World Health Organization
Organisation mondiale de la Santé

EXECUTIVE BOARD
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WHO reform

Regular budget allocations to regions

Report by the Director-General

1. The Executive Board, at its 101st session, considered a study by its special group for the review of the Constitution on allocations from the regular budget to the regions,[1] and recommended a course of action to the Health Assembly in resolution EB101.R10.

2. The model used in the study by the special group has now been reviewed by a group of experts on modelling applied to health systems, as requested in resolution EB101.R10. Its report is attached for the information of the Executive Board.

[1] See document EB101/1998/REC/1, Annex 3.

ANNEX

REVIEW OF THE PROPOSED WHO BUDGET ALLOCATION MODEL

PREAMBLE

WHO is developing a procedure for allocating its regular budget resources to the Member States and regional offices based on criteria which reflect the needs of the countries. It has been stipulated that the procedure to be adopted by the Organization has to be:

- transparent in its structure;
- reasonably easily understandable by potential users at headquarters and in regional offices;
- flexible to accommodate updating of the parameters driving the procedure;
- spreadsheet based.

We have reviewed the model under the following terms of reference:

(a) the method and effect of smoothing the population component of the model, including the effect of using projected populations for the year 2000;

(b) the suitability of using UNDP's Human Development Index (HDI) as one of the indicators for WHO regular budget resource allocation (its advantages and disadvantages);

(c) the choice of indicators to supplement HDI, and their technical and philosophical influence;

(d) the method of applying the indicators to produce an allocation factor for each country;

(e) the effect of changes in the indicator values (sensitivity analysis);

(f) the effect of the constraints placed on the allocation, such as minimum country budget and maximum GNP per capita.

A three-day meeting was held at WHO headquarters to give us an opportunity to better understand the developmental work that has been done to build the budget allocation model and to examine additional data and information needed to perform the review. Two long-distance telephone conferences were held with a third member of the team (J. Veney), who was unable to travel to Geneva.

SUMMARY OF THE MODEL

The WHO budget allocation model calculates an allocation factor for country, intercountry and regional budgets based on two indicators, namely HDI and immunization coverage (as measured by three doses of combined diphtheria-pertussis-tetanus vaccine), weighted by adjusted population size. The final allocation takes into consideration the minimum country budget and maximum GNP per capita constraints, thereby leading to slight readjustments of the country allocations given by the model.

A. METHOD AND EFFECT OF SMOOTHING THE POPULATION COMPONENT OF THE MODEL, INCLUDING THE EFFECT OF USING PROJECTED POPULATIONS FOR THE YEAR 2000

Any resource allocation procedure must necessarily take into account the population size of countries to which the procedure applies. The population distribution by size of WHO Member States and other countries and territories (206 in total) is highly skewed, ranging from 1600 (Tokelau) to 1 243 738 000 (China).

We recommend the use of the word "handling" rather than "smoothing" for dealing with the population component of the resource allocation procedure, as the technique involved does not require statistical correction of an uneven distribution.

In view of its skewed distribution, the use of absolute (raw) population size would result in large countries like China and India, through their sheer population sizes, receiving a major portion of the budget (Figure 1). China, for example, would be allocated one-quarter of the total budget for countries. The procedure proposed was devised to assure a more even distribution of resources among countries, but at the same time, to recognize the substantial variation in population sizes among countries.

The method employed is to dampen the impact of absolute population size. Classical natural logarithmic transformation fails to provide much differentiation among countries. Square of the natural logarithm gives more spread among countries falling into the small- and medium-sized population range, but not among large-sized countries. Multiplying the square of the natural logarithmic transformation by an adjustment value that is proportionate to the original population size but constrained within a range of 1 to 3 produces a clear differentiation among countries over the entire population range. Using this procedure, the country with the largest population, i.e. China, would have an adjustment value of 3, whereas the country with the smallest population, Tokelau, would have an adjustment value of 1. The rest of the countries would have adjustment values between 1 and 3. That way, the original population distribution trend is maintained, except that the scale is miniaturized to produce the dampening effect (see Appendix for the mathematical computation). For ease of reference, we will call this method the "adjusted log population squared" procedure, or ALPS.

ALTERNATIVES TO ALPS

We also examined several alternative approaches to handling the population component, as compared to using ALPS. We looked at several transformations of the population, including the actual value (Figure 1), the log squared (Figure 2a), the third root (Figure 2b), fourth root and fifth root of the population. Only the third root transformation manages to produce a significant differentiation among countries (Figure 2c), but the procedure still fails to provide as much differentiation among large-sized countries as the ALPS method. Another approach was to stratify countries by population sizes and then assign a score to each stratum. This score is then used to replace the raw population size in the computation of the allocation factor (Table 1). (For ease of reference this procedure is referred to as SPS.)

Using this approach, aggregated results at the regional level appeared to be quite similar to those produced by the ALPS procedure (Table 2). However, closer inspection of the individual countries showed that the procedure tended to favour larger allocation for small countries at the expense of the larger countries, as the sample of countries in Table 4 shows. Such a result is not unexpected, since the choice of weights for populations is arbitrary (in this case, 1 to 6). The ALPS model seems preferable since the weights are generated from actual population sizes.

We have attempted to find alternative approaches in order to produce a dampening effect of the raw population sizes, but have not found any method that is more reasonable than the ALPS model.

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We have also examined a model based on population size of countries projected to the year 2000. As shown in Table 2, which gives a comparison of allocations by region and by different models of allocations, there were no appreciable differences in budget allocations using the 1996 and 2000 populations (Table 3).

It should be noted that population size is not an indicator for resource allocation but the basis on which the selected indicators are applied.

B. THE SUITABILITY OF USING HDI AS ONE OF THE INDICATORS FOR WHO REGULAR BUDGET RESOURCE ALLOCATION (ITS ADVANTAGES AND DISADVANTAGES)

We have examined the suitability of HDI as an indicator for resource allocation and found it to be an attractive indicator for at least three reasons. Firstly, it is a composite index and therefore as an indicator for modelling, it is more convenient to use than to have several separate indicators such as maternal mortality rate, infant mortality rate and under-five mortality rate. Secondly, it is so strongly correlated with the other health indices that we examined that little additional information is made available by including these indicators with HDI. Thirdly, HDI has been developed and promoted by a sister United Nations organization, UNDP.

We wish to point out several perceived limitations of HDI. One is that HDI is a composite indicator that tends to give greater emphasis to socioeconomic development. Its use for WHO budget resource allocation should therefore be further augmented by the inclusion of one or more supplementary indicators that are more directly health related. Another disadvantage is that HDI tends to respond relatively slowly to changes in health services. Therefore, a rapid improvement in health services may not necessarily translate to an equally rapid response in HDI change. Thirdly, HDI is only available for 175 out of the total of 206 WHO Member States and other countries and territories. For the budget allocation model, HDI estimates from countries of similar sizes and socioeconomic development in the same region were applied to those countries without HDIs. Fourthly, it was noted that HDIs used were 1994 indices.

C. THE CHOICE OF INDICATORS TO SUPPLEMENT HDI AND THEIR TECHNICAL AND PHILOSOPHICAL INFLUENCE

We have pointed out the need to augment the use of HDI with other health indicators for the allocation model so that the health needs of countries can be better reflected.

We have examined a variety of health performance and health resource indicators such as maternal mortality rate, infant mortality rate, under-five mortality rate, low birth weight and population:physician ratios. Some of these indicators are widely available. Others have their deficiencies, such as incomplete coverage and lack of standard definition.

Many of the widely available health indices mentioned above are so strongly correlated with HDI ($r > 0.9$) that little additional information is obtained by using them as supplementary indices to HDI. The relatively low correlation of HDI with immunization coverage ($r = 0.6$) makes this indicator attractive as a supplementary index.

To address possible concerns over the volatility of immunization coverage as a health index, we examined time series for this indicator for selected developing countries (Table 5).

Immunization coverage statistics from the Expanded Programme on Immunization (Global summary, August 1997) showed that, even for many developing countries, relatively stable trends have been achieved in recent years.

We consider immunization coverage to be a good supplementary indicator to HDI because it adds a health service need dimension to the resource allocation process. As the need decreases over the years, the resource to be provided to meet these needs should also be reduced. This will mean that over the years, there will come a time when almost all countries will be closing the gap between the ideally achievable immunization coverage and their current coverage. This supplementary indicator in the allocation model would then have to be reviewed and possibly replaced by some other indicator. The physical replacement of indicators in the allocation procedure is not a problem because the spreadsheet-based system has been set up to handle the inclusion and exclusion of indicators with relative ease.

D. THE METHOD OF APPLYING THE INDICATORS TO PRODUCE AN ALLOCATION FACTOR FOR EACH COUNTRY

The method of applying the indicators to produce an allocation factor for each country is technically reasonable and it follows the logic of providing resources to areas that evidence need.

In the model, "need" is defined as "the gap between an ideal state and the actual state" for a given indicator in a country. For example, in the case of immunization coverage, the ideal state is taken as total population (100%) coverage. Therefore, if a country has only 70% coverage, the gap is 100 - 70 = 30%.

Some concerns have been shown about an allocation model based on addressing the closure of the gap for a particular indicator, as many countries may not find it possible to attain the ideal state within a given time. The "gap" concept is intended for comparing the relative needs of countries, needs that will always be there. They give a relative measure of need on which allocation is based.

One problem that we found in this exercise to find an equitable model for allocating the WHO regular budget is the absence of a reference set. In other words, there is no "gold standard". The current budget should not be viewed as the reference set, or else we would be looking for a model that provides the technical justification for its allocation, which we were informed is not the objective of the exercise.

E. THE EFFECT OF CHANGES IN THE INDICATOR VALUES (SENSITIVITY ANALYSES)

Sensitivity analyses performed on HDI and immunization coverage show that the model is responsive to changes in the two indicators, as Table 6 shows.

For example, keeping HDI constant and varying immunization coverage through reasonable ranges for Somalia and Indonesia produces expected changes in actual allocation in each country. Holding immunization constant and varying HDI through a reasonable range also produces expected changes in actual allocation.

The model is therefore sensitive to changes in the indicators, particularly because only two indicators are involved. The inclusion of more indicators not highly correlated with HDI and immunization coverage could avoid the problem of marked changes to allocations.

F. THE EFFECT OF THE CONSTRAINTS PLACED ON THE ALLOCATION, SUCH AS MINIMUM COUNTRY BUDGET AND MAXIMUM GNP PER CAPITA

We have examined the proposal to limit WHO country funding to those countries with a GNP per capita of less than US$ 9386, the current World Bank definition for a high-income economy. Thirty-nine countries would fall into this category, among which 19 have allocations under the current (1998-1999) regular budget. We recommend the gradual implementation of this policy so that the affected countries do not have their regular

budget abruptly terminated (see section G). The Republic of Korea, for example, received US$ 2 211 000 under the current regular budget. With implementation of the budget allocation model, it would not receive any funding.

The concept of minimum country budget is reasonable for smaller countries that would (because of population size) receive little or no WHO funding.

G. OTHER COMMENTS

There should be some mechanism to monitor utilization of the allocated budget in countries so that subsequent allocation exercises could take into consideration those countries which have benefited from the budget through efficient planning and management of its use.

We have concentrated our review of the allocation model on an equitable distribution of the WHO budget for country programmes. The model could also be appropriately used for allocating intercountry and regional budgets using regional aggregated values for the selected indicators.

The implementation of the plan should be phased in such a way that no country, intercountry programme, or regional office would lose more than a third of its currently allocated budget in any one of the three bienniums during which the new budget scheme would be implemented. Countries expected to gain from the allocation should gain proportionally to one another over the three bienniums. (See Table 7 for an example of the budget allocation phasing for five hypothetical countries.) The World Bank GNP per capita criterion for developed country status should be applied in such a way that as countries reach and exceed that GNP level, they are phased out of WHO funding on a three-biennium basis as above.

H. CONCLUSION

In conclusion, we endorse the present model for allocating resources. However, mechanisms must be put in place to help countries that are to gain from substantial allocations to make better use of their allocated funds.

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Appendix

ADJUSTED LOG POPULATION SQUARED PROCEDURE FOR BUDGET ALLOCATION

MATHEMATICAL FORMULATION

Let the population of the i^{th} country be denoted by p_i (in thousands) and the j^{th} indicator by c_{ij} and its corresponding optimal value by o_{ij}. The score s_{ij} for the j^{th} indicator for the i^{th} country is given by the population-weighted proportion of the indicator:

$$s_{ij} = (p_i|o_{ij} - c_{ij}|)/\Sigma_i p_i|o_{ij} - c_{ij}|$$

$$= p_i d_{ij}/\Sigma_i p_i d_{ij} \text{ where } d_{ij} = |o_{ij} - c_{ij}|$$

$$s_{.j} = 1$$

The country "allocation" factor is given by:

$$s_{i.} = \Sigma_j s_{ij} = (p_i/n)\Sigma_j\{d_{ij}/\Sigma_i p_i d_{ij}\}$$

$$s_{..} = 1$$

If the budget to be allocated is F, each country's allocation, f_i, is $Fs_{i.}$ that is *country allocation factor* x *global budget*.

$$f_i = (Fp_i/n)\Sigma_j\{d_{ij}/\Sigma_i p_i d_{ij}\}$$

With the logarithmic transformation on the population the "stretching" of the transformed populations is achieved by:

$$k_i [\log_e (p_i)]^2$$

where $k_i = 2(p_i - p_{min})/(p_{max} - p_{min}) + 1$
p_{min} = population of the country with the smallest population
p_{max} = population of the country with the highest population

Hence

$$f_i = (Fk_i[\log_e(p_i)]^2/n)\Sigma_j\{d_{ij}/\Sigma_i\, k_i[\log_e(p_i)]^2 d_{ij}\}$$

TABLE 1. STRATIFYING POPULATIONS BY SIZE (SPS) METHOD

Population size	No. of countries	Score assigned
Under 100 000	21	1
100 000 - 1 000 000	32	2
1 000 001 - 50 000 000	130	3
50 000 001 - 100 000 000	13	4
100 000 001 - 150 000 000	5	5
150 000 001 and over	5	6

TABLE 2. COMPARING ALLOCATIONS BY REGIONS USING ALPS AND SPS METHODS BASED ON HDI AND IMMUNIZATION COVERAGE

	Actual allocation	% allocation	Adjusted log squared population (ALPS)	% allocation	SPS method	% allocation
Africa	95 765 500	29.76	141 986 400	44.12	148 308 600	46.08
The Americas	42 549 100	13.22	38 355 400	11.92	41 757 900	12.97
South-East Asia	74 032 500	23.00	29 322 500	9.11	20 704 500	6.43
Europe	5 284 900	1.64	37 901 100	11.78	39 680 300	12.33
Eastern Mediterranean	59 691 400	18.55	43 853 200	13.63	39 734 900	12.35
Western Pacific	44 506 300	13.83	30 411 700	9.45	31 643 900	9.83
Total	321 829 700	100.00	321 830 300	100.00	321 830 100	100.00

TABLE 3. COMPARISON OF BUDGET ALLOCATIONS BY REGIONS AND MODELS OF ALLOCATION USING 1996 AND 2000 (PROJECTED) POPULATIONS

1996 population used

	Actual allocation	% allocation	Adjusted log squared population	% allocation	Raw population allocation	% allocation	Coded population allocation	% allocation
Africa	95 765 500	29.76	141 986 400	44.12	80 427 600	24.99	148 308 600	46.08
The Americas	42 549 100	13.22	38 355 400	11.92	27 994 300	8.70	41 757 900	12.97
South-East Asia	74 032 500	23.00	29 322 500	9.11	81 675 300	25.38	20 704 500	6.43
Europe	5 284 900	1.64	37 901 100	11.78	26 619 400	8.27	39 680 300	12.33
Eastern Mediterranean	59 691 400	18.55	43 853 200	13.63	41 198 900	12.80	39 734 900	12.35
Western Pacific	44 506 300	13.83	30 411 700	9.45	63 929 700	19.86	31 643 900	9.83
Total	321 829 700	100.00	321 830 300	100.00	321 845 200	100.00	321 830 100	100.00

2000 population used

	Actual allocation	% allocation	Adjusted log squared population	% allocation	Raw population allocation	% allocation	Coded population allocation	% allocation
Africa	95 765 500	29.76	141 986 400	44.12	79 286 600	24.63	148 308 600	46.08
The Americas	42 549 100	13.22	38 355 400	11.92	28 184 800	8.76	41 757 900	12.97
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TABLE 4. COMPARING ALLOCATIONS BY SELECTED COUNTRIES USING ALPS AND SPS METHODS BASED ON HDI AND IMMUNIZATION COVERAGE

Country	Population (thousands)	Current allocation	ALPS allocation	% change from current	SPS allocation	% change from current
Saint Helena	6	143 600	100 000	-30.4	456 600	218.0
Equatorial Guinea	420	1 211 500	1 341 800	10.8	2 063 800	70.4
Lao People's Democratic Republic	5 194	2 334 700	3 063 200	31.2	3 487 700	49.4
Somalia	10 217	4 957 500	5 393 900	8.8	4 920 200	-0.8
Nigeria	118 369	3 554 800	7 650 200	115.2	6 594 800	85.5
Indonesia	203 480	11 506 200	2 886 000	-74.9	2 481 100	-78.4
India	960 178	15 972 500	9 967 800	-37.6	3 540 800	-77.8
China	1 243 738	8 311 600	8 725 800	5.0	2 526 900	-69.6

TABLE 5. IMMUNIZATION COVERAGE BY SELECTED COUNTRIES, 1990-1996

Countries	1990	1991	1992	1993	1994	1995	1996
Rwanda	89	85	83	-	95	90	95
Botswana	56	53	59	57	78	76	83
Viet Nam	85	88	89	91	94	94	94

TABLE 6. EFFECT OF CHANGES IN THE INDICATORS TO MODEL PERFORMANCE

	Immunization	HDI	Allocation factor	Computed allocation	Immunization relative change %	Allocation relative change %
Somalia	16	0.336	0.017055	5 481 600	-11.11	1.63
	18	0.336	0.016782	5 393 900	0.00	0.00
	20	0.336	0.016509	5 306 100	11.11	-1.63
	40	0.336	0.013762	4 423 200	122.22	-18.00
					HDI relative change %	**Allocation relative change %**
	18	0.300	0.017068	5 485 800	-18.92	3.37
	18	0.370	0.016512	5 307 000	0.00	0.00
	18	0.400	0.016273	5 230 300	8.11	-1.45
	18	0.450	0.015897	5 109 300	21.62	-3.73
					Immunization relative change %	**Allocation relative change %**
Indonesia	82	0.668	0.011834	3 803 600	-9.89	31.63
	91	0.668	0.00899	2 889 600	0.00	0.00
	98	0.668	0.006756	2 171 300	7.69	-24.86
	100	0.668	0.006113	1 964 900	9.89	-32.00
					HDI relative change %	**Allocation relative change %**
	91	0.600	0.010224	3 286 100	-10.18	13.72
	91	0.668	0.00899	2 889 600	0.00	0.00
	91	0.735	0.007769	2 496 900	10.03	-13.59
	91	0.800	0.006578	2 114 100	19.76	-26.84

TABLE 7. EXAMPLE OF PHASING OF BUDGET ALLOCATIONS

Country	Current allocation	Projected allocation	Total change	Change per biennium
A	5 000	2 000	-3 000	-1 000
B	5 500	4 900	-200	-67
C	2 000	3 000	1 000	333
D	2 000	2 600	600	200
E	2 000	4 000	2 000	667

FIGURE 1. RAW POPULATION (THOUSANDS)

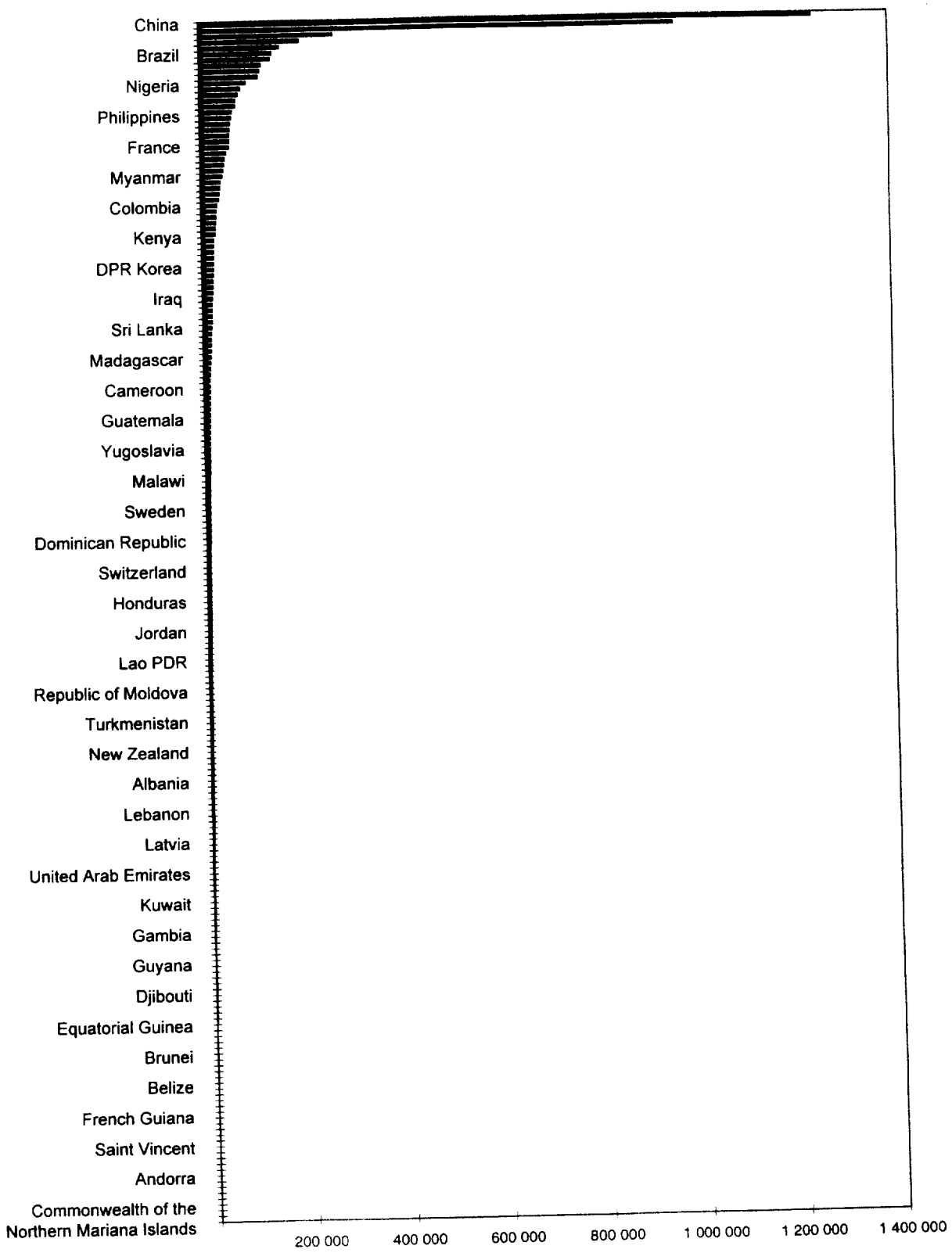


FIGURE 2a. LOG SQUARED POPULATION

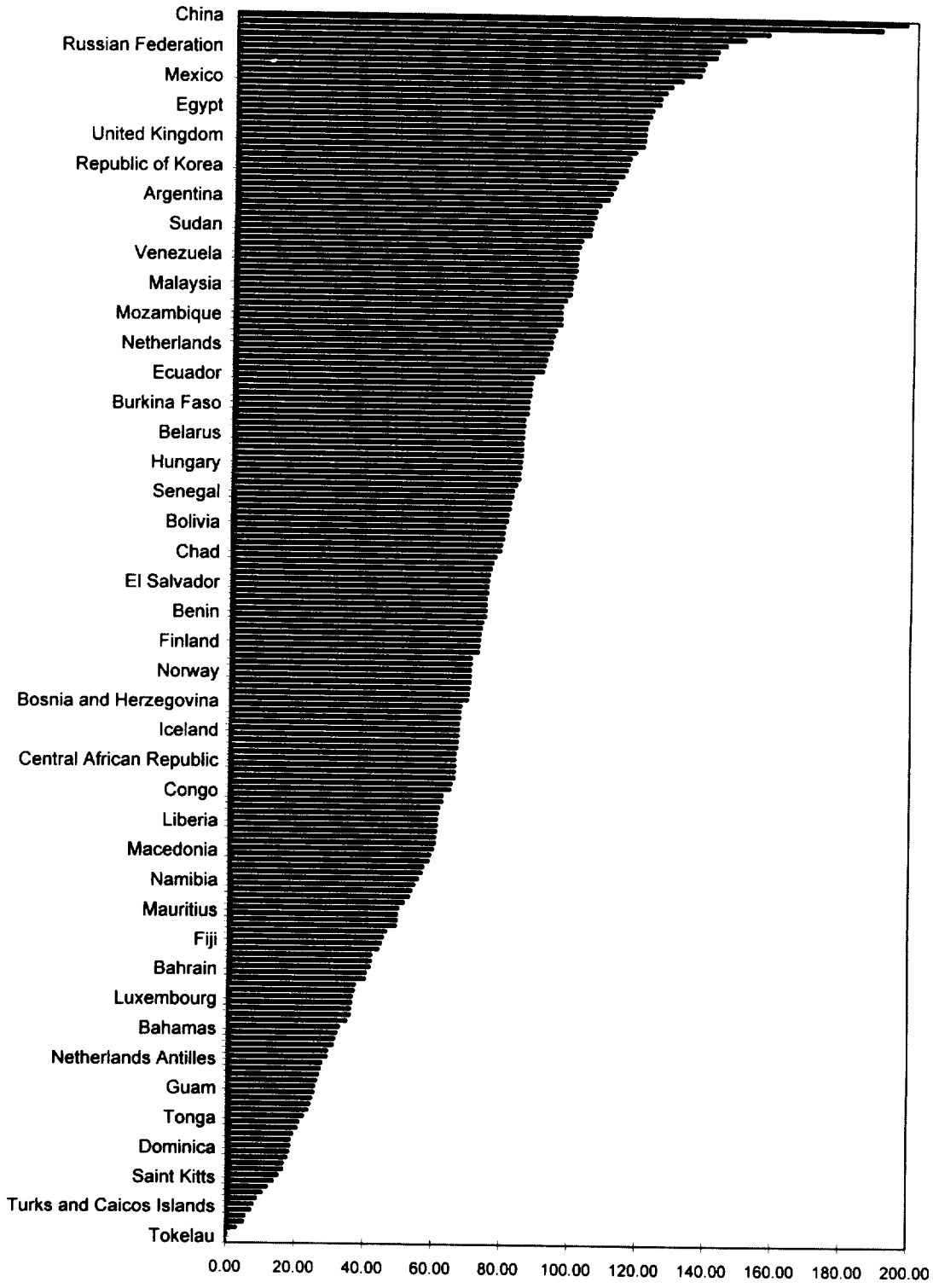


FIGURE 2b. ADJUSTED LOG SQUARED POPULATION

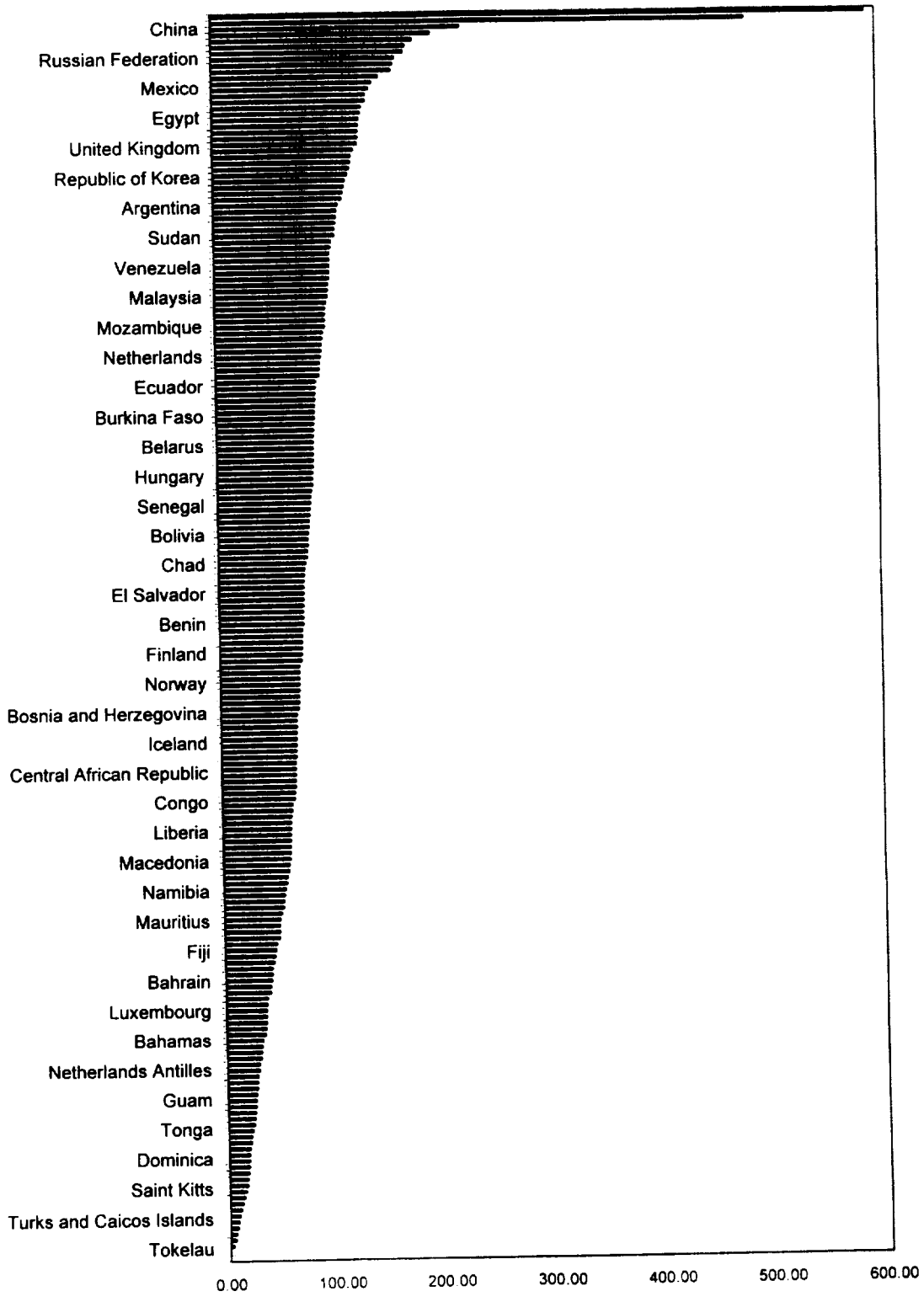
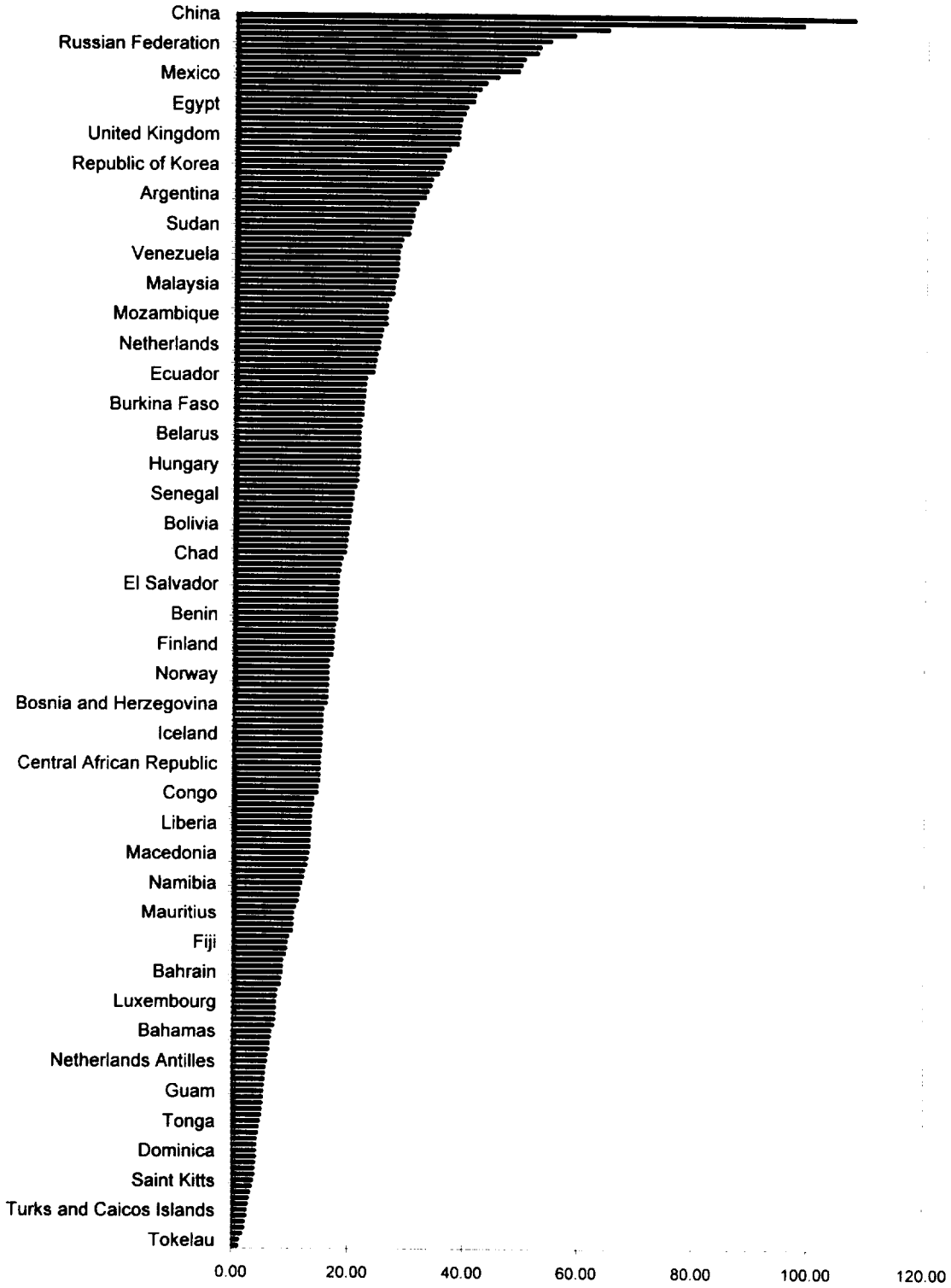


FIGURE 2c. CUBE ROOT POPULATION



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