}$$

In this formula the weighting term $\sqrt{T_{it}/\left(T_{it}+1\right)}$ equalises variances. In general our multiple break tests yield different numbers of breaks for different countries. This means that we apply our panel model on an unbalanced dataset. In order to preserve sample size we therefore make use of this transformation in our estimations.

The advantage of GMM estimation is that many instruments are harnessed for estimation. In the difference GMM context the moment conditions can be compactly written as $E\left(Z_i' \triangle \varepsilon_i\right) = 0$ where Z is an instrument matrix and $\triangle \varepsilon_i$ are the transformed errors. Z_i itself can be written out as:

$$\begin{bmatrix} x_{i1} & 0 & 0 & 0 & 0 & 0 & \cdots \\ 0 & x_{i1} & x_{i2} & 0 & 0 & 0 & \cdots \\ 0 & 0 & 0 & x_{i1} & x_{i2} & x_{i3} & \cdots \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots \end{bmatrix} \tag{5.3}$$

The version of Z_i shown here is that for a predetermined variable where lags one and longer can be used as instruments. The first row shows the instrument set for the variable at $t = 2$. The second row shows the instrument set at $t = 3$: this includes both x_{i2} and x_{i1}, and so on. Because the GMM approach uses separate instruments for each time period Z is sparse and instruments proliferate: the number of instruments increases quadratically in T.

A surfeit of instruments can lead to a weak instrument problem. A large instrument set can lead to over-fitting: there may be a trade-off between the efficiency gained from using many instruments and the finite sample bias from having too many. In panel IV, instruments from earlier in the time-series may be only weakly correlated with the endogenous variable in question. This can lead to a failure to eliminate variables' endogenous components, and the risk of this increases as instruments proliferate with longer T's. Weak instruments also interfere with tests of overidentification (Andersen and Sorensen, 1996; Bowsher, 2002). In particular,

Hansen's test loses power: Bowsher (2002) shows that under some common situations of instrument proliferation the test may never reject the null.

This property of IV estimation suggests the need to check the robustness of results by reducing the instrument count. Roodman (2009) suggests placing a limit on the depth of the lags. Alternatively, he proposes "collapsing" the instrument set. In collapsed form the instruments shown in the matrix above are combined to create the following matrix:

$$\begin{bmatrix} x_{i1} & 0 & 0 & \cdots \\ x_{i2} & x_{i1} & 0 & \cdots \\ x_{i3} & x_{i2} & x_{i1} & \cdots \\ \vdots & \vdots & \vdots & \ddots \end{bmatrix} \tag{5.4}$$

This creates a smaller instrument set as the number of instruments now increases linearly rather than quadratically in T. Restricting the number of instruments, whether through truncation of lags or collapsing the instrument matrix can be a useful way of alleviating finite sample bias in a panel IV setting. In constructing our instruments sets we make frequent use of the collapsing technique.

6 Results

We begin by presenting results for a core set of 23 countries for whom continuous annual data is available in Maddison's historical GDP dataset from 1870 to 2006. These countries are Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Germany, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sri Lanka, Sweden, Switzerland, the UK, Uruguay and the US. The sample contained 144 breaks over the time period. Table 6.1 shows four sets of reversal results with the *PAC* variable for 1870-2006 using the difference and system GMM estimators, forward orthogonal deviations with full and collapsed instruments sets, and robust standard errors.[5] The full and collapsed instrument sets correspond to those depicted in expressions 5.3 and 5.4, respectively. Column 1 shows the results for a difference GMM estimation using the full instrument set. The estimated coefficients are in line with theoretical priors: overall growth reversals shown by the negative coefficient on the *Prior growth trend* term and an access reversal-dampening effect shown by the positive *PAC* $\times$ *Prior growth trend* term. However, the p-values of the specification tests shown in the lower part of the table temper confidence in this estimation. The AR(1) test rejects the null of no serial correlation in the first-differenced errors, a result consistent with the assumption of uncorrelated untransformed errors made in construction of the instrument set. However, this

[5]These estimations were carried out in STATA using `xtabond2` (Roodman, 2009).

Table 6.1: Growth reversals and access, 1870-2006, core 23 countries

	(1) Difference GMM Full matrix	(2) System GMM Full matrix	(3) Difference GMM Collapsed matrix	(4) System GMM Collapsed matrix
Prior growth trend	-2.507***	-2.592***	-3.348***	-2.600***
	(0.592)	(0.430)	(0.972)	(0.975)
PAC x *Prior growth trend*	1.196***	1.477***	2.026***	1.596**
	(0.425)	(0.289)	(0.682)	(0.688)
GDP x *Prior growth trend*	-1.369***	-1.521***	-1.736***	-1.389**
	(0.342)	(0.325)	(0.573)	(0.559)
GDP	0.00255	-0.0131	0.0620*	0.0178
	(0.0254)	(0.00885)	(0.0330)	(0.0211)
PAC	0.0212	-0.00347	0.00620	-0.00361
	(0.0149)	(0.0140)	(0.0307)	(0.0205)
Constant		-0.0140		0.00596
		(0.0131)		(0.0175)
Countries	20	23	20	23
Observations	72	95	72	95
Instruments	46	71	23	29
AR(1)	0.0122	0.0172	0.0108	0.00596
AR(2)	0.0350	0.0801	0.202	0.214
Hansen	0.998	1.000	0.388	0.802
Sargan	0.676	0.945	0.767	0.842

Robust standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

assumption also implies no second order serial correlation in the differenced errors. This is not found to be the case by the AR(2) test which at the 5 percent level rejects the null of no second order serial correlation.

The Sargan test—robust to instrument proliferation but not to heteroskedasticity—easily accepts the null of valid overidentifying restriction. The Hansen test—robust to heteroskedasticity but not to instrument proliferation—has a value of 0.99. For both the difference and system GMM versions the number of instruments is approaching the number of observations. This, alongside the Hansen scores, strongly suggests a weak instrument problem. As discussed in Section 4 such a high value of the Hansen statistic is often the result of weak instruments and interpreting it as unequivocal evidence in favour of the overidentifying restrictions may be hazardous. Variable endogeneity is unlikely to have been purged and the estimated coefficients

may be unreliable. Similar problems arise with system GMM estimation, the results of which are shown in column 2: although the AR(2) is just passed at the 5 percent level, as before the very high Hansen p-value suggests a problem of instrument proliferation.

The estimations using collapsed instrument sets were designed to address these specification problems. The results are shown in columns 3 and 4 for the difference and system GMM estimations respectively. Collapsing the instrument set leads to at least a half fewer instruments. Beginning with the difference GMM version shown in column 3, we see that both autocorrelation tests give acceptable results. The AR(1) test rejects the null of no serial correlation in differenced errors at the 5 percent level. The AR(2) test accepts the null of no second order correlation. The Hansen test is now only 0.39, easily accepting the null of valid overidentifying restrictions without being so high that we might strongly suspect a weak instrument problem. As before, the Sargan test is easily passed. The system GMM version with collapsed instruments also passes these four tests, the AR(2) tests at the 1 percent level. Compared with the full instrument set case, the Hansen p-value is much lower, although it remains quite high.

Overall, the results with the collapsed instrument sets appear to satisfy the assumptions needed for consistent estimation. The difference GMM version (column 3), employing fewer instruments than system GMM seems to best ameliorate the problem of weak instruments, and we take this as our baseline model. There are no formal criteria for assessment of the weak instrument problem: our approach has been to be sceptical of very favourable looking Hansen test results. Collapsing the instrument set is useful but may not remove the problem. Another line of enquiry involves truncating the instrument set by limiting the number of lags used as instruments. In Table 6.2 we test the sensitivity of our baseline result using successively tighter restrictions on the instrument set. Column 1 reproduces the baseline result for comparison. The table shows that our baseline result is robust to a range of restrictions on lag depth. In all cases the autocorrelation tests indicate no serial correlation in the untransformed errors. The tests of overidentifying restrictions are passed. The signs, magnitudes and significance of the coefficients also remain largely intact.

Given this favourable specification evidence we now turn to interpretation of the coefficients themselves, using our baseline estimation. The first key result is the highly significant and large negative coefficient on prior trend growth. This indicates a strong pure reversal effect. Combined with this is a strong reversal-dampening effect from open access shown by the large, positive, highly significant coefficient on the *PAC* $\times$ *Prior growth trend* term. The rest of the terms control for income and level effects. The *GDP* $\times$ *Prior growth trend* term isolates the open access reversal effect picked up by the *PAC* $\times$ *Prior growth trend* term from the conflating effects of income. Thus, a small or insignificant term on the *GDP* $\times$ *Prior growth trend* term alongside a significant and positive one on *PAC* $\times$ *Prior growth trend* would indicate that reversal-dampening effects work mainly through institutions, not

Table 6.2: Baseline estimation, 1870-2006: robustness to the instrument set

	(1) Difference GMM Baseline	(2) Difference GMM Lag depth < 6	(3) Difference GMM Lag depth < 5	(4) Difference GMM Lag depth < 4	(5) Difference GMM Lag depth < 3
Prior growth trend	-3.348***	-3.418***	-3.404***	-3.925***	-3.681***
	(0.972)	(0.961)	(1.088)	(1.240)	(1.307)
PAC x *Prior growth trend*	2.026***	2.079***	1.947**	2.085**	2.432**
	(0.682)	(0.654)	(0.799)	(0.941)	(1.115)
GDP x *Prior growth trend*	-1.736***	-1.770***	-1.724***	-2.150***	-1.878***
	(0.573)	(0.552)	(0.635)	(0.664)	(0.725)
GDP	0.0620*	0.0656	0.0956*	0.136	0.0645
	(0.0330)	(0.0400)	(0.0565)	(0.0836)	(0.101)
PAC	0.00620	0.00588	0.00673	-0.0218	0.0258
	(0.0307)	(0.0314)	(0.0388)	(0.0392)	(0.0640)
Countries	20	20	20	20	20
Observations	72	72	72	72	72
Instruments	23	22	18	13	8
AR(1)	0.0108	0.00946	0.00759	0.00906	0.0220
AR(2)	0.202	0.202	0.250	0.932	0.245
Hansen	0.388	0.307	0.457	0.856	0.844
Sargan	0.767	0.723	0.694	0.856	0.950

Robust standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

through an access-correlated income effect. The result of our baseline specification shows a negative, significant coefficient on the *GDP* $\times$ *Prior growth trend* term, which together with the positive and larger term on *PAC* $\times$ *Prior growth trend* implies an extreme type of "institutions only" result. When separating out the reversal-dampening effects of open access from those of income we see that income on its own actually accentuates reversals. The overall correlation between income and growth stability is driven purely by the effect of open access, itself correlated with income. How does this basic result compare to those in the existing literature? Using a similar specification and post-war data Cuberes and Jerzmanowski (2009) find significant reversal-dampening effects from democracy. Their reversal coefficients and reversal-dampening coefficients are much smaller than ours for our longer timespan. They also find a negative coefficient on the income-trend growth interaction term, but it is not statistically significant.

Making use of historical data opens the way for analysis of how growth-access dynamics change over time. We re-generate the underlying panel of growth regime data for particular sub-periods and then rerun the panel estimations. It would be useful to compare results for the post-war era, the standard period of analysis in much development and empirical growth literature, with what came before. Certain truncations of the timespan are not econometrically feasible. For example, using the pre-war span did not generate enough growth regimes for meaningful analysis. Using the post-war period was possible, however.

Table 6.3 shows the results for the post-war period, using the same set of 23 core countries. The sample for this time period contained 106 breaks. The system GMM estimator shown in columns 2 and 4 performed best in specification tests. The results from these satisfy the AR(1) tests at the 1 percent level whereas those from the difference GMM estimator only do so at the 5 percent level. All the estimations passed the Hansen and Sargan tests, and none show obvious signs of weak instruments. Of the two versions of the system estimator, the version with the collapsed instrument set does better on the AR(2) test, easily passing at the 5 percent level whereas the full matrix version only marginally passes at 5 percent. Although both versions path the tests of overidentifying restrictions, the full matrix version passes the Hansen test more unequivocally.

Given that both system versions perform reasonably we take both as baselines, subjecting them to instrument truncation sensitivity tests as before. The shorter timespan implies a lower number of average regimes and a shorter panel, so that fewer lag depths are available compared to the full timespan. We subject the instrument sets to a single truncation. The results are shown in Table 6.4 in which columns 1 and 2 reproduce the system estimation results with unrestricted lag depths. Columns 3 and 4 show the same estimation with restricted lag depths. In both cases the AR(1) test is failed, in the collapsed matrix case by a large margin. Both versions pass the tests of overidentifying restrictions although in the collapsed case the

Table 6.3: Growth reversals and access, 1950-2006, core 23 countries

	(1) Difference GMM Full matrix	(2) System GMM Full matrix	(3) Difference GMM Collapsed matrix	(4) System GMM Collapsed matrix
Prior growth trend	-1.089	-1.422*	-1.089	-1.649
	(0.826)	(0.763)	(0.826)	(1.042)
PAC x *Prior growth trend*	0.790	1.392**	0.790	1.283
	(0.605)	(0.628)	(0.605)	(0.927)
GDP x *Prior growth trend*	-0.491	-0.617	-0.491	-1.125*
	(0.744)	(0.605)	(0.744)	(0.619)
GDP	-0.0436	-0.00281	-0.0436	-0.00663
	(0.0303)	(0.0118)	(0.0303)	(0.0158)
PAC	0.00445	-0.0188	0.00445	-0.0103
	(0.0186)	(0.0164)	(0.0186)	(0.0228)
Constant		0.0174		0.00809
		(0.0189)		(0.0268)
Countries	20	20	20	20
Observations	37	57	37	57
Instruments	13	23	13	16
AR(1)	0.216	0.0347	0.216	0.0397
AR(2)	0.522	0.545	0.522	0.833
Hansen	0.398	0.556	0.398	0.193
Sargan	0.494	0.728	0.494	0.472

Robust standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

Sargan test is only just passed at the 10 percent level. Overall the system GMM estimator with the full matrix of instruments seems to be more robust to this sensitivity check, even though the truncated version does not pass all of the specification tests.

The estimated coefficient using the better-performing system GMM model with the full instrument set finds significant coefficients on the *Prior growth trend* and the *PAC* × *Prior growth trend* terms signed in line with our theoretical priors. There is an overall pattern of growth reversals in the data, and higher levels of access are associated with less fragility. The term on the *PAC* × *Prior growth trend*, as for the 1870-2006 estimations, is negative, but in this case it is insignificant. Interestingly, the magnitudes and significance levels of the coefficients for this estimation are more similar to those found by Cuberes and Jerzmanowski in their analysis of democracy than for our longer timespan.

We now broaden the analysis to a set of 130 countries, beginning with the 1950-2000 period. To explore fully the possibilities offered by our data we also carry out estimations incorporating earlier years for the full set of countries, including countries with earlier data in an unbalanced GDP panel. We do this for 1870-2000 and for 1830-2000. In the 1950-2000 sample were detected 336 breaks across 132 countries, for the 1870-2000 sample 432 breaks, and for the 1830-2000 sample 447 breaks. For each of these timespans we estimate difference and system GMM models using collapsed and full instrument sets. As before with full instrument sets the estimations generally show signs of weak instruments. For each timespan we subject the results to robustness checking by successively truncating the instrument sets. On this basis we choose a preferred baseline result for each timespan. We do not report these sensitivity checks. Instead, Table 6.5 shows results for all of these timespans together, for each span reporting the baseline estimation which for all of them is the system GMM estimator with a collapsed instrument set. All three estimations pass the autocorrelation tests, and the Hansen and Sargan tests. The number of observations are well in excess of the number of instruments and none of the Hansen tests fall into the suspiciously high range indicative of instrument proliferation.

The results from the full set of countries gives much weaker results that when the result were restricted to the core set of Maddison countries. For all variables, coefficient magnitudes and levels of significance are much lower than for our earlier results. The 1950-2000 results show a negative reversal coefficient (that on *Prior growth trend* term). However, it is now of much smaller size and is insignificant. The coefficient on the access reversal-dampening term remains positive and significant but is much smaller. The longer historic timespans with the full set of countries, whether incorporating data from as far back as 1830 or 1870, tell a similar story. There are significant but lower coefficients on the overall growth reversal term. Those on the *PAC* × *Prior growth trend* term remain signed in line with priors, but become insignificant. Results using the full set of countries are equivocal. Even for these baseline estimations, results

Table 6.4: Baseline estimation, 1950-2006: robustness to the instrument set

	(1) System GMM Full matrix Baseline	(2) System GMM Collapsed matrix Baseline	(3) System GMM Full matrix Lag depth < 2	(4) System GMM Collapsed matrix Lag depth < 2
Prior growth trend	-1.422*	-1.649	-1.773**	-1.741
	(0.763)	(1.042)	(0.836)	(1.582)
PAC x *Prior growth trend*	1.392**	1.283	1.882***	1.759
	(0.628)	(0.927)	(0.706)	(1.601)
GDP x *Prior growth trend*	-0.617	-1.125*	-0.701	-0.847
	(0.605)	(0.619)	(0.736)	(0.935)
GDP	-0.00281	-0.00663	-0.00186	-0.0140
	(0.0118)	(0.0158)	(0.0155)	(0.0281)
PAC	-0.0188	-0.0103	-0.0180	-0.00115
	(0.0164)	(0.0228)	(0.0196)	(0.0431)
Constant	0.0174	0.00809	0.0170	-0.00392
	(0.0189)	(0.0268)	(0.0233)	(0.0499)
Countries	20	20	20	20
Observations	57	57	57	57
Instruments	23	16	16	7
AR(1)	0.0347	0.0397	0.138	0.353
AR(2)	0.545	0.833	0.717	0.791
Hansen	0.556	0.193	0.706	0.272
Sargan	0.728	0.472	0.889	0.105

Robust standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

Table 6.5: Growth reversals and access, expanded country sample for historic timespans

	(1) System GMM Collapsed matrix 1950-2000 Baseline	(2) System GMM Collapsed matrix 1870-2000 Baseline	(3) System GMM Collapsed matrix 1830-2000 Baseline
Prior growth trend	-0.394	-0.788**	-0.783**
	(0.430)	(0.395)	(0.375)
PAC x *Prior growth trend*	0.593*	0.213	0.186
	(0.336)	(0.318)	(0.319)
GDP x *Prior growth trend*	-0.303	-0.409*	-0.405*
	(0.289)	(0.226)	(0.212)
GDP	0.00225	-0.00120	-0.000981
	(0.00747)	(0.00804)	(0.00818)
PAC	-0.00214	-0.000294	0.00847
	(0.0119)	(0.0190)	(0.0188)
Constant	-0.00311	-0.0127	-0.0135
	(0.0148)	(0.0138)	(0.0138)
Countries	126	128	128
Observations	278	340	349
Instruments	16	29	32
AR(1)	0.00343	0.000	0.000
AR(2)	0.288	0.794	0.563
Hansen	0.438	0.228	0.297
Sargan	0.255	0.800	0.974

Robust standard errors in parentheses

* p<0.10,** p<0.05,*** p<0.01

tended not to be robust to the most aggressive reductions in the instruments sets, unlike those for the core 23 countries.

6.1 Summary

We now sum up our results. The most unambiguous results were found when restricting analysis to the core 23 countries. The 1870-2006 span showed robust and strong growth reversals and reversal-dampening effects. For the post-war period, the basic result remained intact, although the magnitudes and levels of significance were lower and results were less robust. Analysis for both timespans indicated an extreme "institutions only" effect in which higher GDP was associated with an accentuation of reversals, although this effect was insignificant in the post-war years.

These fairly strong effects were harder to uncover with an expanded country sample. For the 1950-2000 period we found a smaller, still significant access reversal-dampening effect, although the overall reversal coefficient became insignificant. Adding earlier country timespans to the data whether back to 1870 or to 1830 in an unbalanced panel yielded significant negative coefficients on the reversal term, but no significant reversal-dampening effects although the coefficients remained correctly signed. This set of results was less robust to sensitivity testing.

7 Discussion and conclusion

Results were mixed evidence for the relationship between growth stability and open access. Positive associations were sensitive to the size of the country sample and to the time period used. The result most congruent with related ones in the literature was that for the post-war period for the core 23 countries in which we found overall reversals and reversal-dampening effects of moderate magnitudes and significances. Expansion of the country sample weakened the findings, for whatever time period was used.

The strongest association was found when restricting analysis to the core set of 23 countries for the 1870-2006 period. Here we found much stronger effects than in existing studies. The 23 countries in the sample are dominated by today's developed, open access countries; for earlier years not all of these would be open access. Most of these countries have made the transition to stable-growth, high-income, open access societies. Using this long timespan for this group of countries is likely to capture transition to the open access order accompanied by a consolidation of modern economic growth. Moreover, the PAC variable is a stringent dichotomous criterion for open access that may miss countries at early stages of the open access social order. This might explain these very strong results. Expansion to a broader set of countries largely means adding today's developing countries many of whom have fragile

growth and most of whom add no variation to the PAC variable in that they always score zero. These countries do not add association between less growth fragility and more access along the time dimension of the panel. They might, therefore, dilute the strong association seen when using the core set of countries only.

The results indicate that fragility-dampening effects work through access only. Taking the 1950-2000 period for the core set of country we found that the income level had an insignificant effect on patterns of fragility. In our 1870-2006 timespan this negatively signed effect attained significance. This effect implies that shorn of its access associations, higher income leads to more fragility not less. As with reversal-dampening from access this is sensitive to sample size and timespan. Nevertheless, one might argue that the effect could be an example of a sharp "institutions only" effect in which not only does reversal-dampening only work through access rather than the income level, but that the marginal income effect goes in the opposite direction. The portion of income variability that drives this marginal negative effect could be thought of as "non-institutional" sources of income and growth. One hypothesis could be whether non-institutional sources of growth, not dependent on the economy's social order and institutional characteristics, are instead driven by highly variable exogenous factors. This could be so if non-institutional sources of income were made up of natural resource exports whose values depend on fluctuating global commodity prices.

Overall, then, the analysis of this paper provides some support for linkage between social orders and growth fragility. These findings are qualified. First, the empirical methods that we have used designed to handle dynamic settings are delicate, and not all results robust. Second, the measure of access that we used in the historical fragility analysis is narrow. But by relating it statistically to the fuller measure of access we showed its relevance to assessment of countries' social order characteristics. Although statistical testing of this kind shows nothing more than association, our confidence in the narrow measure must be greater than if there was found to be no obvious relationship between it and the more comprehensive measure of access. In constructing these indices we also confirmed a basic conjecture made by NWW: that more open access is associated with a higher level of development.

Our macro-level empirical approach glosses over the details of how institutions generate economic results. As described in Section 2 NWW's social order framework depends on individual-led causal mechanisms. The evolution from limited to open access societies is caused by a transition mechanism dependent on incentive-compatible actions by elites to bring incrementally greater access. Our analysis says little about these causal processes, except to inform general statements about the extent to which the macroeconomic evidence is consistent with the broad lines of the theories and does not obviously weigh against the existence of the underlying micro-level mechanisms. At best our analysis partially reconciles NWW's theoretical hypotheses with patterns of economic aggregates but the very broadness of these patterns

makes them potentially consistent with other theories. Macro-level investigations, even with emphatic results, can only ever be liberal tests of institutional conjectures. Fuller tests would combine these with micro-institutional analysis, connecting growth evidence with detailed causal drivers.

Appendix A: Bai and Perron's Multiple Break Method

Bai and Perron's break method is designed to detect multiple breaks in a series without the imposition of priors (Bai and Perron, 1998). Consider the model defined in Section 5:

$$y_t = a_r + g_r t + \epsilon_t \tag{7.1}$$

where $t_{r-1} < t < t_r$ for $t = 1, ..., T$ and where y_t is real GDP per person. A particular value of r represents an episode in the process with a certain growth trend starting at time t_{r-1} and ending at t_r when an episode with a different trend growth begins. In Bai and Perron's method the m breakpoints $(t_{1...}t_m)$ and the $m+1$ a_r and g_r coefficients are parameters to be estimated.

A particular set of these m breakpoints leads to a partitioning of the model into $m+1$ regimes. For a particular partition OLS estimates of the coefficients can be found by minimising the sum of squared residuals where we sum within partitions and across partitions:

$$SSR = \sum_{i=1}^{m+1} \sum_{t=t_{r-1}+1}^{t_r} \left[y_t - a_r - g_r t\right]^2 \tag{7.2}$$

Suppose $\hat{a}\left(\tilde{t}\right)$ and $\hat{g}\left(\tilde{t}\right)$ are the estimated coefficients given some partitioning, $\tilde{t} = (t_1, \ldots, t_m)$, then let $S_t\left(\tilde{t}\right)$ be the resulting SSR (computed by substituting $\hat{a}\left(\tilde{t}\right)$ and $\hat{g}\left(\tilde{t}\right)$ into equation (7.2)). Our estimated set of breakpoints, $\tilde{t}^* = (t_1^*, \ldots, t_m^*)$ is that which minimises $S_t\left(\tilde{t}\right)$ over all admissible sets of partitions:

$$(t_1^*, \ldots, t_m^*) = argmin_{t_1,\ldots,t_m} S\left(t_1, \ldots, t_m\right) \tag{7.3}$$

The coefficient estimates are then those arising from the estimation using partition $\tilde{t}^*$, $\hat{a}\left(\tilde{t}^*\right)$ and $\hat{g}\left(\tilde{t}^*\right)$.

Because this is a discrete time problem there are a finite number of partitions; one could therefore carry out the procedure for all possible partitions and find the optimal breakpoints and coefficients. For $m > 2$ this becomes unwieldy. Bai and Perron propose an efficient dynamic programming algorithm to do the job (Bai and Perron, 2003). The optimal partition or set of breakpoints is the solution to the recursive problem given below:

$$SSR^*\left(\{T_{m,T}\}\right) = \min_j \left[SSR^*\left(\{T_{m-1,j}\}\right) + SSR\left(j+1, T\right)\right] \tag{7.4}$$

where $SSR^{*}\left(\{T_{r,n}\}\right)$ is the SSR of the optimal partition of the first n observations with r breaks, and $SSR\left(i,j\right)$ is the SSR of the segment running from observation i to j. Thus the minimum SSR for the whole series is the minimum over the first $m-1$ breakpoints plus the minimum for the final regime.

Using this, the problem can be solved recursively. Firstly, in a series of length T there is a finite number of possible segments. In such a series there are T possible segments of length one, $T-1$ possible segments of length two, $T-2$ possible segments of length three and so on until segments of length T of which there is only one possible. Thus the total number of possible segments is $\sum_{i=1}^{T} i = {}^{1}/_{2}T\left(T+1\right)$. In fact the total number of permissible segments is less than this. If we set a minimum break length, h, this excludes a subset of segments; other necessary restrictions reduce the number still further. The overall SSR for some partition of m segments is a linear combination of the sums of squared residuals of the total permissible number of segments, and the estimated breakpoints are those which yield the minimum value of this linear combination.

The dynamic programming method allows us to compare different partitions and linear combinations to minimise the function given in equation (7.4). One begins by setting the minimum break length, h. The next step is to calculate SSRs for one-break partitions for all subsamples with breaks between h and $T-mh$. The next step is to work with two-break partitions and for the possible end dates of these partitions ($3h$ to $T-\left(m-2\right)h$) find which of the earlier one-break partitions minimises the SSR. These steps are repeated recursively until the optimal m-segment partition is generated which is the solution to the problem stated in equation (7.4). This is repeated for different values of m and the optimal number of breakpoints is selected using an Information Criterion.

To estimate the model (equation (5.1)), these procedures were implemented in the `R` programming language using Zeileis *et al.*'s `strucchange` code (Zeileis *et al.*, 2002).

Appendix B: Variables used to construct the broader measure of access

Variables used for the construction of the doorstep and access indices were drawn from the following datasets: the Institutional Profiles Database (IPD) (Crombrugghe *et al.*, 2009); Polity IV (Marshall and Jaggers, 2007); World Bank Worldwide Governance Indicators (WGI) (Kaufmann *et al.*, 2009); World Bank Doing Business Database (World Bank, 2010); Freedom House Freedom in the World Survey (Freedom House, 2011); Center for Systemic Peace: Coup d'Etat Events dataset (Marshall and Marshall, 2010); Center for Systemic Peace: Major Episodes of Political Violence dataset (Marshall, 2010).

Table 7.1: Variables for Doorstep One index

Variable	Meaning of higher value	Source
XRREG: regulation of executive recruitment, 2007	More regulation	Polity IV
XCONST: constraints on the executive, 2007	More constraints	Polity IV
PARREG: regulation of political participation, 2007	More regulation	Polity IV
RLAW: rule of law, 2007	Stronger rule	WGI
CCOST: cost of contract enforcement, 2007	Higher cost	WB DB
JUSTIND: independence of justice system from government, 2009	More independence	IPD
LEGPROP: legal measures to defend private property rights, 2009	More measures	IPD
CONTWR: respect for written contracts, 2009	More respect	IPD
ENFCO: enforcement of commercial court rulings, 2009	Tighter enforcement	IPD
GOVCO: government termination of contracts without compensation, 2009	Rarer termination	IPD

Table 7.2: Variables for Doorstep Two index

Variable	Meaning of higher values	Source
DURABLE: durability of the polity, 2007	More years since most recent "regime change" defined as a three-point change in *POLITY* score in three years or less	Polity IV
PERSIST: persistence of the polity, 2007	More years with no change in the six component variables	Polity IV
STARTCOST: Cost of starting a business, 2007	Higher cost in % income per person	WB DB
EXRULES: Have executive selection rules changed in last three years, 2009	Rules have not greatly changed in last three years to bolster incumbent's position	IPD
PARTAC: Political parties acceptance of senior government, 2009 changes	More acceptance	IPD
PARTAU: Political party operating autonomy, 2009	More autonomy	IPD
CORPAU: Corporation operating autonomy, 2009	More autonomy	IPD
PARTNEW: possibility of creating new political parties (except by current authorities), 2009	Greater possibility of creation	IPD
CORPNEW: possibility of creating new corporations (except by current authorities), 2009	Greater possibility of creation	IPD
BUSLOC: ease of setting up a local business, 2009	Easier establishment	IPD
ADENTRY: administrative barriers to market entry for new firms, 2009	Less barriers	IPD
POLPLU: political pluralism and participation - can people organise in political groupings/parties and does system allow groupings to operate? 2009	More participation	FIW
ASSRIG: Associational rights - is there freedom for NGOs, unions, professional organisations? 2009	0-12, higher=more rights	FIW
PERSAU: personal autonomy and individuals - can citizens set up businesses and operate them freely? 2009	1-15, higher=more autonomy	FIW

Table 7.3: Variables for Doorstep Three index

Variable	Meaning of higher values	Source
POLFORCE: political authority control over legal armed forces, 2009	More control	IPD
PUBSEC: domestic public security, 2009	More security	IPD
COUP: coup in last five years, 2009	Dummy: 1=coup in last five years	Derived from Coup d'Etat dataset
VIOL: civil or ethnic violence or war in last 5 years, 2008	Dummy: 1=violence in last five years	Derived from Major Episodes of Political Violence dataset
EXECMIL: chief executive is military officer, 2007	Dummy: 1=is a military officer	DPI
DEFMIL: defence minister is military officer, 2007	Dummy: 1=is a military officer	DPI

References

Acemoglu, D. and Robinson, J. (2006) *Economic Origins of Dictatorship and Democracy*. Cambridge University Press.

Andersen, T. and Sorensen, B. (1996) "GMM Estimation of a Stochastic Volatility Model: A Monte Carlo Study." *Journal of Business and Economic Statistics*, 14(3): 328–352.

Arellano, M. and Bond, S. (1991) "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies*, 58(2): 277–298.

Arellano, M. and Bover, O. (1995) "Another Look at the Instrumental Estimation of Error-Components Models." *Journal of Econometrics*, 68(1): 29–51.

Bai, J. and Perron, P. (1998) "Estimating and Testing Linear Models with Multiple Structural Changes." *Econometrica*, 66(1): 47–78.

Bai, J. and Perron, P. (2003) "Computation and Analysis of Multiple Structural Change Models." *Journal of Applied Econometrics*, 18(1): 1–22.

Bhagwati, J. (1982) "Directly Unproductive, Profit-seeking (DUP) Activities." *Journal of Political Economy*, 90(5): 988–1002.

Blundell, R. and Bond, S. (1998) "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models." *Journal of Econometrics*, 87(1): 115–143.

Bowsher, C. (2002) "On Testing Overidentifying Restrictions in Dynamic Panel Data Models." *Economics Letters*, 77(2): 211–220.

Clark, G. (1996) "The Political Foundations of Modern Economic Growth: England 1540-1800." *Journal of Interdisciplinary History*, 26(4): 563–588.

Clark, G. (2001) "Markets and Economic Growth: The Grain Market of Medieval England." Department of Economics, University of California, Davis.

Crombrugghe, D., Farla, K., Meisel, N., Neubourg, C., Ould Aoudia, J. and Szirmai, A. (2009) "Institutional Profiles Database III: Presentation of the Institutional Profiles Database 2009." Direction Generale du Tresor et de la Politique Economique.

Cuberes, D. and Jerzmanowski, M. (2009) "Democracy, Diversification and Growth Reversals." *Economic Journal*, 119(540): 1270–1302.

Eckstein, H. and Gurr, T. (1975) *Patterns of Authority: A Structural Basis for Political Inquiry*. Wiley.

Freedom House (2011) *Freedom in the World*.

Greif, A. (2000) "The Fundamental Problem of Exchange: A Research Agenda in Historical Institutional Analysis." *European Review of Economic History*, 4(3): 251–284.

Hausmann, R., Rodriguez, F. and Wagner, R. (2006) "Growth Collapses." *Center for International Development Working Paper*, 136.

Holtz-Eakin, D. and Newey, H. (1988) "Estimating Vector Autoregressions with Panel Data." *Econometrica*, 56(6): 1371–1395.

Jones, B. and Olken, B. (2008) "The Anatomy of Start-Stop Growth." *Review of Economic and Statistics*, 90(3): 582–587.

Kaufmann, D., Kraay, A. and Mastruzzi, M. (2009) "Governance Matters VIII: Aggregate and Individual Governance Indicators 1996-2008." *World Bank Policy Research Working Paper*, 4978.

Kishtainy, N. (2011) "Measuring Social Orders." Department of Economics, University of Warwick.

Krueger, A. (1974) "The Political Economy of the Rent-Seeking Society." *American Economic Review*, 64(3): 291–303.

Lindert, P. (2004) *Growing Public: Social Spending and Economic Growth Since the Eighteenth Century*. Cambridge University Press.

Marshall, M. (2010) *Major Episodes of Political Violence (MEPV) and Conflict Regions, 1946-2008*. Center for Systemic Peace.

Marshall, M. and Jaggers, K. (2007) *Polity IV Project: Political Regime Characteristics and Transitions, 1800-2006*. Center for Systemic Peace.

Marshall, M. and Marshall, D. (2010) *Coup d'Etat Events, 1946-2009*. Center for Systemic Peace.

McGuire, M. and Olson, M. (1996) "The Economics of Autocracy and Majority Rule: The Invisible Hand and the Use of Force." *Journal of Economic Literature*, 34(1): 72–96.

North, D., Wallis, J. and Weingast, B. (2009) *Violence and Social Orders: A Conceptual Framework for Interpreting Recorded Human History*. Cambridge University Press. 2009.

Olson, M. (1993) "Dictatorship, Democracy and Development." *American Political Science Review*, 87(3): 567–576.

Pritchett, L. (2000) "Understanding Patterns of Economic Growth: Searching for Hills among Plateaus, Mountains and Plains." *World Bank Econonic Review*, 14(2): 221–250.

Rodrik, D. (1999) "Where Did All the Growth Go? External Shocks, Social Conflict and Growth Collapses." *Journal of Economic Growth*, 4(4): 385–412.

Rodrik, D. (2000) "Participatory Politics, Social Cooperation and Economic Stability." *American Economic Review*, 90(2): 140–144.

Roodman, D. (2009) "How to do `xtabond2`: An Introduction to 'Difference' and 'System' GMM in Stata." *Stata Journal*, 9(1): 86–136.

World Bank (2010) *Doing Business 2011: Making a Difference for Entrepreneurs*.

Zeileis, A., Leisch, F., Hornik, K. and Kleiber, C. (2002) "`strucchange`: An `R` package for testing for structural change in linear regression models." *Journal of Statistical Software*, 7(2): 1–38.