Provincial Growth and Development Through the Equitable Sharing of Infrastructure Finance

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Background and Rationale for the Model

- Provision of Constitutionally mandated basic services.
- Efficiency and economic growth.
- Domestic backlogs and equity of access to services.

Capital Cost Disabilities

Provinces within decentralized economies may face “cost disabilities” in the provision of public services. For example:

- *Education:* A Province with a widely dispersed population may face higher costs in providing a school (or hospital) of a given capacity, than a Province with a more concentrated urban population.
- *Health*: A Province with a relatively healthy population may face lower costs in achieving given health outcomes per capita relative to a Province with a population with relatively high concentrations of people with special health problems that are expensive to manage.
- *Transport:* In Provinces with more difficult terrain it may be relatively more costly to build a km of road of a given standard than in Provinces with easier terrain.

- The implication for capital grant schemes is that one Rand of grant money provided to a Province with a cost disability will yield a lower increase in service provision, than the same Rand allocated to a Province with relatively lower costs. Thus, a Rand of grant funds will have a different impact on service provision in each Province.

International Experience with Cost Disabilities

- In recognition of this, many grant models throughout the world take account of cost disabilities when distributing grant funds. The aim is to provide more grant funds than would otherwise be the case to regions with relative cost disabilities. The additional grant is designed to compensate for the region's cost disability.

- For example, grant models in Switzerland, Australia, Canada, Japan and the UK estimate, and take account of, cost disabilities in grant allocations.

Capital Cost Disabilities in South Africa

In the capital grant model for South Africa we have so far measured and incorporated proxies for four Provincial cost disabilities:

1. Income Inequality.
2. Population dispersion.
3. Debilitating Disease.
4. Unemployment.

For each disability measure we construct an average value across all Provinces. We then measure the percentage deviation of each Province from that average value.

These deviations from the average, which can be positive or negative, are then combined to construct a single disability variable for each Province. This is a numerical measure of a Province's disability at an aggregate level, combining all of the four disabilities.

The disability variable is constructed in such a way that it is normalised around the number one.

Hence, three cases can arise for any particular Province:

(i) *Average Cost Province:* Disability variable has a value of one.

(ii) *Low Cost Province:* Disability variable has a value less than one.

(iii) *High Cost Province*: Disability variable has a value greater than one.

The Model Structure

- Against international standard : all provinces have a severe deficiency of capital
- Relatively less severe deficiencies, or domestic backlogs, against some defined local standard.
- Model allocates from a pool of funds:

  (i) a per capita grant to all Provinces to compensate for the overall deficiency of capital; and

  (ii) an additional grant to those Provinces estimated to have 'domestic backlogs'.
- Both components of the grant scheme incorporate the notion of capital cost disabilities.
- The Model operates over three periods.

Reducing Domestic Backlogs

- In period one, the Model calculates a ‘per capita domestic standard’ for provincial public capital.
- Local standard: total value of public capital across all provinces divided by the total SA population.
- Derive for each province the aggregate capital stock required to meet the per capita standard.

Allocations for Domestic Backlogs

- Policy parameter: used to top slice certain portion of grant pool for allocation to address domestic backlogs

- E.g. if the total pool is R 5000 m and policy parameter = 0.5 then R 2500 m of pool would be available to deal with the domestic backlogs.

Per Capita Allocation

- Remainder of pool allocated on a capita basis independent of backlogs.
- Motivation for this portion: All provinces require some additional capital formation to build their capital stocks up towards an international standard.

The Total Grant

- In period one the total grant to any province is the sum of the equal per capita grant allocation and the domestic backlog grant:

- All provinces receive the equal per capita allocation but only those with domestic backlogs receive the domestic backlog grant

Period Two

- Per capita standard held static over model implementation period as backlogs are intended to be historical & thus fixed
- For the second period the domestic backlog for each Province to discount first period backlogs grant
- Again, only the provinces with domestic backlogs receive a domestic backlog grant while all provinces receive an equal per capita allocation

Period Three

- Period 3 follows same logic as period 2
- So by the end 3rd period, domestic backlog for any province i is: Initial estimated backlog less total backlogs grant allocated over 3 periods
- This would be the initial domestic backlog used in any application of the model during a second phase.
- In all periods, both the backlogs and the equal per capita grants adjusted for cost disabilities

Simulations

- The model described in the first part of this talk has been coded into a set of EXCEL spreadsheets which carry out the calculations using a database collected by the FFC.
- In the next few sheets we will show you some screenshots of the program, briefly discuss the database currently used and look at some simulations from the model to give us an idea of how the inclusion of disabilities can affect the results.
- It should perhaps be stressed at this stage that the disabilities and the data are not “set in stone” and that it is possible to either include further disabilities or exclude some of the current ones.
- We begin by looking at the main data input sheets of the program

- The first page, shown on the next slide requires no user input.
- The slide shows the basic data on capital stocks and populations by province in the base year (here assumed to be 2002). This data is imported from the database which is in a separate file.
- The slide also shows the assumed grant pool size and the parameter delta which shares the pool between the backlogs component and the per capita component

MAIN FILE

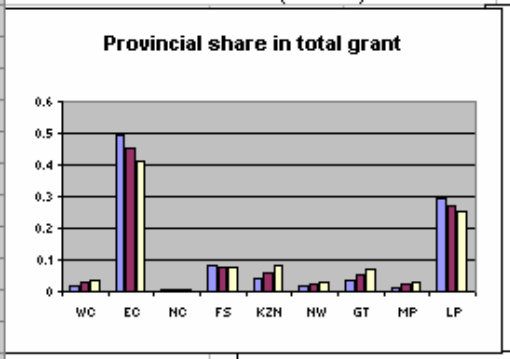
PAGE 1 BASIC DATA — **NO USER INPUT**

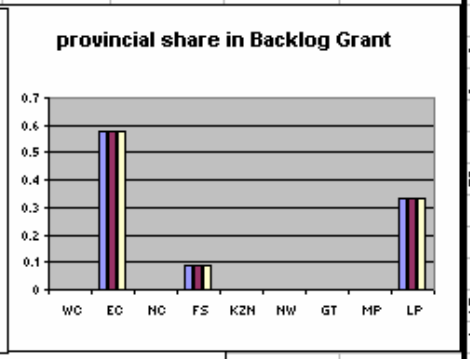
	WC	EC	NC	FS	KZN	NW	GT	MP	LP
CAP STOCKS	6,912	4,058	1,743	3,086	17,608	6,018	12,832	5,405	4,745
POP (Base yr 2002)	4.31	7.13	0.89	2.86	9.21	3.66	8.11	3.16	5.84
POP period1	4.38	7.29	0.90	2.90	9.36	3.72	8.25	3.22	6.02
POP period 1 share	9.51%	15.83%	1.95%	6.30%	20.33%	8.07%	17.92%	7.00%	13.08%
POP period 2	4.45	7.45	0.91	2.94	9.51	3.77	8.39	3.29	6.20
POP period 2 share	9.48%	15.88%	1.93%	6.27%	20.27%	8.04%	17.89%	7.02%	13.22%
POP period 3	4.51	7.61	0.91	2.98	9.66	3.83	8.53	3.36	6.39
POP period 3 share	9.44%	15.92%	1.91%	6.25%	20.21%	8.01%	17.86%	7.03%	13.37%
POP period 4	4.58	7.78	0.92	3.03	9.81	3.89	8.68	3.43	6.58
POP period 4 share	9.41%	15.96%	1.90%	6.22%	20.14%	7.99%	17.82%	7.04%	13.52%
						62,406	TOTAL SA CAP STOCK 2002		

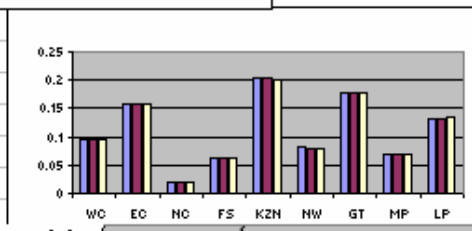
	Delta (δ)	Pool for backlog 1995 Constant Prices	Per Capita Pool 1995 Constant Prices	Total Pool(Rm) 1995 Constant Prices	Population	Deflator 1995=100	Pool for backlog 2003 Constant Prices	Per Capita Pool 2003 Constant Prices	Total Pool(Rm) 2003 Constant Prices	Total Backlog beginning of period in 2003 constant prices	Total backlog beginning of period 1995 constant prices	Backlog reduction per period	Backlog Reduction cumulative
(BASE YR 2002)	0	0	0	**0**	45.17	166.1	0	0	0				
Period 1	0.8	2,675.76	668.94	**3,345**	46.03	179.4	4800	1200	6000	17916.26	9987.436		
Period 2	0.7	2,188.12	937.77	**3,126**	46.90	191.9	3925.2336	1682.243	5607.477	13116.26	7311.671	26.79%	26.79%
Period 3	0.6	1,769.37	1,179.58	**2,949**	47.80	203.5	3174.0434	2116.029	5290.072	9191.027	5123.546	29.93%	48.70%
Period 4					48.71	215.7				6016.984	3354.173	34.53%	66.42%

- The next page – again on the next slide – shows the user input area. This is where the key choices are made by the user. Its worth briefly running through a couple of these.
- Option 2 – include or exclude disabilities
- Option 3 – the values of delta
- Option 5 – the disability weights
- Option 6 – the capital stock allocation weights
- Options 7 to 9 the Disabilities

PAGE 2	USER INPUTS													
OPTION														
1) allow population changes to impact on backlog calculation					2									
Enter a 1 for yes 2 for no - suggested option: 2														
2) Include or exclude disabilities 1 for include 2 for exclude					2									
3) Input values for δ (delta) the share of the total pool allocated						Delta (δ)								
to the Backlogs. Eg entering 0.8 means that 80% of the					Period 1	0.8								
total pool is allocated tothe backlog portion of the total grant					Period 2	0.7								
the remaining 20% to the efficiency (per Capita) portion					Period 3	0.6								
4) Population forecasts can either ignore (enter 0) the					1									
effects of aids or include (enter 1) the effects														







5) weights for the disabilities must be entered below.						
	β_1	β_2	β_3	β_4		
	0.5	0.5	0.5	0.5		
6) User selects the weights to be used to allocate the capital stock						
enter: 1 for SARB weights 2 for Treasury weights 3 for Output weights						
4 for an average of the three and 5 for an average of SARB and Treasury						
Suggested option is 5			5			
7) Disability 1 income distribution				No income	0	
enter a 1 at the point you wish to use as				R1 - R4 800	1	
a cut-off for the calculation. EG a 1 at				R4 801 - R 9 600	0	
N47 would use proportion of households				R9 601 - R 19 200	0	
with income below R19200				R19 201 - R 38 400	0	
All other values must be set to zero				R38 401 - R 76 800	0	
				R76 801 - R153 600	0	
8) Disabililty 2 - currently uses ration of non urban to urban household income						
No user choice required						
9) Disability 3 HIV infection rates. Enter a 1						
to use Dept of Health data or 2 to use the				1		
medical research Council data						
10) Disability 4 - currently uses Stats SA provincial unemployment rates						
No user choice required						

- As can be seen the screen also contains three simple graphs which show the shares in the total grant, the backlog and the per capita component.
- Once all of the other options have been entered the value in cell F38 can be toggled between 1 and 2 to get a snapshot of the effects of including the disabilities.

- Recall that currently 4 disabilities are included in the program. These are based on data sourced by the FFC and, as noted earlier, should be regarded as provisional.
- The 4 disabilities are based on:
- Income Distribution
- The ratio of Urban to Non Urban population
- HIV Infection rates
- Unemployment rates

- Lets use the first, Income Distribution, to illustrate the calculation of the effect of disabilities on the per capita component of the grant.

- To construct the measure we simply calculate the proportion of the total number of household units in the province with incomes below some selected level which the model allows the user to select. As an example and for the simulations below we chose to use households with incomes less than or equal to a maximum of R4800.
- This is illustrated on the next slide which shows a screen from the “disabilities” part of the program
- Note that at the bottom (in red) the program identifies the proportion of population in the province with income levels below the selected amount.
- To the right (in red) the program calculates the disability weights which results from the choice the user makes.
- Note that these depend on all the disabilities but the user can see how the weights change as they change each disability option.

C79 =[FFC1a.xls]model1!L57

Disability measure 1

INCOME INEQUALITY

Disability 1 draws on the FFC supplied data from the file "Infrastructure data requirements 2004.xls"

In particular it utilises the data in the worksheet "Income" which contains data, by province, on household income.

Disability 1 uses the income distribution in the file to construct a measure of disability. Thus it could be argued that the province with the highest proportion of its population with no income, or income below, say, R4801 has the biggest problem in terms of poverty alleviation and thus needs a greater share in the capital allocation.

To construct the measure the user enters a 1 in one of the cells C7:C13. The program then uses this information to calculate proportions of the population in each province with incomes LESS than the UPPER bound in cells A7:A18.

In order to fit in with ouur disability calculations the measure should be such that the higher the value the greater the disability.

This is the case here - higher values indicate higher proportions of the households fall into the lower income brackets chosen.

No income	0
R1 - R4 800	1
R4 801 - R 9 600	0
R9 601 - R 19 200	0
R19 201 - R 38 400	0
R38 401 - R 76 800	0
R76 801 - R153 600	0
R153 601 - R307 200	
R307 201 - R614 400	
R614 401 - R1 228 800	
R1 228 801 - R2 457 600	
R2 457 601 and more	

VVC	EC	NC	FS	KZN	NW	GT	MP	LP
14.70583	40.12557	22.97711	37.31728	35.5118	34.18668	23.6607	34.39272	43.30608

$\bar{y}_i$
0.764324
1.1399
0.870485
1.09066
1.060132
1.038271
0.879893
1.04164
1.198357

- Lets use this disability to illustrate the mechanics of the calculation.
- Table 3 shows the key results for disability 1 in terms of its effect on the per capita component of the grant.
- Lets just quickly look at what the various elements in the table represent and how they are calculated.

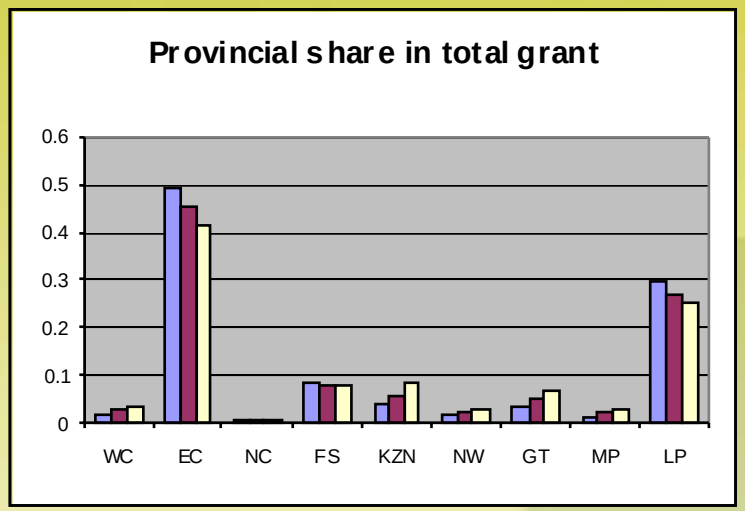
Table 3 Key Disability measures for Disability 1

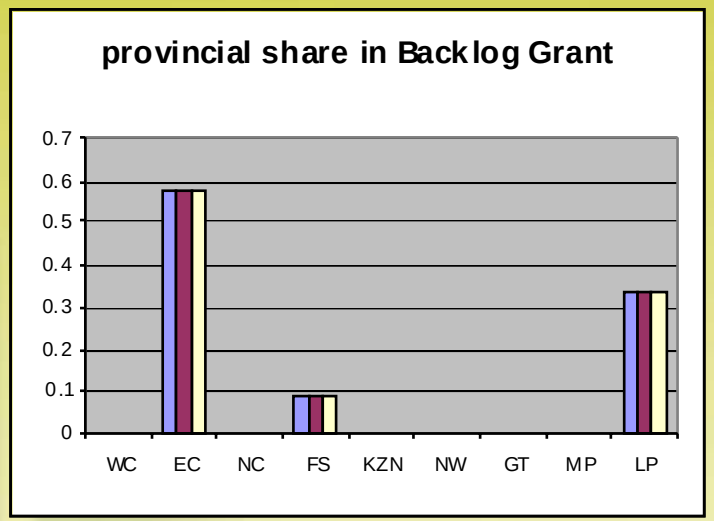
	Disability Measure (X)	Deviation of X from mean value (D)	Disability Weights (γ)	Provinces Pop. As proportion of Total Pop	τ_i period 1 of simulation
WC	14.71	-53.8%	0.76	9.5%	7.1%
EC	40.13	26.2%	1.14	15.8%	17.6%
NC	22.98	-27.7%	0.87	1.9%	1.7%
FS	37.32	17.4%	1.09	6.3%	6.7%
KZN	35.51	11.7%	1.06	20.3%	21.0%
NW	34.19	7.5%	1.04	8.1%	8.2%
GT	23.67	-25.6%	0.88	17.9%	15.4%
MP	34.39	8.2%	1.04	7.0%	7.1%
LP	43.31	36.2%	1.20	13.1%	15.3%

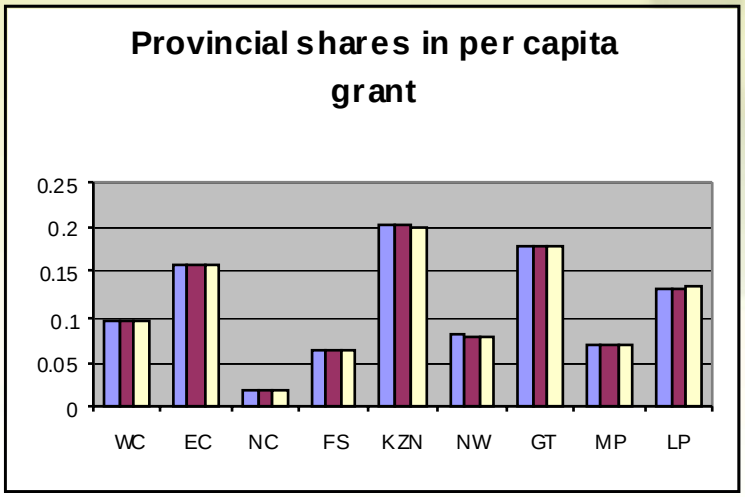
- To see the effect of the disabilities on both the per capita and the backlogs components of the grant it will be helpful to look at a simple simulation.
- However the formula for the backlogs calculation is comparatively simple and it tells us that if a province has a disability weight of greater than 1 its backlog will be increased alternatively if its disability weight is less than 1 its backlog will fall.

- To illustrate the effects of the inclusion of disability weights we first ran a simulation assuming no disabilities. The key assumptions made in the simulation can be seen in the next slide.

- The capital stock weightings (the weights used to allocate the capital stock between the provinces) are based on an average of Treasury and SARB weights (see Table 2).
- The size of the total grant pool available can be determined in a number of ways. In the base run, we chose to determine the pool exogenously at R 6000 Millions in 2003 current prices for each of the three simulation periods giving a total of R18,000 Million.
- The parameter δ needs to be set over the three periods. Recall that this determines the proportion of the total pool allocated to the backlogs component, (1-δ) going to the efficiency component. In the base run this was set at 0.8 in period one, 0.7 in period two and 0.6 in period three.

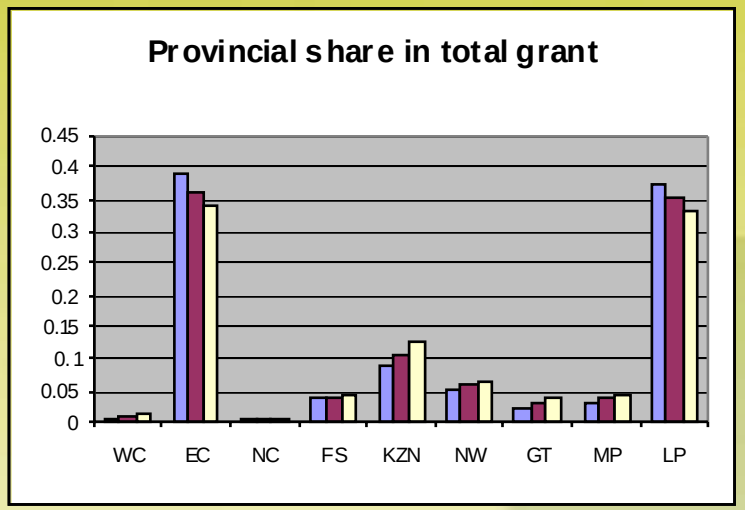


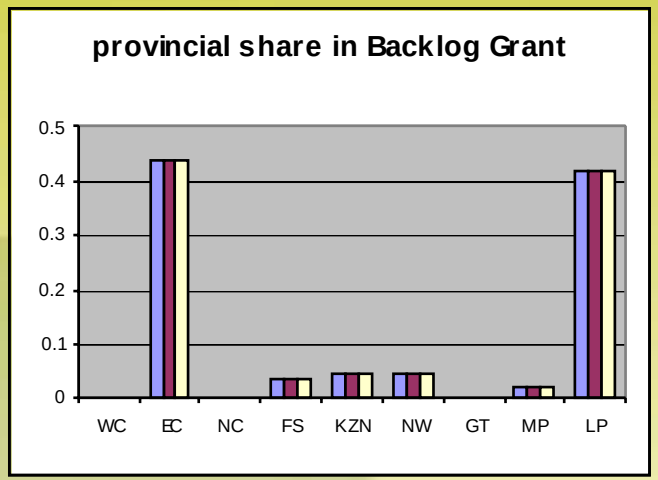


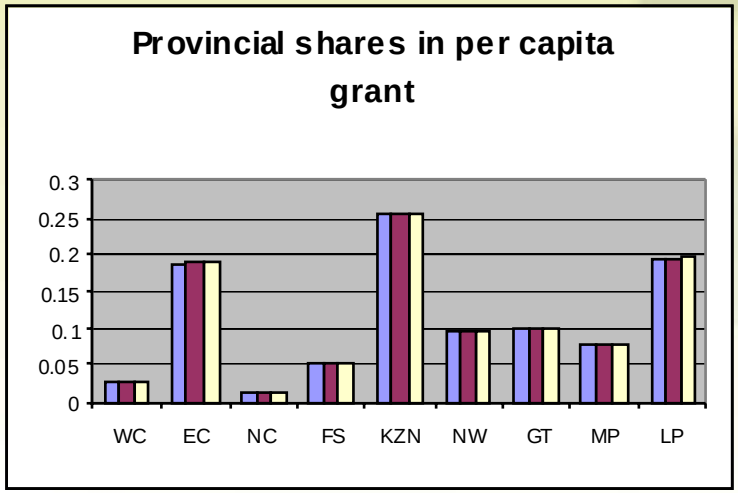


Total Backlog beginning of period in 2003 constant prices	Total backlog beginning of period 1995 constant prices	Backlog reduction per period	Backlog Reduction cumulative
17916.26	9987.436		
13116.26	7311.671	26.79%	26.79%
9191.027	5123.546	29.93%	48.70%
6016.984	3354.173	34.53%	66.42%

- Now lets include the disabilities
- Again we leave the previous assumption as they were and add the following:
- The betas (β) which weight the disabilities need to be set. We chose to set
  $\beta 1 = \beta 2 = \beta 3 = \beta 4 = 0.5$
- For disability 1, income inequality, we chose to use the proportion of households with income below R 4800.
- For disability 2, the ratio of rural to urban income / population density we chose to use the proportion of non urban households in the province.
- For disability 3, AIDS infections, we chose to use to use the HIV prevalence rates.
- For Disability 4, unemployment rate, we chose to use recently released data on unemployment rates.







Total Backlog beginning of period in 2003 constant prices	Total backlog beginning of period 1995 constant prices	Backlog reduction per period	Backlog Reduction cumulative
39379.13	21951.93		
34579.13	19276.17	12.19%	12.19%
30653.9	17088.04	11.35%	22.16%
27479.85	15318.67	10.35%	30.22%

- Some key things to note in those pictures:
- Once disabilities are included more provinces share in the Backlog component of the grant.
- But the inclusion of disability effects increases the size of the calculated backlogs and shares the “pie” of the backlog component of the grant out amongst more provinces so backlog elimination takes longer.
- As the parameter δ varies, for example in the current simulation declines, the backlogs have a smaller effect on the total grant, the larger backlog provinces thus see their grants decline.