How to measure banking regulation and supervision

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AGENDA

- 1. Motivation (inc. literature review)
- 2. Objectives of the study
- 3. Sample and methodology
- 4. Results and discussion
- 5. Conclusion and contributions

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1. MOTIVATION

- Previous research on banking regulation and supervision (RS):
  - Collection and comparison of countries' practices (Barth *et al.*, 2006; Barth *et al.*, 2008; Cihak *et al.*, 2012; Anginer *et al.*, 2019);
  - RS compliance with given quality standards (Neyapti and Dincer, 2005; Cihak and Tieman, 2008);
  - Basel core principles (Aiyar *et al.*, 2015; Jacques, 2017);
  - Capital regulation structure/capital adequacy (Wall and Peterson, 1996, *inter alia*);

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1. MOTIVATION

- Previous research on banking regulation and supervision (RS):
  - Relation between RS practices and banks efficiency (Barth *et al.* 2013; Yang *et al.*, 2019);
  - Supervisory independence (Barth *et al.* 2013a);
  - Supranational supervision (Beck and Wagner, 2016);
  - Use of single variables related to capital requirements, deposit insurance or market discipline;
  - …

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1. MOTIVATION

- Efforts to provide a big picture of banking RS around the world, at institutional level:

  - IMF and World Bank inventories and assessments of countries' RS practices → the Financial Sector Assessment Program (FSAP);
  - Bank Regulation and Supervision Survey (BRSS).

Conducted by the World Bank and answered by the official regulatory and supervisory authorities of each country, has been collecting comparable data across the participant countries since 1997, providing comprehensive information on RS practices for more than 100 central banks worldwide.

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1. MOTIVATION

- Bank Regulation and Supervision Survey (BRSS)

This information has not been fully exploited by scientific papers:
- one or two survey answers as a proxy for banking RS;
- compare responses from the different versions of the survey;
- assess banking RS evolution or efficiency;
- construct partial indices, related to specific domains of RS;
- find differences between regulatory and supervisory practices of countries with and without banking crises.

See *inter alia* Barth *et al.* (2004, 2006, 2008), Barth et al. (2013a), Pereira Pedro *et al.* (2018), Swamy (2018), Anginer *et al.* (2019) and Yang *et al.* (2019).

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2. OBJECTIVES OF THE STUDY

- (Using partial information) Previous studies allowed a better understanding of RS progression and its adjustments to systemic events (such as banking crises).

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fragmented and limited vision of the phenomenon

Aim of the study: To summarize the vast range of information provided by the BRSS using proper statistical methods to concisely identify variables characterizing RS practices around the world.

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Representing the most suitable proxies to measure RS.

In general terms: Offer an extensive perspective of the RS international scenario.

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3. SAMPLE AND METHODOLOGY

- **Sample**: 141 countries

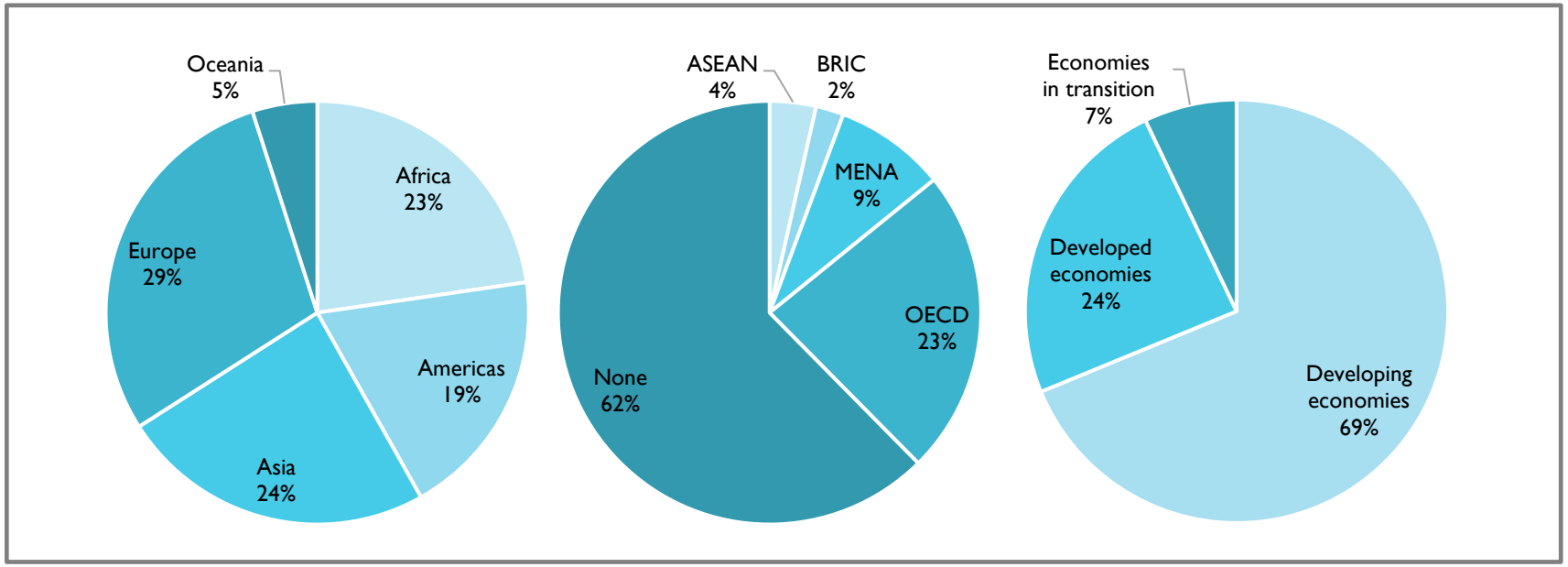

Fig. 1 Sample description, by continental regions, political and economic alliances, and country development level. *Source:* Authors' calculations.

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3. SAMPLE AND METHODOLOGY

- **Data source**: 2012 version of the BRSS2011 (last final version available).

- Topics:
  - entry into banking;
  - ownership;
  - capital;
  - activities;
  - external auditing requirements;
  - internal management requirements;
  - liquidity and diversification requirements;
  - depositors' (savings) protection schemes;
  - provision requirement);
  - information disclosure;
  - discipline/problem institution/exit;
  - supervision.

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3. SAMPLE AND METHODOLOGY

- Quantitative and qualitative variables (119 variables) → Nonlinear principal components analysis (NLPCA) with optimal variable transformation (optimal scaling)

- NLPCA is a statistical method useful:
  - the presence of a large number of variables inhibits an efficient analysis of the relationships between subjects (countries in this case) and observed variables (some of which have a categorical nature),
  - promoting a simultaneous quantification of categorical variables and reduction of data dimensionality.

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3. SAMPLE AND METHODOLOGY

- To apply NLPCA to our data, we used the *categorical principal components analysis* (CATPCA) script of the SPSS software:

  - CAPTCA converts string variables into positive integers by ascending alphanumeric order;
  - (to obtain the optimal quantification of each category) it minimizes a least-squares loss function that measures the loss of information resulting from the transformation of the original set of variables into a smaller group (the principal components), Linting *et al.* (2007).

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In contrast to the original categorical variables, their numerical quantification has metrical properties and can be represented as a vector in the space determined for the objects.

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3. SAMPLE AND METHODOLOGY

- CATPCA:
  - The coordinates of the vectors are given by the component loadings, i.e. the (Pearson) correlations between the quantified variables and the principal components (weighted sums of the quantified variables).
  - The coordinates of each country in each principal component are called object scores.
  - In addition to the vector model, CATPCA also provides the centroid model, which assigns coordinates to each category that are then represented in the same space as the countries.

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3. SAMPLE AND METHODOLOGY

- Joint objective function for CATPCA:
  - Linear combination of the loss function of the vector model and the objective function of the centroid model.

Part 1: is minimized for the *m* variables represented as a vector

$$L(\mathbf{Y};\mathbf{A};\mathbf{X}) = (M_V + M_B)^{-1}[M_V L_V(\mathbf{y}_V;\mathbf{A};\mathbf{X}) + M_B L_B(\mathbf{Y}_B;\mathbf{X})]$$

Part 2: is minimized for the representation of the categorical variables

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3. SAMPLE AND METHODOLOGY

- The optimal $\hat{X}$ is given by:

$$\hat{\mathbf{X}} = M^{-1}\left[\sum_{m\in K_V} \mathbf{G}_m \mathbf{y}_m \mathbf{a}'_m + \sum_{m\in K_B} \mathbf{G}_m \mathbf{Y}_m\right]$$

Allows object scores to be orthonormalized as $\hat{X}'\hat{X} = N\mathbf{I}$ (uncorrelated).

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4. RESULTS AND DISCUSSION

- Extraction methods for principal components:

1. Kaiser criterion (in association with C-alpha coefficient > 0);
   - Retain PC whose eigenvalues (variance accounted for each PC) > 1

2. Scree plot visual analysis
   - Retain PC until the "elbow" shape (little information is added when eigenvalues drop sharply)

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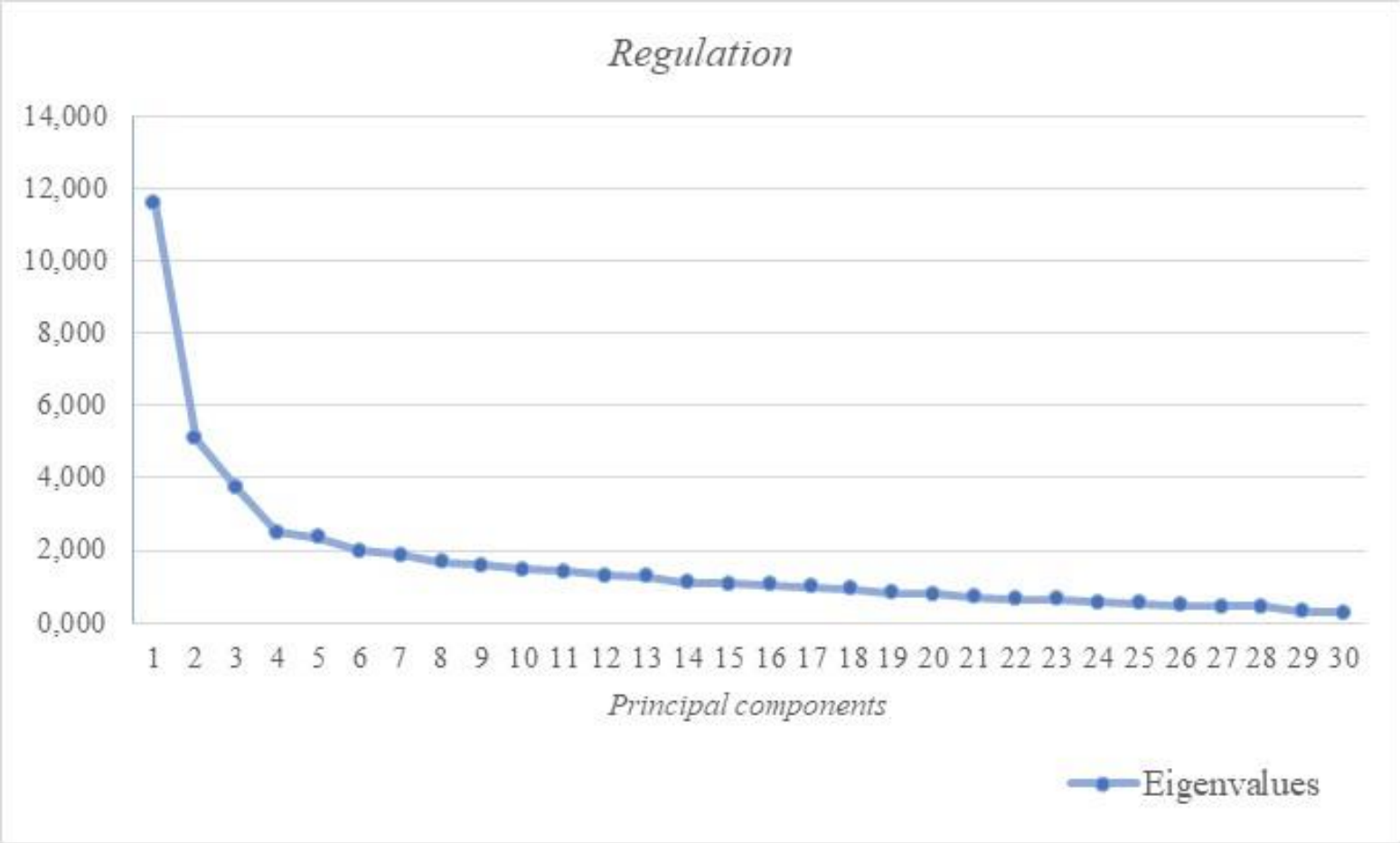

Fig. 2 Scree plot, regulation. *Source*: Authors' calculations.

Scree plot results from CATPCA estimates for 82 variables, including 30 as analysis variables (corresponds to the number of PC in the graphic) and the remaining as supplementary variables. These 30 PC explain 97.59% of the total variance of the model. Hence, only a small % of variance (2.41%) is explained by the supplementary variables (all quantitative variables were assumed as supplementary due to their number of missing values).

Table 2 – CATPCA results: regulation

	Kaiser criterion			*Scree plot criterion*		
Dimension	*Cronbach's Alpha*	*Variance accounted for*		*Cronbach's Alpha*	*Variance accounted for*	
		Total (Eigenvalue)	*% of Variance*		*Total (Eigenvalue)*	*% of Variance*
1	0.934	11.884	23.302	0.936	12.164	23.852
2	0.829	5.349	10.488	0.851	6.019	11.802
3	0.766	4.009	7.861	0.764	3.991	7.825
4	0.634	2.641	5.179	0.705	3.238	6.349
5	0.608	2.475	4.852			
6	0.590	2.373	4.653			
7	0.469	1.850	3.627			
8	0.432	1.735	3.402			
9	0.345	1.511	2.964			
10	0.312	1.441	2.826			
11	0.290	1.398	2.740			
12	0.210	1.260	2.471			
13	0.196	1.238	2.427			
14	0.126	1.141	2.236			
15	0.100	1.109	2.174			
Total	0.995[a]	41.413	81.202	0.980[a]	25.412	49.828

a. Total Cronbach's Alpha is based on the total Eigenvalue.

- Small n.º of PC to allow meaningful interpretations;
- Eigenvalues based on the correlation matrix of the quantified variables = clear interpretation of the plot. (Fabrigar *et al.* 1999 and Linting *et al.* 2007)

	Kaiser criterion															*Scree plot method*			
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**1**	**2**	**3**	**4**
Q.1.1	-0,131	0,236	-0,102	-0,209	0,035	-0,241	-0,070	0,179	-0,384	0,068	**0,525**	-0,313	0,058	-0,109	-0,144	-0,080	**0,556**	-0,021	-0,012
Q.1.3	0,018	-0,202	0,059	-0,108	0,154	-0,078	-0,099	0,036	0,229	**0,615**	0,190	0,157	-0,111	0,085	0,069	0,029	-0,217	0,068	0,076
Q.1.4.1	0,024	0,021	-0,085	0,021	0,069	-0,158	-0,126	0,364	0,254	0,293	-0,163	0,425	-0,141	-0,355	0,128	0,022	0,042	-0,093	-0,115
Q.1.4.2	0,218	**0,683**	-0,145	-0,016	-0,013	-0,085	-0,249	-0,047	0,035	-0,117	0,174	-0,009	0,199	-0,210	-0,016	0,225	**0,684**	-0,108	0,040
Q.1.4.3	0,254	-0,027	-0,130	0,215	0,129	0,211	-0,351	0,056	0,362	0,082	-0,083	-0,017	0,217	-0,018	-0,240	0,267	-0,038	-0,138	0,123
Q.1.5	0,162	0,056	0,135	-0,052	-0,009	0,351	-0,375	0,212	0,059	-0,292	0,171	-0,216	-0,154	-0,053	0,305	0,172	0,044	0,132	0,174
Q.1.6	0,009	-0,205	0,271	0,253	-0,021	0,098	0,310	**0,595**	-0,253	-0,056	0,017	0,091	0,008	-0,356	0,157	0,115	**0,718**	-0,092	-0,012
Q.1.8	0,137	0,167	0,075	0,365	0,191	0,412	**0,526**	0,310	-0,066	0,129	-0,101	-0,074	0,194	-0,028	-0,176	-0,297	0,102	-0,067	0,329
Q.1.13	-0,061	0,069	0,062	0,373	**0,555**	**-0,574**	-0,114	0,082	-0,017	0,181	-0,036	-0,117	-0,089	-0,006	0,031	0,196	-0,076	-0,019	**0,619**
Q.2.5.1	-0,101	0,128	**0,786**	-0,076	-0,022	-0,027	0,001	0,092	-0,141	0,101	0,027	-0,014	0,021	-0,344	0,174	-0,106	0,104	**0,766**	0,015
Q.2.6	0,179	0,402	0,428	0,304	0,257	-0,104	0,063	0,350	0,145	-0,183	0,028	0,162	-0,132	0,250	-0,160	0,178	0,384	0,431	-0,069
Q.2.7	0,148	0,459	0,442	0,155	0,110	0,080	0,099	0,372	0,135	-0,254	0,133	0,115	-0,103	0,256	-0,222	0,152	0,432	0,465	-0,027
Q.3.1	-0,268	-0,055	0,101	0,165	-0,608	-0,412	0,296	0,029	-0,031	-0,161	-0,033	0,012	0,178	0,154	0,061	-0,309	-0,039	0,101	-0,661
Q.3.2	-0,230	-0,002	0,031	0,105	-0,650	-0,461	0,082	0,093	0,190	-0,064	-0,010	-0,133	0,053	-0,086	0,062	-0,266	0,054	0,043	-0,717
Q.3.18	0,077	0,060	0,031	-0,231	-0,253	0,461	-0,248	0,325	0,093	0,100	-0,136	-0,129	-0,095	0,213	0,178	0,119	-0,015	0,053	0,285
Q.4.1	-0,065	0,194	**0,924**	-0,152	-0,002	-0,008	-0,056	-0,193	0,084	0,072	0,003	-0,021	0,078	0,015	0,013	-0,057	0,132	**0,952**	0,090
Q.4.2	-0,079	0,192	**0,920**	-0,156	-0,006	-0,020	-0,033	-0,194	0,089	0,078	-0,008	-0,030	0,089	0,019	0,012	-0,099	0,134	**0,943**	0,074
Q.4.3	-0,087	0,182	**0,922**	-0,157	-0,005	-0,021	-0,044	-0,194	0,085	0,081	-0,014	-0,033	0,074	0,014	0,015	-0,100	0,129	**0,943**	0,073
Q.4.4.1	-0,135	-0,079	-0,144	-0,068	-0,062	-0,070	0,189	0,009	**0,582**	0,129	0,368	-0,390	-0,087	-0,206	-0,166	-0,130	0,134	0,089	-0,461
Q.5.1.1	-0,024	0,006	0,028	0,392	0,310	-0,096	-0,282	-0,049	0,137	-0,074	-0,373	-0,378	-0,041	0,100	0,243	0,115	0,049	0,046	-0,038
Q.5.1.2	-0,089	-0,020	-0,077	-0,481	0,319	-0,096	0,263	0,170	0,247	-0,159	-0,162	-0,126	0,147	-0,074	0,284	-0,101	-0,022	-0,040	0,289
Q.7.2	0,232	**0,892**	-0,174	-0,053	-0,073	-0,125	-0,105	-0,036	0,079	-0,120	-0,025	0,094	-0,048	-0,108	-0,042	0,233	**0,910**	-0,119	-0,032
Q.7.2.2	0,235	**0,893**	-0,172	-0,046	-0,073	-0,120	-0,105	-0,032	0,083	-0,116	-0,022	0,093	-0,048	-0,112	-0,040	0,239	**0,910**	-0,122	-0,027
Q.7.4	0,082	**0,675**	-0,172	-0,091	-0,090	-0,165	0,087	-0,008	-0,236	0,191	-0,005	0,002	-0,036	0,228	0,391	0,070	**0,678**	-0,128	-0,066
Q.7.4.1	0,052	**0,704**	-0,180	0,035	0,070	0,113	0,260	-0,061	-0,199	0,361	-0,036	-0,071	0,043	0,170	0,304	0,046	**0,678**	-0,156	0,098
Q.8.1	**0,869**	-0,073	0,047	-0,077	0,012	0,024	0,058	-0,045	-0,083	-0,044	-0,076	0,070	-0,126	0,059	-0,051	**0,861**	-0,061	0,058	0,007
Q.8.2.1	0,275	0,066	0,091	-0,163	0,163	0,099	-0,098	0,167	-0,305	0,030	0,165	-0,422	-0,237	-0,078	-0,119	0,280	0,052	0,113	0,184
Q.8.4	**0,923**	-0,095	0,037	-0,003	-0,101	-0,029	0,116	-0,085	0,006	-0,018	-0,054	0,005	-0,036	-0,008	0,022	**0,921**	-0,086	0,043	-0,074
Q.8.4.1	**0,925**	-0,084	0,052	-0,018	-0,047	-0,030	0,067	-0,027	-0,025	0,001	-0,121	-0,033	-0,127	0,044	-0,053	**0,921**	-0,078	0,058	-0,077
Q.8.4.2	**0,925**	-0,076	0,054	-0,016	-0,082	-0,021	0,131	-0,054	-0,039	-0,037	-0,107	-0,042	-0,117	0,023	-0,061	**0,919**	-0,068	0,063	-0,086

Table 3 – CATPCA results: component loadings for regulation PC.
Bold values in light shading represent component loadings (correlations between variables and components) above 0.5

	Kaiser criterion															*Scree plot method*			
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**1**	**2**	**3**	**4**
Q.8.4.3	**0,870**	-0,070	0,057	0,021	0,069	-0,146	0,053	0,034	-0,049	-0,039	-0,079	-0,074	-0,174	0,085	-0,131	**0,866**	-0,055	0,074	-0,095
Q.8.5	**0,942**	-0,095	0,033	-0,052	-0,060	-0,038	0,071	-0,071	-0,040	0,025	-0,070	0,025	-0,020	-0,056	-0,028	**0,939**	-0,089	0,046	-0,049
Q.8.6	**0,943**	-0,083	0,069	-0,023	-0,102	-0,073	0,065	-0,001	-0,081	0,011	-0,029	-0,019	0,008	-0,140	0,032	**0,940**	-0,070	0,069	-0,107
Q.8.7	**0,939**	-0,081	0,030	0,005	-0,085	-0,044	-0,013	-0,062	-0,024	-0,018	-0,092	-0,071	0,029	-0,024	0,016	**0,937**	-0,076	0,025	-0,102
Q.8.10	**0,904**	-0,087	0,016	-0,013	-0,038	0,033	0,016	-0,104	0,052	0,001	0,019	-0,009	0,025	-0,109	0,042	**0,907**	-0,083	0,022	0,031
Q.8.12	**0,907**	-0,058	0,015	-0,035	-0,004	-0,077	-0,007	-0,017	0,003	0,027	0,024	-0,037	-0,011	-0,046	0,006	**0,906**	-0,051	0,018	-0,051
Q.8.13	**0,894**	-0,089	0,017	0,062	0,080	-0,111	-0,097	-0,036	0,030	0,052	-0,029	-0,060	0,010	-0,079	0,055	**0,895**	-0,081	0,009	-0,043
Q.8.14	**0,928**	-0,089	0,015	-0,030	-0,052	-0,045	-0,031	-0,030	0,011	0,055	0,027	-0,022	0,054	-0,112	0,013	**0,927**	-0,085	0,021	-0,043
Q.8.17.2	**0,670**	-0,036	-0,058	-0,012	0,004	0,017	0,109	0,163	0,234	0,072	0,347	-0,016	0,293	0,272	0,155	**0,672**	-0,048	-0,042	0,004
Q.8.17.3	**0,702**	-0,072	-0,025	0,095	-0,069	-0,181	-0,021	0,181	0,167	0,050	0,316	0,028	0,218	0,297	0,155	**0,706**	-0,069	-0,016	-0,177
Q.9.1	-0,097	-0,019	0,013	0,448	0,466	-0,489	0,101	-0,247	-0,021	-0,047	0,115	-0,004	-0,197	-0,022	0,090	-0,221	0,034	-0,079	-0,220
Q.9.2	0,233	**0,900**	-0,178	-0,097	-0,140	0,017	-0,046	-0,024	0,102	-0,077	-0,038	0,093	-0,021	-0,126	-0,050	0,240	**0,922**	-0,170	0,036
Q.9.5	-0,010	-0,086	0,045	-0,367	0,186	0,056	0,337	-0,307	-0,028	0,077	0,219	0,245	-0,043	0,000	-0,122	0,037	-0,068	0,088	0,385
Q.10.1	-0,025	-0,041	-0,072	-0,478	0,358	-0,150	0,301	0,018	0,235	-0,288	-0,206	-0,116	0,247	-0,123	0,097	-0,028	-0,033	-0,027	0,268
Q.10.2.1	0,046	-0,116	0,030	-0,366	-0,142	-0,512	-0,366	0,328	-0,152	-0,002	-0,024	0,218	-0,011	0,080	-0,112	-0,004	-0,068	0,074	-0,446
Q.10.2.2	0,059	0,063	0,170	**0,582**	-0,315	0,303	-0,210	-0,244	-0,046	0,062	0,062	0,004	0,090	-0,091	0,016	0,303	-0,066	-0,117	-0,400
Q.10.2.4	0,169	-0,048	0,012	0,225	0,325	-0,104	-0,211	-0,069	-0,247	-0,204	0,057	0,084	**0,598**	-0,021	-0,014	0,180	-0,075	-0,011	0,185
Q.10.2.5	0,291	-0,275	-0,064	0,380	-0,052	0,133	-0,058	-0,012	0,056	0,066	0,229	0,154	0,161	-0,191	0,202	0,299	-0,299	-0,117	-0,004
Q.10.5.1	0,297	-0,157	-0,055	-0,368	0,431	0,266	-0,206	-0,047	-0,097	-0,187	0,196	0,280	0,031	0,037	0,125	0,269	-0,146	-0,064	**0,634**
Q.10.5.2	-0,066	-0,015	0,023	0,271	0,000	0,118	0,198	-0,251	0,151	-0,410	0,357	0,167	-0,382	-0,044	0,301	0,109	-0,082	-0,040	0,285
Q.10.7	0,150	**0,787**	-0,173	0,098	0,151	0,252	0,205	-0,104	0,043	0,188	-0,050	-0,037	0,072	-0,097	-0,090	0,143	**0,771**	-0,150	0,198
Q.1.7a.*	-0,031	0,419	0,219	0,047	0,029	0,115	0,052	-0,208	-0,078	0,034	-0,093	-0,078	0,025	-0,085	-0,039	-0,025	0,399	0,233	0,064
Q.1.7b.*	-0,020	0,420	0,221	0,035	0,040	0,111	0,045	-0,199	-0,072	0,058	-0,094	-0,075	0,035	-0,083	-0,043	-0,019	0,398	0,233	0,068
Q.1.10a.*	-0,016	0,377	0,246	0,154	0,072	0,151	0,145	0,078	-0,058	-0,090	-0,192	-0,045	-0,032	0,036	-0,110	-0,019	0,353	0,250	-0,009
Q.1.10b.*	0,017	0,326	0,232	0,226	0,240	0,053	0,078	0,052	-0,091	-0,059	-0,161	-0,091	-0,035	0,039	-0,098	0,020	0,309	0,229	0,045
Q.1.10c.*	-0,010	0,350	0,242	0,235	0,245	0,023	0,082	0,090	-0,063	-0,029	-0,178	-0,045	-0,052	0,045	-0,092	-0,022	0,332	0,233	0,022
Q.1.11a.*	0,025	0,331	0,229	0,175	0,030	0,165	0,147	0,022	-0,089	-0,108	-0,182	-0,184	-0,041	-0,026	-0,150	-0,023	-0,342	-0,247	0,011
Q.1.11b.*	0,035	0,315	0,228	0,239	0,251	0,054	0,050	0,046	-0,080	-0,032	-0,158	-0,099	-0,030	-0,015	-0,136	0,015	0,309	0,227	0,054
Q.1.11c.*	-0,034	0,340	0,231	0,272	0,221	0,048	0,074	0,049	-0,088	-0,051	-0,168	-0,106	-0,049	-0,027	-0,124	-0,028	0,330	0,230	0,034
Q.1.12a.*	-0,105	-0,278	-0,268	-0,207	-0,095	-0,130	-0,162	-0,021	0,174	0,128	0,073	-0,027	0,041	0,136	-0,026	-0,097	-0,259	-0,246	-0,001
Q.1.12b.*	0,094	0,263	0,266	0,300	0,228	0,025	0,107	0,011	-0,188	-0,100	-0,060	0,009	-0,031	-0,151	0,021	-0,087	-0,247	-0,239	-0,039
Q.1.12c.*	0,057	0,281	0,271	0,315	0,211	0,018	0,122	0,025	-0,182	-0,099	-0,083	0,009	-0,062	-0,156	0,020	0,050	0,266	0,242	0,013
Q.2.3.1*	-0,079	0,017	-0,037	-0,258	-0,180	-0,055	0,033	-0,157	-0,057	0,037	-0,143	-0,154	-0,119	-0,151	-0,078	-0,099	0,054	-0,019	-0,073

Table 3 – CATPCA results: component loadings for regulation PC.
Bold values in light shading represent component loadings (correlations between variables and components) above 0.5

	Kaiser criterion															*Scree plot method*			
Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**1**	**2**	**3**	**4**
Q.2.5.2*	-0,180	-0,053	-0,299	-0,179	-0,179	-0,037	-0,069	-0,102	-0,013	-0,198	0,025	0,005	0,056	0,224	-0,003	-0,232	-0,093	-0,232	-0,101
Q.2.6.1*	0,131	0,115	0,112	0,005	0,187	-0,111	0,197	0,048	0,128	-0,095	0,113	0,018	-0,006	-0,072	0,154	0,115	0,129	0,143	-0,001
Q.3.3.1*	0,159	-0,139	-0,059	-0,031	0,127	0,160	-0,163	0,036	0,116	0,040	-0,160	-0,074	-0,028	-0,008	0,030	0,168	-0,157	-0,063	0,150
Q.3.4.1*	0,104	0,022	-0,015	0,185	0,132	0,268	-0,010	-0,020	0,133	0,034	0,130	0,015	0,263	0,042	-0,076	0,194	-0,118	-0,036	0,169
Q.3.18.2*	-0,074	0,060	0,036	-0,074	-0,047	-0,099	0,145	0,048	0,105	-0,156	0,110	0,073	-0,078	-0,070	0,017	-0,083	0,014	-0,074	0,088
Q.8.11*	**-0,603**	-0,021	-0,152	-0,101	-0,137	-0,008	-0,048	0,008	-0,063	-0,104	0,053	-0,017	-0,139	0,004	-0,204	**-0,603**	-0,009	-0,133	-0,039
Q.8.11.1*	0,495	-0,002	0,152	0,140	0,045	0,025	0,084	-0,087	-0,047	-0,072	0,045	-0,062	-0,063	0,023	0,093	-0,494	0,004	-0,133	0,039
Q.8.13.1*	0,490	-0,054	-0,065	0,033	0,080	-0,028	0,004	-0,019	-0,035	0,215	0,001	-0,031	-0,005	-0,073	0,001	0,489	-0,045	-0,078	0,076
Q.8.17.1*	-0,466	0,000	-0,080	-0,001	-0,098	0,021	0,011	-0,129	-0,086	-0,174	-0,046	0,001	-0,218	-0,144	-0,250	0,464	-0,015	0,080	0,048
Q.9.1.3a.*	0,273	-0,195	-0,041	0,043	0,130	0,242	-0,036	0,165	0,172	-0,051	-0,037	-0,020	0,128	0,009	-0,059	0,287	-0,219	-0,052	0,233
Q.9.1.3b.*	0,274	-0,192	-0,041	0,118	0,160	0,262	-0,081	0,154	0,206	-0,038	-0,029	-0,008	0,123	-0,021	-0,013	0,284	-0,221	-0,052	0,242
Q.9.1.3c.*	0,320	-0,153	-0,017	0,128	0,231	0,280	-0,070	0,100	0,100	-0,008	-0,069	0,005	0,056	-0,098	-0,017	0,335	-0,170	-0,036	0,263
Q.9.6.3a.*	0,227	-0,217	-0,004	0,188	0,031	0,171	-0,293	0,146	0,086	-0,053	-0,041	0,134	0,003	-0,062	-0,060	0,298	-0,207	-0,011	0,040
Q.9.6.3b.*	0,298	-0,190	-0,040	0,211	0,136	0,275	-0,240	0,050	0,119	-0,037	-0,049	0,105	-0,006	0,048	-0,108	0,330	-0,196	-0,047	0,145
Q.9.6.3c.*	0,297	-0,198	-0,008	0,244	0,106	0,266	-0,224	0,108	0,103	-0,021	-0,059	0,119	0,017	-0,063	-0,048	0,336	-0,212	-0,030	0,133
Q.10.8*	-0,127	-0,200	0,069	-0,178	-0,429	-0,163	0,062	0,100	-0,044	0,131	-0,051	0,006	0,110	-0,031	0,040	-0,368	0,024	0,116	-0,175
Q.10.9*	-0,065	0,220	-0,060	0,138	0,124	0,159	0,077	-0,018	0,116	-0,198	-0,019	0,047	-0,031	0,029	0,032	-0,116	0,195	-0,054	0,080
Q.13.7.1*	-0,155	-0,257	0,064	-0,249	-0,019	-0,156	-0,033	-0,072	-0,151	-0,052	-0,080	-0,088	-0,344	0,104	-0,015	-0,159	-0,237	0,081	-0,061
Q.13.7.2*	-0,039	-0,250	0,095	-0,156	0,022	-0,084	-0,019	0,091	-0,110	-0,064	-0,091	-0,040	-0,260	0,069	0,005	-0,025	-0,237	0,075	-0,057

* Supplementary variable.

Table 3 – CATPCA results: component loadings for regulation PC.
Bold values in light shading represent component loadings (correlations between variables and components) above 0.5

Principal component 1 | *Deposit insurance*

Variables	*Component Loadings* PC 1	PC 2	PC 3	PC 4
8.1 Is there an explicit deposit insurance protection system for commercial banks?	**0,861**	-0,061	0,058	-0,007
8.4 Does the deposit insurance agency/fund administrator have the following powers as part of its mandate? c. Bank intervention authority.	**0,921**	-0,086	0,043	0,074
8.4.1 Does the deposit insurance authority by itself have the legal power to cancel or revoke deposit insurance for any participating bank?	**0,921**	-0,078	0,058	0,077
8.4.2 Can the deposit insurance agency/fund take legal action for violations against laws, regulations, and bylaws (of the deposit insurance agency) against bank directors or other bank officials?	**0,919**	-0,068	0,063	0,086
8.4.3 Has the deposit insurance agency/fund ever taken legal action for violations against laws, regulations, and bylaws (of the deposit insurance agency)against bank directors or other bank officials?	**0,866**	-0,055	0,074	0,095
8.5 Is participation in the deposit insurance system compulsory for the following banking entities?	**0,939**	-0,089	0,046	0,049
8.6 Are the following types of deposits excluded from deposit insurance coverage?	**0,940**	-0,070	0,069	0,107
8.7 The deposit insurance coverage type is: a. Per depositor account; b. Per depositor; c. Per depositor per institution; d. Other (please explain).	**0,937**	-0,076	0,025	0,102

Principal component 1 | *Deposit insurance*

	Component Loadings			
Variables	*PC 1*	*PC 2*	*PC 3*	*PC 4*
8.10 Is there formal coinsurance, i.e. are ALL depositors explicitly insured for less than 100% of their deposits?	**0,907**	-0,083	0,022	-0,031
8.11 What percentage of the total deposits of participating commercial banks was actually covered by the scheme as of end of 2010?	**-0,603**	-0,009	-0,133	0,039
8.12 Is there an ex ante fund/reserve to cover deposit insurance claims in the event of the failure of a member bank?	**0,906**	-0,051	0,018	0,051
8.13 Funding is provided by: a. Government; b. Banks; c. Combination/Other (please explain).	**0,895**	-0,081	0,009	0,043
8.14 Do deposit insurance fees/premiums charged to banks vary based on some assessment of risk?	**0,927**	-0,085	0,021	0,043
8.17.2 Were insured depositors wholly compensated (to the extent of legal protection) the last time a bank failed?	**0,672**	-0,048	-0,042	-0,004
8.17.3 Were any deposits not explicitly covered by the deposit insurance scheme at the time of failure compensated the last time a bank failed (excluding funds later paid out in liquiditation procedures)?	**0,706**	-0,069	-0,016	0,177

Table 4 – Principal components composition and labels, regulation

Bold values represent component loadings above 0.5 (in absolute value). Variables with higher correlations in each PC determined its label (Marôco, 2018).

Principal component 2 | *Requirements on banking licensing, liquidity diversification, and credit*

	Component Loadings			
Variables	*PC 1*	*PC 2*	*PC 3*	*PC 4*
1.1 What body/agency grants commercial banking licenses? Please include the name of licensing agency. If more than one, please describe their respective licensing roles.	-0,080	**0,556**	-0,021	-0,012
1.4.2 Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities?	0,225	**0,684**	-0,108	-0,040
1.6 Which of the following are legally required to be submitted before issuance of the banking license?	0,115	**0,718**	-0,092	0,012
7.2 Are there any regulatory rules or supervisory guidelines regarding asset diversification?	0,233	**0,910**	-0,119	0,032
7.2.2 Are banks prohibited from making loans abroad?	0,239	**0,910**	-0,122	0,027
7.4 Are the following requirements in place in your jurisdiction? b. Central Bank reserve and/or deposit requirements.	0,070	**0,678**	-0,128	0,066
7.4.1 Are banks required to hold reserves in foreign currencies or other foreign-denominated instruments in order to fulfill the requirements listed above?	0,046	**0,678**	-0,156	-0,098
9.2 Which criteria are taken into account to classify loans and advances as non-performing …?:	0,240	**0,922**	-0,170	-0,036
10.7 Are commercial banks required by supervisors to have external credit ratings?	0,143	**0,771**	-0,150	-0,198

Principal component 3 | *Capital ownership and complementary banking activities*

	Component Loadings			
Variables	*PC 1*	*PC 2*	*PC 3*	*PC 4*
2.5.1 Can related parties own capital in a bank?	-0,106	0,104	**0,766**	-0,015
4.1 What are the conditions under which banks can engage in securities activities?	-0,057	0,132	**0,952**	-0,090
4.2 What are the conditions under which banks can engage in insurance activities?	-0,099	0,134	**0,943**	-0,074
4.3 What are the conditions under which banks can engage in real estate activities?	-0,100	0,129	**0,943**	-0,073

Principal component 4 | *Entry into banking denied applications and information disclosure*

	Component Loadings			
Variables	*PC 1*	*PC 2*	*PC 3*	*PC 4*
1.13 What were the primary reasons for denial of the applications in questions 1.7, 1.10, 1.11 and 1.12?	-0,196	0,076	0,019	**0,619**
10.5.1 Do banks disclose to the public …? b. Off-balance sheet items; c. Governance and risk management framework	0,269	-0,146	-0,064	**-0,634**

4. RESULTS AND DISCUSSION

- Banking regulatory practices that best describe the global regulatory framework (representing the most relevant proxy candidates to measure banking regulation):

  - Deposit insurance (Cull *et al.*, 2002; Demirguç-Kunt and Kane, 2002; and Cihak *et al.*, 2012, *e.g.*);
  - Liquidity and diversification requirements;
  - Complementary banking activities;
  - Market discipline (Lane, 1993; Barth *et al.* (2004); Ushida and Satake (2009); Swany, 2018; and Anginer *et al.*, 2019, *e.g.*);
  - Capital (with less expression) (Moosa, 2010; Aiyar *et al.* 2015; and Jacques, 2017).

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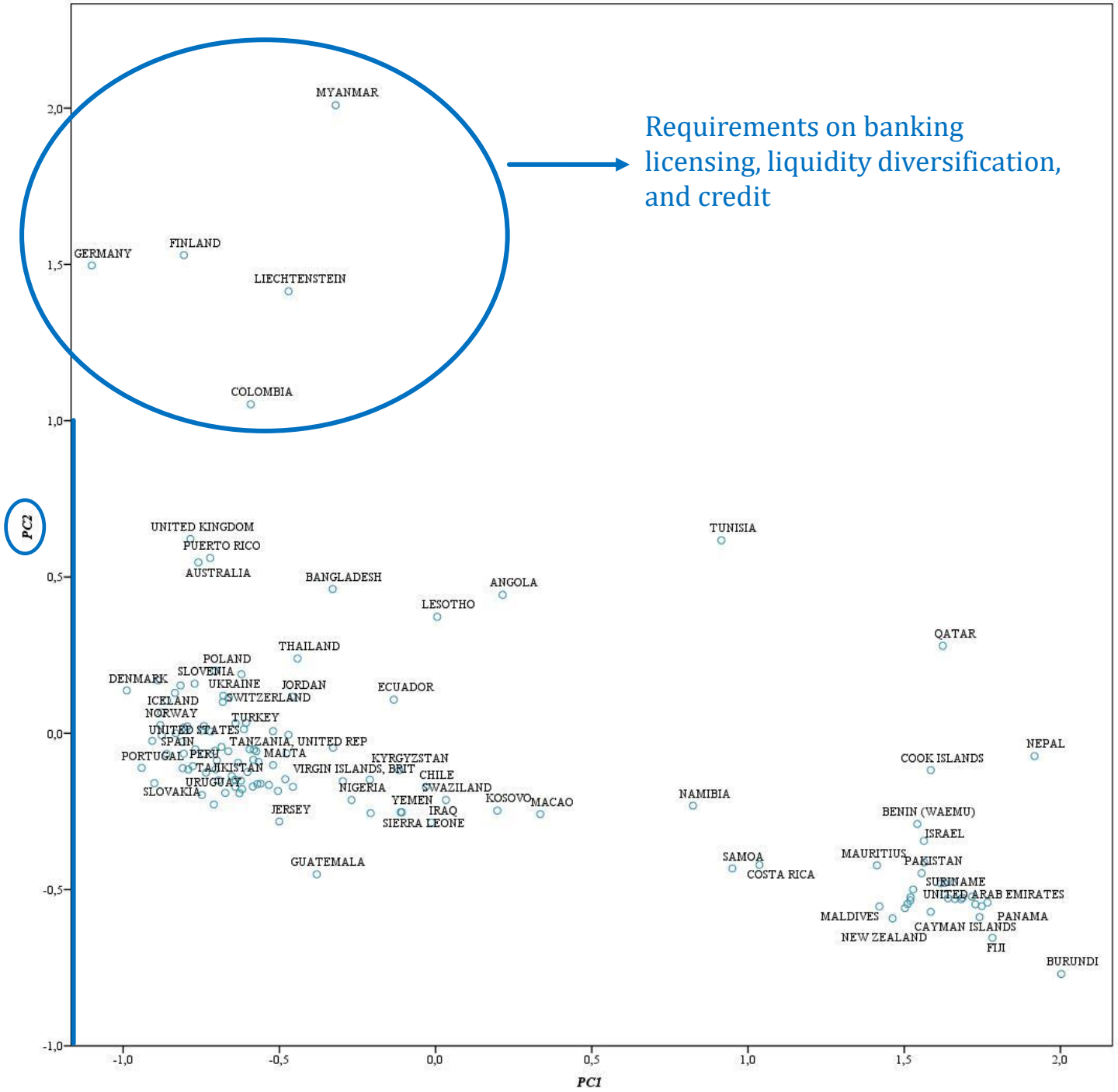
ALENTEJO 2020
European Union European Social Fund
SFRH/BPD/108826/2015



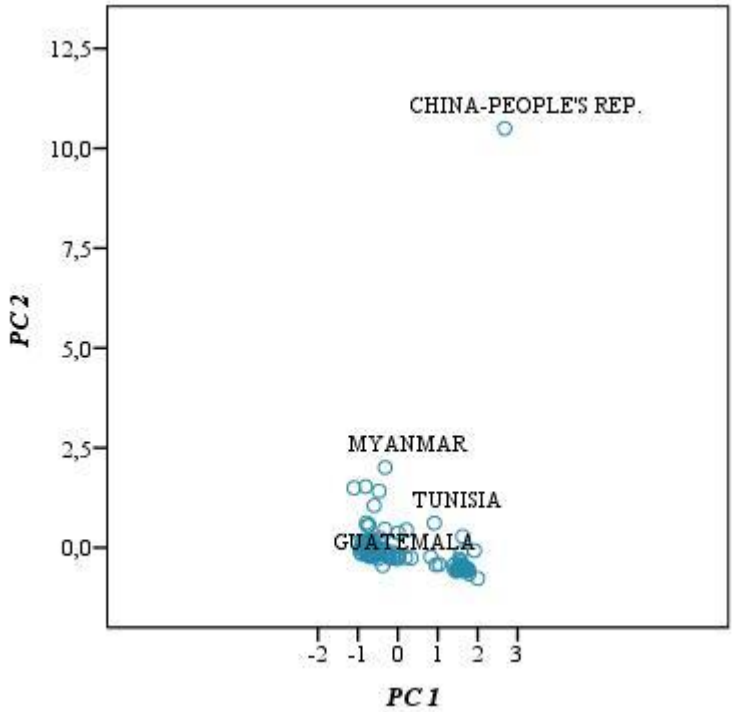
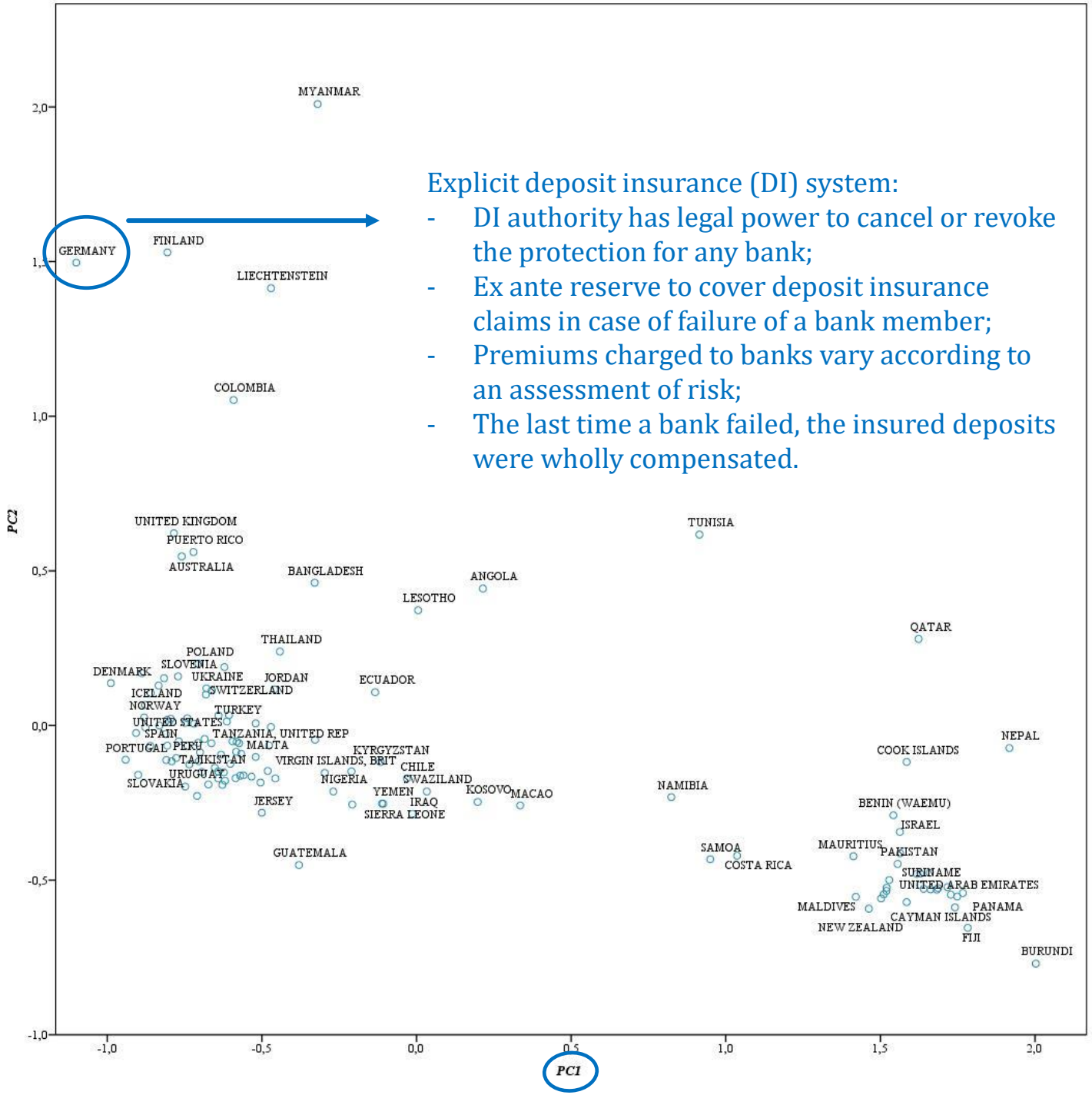


Fig. 3 Object points labeled by country, regulation.
Source: Authors' calculations.

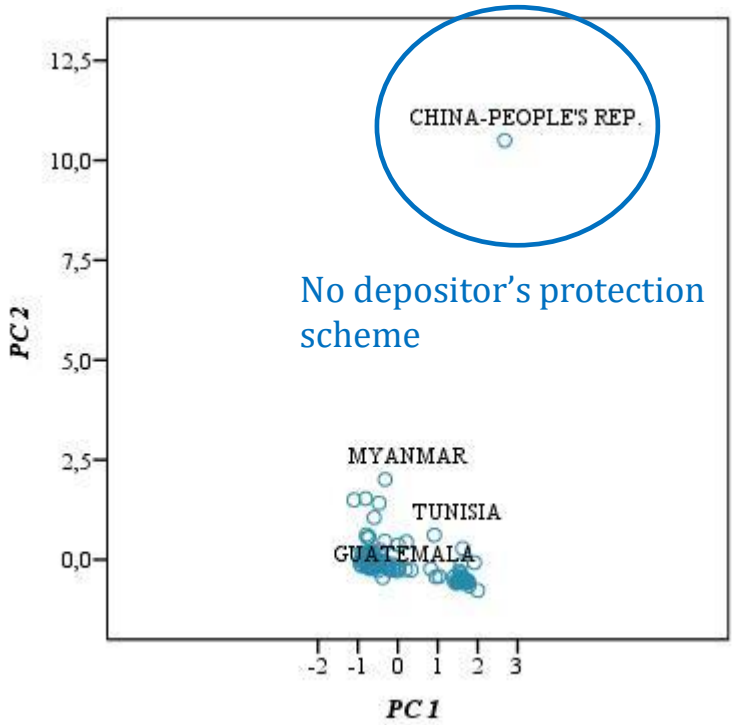
Country scores from CATPCA on 82 variables, (30 as analysis variables and 52 supplementary variables).

The points represent the coordinates of each country in each principal component with, approximately, zero mean and unit standard deviation.



Explicit deposit insurance (DI) system:

- DI authority has legal power to cancel or revoke the protection for any bank;
- Ex ante reserve to cover deposit insurance claims in case of failure of a bank member;
- Premiums charged to banks vary according to an assessment of risk;
- The last time a bank failed, the insured deposits were wholly compensated.



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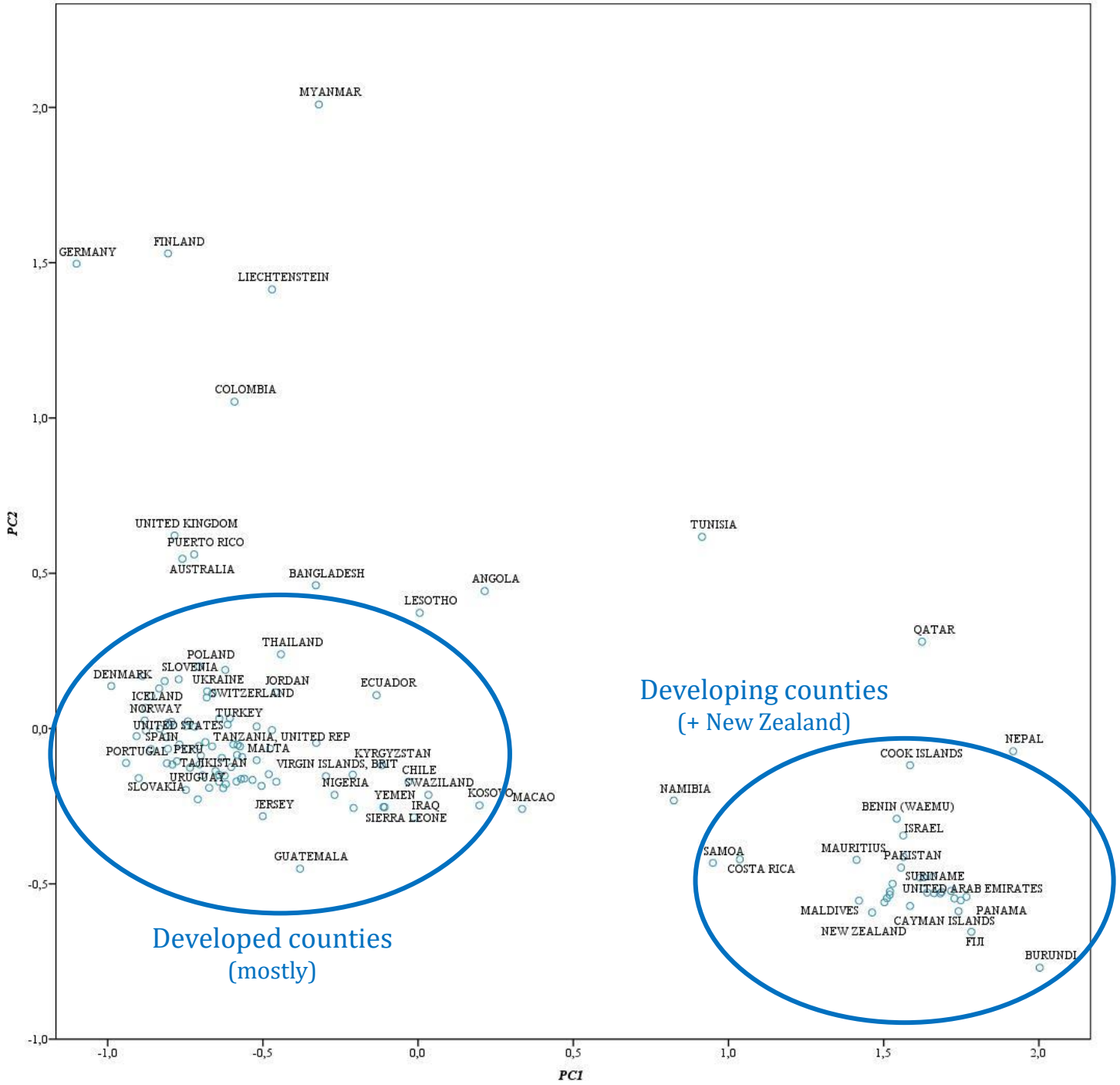

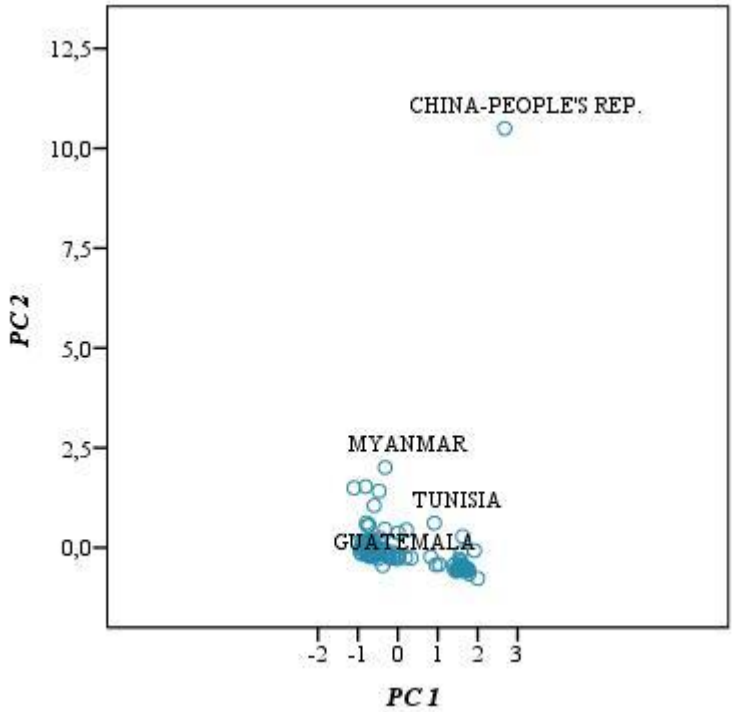

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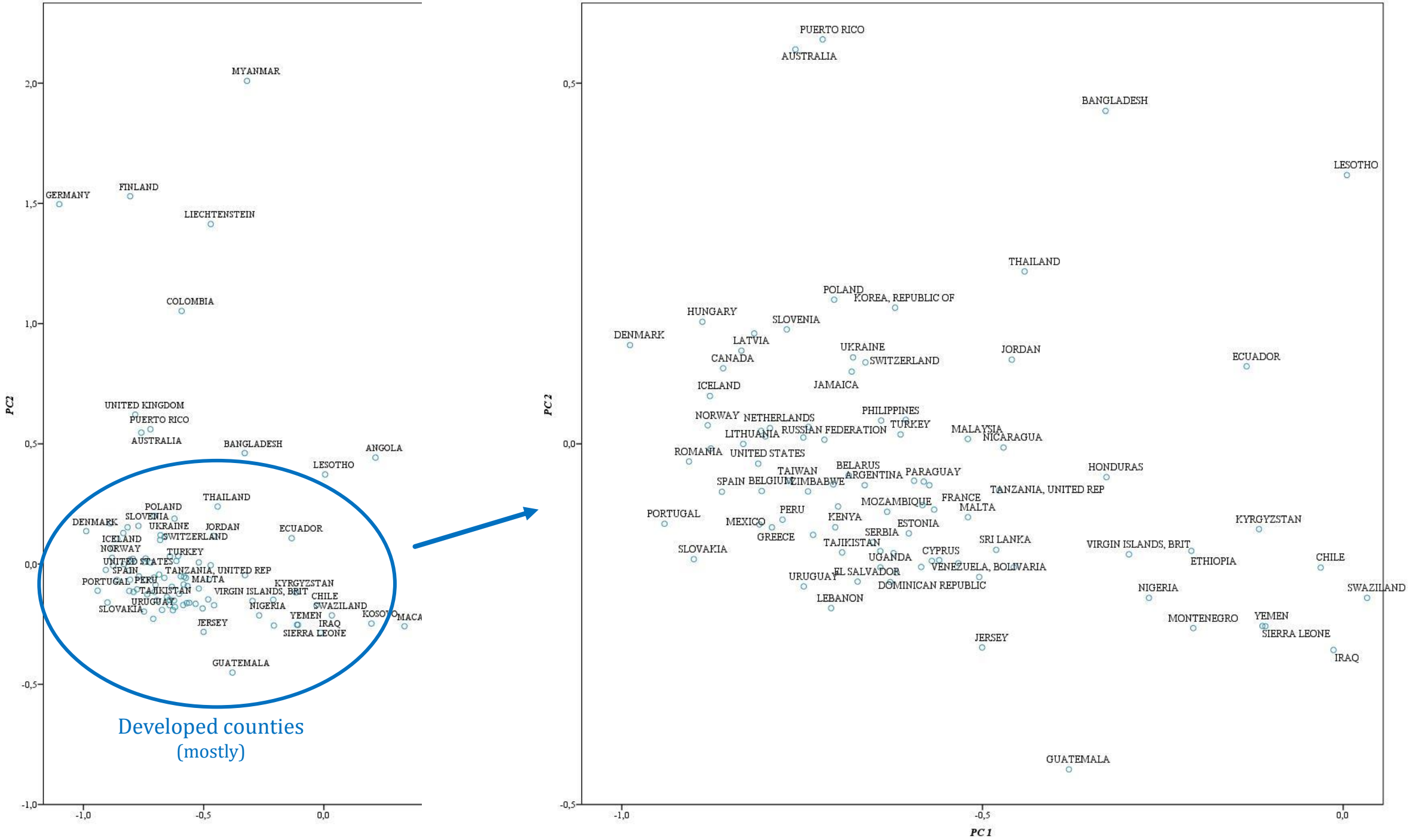
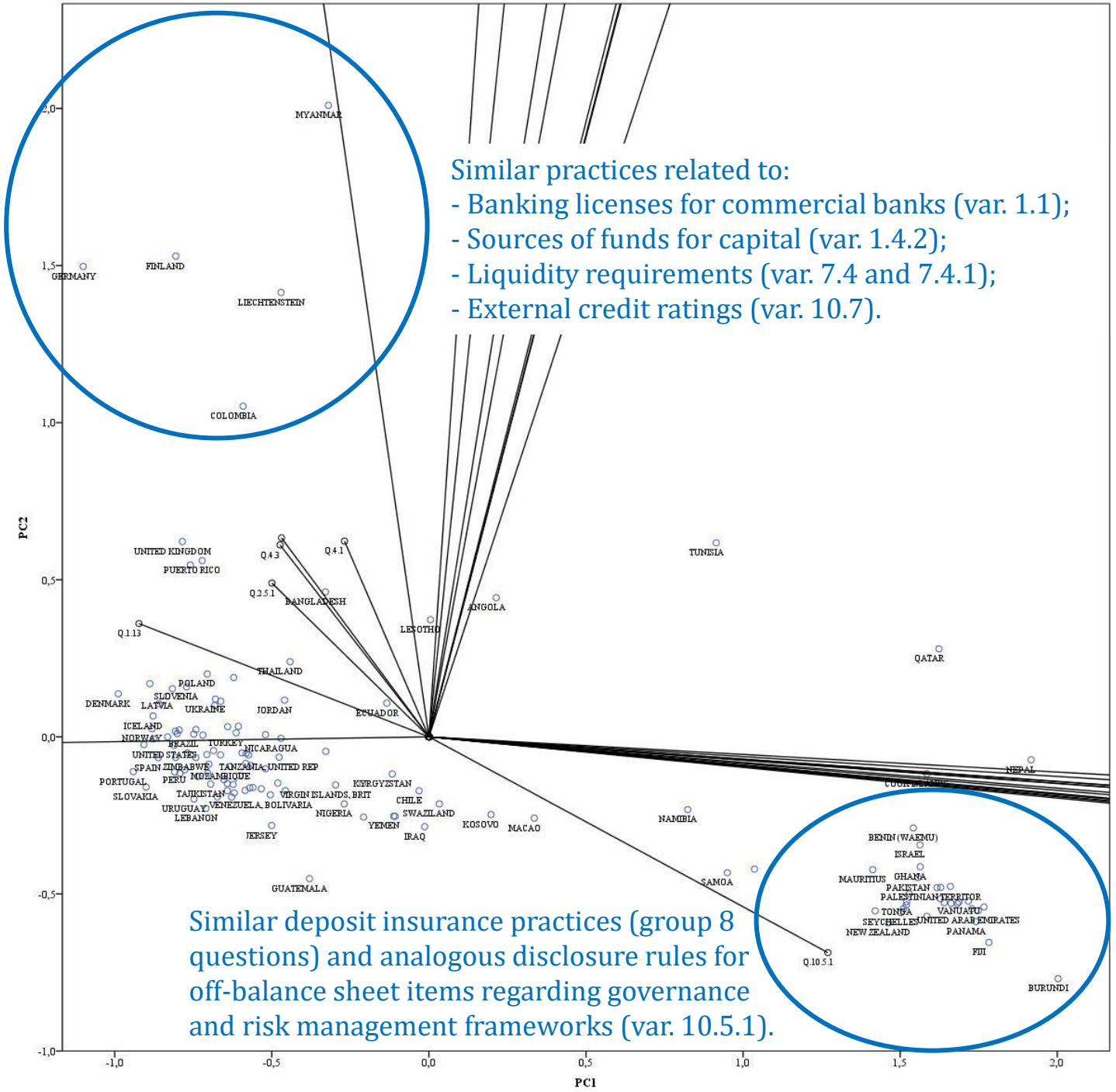
Country scores from CATPCA on 82 variables, (30 as analysis variables and 52 supplementary variables).

The points represent the coordinates of each country in each principal component with, approximately, zero mean and unit standard deviation.

→ (Informal) clusters


PC2
PC1
MYANMAR
GERMANY
FINLAND
LIECHTENSTEIN
COLOMBIA
UNITED KINGDOM
PUERTO RICO
AUSTRALIA
BANGLADESH
ANGOLA
LESOTHO
THAILAND
POLAND
SLOVENIA
DENMARK
UKRAINE
JORDAN
ECUADOR
ICELAND
SWITZERLAND
NORWAY
TURKEY
UNITED STATES
SPAIN
TANZANIA, UNITED REP
PORTUGAL
PERU
MALTA
KYRGYZSTAN
TAJIKISTAN
VIRGIN ISLANDS, BRIT
CHILE
URUGUAY
NIGERIA
SWAZILAND
SLOVAKIA
KOSOVO
MACA
YEMEN
IRAQ
JERSEY
SIERRA LEONE
GUATEMALA
HUNGARY
KOREA, REPUBLIC OF
LATVIA
CANADA
SWITZERLAND
JAMAICA
NETHERLANDS
PHILIPPINES
TURKEY
RUSSIAN FEDERATION
LITHUANIA
MALAYSIA
NICARAGUA
ROMANIA
BELARUS
TAIWAN
ARGENTINA
PARAGUAY
HONDURAS
ZIMBABWE
MOZAMBIQUE
FRANCE
MALTA
MEXICO
KENYA
ESTONIA
SERBIA
GREECE
TAJIKISTAN
SRI LANKA
CYPRUS
UGANDA
VENEZUELA, BOLIVARIA
EL SALVADOR
DOMINICAN REPUBLIC
LEBANON
ETHIOPIA
MONTENEGRO
Developed counties
(mostly)



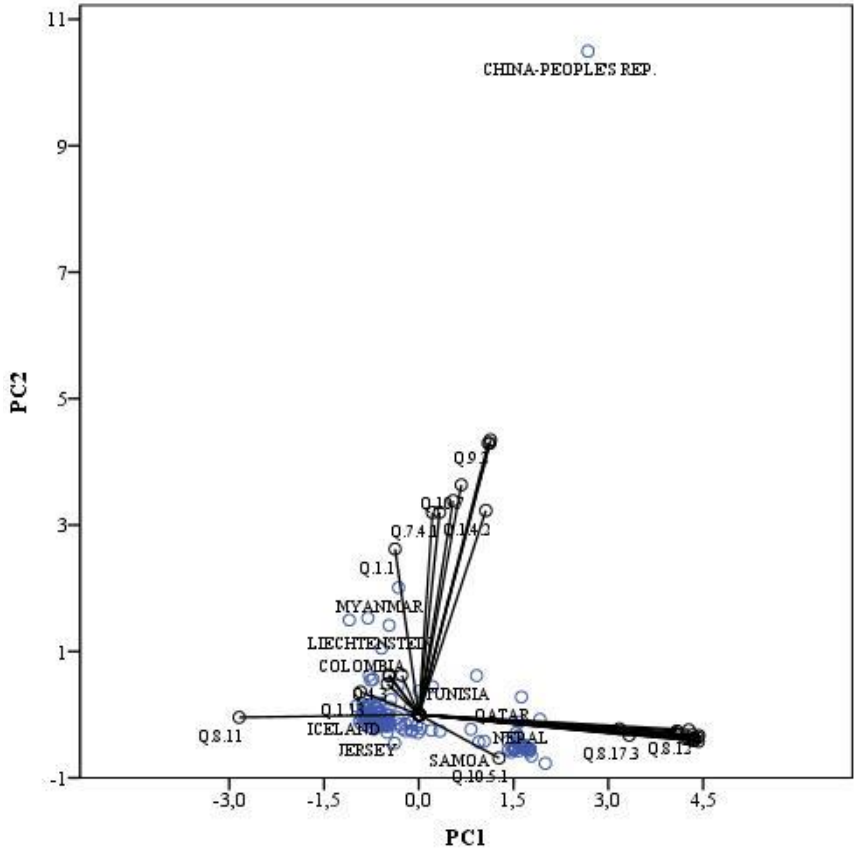


Fig. 4 Biplot of objects and component loadings, regulation.
Source: Authors' calculations.

Plot of country scores (the points) and component loadings (the vectors) from CATPCA on the relevant variables to determine regulation.

The square of the original length ([-1, 1]) of the vectors from the origin up to the component loading point represents the variable's total variance accounted for.

Shorter vectors are those of the variables determining PC3 and PC4 not represented in this two-dimensional plot.

Principal component 1 | *Supervision institutional structure and mandate*

Variables	*Component loadings* PC1	PC2	PC3
12.1 What body/agency supervises commercial banks for prudential purposes?	**0,707**	-0,263	0,075
12.3.2 Can the supervisory authority force a bank to change its internal organizational structure?	**0,904**	-0,290	0,056
12.4 To whom is the supervisory agency legally responsible or accountable?	**0,589**	-0,227	0,108
12.5 How is the head of the supervisory agency appointed?	**0,910**	-0,279	0,048
12.6 Does the head of the supervisory agency have a fixed term?	**0,860**	0,161	-0,120
12.7 Can the head of the supervisory agency be removed by …	**0,866**	0,189	-0,127
12.9 Can individual supervisory staff be held personally liable for damages to a bank caused by their actions or omissions committed in the good faith exercise of their duties?	**0,733**	-0,074	-0,010
12.12 If an infraction of any prudential regulation is found in the course of supervision, must it be reported?	**0,535**	-0,278	0,091
12.12.1 Are there mandatory actions that the supervisor must take in these cases?	**0,620**	-0,245	0,076

Table 6 – Principal components composition, supervision

Bold values represent component loadings above 0.5. Variables with higher correlations in each PC determine its label.

Source: Authors' calculations.

Principal component 2 | *Discipline: enforcement and resolution*

Variables	*Component loadings* PC1	PC2	PC3
11.1 Please indicate whether the following enforcement powers are available to the supervisory agency: a. Cease and desist-type orders for imprudent bank practices; f. Require banks to constitute provisions to cover actual or potential losses; j. Require banks to reduce or suspend dividends to shareholders; k. Require banks to reduce or suspend bonuses and other remuneration to bank directors and managers	0,220	**0,686**	-0,268
11.5a. Which authority has the powers to perform the following problem bank resolution activities? a. Declare insolvency	0,318	**0,823**	-0,317
11.5b. Which authority has the powers to perform the following problem bank resolution activities? b. Supersede shareholders' rights	0,207	**0,776**	-0,226
11.5c. Which authority has the powers to perform the following problem bank resolution activities? c. Remove and replace bank senior management and directors	0,198	**0,793**	-0,261

Table 6 – Principal components composition, supervision

Bold values represent component loadings above 0.5. Variables with higher correlations in each PC determine its label.

Source: Authors' calculations.

Principal component 3 | *Exit: insolvency*

	Component loadings		
Variables	PC1	PC2	PC3
11.4 Is there a separate bank insolvency framework that is distinct from that of non-financial firms?	0,072	0,282	**0,631**
11.5 Which authority has the powers to perform the following problem bank resolution activities? e. Appoint and oversee a bank liquidator/receiver	0,049	0,286	**0,885**
11.6 Is court approval required for the following bank resolution activities? b.Supersede shareholders' rights; c. Remove and replace bank senior management and directors; e. Appoint and oversee a bank liquidator/receiver	0,068	0,321	**0,810**
11.7 Can the bank shareholders appeal to the court against a resolution decision of the banking supervisor?	-0,050	-0,314	**-0,870**

Table 6 – Principal components composition, supervision

Bold values represent component loadings above 0.5. Variables with higher correlations in each PC determine its label.

Source: Authors' calculations.

4. RESULTS AND DISCUSSION

- These conclusions corroborate previous studies defending similar practices as major concerns of supervision structures, such as:

  - the importance of independent* (Eichengreen and Dincer, 2001) or supranational (Beck and Wagner, 2016) supervisors;
  - the extend of information included in supervisory reports (Neyapti and Dincer, 2005);
  - The head of supervisory contract terms and supervisory agency powers (Barth *et al.* 2013b).

*From governmental bodies.

Acknowledgements:

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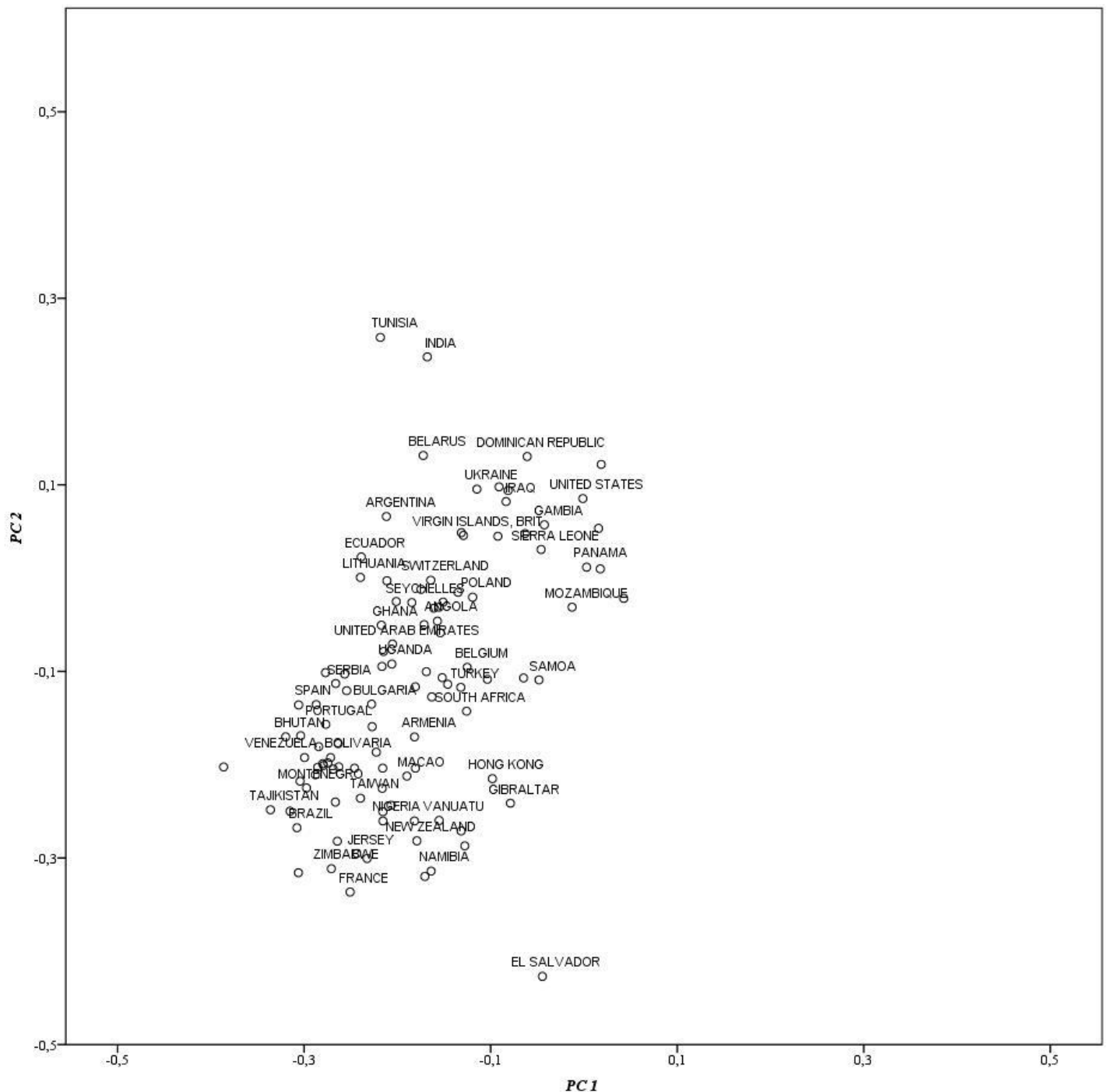

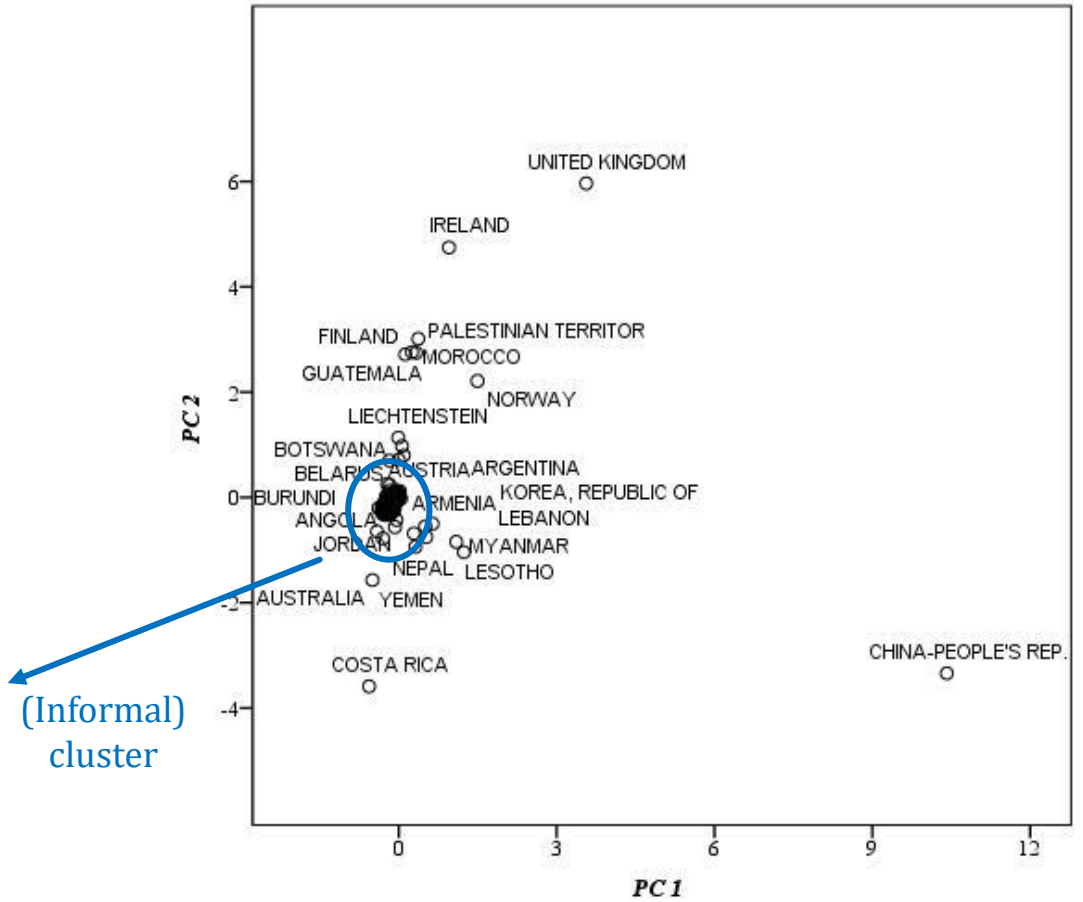

(Informal) cluster

Fig. 6 Object points labeled by country, supervision.
Source: Authors' calculations.

Country scores from CATPCA on 35 variables, (23 as analysis variables and 12 supplementary variables).

The points represent the coordinates of each country in each principal component with, approximately, zero mean and unit standard deviation.

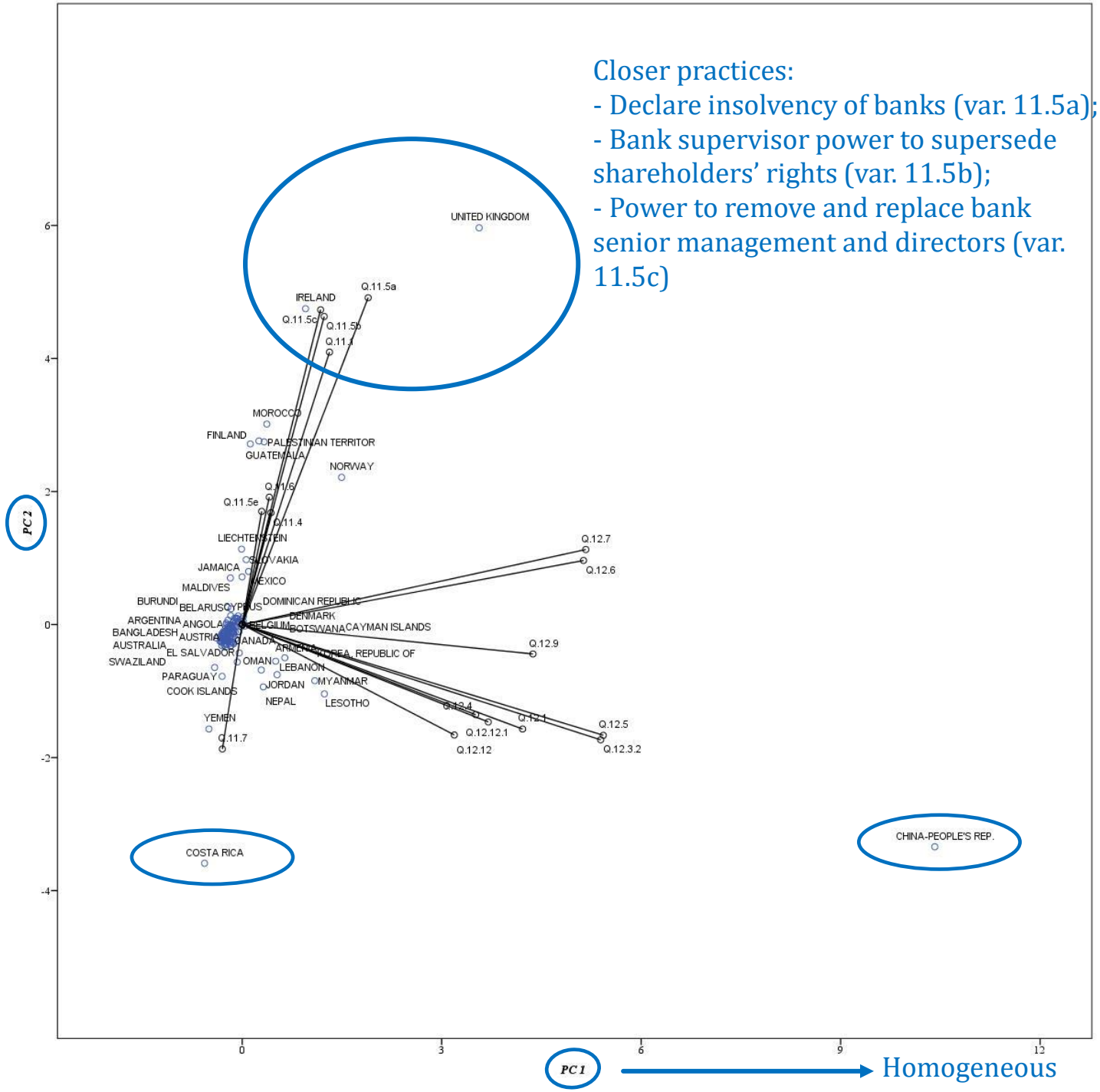

Fig. 7 Biplot of objects and component loadings, supervision. *Source*: Authors' calculations.

Plot of country scores (the points) and component loadings (the vectors) from CATPCA on the relevant variables to determine regulation.

The square of the original length ([-1, 1]) of the vectors from the origin up to the component loading point represents the variable's total variance accounted for.

Shorter vectors are those of the variables determining PC3 not represented in this two-dimensional plot.

4. RESULTS AND DISCUSSION

- Robustness checks:
  - Test results strength;
  - Capture the (potential) influence of countries' economic development;
  - Differences induced by the legal frameworks of offshore countries.

	All sample	***OECD***	***Non offshore***	***Offshore***
Number of sampled countries	141	31	118	23

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4. RESULTS AND DISCUSSION

- Robustness checks

Variables - regulation	*All sample*	*OECD*	*Non offshore*	*Offshore*
Deposit insurance variables (8.1 to 8.17.2)	**PC1**	**PC1**	**PC1**	**PC1**
9.2 Which criteria are taken into account to classify loans and advances as non-performing …?:	**PC2**	**PC2**	**PC2**	**PC2**

Table 7 – RS variables by sub-sample and PC. *Source*: Authors' calculations.

Robustness checks, confirming the variables that best characterize RS practices around the world, regardless of the sample composition.

The 1st component explains most data variability (and highest internal consistency) → evidence that depositor's protection schemes are key regulatory practices regardless countries development level or legal framework differences.

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4. RESULTS AND DISCUSSION

- Robustness checks:

Variables - supervision	*All sample*	*OECD*	*Non offshore*	*Offshore*
11.5e. Which authority has the powers to perform the following problem bank resolution activities? e. Appoint and oversee a bank liquidator/receiver	PC3	PC1	PC2	PC1
12.6 Does the head of the supervisory agency have a fixed term?	PC1	PC1	PC1	PC2
12.7 Can the head of the supervisory agency be removed by …	PC1	PC1	PC1	PC2
12.12 If an infraction of any prudential regulation is found in the course of supervision, must it be reported?	PC1	PC3	PC1	PC4

Table 7 – RS variables by sub-sample and PC. *Source*: Authors' calculations.

Robustness checks, confirming the variables that best characterize RS practices around the world, regardless of the sample composition.

Less robust results towards a specific PC, but reliable to support the relevance of 4 variables measuring supervision.

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5. CONCLUSION

- Contributions:
  - Compile and summarize the quantitative and qualitative information available on RS for 141 countries;
  - Identify the most reliable banking RS variables to measure RS practices around the world;
  - Identify similitudes and discrepancies between the observed countries;
  - Find robust results regardless of countries development levels or the legal framework of each jurisdiction.

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5. CONCLUSION

- Main conclusions:
  - Results weakened the role of capital requirements (due to little robustness when comparing different sample compositions);
  - Deposit insurance is on the top of relevant variables to measure banking regulation;
  - Supervisory agencies resolution powers, the characteristics of head of supervisory agency mandate, and the report of prudential regulation infractions are the most relevant proxies to measure supervision;
  - The observance of similar RS practices between countries is not related to its development levels or its inclusion in a political group.

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How to measure banking regulation and supervision

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