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# Four Scenarios of Development and the Role of Economic Policy.

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## Abstract

We ask which economic policies can help a country create the most favourable conditions for development. We observe that the dynamics of several development indicators can be grouped into four clusters, each cluster corresponding to a different combination of growth and changes in inequality. Based on this observation, we define four different development scenarios and use limited dependent variable regressions to study how structural and policy factors affect a country's probability to achieve the most (or the least) favourable of these scenarios. Our results point to a comforting picture: through the choice of appropriate policies countries can effectively increase their chances to achieve the most favourable development scenario.

## I. Introduction

Between 1993 and 2000 South Africa experienced an increase in the poverty headcount accompanied by a sharp decrease in average life expectancy and a growing proportion of undernourished children. Similar trends were observed in Ivory Coast, Moldova, Belarus, and Burundi, just to mention a few countries. Over the same period of time, countries like Lithuania, Vietnam, Pakistan, and Gambia achieved a significant reduction in monetary poverty, longer life expectancy, higher rates of immunisation, and lower rates of child mortality and undernourishment. This large variety of development experiences raises a simple, albeit crucial, question: to what extent can economic policies help create favourable conditions for faster development?

In this article we attempt to provide an answer to this question by exploiting an interesting feature of the development data. We observe that the dynamics of several development indicators can be grouped into four clusters, each cluster corresponding to a different combination of growth and changes in inequality. In this way, we can identify four scenarios of development. We then use an ordered probit model to study how structural and policy factors affect the probability of a country ending-up in the most (or least) favourable of these four scenarios. As discussed in more detail below, this approach has a couple of important advantages. First, given that the scenarios account for the different dynamics of several development indicators (and not just one indicator), our approach allows us to study the conditions for *broad* development. That is, we look at development in its multidimensionality and not just at how policies can help improve one specific development indicator. Moreover, we can do this without having to construct an arbitrary aggregate measure of development. Second, with the ordered probit model we avoid some of the pitfalls that arise when using growth and inequality as continuous dependent variables in single or system equation estimation. These advantages come at no real cost in terms of loss of information as the categorical dependent variable in our model turns out to be a very strong predictor of development outcomes, possibly even stronger than the continuous measures of growth and inequality.

Our main results can be summarised as follows. The probability of a country being in scenarios that are most favourable to development increases the higher the growth rate of agricultural productivity, the more rapid the accumulation of human capital, the faster the structural transformation of the productive system, and the more widespread access to infrastructures is. We also find some important structural effects linked to a country's legal origin and geographical position. Finally, we provide evidence of the importance of initial conditions: economies at earlier stages of economic development and initially characterised by wider inequalities are more likely to end up in a scenario that is more favourable to development. Taken together, these results highlight what we believe is an important story: countries are not destined by nature or colonial heritage to remain trapped into underdevelopment. 'Good' policies exist that can help countries achieve scenarios that are most conducive to a rapid improvement of development indicators.

The rest of the article is organised as follows. In section II we set our article in the context of the existing literature. In section III we define and characterise the four scenarios that constitute the object of our study. Section IV discusses the econometric results. Section V provides a summary and conclusion. An Online Appendix with detailed material, including data construction and sources, additional econometric results, and sensitivity analysis is made available separately.

## II. This Article in the Context of the Literature

This article relates to the vast literature on the empirical determinants of development outcomes which consists of several strands. There is of course a well established line of research that uses per capita gross domestic product (GDP) as a proxy for development, thus estimating regression models in the level of income. Notable examples of this approach include, inter alia, Acemoglu et al. ([3]), Sachs ([35]), Rodrik et al. ([34]), Cartensen

and Gundlach (2006), Nunn ([30]), Bhattacharyya ([9]), and Alexeev and Conrad ([6]). A second avenue of research estimates single equation regressions of specific development indicators, such as, the poverty headcount (see, among others, Bourguignon, [11]; Chhibber and Nayyar, [15]; Loayza and Raddatz, [27]; and Ravallion and Datt, [33]); mortality, life expectancy, or some other health indicator (see Powles, [32]; Deaton, [19]; and Cutler et al., [17]);[1] school enrolment rates, literacy rates, or related measures of educational attainments (see, inter alia, Flug et al., [22]; Gupta et al., [23]; Carmignani, [12]).

Even though there is likely to be a positive correlation between different development dimensions, disaggregate indicators such as those mentioned above are not representative of development in its multidimensionality. For this reason, a third strand of empirical analysis, more recent and certainly less voluminous than the previous two, makes use of some aggregate measure of development as the dependent variable in the regression model. This practice is indeed facilitated by the availability of a well-known index of human development (HDI). This index is prepared by the United Nations Development Programme exactly with the scope to condense different components of a broad notion of development into a single indicator. While not immune from criticisms, especially with respect to the weighting system used to aggregate the individual components, the HDI has been used in academic research (see, for instance, Zgheib et al., [36]; Constantini and Monni, [16]). An alternative is suggested by Avom and Carmignani ([12]) who aggregate different indicators of health and education by means of principal components.

In this article we take a different methodological route to the analysis of the determinants of development. Instead of measuring development directly, we identify the scenarios that lead to development (or underdevelopment) and then study the probability of a country ending-up in any one of these scenarios. The scenarios arise from the combination of growth and changes in inequality. We therefore have: (i) scenario one: positive growth and decreasing inequality; (ii) scenario two: positive growth and increasing inequality; (iii) scenario three: negative growth and decreasing inequality; and (iv) scenario four: negative growth and increasing inequality. These scenarios correspond to systematically different dynamics of several development indicators so that, in fact, they are naturally ordered from most conducive to development (scenario one) to least conducive to development (scenario four). Once the scenarios are defined, an ordered probit model will be used to see how different structural and policy factors affect the probability of a country achieving the most favourable (or the least favourable) scenario. To this purpose, we construct a categorical variable that takes values 0, 1, 2, and 3 (the variable equals 0 for observations falling in scenario one, value 1 for observations falling in scenario two and so on). In this way we can adopt a rich specification of the right hand side variables while accounting for the simultaneous evolvement of growth and inequality. Methodologically our article is therefore nested within the class of models with limited dependent variables that have been analysed in Maddala ([29]).

There are important advantages in pursuing this approach. First, we are able to study the determinants of broad development rather than focusing on a single specific dimension or indicator. The ordering of scenarios from most favourable to least favourable holds for several different development measures, including the poverty headcount, child mortality, life expectancy, malnutrition, immunisation, and female literacy. Therefore, we are not just running, say, a poverty regression. Instead, by studying what affects the probability of a country achieving the most favourable scenario, we are in fact studying how policy and structural factors contribute to the creation of conditions that are conducive to development in its multiple forms. Equally important is the fact that we are able to do this without having to aggregate different indicators into a single synthetic measure. We therefore avoid the complications and arbitrary choices associated with the design of a weighting system that instead plague the construction of the HDI.

A second advantage of our approach is that it does not require us to model growth and inequality separately. As pointed out in Lundberg and Squire ([28]), single equation estimation of growth and inequality is problematic

given that the two processes are jointly endogenous. In this context, system estimation offers a superior alternative by modelling growth and inequality as the joint outcomes of other variables. But system estimation is not immune from pitfalls. In fact, the estimation of structural parameters in a system of endogenous equations requires exclusion restrictions (see Huang et al., [25]). However, finding theoretically justifiable and meaningful exclusion restrictions is a hard task. Furthermore, if one equation in the system is misspecified, then the estimates of the other equations in the system will also be contaminated. In this sense, estimates from Three Stage Least Squares (3SLS), or even Seemingly Unrelated Regression Equations (SURE), often turn out to be very sensitive to the choice of regressors and identifying restrictions. Finally, when the equations in the system are simultaneously endogenous, multicollinearity between any of the endogenous dependent variables and the other regressors can significantly reduce the precision of coefficient estimates. To deal with these problems, one might want to adopt parsimonious specifications of the two equations, but this, in turn, increases the risk of misspecification. With our approach, instead, we are able to estimate a rich specification of the right hand side variables while accounting for the simultaneous evolvement of growth and inequality.

Using a categorical variable when continuous variables (in this case growth and changes in inequality) are available might involve a cost in terms of loss of information. However, we argue that this cost, in the specific case of our dataset, is not large. We provide three bits of evidence to support our statement. First, we estimate a standard system of two equations with growth and inequality as dependent variables (see Online Appendix, section AI). While the sign of the estimated coefficients from the system is generally coherent with the sign of the estimated coefficients from the ordered probit model, the standard errors tend to be larger in the system. In other words, the ordered probit model seems to yield more precise estimates. Second, we show that our categorical variable has a very strong and significant association with development outcomes. To this purpose, we regress development indicators on the categorical variable (see Online Appendix, section AII). The estimated coefficient of the categorical variable is always statistically significant at the 1 per cent level and the goodness of fit of the regression ranges between 0.3 and 0.4. A regression of the same development indicators on growth and changes in inequality yields similar goodness of fit, with estimated coefficients that occasionally fail to be significant at the 1 per cent level. Moreover, the coefficient of the categorical variable remains highly significant even when growth and inequality are added to the regression. Third, as documented in the next section, variation across scenarios explains a large proportion of total variation in development indicators, growth, and changes in inequality. This means that explaining why some countries are able to achieve scenario one while others are not goes a long way towards explaining why some countries develop and others do not.

### III. Scenarios of Development

Our dataset consist of a sample of 145 observations covering 71 developing countries. Each observation is taken over sub-periods of at least five years. For each variable, we measure its level at the beginning of the relevant sub-period (the 'initial' value) and its annualised rate of change over the entire sub-period.[2]

For any given country  $c$  and sub-period  $t$ , let  $y_{c,t}$  denote the change in per capita GDP and  $g_{c,t}$  the change in the Gini coefficient. We partition the sample along these two dimensions according to the following rule:

- – scenario one:  $y_{c,t} > 0$  and  $g_{c,t} < 0$  (positive growth with decreasing inequality)
- – scenario two:  $y_{c,t} > 0$  and  $g_{c,t} > 0$  (positive growth with increasing inequality)
- – scenario three:  $y_{c,t} < 0$  and  $g_{c,t} < 0$  (negative growth with decreasing inequality)
- – scenario four:  $y_{c,t} < 0$  and  $g_{c,t} > 0$  (negative growth with increasing inequality).

In the full sample of all 145 observations, there are 55 observations that fall in scenario one, 54 in scenario two, 15 in scenario three, and 21 in scenario four.

That a combination of positive growth and decreasing inequality is the best possible scenario for the reduction of the poverty headcount is a well-known result from the poverty literature (see, for instance, Bourguignon, [11]). In the rest of this section we provide evidence that the ordering from most favourable (scenario one) to least favourable (scenario four) holds for various other dimensions of development.

We consider five development indicators in addition to the poverty headcount: child mortality, life expectancy, child immunisation against diphtheria, pertussis, and tetanus (DPT), child malnutrition, and female literacy. The average rate of change of these indicators in the four scenarios is shown in Table 1. The table also shows the average rate of growth and change in inequality in each scenario. In the last column we report the standard deviation of rates of change between scenarios in per cent of the standard deviation of rates of change in the full sample. This latter statistic is therefore useful to assess how important variation *between* scenarios is relative to variation *within* scenarios.

Table 1. Characterisation of poverty reduction scenarios

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Variation between scenario Total variation
Poverty headcount	-7.57 (2.25)	-2.25 (2.27)	-1.05 (4.47)	16.96 (3.65)	0.53
Life expectancy	0.43 (0.10)	0.16 (0.08)	-0.29 (0.15)	-0.41 (0.23)	0.58
Immunisation DPT	3.85 (1.03)	2.26 (1.02)	-0.03 (0.27)	-3.13 (1.11)	0.64
Female literacy	3.17 (1.31)	1.89 (0.14)	1.01 (1.12)	-1.15 (0.28)	0.49
Malnutrition	-2.11 (0.88)	-1.21 (0.45)	-0.71 (1.05)	0.27 (0.31)	0.61
Child mortality	-4.42 (0.35)	-2.75 (0.81)	-1.04 (0.33)	0.98 (0.41)	0.47
Per-capita income	2.63 (0.30)	2.78 (0.31)	-1.61 (0.58)	-3.73 (0.49)	0.58
Gini	-1.66 (0.25)	1.69 (0.25)	-2.27 (0.48)	3.76 (0.40)	0.71

Notes: All the variables are expressed in annualized percentage changes. The number in brackets are the standard deviations of the estimated  $\alpha$  from the following ordinary least squares (OLS) regression:  $x_{i,t} = \alpha_1 S_1 + \alpha_2 S_2 + \alpha_3 S_3 + \alpha_4 S_4 + \varepsilon_{i,t}$ , where  $x$  is the percentage change in a generic development indicator,  $i$  is a generic country and  $t$  a generic sub-period,  $S_j$  is a dummy variable taking value 1 if the observation falls in scenario  $j$  (where  $j = 1, 2, 3, 4$ ), and  $\varepsilon$  is a disturbance.

The data in the table confirm that the four scenarios are clearly ordered. Scenario one is most conducive to development, followed by scenarios two, three, and four, respectively. Scenario four is the least conducive to development. The differences between scenarios are generally large and statistically significant. In fact, for each indicator, we estimated a regression of its rate of change in scenario  $j$  on a constant and dummies for the other scenarios. The estimated coefficients from these regressions are equal to the difference in the rate of change between scenario  $j$  and any of the other scenarios. We find that these estimated coefficients are generally statistically significant at usual confidence levels.[3] The statistics reported in the last column also indicate that variation between scenarios on average accounts for more than half of the total variation in the sample. All in all, it seems that understanding what drives a country towards any particular scenario is the key to explaining why development trajectories differ so much across countries.

The data also say something interesting on the relationship between growth and changes in inequality. Political economy models often predict a trade-off between growth and redistribution, thus implying that a scenario of positive growth and decreasing inequality is difficult to achieve (see Alesina and Rodrik, [5]; Persson and Tabellini, [31]). While the available empirical evidence on this trade off is ambiguous (see for instance Banerjee and Duflo, [8]), in our dataset growth and decreasing inequality do not appear to be mutually exclusive. As just mentioned, one-third of total sample observations actually fall in scenario one and another third fall in scenario two. Therefore, everything else being equal, a country going through a period of positive growth is equally likely to experience sharpening inequalities as it is to experience decreasing inequalities. Moreover, the average rate of growth in the two scenarios is quite similar, meaning that countries that reduce inequality are not necessarily penalised in terms of slower growth. In the Online Appendix (section AIII), we provide both parametric and non-parametric evidence confirming that there is no trade-off between growth and decreasing inequality in our data.

## IV. Econometric Results

Our purpose in this section is to understand what affects a country's probability to achieve any of the four scenarios identified in section III. We go about this task by setting up a standard ordered probit model. We then design a relatively rich specification of regressors to represent an array of economic policies and structural factors. Finally, we submit our baseline results to various checks (some of which are described in more detail in the Online Appendix).

### The Model

#### Econometric setting

For each generic observation  $i$  in the dataset, the dependent variable is coded as follows:  $s_i = 0$  if the observation falls in scenario one,  $s_i = 1$  if the observation falls in scenario two,  $s_i = 2$  if the observation falls in scenario three, and  $s_i = 3$  if the observation falls in scenario four. The econometric model therefore takes the form of a multinomial model.

As well-known multinomial models vary according to whether the categories of the dependent variables are ordered or not. We have argued in sections II and III that our dependent variable involves inherently ordered outcomes, going from the most favourable scenario to the least favourable scenario for development. The probability of observation  $i$  falling in scenario  $j$  ( $j = 0, 1, 2, 3$ ) is then defined as:

$$\text{Prob}(s_i = j | x_i) = \Phi(\mu_j - x_i' \beta) - \Phi(\mu_j - 1 - x_i' \beta)$$

(1)

where  $\mathbf{x}$  is a vector of explanatory variables (that is, the structural factors, initial conditions, and policy variables included in the dataset),  $\Phi$  denotes the standard normal cumulative distribution function (c.d.f.), and  $\mu$ s and  $\beta$  are parameters to be estimated.

The intuition underlying the ordered probit model (1) is that 'conduciveness to development' is a latent process defined by some interaction between  $\Delta y$  (changes in per capita income) and  $\Delta g$  (changes in income inequality), which are in turn explained by the vector of variables  $\mathbf{x}$ . While the latent process is not observed, the observed values of  $\Delta y$  and  $\Delta g$  allow identifying the four categories of the dependent variable  $s_i$ . In model (1) the stochastic component of the latent process is assumed to have a standard normal distribution. We also estimated a model using a logistic distribution and results were not qualitatively different.

Model (1) is estimated by maximum likelihood. The sign of the regression parameters  $\beta$  can be interpreted in terms of the effect that explanatory variables have on the probabilities: a positive estimated coefficient on the

generic variable  $x$  means that an increase in  $x$  decreases the probability of being in the lowest category and increases the probability of being in the highest category.

### Choice and interpretation of explanatory variables

The set of explanatory variables in model (1) includes country fixed effects, initial conditions, and policy variables (see Online Appendix, section AV for details on definitions and sources). Starting with the fixed effects, we control for British legal origin (*legor\_uk*), distance from equator (*lat\_abst*) and ethnic fragmentation (*ethnix*). These are time invariant effects that are likely to be important in determining the quality of governance and institutions. In turn, good institutions should strengthen growth and reduce inequalities.[4] We therefore expect negative coefficients on both *legor\_uk* and *lat\_abst* and a positive coefficient on *ethnix*. Among the country fixed effects we also include a dummy for socialist legal origins (*legor\_so*). Socialist countries in our sample are peculiar in two respects: (i) they were characterised for most of the sample period by extremely low inequality, reflecting the socialist or communist ideology, and (ii) most of them went through a prolonged period of negative growth and growing inequality in connection with the transition from plan to market. We thus expect *legor\_so* to display a positive estimated coefficient in our model.

The initial conditions we consider are the initial levels of per capita income (*i\_y\_pc*) and Gini coefficient (*i\_gini*). The large body of theoretical and empirical work on conditional convergence suggests that negative growth should be more likely at higher initial levels of per capita income. The coefficient on *i\_y\_pc* should therefore be positive, even though it is not entirely clear how a higher initial income could affect the likelihood of reductions in inequality. An initially higher level of inequality makes the reduction of inequality more likely, as it is probably easier to lower a Gini coefficient of, say, 60 than a Gini coefficient of, say, 30. As already discussed, a higher Gini coefficient should not be an obstacle to growth, so that in the end *i\_gini* is expected to have a negative coefficient.

While time invariant effects and initial conditions are all measured in levels, the remaining controls are measured as annualised percentage changes. We include three indicators that are meant to capture the structural transformation of the economy. These are the rate of agricultural productivity growth (*agr\_prod*), the change in the agriculture share of GDP (*agr\_va*), and the change in the industry share of GDP (*ind\_va*). In the literature, industrialisation is often seen as the key to growth accelerations.[5] A traditional Kuznets-type of argument then suggests that this transformation would be accompanied by an increase in inequality, at least at the early stages of development. However, it is unclear to what extent a shift from agriculture to industry effectively leads to persistently higher inequality. In this respect, our expectation is that the growth effect of changes in sectoral shares is probably stronger than their distributional effect. The estimated coefficient on *agr\_va* should hence be negative while the one on *ind\_va* should be positive. At the same, the large weight that the agricultural sector maintains in many developing economies suggests that productivity growth in that sector is likely to impact significantly on the growth rate of the economy. To the extent that it reflects a transition from traditional to modern agriculture, a faster rate of productivity growth should also be associated with lower inequalities. Consequently, *agr\_prod* is expected to display a negative coefficient.

The increase in the density of telephone lines (*t\_comm*) and the expansion of the proportion of irrigated land (*irrigated*) are meant to capture the dynamics of infrastructure development. Better infrastructures are expected to foster growth.[6] However, their contribution to the dynamics of inequality is ambiguous as it is likely to depend on their localisation on the territory. If governments decide to develop new infrastructures to satisfy the higher demand expressed by already economically more advanced areas, then the risk is that inequality in the country will increase. Avom and Carmignani ([12]) provide evidence that this negative distributional effect might be statistically significant. Therefore, the coefficient on *t\_comm* and *irrigated* is expected to be negative, but the prediction is somewhat ambiguous.



Finally, the policy environment is represented by the growth rates of four variables: (i) credit to the private sector (*credit*), (ii) international trade (*trade*), (iii) government size (*gov\_cons*), and (iv) investment in human capital (*tyr*). All of these variables are quite commonly used in the applied analysis of growth and inequality. The survey of results presented by Durlauf et al. ([20]) suggest that *credit*, *trade*, and *tyr* should all promote growth, while there is no consensus on the sign of the effect of *gov\_cons*. A wider access to credit should also help reduce inequalities. Similarly, an increase in human capital investment is usually regarded as an improvement in earning opportunities for the population at large, thus implying a potentially smoother distribution of income. A larger government should also contribute to reducing inequalities, to the extent that its size correlates with the extent of redistribution. On the contrary, results in Lundberg and Squire ([28]) and Carmignani ([13]) indicate that openness to trade can sharpen inequalities, even though the effect is not necessarily statistically strong. Overall, there is no ambiguity about the expected sign of *tyr* and *credit*, which should be negative. On the other hand, for both *gov\_cons* and *trade* a clear-cut prediction cannot be made.

## Results

The estimated coefficients of model (1) are reported in Table 2. We initially tested for the potential endogeneity of the regressors by running separate regressions of  $\Delta y$  and  $\Delta g$  on the set of time-invariant effects and initial conditions plus each of the other variables.[7] We applied the Hausman endogeneity test (Davidson and MacKinnon, [18]), using lagged values of the potentially endogenous variables as instruments. It turns out that *credit*, *tyr*, *gov\_cons*, and *trade* are all endogenous to  $\Delta y$  and/or  $\Delta g$ . We therefore use their lagged values in the estimation of the ordered probit model.

Table 2. Regression results

	I	II	III	IV			
				Gini_down	Y_pc_up	VI	V
Legor_uk	0.092	-0.158	-0.120	0.719*	-0.637	..	..
Legor_so	2.719***	0.008	2.319**	-0.130	-5.284***	2.172***	0.413
Lat_abst	-3.311**	-2.868**	-3.578**	2.58	4.272**	-2.944**	-2.636***
Ethnic	-0.548	-0.409	-0.718	1.024	0.0138	..	..
I_yp_c	0.729***	0.397***	0.691***	-0.188	-1.659***	0.623***	0.402***
I_gini	-1.195*	-2.428***	-1.701**	2.080**	0.244	-1.624**	-2.204***
Agr_prod	-0.212***	-0.177***	-0.215***	0.134**	0.255***	-0.198***	-0.171***
Agr_va	0.121***	0.108***	0.109**	-0.018	-0.196***	0.122***	0.117***
Ind_va	-0.051	-0.019	-0.052	-0.013	0.142	..	..
T_comm	-0.061**	-0.051**	-0.035	-0.050**	0.234***	-0.0561**	-0.053***
Irrigated	-0.035	-0.048	-0.056	0.107**	-0.007	..	..
Credit	-0.216	0.008	-0.324	0.415*	0.081	..	..
Trade	0.202	0.022	0.182	-0.071	-0.879	..	..
Govcons	-0.529	-0.261	-0.537	0.656	0.943	..	..
Tyr	-1.005***	..	-0.921**	0.071	2.681***	-0.607**	..
Obs.	89	122	89	90	93	134	

Notes: Models 1, 2, 3, 5, and 6 are estimated using an ordered probit. Model 4 is estimated by bivariate probit. To account for possible reverse causality, *credit*, *govcons*, *trade*, and *tyr* are all lagged. See the Online Appendix for variables definition. \*, \*\*, \*\*\* indicate that estimated coefficients are significant at 1 per cent, 5 per cent, and 10 per cent confidence level respectively.

Column I provides our baseline results. All of the statistically significant coefficients are in line with our a priori expectations. Among the time-invariant effects, those that matter the most are geographical location and socialist legal origin. Initial conditions are statistically very important: a richer country with a lower initial Gini

coefficient is less likely to achieve the most favourable scenario for development. The stage of structural transformation of the economy also matters: to be conducive to positive growth and declining inequalities, the transition from agriculture to industry must be accompanied by the modernisation of the agricultural system and hence by the acceleration of agricultural productivity growth. Finally, the development of telecommunication infrastructures and the increase in the education level of the population are also conducive to the achievement of a scenario of positive growth and declining inequality.[8]

In column II we drop the variable *tyr*, which is not available for all countries in the sample, in order to maximise the number of observations for estimation. The only noteworthy change concerns the variable *legor\_so*, which now becomes statistically insignificant. In fact, education data for socialist countries are not widely available. The regression with *tyr* therefore includes few observations on socialist legal origins and these few observations are concentrated in the period that corresponds to the transitional recession. The recovery of several socialist countries, with positive growth and lowering inequalities, towards the end of the 1990s and the early 2000s is therefore not captured by the estimates in column I. However, it is captured by the estimates in column II. The fact that in column II the coefficient of *legor\_so* is not significant can therefore be interpreted as evidence that, outside the period of the transitional recession, being of a socialist origin does not necessarily push countries towards an unfavourable development scenario.

In column III we make use of a three-category definition of the dependent variable. The evidence discussed in section III indicates that (i) scenarios are clearly ordered and (ii) differences between scenarios are statistically significant. Nevertheless, for a couple of development indicators, the difference between scenarios two and three might not be strong (see also note 3). Therefore, we test the robustness of our results by estimating a model where the dependent variable has only three categories: 0 for scenario one, 1 for scenarios two and three, and 2 for scenario four. The results do not dramatically differ from those reported in column I. However, we do notice that the coefficient on *t\_comm* is now less precisely estimated. When dropping the variable *tyr* (estimates available from the authors upon request) *t\_comm* returns to be statistically significant, while *legor\_so* becomes non-significant. All in all, we believe that the core of our results holds true whether four or three categories are defined for the dependent variable. As a further sensitivity check, in the Online Appendix (section AIV) we also report evidence from a multinomial logit model with unordered outcomes.

In column IV we estimate the effect of each variable separately on the probability of achieving (i) positive growth and (ii) lower inequality. The underlying setting is a bivariate probit model. In practice, we estimate two probit equations: in the first one, the dependent variable takes value one if the Gini indicator decreases (*gini\_down*); in the second equation, the dependent variable takes value one if growth is positive (*y\_pc\_up*). However, we do allow for correlated disturbances across the two probit equations, much in the same spirit as the seemingly unrelated regression model for continuous variables. A positive estimated coefficient now indicates that the regressor increases the probability of reducing inequality or achieving positive growth.

The estimates in column IV are useful to understand whether a particular variable plays its role mainly through the distributional effect (that is, the effect on the change in inequality) or the growth effect (that is, the effect on the change in per capita income). Interestingly, a few variables appear to activate both effects. This is the case for agricultural productivity growth and telecommunication infrastructures. However, while *agr\_prod* increases both the probability of reducing Gini and the probability of positive growth, *t\_comm* generates effects of opposite sign. In particular, *t\_comm* increases the probability of  $\Delta y > 0$ , but it also reduces the probability of  $\Delta g < 0$ . The estimates reported in columns I and II suggest that in the end the growth effect dominates, so that *t\_comm* positively contributes to the achievement of a scenario of growth and decreasing inequality. Of the other variables that are significant in the aggregate models, most tend to affect the probability of positive growth more than the probability of lowering inequality. It is, however, important to stress that, with the exception of *t\_comm*, none of the variables that promotes a positive growth also increase the likelihood of

higher inequalities. Similarly, none of the variables that increase the probability of *gini\_down* also decrease the probability of positive growth. Taken together, these findings mean that growth and decreasing inequality are not mutually exclusive, as long as the appropriate set of policies and conditions is in place.

Finally, we estimate a simplified specification of the benchmark model that only includes the statistically significant variables. We perform this exercise both excluding *tyr* (column V) and including *tyr* (column VI) among the regressors. All of the variables retain their sign and level of statistical significance, thus suggesting that the estimates are not determined by spurious correlations arising from the inclusion of irrelevant regressors. Note that the results on *legor\_so* are consistent with the findings from the benchmark specification in column I. As an additional robustness test (not reported in Table 2, but available upon request), we take each of the non-significant variables from column I (or II) and add it, one at a time, to the simplified specification of column V (or VI). None of these other variables turns out to be significant. At the same time, the estimated coefficients of the variables of the simplified specification remain very similar to those reported in the table.

## V. Conclusions

In this article we are concerned with the contribution of economic policies to the creation of conditions that are most conducive to development. Our point of departure is the observation that the dynamics of several development indicators can be clustered in four groups and that each group corresponds to a specific combination of growth and changes in inequality. We can then identify four scenarios that are ordered from most conducive to least conducive to development. We use an ordered probit model to study how policies and structural factors affect a country's probability of achieving the most (or least) favourable scenario. This approach presents a couple of advantages. First, we are able to study the determinants of *broad* development rather than focusing on a single specific dimension or indicator. Equally important is the fact that we can do this without having to come up with some arbitrary procedure to aggregate individual development indicators into a single measure. Second, with the ordered probit model we avoid some of the pitfalls that arise when using growth and inequality as continuous dependent variables in single or system equation estimation. These advantages come at no real cost in terms of loss of information as the categorical dependent variable in our model is a very strong predictor of development outcomes, possibly even stronger than the continuous variables growth and inequality.

The results point to a comforting picture: good policies help create favourable conditions for development. In this sense, countries are not condemned to be underdeveloped by initial conditions, geography, or historical legacies. By implementing the appropriate set of policies, a country can achieve the scenario of positive growth with declining inequality that provides the most favourable conditions for sustained development. In this respect, policies promoting the accumulation of human capital and the development of infrastructures appear to be particularly beneficial. Supporting the structural transformation of the economy and the expansion of the industrial sector is also going to play an important role. However, our findings indicate that while promoting structural transformation, governments should avoid treating agriculture as a 'neglected sector'. In fact, structural transformation should be accompanied by a process of modernisation of the agricultural system to increase agricultural productivity.

## Acknowledgements

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# Online Appendix

## AI. System Estimates

Table A1 reports estimates of the following system:

Where  $y$  and  $g$  are (log) per capita income and Gini index,  $\Delta$  is the difference operator (so that  $\Delta y$  and  $\Delta g$  respectively denote the growth rate of GDP per capita and the rate of change of income inequality),  $\mathbf{X}$  and  $\mathbf{Z}$  are sets of country-fixed effects (for example, legal origins, distance from equator, ethnic fractionalisation) and initial values (for example, initial value of log per-capita GDP and/or initial value of log Gini coefficient),  $\mathbf{W}$  and  $\mathbf{M}$  are sets of other policy and structural factors (all expressed in annualised percentage change),  $\varepsilon$  and  $u$  are random disturbances,  $i$  denotes a generic country,  $t$  denotes a generic sub-period, and  $\alpha_0, \alpha_1, \gamma_0, \gamma_1, \mathbf{A}, \mathbf{B}, \Gamma$ , and  $\Lambda$  are the parameters to be estimated.

To identify the system, some exclusion restrictions must be imposed. In fact, growth and inequality are likely to be driven by similar processes. Therefore, it is difficult to come up with exclusion restrictions that have a solid theoretical justification. In fact, this is one of the major pitfalls associated with the estimation of models of growth and inequality. Nevertheless, we explore two different alternatives. In column I we impose restrictions by excluding from (A2) some of the controls included in (A1) and vice versa. In column II instead we set  $\alpha_1$  and  $\gamma_1$  equal to zero and estimate a 'quasi-reduced' form model, as suggested by Lundberg and Squire (2003). Estimation is by Generalized Method of Moments (GMM). Potentially endogenous regressors (that is, those in  $\mathbf{B}$  and  $\Lambda$ ) are instrumented by their level at the beginning of each sub-period and the lagged value of the rate of change over the five years before the beginning of each sub-period. The results of the test of over-identifying restrictions are reported at the bottom of the table.

Table A1. System estimates

	Column I		Column II	
	Growth (eq. A1)	Inequality (eq. A2)	Growth (eq. A1)	Inequality (eq. A2)
Legor_uk	0.967**	-0.082	1.622**	-1.125**
Legor_so	-0.997	-0.089	-1.655	2.156
Lat_abst	..	-1.180*	2.565	-3.846**
Ethnic	0.814	-1.126	0.535	-1.443
I_yp_c	-0.035**	..	-0.171**	-0.263
I_gini	..	-2.830***	1.665	-4.580***
Agr_prod	0.564***	-0.614**	0.140**	-0.310*
Agr_va	-0.043	..	-0.202*	0.074
Ind_va	0.062	-0.025	0.061	-0.035
T_comm	0.430***	0.290**	0.415***	0.129*
Irrigated	-0.012	-0.189	-0.281	-0.531
Credit	-0.028	-0.015	0.003	-0.037
Trade	-0.001	-0.045	-0.048	0.028
Govcons	0.184*	-0.253	0.031	-0.271**
Tyr	0.337**	-0.341*	0.529***	-0.453**
Y_pc	..	-0.861***		
Gini	-0.591***	..		
J stat (p-value)	0.104 (0.637)	0.137 (0.454)		

Notes: GMM estimates of the system of equation A1-A2. Estimated coefficients of the constant terms in each equation are not reported. \*, \*\*, \*\*\* denote statistical significance at the 10 per cent, 5 per cent, and 1 per cent confidence level respectively.

Two main conclusions can be drawn from the estimates in the table. First of all, the system estimates and the ordered probit estimates are qualitatively quite similar. In particular, the sign of the estimated coefficients in the system is fully coherent with the sign of the estimated coefficients in the ordered probit model. Variables that have a negative (positive) and significant coefficient in the ordered probit model also display a positive (negative) coefficient in the growth regression and/or a negative (positive) coefficient in the inequality regression. Second, if anything, ordered probit estimates are a bit more precise than system estimates. On average, the degree of statistical significance of coefficients in the ordered probit model is higher than in the system and some of the variables that happen to be significant in the ordered probit model are not significant in the system. Given the discussion and evidence presented in sections II and III of the article and in section AII below, this should not be, perhaps, too surprising.

## AII. Regressions of Development Indicator

Table A2 reports Generalized Least Squares (GLS) estimates of a regression of development indicators (expressed in percentage change) on the categorical dependent variable of the ordered probit model, growth, and inequality (expressed in percentage change). We perform this exercise to see whether using a categorical dependent variable rather than two separate continuous variables involves any cost in terms of explaining development patterns.

The top panel of the table reports results of the regression with the categorical variable as the only regressor. The central panel of the table reports the results of the regression with growth and inequality as the two regressors. Finally, the bottom panel of the table shows the results of the regression with all of the three variables included on the right hand side (r.h.s.). For each regression we report  $R^2$  as a standard measure of goodness of fit. To interpret the results, recall that the categorical variable takes value 0 for scenario one (most conducive to development), value 1 for scenario two, value 2 for scenario three, and value 3 for scenario four (least conducive to development).

Table A2. Regressions of development indicators

	Poverty headcount	Life expectancy	Immunisation	Years of schooling	Malnutrition	Child mortality
Ordered variable	0.876***	-0.0789***	1.272***	0.756***	-0.563***	-0.153***
$R^2$	0.35	0.28	0.37	0.35	0.41	0.32
Growth	-1.431***	0.076**	0.302***	0.376**	-0.650**	-0.045**
Inequality	2.192***	0.048*	0.381	-0.051*	-0.05	0.035**
$R^2$	0.39	0.24	0.33	0.38	0.27	0.36
Ordered variable	0.756***	-0.052**	1.036*	0.631***	-0.326*	-0.201***
Growth	-1.286**	0.054**	0.102*	0.252*	-0.717***	-0.016*
Inequality	1.054*	0.005	0.055	-0.079**	-0.01	0.018*
$R^2$	0.42	0.31	0.30	0.38	0.49	0.36

Notes: GLS estimates of the regression of each development indicator on the categorical variable, growth, and inequality. \*, \*\*, \*\*\* denotes statistical significance at usual confidence levels.

The estimates suggest three main considerations. First, the association between development outcomes and the categorical variable is highly significant. Second, the goodness of fit of the regression with the categorical variable is as high as the goodness of fit of the regression with the two continuous variables. In this sense, it does not seem that by using the categorical variable we are explaining much less of the total variation of the development indicators. Third, when the categorical variable is used in the regression together with the two

continuous variables, a problem of multicollinearity (obviously) arises. In spite of this, the categorical variable remains significant at usual confidence level and it is often statistically more significant than any of the other two continuous variables.

These results lead us to believe that the use of the categorical variable, in the specific case of this exercise, does not involve a large cost in terms of loss of information.

### AIII. Parametric and Non-parametric Evidence on the Relationship between Growth and Changes i...

To provide a bit more systematic evidence on the relationship between growth and changes in inequality in our dataset, we fit a scatter plot of the two variables using two different methods. The first method (panel A of Figure A1) is a standard linear regression, which implicitly assumes a linear relationship between the two variables. The second method (panel B of Figure A1) is a non-parametric fit that is known as *lowess* (Cleveland, 1993). In a nutshell, let  $(\Delta y_i, \Delta g_i)$  be a generic observation on per capita growth and changes in inequality. We then run a locally weighted polynomial regression of  $\Delta g_i$  on  $\Delta y_i$  using only a subset of observations that lie around  $\Delta y_i$ , with smaller weights being given to the observations that are more distant from  $\Delta y_i$ . The fitted value of this local regression evaluated at  $\Delta y_i$  is used as the smoothed value in constructing the curve that links  $\Delta g$  and  $\Delta y$ . The procedure is repeated for each observation  $(\Delta y_i, \Delta g_i)$  in the full sample until the curve can be traced out. With this procedure, we therefore impose as little structure on the functional form of the relationship as possible, which in turn allows us to better account for possible non-linearities.

Graph: Figure A1 The relationship between growth and changes in inequality.

The scatter plot in panel A suggests that the correlation between growth and changes in the Gini coefficient is negative: as the growth rate increases, the increase in inequality decreases and eventually becomes negative. While nothing can be said about the direction of causality, the downward sloping regression line supports the view that there is no trade-off between growth and redistribution. The non-parametric fitted line in panel B indicates that the relationship might effectively be non-linear: sharply negative at negative values of the growth rate and then substantially flat. In fact, one might argue that the overall negative slope of the regression line in panel A is largely driven by the observations at negative (or low positive) values of the growth rate. Once growth turns more significantly positive, the correlation is very close to zero, meaning that growth and declining inequality move independently from each other. Even in this case, however, the data do not point to a systematic trade-off in the sense that countries do not necessarily have to accept a lower growth rate to promote a decrease in inequality and vice versa. The issue is then to understand which policies a country can implement to achieve a combination of growth and declining inequality.

### AIV. Multinomial Logit Model

In sections II and III we argue that our dependent variable is inherently ordered and therefore we estimate an ordered probit model. While we believe that the statistics reported in section III of the article support this approach, we acknowledge the possibility that theoretically our scenarios might not represent ordered categories. In this case, the appropriate econometric framework would be a multinomial logit (or probit) model. The model specifies the probability of observation  $i$  to be in category  $j$  (where  $j = \text{scenario } 1, \dots, \text{scenario } 4$ ) as:

Graph

where all the variables are as in Equation (1) of the article. The identification of model (A3) requires  $\alpha_j$  to be set to 0 for one of the categories (the so called base outcome) and hence estimated coefficients are interpreted with respect to that category.

Estimates of Equation (A3) are reported in Table A3.<sup>1</sup> A set of estimated coefficients is reported for each scenario, with the exception of scenario one. This is because scenario one is chosen as the base scenario. Then, the estimated coefficients measure the marginal effect that each regressor has on the probability of a given scenario relative to the base scenario.

Table A3. Multinomial logit

	Scenario 2	Scenario 3	Scenario 4
Legor_uk	-0.962	-0.357	-1.157
Legor_so	-1.255	-4.592***	0.932
Lat_abst	-3.636	-1.857	-14.554**
Ethnic	-1.486	-0.254	-2.519
I_yp_c	0.549	0.412	2.649***
I_gini	-5.346***	-0.102	-16.222***
Agr_prod	-0.160*	-0.369**	-0.786***
Agr_va	0.095	0.348**	0.360**
Ind_va	0.094	-0.016	-0.245
T_comm	-0.042	-0.593***	-0.182
Irrigated	-0.229**	-0.029	-0.781***
Credit	0.120	0.929	-0.667
Trade	0.246	0.500	-1.437
Govcons	-1.318	-2.381	-0.208
Obs.	122		

Notes: Scenario 1 is the base outcome in the multinomial logit regression. Estimated coefficients therefore measure the effect that regressors have on the probability of the other scenarios relative to the base scenario. To account for possible reverse causality, credit, trade, and govcons are lagged. See section AV for variables definition. \*, \*\*, \*\*\* indicate statistical significance of the estimated coefficient at the 10 per cent, 5 per cent, and 1 per cent confidence level respectively.

While the interpretation of coefficients is clearly different from the ordered probit model estimated in the article, we believe that the multinomial logit results are qualitatively in line with those reported in Table 2 of the article. In particular, a higher initial per capita income and a lower initial degree of inequality reduce the probability to achieve the growth and redistribution scenario. At the same time, faster agricultural productivity growth and better infrastructure increase the likelihood of a country to achieve growth and redistribution.

## AV. Variables Description

Unless otherwise indicated, all of the variables are expressed in annualised percentage changes. WDI is the World Development Indicators Database of the World Bank, 2008 issue.

- Poverty headcount: percentage of population living on less than 1 dollar per day (source: PovcalNet, World Bank).
- Life expectancy: number of years that an average individual in the population is expected to live (source: WDI).
- Child mortality: number of children under died before age five per 1000 born (source: WDI).
- Immunisation DPT: percentage of children ages 12–23 months who received vaccinations before 12 months (source: WDI).
- Malnutrition: percentage of children under age five whose weight for age is more than two standard deviations below the median for the international reference population ages 02–59 months (source: WDI).
- Female literacy: percentage of female population that can read and write (source: WDI).

- *i\_yp\_c*, per-capita income: real per-capita GDP at constant US dollars (base year 2000) (source: WDI). This variable is expressed in levels.
- *i\_gini*, Gini coefficient of inequality of income distribution (source: PovcalNet, World Bank). This variable is expressed in levels.
- *govcons*, government size: total government consumption in percent of GDP (source: WDI).
- *Credit*, financial depth: domestic credit to the private sector in percent of GDP (source: WDI).
- *Trade*, international trade openness: exports plus imports in percent of GDP (source: WDI).
- *tyr*, education: number of years of schooling of the average individual in the population (source: Barro and Lee, 2001; UNESCO).
- *Legor\_uk*, UK legal origin: dummy variable taking value 1 if country's legal system originates from the UK common law code (source: La Porta et al., 1999). This variable is expressed in levels.
- *Legor\_so*, Socialist legal origin: dummy variable taking value 1 if country's legal system originates from the socialist law (source: La Porta et al., 1999). This variable is expressed in levels.
- *Ethnic*, ethnic fragmentation: probability that two randomly selected individuals are not from the same ethnic group (source: La Porta et al., 1999). This variable is expressed in levels.
- *Agr\_prod*, Agricultural productivity: agricultural output per worker employed in the agricultural sector (source: WDI).
- *Agr\_va*: value added of agricultural sector in percent of GDP (source: WDI).
- *Ind\_va*: value added of the industrial sector in percent of GDP (source: WDI).
- *T\_comm*: density of telecommunication infrastructures. Number of telephone mainlines per 1000 inhabitants (source: WDI).
- *Irrigated*: proportion of irrigated agricultural land in percent of total agricultural land (source: WDI).

## Note

1. We exclude *tyr* to maximise the number of observations. In fact, when *tyr* is included, all coefficients retain the sign reported in Table A3. However, the small number of observations implies large standard errors and only few of the coefficients turn out to be statistically significant at either the 1 per cent or 5 per cent confidence level.

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## Notes

### Footnotes

1. *The empirical estimation of the determinants of specific health indicators is obviously a main area of interest in medical science. See for instance Houweling et al. ([24]) and Blouin et al. ([10]) for two recent contributions of interest to development economists.*



2. The short time series dimension of our panel is due to (i) the limited availability of many development indicators on a time series basis and (ii) the requirement that percentage changes be computed over periods of at least five years. The Online Appendix provides a full description of sources and details on the construction of the dataset.
3. There are few notable exceptions. Thus, with respect to the poverty headcount and malnutrition the difference between scenario two and scenario three is not significant. With respect to female literacy the difference between scenario three and scenario four is not significant. All of the estimated coefficients are available from the authors upon request.
4. The determinants of institutional quality are analysed by La Porta et al. ([26]) and Acemoglu and Johnson ([2]). Acemoglu ([1]: ch. 22) provides a survey of the voluminous research on the relationship between institutions and growth. Finally, the effect of institutions on income inequality is investigated, inter alia, in Carmignani ([13]).
5. See, for instance, Aghion and Howitt ([4]: ch. 10).
6. Esfahani and Ramírez ([21]), among others, discuss the positive contribution of infrastructures to growth.
7. Time invariant effects and initial conditions are pre-determined and therefore treated as exogenous. In the end, we test for the endogeneity of  $t\_comm$ ,  $irrigated$ ,  $credit$ ,  $trade$ ,  $tyr$ , and  $gov\_cons$ .
8. The estimated threshold parameters  $\mu$  for the mode in column I are:  $\mu_1 = -4.43$  (-9.76, 0.89),  $\mu_2 = -2.94$  (-8.25, 2.36),  $\mu_3 = -2.14$  (-7.46, 3.16). Estimates for the other models are qualitatively similar and can be obtained from the authors upon request.

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