

Going beyond functionings to capabilities: an
econometric model to explain and estimate capabilities

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An attempt

- to understand the complex mechanisms involved in capability enhancement
- by providing a theoretical structure for their representation, explanation and measurement
- leading to an econometric model that can be estimated using real data
- yielding estimators that reflect capabilities derived from functionings

Outline of the presentation

Introduction

Simultaneity

Measurement

Theoretical Framework

Econometric Model

Empirical Application

Conclusions

Introduction

The basic purpose of development is to enlarge people's choices so that they can lead the life they want to (Sen (1985, 1999)).

Development or welfare is a multidimensional concept enveloping diverse social, economic, cultural and political dimensions

Capabilities are the *choices* that one has

Functionings are the actual outcomes or the levels of achievement attained in the various dimensions

Capabilities are unobservable

Functionings are observable/measurable

Therefore an appealing framework is:

A model which assumes that the capabilities are *latent* variables *manifesting* themselves through a set of observed indicators.

Examples of such models used in our context: Principal components, factor analysis and MIMIC (multiple indicators and multiple causes)

Principal components:

The latent variables are estimated as linear combinations of the observed indicators chosen in such a way as to reproduce the original data as closely as possible.

But there is no underlying theoretical model.

Factor analysis:

Offers a theoretical explanation: the observed values are postulated to be (linear) functions of a certain number (fewer) of unobserved latent variables (called factors). Thus it provides a framework for going beyond functionings to reach the capabilities represented by the latent factors.

But this model does not *explain* the latent variables (or the capabilities in our context) in that it does not say what causes these capabilities to change.

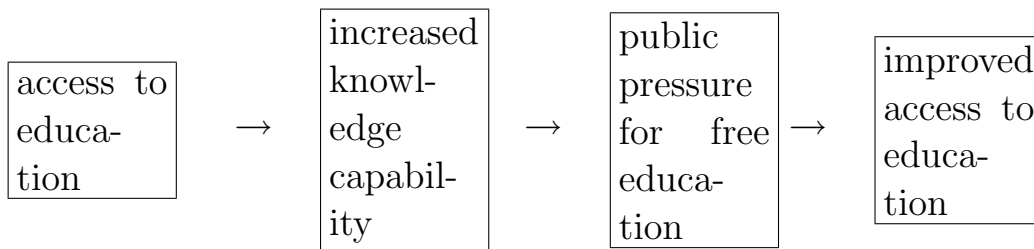
MIMIC model:

Here it is not only believed that the observed variables are manifestations of an underlying unobserved latent concept but also that there are other exogenous variables that “cause” and influence the latent factor(s).

This model is a step ahead in the right direction but...

We believe: Not only do these “causes” influence capabilities or human development but they are also influenced by it.

A simple example :



Other relevant models for the above situation:

LISREL with ordinal variables

MIMIC with exogenous variables

But *the capability approach* needs more...

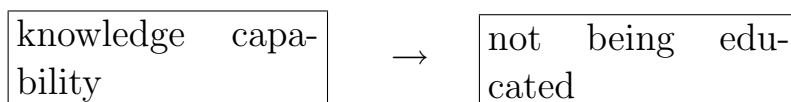
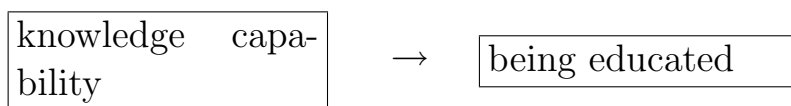
The Simultaneous Nature of Capabilities

Remember capabilities are the choices that one faces in life and functionings are the outcomes.

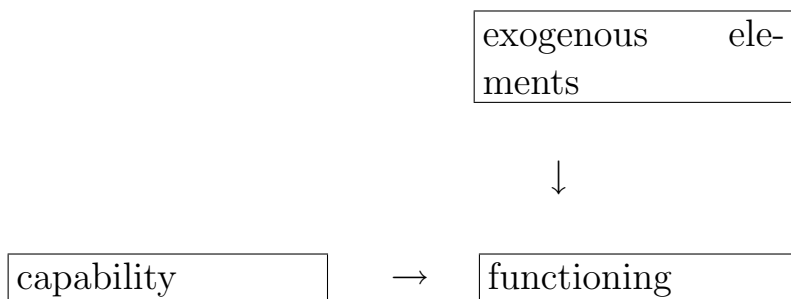
So given a capability level it is possible to have more than one achievement levels.

Take education for instance.

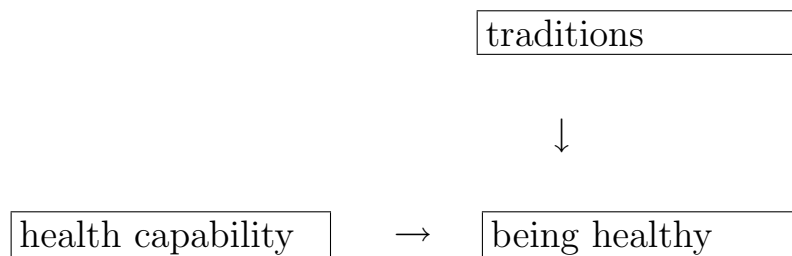
From capability to more than one achievements



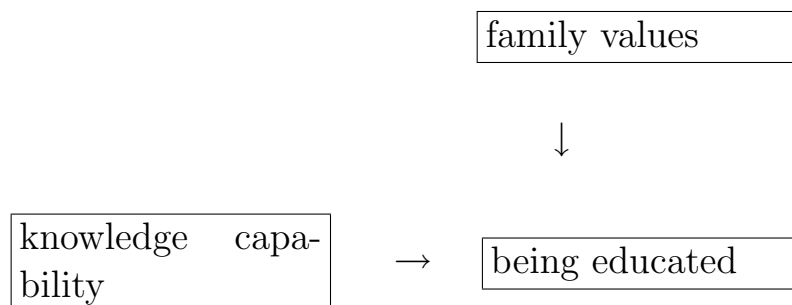
Why: because of exogenous elements



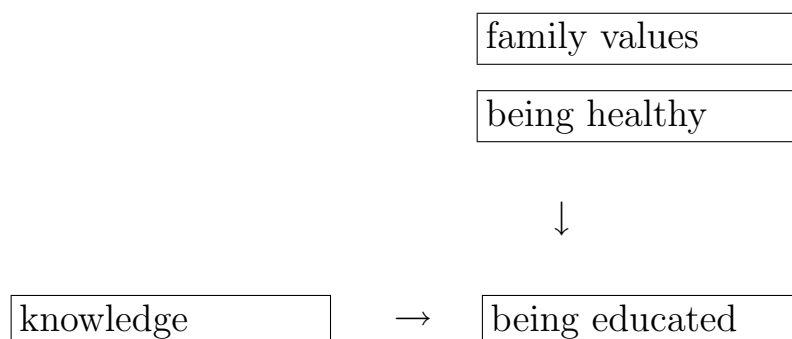
For instance in the case of health



Similarly in the case of education

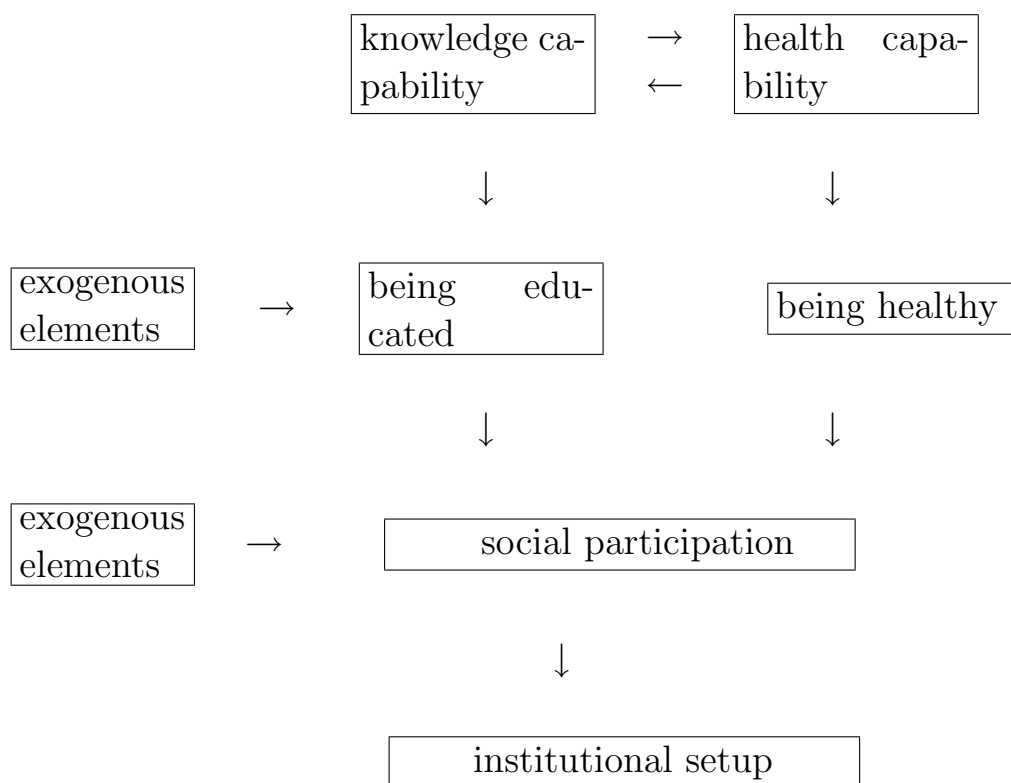


But we could also add 'being healthy' as an influencing factor for education or vice versa: interdependence



Now,

Education and health encourage social participation



Increased social participation in turn affects the institutional setup: so some of these ‘exogenous’ elements not so ‘exogenous’ after all!

Therefore:

Capabilities are interdependent

Not only do capabilities interact among themselves but also with some external elements representing the socio-political setup.

Thus there are feedback effects; some external factors are in fact potentially endogenous.

For other factors like individual characteristics, traditions, culture, the causal link only operates in one direction (making them purely exogenous).

The Measurement Issue

Capabilities by definition cannot be directly measured.

Hence they need to be specified as latent unobservable variables in our model.

What can be measured however are the functionings namely the achievements in each dimension both at the individual (household) and at the national levels. These achievements are generally identified by proper indicators reflecting the performance in the associated dimension.

One normally has a vector of functionings rather than a scalar indicator corresponding to each domain.

For example in the case of health, at the national level, one can think of classic indicators such as life expectancy, infant mortality, child mortality and in the case of education literacy rate, enrolment ratio etc.

Types of indicators available in practice:

Quantitative or Continuous

Most common like the above-mentioned life expectancy, per capita number of doctors etc.

Qualitative

Binary or dichotomous: two outcomes

For instance the existence of the right to vote or not, existence of safe water access or not, existence of adequate sanitation facilities or not, also subjective assessments like whether a person considers herself to be poor or not.

Polychotomous: more than two outcomes

Ordinal or sequential: e.g. different levels of education - no formal education, primary, secondary, college...

With no order for example religion - Hindu, Muslim, Buddhist, Christian etc.

Truncated or censored

Truncated when not observed for a particular range of values, censored when observed only if greater than a threshold value.

The General Theoretical Framework

- (i) Capabilities are *latent, unobservable* and interdependent, and are *endogenous* in our structural model.
- (ii) Capabilities are influenced by a set of social, political and institutional factors some of which may in turn be influenced by them. (In addition to capabilities there are also some *observed endogenous* variables in our model.)
- (iii) Capabilities are also influenced by a set of observable external/*exogenous* causes (such as traditions, cultural elements, natural environmental factors and some social, political, institutional ones which are not part of (ii)).
- (iv) Achievements/functionings are measurable and are linked to the underlying capabilities (the set of relationships linking the two is the so-called measurement model or the qualitative response model).
- (v) The relationships between the latent capabilities and the observed functionings are also affected by *exogenous* elements (for instance individual characteristics).

Some notations

y^* a vector of latent unobserved capabilities say $(m \times 1)$

y a vector of observed indicators representing the functionings associated with the capability vector say $(p \times 1)$

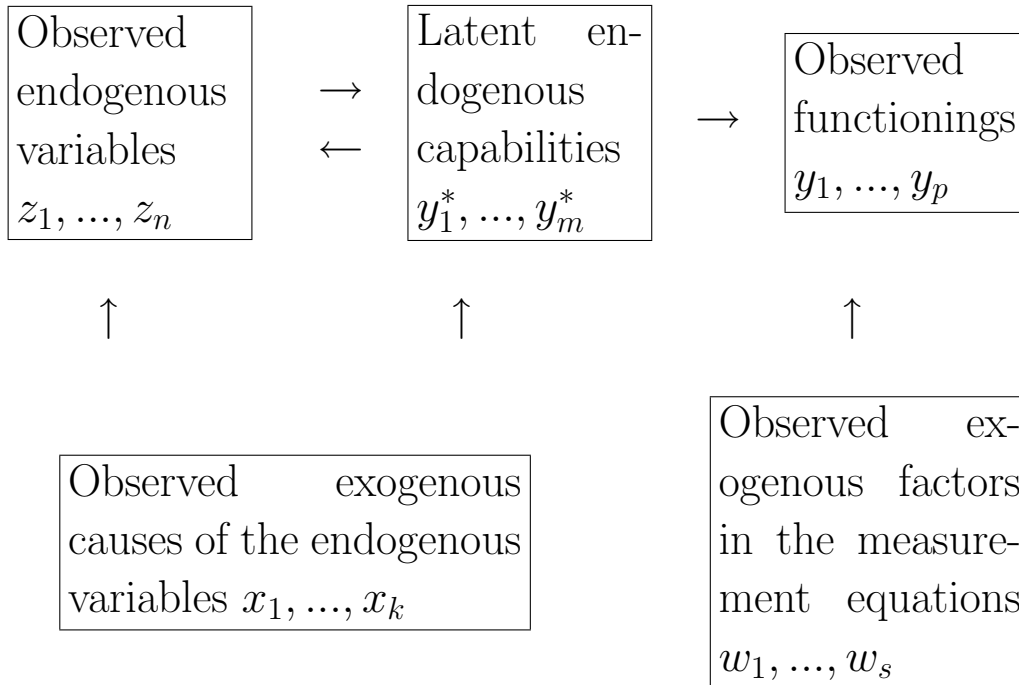
as discussed earlier, some these y 's could be continuous, some qualitative or discrete

z a vector of observed variables that influence the capabilities but are also influenced by them say $(n \times 1)$

x a vector of exogenous "causes" of y^* and z say $(k \times 1)$

w a vector of exogenous factors entering the measurement equations i.e. the relationships between observed indicators y and latent variables y^* say $(s \times 1)$

Our framework:



The Econometric Model

$$Ay^* + Bz + Cx + u = 0 \quad (1)$$

$$g(y) = h(y^*, w) + v \quad (2)$$

Equations (1) represent the structural simultaneous equation model (SEM) which jointly explains (y^*, z) in terms of x , with A , B , C being the corresponding coefficient matrices of appropriate dimensions.

Equations (2) form the measurement model or the qualitative response model (QRM) where it is specified how the latent variables are related to the observed responses through functions $g(\cdot)$ and $h(\cdot)$. Note the presence of exogenous variables in both the models.

Estimation:

By two-stage methods via the reduced form (see example)

Some special cases:

Case 1

If y is continuous, $g(\cdot), h(\cdot)$ linear and there is no w we get the standard LISREL model (cf. Joreskog (1973)) (with observed rather than latent exogenous, refer to an earlier remark in this respect).

Case 2

With ordinal y and no w we have LISREL with ordinal variables (cf. Joreskog (2002), Muthen (1983, 1984)). The latter author has two types of measurement equations: ‘inner’ measurement equations and ‘outer’ measurement equations as he allows for *latent* response variables and *observed* response variables.

Case 3

If y^* scalar, $A = 1$, no z , no w , y continuous we have the MIMIC model (cf. Joreskog and Goldberger (1975)).

Case 4

Same as Case 3 with y^* a vector, $A = I$, we have the extended or generalised MIMIC.

Case 5

Same as Case 4 with w and z , we have the MIMIC with covariates (cf. Moustaki (2003)).

Case 6

If y^* is observed (no measurement equation) then we have the classical SEM (cf. e.g. Theil (1979), Hausman(1983)).

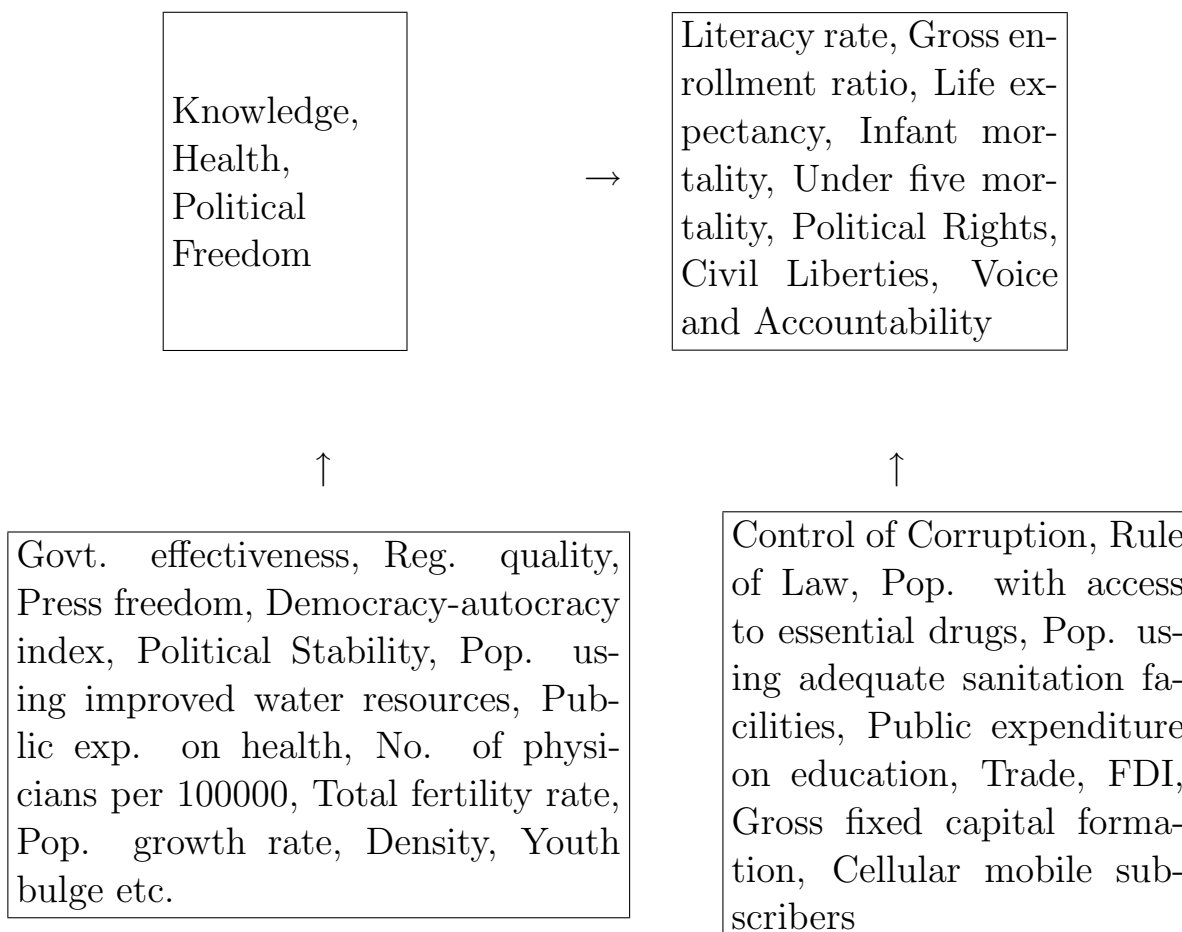
Case 7

If y^* is observed and $A = I$, then we have the SUR model (cf. Zellner (1962)).

Case 8

When y^* is scalar (no z) and y is either discrete or limited dependent we have the classical qualitative dependent variable model (see Amemiya (1985)).

Empirical Model



Data Sources

UNDP:	Human Development Data
World Bank Group:	World Development Indicators
World Bank Group:	Worldwide Governance Research Indicators
CIFP:	Risk Assessment Indicators

List of Variables

The latent endogenous variables	
y_1^* :	Knowledge
y_2^* :	Health
y_3^* :	Political Freedom
The achievement indicators	
y_1 :	Political Rights
y_2 :	Civil Liberties
y_3 :	Voice and Accountability
y_5 :	Life expectancy at birth (years)
y_6 :	Adult literacy rate (% age 15 and above)
y_7 :	Combined primary, secondary & tertiary gross enrolment ratio (%)
y_8 :	Infant mortality rate (per 1,000 live births)
y_9 :	Under-five mortality rate (per 1,000 live births)

List of Variables: contd.

Possible exogenous variables (observed)	
For the structural part	
x_1 :	Government Effectiveness
x_2 :	Regulatory Quality
x_3 :	Population using improved water sources (%)
x_4 :	Cellular mobile subscribers (per 1.000 people)
x_5 :	Public expenditure on health (% of GDP)
x_6 :	Total debt service (% of GDP)
x_7 :	Density (persons per sq.km.)
x_8 :	Political Stability
x_9 :	Population Growth Rate (Annual %)
x_{10} :	Urban Population Growth Rate (Annual %)
x_{11} :	Youth Bulge (Pop. Aged 0-14 as a % of Total)
x_{12} :	Physicians (per 100,000 people)
x_{13} :	Press Freedom
x_{14} :	Democracy - Autocracy Index
x_{15} :	Total fertility rate (per woman)
x_{16} :	Foreign direct investment (PPP USD)
x_{17} :	Gross fixed capital formation (PPP USD)
x_{18} :	Trade (PPP USD)
For the measurement part	
w_1 :	Control of Corruption
w_2 :	Rule of Law
w_3 :	Population with access to essential drugs (%)
w_4 :	Population using adequate sanitation facilities (%)
w_5 :	Public expenditure on education (% of GDP)

Table 1. Results of the Measurement Model

Dep. var.	y_1	y_2	y_3	y_5	y_6	y_7	y_8
Expl. var.							
y_1^*	—	—	—	—	1 (0)	0.708 (0.056)	—
y_2^*	—	—	—	1 (0)	—	—	-3.865 (0.343)
y_3^*	1 (0)	0.662 (0.035)	0.395 (0.019)	—	—	—	—
w_3	—	—	—	0.042 (0.029)	—	—	-0.103 (0.092)
w_5	—	—	—	—	1.719 (0.823)	1.584 (0.834)	—
R^2	0.921	0.880	0.951	0.834	0.868	0.796	0.969

Figures inside parentheses are standard deviations.

Table 2. Results of the Structural Equation Model

Explanatory variables	Dependent variables	y_1^*	y_2^*	y_3^*
y_1^*		—	—	0.011 (0.004)
y_2^*		1.374 (0.269)	—	—
y_3^*		—	0.284 (0.308)	—
w_1		—	—	0.614 (0.180)
w_4		—	0.065 (0.023)	—
x_7		-0.030 (0.005)	—	—
x_{11}		-64.293 (30.547)	—	—
x_{12}		—	0.001 (0.006)	—
x_{13}		—	—	0.077 (0.005)
x_{14}		0.584 (0.588)	—	—
x_{15}		—	-4.003 (0.481)	—
R^2		0.821	0.798	0.892

Figures inside parentheses are standard deviations.

Table 3. Explanations of abbreviations used in rank tables

hdi:	human development index
\hat{H} :	our aggregate index based on estimated factor scores
GDP:	Gross Domestic Product per capita
y^*1 :	‘knowledge’ or ‘education’ dimension
y^*2 :	‘health’ dimension
y^*3 :	‘political freedom’ dimension
rhdi:	rank according to HDI
rhhat:	rank according to \hat{H}
rgdpn:	rank according to (normalised) GDP
ry^*n :	rank according to y_n^* for $n=1,2,3$

Table 4. Rank Correlations

rhhat,rhdi	rhav,rhdi	rhdi, ry*1	rhdi, ry*2	rhdi, ry*3	rhdi,rgdpn	rhhat,rgdpn
0.861	0.915	0.917	0.916	0.528	0.756	0.756
hdi,hhat	hdi,hav	hdi,y*1	hdi,y*2	hdi,y*3	hdi,gdpn	hhat,gdpn
0.851	0.914	0.948	0.94	0.426	0.891	0.796

Table 5. Country Rankings

COUNTRY	rankhdi	rankhhat	rankgdpn	ranky*1	ranky*2	ranky*3
Argentina	1	2	2	2	3	6
Hungary	2	6	1	5	2	12
Slovakia	3	5	3	1	4	2
Chile	4	3	31	9	5	31
Uruguay	5	4	6	3	6	5
Costa Rica	6	12	12	4	9	3
Mexico	7	8	4	10	1	29
Panama	8	9	5	16	12	19
Bulgaria	9	19	7	18	21	8
Romania	10	1	15	17	19	4
Colombia	11	10	11	23	8	9
Mauritius	12	23	23	8	10	35
Venezuela	13	16	9	11	23	10
Thailand	14	29	20	21	13	23
Brazil	15	14	14	6	22	1
Philippines	16	15	30	15	7	16
Kazakhstan	17	31	8	7	11	51
Peru	18	7	17	29	14	14
Jamaica	19	21	26	25	15	15
Turkey	20	13	13	14	16	54
Sri Lanka	21	37	10	34	32	47
Paraguay	22	22	22	22	33	37
Dominican Rep.	23	35	18	31	25	7
Uzbekistan	24	11	29	13	37	41
China	25	18	38	28	27	50
Iran	26	27	27	33	36	38
Jordan	27	34	16	20	34	13
Kyrgyzstan	28	38	25	24	18	18
Guyana	29	20	19	26	26	27
Algeria	30	41	36	36	20	46

Table 5. Country Rankings: contd.

COUNTRY	rankhdi	rankhhat	rankgdpn	ranky*1	ranky*2	ranky*3
South Africa	31	39	39	35	39	21
Syria	32	36	21	12	24	22
Vietnam	33	28	32	19	29	34
Indonesia	34	26	34	37	28	11
Bolivia	35	47	37	27	38	39
Egypt	36	17	28	32	30	49
Honduras	37	46	40	30	17	20
Guatemala	38	25	24	40	46	28
Morocco	39	51	35	38	41	42
Zimbabwe	40	33	41	42	31	48
Ghana	41	32	33	43	35	36
Cambodia	42	30	53	49	43	45
Kenya	43	24	52	41	40	43
Pakistan	44	50	44	47	45	17
Togo	45	43	48	39	50	26
Bangladesh	46	40	42	45	44	55
Madagascar	47	42	45	44	42	40
Mauritania	48	45	46	51	47	52
Zambia	49	49	50	50	53	53
Senegal	50	54	55	46	51	30
Benin	51	44	43	53	49	44
Guinea	52	53	51	55	52	25
Gambia	53	48	47	52	55	24
Mali	54	55	54	48	48	32
Chad	55	52	49	54	54	33

Table 6. Rank Differences

COUNTRY	rhdi-rhhat	rgdpn-rhhat	ry*1-rhhat	ry*1-rhdi	ry*3-rhhat	ry*3-rhdi
Argentina	-1	0	0	1	4	5
Hungary	-4	-5	-1	3	6	10
Slovakia	-2	-2	-4	-2	-3	-1
Chile	1	28	6	5	28	27
Uruguay	1	2	-1	-2	1	0
Costa Rica	-6	0	-8	-2	-9	-3
Mexico	-1	-4	2	3	21	22
Panama	-1	-4	7	8	10	11
Bulgaria	-10	-12	-1	9	-11	-1
Romania	9	14	16	7	3	-6
Colombia	1	1	13	12	-1	-2
Mauritius	-11	0	-15	-4	12	23
Venezuela	-3	-7	-5	-2	-6	-3
Thailand	-15	-9	-8	7	-6	9
Brazil	1	0	-8	-9	-13	-14
Philippines	1	15	0	-1	1	0
Kazakhstan	-14	-23	-24	-10	20	34
Peru	11	10	22	11	7	-4
Jamaica	-2	5	4	6	-6	-4
Turkey	7	0	1	-6	41	34
Sri Lanka	-16	-27	-3	13	10	26
Paraguay	0	0	0	0	15	15
Domin. Rep.	-12	-17	-4	8	-28	-16
Uzbekistan	13	18	2	-11	30	17
China	7	20	10	3	32	25
Iran	-1	0	6	7	11	12
Jordan	-7	-18	-14	-7	-21	-14
Kyrgyzstan	-10	-13	-14	-4	-20	-10
Guyana	9	-1	6	-3	7	-2
Algeria	-11	-5	-5	6	5	16

Table 6. Rank Differences: contd.

COUNTRY	rhdi-rhhat	rgdpn-rhhat	ry*1-rhhat	ry*1-rhdi	ry*3-rhhat	ry*3-rhdi
South Africa	-8	0	-4	4	-18	-10
Syria	-4	-15	-24	-20	-14	-10
Vietnam	5	4	-9	-14	6	1
Indonesia	8	8	11	3	-15	-23
Bolivia	-12	-10	-20	-8	-8	4
Egypt	19	11	15	-4	32	13
Honduras	-9	-6	-16	-7	-26	-17
Guatemala	13	-1	15	2	3	-10
Morocco	-12	-16	-13	-1	-9	3
Zimbabwe	7	8	9	2	15	8
Ghana	9	1	11	2	4	-5
Cambodia	12	23	19	7	15	3
Kenya	19	28	17	-2	19	0
Pakistan	-6	-6	-3	3	-33	-27
Togo	2	5	-4	-6	-17	-19
Bangladesh	6	2	5	-1	15	9
Madagascar	5	3	2	-3	-2	-7
Mauritania	3	1	6	3	7	4
Zambia	0	1	1	1	4	4
Senegal	-4	1	-8	-4	-24	-20
Benin	7	-1	9	2	0	-7
Guinea	-1	-2	2	3	-28	-27
Gambia	5	-1	4	-1	-24	-29
Mali	-1	-1	-7	-6	-23	-22
Chad	3	-3	2	-1	-19	-22

Conclusions

On the theoretical side

We have presented a framework that distinguishes and provides a link between *latent* capabilities and *observed* functionings,

offers an *explanation* of the level of capabilities both in terms of endogenous and exogenous factors,

allows for the possibility to have different functionings for the same level of capabilities due to the presence of exogenous variables,

and can *predict* capability levels.

On the empirical side

What are the lessons to be learnt from our model results and rank comparisons?

Include as many dimensions as possible while computing any measure of overall development or welfare because each new component does have a significant contribution

A better social and political environment not only helps the ‘realisation’ of capabilities but also augments the level of capabilities themselves

Thus the State has a role to play and a positive one in terms of better social infrastructure and better governance

To lead the way to a ‘virtuous’ development cycle