Does Human Generate Social and Institutional Capital? Exploring Evidence From Time Series Data in a Middle Income Country

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Abstract

ABSTRACT: This paper presents an analysis of the interaction of human capital investment and the development of social and political institutions. We find that human capital matters - for growth through its quality dimension; for distributional conflict by raising political aspirations. But human capital does not stand alone either. The level of economic development (output) matters, distributional (instability) conflict as well as the rights dispensation can come to influence human capital investment decisions in their own right. Social, human capital, political as well as economic dimensions are densely interwoven in webs of association.

KEYWORDS: Human capital investment, fractionalization, social and political dimensions of economic growth, South Africa

JEL Classification: O4,O1,12,Z13

1.   Introduction: Theoretical Priors

The departure point of the present paper is that time series data from South Africa permits of the exploration of a number of new forms of interaction between social and institutional variables, and a range of distinct measures of human capital creation. In the subsections that follow, we explore the data for the nature such associations might take. Before we embark on the exploratory data analysis, we begin with the postulation of a number of theoretical possibilities concerning the association between human capital and social and institutional structures.

The now large literature on economic growth has already come to establish the possibility of an impact of institutions and social capital on long term economic development.[1] Formulations have been both

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[1] A review can be found in Fedderke (1997).

self-consciously empirical,[2] explicitly theoretical,[3] or a combination of the two.[4] Motivation for the inclusion of a wide range of institutional and social capital measures ranges from the need to control for property rights,[5] to control for the lack of discretionary power on the part of the state,[6] the predictability of the investment environment,[7] the lowering of transactions costs in exchange transactions through both formal property rights and informal social capital structures,[8] the impact of distributional conflict mobilized along ethnic lines,[9] direct disruptive impacts of political instability, [10]and various invocations of modernization theory.[11]

Similarly the introduction of human capital as a driver of economic growth is well established in the literature.[12] The impact of human capital is introduced directly into the production function, [13]indirectly as a spill-over from the process of investment in physical capital[14] and from direct Schumpeterian human capital investment in innovation.[15]

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[2]See for instance the standard citation provided by Barro (1991).

[3]See for instance Alesina et al (2002).

[4]Such as in Easterly and Levine (1997) and Rodrik, Subramanian and Trebbi, 2004.

[5]See North & Thomas (1973, 1973), North (1981, 1990), and Scully (1988, 1992) by way of example.

[6]See Borner et al (1995).

[7]See Dixit and Pindyck (1994), and the specific application in Fielding (1997) and Fedderke (2004) to South Africa.

[8]See Coleman (1988, 1990), Fukuyama (1995a, 1995b), and Fedderke, De Kadt and Luiz (1999).

[9]See Easterly and Levine (1997), Alesina and Perotti (1993) Deutsch (1961) and Persson and Tabellini (1994).

[10]See the discussions in Alesina and Perotti (1993), Barro (1991), Edwards and Tabellini (1991), Londregan and Poole (1990), Knack and Keefer (1995) and Venieris and Gupta (1986).

[11]Typically Lipset (1959).

[12]For a comprehensive overview see Fedderke (2002).

[13]As in Lucas (1988), and alternatively Mankiw, Romer and Weil (1992).

[14]As in Arrow (1962), Romer (1986).

[15]See Romer (1990), Grossman and Helpman (1991) and Aghion and Howitt (1992).

The introduction of a range of indicators that cover human capital formation, as well as social, institutional even political dimensions raises a concern that has now often been voiced in the literature surrounding economic growth. The presence of such a wide range of indicators introduces the possibility of complex forms of associations not only between the outcome variable and the intended drivers of the outcome variables, but amongst the drivers themselves. This is in addition to the standard difficulty of potential feedback effects from the economic development indicators to institutional, political and social dimensions. Examples are provided by Fedderke and Klitgaard (1998) on the basis of empirical evidence. Alesina et al (2002) provide additional evidence and theoretical deliberation. In Fedderke, Luiz and De Kadt (2004) we provide an extensive investigation of the impact webs of associations between institutional, social and political dimensions might have, employing time series data for South Africa.

For instance, suppose the presumption (based on the range of literature cited above) is that:

$$Y = F(K, L, R, H) \tag{1}$$

where Y denotes output, K physical and H human capital, L labour input, and R an institutional dimension.

It is also feasible that institutions are not independent of the level of economic development (the modernization hypothesis),[16] nor of the

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[16]Deutsch (1961: 78) defined modernisation as

the process in which major clusters of old social, economic, and psychological commitments are eroded or broken and people become available for new patterns of socialisation and behaviour ... away from a life of isolation, traditionalism and political apathy, and ... into a different life of broader and deeper involvement in the vast complexities of modern life, including potential and actual involvement in mass politics.

It was expected that socio-economic progress would promote educational attainment by the population at large, which would further understanding of political issues and increase their expectations for political participation and civil liberties. This, in turn, would be strengthened by the increasing availability and pervasiveness of the mass media, as information technology becomes more accessible to

state of human capital. Increases in the human capital stock may well generate increased demands for political self-expression, or improve the understanding of any disempowered portions of the population of how to organize in support of their interests (Fukuyama, 1992: 116, Deutsch, 1961, Apter, 1968, Neubauer, 1967).The consequence may well be both an increase in political instability, a decrease or an increase in political rights or no change at all in rights (depending on whether ruling elites respond by attempting to repress or coerce dissent). But the educational system may also carry direct homogenizing consequences for social dimensions such as the linguistic diversity of the population, or, depending on the nature of the educational system, on religious diversity (think of any one of a number of theocratic states) (Fukuyama, 1992: 46).

Nor for that matter is it implausible that the state of institutions can come to influence human capital. In Fedderke and Luiz (2002) we showed that school performance for the African population in South Africa was strongly determined by the level of political instability (amongst other things). Given that the school population was intimately involved in the opposition to Apartheid, with a substantial part of the African National Congress' strategy relying on the mobilization of school populations, this is not an implausible finding. But the point surely generalizes beyond the South African experience. One possibility is that democracy leads to a greater recognition of the demands for the human capital required to succeed in the labour market. But autocratic political dispensations might also be more able to ensure the social savings required to generate the resources required for the production of good quality human capital. Certainly both Putnam (1993, 1995) and Fukuyama (1995) suggest the possibility of a link between social and human capital. Indeed, the original introduction of social capital was precisely in relation to the generation of human cap-

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all. Increasing prosperity would also lead to the expansion and mobilisation of disadvantaged sections of society. All these factors would culminate in a revolt against the political status quo controlled by the traditional elites, in favour of competition for political power.

ital in inner city neighborhoods (see Coleman 1988). The empirical findings of Glaeser et al (2004), echoing the theoretical propositions advanced by Djankov et al (2003), confirm that both the institutional and productive capacities of societies are shaped by human and social capital endowments.

Thus the suggestion is that equation 1 might be supplemented by:

$$R = G(Y, H) \tag{2}$$

$$H = H(Y, R) \tag{3}$$

At least to the extent that such relations should be tested for.

There is a second order concern here. The general suggestion that human capital might drive both output and the state of institutions, and might itself be influenced by the level of economic resources and the state of institutions sounds plausible. But it also leaves a substantial part of the question begging.

Which institutions, how, at what stage of economic development, for what types of human capital, are all questions that immediately spring to mind. The questions extend to both the institutional and the human capital dimensions. In terms of rights, for instance, political and property rights might come to impact on human capital formation both to a different degree, and might impact on different types of human capital formation, different levels of human capital formation (primary vs. secondary vs. tertiary), or on the quality as opposed to the quantity of human capital. Given the diversity of institutional dimensions now available, the difficulty for the empirical researcher is generally that theoretical guidance is absent. The approach we adopt in the present paper is therefore one of exploring extensively what patterns of association emerge from the data.

Since the intention in the present paper is to have a wide coverage of institutional and human capital measures, in a context that allows for the exploration of directions of "causation," and in the presence of wide variances in the dimensions being measured, South Africa offers itself as an interesting case study. For South Africa we have a wide

range of measures of the institutional environment. These include political rights, property rights, racial, linguistic and religious fractionation, political fractionation, and political instability.[17] The same can be said for human capital measures, which cover the quantity of human capital output (as measured by school enrolment rates - for the total population, as well as the principal racial categories - and total degrees issued by universities), proxies for the quality of human capital produced (the proportion of school matriculants sitting for mathematics in their standardized exit examinations; the proportion of total degrees in the natural, engineering and mathematical sciences), the level of inputs into the educational system (pupil-teacher ratios, real per-pupil expenditure), proxies for throughput rates of the educational system (the proportion of the pupil population graduating), as well as the quantity of "applied" training output (apprenticeships).[18]

Such data is available over long time runs in South Africa: covering the 1917 -1997 period. The interaction between such variables is thus able to be explored in a time series context - including testing for the direction of association between variables.

Finally, what renders South Africa particularly interesting is that in both institutional and human capital dimensions variation is large by any standards. Political instability has varied from virtual complete stability to periods of intense and sustained instability. Rights similarly have varied substantially over time - see the extensive discussion in Fedderke, De Kadt and Luiz (2000). In Fedderke, Luiz and De Kadt (2004) we demonstrate that even in the case of the fractionation indexes (linguistic, religious, racial) South Africa shows often strong changes over the course of the twentieth century. Given the Apartheid discrimination between racial groups, human capital production in South Africa has similarly varied from first to typically third world standards - see the extensive discussion in Fedderke, De Kadt and Luiz (1999, 2003).

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[17]See Feddderke, De Kadt and Luiz (2001) and Feddderke, Luiz and De Kadt (2004).

[18]See Fedderke, De Kadt and Luiz (2000, 2003).

The case lends itself to the exploration of interactions between social, political and economic dimensions of development. In part to understand South Africa itself - but above all to shed light on the interaction of these three dimensions by utilizing the evidence that only longitudinal data can provide, in order to draw general inferences on the institutional determinants of economic growth.

Section 2 of the paper begins the exploration of the possible interaction between human capital formation, social, political and institutional variables, as well as a range of indicators of economic development. Section 3 reports the impact of human capital formation on social, political and institutional variables (SPIVs). Section 4 investigates the nature of the impact of human capital on economic growth. Section 5 establishes what impact social, political and institutional variables have on human capital investment. Section 6 presents structural equation results, and section 7 concludes.

2.   Patterns of Association

Since the core questions in this paper relate to the nature of association between variables in a wide range of dimensions, in a context that is poorly theorized, we begin by an extensive exploration of the bivariate structure of interaction between variables included in this study. We provide a guide to the variables used, and the source of the data employed in Appendix A.

In order to explore the directions of association between the variables included in this study, we consider the use of the test statistic proposed by Pesaran, Shin and Smith (1996, 2001) (hereafter PSS) F-statistics.[19] We report the resultant F-statistics in Table I and Table

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[19]See also the discussion in Pesaran (1997) and Pesaran and Shin (1995a, 1995b) and Pesaran, Shin and Smith (2001). Suppose that the question is whether there exists a long run relationship between the set of variables $y_t, x_{1,t...}x_{n,t}$. Univariate time series characteristics of the data are not known for certain. The PSS approach to testing for the presence of a long run relationship proceeds by estimating the error correction specification given by:

II. [20] A number of distinct patterns emerge from the data:

- A relatively large number of human capital variables exercise an impact on the SPIV-variables

- A relatively small number of SPIV-variables exercise an impact on the human capital variables.

- Core features of the impact of the human capital variables on the SPIV-variables are: [21]

    1. − Linguistic fractionation is driven by virtually all human capital measures employed in this study.

$$\Delta y_t = a_0 + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + \sum_{j=1}^{n} \sum_{i=1}^{p} \gamma_{j,i} \Delta x_{j,t-i} +$$
$$\left(\delta_1 y_{t-1} + \sum_{k=2}^{n+1} \delta_k x_{k,t-1} \right) + \varepsilon_t$$

The test proceeds by computing the standard F-statistic for the joint significance of $\delta_1 = \delta_2 = \ldots = \delta_{n+1} = 0$, under all feasible alternative LHS variables. While the distribution of the test statistic is non-standard, with $x_{i,t} \sim I(0) \forall i$ providing a lower bound value, $x_{i,t} \sim I(1) \forall i$ an upper bound value to the test statistic. The test is analogous to a Granger causality test, but in the presence of non-stationary data. This renders the PSS F-test suitable in the current context.

[20] Appendix B reports the univariate time series characteristics of the data. In Fedderke, Luiz and De Kadt (2004), we examine the implications of conducting estimations in the light of the full information on the order of integration of the data. The PSS ARDL cointegration estimation technique employed below, is considered robust to differences in the order of integration of the data - see the discussion in Pesaran (1997) and Pesaran, Shin and Smith (1995a,b, 1996). Nevertheless, readers should note that results can prove sensitive to data transformation - as demonstrated in Fedderke, Luiz and De Kadt (2004).

[21] We also found an impact of white real per capita expenditure on political rights, and from school enrollment rates on property rights.

- – Political instability is driven by a range of human capital measures. [22]

- – Growth is also driven by a wide range of human capital measures.[23]

- Core features of the impact of the SPIV- and economic variables on the human capital-variables are: [24]

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    - ∗ Enrolment rates in schooling are driven by the real GDP, capital stock measures, and political rights.

    - ∗ Tertiary educational output (total degrees as well as math and science proportions) appears to be driven by political instability, property rights and real GDP, and some (racial and religious) fractionalization measures.

    - ∗ The proportion of matriculants sitting mathematics is driven by political instability and growth.

In what follows we explore these potential patterns of association between the variables further. We employ the ARDL cointegration

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[22]These include school enrolment rates, measures of inputs into the schooling production function (pupil-teacher ratios, real per capita expenditure), measures of schooling throughput (proportion of pupils in matriculation), and both quantity (total degrees) and quality (proportion of NES degrees) measures of tertiary education.

[23]These include school enrolment rates, measures of school quality (maths proportions), measures of inputs into the schooling production function (pupil-teacher ratios, real rep capita expenditure), measures of schooling throughput (proportion of pupils in matriculation), and both quantity (total degrees) and quality (proportion of NES degrees) measures of tertiary education.

[24]We also find evidence suggesting that the number of apprenticeship contracts is driven by the real capital stock; that pupil-teacher ratios are driven by religious and political fractionation; matriculation pass rates are driven by religious, political and linguistic fractionation; real per pupil expenditure is driven by the real capital stock, political instability and linguistic fractionation measures.

estimation techniques proposed by Pesaran (1997), Pesaran and Shin (1995a,b, 1996), and Pesaran, Shin and Smith (1996, 2001). We employ the structure provided by the evidence to emerge from the F-tests and commented on above.

3.   The Impact of Human Capital Formation on SPIV's

To explore the patterns of association between the variables suggested by the PSS F-tests further, we estimated the suggested associations by means of ARDL cointegration techniques. The starting point of the analysis is bivariate. Summary reports are provided in the form of diagrammatic representations of the results for each of the structural divisions dealt with below. We report only statistically significant results, unless otherwise indicated.[25]

The impact of human capital on the SPIV variables of this study is pervasive, multi-dimensional, multi-layered and narrowly focused. What we mean by this apparently contradictory statement is that human capital impacts on the SPIV's, but through very specific channels in the sense of affecting only a few of the SPIV measures. However, where human capital does impact on SPIV's, we find that the impact is pervasive in that a relatively large number of the human capital measures impact on the SPIV. The impact also tends to be multidimensional in the sense that quality and quantity dimensions of human capital formation will impact on the SPIV, and multi-layered since schooling, tertiary and practical human capital formation comes to exercise an impact.

The two main channels through which human capital impacts on social and political dimensions is through its impact on linguistic fractionation, and through its impact on political instability. In the case of linguistic fractionation, we find results that are broadly consistent with the modernization hypothesis. In the case of political instability, human capital formation appears to fuel political aspirations.

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[25]Detailed results in tabular form are available from the authors on request.

The only remaining statistically significant impacts of human capital on the SPIV's are restricted to the political and property rights dimensions. Schooling inputs in the form of real per pupil expenditure in white schooling exercises a positive impact on political rights. A finding that might be considered to be consistent with a modernization process akin to that found for linguistic fractionation (for details see below). In the case of property rights, we find both total and black school enrolment to be positively associated with property rights - again a finding consistent with rising aspirations under conditions of increased access to human capital.

We therefore focus our discussion on the two main channels through which human capital formation appears to function: linguistic fractionation and political instability.

4.   The Impact of Human Capital Formation on Linguistic Fractionation

Human capital formation in South Africa appears to have had a pervasive impact on linguistic fractionalization over the twentieth century.

This general finding is not surprising. A schooling system which maintains a systematic language policy, and which is in any degree inclusive of succeeding generations of scholars, is likely to exercise an influence on the language of first preference of households.

But there are additional plausible influences on linguistic preferences of households also. The language of commerce and industry in South Africa has predominantly been English. In addition, under the Apartheid dispensations policy orientation strongly favoured Afrikaans. As a consequence there were strong incentives for all population groups to acquire either English or Afrikaans or both as working languages [26] - with the consequence that at least some households con-

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[26]Afrikaans remains the most widely understood language across all population groups, with 46% of the population understanding Afrikaans, 43% English, and 22% Zulu - see Shuring (1991:640). Though the top three ranking first languages

ceivably switched from other languages to the working languages as the language of first use.

Within these general insights, there is important nuance to be found in the empirical evidence. Figure 1 provides a summary of the estimation results.

Core findings to emerge are as follows:

- The *quantity* of schooling, as measured by school enrolment rates, appears to have served the function of *integrating* the diverse linguistic groups during the twentieth century. As already suggested, the presence of language policies that emphasized English and Afrikaans, with other languages being relegated to third language status, renders this finding plausible. School throughput (as measured by the proportion of the school population matriculating) exercises the same impact under conditions broadening access to schooling for blacks. [27]

- The *quality* of education - as measured by the proportion of matriculants sitting mathematics and the matriculation pass rate in the part of the schooling system that received the strongest financial and teaching support (white schooling) - appears to afford the opportunity of greater linguistic fractionation. One explanation of this finding, is that better schooling systems can support more differentiated linguistic instruction (white schooling had very diverse third language choices available), and hence perpetuate linguistic diversity. The proportion of matriculants sitting mathematics has been in steady decline[28] - a trend mirrored in the range of third language instruction [29] - providing a

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of households remain Zulu, Xhosa, and Afrikaans - see Race Relations (2003).

[27]Fedderke et al (2000) provides an extensive discussion of the South African schooling human capital indicators employed in the present study, and how they relate to the quantity, quality, and policy environment.

[28]See the extensive discussion in Fedderke et al (2000).

[29]See for instance Mesthrie (1993), and the discussions in Mesthrie (2002).

suggestive indication that the link from the quality of the schooling system, to the range of linguistic instruction to final household linguistic fractionation may well be operative for South Africa.

- The *inputs* into schooling, as measured by pupil-teacher ratios and real per pupil expenditures, can either serve to raise or lower linguistic fractionation. White measures are positively related to linguistic fractionation, black measures are negatively related. The implication is twofold. Most significantly, policy orientation in schooling carries implications for linguistic fractionation. White schooling policy in South Africa emphasized quality and afforded wide choice, though it was expensive to maintain.[30] Thus linguistic diversity was fostered in the presence of good resourcing in white schooling. In effect, sound quality of schooling for whites allowed immigrant populations to maintain their linguistic provenance. By contrast under Apartheid in black schooling policy did not emphasize quality, but focused on broadening access instead. In addition, incentives for the black population wishing to gain access to the languages of industry and administration were to acquire the relevant working languages. Improved inputs here thus plausibly had the effect of improving integration. Moreover, the formal educational system may have played a role in systematizing African languages over time, with the result that regional differentiation would have diminished over time - much as in Europe for instance.[31]

- While our discussion has focused on the schooling system, we note that the conclusions generalize to the tertiary education system also. Both the quantity and the quality points are found for the university system also, with the total *number* of degrees (as proxy for the quantity dimension) serving to lower linguistic

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[30]See again the discussion in Fedderke et al (2000).

[31]Examples from Germany, France, Italy and the UK spring to mind. See the discussion in Anderson (1983) and Weber (1979).

fractionation, while the *proportion* of NES degrees (as proxy for the quality dimension) increases linguistic fractionation.[32]

- The point even extends to the practical training afforded by apprenticeship contracts. An increase in the quantity of apprenticeship training, lowers linguistic fractionation.

A number of general points bear noting about this evidence. *First,* note that public education policies are able to exercise an influence on a social dimension traditionally thought of as substantially immutable (viz. for instance linguistic fractionation). *Second,* incentives faced by social agents may also come to influence linguistic fractionation substantially over time. *Third,* the impact of human capital formation on linguistic fractionation is exercised across a wide range of different dimensions of human capital formation (quality vs. quantity), and across a wide range of levels of human capital formation (schooling vs. tertiary vs. practical training). *Finally,* and perhaps surprisingly, linguistic fractionation shows little signs of itself coming to influence human capital formation (see the discussion in section 5 below) - at least in South Africa.

In broad terms, the evidence might be deemed consistent with the modernization hypothesis, though the quality dimension adds nuance. Those population groups most engaged in a process of economic "modernization," (in the sense of entering formal labour market structures often explicitly denied them) are those that have employed human capital formation in a process of social inclusion and integration. The educational and economic elites by contrast have deployed human capital formation as part of its consumption opportunities - emphasizing the possibility of linguistic diversity, since they were already economically and socially integrated and privileged.

These conclusions prove to be robust to the extension of estimation to a multivariate framework. In order to extend the analysis to

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[32] See Fedderke et al (2003) on the extensive presentation of the data, and its relation to the quantity, quality and policy of tertiary education

a multivariate framework, we employ the ARDL cointegration estimation framework of Pesaran and Shin (1995a,b) and Pesaran, Shin and Smith (2001), since this estimation method is more robust to differences in the order of integration across variables than the Johansen VECM framework, which requires all variables to be vI(1).[33] In columns 1 and 2 of Table III we report the estimation of a relationship which controls for the quantity of human capital formation (by either total or black school enrolment rates), for the quality of human capital formation (by the proportion of NES degrees, and the proportion of white matriculants sitting mathematics),[34] as well as real per pupil expenditure in black schools.

The findings remain consistent with those that we obtained for the simple bivariate associations reported above - and the error correction mechanisms confirm the presence of an equilibrium relationship. The measures associated with the quantity and expenditure of schooling for blacks consistently serve to lower linguistic fractionation. The measures associated with the quality of schooling, allow for greater linguistic diversity.

The conclusion remains: human capital formation can change the degree of linguistic fractionation. And the nature of human capital formation can profoundly influence the nature of such change, with the primary distinction being between quantity and quality of human capital formation.

Linguistic fractionation is therefore less fixed than it is often held to be, and human capital policies and incentives move linguistic characteristics of society potentially dramatically.[35]

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[33]See Johansen (1988) and Johansen and Juselius (1990, 1992).

[34]Mathematics in the white schooling system would constitute the most demanding instruction in the best part of South African schooling - and hence serve as proxy for schooling quality.

[35]The example of Asian linguistic fractionation in South Africa that we explore in greater detail in Fedderke, Luiz and De Kadt (2004) provides a dramatic illustration of this finding.

5.   The Impact of Human Capital Formation on Political Instability

Human capital formation in South Africa also appears to have had a substantial influence on the level of political instability in South Africa. Again, the impact of human capital is found to emerge from across a range of human capital dimensions (both quantity and quality measures), and across a range of levels of human capital (schooling vs. tertiary).

The general findings to emerge are really two-fold.

First, access to human capital by marginalized and oppressed social groupings appears to have served to raise political aspirations in South Africa, fuelling demands for change, and hence political instability. [36]

Second, for economic and social elites the effect of increased and improved access to human capital raises the cost of conflict. The incentives become either to search for a resolution to conflict, or to move to draconian forms of political repression - in short, to limit the extent of political conflict. [37]

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[36] Indeed black schooling in South Africa became one of the focal points of popular uprisings by the marginalized against the apartheid system (Wilson and Ramphele, 1989: 340, Bonner et al, 1993). The 1976 Soweto uprisings represents one of the most vivid examples of political instability associated with the black schooling system but in fact this resistance was continuous at black schools. The schooling system provided a fertile ground for this mobilization and unrest because education liberates people from 'prejudices and traditional forms of authority. Education also makes people demand more of themselves and for themselves' (Fukuyama, 1992: 116).

[37] For example, Lipton (1985: 227) states that by the early 1970s, there was a 'growing convergence of views among capitalists about the rising costs and inconvenience of apartheid.' Furthermore, the increasing international hostility towards apartheid posed a threat to the external economic interests of capitalists. The apartheid state came under increasing challenge in the 1980s, as South African society became increasingly mobilised. Du Toit (1995: 348-350) asserts that the state's response to this defiance was initially to embark on 'reform apartheid' in the 1970s and early 1980s, and later turn to the counter-revolutionary 'total strategy' offensive. The constitutional reforms of the former strategy were visible in the Tricameral Parliament (1984) and the Regional Services Councils (1985). The

Detailed results are depicted in Figure II. In particular, we find that:

- The *quantity* of both schooling and tertiary education (measured by school enrolment rates and total and NES degrees), appears to have served the function of *increasing* the level of political instability over the sample period. School throughput (measured by the proportion of the school population matriculating) exercises the same impact. Since the sample period was one of broadening access to schooling for blacks, the throughput measure may well be capturing the same information as the direct quantity measures.

- The *quality* of education appears to have little impact on the level of political instability. The only exception is at the tertiary level and is given by the proportion of NES degrees, which is negatively associated with political instability.

- The impact of *inputs* into schooling differs between white and black schooling. Increasing black per capita expenditure has a positive impact on political instability, providing an interpretation consistent with that reached on the quantity of human capital formation: increased access to human capital stimulates aspirations for access to political power. Only the pupil-teacher ratio proves significant for white schooling - with a higher pupil-teacher ratio associated with higher instability. Our interpretation of the finding is that this association is an indirect reflection of the impact of Apartheid distributional policies on the political process. The white pupil-teacher ratio declined consistently since the 1950's - reflecting the level of resourcing devoted to

intention was to co-opt sections of the population into the formal political process, but to do so in such a way that they would be unable to determine the course of decisions. To placate civil bodies, various forms of petty apartheid were eased (for example, the deracialisation of public facilities).

white schooling. It thus directly reflects the injustice of the policy, and it is not surprising that declining white pupil teacher ratios (with the implied resourcing effects) should trigger greater agitation for political transformation on the part of the majority of the population.[38] It might also suggest that the white elite in South Africa had an increasing incentive to damp political conflict - either by recourse to ever increasing repression (further stimulating opposition), or finally by reaching a political accommodation.

The first general point we drew at the outset of this subsection follows readily from the specific evidence. Greater access to human capital creation uniformly appears to have fuelled the political aspirations of the black population - with the consequence that political instability increased. All of the statistically significant measures of human capital creation for the black population carries this inference.

The second general finding is more tentative, and we postulate it hypothetically. The possibility really arises from the finding on white pupil-teacher ratios and to some extent on the NES degree proportion.[39] With a rising investment in the human capital stock of an elite (NES degree proportions), and a rising investment in the means of delivery of such an investment (pupil-teacher ratios), the elite has an incentive to defend that investment through increased repression. The result is likely to be greater pressure for reform by the excluded, triggering yet further repressive responses. The result may be an upward ratcheting of political instability and human capital privilege of the sort that was witnessed in South Africa under Apartheid. At least up to the point where the cost of the conflict outweighs the cost

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[38]Note that the black pupil-teacher ratio carries the reverse sign to that on white schooling - consistent with our interpretation. It is insignificant - perhaps due to the shorter sample period for which reliable data is available for black schooling.

[39]The latter measure does capture the training of a social elite, which was predominantly white over the sample period of the study - though not entirely so. As a consequence the interpretation presented follows for this variable in overwhelming though not perfect extent.

of political accommodation for the elite - at which point democratic transformation may follow. The South African experience is suggestive here.

Again the inferences drawn on the basis of the bivariate data exploration generalize to multivariate estimation contexts. We employ the ARDL cointegration estimation framework suggested by Pesaran et al (2001). Columns 7 and 8 of Table III report the impact of both quantity (either total or black school enrolment rates) and quality (NES degree proportion) measures of human capital on political instability. Variables maintain the signs they established in the bivariate associations, and the error correction mechanism continues to confirm the presence of an equilibrium relationship. Once again, the quantity of schooling proves to have increased the pressure for political transformation in South Africa, while the quality of schooling served to diminish such pressure.

The interpretation provided above, of rising political aspirations with rising access to human capital, and of rising vested interests in maintaining stability with rising quality of human capital thus remains consistent with the multivariate evidence.

We will note in a following subsection that political instability may itself come to influence the nature of human capital formation.[40] But for the moment we note again that human capital creation appears to have notable consequences for the institutional dispensations of a society also.

6.   The Impact of Human Capital Formation on Economic Growth

The possibility of an impact of human capital formation on long run growth has a long history in the literature. Theoretically, human capital exercises its impact as the result of learning spill-overs from direct physical capital investment,[41] through enabling Schum-

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[40]Fedderke and Luiz (2002) explores the point in greater detail.

[41]In the Arrow(1962) and Romer (1986) mold.

peterian innovation, [42] directly through its inclusion in the production function,[43] or directly in a modified Solow-Swan model.[44] For a comprehensive review of the issues see Fedderke (2002).

Empirically, findings on the impact of human capital on growth have been mixed. While one strand of the literature has found support of a positive impact of human capital on growth,[45] dissenting voices have consistently questioned the findings, disputing the strength of the association, the sign of the association, even the plausibility of any relationship being present in the first instance.[46] To the best of our knowledge, evidence on the impact of human capital on South African growth has only received one prior examination. Fedderke (2001) explores the possibility of the Schumpeterian channel of influence on TFP growth. The central finding to emerge is that while quality measures of human capital formation has a positive impact on TFP innovation, quantity measures of have a negative impact.

In the present study we have access to a wide range of human capital measures, covering both quantity and quality dimensions, differing levels of human capital formation (schooling, tertiary and practical), input measures into human capital formation, and throughput rates of human capital production. We therefore briefly explore the possibility of a direct impact of human capital formation on long run growth.

The general findings to emerge are symmetrical to those reported for TFP growth. Once again, *quantity* measures of human capital formation are negatively associated with economic growth, while *quality* measures are positively associated.[47]

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[42] Through increasing the intermediate inputs into production in the Romer (1990) or Grossman and Helpman (1991) formulation, or the quality ladders approach of Aghion and Howitt (1992).

[43] As in Lucas (1988).

[44] As in Mankiw, Romer and Weil (1992).

[45] See for instance Jones (2002).

[46] See Easterly (2001: ch4) and Pritchett, 2001.

[47] In Fedderke et al (2000) we discuss the nature of the apartheid educational system. We show that even in the flagship white education system the emphasis was often on throughput rather than quality. The proportion of white matriculants

Figure III summarizes the findings - recognizing the symmetry of results between the real growth rate, and the real per capita growth rate.

The specific findings are that:

- The *quantity* of both schooling and tertiary education (measured by school enrolment rates and total and NES degrees), is negatively associated with economic growth. School throughput (measured by the proportion of the school population matriculating) exercises the same impact. Since the sample period was one of broadening access to schooling for blacks, the throughput measure may well be capturing the same information as the direct quantity measures. The negative finding on the South African quantity measures of human capital formation may well be explained by the fact that the majority of the schooling system in South Africa was of poor quality. At the same time, a large proportion of GDP was allocated to education (approximately 8% of GDP by the early 1990's - far higher than the average of 4% in upper middle income countries).[48] Thus allocating a significant amount of resources to low quality human capital formation may prove to be a misallocation of resources - with opportunity costs for the formation of other forms of capital in society. The interpretation of the quantity measures of human capital in South Africa, may thus be symmetrical to the interpretation of the quality measures of human capital forma-

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sitting for mathematics fell from 100% in the 1920s to 40% by the 1980s. In the black education system this phenomenon was even more severe. Public black education only started receiving attention from the late 1950s and then the focus was on expanding access to education (widening) to the black masses rather than on building quality (deepening) the education system. It is therefore not surprising that quantity measures show up negatively associated with growth because it was often achieved at the expense of lowering quality.

[48]See the extensive discussion of these points in the context of an educational production function for whites and blacks in South Africa in Fedderke and Luiz (2002).

tion advanced below. Quantity in the absence of quality does not deliver any bang for your buck.[49]

- The *quality* of both schooling and tertiary education (measured by the proportion of matriculants sitting mathematics, and the proportion of NES degrees) has a positive impact on long run growth. The divergent finding is that matriculation pass rates are negatively associated with long run growth.

- The impact of *inputs* into human capital formation differentiates between different parts of the educational system in South Africa. While increased inputs into the black schooling system have a negative impact on growth (measured by real per pupil expenditure), increased inputs into the white schooling system had a positive impact (measured by real per pupil expenditure). In Fedderke et al (2000) we provided detailed evidence of the quality differential between black and white schooling in South Africa. On the evidence the distinction drawn between the two schooling systems was that black schooling provided widened access to low quality schooling, while white schooling provided relatively high quality education - though to a small section of the population. The divergent evidence can thus be interpreted as providing additional support to the distinction between the impact of quantity versus quality of human capital creation on economic growth. The divergent finding is that rising pupil-teacher ratios in white schooling are negatively related to economic growth.

- We note also that the black pupil-teacher ratio and the NES degree proportion both appear to have a positive impact on the real capital stock -though we are unsure of the appropriate interpretation of this finding.

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[49]This is not to say that human capital should not be extended, but rather that it should not be at the expense of quality.

The implication of these findings is immediate. The findings suggest that human capital does matter for growth. But it also matters what form human capital investment takes. Quality matters more than quantity of education - at least for growth purposes. In this sense the findings of the present paper confirm or are consistent with the more elaborate econometric results to emerge from Fedderke (2001) on human capital impacts on TFP growth. Finally, the results serve to provide some insight into why international studies into the impact of human capital on economic development might come to generate divergent findings. Especially in cross-country studies it is difficult to control for differentials in the quality of educational production - rendering results sensitive to country sample selection and potentially the time period of the sample. In general, few of the growth studies that control for human capital differentiate between both quantity and quality of education. Yet the results of the present study suggest that the real purchase of human capital on economic growth emerges precisely from quality rather than quantity of education.

Finally, we note also that the impact of human capital formation on growth does not emerge only from schooling. The impact of human capital formation appears to generalize across different levels of human capital investment. Given that we find the positive impact of human capital formation to emerge from quality, this finding is plausible. Good schooling systems may well depend on good tertiary educational systems, since sound teacher inputs are unlikely to be independent of the tertiary level training the teachers receive. In effect, quality in education may be subject to indivisibilities.

As in the previous subsections, we confirm that these findings extend to multivariate estimation. Utilizing the ARDL cointegration framework of Pesaran et al (2001), columns 3 through 6 of Table III report multivariate specifications for both growth in real GDP and real per capita GDP. We control for both the quantity of human capital formation (by either total or black school enrolment rates), and for the quality of human capital formation (by the proportion of NES degrees, and the proportion of white matriculants sitting mathematics).

Signs remain consistent with the bivariate findings: it is the quality rather than the quantity of human capital formation that is important for growth purposes, and the error correction coefficients confirm the presence of an equilibrium relationship. The only difference in these findings is that the quantity measures prove to be statistically insignificant, rather than negative, where quality of human capital investment is also controlled for. The resource misallocation interpretation suggested above for the negative bivariate associations should thus be treated with caution: but the importance of quality for growth remains a robust finding.

Human capital matters for growth in South Africa. But not just any old human capital. Quality is integral to the growth process - quantity only if it is a vehicle for delivering quality.

7.   The Impact of SPIV's on Human Capital Formation

There are also some potential feedback effects from the SPIV's included in the study to human capital formation. While the impact of human capital on SPIV's appears to be more pervasive, a number of noteworthy patterns plausible on *a priori* grounds emerge from the ARDL cointegration estimations.

First amongst these is a positive impact from the real capital stock and real output measures on the quantity of human capital creation (all of the enrolment rates included in the study), including practical training (apprenticeship contracts), as well as a positive impact from real capital stock on real per pupil expenditure (in white schooling). There are three alternative interpretations of the evidence. The first is a straightforward demand-effect. Growth in the economy as measured by output and capital stock, leads to a spill-over demand effect for increased skills, and hence for schooled or trained labour. The second is as a diversification effect - with the accumulation of capital or wealth, the capital stock of the economy assumes more differentiated formats, with an increased reliance on human capital in addition to physical capital. Finally, note that the evidence is also consistent with

a Romer (1986) learning spill-over type effect, with human capital creation accompanying the investment in physical capital (hence output growth).[50]

Second, there are impacts that reflect the unique history of South Africa, but also highlight that human capital formation can itself come to reflect struggles over the distribution of resources. Thus we find a negative impact of political fractionation on white and black matriculation pass rates and a positive impact on white pupil-teacher ratios. Finally, political instability has a positive impact on black real per pupil expenditure in schooling, and a negative impact on the white mathematics proportion amongst matriculants.

All of these impacts are consistent with the distributional struggles that racially biased policies of the twentieth century generated in South Africa. In South Africa, political fractionation decreased under the Apartheid parliaments, and was higher at other times.[51] The implication here is therefore that under Apartheid (decreased fractionation), white pupil-teacher ratios fell, and matriculation pass rates rose. This confirms the emphasis placed on allocating substantial resources to white human capital formation found by many studies. The improved inputs come to be reflected in an improved performance in the standardized examinations conducted at the conclusion of the matriculation year.

But the improved allocation of resources to whites was not uncontested. In Fedderke, De Kadt and Luiz (2000, 2003) we detail that while the black education system was both poor, and under resourced relative to the white, the 1970's and 1980's saw a widening of access particularly to schooling, but also to tertiary education by blacks - with a related increase in resourcing. The evidence of the present pa-

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[50]The correspondence is not exact. Romer (1986) spill-overs take the form of learing effects amongst the existing labour force, hence generating efficiency gains in production - not a stimulus of human capital investment in formal schooling. However, the existence of learning effects in industry may create a preparatory up-skilling by rational labour suppliers.

[51]See the discussion in Fedderke, De Kadt and Luiz (2001) and Fedderke, Luiz and De Kadt (2004).

per links this process to political instability. The positive impact of political instability on black real per pupil expenditure, and the negative impact on the white mathematics proportion amongst matriculants, suggests that increasing political pressures on the white-dominated state might have generated attempts to buy greater political calm, by increasing the relative allocation of resources to black schooling.

While policy during the twentieth century thus generated a pervasive bias toward allocating increased resources devoted to improving the quality of education for whites, distributional and political struggles did not allow such bias to remain uncontested. Political opposition forced a reaction from the state even under Apartheid policy - with increased resources coming to be allocated to black education over time[52] (though differentials to whites remained large).[53]

Two general points emerge from the present subsection. The first is that we find confirmation for demand- or spill-over type effects in South Africa. Increases in production and/or capital stock appear to generate increases in human capital formation also. Second, distributional conflict associated with social fractionation is not restricted to economic output alone - distributional conflict can extend to the production of human capital also. The point of Easterly and Levine (1997) concerning social fragmentation thus finds general purchase in South Africa.

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[52]Even in the early 1990's, per pupil expenditure on whites was seven times that on black pupils. See Fedderke et al (2000).

[53]There are also a number of additional impacts of SPIV's on human capital creation that we note, but find a little more difficult to place in a wider conceptual framework:

-Both religious fractionation and real GDP have a positive impact on black pupil-teacher ratios.

- Both religious fractionation and racial fractionation have a positive impact on the NES degree proportion.

Given the difficulty of interpretation, we do not comment further on these findings.

8. A Structural Model

Exploratory data analysis provides concrete content to the general structural model of equations (1.1) through (1.3). Practical considerations of time series estimation preclude consideration of all but a parsimonious representation of the general lessons that have emerged from the exploratory data analysis. We emphasize the key generic lessons to have emerged in formulating the structural model with which we conclude our analysis.

First, the key institutional dimensions of the structural system are those that explicitly represent the level of explicit conflict present in the society and economy, and which capture the key social identity dimension along which distributional conflict was organized. In the South African context, this required the inclusion both of the measure of political instability, and of racial (as opposed to the more standard ethno-linguistic) fractionalization. Second, this provides three structural equations in real per capita output, in human capital, and in political instability. Third, we control for both the quantity and the quality dimensions of human capital investment, recognizing that these may have distinct impacts on institutional and growth outcomes.

The univariate time series structure of the data employed in the study is reported in Appendix B. The evidence confirms the presence of level, first difference and second difference stationary variables. Estimation of the structural system is by standard time series techniques, with variables that are first-difference stationary. Johansen[54] techniques of estimation are now standard, so that discussion of estimation methodology here can be brief. We employ a vector error-correction mechanism (VECM) framework, for which, in the case of a set of k variables, we may have cointegrating relationships denoted r, such that $0 \leq r \leq k - 1$. This gives us a k-dimensional VAR:

$$z_t = A_1 z_{t-1} + \cdots + A_m z_{t-m} + \mu + \delta_t \tag{4}$$

[54]See Johansen (1991) and Johansen and Juselius (1990).

where m denotes lag length, a μ set of deterministic components and δ a Gaussian error term. Reparameterization provides the VECM specification:

$$\Delta z_t = \sum_{i=1}^{k-1} \Gamma_i \Delta z_{t-i} + \Pi z_{t-k+1} + \mu + \delta_t \tag{5}$$

The existence of r cointegrating relationships amounts to the hypothesis that:

$$H_1(r) : \Pi = \alpha \beta' \tag{6}$$

where Π is $p \times p$, and α, β are $p \times r$ matrices of full rank. $H_1(r)$ is thus the hypothesis of reduced rank of Π. Where $r > 1$, issues of identification arise.[55] Estimation is by VECM cointegration.

We begin with a structural system that incorporates both the generic lessons to emerge from the preceding exploratory data analysis, and the most general formulation of the base-line propositions proposed in the fractionalization literature. Core to this approach is the proposition that the social fractionalization at the root of distributional conflict, has an impact not only on instability, but directly on the quality of policy formulation. In the current context, therefore, as a starting position we postulate a possible impact of fractionalization on political instability, on output directly (due to poor growth-related policy formulation), and on human capital investment.[56] In South Africa, the social cleavage at the heart of distributional conflict has been race, and hence we employ racial fractionalization as the appropriate measure in our structural equation model.

We postulate a labour intensive output (denoted LYPC) equation which loads on the investment rate (IY), the user cost of capital (UC),

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[55] See Wickens (1996), Johansen and Juselius (1990, 1992), Pesaran and Shin (1995a, 1995b), Pesaran, Shin and Smith (1996).

[56] That South African human capital formation has been adversely affected by the pursuit of racially motivated policy formulation is standard in the literature. See for instance Fedderke and Luiz (2002), Fedderke et al (2000, 2003), as well as Case and Deaton, 1999.

political instability (INSTAB), math and science degree proportions (NESPR), as well as the change in racial fractionalization (DRACE).[57] Second, we postulate that political instability (INSTAB) in turn is driven by the change in racial fractionalization (DRACE), per capita output (LYPC), property rights (PROP) and human capital investment in both quality and quantity dimensions (NESPR, TENROL). Finally, we postulate that the quality dimension of human capital investment (NESPR) is determined by the change in racial fractionalization (DRACE), per capita output (LYPC), political rights (POL), and the quantity of human capital production (TENROL). We further incorporate the insight of Fedderke and Luiz (2005) that crime rates (CRIMPOP) impact on South African growth processes also. Hence:

$$\Pi z_{t-k+1} = \alpha \beta z_{t-k+1} \tag{7}$$

$$where$$

$$\alpha = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \\ \alpha_{41} & \alpha_{42} & \alpha_{43} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \\ \alpha_{61} & \alpha_{62} & \alpha_{63} \\ \alpha_{71} & \alpha_{72} & \alpha_{73} \\ \alpha_{81} & \alpha_{82} & \alpha_{83} \\ \alpha_{91} & \alpha_{92} & \alpha_{93} \\ \alpha_{10.1} & \alpha_{10.2} & \alpha_{\cdot 10.3} \\ \alpha_{11.1} & \alpha_{11.2} & \alpha_{11.3} \end{bmatrix}$$

$$\beta = \begin{bmatrix} \beta_{11} & \beta_{12} & 1 & \beta_{14} & \beta_{15} & \beta_{16} & \beta_{17} & \beta_{18} & \beta_{19} & \beta_{1.10} & \beta_{1.11} \\ \beta_{21} & 1 & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} & \beta_{28} & \beta_{29} & \beta_{2.10} & \beta_{2.11} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} & \beta_{35} & \beta_{36} & \beta_{37} & \beta_{38} & 1 & \beta_{3.10} & \beta_{3.11} \end{bmatrix}$$

$$z'_{t-k+1} = \begin{bmatrix} DRACE, LNYPC, INSTAB, POL, PROP, IY \\ , UC, CRIM, NESPR, TENROL, T \end{bmatrix}$$

in which T denotes a time trend, and identification proceeds by $\beta_{14} = \beta_{16} = \beta_{17} = \beta_{18} = 0; \beta_{24} = \beta_{25} = \beta_{2.10} = 0; \beta_{35} = \beta_{36} = \beta_{37} = \beta_{38} = 0$. In addition, we impose weak-exogeneity restrictions on racial fractionalization and the property rights dimension, such that, $\alpha_{11} = \alpha_{12} = \alpha_{13} = \alpha_{51} = \alpha_{52} = \alpha_{53} = 0$.[58]. Given space constraints, in the

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[57]The first difference specification is driven by the iI(2) structure of racial fractionalization in South Africa. Inclusion into the Johansen VECM framework thus requires the first difference transformation.

[58]The exogeneity restrictions were extensively tested. Results that justify the restrictions under which estimation proceeds here have been presented more extensively elsewhere - see Fedderke and Luiz (2005). Exogeneity of the racial com-

discussion of the empirical results which follows, we focus primarily on the characteristics of the ß-cointegrating vectors, though we uniformly note the stability characteristics of the structural models that we investigate.[59]

Note that the specification of the structural model is such as to capture the theoretical structure postulated by equations (1.1) through (1.3) - though it also captures the most generic lessons derived from the preceding exploratory data analysis. Human capital creation is granted both a direct impact on growth, through the quality dimension, and an aspirational impact on instability through both quantity and quality dimensions. The model also explicitly allows for feedback from institutions to human capital formation - with output, social fragmentation and distributional (instability) conflict being afforded the opportunity to impact on human capital investment. Core results from the exploratory data analysis are thus present - though with a "flattening" of nuance necessitated by the parsimony requirements our sample size imposes on us.

Table IV reports the maximal eigenvalue and trace statistics on the number of cointegrating vectors present in the data.

Both tests reveal the presence of at least two cointegrating vectors - and in the case of the trace statistic of up to three CV's at the 10% level of significance. Given that generally the trace statistic is given preference on the grounds of its better power characteristics in small samples, and given the theoretical priors of equations (1.1) through (1.3), we proceed on the assumption of three CV's.

Results from estimation are reported in column (1) of Table V.

Estimation results are generally in line with priors. Rising per

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position of a population has immediate intuitive purchase. While property rights exogeneity may be more controversial, note that the restriction is merely on contemporaneous feedback effects. Moreover, that property rights might lead political rights has additional support in the literature (Sened, 1997; Weimer, 1997; Schultz, 1992), and is justifiable on the grounds that rights over property might be granted in an attempt to lower the danger of political change that might widen access to rights over setting the fundamental rules of the game.

[59]Full details of the a-loading matrix are available from the authors on request.

capita GDP, and improving property rights serve to lower political instability.[60]   Improving quality of human capital investment (NE-SPR) lowers instability, while an increase in the quantity measure of human capital investment (TENROL) serves to raise political instability, confirming the findings of our exploratory data analysis. Finally, rising racial fractionalization (DRACE) serves to raise political instability. Rising racial fractionalization, political instability and crime rates all serve to lower real per capita output, while rising real investment rates, user cost of capital, and the quality of human capital measure all serve to increase real per capita GDP. Of the preceding all variable signs correspond to standard theoretical priors and the preceding exploratory data analysis. The only potential surprise arises with respect to the positive association between the user cost of capital and output. Nevertheless, the finding is consistent both with a Romer (1990)-type framework, in which final goods production rises in real interest rate since the sustainable rate of return on capital increases, and (more directly for the current context) with the finding that stringent macroeconomic stabilization policy is growth enhancing.[61] In the third cointegrating vector, the quality of human capital investment rises in the quantity of human capital investment, real per capita GDP, political instability, and political rights.

Unfortunately, the base-line results of column (1) suffer from three distinct problems that collectively are fatal for the specification being tested. First, the implied elasticities (computed at variable mean magnitudes) that attach to output (54.80) and the quantity human capital variable (74.96) in the political instability equation, and racial fractionalization (168.48) suggest a strength of impact that is implausible. On the other hand, the remaining implied elasticities of the specification do not suffer from this constraint. Second, note that particularly the change in racial fractionalization variable is simply not statistically significant in either the political instability or the human capital

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[60]Confirming the findings of Fedderke and Luiz (2005).

[61]The finding has strong empirical provenance see for example - and for the South African time series context is strongly confirmed by Mariotti (2002).

investment equations. Third, as cointegrating relationships the three equations do not show error correction behaviour - as evidenced from impulse response functions.[62] Extensive sensitivity tests of the specification, particularly with regard to the role of property rights, did not serve to resolve the three estimation problems.[63]

As a second specification we thus postulated a fractionalization impact only on output and on instability, excluding a direct fractionalization disruption of human capital investment. Further, the direct impact of crime rates on output is zero-restricted, though crime rates continue to exercise an impact in the short run dynamics of the specifications. Thus identification proceeds by $\beta_{14} = \beta_{16} = \beta_{17} = \beta_{18} = 0; \beta_{24} = \beta_{25} = \beta_{28} = \beta_{2,10} = 0; \beta_{31} = \beta_{35} = \beta_{36} = \beta_{37} = \beta_{38} = 0$, while the weak-exogeneity restrictions on racial fractionalization and the property rights dimension, such that, $\alpha_{11} = \alpha_{12} = \alpha_{13} = \alpha_{51} = \alpha_{52} = \alpha_{53} = 0$, remained unchanged.

Results are reported in column (2) of Table V.

Results in general remain unchanged from those reported under column (1). Variable signs remain consonant with theoretical and exploratory data analysis priors (with one exception discussed below). A crucial gain under the revised specification is that the three cointegrating vectors demonstrate the presence of error correction behaviour in all three vectors, lending stronger confirmation to the presence of cointegration in the data. Statistical significance of the change in racial fractionalization variable is now present in both the output and the instability equations. Unfortunately, the economic significance of the variables that was questionable in the first estimated structural system, remains problematic. Human capital (elasticities of 37.35, 26.46 for the quality and quantity human capital dimensions respectively) in the instability equation, and changes in racial fractionalization (elasticity of 29.9) in the output equation continue to have implausibly large impacts. Note further that both the quantity and the quality

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[62]Space constraints preclude the full reporting of the impulse responses for this and subsequent structural models. Results are available from authors on request.

[63]Full results are available from the authors on request.

of human capital investment in the instability equation serve to raise political instability - reversing the divergent impact of the base-line structural specification and the exploratory data analysis.

As a final structural specification we therefore also zero restrict the direct impact of the change in racial fractionalization on output as well as its impact on human capital formation. Crime rates are excluded from the specification altogether. Identification is therefore by means of $\beta_{14} = \beta_{16} = \beta_{17} = 0; \beta_{21} = \beta_{24} = \beta_{25} = \beta_{2,9} = 0; \beta_{31} = \beta_{35} = \beta_{36} = \beta_{37} = 0$; with weak-exogeneity restrictions on racial fractionalization and the property rights dimension again unchanged at $\alpha_{11} = \alpha_{12} = \alpha_{13} = \alpha_{51} = \alpha_{52} = \alpha_{53} = 0$.

Estimation results are reported in column (3) of Table V.

In the third specification all variable signs correspond to theoretical priors; error correction is present for the long run relationships estimated in the three cointegrating vectors; and while the human capital quality elasticity in the instability equation remains large, the order of magnitude is substantially lower than in the preceding two specifications. As for the second structural specification, both the quantity and the quality of human capital investment proxies serve to increase the level of instability - again reversing the findings of the preceding exploratory data analysis. Impulse response functions confirm the presence of error correction behaviour for all three structural relationships.

A number of core implications follow from the estimation.

First, human capital exercises both a direct impact on output (via the quality dimension of human capital investment), and an indirect impact through its impact on political instability. Importantly, while human capital investment serves to raise output through its direct impact, the estimation findings are consistent with the possibility that human capital investment raises political aspirations, and hence political instability under conditions of poor political rights dispensations. The human capital impact on growth thus has two countervailing features. The direct impact on output is positive; but since human capital also serves to raise instability and since instability lowers output, it

exercises a negative impact on output also. The net effect of a one percent increase in human capital on the estimated elasticities at variable mean values is marginally negative - though very small (elasticity of 0.06). In the context of developing and middle income countries that often find themselves in political transition, the potential dual impact of human capital may provide at least a partial explanation of why the international literature on the growth impact of human capital finds an unstable, sometimes negative sometimes positive, or ambiguous empirical impact of human capital variables.[64]

Second, human capital itself comes to depend not only on the level of economic development (as measured by per capital GDP), but on the institutional dispensation under which economic agents accumulate human capital. Political instability as well as improving political rights are found to fuel investment in quality human capital. Since political instability is likely present precisely under conditions under which pressure for political reform and hence improving rights are high, such findings are consistent with increased incentives on the part of agents to increase investment in mobile capital (rather than irreversible investment in physical capital), of as high a quality as is feasible. The implied objective is to maximize the accumulation of capital that is maximally mobile in international terms.

The results of Glaeser et al (2004) who find an impact of human capital on institutions finds confirmation from both our structural and our exploratory data findings.[65] Human capital formation does indeed lead to institutional transformation by stimulating the political instability that finally led to the political transformation of South Africa. The nuance to emerge from the findings reported here is that the institutional context also exercises an influence on human capital formation. Both instability, and the level of rights appears to impact on human capital investment decisions also.

Third, the contrast provided by the results of the specifications reported under columns (1), (2) and (3) of Table V, sheds additional

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[64]See Pritchett, 2001.

[65]Similar findings are also reported by Djankov et al (2003).

light on debates surrounding the impact of fractionalization, conflict and growth. Our results suggest that the primary channel of influence of social cleavage is through raising the level of (distributional) conflict - in our study measured by political instability. While there is some evidence to suggest that there may be a direct impact of racial fractionalization on output (perhaps due to poor policy choices), such evidence is weakened by the implausibly strong impact returned from estimation. In broad terms our results are thus consistent with the implications of for instance Easterly and Levine (1997) [66]- but our findings add the important caveat that the channel of influence through which fractionalization exercises its influence may simply be conflict. Controlling for both conflict (properly measured) and fractionalization in growth specifications may be an unnecessary overspecification of the requisite model. Finally, the reported results, especially in the light of our findings that suggest linguistic fractionalization to be an endogenous outcome of human capital formation, with racial fractionalization being the true driver of distributional conflict in South Africa, suggests that homogenous measures of fractionalization across societies may not be readily available. Which social cleavage serves as the organizing device for distributional conflict may differ between societies - with immediate consequences for cross sectional study.

9. Conclusions and Evaluation

The structural model estimated above has demonstrated that results consistent with the theoretical deliberations of the introduction can be obtained from our data set. Importantly, the nuance provided by our exploratory data analysis was useful in obtaining a more precise specification of the structural relations, faced as we were by a large and often confusingly interrelated data set. The core lessons of the investigation remain that human capital matters - for growth through

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[66]Though studies that employ fractionalization either affirming the Easterly and Levine (1997) result, or critical of it, are myriad. See for instance Sachs and Warner, 1997; and Englebert, 2000.

its quality dimension; for distributional conflict by raising political aspirations. But human capital does not stand alone either. The level of economic development (output) matters, distributional (instability) conflict as well as the rights dispensation can come to influence human capital investment decisions in their own right. Social, human capital, political as well as economic dimensions are densely interwoven in webs of association. Not without system, but nevertheless complexly interwoven.

For us a central learning point of this analysis has been that theory is important in understanding such complex interactions. But learning from extensive exploratory data analysis in nuancing theoretical structure when fitting it to data was equally important - all the more so in its exploration not only of multiple feasible dimensions of the data, but also in terms of the directions of association between variables in a time series context. There is scope to draw conclusions here beyond those that are feasible from the cross-country studies that have dominated the growth literature thus far.

Six general substantive conclusions emerge from the study for the growth literature.

Fractionalization matters for economic growth. This confirms other findings in the literature. But importantly fractionalization appears to lower growth primarily by raising instability or distributional conflict, rather than necessarily leading to poor policy choices (though some of this may happen too under high fractionalization). This is good news for policy purposes, since if instability can be controlled, the effect of fractionalization can be quarterized without having to also insure the policy making process against the impact of extensive social cleavage. [67]

A corollary to the inference drawn on the mechanism through

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[67] This leaves moot the question of how best to minimize instability - through repression or through sound rights dispensations. One might hypothesize that rights represent the more stable long term solution, though the literature does suggest that the transitional dynamics here may be non-monotonic. See for instance Barro (1999) and Przeworski et al (2000).

which fractionalization functions, is that the particular social cleavage along which distributional conflict is organized, may vary according to historical and social location. In South Africa during the twentieth century it appears to have been racial cleavage - but in other contexts this could be religious (Northern Ireland, Sudan), or as suggested by the literature ethno-linguistic fractionalization.

Linguistic fractionalization is now frequently employed in the growth literature. Yet our results show that linguistic fractionalization is endogenously determined by a range of different types and levels of human capital investment. Far from being a constant, unchanging determinant of underlying distributional conflict potential, it responds to changing human capital endowments. Even where linguistic cleavages generate conflict potential therefore, this need not be a permanent risk factor. It also follows immediately that since human capital formation does exercise this influence, significant dangers arise from this potentially potent policy tool. Narrow sectional interests may capture the policy making process, and pursue their specific interests through the human capital creation, with profound consequences for the political, social and institutional processes. Fractionalization may come to be fostered, deepened and then mobilized in the interests of specific interests, with distributional conflict and hence lower growth following apace. South Africa, with its pursuit of narrowly based racial policies which were often pursued precisely through the medium of the educational system provides a particularly salient example of just this danger.

In addition to its impact on linguistic fractionalization, human capital comes to influence not only growth, but distributional conflict directly also. In opening these concluding remarks we have already noted that the quality of human capital raises growth, while both the quality and quantity of human capital raises political instability.

But the point here really extends beyond the immediate finding. Middle income countries often find themselves in circumstances of substantial social and political upheaval. Our findings suggest that under such circumstances, human capital investment is a source for such dy-

namics, by raising political aspirations and hence the motivation for social and political transformation. Growth needs more than physical capital accumulation. But the associated need for human capital investment may well carry the seeds of destruction for any political elites expanding human capital endowments with narrow intentions of raising economic without political welfare.

Finally, there is more good news here. Since human capital does not stand alone, but itself comes to respond to economic (as well as institutional) development, embarking on a positive growth path appears to promise unleashing the forces of social and political transformation. Undemocratic dispensations may well be able to choose growth compatible development paths; but the absence of democracy does not appear sustainable with the consequence (including rising human capital endowments) of development.

Pointing to the possibility that social, institutional and political dimensions may be important to growth are helpful in widening our understanding of long run economic prospects. But we need to bear in mind both that such characteristics are not immutable over time, and that such dimensions may have strong links to human capital formation both at various levels of education, and in a variety of different dimensions of human capital investment.

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Appendix A: Key to Variable Names

	Description
LANGFRAC	Linguistic fractionation: based on national census information.
RELFRAC	Religious fractionation: based on national census information.
POLFRAC	Political fractionation: based on representation in national parliament.
INSTAB	Political instability: based on measure reported in Fedderke et al. (2000).
RACE	Racial fractionation: based on national census information.
lnRGDP	Log of real GDP.
GROWTH	Growth in real GDP.
lnRPCGDP	Log of real per capita GDP.
PCGROWTH	Growth in real per capita GDP.
POLRGHT	Political rights: based on measure reported in Fedderke et al. (2000).
PROPRGHT	Property rights: based on measure reported in Fedderke et al. (2000).
dK/dt	Change in real capital stock.
WPUBPTR	White public school pupil teacher ratio: based on measure reported in Fedderke et al. (1999).
WMATHPRP	White proportion of matriculants reading mathematics: based on measure reported in Fedderke et al. (1999).
BPUBPTR	Black public school pupil teacher ratio: based on measure reported in Fedderke et al. (1999).
BMATHPRP	Black proportion of matriculants reading mathematics: based on measure reported in Fedderke et al. (1999).
WENROL	White primary and secondary school enrolment rate: based on measure reported in Fedderke et al. (1999).
CAENROL	Coloured and Asian primary and secondary school enrolment rate: based on measure reported in Fedderke et al. (1999).
lnBENROL	Log of black primary and secondary school enrolment rate: based on measure reported in Fedderke et al. (1999).
lnTOTENROL	Log of total primary and secondary school enrolment rate: based on measure reported in Fedderke et al. (1999).
lnTOTDEGR	Log of total degrees issued by all South African universities: based on measure reported in Fedderke et al. (2003).
NESDEG	Total number of degrees issued by all South African universities in the natural, engineering and mathematical sciences: based on measure reported in Fedderke et al. (2003).
NESDEGPRP	Proportion of total degrees issued in the the natural, engineering and mathematical sciences by South African universities: based on measure reported in Fedderke et al. (2003).
APPRENT	Total number of apprenticeship contracts registered: based on measure reported in Fedderke et al. (2003).
WMATRICPRAT	White matriculation pass rate: based on measure reported in Fedderke et al. (1999).
BMATRICPRAT	Black matriculation pass rate: based on measure reported in Fedderke et al. (1999).
WMATRICPR	Proportion of white school pupils in matric year: based on measure reported in Fedderke et al. (1999).
lnBMATRICPR	Log of proportion of black school pupils in matric year: based on measure reported in Fedderke et al. (1999).
WRPCEXP	Real per capita expenditure on white school pupils: based on measure reported in Fedderke et al. (1999).
BRPCEXP	Real per capita expenditure on black school pupils: based on measure reported in Fedderke et al. (1999).
LOTE	Log-odds ratio for total primary and secondary school enrolment rates.
LOWE	Log-odds ratio for white primary and secondary school enrolment rates.
LOBE	Log-odds ratio for black primary and secondary school enrolment rates.
LONESE	Log-odds ratio for proportion of total degrees issued in the natural, engineering and mathematical sciences.
LOCAE	Log-odds ratio for coloured and asian primary and secondary school enrolment rates.
LOWMAPR	Log-odds ratio for white matriculation pass rate.
LOBMAPR	Log-odds ratio for black matriculation pass rate.
LOWMTPR	Log-odds ratio for white proportion of matriculants sitting mathematics.
LOBMTPR	Log-odds ratio for white proportion of matriculants sitting mathematics.
LOWMAPO	Log –odds ratio for proportion of white scholars in matriculation year.
LOBMAPO	Log –odds ratio for proportion of black scholars in matriculation year.

Appendix B: The Univariate Structure of the Data ADF Statistics on Stationarity

Variable	v I(0)	v I(1)	v I(2)	Critical Value
LANGFRAC	-3.45*	-	-	-2.92
RELFRAC	-2.40	-1.36	-8.07*	-2.91
POLFRAC	-1.97	-7.54*	-	-2.90
INSTAB	-3.43	-7.66*	-	-3.49
RACE	1.25	-1.12	-6.01*	-2.90
LNRGDP	-2.18	-4.86*	-	-2.90
GROWTH	-4.82*	-	-	-2.91
POLRGHT	-033	-4.61*	-	-2.92
PROPRGHT	1.39	-6.69*	-	-2.93
dK/dT	-0.74	-5.56*	-	-2.93
WMATHPRP	-1.79	-7.14*	-	-2.92
BPUBPTR	-1.34	-8.40*	-	-2.92
BMATHPRP	-2.91	-6.98*	-	-2.96
WENROL	-0.35	-6.42*	-	-2.90
CAENROL	-1.11	-4.37*	-	-2.92
lnBENROL	0.29	-4.56*	-	-2.92
lnTOTENROL	0.46	-4.56*	-	-2.92
lnTOTDEGR	-1.19	-3.58*	-	-2.90
NESDEG	3.81	-4.95*	-	-2.90
NESDEGPRP	-2.75	-8.16*	-	-2.90
APPRENT	-1.97	-3.35*	-	-2.91
WMATRICPR	-0.76	-3.94*	-	-2.90
lnBMATRICPR	-0.60	-5.49*	-	-3.00
WRPCEXP	-1.35	-5.27*	-	-2.90
BRPCEXP	0.28	-5.30*	-	-2.92
LOTE	1.34	1.05	-8.69*	-2.92
LOWE	-0.15	-6.43*	-	-2.90
LOBE	1.77	-0.90	-7.90*	-2.92
LONESE	-2.21	-11.07*	-	-2.90
LOCAE	-0.90	-4.23*	-	-2.92
LOMAPR	0.08	-9.96*	-	-2.90
LOBPAPR	-1.68	-5.68*	-	-2.99
LOWMTPR	-2.45	-5.56*	-	-2.90
LOBMTPR	-2.96	-4.94*	-	-2.99
LOWMAPO	0.13	-6.11*	-	-2.90
LOBMAPO	-0.59	-5.48*	-	-3.00

Table I: PSS F-tests for direction of association: human capital measures on institutional measures. Row headings denote outcome variables. Column headings forcing variables. * denotes unambiguous significance of the test statistics, allowing the rejection of the null of no association. ** denotes an indeterminate test statistic.

	TOTEN ROL	LOTE	WEN ROL	LOWE	CAEN ROL	LOCAE	BEN ROL	LOBE	TOTAL DEG	NESDEG	NESPRP	LOWESE	APPRENT	WPUBPTR	BPUBPTR
RELFRAC	3.67	3.73	2.34	2.43	2.22	2.21	3.81	3.90	3.04	2.77	2.03	2.08	1.94	3.07	5.09**
LANGFRAC	189.83*	204.41*	18.34*	21.10*	80.41*	86.03*	12.21*	12.22*	12.30*	12.29*	12.70*	12.78*	12.47*	12.00*	9.72*
POLFRAC	2.65	1.65	2.50	1.34	2.92	2.15	2.00	1.81	3.78	4.40	1.38	2.16	4.70	2.67	2.79
POLRGHT	5.34**	2.35	0.91	1.02	3.84	4.34	4.87	2.88	4.86	7.06*	3.38	3.74	1.01	5.65**	0.09
PROPRGHT	5.27**	5.22**	4.02	4.19	5.35**	6.01*	4.03	5.03*	3.02	5.13**	4.70	4.42	2.00	6.20*	2.98
INSTAB	12.07*	10.60*	7.46*	7.99	11.39*	10.11*	11.68*	10.16*	9.46*	8.63*	5.13**	4.18	3.45	9.35*	5.19**
LNRGDP	1.45	0.30	2.62	2.39	1.78	2.26	1.17	0.49	1.73	2.20	16.06*	2.86	3.28	3.99	4.2
GROWTH	7.54*	7.98*	6.56*	6.75*	4.23	4.46	8.66*	8.03*	8.48*	8.35*	4.25	4.39	4.86	7.68*	1.6
LNRGDPCAP	1.73	0.73	2.56	2.54	3.44	3.99	0.89	1.05	1.61	2.41	3.23	3.33	3.80	4.16	3.43
GROWTHCAP	1.21	6.71*	6.83*	7.00*	3.55	3.83	8.62*	8.03*	8.13*	8.31*	4.48	4.49	4.61	7.86*	1.9
LNK	0.54	0.79	1.71	1.67	2.14	2.79	0.25	0.70	4.28	1.18	6.30*	6.96*	1.23	1.91	5.90*
DKDT	1.36	1.25	1.29	1.52	2.58	3.02	1.27	1.29	3.55	1.00	6.93*	7.71*	0.98	1.01	0.43
RACEFRAC	3.08	4.94**	3.37	3.87	2.99	3.14	2.54	4.76	2.82	2.87	0.79	0.31	3.14	0.42	1.5

	WMAT PRAT	LOW MAPR	BMAT PRAT	LOB MAPR	WMATH PRP	LOW MTPR	BMATH PRP	LOBMTPR	WMATRI CPR	LOW MAPO	BMATRIC PR	LOB MAPO	WRP CEXP	BRP CEXP
RELFRAC	1.19	1.87	0.56	0.61	3.69	2.64	1.52	0.71	2.63	2.79	1.68	2.27	2.30	3.68
LANGFRAC	30.15*	11.35*	1.64	1.80	8.53*	8.30*	1.21	0.93	12.54*	103.04*	7.03*	3.96	15.21*	57.98*
POLFRAC	3.23	2.51	1.87	1.35	5.17**	1.99	0.64	1.98	0.37	0.82	2.46	2.16	4.58	1.36
POLRGHT	2.92	2.99	4.13	4.71	0.67	0.64	1.59	2.78	4.63	4.95	5.07**	5.41**	6.05*	11.38*
PROPRGHT	5.08*	4.14	0.54	1.70	5.06**	2.85	4.25	3.87	4.02	3.87	3.77	4.13	3.81	12.92*
INSTAB	3.73	4.14	3.01	1.83	3.70	3.75	3.98	4.10	11.12*	8.93*	2.92	2.78	6.07*	11.36*
LNRGDP	2.06	3.89	4.11	2.87	3.16	4.09	5.69**	3.92	7.10*	8.77*	1.82	2.24	9.14*	6.82*
GROWTH	6.65*	7.66*	1.42	0.86	5.63**	7.94*	8.51*	5.03**	11.44*	13.52*	2.00	2.52	5.53**	8.40*
LNRGDPCAP	2.42	3.28	4.03	4.25	3.85	5.31**	7.96*	3.21	7.33*	10.11*	2.06	1.89	7.61*	8.94*
GROWTHCAP	6.39*	7.50*	1.96	0.88	5.35**	7.60*	8.58*	4.95**	11.68*	13.60*	2.03	2.59	5.43**	8.47*
LNK	2.34	4.57	12.74*	13.87*	4.22	4.05	4.66	2.45	1.01	2.40	5.24**	4.47	1.36	2.60
DKDT	2.15	2.70	0.46	0.56	1.58	1.38	4.79	1.89	0.90	0.61	3.73	1.02	0.84	1.74
RACEFRAC	1.10	0.95	0.88	5.94*	0.13	0.12	9.07*	4.78	2.38	2.68	1.75	1.12	2.94	1.54

Table II: PSS F-tests for direction of association: institutional measures on human capital measures. Row headings denote outcome variables. Column headings forcing variables. * denotes unambiguous significance of the test statistics, allowing the rejection of the null of no association. ** denotes an indeterminate test statistic.

	RelFrac	LangFrac	PolFrac	PolRght	PropRght	Instab	lnRGDP	Growth	lnRGDPCAP	GrowthCap	lnK	dKdt	Race
Totenrol	1.52	2.31	1.83	0.89	0.43	2.46	1.95	2.34	1.25	2.38	1.34	1.63	1.48
LOTE	2.21	1.67	3.14	1.3	3.29	6.32*	1.91	0.87	2.15	0.91	1.7	1.13	1.3
Wenrol	2.73	4.55	1.03	11.38*	1.54	0.8	2.78	0.2	2.22	2.22	7.63*	0.44	1.62
LOWE	2.64	3.65	0.97	9.49*	1.83	0.72	3.45	0.17	2.08	0.53	6.69*	0.53	1.42
Caenrol	2.73	1.1	2.98	3.52	0.25	1.28	7.46*	0.48	14.97*	0.46	8.05*	2.1	0.9
LOCAE	2.78	0.9	2.66	3.4	0.52	0.87	9.60*	0.75	14.28*	0.67	8.04*	1.98	0.69
Benrol	2.41	2.62	3.01	2.38	0.3	3.19	2.68	2.98	2	3.05	1.72	2.05	1.38
LOBE	2.65	0.88	4.22	3.45	3.78	8.14*	2.8	0.83	3.06	0.87	2.61	1.04	0.82
TotalDeg	3.6	2.25	4.17	0.72	9.44*	5.06**	3.76	3.67	3.65	3.67	1.38	1.89	1.48
NESDeg	0.44	2.39	6.69*	0.83	5.88*	6.07*	5.37**	4.75	4.92	4.78	3.89	1.88	1.25
NESPrp	5.85*	0.41	0.75	0.79	0.81	1.03	2.88	1.8	1.94	1.73	2.36	0.03	17.32*
LOWESE	4.77	0.23	17.8*	0.77	0.71	0.85	2.08	1.95	1.69	1.86	1.18	0.01	19.28*
Apprent	4.02	1.84	1.7	1.82	3.84	3.84	0.84	3.41	1.06	3.58	7.22*	2.72	0.21
Wpubptr	2.19	0.04	7.47*	3.2	2.36	0.72	2.29	0.72	2.55	0.71	4.08	2.95	3.16
Bpubptr	8.10*	3.28	2.88	3.58	3.99	1.86	5.15**	1.51	4.78	1.51	7.79*	3.86	6.78*
Wmatprat	6.33*	0.1	5.01**	2.12	0.45	0.66	4.43	4.39	3.75	4.48	0.04	0.04	0.96
LOWMAPR	2.26	0.48	1.9	1.11	0.47	2.64	3.47	2.33	0.7	2.42	2.39	0.003	1.27
Bmatprat	5.80*	5.72**	3.46	1.57	2.33	1.01	1.6	1.64	0.56	1.66	3.56	3.24	1.57
LOBMAPR	5.85*	6.18*	5.86*	1.25	1.56	1.88	1.23	1.09	0.44	1.09	2.37	3.32	0.62
Wmathprp	4.67	3.24	1.55	3.7	4.24	5.69**	4.14	2.18	4.42	2.22	2.49	4.63	2.88
LOWMTPR	3.45	3.57	1.85	3.92	4.4	5.27*	3.07	6.37*	3.56	6.54*	2.84	4.83	1.34
Bmathprp	1.76	1.59	3.87	1.29	2.6	3.68	2.74	2.09	3.68	2.1	3.52	2.61	0.95
LOBMTPR	1.99	1.86	6.60*	2.3	2.88	1.97	2.24	1.53	2.07	1.52	1.16	1.85	3.9
Wmatricpr	0.19	0.52	2.38	1.26	1.15	1.53	2.25	0.11	1.91	0.11	4.96	0.57	1.17
LOWMAPO	0.63	0.01	1.02	1.84	1.54	1.08	1.63	0.1	1.33	0.1	4.76	0.74	3.14
Bmatricpr	0.91	4.07	3.07	0.19	2.57	2.16	0.53	1.36	0.61	1.38	7.94*	2.54	2.87
LOBMAPO	1.29	2.99	1.29	0.26	1.13	0.65	2.47	0.53	0.04	0.52	4.71	1.7	2.6
Wrpcexp	2.5	6.32*	1.1	1.06	0.44	2.96	0.84	1.24	1.27	1.27	24.92*	0.81	1.69
Brpcexp	0.15	0.76	3.62	1.45	3.25	7.19*	2.54	1.04	1.66	1.04	4.76	2.39	3.21

Table III: Multivariate ARDL Cointegration extensions. * denotes significance at the 5%, ** at the 10% level. η_{AR}, η_H denote a chi-squared distributed test for autocorrelation and heteroscedasticity respectively. ARDL denotes the optimal lag structure chosen on the basis of the relevant information criterion. Φ denotes the error correction term in the ARDL specification, and adj-R^2 the goodness of fit of the ARDL specification. AIC denotes the Akaike information criterion, "Manual" the manual choice of a lag structure for the ARDL, Adj-R^2 the use of the adjusted R^2 information criterion. Round parentheses denote standard errors. Square parentheses denote probability levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	LangFrac	LangFrac	Growth	Growth	GrowthPC	GrowthPC	Instab	Instab
Constant	0.83*	0.83*	-22.66*	-24.60*	-0.23*	-0.27*	34168.1*	35815.9*
	(0.005)	(0.005)	(9.28)	(9.13)	(0.09)	(0.08)	(7708.7)	(7621.9)
lnTOTENROL	-0.01*		0.58		0.01		11311.0*	
	(0.002)		(1.83)		(0.02)		(2724.2)	
lnBENROL		-0.01*		0.44		0.01		8344.3*
		(0.002)		(1.32)		(0.01)		(2059.4)
NESDEGPRP	0.07*	0.07*	73.10*	73.64*	0.74*	0.82*	-77904.4*	-78447.3*
	(0.02)	(0.02)	(25.65)	(24.16)	(0.26)	(0.21)	(38067.7)	(37871.8)
WMATHPRP	0.02*	0.02*	13.79**	15.37**	0.14**	0.16*		
	(0.002)	(0.003)	(8.00)	(8.23)	(0.08)	(0.07)		
BRPCEXP	$-0.35 \times 10^{-4*}$	$-0.33 \times 10^{-4*}$						
	(0.12×10^{-4})	(0.13×10^{-4})						
η_{AR}	17.75	18.83	0.23	2.20	0.29	0.64	0.56	0.04
	[0.00]	[0.00]	[0.63]	[0.14]	[0.59]	[0.42]	[0.45]	[0.84]
η_H	0.91	0.60	0.03	2.16	0.10	0.64	14.05	13.76
	[0.34]	[0.44]	[0.87]	[0.14]	[0.75]	[0.42]	[0.00]	[0.00]
ARDL	4,4,2,0,0	4,4,2,0,0	3,3,6,4	3,3,4,4	3,3,6,4	3,3,6,4	4,6,6	4,6,6
Φ	-0.95*	-0.95*	-1.38*	-1.35*	-1.37*	-1.42*	-1.25*	-1.31*
	(0.04)	(0.04)	(0.27)	(0.27)	(0.27)	(0.24)	(0.20)	(0.20)
Adj-R^2	0.96	0.96	0.55	0.46	0.54	0.57	0.39	0.44
Info	AIC	Manual	Adj R^2	Adj R^2	Adj R^2	Adj R^2	AIC	AIC

Table IV: Maximal eigenvalue and trace statistics; VAR=2; * denotes rejection of the null at the 5%, ** at the 10 % level

Null	Alternative	Eigenvalue Statistic	95% Critical Value	Trace Statistic	95% Critical Value
$r=0$	$r=1$	107.17*	61.22	310.14*	215.79
$r\leq1$	$r=2$	63.61*	55.83	202.97*	177.79
$r\leq2$	$r=3$	39.20	50.10	139.36**	141.73
$r\leq3$	$r=4$	34.04	43.72	100.16	108.90
$r\leq4$	$r=5$	22.35	37.85	66.12	81.20
$r\leq5$	$r=6$	19.31	31.68	43.77	56.43
$r\leq6$	$r=7$	15.60	24.88	24.46	35.37
$r\leq7$	$r=8$	8.86	18.08	8.86	18.08

Table V: Structural Equation Estimation Results

	(1)			(2)			(3)		
	CV1	CV2	CV3	CV1	CV2	CV3	CV1	CV2	CV3
DRACE	−4400.5 (4503)	371.55 (70.54)	18.00 (18.40)	−377.7 (656.6)	65.93 (9.32)	0.00	−1273.0 (150.19)	0.00	0.00
LYPC	172.84 (43.72)	1.00	−0.72 (0.18)	35.88 (34.20)	1.00	0.60 (0.10)	43.88 (5.28)	1.00	−0.55 (0.04)
INSTAB	1.00	0.006 (0.002)	−0.004 (4.32e−006)	1.00	0.01 (0.001)	0.00	1.00	0.02 (0.00023)	−0.003 (0.0002)
POL	0.00	0.00	−7.01e−005 (4.85e−006)	0.00	0.00	0.004 (0.0002)	0.00	0.00	−0.002 (0.0002)
PROP	0.004 (0.001)	0.00	0.00	0.28 (0.17)	0.00	−0.001 (0.001)	0.01 (0.02)	0.00	0.00
INVRAT	0.00	−1.91 (0.61)	0.00		−0.98 (0.27)	0.00	0.00	−0.34 (0.09)	0.00
UC	0.00	−0.06 (0.01)	0.00	0.00	−0.02 (0.002)	0.00	0.00	−0.004 (0.001)	0.00
CRIM	0.00	20.84 (2.89)	0.00	0.00	0.00	0.00	n/a	n/a	n/a
NESPR	−242.41 (0.30)	−9.60 (1.42)	1.00	−616.69 (24.41)	−5.03 (0.47)	1.00	−500.06 (32.27)	−8.13 (0.49)	1.00
TENROL	496.23 (92.37)	0.00	−2.04 (0.38)	−175.14 (65.00)	0.00	0.97 (0.20)	−27.62 (10.01)	0.00	−0.39 (0.07)
T	−6.97 (1.92)	−0.04 (0.01)	0.03 (0.01)	−0.94 (1.28)	−0.03 (0.002)	−0.01 (0.004)	−1.74 (0.25)	−0.04 (0.002)	0.01 (0.002)
	Elasticities at Means:			Elasticities at Means:			Elasticities at Means:		
DRACE	2.10	168.48	−0.14	0.18	29.90		0.61		
LYPC	54.80		−3.77	11.38		3.13	13.91		−2.89
INSTAB		0.02	−0.07		0.03			0.05	−0.05
POL			−0.01			0.47			−0.27
PROP	0.05			3.98		−0.34	0.16	0.00	
INVRAT		−0.42			−0.22			−0.07	
UC		−0.72			−0.19			−0.05	
CRIM		1.15							
NESPR	−14.68	−1.83		−37.35	−0.96		−30.28	−1.55	
TENROL	74.96		−5.09	−26.46		2.42	−4.17		−0.97