DEPENDENCIES BETWEEN TRAVEL AND TOURISM COMPETITIVENESS SUBINDEXES: THE ROBUST QUANTILE REGRESSION APPROACH

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Abstract

Since 2007 the World Economic Forum has studied national competitiveness in Travel and Tourism (T&T) industry and has published report which allows for cross-country comparison of T&T competitiveness. The aim of this paper is to determine dependencies between 14 subindexes on which is based measurement of T&T competitiveness index. Paper analyses the dependencies between mentioned subindexes among 141 economies during the year 2015. Through robust quantile regression analysis was found various relationships at various quantile levels. For some pairs of variables was found the same results for all quantile levels, for other pairs of variables was found different results for different quantile levels. Results are proposed for 13x13 pairs of variables on 11 quantile levels. Using multivariate quantile regression between selected variables was proven similar result, which was found before. For example, using multivariate quantile regression was found that variable Natural Resources depends on variables Air Transport Infrastructure, and Health and Hygiene at almost all, and on variable Business Environment at middle and high examined quantile levels. Variable Natural Resources depends on variable International Openness only at the middle quantile levels and on variable Human Resources and Labour Market, and Ground and Port Infrastructure only at the low quantile levels.

Key words: Travel and Tourism competitiveness index, quantile regression analysis, tourism, competitiveness

JEL Code: C31, L83, Z32

Introduction

There is rising trend of economic significance of tourism in the developing world, because tourism represents a crucial factor in economic development of many countries. In this context, an international comparison of the main components of the competitiveness of the tourism sector can provide us valuable information connected with accumulation of investment in

potential destinations suitable for the development and promotion of tourism. Selection factors of competitiveness provides easy identification of the position of the country, identifies its strengths and weaknesses, on which depend arrivals, revenue from tourism and destination development. Much of existing literature focused on tourism competitiveness. Ritchie and Crouch (2003) described six important dimensions of tourism competitiveness, which involves social, cultural, political, technological and environmental strengths. Bolaky (2011) studied tourism competitiveness in the Caribbean and explored what can enhance tourism competitiveness in this region. Hamarneh (2015) provided empirical analysis in this area and described various models of tourism competitiveness, such as Porter, the Poon concept, the WES approach, mentioned Ritchie and Crouch model, Travel and Tourism Competitiveness Index, OECD model and others. Bačík et al. (2016) pointed out that when tourism sector want to attract people and have competitive advantage it is not enough to use different and unconventional tools, but important is to come up with something new.

1 Travel and Tourism Competitiveness Index

Since 2007 the World Economic Forum studied national competitiveness in Travel and Tourism (T&T) industry and published report which allows for cross-country comparison of T&T competitiveness. It means that through this index are explored factors and policies driving T&T competitiveness in nations worldwide. According to World Economic Forum (2007) T&T Competitiveness Index measures "the factors and policies that make it attractive to develop T&T sector in different countries". This index provides a comprehensive strategic benchmarking tool and contributes to the development and competitiveness of a given country.

T&T Competitiveness Index was used to analyse in a lot of papers. Cîrstea (2014) studied tourism competitiveness among the top 15 most competitive countries presented in the Global Competitiveness Report. He measured the correlation between tourism competitiveness indicator and three major categories and specific pillars of competitiveness. Pulido-Fernández and Rodríguez-Díaz (2016) used in their study an alternative methodology for calculating T&T Competitiveness Index. Their approach was based on the two points of reference to propose a new standardisation. Ivanov and Ivanova (2016) wanted to answer the question whether hotel chains improve destination's competitiveness and used T&T Competitiveness Index data. They found that there exists positive and stronger relationship between the general business environment and destination's competitiveness than between the general business environment and the presence of the hotel chains. Reliability of Environmental sustainability subindex

measured Dias (2017) and showed that new index is reliable and original index obtained by exploratory factor analysis not. Khan et. al. (2017) investigated the impact of air transportation, railways transportation, travel and transport services on international inbound and outbound tourism. The results show that transportation sector is important and desirable to promote tourism worldwide.

1.1 Composition of T&T Competitiveness Index

T&T Competitiveness Report has been published six times up to the year 2015 but composition of index has been changed over the years. The main index is divided into 3 or 4 subindexes which are made up by selected pillars. Each of the pillars was calculated from subpillas. Composition of T&T Competitiveness Index during reported years are presented in table 1.

Tab. 1: Composition of T&T Competitiveness Index over the years

Year	2007	2008, 2009, 2011, 2013	2015
Subindex I.	T&T regulatory framework	T&T regulatory framework	Enabling Environment
Pillars of subindex I.	1. Policy rules and regulations 2. Environmental regulation 3. Safety and security 4. Health and hygiene 5. Prioritization of Travel & Tourism	1. Policy rules and regulations 2. Environmental regulation 3. Safety and security 4. Health and hygiene 5. Prioritization of Travel & Tourism	1. Business Environment (BE) 2. Safety and Security (SS) 3. Health and Hygiene (HH) 4. Human Resources and Labour Market (HRL) 5. ICT Readiness (ICT)
Subindex II.	T&T business environment and infrastructure	T&T business environment and infrastructure	T&T Policy and Enabling
Pillars of subindex II.	6. Air transport infrastructure 7. Ground transport infrastructure 8. Tourism infrastructure 9. ICT infrastructure 10. Price competitiveness in the T&T industry	6. Air transport infrastructure 7. Ground transport infrastructure 8. Tourism infrastructure 9. ICT infrastructure 10. Price competitiveness in the T&T industry	6. Prioritization of Travel and Tourism (TT) 7. International Openness (IO) 8. Price Competitiveness (PC) 9. Environmental Sustainability (ES)
Subindex III.	T&T human, cultural, and natural resources	T&T human, cultural, and natural resources.	Infrastructure
Pillars of subindex III.	11. Human resources 12. National tourism perception 13. Natural and cultural resources	11. Human resources 12. Affinity for Travel & Tourism 13. Natural resources 14. Cultural resources	10. Air Transport Infrastructure (ATI) 11. Ground and Port Infrastructure (GPI) 12. Tourist Service Infrastructure (TSI)
Subindex IV.			Natural and Cultural Resources
Pillars of subindex IV.			13. Natural Resources (NR) 14. Cultural Resources and Business Travel (CRB)

Source: Own processing

As we mentioned the T&T Competitiveness Index methodology, names of subindexes, and pillars have been changed in 2015. In new methodology is to form 14 pillars used 90 instead of 79 indicators. The five pillars which form first subindex Enabling Environment are directly linked to economic growth. The second subindex Prioritization of T&T is consist of four pillars which can direct measure of observable T&T policies (Prioritization of Travel and Tourism), which can directly impact tourists' decision to select a destination (International Openness, Price Competitiveness) and which indicates to what extent natural capital is being conserved (Environmental Sustainability). The third subindex Infrastructure is isolated from 2015 because connectivity and hospitality infrastructure which is assessed more clearly, will allow accurate information to policymakers. Last subindex Natural and Cultural Resources was also isolated, because these two heritages can constitute main reason to visit a country (World Economic Forum, 2015).

2 Data and Methodology

Our dataset consist of values of Travel and Tourism Competitiveness Index and its pillars among 141 countries from the year 2015. The names of pillars are mentioned it the table 1.

The effect of change in the selected pillar depending on the other pillars would be tested by using simple ordinary least squares method, which describes conditional mean of response variable as a linear function of explanatory variable. But in our study, we focus on these relationships of investigated variables by using quantile regression. According to Agresti (2015), quantile regression models quantiles of a response variable as a function of explanatory variables. This method can be less severely affected by outliers than is ordinary least squares. When the response conditional distributions are highly skewed with possibly highly non-constant variance, the method can describe the relationship better than a simple normal model with constant variance. Quantile regression model fitting minimizes of a weighted sum of absolute residuals, formulated as a linear programming problem. However, when the normal linear model truly holds, the least squares estimators are much more efficient.

Koenker and Bassett (1978) specified the τ-th regression quantile function as $Q(\tau \mid x) = x^T \beta(\tau)$ and consider of $\hat{\beta}(\tau)$ solving

$$\min_{\beta \in R^p} \sum_{i=1}^{n} \rho_\tau \left(y_i - x_i^T \beta \right) \qquad (1)$$

with check function $\rho_\tau(u) = u\tau$ for $u \geq 0$ and $\rho_\tau(u) = u(\tau - 1)$ for $u < 0$. Quantile regression problem may be reformulated as a linear program.

As reported by Fenske (2012), quantiles are defined based on the cumulative distribution function (*cdf*) F_Y of a continuous random variable *Y*. The $\tau \cdot 100\%$ quantile of *Y* can be written as a value, y_τ where

$$F_Y(y_\tau) = P(Y \leq y_\tau) = \int_{-\infty}^{y_\tau} f(u)du = \tau \qquad (2)$$

for $\tau \in (0,1)$. It is only unique if F_Y is strictly monotonic increasing. In case that information on an additional random variable *X* is given, the quantile can similarly be expressed conditional on *X* is equal *x*:

$$F_Y(y_\tau(x) | X = x) = P(Y \leq y_\tau(x) | X = x) = \tau \qquad (3)$$

The quantile function $Q_Y(\tau | X = x)$ is defined as the smallest *y* where the quantile property is fulfilled. If F_Y is strictly increasing, the quantile function is set to the inverse of the *cdf* of *Y*. The relationship between quantile function and *cdf* can be expressed as

$$F_Y(y_\tau(x) | X = x) = \tau \Leftrightarrow Q_Y(\tau | X = x) = y_\tau(x) \qquad (4)$$

for strictly increasing F_Y, which emphasizes that the quantile function describes $\tau \cdot 100\%$ quantiles of *Y* depending on covariates *x* and a quantile parameter $\tau \in (0,1)$.

Quantile regression is an approach to model the conditional quantile function of a continuous variable of interest *Y*, e.g. response variable, depending on further variables or covariates *X*. In the linear model it can be expressed as $y_i = x_i^T \beta_\tau + \varepsilon_{\tau i}, \quad i = 1,2,\ldots,n$. The index $i, \quad i = 1,2,\ldots,n$, denotes the observation, y_i is the response value and $x_i = (1, x_{i1},\ldots,x_{ip})^T$ is the given covariate vector for observation i. The quantile-specific linear effects are denoted by $\beta_\tau = (\beta_{\tau 0}, \beta_{\tau 1},\ldots,\beta_{\tau p})^T$, and $\tau \in (0,1)$ indicates a quantile parameter which has to be fixed in advance. The random variable $\varepsilon_{\tau i}$ is assumed to be an unknown error term with *cdf* $F_{\varepsilon_{\tau i}}$ and density $f_{\varepsilon_{\tau i}}$ depending on quantile parameter τ and observation i. For quantile regression, no specific assumptions are made apart from $\varepsilon_{\tau i}$ and $\varepsilon_{\tau j}$ being independent for $i \neq j$, and $\int_{-\infty}^{0} f_{\varepsilon_{\tau i}}(\varepsilon_{\tau i})d\varepsilon_{\tau i} = F_{\varepsilon_{\tau i}}(0) = \tau$. Due to this assumption, the quantile function $Q_{Y_i}(\tau | x_i)$ of the response variable Y_i conditional on covariate vector x_i at a given quantile parameter τ is equal to $x_i^T \beta_\tau$.Thus, the parameter $\beta_{\tau 1}$, for example, can be interpreted as the change of the conditional quantile function when x_{i1} changes to $x_{i1} + 1$, given all other covariates remain constant (Fenske, 2012).

Results

Table 2 gradually shows coefficients of 13 pillars as dependent variable, which were estimated at the 15th, 20th, 25th, 40th, 50th, 60th, 70th, 75th, 80th and 85th quantile levels using multiple quantile regression on the other pillars (14th pillar has been omitted due to the range). The tests of significance were based on the robust bootstrap estimations of standard errors (Koenker, Hallock, 2001). There can be seen in detail the relationship of each selected quantiles of dependent variable on the remaining twelve variables.

Tab. 2: Estimated parameters as a results of 13 multiple quantile regressions

Dependent: BE												
τ	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	-0.061	-0.284[b]	0.795[d]	0.093	0.013	0.023	0.119	0.238	0.260[b]	0.210	-0.143	-0.205[b]
0.20	-0.075	-0.288[c]	0.674[c]	0.223	0.084	-0.067	0.078	0.176	0.214[b]	0.185	-0.142	-0.202[b]
0.25	-0.057	-0.294[d]	0.658[c]	0.246	0.089	-0.025	0.085	0.131	0.217[d]	0.143	-0.147[a]	-0.185[c]
0.30	-0.026	-0.323[d]	0.631[d]	0.259[a]	0.084	-0.024	0.096	0.114	0.217[d]	0.134	-0.136[b]	-0.177[c]
0.40	0.006	-0.330[d]	0.549[c]	0.341[c]	0.199[c]	-0.035	0.118	0.103	0.210[d]	0.068	-0.151[b]	-0.192[b]
0.50	0.100	-0.328[d]	0.349[b]	0.351[c]	0.182[b]	-0.020	0.119	0.052	0.175[b]	0.078	-0.133[a]	-0.128
0.60	0.094	-0.267[d]	0.310[b]	0.295[d]	0.133	-0.059	0.150[a]	0.096	0.188[b]	0.131	-0.114	-0.046
0.70	0.140[b]	-0.209[c]	0.343[b]	0.245[c]	0.209[b]	-0.109[a]	0.109	0.081	0.138[a]	0.109 [a]	-0.097	-0.074
0.75	0.130[b]	-0.210[c]	0.331[b]	0.250[c]	0.210[b]	-0.100	0.080	0.068	0.118	0.121 [b]	-0.104	-0.059
0.80	0.150[b]	-0.241[d]	0.392[b]	0.262[c]	0.147	-0.070	0.142[a]	0.104	0.127	0.130 [b]	-0.100	-0.076
0.85	0.156[a]	-0.250[c]	0.301	0.304[b]	0.143	-0.074	0.100	0.053	0.093	0.128 [a]	-0.071	-0.064
Dependent: SS												
τ	**BE**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	0.264	0.137	0.609	0.039	-0.204	-0.104	-0.124	0.763[c]	-0.125	-0.070	-0.044	-0.160
0.20	0.153	0.089	0.943[a]	0.003	-0.097	-0.097	0.008	0.721[c]	-0.098	0.031	-0.114	-0.118
0.25	0.086	0.054	0.820[b]	0.073	-0.074	-0.154	0.023	0.687[c]	-0.055	0.094	-0.120	-0.013
0.30	0.115	0.076	0.769[a]	0.028	-0.114	-0.109	-0.029	0.628[c]	-0.032	0.089	-0.131	-0.059
0.40	0.256	0.066	0.514	0.046	-0.058	-0.081	0.077	0.415[b]	-0.016	0.067	-0.051	-0.061
0.50	0.036	0.025	0.543[a]	0.056	0.084	-0.152	-0.003	0.366[a]	-0.018	0.107	-0.061	-0.063
0.60	0.186	0.001	0.319	0.164	0.037	-0.190	0.018	0.189	-0.085	0.090	0.050	-0.007
0.70	0.196	0.020	0.207	0.098	-0.009	-0.098	0.009	0.224	0.006	0.031	0.083	-0.078
0.75	0.199	-0.004	0.188	0.093	-0.007	-0.098	-0.008	0.282[b]	0.021	0.015	0.067	-0.084
0.80	0.176	0.013	0.151	0.105	-0.034	-0.088	0.014	0.312[b]	0.025	0.027	0.060	-0.069
0.85	0.145	0.008	0.115	0.144	-0.012	-0.073	0.039	0.276	0.018	-0.001	0.074	-0.032
Dependent: HH												
τ	**BE**	**SS**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	-0.761[c]	-0.035	0.231	0.951[d]	0.149	0.092	0.034	-0.100	-0.041	-0.122	0.260[a]	-0.240[b]
0.20	-0.778[d]	-0.054	0.250	0.982[d]	0.148	0.078	-0.048	-0.053	-0.009	-0.166	0.228[a]	-0.268[c]
0.25	-0.751[d]	0.010	0.282	1.047[d]	0.158	0.086	-0.006	-0.149	-0.033	-0.153	0.156	-0.239[b]
0.30	-0.781[d]	-0.006	0.322	1.016[d]	0.168	0.065	-0.042	-0.152	-0.026	-0.058	0.118	-0.231[b]
0.40	-0.679[d]	0.075	0.537[a]	0.830[d]	0.097	0.068	-0.024	-0.283	-0.015	-0.007	0.075	-0.210[b]
0.50	-0.629[d]	0.031	0.514	0.828[d]	0.073	-0.045	0.069	-0.156	-0.056	0.060	0.083	-0.187[a]

0.60	-0.689[d]	0.106	0.837[b]	0.675[d]	-0.028	0.063	0.008	-0.216	0.024	-0.057	0.072	-0.296[b]
0.70	-0.697[c]	0.000	0.881[b]	0.655[c]	-0.018	-0.033	0.075	-0.110	0.013	0.007	0.092	-0.299[b]
0.75	-0.802[c]	0.042	0.932[c]	0.513[b]	0.078	-0.037	0.056	-0.101	0.071	0.086	0.119	-0.348[c]
0.80	-0.673[c]	0.111	1.006[c]	0.364[a]	0.093	-0.119	0.112	-0.163	0.057	0.101	0.160	-0.297[b]
0.85	-0.624[b]	0.106	1.058[d]	0.322[a]	0.045	-0.093	0.119	-0.130	0.074	0.062	0.206	-0.276
Dependent: HRL												
τ	**BE**	**SS**	**HH**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	0.305[c]	-0.008	0.278[b]	0.135	0.020	0.158[b]	-0.007	-0.063	-0.044	-0.020	-0.071	0.092
0.20	0.226[b]	0.075	0.226[c]	0.123	0.056	0.193[c]	0.056	-0.063	0.020	-0.063	-0.067	0.067
0.25	0.234[c]	0.076	0.212[c]	0.138[a]	0.087	0.180[c]	0.031	-0.066	0.011	-0.058	-0.075	0.076
0.30	0.248[d]	0.060	0.189[c]	0.162[b]	0.109[a]	0.161[c]	0.035	-0.064	-0.009	-0.054	-0.061	0.086[a]
0.40	0.279[d]	0.056	0.144[b]	0.160[b]	0.107[b]	0.133[c]	0.016	-0.086	-0.033	-0.035	-0.026	0.076[b]
0.50	0.258[d]	0.057	0.146[c]	0.157[b]	0.133[b]	0.113[c]	0.006	-0.060	-0.019	-0.040	-0.045	0.057
0.60	0.230[c]	0.073[a]	0.186[c]	0.107	0.117[b]	0.069	-0.017	-0.021	0.050	-0.048	-0.072	0.056
0.70	0.220[c]	0.093[b]	0.093	0.180[b]	0.125[a]	0.046	-0.049	-0.071	-0.009	-0.049	-0.036	0.031
0.75	0.240[c]	0.106[b]	0.087	0.171[b]	0.112[a]	0.044	-0.074	-0.092	-0.015	-0.048	-0.029	0.047
0.80	0.337[c]	0.138[c]	0.085	0.139[a]	0.106	0.025	-0.108	-0.169[a]	-0.055	-0.067	0.012	0.094
0.85	0.316[b]	0.145[b]	0.056	0.177[a]	0.111	0.017	-0.081	-0.158	-0.060	-0.067	0.009	0.105
Dependent: ICT												
τ	**BE**	**SS**	**HH**	**HRL**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	0.382	0.045	0.321[b]	0.179	-0.254	0.074	0.000	0.092	0.094	0.073	0.343[b]	0.069
0.20	0.328	0.022	0.346[c]	0.076	-0.287	0.062	0.036	0.166	0.099	0.142	0.311[b]	0.100
0.25	0.298	0.071	0.345[c]	0.217	-0.260[a]	0.035	0.129	0.137	0.076	0.239[a]	0.228[a]	0.139
0.30	0.318	0.052	0.349[c]	0.237	-0.194	0.001	0.087	0.179	0.041	0.203[b]	0.237[a]	0.114
0.40	0.472[c]	0.055	0.455[d]	0.084	-0.152	0.056	0.020	0.150	0.018	0.194[b]	0.120	0.160[a]
0.50	0.461[c]	0.033	0.442[d]	0.185	-0.246[c]	0.042	0.010	0.195	0.069	0.128	0.146	0.140[a]
0.60	0.409[c]	0.037	0.422[d]	0.253	-0.210[b]	0.015	-0.013	0.188	0.078	0.150[a]	0.128	0.131[a]
0.70	0.354[b]	0.067	0.445[d]	0.315	-0.214[b]	-0.012	-0.044	0.165	0.127	0.105	0.109	0.091
0.75	0.286[a]	0.112	0.416[d]	0.332	-0.193[a]	-0.007	-0.029	0.212	0.144	0.126	0.075	0.090
0.80	0.338[b]	0.039	0.442[d]	0.389[a]	-0.211[a]	-0.099	-0.102	0.107	0.147	0.122	0.091	0.048
0.85	0.337[b]	0.017	0.450[d]	0.493[b]	-0.232[a]	-0.111	-0.030	0.094	0.159	0.102	0.106	0.029
Dependent: TT												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	0.357	0.013	-0.004	0.190	-0.261	0.272[a]	-0.011	0.042	0.035	-0.079	0.337[c]	0.064
0.20	0.331	-0.059	0.119	0.251	-0.331[b]	0.252[b]	0.002	0.154	0.045	-0.046	0.252[b]	0.067
0.25	0.323[a]	-0.076	0.105	0.320	-0.309[b]	0.221[b]	-0.039	0.046	0.079	-0.056	0.270[c]	-0.021
0.30	0.407[b]	-0.088	0.110	0.278	-0.361[c]	0.198[b]	-0.019	0.002	0.054	-0.017	0.311[c]	0.021
0.40	0.381[b]	-0.097	0.089	0.303	-0.397[c]	0.175[b]	0.002	0.008	0.050	-0.001	0.422[d]	-0.012
0.50	0.283[a]	-0.023	-0.025	0.375	-0.274[b]	0.123	0.016	-0.046	-0.051	0.052	0.395[d]	0.075
0.60	0.179	-0.018	-0.062	0.586[c]	-0.399[c]	0.078	0.039	-0.037	0.112	0.066	0.377[c]	-0.001
0.70	0.186	-0.057	-0.098	0.659[b]	-0.346[b]	0.127	-0.023	-0.167	0.045	0.061	0.421[d]	-0.064
0.75	0.153	-0.067	-0.014	0.613[a]	-0.422[a]	0.100	0.033	-0.121	0.000	0.163	0.470[d]	-0.041
0.80	0.129	-0.025	-0.020	0.693[a]	-0.445[a]	0.108	0.011	-0.158	0.026	0.127	0.456[d]	-0.051
0.85	0.140	0.009	-0.161	0.667	-0.223	0.027	0.057	-0.277	-0.045	0.223	0.377[c]	-0.072
Dependent: IO												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**PC**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	-0.161	-0.067	0.021	0.266	0.043	0.267	-0.196	0.077	-0.099	0.257	0.025	0.204
0.20	-0.106	-0.018	0.013	0.237	0.014	0.275[a]	-0.219	-0.022	-0.158	0.218	0.143	0.221[a]

0.25	-0.049	-0.087	0.058	0.232	-0.040	0.288[b]	-0.203	-0.020	-0.122	0.293[a]	0.084	0.215[a]
0.30	-0.065	-0.111	0.076	0.307	-0.091	0.260[a]	-0.142	0.040	-0.127	0.351[b]	0.081	0.212[a]
0.40	-0.022	-0.087	0.102	0.363	-0.024	0.280[a]	-0.188	0.062	-0.127	0.185	0.050	0.274[b]
0.50	-0.158	-0.287	0.213	0.498	-0.071	0.103	-0.029	0.397	0.007	0.279[a]	0.034	0.158
0.60	-0.109	-0.201	0.010	0.480	0.032	0.172	0.085	0.334	-0.052	0.252[a]	0.125	0.141
0.70	0.022	-0.303[a]	0.040	0.405	0.000	0.191	0.062	0.328	-0.061	0.203	0.126	0.172
0.75	0.036	-0.350[a]	0.003	0.488	-0.044	0.235	-0.002	0.329	-0.082	0.220	0.125	0.165
0.80	-0.041	-0.300	-0.089	0.426	0.070	0.169	-0.009	0.291	-0.066	0.177	0.156	0.146
0.85	-0.116	-0.288	-0.139	0.343	0.284	0.045	0.151	0.315	-0.001	0.071	0.155	0.044
Dependent: PC												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**ES**	**ATI**	**GPI**	**TSI**	**NR**
0.15	0.185	-0.012	0.044	0.005	-0.052	-0.071	-0.018	-0.437[a]	-0.064	-0.113	0.022	-0.227
0.20	0.409	0.050	0.177	-0.205	-0.086	-0.104	0.104	-0.499[b]	-0.275	-0.197[b]	0.030	0.008
0.25	0.318	-0.047	0.104	0.095	-0.140	-0.042	-0.100	-0.471[c]	-0.157	-0.132	0.004	0.023
0.30	0.299	-0.029	0.087	0.085	-0.104	-0.103	-0.038	-0.505[c]	-0.154	-0.137	0.012	-0.013
0.40	0.372[b]	-0.114	0.035	0.073	-0.057	-0.157	-0.017	-0.567[d]	-0.268[b]	-0.094	0.086	0.039
0.50	0.360[b]	-0.136	-0.009	-0.055	0.049	-0.114	-0.103	-0.540[c]	-0.256[b]	-0.083	0.079	-0.003
0.60	0.273	-0.074	-0.020	-0.085	0.085	-0.096	-0.127	-0.655[d]	-0.265[b]	0.002	0.069	0.018
0.70	0.253	-0.160	-0.017	-0.160	0.121	-0.049	-0.088	-0.453[b]	-0.100	0.069	-0.085	-0.038
0.75	0.253	-0.168	-0.014	-0.232	0.135	-0.022	-0.067	-0.330	-0.034	0.019	-0.130	-0.046
0.80	0.252	-0.150	-0.015	-0.334	0.151	-0.050	-0.047	-0.228	-0.004	-0.021	-0.141	-0.023
0.85	0.325	-0.132	0.059	-0.441	0.105	-0.081	-0.023	-0.136	0.048	-0.103	-0.163	0.008
Dependent: ES												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ATI**	**GPI**	**TSI**	**NR**
0.15	0.104	0.306[b]	-0.136	-0.283	0.245	-0.123	0.184	-0.230[a]	-0.244	0.017	0.073	0.083
0.20	0.121	0.236[c]	-0.131	-0.278	0.209	-0.131	0.200	-0.231[a]	-0.205	0.009	0.100	0.077
0.25	0.177	0.212[b]	-0.138	-0.098	0.202	-0.173	0.089	-0.238[b]	-0.217	-0.015	0.145	0.087
0.30	0.155	0.191[b]	-0.131	-0.107	0.252	-0.114	0.044	-0.309[c]	-0.198[a]	-0.010	0.102	0.068
0.40	0.121	0.233[b]	-0.151	0.017	0.175	-0.166	0.059	-0.306[c]	-0.193[b]	0.010	0.169[a]	0.031
0.50	0.166	0.228[c]	-0.145[a]	-0.088	0.139	-0.183	0.031	-0.296[c]	-0.183[b]	0.049	0.208[b]	0.006
0.60	0.132	0.217[c]	-0.179[a]	-0.120	0.145	-0.161	0.036	-0.315[c]	-0.111	0.035	0.226[b]	-0.037
0.70	0.256[a]	0.212[a]	-0.076	-0.228	0.150	-0.076	0.047	-0.267[b]	-0.116	0.031	0.117	-0.028
0.75	0.191	0.152	-0.062	-0.188	0.141	0.036	0.022	-0.262[b]	-0.119	0.076	0.058	-0.042
0.80	0.251	0.099	-0.128	-0.176	0.135	-0.014	-0.030	-0.289[b]	-0.135	0.118	0.123	-0.074
0.85	0.248	0.100	-0.139	-0.192	0.104	-0.015	0.001	-0.252[b]	-0.125	0.124	0.181	-0.122
Dependent: ATI												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**GPI**	**TSI**	**NR**
0.15	0.138	0.007	-0.041	-0.051	0.291	0.114	-0.084	-0.116	-0.248	0.303[b]	0.083	0.243[a]
0.20	0.154	0.004	-0.036	-0.063	0.292	0.106	-0.085	-0.146	-0.245	0.294[b]	0.080	0.237[a]
0.25	0.217	-0.029	0.015	-0.063	0.248	0.063	-0.054	-0.142	-0.238	0.282[a]	0.077	0.241[b]
0.30	0.225	-0.050	0.004	-0.094	0.272[a]	0.086	-0.033	-0.175	-0.270[a]	0.273[b]	0.082	0.258[b]
0.40	0.271	-0.011	0.066	-0.052	0.187	0.090	-0.099	-0.168	-0.261	0.338[c]	0.052	0.425[d]
0.50	0.419[c]	0.077	0.068	-0.412	0.266	0.041	-0.046	-0.078	-0.239	0.328[b]	0.082	0.441[d]
0.60	0.450[c]	0.066	0.026	-0.368	0.267	0.051	-0.031	-0.064	-0.224	0.323[b]	0.114	0.420[d]
0.70	0.506[c]	0.067	0.055	-0.282	0.158	0.086	0.006	-0.070	-0.207	0.320[b]	0.129	0.410[d]
0.75	0.598[c]	-0.099	0.134	-0.197	0.104	0.063	-0.010	-0.127	-0.261	0.303[a]	0.111	0.481[d]
0.80	0.550[b]	-0.132	0.156	-0.250	0.189	0.105	0.009	-0.112	-0.279	0.226	0.126	0.444[c]
0.85	0.554	-0.173	0.084	-0.110	0.167	0.056	0.007	-0.181	-0.282	0.184	0.186	0.420[c]

Dependent: GPI												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**TSI**	**NR**
0.15	0.088	0.013	-0.230	0.290	0.371	0.025	0.117	0.047	0.076	0.200[b]	0.046	-0.264[c]
0.20	0.064	0.015	-0.234[a]	0.307	0.402	0.052	0.127	0.035	0.125	0.225[b]	-0.010	-0.268[b]
0.25	0.012	0.069	-0.174	0.266	0.325	0.131	0.117	-0.017	0.174	0.306[c]	-0.035	-0.242[b]
0.30	0.131	0.071	-0.101	0.097	0.195	0.147	0.091	-0.099	0.162	0.294[b]	0.051	-0.146
0.40	0.304	0.077	-0.001	0.010	0.276	-0.010	0.172	-0.115	0.142	0.213	-0.029	-0.044
0.50	0.432[a]	0.076	0.089	-0.029	0.196	-0.096	0.293[b]	-0.153	0.082	0.158	0.011	-0.064
0.60	0.478[b]	0.079	0.070	-0.206	0.228	-0.019	0.269[b]	-0.202	0.135	0.197	0.019	-0.102
0.70	0.510[b]	0.024	0.071	-0.197	0.227	-0.028	0.233	-0.266	0.123	0.272	0.031	-0.130
0.75	0.514[b]	-0.017	0.085	-0.127	0.232	-0.012	0.209	-0.288	0.073	0.245	0.014	-0.088
0.80	0.524[c]	0.105	0.172	-0.378	0.219	0.069	0.120	-0.001	0.148	0.287	0.061	-0.046
0.85	0.475[a]	0.029	0.068	-0.245	0.287	0.082	0.142	-0.013	0.127	0.289	0.104	-0.113
Dependent: TSI												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**NR**
0.15	-0.067	-0.062	0.140	-0.276	0.487[b]	0.329	0.102	-0.031	0.284	0.057	-0.017	0.072
0.20	-0.116	0.033	0.199	-0.592	0.570[b]	0.546[c]	0.051	-0.030	0.221	0.096	-0.054	0.065
0.25	-0.196	0.098	0.176	-0.582[a]	0.573[c]	0.593[c]	0.101	0.002	0.169	0.119	-0.048	0.041
0.30	-0.288	0.102	0.200	-0.554[a]	0.585[c]	0.574[d]	0.148	-0.024	0.078	0.088	-0.032	0.049
0.40	-0.372	0.036	0.078	-0.284	0.601[c]	0.593[d]	-0.040	-0.052	0.185	0.132	0.185	0.030
0.50	-0.392[a]	0.021	0.082	-0.207	0.488[b]	0.585[d]	0.002	-0.017	0.277	0.225	0.119	0.004
0.60	-0.272	-0.006	0.155	-0.392	0.555[c]	0.536[d]	0.056	-0.116	0.246	0.194	0.087	-0.025
0.70	-0.403	-0.007	0.119	-0.112	0.455[a]	0.621[c]	0.045	-0.035	0.241	0.204[a]	0.115	0.013
0.75	-0.257	-0.109	0.252	-0.083	0.314	0.558[c]	0.035	-0.077	0.170	0.151	0.143	0.085
0.80	-0.179	-0.240	0.268	-0.082	0.330	0.516[b]	0.102	0.022	0.323	0.137	0.102	0.091
0.85	-0.249	-0.199	0.211	-0.079	0.401	0.466[a]	0.147	0.103	0.294	0.109	0.216	0.140
Dependent: NR												
τ	**BE**	**SS**	**HH**	**HRL**	**ICT**	**TT**	**IO**	**PC**	**ES**	**ATI**	**GPI**	**TSI**
0.15	-0.238	-0.152	-0.293	0.867[b]	0.051	-0.034	0.123	-0.131	0.155	0.356[a]	-0.335	-0.008
0.20	-0.477	-0.022	-0.383[b]	0.707[a]	0.181	0.001	0.108	-0.035	0.045	0.387[b]	-0.336[a]	0.045
0.25	-0.503	-0.030	-0.347[b]	0.653[b]	0.167	-0.064	0.162	-0.023	0.120	0.403[b]	-0.346[b]	0.052
0.30	-0.468	-0.027	-0.430[c]	0.686[b]	0.167	-0.045	0.276[b]	-0.004	-0.009	0.546[c]	-0.422[b]	0.046
0.40	-0.707[b]	-0.049	-0.394[c]	0.780[b]	0.202	-0.033	0.296[b]	0.024	0.073	0.565[d]	-0.290[a]	-0.075
0.50	-0.616[b]	-0.008	-0.430[d]	0.491	0.226	0.045	0.361[b]	0.002	-0.058	0.630[d]	-0.261	-0.060
0.60	-0.530[b]	-0.029	-0.385[c]	0.245	0.161	0.030	0.311[a]	0.075	0.043	0.667[d]	-0.185	0.033
0.70	-0.540[b]	-0.154	-0.364[b]	0.470	-0.068	-0.049	0.217	0.097	0.289	0.808[d]	-0.161	0.149
0.75	-0.619[b]	-0.146	-0.419[a]	0.500	-0.004	-0.046	0.166	0.099	0.280	0.835[d]	-0.156	0.127
0.80	-0.601[b]	-0.185	-0.507[b]	0.476	0.036	0.153	0.241	-0.076	0.031	0.644[c]	-0.174	0.223
0.85	-0.645[b]	-0.069	-0.616[b]	0.899[a]	-0.032	-0.021	0.188	-0.077	-0.043	0.619[b]	-0.199	0.303

Source: Author's own calculations in R

Notes: "*a*", "*b*", "*c*", "*d*" denotes 10%, 5%, 1%, and 0.1% significance level; vertical lines divide sub-indexes.

Conclusion

Quantile regression allows us to capture changes at various quantile levels. Pattern of results of simple quantile regression of all pairs of variables (not reported there) shows the significance of the vast majority of cases. The results of 13 multiple quantile regressions presented in Table

2 provide a better understanding of the relationships between pillars inside and outside the subindexes at various quantile levels. For example, *Tourist Service Infrastructure* (TSI) depends only on *ICT Readiness* (ICT) up to 0.7 quantile level and on *T&T Policy and Enabling* (TT) from 0.2 quantile level and both these independent variables are from other various subindexes like TSI.

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