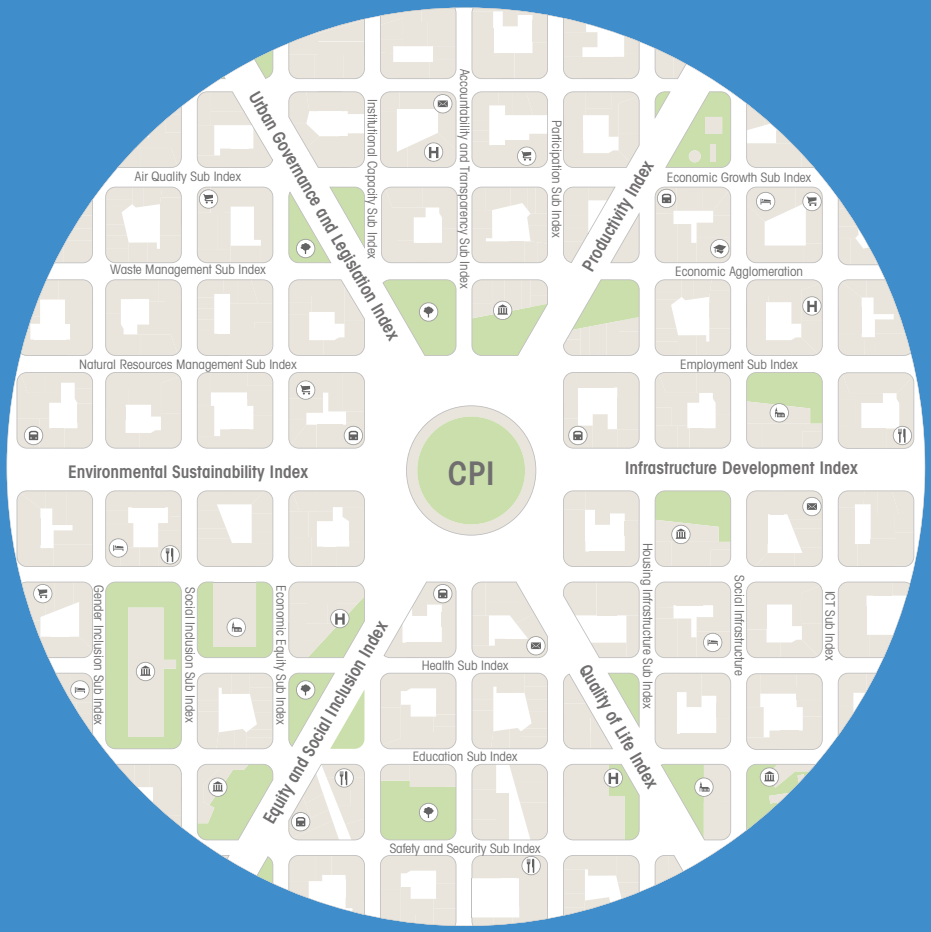
MEASUREMENT OF CITY PROSPERITY

Methodology and Metadata



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1. INTRODUCTION

The City Prosperity Index (CPI) is, by definition, a multidimensional index. Hence, the prosperity of a city is determined based on a collection of factors or dimensions that are related to conceptualisations of a prosperous city. The CPI accounts for six dimensions that describe different aspects of urban prosperity according to the UN-Habitat standards: Productivity, Infrastructure Development, Quality of Life, Social Equity and Inclusion, Environmental Sustainability and Urban Governance (UN-Habitat, 2011). Each of these dimensions is composed of sub-dimensions that describe different aspects of the dimension. The number of sub-dimensions in each dimension is not necessarily equal. Furthermore, each sub-dimension is defined from a group of variables (or indexes) that are measured for each city. The number of variables within each sub-dimension can vary.

Taking into account the above characteristics, this index is constructed through the following tasks:

A. Variable standardisation.
B. The construction of a weighting scheme that involves adding standardised information to form one single value. This value denotes the level of city prosperity.

The following sections describe the methodology used to perform these tasks

2. THE CITY PROSPERITY INDEX (CPI)

2.1 VARIABLE STANDARDISATION

Variable standardisation transforms a variable from its original measurement unit into a dimensionless measure that ranges between 0 and 100. From this transformation, a broad and varied range of variables (measures that are originally formed in different units and scales) can be included in the CPI index. Standardisation also accounts for the fact that there is a direct relationship between the variable and the CPI. Hence, a larger variable value will correspond with an increase in the index and higher prosperity.

The section below presents different approaches to standardisation. Each variable within the CPI is treated using just one form of standardisation. For each standardisation approach, an example is given to promote clarity, and at the end of the section (Figure 4), a flowchart of the process for determining the appropriate variable standardisation approach is presented.

Standardisation 1.1: Not required

Variable X does not need to be standardised when it meets the following requirements:
- It is bounded between 0 and 100
- Both values can feasibly be reached. This condition is important, as there are variables that, despite being bounded between 0 and 100, are unlikely to reach these extreme values (e.g., the percentage variable of Renewable Energy Consumption is bounded between 0 and 100 and can easily reach the zero value, but it cannot as easily to reach a value of 100). In such cases, the alternative standardisation approach described below must be applied.
- There is a direct relationship between the variable and the CPI.

When these requirements are met, the following equation is used:

$$X^{(s)} = X$$

Example: The Infrastructure Development dimension includes the Housing Infrastructure sub-dimension. One of the variables that belongs to this sub-dimension is Access to Electricity, which is measured as the percentage of homes in a city that are connected to this public service. A higher service coverage percentage is thus expected to correlate with greater city prosperity. Furthermore, cities can have no electricity coverage or complete electricity coverage. Therefore, this variable is directly added to the index without undergoing any transformation.

Standardisation 1.2: Simple reversion

This standardisation approach differs from that presented in section 1.1, as variable X is inversely related to the CPI. In these cases, the variable must be inversed to guarantee the direct relationship condition between the variable and the CPI. This inversion has the following form:

X is the observed value of the variable and $X^{(s)}$ is its standardised value. Then

$$X^{(s)} = 100 - X$$

Example: The Social Equality and Inclusion dimension includes the Economic Equality sub-dimension. One variable within this sub-dimension is the Poverty Rate, which is measured as a percentage. Although the variable varies between 0 and 100, it has an inverse relationship with the CPI because an increase in the Poverty Rate will generate lower prosperity levels in the city. Thus, to ensure that the direct relationship condition is achieved, the variable is introduced into the CPI as
$X^{(s)} = 100 - proverty\_rate$; thus, a higher $X^{(s)}$ value correlates with a higher CPI.

Standardisation 2.1: Direct classic standardisation.

Variable *X* requires direct classic standardisation when there is evidence that its measurements move, with high probability, within a determined range and that there is a direct relationship between the variable and the CPI. In these cases, the following standardisation approach is used:

Let *X* be the observed value of the variable and let $X^{(s)}$ be its standardised value. Then

$$X^{(s)} = 100 \frac{X - Min\ (X)}{Max(X) - Min\ (X)}$$

where *Max (X)* and *Min (X)* are the maximum and minimum values observed for *X* respectively. If a city has an *X* value that is greater than *Max (X)*, the value assigned via standardisation will be 100. If a city has an *X* value lower than *Max (X)*, the value assigned via standardisation will be 0.

Requirements: *X Max (X)* and *Min (X)* In some cases, maximum and minimum values are calculated based on the transformed variable using in (X) or $(X)^{(1/k)}$ operators to guarantee more symmetrical distributions and superior outlier identification.

Example: The Quality of Life contains dimension includes the Health sub-dimension. One variable of this sub-dimension is Life Expectancy at Birth, which is measured in years. According to the World Bank (2014), in 2012, Life Expectancy at Birth varied from 45.33 years (Sierra Leone) to 83.48 years (Hong Kong SAR). Thus, a city with a Life Expectancy at Birth value of 77.08 years will have the following standardised value:

$$X^{(s)} = 100 \frac{77.08\ years - 45.33\ years}{83.48\ years - 45.33\ years} = 83.22$$

Please note that this operation eliminates the measurement units of the variable and that the value obtained ranges between 0 and 100.

Standardisation 2.2: Reversed classic standardisation.

This standardisation approach differs from the approach described in section 2.1 in that variable *X* is inversely related to CPI. In these cases, the following standardisation technique is used:

Let *X* be the observed value of the variable and let $X^{(s)}$ be its standardised value. Then

$$X^{(s)} = 100\left(1 - \frac{X - Min\ (X)}{Max(X) - Min\ (X)}\right)$$

where *Max (X)* and *Min (X)* are the minimum and maximum observed values of *X* respectively. If a city has a value of *X* that is greater than ---- , the value assigned via standardisation will be 100. If a city has a value of that is less than *Min (X)*, then the value assigned via standardisation will be zero.

Requirements: *X , Max (X)* and *Min (X) In some cases, maximum and minimum values are calculated based on the transformed variable using* in (X) or $(X)^{(1/k)}$ *operators to guarantee more symmetrical distributions and superior outlier identification.*

Example: The Environmental Sustainability dimension includes the Air Quality sub-dimension. One variable within this sub-dimension is CO2 Emissions, which is measured in CO2 metric tonnes per capita. According to the World Bank (2014), the average minimum and maximum values for this variable from 2008 to 2010 were 0.01 and 44.20 metric tonnes, respectively. Thus, a city with 1.44 metric tonnes of emissions will have the following standardised value:

$$X^{(s)} = 100\left(1 - \frac{1.44\ metric\ tonnes - 0.01\ metric\ tonnes}{44.20\ metric - 0.01\ metric\ tonnes}\right) = 96.76$$

Please note that this operation eliminates variable measurement units and that the value obtained ranges between 0 and 100.

Standardisation 3: Standardisation with minimum objective.

Some variables include a minimum objective value X^* that relates to a CPI proposed by a specific international organisation, according to which the city is considered prosperous. In these cases, the "Standardisation with minimum objective" technique is applied using the following approach:

If the value of X does not reach the objective value, X^* , its standardised value will be less than 100, and it will decrease to the extent to which X moves to the left of X^* Values of X lower than 0 will have a standardised value of 0. If X reaches or exceeds the objective value, the standardised value of X will be 100. The following standardisation approach is proposed:

$$X^{(s)} = \begin{cases} 0 & \text{if } X < 0 \\ 100\left(1 - \left|\frac{X - X^*}{X^*}\right|\right) & \text{if } 0 \le X < X^* \\ 100 & \text{if } X \ge X^* \end{cases}$$

For X values varying between 0 and X^* , the marginal effect is constant and equals $1/X^*$.

Requirements: X, X^*.

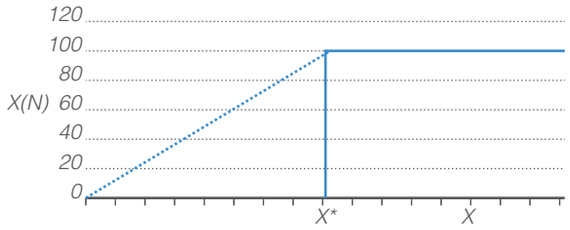

Figure 1. Standardisation with minimum objective

Example: The Infrastructure Development dimension includes the Road Connectivity sub-dimension. One variable within this sub-dimension is the Intersection Density of the city, which is measured as the number of road intersections per square kilometre. According to UN-Habitat (2013), an objective value of $X^* = 100$ intersections/km2 is recommended for a city. If a city includes $X - 50$ intersections/km2, its standardised value will be

$$X^{(s)} = 100\left(1 - \left|\frac{50int/Km^2 - 100int/Km^2}{100int/Km^2}\right|\right) = 50.00$$

Please note that this operation eliminates variable measurement units and that the value obtained ranges between 0 and 100.

Standardisation 3: Standardisation with minimum objective.

Some variables that form the index include a maximum objective value, X^* that is considered a city prosperity benchmark according to an international organization. In these cases, the "Standardisation with maximum objective" procedure is applied using the following approach:

If the value of X exceeds the objective value, X^*, then its standardised value will be less than 100, and it will decrease to the extent to which X moves to the right of X^*. Values of X that are greater than $2X^*$ will have a standardised value of 0. If X is lower than or equal to the objective, then the standardised value of X will be 100. The following standardisation approach is proposed:

$$X^{(s)} = \begin{cases} 0 & \text{if } X < 2X^* \\ 100\left(1 - \left|\frac{X - X^*}{X^*}\right|\right) & \text{if } X^* \le X < 2X^* \\ 100 & \text{if } X \ge X^* \end{cases}$$

For values of X between X^* and $2X^*$, the marginal effect is constant and equal to $-1/X^*$.

Requirements: X, X^*.

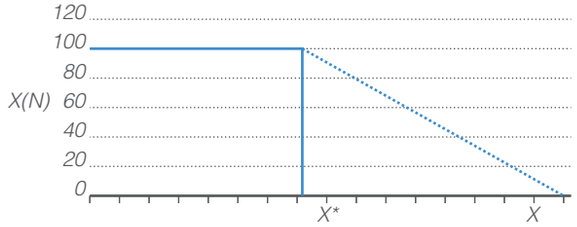

Figure 2. Maximum objective standardisation

Example: The Environmental Sustainability includes the Air Quality sub-dimension. One variable of this sub-dimension is PM10 Concentration, which is measured in micrograms per cubic metre ($\mu g/m^3$) . The European Commission (2013) has established a recommended objective value of no more than $X^* = 40\ \mu g/m^3$ If a city reports $X^* = 54{,}63\ \mu g/m^3$, the normalised value of this variable will be as follows:

$$X^{(s)} = 100\left(1 - \left|\frac{54.63\ \mu/m^3 - 40\ \mu g/m^3}{40\ \mu g/m^3}\right|\right) = 63.43$$

Please note that his operation eliminates variable measurement units and that the value obtained ranges between 0 and 100.

Standardisation 5: Standardisation with single objective.

For this class of variables, a unique objective value is proposed by an international organisation according to which the city is considered prosperous. If the value of X differs from the objective value, X^*, its standardised value will be lower than 100, and it will decrease as X moves away from X^*. If X achieves the objective value, the standardised value of X will be 100. The following standardisation approach is proposed:

$$X^{(s)} = \begin{cases} 0 & \text{if } X \leq 0 \text{ o } X \geq 2X^* \\ 100\left(1 - \left|\frac{X - X^*}{X^*}\right|\right) & \text{if } 0 < X < 2X^* \\ 100 & \text{if } X = X^* \end{cases}$$

For values of X ranging between 0 and X^*, the marginal effect in growth will be constant and equal to $1/X^*$, and for values of X ranging between X^* and $2X^*$, the marginal effect will be $1/X^*$.

Requirements: X, X^*.

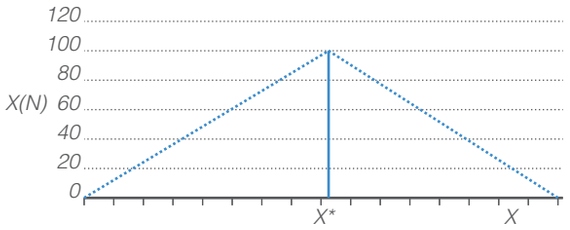

Figure 3. Single objective standardisation

Example: The Social Equality and Inclusion dimension includes the Gender Inclusion sub-dimension. The Women in Local Government variable is included in this sub-dimension. This variable is measured as a percentage with an objective value of $X^* = 50\%$ (Mossuz-Lavau, 2005). If this variable is $X = 31.32\%$ for a specific city, then the previous procedure will generate the following standardised value:

$$X^{(s)} = 100\left(1 - \left|\frac{31.32\% - 50\%}{50\%}\right|\right) = 62.64$$

Please note that this operation eliminates variable measurement units and that the value obtained ranges between 0 and 100.

Figure 4 presents a flowchart that summarises the procedure for determining the appropriate standardisation approach for a particular variable.

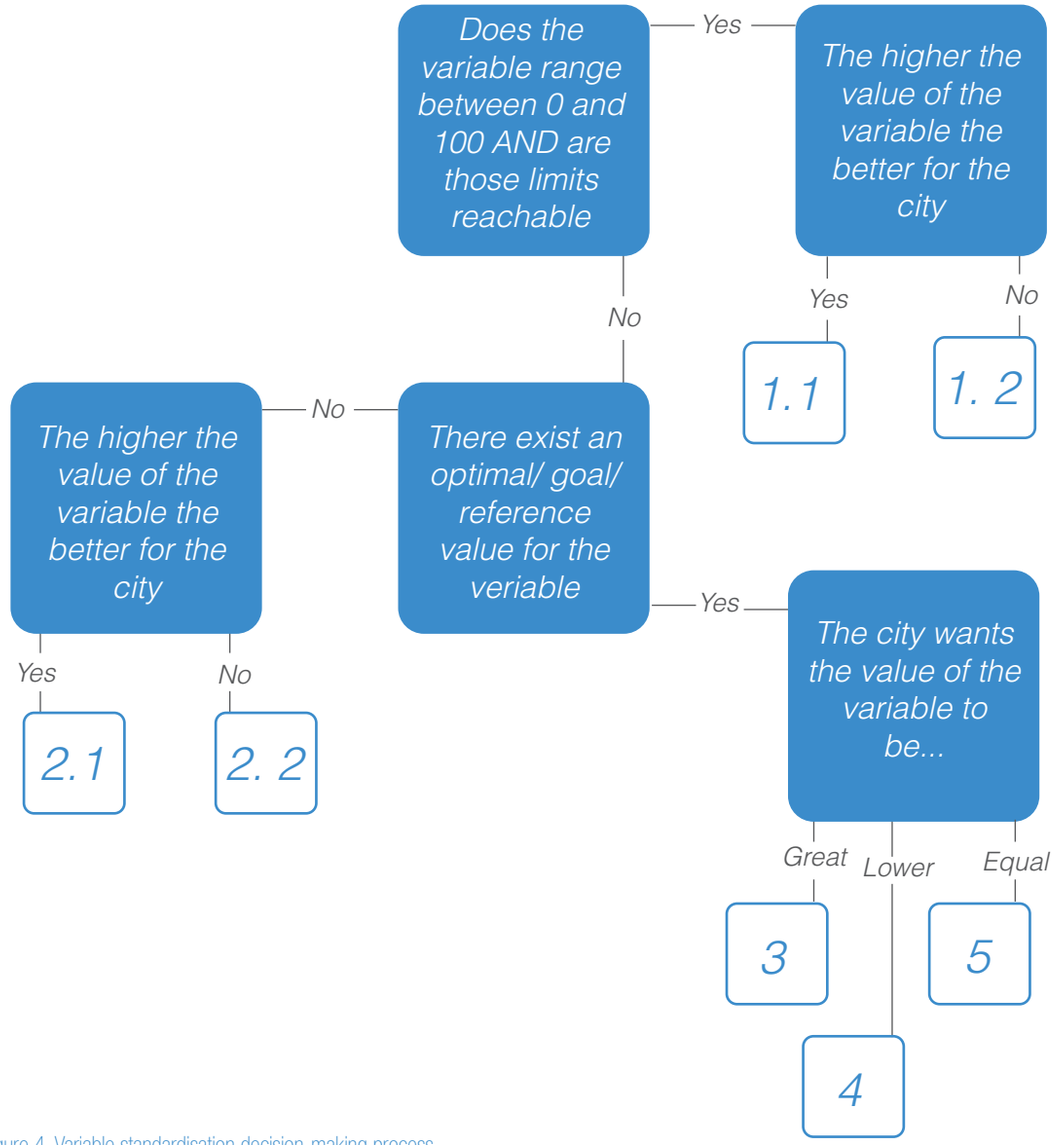

Figure 4. Variable standardisation decision-making process

2.2 WEIGHTING SCHEME CONSTRUCTION

The standardisation approaches described present the following advantages and disadvantages:

Advantages: Ease of interpretation, simplicity and little information required for calculations.

Disadvantages: As the variables included in the index definition are non-negative, the lower boundary of 0 included in the minimum objective and single objective standardisation approaches seem appropriate for the purposes of variable standardisation. However, the upper boundary of $2X^*$ may be modified if necessary to enable a decline to zero at a slower rate.

As mentioned above, the CPI (basic and extended) is defined based on six dimensions. Each dimension is defined from a collection of sub-dimensions, and each of these typically includes a distinct number of variables. Once the variables have been standardised, using the procedures demonstrated in the prior section, index construction involves defining a methodology that allows to add information from these variables to a new variable. This new variable will form an index for comparing prosperity levels between cities. We thus now describe a nested weighting scheme through which index dimension, sub-dimension and variable weights are established.

The weighting scheme

Existing research literature discusses various methodologies for obtaining weighting schemes (see OECD, 2008). The weighting scheme designed for the CPI follows the recommendations of Alkire and Foster (2011), who presented a weighting scheme for the multidimensional poverty index. In generalising their recommendations, the following weighting scheme is utilised:

A. Dimensions have equal weight in the index.
B. Sub-dimensions have equal weight within dimensions.
C. Variables have equal weight within sub-dimensions.

This weighting scheme clearly reveals an assumption that all chosen dimensions are equally effectual in determining city prosperity. This assumption similarly applies to the sub-dimensions of each dimension and to the variables within each sub-dimension.

Example: Let us assume that an index is defined from dimensions D_1 and D_2 and that D_1 contains two sub-dimensions S_{11} and S_{12} while D_2 contains three sub-dimensions (S_{21}, S_{22} and S_{23}). Table 2 presents the weighting scheme of this index, in which each sub-dimension is determined based on a certain number of variables shown in the fifth column:

Dimension	*Weight D_j*	*Sub-Dimension*	*Weight of S_{Ji} within D_j*	*Number of variables in S_{Ji}*	*Variable weight within S_{Ji}*
D1	*1/2*	S_{11}	*1/2*	*3*	*1/3*
		S_{12}	*1/2*	*4*	*1/4*
D2	*1/2*	S_{21}	*1/3*	*2*	*1/2*
		S_{22}	*1/3*	*2*	*1/2*
		S_{23}	*1/3*	*2*	*1/3*

Table 2. Nested weights

Note that:

A. Each dimension has the same weight (1/2) in the index.
B. The two sub-dimensions of D_1 are assigned the same weight (1/2) within this dimension; the three sub-dimensions of D_2 are also assigned the same weight (1/3) within this dimension.
C. Each of the three variables of the first sub-dimension (D_1) have the same weight of 1/3 within the sub-dimension. Similarly, the four variables of the second sub-dimension composing the first dimension are each assigned

a weight of (1/4) within this sub-dimension. Likewise, the variables for the first, second and third sub-dimensions of the second dimension are assigned a weight of 1/2, 1/2 and 1/3, respectively, within this sub-dimension.

Dimension	Weight D_j	Sub-Dimension	Weight of S_{ji} within D_j	Number of variables in S_{ji}	Variable weight within S_{ji}
D1	1/2	S_{11}	(1/2)(1/2)=1/4	3	(1/2)(1/2)(1/3)=0.08333
		S_{12}	(1/2)(1/2)=1/4	4	(1/2)(1/2)(1/4)=0.06250
D2	1/2	S_{21}	(1/2)(1/3)=1/6	2	(1/2)(1/3)(1/2)=0.08333
		S_{22}	(1/2)(1/3)=1/6	2	(1/2)(1/3)(1/2)=0.08333
		S_{23}	(1/2)(1/3)=1/6	2	(1/2)(1/3)(1/3)=0.05556
Total	1		1		1

Table 3. Weights within the index

The last row of Table 3 demonstrates that the weighting scheme is such that:

A. The sum of the index dimension weights is 1; each dimension weighs 1/2 in the index.
B. The sum of the index sub-dimension weights is 1. The two sub-dimensions of the first dimension each weigh 1/4 in the index, while the three sub-dimensions of the second dimension each weigh 1/6 in the index.
C. The sum of the index variable weights is 1. Each of the three variables of the first sub-dimension of dimension 1 weighs 0.08333; each variable of the second sub-dimension of dimension 1 weighs 0.06250. Similarly, variables in the first, second and third sub-dimensions of dimension 2 weigh 0.08333, 0.08333 and 0.05556, respectively.

Using this scheme, Table 3 presents the index dimension, sub-dimension and variable weights.

The sum of the index variable weights must be calculated to account for the number of variables present in each sub-dimension. In the example provided, the sum of the variable weights in the index = [3(1/2)(1/2)(1/3)] + [4(1/2)(1/2)(1/4)] + [2(1/2) (1/3)(1/2)] + [2(1/2) (1/3)(1/2)] + [3(1/2) (1/3)(1/3)] = 1

Using the above procedure, Table 4 shows the general weighting scheme for the CPI. It is assumed that the index is composed of six dimensions D_j; that in each dimension there are h_j sub-dimensions, S_{ji}, i=1,…, h_j, j=1,…,6; and that in each sub-dimension S_{ji} there are n_{ji} variables that define it.

Dimension	Dimension weigh in the index	Sub-Dimension	Sub-dimension weighting within the dimension	Number of variables in the sub-dimension	Variable weighting within he sub-dimension	Variable weighting within the dimension
D1	1/6	S_{11}	1/h1	V_{111}	1/n11	(1/h1)(1/n11)
				…	…	
				$V_{11n_{11}}$	1/n11	
		S_{12}	$1/h_1$	V_{121}	$1/n_{12}$	$(1/h_1)(1/n_{12})$
				…	…	
				$V_{12n_{12}}$	$1/n_{12}$	
		…	…	…	…	…
		S_{1h_1}	$1/h_1$	V_{1h_11}	$1/n_{1h1}$	$(1/h_1)(1/n_{1h1})$
				…	…	
				$V_{1h_1n_{1h_1}}$	$1/n_{1h1}$	
D2	1/6	S_{21}	$1/h_2$	V_{211}	$1/n_{21}$	$(1/h_2)(1/n_{21})$
				…	…	
				$V_{21}1n_{21}$	$1/n_{21}$	
		S_{22}	$1/h_2$	V_{221}	$1/n_{22}$	$(1/h_2)(1/n_{22})$
				…	…	
				$V_{22}1n_{22}$	$1/n_{22}$	
		…	…	…	…	…
		S_{2h_2}	$1/h_2$	V_{2h_11}	$1/n_{2h2}$	$(1/h_2)(1/n_{2h2})$
				…	…	
				$V_{2h_2n_{h_2}}$	$1/n_{2h2}$	

…	…	…	…	…	…	…
D6	1/6	S_{61}	$1/h_6$	V_{611}	$1/n_{61}$	$(1/h_6)(1/n_{61})$
				…	…	
				$V_{61}n_{61}$	$1/n_{61}$	
		S_{62}	$1/h_6$	V_{221}	$1/n_{62}$	$(1/h_6)(1/n_{62})$
				…	…	
				$V_{22}n_{62}$	$1/n_{62}$	
		…	…	…	…	…
				$V_6\ h_61$	$1/n_{6h6}$	$(1/h_6)(1/n_{h62})$
				…	…	
		S_6h_6	$1/h_6$	$V_6\ h_6n_6\ h_6$	$1/n_{6h6}$	$(1/h_6)(1/n_{6h6})$

Using this weighting scheme, the Basic and Extended Indexes are constructed.

Table 4. CPI weighting scheme

2.3 BASIC INDEX CONSTRUCTION

Extended CPI weights

Table 5 shows the weighting scheme for the Basic CPI.

Dimension	Dimension weigh in the index	Sub-Dimension	Sub-dimension weighting within the dimension	Number of variables in the sub-dimension	Variable weighting within the sub-dimension	Variable weighting within the dimension
Productivity (P)	1/6	EG	1/3	City Product	1/2	(1/3)(1/2)
				Old Age Dependency	1/2	
		EA	1/3	Economic Density	1	(1/3)(1)
		E	1/3	Unemployment Rate	1	
Infraestructure Development (ID)	1/6	HI	1/5	Improved Shelter	1/2	(1/5)(1/2)
				Access to Improved Water	1/2	
		SI	1/5	Physicians Density	1	(1/5)(1)
		ICT	1/5	Internet Access	1	
		UM	1/5	Use of Public Transport	1/2	(1/5)(1/2)
				Average Daily Travel Time	1/2	
		SC	1/5	Street Intersection Density	1/3	(1/5)(1/3)
				Street Density	1/3	
				Land allocated to streets	1/3	
Quality of Life (QoL)	1/6	H	1/4	Life Expectancy at Birth	1/2	(1/4)(1/2)
				Under-Five Mortality Rate	1/2	
		E	1/4	Literacy Rate	1/2	
				Mean Years of Schooling	1/2	
		SS	1/4	Homicide rate	1	(1/4)(1)
		PS	1/4	Green area per capita	1	

Equity and Social Inclusion (ESI)	*1/6*	*EE*	*1/3*	*Gini Coefficient*	*1/2*	*(1/3)(1/2)*
				Poverty Rate	*1/2*	
		SI	*1/3*	*Slum Households*	*1/2*	
				Youth Unemployment	*1/2*	
		GI	*1/3*	*Equitable Secondary School*	*1*	*(1/3)(1)*
Environmental Sustainability (ES)	*1/6*	*AQ*	*1/3*	*Number of monitoring stations*	*1*	*(1/3)(1)*
		WM	*1/3*	*Solid waste Collection*	*1/2*	*(1/3)(1/2)*
				Waste water treatment	*1/2*	
		WE	*1/3*	*Share of protected area in natural systems*	*1/2*	
				Share of renewable energy consumption	*1/2*	
Urban Governance and Legislation (UGL)	*1/6*	*P*	*1/4*	*Voter turnout*	*1*	*(1/4)(1)*
		AT	*1/4*	*Corruption*	*1*	
		IC	*1/4*	*Local Expenditure Efficiency*	*1/2*	*(1/4)(1/2)*
				Own Revenue Collection	*1/2*	
		RQ	*1/4*	*Days to Start a Business*	*1*	*(1/4)(1)*

Table 5. Weighting scheme for the Basic CPI

Basic CPI assemblage

The Basic CPI is constructed over two phases.

Stage 1. Dimension construction

Given the possibility that the value of a sub-dimension may be zero, to obtain the value of each dimension, an additive aggregation of sub-dimensions must be utilised as indicated below.

Pi: Productivity Index

$$Pi=(1/3)[EG+EA+E]$$

EG = (1/2)[City Product+Old Age Dependency]
EA=Economic Density
E=Unemployment Rate

Id: Infrastructure Development Index

$$Id=(1/5)[HI+SI+ICT+UM+SC]$$

HI=(1/2)[Improved Shelter+Access to Improved Water]
SI=Physicians Density
ICT=Internet Access
UM=(1/2)[Use of Public Transport+Average Daily Travel Time]
SC=(1/3)[Street Intersection Density+Street Density+Land allocated to streets]

Ql: Quality of Life Index

$$Ql=(1/4)[H+E+SS+PS]$$

Stage 2. Basic CPI index construction

The Basic CPI is constructed through the geometric aggregation of dimensions that were calculated in the prior stage, that is

$$Basic\ CPI=[(Pi)(Id)(Ql)(Esi)(Es)(Ugl)]^{1/6}$$

H=(1/2)[Life Expectancy at Birth+Under-Five Mortality Rate]
E=(1/2)[Literacy Rate+Mean Years of Schooling]
SS=Homicide rate
PS=Green area per capita

Esi: Equity and Social Inclusion Index

Esi=(1/3)[EE+SI+GI]

EE=(1/2)[Gini Coefficient+Poverty Rate]
SI=(1/2)[Slum Households+Youth Unemployment]
GI=Equitable Secondary School

Es: Environmental Sustainability Index

Es=(1/3)[AQ+WM+WE]

AQ=Number of monitoring stations
WM=(1/2)[Solid waste Collection+Waste water treatment]
WE=(1/2)[Share of protected area in natural systems+Share of renewable energy consumption]

Ugl: Urban Governance and Legislation Index

Ugl=(1/4)[P+AT+IC+RQ]

P=Voter turnout
AT=Corruption
IC=(1/2)[Local Expenditure Efficiency+Own Revenue Collection]
RQ=Days to Start a Business`

2.4 EXTENDED INDEX CONSTRUCTION

Extended CPI weights

The following Table presents the Extended CPI weighting scheme.

Dimension	*Dimension weigh in the index*	*Sub-Dimension*	*Sub-dimension weighting within the dimension*	*Variables in the sub-dimension*	*Variable weighting within the sub-dimension*	*Variable weighting within the dimension*
Productivity (P)	*1/6*	*EG*	*1/3*	*City Product*	*1/3*	*(1/3)(1/3)*
				Old Age Dependency	*1/3*	
				Mean Household Income	*1/3*	
		EA	*1/3*	*Economic Density*	*1/2*	*(1/3)(1/2)*
				Economic Specialization	*1/2*	
		E	*1/3*	*Unemployment Rate*	*1/3*	*(1/3)(1/3)*
				Employment to Population Ratio	*1/3*	
				Informal Employment	*1/3*	
Infraestructure Development (ID)	*1/6*	*HI*	*1/5*	*Improved Shelter*	*1/6*	*(1/5)(1/6)*
				Access to Improved Water	*1/6*	
				Access to Improved Sanitation	*1/6*	
				Access to Electricity	*1/6*	
				Sufficient Living Area	*1/6*	
				Residential Density	*1/6*	
				Residential Density	*1/6*	
		SI	*1/5*	*Physicians Density*	*1/2*	*(1/5)(1/2)*
				Number of Public Libraries	*1/2*	

		ICT	1/5	Internet Access	1/3	(1/5)(1/3)
				Home Computer Access	1/3	
				Average broadband speed	1/3	
		UM	1/5	Use of Public Transport	1/5	(1/5)(1/5)
				Average Daily Travel Time	1/5	
				Length of Mass Transport Network	1/5	
				Traffic Fatalities	1/5	
				Affordability of Transport	1/5	
		SC	1/5	Street Intersection Density	1/3	(1/5)(1/3)
				Street Density	1/3	
				Land allocated to streets	1/3	
Quality of Life (QoL)	1/6	H	1/4	Life Expectancy at Birth	1/4	(1/4)(1/4)
				Under-Five Mortality Rate	1/4	
				Vaccination Coverage	1/4	
				Maternal Mortality	1/4	
		E	1/4	Literacy Rate	1/5	(1/4)(1/5)
				Mean Years of Schooling	1/5	
				Under-Six Participation	1/5	
				Net enrollment rate in higher education	1/5	
				Number of Top Universities	1/5	
		SS	1/4	Homicide rate	1/2	(1/4)(1/2)
				Theft rate	1/2	
		PS	1/4	Green area per capita	1/2	(1/4)(1/2)
				Accessibility to Open Public Area	1/2	
Equity and Social Inclusion (ESI)	1/6	EE	1/3	Gini Coefficient	1/2	(1/4)(1/2)
				Poverty Rate	1/2	
		SI	1/3	Slum Households	1/2	
				Youth Unemployment	1/2	
		GI	1/3	Equitable Secondary School	1/3	(1/4)(1/3)
				Women in the Work Force	1/3	
		UD	1/4	Land Use Mix	1	(1/4)(1)
Environmental Sustainability (ES)	1/6	AQ	1/3	Number of monitoring stations	1/3	(1/3)(1/3)
				PM10 Concentration	1/3	
				CO2 Emissions	1/3	
		WM	1/3	Solid waste Collection	1/3	
				Waste water treatment	1/3	
				Solid waste recycling share	1/3	
		WE	1/3	Share of protected area in natural systems	1/2	(1/3)(1/2)
				Share of renewable energy consumption	1/2	
Urban Governance and Legislation (UGL)	1/6	P	1/4	Voter turnout	1/3	(1/4)(1/3)
				Civic participation	1/3	
				Trade unions density	1/3	
		AT	1/4	Corruption	1/2	(1/4)(1/2)
				Transparency and Accountability	1/2	
		IC	1/4	Local Expenditure Efficiency	1/3	(1/4)(1/3)
				Own Revenue Collection	1/3	
				Subnational Bebt	1/3	
		RQ	1/4	Days to Start a Business	1/2	(1/4)(1/2)
				City inflation	1/2	

Table 6. Weighting scheme for the Extended CPI

Extended CPI assemblage

The Extended CPI is also constructed over two stages.

Stage 1. Dimension construction

Given the possibility that the value of a sub-dimension may be zero, to obtain the value of each dimension, an additive aggregation of sub-dimensions must be utilised as indicated below.

Pi——————————Productivity Index

Pi=(1/3)[EG+EA+E]

EG=(1/3)[City Product+Old Age Dependency+Mean Household Income]
EA=(1/2)[Economic Density+Economic Specialization]
E=(1/3)[Unemployment Rate+Employment to Population Ratio +Informal Employment]

Id—Infrastructure Development Index

Id=(1/5)[HI+SI+ICT+UM+SC]

HI=(1/6)[Improved Shelter+Access to Improved Water +Access to Improved Sanitation +Access to Electricity +Sufficient Living Area +Residential Density]
SI=(1/2)[Physicians Density+Number of Public Libraries]
ICT=(1/3)[Internet Access+Home Computer Access+Average broadband speed]

Stage 2. Extended CPI index construction

The Extended CPI is constructed through the geometric aggregation of dimensions that were calculated in the prior stage, that is,

$$\text{Extended CPI}=[(Pi)(Id)(QI)(Esi)(Es)(Ugl)]^{1/6}$$

UM=(1/5)[Use of Public Transport+Average Daily Travel Time+Length of Mass Transport Network+Traffic Fatalities+Affordability of Transport]
SC=(1/3)[Street Intersection Density+Street Density+Land allocated to streets]

QI——————————Quality of Life Index

QI=(1/4)[H+E+SS+PS]

H=(1/4)[Life Expectancy at Birth+Under-Five Mortality Rate+Vaccination Coverage+
Maternal Mortality]
E=(1/5)[Literacy Rate+Mean Years of Schooling+Under-Six Participation+Net enrollment rate in higher education+Number of Top Universities]
SS=(1/2)[Homicide rate+Theft rate]
PS=(1/2)[Green area per capita+Accessibility to Open Public Area]

Esi–Equity and Social Inclusion index

Esi=(1/4)[EE+SI+GI+UD]

EE=(1/2)[Gini Coefficient+Poverty Rate]
SI=(1/2)[Slum Households+Youth Unemployment]
GI=(1/3)[Equitable Secondary School+ Women in Local Government+Women in the Work Force]
UD= Land Use Mix

Es–Environmental Sustainability Index

Es=(1/3)[AQ+WM+WE]

AQ=(1/3)[Number of monitoring stations+PM10 Concentration+CO2 Emissions]
WM=(1/3)[Solid waste Collection+Waste water treatment+Solid waste recycling share]
WE=(1/2)[Share of protected area in natural systems+Share of renewable energy consumption]

Ugl————Urban Governance and Legislation Index

Ugl=(1/4)[P+AT+IC+RQ]

P=(1/3)[Voter turnout+Civic participation+Trade unions density]
AT=(1/2)[Corruption+Transparency and Accountability]
IC=(1/3)[Local Expenditure Efficiency+Own Revenue Collection+Subnational Bebt]
RQ=(1/2)[Days to Start a Business+City inflation]

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3. METADATA

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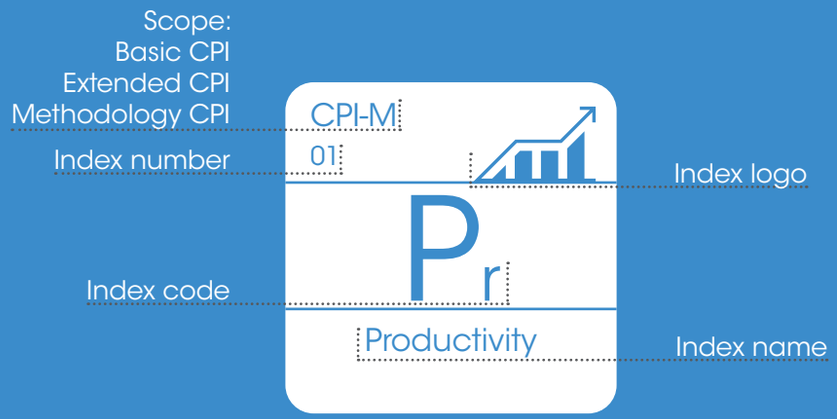

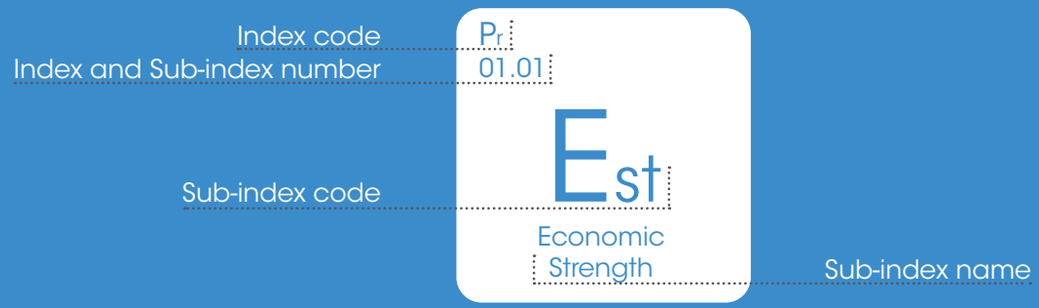

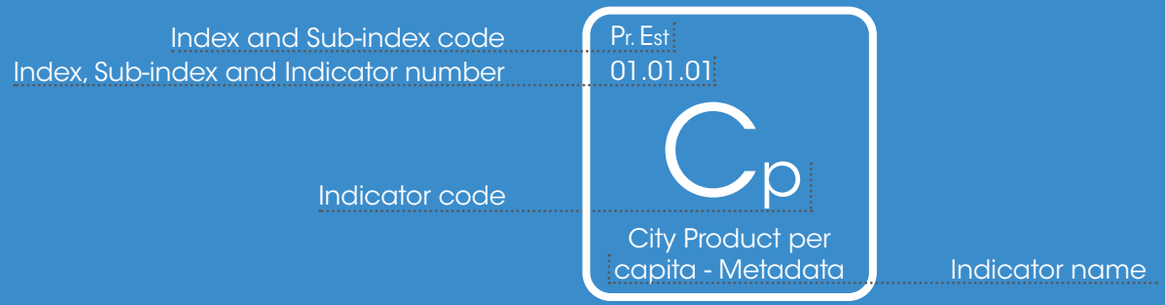

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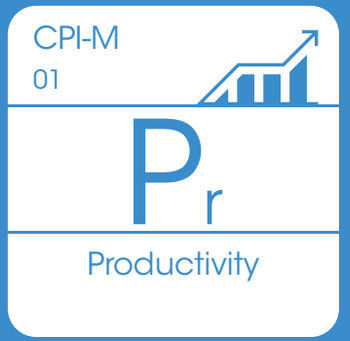
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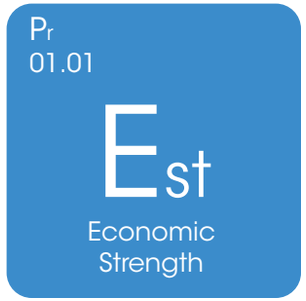
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Cp

City Product per capita - Metadata

Indicator	City Product per capita - Metadata
Scope	Basic CPI
Rationale	Cities have traditionally served as economic centres and have become the primary providers of services and engines of economic growth and development. Additionally, cities currently generate over half of national economic activity worldwide (UN-Habitat, 2003). Urban production, as measured through the City Product, is an important indicator of the economic development of a city vis-à-vis national development and provides information about income levels and the capacity to generate employment (United Nations, 2001). A prosperous city increases its City Product per capita to achieve higher levels of economic well-being
Definition	The City Product per capita is the sum of the gross value added by all producers within a city relative to its total population.
Unit [ ]	US$ per capita (2011 PPP)
Methodology	The City Product per capita is calculated as the sum of the products of the national Gross Domestic Product (GDP) of each economic sector (primary, industrial and service) and the city's share of that sector's total employment divided by total city population as follows:

Methodology

$$\textit{City Product per capita} = \frac{\sum_{j=1}^{J} \textit{National Product}_j * \left(\frac{\textit{city employment}_j}{\textit{national employment}_j}\right)}{\textit{Total City Population}}$$

where j represents the industry sector. When city employment information by sector is not available, it is possible to use census information about the employment structure.
The following table should be completed for each sector (using the most detailed categories available):
The total City Product is the sum of all City Sector Products (5) converted

Sector	*National Product (1)*	*National Employment (2)*	*City Employment (3)*	*Employment Ratio (4)=(3)÷(2)*	*City Sector Product (5)=(4)*(1)*
Agriculture and mining					
Manufacturing, utilities, construction					
Wholesale andretail trade, transport and communication					
Finance, insurance, real estate and business services					
Community, personal and other services					
Government					
Other					

to international dollars using the annual Purchasing Power Parity (PPP) exchange rate to obtain comparable figures across countries.

Sources

National Product by industry: available from national accounts. The classification used here is a simplified SITC standard industry classification, which is used for standard national accounting (United Nations, 2008)

Sources

National and city employment: workforce statistics by economic sector. Data for this indicator are derived from living standards household surveys or labour force censuses.

Population: national population censuses.

Exchange rate (PPP): World Bank [1].

Benchmark

Min = US$714.64 per capita, 2011 PPP

Max = US$108,818.96 per capita, 2011 PPP

Calculated from World Bank data (2014).

Standardisation: 2.1

$$\textit{City Product per capita}^{(S)} = 100 \left[\frac{\ln(\textit{City Product per capita}) - \ln(\textit{Min})}{\ln(\textit{Max}) - \ln(\textit{Min})} \right]$$

$$\textit{City Product per capita}^{(S)} = 100 \left[\frac{\ln(\textit{City Product per capita}) - 6.57}{11.60 - 6.57} \right]$$

Decision:

$$\textit{City Product per capita}^{(S)} = \begin{cases} 100, \text{ If } \ln(\textit{City Product per capita}) \geq 11.60 \\ \textit{City Product per capita}^{(s)}, \text{ If } 6.57 < \ln(\textit{City Product per capita}) < 11.60 \\ 0, \text{ If } \ln(\textit{City Product per capita}) \leq 6.57 \end{cases}$$

Limitations

The method to calculate the City Product per capita assumes that mean sector labour productivity is the same for workers across regions of the country. Hence, this indicator does not consider differences in labour productivity by sector across cities in the same country. Moreover, when census data are utilised, the indicator assumes that the sector structure has not changed between the census date and calculation date. Because the City Product per capita is based on GDP per capita, informal sector production is not considered. Therefore, the CPI includes a variable for mean household income.

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[1]: http://data.worldbank.org/indicator/PA.NUS.PPPC.RF, Accessed August 10, 2014.

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Pr. Est
01.01.02

Oad

Old Age Dependency Ratio (reversed)

Indicator	Old Age Dependency Ratio (reversed)
Scope	Basic CPI
Rationale	An ageing population is a major demographic trend in many countries (especially in developed countries). The increasing share of older persons presents challenges for the economic performance of cities. First, an older population implies increasing government expenditures for health and social security, which may imply higher taxes for the working population to finance pensioners. Second, population ageing implies that fewer individuals will be able to work in the future, which affects growth, employment, savings, investment and consumption (United Nations. Dept. of Economic and Social Affairs. Population Division, 2001). A prosperous city seeks policies to maintain a healthy relationship between younger and older residents to avoid high levels of dependency and decreases in the future labour supply.
Definition	The Old Age Dependency Ratio is the ratio of the total number of elderly persons (aged 65 and over) to the number of persons of working age (aged from 15 to 64) (United Nations. Dept. of Economic and Social Affairs. Population Division, 2001)
Unit [ ]	%

Methodology	$$Old\ Age\ Dependency\ Ratio = 100 \left[\frac{people\ aged\ 65\ and\ over}{people\ ages\ 15\ to\ 64} \right]$$
Sources	Labour market surveys, living standards household surveys and censuses.
Benchmark	Min: 2.92% Max: 40.53% Calculated from World Bank data (2014).
Standardisation: 2.2	$$Old\ Age\ Dependency\ Ratio^{(s)} = 100 \left[1 - \frac{ln(Old\ Age\ Dependency\ Ratio) - ln(Min)}{ln\ (Max) - ln\ (Min)} \right]$$ $$Old\ Age\ Dependency\ Ratio^{(s)} = 100 \left[1 - \frac{ln(Old\ Age\ Dependency\ Ratio) - 1.07}{3.70\text{-}1.07} \right]$$ Decision: $$Old\ Age\ Dependency\ Ratio^{(s)} = \begin{cases} 0, \text{ If } ln\ (Old\ Age\ Dependency\ Ratio) \geq 3.70 \\ Old\ Age\ Dependency, \text{ If } 1.07 < ln \left(Old\ Age\ Dependency\ Ratio \right) < 3.70 \\ 100, \text{ If } ln\ (Old\ Age\ Dependency\ Ratio) \leq 1.07 \end{cases}$$

Limitations

No international agreement about a target dependency ratio values exists. Hence, it is not possible to determine exactly what a healthy relationship between younger and older people means (United Nations. Dept. of Economic and Social Affairs. Population Division, 2006). Moreover, the dependency ratio ignores some additional facts. First, it ignores the fact that persons 65 years and older are not necessarily dependent; they might be wealthy or still working (especially in developing countries). Second, many young people might be currently unemployed. These facts imply that dependency estimates could be inaccurate (Eurofound, 2012).

References

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Pr. Est
01.01.03

Mhi

Mean Household Income - Metadata

Indicator	Mean Household Income
Scope	Extended CPI
Rationale	Household income enables consumption; improves access to education, healthcare and housing; and, broadly, achieves higher living standards and resistance to economic shocks (Canberra, 2011). A prosperous city seeks to build the appropriate foundations to increase mean household income to increase well-being.
Definition	Mean household income includes income earned by the average household in a city and is calculated by dividing the disposable income of all households (according to household surveys) by the number of households in the city [1].
Unit [ ]	US$ per household (PPP).
Methodology	To calculate mean household income, the disposable household income distribution of a city must be obtained. Disposable household income is defined as the sum of income from labour, monetary income from capital, monetary social security transfers (including work-related insurance transfers, universal transfers, and assistance transfers), and non-monetary social assistance transfers as well as monetary and non-monetary private transfers less the amount of income taxes and social contributions paid [2].

Methodology	Then, all disposable household incomes must be adding and dividing by the number of households on the city. Finally, these data must be converted to PPP to produce a comparable measure of mean household income across countries. Labour market surveys, living standards household surveys and censuses.
Sources	Household Income: Living standard household and income expenditure household surveys. Exchange rate (PPP): World Bank, 2012 [3].
Benchmark	Min = US$6,315 per household (PPP). Max = US$44,773 per household (PPP). Own calculations from the Luxembourg Income Study (LIS) Database Key Figures as of 18-Jun-2014 [2] first converted to Local Currency Units and then to USD PPP using the PPP exchange rate. World Bank, 2012 [3].
Standardisation: 2.1	$$Mean\ Household\ Income^{(s)} = 100\left[\frac{Mean\ Household\ Income - Min}{Max - Min}\right]$$ $$Mean\ Household\ Income^{(s)} = 100\left[\frac{Mean\ Household\ Income - 6{,}315}{44{,}773 - 6{,}315}\right]$$ Decision: $$Mean\ Household\ Income^{(s)} = \begin{cases} 100,\ If\ Mean\ Household\ Income \geq 44{,}773 \\ Mean\ Household\ Income^{(s)},\ If\ 6{,}316 < \left(Mean\ Household\ Income\right) < 44{,}773 \\ 0,\ If\ Mean\ Household\ Income \leq 6{,}315 \end{cases}$$

Limitations

Mean household income does not consider the income distribution of the population, which implies that highly unequal cities could have higher mean household incomes due to high levels of income concentration. Whether this situation indicates a prosperous city is questionable.
Moreover, developed countries tend to use equivalence scale measures to calculate disposable total income, while developing countries do not. Therefore, cross-country comparisons should be made cautiously.

References

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URL references:

[1]: http://www.eastsussexinfigures.org.uk/webview/index/en/ESCCFigures/East-Sussex-in-Figures-4.d.43/Tables-charts-and-maps.d.44/Economy-jobs-and-prosperity.d.54/Earnings-income-and-wealth.d.88/Average-household-income-in-2014-parishes/fCube/200_C1, accessed August 18, 2014.

[2]: http://www.lisdatacenter.org/data-access/key-figures/disposable-household-income/, accessed August 18, 2014.

[3]: http://data.worldbank.org/indicator/PA.NUS.PPP, accessed August 14, 2014.

Pr
01.02

Ea

Economic
Agglomeration

Pr. Ea
01.02.01

Ede

Economic Density - Metadata

Indicator	Economic Density
Scope	Basic CPI
Rationale	Economic density affects productivity in several ways. Density can reduce the costs of goods and services due to geographical proximity (transaction costs). Economic density also enables the specialisation of production of intermediate and final goods as well as of the labour force, which decreases production costs (Ciccone & Hall, 1996; Jenks, Burton and Williams, 2005). A prosperous city leverages these agglomeration effects to increase the well-being of its population.
Definition	Economic Density is the City Product divided by the city area (square kilometres).
Unit [ ]	US$ (PPP)/km2
Methodology	$$Economic\ Density = \frac{City\ Product\ (\$PPP)}{City\ square\ kilometres}$$ To produce a comparable measure, the City Product should be obtained from the economic growth sub-dimension.

Sources	City Product: City Product per capita Metadata. Square kilometres: City Map.
Benchmark	*X*:* 526,032 US$ (PPP)/km2 The reference for the benchmark is the 1995 world GDP per square kilometre estimate from Gallup, Sachs and Mellinger (1999). To determine the maximum benchmark value, the lower limit of the highest GDP density interval is considered the reference (442,000). The interval mid-point is not used because the maximum density value is extreme (546,000,000). This value is adjusted by the per capita GDP growth rate averages of the most economically dense countries (including Germany, Japan, Italy and the United Kingdom).
Standardisation: 3	$$Economic\ Density^{(s)} = 100\left(1 - \left\lvert\frac{Economic\ Density - X^*}{X^*}\right\rvert\right)$$ $$Economic\ Density^{(s)} = 100\left(1 - \left\lvert\frac{Economic\ Density - 526{,}032}{526{,}032}\right\rvert\right)$$ Decision: $$Economic\ Density^{(s)} = \begin{cases} Economic\ Density^{(S)},\ If\ 0 \le Economic\ Density < 526{,}032 \\ 100, If\ Economic\ Density \ge 526{,}032 \end{cases}$$

Limitations

The economic density indicator assumes that the economic activity of a city is homogenously spatially distributed, i.e., regional differences within a city are not considered. Moreover, it is possible that highly concentrated economic activity generates negative externalities (e.g., rising prices or lower quality of life).

References

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Jenks, Mike, Burton, Elizabeth and Katie, Williams, Eds. (2005). The compact City. A sustainable Urban Form? Taylor & Francis e-Library. United Kingdom.

Pr. Ea
01.02.02

Esp

Economic Specialisation - Metadata

Indicator	Economic Specialisation
Scope	Extended CPI
Rationale	A major insight from economic geography and economic development is that firms value agglomeration. Firms prefer to locate near other firms in the same or related product lines and in locations with favourable access to markets (World Bank, 2009). A critical element of this agglomeration process is specialisation, which implies that a city specialises in certain economic activities to generate and benefit from increasing returns to scale. The latter are related to decreasing transaction and information costs, increasing specialisation in labour and input markets and promoting innovation (Romer, 1987; Feldman and Audretsch, 1999). A prosperous city seeks increasing economic specialisation to improve its competitiveness, economic growth and income.
Definition	Industrial specialisation indicates the degree to which a city concentrates its economic activity on certain goods and services, usually to improve productivity and benefit from increasing returns to scale (Romer, 1987; Feldman and Audretsch, 1999).
Unit [ ]	Dimensionless (a value between 0 and 1).

Methodology

One measure of concentration is the Herfindahl-Hirschman index (H), which is commonly used to analyse the market structure and concentration of a specific sector. H is also used to measure general industry concentration in a city or region (Dewhurst and McCann, 2002). H index is defined as

$$H = \sum_{i=1}^{N} S_i^2,$$

follows:
where S_i^2 is the share of employment in industry i in the city and N is the total number of industries. The share, S_i^2, is expressed as a number, that is, 0.15 rather than 15%.
H ranges from $1/N$ to one, where values above 0.25 indicate high concentration (U.S. Department of Justice and the Federal Trade Commission, 2010).
The normalised version of H, is H^*, which ranges from 0 to 1 and is computed as follows:

$$H^* = \frac{(H - 1/N)}{1 - 1/N}$$

IMPORTANT: To facilitate the treatment of this variable within the CPI, H^* will be utilised.

Sources

National or local industry surveys, labour market surveys, living standard household surveys, censuses, and chambers of commerce (in cities with low level of informality).

Benchmark

A high level of concentration occurs when

$$H^* \geq \frac{(0.25 - 1/N)}{1 - 1/N}$$

Benchmark

The benchmark value, X, is defined as follows:*

$$X^* = \frac{(0.25 - 1/N)}{1 - 1/N}$$

Note that this benchmark varies across cities as the number of industries changes. However, this does not affect the comparability of the standardised value.

Standardisation: 3

$$H^{*(s)} = 100 \left(1 - \left| \frac{H^* - X^*}{X^*} \right| \right)$$

$$H^{*(s)} = 100 \left(1 - \left| \frac{H^* - \frac{(0.25 - 1/N)}{1 - 1/N}}{\frac{(0.25 - 1/N)}{1 - 1/N}} \right| \right)$$

Decision:

$$H^{*(s)} = 100 \begin{cases} H^{*(S)}, \text{If } 0 \le H^* < \frac{(0.25 - 1/N)}{1 - 1/N} \\ 100, \text{ If } H^* \ge \frac{(0.25 - 1/N)}{1 - 1/N} \end{cases}$$

Limitations

A larger H value implies higher concentration of economic activity in a specific set of sectors. However, cities may specialise in low productivity sectors in which it is not possible to exploit economies of scale. Additionally, economic specialisation competes with diversification, which might be desirable to avoid dependence on a limited group of sectors (Duranton and Puga, 2000). Finally, this measure does not consider spatial aspects.

References

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Pr
01.03

Em

Employment

Pr. Em
01.03.01

Ur

Unemployment Rate (reversed) - Metadata

Indicator	Unemployment Rate (reversed)
Scope	Basic CPI
Rationale	The unemployment rate is among the most comprehensive indicators of economic activity. High levels of unemployment are detrimental to city economies and reflect structural problems in the labour market. Moreover, people who are willing to work but are unable to do so suffer not only income losses but also mental health, social relationship and personal vulnerability effects (Darity and Goldsmith, 1996). In addition, rising levels of unemployment reflect macroeconomic uncertainty that leads to lower consumption, investment and production. A prosperous city seeks to reduce unemployment to lead the economy onto a growth path with improved opportunities for its inhabitants.
Definition	According to the International Labor Organization (2013), the unemployment rate comprises the share of the labour force (above 15 years old) that, during the reference period, is without work but available for and seeking employment.
Unit [ ]	%

Ur

Methodology	$$Unemployment\ Rate = 100\left[\frac{Unemployed}{Labour\ Force}\right]$$
Sources	Labour markets surveys, living standard surveys, and censuses.
Benchmark	*Min = 1.00%* *Max = 28.20%* *Calculated from World Bank data (2014).*
Standardisation: 2.2	$$Unemployment\ Rate^{(S)} = 100\left[1 - \frac{\sqrt[4]{Unemployment\ Rate} - \sqrt[4]{Min}}{\sqrt[4]{Max} - \sqrt[4]{Min}}\right]$$ $$Unemployment\ Rate^{(S)} = 100\left[1 - \frac{\sqrt[4]{Unemployment\ Rate} - 1}{2.3 - 1}\right]$$ Decision: $$Unemployment\ Rate^{(S)} = \begin{cases} 0, \text{ If } \sqrt[4]{Unemployment\ Rate} \geq 2.3 \\ Unemployment\ Rate^{(S)}, \text{ If } 1 < \sqrt[4]{Unemployment\ Rate} < 2.3 \\ 100, \text{If } \sqrt[4]{Unemployment\ Rate} \leq 1 \end{cases}$$

Limitations

The unemployment rate generally includes individuals aged 15 years and over, but some countries use different lower limits or impose upper limits, which means that country comparisons must be made cautiously. Additionally, the unemployment rate does not consider the type of unemployment, such as cyclical and short term or structural and long term unemployment. Finally, this measure masks the composition of the unemployed population and therefore ignores the particularities of education level, ethnic origin, socioeconomic background, work experience, etc. (ILO, 2013).

References

Bibliographic references:

Darity, William Jr. and Goldsmith, Arthur H. (1996). Social Psychology, Unemployment and Macroeconomics. The Journal of Economic Perspectives. Vol 10 (1).

International Labour Organization (ILO). (2013). Key Indicators of the Labour Markets. 8th edition.

The World Bank (2014). World Development Indicators 1960 – 2013. [1]

URL references:

[1]: http://data.worldbank.org/indicator/SL.UEM.TOTL.ZS, accessed August 9, 2014.

Pr. Em
01.03.02

Ep

Employment to Population Ratio- Metadata

Indicator	Employment to Population Ratio
Scope	Basic CPI
Rationale	The ability of a city to create employment opportunities is a key indicator of growth and social development. Labour market opportunities have a direct effect on the income and wealth of a city and can help reduce poverty and improve social mobility (United Nations, 2006). A prosperous city should seek to provide employment opportunities for its inhabitants.
Definition	The Employment to Population Ratio is the proportion of a country's working age population that is employed (generally, persons over 15 years old) (International Labour Organization, 2013).
Unit [ ]	%
Methodology	$Employment\ to\ Population\ Ratio = 100\left[\frac{Total\ Number\ of\ employees}{Working\ Age\ Population}\right]$
Sources	Household surveys of the labour force and censuses.
Benchmark	*Min = 30.50%* *Max = 75.00%*

Standardisation: 2.1

$$Employment\ to\ Population\ Ratio^{(s)} = 100\left[\frac{Employment\ to\ Population\ Ratio - Min}{Max - Min}\right]$$

$$Employment\ to\ Population\ Ratio^{(s)} = 100\left[\frac{Employment\ to\ Population\ Ratio - 30.50}{75.00 - 30.50}\right]$$

Decision:

$$Employment\ to\ Population\ Ratio^{(s)} = \begin{cases} 100,\ If\ Employment\ to\ Population\ Ratio \geq 75.00 \\ Employment\ to\ Population\ Ratio^{(s)},\ If\ 30.50 < Employment\ to\ Population\ Ratio < 75.00 \\ 0,\ If\ Employment\ to\ Population\ Ratio \leq 30.50 \end{cases}$$

Limitations

The comparability of employment ratios across countries is affected most significantly by variations in the definitions of employment and working age population. Employment does not consider the type of employment (e.g., formal or informal) or the number of hours worked. The working age population is normally defined as persons aged 15 years and older. However, the lower limit can vary by country due varying societal standards for education and work eligibility. Many developed countries also impose an upper limit on work of 65 or 70 years (International Labour Organization, 2013). Therefore, cities in different countries should be compared cautiously.

References

Bibliographic references:

International Labour Organization. (2013). Key Indicators of the Labour Markets. 8th edition.
United Nations. (2006). Full and Productive Employment and Decent Work: Dialogues at the Economic and Social Council.

Pr. Em
01.03.03

Ie

Informal Employment (reversed) - Metadata

Indicator	Informal Employment (reversed)
Scope	Extended CPI
Rationale	Economic performance reflects the capacity of a city to provide adequate employment for its residents. Informal employment is characterised by lower levels of productivity, skilled labour demand, and social security provision as well as greater tax evasion. Higher levels of informality are closely related to lower incomes (including lower wages) and thus a reduced likelihood of leaving poverty (ILO, 2013b). A prosperous city reduces informality to improve the productivity, education and working conditions of its labour force.
Definition	Informal Employment comprises all jobs in unregistered and/or small-scale private unincorporated enterprises that produce goods and services for sale, including units that employ hired labour and those operated by individuals working as self-employed persons alone or with unpaid family member labour (International Labour Organization, 2013a).
Unit [ ]	%
Methodology	$Informal\ Employment = 100 \left[\frac{Number\ of\ Informal\ Employees}{Total\ Number\ of\ Occupied\ Persons} \right]$

Ie

Sources	Labour force surveys, living standard household surveys, and censuses.
Benchmark	*Min = 11 %* *Max = 75 %* *According to the ILO (2002, 2013b), up to three-quarters of non-agricultural employment in developing countries is informal. In OECD countries, approximately 11% of total employment is informal (using part-time employment as a proxy for informal employment).*
Standardisation: 2.2	$Informal\ Employment^{(s)} = 100 \left[1 - \frac{Informal\ Employment - Min}{Max - Min} \right]$ $Informal\ Employment^{(s)} = 100 \left[1 - \frac{Informal\ Employment - 11}{75 - 11} \right]$ Decision: $Informal\ Employment^{(s)} = \begin{cases} 0,\ If\ Informal\ Employment \geq 75 \\ Informal\ Employmento^{(s)},\ If\ 11 < Informal\ Employmento < 75 \\ 100,\ If\ Informal\ Employment \leq 11 \end{cases}$

Limitations

Small-scale private enterprises are defined nationally. To allow for comparability, we utilise the ILO definition in which enterprises with fewer than five employees are considered to be informal. The size limit should apply to the largest establishment of multiple-establishment enterprises (International Labour Organization, 2013a).

References

Bibliographic references:

International Labour Organization (2002). Women and Men in the Informal Economy A statistical picture

International Labour Organization (2013b). Women and Men in the Informal Economy A statistical picture. Second Edition.

International Labour Organization (2013a). Measuring Informality: A statistical manual of the informal sector and informal employment.

CPI-M
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Id

Infrastructure and
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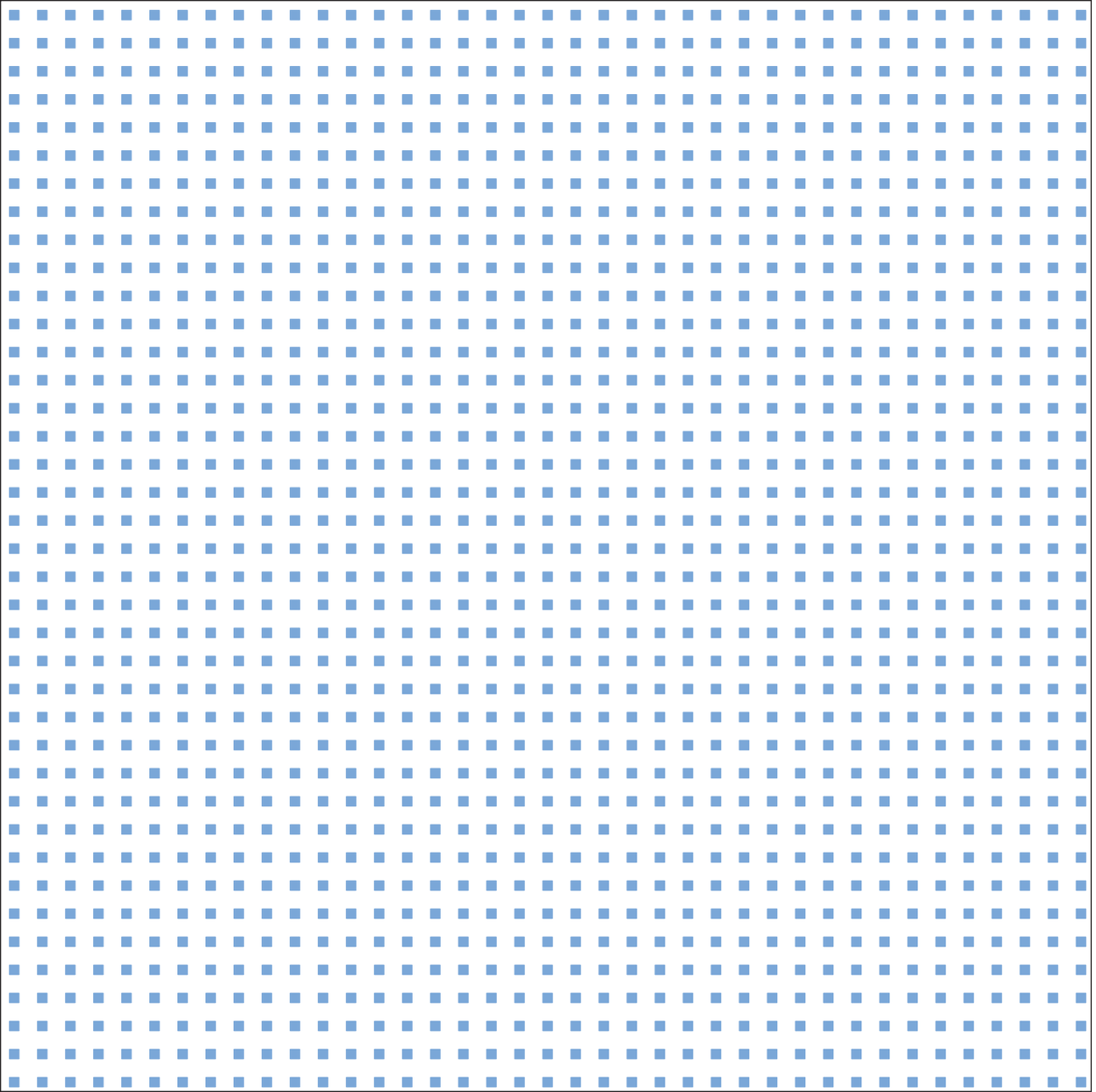

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02.01

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Housing
Infrastructure

Id. Hi
02.01.01

Is

Improved Shelter - Metadata

Indicator	Improved Shelter
Scope	Basic CPI
Rationale	Households residing in slums usually occupy non-durable dwellings that expose them to high morbidity and mortality risks. Slums are defined by a lack one of five components, including durable structures [1]. A housing structure is considered to be durable when certain strong building materials are used for the roof, walls and floor. Although a house may be built with durable materials, the dwellers may not enjoy adequate protection against weather and climate due to the overall state of the dwelling. Some materials may not look durable, in a modern sense, but they are, in a traditional sense, when combined with repair skills. For example, vernacular housing is constructed using natural materials in villages and is maintained by its residents annually (UN-Habitat, 2009). A prosperous city avoids non-durable housing to ensure safe living conditions for its population.
Definition	The proportion of households living in a durable housing unit, i.e., built on a non-hazardous location with a permanent and adequate structure that protects its inhabitants from extreme climatic conditions, such as rain, heat, cold, and humidity. The quality of construction (e.g., materials used for the walls, floor and roof) should be considered when categorising housing units

Is

Definition	(United Nations, 2007). According to UN-Habitat (2009), the following locations should be considered hazardous: – Geologically hazardous zones (landslide, earthquake and flood areas); – Garbage-mountains; – High-industrial pollution areas; – Other high-risk zones, e.g., railroads, airports, energy transmission lines. The following durability factors should be considered when categorising housing units: – Quality of construction (e.g., materials used for the walls, floor and roof); – Compliance with local building codes, standards and bye-laws.
Unit [ ]	%
Methodology	$$Improved\ Shelter = 100 \left[\frac{Number\ of\ Households\ Living\ in\ a\ House\ Considered\ Durable}{Total\ Number\ of\ Households} \right]$$
Sources	Living standards households surveys and censuses.
Benchmark	Min= 84.80% Max = 98.40% Obtained from UN-Habitat (2005).

Standardisation: 2.1

$$Improved\ Shelter^{(s)} = 100 \left[\frac{Improved\ Shelter - Min}{Max - Min} \right]$$

$$Improved\ Shelter^{(s)} = 100 \left[\frac{Improved\ Shelter - 84.80}{98.40 - 84.80} \right]$$

Decision:

$$Improved\ Shelter^{(s)} = \begin{cases} 100, \text{ If } Improved\ Shelter \geq 98.40 \\ Improved\ Shelter^{(s)}, \text{ If } 84.80 < Improved\ Shelter < 98.40 \\ 0, \text{ If } Improved\ Shelter \leq 84.80 \end{cases}$$

Limitations

Durability of building materials is largely subject to local conditions as well as to local construction and maintenance traditions and skills. The materials considered to be durable under local conditions must be determined by local experts. For example, a common problem in the outskirts of cities in developing countries is that dwellings often follow rural construction patterns using materials that are considered to be non-durable in urban conditions (UN-Habitat, 2009).
The Multidimensional Poverty Index or the Unsatisfied Basic Needs Index can provide a framework to support the differences in assessing the durability of building materials.

References

Bibliographic references:

United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York.

References

UN-Habitat (2009). Urban Indicators Guidelines; Better Information, Better Cities. Monitoring the Habitat Agenda and the Millennium Development Goals-Slum Target.

UN-Habitat (2005), Urban Indicators Programme Phase III and United Nations, World Urbanization Prospects; The 2003 revision. [1]

URL references:

[1]: http://ww2.unhabitat.org/mediacentre/documents/sowcr2006/SOWCR%205.pdf, accessed July 2, 2014.

Id. Hi
02.01.02

Aiw

Access to Improved Water- Metadata

Indicator	Access to Improved Water
Scope	Basic CPI
Rationale	According to UN-Habitat (2009), clean water is necessary for life and health but nearly 2 billion people lack access to an adequate water supply or can only obtain water at high prices. Households in informal settlements are rarely connected to the network and rely on water purchased from vendors at up to 200 times the tap price. Improving access to safe water reduces the burden, especially of women, of collecting water from available sources and reduces water-related diseases, which both improve quality of life (UN-Habitat, 2009). A prosperous city must provide access to improved water to its entire population so that individuals can spend their time on productive activities rather than obtaining drinking water.
Definition	The percentage of urban households with access to an improved source of drinking water. According to the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation [1], improved sources of drinking water include the following: - Piped water into a dwelling - Piped water into a yard/plot - Public taps or standpipes - Tube wells or boreholes - Protected dug wells

Definition	- Protected springs - Rainwater The following are considered unimproved sources of drinking water: - Unprotected springs - Unprotected dug wells - Carts with small tanks/drums - Tanker-trucks - Surface water - Bottled water
Unit [ ]	%
Methodology	$\text{Access to Improved Water} = 100 \left[\frac{\text{Number of Households with Sustainable Access to Piped Water Source}}{\text{Total Number of Households}} \right]$
Sources	Living standards household surveys and censuses. Public utility service companies.
Benchmark	Min= 50% Max = 100% Calculated from The World Bank (2014).

Standardisation: 2.1

$$\text{Access to Improved Water}^{(s)} = 100 \left[\frac{\text{Access to Improved Water} - \text{Min}}{\text{Max} - \text{Min}} \right]$$

$$\text{Access to Improved Water}^{(s)} = 100 \left[\frac{\text{Access to Improved Water} - 50}{100 - 50} \right]$$

Decision:

$$\text{Access to Improved Water}^{(s)} = \begin{cases} \text{Access to Improved Water}^{(s)}, & \text{If } 50 < \text{Access to Improved Water} \leq 100 \\ 0, & \text{If Access to Improved Water} \leq 50 \end{cases}$$

Limitations

According to the United Nations (2007), although the existence of a water outlet near the household is often used as a proxy for the availability of safe water, there is no guarantee that water will always be available or safe or that people always use such sources.

References

Bibliographic references:

United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York.

UN-Habitat (2009). Urban Indicators Guidelines; Better Information, Better Cities. Monitoring the Habitat Agenda and the Millennium Development Goals-Slum Target.

The World Bank (2014). World Development Indicators 1960 – 2013. [2]

References

URL references:

[1]: http://www.wssinfo.org/definitions-methods/watsan-categories/, accessed July 2, 2014.
[2]: http://data.worldbank.org/indicator/SH.H2O.SAFE.UR.ZS, accessed July 2, 2014.

Id. Hi
02.01.03

Ais

Access to Improved Sanitation- Metadata

Indicator	Access to Improved Sanitation
Scope	Extended CPI
Rationale	The lack of sanitation is a major public health problem that causes disease and death. Highly infectious, excreta-related diseases, such as cholera, still affect communities in developing countries. Diarrhoea, which spreads easily with poor hygiene and inadequate sanitation, kills approximately 2.2 million people each year of which most are children under age five. Inadequate sanitation, through its impacts on health and the environment, has considerable implications for economic development. Individuals miss work due to sickness from excreta-related diseases. Moreover, the lack of excreta management poses a fundamental threat to global water resources. Adequate sanitation is important for both urban and rural populations, but the risks are greater in slum areas where it is more difficult to avoid contact with waste (UN-Habitat, 2009). A prosperous city seeks to guarantee full coverage of sewer system facilities to improve quality of life and reduce productivity losses due to sickness resulting from excreta-related diseases.
Definition	The percentage of the population with access to facilities that hygienically separate human excreta from human, animal and insect contact (UN-Habitat, 2009). According to the WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation [1], improved sanitation includes the following facilities:

Definition	- Flush toilets - Piped sewer systems - Septic tanks - Flush/pour flush to pit latrines - Ventilated improved pit latrines - Pit latrines with slabs - Composting toilets Unimproved sanitation includes the following facilities: - Flush/pour flush to elsewhere - Pit latrines without slabs - Buckets - Hanging toilets or hanging latrines - No facilities, e.g., bush or field
Unit [ ]	%
Methodology	$$\textit{Access to Improved Sanitation} = 100 \left[\frac{\textit{Number of Households with Improved Sanitation}}{\textit{Total Number of Households}} \right]$$
Sources	Living standards household surveys and censuses. Public utility service companies.
Benchmark	Min= 15% Max = 100% Calculated from World Bank data (2014).

Standardisation: 2.1

$$\text{Access to Improved Sanitation}^{(s)} = 100 \left[\frac{\text{Access to Improved Sanitation} - \text{Min}}{\text{Max} - \text{Min}} \right]$$

$$\text{Access to Improved Sanitation}^{(s)} = 100 \left[\frac{\text{Access to Improved Sanitation} - 15}{100 - 15} \right]$$

Decision:

$$\text{Access to Improved Sanitation}^{(s)} = \begin{cases} \text{Access to Improved Sanitation}^{(s)}, & \text{If } 15 < \text{Access to Improved Sanitation} \leq 100 \\ 0, & \text{If Access to Improved Sanitation} \leq 15 \end{cases}$$

Limitations

According to the United Nations (2007), this indicator uses a proxy for adequate sanitation facilities because it is not currently possible to define the proportion of the population with access to sanitary facilities according to the conceptual definitions above.

References

Bibliographic references:

United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York.

UN-Habitat (2009). Urban Indicators Guidelines; Better Information, Better Cities. Monitoring the Habitat Agenda and the Millennium Development Goals-Slum Target.

The World Bank (2014). World Development Indicators 1960 – 2013. [2]

References

URL references:

[1]: http://www.wssinfo.org/definitions-methods/watsan-categories/, accessed July 2, 2014.
[2]: http://data.worldbank.org/indicator/SH.STA.ACSN.UR, accessed July 2, 2014.

Id. Hi
02.01.04

Ae

Access to Electricity - Metadata

Indicator	Access to Electricity
Scope	Extended CPI
Rationale	Access to electricity is important to fulfilling basic needs, working and studying. Energy services are important in providing adequate food, shelter, water, sanitation, medical care, education and access to communication. Reliable, adequate and affordable energy services are necessary to guarantee sustainable development (United Nations, 2007). A prosperous city must provide access to electricity to its entire population to improve living standards, economic development and productivity.
Definition	The percentage of households that are connected to the grid and receive a continuous supply of electricity.
Unit [ ]	%
Methodology	$$Access\ to\ Electricity = 100\left[\frac{Number\ of\ Households\ with\ Connection\ to\ the\ City\ Electricity\ Grid}{Total\ Number\ of\ Households}\right]$$
Sources	Living standards household surveys and censuses. Public utility service companies.

Benchmark	Min= 7% Max = 100% Calculated from World Bank data (2014).
Standardisation: 2.1	$$Access\ to\ Electricity^{(s)} = 100\left[\frac{Access\ to\ Electricity - Min}{Max - Min}\right]$$ $$Access\ to\ Electricity^{(s)} = 100\left[\frac{Access\ to\ Electricity - 7}{100 - 7}\right]$$ Decision: $$Access\ to\ Electricity^{(s)} = \begin{cases} Access\ to\ Electricity^{(s)}, & If\ 7 < Access\ to\ Electricity \leq 100 \\ 0, & If\ Access\ to\ Electricity \leq 7 \end{cases}$$
Limitations	This indicator would not include off-grid access to electricity, i.e., solar, wind or other alternative energy source, at the household level.
References	Bibliographic references: United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York. The World Bank (2014). World Development Indicators 1960 – 2013. [1] URL references: [1]: http://data.worldbank.org/indicator/EG.ELC.ACCS.ZS, accessed July 2, 2014.

Id. Hi
02.01.05

SIa

Sufficient Living Area - Metadata

Indicator	Sufficient Living Area
Scope	Extended CPI
Rationale	This is an indicator of adequate shelter, a basic human need. Reduced space per person is often associated with certain health risks and is therefore considered typical of slums [1]. Overcrowding is associated with few square meters per person, high occupancy rates – the number of persons sharing a room - and many single room units. Slums worldwide include dwellings that are often overcrowded with five and more persons sharing a one-room unit used for cooking, sleeping, and other household activities. Several local definitions of slums include thresholds for the minimum area, number of structures in a settlement cluster, number of households or people and density of dwellings in an area (UN-Habitat, 2009). A prosperous city seeks to avoid overcrowding to improve public health and quality of life.
Definition	The proportion of households with fewer than four persons per room. A house provides sufficient living area for a household if three or fewer people share the same room (UN-Habitat, 2009). A room is defined as a space in a housing unit or other living quarters enclosed by walls reaching from the floor to the ceiling or roof covering, or

Definition	a height of at least two meters, of an area large enough to hold a bed for an adult, that is, at least four square meters. The total number of rooms therefore includes bedrooms, dining rooms, living rooms, studies, habitable attics, servants' rooms, kitchens and other separate spaces (UN-Habitat, 2009).
Unit [ ]	%
Methodology	$$\textit{Sufficient living area} = 100 \left[\frac{\textit{Number of Households with Less Than Four Persons per Room}}{\textit{Total Number of Households}} \right]$$
Sources	Censuses or living standards household surveys.
Benchmark	Min = 2.50% Max = 57.80% Own calculations from Global Urban Observatory, Database: Urban Info v2.0, Indicator: Proportion of urban population with sufficient living area, data by country (1991 – 2007) [2].
Standardisation: 2.1	$$\textit{Sufficient living area}^{(S)} = 100 \left[\frac{\sqrt[4]{\textit{Sufficient living area}} - \sqrt[4]{\textit{Min}}}{\sqrt[4]{\textit{Max}} - \sqrt[4]{\textit{Min}}} \right]$$ $$\textit{Sufficient living area}^{(S)} = 100 \left[\frac{\sqrt[4]{\textit{Sufficient living area}} - 1.26}{2.76 - 1.26} \right]$$

Standardisation: 2.1

Decision:

$$\text{Sufficient living area}^{(S)} = \begin{cases} 100, \text{ If } \sqrt[4]{\text{Sufficient living area}} \geq 2.76 \\ \text{Sufficient living area}^{(S)}, \text{ If } 1.26 < \sqrt[4]{\text{Sufficient living area}} < 2.76 \\ 0, \text{ If } \sqrt[4]{\text{Sufficient living area}} \leq 1.26 \end{cases}$$

Limitations

This measure does not consider the size of the room. Large rooms with more than three persons may not be considered overcrowded.
Additional indicators of overcrowding, such as the average in-house living area per person, number of households per area, number of persons per bed, number of children under five per room, may also be viable measures (UN-Habitat, 2009).

References

Bibliographic references:

UN-Habitat (2009). Urban Indicators Guidelines; Better Information, Better Cities. Monitoring the Habitat Agenda and the Millennium Development Goals-Slum Target.

URL references:

[1]:http://ww2.unhabitat.org/mediacentre/documents/sowcr2006/SOWCR%205.pdf, accessed June 25, 2014.
[2]: http://www.devinfo.info/urbaninfo/, accessed 13 August 2014.

Id. Hi
02.01.06

Rd

Residential Density - Metadata

Indicator	Residential Density
Scope	Extended CPI
Rationale	High density indicates a concentration of people and activities. In the context of rapid urbanisation, high density is smart and is at the core of sustainable urban planning. High density has the following economic, social and environmental benefits (UN-Habitat, 2013): - Efficient land use slows urban sprawl because high-density neighbourhoods can accommodate more people. - High-density neighbourhoods tend to decrease the costs of public services, such as police and emergency response, school transport, roads, water and sewage, etc. - Support for improved community services. - Reduced car dependency and parking demand with corresponding increased support for public transport. - Provision of social equity. - Support for improved public, open spaces. - Increased energy efficiency and decreased pollution. Worries about the perceived connection between density and social problems, such as crime, poverty and depression, are not supported by research. Studies indicate no such correlation when factors such as income and class are accounted for. A well-designed and organised high-density neighbourhood can be safe and comfortable, but high quality design is essential to achieve viable high-density areas (UN-Habitat, 2013).

Rd

Definition	(Gross density) The population divided by total urban area.
Unit [ ]	People / km2
Methodology	The urban population is divided by the total area of the city in square kilometres (km2). $Residential\ Density = \frac{City\ population}{Urban\ area}$
Sources	Population data are usually collected through censuses and surveys. Local authorities must properly delimit the urban area (or perimeter).
Benchmark	A density of at least 15,000 people/km2 (150 people/ha or 61 people/acre) is considered appropriate to promote high-density urban growth, alleviate urban sprawl and maximise land efficiency (UN-Habitat, 2013). Both excessive and insufficient density can penalise the index.
Standardisation: 5	$Residential\ Density^{(s)} = 100\left(1 - \left\lvert \frac{Residential\ Density - X^*}{X^*} \right\rvert\right)$ $Residential\ Density^{(s)} = 100\left(1 - \left\lvert \frac{Residential\ Density - 15{,}000}{15{,}000} \right\rvert\right)$

Standardisation: 5

Decision:

$$Residential\ Density^{(s)} = \begin{cases} 0, \text{ if } Residential\ Density \leq 0 \text{ or } Residential\ Density \geq 2 \times 15{,}000 \\ Residential\ Density^{(s)}, \text{ If } 0 < Residential\ Density^{(s)} < 2 * 15{,}000 \\ 100, \text{ If } Residential\ Density = 15{,}000 \end{cases}$$

Limitations

This indicator does not consider the quality of urban design, which is essential to achieving viable high-density areas (UN-Habitat, 2013).

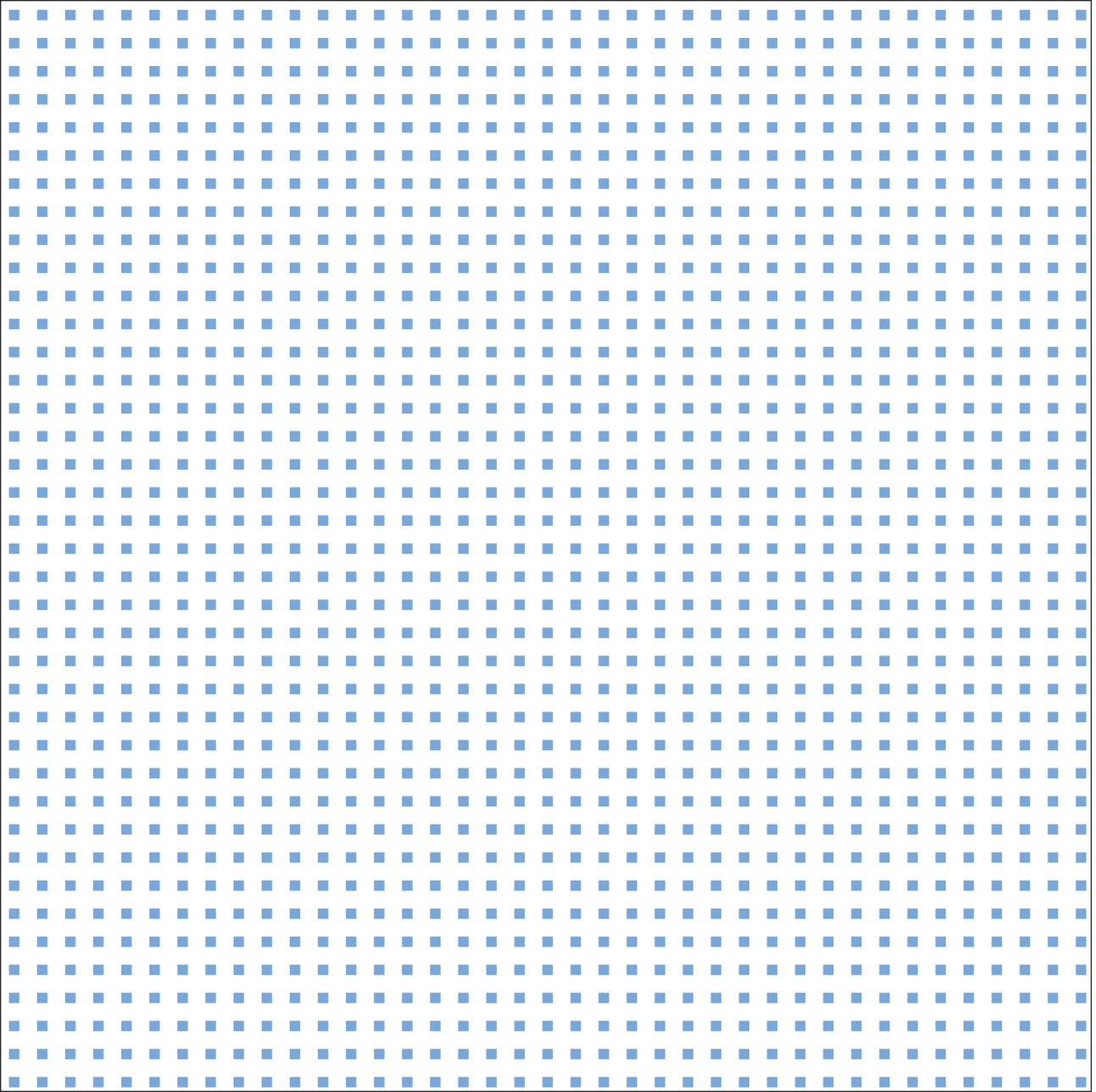
References

Bibliographic references:

UN-Habitat, 2013. Discussion Note 1. Urban Planning. A new strategy of sustainable neighborhood planning: Five principles. [1].

URL references:

http://unhabitat.org/wp-content/uploads/2014/05/5-Principles_web.pdf, accessed 28 July 2014.



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02.02

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Social
Infrastructure

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02.02.01

Pd

Physician Density - Metadata

Indicator	Physician Density
Scope	Basic CPI
Rationale	The number of physicians (medical doctors) available in a city, properly weighted by the total urban population, provides an indication of the strength of a city's health system. The number of physicians is positively associated with immunisation coverage, outreach of primary care, and infant, child and maternal survival (WHO, World Health Statistics 2006 [1]). A prosperous city seeks to provide health services to the majority of its population to reduce health related productivity losses and improve quality of life.
Definition	The number of physicians per 1,000 people. Physicians are doctors that study, diagnose, treat, and prevent illness, disease, injury, and other physical and mental impairments in humans through the application of modern medicine [2]. Physicians (medical doctors) include generalist and specialist medical practitioners.
Unit [ ]	# / 1,000
Methodology	$Physician\ Density = 1{,}000 \left[\frac{Number\ of\ Physicians\ Available\ Within\ the\ City}{City\ population} \right]$

Sources	Censuses, labour force statistics and surveys. Local authorities must provide the number of physicians. Cities report the number of physicians based on administrative records, such as registered physicians in the city.
Benchmark	Min = 0.01 Max = 7.74 Calculated from World Bank data (2014).
Standardisation: 2.1	$Physician\ Density^{(S)} = 1{,}000 \left[\frac{\sqrt[2]{Physician\ Density} - \sqrt[2]{Min}}{\sqrt[2]{Max} - \sqrt[2]{Min}} \right]$ $Physician\ Density^{(S)} = 1{,}000 \left[\frac{\sqrt[2]{Physician\ Density} - 0.1}{2.78 - 0.1} \right]$ Decision: $Physicians\ Density^{(S)} = \begin{cases} 100, \text{ If } \sqrt[2]{Physician\ Density} \geq 2.78 \\ Physicians\ Density^{(S)}, \text{ If } 0.1 < \sqrt[2]{Physician\ Density} < 2.78 \\ 0, \text{ If } \sqrt[2]{Physician\ Density} \leq 0.1 \end{cases}$

Limitations

The data to measure this indicator at the city level may be difficult to obtain in some countries (e.g., Colombia). Moreover, traditional healers that are important to the primary care health systems of some countries are not considered by this indicator.

References

Bibliographic references:

The World Bank (2014). World Development Indicators 1960 – 2013. [3]

URL references:

[1]: http://www.cityindicators.org/IndicatorsDescriptions/49851779Hlth-%20physicians.pdf, accessed June 11, 2014.

[2]: https://www.cia.gov/library/publications/the-world-factbook/geos/co.html, accessed June 27, 2014.

[3]: http://data.worldbank.org/indicator/SH.MED.PHYS.ZS/countries/1W?order=wbapi_data_value_2010%20wbapi_data_value&sort=asc&display=default, accessed July 2, 2014.

Id. Si
02.02.02

Npl

Number of Public Libraries - Metadata

Indicator	Number of Public Libraries
Scope	Extended CPI
Rationale	The number of public libraries per 100,000 people is an indicator of city willingness and ability to educate the general public as well as no-cost opportunities for the public to educate itself [1]. Public libraries can foster education and productivity and complement the education offered in a city. A prosperous city seeks to improve education offerings and foster research and reading habits among its residence to fight poverty traps and crime nests.
Definition	The number of public libraries per 100,000 people.
Unit [ ]	# / 100,000
Methodology	$$Number\ of\ public\ libraries = 100{,}000 \left[\frac{Number\ Public\ Libraries\ Available\ Within\ the\ City}{City\ population} \right]$$
Sources	Population data are usually collected by censuses and surveys. Local authorities must provide number of libraries.

Benchmark	Min = 1 Max = 7 Calculated from World Cities Culture Forum Indicators, Number of public libraries per 100,000 population [2].
Standardisation: 2.1	$$Number\ of\ public\ libraries^{(s)} = 100{,}000 \left[\frac{Number\ of\ public\ libraries - Min}{Max - Min} \right]$$ $$Number\ of\ public\ libraries^{(s)} = 100{,}000 \left[\frac{Number\ of\ public\ libraries - 1}{7 - 1} \right]$$ Decision: $$Number\ of\ public\ libraries^{(s)} = \begin{cases} 100,\ If\ Number\ of\ public\ libraries \geq 7 \\ Number\ of\ public\ libraries^{(s)},\ If\ 1 < Number\ of\ public\ libraries < 7 \\ 0,\ If\ Number\ of\ public\ libraries \leq 1 \end{cases}$$
Limitations	This indicator does consider the size of the library or its actual usage. In some countries, a public library may be composed of several buildings located throughout the city to serve more people while being managed by one institution, which is considered one library although each branch could be counted.
References	URL references: [1]: http://www.thedailybeast.com/articles/2010/10/24/ranking-americas-smartest-and-dumbest-cities.html, accessed August 8, 2014. [2]: http://www.worldcitiesculture forum.com/indicators/number-public-libraries-100000-population, accessed June 11, 2014.


Id
02.03
Ict
ICT

Id. Ict
02.03.01

Ia

Internet Access - Metadata

Indicator	Internet Access
Scope	Basic CPI
Rationale	Usage of the Internet, an information distribution system, increases the accessibility of education and information. The Internet can reduce time lags and provide new information resources as well as economic opportunities and possibilities for more environmentally friendly options in the marketplace (United Nations, 2007). The Internet can allow businesses from developing nations to leapfrog into the development mainstream and offers considerable promise in facilitating the delivery of basic services, such as health and education, which are currently unevenly distributed (United Nations, 2007). Access to the Internet is critical to fostering creativity, productivity and economic growth. A prosperous city seeks to provide access to the Internet to the majority of its population to ensure connectivity and equal opportunities.
Definition	The percentage of Internet users or Internet users per 100 people. The Internet is defined as a world-wide public computer network that provides access to a number of communication services, including the World Wide Web, email, news, entertainment and data files. The Internet may be accessed via computers, Internet-enabled mobile phones, digital TVs, game consoles, etc. (United Nations, 2007). Internet users are people with access to this worldwide network [1].

Unit [ ]	%
Methodology	$Internet\ access = 100 \left[\frac{number\ of\ Internet\ users}{total\ population} \right]$
Sources	Censuses, surveys, or Internet user surveys.
Benchmark	Min= 0% Max = 100%
Standardisation: 1.1	Not required.
Limitations	This indicator does not consider the quality of Internet access. Poor quality access may be insufficient to foster creativity, productivity and economic growth.
References	Bibliographic references: United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York. URL references: [1]: http://data.worldbank.org/indicator/IT.NET.USER.P2, accessed August 14, 2014.

Id. Ict
02.03.02

Hca

Home Computer Access - Metadata

Indicator	Home Computer Access
Scope	Extended CPI
Rationale	Home computer access and Internet access are powerful tools for fostering equality by allowing anyone to increase their creativity and productivity and contribute to economic growth (United Nations, 2007). A prosperous city seeks to improve access to home computers to increase economic and education opportunities for its residents.
Definition	Percentage of households that own home computers.
Unit [ ]	%
Methodology	$Home\ computer\ access = 100 \left[\frac{number\ of\ households\ that\ own\ home\ computers}{total\ number\ of\ households} \right]$
Sources	Censuses and surveys.

Benchmark	Min= 0% Max = 100%
Standardisation: 1.1	Not required.
Limitations	This indicator does not address the digital divide in a city, which is more than a simple access problem and cannot be solved by providing home computers.
References	Bibliographic references: United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York.

Id. Ict
02.03.03

Abs

Average Broadband Speed - Metadata

Indicator	Average Broadband Speed
Scope	Extended CPI
Rationale	As an information distribution system, Internet usage increases opportunities for education and information for all (United Nations, 2007). This indicator complements the Internet access indicator by quantifying the average broadband speed in a city. Broadband Internet access is important to participate in some economic and social activities that require high speed Internet access, such as real-time video applications and peer-to-peer audiovisual content sharing (OECD, 2009). A prosperous city seeks to increase average broadband speed to foster productivity and ensure equal opportunities.
Definition	The average broadband speed is the average speed of broadband connections within the city for Internet access. The Internet is defined as a worldwide public computer network that provides access to a number of communication services, including the World Wide Web, email, news, entertainment and data files (United Nations, 2007). Broadband provides non-mobile Internet access at speeds greater than 256 Kbps (OECD, 2009); however, current speeds can reach several Megabits per second (Mbps, where one Mbps equals 1,000 Kbps). The broadband speed is the average download speed.

Unit [ ]	Mbps (Megabits per second)
Methodology	The Average Broadband Speed is collected at the city level by Ookla Net Index Explorer [1]. If not available for the city, figures can be collected from local Internet Service Providers.
Sources	Internet Service Providers usually measure the average broadband speed, while the Ookla company developed the Net Index [1], a complete picture of global broadband performance that provides month-by-month measures since 2012 based on end-user speed tests of current broadband speed. When city data in the Ookla Net Index Explorer, local Internet Service Providers must be contacted to provide current broadband speeds.
Benchmark	Min = 0.6 Mbps Max = 12.8 Mbps Average broadband speeds for 2013 at the country level from Akamai's State of the Internet, Q4 2013 Report, Vol 6, No 4. [2]
Standardisation: 2.1	$$Average\ Broadband\ Speed^{(s)} = 100\left[\frac{Average\ Broadband\ Speed - Min}{Max - Min}\right]$$ $$Average\ Broadband\ Speed^{(s)} = 100\left[\frac{Average\ Broadband\ Speed - 0.6}{12.8 - 0.6}\right]$$

Standardisation: 2.1

Decision:

$$\text{Average Broadband Speed}^{(s)} = \begin{cases} 100, \text{ If Average Broadband Speed} \geq 12.8 \\ \text{Average Broadband Speed}^{(s)}, \text{ If } 0.6 < \text{Average Broadband Speed} < 12.8 \\ 0, \text{ If Average Broadband Speed} \leq 0.6 \end{cases}$$

Limitations

Some cities are not included in the Ookla Net Index Explorer data. The advertised broadband speed of local Internet Service Providers is usually below the current broadband speed reported in the Ookla Index Explorer.

References

Bibliographic references:

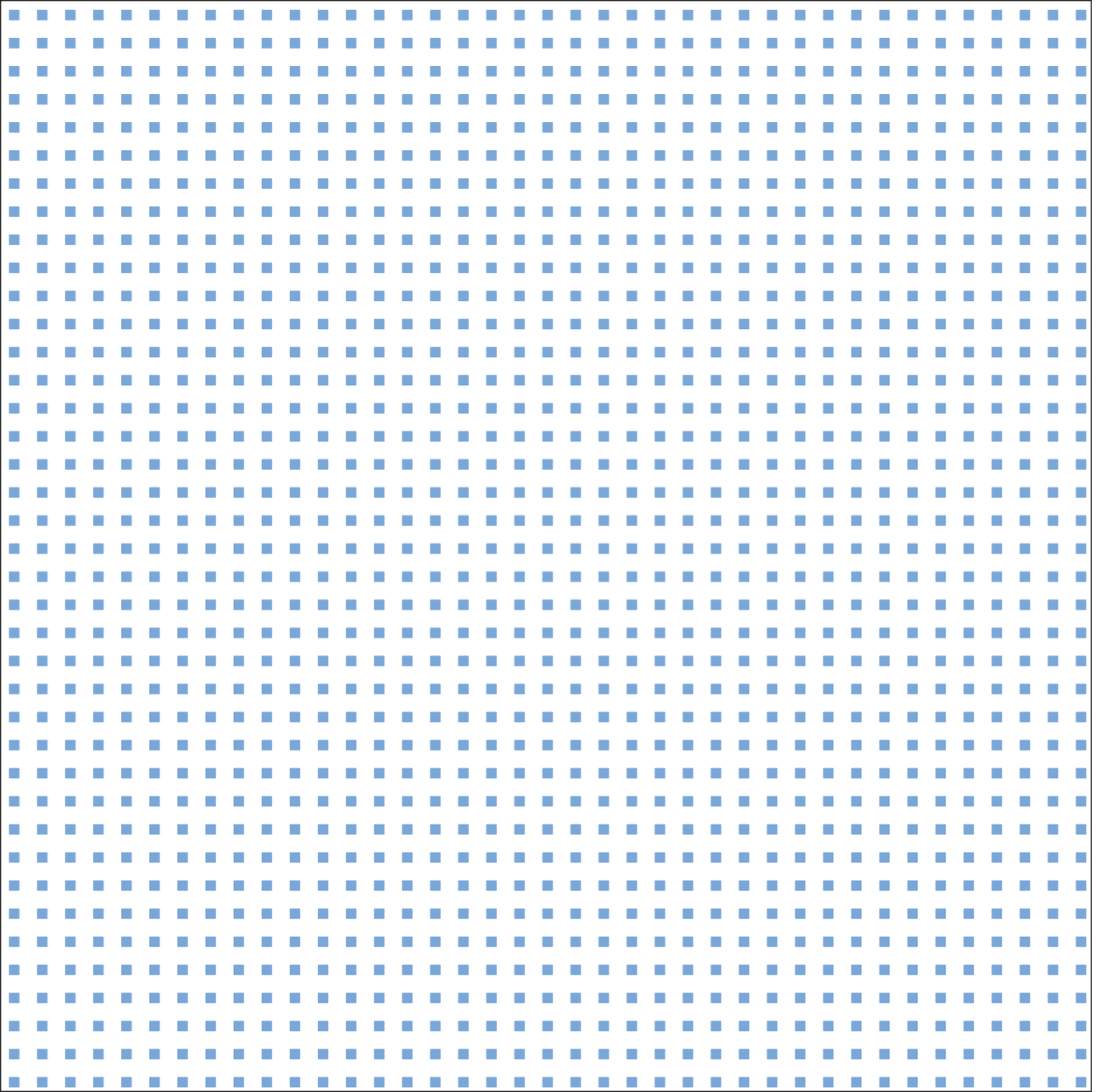
United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York.

OECD (2009) Indicators of Broadband Coverage. Technical report DSTI/ICCP/CISP(2009)3/FINAL, 10-Dec-2009.

URL references:

[1]: http://explorer.netindex.com (Net Index Explorer by Ookla), accessed 30 July 2014.

[2]: http://www.akamai.com/dl/akamai/akamai-soti-q413.pdf?WT.mc_id=soti_Q413 (Akamai's State of the Internet, Q4 2013 Report, Vol 6, No 4), accessed 30 July 2014.



Id
02.04

Um

Urban Mobility

Id. Um
02.04.01

Upt

Use of Public Transport - Metadata

Indicator	Use of Public Transport
Scope	Basic CPI
Rationale	Dependence on car use has generated many environmental, economic and social problems in most urban areas, such as congestion, pollution, and traffic fatalities. Many alternatives have been proposed to mitigate the impacts of car use in urban areas. Some options imply the improvement of other transportation modes, such as walking, cycling and public transit. Other initiatives imply actions to reduce car use, such as congestion charges (Winston, 2003). A prosperous city seeks to reduce car use by improving the quality of other systems based on public and non-motorised transport.
Definition	Percentage of trips made in a public transport (PT) mode
Unit [ ]	%
Methodology	Method A: $Use\ of\ PT\ Ratio = 100 \left[\frac{number\ of\ trips\ in\ PT}{number\ of\ total\ motorized\ trips} \right]$

Sources	Local transport authorities.
Benchmark	Min = 5.95% Max = 62.16% Calculated from CERTU world regions (CERTU, 2008)
Standardisation: 2.1	$Use\ of\ PT\ Ratio^{(s)} = 100 \left[\frac{Use\ of\ PT\ Ratio - Min}{Max - Min} \right]$ $Use\ of\ PT\ Ratio^{(s)} = 100 \left[\frac{Use\ of\ PT\ Ratio - 5.95}{62.16 - 5.95} \right]$ Decision: $Use\ of\ PT\ Ratio^{(s)} = \begin{cases} 100,\ If\ Use\ of\ PT\ Ratio \geq 62.16 \\ Use\ of\ PT\ Ratio^{(s)},\ If\ 5.95 < Use\ of\ PT\ Ratio < 62.16 \\ 0,\ If\ Use\ of\ PT\ Ratio \leq 5.95 \end{cases}$
Limitations	Non-formal transport is very frequent in some cities, but surveys do not always capture this information.

References

Bibliographic references:

CERTU (2008). Guide pédagogique: Stratégie de Mobilité durable. Lyon (Francia). p.73
Winston, H. Motor vehicles and the environment. Resources for the future RFF Report. Washington. 2003 [1].

URL references:

[1] http://www.rff.org/rff/Documents/RFF-RPT-carsenviron.pdf, accessed August 14, 2014.

Id. Um
02.04.02

Adt

Average Daily Travel Time (reversed) - Metadata

Indicator	Average Daily Travel Time (reversed)
Scope	Basic CPI
Rationale	The time spent in commuting is an indirect measure of the quality of mobility systems and the distribution of activities in a territory. In many cases, average travel times increase due to traffic congestion. A prosperous city seeks to reduce travel time by promoting the use of more efficient modes of transport, such as mass transit, cycling and walking, and by reducing car use (Rodriguez and Comtois, 2006).
Definition	The average estimated travel time per trip using any transport means in minutes.
Unit [ ]	Minutes (min.)
Methodology	The average travel time from all trips using all modes of transport. Note that the average time is only for the average trip.
Sources	Local transport authorities and, in some countries, living standards households surveys.

Benchmark	X*= 30 min. Calculated from CAF Development Bank of Latin America (2009).
Standardisation: 4	$$Average\ daily\ travel\ time^{(s)} = 100\left(1 - \left\lvert \frac{Average\ daily\ travel\ time - X^*}{X^*} \right\rvert\right)$$ $$Average\ daily\ travel\ time^{(s)} = 100\left(1 - \left\lvert \frac{Average\ daily\ travel\ time - 30}{30} \right\rvert\right)$$ Decision: $$Average\ daily\ travel\ time^{(s)} = \begin{cases} 0, \text{ if } Average\ daily\ travel\ time \geq 2*30 \\ Average\ daily\ travel\ time^{(s)}, \text{ If } 30 < Average\ daily\ travel\ time < 2*30 \\ 100, \text{ If } Average\ daily\ travel\ time \leq 30 \end{cases}$$
Limitations	The average travel time can be estimated from different sources, especially surveys. Some of these calculations are made as functions of individual perceptions, which can generate deviations from true travel times. Calculations made from mobility surveys are more accurate because they are not based on perceptions.

References

Bibliographic references:

CAF Banco de Desarrollo de América Latina (2009). Observatorio de Movilidad Urbana para América Latina: Información para mejores políticas y mejores ciudades. CAF. [1]

Rogriguez, J. Comtois, C. The geography of transports systems. New York. 2006.

URL references:

[1] http://omu.caf.com/media/30839/desarrollourbano_y_movilidad_americalatina.pdf, accessed June 11, 2014.

Id. Um
02.04.03

Lmt

Length of Mass Transport Network - Metadata

Indicator

Length of Mass Transport Network

Scope

Extended CPI

Rationale

Transit connects and integrates distant parts of a city. High-capacity public transit allows for highly efficient and equitable urban mobility and supports dense development patterns. Various forms of transit support urban transport needs, including low- and high-capacity vehicles, taxis, motorised rickshaws, bi-articulated buses and trains (ITDP, 2013).
A prosperous city seeks to cover most of the territory through an adequate public transport network system based on optimal technologies, quality and performance to ensure a comfortable and efficient system.

Definition

The total length of all superior modes of public transport; i.e., BRT, trolleybus, tram, light rail and subway, and cable cars, relative to the size of the city (number of inhabitants).

Unit [ ]

km /1,000,000 people.

Methodology

$$Length\ of\ mass\ transport\ network = 1{,}000{,}000 \left[\frac{Total\ length\ of\ mass\ transport\ lanes}{number\ of\ inhabitants} \right]$$

Sources

Local transportation authorities.

Lmt

Benchmark

X*= 80 km per 1,000,000 people.
Obtained from CERTU (2008) p.131

Standardisation: 3

$$Length\ of\ mass\ transport\ network^{(s)} = 100 \left(1 - \left| \frac{Length\ of\ mass\ transport\ network - X^*}{X^*} \right| \right)$$

$$Length\ of\ mass\ transport\ network^{(s)} = 100 \left(1 - \left| \frac{Length\ of\ mass\ transport\ network - 80}{80} \right| \right)$$

Decision:

$$Length\ of\ mass\ transport\ network^{(s)} = \begin{cases} 0,\ if\ Length\ of\ mass\ transport\ network < 0 \\ Length\ of\ mass\ transport\ network^{(s)},\ If\ 0 \leq Length\ of\ mass\ transport\ network < 80 \\ 100,\ If\ Length\ of\ mass\ transport\ network \geq 80 \end{cases}$$

Limitations

These data must be considered carefully because they do not include conventional bus transport even if this remains the principal service of public transport in the city (for example, in many cities in developing countries).

References

Bibliographic references:
Institute for Transportation and Development Policy (2013) TOD Standard v. 2.0. New York. [1]

CERTU. (2008). Guide pédagogique: Stratégie de Mobilité durable. Lyon (Francia).

URL references:
[1]: http://mexico.itdp.org/wp-content/uploads/TOD_v2_FINAL.pdf, accessed August 14, 2014.

Id. Um
02.04.04

Tf

Traffic Fatalities (reversed) - Metadata

Indicator	Traffic Fatalities (reversed)
Scope	Extended CPI
Rationale	Traffic fatalities are the eighth leading cause of death globally and the leading cause of death for people aged 15–29. The World Health Organization predicts that, by 2020, traffic fatalities will be the third leading cause of mortality in the world. This issue is not simply a health matter, and many cities have found that reducing traffic fatalities reduces related health and productivity losses (World Health Organization, 2004). Over one-third of traffic fatalities in low and middle-income countries involve pedestrians and cyclists. Less than 35% of low- and middle-income countries have policies in place to protect these road users (World Health Organization, 2013). A prosperous city reduces traffic fatalities through physical (infrastructure) and policy actions.
Definition	The number of fatalities from traffic accidents per 100,000 people per year.
Unit [ ]	# / 100,000 people

Tf

Methodology	$Traffic\ fatalities = 100{,}000 \left[\frac{Total\ traffic\ fatalities\ per\ year}{City\ population} \right]$
Sources	Traffic or transportation authorities.
Benchmark	Min = 1 fatalities per 100,000 people per year Max = 31 fatalities per 100,000 people per year Calculated from data provided by the World Health Organization [1].
Standardisation: 2.2	$Traffic\ fatalities^{(s)} = 100 \left[1 - \frac{Traffic\ fatalities - Min}{Max - Min} \right]$ $Traffic\ fatalities^{(s)} = 100 \left[1 - \frac{Traffic\ fatalities - 1}{31 - 1} \right]$ Decision: $Traffic\ fatalities^{(s)} = \begin{cases} 0, If\ Traffic\ fatalities \geq 31 \\ Traffic\ fatalities^{(S)}, If\ 1 < Traffic\ fatalities < 31 \\ 100, If\ Traffic\ fatalities \leq 1 \end{cases}$
Limitations	Frequently, this information is not reported or only partially reported by authorities. This information must be obtained for each city, including the data to be compared to other cities.

References

Bibliographic references:

World Health Organization (2004). World report on road traffic injury prevention. Geneva. [2]

World Health Organization (2013). Global report on road safety. Luxembourg. [3]

URL references:

[1]: http://apps.who.int/gho/data/node.main.A997, accessed June 11, 2014.

[2]: http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/, accessed June 11, 2014.

[3]: http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/, accessed June 11, 2014.

Id. Um
02.04.05

At

Affordability of Transport (reversed) - Metadata

Indicator	Affordability of Transport (reversed)
Scope	Extended CPI
Rationale	Urban transport can contribute to poverty reduction indirectly through its impact on a city's economy and directly through its impact on the daily needs of the poor (World Bank, 2005). Urban growth often has perverse distributional effects. Individuals reside in peripheral areas for many reasons, including cultural reasons. However, people are often forced to live on less expensive land in slums or on regular territories located along a city periphery. These locations considerably affect the time and cost of transport (World Bank, 2005). However, urban growth is not the only reason transport is expensive for the poor. The affordability index can be used as an indicator of whether public transport is too expensive in a given city and therefore whether intervention is required. The index could be used to compare the affordability of transport before and after a policy is introduced (World Bank, 2009). A prosperous city seeks to reduce the proportion of the household budget allocated to transport. Prosperous cities should seek (1) location efficient neighbourhoods—compact with walkable streets, access to transit, and a variety of amenities and (2) public transport that is affordable to the poor.

Definition	Affordability refers to the extent to which the financial cost of journeys require an individual or household to make sacrifices to travel or the extent to which they can afford to travel when they want to. Therefore, affordability indicates the ability to make necessary journeys to work, school, health and other social services; to visit family member; or to make other urgent journeys without having to curtail other essential activities (World Bank, 2009). Total amount per month per person invested in public transport in relation to the per capita income of the lowest income quintile of the population.
Unit [ ]	%
Methodology	1. Estimate the average cost per trip using public transport in the city. 2. Estimate the average per capita income of bottom quintile of the city. 3. Multiply the average cost per trip using public transport by 60 and divide it by the average per capita income of bottom quintile. $$Affordability\ of\ transport = 100\left[\frac{Number\ of\ trips\ *\ average\ cost\ per\ trip}{Per\ capita\ income}\right]$$ According to the methodology adopted from the World Bank, the number of trips is equal to 60 and per capita income is related to the lowest income quintile in the city.
Sources	Various surveys. Living standard household surveys to obtain per capita income and, sometimes, average cost per trip. However, this latter figure may also be obtained from mobility surveys or traffic department data.
Benchmark	Min = 4% Max = 26% Estimated from the benchmark provided by the World Bank (2005). p 14.

Standardisation: 2.2

$$Affordability\ of\ transport^{(s)} = 100\left[1 - \frac{Affordability\ of\ transport - Min}{Max - Min}\right]$$

$$Affordability\ of\ transport^{(s)} = 100\left[1 - \frac{Affordability\ of\ transport - 4}{26 - 4}\right]$$

Decision:

$$Affordability\ of\ transport^{(s)} = \begin{cases} 0,\ If\ Affordability\ of\ transport \geq 26 \\ Affordability\ of\ transport^{(s)},\ If\ 4 < Affordability\ of\ transport < 26 \\ 100,\ If\ Affordability\ of\ transport \leq 4 \end{cases}$$

Limitations

The average per capita income of the bottom quintile of the city is not available on a systematic basis. However, surveys are available for some cities, and these suggest that the city income distribution is indeed similar to that at the national level (World Bank, 2005). However, individuals do not often declare the total amount of money that they receive and they can exaggerate the costs of daily transportation.

References

Bibliographic references:

World Bank (2005). Affordability of Public Transport in Developing Countries. Washington. [1]

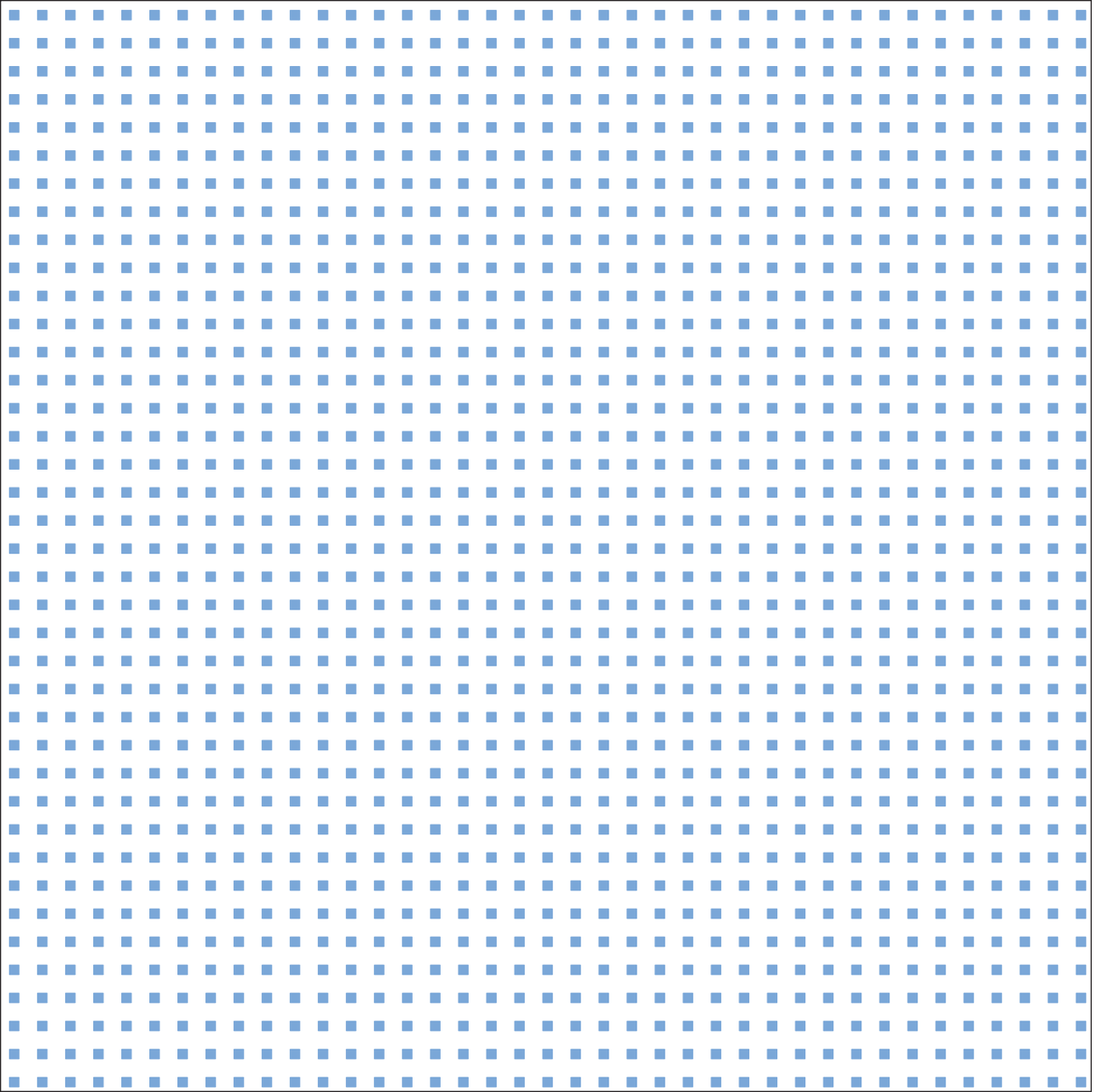
World Bank (2007). Affordability and Subsidies in Public Urban Transport. Washington. [2]

References

URL references:

[1]http://siteresources.worldbank.org/INTTRANSPORT/214578-1099319223335/20460038/TP-3_affordability_final.pdf, accessed June 11, 2014.

[2]http://elibrary.worldbank.org/doi/pdf/10.1596/1813-9450-4440,accessed June 11, 2014.



I_d
02.05

S_C

Street Connectivity

Id. Sc
02.05.01

Sid

Street Intersection Density - Metadata

Indicator	Street Intersection Density
Scope	Basic CPI
Rationale	Walkability depends on block size because intersections provide places where cars must stop and pedestrians can cross. The greater the intersection density, the smaller the blocks and more walkable the neighbourhood (Ewing, 1999). However, block size is insufficient. Traffic regulation and control of intersections to prioritise pedestrians is critical to facilitate walking (Institute for Transportation and Development Policy, 2013). A prosperous city seeks the proper block size to promote walkability.
Definition	The number of street intersections per square kilometre of land
Unit [ ]	# / km2
Methodology	1. Obtain a street network map of the urban area 2. Verify topology: each street segment must be properly connected to other segments. 3. Obtain the start and end of each segment. 4. Collect events from start and end: collect multiple endpoints at an intersection together and count the number of endpoints at each intersection. 5. Exclude points with fewer than 3 events, that is, dead ends or broken

Methodology	segment ends. 6. Count the remaining points and divide by the urban area in km2.
Sources	Local urban planning authorities based on cartography
Benchmark	X*= 100 intersections per km2 and is based on UN-Habitat data (2013).
Standardisation: 3	$$\textit{Street intersection density}^{(s)} = 100\left(1 - \left\lvert \frac{\textit{Street intersection density} - X^*}{X^*} \right\rvert\right)$$ $$\textit{Street intersection density}^{(s)} = 100\left(1 - \left\lvert \frac{\textit{Street intersection density} - 100}{100} \right\rvert\right)$$ Decision: $$\textit{Street intersection density}^{(s)} = \begin{cases} 0, \text{ if Street intersection density} < 0 \\ \textit{Street intersection density}^{(s)}, \text{ If } 0 \leq \textit{Street intersection density} < 100 \\ 100, \text{ If Street intersection density} \geq 100 \end{cases}$$
Limitations	This indicator helps determine whether a city is permeable enough to ensure walkability; however, it assumes that all intersections are secure for pedestrians, which might not be true.

References

Bibliographic references:

Ewing, E.H. (1999) Pedestrian and transit friendly design: A primer for smart growth. Smart growth network. [1]

Institute for Transportation and Development Policy (2013) TOD Standard v. 2.0. New York.

UN Habitat (2013). The relevance of street patterns and public spaces in urban areas. working paper.

URL references:

[1]: http://epa.gov/smartgrowth/pdf/ptfd_primer.pdf, accessed August 14, 2014.

Id. Sc
02.05.02

Sd

Street Density - Metadata

Indicator	Street Density
Scope	Basic CPI
Rationale	The proportion of urban areas dedicated to streets and public spaces is a crucial feature of the spatial plans of cities. The road network is the integrative and dynamic factor between individuals and socioeconomic activities. It is a structuring component of geographic space and defines the socio-dynamics of an area being conditioned by the spatial pattern, which restricts the location of roads and human settlements (UN-Habitat, 2013). Short and direct pedestrian and cycling routes require highly connected network of paths and streets around small, permeable blocks. These features are primarily important for walking and for transit station accessibility, which can be easily discouraged by detours. (ITDP, 2013) A prosperous city seeks a tight network of paths and streets offering multiple routes to many destinations that also make walking and cycling trips varied and enjoyable. (ITDP, 2013). In fact, cities that have adequate streets, public spaces and greater connectivity are more liveable and productive (UN-Habitat, 2013).
Definition	The number of kilometres of urban streets per square kilometre of land
Unit [ ]	km / km2

Sd

Methodology	1. Select only the streets included in the urban area 2. Count the number of kilometres of urban streets 3. Divide the number of kilometres by the total urban surface. $Street\ density = \frac{Total\ lenght\ of\ urban\ streets}{Total\ of\ urban\ surface}$
Sources	Local urban planning authorities based on cartography
Benchmark	X*= 20 kilometer of urban streets per km2. Based on UN-Habitat 2013.
Standardisation: 5	$Street\ density^{(s)} = 100\left(1 - \left\lvert \frac{Street\ density - 20}{20} \right\rvert\right)$ $Street\ density^{(s)} = 100\left(1 - \left\lvert \frac{Street\ density - 20}{20} \right\rvert\right)$ Decision: $Street\ density^{(s)} = \begin{cases} 0,\ if\ Street\ density = 0\ or\ Street\ density = 2 * 20 \\ Street\ density^{(s)},\ If\ 0 < Street\ density < 2 * 20 \\ 100, If\ Street\ density = 20 \end{cases}$

Limitations

Because this is a measure of permeability, this indicator includes all types of streets (principal and secondary). Walkability is based on permeability, which is guaranteed by all streets in a city. This measure must be combined with the intersection density indicator because many parallel streets without having intersections might produce adequate street density but insufficient permeability.

References

Bibliographic references:

Institute for Transportation and Development Policy (2013) TOD Standard v. 2.0. New York. [1]

UN Habitat (2013). The relevance of street patterns and public space in urban areas. [2]

Universidad Nacional de Luján, Argentina. Programa de Estudios Geográficos (PROEG). Patrón espacial de la cobertura vial como factor integrador y dinamizador de la movilidad urbana en el municipio Chacao, estado Miranda. Revista digital del Grupo de Estudios sobre Geografía y Análisis Espacial con Sistemas de Información Geográfica (GESIG). Luján. 2012. [3]

URL references:

[1]: http://mexico.itdp.org/wp-content/uploads/TOD_v2_FINAL.pdf, accessed August 14, 2014.

[2]: http://mirror.unhabitat.org/downloads/docs/StreetPatterns.pdf, accessed August 14, 2014.

[3]: http://www.gesig-proeg.com.ar/documentos/revista-geosig/2012/Investigacion/07-MARTINEZ-GEOSIG4-2012.pdf, accessed June 11, 2014.

Id. Sc
02.05.03

Las

Land Allocated to Streets - Metadata

Indicator	Land Allocated to Streets
Scope	Basic CPI
Rationale	Transportation systems consume a large amount of land through both the circulation and parking of vehicles. Land must also be allocated for complementary facilities, such as public transport terminals, stations, offices and warehouses related to transportation (CAF, 2010). When cities are shaped for people, personal motor vehicles become largely unnecessary in daily life. Walking, cycling, and high-capacity transit are easy and convenient and can be supplemented by a variety of intermediary transit modes and rented vehicles that are much less space intensive. Valuable urban space resources can be reclaimed from unnecessary roads and parking and reallocated to more socially and economically productive uses (ITDP, 2013). However, adequate land dedicated to streets may guarantee enough space for proper mobility because new or future public transport systems depend on that space. A prosperous city seeks an optimal allocation of land for streets to guarantee mobility system performance, share space among modes and to avoid sizeable extensions of space dedicated to personal motor vehicles. Cities that have adequate streets, public spaces and connectivity are more liveable and productive
Definition	The total urban area of streets.

Unit [ ]	%
Methodology	1.Select only the streets included in the urban area 2. Estimate the total urban surface allocated to streets 3. Divide the number of square kilometres of urban streets by the total square kilometres of urban surface. $$Land\ alocated\ to\ streets = \frac{Total\ surface\ of\ urban\ streets}{total\ surface\ of\ urban\ area}$$
Sources	Local urban planning authorities based on cartography
Benchmark	Min = 6% Max = 36% Based on UN-Habitat (2013). Page 4.
Standardisation: 2.1	$$Land\ alocated\ to\ streets^{(s)} = 100\left[1 - \frac{Land\ alocated\ to\ streets - Min}{Max - Min}\right]$$ $$Land\ alocated\ to\ streets^{(s)} = 100\left[1 - \frac{Land\ alocated\ to\ streets - 6}{36 - 6}\right]$$

Standardisation: 2.1

Decision:

$$\textit{Land allocated to streets}^{(s)} = \begin{cases} 100, \text{ If Land allocated to streets} \geq 36 \\ \textit{Land allocated to streets}^{(s)}, \text{ If } 6 < \textit{Land allocated to streets} < 36 \\ 0, \text{ If Land allocated to streets} \leq 6 \end{cases}$$

Limitations

It is unusual to obtain complete information about city streets. It is sometimes necessary to make assumptions about street dimensions, and remote sensing data could be useful in these cases.

References

Bibliographic references:

CAF (2010) Observatorio de Movilidad. Análisis de movilidad urbana, espacio, medio ambiente y equidad. Bogotá.

Institute for Transportation and Development Policy (2013) TOD Standard v. 2.0. New York.

UN-Habitat (2013) The relevance of street patterns and public spaces in urban areas. Working paper. [1]

URL references:

[1]: http://unhabitat.org/the-relevance-of-street-patterns-and-public-space-in-urban-areas/, accessed June 11, 2014.

CPI-M
03

Quality of Life


Qi
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He
Health

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Leb

Life Expectancy at Birth - Metadata

Indicator	Life Expectancy at Birth
Scope	Basic CPI
Rationale	Life expectancy at birth provides a broad perspective of health in a city because it reflects the overall mortality of the population. Life expectancy is related to the health of the population and is a key factor in fostering economic growth, sustainable development and well-being. It summarises the mortality pattern that prevails across age groups – children, adolescents, adults and elderly (WHO, 2006). A prosperous city increases the life expectancy of its citizens to increase their quality of life.
Definition	Life expectancy is the average number of years that a newborn could expect to live if he or she were subject to the age-specific mortality rates of a given period (United Nations, 2007).
Unit [ ]	Years
Methodology	Estimating this indicator when it is unavailable at the city level requires construction of a life table. This procedure is widely accepted. According to the World Health Organization (2014), "life tables have been developed for all Member States for years 1990-2012 starting with a systematic review

Methodology	of all available evidence from surveys, censuses, sample registration systems, population laboratories and vital registration on levels and trends in under-five and adult mortality rates." According to Fitzpatrick (2001), the following information is needed to estimate a life table: population expressed in year age bands (usually 5-year age bands) and deaths in year age bands (usually 5-year age bands). Then, all other columns and life expectancy can be calculated. The final life expectancy is calculated through the following formula: $$\textit{Life expectancy at birth: } e_0 = \frac{T_0}{l_0}$$ This equation has been adapted from the following generalised life expectancy estimation formula used to estimate the life table: $$e_x = \frac{T_x}{l_x}$$ e_x: Life expectancy at age x, that is, the number of years a person aged x can be expected to live. T_x: Total number of years lived at age x after the interval. l_x: Number of people alive at the start of the interval Both T_x and l_x include previous calculations of the probability of surviving, average proportion of the years lived by those who died and interval adjustments (For more estimation details, see Fitzpatrick, 2001). As noted by the World Health Organization (2014), there are alternative ways to estimate life tables and life expectancy. Some methods may adjust for health and country conditions (e.g., high levels of HIV). The procedure selected depends on the country.
Sources	This indicator is estimated (and projected) by the statistics departments of cities or governments.

Sources

Country statistics departments, vital registration systems, censuses or demographic surveys

Worldwide, the Lead Agency is the United Nations Department of Economic and Social Affairs (UN/DESA)

Other Contributing Organizations include the United Nations/DESA/Statistics Division; United Nations Children's Fund (UNICEF); and World Health Organization (WHO).

Benchmark

Min = 54 years

Max = 83.48 years

Calculated from the World Bank: World Development Indicators [2].

Standardisation: 2.1

$$Life\ expectancy\ at\ birth^{(s)} = 100\left[\frac{Life\ expectancy\ at\ birth - Min}{Max - Min}\right]$$

$$Life\ expectancy\ at\ birth^{(s)} = 100\left[\frac{Life\ expectancy\ at\ birth - 54}{83.48 - 54}\right]$$

Decision:

$$Life\ expectancy\ at\ birth^{(s)} = \begin{cases} 100, \text{ If } Life\ expectancy\ at\ birth \geq 83.48 \\ Life\ expectancy\ at\ birth^{(s)}, \text{ If } 54 < Life\ expectancy\ at\ birth < 83.48 \\ 0, \text{ If } Life\ expectancy\ at\ birth \leq 54 \end{cases}$$

Limitations

Usually this indicator is estimated every five years because yearly changes may not be identifiable. When high quality data for deaths (from vital registrations) or appropriate age adjustments can be found, population censuses provide adequate information. Without high quality data, a method that includes indicators of mortality obtained from special questions in censuses or demographic surveys can be used (United Nations, 2007).

Limitations

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[4]:http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/health/life_expectancy.pdf, accessed June 11, 2014.
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03.01.02

Ufm

Under-five Mortality Rate (reversed) - Metadata

Indicator	Under-five Mortality Rate (reversed)
Scope	Basic CPI
Rationale	Reducing child mortality is among the most strongly and universally supported development goals. In high-mortality settings, a large proportion of deaths occur before age five. Moreover, under-five mortality provides an adequate measure of child health and human development. This measure also reflects social, economic conditions and captures factors, such as disease incidence and prevalence, which may not be easy to identify at the city level (Millennium Development Goals, 2012; United Nations, 2007). Under-five mortality levels are influenced by poverty; education (particularly of mothers); availability, accessibility and quality of health services; environmental risks, including access to safe water and sanitation; and by nutrition (United Nations, 2007). A prosperous city seeks to improve quality of life by decreasing the under-five mortality rate.
Definition	Life expectancy is the average number of years that a newborn could expect to live if he or she were subject to the age-specific mortality rates of a given period (United Nations, 2007).
Unit [ ]	# / 1,000 live births

Methodology	$$\text{Under-five mortality rate} = \frac{\text{Number of under-five deaths}}{\text{1,000 live births}}$$
Sources	Country statistics departments, vital registration systems, censuses or demographic surveys. Worldwide, the lead agency is the United Nations Department of Economic and Social Affairs (UN/DESA) Other Contributing Organizations include the United Nations/DESA/Statistics Division; United Nations Children's Fund (UNICEF); and World Health Organization (WHO).
Benchmark	Min = 2.20 children per 1,000 live births Max = 181.60 children per 1,000 live births Obtained from the World Health Organization [2].
Standardisation: 2.2	$$\text{Under-five mortality rate}^{(s)} = 100\left[1 - \frac{\ln(\text{Under-five mortality rate}) - \ln(\text{Min})}{\ln(\text{Max}) - \ln(\text{Min})}\right]$$ $$\text{Under-five mortality rate}^{(s)} = 100\left[1 - \frac{\ln(\text{Under-five mortality rate}) - 0.79}{5.20 - 0.79}\right]$$ Decision: $$\text{Under-five mortality rate}^{(s)} = \begin{cases} 0, \text{If } \ln(\text{Under-five mortality rate}) \geq 5.20 \\ \text{Under-five mortality rate}^{(s)}, \text{ If } 0.79 < \ln\left(\text{Under-five mortality rate}\right) < 5.20 \\ 100, \text{ If } \ln(\text{Under-five mortality rate}) \leq 0.79 \end{cases}$$

Limitations

Some countries use the rate for children under 6 years old; therefore, caution is required when computing and comparing this indicator across countries. In these cases, the indicator could be the under–six mortality rate. In addition, some countries may misreport or not report infant and child mortality due to inefficient vital registration systems. Adjustments for incomplete registrations can be used using demographic and health surveys (United Nations, 2007).

References

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[3]:http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/health/under_five_mortality.pdf, accessed June 11, 2014.

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Vc

Vaccination Coverage - Metadata

Indicator	Vaccination Coverage
Scope	Extended CPI
Rationale	This indicator, also known as the immunisation rate, monitors healthcare system quality in a city. It indicates whether immunisation against infectious childhood diseases has been accomplished at the city level (WHO, 2014). The goal of immunisation is to reduce morbidity and mortality due to communicable diseases. Moreover, lower vaccination coverage may produce long run consequences, such as increased absences, lower productivity and higher medical costs (Andre et al, 2008). A prosperous city seeks to cover its entire population with a basic vaccination scheme.
Definition	The percent of the eligible population that has been immunised according to national immunisation policies. The definition includes the following three components: (i) the proportion of children immunised against diphtheria, tetanus, pertussis, measles, poliomyelitis, tuberculosis and hepatitis B before their first birthday; (ii) the proportion of children immunised against yellow fever in affected countries of Africa; and (iii) the proportion of women of child-bearing age immunised against tetanus (United Nations, 2007).
Unit [ ]	%

Methodology	According to the United Nations (2007), eligible populations usually includes the following: $$Vaccination\ Coverage = 100 \frac{population\ that\ have\ been\ immunized\ according\ to\ national\ immunization\ policies}{Eligible\ population\ according\ to\ national\ immunization\ policies}$$ - Infants: The numerator is the number of infants fully immunised during a specified period (year), while the denominator is the number of one year old infants (target age group) in the same period. - Women: The numerator is the number of women immunised with two or more doses of tetanus toxoid during pregnancy, while the denominator is the number of live births.
Sources	Country statistics departments, vital registration systems, censuses or demographic surveys, health surveys, national immunisation programs, the World Health Organization, Millennium Development Goals
Benchmark	Min = 0% Max = 100% Due to the estimation procedure, some percentages might surpass 100%. Nevertheless, the indicator remains between 0 and 100 by coding any value that surpasses 100% as 100%.
Standardisation: 1.1	Not required

Limitations

Given the composite nature of this indicator, it may be difficult to collect sufficient data for all vaccine-preventable diseases (United Nations, 2007). While this indicator is appropriate to measure the extent of vaccination coverage in a city, it does not reflect preventive factors, such as education or diet.

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[3]: http://www.who.int/bulletin/volumes/86/2/07-040089/en/, accessed August 7, 2014.

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03.01.04

Mm

Maternal Mortality (reversed) - Metadata

Indicator	Maternal Mortality (reversed)
Scope	Extended CPI
Rationale	This indicator monitors access to primary health care facilities. Problems during pregnancy and childbirth directly affect women's survival and the quality of life of the population, especially in developing countries. This indicator reflects the risks associated with each pregnancy related to access to and quality of health services in a city (WHO et al., 2012; WHO, 2014). According to the World Health Organization (WHO), maternal mortality could be reduced by skilled care before, during and after childbirth. A prosperous city seeks to minimise its maternal mortality rate
Definition	The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration or site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes (MMEIG).
Unit [ ]	# / 100,000 live births
Methodology	$$Marternal\ mortality = 100{,}000 \left[\frac{Number\ of\ deaths\ of\ women\ while\ pregnant\ or\ within\ 42\ days\ of\ termination\ of\ pregnancy}{live\ births} \right]$$

Sources	Country statistics departments, vital registration systems, censuses or demographic surveys; health surveys or departments of health; the World Health Organization; and Millennium Development Goals.
Benchmark	Min = 1 mother per 100,000 live births Max = 1,100 mothers per 100,000 live births Obtained from the World Health Organization [1]
Standardisation: 2.2	$$Maternal\ mortality^{(s)} = 100 \left[1 - \frac{ln\,(Maternal\ mortality) - ln\,(Min)}{ln\,(Max) - ln\,(Min)} \right]$$ $$Maternal\ mortality^{(s)} = 100 \left[1 - \frac{ln\,(Maternal\ mortality)}{7} \right]$$ Decision: $$Maternal\ mortality^{(s)} = \begin{cases} 0, \text{ If } ln\,(Maternal\ mortality) \geq 7 \\ Maternal\ mortality^{(s)}, \text{ If } 0 < ln \left(\frac{Maternal}{mortality} \right) < 7 \\ 100, \text{ If } ln\,(Maternal\ mortality) = 0 \end{cases}$$
Limitations	Caution is required in interpreting maternal mortality figures due to the reluctance to report abortion-related deaths, memory recall problems, or lack of medical attribution In addition, the selectivity of the service-using population may have greater effects on maternal mortality related to cultural factors in developing countries. (WHO, 2006).

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Education

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Lr

Literacy Rate - Metadata

Indicator	Literacy Rate
Scope	Basic CPI
Rationale	The literacy rate reflects the most basic educational goals, which are the ability to read and write. As the United Nations and the Millennium Development Goals (MDGs) state, "literacy is crucial to the acquisition, by every child, youth and adult, of essential life skills that enable them to address the challenges they face in life" UNESCO (2014). Therefore, every city must guarantee its citizens access to quality education, which must include reading and writing skills. A prosperous city seeks a high literacy rate to improve productivity, economic growth and quality of life.
Definition	The adult literacy rate is the percentage of population aged 15 years and older that is literate, that is, able to read and write a short, simple statement (usually a paragraph) related to his/her everyday life (United Nations, 2007).
Unit [ ]	%
Methodology	$Literacy\ rate = 100 \left[\frac{Number\ of\ literate\ adults\ (15\ years\ and\ over)}{Population\ (15\ years\ and\ over)} \right]$

Sources	Living standard household surveys, ministries of education administrative registers.
Benchmark	Min= 15.0% Max = 99.9% Calculated from World Bank data (2014).
Standardisation: 2.1	$Literacy\ rate^{(s)} = 100 \left[\frac{Literacy\ rate - Min}{Max - Min} \right]$ $Literacy\ rate^{(s)} = 100 \left[\frac{Literacy\ rate - 15.0}{99.9 - 15.0} \right]$ Decision: $Literacy\ rate^{(s)} = \begin{cases} 100, If\ Literacy\ rate \geq 99.9 \\ Literacy\ rate^{(S)}, If\ 15.0 < Literacy\ rate < 99.9 \\ 0, If\ Literacy\ rate \leq 15.0 \end{cases}$
Limitations	Most surveys rely on self-declaration but do not perform actual assessments of reading and writing. The simple definition due to restricted availability of information, especially in developing countries, does not consider number comprehension. A person could be literate but not numerate. Fi-

Limitations

nally, different social interactions require different levels of literacy; therefore, this definition should be sufficiently broad.

References

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Mys

Mean Years of Schooling - Metadata

Indicator	Mean Years of Schooling
Scope	Basic CPI
Rationale	An indicator of mean years of schooling provides information about the human capital stock using an output-based approach [1]. Cities with higher levels of human capital tend to have higher rates of economic growth and productivity. This productivity is generally reflected in higher wages for the entire population (Psacharopolous and Arriagada, 1986). For example, Psacharopoulos and Patrinos (2004) present empirical evidence based on raw estimates of returns to education for 98 countries that the average rate of return to an additional year of schooling is a 10 percent increase in wages. The higher this indicator, the higher the economic returns the citizens receive. A prosperous city seeks to provide optimal conditions for its inhabitants to invest in additional years of schooling.
Definition	The average years of education for residents aged 25 years and older.
Unit [ ]	Years
Methodology	Following UNESCO (2013), the methodology can be defined by two equations.

Methodology	The following formula produces Mean years of schooling adjusted by the duration of individual levels: $Mean\ years\ of\ schooling = \sum_{a}\sum_{l} HS_{al} * YS_{al}$ Where HS_{al} is the proportion of the population in age group a for which the level of education l is the highest level attained; and YS_{al} is the official duration of the level of education l for age group a at the time when this age group was in school. *Mean years of schooling* for residents aged 25 years and older is thus the population-weighted average *years of schooling* for each age group a. If the duration of each level of education remains constant over time, the formula can be simplified as follows: $Mean\ years\ of\ schooling = \sum_{l} HS_{l} * YS_{l}$ Where HS_{l} is the proportion of the population for which the level of education *l* is the highest level attained; and YS_{l} is the official duration of the level of education *l*.
Sources	Living standards household surveys, labour markets surveys, censuses.
Benchmark	X*= 14 years The objective is to provide tertiary education to all population, which usually includes: 6 years of primary, 3 years of secondary, 3 years upper secondary and minimum 2 years of technical program (Obtained from UNESCO, 2013).

Standardisation: 3

$$Mean\ years\ of\ schooling^{(s)} = 100\left(1 - \left|\frac{Mean\ years\ of\ schooling - X^*}{X^*}\right|\right)$$

$$Mean\ years\ of\ schooling^{(s)} = 100\left(1 - \left|\frac{Mean\ years\ of\ schooling - 14}{14}\right|\right)$$

Decision:

$$Mean\ years\ of\ schooling^{(s)} = \begin{cases} 0,\ if\ Mean\ years\ of\ schooling < 0 \\ Mean\ years\ of\ schooling^{(s)},\ If\ 0 \leq Mean\ years\ of\ schooling < 14 \\ 100,\ If\ Mean\ years\ of\ schooling \geq 14 \end{cases}$$

Limitations

While the optimal value is based on a system that includes 6 years of primary school, 3 years of secondary school, 3 years upper secondary school and a minimum of 2 years of technical training as proposed by UNESCO in 2013, systems might vary by country and require adjustment. Therefore, caution is required when examining cross-country comparisons. Although the system varies by country [6], 14 years of schooling can be considered an upper bound. In addition, this is an indicator of the stock of human capital; it does not measure the quality of education (or quality of human capital).

References

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03.02.03

Usp

Under-six Participation in First Stage Development Programmes- Metadata

Indicator	Under-six Participation in First Stage Development Programmes
Scope	Extended CPI
Rationale	A prosperous city should provide access to early childhood education (for children under six years old) because such education is fundamental to improving future performance at school and improving society (Grantham-McGregor et al., 2007; Kamerman, 2002). Yet, only "1% of eligible Sub-Saharan children are enrolled in preschool programs; and few developing countries have achieved preschool coverage of even 25 to 30%. By contrast, 80% of three-year-olds in Belgium, Denmark, France and are enrolled in nursery or preschool centers" Bennett (1993) as cited in Young (1996:pg 3). A prosperous city seeks to increase participation in First Stage Development Programmes (FSDP) to guarantee a better future for its children and society.
Definition	The under-six population enrolled in a first stage education programme. These programmes can be financed by the local government, central government or private sources.
Unit [ ]	%

Usp

Methodology	$Under\text{-}six\ Participation\ in\ FSDP = 100\left[\frac{Children\ under\ 6\ in\ FSDP}{Total\ children\ under\ 6}\right]$
Sources	Living standards household surveys, country education and health ministries.
Benchmark	Min= 0% Max = 100%
Standardisation: 1.1	Not required.
Limitations	The indicator does not measure the quality or type of received benefits. While some programs target health issues (mostly nutrition related), others focus on educational aspects. In addition, programmes may not cover mother training in both health and education aspects of early childhood development. However, the indicator includes access to early childhood development programmes, which is the first step to increasing quality of life.
References	Bibliographic references: Bennett, J. (1993). Early Childhood Care and Education Today – Worldwide Trends. In Lillian Katz, ed. International Encyclopedia of Education, 2nd Edition. Grantham-McGregor, Sally, et al., (2007) 'Developmental Potential in the First 5 Years for Children in Developing Countries', The Lancet, vol. 369, no. 9555, 6–12, pp. 60–70.

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Ner

Net Enrolment Rate in Higher Education - Metadata

Indicator	Net Enrolment Rate in Higher Education
Scope	Extended CPI
Rationale	Tertiary education is of primary importance once cities are able to provide access to primary and secondary education. Through tertiary education, individuals develop skills that will be relevant to the labour market. Individuals with higher levels of education have more opportunities to find employment and usually receive more benefits, such as higher wages and better health and social outcomes, than individuals with lower levels of education do (Heckman et al., 2011). Such improvements, in turn, will directly affect economic growth, well-being and quality of life. A prosperous city seeks to improve the quality of life of its inhabitants by designing policies and proper conditions to increase enrolment in tertiary education.
Definition	The number of individuals enrolled in tertiary education (also called post-secondary education), that correspond to a tertiary education age range (i.e., between 18 to 23 years) compared to the total population of the same age. This indicator considers a period of five years after high school graduation to enter tertiary education. (UNESCO, 2014).
Unit [ ]	%

Methodology	$$\text{Net Enrollment Rate in Higher Education} = 100 \left[\frac{\text{Population enrolled in tertiary education aged 18-23}}{\text{Population aged 18-23}} \right]$$
Sources	Living standard household surveys, country ministries of education
Benchmark	Min = 0% Max = 100% Due to the calculation procedure, some percentages might exceed 100%. Nevertheless, the range of the indicator will be maintained between 0 and 100 to standardise it. Any value that exceeds 100% will be coded as 100%.
Standardisation: 1.1	Not required.
Limitations	The age range and duration of tertiary education vary by country; therefore, cross-country comparisons should be made cautiously. This indicator measures access to tertiary education but does not measure quality of education. In addition, the duration of tertiary programs may vary by country and programme.
References	Bibliographic references: Heckman, J.; Humphries, J.; Urzua, S. and Veramendi, G. (2011). The Effects of Schooling on Labor Market, Health, and Social Outcomes. Working Papers 2011-002, Human Capital and Economic Opportunity Working Group. UNESCO Institute for Statistics. (2014). Glosary of Indicators [1] URL references: [1]: http://glossary.uis.unesco.org/glossary/en/term/2048/en, accessed August 7, 2014.

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03.02.05

Ntu

Number of Top Universities - Metadata

Indicator	Number of Top Universities
Scope	Extended CPI
Rationale	Lack of access to higher education is at the base of many social problems given that highly skilled inhabitants tend to have higher levels of productivity. Moreover, a limited supply of tertiary education encourages people to abandon a city, reducing its human capital. High quality education spurs knowledge and innovation, which affects economic and social development and increases a city's quality of life (Kis, 2005; Hansson, 2007; Walton, 2008). The number of top universities, as listed annually in the QS Ranking, located in the city provides an indication of the education supply in the city and the educational level of its inhabitants. A prosperous city that seeks to improve quality of life should increase the supply of higher education to reduce poverty, increase economic growth and promote innovation and product development.
Definition	The number of universities listed in the QS Ranking located in the city.
Unit [ ]	#
Methodology	The number of universities located in the city according to the most recent QS World University Ranking.

Sources	Most recent QS World University Ranking.
Benchmark	Min = 0 Top universities Max = 4 Top universities This figure is calculated from the QS Ranking 2013: QS Top Universities [1] frequency of top universities by city.
Standardisation: 2.1	$$Number\ of\ Universities^{(s)} = 100\left[\frac{number\ of\ top\ universities located\ in\ the\ city - Min}{Max - Min}\right]$$ $$Number\ of\ Universities^{(s)} = 100\left[\frac{number\ of\ top\ universities located\ in\ the\ city}{4}\right]$$ Note that the numerator does not differentiate universities by their rank. Decision: $$Number\ of\ Universities^{(s)} = \begin{cases} 100,\ If\ Number\ of\ Universities \geq 4 \\ Number\ of\ Universities^{(s)},\ If\ 0 < Number\ of\ Universities < 4 \\ 0,\ If\ Number\ of\ Universities \leq 0 \end{cases}$$
Limitations	A wide variety of university rankings considers different aspects of the educational process (i.e., reputation or scientific production). However, most rankings produce a consistent group of top universities across the globe. The QS World University ranking is comprehensive and internationally accepted and therefore provides an adequate benchmark.

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Safety and Security

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03.03.01

Hr

Homicide Rate (reversed) - Metadata

Indicator	Homicide Rate (reversed)
Scope	Basic CPI
Rationale	Crime negatively affects cities, mainly by affecting personal security, attractiveness of an area for recreation, and general amenities. The homicide rate approximates the degree of criminality in a city. Local governments must work to reduce crime; their job is to guarantee the rights of their citizens to be protected from crime, violence and aggression. In a safe city, individuals can prosper and society can develop (United Nations, 2005). A prosperous city seeks increase inhabitant quality of life through improved security that leads to a reduction in the number of homicides.
Definition	The number of deaths caused by other people per 100,000 inhabitants.
Unit [ ]	Homicides per 100,000 inhabitants
Methodology	$Homicide\ rate = 100{,}000\ \frac{homicides}{city\ population}$
Sources	Local police data or data from a criminal observatory (if available).

Hr

Benchmark	Min = 1 homicides per 100,000 inhabitants Max = 1,654 homicides per 100,000 inhabitants Obtained from United Nations Office on Drugs and Crime [1]
Standardisation: 2.2	$Homicide\ rate^{(s)} = 100\left[1 - \frac{ln\ (Homicide\ rate) - ln\ (Min)}{ln\ (Max) - ln\ (Min)}\right]$ $Homicide\ rate^{(s)} = 100\left[1 - \frac{ln\ (Homicide\ rate)}{7.41}\right]$ Decision: $Homicide\ rate^{(s)} = \begin{cases} 0,\ If\ ln\ (Homicide\ rate) \geq 7.41 \\ Homicide\ rate^{(s)},\ If\ 0 < ln\ (Homicide\ rate) < 7.41 \\ 0,\ If\ Number\ of\ Universities \leq 0 \end{cases}$
Limitations	This indicator may differ based on the efficiency of police systems by country and by whether the police are responsive to central governments. City governments may be unable to affect the rate; however, this indicator does not aim to identify police efficiency. In addition, this indicator may omit deaths caused by injuries, suicides and non-reported homicides (more common in countries experiencing conflict).

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[1]: https://www.unodc.org/gsh/en/data.html , accessed June 11, 2014.

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QI. Ss
03.03.02

Tr

Theft Rate (reversed) - Metadata

Indicator	Theft Rate (reversed)
Scope	Extended CPI
Rationale	This indicator provides relevant information about security and safety. The theft rate is correlated with the homicide rate but represents a lower degree of violence. On the one hand, the homicide rate is one type of crime, specialized crime; on the other hand, thefts (burglary, robbery, assault, motor theft) are committed by people who do not need specialized arms or previous preparation (Marvell, 1999). A prosperous city seeks to minimise the theft rate.
Definition	The number of reported thefts affecting individuals, residences and commerce, including vehicles and motorcycles per 100,000 inhabitants.
Unit [ ]	Thefts per 100,000 inhabitants
Methodology	$Theft\ rate = 100{,}000\ \frac{thefts}{city\ population}$
Sources	Local police or criminal observatory data (if available).

Benchmark

Min = 25.45 thefts per 100,000 inhabitan

Max = 6,159.11 thefts per 100,000 inhabitants

Obtained from the United Nations Office on Drugs and Crime [1] (Aggregate information for thefts, assault, robbery, kidnapping, theft of private cars and burglary).

Standardisation: 2.2

$$Theft\ rate^{(S)} = 100\left[1 - \frac{\sqrt[4]{Theft\ rate} - \sqrt[4]{Min}}{\sqrt[4]{Max} - \sqrt[4]{Min}}\right]$$

$$Theft\ rate^{(S)} = 100\left[1 - \frac{\sqrt[4]{Theft\ rate} - 2.24}{8.86 - 2.24}\right]$$

Decision:

$$Theft\ rate^{(S)} = \begin{cases} 0, If\ \sqrt[4]{Theft\ rate} \geq 8.86 \\ Theft\ rate^{(S)},\ If\ 2.24 < \sqrt[4]{Theft\ rate} < 8.86 \\ 100,\ If\ \sqrt[4]{Theft\ rate} \leq 2.24 \end{cases}$$

Limitations

There is evidence of misreporting and underreporting of small crimes (Baer & Chambliss, 1997; Pudney et al., 2000); therefore, these results may be underestimated in some cities. Additionally, this indicator does not distinguish among the types of thefts, which may vary across countries. This indicator aims to capture the extent of crime

References

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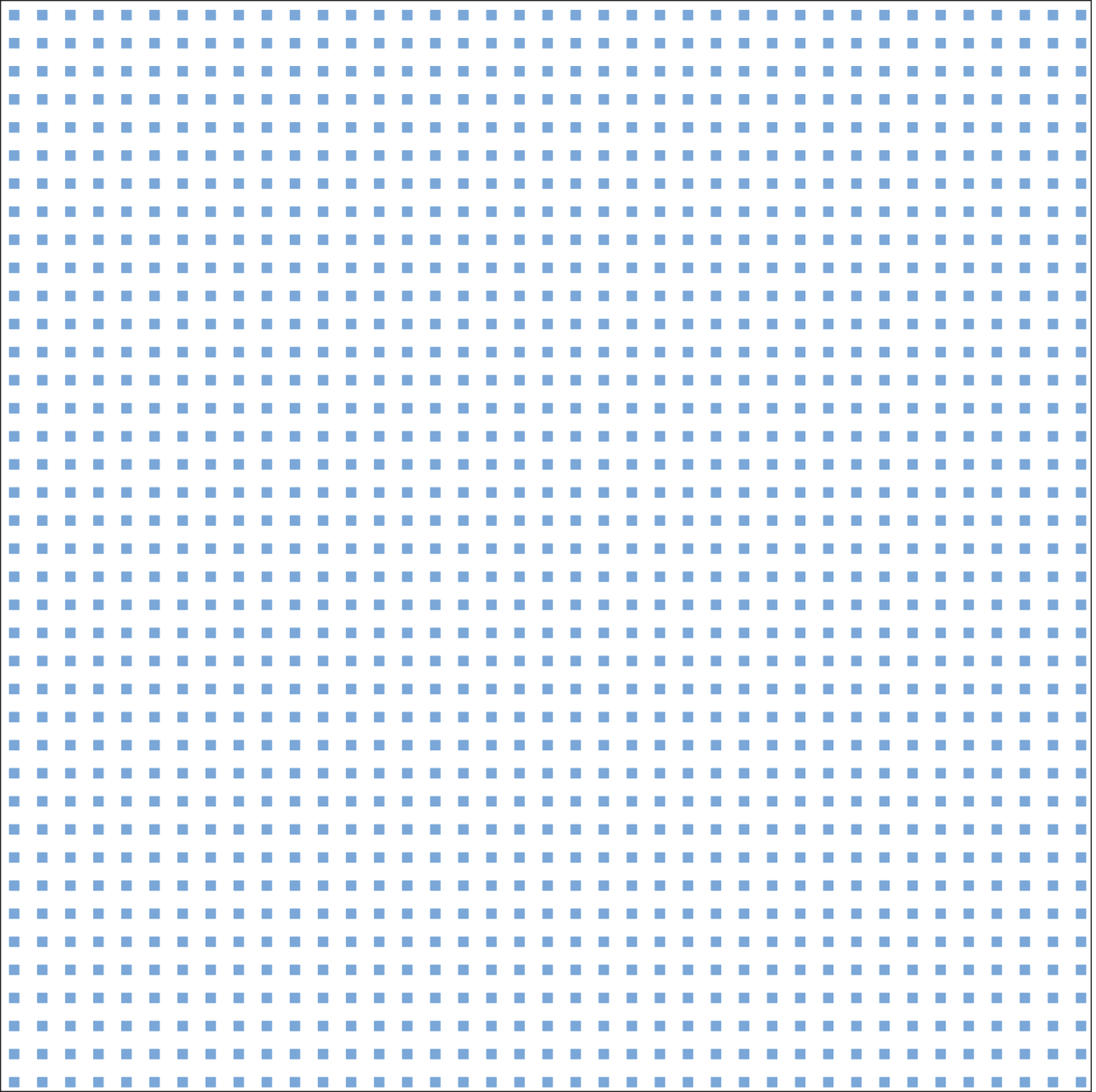
[2]: http://homicideworkinggroup.cos.ucf.edu/include/documents/hrwg9798-6.pdf, accessed June 11, 2014.



Qi
03.04

Ps
Public Space

QI. PS
03.04.01

Ga

Green Area per capita - Metadata

Indicator	Green Area per capita
Scope	Basic CPI
Rationale	This indicator provides information about the amount of dedicated green space. Green spaces generate environmental sustainability and are defined as public and private areas that contain flora, such as plants, trees and grass (e.g., forests, parks, and gardens). These areas also compensate for CO2 emissions. A prosperous city seeks to increase its green area per capita to improve air quality and quality of life.
Definition	The total green area within the city (forests, parks, gardens, etc.) per inhabitant.
Unit [ ]	Square meters (m2) per inhabitant
Methodology	$\textit{Green area per capita} = \frac{\textit{Total green area within the city}}{\textit{city population}}$
Sources	Local urban planning authorities.

Benchmark	X*= 15 m2/hab. Obtained from POT Medellín (2013) based on the World Health Organization's suggestion.
Standardisation: 2.2	$\textit{Green area per capita}^{(s)} = 100 \left(1 - \left\lvert \frac{\textit{Green area per capita} - X^*}{X^*} \right\rvert\right)$ $\textit{Green area per capita}^{(s)} = 100 \left(1 - \left\lvert \frac{\textit{Green area per capita} - 15}{15} \right\rvert\right)$ Decision: $\textit{Green area per capita}^{(s)} = \begin{cases} 0, \text{ if Green area per capita} < 0 \\ \textit{Green area per capita}^{(s)}, \text{ If } 0 < \textit{Green area per capita} < 15 \\ 100, \text{ If Green area per capita} \geq 15 \end{cases}$
Limitations	Cities located in deserted areas have a natural disadvantage; however, is a duty of the city to guarantee a minimum amount of green space to its population.

References

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URL references:

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QI. Ss
03.04.02

Aop

Accessibility of Open Public Areas - Metadata

Indicator	Accessibility of Open Public Areas
Scope	Extended CPI
Rationale	This indicator provides information about the open public areas in a city has and whether this amount is sufficient for its population. Additionally, this indicator considers the accessibility of open public areas and the distribution of the total area across the city. In most countries, the concept of an open public area is related to green areas (where green areas are defined as public and private areas that have flora such as plants, trees and grass). Nevertheless, the two principal roles of an open public area are to provide a space for healthy social interaction space and improve air quality (WHO, 2012). Individuals residing in towns and cities should have access to natural green spaces or open public spaces less than 300 meters from home (Natural England; see also The Wildlife Trust & Natural England, 2009; Harrison et al., 1995; Barker, 1997; Handley et al., 2003; Wray et al., 2005; [1]) A prosperous city has enough open public area for its residents, which is properly distributed and easy to access.
Definition	The percentage of the urban area located less than 300 meters away from an open public space.

Definition	An open area is concept is related to free access. According to POT Medellin (2013), Sandalack & Alaniz (2010) and the Project for Public Spaces [2], open public spaces include the following: - Parks: open spaces inside a municipality that provide free air recreation and contact with nature. Their principal characteristic is the significant proportion of green area. - Civic parks: open spaces created by building agglomeration around an open area, which was later transformed into a representative, civic area. They are characterised by considerable nature, specifically gardens. They are good place for cultural events and passive recreation. - Squares: open spaces created by building agglomeration around an open area. Its main characteristics are the significant proportion of architectonic elements and interaction among buildings and the open area. Squares are usually public spaces that are relevant to the city due to their location, territorial development, or cultural importance. - Recreational green areas: public green areas that contribute to environmental preservation. All recreational green areas must guarantee accessibility and must be linked to urban areas. Their main functions are ornamental and passive recreation. - Facility public areas: open meeting spaces and recreational facilities that are part of city facilities (defined as places that are elementary to all cities; i.e., public libraries, stadium, public sports centres, etc.). These areas have the following characteristics: public property, free transit and access, and both active and passive recreation. (e.g., the public area outside a stadium).
Unit [ ]	%
Methodology	Methodology A: $$Accessibility\ of\ open\ public\ area = 100\ \frac{population\ less\ than\ 300m\ away\ from\ an\ open\ public\ area}{city\ population}$$

Methodology

The population refers to every person who lives less than 300 m away from an open public area; however, obtaining individual data that complies with this characteristic is difficult and few cities can obtain such information.
If this information is available, the indicator should be estimates accordingly; otherwise, Methodology B must be followed.

Methodology B
Proportion of urban area that is more than 300 meters away from an open green space.

$$\textit{Accessibility of open public area} = 100 \frac{\textit{urban area less than 300m away from an open public area}}{\textit{total urban area}}$$

To calculate the indicator it is necessary to use a map of urban open public areas in the following steps:
- Delineate a buffer of 300 meters from the open public space polygons.
- Merge and clip with urban perimeter.
- Calculate areas inside the 300 meters buffer.
- Calculate the proportion of urban area located inside the buffer.

Remote sensing imagery can be used to identify intra-urban open public areas when other information is unavailable.

Sources

Local urban planning authorities.

Benchmark

Min= 0%

Max = 100%

Standardisation: 1.1

Not required.

Limitations

Types of open public spaces vary by city; however, the types listed above are the most commonly accepted. Contemporary constraints on mobility and behaviour must be examined before physical distance to measure the effective accessibility of the open public space. There are social and cultural constraints on access, such as anxiety and fears for personal safety (Harrison et al., 1995)

References

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Harrison, C., Burgess, J., Millward, A., Dawe, G., 1995. Accessible natural green space in towns and cities: a review of appropriate size and distance criteria. English Nature research report number 153. English Nature, Peterborough.

Barker, G., 1997. A framework for the future: green networks with multiple uses in and around towns and cities. English Nature research report number 256. English Nature, Peterborough.

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URL references:

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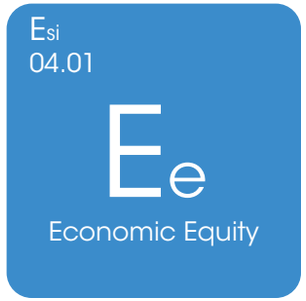
CPI-M
04

Esi

Equity and Social Inclusion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Economic Equity

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G_C

Gini Coefficient (reversed) - Metadata

Indicator	Gini Coefficient (reversed)
Scope	Basic CPI
Rationale	This indicator measures income inequality. The Gini Index is a widely known indicator that measures income across the income (or consumption expenditure) distribution. In this context, it is intended to estimate the income distribution of a city. Cities are generally the cores of economic development and a prosperous city cannot develop under existing inequality. Moreover, addressing income inequality should be a core policies that aims to build a more equitable and inclusive city. There is compelling evidence for the relationship between urban development and income inequality. Glaeser et al (2008) demonstrate that income inequality is related to high crime rates, unhappiness and lower growth rates (of both income and population). A prosperous, equitable and inclusive city seeks to reduce income disparities among its inhabitants.
Definition	The Gini Index measures the extent to which the distribution of income (or consumption expenditure) among individuals or households within an economy deviates from a perfectly equal distribution [1]. A Gini coefficient of zero expresses perfect equality (for example, a city in which everyone has the same income). A Gini coefficient of one (or 100%) expresses maximal inequality (for example, a city in which one person has all the income) (Mandal, 2014).

Unit [ ]	Dimensionless (value between 0 and 1).
Methodology	$$Gini = \frac{1}{2m}\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|y_i - y_j\right|,$$ where y_i = Minimum level of income; y_j = Maximum level of income; n = Total population; and m = Average income. If available, consumption expenditure is preferable to income. However, most household surveys do not request this information. The measure of welfare used is household per capita income, which includes labour (monetary and in kind) and non-labour income (monetary and in kind).
Sources	City household surveys; national level surveys with representative city households; income and expenditure surveys.
Benchmark	Min = 0.24 Max = 0.63 Calculated from World Bank data (2014).
Standardisation: 2.2	$$Gini^{(s)} = 100\left[1 - \frac{Gini - Min}{Max - Min}\right]$$ $$Gini^{(s)} = 100\left[1 - \frac{Gini - 0.24}{0.63 - 0.24}\right]$$

Standardisation: 2.2

Decision:

$$Gini^{(S)} = \begin{cases} 0, If\ Gini \geq 0.63 \\ Gini^{(S)},\ If\ 0.24 < Gini < 0.63 \\ 100,\ If\ Gini \leq 0.24 \end{cases}$$

Limitations

Due to the data characteristics, some cities may switch to households rather than individuals. When different populations are not measured with consistent definitions, the results are not fully comparable. Given the construction of the Gini coefficient cities with similar incomes, Gini coefficients may have different income distributions. [3]. Given that the Gini coefficient measures relative wealth, it should be noted that an increase of the Gini coefficient does not imply absolute poverty reduction; therefore, a complementary measure of poverty is needed.

References

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References

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Pra

Poverty Rate (reversed) - Metadata

Indicator	Poverty Rate (reversed)
Scope	Basic CPI
Rationale	This indicator measures the extreme poverty rate. Progress against poverty is now a widely accepted yardstick for assessing the overall performance of developing economies; therefore, cities, the core of economic development, must use poverty as a core indicator. Moreover, this indicator is used to monitor progress towards the achievement of Millennium Development Goal 1 - eradicate extreme poverty and hunger - established in 2000 by world leaders at the general assembly of the United Nations in the third plenary session [1]. This agreement established a threshold of one dollar PPP per day, which was later revised to one dollar and twenty five cents [2]. The proportion of the population below this measure provides a uniform measure of absolute poverty for the developing world using data from nationally representative household surveys (Chen and Ravallion, 2007). A prosperous city seeks to increase the well-being of its population by minimising poverty levels to create a prosperous, equitable and inclusive city.
Definition	This indicator captures the percentage of the extremely poor population with respect to the total population of the city. To do this, it is necessary to compare household per capita income (which is composed of household labour and non-labour income) to a poverty line. The international extreme poverty line is set at $1.25 PPP per day, measured in international prices [3]. A person is considered poor if his or her income level falls below a minimum

Definition	level necessary to meet basic needs. When estimating poverty worldwide, a uniform poverty line must be used and expressed in a common unit. For the purposes of global aggregation and comparison, international organizations use a poverty line of $1.25 [4]. This indicator ranges from 0 (no one below the poverty line) to 100 (the entire population is below the poverty line). To ensure a positive effect of this index in the economic equity sub-dimension, we invert the indicator by taking the maximum value and subtracting the actual poverty rate value.
Unit [ ]	%
Methodology	$$Poverty\ rate = 100\ \frac{Population\ below\ \$1.25\ PPP\ a\ day}{Total\ population}$$ If available, it is preferable to use consumption expenditure rather than income. However, most household surveys do not request this information. The measure of welfare to be used is household per capita income, which includes labour (monetary and in kind) and non-labour (monetary and in kind) income.
Sources	Data are computed from cities household surveys; national household surveys with city representation.
Benchmark	Min = 0.02% Max = 81.29% Calculated from World Bank data (2014).

Standardisation: 2.2

$$Poverty\ rate^{(S)} = 100\left[1 - \frac{\sqrt[4]{Poverty\ rate} - \sqrt[4]{Min}}{\sqrt[4]{Max} - \sqrt[4]{Min}}\right]$$

$$Poverty\ rate^{(S)} = 100\left[1 - \frac{\sqrt[4]{Poverty\ rate} - 0.38}{3.00 - 0.38}\right]$$

Decision:

$$Poverty\ rate^{(S)} = \begin{cases} 0, If\ \sqrt[4]{Poverty\ rate} \geq 3.00 \\ Poverty\ rate^{(S)},\ If\ 0.38 < \sqrt[4]{Poverty\ rate} < 3.00 \\ 100,\ If\ \sqrt[4]{Poverty\ rate} \leq 13.0 \end{cases}$$

Limitations

The national poverty rate is a headcount measure that fails to reflect the wide differences in income (consumption expenditure) levels possible among the poor. In addition, this indicator measures income (consumption expenditure) and does not consider other dimensions of poverty, such as inequality, vulnerability, housing quality, etc. [3] Therefore, it must be complemented with other measures that capture these factors.

References

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[3]: http://data.worldbank.org/indicator/SI.POV.DDAY , accessed August 12, 2014.

Esi
04.02

Si

Social Inclusion

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04.02.01

Sh

Slum Households (reversed) - Metadata

Indicator	Slum Households (reversed)
Scope	Basic CPI
Rationale	Spatial inequalities are generally expressed as the segregation of certain groups, which resemble poverty as well as inadequate life conditions (United Nations, 2007). Moreover, rapid urbanization, if not well managed, will increase informal settlements and poverty (Duque et al., 2012). Therefore, to sharpen policies it is necessary to identify and quantify the slums in a city. A prosperous and inclusive city is able to reduce spatial inequalities.
Definition	The proportion of people living in households lacking at least one of the following five housing conditions: access to improved water; access to improved sanitation facilities; sufficient-living area (i.e., not overcrowded); and durable housing (United Nations, 2007).
Unit [ ]	%
Methodology	The proportion of households that lack one or more of the following: durable housing, sufficient living space, easy access to safe water, and access to adequate sanitation. The United Nations (2007) proposes the following definitions. Access to improved water. A household is considered to have access to improved drinking water if it has sufficient water for family use, which is at

Methodology	least 20 litres/person/day. The following criteria are used to determine access to improved water: - Piped connection to house or plot - Bore hole - Public stand pipe serving no more than 5 households - Protected dug well - Protected spring - Rain water collection - Bottled water (new) Access to improved sanitation. A household has access to improved sanitation according to the following criteria: - Direct connection to public sewer - Direct connection to septic tank - Poor flush latrine - Ventilated improved pit latrine - Pit latrine with slab, (this condition is weighted 50% of the total) Sufficient-living area. A dwelling provides sufficient living area for a household if there are fewer than four people per habitable room. Additional indicators of overcrowding have been proposed: area-level indicators, such as average in-house living area per person or the number of households per area. Additionally, housing-unit level indicators, such as the number of persons per bed or the number of children under five per room, may also be viable. Structural quality/durability of dwellings: A house is considered durable if it is built on a non-hazardous location and has a permanent and adequate structure to protect its inhabitants from extremes of climatic conditions. The following criteria are used to determine the structural quality/durability of dwellings:

Methodology

- Permanency of structure
- Permanent building material for the walls, roof and floor
- Compliance of building codes
- The dwelling is not in a dilapidated state
- The dwelling is not in need of major repair
- The dwelling is not located on a steep slope
- The dwelling is not located on or near toxic waste
- Location of house (hazardous)
- The dwelling is not located in a flood plain
- The dwelling is not located in a dangerous right of way (rail, highway, airport, power lines

Formally,

$$Slum\ Households = 100\ \frac{Number\ of\ people\ living\ in\ slum}{City\ population}$$

Sources

Global Urban Indicators Database 2012; UN-HABITAT; data are computed from household surveys; and censuses.

Benchmark

Min = 0%

Max = 80%

Obtained from Millennium Development Goals: "Goal 7. Ensure environmental sustainability" [2]

Standardisation: 2.2

$$Slum\ Households^{(s)} = 100\left[1 - \frac{Slum\ Households - Min}{Max - Min}\right]$$

$$Slum\ Households^{(s)} = 100\left[1 - \frac{Slum\ Households}{80}\right]$$

Standardisation: 2.2

Decision:

$$Slum\ Households^{(s)} = \begin{cases} 0,\ If\ Slum\ Households \geq 80 \\ Slum\ Households^{(S)},\ If\ 0 < Slum\ Households < 80 \\ 100,If\ Slum\ Households = 10 \end{cases}$$

Limitations

The indicator does not consider the spatial dimension of slums. Because the indicator cannot consider how many and the extent to which the five conditions of deprived housing are fulfilled, it cannot provide information on the severity of slum conditions (United Nations, 2007).

References

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Esi.Si
04.02.02

Yu

Youth Unemployment (reversed) – Metadata

Indicator	Youth Unemployment (reversed)
Scope	Basic CPI
Rationale	In general, youth unemployment rates are higher than adult unemployment rate in both developed and developing countries (Byambadori, 2007; O'Higgins 1997). Existing research indicates that youth unemployment rates vary more in response to economic conditions than adult rates do, increasing more during recessions and recovering more quickly during booms (O'Higgins 1997). This critical fact affects the potential labour markets of a city as well as its sustainability. Considering current economic circumstances, addressing youth unemployment has become a priority for developed and developing countries through local programmes that aim to increase labour market possibilities and skill development [1]. An inclusive city should provide employment opportunities for young residents.
Definition	Youth unemployment comprise all persons between the ages of 15 and 24 who, during the reference period, were (a) without work; i.e., had not worked for even one hour in any economic activity (paid employment, self-employment, or unpaid work for a family business or farm); (b) currently available for work; and (c) actively seeking work; i.e., had taken active steps to see work during a specified recent period (usually the past four weeks). The youth labour force comprises all persons between the ages of 15 and 24 who were employed or unemployed over a specified reference period [1].

Unit [ ]	%
Methodology	$Youth\ Unemployment = 100\ \frac{Number\ of\ unemployed\ young\ persons}{youth\ labor\ force}$ Labor Force. The economically active population of a country between ages 15 and 65, including all persons employed, unemployed and members of the armed forces but excluding students and people who provide unpaid care to others, such as housewives [2].
Sources	Living standards households surveys; censuses; reports from labour agencies.
Benchmark	Min = 2.7% Max = 62.8% Obtained from the Millennium Development Goals: "Goal 1. Eradicate extreme poverty and hunger" [3]
Standardisation: 2.2	$Youth\ Unemployment^{(S)} = 100\left[1 - \frac{\sqrt[4]{Youth\ Unemployment} - \sqrt[4]{Min}}{\sqrt[4]{Max} - \sqrt[4]{Min}}\right]$ $Youth\ Unemployment^{(S)} = 100\left[1 - \frac{\sqrt[4]{Youth\ Unemployment} - \sqrt[4]{Min}}{2.82 - 2.24}\right]$

Standardisation: 2.2

Decision:

$$Youth\ Unemployment^{(S)} = \begin{cases} 0, If\ \sqrt[4]{Youth\ Unemployment} \geq 2.82 \\ Youth\ Unemployment^{(S)},\ If\ 0.38 < \sqrt[4]{Youth\ Unemployment} < 3.00 \\ 100,\ If\ \sqrt[4]{Youth\ Unemployment} \leq 1.28 \end{cases}$$

Limitations

Some factors attributable to unemployment statistics may affect comparability across countries. The definition of who is in and not in the labour force may differ by country and age [1].

References

Bibliographic references:

Byambadori, Purvee (2007). The youth unemployment situation in Sweden. University of Goteborg, Department of Social Work [4]

O'Higgins, Neil (1997). The challenge of youth unemployment. Employment and Training Department of ILO.

URL references:

[1]: http://www.ilo.org/public/english/employment/yen/whatwedo/projects/indicators/2.htm, accessed June 11, 2014.

[2]: http://www.worldbank.org/depweb/beyond/beyondsp/glossary.html , accessed August 8, 2014.

[3]: http://mdgs.un.org/unsd/mdg/Metadata.aspx?IndicatorId=0&SeriesId=630, accessed June 11, 2014.

References

[4]: https://gupea.ub.gu.se/handle/2077/4603, accessed June 11, 2014.


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Gender Inclusion

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04.03.01

Ess

Equitable Secondary School Enrolment - Metadata

Indicator

Equitable Secondary School Enrolment

Scope

Basic CPI

Rationale

In many cities, gender inequality persists and women continue to face discrimination in access to education, employment and economic assets as well as participation in government. Ensuring equitable enrolment in secondary education will directly affect the well-being of society due to its long lasting effects. Education is critical to reaching long run development. Female education creates powerful poverty-reducing synergies and yields enormous intergenerational gains. It is positively correlated with increased economic productivity, more robust labour markets, higher earnings, and improved societal health and well-being. This indicator, aligned with Millennium Development Goal 3 (promote gender equality and empower women), monitors whether boys and girls complete secondary schooling (Tembon and Ford, 2008). A prosperous city should reduce gender inequality to provide equal opportunities for males and females.

Definition

The ratio of net secondary education enrolment of boys to girls in both private and public schools. The ratio of male to female enrolment in secondary school. An ideal scenario would be 1, and any deviation from 1 is undesirable and reflects inequalities between males and females.

Unit [ ]

Dimensionless (Value between 0 and ∞).

Methodology

$$\text{Equitable Secondary School Enrollment} = \frac{\frac{\text{female enrollment in secondary school}}{\text{female that belong to the secondary education age range}}}{\frac{\text{male enrollment in secondary school}}{\text{male that belong to the secondary education age range}}}$$

The secondary education age range varies across countries.

Sources

Household surveys; administrative registries of ministries of education; statistical offices.

Benchmark

$X^* = 1$

Standardisation: 5

$$\text{Equitable Secondary S.E.}^{(s)} = 100\left(1 - \left|\frac{\text{Equitable Secondary S.E.} - X^*}{X^*}\right|\right)$$

$$\text{Equitable Secondary S.E.}^{(s)} = 100\left(1 - \left|\frac{\text{Equitable Secondary S.E.} - 1}{1}\right|\right)$$

Decision:

$$\text{Equitable Secondary S.E.}^{(s)} = \begin{cases} 0, \text{ if Equitable Secondary S.E.} = 0 \text{ or Equitable Secondary S.E.} = 2 * 1 \\ \text{Equitable Secondary S.E.}^{(s)}, \text{ If } 0 < \text{Equitable Secondary S.E.} < 2 * 1 \\ 100, \text{ If Equitable Secondary S.E.} = 1 \end{cases}$$

Limitations

The number of years of secondary education may vary; therefore, this indicator may not be fully comparable between cities. In some special cases, net enrolment may exceed 100% due to discrepancies between enrolment and population data. A threshold of one hundred percent could be used.

References

Bibliographic references:
Tembon, M., & Fort, L. (2008). Girls' education in the 21st century: gender equality, empowerment, and economic growth. Washington, DC: World Bank.

Esi.Gi
04.03.02

Wlg

Women in the Local Government - Metadata

Indicator	Women in Local Government
Scope	Extended CPI
Rationale	In most cities of the world, female participation in decision-making positions is disproportionately limited. This fact accentuates the problems of gender inequality and exclusion. Promoting gender equality and the empowerment of women to eliminate all forms of gender-based discrimination in decision-making positions is essential to defeating poverty and fostering sustainable development. Policies aimed at eradicating the gender gap are crucial to allow women to develop the skills and competencies they need to better participate in decision-making positions and increase their contributions to the local and global economies [1]. Female participation is limited, and from this perspective, females are excluded from the opportunity to make decisions and fight for laws that benefit themselves. When this occurs, the skills and opportunities for training and development of women are stymied and the social and economic growth of cities is hampered [2]. A prosperous city must be inclusive in political representation.
Definition	Female representation in decision-making positions (i.e., city mayor and council) is a measure of gender equality and equity established by the UN to observe the inclusion of women in the socio-political life of a nation and its cities. Moreover, it aims to capture the influence of the female population on local policies. The index does not differentiate among nations with minimum quotas for female participation in government and representation reached freely.

Unit [ ]	%
Methodology	$$Women\ in\ local\ government = 100\ \frac{number\ of\ women\ in\ government\ jobs}{Total\ of\ government\ jobs}$$
Sources	Administrative registries [3]; local governments; electoral offices.
Benchmark	X*= 50% Obtained from Mossuz-Lavau (2005) [4].
Standardisation: 5	$$Women\ in\ local\ government^{(s)} = 100\left(1 - \left\lvert \frac{Women\ in\ local\ government - X^*}{X^*} \right\rvert\right)$$ $$Women\ in\ local\ government^{(s)} = 100\left(1 - \left\lvert \frac{Women\ in\ local\ government - 50}{50} \right\rvert\right)$$ Decision: $$Women\ in\ local\ government^{(s)} = \begin{cases} 0,\ if\ Women\ in\ local\ government = 0\ or\ Women\ in\ local\ government = 2*50 \\ Women\ in\ local\ government^{(s)},\ If\ 0 < Women\ in\ local\ government < 2*50 \\ 100,\ If\ Women\ in\ local\ government = 50 \end{cases}$$

Limitations

Some countries may have female participation quotas established by law. In these particular cases, it would not be possible to identify whether the participation of women in government is by imposition or free. In addition, some cities may not elect their major or councils. However, given that the indicator aims to capture female influence on policies, these limitations could be justified.

References

Bibliographic references:

Circle of Rights, (2004). Economic, social and cultural rights of women. Module 4. Universidad de Minnesota en Estados Unidos. [2]

Mossuz-Lavau, J. (2005). La paridad hombres/mujeres en política. Embajada de Francia en Bogotá. [4]

URL references:

[1] http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/econ_development/women_wage_employment.pdf , accessed June 11, 2014.

[2] http://www1.umn.edu/humanrts/edumat/IHRIP/circle/modules/module4.htm , accessed July 12, 2014.
[3] http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=557, accessed June 11, 2014.

[4] http://www.ambafrance-co.org/La-paridad-hombres-mujeres-en, accessed June 11, 2014.

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04.03.03

Ww

Women in the Workforce - Metadata

Indicator	Women in the Workforce
Scope	Extended CPI
Rationale	In most cities around the world, women are disproportionately represented in labour markets. Promoting gender equality and the empowerment of women to eliminate all forms of gender-based discrimination in labour markets is essential to defeat poverty and foster sustainable development (United Nations, 2007). Policies aimed at eradicating the gender gap in education are crucial to allow women to develop the skills and competencies they need to better participate in the labour market and make their contribution to the global economy. Their increased role in turn will boost women's economic security, which ultimately helps families out of poverty and hunger and improves the health and education of their children. These changes are fundamental for sustainable development [1]. A prosperous city seeks to increase female participation in the work force to achieve equal opportunities for men and women and improve health and education.
Definition	The share of women in the labour force is the share of female workers in the non-agricultural sector expressed as a percentage of total employment of the city. The non-agricultural sector includes industry and services. Industry includes mining and quarrying (including oil production), manufacturing, construction, electricity, gas, and water, corresponding to divisions 2-5 in the International Standard Industrial Classification of All Economic Activities (ISIC-Rev.2) [2] and tabulation categories C-F (ISIC-Rev. 3) [2] (United

Definition	Nations, 2007). Services include wholesale, retail trade, restaurants, and hotels; transport, storage, and communications; financing, insurance, real estate, and business services; and community, social, and personal services, corresponding to divisions 6-9 (ISIC-Rev. 2) and tabulation categories G-Q (ISIC-Rev. 3). This indicator is consistent with Millennium Development Goals 3: "Promote gender equality and empower women." This index is obtained by dividing the number of women in non-agricultural paid employment by the total number of people in paid employment in the non-agricultural sector and multiplying it by 100 (United Nations, 2007).
Unit [ ]	%
Methodology	$$Women\ in\ the\ workforce = 100 \frac{number\ of\ women\ in\ non\text{-}agricultural\ paid\ employment}{total\ number\ of\ people\ in\ paid\ employment\ in\ the\ non\text{-}agricultural\ sector}$$
Sources	Living standards household surveys; censuses.
Benchmark	X*= 50% Obtained from Millennium Development Goals: "Promote gender equality and empower women" [3]
Standardisation: 5	$$Women\ in\ the\ workforce^{(s)} = 100 \left(1 - \left\lvert \frac{Women\ in\ the\ workforce - X^*}{X^*} \right\rvert\right)$$ $$Women\ in\ the\ workforce^{(s)} = 100 \left(1 - \left\lvert \frac{Women\ in\ the\ workforce - 50}{50} \right\rvert\right)$$

Standardisation: 5

Decision:

$$\textit{Women in the workforce}^{(s)} = \begin{cases} 0, \text{ if } \textit{Women in the workforce} = 0 \text{ or } \textit{Women in the workforce} = 2 * 50 \\ \textit{Women in the workforce}^{(s)}, \text{ If } 0 < \textit{Women in the workforce} < 2 * 50 \\ 100, \text{ If Women in the workforce} = 50 \end{cases}$$

Limitations

In many countries (especially developing countries), wage employment represents only a small portion of total employment. As a result, the contributions of women to the national economy may be underestimated and misrepresented. In addition, this indicator fails to reveal differences in the quality of employment in terms of earnings, work conditions, or legal and social protection they offer. [1]

References

Bibliographic references:

United Nations (2007). Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition, United Nations, New York. [1]

URL references:

[1] http://www.un.org/esa/sustdev/natlinfo/indicators/methodology_sheets/econ_development/women_wage_employment.pdf, accessed June 11, 2014.
[2]: http://laborsta.ilo.org/ , accessed June 11, 2014.
[3] http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=722, accessed June 11, 2014.


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Urban Diversity

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04.04.01

Lum

Land use mix - Metadata

Indicator	Land use mix
Scope	Extended CPI
Rationale	When land use is balanced through complementary uses and activities within a local area (a mix of residences, workplaces and local commerce), many daily trips are short and walkable. Diverse uses peaking at different times ensure animated and safe local streets, encourage walking and cycling, and foster a vibrant human environment where people want to live (Kajtazi, 2007). The location of activities within a city is very important due to its influence on spatial interactions. If we consider distance as a function of location, the importance of a suitable location has significantly influences economic activities and land use; i.e., the specialization of urban space and therefore the sectorisation of the city [1]. Land use characterizes the cityscape while its spatial distribution determines the structure and organization of the city (Institute for Transportation and Development Policy, 2013). A prosperous city seeks to distribute major urban activities to balance its systems and functions.
Definition	Diversity of land use per square kilometre
Unit [ ]	Dimensionless (value between 0 and 1.61).

Methodology	1. Obtain urban land use maps classified as follows: residential, commercial + services, industrial, public facilities, and public spaces. Public facilities are all the institutional structures defined for purposes such as education, culture, sports, and administration. Public spaces include all open spaces that could be used for recreation, such as parks, public spaces related to equipment, and green zones that are accessible to people. 2. Overlay a regular grid of 500 x 500 m cell size. 3. Calculate the area allocated to each land use class within each cell. 4. The land allocated to streets must not be included, which means that this value must be extracted from the total of surface. 5. Calculate de Shannon-Wiener diversity index for each cell j as follows: $Shannon\text{-}Wienner\ diversity\ index_j = [-\sum_i p_i * ln\,(p_i)\,],$ where p_i is the share of each land use class within the cell calculated as the area of each class divided by the total cell unit area (250.000 m2). 6. Calculate the average as follows: $Land\ use\ mix = \frac{\sum_j Shannon\text{-}Wienner\ diversity\ index_j}{Total\ number\ of\ cells}$
Sources	Local urban planning authorities.
Benchmark	Min = 0 Max = 1.61, which is the maximum value of the Shannon-Wiener diversity index for five categories; i.e., Max(Shannon"-" Wienner diversity index) = ln(5) = 1.61.

Standardisation: 5

$$Land\ use\ mix^{(s)} = 100\left[\frac{Land\ use\ mix - Min}{Max - Min}\right]$$

$$Land\ use\ mix^{(s)} = 100\left[\frac{Land\ use\ mix}{1.61}\right]$$

Decision:

$$Land\ use\ mix^{(S)} = \begin{cases} 100,\ If\ Land\ use\ mix \geq 1.61 \\ Land\ use\ mix^{(S)},\ If\ 0 < Land\ use\ mix < 1.61 \\ 0,\ If\ Land\ use\ mix \leq 0 \end{cases}$$

Limitations

Because this information comes from the regulatory plans, they do not always reflect reality on the ground. Sometimes urban development is inconsistent with regulatory plans.

References

Bibliographic references:

Kajtazi, B. (2007) Measuring multifunctionality of urban area. International Institute for Geo-Information Science and Earth Observation, Enschede, the Netherlands. [1]

Institute for Transportation and Development Policy (2013) TOD Standard v. 2.0. New York.

References

URL references:

[1]: http://www.itc.nl/library/papers_2007/msc/upla/kajtazi.pdf , accessed June 11, 2014.

CPI-M
05

Es

Environmental
Sustainability


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05.01
Aq
Air Quality

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05.01.01

Nms

Number of Monitoring Stations - Metadata

Indicator	Number of Monitoring Stations
Scope	Basic CPI
Rationale	Winds, topography, land use, source locations, etc. can cause a significant level of spatial heterogeneity in PM10, SO2 and NO2 concentration levels. Thus, the quality of measures of PM10, SO2 and NO2 concentrations depends on the number of monitoring stations located throughout the urban area (U.S. Government, 2014). A prosperous city seeks properly measure air quality using several monitoring stations.
Definition	The number of operative Fixed Automatic Monitoring Stations located in the urban area.
Unit [ ]	#
Methodology	The number of operative Fixed Automatic Monitoring Stations located in the urban area.
Sources	Local environmental authorities.
Benchmark	Min = 0 Max = Set the maximum value according to the following table:

Benchmark

Population category	*>= 48 µg/m3 of PM10*	*>= 32 µg/m3 and < 48 µg/m3 of PM10*	*< 32 µg/m3 of PM10*
>1,000,000	*10*	*8*	*4*
500,000-1,000,000	*8*	*4*	*2*
250,000-500,000	*4*	*2*	*1*
100,000-250,000	*2*	*1*	-

The table above is adapted from the Electronic Code of Federal Regulations (U.S. Government, 2014: Table D-4 of Appendix D to Part 58—PM10 Minimum Monitoring Requirements -Approximate Number of Stations Per MSA-)

Standardisation: 2.1

$$\text{Number of monitoring stations}^{(s)} = 100\left[\frac{\text{number of monitoring stations} - \text{Min}}{\text{Max} - \text{Min}}\right]$$

$$\text{Number of monitoring stations}^{(s)} = 100\left[\frac{\text{number of monitoring stations}}{\text{Max}}\right]$$

Decision:

$$\text{Number of monitoring stations}^{(s)} = \begin{cases} 100, \text{ If Number of monitoring stations} \geq \text{Max.} \\ \text{Number of monitoring stations}^{(s)}, \text{ If } 0 < \text{Number of monitoring stations} < \text{Max} \\ 0, \text{ If Number of monitoring stations} \leq 0 \end{cases}$$

Limitations

As shown in the table above, the suggested number of Fixed Automatic Monitoring Stations in the urban area depends on the PM10 concentration levels. Moreover, the accuracy of PM10 concentration measurement depends on the number of Fixed Automatic Monitoring Stations. Thus, it is

Limitations

important to ensure that the number of stations is based on accurate PM10 concentrations. If a city has a small number of Fixed Stations, it would be important to use additional Mobile Stations to assess how many Fixed Stations are lacking.

References

Bibliographic references:

U.S. Government (2014). Electronic Code of Federal Regulations. U.S. Government Printing Office. [1]

URL references:

[1]: http://www.ecfr.gov/cgi-bin/retrieveECFR?gp=&SID=0f-3bfa1634 2b3e5b8587 43bbbbdcfa4f&r=PART&n=40y6.0.1.1.6#40:6.0.1.1.6.2, accessed June 11, 2014.

Es. Aq
05.01.02

Pmc

PM10 Concentration (reversed) - Metadata

Indicator	PM10 Concentration (reversed)
Scope	Extended CPI
Rationale	Particles of ~10 micrometres or less (PM10), emitted from households, industry power stations, transportation, among others, can penetrate the lungs and cause health problems (World Health Organization, 2011).
Definition	The annual daily mean of PM10 concentrations in the atmosphere. The estimates represent the average annual exposure level of the average urban resident to outdoor particulates.
Unit [ ]	Micrograms per cubic meter (µg/m3).
Methodology	The concentration of PM10 is regularly measured from fixed-site, population-oriented monitors located in urban areas. High-quality measurements of PM10 concentration from all monitors in the urban area can be averaged to develop a single estimate. Care should be taken to ensure that the monitors used are not unduly influenced by a single source of pollution (i.e., a power plant, factory or highway). The monitors should reflect exposures over a wide area (World Health Organization, 2011).

Sources	- Records from fixed or mobile Dust/PM monitoring stations available from local governments and - World Bank data (2014).
Benchmark	Obtained from the European Commission (2013). $X^* = 40\ \mu g/m^3$
Standardisation: 2.2	$$PM10\ concentration^{(s)} = 100\left(1 - \left\lvert\frac{PM10\ concentration - X^*}{X^*}\right\rvert\right)$$ $$PM10\ concentration^{(s)} = 100\left(1 - \left\lvert\frac{PM10\ concentration - 40}{40}\right\rvert\right)$$ Decision: $$PM10\ concentration^{(s)} = \begin{cases} 0, \text{ if } PM10\ concentration \geq 2 * 40 \\ PM10\ concentration^{(s)}, \text{ If } 40 < PM10\ concentration < 2 * 40 \\ 100, \text{ If } PM10\ concentration \leq 40 \end{cases}$$
Limitations	To produce an accurate measure of the PM10 concentration in the city, it is important to measure this variable at different sites. The appropriate number of Fixed Automatic Monitoring Stations is reported in the following table:

Limitations

Population category	*>= 48 µg/m3 of PM10*	*>= 32 µg/m3 and < 48 µg/m3 of PM10*	*< 32 µg/m3 of PM10*
>1,000,000	*10*	*8*	*4*
500,000-1,000,000	*8*	*4*	*2*
250,000-500,000	*4*	*2*	*1*
100,000-250,000	*2*	*1*	*-*

The above table is adapted from the Electronic Code of Federal Regulations (U.S. Government, 2014: Table D-4 of Appendix D to Part 58—PM10 Minimum Monitoring Requirements -Approximate Number of Stations Per MSA-).
The World Bank (2014) warns that there are non-anthropogenic sources of outdoor particulate matter pollution (e.g., dust storms). These sources deteriorate air quality but are beyond the control of local authorities.

References

Bibliographic references:

World Health Organization (2011). Indicator and Measurement Registry version 1.7.0. [1]
The World Bank (2014). World Development Indicators 1960 – 2013. [2]
European Commission (2013). The Clean Air Policy Package. [3]

URL references

[1]: http://apps.who.int/gho/indicatorregistry/App_Main/view_indicator.aspx?iid=1349, accessed June 11, 2014.
[2]: http://data.worldbank.org/indicator/EN.ATM.PM10.MC.M3, accessed June 11, 2014.
[3]: http://ec.europa.eu/environment/air/quality/standards.htm, accessed June 11, 2014.

Es. Aq
05.01.03

Ce

CO2 emissions (reversed) - Metadata

Indicator	CO_2 emissions (reversed)
Scope	Extended CPI
Rationale	CO_2 is the most representative greenhouse gas (GHG) that contributes to global warming. Since the industrial revolution, the concentration of this gas in the atmosphere has increased dramatically (The World Bank, 2014). A prosperous city seeks to reduce CO_2 emissions to improve environmental sustainability and air quality.
Definition	Total CO_2 emissions in a year. Carbon dioxide emissions are produced by burning fossil fuels and manufacturing cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring (The World Bank, 2014).
Unit [ ]	Metric tonnes of CO_2 per capita
Methodology	There exists a wide range of models for measuring greenhouse gas emissions from different sources. One of the most utilized systems is the Long range Energy Alternatives Planning System (LEAP) developed at the Stockholm Environment Institute (Heaps, 2008). The city's local environmental authorities should measure and report the greenhouse gas emissions, which include CO_2.

Sources	Local environmental authorities.
Benchmark	Min = 0.01 Metric tones Max = 40.31 Metric tones Calculated from The World Bank (2014).
Standardisation: 2.2	$$CO_2\ emissions^{(s)} = 100\left[1-\frac{\sqrt[5]{CO_2\ emissions}-\sqrt[5]{Min}}{\sqrt[5]{Max}-\sqrt[5]{Min}}\right]$$ $$CO_2\ emissions^{(s)} = 100\left[1-\frac{\sqrt[5]{CO_2\ emissions}-0.39}{2.09-0.39}\right]$$ Decision: $$CO_2\ emissions^{(s)} = \begin{cases} 0, \text{ If } \sqrt[5]{CO_2\ emissions} \geq 2.09 \\ CO_2\ emissions^{(s)}, \text{ If } 0.39 < \sqrt[5]{CO_2\ emissions} < 2.09 \\ 100, \text{ If } \sqrt[5]{CO_2\ emissions} \leq 0.39 \end{cases}$$
Limitations	These calculations do not usually include fuel burned by aircraft and ships.

References

Bibliographic references:

The World Bank (2014). World Development Indicators 1960 – 2013. [1]

Heaps, C. (2008) Long Range Energy Alternatives Planning System: An introduction. Stockholm Environment Institute. [2

URL references

[1]: http://data.worldbank.org/indicator/EN.ATM.CO2E.PC, accessed June 11, 2014.

[2]: http://www.energycommunity.org/documents/LEAPIntro.pdf, accessed June 11, 2014.


Es
05.02
Wm
Waste Management

Es. Wm
05.02.01

Swc

Solid Waste Collection - Metadata

Indicator	Solid Waste Collection
Scope	Basic CPI
Rationale	Waste collection is the collection and transport of waste to the place of treatment or discharge by municipal services or similar institutions, or by public or private corporations, specialized enterprises or general government (United Nations, 1997). A prosper city seeks to collect the most part of solid waste to improve standards of living and to decrease the probability of waste related vector diseases.
Definition	Share of waste collected by the city and adequately disposed either in sanitary landfills, incineration sites or in regulated recycling facilities. Expressed in terms of the total volume of waste generated by the city (The Economic Intelligence Unit, 2010: pg.30)
Unit [ ]	%
Methodology	$Solid\ waste\ collection = 100 \left[\frac{Volume\ of\ waste\ collection}{total\ volume\ of\ waste\ generated\ by\ the\ city} \right]$
Sources	Local solid waste management plans, local authorities.

Swc

Benchmark	Min = 0% Max = 100%
Standardisation: 1.1	Not required
Limitations	To avoid unfair comparisons this variable do not differentiate between the level of sophistication of the waste collection systems.
References	Bibliographic references: The Economic Intelligence Unit (2010). Latin American Green City Index: Assessing the environmental performance of Latin America's major cities. [1] United Nations (1997). Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, New York. URL references [1]: http://www.siemens.com/press/pool/de/events/corporate/2010-11-lam/Study-Latin-American-Green-City-Index.pdf, accessed June 11, 2014.[2]: http://www.energycommunity.org/documents/LEAPIntro.pdf, accessed June 11, 2014.

Es. Wm
05.02.02

Wwt

Wastewater Treatment - Metadata

Indicator	Wastewater Treatment
Scope	Basic CPI
Rationale	Water is fundamental to life and human activities. If water is not properly cleaned after use, wastewater can have a considerable negative impact on the environment and can become a disease vector (US Environmental Protection Agency, 2008; USGS, 2014). Urban wastewater treatment is mitigates the impact of urban life on the environment by reducing water pollution. A prosperous city seeks to maximise the percentage of treated wastewater to ensure environmental sustainability and reduce pollution.
Definition	The percentage of wastewater treated from wastewater produced within the urban agglomeration.
Unit [ ]	%
Methodology	$Wastewater\ treatment = 100 \left[\frac{sewage\ treatment\ in\ m^3 / year}{sewage\ effluent\ in\ m^3 / year} \right]$
Sources	Wastewater treatment plans, local authorities.

Benchmark	Min = 0% Max = 100%
Standardisation: 1.1	Not required
Limitations	The accuracy of sewage effluent measures may vary across countries because the direct measurement of this variable is plagued by technical challenges. Therefore, several countries estimate sewage effluent as a function of water consumption, which includes both the water supply system and alternative water sources. In this case, the regulatory agencies establish a conversion factor between consumption and discharge of the form sewage=water in × factor where factor≤1.
References	Bibliographic references: USGS (2014). The USGS Water Science School: Wastewater Treatment. [1] US Environmental Protection Agency (2008). Tribal Compliance Assistance Center: Wastewater Topics. [2] URL references [1]: http://water.usgs.gov/edu/wuww.html, accessed June 11, 2014. [2]: http://www.epa.gov/tribalcompliance/wwater/wwwastedrill.html, accessed June 11, 2014.

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Swr

Solid Waste Recycling Share - Metadata

Indicator	Solid Waste Recycling Share
Scope	Extended CPI
Rationale	Recycling and reusing solid waste reduces the amount of waste to be disposed of in landfills (US Environmental Protection Agency, 2014). A prosperous city seeks to recycle most of its solid waste to increase the lifespan of its landfills and to profit from solid waste as much as possible.
Definition	The recycling rate is the tonnage recycled from municipal waste divided by the total municipal waste. Recycling includes material recycling, composting and anaerobic digestion. Municipal waste consists largely of waste generated by households but may include similar wastes generated by small businesses and public institutions and collected by the municipality. This latter part of municipal waste may vary from municipality to municipality and from country to country, depending on the local waste management system (Eurostat, 2013).
Unit [ ]	%
Methodology	$$Solid\ waste\ recycling\ share = 100\left[\frac{volume\ of\ waste\ recycled}{total\ collected\ waste}\right]$$

Sources	Local solid waste management plans and local authorities.
Benchmark	X*= 50% Obtained from European Parliament, Council of the European Union (2008).
Standardisation: 3	$$Solid\ waste\ recycling\ share^{(s)} = 100\left(1 - \left\lvert\frac{Solid\ waste\ recycling\ share - X^*}{X^*}\right\rvert\right)$$ $$Solid\ waste\ recycling\ share^{(s)} = 100\left(1 - \left\lvert\frac{Solid\ waste\ recycling\ share - 50}{50}\right\rvert\right)$$ Decision: $$Solid\ waste\ recycling\ share^{(s)} = \begin{cases} Solid\ waste\ recycling\ share^{(s)}, & If\ 0 \le Solid\ waste\ recycling\ share < 50 \\ 100, & If\ Solid\ waste\ recycling\ share \ge 50 \end{cases}$$
Limitations	Data quality varies widely among different countries. Accurate recycling statistics are available in cities with Solid Waste Management Plan, while rough estimates usually come from cities with informal recycling systems.

References

Bibliographic references:

Eurostat (2013). Recycling rate of municipal waste (t2020_rt120). [1]

Eurostat (2014). Recycling rate of municipal waste (t2020_rt120). [2]

European Parliament, Council of the European Union (2008). Directive 2008/98/EC on waste and repealing certain Directives. Official Journal of the European Union. [3]

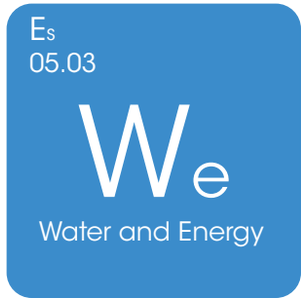
US Environmental Protection Agency (2014). Municipal Solid Waste. [4]

URL references

[1]: http://epp.eurostat.ec.europa.eu/cache/ITY_SDDS/EN/t2020_rt120_esmsip.htm#relatedmd1401955141433, accessed June 11, 2014.

[2]: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&plug-in=1&language=en&pcode=t2020_rt120, accessed June 11, 2014.
[3]: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008L0098, accessed June 11, 2014.

[4]: http://www.epa.gov/epawaste/nonhaz/municipal/, accessed June 11, 2014.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Water and Energy

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05.03.01

Spa

Share of Protected Area in Natural Systems that Provide Water to the City - Metadata

Indicator	Share of Protected Area in Natural Systems that Provide Water to the City
Scope	Basic CPI
Rationale	Natural systems that provide water to the city provide a vital service to the city (Secretariat of the Convention on Biological Diversity, 2008). A prosperous city seeks to ensure the sustainability of water resources by legally protecting these ecosystems.
Definition	The share of protected area in natural systems that provide water to the city.
Unit [ ]	%
Methodology	$\text{Share of the protected area} = 100\left[\frac{\text{protected area}}{\text{total area of water provider ecosystems}}\right]$
Sources	Environmental agencies, national and local governments.
Benchmark	Min= 0% Max = 100%

Swr

Standardisation: 1.1	Not required.
Limitations	Some natural systems that provide water to the city may belong to other municipalities; however, these areas should be included in the calculation.
References	Bibliographic references: Secretariat of the Convention on Biological Diversity (2008). Protected Areas in Today's World: Their Values and Benefits for the Welfare of the Planet. Montreal, Technical Series no. 36. [1] URL references [1]: http://www.cbd.int/doc/publications/cbd-ts-36-en.pdf, accessed June 11, 2014.

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Sre

Share of Renewable Energy Consumption - Metadata

Indicator	Share of Renewable Energy Consumption
Scope	Basic CPI
Rationale	The incentive to use renewable energy for electricity, transport, or even total primary energy supply has been motivated by global warming as well as other ecological and economic concerns. The Intergovernmental Panel on Climate Change argued that there are few fundamental technological limits to integrating a portfolio of renewable energy technologies to meet most of total global energy demand (Intergovernmental Panel on Climate Change, 2011). A prosperous city seeks to improve energy consumption sustainability and reduce emissions from energy generation by using clean and renewable energy sources.
Definition	Electricity production from renewable sources (% of total) is the share of electricity produced by geothermal, solar photovoltaic, solar thermal, tide, wind, industrial waste, municipal waste, primary solid biofuels, biogases, biogasoline, biodiesels, other liquid biofuels, non-specified primary biofuels and waste, and charcoal in total electricity production, which is the total number of GWh generated by power plants separated into electricity plants and CHP plants. Hydropower is excluded (The World Bank, 2014).
Unit [ ]	%

Sre

Methodology	Share of renewable energy sources from total energy sources, expressed as percentage.
Sources	Electricity companies that feed the city grid; the International Energy Agency (IEA) (The World Bank, 2014).
Benchmark	Min = 0 % Max = 20 % Obtained from European Commission, the World Bank (2014).
Standardisation: 2.1	$$\text{Share of renewable energy consumption}^{(s)} = 100\left[\frac{\text{Share of renewable energy consumption} - \text{Min}}{\text{Max-Min}}\right]$$ $$\text{Share of renewable energy consumption}^{(s)} = 100\left[\frac{\text{Share of renewable energy consumption}}{20}\right]$$ Decision: $$\text{Share of renewable energy consumption}^{(s)} = \begin{cases} 100, \text{If Share of renewable energy consumption} \geq 20 \\ \text{Share of renewable energy consumption}^{(s)}, \text{If } 0 < \text{Share of renewable energy consumption} < 20 \\ 0, \text{If Share of renewable energy consumption} = 0 \end{cases}$$

Limitations

When the cities within a country obtain their energy from a nationally connected system, there will not be differences in the values of the share of renewable energy consumption.

References

Bibliographic references:

Intergovernmental Panel on Climate Change (2011). “Special Report on Renewable Energy Sources and Climate Change Mitigation”. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. p. 17.

The World Bank (2014). World Development Indicators 1960 – 2013. [1]

URL references

[1]: http://wdi.worldbank.org/table/3.7, accessed June 11, 2014.

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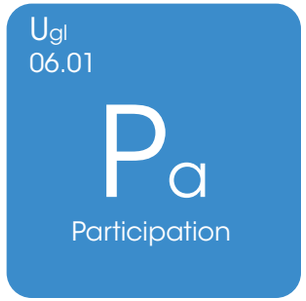
Urban Governance
and Legislation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Pa
Participation

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V_t

Voter Turnout - Metadata

Indicator	Voter Turnout
Scope	Basic CPI
Rationale	Voter turnout indicates the degree of civic engagement within a society and individual participation in elections. Political participation is the foundation of democratic institutions, ensures government and institutional accountability and increases the likelihood that decisions and policies reflect the will of the majority. People vote to affect the actions of government in ways that are meaningful to them (OECD, 2011, p. 189). Although voter turnout is the best measure of civic and political engagement, it is not ideal because of institutional differences in electoral systems. Finally, people who are more educated or older are more likely to vote [2]. A prosperous city motivates eligible voters to participate in elections to promote democracy, increase the likelihood that the political system reflects the will of the majority and increase the legitimacy of the city government [2].
Definition	Voter turnout is the number of eligible voters who cast a ballot in an election, which varies by country based on type of electoral system, place of residence, level of education, and type of election (national or local).
Unit [ ]	%

Methodology	$$Voter\ turnout = 100\ \frac{Voters\ who\ cast\ a\ ballot\ in\ a\ local\ election}{Number\ of\ eligible\ voters}$$ The number of eligible voters varies by country and is not always the total adult population. Local elections do not occur annually, but voter turnout from the last election can be used
Sources	National electoral authorities; International Institute for Democracy and Electoral Assistance (IDEA).
Benchmark	Min = 0% Max = 100%
Standardisation: 1.1	Not required
Limitations	This indicator cannot be used in non-democratic countries.
References	Bibliographic references: OECD (2011) "Civic engagement and governance", in How's life? Measuring well-being. OECD Publishing. [1] URL references [1]: http://dx.doi.org/10.1787/9789264121164-11-en, accessed August 6, 2014. [2]: http://www.oecdbetterlifeindex.org/topics/civic-engagement/, accessed August 6, 2014.

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Cpa

Civic Participation - Metadata

Indicator	Civic Participation
Scope	Extended CPI
Rationale	Voter turnout provides only partial information about political participation, and there is a need to consider other forms of political engagement related a city government (OECD, 2011, p.190). Civic engagement can be defined as the individual and collective actions designed to identify and address issues of public concern [2]. People with high levels of civic engagement are positive about the communities in which they live and actively work to improve them [3]. Engagement in civic associations is important because they can counteract public policies, observe authorities and government institutions, and improve the quality of democracy. A prosperous city seeks to increase civic participations to foster democracy as well as align policy and government actions with needs and will of its residents.
Definition	The percentage of adults engaged in civic associations (including religious organizations).
Unit [ ]	%
Methodology	$Civic\ participation = 100\ \frac{People\ engaged\ in\ civic\ associations}{Adults\ in\ the\ city}$

Sources	Household surveys and censuses.
Benchmark	Min = 0% Max = 100%
Standardisation: 1.1	Not required
Limitations	This indicator may not be reliable in cities in non-democratic countries.
References	Bibliographic references: OECD (2011) "Civic engagement and governance", in How's life? Measuring well-being. OECD Publishing. [1] URL references [1]: http://dx.doi.org/10.1787/9789264121164-11-en, accessed August 6, 2014. [2]: http://www.apa.org/education/undergrad/civic-engagement.aspx, accessed August 6, 2014. [3]: http://www.gallup.com/poll/145589/civic-engagement-highest-developed-countries.aspx, accessed August 6, 2014.

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Tud

Trade Union Density-Metadata

Indicator	Trade Union Density
Scope	Extended CPI
Rationale	"Freedom of association and the effective recognition of the right to collective bargaining are fundamental principles and rights at work. They are the bedrock of sound industrial relations and effective social dialogue" (Hayter and Stoevska, 2011, p. 1). Engagement in trade unions is crucial to maintaining and improving work conditions. A prosperous city encourages employees to organize trade unions to improve working conditions, productivity and income.
Definition	According to the International Labour Organization (ILO) [2], trade union density is the total number of union members who are employed as a percentage of the total number of persons employed. A trade union is defined as a workers' organization constituted to defend the interests of workers. Trade union membership is defined as the total number of workers that belong to a trade union. This figure must exclude, whenever possible, union members who are not employed (unemployed, retired, etc.) [2].
Unit [ ]	%

Methodology	$$\textit{Trade union density} = 100 \frac{\textit{Number of union members who are employed}}{\textit{total number of persons in employment.}}$$
Sources	Administrative records, labour market surveys, household surveys and censuses.
Benchmark	Min = 0% Max = 100%
Standardisation: > 1.1	Not required
Limitations	The number of trade union members decreased over time in many countries. Trade union density figures may not be precise because the unions themselves do not publish detailed figures or because the published figures include union members who are not employed (Fulton, 2013). According to Hayter and Stoevska (2011), trade union density rates might be comparatively low in some countries; however, collective bargaining plays a significant role in regulating the terms and conditions of employment. Additionally, the coverage of workers by collective agreements might be high; in countries such as those of the former Soviet Union and in regimes where a single union system prevails, trade union density rates may be comparatively high but reflects neither the strength of the union nor freedom of association.

References

Bibliographic references:

Hayter, S. and Stoevska, V. (2011) Social Dialogue Indicators, International Statistical Inquiry 2008-09. Technical Brief. International Labour Office, Geneva. [1]

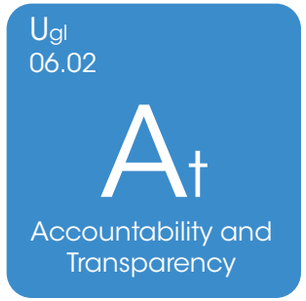
Fulton, L. (2013) Worker representation in Europe. Labour Research Department and ETUI. [3].

URL references

[1]: http://laborsta.ilo.org/applv8/data/TUM/TUD%20and%20CBC%20Technical%20Brief.pdf, accessed 18 July, 2014.

[2]: http://www.ilo.org/ilostat/faces/help_home/conceptsdefinitions?_adf.ctrl-state=puiqtjn18_198&clean=true&_afrLoop=1299977073686, accessed 18 August, 2014.

[3]: http://www.worker-participation.eu/National-Industrial-Relations/Across-Europe/Trade-Unions2, accessed 18 August, 2014.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Accountability and
Transparency

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Co

Corruption (reversed)
- Metadata

Indicator	Corruption (reversed)
Scope	Basic CPI
Rationale	Corruption among local authorities poses a fundamental threat to city life by affecting everything related to the city government, including access to security and justice; quality of public transport and infrastructure, such as schools, hospitals, other public goods and public facilities; and government services [1]. Corruption takes a significant toll on the city budget by wasting money and creating sizeable obstacles to city development and economic growth. A prosperous city seeks to minimise corruption to have the ability to spend the whole city budget correctly to improve the quality of life of its people.
Definition	The Corruption Perceptions Index ranks countries and territories by the perceived corruption of their public sector on a scale that ranges from 0 to 100, where 0 indicates a country is perceived as highly corrupt and 100 indicates a country perceived as very clean. A country's rank indicates its position relative to the other countries and territories included in the index (Transparency International, Corruption Perceptions Index, [2]).
Unit [ ]	Dimensionless (value between 0 and 100).

Co

Methodology	Use the Corruption Perception Index, published by Transparency International, to assign each city the value of its corresponding country.
Sources	Transparency International [2]
Benchmark	Min = 0 (highly corrupt) Max = 100 (very clean)
Standardisation: 1.1	Not required
Limitations	It is not possible to differentiate between two cities in the same country. The Corruption Perception Index ranks 177 countries for 2013. Some countries are not included.
References	URL references [1]: http://www.fbi.gov/about-us/investigate/corruption/public_corruption, accessed August 6, 2014. [2]: http://www.transparency.org/research/cpi/overview, accessed August 6, 2014.

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Tal

Transparency and Accountability to the Local Population - Metadata

Indicator	Transparency and Accountability to the Local Population
Scope	Extended CPI

Rationale

Improving government accountability improves service delivery, particularly for the poor, and accountability mechanisms safeguard against misuse and abuse of local discretion (World Bank, 2003). Accountability is a relationship between local authorities and residents, which is based in answerability and enforcement. Answerability refers to the obligation of authorities to inform residents about their conduct and the people's power to interrogate these authorities and question the adequacy of the information and legitimacy of the conduct, while enforcement refers to the people's power to pass judgment on the conduct of the authorities (Yilmaz et al., 2008). Easy access to information about local government functioning is critical to improving government accountability by minimising opportunities for corruption within the local government and helping to examine the local realities and specific conditions that perpetuate corruption (UN-Habitat and Transparency International, 2004).

Many local authorities operate websites for their cities and use the Internet to conduct as many of their transactions with its citizens as are possible. Every literate person with Internet access can review information made public on the web. The provision of both general and specific information on local government websites strengthens the link and trust between the people and local authorities, which in turn builds a more informed citizenry

Rationale

and a more transparent community (UN-Habitat and Transparency International, 2004). Although many local authorities already publish considerable amounts of data, the challenge now is to be systematic to maximize everyone's ability to benefit [1]. Transparency and accountability to local people using the Internet requires a commitment by the local government or the organization maintains the web page provide an updated site, and it requires human and financial resources as well as electronic capability on the part of the local government (UN-Habitat and Transparency International, 2004). A prosperous city seeks to increase transparency and accountability to avoid corruption and increase trust in the local government.

Definition

To evaluate the degree of access to information about local authorities through the Internet, the local government website must be assessed according to the existence of a number of required elements listed below (see Methodology).

Unit [ ]

%

Methodology

The following elements must be reviewed to calculate this indicator. The value of the indicator is the sum of the positive answers.

$$\textit{Transparency and accountability to local people} = 100\ \frac{\textit{number of elements present in the local web page}}{10}$$

Does the E-government possess the following element? Yes=1; No=0

1- Budgets and spending
2- Senior salaries
3- Organizational chart
4- Copies of contracts and tenders
5- Access to statistics
6- Posting public notices on meetings, resolution, etc.

Methodology	7- Local reporting of complaints, concerns, and emergencies. 8- Results of local elections 9- Tax information 10- Open tendering procedures
Sources	Local authority websites.
Benchmark	Min = 0% (low transparency) Max = 100% (high transparency)
Standardisation: 1.1	Not required
Limitations	According to UN-Habitat and Transparency International (2004), widespread computer literacy and access to the Internet is required for local residents to make published information valuable.
References	Bibliographic references: UN-Habitat (United Nations Human Settlements Programme) and Transparency International (2004). Urban Governance Toolkit Series. HS/702/04E. Nairobi. (ISBN: 92-1-131694-4). [2] World Bank (2003). World Development Report 2004: Making Services Work for Poor People. World Bank. © World Bank. https://openknowledge.worldbank.org/handle/10986/5986 License: CC BY 3.0 IGO.[3]

References	Yilmaz, S.; Beris, Y.; and Serrano-Berthet, R. (2008). Local Government discretion and accountability: A diagnostic framework for local governance. Social Development Papers, Local Governance & Accountability Series, Paper No. 113. World Bank, Social Development Department. URL references [1]: http://localtransparency.readandcomment.com, accessed August 6, 2014. [2]: http://ww2.unhabitat.org/cdrom/transparency/html/2b_5.html, accessed August 6, 2014. [3]: https://openknowledge.worldbank.org/handle/10986/5986, accessed August 6, 2014.


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Ic
Institutional
Capacity

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Lee

Local Expenditure Efficiency- Metadata

Indicator	Local Expenditure Efficiency
Scope	Basic CPI
Rationale	Local expenditure provides information about the amount of money the local government spends to provide public goods and support administrative functions. Although this information is valuable, it does not consider whether this money reflects the capacity or efficiency of the local government. The proportion of real expenditure with respect to estimated budget can evidence the capacity of local governments to anticipate their future expenditure and improve the use of their resources (McLure and Martinez-Vazquez, 2004) The objective is not to reach a higher level of local expenditure. Instead, the city searches for an appropriate level that is aligned with the fiscal capacity of the city. A prosperous city seeks to approximate the balanced budget constraint. To approximate this fiscal rule, local governments must predict their budgets according to their needs and revenue, which implies that the real local expenditure is similar to estimated expenditures (Sutherland et al., 2006; Garcia, 2012; Marcel, 2013).
Definition	Local real expenditure divided by local estimated expenditure.
Unit [ ]	%

Methodology	The information required can be extracted from local fiscal accounts. To calculate this indicator the city's local expenditure and estimated expenditure for the previous year are required. $$Local\ Expenditure\ = 100\ \frac{Real\ local\ expenditure}{Estimated\ expenditure}$$
Sources	Local fiscal accounts; Government Finance Statistics (IMF).
Benchmark	X*= 100%, which means that the local government has the capacity to predict its budget correctly. Its fiscal system considers all possible shocks and local expenditure is efficient.
Standardisation: 5	$$Local\ Expenditure^{(s)} = 100\left(1-\left\lvert\frac{Local\ Expenditure - X^*}{X^*}\right\rvert\right)$$ $$Local\ Expenditure^{(s)} = 100\left(1-\left\lvert\frac{Local\ Expenditure - 100}{100}\right\rvert\right)$$ Decision: $$Local\ Expenditure^{(s)} = \begin{cases} 0,\ if\ Local\ Expenditure = 0\ or\ Local\ Expenditure = 2 * 100 \\ Local\ Expenditure^{(S)},\ If\ 0 < Local\ Expenditure < 2 * 100 \\ 100,\ If\ Local\ Expenditure = 100 \end{cases}$$
Limitations	It might be difficult to obtain information about predicted local government expenditure. Nevertheless, some cities must publish this information by law.

References

Bibliographic references:

Sutherland, D.; Price, R. & Joumard, I. (2006). Fiscal rules for subnational governments: Design and impact. OECD Network on Fiscal Relations Across Levels of Government.

García, G. (2012). Reglas fiscales para la estabilidad y sostenibilidad. En: Las Instituciones Fiscales del Mañana. Banco Interamericano de Desarrollo (editor).

Marcel, M. (2013). Structural fiscal balances: methodological, conceptual and practical alternatives. Inter-American Development Bank: Fiscal and Municipal Management Division.

McLure, C.E., and Martinez-Vazquez, J. (2004) The Assignment of Revenues and Expenditures in Intergovernmental Fiscal Relations. The World Bank. [1]

URL references

[1]: http://www1.worldbank.org/publicsector/decentralization/March-2004Course/AssignmentRevenues.pdf , accessed August 6, 2014.

Ugl. Ic
06.03.02

Orc

Own Revenue Collection - Metadata

Indicator	Own Revenue Collection
Scope	Basic CPI
Rationale	Decentralization increases the responsibilities of subnational governments in city development. As part of this process, subnational governments, such as cities, must mobilise resources to finance expenditures in their regions (Canavire-Bacarreza et al., 2012). These resources comprise, in general, own revenue collection, shared revenue and government transfers. Revenue sources must be balanced and controlled, but a large proportion of government transfers generates dependence on these resources and causes most shortages of city's own source revenue. (Bird & Smart, 2002; Bird, 2011). A prosperous city seeks to generate its own revenue and reduce dependence on government transfers. Greater fiscal autonomy guarantees more expenditure efficiency and can be used as local fiscal performance signalling.
Definition	Own source revenue as a percentage of total city revenue.
Unit [ ]	%

Methodology	The information required can be extracted from local fiscal accounts. It is important to obtain information about the sources of the local revenue. With this information the following proportion must be calculated: $Own\ Revenue\ Collection = 100\ \frac{Own\ source\ revenue}{Total\ local\ revenue}$
Sources	Local Fiscal Accounts.
Benchmark	Min: 17% Max: 80% These data are obtained from Fiscal Decentralization Indicators of the IMF's Government Finance Statistics (GFS) and The World Bank [2].
Standardisation: 2.1	$Own\ Revenue\ Collection^{(s)} = 100\left[1 - \frac{Own\ Revenue\ Collection - Min}{Max - Min}\right]$ $Own\ Revenue\ Collection^{(s)} = 100\left[1 - \frac{Own\ Revenue\ Collection - 17}{80\text{-}17}\right]$ Decision: $Own\ Revenue\ Collection^{(s)} = \begin{cases} 100,\ If\ Own\ Revenue\ Collection \geq 80 \\ Own\ Revenue\ Collection^{(S)},\ If\ 17 < Own\ Revenue\ Collection < 80 \\ 0,\ If\ Own\ Revenue\ Collection \leq 17 \end{cases}$

Limitations

In some countries, the definition of “own revenue” might be difficult to specify. Nevertheless, this indicator allow deep analysis of the meaning of own revenue. It produces information about the capacity of local government to manage and collect its resources (the main own revenue sources at the city level are property and vehicle taxes as well as charges and fees – Tax Policy Center).

References

Bibliographic references:

Bird, R. & Smart, M. (2002). Intergovernmental fiscal transfers: Lessons from international experience. World Development, 30(6), 899–912

Bird, R. (2011). Subnational taxation in developing countries: A review of the literature. Journal of International Commerce, Economics and Policy, 2(1), 139-161.

Canavire-Bacarreza, G.; Martínez-Vázquez, J. & Sepúlveda, C. (2012). Sub-national revenue mobilization in Peru. IDB Bank Working Papers Series, 299.

Tax Policy Center. The tax policy briefing book. [1]

URL references

[1]: http://www.taxpolicycenter.org/briefing-book/state-local/revenues/local_revenue.cfm, accessed August 19, 2014.

[2]: http://www1.worldbank.org/publicsector/decentralization/fiscalindicators.htm, accessed August 20, 2014

Ugl. Ic
06.03.03

Sd

Subnational Debt (reversed) - Metadata

Indicator	Subnational Debt (reversed)
Scope	Extended CPI
Rationale	Some cities (local governments) can alternatively borrow money from the private sector or international funds. This debt is usually used to finance expensive projects that would be nearly impossible to finance with local or central government revenues alone. Nevertheless, cities must guarantee they will repay their loans (Vulovic, 2011). It is accepted to apply limits to the level of debt (usually under a regulatory scheme). The objective of maintaining city debts within the established limit is to guarantee local and national budget sustainability because in many cases when the local government is unable to pay for its own debt, the central government will have to assume it (Sutherland et al., 2006; Garcia, 2012; Marcel, 2013). A prosperous city seeks the proper use of loans for projects that produce important impacts for the city.
Definition	The percentage of subnational debt from local government total revenue.
Unit [ ]	%
Methodology	The information required can be extracted from local fiscal accounts. The formula to estimate debt sustainability is the following:

Methodology	$$Subnational\ Debt = 100 \frac{Amount\ of\ debt}{Total\ local\ revenue}$$
Sources	Local Fiscal Accounts.
Benchmark	X*= 60% Drawn from the IMF (2011) based on information about debt ceilings in some European Union and World Economic Outlook Database countries, which suggest a threshold of debt equal to 60% of the country GDP. "When public debt exceeds or is projected to exceed 60 percent of GDP for a substantial part of the projection horizon […] a detailed discussion of potential risks to sustainability arising from high debt levels would normally be expected"
Standardisation: 2.1	$$Subnational\ Debt^{(s)} = 100 \left(1 - \left\lvert \frac{Subnational\ Debt - X^*}{X^*} \right\rvert\right)$$ $$Subnational\ Debt^{(s)} = 100 \left(1 - \left\lvert \frac{Subnational\ Debt - 60}{60} \right\rvert\right)$$ Decision: $$Subnational\ Debt^{(s)} = \begin{cases} 0,\ if\ Subnational\ Debt \geq 2 * 60 \\ Subnational\ Debt^{(S)},\ If\ 60 < Subnational\ Debt < 2 * 60 \\ 100,\ If\ Subnational\ Debt \leq 60 \end{cases}$$

Limitations

Some countries may not allow borrowing at subnational or local level; therefore, caution should be taken in cross-country comparisons.

References

Bibliographic references:

Sutherland, D.; Price, R. & Joumard, I. (2006). Fiscal rules for subnational governments: Design and impact. OECD Network on Fiscal Relations Across Levels of Government.

García, G. (2012). Reglas fiscales para la estabilidad y sostenibilidad. En: Las Instituciones Fiscales del Mañana. Banco Interamericano de Desarrollo (editor).

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International Monetary Fund - IMF (2011). Modernizing the framework for fiscal policy and public debt sustainability analysis.

Vulovic, V. (2011). Sub-national borrowing, is it really a danger?. Economics Dissertations, Georgia State University, 77.


Ugl
06.04
Rq
Regulatory Quality

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06.04.01

Dsb

Days to Start a Business (reversed) - Metadata

Indicator	Days to Start a Business (reversed)
Scope	Basic CPI
Rationale	A government should provide competitive environment in the market it regulates. Competition improves quality of goods and services, lowers costs for both producers and consumers, and creates facilities for those who want enter to any market. Excessive business regulation affects economics performance and development because it increases the costs of engaging in the formal economy (Doing Business, 2014). A prosperous city should develop regulatory environment that permits the entry of any firm in the market.
Definition	One way to identify the ease of starting a business is the number of days it takes a firm to register. Registration must include obtaining all necessary licenses and permits and completing any required notifications, verifications or inscriptions for the company and employees with the relevant authorities. [1]
Unit [ ]	Days
Methodology	Days to start a business recorded in calendar days. The measure captures the median duration that incorporation lawyers indicate is necessary in practice to complete a procedure.

Sources	Doing Business indicator; entrepreneur surveys.
Benchmark	Min= 2 days Max= 208 days Obtained from the Doing Business ranking. [2]
Standardisation: 2.2	$Days\ to\ start\ a\ business^{(s)} = 100\left[1 - \frac{Own\ Revenue\ Collection - ln\ (Min)}{ln\ (Max) - ln\ (Min)}\right]$ $Days\ to\ start\ a\ business^{(s)} = 100\left[1 - \frac{ln(Days\ to\ start\ a\ business) - 0.69}{5.34 - 0.69}\right]$ Decision: $Days\ to\ start\ a\ business^{(s)} = \begin{cases} 0, If\ ln\ (Days\ to\ start\ a\ business) \geq 5.34 \\ Days\ to\ start\ a\ business^{(S)}, If\ 0.69 < ln\ (Days\ to\ start\ a\ business) < 5.34 \\ 100, If\ ln\ (Days\ to\ start\ a\ business) \leq 0.69 \end{cases}$
Limitations	These data are obtained through enterprise surveys conducted mostly by the World Bank, which implies that data are not available for all cities.

References

Bibliographic references:

Doing Business (2014). Understanding Regulations for Small and Medium-Size Enterprises. 11th Edition

URL references

[1]: http://www.doingbusiness.org/Methodology/starting-a-business#time, accessed August 6, 2014.

[2]: http://www.doingbusiness.org/data/exploretopics/starting-a-business, accessed August 6, 2014.

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06.04.02

Ci

City inflation-
Metadata

Indicator	City Inflation
Scope	Extended CPI
Rationale	Price stability implies avoiding both prolonged inflation and deflation. Under price stability, people can recognize changes in relative prices that allow them to make well-informed consumption and investment decisions. Reduced real interest rates and increased incentives for investment result. Additionally, distortions caused by inflation or deflation, exacerbated distortionary impacts of taxes and social security and arbitrary redistribution of wealth as a result of unexpected inflation or deflation is prevented (European Central Bank, 2013). A prosperous city seeks to maintain price stability through continuous price surveillance policies and a regulatory environment that promotes economic competition.
Definition	The inflation rate is defined as the yearly change in the Consumer Price Index (CPI).
Unit [ ]	%

Methodology	Inflation in year t is calculated as follows: $Inflatio_t = 100 \frac{CPI_t - CP_{t-1}}{CP_{t-1}}$
Sources	IPC: National Institutes of Statistics.
Benchmark	X*=2% Most important central banks around the world, such as the European Central Bank [1] and Federal Reserve Bank [2], consider inflation rates of below but close to 2% low enough to reap the economic benefits of price stability.
Standardisation: 5	$Inflation^{(s)} = 100 \left(1 - \left\lvert \frac{Inflation - X^*}{X^*} \right\rvert\right)$ $Inflation^{(s)} = 100 \left(1 - \left\lvert \frac{Inflation - 2}{2} \right\rvert\right)$ Decision: $Inflation^{(s)} = \begin{cases} 0, \text{ if } Inflation \geq 5.34 = 0 \text{ or } Inflation = 2 * 2 \\ Inflation^{(S)}, \text{ If } 0 < Inflation < 2 * 2 \\ 100, \text{ If } Inflation = 2 \end{cases}$

Limitations

Inflation is strongly related to monetary policy; however, this policy is not under the control of city economic authorities, which implies that the capacity of a city to control inflation is limited.

References

Bibliographic references:

European Central Bank (2013). Definition of Price Stability. [3]

URL references

[1]: https://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html, accessed August 6, 2014.

[2]: http://www.federalreserve.gov/faqs/economy_14400.htm, accessed August 6, 2014.

[3]: http://www.ecb.europa.eu/mopo/strategy/pricestab/html/index.en.html, accessed August 6, 2014.