Forthcoming changes in world population distribution and global connectivity: implications for global foresight

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Abstract: For the first-world citizens, globalisation seems to be an all-pervasive phenomenon. Our research reveals that global connectivity rates differ dramatically for various countries and correspondingly, their populations. What will this picture look like in, say, 50 years? We combine demographic projections with our knowledge on the recent dynamics of national rates of global connectivity to estimate the proportion of world population which is expected to live in countries with varying rates of global connectivity. We show that the distribution of world population among the states with various rates of global connectivity is bound to experience significant changes in the coming decades, which should be taken into account at various attempts of providing global foresight.

Keywords: globalisation; measuring globalisation; demographic projections; global connectivity; world population; global population forecast; global foresight.

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1 Introduction

In this paper, we look into the relation between globalisation and global demographic landscape in order to reveal how the projected demographic changes can affect globalisation (and *vice versa*) in the nearest and more distant future (we investigate the period until 2100).

Let us first define the basic notions used in this paper. Indeed, our understanding of the very essence of globalisation will depend on the exact definition chosen for this phenomenon. In our opinion, a comprehensive definition allowing for a multi-dimensional, systemic vision of globalisation was offered by a prominent global politics and economics scholar Modelski (2008), whose idea lied in combining two approaches: the 'connectivist' approach, viewing globalisation as the increase of transborder interactions, relations and flows and the institutional approach, which explains globalisation as the emergence and evolution of global, planetary-scale institutions. [1] So, we select a number of global institutions with network structure formed by transborder interactions and flows (for the reason for such selection, see Section 2). We then proceed to build network models and apply network analysis methods in order to characterise the structural position of each country within these networks. In particular, for each country, we define the maximal degree of the *k*-core to which it belongs. Next,

we define the maximal *k*-core degree in the whole network (for more detail on the notion of *k*-cores, see Shulgin et al., 2018). After that, we divide the first by the second and thus obtain a certain figure characterising the country's structural position within the given global network and reflecting its degree of involvement into this network; this figure is interpreted as the country's global connectivity rate.

As for the global demographic landscape, we view it through the prism of globalisation, tracing the current distribution of the world population among the countries with the highest, medium, low and lowest-low rates of global connectivity. It has been showed by various researchers that the forthcoming global demographic changes are bound to be rather profound and can be followed by turbulence in the world order (see, e.g., Weiner and Russell, 2001; Coleman and Rowthorn, 2011; Sciubba, 2011; Yoshihara and Silva, 2012; Apt, 2013; Goldstone et al., 2014; Korotayev and Zinkina, 2015; Kim and Sciubba, 2015; Teitelbaum, 2015).

The main aim of the paper is to investigate how the forthcoming demographic changes can influence absolute numbers and relative proportions of people residing in societies with various degrees of global connectivity. We use the medium set of demographic projections calculated by the United Nations (2017a) Population Division to investigate these changes. Of course, these projected changes in the population of various countries are not the only factor which can probably influence the distribution of people between countries with varying degrees of global connectivity. Numerous other factors can be named, such as migration policies, economic growth or stagnation, sudden episodes of major socio-political destabilisation, severe natural disasters, etc. However, in this paper, we choose to concentrate on the possible influence of demographic factors, as demographic projections (calculated by the United Nations Population Division) are among the most reliable forecasts in a rather long-term (decades) perspective. Still, other factors which can possibly influence the distribution of people between countries with varying degrees of global connectivity deserve to become objects of further research as well.

2 Theoretical frameworks

As early as the mid-1990s, Manuel Castells, a prominent sociologist, presented his research on social structures and put forward an assumption that in the context of informational era the most important social functions and processes were increasingly organised in the form of networks. According to his thought, entities belonging or not belonging to a certain network, as well as the interrelations between various networks provide one of the most important sources of power in the human society nowadays, which he called 'the network society' (see, e.g., Castells,1996, 2011).

Importantly, Castells (1999) states that inclusion into the network or exclusion from it defines the configuration of the most important ongoing processes in human society. That is why it is critically important to investigate the network structure of such processes in order to understand their essence. Globalisation is undoubtedly one of such processes – a new historical reality, in Castells' (1999) viewpoint. Castells (1999) views globalisation not just as a dominant process of a planetary scale; he also uncovers its influence on the numerous dimensions of the society's existence and evolution. Thus, a thorough investigation of the network structure of globalisation can help us understand the nature

of many other major processes ongoing in our society in the spheres of information, culture, governance, etc.

Castell (1999) states that the network society is built around global network structures of capital, governance and information. It seems reasonable to start the research on the network structure of globalisation with one of these aspects. We choose the economic one (related to capital) because (as we have mentioned earlier) Castells (1999) himself claimed that although globalisation is a multidimensional process, it can be better understood starting with its economic dimension (see also Grinin and Korotayev, 2010). The particular choice of networks is related to the theoretical synthesis of the new economic geography, which finds strong interrelations between three global networks, namely trade, foreign direct investment (FDI) and migration (for more detail, see Candau, 2013).

3 Data

For measuring national rates of global connectivity, we rely on the involvement of countries in several global networks, such as *trade in goods*, trade in services, FDI and international migration:

- Data on country-to-country trade in goods are taken from UN COMTRADE database according to the harmonised commodity description and coding systems classification (United Nations, 2017b). Basically, we use data on the total value of import from country A to B and from B to A (in current dollar prices). In the cases of missing data on import from A to B, we use data on export from B to A instead (the so-called 'mirroring').[2] In this paper, we use a symmetric approach that allows us to use the model of undirected graph. Naturally, this leads to a simplification of the reality of the global world, as this approach conceals all asymmetries in the relations between countries (e.g., when trade flow from A to B significantly exceeds the one from B to A). However, even the cases of extremely asymmetrical relations imply the presence of an economic connection between A and B – even if it exists in the form of severe economic dependency of B on A (or *vice versa*), it is still a connection and that is the most important point for the analysis of global connectivity rates. Of course, a different approach such as using directed graphs is also possible here – in fact, we use it elsewhere for similar goals (Shulgin et al., 2016) – and might well be used in further research of the topic.
- Data on bilateral *trade in services* are obtained from 'the trade in services' database which accumulates data on trade in services compiled by OECD, Eurostat, United Nations and IMF (World Bank, 2017).
- Data on *accumulated stock of bilateral FDI* are obtained from the United Nations (2017b) COMTRADE database.
- Data on *accumulated stock of migrants* are obtained from the United Nations (2017c), which has published data on the migrant stocks classified by the country of origin for 197 countries of the world every five years since 1990.

We investigate the structure of these networks during three periods: 2000–2004, 2005–2009 and 2010–2017.

For the scenarios of demographic future, we use medium scenario population projections 2017 calculated by United Nations (2017c) Population Division.

4 Methods

There exists a plethora of network metrics that could be applied to various research tasks related to the investigation of social networks. They are mostly related to graph analysis. Indeed, the key notions of network analysis include actors and relations between these actors, which can be viewed as nodes (vertices) and edges of a graph. Within research on global networks, one can use such network metrics as node degree (the number of relations a country has); node strength (the number and weight of relations a country has); various metrics of centrality (closeness centrality, betweenness centrality, eigenvector centrality etc.), which characterise the structural position of a country within the given network; clusterisation coefficient and assortativity coefficient (which look into the structure of relations in the whole network) and many others (for more details, see Borgatti et al., 2013).

For our research aim, we use a two-stage algorithm. During the first stage, we construct network models and analyse the structure of networks in order to reveal the positions of particular countries therein; this allows us to calculate country rates of global connectivity. During the second stage, we combine the results of network analysis with demographic projections in order to reveal how many people are expected to live in countries with varying connectivity rates in the nearest decades (say, up to 2050) and in more distant future (until 2100). Let us describe both stages in more detail.

4.1 First stage: network models

For each of the four networks we build three matrices N × N (one matrix for each of the three consecutive time periods), where N is the total number of countries and column *i* presents the data on the relations of country *i* with all the other countries in the given network. A symmetrical matrix of relations can be viewed as an undirected graph, so our further investigation is based on the methods of network analysis of graphs. Our task is to select not necessarily a completely interconnected group, but rather a group of the largest possible size with the largest possible degree of interconnectedness. For this, let us use the concept of a *k*-core. A *k*-core is a subset of vertices each of which has no less than *k* relations with other vertices in this subset. Apart from reflecting the structure of the graph, the *k*-core metric has one more noteworthy feature. It allows us not just to find the vertices (countries) with the highest number of connections, but rather reveals the countries with the greatest number of connections to other highly-connected countries (sort of a 'high connectivity club') (for more details on the method, see Shulgin et al., 2018).

For each country, we define the maximal degree of the *k*-core to which it belongs (K_i). Next, we define the maximal *k*-core degree in the whole network (K_{max}). Third, we divide K_i by K_{max}. The value of K_i / K_{max} for a given country *i* equals to 1 if this country belongs to the *k*-core of maximal density. Otherwise, for example, $K_i / K_{max} = 0.5$ if country *i* belongs to a *k*-core with a degree half as big as the maximal *k*-core degree in the graph. To set another example, $K_i / K_{max} = 0$ if country *i* is represented by a fully isolated

vertex and has no relations whatsoever with any other country (vertex) within the given network. Thus, for each country we obtain a certain value which reflects its position in each of four networks (goods, services, FDI and migration). These four different rates are then summarised. During the procedure of summing the four networks, we do not use any extra weights, as in each network the values obtained represent the same type of structural characteristics of the country which reflect the position of the corresponding vertex within the network. The maximal value of global connectivity for a given country is 4 (which means that in each of the four networks this country rates at 1, the highest value possible).

4.2 Second stage: demographic projections

We rely on the medium scenario of demographic projections calculated by the United Nations Population Division to obtain the projected values of population residing in various countries of the world for the period until 2100. We then sum up the projected population values for groups of countries with different global connectivity rates.

5 Results

We obtain the following values of global connectivity rates (see Table 1).

We classify all countries into six groups according to their global connectivity rates:

- 'The leaders' (the top six countries with connectivity rates ranging from 3.99 to 4.00 in 2010–2017).
- Highly connected countries (7th to 25th countries in Table 1 with connectivity rates ranging from 3.75 to 3.99; the total of 19 countries).
- High-medium connected countries (26th to 48th countries in Table 1 with connectivity rates ranging from 3 to 3.75; the total of 23 countries).
- Medium-connected countries (49th to 78th countries in Table 1 with connectivity rates ranging from 2 to 3; the total of 30 countries).
- Low-connected countries (79th to 154th countries in Table 1 with connectivity rates ranging from 1 to 2; the total of 76 countries).
- Lowest-low connected countries (155th to 197th countries in Table 1 with connectivity rates ranging from 0 to 1; the total of 43 countries).

For each group of countries, we calculate the total annual population for the period from 1970 till 2017, as well as the total annual population projected according to the United Nations Population Division medium scenario until 2100. Real and projected population dynamics for each of the six country groups is presented in Figure 1. Here, we make an assumption that the countries will continue to belong to the same groups to which they belong nowadays. Of course, this is a simplification, as countries can experience an increase or a decrease in their global connectivity rates and thus shift to another group. However, (as we will show below), even though the exact values of the countries' global connectivity rates can fluctuate from one time period to another, the cases of countries actually moving from one group to another are rather rare, especially

among the low-connected countries. So, bearing in mind that the real picture might be somewhat less static, we still can proceed to investigate real and projected population dynamics for six country groups (specified according to global connectivity rates observed in 2010).

Table 1 Global connectivity rates for various countries of the world in 2000–2004, 2005–2009 and 2010–2017

Country		*2000–2004*	*2005–2009*	*2010–2017*
1	UK	4.000	4.000	4.000
2	USA	4.000	4.000	4.000
3	Germany	3.999	4.000	4.000
4	Italy	3.996	4.000	4.000
5	France	3.999	4.000	4.000
6	Spain	3.994	3.994	3.995
7	Netherlands	3.992	3.987	3.982
8	Switzerland	3.991	3.986	3.980
9	Belgium	3.978	3.972	3.973
10	China	3.917	3.952	3.959
11	Japan	3.952	3.947	3.944
12	Canada	3.951	3.960	3.943
13	Russian Federation	3.628	3.913	3.919
14	Ireland	3.867	3.908	3.907
15	Sweden	3.928	3.915	3.895
16	Australia	3.890	3.926	3.890
17	Poland	3.800	3.865	3.872
18	Republic of Korea	3.821	3.861	3.852
19	Austria	3.847	3.887	3.848
20	Denmark	3.879	3.860	3.823
21	India	3.382	3.711	3.796
22	Brazil	3.698	3.899	3.790
23	Singapore	3.727	3.747	3.780
24	Norway	3.821	3.819	3.757
25	Hong Kong	3.754	3.752	3.751
26	Turkey	3.687	3.800	3.742
27	Hungary	3.674	3.728	3.692
28	Finland	3.742	3.725	3.687
29	Portugal	3.794	3.731	3.663
30	Czech Republic	3.546	3.648	3.646
31	Luxembourg	3.547	3.581	3.588
32	Greece	3.621	3.637	3.560

Note: Sorted in the descending order of values for 2010–2017.

Source: See Shulgin et al. (2018)

Table 1 Global connectivity rates for various countries of the world in 2000–2004, 2005–2009 and 2010–2017 (continued)

Country		*2000–2004*	*2005–2009*	*2010–2017*
33	South Africa	3.529	3.647	3.542
34	Thailand	3.488	3.686	3.493
35	Malaysia	3.343	3.662	3.471
36	Romania	2.995	3.522	3.456
37	Chile	2.748	3.447	3.430
38	Israel	3.454	3.609	3.402
39	Mexico	3.104	3.547	3.398
40	Bulgaria	3.103	3.341	3.281
41	New Zealand	3.272	3.310	3.232
42	Slovakia	3.096	3.252	3.229
43	Indonesia	3.128	3.392	3.222
44	Cyprus	3.096	3.230	3.185
45	Ukraine	3.061	3.167	3.129
46	Philippines	3.062	3.347	3.073
47	Argentina	3.013	3.259	3.066
48	Croatia	3.071	3.074	3.026
49	Pakistan	2.600	3.055	2.925
50	Egypt	2.910	2.799	2.922
51	Lithuania	2.835	2.962	2.888
52	Slovenia	2.888	2.883	2.834
53	Latvia	2.756	2.908	2.801
54	Estonia	2.734	2.833	2.793
55	Morocco	2.838	2.862	2.747
56	United Arab Emirates	2.880	3.169	2.715
57	Malta	2.349	2.657	2.703
58	Bolivarian Republic of Venezuela	2.694	2.659	2.687
59	Nigeria	2.307	2.389	2.634
60	Islamic Republic of Iran	2.645	2.589	2.568
61	Saudi Arabia	2.834	3.405	2.557
62	Kazakhstan	2.669	2.779	2.550
63	Colombia	2.309	2.451	2.547
64	Belarus	2.342	2.529	2.433
65	Iceland	2.306	2.587	2.409
66	Vietnam	2.654	3.015	2.305
67	Peru	2.290	2.539	2.297
68	Uruguay	2.061	2.152	2.227

Note: Sorted in the descending order of values for 2010–2017.

Source: See Shulgin et al. (2018)

Table 1 Global connectivity rates for various countries of the world in 2000–2004, 2005–2009 and 2010–2017 (continued)

Country		*2000–2004*	*2005–2009*	*2010–2017*
69	Kuwait	2.308	2.517	2.218
70	Panama	2.437	2.576	2.198
71	Serbia	1.135	2.170	2.190
72	Bangladesh	2.225	2.357	2.158
73	Qatar	2.008	2.397	2.128
74	Mauritius	1.691	2.051	2.114
75	Azerbaijan	2.073	2.380	2.079
76	Algeria	2.299	2.373	2.051
77	Lebanon	2.261	2.267	2.015
78	Jordan	2.254	2.356	2.001
79	Libya	2.088	2.368	1.984
80	Sri Lanka	2.128	2.083	1.950
81	Bahrain	1.952	2.143	1.929
82	Ecuador	1.991	2.078	1.906
83	Costa Rica	1.873	1.968	1.861
84	Georgia	1.761	2.006	1.860
85	Syrian Arab Republic	2.150	2.145	1.837
86	Bosnia and Herzegovina	1.959	2.074	1.814
87	Tunisia	2.158	2.151	1.805
88	Oman	1.762	1.991	1.795
89	The former Yugoslav Republic of Macedonia	1.775	1.791	1.757
90	Albania	1.691	1.712	1.754
91	Ghana	1.790	1.845	1.737
92	Republic of Moldova	1.810	1.913	1.693
93	Bermuda	1.561	1.722	1.690
94	Cayman Islands	1.831	1.851	1.680
95	Ethiopia	1.710	1.778	1.677
96	Kenya	1.865	1.895	1.669
97	Yemen	1.745	1.818	1.665
98	Dominican Republic	1.876	1.904	1.661
99	Iraq	1.761	1.764	1.655
100	Armenia	1.625	1.816	1.655
101	Plurinational State of Bolivia	1.615	1.649	1.630
102	Kyrgyzstan	1.647	1.700	1.627
103	Guatemala	1.675	1.717	1.609

Note: Sorted in the descending order of values for 2010–2017.

Source: See Shulgin et al. (2018)

Table 1 Global connectivity rates for various countries of the world in 2000–2004, 2005–2009 and 2010–2017 (continued)

Country		*2000–2004*	*2005–2009*	*2010–2017*
104	Bahamas	1.791	1.889	1.589
105	Sudan	1.569	1.595	1.585
106	Cote d'Ivoire	1.697	1.704	1.575
107	United Republic of Tanzania	1.735	1.765	1.568
108	Paraguay	1.553	1.575	1.558
109	Uzbekistan	1.703	1.740	1.558
110	Zambia	1.453	1.656	1.556
111	Angola	1.582	1.756	1.544
112	Afghanistan	1.450	1.670	1.543
113	Senegal	1.621	1.662	1.542
114	Uganda	1.565	1.626	1.525
115	Nepal	1.452	1.490	1.516
116	Cambodia	1.567	1.890	1.509
117	Congo	1.455	1.630	1.508
118	Cameroon	1.579	1.626	1.505
119	El Salvador	1.631	1.636	1.501
120	Montenegro	0.420	1.279	1.499
121	Mozambique	1.490	1.529	1.476
122	Myanmar	1.519	1.477	1.454
123	Honduras	1.560	1.571	1.454
124	Cuba	1.842	1.736	1.443
125	State of Palestine	0.991	1.390	1.412
126	Nicaragua	1.538	1.501	1.404
127	Namibia	1.504	1.492	1.372
128	Zimbabwe	1.496	1.419	1.352
129	Mali	1.412	1.407	1.344
130	Togo	1.317	1.303	1.340
131	Trinidad and Tobago	1.509	1.531	1.320
132	Benin	1.301	1.315	1.302
133	Liberia	1.637	1.599	1.296
134	The Democratic Republic of the Congo	1.307	1.367	1.277
135	Barbados	1.501	1.374	1.276
136	Gabon	1.472	1.480	1.255
137	Jamaica	1.560	1.430	1.237
138	Botswana	1.201	1.239	1.219
139	Burkina Faso	1.255	1.272	1.219

Note: Sorted in the descending order of values for 2010–2017.

Source: See Shulgin et al. (2018)

Table 1 Global connectivity rates for various countries of the world in 2000–2004, 2005–2009 and 2010–2017 (continued)

Country		*2000–2004*	*2005–2009*	*2010–2017*
140	Rwanda	1.200	1.241	1.219
141	Mauritania	1.270	1.282	1.219
142	Malawi	1.321	1.325	1.216
143	Guinea	1.398	1.428	1.205
144	Niger	1.231	1.240	1.199
145	Democratic People's Republic of Korea	1.271	1.259	1.171
146	Mongolia	1.079	1.111	1.113
147	Somalia	1.130	1.106	1.103
148	Tajikistan	1.267	1.273	1.099
149	Turkmenistan	1.269	1.194	1.086
150	Madagascar	1.170	1.210	1.075
151	Sierra Leone	1.221	1.158	1.070
152	Burundi	1.041	1.089	1.045
153	Belize	1.151	1.190	1.021
154	Brunei Darussalam	1.224	1.325	1.007
155	Swaziland	1.047	1.047	0.991
156	Guyana	1.133	1.114	0.989
157	Lao People's Democratic Republic	1.058	1.053	0.975
158	Gambia	1.058	1.012	0.962
159	Cabo Verde	1.076	1.081	0.959
160	Seychelles	1.095	1.225	0.949
161	Haiti	0.955	0.986	0.940
162	Suriname	1.062	1.075	0.930
163	Eritrea	1.106	0.943	0.919
164	Papua New Guinea	1.042	0.832	0.886
165	Central African Republic	0.870	0.911	0.860
166	Chad	0.954	0.942	0.851
167	Antigua and Barbuda	0.949	1.059	0.847
168	Fiji	1.020	0.969	0.841
169	Andorra	0.996	1.001	0.803
170	Maldives	0.857	0.855	0.783
171	Dominica	0.880	0.863	0.757
172	Saint Vincent and the Grenadines	0.817	0.825	0.754
173	Gibraltar	0.972	1.038	0.731
174	Equatorial Guinea	0.677	0.827	0.726
175	Saint Kitts and Nevis	0.654	0.706	0.682

Note: Sorted in the descending order of values for 2010–2017.

Source: See Shulgin et al. (2018)

Table 1 Global connectivity rates for various countries of the world in 2000–2004, 2005–2009 and 2010–2017 (continued)

Country		*2000–2004*	*2005–2009*	*2010–2017*
176	Lesotho	0.719	0.604	0.640
177	Guinea-Bissau	0.736	0.690	0.632
178	Marshall Islands	0.447	0.632	0.631
179	Samoa	0.614	0.630	0.625
180	Bhutan	0.491	0.644	0.584
181	South Sudan	0.263	0.247	0.564
182	Greenland	0.607	0.631	0.548
183	Djibouti	0.585	0.704	0.540
184	Vanuatu	0.529	0.579	0.536
185	Saint Lucia	0.819	0.798	0.531
186	Timor-Leste	0.522	0.511	0.515
187	Grenada	0.857	0.831	0.509
188	Sao Tome and Principe	0.524	0.521	0.503
189	Solomon Islands	0.478	0.506	0.488
190	Tonga	0.454	0.476	0.456
191	Comoros	0.547	0.611	0.431
192	San Marino	0.351	0.495	0.425
193	Federated States of Micronesia	0.382	0.395	0.349
194	Kiribati	0.334	0.350	0.349
195	Palau	0.231	0.327	0.310
196	Tuvalu	0.257	0.251	0.203
197	Holy See (Vatican City State)	0.103	0.165	0.156

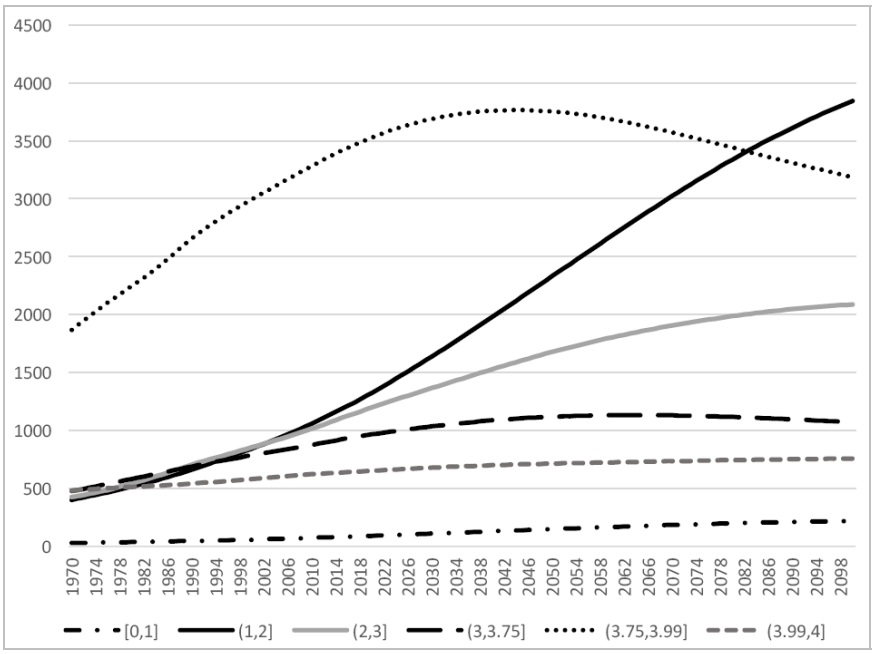
Note: Sorted in the descending order of values for 2010–2017.

Source: See Shulgin et al. (2018)

It is easy to see that the group of highly-connected countries is the most populous one, though it is not the most numerous one in terms of the number of countries entering it. This should largely be attributed to the fact that the two world giants, China and India, both enter this group. All in all, nearly one-half of the world population (3.46 billion people) currently resides in highly-connected countries. Low-connected group of countries comes second in terms of population numbers (hosting 1.15 billion of people), followed very closely by medium-connected countries (with the total number of residents equal to 1.15 billion as well). High-medium group of countries hosts about 0.94 billion, approximately 0.64 billion reside in the highest connected countries and 0.085 reside in the lowest-low-connected countries.

However, the situation is bound to experience some rather dramatic changes in the coming decades. The most pronounced trends are as follows: the proportion of population in the highest-connected, highly-connected and high-medium-connected countries will decline by 2050 and even further by 2100, while the proportions of those residing in medium-connected, low-connected (and to some extent also lowest-low connected) countries will significantly rise – see Table 2.

Figure 1 Real and projected population dynamics for six country groups, thousands



Note: Specified according to global connectivity rates observed in 2010.

Source: Authors' calculations based on the UN Population Division medium scenario of population projections (United Nations, 2017a)

Table 2 Absolute numbers (mln. people) and relative proportions (%) of world population residing or projected to reside in groups of countries with varying global connectivity rates in 2017, 2050 and 2100

Country group	*Population in 2017, mln.*	*Population in 2050, mln.*	*Population in 2100, mln.*
Highest connected	643.4	714.3	757.9
Highly-connected	3,464.1	3,752.8	3,186.3
High-medium-connected	941.3	1,118.9	1,070.2
Medium-connected	1,146.1	1,677.9	2,088.0
Low-connected	1,146.1	2,331.5	3,843.2
Lowest-low-connected	85.3	149.1	218.6
Country group	*Population in 2017, % of world total*	*Population in 2050, % of world total*	*Population in 2100, % of world total*
Highest connected	8.7	7.3	6.8
Highly-connected	46.6	38.5	28.5
High-medium-connected	12.7	11.5	9.6
Medium-connected	15.4	17.2	18.7
Low-connected	15.4	23.9	34.4
Lowest-low-connected	1.1	1.5	2.0

Source: Authors' own research

The most pronounced increase in the proportion of world population is expected for the low-connected countries; while they now host 15.4% of the world population, this figure is expected to increase more than 1.5 times already by 2050 and more than double by the end of the century. The absolute number of the residents of this group of countries is likely to more than double by 2050 and more than triple by 2100. On the contrary, the share of people living in the highly-connected countries is expected to experience a significant drop (by 1.5 times by 2100). Their absolute number will continue to slightly grow until the late 2040s, but will also slightly drop during the second half of the century. In the next section, we will proceed to discuss the background of these changes and some implications which these changes can bear for the global landscape.

6 Discussions

Let us first briefly discuss the nature of the expected changes. Most of the likely redistribution of the world population is bound to take place not due to some huge migration flows, but simply as a result of the fact that global demographic transition has been proceeding at different rates in various countries and the latter currently find themselves in rather varying demographic situations. Most countries entering the highest and highly-connected groups of countries have already completed their demographic transitions or find themselves close to completion, either through a long natural process (like most European countries) or due to a contribution from specific nation-wide state policies aimed at curbing fertility (like in China and India). This means that their fertility rates are close to simple reproduction level or even below it, so not much natural increase is expected in these countries – indeed, for most of them certain population decline is projected by the United Nations' (2017a) medium population scenario for the period until 2050 and even more so in 2050–2100. On the other hand, the low-connected group largely consists of countries which got delayed in their demographic transitions and still possess persistently high fertility rates; this is particularly the case for almost all tropical African countries (see Zinkina and Korotayev, 2014a, 2014b; Korotayev and Zinkina, 2014, 2015; Korotayev et al., 2016b), many of which belong to this specific group. These countries possess very large cohorts of youths and children, thus having accumulated a colossal demographic inertia – indeed, even if demographic transition there accelerates immediately, population doubling in the next decades is pretty much unavoidable in these countries (Zinkina and Korotayev, 2014a; Korotayev and Zinkina, 2014).

This assumption makes us pose another question – how exact and how certain are these projections? We should emphasise that in terms of population projections, we are dealing with a scenario forecast, not with a probability forecast – so we do not imply (and neither does the UN Population Division) that this scenario is the most probable one. Still, its degree of certainty is considerably high – especially for the nearest decades (as most of the people who will be living during these decades have already been born). However, our projections include also an assumption regarding globalisation – by default we assume that though the countries may experience some changes in their global connectivity rates, they will nevertheless remain in the same groups where they find themselves now. How valid is this assumption? Various globalisation indices have shown national globalisation rates to be rather volatile; for example, according to the Ernst & Young (2012) economist intelligence unit index, France obtained +6 positions in the overall globalisation ranking of countries between 2011 and 2012; at the same time,

both Taiwan and Israel experienced a visible decline in their globalisation rankings. However, we suppose that this volatility is largely generated by the nature of the chosen approach to the measurement of globalisation (i.e., indices themselves). This change can easily mean not that a country is becoming more or less globalised, but that one or two indicators in the index underwent a change (e.g., some change in trade volumes due to changed tariffs, or decreasing number of international phone calls – because people started using Skype, etc.) (Zinkina et al., 2013).

Network metrics suggest that global connectivity changes rather more slowly than globalisation indices imply. There were, of course, some changes in the exact values of the countries' global connectivity rates. However, our own research shows that in 2005–2010, only two out of 237 countries and territories, India and Singapore, experienced a transition to a higher-value group (from the high-medium-connected to the highly-connected countries). For comparison, in 2000–2010, ten out of 237 countries and territories experienced a transition to a higher-value group:

- Brazil, Russia, India and Singapore (from the high-medium-connected to the highly-connected countries)
- Romania and Chile (from the medium-connected to the high-medium-connected countries)
- Mauritius and Serbia (from the low-connected to the medium-connected countries)
- Palestine and Montenegro (from the lowest-low to the low-connected countries).

Let us now turn to changes in countries' global connectivity rates in absolute values. The total of only four countries experienced really large (by more than 0.5 points) increases in their rates from 2000–2004 to 2010–2017. Ten more countries experienced a considerably large (by 0.25–0.5 points) increase in these rates. However, if we omit very small island states (where high volatility of global connectivity rates can be observed due to the very size of the states), there are three (Montenegro, Serbia and Chile) and nine (Romania, Mauritius, Palestine, India, Malta, Nigeria, Pakistan, Mexico and Russia) country cases left. Eight out of these 12 countries already belonged to high-medium or medium groups in 2000. As for the low and lowest-low-connected countries, only four of them managed to achieve a considerable increase in their global connectivity rates. It should be noted here that two out of these four countries, Serbia and Montenegro, had the greatest increase out of all countries in our sample, but this increase occurred against the background of restoration after severe conflicts, which was, of course, not the only factor of their 'leaps', but seems to have made a considerable contribution (as trade and FDI flows resumed with the restoration of peace). Generally speaking, it seems a rather hard task for a low or lowest-low connected country to achieve significant progress in terms of its global connectivity, as is the task of moving to a higher-order group.

7 Conclusions

What implications can we draw from this picture? First, though the exact values of the countries' global connectivity rates are liable to changes from year to year, only a considerably limited number of countries experienced changes that allowed them to transit to a higher connectivity group. Moreover, no country has been able to transfer

two or three groups higher. Second, most such transitions were observed among countries with rather high global connectivity rates. Among the lower-connected countries, only four cases of transition to higher connectivity groups were observed in 2000–2010. Notably, three of them (Serbia, Montenegro and Palestine) experienced restoration of their economies after severe conflicts during this period, which might have contributed to this growth (along with other factors). The remaining one case is observed for a very small country, Mauritius (and it should be noted that both globalisation indices and network connectivity measures are more volatile for small countries than for larger economies due to higher relative volatility of national economic indicators in smaller countries). From this, we can conclude that it is a rather challenging task for a low-connected country to significantly increase its global connectivity rates; so, with all likelihood, the major part of low and lowest-low-connected countries (especially the larger ones) will retain comparatively low levels of global connectivity. Coupled with expected population doubling in this country group before 2050, we have grounds to expect even a certain de-globalisation in the sense of significantly more people residing in the low-globalised parts of the world (on the previous waves of globalisation and de-globalisation see, e.g., Chase-Dunn et al., 2000; Grinin and Korotayev, 2009; Korotayev et al., 2016a). This assumption should be liable to further research and should be taken into account in various attempts at global forecast and global foresight.

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Notes

1 Let us emphasise that 'institutions' is a very generic term for Modelski (2008), so this notion includes, e.g., global free trade, multinational enterprises, global governance, worldwide social movements, ideologies, etc.

2 The procedure of mirroring implies using present export statistics when import statistics is absent. This approach can increase the number of errors, as export statistics can differ from import statistics, but such inexact data is still better for network models than missing data (as the latter can nullify existing connections between countries and thus distort the structure of the network).