

Cultural Correlates of National Innovative Capacity: A Cross-National Study of Non-Institutional Dimensions of Innovation

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Motivation for the Study (1)

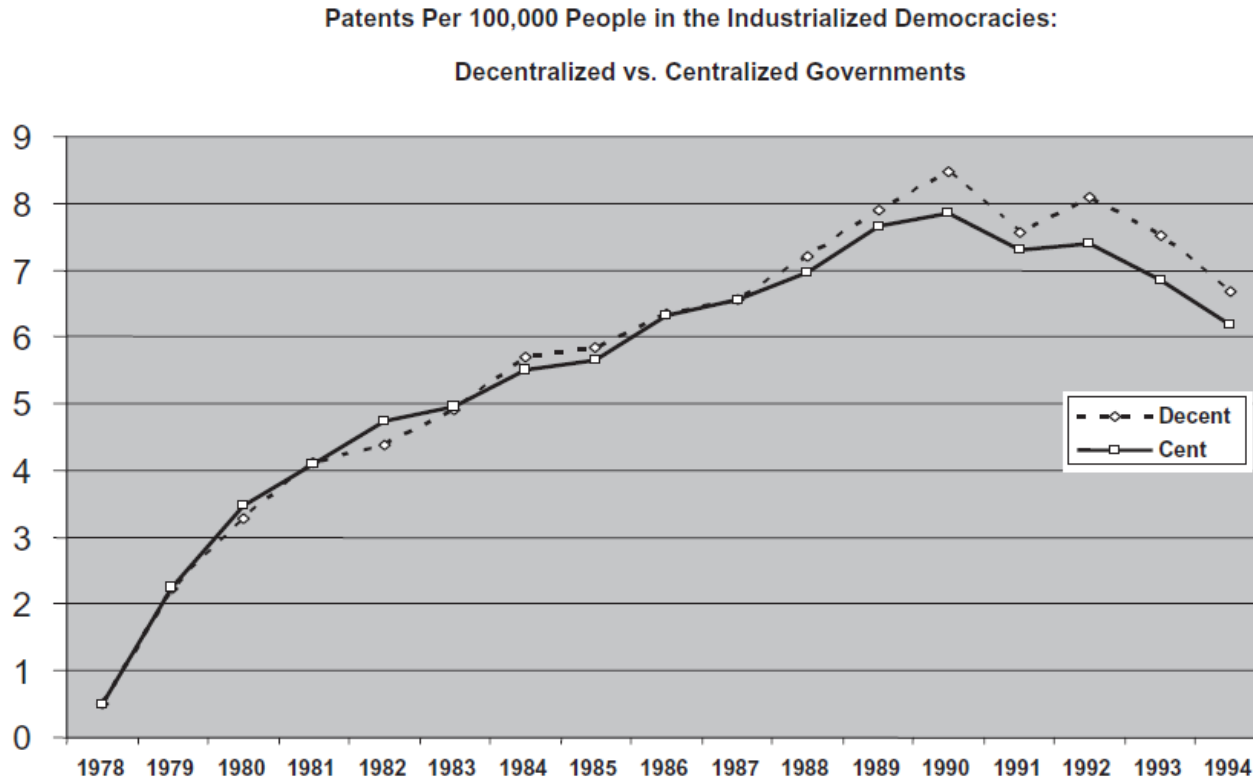


Figure 1. Innovation in Advanced Democracies: Decentralized versus Centralized States
Source: European Patent Office (2003).¹⁹

- Is there any evidence to support a general relationship between government structure and technological innovation? (Taylor 2007)
- Although many scholars believe that there is high correlation between them, the research results remain unclear
- Rather, it seems that there must be a missing piece to be explained.

Motivation (2)

- Technological innovation prospers on creativity, which in turn hinges on a free-thinking mind. → More democratic, less centralized political systems that allow greater individual freedom would be more propitious for innovation.
- Yet Japan and four Asian tigers (South Korea, Taiwan, Hong Kong, and Singapore) succeeded in fast-track modernization based on technological innovation under strongly authoritarian regimes.
- *Are more decentralized systems more innovative?*

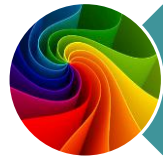
Existing Conjectures

- Political decentralization as “an increase in both the numbers and equality of centers of political power and policy making” (Taylor 2007)

Four mechanisms
linking
decentralization and
innovation



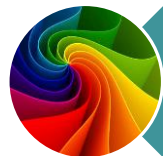
Decentralization → increase in # of political/economic units → multiple technological and experimental efforts (Acemoglu et al. 20015, Mokyr 2005)



Decentralization → increasing competition → increasing incentives for innovation (“Delaware effect”) (Carey 1974, Oates 1972)



Decentralization → superior information reflecting local conditions and preferences (Hayek 1945, Tiebout 1956)



Decentralization → more resistant to capture by status quo interest groups (Dresner 2001, Weingast 1995)

Our Contribution

1. Extending and updating Taylor's study using more recent data
 - Taylor's study (2007) used the data (POLCON III) → We add POLCON V covering years through 2012
 - In particular POLCON V contains Tsebelis' veto point index.
2. Exploring a new dimension of decentralization
 - Existing studies mainly focused on “institutional” centralization (e.g., vertical vs. horizontal centralization)
 - This study adds a “non-institutional” dimension of decentralization reflected in cultural factors.

Data and Variables (1)

- Used the data from 34 OECD countries largely due to data availability
- Dependent Variable:
 - Patent applications per 100,000 (same variable used in Taylor's study)
- Major Independent Variables:
 - Institutional Dimension → Heinsz' Political Constraint Index (POLCON) (0~1)
 - Non-institutional Dimension → Hofstede's 6 Cultural Dimensions (0~100)
- Control Variables:
 - Common to the previous studies of national innovation rates (Taylor 2007, 2012; Furman et al. 2002)
→ GDP per capita, R&D Expenditure, Military Spending, Education Expenditure, Trade Openness, Fuel Exports (from the World Development Indicators)

Data and Variables (2)

- “Non-institutional” dimensions of decentralization → Geert Hofstede’s dimensions of national culture

Power Distance	The extent to which the less powerful members of organizations and institutions (like the family) accept and expect that power is distributed unequally
Uncertainty Avoidance	The extent to which a culture programs its members to feel either uncomfortable or comfortable in unstructured (novel, unknown or surprising) situations.
Individualism	The extent to which individual ties are loose so that individuals look after themselves and their immediate families
Masculinity	The extent to which men’s values are significantly different from women’s values with the former being more aggressive and assertive
Long-Term Orientation	The extent to which a society fosters pragmatic virtues oriented towards future rewards (saving, persistence, adaptation to changing circumstances)
Indulgence	The extent to which a society allows relatively free gratification of basic and natural human drives related to enjoying life and having fun.

Methods/Strategies of Analysis

- Simple median-divided comparison of DV and major IVs
 - Countries spread over four quadrants of higher- vs. lower-than-the median over DV and a selected IV
- Correlations between institutional and non-institutional variables of decentralization
 - To see if they are meaningfully divergent
- OLS regression analysis of the following form:

$$\text{Patent/capita} = \beta_0 + \beta_1 * (\text{POLCON.V}) + \beta_2 * (\text{PD}) + \beta_3 * (\text{IDV}) + \beta_4 * (\text{MAS}) + \beta_5 * (\text{UAI}) + \beta_6 * (\text{LTO}) + \beta_7 * (\text{IND}) + e_i$$

Summary Statistics

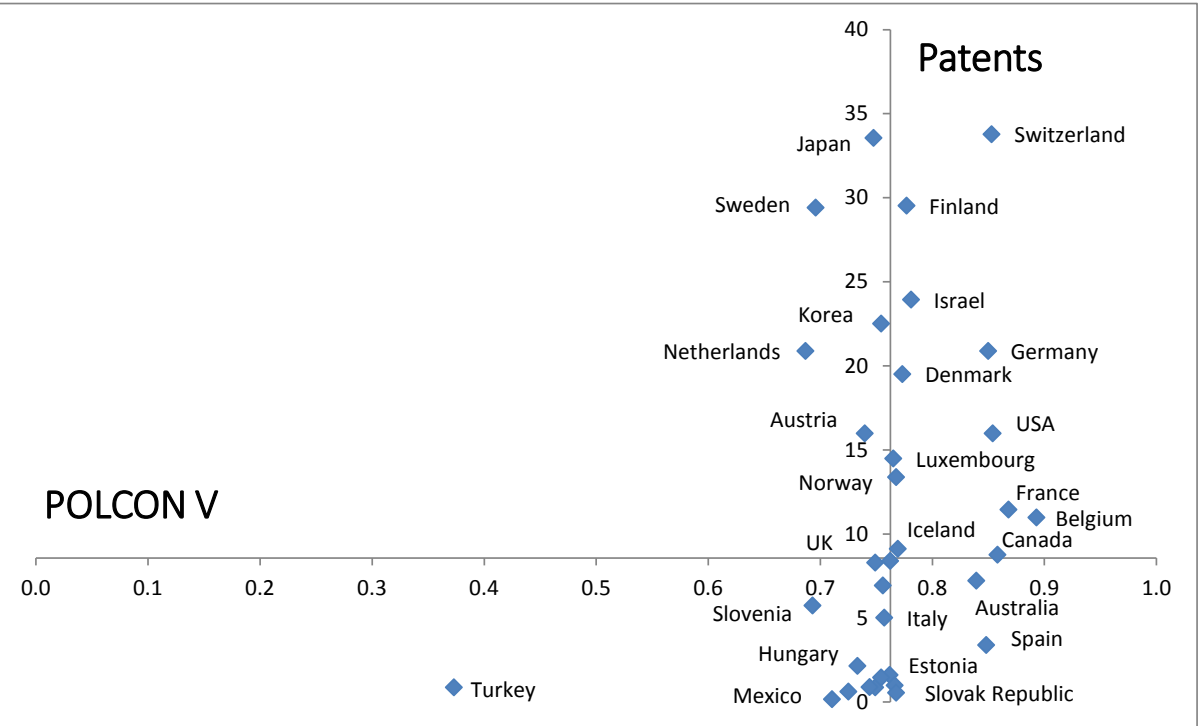
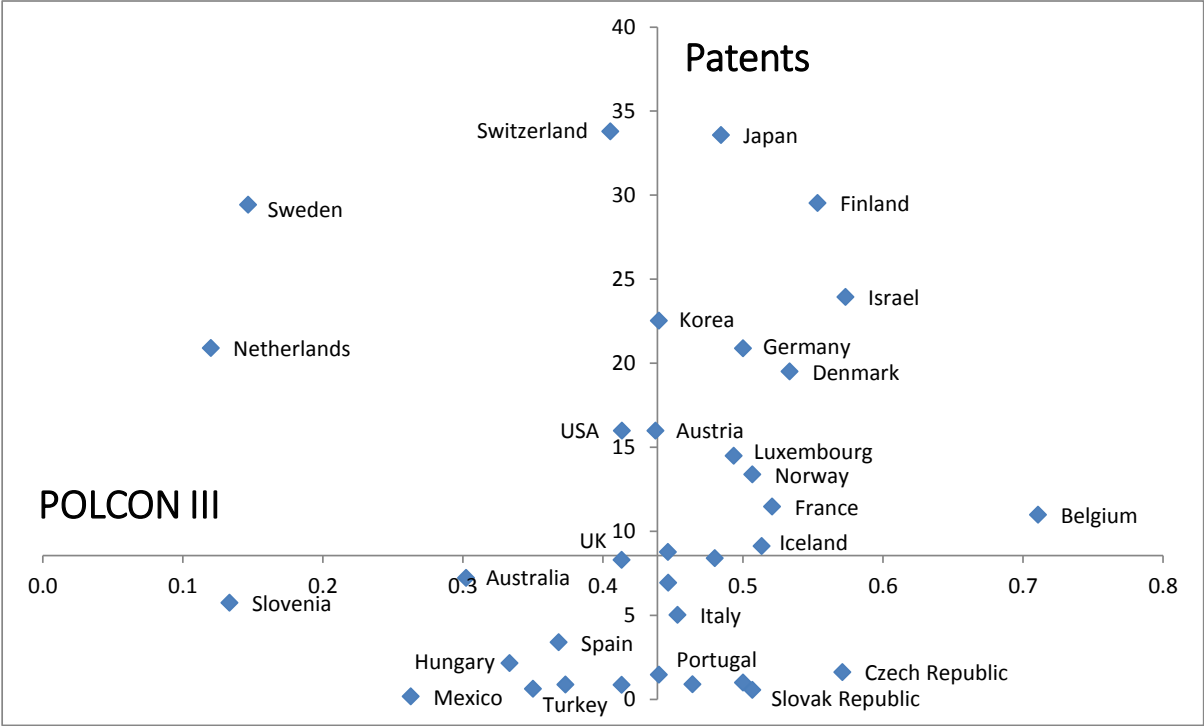
Variable	Obs	Mean	Std.dev.	Min	Max
Patents (per 100,000)	34	11.45	10.32	0.16	33.77
GDP/capita	34	40.40	23.87	9.82	106.02
R&D spending (% GDP)	34	2.07	1.00	0.42	4.04
Military spending (% GDP)	34	1.57	1.07	0.12	5.74
Trade openness (% GDP)	34	102.98	63.22	30.67	353
Fuel exports (% GDP)	34	10.75	13.51	0.92	70.00
Education spending (% GDP)	31	5.45	1.08	3.85	8.55
POLCON	34	0.76	0.09	0.37	0.89
Power Distance (PD)	34	46.74	20.09	11	100
Individualism (IND)	34	60.18	20.04	18	91
Masculinity (MAS)	34	49.68	24.83	5	100
Uncertainty Avoidance (UAI)	34	67.35	21.41	23	100
Long-Term Orientation (LTO)	34	51.65	21.43	21	100
Indulgence (IND)	33	53.45	18.58	16	97

Correlations of Institutional & Non-Institutional Variables

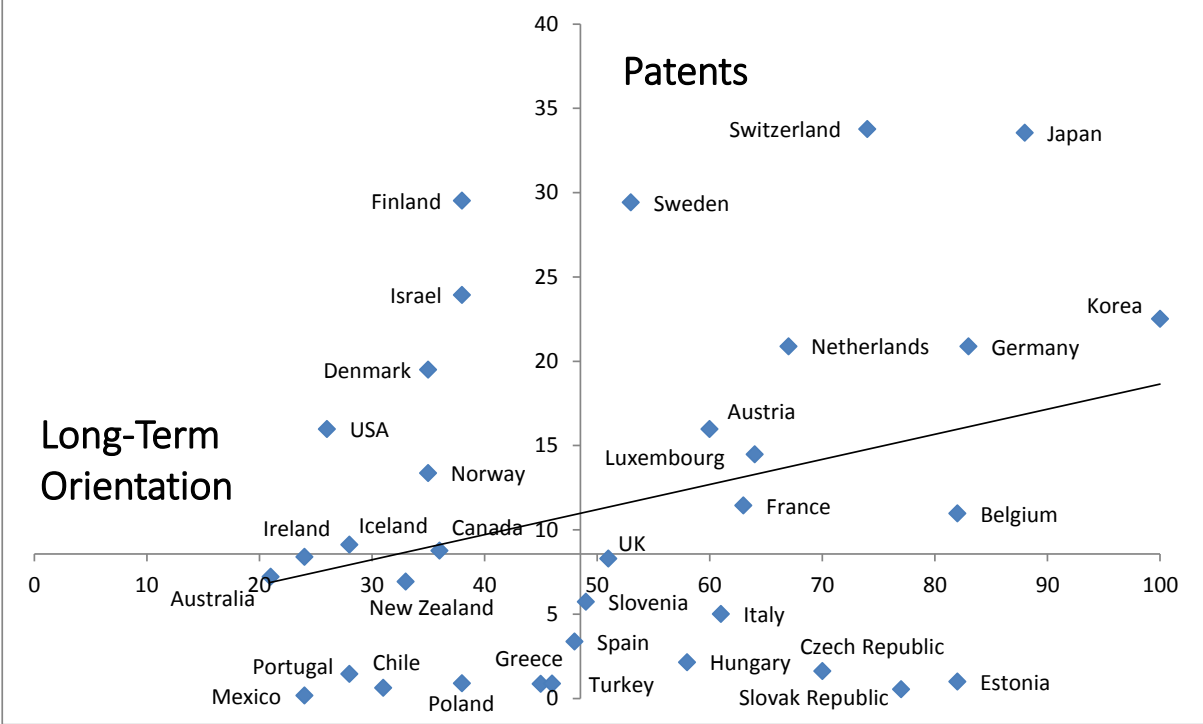
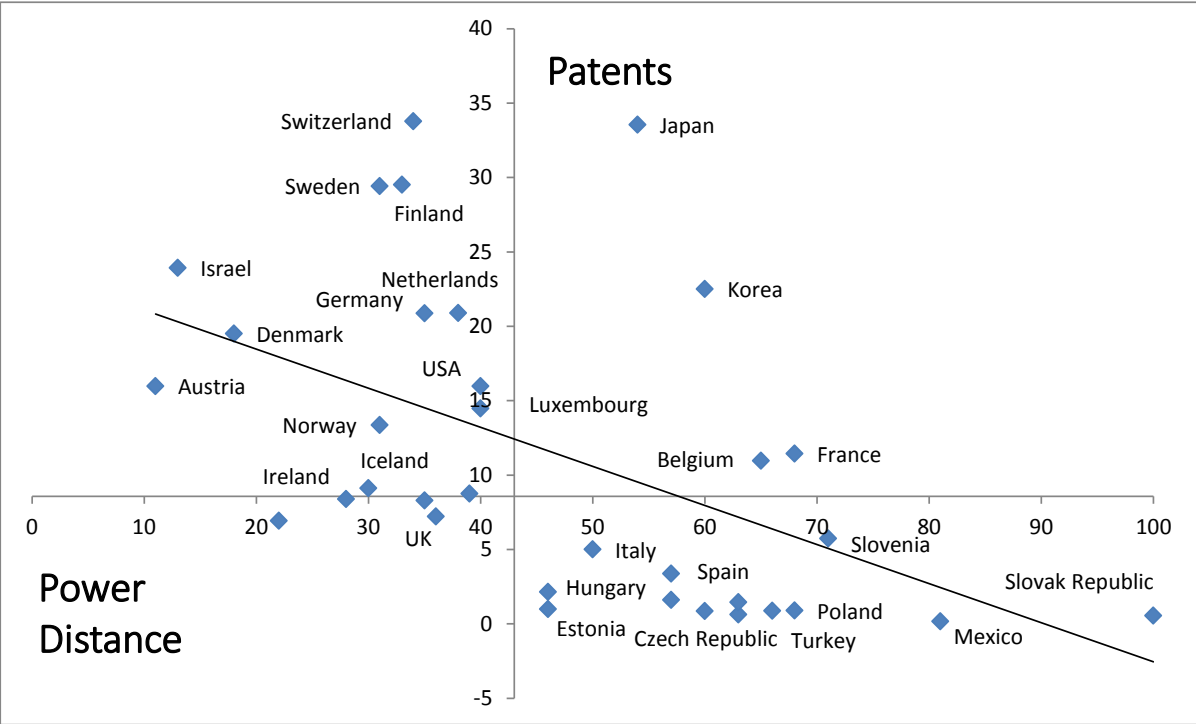
- Apparently the two dimensions are not neatly correlated.

	POLCON	PD	IDV	MAS	UAI	LTO	IND
POLCON	1						
PD	-0.17	1					
IDV	0.40	-0.51	1				
MAS	0.14	0.22	0.12	1			
UAI	-0.12	0.56	-0.64	0.19	1		
LTO	0.09	0.22	-0.10	0.25	0.24	1	
IND	0.02	-0.39	0.24	-0.20	-0.46	-0.55	1.00

Findings (1): Patents vs. POLCON



Findings (2): Patents vs. Cultural Variables



Regression Results (1): Baseline Model

- Only two cultural variables (PD, LTO) are significant, and POLCON is insignificant.
- Most regressions of cultural variables show higher explanatory power than the POLCON regression.
- As to the relative size of the impact, PD shows the largest effect.

Italicized: standardized beta coefficient
[Parenthesized]: standard errors

DV=	PCT Patents per 100.000						
POLCON	25.2						
	<i>0.212</i>						
	[12.8]						
PD		-0.263					
		<i>-0.511</i>					
		[0.08]	***				
IDV			0.101				
			<i>0.197</i>				
			[0.09]				
MAS				-0.050			
				<i>-0.121</i>			
				[0.07]			
UAI					-0.138		
					<i>-0.286</i>		
					[0.08]		
LTO						0.149	
						<i>0.310</i>	
						[0.08]	*
IND							0.133
							<i>0.240</i>
							[0.10]
Constant	-7.80	23.7	5.34	13.9	20.7	3.75	3.95
	[15.8]	[3.96]	[5.65]	[4.04]	[5.76]	[4.51]	[5.42]
		***		***	***		
Obs	34	34	34	34	34	34	33
R ²	0.05	0.26	0.04	0.01	0.08	0.10	0.06
Adj. R ²	0.02	0.24	0.01	-0.02	0.05	0.07	0.03
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$							

Regression Results (2): (Almost) Full Model

- Again POLCON is insignificant.
- With the addition of full controls, only LTO turns out to be significant.
- Most controls are significant (boosting R^2).

DV=	PCT Patents per 100.000							
POLCON	-3.38							
	[16.7]							
PD		-0.06						
		[0.09]						
IDV			-0.09					
			[0.08]					
MAS				-0.04				
				[0.06]				
UAI					0.00			
					[0.07]			
LTO						0.19		
						[0.06]	***	
IND								-0.06
								[0.09]
GDP/capita	0.36	0.32	0.39	0.35	0.35	0.36	0.36	
	[0.07] ***	[0.08] ***	[0.07] ***	[0.06] ***	[0.07] ***	[0.05] ***	[0.07] ***	
Mil spend	1.46	1.27	1.49	1.38	1.45	1.48	-0.17	
	[1.38]	[1.4]	[1.35]	[1.37]	[1.39]	[1.16]	[2.05]	
Trade open	-0.05	-0.04	-0.05	-0.05	-0.05	-0.07	-0.06	
	[0.02] *	[0.03] *	[0.02] **	[0.02] *	[0.02] *	[0.02] ***	[0.03] **	
Fuel exports	-0.35	-0.33	-0.36	-0.36	-0.34	-0.30	-0.33	
	[0.11] ***	[0.12] ***	[0.11] ***	[0.12] ***	[0.11] ***	[0.10] ***	[0.12] ***	
Constant	6.04	7.26	7.77	5.97	3.62	-5.22	9.43	
	[12.8]	[7.37]	[5.77]	[5.87]	[7.39]	[4.70]	[7.59]	
Obs	34	34	34	34	34	34	33	
R^2	0.52	0.53	0.54	0.53	0.52	0.66	0.52	

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Regression Results (3): Issue of R&D Expenditure

- R&D expenditure is one of the critical inputs into innovation.
- When R&D spending is controlled for, no independent variable is significant.
- With the inclusion of R&D, R^2 increases dramatically.

DV=	PCT Patents per 100.000								
POLCON	-12.3								
	[11.0]								
PD		0.02							
		[0.06]							
IDV			-0.03						
			[0.05]						
MAS				0.05					
				[0.04]					
UAI					0.02				
					[0.05]				
LTO						0.05			
						[0.04]			
IND								0.06	
								[0.05]	
GDP/capita	0.15	0.15	0.16	0.15	0.15	0.15	0.15	0.12	
	[0.04] ***	[0.05] ***	[0.04] ***	[0.04] ***	[0.04] ***	[0.04] ***	[0.04] ***	[0.04] **	
R&D spend	7.57	7.57	7.37	7.61	7.44	6.98	7.57		
	[0.95] ***	[1.04] ***	[0.95] ***	[0.95] ***	[0.95] ***	[0.99] ***	[1.03] ***		
Constant	-1.09	-11.4	-8.00	-12.6	-11.6	-11.8	-12.5		
	[7.93]	[5.07] **	[3.22] **	[3.26] ***	[4.81] **	[2.87] ***	[3.33] ***		
Obs	34	34	34	34	34	34	33		
R^2	0.78	0.77	0.77	0.78	0.77	0.78	0.77		

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Regression Results (4): Full Model

- &D expenditure is one of the critical inputs into innovation.
- When R&D spending is controlled for, no independent variable is significant.
- With the inclusion of R&D, R^2 increases dramatically.

DV=	PCT Patents per 100.000								
POLCON	-33.9								
	[17.9] *								
PD		0.05							
		[0.07]							
IDV			-0.05						
			[0.06]						
MAS				0.01					
				[0.05]					
UAI					0.01				
					[0.06]				
LTO						0.10			
						[0.06]			
IND								0.06	
								[0.07]	
GDP/capita	0.30	0.27	0.29	0.24	0.25	0.25	0.22		
	[0.07] ***	[0.08] ***	[0.09] ***	[0.08] ***	[0.08] ***	[0.07] ***	[0.08] ***		
Mil spend	-0.22	-0.42	-0.30	-0.60	-0.57	-0.15	-0.95		
	[1.00]	[1.08]	[1.09]	[1.06]	[1.07]	[1.04]	[1.45]		
Trade open	-0.02	-0.02	-0.02	-0.02	-0.02	-0.04	-0.02		
	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.03]		
Fuel exports	-0.24	-0.23	-0.23	-0.20	-0.21	-0.21	-0.18		
	[0.09] **	[0.10] **	[0.10] **	[0.11] *	[0.10] **	[0.09] **	[0.10] *		
Edu spend	-1.10	-0.43	-0.64	-0.66	-0.68	0.33	-1.31		
	[0.92]	[1.08]	[0.97]	[1.17]	[1.07]	[1.15]	[1.13]		
R&D spend	6.61	6.97	6.40	6.95	6.82	5.59	7.20		
	[1.21] ***	[1.28] ***	[1.38] ***	[1.34] ***	[1.32] ***	[1.46] ***	[1.36] ***		
Constant	23.3	-8.45	-1.66	-4.14	-4.76	-10.7	-3.36		
	[14.9]	[9.62]	[5.97]	[8.55]	[9.70]	[7.33]	[6.73]		
Obs	31	31	31	31	31	31	30		
R ²	0.84	0.82	0.82	0.81	0.81	0.83	0.81		

***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.10$

Discussion

- Our regression findings are not strong enough to support the effect of non-institutional dimensions of decentralization such as national culture.
- Insignificance of major independent variables capturing decentralization seems to be largely due to the multicollinearity problem of controls (esp., R&D expenditure).
- A more ingenious approach to isolating the effect of non-institutional dimensions is needed as well as theoretical conjectures linking them to innovation.