Ye Qing
Ph.D, China Modernization Research Center, Chinese Academy of Sciences, University of Chinese Academy of Sciences, Beijing, China
Fan Rong
University of Chinese Academy of Sciences, Beijing, China

QUALITY OF LIFE ASSESSMENT IN 131 COUNTRIES AROUND THE WORLD (2000−2016)

A better life is a common dream and unremitting pursuit of humankind, and the Quality of Life is a crucial indicator to measure a better life. There is much research on the QoL but no uniform definition. QoL is a highly comprehensive concept. Its multidimensional evaluation covers all aspects of residents' lives, including composite index on subjective and objective fields such as living standards, income, work, housing, health, education, government governance, environment, and satisfaction. Many indicators reflect the QoL and influencing factors, and the differences between countries and times are substantial. The OECD's good life index selects 24 indicators to conduct an open evaluation of the QoL in 38 countries from the two aspects of material living conditions and QoL (Better Life Index — Edition 2017). Diener established the basic Quality of Life index (The basic QoL index) and the advanced Quality of Life index (The advanced QoL index), each of which selected seven indicators to evaluate the QoL in 77 developing and developed countries (A Value Based Index for Measuring National QoL, 1995). Somarriba evaluated the QoL in 28 European countries in 2008 from the seven dimensions of work, life, education, leisure life, income, health, safety, and trust. Three different evaluation methods were used to obtain three evaluation results (Somarriba, 2009). Maridal selects 39 indicators from the five dimensions of community and relationship, freedom and opportunity, health and environment, living standards, peace, and security, and evaluates the quality of social life in 143 countries from 2000 to 2015 (Maridal, 2017). Zhao Yanyun et al. selected 37 indicators in 11 aspects to build a QoL evaluation index system. They conducted a comprehensive evaluation of the QoL in 49 sample countries (Zhao, Wang, 2003). Examples of other indices for QoL evaluation are given below.

Table 1

Common indices for QoL evaluation (examples)

Evaluation index	Key contributors	Dimension or indicator
Physical Quality of Life index (PQLI)	D·Morris,1979	Three indicators of literacy rate, infant mortality rate, life expectancy
Human Development index (HDI)	Sen, 1993	Three dimensions of health, education, and economic development
Well-being index (WBI)	McGillivray 2005	Same as HDI except for the per capita income indicator
Index of social progress (ISP)	Estes 1998	41 indicators, such as health, education, and social services
Social Development index (SDI)	Ray 2008	Ten indicators, such as life expectancy, number of phone calls, power consumption
Better Life index (BLI)	OECD 2011	11 indicators, such as work, education, income, social satisfaction

I. QoL evaluation methods

From a modern perspective, QoL mainly involves four aspects: individual QoL, public QoL, living environment, and life satisfaction, and can be further divided into two areas: index of actual living and life satisfaction, with six dimensions and 18 sub-categories. On this basis, 38 typical indicators were selected to measure the relative goodness of the country's QoL (Figure 1, Table 2).

		Objective satisfaction	Subjective satisfaction
		Life Satisfaction index (S_L)	
Personal life	**Quality of actual life (QALI)**	**QLI**	
Public life			
Living environment			

$$QALI = (Individual\ QLI \cdot Public\ QLI \cdot Quality\ of\ living\ environment\ index)^{1/3}$$

$$QLI = (QALI \cdot S_L)^{1/2}$$

Figure 1. Two-dimensional model for QoL evaluation (schematic diagram)

1. Mathematical Model for QoL Evaluation

The mathematical model for QoL evaluation is as follows:

$$\begin{cases}
QLI = (QALI \cdot S_L)^{1/2} \\
QALI = (I_P \cdot I_C \cdot I_E)^{1/3} \\
I_P = (\sum R_i) / N_P \ (i = 1,2,......N_P) \\
I_C = (\sum S_j) / N_C \ (j = 1,2,......N_C) \\
I_E = (\sum T_k) / N_E \ (k = 1,2,......N_E) \\
S_L = (\sum Q_m) / N_S \ (m = 1, 2,......N_S) \\
R_i = 100 \cdot i_{Actual\ value} / i_{Standard\ value} \ (positive\ indicator\ R_i \leqslant 100) \\
R_i = 100 \cdot i_{Standard\ value} / i_{Actual\ value} \ (negative\ indicator\ R_i \leqslant 100) \\
S_j = 100 \cdot j_{Actual\ value} / j_{Standard\ value} \ (positive\ indicator\ S_j \leqslant 100) \\
S_j = 100 \cdot j_{Standard\ value} / j_{Actual\ value} \ (negative\ indicator\ S_j \leqslant 100) \\
T_k = 100 \cdot k_{Actual\ value} / k_{Standard\ value} \ (positive\ indicator\ T_k \leqslant 100) \\
T_k = 100 \cdot k_{Standard\ value} / k_{Actual\ value} \ (negative\ indicator\ T_k \leqslant 100) \\
Q_m = 100 \cdot m_{Actual\ value} / m_{Standard\ value} \ (positive\ indicator\ Q_m \leqslant 100) \\
Q_m = 100 \cdot m_{Standard\ value} / m_{Actual\ value} \ (negative\ indicator\ Q_m \leqslant 100)
\end{cases}$$

QLI is the Quality of Life index, QALI is the Quality of Actual Life Index, S_L is the Life Satisfaction index, I_P is the personal QLI, I_C is the public QLI, I_E is the quality of living environment index, R_i is the index of the ith indicator of individual QoL, i is the number of individual QoL evaluation indicators, N_P is the total number of individual QoL evaluation indicators, S_j is the index of the jth indicator of public QoL, j is the number of public QoL evaluation indicators, N_C is the total number of public QoL evaluation indicators, T_k is the index of the kth indicator of quality of living environment, k is the

number of quality of living environment evaluation indicators, N_E is the total number of quality of living environment evaluation indicators, Q_m is the index of the m-th indicator of life satisfaction, m is the number of quality of living environment evaluation indicators, N_S is the total number of life satisfaction evaluation indicators m is the index of the mth index of Life Satisfaction, m is the number of life environment quality evaluation index, N_S is the total number of life satisfaction evaluation index. The value of each index is taken as less than or equal to 100, the actual value of each indicator is its actual value, and the standard value is the weighted average of that indicator in high-income countries in 2016.

2. Index system for the QoL evaluation

According to the above evaluation model, select representative index data to form the evaluation system (Table 2).

Table 2

Index System of QoL Evaluation

Fields	Dimensions	Sub-dimensions	Evaluation indicators	Indicator interpretation and measurement	Nature of indicator	Data source
1	2	3	4	5	6	7
Index of actual living	Individual life	Nutrition	Protein supply per capita	Gram/day	positive indicator	FAO
			Fruit supply per capita	Gram/day	positive indicator	FAO
		Health	Life expectancy on average	Years	positive indicator	WDI
			Infant mortality	Number/1000 people	negative indicators	WDI
			Tuberculosis incidence	Number/100000 people	negative indicators	WDI
		Housing	Rooms per person	Number	positive indicator	OECD
			Car penetration rate	Number/1000 people	positive indicator	OICA
		Family	Household consumption per capita	US Dollar, 2010	positive indicator	WDI
			Energy consumption per capita	Kilogram oil valent weight	positive indicator	WDI
			Engel coefficient	Percentage	negative indicators	EURO
	Public life	Economic life	National income per capita	US Dollar, 2011	positive indicator	WDI
			Leisure and wellness time	Hour	positive indicator	OECD
			Minimum monthly wage	US Dollar/Month	positive indicator	ILO
		Social life	College enrollment	Percentage	positive indicator	WDI
			Average years in education	Years	positive indicator	HDI

1	2	3	4	5	6	7
			The proportion of people in absolute poverty	Percentage	negative indicators	WDI
			Pension insurance coverage	Percentage	positive indicator	EU
		Cultural life	International travel per capita	Times	positive indicator	WDI
			Internet penetration rate	Percentage	positive indicator	WDI
		Political life	Civil rights	Ratings	**	FH
	Living environment	Public facilities	Safe drinking water penetration rate	Percentage	positive indicator	WDI
			Screens per capita	Number/100000 people	positive indicator	UNESCO
		Public services	Pupil-Teacher ratio	Percentage	negative indicators	WDI
			Physician ratio	Number/1000 people	positive indicator	WDI
			Nurse ratio	Number/1000 people	positive indicator	WDI
			Voyages per capita	Times/Year	positive indicator	WDI
		Public safety	Prison population ratio	Number/100000 inhabitants	negative indicators	EU & WPB
			Traffic accident fatality rate	Number/100000 people	negative indicators	WDI
		Ecosystem	PM2.5 annual average concentration	Micrograms/ Cubic meters	negative indicators	WDI
			Municipal wastewater treatment rate	Percentage	positive indicator	OECD
Life Satisfaction index	Individual Life Satisfaction	Objective satisfaction	The proportion of the undernourished population	Percentage	negative indicators	WDI
			Suicide rate*	Number/100000 people	negative indicators	WDI
		Subjective satisfaction	Life Satisfaction	Index	positive indicator	WVS
	Public Life Satisfaction	Objective satisfaction	Unemployment rate*	Percentage	negative indicators	WDI
			Income inequality	Ratio	negative indicators	WDI
		Subjective satisfaction	Economic Life Satisfaction	Index	positive indicator	WVS
	Living environment satisfaction	Objective satisfaction	Unease of doing business rank	Index	negative indicators	WDI
		Subjective satisfaction	Water quality satisfaction	Percentage	positive indicator	OECD

Note: *Typical indicators (such as suicide rate, unemployment rate) reflecting the QoL. Still, these two indicators' statistical data quality and international comparability could be better, so they will not participate in the evaluation for the time being. Expect to add more when data quality improves. The smaller the value of **, the greater the civil rights, and the same later.

3. Baseline values for QoL evaluation

The average value of the indicator for high-income countries in the current year is used as the benchmark value for QoL evaluation (Table 3).

The benchmark value is generally selected as the average value of WDI high-income countries; when this value is unavailable, the weighted average of the top 20 countries ranked in the second modernization index in 2015 is calculated as the benchmark value.

Table 3

Standard values of QoL evaluation indicators

	Indicators and units	2000	2010	2016	Obtaining method
1	2	3	4	5	6
Index of actual living	Protein supply per capita/(Gram/day)	105	104	104	Calculated weighted average***
	Fruit supply per capita/(Gram/day)	276	259	270	Calculated weighted average
	Life expectancy on average/Years	77	80	80	WDI Data
	Infant mortality rate (/1000 people)	7.2	5.5	4.7	WDI Data
	Tuberculosis incidence (/100000 people)	18	15	12	WDI Data
	Rooms per person/Number	1.8	2.0	2.1	Calculated weighted average
	Car penetration rate (/1000 people)	383	440	450	Calculated weighted average
	Household consumption per capita/ US Dollar, 2010	20 410	22 806	24 292	WDI Data
	Energy consumption per capita/Kilogram oil valent weight	4935	4839	4604	WDI Data
	Engel coefficient/(Percentage)*	13.1	12.4	12.5	Calculated weighted average
	National income per capita / US Dollar, 2011	35 289	39 451	42 376	WDI Data
	Leisure and wellness time/Hour	–	14.9	14.9	Calculated weighted average
	Minimum monthly wage/US Dollar	942	1445	1443	Calculated weighted average
	College Enrollment/(Percentage)	56	74	75	WDI Data
	Average years in education/Years	11.4	12.4	12.8	Calculated weighted average
	The proportion of the population in absolute poverty/(Percentage)	0.7	0.6	0.7	WDI Data
	Pension insurance coverage rate/ (Percentage)	87	92	92	Calculated weighted average
	International travel per capita/(Times/ Year)	0.52	0.57	0.65	WDI Data
	Internet penetration rate / (Percentage)	31	72	82	WDI Data
	Civil rights (rank)	1.5	1.2	1.2	Rating Data
	Safe drinking water penetration rate / (Percentage)	98	99	99	WDI Data

The end of the table 3

1	2	3	4	5	6
	Screens per capita / (Number/100000 people)	9.1	9.1	9.2	Calculated weighted average
	Pupil-Teacher ratio/(Percentage)	16	14	14	WDI Data
	Physician ratio/(/1000 people)	2.6	3.0	3.0	WDI Data
	Nurse ratio/ (/1000 people)	8.2	9.9	10.5	Calculated weighted average
	Voyages per capita/(Times/Year)	1.27	1.52	1.86	WDI Data
	Prison population ratio/(/100000 inhabitants)**	135	146	138	Calculated weighted average
	Traffic accident fatality rate/ (Number/100000 people)	14	9.0	8.2	WDI Data
	PM2.5 annual average concentration/ (Micrograms/Cubic meters)	16	16.8	20	WDI Data
	Municipal wastewater treatment rate/ (Percentage)	90	96	97	Calculated weighted average
Life Satisfaction	The proportion of undernourished population/(Percentage)	2.8	2.8	2.7	WDI Data
	Life Satisfaction (Index)	7.17	7.18	7.15	Calculated weighted average
	Income inequality (Ratio)	6.4	6.6	6.8	Calculated weighted average
	Economic Life Satisfaction (Index)	6.23	6.10	6.15	Calculated weighted average
	Unease of doing business rank	–	16	16.1	Calculated weighted average
	Water quality satisfaction/(Percentage)	–	88	86	Calculated weighted average

Note: *The standard value is taken as the arithmetic mean of high-income countries due to the data availability rate of only 60% in high-income countries and the lack of data for countries with large populations, such as the United States.

**The calculated weighted average for this indicator for 2016 was 303, with the US value being 655, much higher than 19 other countries. The weighted average of the 19 countries is 96, and the arithmetic mean of the 20 sample countries, including the United States, is selected as the standard value.

*** «Calculated weighted average» is calculated by weighting the population proportions.

Data quality varies from country to country. There may be some differences between the results obtained from panel data and the actual QoL situation, so the evaluation results are for reference only.

II. Evaluation results of QoL in 131 countries

1. 2016 World QoL evaluation results

According to the QLI grouping, 25 countries, such as Norway and Sweden, are classified as developed countries in terms of QoL, 27 countries, such as Lithuania and Poland, are classified as moderately developed countries in terms of QoL. 28 countries, such as Lebanon and China are classified as preliminarily developed countries in terms of QoL, and 51 countries such as Paraguay and Ghana are classified as under developed countries in terms of QoL (Table 4).

Table 4

World QLI, 2016

Group	Country	QLI	Country	QLI	Country	QLI	Country	QLI
25 developed countries	Norway	100	United Kingdom	97	Switzerland	89	Korea	86
	Sweden	99	Ireland	97	Estonia	88	Spain	85
	Finland	99	Germany	96	France	87	Belgium	83
	New Zealand	98	Austria	94	Singapore	87	Portugal	83
	Australia	98	Netherlands	93	Slovenia	86	Czech Republic	82
	Denmark	98	United States	90	Japan	86	Latvia	81
	Canada	97						
27 moderately developed countries	Lithuania	79	Malaysia	69	Romania	63	Armenia	55
	Poland	77	Croatia	68	Bulgaria	62	Ukraine	54
	Italy	76	Kazakhstan	68	Chile	62	Azerbaijan	54
	Hungary	74	Belarus	65	Kuwait	60	Thailand	53
	Greece	72	Turkey	64	Macedonia	60	Brazil	52
	Israel	72	Russia	64	Mexico	59	Georgia	51
	Slovakia	71	Uruguay	64	Argentina	59		
28 preliminarily developed countries	Lebanon	49	Tunisia	45	South Africa	40	Vietnam	36
	China	48	Jordan	44	Iran	40	Mongolia	35
	Moldova	47	Peru	44	Uzbekistan	40	Philippines	33
	Albania	46	Ecuador	43	Egypt	39	El Salvador	32
	Colombia	45	Morocco	43	Turkmenistan	38	Indonesia	31
	Kyrgyzstan	45	Saudi Arabia	43	Jamaica	37	Sri Lanka	31
	Costa Rica	45	Algeria	42	Panama	37	India	30
51 under developed countries	Paraguay	29,6	Rwanda	22	Côte d'Ivoire	19	Ethiopia	14
	Ghana	29	Myanmar	22	Lesotho	19	Burundi	14
	Dominica	28	Namibia	22	Bangladesh	19	Mozambique	14
	Tajikistan	28	Kenya	21	Senegal	18	Niger	14
	Venezuela	28	Honduras	21	Angola	18	Malawi	14
	Pakistan	26	Laos	21	Syria	17	Madagascar	13
	Nigeria	25	Mauritania	21	Togo	17	Zambia	13
	Guatemala	25	Mali	21	Benin	16	Uganda	13
	Nepal	25	Papua New Guinea	21	Burkina Faso	16	Sierra Leone	13
	Nicaragua	24	Zimbabwe	21	Tanzania	15	Chad	11
	Yemeni Republic	23	Haiti	20	Republic of Congo	15	Central Africa	9
	Bolivia	23	Guinea	20	Democratic Republic of Congo	15	Eritrea	9
	Botswana	23	Cameroon	20	Cambodia	15		

Note: Grouped according to the QLI: developed countries with QoL, QLI greater than 80; Moderately developed countries, QLI greater than 50 less than 80; preliminarily developed countries, QLI less than 50 more than 30; less developed countries, QLI less than 30.

The top 10 countries in the world in the 2016 QLI are Norway, Sweden, Finland, New Zealand, Australia, Denmark, Canada, the United Kingdom, Ireland, and Germany. The United States ranked 13th, France ranked 16th, and Japan ranked 19th. Data on the leading indicators for developed countries with QoL are as follows (Table 5).

Table 5

Frontiers of QoL in the World, 2016

	Indicators and units	Sweden	New Zealand	Canada	The UK	Germany	The US	France
	Protein supply per capita/ (Gram/day)	108	93	105	103	102	110	111
	Fruit supply per capita/ (Gram/day)	342	271	372	349	242	286	313
	Life expectancy on average/ Years	82	82	82	81	81	79	82
	Infant mortality rate/ (Number/1000 people)	2.4	4.5	4.6	3.7	3.2	5.7	3.5
	Tuberculosis incidence (Number/100000 people)	8.2	7.3	5.2	9.9	8.1	3.1	7.7
	Rooms per person/Number	1.8	2.4	2.5	1.9	1.8	2.4	1.8
	Car penetration rate (Number/1000 people)	476	670	616	515	552	381	480
	Household consumption per capita/ US Dollar, 2010	25 718	22 434	29 051	27 000	25 194	36 373	23 027
	Energy consumption per capita/Kilogram oil valent weight	5103	4445	7604	2764	3818	6798	3690
	Engel coefficient/ (Percentage)*	13	–	–	13	12	–	16
The actual QoL	National income per capita / US Dollar, 2011	47 378	33 679	42 664	38 680	45 203	54 104	38 702
	Leisure and wellness time/ Hour	15	15	14	15	16	14	16
	Minimum monthly wage/US Dollar	–	1954	1717	–	1593	1257	1623
	College enrollment/ (Percentage)	62	82	59	57	66	79	65
	Average years in education/ Years	12	13	13	13	13	13	12
	The proportion of the population in absolute poverty/(Percentage)	0.5	0.1	0.5	0.2	0.1	1.2	0.1
	Pension insurance coverage rate/(Percentage)	100	98	98	100	100	93	100
	International travel per capita/(Times/Year)	1.66	0.56	0.86	1.08	1.10	0.23	0.40
	Internet penetration rate / (Percentage)	90	88	90	95	90	76	86
	Civil rights (Rating)	1	1	1	1	1	1	2
	Safe drinking water penetration rate / (Percentage)	100	100	100	100	100	99	100

The end of the table 5

Indicators and units	Sweden	New Zealand	Canada	The UK	Germany	The US	France
Screens per capita / (Number/100 000 people)	9.2	10.3	9.6	7.0	6.3	14.0	10.1
Pupil-Teacher Ratio/ (Percentage)	12	14	17	17	12	14	18
Physician ratio/ (Number/1000 people)	4.2	3.1	2.5	2.8	4.2	2.6	3.2
Nurse ratio/(Number/1000 people)	11.9	11.1	9.8	8.4	13.8	9.9	10.6
Voyages per capita/(Times/ Year)	1.5	3.2	2.4	2.2	1.5	2.5	1.0
Prison population ratio/ (Number/100 000 inhabitants)**	57	203	114	146	78	655	100
Traffic accident fatality rate/ (Number/100 000 people)	2.9	6.1	5.8	2.9	4.2	10.8	5.1
PM2.5 annual average concentration/(Micrograms/ Cubic meters)	5.2	5.5	7.5	11.5	13.5	9.2	11.9
Municipal wastewater treatment rate/(Percentage)	100	94	97	100	100	–	100

Life Satisfaction	The proportion of undernourished population/(Percentage)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Life Satisfaction (Index)	7.55	7.65	–	–	7.36	7.37	–
	Income inequality (Ratio)	4.6	–	6.2	5.4	5.1	9.4	5.2
	Economic Life Satisfaction (Index)	6.94	6.88	–	–	6.62	6.15	–
	Unease of doing business rank	10	1	18	7	20	6	31
	Water quality satisfaction/ (Percentage)	95	92	90	87	94	84	84

In 2016, the national QoL, as reflected by the QLI, varied by 10. Specifically, the gap in personal QoL is 19 times; the gap in public QoL is the largest, 32 times; the gap in living environment quality is 15 times; the gap in Life Satisfaction is 11 times (Table 6).

Table 6

Country Gaps in World QoL in 2016

	QLI	$QALI$	I_P	I_c	I_E	S_L
Maximum value	100	100	100	100	100	100
Minimum value	9	6	5	3	6	8
Average value	47	43	42	42	45	53
Polar difference (maximum value — minimum value)	91	94	95	97	94	92
Standard deviation	28	29	30	31	28	28
Relative difference (maximum value ÷ minimum value)	11	16	20	33	16	12
Coefficient of variation (standard deviation ÷ mean)	0.60	0.68	0.70	0.73	0.62	0.53

In 2016 compared to 2000, 87 countries experienced an increase in the QoL; 34 countries experienced a decrease in the QoL; and ten countries experienced no significant change in the QoL.

In 2016 compared to 2000, 68 countries saw their QoL ranking increase, 56 countries saw their QoL ranking decrease, and seven countries saw no change in their ranking.

The third is the change in country grouping of QoL (Table 7).

Table 7

Transition probabilities of country status for world QoL (Markov chain analysis)

Group	Number of countries	Developed	Moderately developed	Preliminarily developed	Under developed
	2000	Probability of transfer from 2000 to 2016 (%)			
Developed	23	91	9	0	0
Moderately developed	22	18	77	5	0
Preliminarily developed	27	0	26	70	4
Under developed	59	0	2	14	85

Note: Country grouping by QLI: developed countries $\geqslant$ 80; moderately developed countries: $\geqslant$ 50, < 80; preliminarily developed $\geqslant$ 30, < 50; under developed countries < 30. The statistical results have specific systematic errors because of the data acquisition rate.

During the period from 2000 to 2016, the downgrade probability for countries with developed QoL: was 9% downgrade to moderately developed countries; the upgrade probability for countries with moderately developed QoL: was 18% upgrade to developed countries; the upgrade probability for countries with a preliminarily developed QoL: 26% upgrade to a moderately developed country; the upgrade probability for countries with under developed QoL: 14% upgrade to a preliminarily developed country.

If developed countries are relatively modern, other countries (moderately developed, preliminarily developed, and under developed) are relatively non-modern. In the past 17 years, the probability of a modernized country with a comparable QoL being downgraded to a non-modernized country is about 1−2%, and the probability of a relatively non-modernized country being upgraded to a modernized country is about 3%.

2. Modernization changes in the QoL in the world from 2000 to 2016

The international QLI gap decreased between 2000 and 2016 (Table 8).

Table 8

International gap in the world QLI, 2000−2016

Comparison item	2000	2010	2016
Maximum value	100	100	100
Minimum value	6	9	9
Average value	42	45	47
Polar difference	94	91	91
Standard deviation	29	28	28
Relative deviation	18	11	11
Coefficient of variation	0.68	0.62	0.60

The QoL in different countries has been quite different in the past ten years. This difference is reflected in the changes in the QLI every year and in the national QoL level changes.

Some countries have downgraded from the QoL in developed countries to moderately developed countries, some countries have upgraded from the QoL in under developed countries to preliminarily developed countries, some countries have upgraded from the QoL in under developed countries to a moderately developed country, some countries have upgraded from the QoL moderately developed countries to developed countries.

From 2000 to 2016, 25 countries changed their QoL status. 20 of them were upgraded, and five were downgraded (Table 9).

Table 9

Countries with Changes in the World Status of QoL from 2000 to 2016

Countries upgraded			Countries degraded		
Country	Grouping in the year 2000	Grouping in the year 2016	Country	Grouping in the year 2000	Grouping in the year 2016
Estonia	moderately developed	developed	Italy	developed	moderately developed
Latvia	moderately developed	developed	Israel	developed	moderately developed
Korea	moderately developed	developed			
Czech Republic	moderately developed	developed			
Macedonia	preliminarily developed	moderately developed	Saudi Arabia	moderately developed	preliminarily developed
Kazakhstan	preliminarily developed	moderately developed			
Belarus	preliminarily developed	moderately developed			
Armenia	preliminarily developed	moderately developed			
Georgia	preliminarily developed	moderately developed			
Thailand	preliminarily developed	moderately developed			
Azerbaijan	preliminarily developed	moderately developed			
Brazil	under developed	moderately developed	Venezuela	preliminarily developed	under developed
India	under developed	preliminarily developed	Tajikistan	preliminarily developed	under developed
Indonesia	under developed	preliminarily developed			
El Salvador	under developed	preliminarily developed			
Sri Lanka	under developed	preliminarily developed			
Colombia	under developed	preliminarily developed			
Ecuador	under developed	preliminarily developed			
Panama	under developed	preliminarily developed			
Mongolia	under developed	preliminarily developed			

In the past 17 years, the structure of the world's QoL has undergone specific changes (Table 10).

Table 10

Structure of QoL in the world from 2000 to 2016

Item	2000	2010	2016	2000	2010	2016
Group	Number of countries			% of total		
Developed groups	23	24	25	17.6	18.3	19.1
Moderately developed groups	22	24	27	16.8	18.3	20.6
Preliminarily developed	27	31	28	20.6	23.7	21.4
Under developed groups	59	52	51	45.0	39.7	38.9
Total	131	131	131	100	100	100

Note: Due to the unavailability of data, three indicators were reduced for the 2000 evaluation, and the QLI for that year may need to be corrected.

Of 23 developed countries with QoL in 2000, 21 remained developed countries, but two countries downgraded (Italy and Israel) by 2016; In 2000, 59 countries with poor QoL were under developed, and by 2016, 50 countries were still under developed. Brazil was upgraded to moderately developed, and eight countries, including India, were upgraded to preliminarily developed (Table 9).

A specific correlation exists between the national QLI and the country's leading economic indicators (GNI per capita, GDP per capita). The correlation between the QALI and the leading economic indicators is stronger than the correlation between the QLI and the leading economic indicators. The correlation between the national QoL and the state modernization index (SMI) is also highly significant. The correlation between the QALI and the SMI is stronger than the correlation between the QLI and the SMI (Table 11).

Table 11

Correlation coefficients of world QoL with the leading economic indicators and world modernization from 2000 to 2016

Indicator/Index	2016			2010			2000		
	QLI		*QALI*	*QLI*		*QALI*	*QLI*		*QALI*
GNI per capita	0.86	<	0.88	0.84	<	0.87	0.86	<	0.88
GDP per capita	0.86	<	0.89	0.85	<	0.89	0.87	<	0.89
SMI	0.91	<	0.94	0.95	<	0.97	0.95	<	0.96

Note: Their correlations are all highly significant by *t*-test.

3. Evaluation of the modernization of the world's QoL from 2000 to 2010

(1) World QoL evaluation resulted in 2000

The top 10 countries in the world QLI in 2000 were: Norway, Sweden, Canada, Denmark, the Netherlands, Finland, Switzerland, Austria, Australia, and Germany; 23 countries such as Norway and Sweden, whose QLI exceeds 80, are developed countries with QoL, and their QoL represents the advanced level in the world in that year; 22 countries, including Greece and Korea, have a QLI above 50 and are considered moderately developed countries in terms of QoL; 27 countries, including Kazakhstan and China, have a QLI above 30 and are among the preliminarily developed countries in terms of QoL; 59

countries, such as Myanmar and Kenya, have a QLI less than 30 and are under developed countries in terms of QoL; The ten countries with the lowest QLI are: Ethiopia, Rwanda, Angola, Papua New Guinea, Central Africa, Togo, Cambodia, Eritrea, Burundi, and the Democratic Republic of Congo.

In 2000, the most significant gap in the country's QLI was 94, with a relative gap of 17 times. 23 countries are among the developed countries in terms of QoL, representing approximately 18% of the valid sample of countries; 22 countries are moderately developed countries in terms of QoL, representing approximately 17% of the valid sample of countries; 27 countries are among the preliminarily developed countries in terms of QoL, representing approximately 21% of the valid sample of countries; 59 countries are among the under developed countries in terms of QoL, representing approximately 45% of the valid sample of countries.

(2) 2010 World QoL evaluation results

In 2010, the top 10 countries in the QLI were: Norway, Sweden, Finland, Denmark, Australia, Canada, United Kingdom, New Zealand, Ireland, and Germany; There are 24 countries with a QLI above 80, which are among the developed countries with a QoL that represents the advanced level of the world in that year; 24 countries, including Hungary and Poland, have a QLI above 50 and are considered moderately developed countries in terms of QoL; 31 countries, including Georgia and China, have a QLI above 30 and are preliminarily developed countries in terms of QoL; 52 countries, including Nigeria, have a QLI less than 30 and are under developed countries in terms of QoL; The ten countries with the lowest modernization index are Madagascar, the Democratic Republic of the Congo, Mozambique, Tanzania, Burundi, Cambodia, Sierra Leone, Central Africa, Chad, and Eritrea.

In 2010, the enormous gap in the country's QLI was 91, with a relative gap of 10 times. 24 countries belong to countries with developed QoL, accounting for about 18% of the valid national samples; 24 countries are moderately developed countries in terms of QoL, representing about 18% of the valid sample of countries; 31 countries are among those with a preliminarily developed QoL, representing approximately 24% of the valid national samples; 52 countries are among the under developed countries in terms of QoL, representing about 40% of the valid national samples.

III. China's QoL evaluation results

Since 2000, Chinese residents' QoL has dramatically improved. Among them, the Chinese QLI has increased from 30 to 48, an increase of 18; The ranking has advanced from 72nd to 54th. The QALI improved by 25 from 17 to 43; The ranking rose from 87th to 54th. These figures show from one perspective that the QoL of Chinese residents has made significant progress, but the gap with the world's frontier is still pronounced (Table 12).

Table 12

China's QLI and ranking from 2000 to 2016

Year	QLI	Ranking	QALI	Ranking	National sample size
2016	48	54	43	54	131
2010	39	64	30	68	131
2000	30	72	17	87	131

1. QoL in China in 2016

China was among the preliminarily developed countries in terms of QoL in 2016, with a QLI of 48, ranking China 54th out of 131 countries in the world; With a QALI of 43, it also ranks 54th out of 131 countries. China was in the middle of developing countries regarding the QoL, and the gap from the world's advanced level was relatively large.

The overall QoL and most indicators in China in 2016 had a significant international gap (Table 13).

Table 13

International gap in China's QoL in 2016

	Indicator and Unit	Nature of Indicator	High-income countries	China	Absolute gap	Relative gap
QLI	QLI	positive indicator	100	48	52	2.1
	QALI	positive indicator	100	43	57	2.3
	Individual QLI	positive indicator	100	44	56	2.3
	Public QLI	positive indicator	100	36	64	2.8
	Quality of living environment index	positive indicator	100	49	51	2.0
	Life Satisfaction index	positive indicator	100	54	46	1.9
The actual QoL	Protein supply per capita/(Gram/day)	positive indicator	104	94	10	1.1
	Fruit supply per capita/ (Gram/day)	positive indicator	270	258	12	1.0
	Life expectancy on average/Years	positive indicator	80	76	4	1.1
	Infant mortality rate/ (Number/1000 people)	negative indicator	4.7	8.6	3.9	1.8
	Tuberculosis incidence (Number/100 000 people)	negative indicator	12	64	52	5.3
	Rooms per person/ Number	positive indicator	2.1	2	0.1	1.1
	Car penetration rate (Number/1000 people)	positive indicator	450	99	351	4.5
	Household consumption per capita/ US Dollar, 2010	positive indicator	24 292	2576	21 716	9.4
	Energy consumption per capita/Kilogram oil valent weight	positive indicator	4604	2237	2367	2.1
	Engel coefficient/ (Percentage)*	negative indicator	12.5	39.8	27.3	3.2
	National income per capita / US Dollar, 2011	positive indicator	42 376	14 354	28 022	3.0
	Leisure and wellness time/Hour	positive indicator	14.9	–	–	–
	Minimum monthly wage/US Dollar	positive indicator	1443	226	1217	6.4
	College enrollment/ (Percentage)	positive indicator	75	48	27	1.5
	Average years in education/Years	positive indicator	12.8	7.6	5.2	1.7

The end of the table 13

	Indicator and Unit	Nature of Indicator	High-income countries	China	Absolute gap	Relative gap
	The proportion of the population in absolute poverty/(Percentage)	negative indicator	0.7	1.9	1.2	2.7
	Pension insurance coverage rate/ (Percentage)	positive indicator	92	63	29	1.5
	International travel per capita/(Times/Year)	positive indicator	0.65	0.1	0.55	6.5
	Internet penetration rate / (Percentage)	positive indicator	82	53	29	1.5
	Civil rights (Rating)	*	1	6	5	6.0
	Safe drinking water penetration rate / (Percentage)	positive indicator	99	96	3	1.0
	Screens per capita / (Number/100 000 people)	positive indicator	9.2	2.5	6.7	3.7
	Pupil-Teacher ratio/ (Percentage)	negative indicator	14.2	16.5	2.3	1.2
	Physician ratio/ (Number/1000 people)	positive indicator	3	1.8	1.2	1.7
	Nurse ratio/ (Number/1000 people)	positive indicator	10.5	2.3	8.2	4.6
	Voyages per capita/ (Times/Year)	positive indicator	1.86	0.35	1.51	5.3
	Prison population ratio/(Number/100000 inhabitants)**	negative indicator	138	119	−19	0.9
	Traffic accident fatality rate/(Number/100 000 people)	negative indicator	8.2	19.4	11.2	2.4
	PM2.5 annual average concentration/ (Micrograms/Cubic meters)	negative indicator	19.7	56	37	2.9
	Municipal wastewater treatment rate/ (Percentage)	positive indicator	97	93.4	3.6	1.0
Life Satisfaction	The proportion of undernourished population/ (Percentage)	negative indicator	2.7	8.7	6	3.2
	Life Satisfaction (Index)	positive indicator	7.15	6.85	0.35	1.1
	Income inequality (Ratio)	negative indicator	6.8	9.2	2.4	1.4
	Economic Life Satisfaction (Index)	positive indicator	6.15	6.19	0.01	1.0
	Unease of doing business rank	negative indicator	16.1	78	61.9	4.8
	Water quality satisfaction/ (Percentage)	positive indicator	86	–	–	–

Note: The smaller the value of *, the greater the civil rights. positive indicators: absolute gap = high-income country value — China value, relative gap = high-income country value ÷ China value.negative indicator: absolute gap = China value — high-income country value, relative gap = China value ÷ high-income country value.

The international gap in QLI. In 2016, the absolute gap between China's QLI and the average value of high-income countries was 52, and the relative gap was about 2.1 times. Among them, China has the most prominent international gap in public QoL, with a difference of 1.8 times with high-income countries; the smallest gap in Life Satisfaction is only 90% worse than in high-income countries. Compared with the average value of high-income countries, the QALI has an absolute gap of 57. The relative gap is about 2.3 times higher than the international QLI gap.

International gaps in individual QoL indicators. In 2016, compared with high-income countries, the most significant gap between China and high-income countries was household consumption per capita, which was 8.4 times worse, 4.3 times difference in tuberculosis incidence, 3.5 times difference in car penetration, 2.2 times difference in Engel coefficient and 1.1 times difference in per capita energy consumption; The international gap for all other indicators is less than one times.

(3) International gap in the quality of public life. In 2016, the difference between China and high-income countries in terms of the number of international trips per capita and the minimum monthly wage was 5.5 times and 5.4 times, respectively; the difference in national income per capita was two times, and the difference in the proportion of absolute poverty was 1.7 times; The international gap in all other indicators was less than one times.

(4) The international gap in the quality of the living environment. In 2016, compared with high-income countries, China had a 4.3 times difference in the annual number of voyages per capita, 3.6 times difference in the nurse ratio, 2.7 times difference in the number of screens per capita, 1.9 times and 1.4 times difference in the annual average concentration of PM2.5 and traffic fatalities, respectively, and 70% difference in the physician ratio; the international gap in all other indicators was not very large.

(5) International gap in Life Satisfaction. In 2016, China had the most prominent international gap of 4.8 times in the unease of doing business rank compared with high-income countries; the international gap of 3.2 times in the proportion of the undernourished population and 40% difference in income inequality; the international gap of Life Satisfaction was small due to the lack of Chinese data for comparison, and there was almost no gap in the indicator of economic Life Satisfaction.

2. Changes in QoL in China from 2000 to 2016

Since 2000, China's QLI has risen from 30 to 48, an improvement of 18, and its world ranking has risen from 72nd to 54th. China's QALI rose from 17 to 43, an increase of 25, and its world ranking rose from 87th to 54th (Figure 2, Table 14). China has made significant improvements in its QoL.
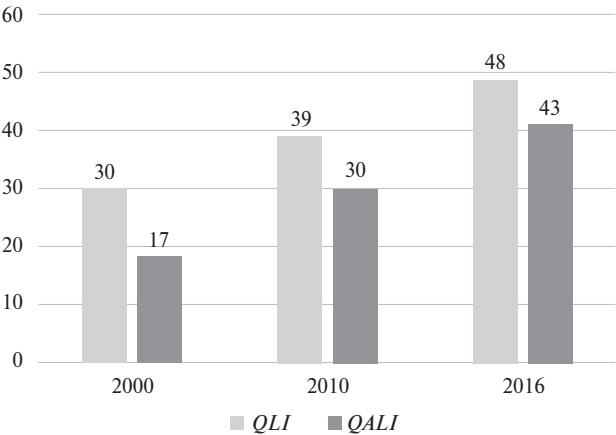

Figure 2. China's QLI from 2000 to 2016

From 2000 to 2016, both the absolute and relative gaps between China's QoL and the world's advanced level narrowed, so did the absolute and relative gaps between China's QoL and the world average. In 2016, China's QLI was slightly higher than the world average (Table 14).

Table 14

China's QoL modernization process from 2000 to 2016

Item	QLI			QALI		
	2000	2010	2016	2000	2010	2016
China index	30	39	48	17	30	43
World index maximum	100	100	100	100	100	100
World index minimum	6	9	9	5	6	6
World index average (calculated)	43	45	47	37	41	43
The absolute gap between China and the maximum	70	61	52	83	70	57
The relative gap between China and the maximum	3.4	2.6	2.1	6.0	3.3	2.3
The absolute gap between China and the average	13	6	−1.3	20	11	-0.2
The relative gap between China and the average	1.4	1.2	1.0	2.2	1.4	1.0
China ranking	72	64	54	87	68	54
National sample size	131	131	131	131	131	131

The performance of individual indicators of QoL in China varied between 2000 and 2016. Among the individual QoL indicators, the indicators with better performance are protein supply per capita, fruit supply per capita, and average life expectancy. The poorer indicators are infant mortality rate, tuberculosis incidence rate, car penetration rate, Engel coefficient, and household consumption per capita. The indicator of the number of rooms per capita has improved rapidly from 2000 to 2016 (Table 15). Regarding the public QoL indicators, only the indicator of average years in education performed slightly better; the indicators of national income per capita, a minimum monthly wage, and the number of international trips per capita performed poorly; and the four indicators of university enrollment, percentage of absolute poverty, pension insurance coverage, and Internet penetration increased rapidly from 2000 to 2016 (Table 19). The indicators that performed better in terms of quality of living environment indicators were safe drinking water penetration, pupil-teacher ratio, physician ratio, and prison population ratio; the indicators that performed worse were number of screens per capita, nurse ratio, number of voyages per capita, traffic accident fatality rate and PM2.5 annual average concentration; the indicator of municipal wastewater treatment rate improved rapidly (Table 15).

Regarding S_L, the three indicators of life satisfaction, economic life satisfaction, and income inequality all performed well. In comparison, the two indicators of the malnourished population proportion and nutritional inconvenience index performed poorly (Table 15).

Since 2000, China's QoL has dramatically improved in the 20 years. The absolute level of China's QoL has continued to improve, as well as the relative level. Although the achievements are apparent, the gap between China and the world's advanced level is also objective.

Table 15

Performance of QoL evaluation indicators in China, 2000 to 2016

	Indicator and unit	Nature of indicator	2000	2010	2016	2016 reference value
1	2	3	4	5	6	7
Individual QoL	Protein supply per capita/(Gram/day)	positive indicator	84	95	94	104
	Fruit supply per capita/(Gram/day)	positive indicator	120	213	258	270
	Life expectancy on average/Years	positive indicator	72	75	76	80
	Infant mortality rate/(Number/1000 people)	negative indicator	30	13.6	8.6	4.7
	Tuberculosis incidence (Number/100 000 people)	negative indicator	109	77	64	12
	Rooms per person/Number	positive indicator	1.0	1.6	2.0	2.1
	Car penetration rate (Number/1000 people)	positive indicator	7	46	99	450
	Household consumption per capita/ US Dollar, 2010	positive indicator	410	1990	2576	24 292
	Energy consumption per capita/Kilogram oil valent weight	positive indicator	899	1955	2237	4604
	Engel coefficient/(Percentage)*	negative indicator	47	40	40	12.5
Public QoL	National income per capita / US Dollar, 2011	positive indicator	3662	9485	14 354	42 376
	Leisure and wellness time/Hour	positive indicator			–	14.9
	Minimum monthly wage/US Dollar	positive indicator	50	142	226	1443
	College enrollment/(Percentage)	positive indicator	7.6	24	48	75
	Average years in education/Years	positive indicator	6.5	7.1	7.6	12.8
	The proportion of the population in absolute poverty/(Percentage)	negative indicator	41	11.2	1.9	0.7
	Pension insurance coverage rate/(Percentage)	positive indicator	11	27	63	92
	International travel per capita/(Times/Year)	positive indicator	0.01	0.04	0.1	0.65
	Internet penetration rate / (Percentage)	positive indicator	1.8	34	53	82
	Civil rights (Rating)	*	6	6	6	1
Quality of the living environment	Safe drinking water penetration rate / (Percentage)	positive indicator	80	91	96	99
	Screens per capita / (Number/100 000 people)	positive indicator	0.2	0.5	2.5	9.2
	Pupil-Teacher Ratio/(Percentage)	negative indicator	22	16.8	16.5	14.2

1	2	3	4	5	6	7
	Physician ratio/(Number/1000 people)	positive indicator	1.3	1.5	1.8	3
	Nurse ratio/(Number/1000 people)	positive indicator	1	1.5	2.3	10.5
	Voyages per capita/(Times/Year)	positive indicator	0.05	0.20	0.35	1.86
	Prison population ratio/(Number/100 000 inhabitants)**	negative indicator	111	121	119	138
	Traffic accident fatality rate/(Number/100 000 people)	negative indicator	22	21	19	8.2
	PM2.5 annual average concentration/ (Micrograms/Cubic meters)	negative indicator	52	58	56	20
	Municipal wastewater treatment rate/ (Percentage)	positive indicator	34	82	93	97
Life Satisfaction	The proportion of undernourished population/ (Percentage)	negative indicator	16	12	8.7	2.7
	Life Satisfaction (Index)	positive indicator	6.53	6.76	6.85	7.15
	Income inequality (Ratio)	negative indicator		9.3	9.2	6.8
	Economic Life Satisfaction (Index)	positive indicator	5.65	5.94	6.19	6.15
	Unease of doing business rank	negative indicator			78	16.1
	Water quality satisfaction/(Percentage)	positive indicator	–	–	–	86

Note: The smaller the value of *, the greater the civil rights. (1) Reference values for each year are the average values of high-income countries in that year; (2) Due to the unavailability of data, the household consumption per capita in 2016 is replaced by the data in 2010.

IV. Conclusion

Between 2000 and 2016, there was significant progress in the overall QoL worldwide. Among the 131 countries, 87 experienced an increase in QLI, whereas 34 countries experienced a decrease, with the number of countries experiencing an increase being 2.6 times greater than those experiencing a decrease. Of the 25 countries with changes in QoL level, 80% experienced an improvement in QoL level, with the number of countries experiencing an increase being four times greater than those experiencing a decrease. In countries with changes in relative QoL modernization, the probability of a relatively non-modernized country upgrading to a relatively modernized country is approximately 3%, which is close to twice the probability of a relatively modernized country transforming into a relatively non-modernized country. The national QLI is highly correlated with the SMI, with a greater than 90% correlation. The correlation between the country's QLI and the leading economic indicators (GNI per capita, GDP per capita) is also strong, with correlations ranging from 84% to 89%. Further, the correlation between the QALI and the SMI and the leading economic indicators (GNI per capita, GDP per capita) is stronger than the correlation between the QLI and the SMI and the leading economic indicators (GNI per capita, GDP per capita) in the same period.

During this period, China's QLI increased from 30 to 48, narrowing the relative gap with high-income countries from 3.3 to 2.1 times. At the same time, China's ranking worldwide rose by 18 places, from below average to above average. The QALI also increased from 17 to 43, decreasing the relative gap with high-income countries from 5.9 times to 2.3 times. Additionally, China's ranking worldwide rose by 33 places, from lower ranks to upper-middle ranks. Therefore, the improvement in China's QoL is reflected not only in narrowing the gap with high-income countries but also in improving its international ranking. However, even the SL, which has the smallest gap with high-income countries among all QoL indices, is still 0.9 times lower than that of high-income countries, indicating that there is still significant room for improvement in China.

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