Latin American Subnational Innovation Competitiveness Index

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For policymakers to bolster the global competitiveness of their nations and regions, they first must know where they stand. This report benchmarks the 182 regions of Brazil, Chile, Colombia, Mexico, Peru, and the United States using 13 commonly available indicators of strength in the knowledge economy, in globalization, and in innovation capacity.

KEY TAKEAWAYS

- The United States claims all the top 47 regions, with Massachusetts, California, and Washington ranking the top three.
- Three states in the United States (Mississippi, Alaska, and West Virginia) rank lower than the very-best-performing Latin American regions.
- The five best-performing regions in Latin America are Mexico City, Mexico; Sao Paulo, Brazil; Lima, Peru; Bogotá, Colombia; and Arequipa, Peru.
- While Latin American regions lag behind U.S. regions in their overall scores, there is less variation in regional scores in Latin America.
- Peruvian regions, along with many regions in Colombia, Brazil, and Mexico, lag behind U.S. regions most visibly in broadband adoption. U.S. regions also particularly excelled at venture capital and patent applications compared to their Latin peers.
- Policymakers must open their regional innovation markets to both a continental and global scale to create internationally competitive ecosystems and accelerate development.
- Policymakers must boost local research and development (R&D), entrepreneurship, and patent applications for a resilient economy with cutting-edge development opportunities.

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INTRODUCTION

Despite Latin America accounting for only 8 percent of the global population and 6.5 percent of global economic output, the region possesses several characteristics that will be influential in the coming decades.[1] Notably, Latin America's role in global critical mineral reserves is remarkable. The region is responsible for 40 percent of the world's copper production and 35 percent of lithium production, among others.[2] As the rapid expansion of green technology and the green transition relies on these critical minerals, the region stands to gain significant economic and political advantages by ensuring a reliable supply of these minerals to the global economy, thereby elevating its role in the process.[3] The countries examined in this study—Brazil, Chile, Colombia, Mexico, Peru—represent 35 percent of the region's population and 40 percent of its economic output, and thus greatly shape the economic reality of the region.[4]

Despite being a vitally important region in the global economy, Latin America lags behind the more-developed parts of the world in terms of economic development. Most countries in the region face the risk of getting trapped in the middle-income category and struggle to advance into high-income economies. As the Information Technology and Innovation Foundation (ITIF) highlighted in a previous publication, in today's interconnected world, the ability to maintain economic strength and international significance depends greatly on promoting innovation and embracing technological progress, which are essential to achieve growth in per-capita gross domestic product (GDP).[5] Therefore, such countries must develop their own innovation strategies to avoid the middle-income trap.

The significance of an innovation strategy for a country cannot be overstated. In the 21st century, a country's sustained development and economic growth depend on its ability to develop and transfer knowledge and technology, enhance productivity, and foster resilience. Numerous crucial elements shape a country's innovation ecosystem, including the quality of education and academic institutions, the level of public and private investments dedicated to research and development (R&D) and innovation, the presence of highly skilled R&D professionals, the economy's vibrancy, and the entrepreneurial spirit. However, while more developed countries, such as the the United States, typically invest about 3 percent of GDP in R&D activities, Latin America only invests a mere 0.67 percent of GDP.[6] This low level of investment is also reflected in the fact that Latin America contributes only 2.75 percent of the world's scientific publications on innovation, despite its more-sizeable economic and population representation.[7]

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The Global Innovation Index (GII) is a prominent tool that provides comprehensive assessments of innovation performance on a global and regional scale. The GII offers a multidimensional perspective on innovation, evaluating factors such as R&D investments, human capital, and business sophistication, which collectively contribute to a country's innovation capacity.[8] In line with the GII, ITIF has contributed significantly to the discourse on innovation competitiveness through its series of insightful subnational innovation competitiveness reports, which provide nuanced insights into the intricate relationships between innovation, economic development, and regional competitiveness, offering valuable perspectives for policymakers, businesses, and researchers alike. For instance, ITIF's "State New Economy Index" report series delves into the role of innovation in driving U.S. state-level economic growth and highlights the transformation of industries through technological advancements.[9] The "North American Subnational Innovation Competitiveness (NASICI)" report delves into innovation dynamics within the North American region, emphasizing the significance of local ecosystems in enhancing competitiveness. Furthermore, the Global Trade and Innovation Policy Alliance's (GTIPA) 2022 "Transatlantic Subnational Innovation Competitiveness (TASICI)" report examines the innovation landscapes in Europe (Germany and Italy) and North America (Canada and the United States), shedding light on the interplay between subnational entities and cross-border collaboration.[10]

However, the literature has so far lacked an analysis of innovation capacity and performance specific to the Latin American region. It is certain that the region's innovation and economic development will have a significant impact on the global economy. Whether countries in the region can evolve and renew themselves will have consequences, as failure to do so will also carry implications. This study aims to showcase the continent's subnational innovation capabilities, opportunities, and potential future direction through examining the innovation capacity of regions in five influential Latin American countries: Brazil, Chile, Colombia, Mexico, and Peru. The results are compared to U.S. states.

THE INDEX

The Latin American Subnational Innovation Competitiveness Index ("LASICI") captures the innovation performance of 182 regions across 6 countries and 2 continents: Peru (24 departments), Brazil (27 regions), Chile (16 regions), Mexico (32 states), Colombia (33 departments), and the United States (50 states). In this report, we refer to states and departments as regions to simplify the comparative analysis.

This report consists of 13 indicators representing the relevant determinants of a successful innovation ecosystem, grouped into three categories:

- **Knowledge-Based Workforce**: Indicators measure the educational attainment of the workforce; immigration of knowledge workers; employment in professional, technical, and scientific (PTS) activities; and manufacturing sector productivity.
- **Globalization**: Indicators measure high-tech exports and inward FDI.
- **Innovation Capacity**: Indicators measure a region's share of households subscribing to broadband Internet, expenditures on R&D, the number of R&D personnel, the creation of new businesses, patent output, the extent of progress toward decarbonization, and VC investment.

The most important category of the LASICI is innovation capacity, which accounts for 56 percent of the index's weight, while the knowledge economy indicators account for 31 percent of the index's weight, and the globalization indicators account for the remaining 13 percent.

RESULTS

Ranking List

Table 1: Overall and component performance of regions in LASICI

Overall Rank	Country	Regions	Overall Score	Knowledge Score	Knowledge Rank	Globalization Score	Globalization Rank	Inn Capacity Score	Inn Capacity Rank
1	USA	Massachusetts	95.3	94.9	1	62.4	15	95.5	1
2	USA	California	90.1	87.2	5	56.2	20	93.1	2
3	USA	Washington	81.2	75.0	9	35.8	40	89.7	3
4	USA	Maryland	73.3	88.7	3	22.7	88	69.3	6
5	USA	Oregon	70.3	64.0	17	78.0	11	72.0	4
6	USA	New Jersey	70.1	88.0	4	31.1	58	62.9	10
7	USA	Michigan	66.6	62.7	21	48.9	24	71.4	5
8	USA	Connecticut	66.4	76.9	6	44.0	27	62.2	12
9	USA	Delaware	66.0	68.6	12	43.4	30	67.2	8
10	USA	New Hampshire	64.7	58.4	25	80.4	9	65.9	9
11	USA	Minnesota	63.4	66.9	14	52.7	22	62.6	11
12	USA	New Mexico	61.9	56.9	29	49.4	23	67.4	7
13	USA	Colorado	61.0	74.5	10	34.9	42	56.2	15
14	USA	Illinois	60.1	73.3	11	66.7	13	50.4	20
15	USA	Texas	59.9	75.5	8	84.9	4	45.7	25
16	USA	Virginia	58.6	90.2	2	30.6	60	42.3	28
17	USA	Utah	58.6	63.5	18	43.6	29	58.3	13
18	USA	New York	58.1	75.6	7	31.2	57	51.3	19
19	USA	North Carolina	55.2	66.1	15	31.8	52	52.7	16
20	USA	Pennsylvania	54.7	65.0	16	35.5	41	52.1	18
21	USA	Arizona	53.3	60.3	22	60.3	16	48.9	23
22	USA	Idaho	52.6	47.9	44	57.1	18	56.6	14
23	USA	Wisconsin	51.7	50.4	38	64.5	14	52.2	17
24	USA	Ohio	50.8	58.1	26	42.0	33	49.2	22
25	USA	Indiana	48.9	51.3	36	43.7	28	50.3	21
26	USA	Rhode Island	48.5	59.1	23	29.4	64	46.6	24
27	USA	Missouri	46.2	56.9	30	38.8	36	42.7	26
28	USA	Kansas	45.0	58.9	24	32.1	50	40.5	29
29	USA	Georgia	44.9	62.8	20	34.5	43	37.3	30
30	USA	Florida	44.7	67.2	13	42.5	32	32.6	36
31	USA	Iowa	42.9	47.5	46	45.1	25	42.6	27

Overall Rank	Country	Regions	Overall Score	Knowledge		Globalization		Inn Capacity	
				Score	Rank	Score	Rank	Score	Rank
32	USA	Tennessee	41.6	53.5	34	56.1	21	34.5	32
33	USA	Vermont	41.2	48.9	42	82.4	6	32.8	34
34	USA	Nebraska	38.3	55.5	31	29.4	63	32.0	38
35	USA	South Carolina	37.8	50.0	39	42.8	31	32.7	35
36	USA	Wyoming	37.6	57.4	28	12.6	168	32.2	37
37	USA	Nevada	37.3	54.6	32	37.6	39	29.7	41
38	USA	North Dakota	37.0	46.4	48	38.3	37	34.5	33
39	USA	Alabama	36.3	47.7	45	18.5	113	35.7	31
40	USA	Maine	36.1	50.4	37	38.0	38	30.4	39
41	USA	Kentucky	36.0	46.2	49	56.4	19	30.0	40
42	USA	Louisiana	34.5	63.2	19	15.3	152	22.6	57
43	USA	Oklahoma	33.1	47.1	47	32.9	47	28.4	43
44	USA	Montana	32.6	49.4	41	13.4	164	29.1	42
45	USA	Hawaii	31.0	52.6	35	7.2	179	25.3	49
46	USA	Arkansas	29.5	44.6	50	24.1	81	25.5	47
47	USA	South Dakota	28.3	39.2	55	27.4	74	26.7	46
48	Mexico	Mexico City	28.2	58.0	27	21.8	90	14.6	104
49	Brazil	São Paulo	27.9	19.9	133	95.2	1	28.0	44
50	USA	West Virginia	27.1	43.8	52	28.8	68	21.3	65
51	Peru	Lima	27.0	54.0	33	25.1	79	14.8	101
52	USA	Mississippi	26.7	34.0	67	44.8	26	24.7	53
53	USA	Alaska	26.5	44.1	51	13.5	163	22.5	58
54	Colombia	Bogotá	23.7	35.2	65	17.2	120	23.3	55
55	Peru	Arequipa	23.7	48.9	43	28.6	70	12.2	131
56	Mexico	Nuevo León	23.5	49.6	40	19.5	109	12.9	120
57	Brazil	Rio de Janeiro	23.1	17.8	143	79.6	10	24.0	54
58	Brazil	Paraná	23.0	14.3	152	85.9	3	25.2	50
59	Brazil	Minas Gerais	21.9	15.2	150	83.9	5	23.0	56
60	Chile	Santiago	21.8	33.7	69	19.8	93	20.7	70
61	Brazil	Santa Catarina	21.4	16.8	146	41.3	35	27.9	45
62	Brazil	Rio Grande do Sul	20.6	14.5	151	59.1	17	25.3	48
63	Mexico	Querétaro	20.3	41.9	53	21.2	91	12.3	129
64	Brazil	Espírito Santo	20.2	13.0	156	81.7	7	22.0	61
65	Colombia	Antioquia	20.1	29.7	84	17.7	117	20.9	68

Overall Rank	Country	Regions	Overall Score	Knowledge		Globalization		Inn Capacity	
				Score	Rank	Score	Rank	Score	Rank
66	Colombia	Vaupés	19.6	23.3	115	15.5	143	24.8	52
67	Peru	Ica	19.0	40.8	54	41.8	34	7.7	174
68	Mexico	Sonora	18.9	35.9	61	12.4	170	15.5	98
69	Brazil	Distrito Federal	18.8	23.2	117	7.0	180	24.9	51
70	Colombia	Santander	18.7	27.2	96	16.6	125	20.4	72
71	Colombia	Atlántico	18.3	27.7	92	17.4	118	19.2	78
72	Mexico	Coahuila	18.3	38.0	56	18.9	112	12.0	133
73	Colombia	Amazonas	18.3	31.3	76	15.5	143	17.1	86
74	Colombia	Caldas	18.1	26.9	98	16.3	126	19.7	77
75	Mexico	Quintana Roo	18.1	33.7	68	19.0	111	14.6	105
76	Peru	Moquegua	18.0	36.9	58	27.3	75	10.9	143
77	Chile	Los Ríos	17.6	24.1	106	19.8	93	20.2	75
78	Mexico	Aguascalientes	17.6	35.5	63	17.0	122	12.8	122
79	Colombia	Cundinamarca	17.4	28.2	88	16.2	127	17.6	84
80	Colombia	San Andrés y Providencia	17.3	31.3	76	18.2	116	15.1	99
81	Brazil	Pernambuco	17.3	10.6	166	66.7	12	21.1	67
82	Colombia	Quindío	17.1	23.6	110	15.5	135	20.3	73
83	Chile	Antofagasta	17.0	30.5	80	19.8	93	14.9	100
84	Chile	Tarapacá	17.0	32.3	71	19.8	93	13.6	110
85	Colombia	Norte de Santander	17.0	28.4	87	15.9	130	16.8	89
86	Colombia	Risaralda	16.9	27.1	97	16.0	129	17.6	85
87	Mexico	Jalisco	16.9	35.5	62	14.5	158	12.1	132
88	Mexico	Baja California	16.6	32.3	72	17.1	121	13.3	115
89	Chile	Magallanes	16.5	28.0	90	19.8	93	15.7	97
90	Chile	Ñuble	16.5	24.2	104	19.8	93	18.2	80
91	Mexico	Chihuahua	16.0	32.7	70	19.3	110	11.7	139
92	Colombia	Valle del Cauca	15.9	23.4	112	16.9	124	18.1	81
93	Peru	Tumbes	15.8	35.9	59	31.4	54	7.3	178
94	Colombia	Boyacá	15.8	20.9	129	15.5	140	20.0	76
95	Peru	Lambayeque	15.8	34.6	66	26.8	76	8.9	162
96	Peru	Tacna	15.8	35.9	60	25.4	78	8.2	168
97	Peru	La Libertad	15.7	37.0	57	23.2	86	7.7	175
98	Colombia	Guainía	15.5	31.3	76	15.5	143	12.5	125
99	Colombia	Casanare	15.2	31.3	76	16.2	128	11.8	137

Overall Rank	Country	Regions	Overall Score	Knowledge		Globalization		Inn Capacity	
				Score	Rank	Score	Rank	Score	Rank
100	Brazil	Ceará	15.0	13.7	154	29.7	61	21.2	66
101	Colombia	Meta	14.9	23.0	119	15.5	143	17.0	87
102	Mexico	Baja California Sur	14.9	27.6	93	24.1	80	12.5	126
103	Peru	Cusco	14.8	27.9	91	26.3	77	11.9	135
104	Chile	Valparaíso	14.8	23.4	114	19.8	93	16.0	93
105	Peru	Áncash	14.8	35.5	64	20.2	92	7.6	176
106	Peru	Junín	14.6	29.8	82	22.6	89	10.9	144
107	Mexico	Morelos	14.6	28.5	86	23.5	85	11.6	140
108	Colombia	Guaviare	14.6	31.3	76	15.5	143	10.9	142
109	Colombia	Putumayo	14.5	31.3	76	15.5	143	10.8	146
110	Chile	Arica y Parinacota	14.5	21.5	127	19.8	93	16.6	90
111	Brazil	Goiás	14.4	10.8	165	32.8	48	21.6	63
112	Colombia	Arauca	14.4	31.3	76	15.6	133	10.5	149
113	Mexico	Mexico	14.2	30.1	81	17.3	119	10.7	147
114	Chile	Bío-Bío	14.1	23.4	113	19.8	93	14.8	102
115	Brazil	Mato Grosso do Sul	13.9	11.7	160	28.8	69	20.8	69
116	Mexico	Colima	13.7	26.5	99	10.8	175	13.5	113
117	Brazil	Amazonas	13.7	7.6	173	93.3	2	12.8	121
118	Colombia	Cesar	13.5	19.7	137	15.5	136	16.9	88
119	Mexico	Tamaulipas	13.5	27.6	94	22.7	87	10.4	150
120	Chile	Aysen	13.5	22.2	124	19.8	93	14.6	106
121	Colombia	Magdalena	13.4	18.3	141	15.8	131	17.7	83
122	Peru	Ayacucho	13.4	28.2	89	32.4	49	8.3	167
123	Colombia	Bolívar	13.3	20.5	131	17.0	123	15.9	95
124	Brazil	Maranhão	13.2	5.1	182	80.7	8	15.9	96
125	Chile	Los Lagos	13.2	23.0	120	19.8	93	13.5	111
126	Chile	Maule	13.2	23.7	109	19.8	93	13.0	118
127	Mexico	Yucatán	13.1	27.3	95	11.8	173	11.7	138
128	Mexico	San Luis Potosí	13.1	28.5	85	18.2	115	9.8	158
129	Brazil	Sergipe	12.8	7.4	174	29.0	67	22.0	60
130	Mexico	Sinaloa	12.7	26.0	100	12.0	171	11.8	136
131	Mexico	Puebla	12.5	24.4	103	23.8	84	10.8	145
132	Brazil	Bahia	12.5	8.1	172	33.4	45	20.2	74
133	Peru	Loreto	12.0	29.7	83	14.5	157	7.8	173

Overall Rank	Country	Regions	Overall Score	Knowledge		Globalization		Inn Capacity	
				Score	Rank	Score	Rank	Score	Rank
134	Colombia	Tolima	12.0	17.0	145	15.5	138	16.2	92
135	Colombia	Huila	11.9	16.5	147	15.5	141	16.5	91
136	Brazil	Paraíba	11.9	6.8	177	18.4	114	22.5	59
137	Mexico	Guanajuato	11.8	25.8	101	13.6	162	10.2	155
138	Chile	Araucanía	11.7	19.8	136	19.8	93	13.2	116
139	Peru	Piura	11.7	24.6	102	31.5	53	7.9	171
140	Chile	O'Higgins	11.5	19.9	135	19.8	93	12.8	124
141	Peru	San Martín	11.4	23.5	111	29.4	65	8.6	164
142	Peru	Huánuco	11.2	22.2	123	31.4	56	8.9	161
143	Mexico	Tabasco	11.2	24.0	108	14.5	156	10.3	154
144	Brazil	Rio Grande do Norte	11.2	7.3	175	14.3	160	21.7	62
145	Chile	Coquimbo	11.1	19.5	138	19.8	93	12.4	128
146	Peru	Ucayali	11.1	23.2	118	28.1	71	8.5	165
147	Peru	Amazonas	11.0	21.4	128	33.3	46	8.8	163
148	Brazil	Mato Grosso	11.0	12.0	159	28.0	73	15.9	94
149	Peru	Apurímac	10.8	20.8	130	28.0	72	9.6	159
150	Mexico	Zacatecas	10.7	18.1	142	29.3	66	11.1	141
151	Mexico	Veracruz	10.6	22.9	121	15.0	154	10.1	156
152	Peru	Puno	10.5	24.1	107	31.9	51	6.2	180
153	Colombia	Cauca	10.4	15.3	149	15.5	137	14.7	103
154	Brazil	Piauí	10.3	6.0	178	31.4	55	18.3	79
155	Mexico	Durango	10.2	21.8	125	12.9	167	10.4	153
156	Peru	Cajamarca	10.1	21.8	126	34.0	44	6.8	179
157	Mexico	Hidalgo	10.0	24.2	105	13.3	165	8.4	166
158	Mexico	Tlaxcala	9.9	18.5	140	24.0	82	10.4	152
159	Mexico	Campeche	9.8	22.8	122	10.6	176	9.5	160
160	Brazil	Amapá	9.8	5.2	181	14.8	155	20.6	71
161	Brazil	Alagoas	9.7	5.4	180	9.0	178	21.3	64
162	Chile	Atacama	9.5	19.1	139	19.8	93	10.0	157
163	Peru	Madre de Dios	9.2	19.9	134	29.5	62	7.3	177
164	Brazil	Tocantins	9.1	8.2	171	11.6	174	17.9	82
165	Colombia	Sucre	8.8	12.6	157	15.5	142	13.8	109
166	Mexico	Nayarit	8.8	17.4	144	15.1	153	10.6	148
167	Colombia	Córdoba	8.5	11.1	163	15.5	143	14.4	108

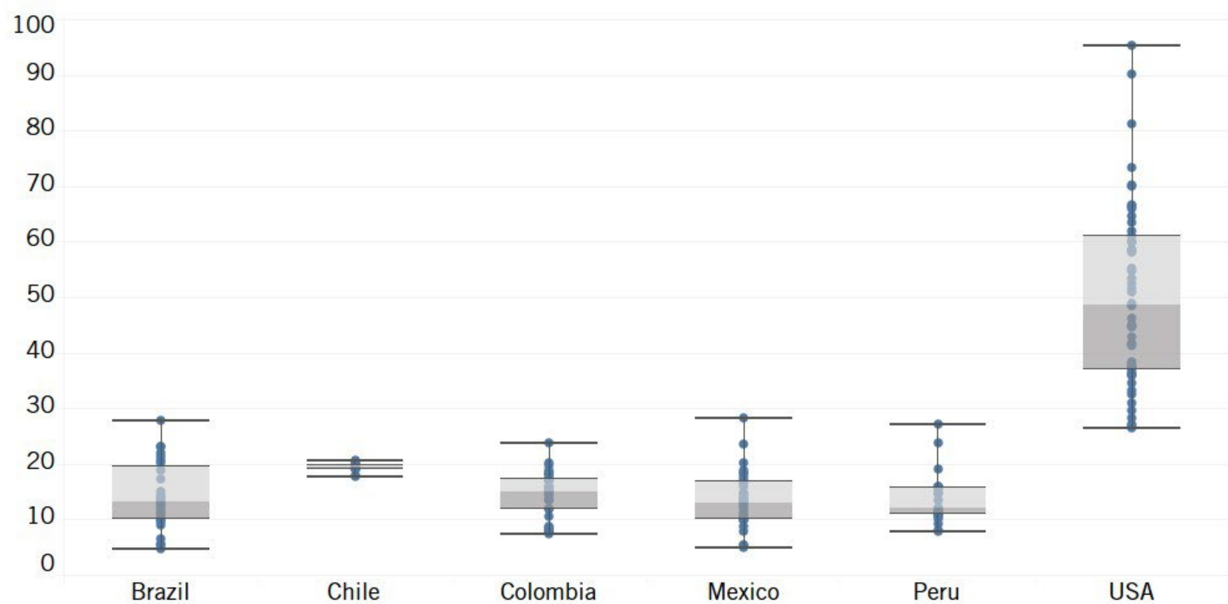
Overall Rank	Country	Regions	Overall Score	Knowledge		Globalization		Inn Capacity	
				Score	Rank	Score	Rank	Score	Rank
168	Colombia	Nariño	8.2	10.2	167	15.7	132	14.4	107
169	Colombia	Caquetá	8.1	11.5	161	15.5	143	13.4	114
170	Peru	Pasco	8.0	20.4	132	23.8	83	5.9	181
171	Colombia	La Guajira	7.9	10.9	164	15.6	134	13.5	112
172	Mexico	Michoacán de Ocampo	7.9	16.2	148	12.0	172	10.4	151
173	Peru	Huancavelica	7.7	9.1	168	31.0	59	11.9	134
174	Colombia	Vichada	7.5	23.3	116	15.5	139	4.5	182
175	Colombia	Chocó	7.3	11.3	162	15.5	143	12.2	130
176	Brazil	Rondônia	6.5	8.9	169	12.4	169	13.1	117
177	Brazil	Pará	5.7	7.3	176	14.5	159	12.4	127
178	Brazil	Acre	5.4	8.4	170	4.8	182	12.8	123
179	Mexico	Oaxaca	5.4	14.2	153	10.0	177	7.9	170
180	Mexico	Chiapas	5.3	13.2	155	13.2	166	8.0	169
181	Mexico	Guerrero	4.9	12.1	158	14.0	161	7.8	172
182	Brazil	Roraima	4.7	5.9	179	6.1	181	13.0	119

Index Scores

Overall

American states lead in this index of subnational innovation competitiveness, with 47 of its 50 states ranked higher than Mexico City, which is the best-performing region in Latin America (see Figure 1). Compared to the United States, the Latin American countries in this study have much less regional variation in their scores. The difference between the maximum and the minimum subnational innovation competitiveness score is the smallest in Chile, and a handful of the very-best-performing regions in Brazil, Mexico, and Peru rank higher than three U.S. states.

Figure 1: Maximum, minimum, quartiles, and median of overall subnational innovation competitiveness scores by country (dots denote the regions)[11]



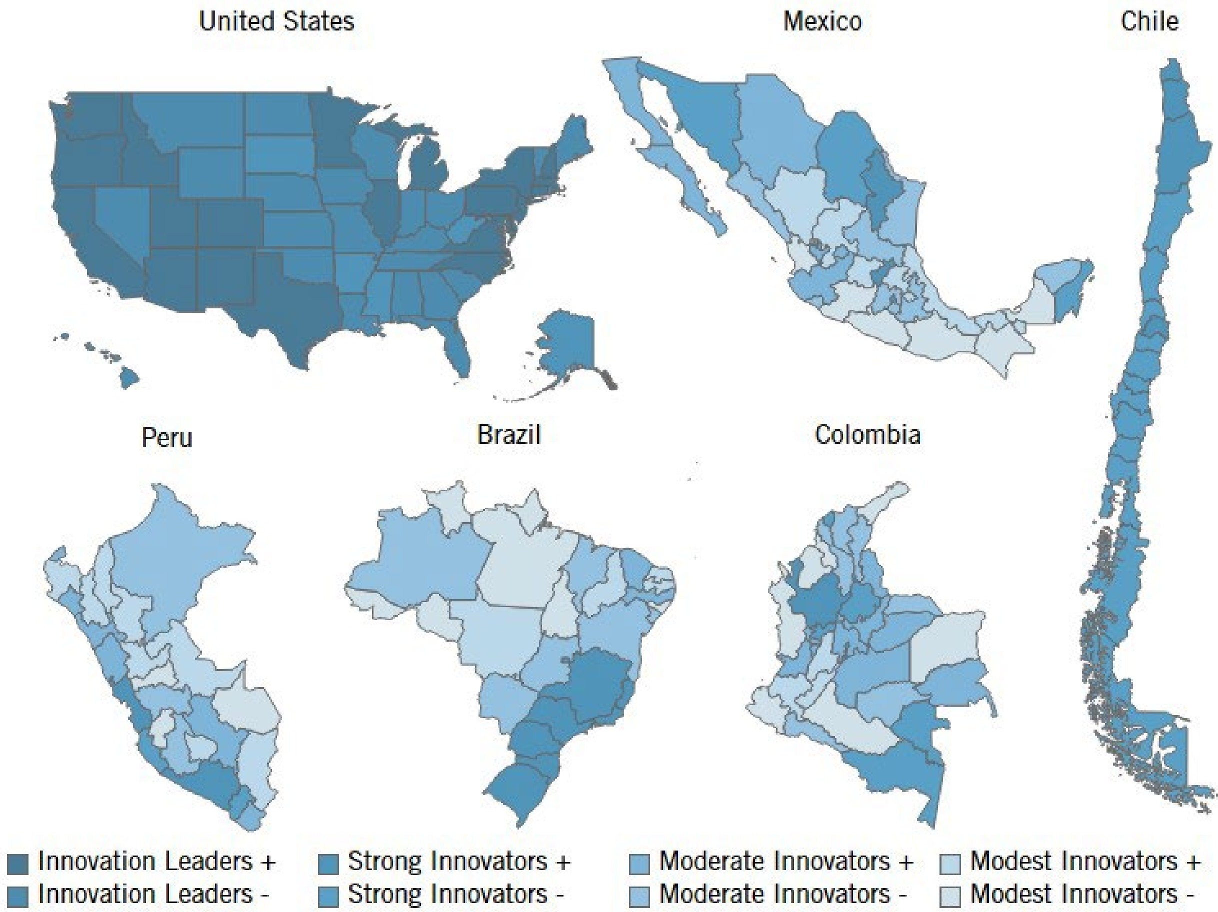
Regions were sorted into eight innovation competitiveness categories: modest innovator -, modest innovator +, moderate innovator -, moderate innovator +, strong innovator -, strong innovator +, innovation leader -, and innovation leader+ based on the regions' positions in the ranking. The number of regions in each category was selected to be 23 to place an equal number of regions in each category given that there are 182 regions in total.[12] The minus sign in the name of the category indicates that its regions fall into a lower category than those regions that are in the respective category with a positive sign. As the colors of the charts indicate, the categories' ascending order is modest innovator, moderate innovator, strong innovator, and innovation leader, in line with the rankings in the European Innovation Scorecard.

American states lead in this index of subnational innovation competitiveness, with 47 of its 50 states ranked higher than Mexico City, which is the best-performing region in Latin America.

The east and west coasts of the United States exhibit strong innovation performance, while states in the middle of the country are lagging modest innovators, such as West Virginia or South

Dakota (see Figure 2). The United States scores diversely as it has states in all eight innovation categories. Colombia's best-performing regions are Bogotá and Antioquia. The strong innovator regions in Colombia are Bogotá and Antioquia. In Chile, the strong innovator regions are Santiago and Antofagasta. Many Mexican regions fall in the moderate or modest innovators category; however, Mexico City and Nuevo León are strong innovators due to their globalized economy and strong innovation capacity. Peru's strong innovator regions are Arequipa and Lima, while the region of Ica is only a moderate innovator. Brazil's strong innovator regions are Rio de Janeiro and São Paulo, while the region of Ceará is only a moderate innovator.

Figure 2: Overall SASICI subnational innovation competitiveness scores[13]

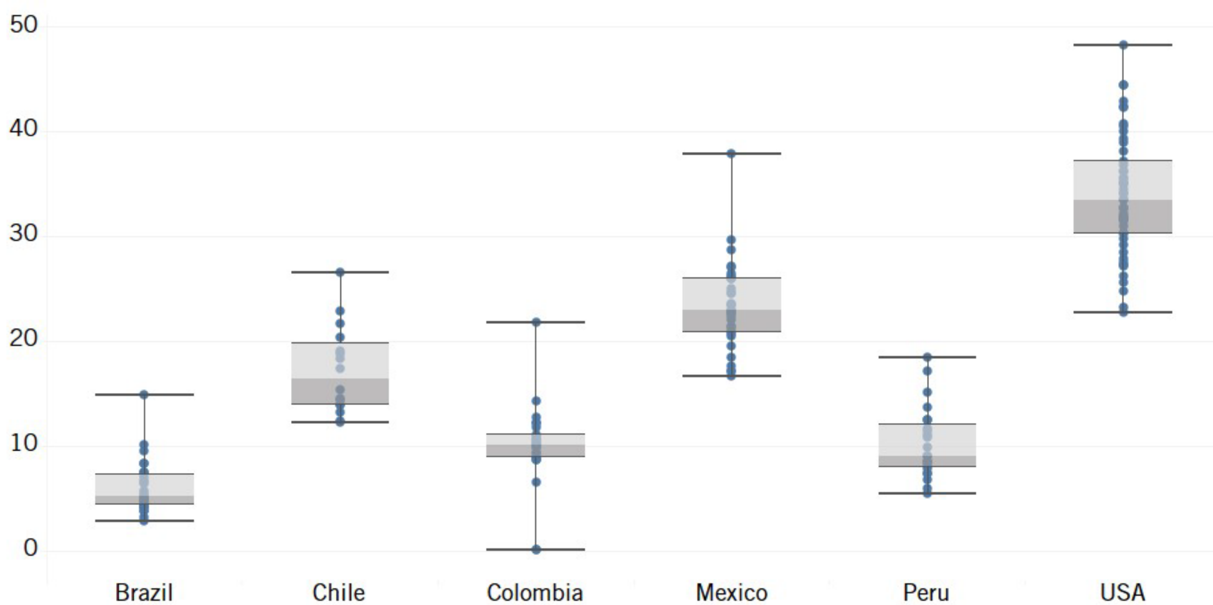


Knowledge Economy

Highly Educated Population

Why is this important? This indicator measures the share of a region's 25–64-year-old ("prime age") population with a bachelor's degree (or equivalent) or higher. Education provides citizens with the skills and knowledge necessary to compete and innovate in the modern economy. While more time spent in school does not necessarily guarantee sufficient applied skills to compete in the modern global innovation economy—for example, the Council for Aid to Education found that 44 percent of current U.S. university graduates are not proficient in essential career skills—the proportion of highly educated residents remains a strong indicator of human capital.[14] Moreover, evidence suggests that more educated individuals are more likely and willing to adopt new technological innovations.[15]

Figure 3: Share of the 25–64-year-old population with a bachelor's degree (or equivalent) or higher, 2019 (%)[16]



The rankings: The data highlights Peru's intriguing trend in education. Regions like Arequipa (18.5 percent) and Lima (17.1 percent) stand out in educational attainment (see Figure 3 and Figure 4). By contrast, the San Martín (6.8 percent) and Ucayali (5.9 percent) regions have comparatively lower educational attainment.

In Mexico, the data showcase a divergence between regions such as Mexico City (37.9 percent) and Chiapas (16.7 percent). This reveals a regional contrast in educational attainment and innovation potential, possibly influenced by varying economic conditions, educational infrastructure, and policy priorities.

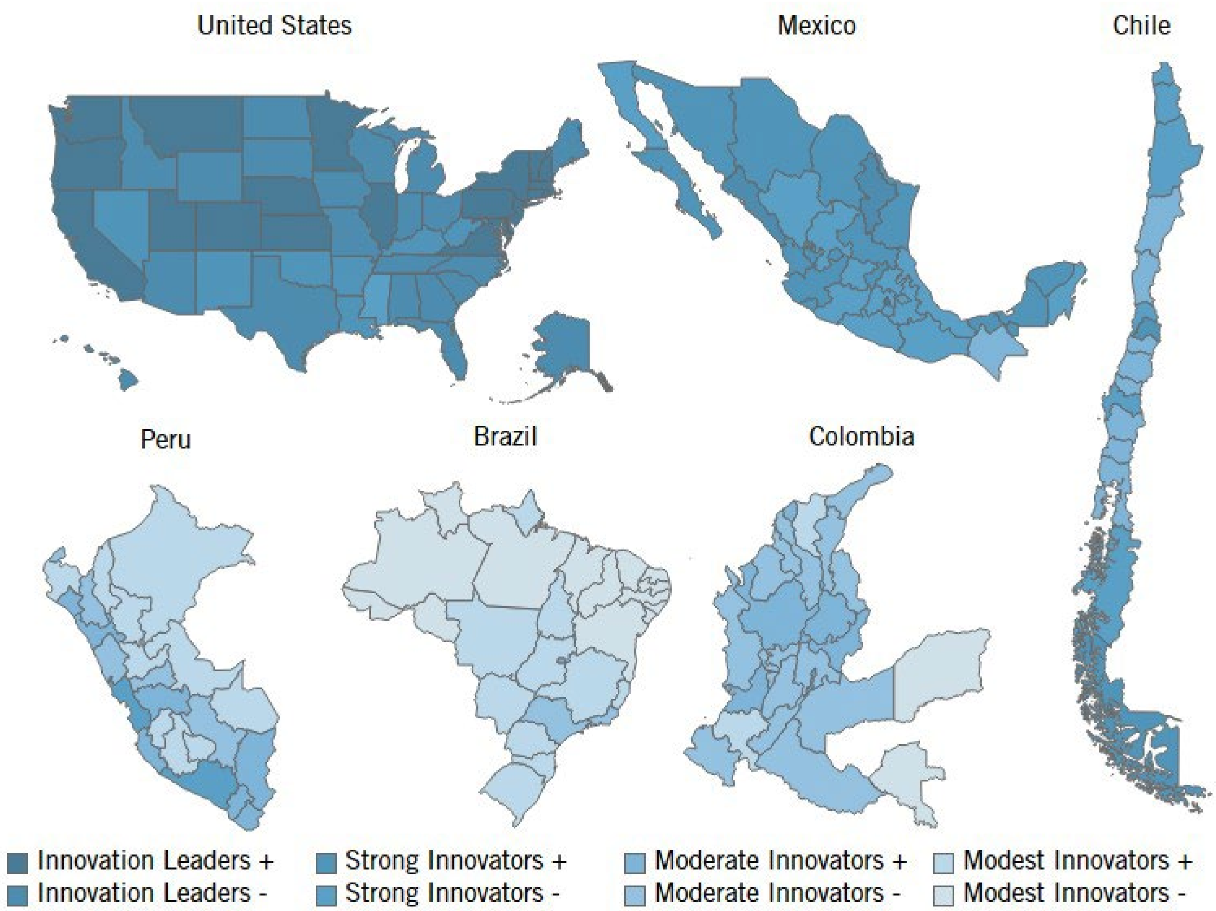
Similarly, Chile displays regional variations, with Magallanes (26.6 percent) standing out as a hub of educational achievement compared to Ñuble (12.4 percent). This suggests a divide in educational resources and opportunities, reflecting the impact of regional economic disparities and access to quality education.

Brazil's education landscape exhibits a mix of patterns. Distrito Federal (14.9 percent) and São Paulo (10.1 percent) stand out in educational attainment, possibly driven by economic activity and cultural attractions. Conversely, regions like Pará (3.3 percent) and Maranhão (2.9 percent) showcase underperformance in education.

In Columbia, regions like Bogotá (21.8 percent), Atlántico (14.3 percent), and Boyacá (12.7 percent) exhibit higher percentages of highly educated populations compared to regions such as Vaupes (0.1 percent) and Vichada (0.1 percent). This disparity mirrors the broader socioeconomic gaps that potentially influence educational access and attainment.

Within the United States, the data unveils a rich tapestry of educational landscapes. States like Massachusetts (48.2 percent) and California (36.2 percent) reflect the influence of renowned universities and tech clusters, contributing to high levels of educational attainment. Conversely, states such as Mississippi (22.8 percent) face educational challenges rooted in socioeconomic disparities and limited resources.

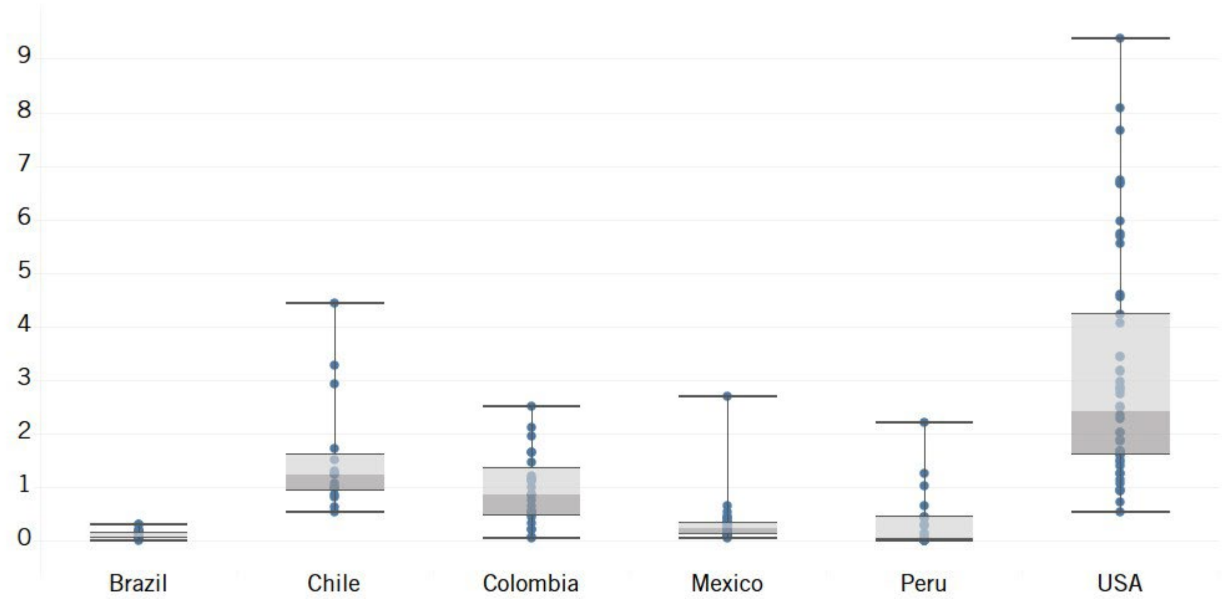
Figure 4: Performance map in highly skilled workforce indicator[17]



Skilled Immigration

Why is this important? Skilled immigration brings together workers with unique educational experiences and backgrounds as a driver of innovative ideas. Level of skill can be difficult to quantify, so this indicator is instead measured via educational attainment, calculated as a region's share of foreign-born workers with at least some tertiary education relative to the total regional population. A 2016 ITIF study found that foreign-born workers living in the United States are highly represented in the number of scientists and engineers producing meaningful innovations, compared with the overall levels of immigration in the United States.[18] Similarly, half of Silicon Valley's artificial intelligence (AI) start-ups have foreign-born founders.[19] A separate study found that 52 percent of all Silicon Valley start-ups have at least one foreign-born founder.[20] In addition to contributing to a state's stock of skilled human capital, highly educated immigrant populations raise wages for both domestic- and foreign-born workers.[21]

Figure 5: Share of population that is foreign-born and has some tertiary education, 2019 (%)[22]



The rankings: The United States has the highest level of skilled immigrants, with Chile being a distant second. On the other hand, countries like Brazil and Peru generally exhibit lower levels.

While the United States leads in attracting skilled immigrants, there are varying levels of skilled immigration across its states. New Jersey and California lead the way with higher skilled immigration indicators (9.4 percent and 8.1 percent, respectively), but other areas like Mississippi and West Virginia display relatively lower indicators (0.5 percent and 0.7 percent). This diverse trend underscores the United States' mixed appeal to skilled migrants, with certain regions standing out as magnets for skilled professionals.

Chile's skilled immigration landscape exhibits a mix of patterns. Regions like Santiago (4.4 percent) and Tarapacá (3.3 percent) stand out in skilled immigration, possibly driven by economic activity and cultural attractions. Conversely, regions like Ñuble (0.6 percent) and Araucanía (0.5 percent) showcase underperformance in skilled immigration.

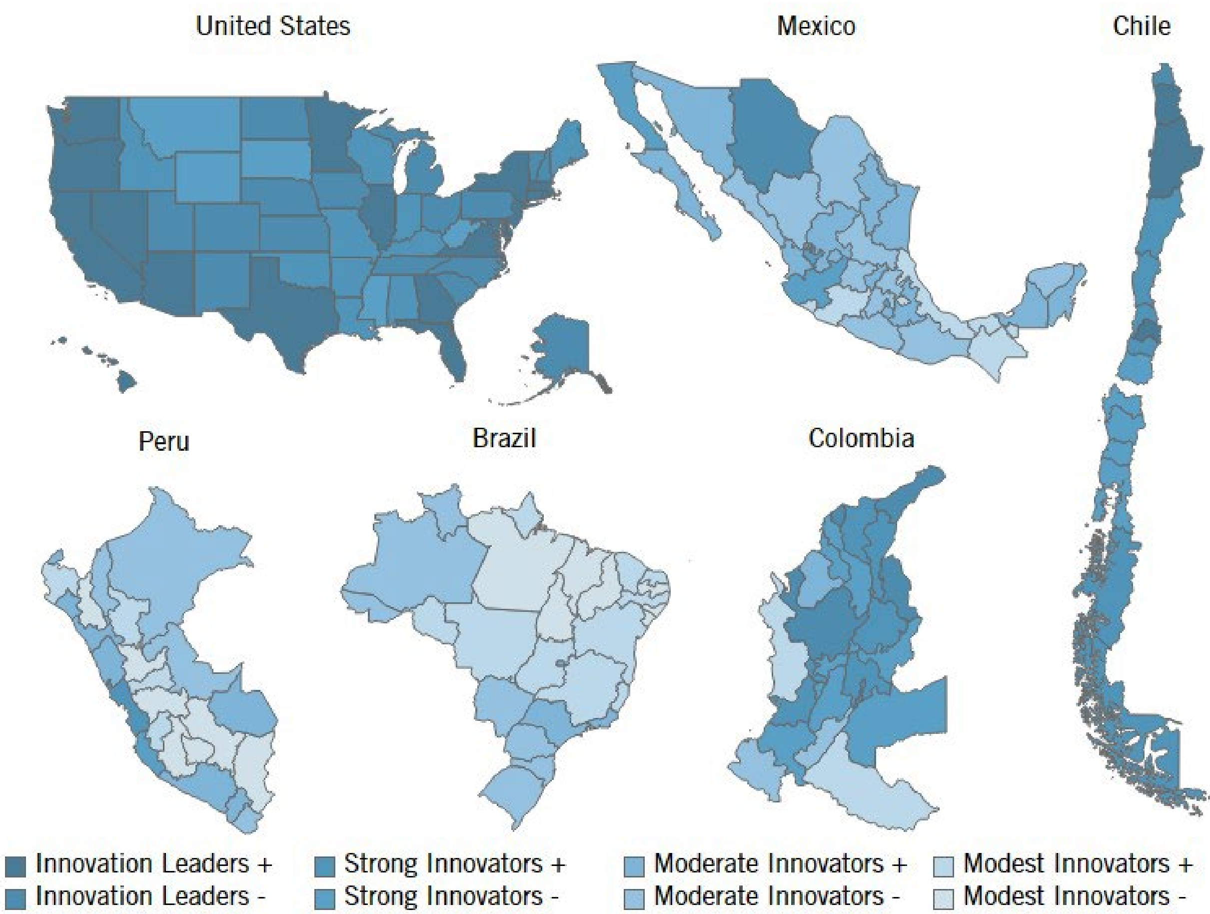
Mexico's skilled immigration landscape portrays more consistent patterns. Chihuahua (2.7 percent) stands out with higher skilled immigration indicators, while others show less allure to skilled migrants, such as Colima and Tlaxcala (0.1 percent and 0.1 percent). Latin regions that are close to the United States attract more skilled immigrants.

The data highlights Peru's similar trend in attracting skilled migrants. Lima (2.2 percent) stands out as a hub for skilled immigrants. Other regions, like Cusco (0.02 percent), Cajamarca (0.02 percent), and Apurímac (0.01 percent), attract essentially no skilled immigrants at all.

Colombia's skilled immigration trend showcases regional disparities. Bogotá (2.5 percent), La Guajira (2.1 percent), and Norte de Santander (2.0 percent) demonstrate relatively high skilled immigration, potentially due to economic opportunities in urban centers. Meanwhile, Caquetá (0.1 percent) and Chocó (0.1 percent) reflect comparatively lower levels of skilled immigration.

Brazil's skilled immigration trends are the lowest of all the countries. Regions like Rio de Janeiro (0.3 percent) and Sao Paulo (0.3 percent) present the highest skilled immigration levels, indicating their status as hubs for skilled migrants. Other regions, like Maranhão (0.01 percent) and Piauí (0.01 percent), attract very little skilled immigration.

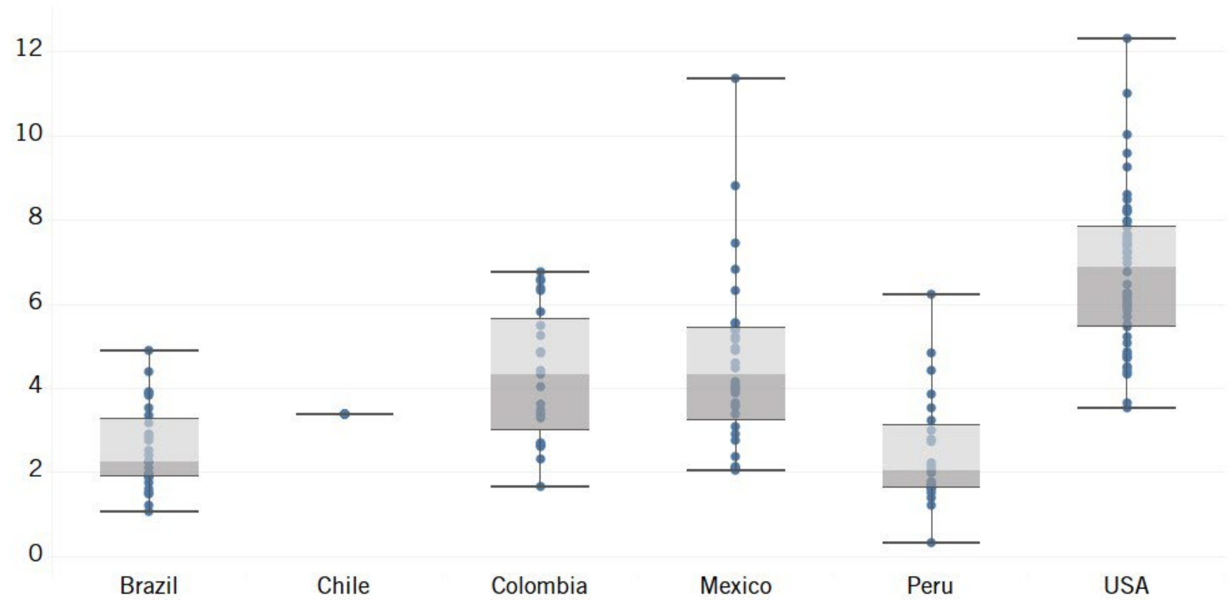
Figure 6: Performance map in skilled immigration indicator[23]



Professional, Scientific, and Technical Employment

Why is this important? This indicator measures the share of employees working in PTS activities in each region. This includes, for example, engineers, researchers, and lawyers. PTS services include those needed to facilitate the development, implementation, and commercialization of innovations. Automation and globalization also make high-value-added professional services increasingly important in the modern economy. These occupations are highly knowledge-intensive and therefore harder to offshore. States with greater concentrations in these occupations are thus somewhat less threatened by increased levels of globalization.

Figure 7: Share of employees in professional, technical, and scientific services fields, 2019 (%)[24]



The rankings: The data reveal a range of PTS employment across Peru's regions. Regions such as Lima (6.2 percent), Tacna (4.8 percent), and Arequipa (4.4 percent) showcase higher levels of skilled employment. These regions demonstrate Peru's growing capacity to attract and accommodate skilled professionals in diverse fields.

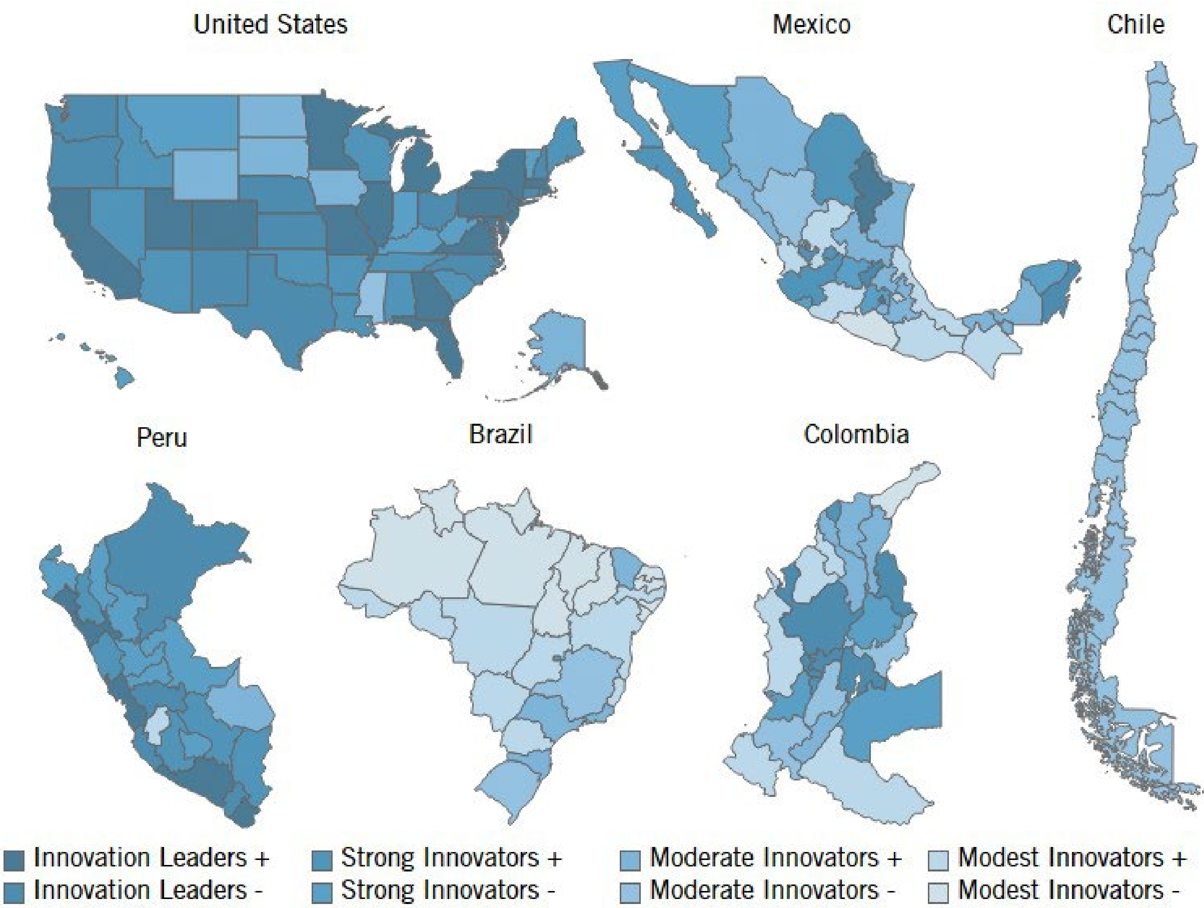
Brazil exhibits a similar trend with certain regions leading in PTS employment. Notably, Distrito Federal (4.9 percent), São Paulo (4.4 percent), Santa Catarina (3.9 percent), and Rio de Janeiro (3.8 percent) stand out as hubs for skilled labor. These regions' higher percentages signal Brazil's allure as a destination for professionals seeking advanced career opportunities.

Chile's employment landscape reflects varying degrees of PTS employment. Regions like Santiago (3.4 percent) lead in this aspect, indicating their role as economic and cultural centers. The data underscore Chile's capacity to provide skilled opportunities in sectors ranging from technology to the arts.

Colombia presents a dynamic picture, with regions such as Norte de Santander (6.8 percent), Caldas (6.6 percent), and Risaralda (6.6 percent) featuring prominently in PTS employment. These regions highlight Colombia's renowned research and innovation ecosystem, contributing to a robust employment landscape.

The United States' PTS employment trends vary across its states. Virginia (12.3 percent), Massachusetts (11.0 percent), and Maryland (10.0 percent) stand out with high PTS employment scores, signifying the country's technological and economic prowess. The data underscore the United States' appeal to professionals seeking diverse career opportunities.

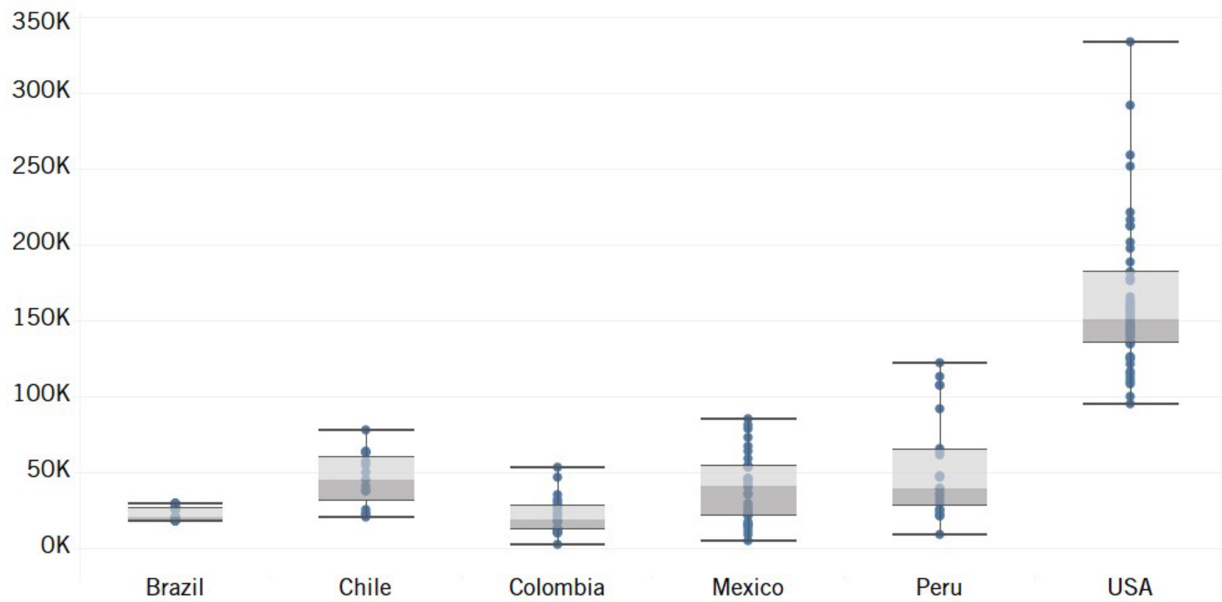
Figure 8: Performance map in professional, technical, and scientific employment indicator[25]



Manufacturing Labor Productivity

Why is this important? Gross value added (GVA) measures the contribution to GDP made by an individual producer, industry, or sector. This indicator measures the average GVA per manufacturing worker on a purchasing power parity (PPP) basis. Within manufacturing, high-value-added firms are most often capital-intensive, producing more technologically complex products and organizing their workers to take better advantage of their skills. They typically pay higher wages because their workers are more productive, generating greater value for each hour worked. All else being equal, firms with higher value-added levels are more likely to be able to meet global competitiveness challenges. Unfortunately, U.S. manufacturing labor productivity has been in decline for some time, falling by 1.34 percent between 2012 and 2019.[26]

Figure 9: PPP-adjusted gross value added per worker in the manufacturing sector, 2019 (USD)[27]



The rankings: Manufacturing labor productivity in Peru showcases regional differences. Tumbes ($121,726) and Ica ($113,133) among others demonstrate strong productivity, underlining Peru's industrial prowess, while regions such as Cajamarca ($21,086) and Huancavelica ($8,658) lag significantly behind.

Brazil exhibits notable regional differences in manufacturing labor productivity. Rio de Janeiro ($29,541) and Paraná ($25,695) lead, reflecting their advanced manufacturing sectors. At the bottom are Sergipe and Bahia (both $17,856).

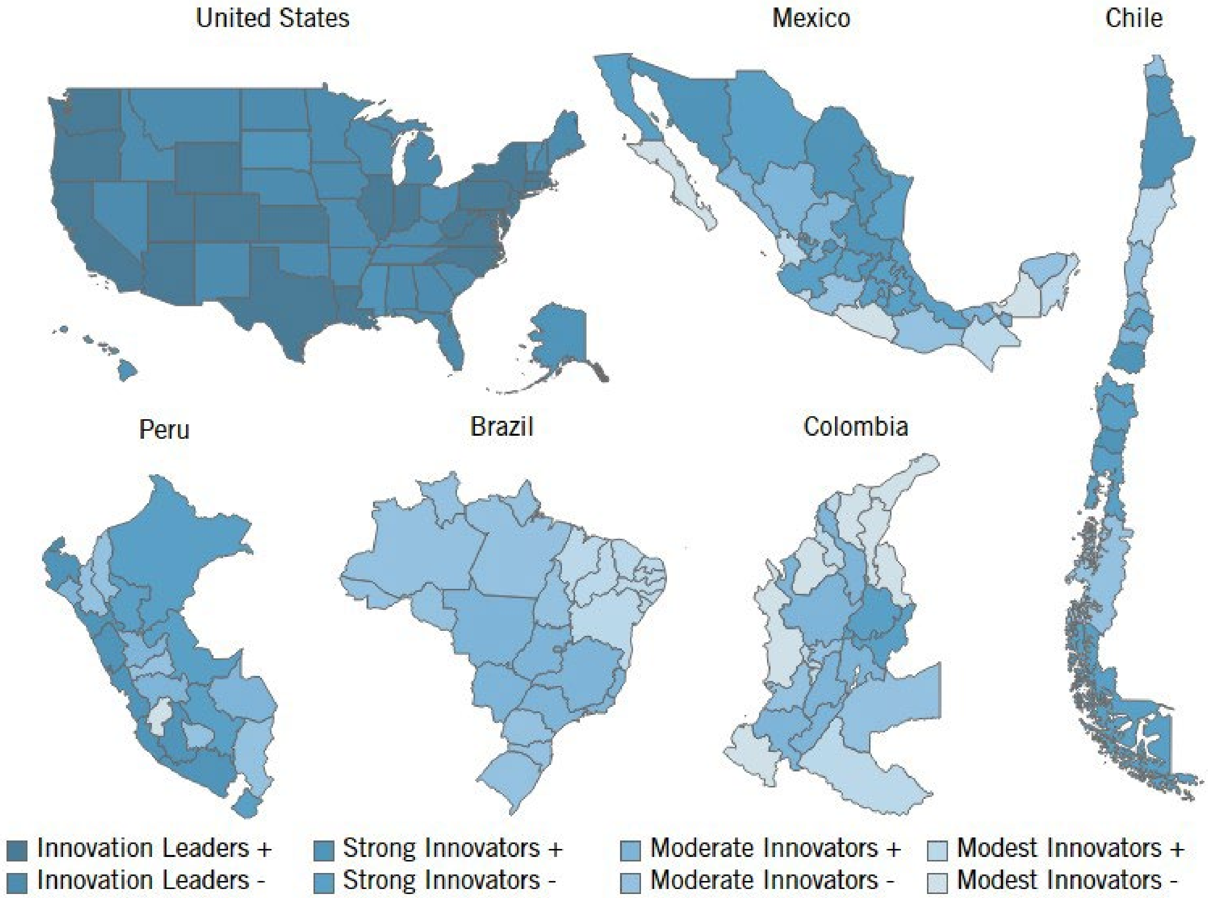
Mexico's regions display mixed productivity figures. Coahuila ($85,131), Querétaro ($80,815), and Nuevo León ($78,830) are the leading regions in Mexico. By contrast, the regions of Campeche ($8,535) and Guerrero ($5,040) significantly lag behind the rest of Mexico's regions.

Chile's manufacturing productivity varies widely across its regions. Tarapacá ($77,949) and Antofagasta ($63,479) excel, spearheaded by their leading mining industries. . Regions like Atacama ($19,967) and Arica y Parinacota ($22,295) exhibit lower productivity, potentially indicating challenges in their manufacturing sectors.

Colombia showcases considerable variation in manufacturing productivity across its regions. Santander ($53,158) and Boyacá ($46,235) lead, reflecting the strength of these regions. Regions like Nariño ($9,915) and La Guajira ($2,295) also stand out as significantly lagging.

U.S. states exhibit significant diversity in their levels of manufacturing productivity. The data reports that states such as Louisiana ($333,712) and Wyoming ($291,511) have the highest levels of manufacturing productivity, although this data is significantly skewed by the prevalence of the oil and gas sectors (such as refining) in these states' economies. (Unfortunately, to maintain the international comparisons needed for this study, it was not possible to back out the distortive effects of these states' large energy sectors.) Indiana, Ohio, and Michigan were more indicative of the actual performance of the more manufacturing-oriented U.S. states (with values of $176,518, $152,458, and $147,100, respectively). States like Hawaii ($108,148) and Vermont ($100,084) display comparatively lower manufacturing output, possibly due to their smaller industrial bases.

Figure 10: Performance map in manufacturing labor productivity indicator (no data on Moquegua)[28]

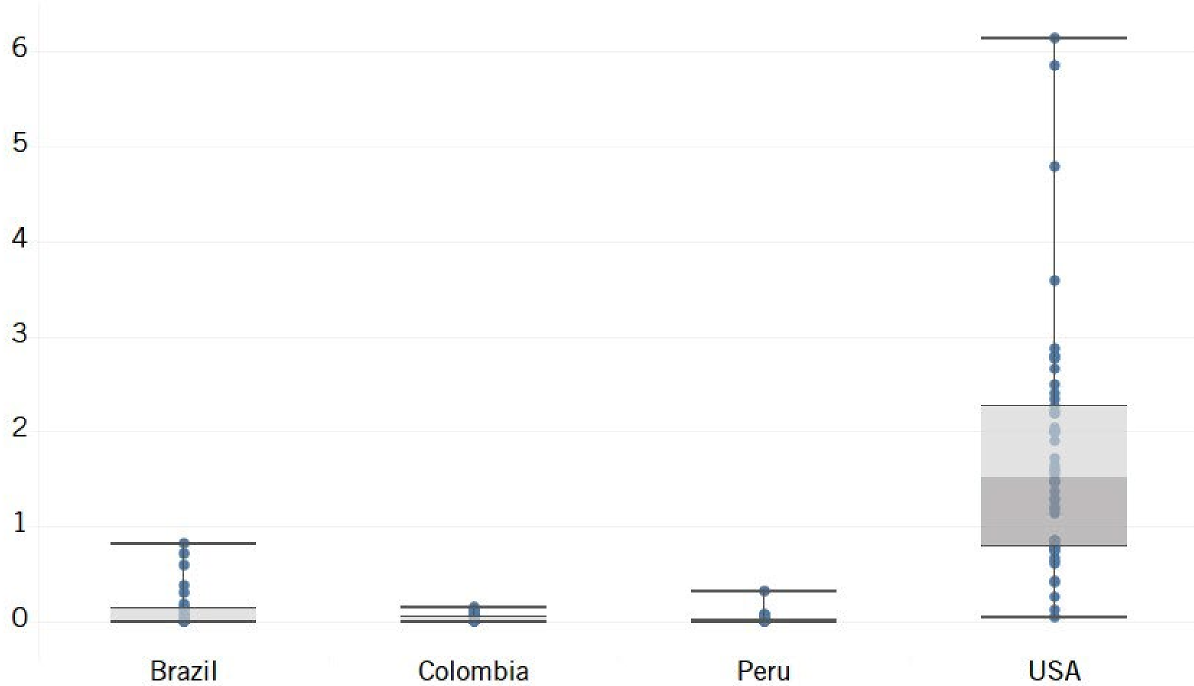


Globalization

High-Tech Exports

Why is this important? This indicator measures a region's exports in the machinery manufacturing; computer and electronic products manufacturing; and electrical equipment, appliances, and components manufacturing industries (North American Industry Classification System "NAICS" 333–335 or equivalent) as a share of GDP. These represent high-value-added goods that are crucial in the modern global economy. Considering a region's exports of these goods as a share of its GDP shows to what extent a region has a comparative advantage in high-tech production and export. Moreover, this indicator represents a region's position in global value chains for the production of these goods.

Figure 11: Exports in NAICS 333–335 (or equivalent) as a share of GDP, 2017 (%)[29]



The rankings: High-tech exports in Peru showcase interesting regional disparities. Lima (0.3 percent) and Ica (0.1 percent), while not a powerhouse in this regard, stand out as scoring highest. Most other regions like Junín (0.001 percent) and Pasco (0.001 percent) have almost no high-tech exports.

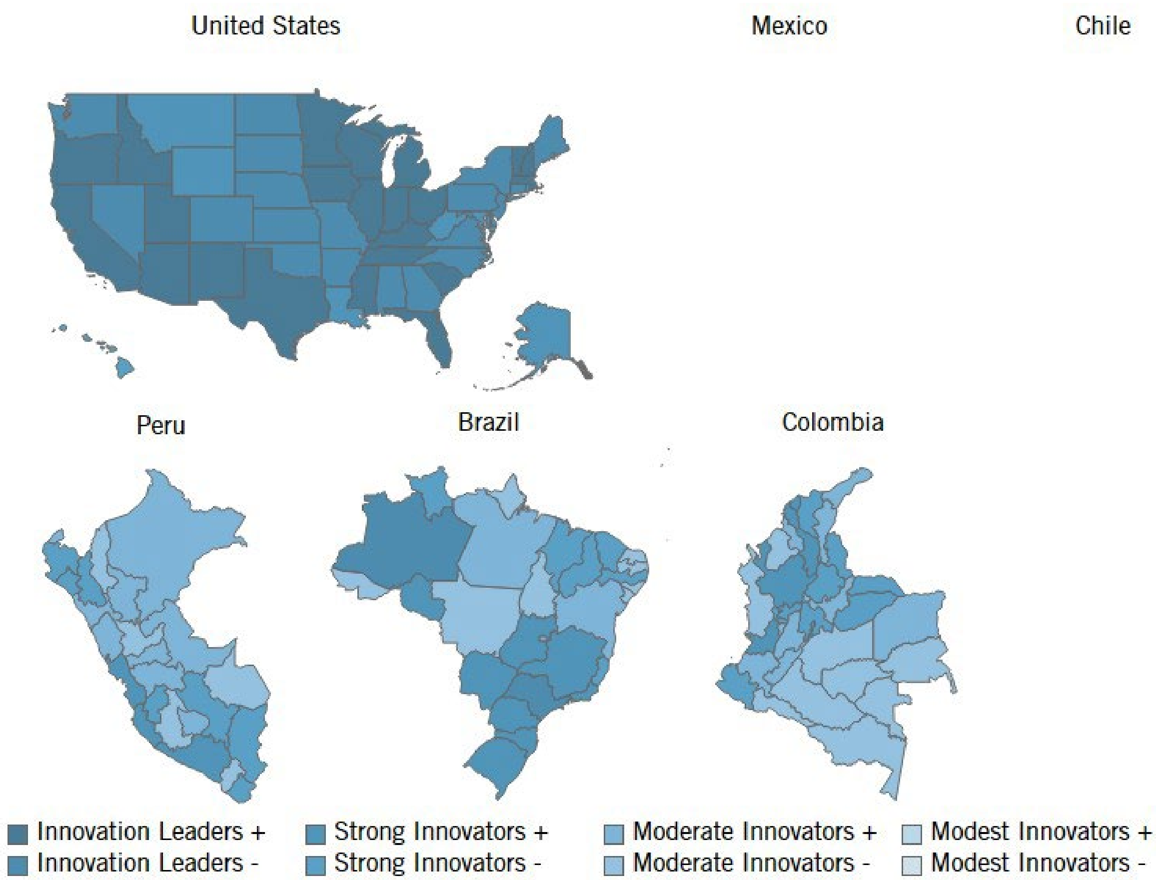
Brazil exhibits diverse high-tech export distribution. Regions like Rio de Janeiro (0.6 percent) show potential in technology export, while Sao Paulo (0.8 percent) and Amazonas (0.7 percent) lead the way. By contrast, regions including Pará (0.001 percent) and Bahia (0.002 percent) have hardly any high-tech exports.

Colombia also showcases regional diversity in high-tech exports, with regions such as San Andrés y Providencia (0.2 percent), Atlántico (0.1 percent) and Bogotá (0.1 percent) leading the way. Regions like Boyacá (0.001 percent) and Huila (0.001 percent) have hardly any high-tech exports.

The United States demonstrates a wide range of high-tech export levels among its states. States such as Oregon (5.8 percent) excel due to their technology-driven sectors. However, there are variations, with states like Alaska (0.1 percent) and Wyoming (0.3 percent) indicating room for technological expansion. Wyoming's very weak performance on this indicator reinforces the point that its high performance on the prior manufacturing labor productivity indicator is highly distorted by its energy sector.

Data was not sufficiently available at the subnational level to include analysis for Chile and Mexico on this indicator.

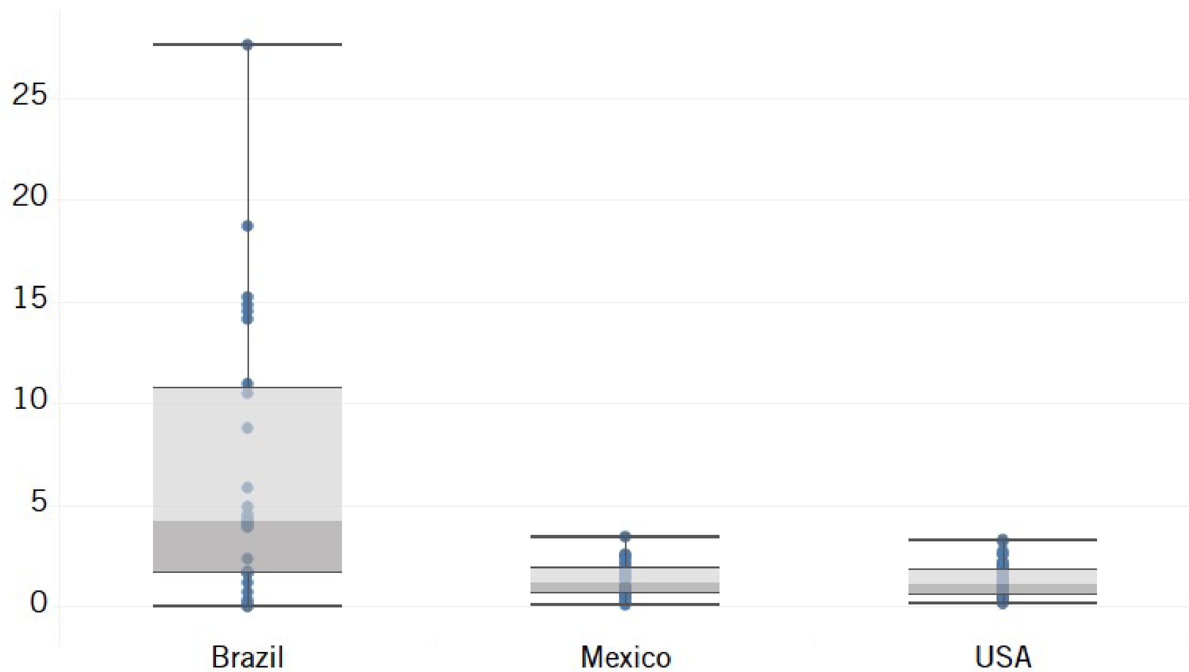
Figure 12: Performance map in high-tech exports indicator[30]



Inward FDI

Why is this important? This indicator measures the inward FDI a region receives relative to its GDP, measured as the funds an entity in the region receives from a foreign-based entity to purchase, establish, or expand enterprises. Inward FDI not only spurs domestic economic activity but also facilitates technology transfer between foreign-owned enterprises and local establishments. Foreign owners can also introduce domestic firms to new international markets and help regions carve out positions in global supply chains. Inward FDI has also been associated with greater economic growth in market economies and tends to be more productive and induce greater levels of investment by domestic firms.[31]

Figure 13: Inward foreign direct investment as a percentage of GDP, 2017–2018 (average) (%) [32]



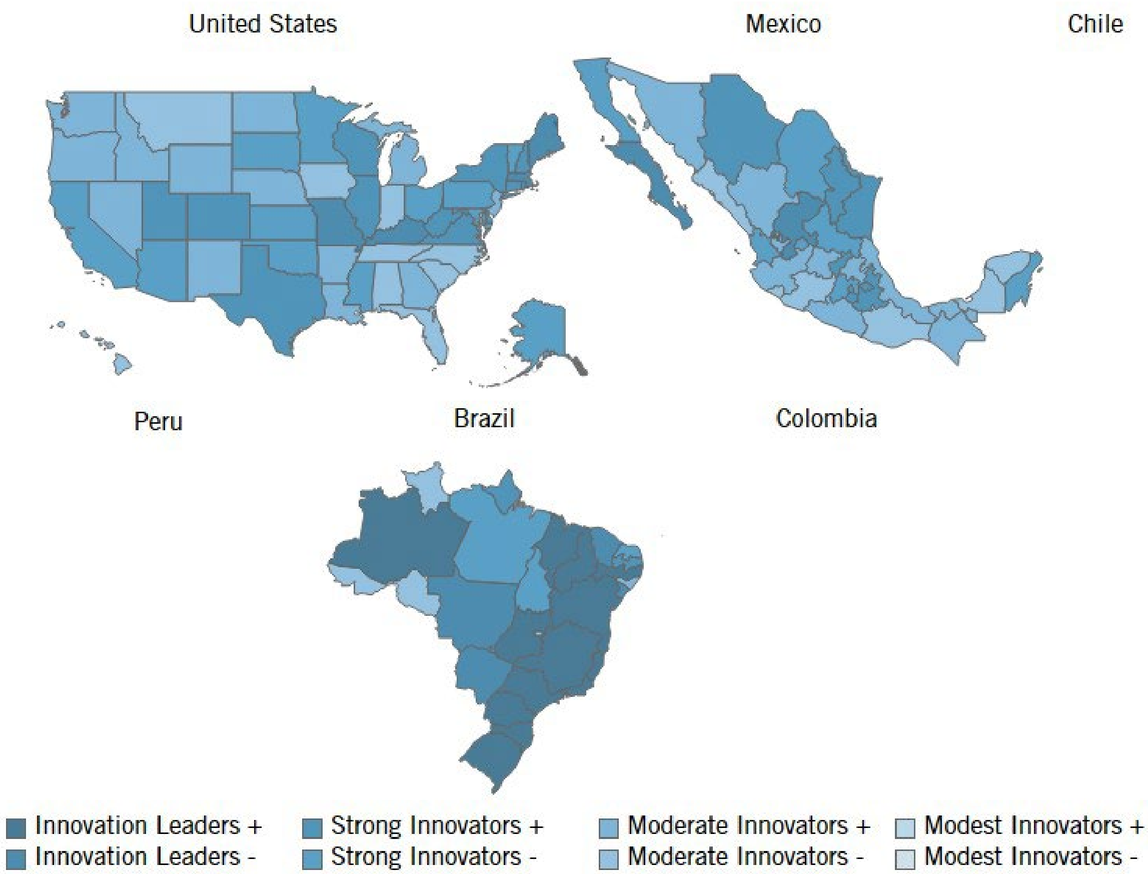
Because FDI can be very volatile from year to year, regions' averages over three years are considered. Measures for each country required varying degrees of estimation; the methods are described in the appendix. This report does not include Colombia, Peru, and Chile for this indicator because regional data was not available for those countries.

Brazil's FDI trends show very divergent outcomes. Notably, Amazonas (27.6 percent), Paraná (18.7 percent), Minas Gerais (15.2 percent), and São Paulo (14.9 percent) lead the way. By contrast, regions like Rondônia (0.16 percent) and Roraima (0.03 percent) attract essentially no foreign investment.

Mexico showcases a diverse FDI picture across its regions. Zacatecas (3.4 percent) and Baja California Sur (2.6 percent) stand out as the most attractive regions for foreign investors. However, Oaxaca (0.1 percent) and Colima (0.3 percent) show a significantly lower FDI inflow.

The United States, being a major global player, exhibits diverse FDI trends across its states. States like Maine (3.3 percent) and Missouri (3.2 percent) evince high attractiveness to foreign investors. However, some states like Montana (0.2 percent) and Iowa (0.2 percent) show slightly less FDI inflow.

Figure 14: Performance map in inward FDI indicator[33]

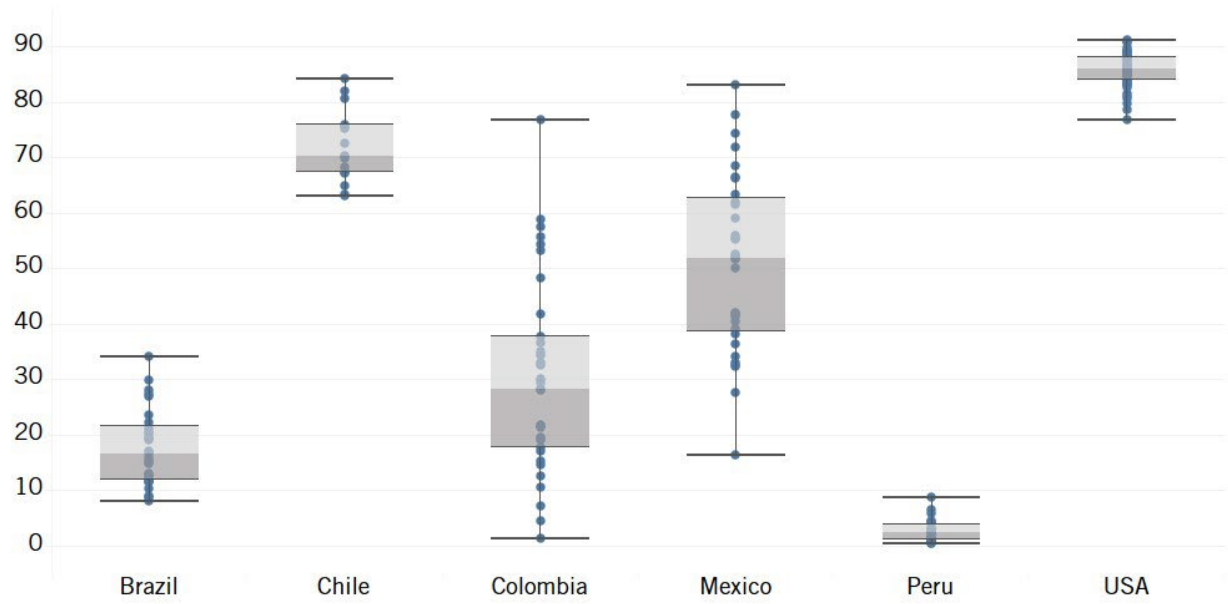


Innovation Capacity

Broadband Adoption

Why is this important? This indicator measures broadband adoption—that is, the share of households within each region that subscribe to a broadband Internet connection, either mobile or fixed. (All measures of broadband adoption used include satellite adoption as well). The Internet is now essential to full participation in today's increasingly digitalized global economy. The COVID-19 pandemic vividly demonstrated how crucial widespread Internet adoption is for societies, enabling telework, tele-education, telehealth, etc. Increased access to the Internet has also been associated with greater productivity and economic growth.[34]

Figure 15: Share of households that have adopted broadband Internet, 2019 (%)[35]



The rankings: Peru showcases a relatively low level of broadband adoption across its regions. Lima (8.7 percent) leads the way, followed by Arequipa (6.3 percent) and Tacna (5.8 percent). These numbers highlight Peru's need for greater investment in digital connectivity and the accessibility of broadband Internet services.

Brazil's regions display considerable variation in digital infrastructure. Santa Catarina (34.0 percent) and São Paulo (29.9 percent) stand out as leaders in broadband adoption. By contrast, regions like Maranhão (8.0 percent) and Pará (8.6 percent) lag.

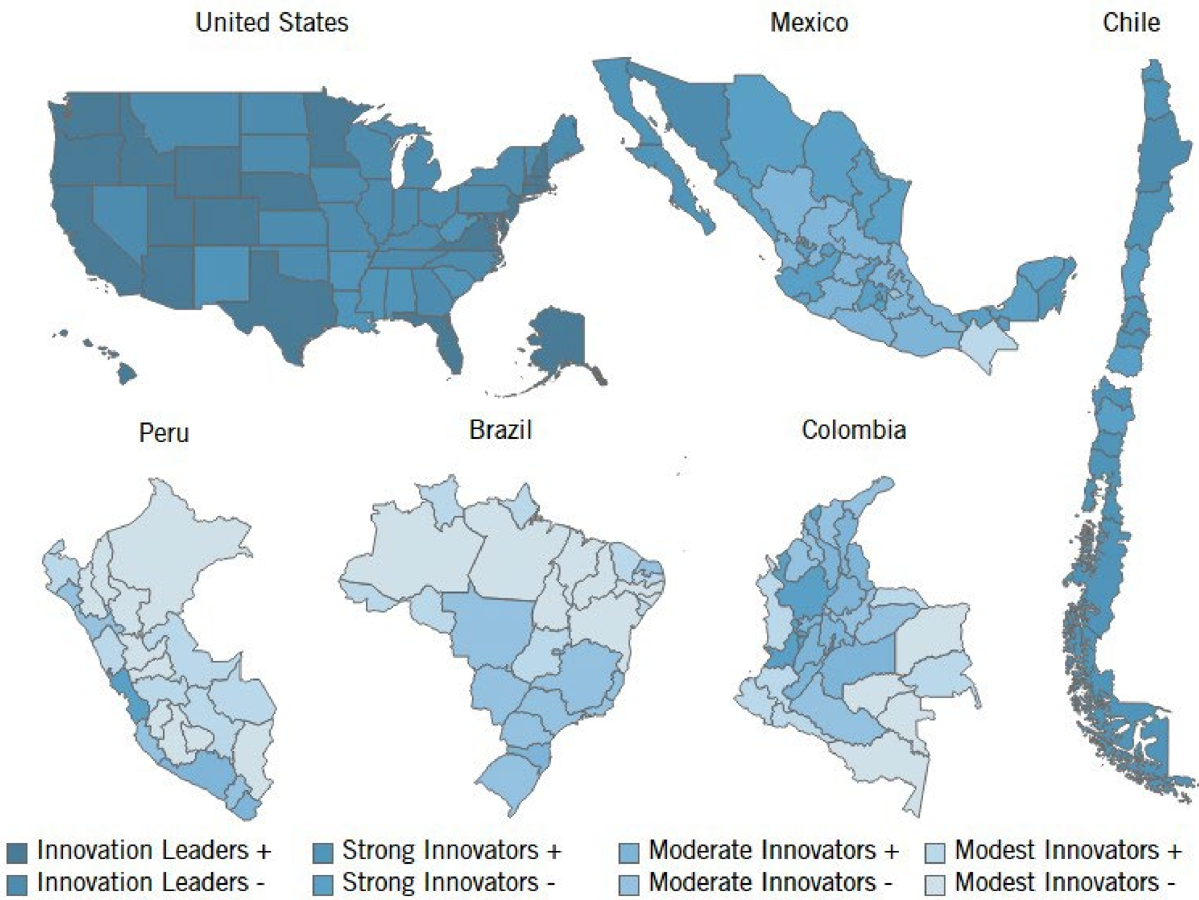
Mexico's broadband adoption levels vary across its regions. Sonora (83.0 percent) and Baja California Sur (77.7 percent) lead the way, highlighting their focus on digital connectivity. However, regions like Chiapas (16.4 percent) and Tlaxcala (27.5 percent) suggest a need for enhanced efforts to improve broadband access.

Chile's regions evince mixed broadband Internet adoption rates. Regions like Antofagasta (84.3 percent), Santiago (82.0 percent), and Magallanes (80.6 percent) lead the way, while others like Araucanía (63.1 percent) and Maule (63.2 percent) show room for improvement in digital infrastructure.

Colombia exhibits significant regional diversity in digital connectivity, with many regions showcasing low broadband adoption rates, like Vaupés (1.3 percent) and Vichada (4.5 percent). Bogotá (76.9 percent) and Antioquia (58.8 percent) stand out as leaders in digital integration.

The United States showcases a less-diverse range of broadband adoption rates across its states. Washington (91.2 percent), Colorado (91.0 percent), and California (89.8 percent) lead the way, indicating their strong digital infrastructure. States like Mississippi (76.8 percent) and Louisiana (80.6 percent) show room for improvement in broadband adoption, but still perform considerably ahead of most Latin American regions.

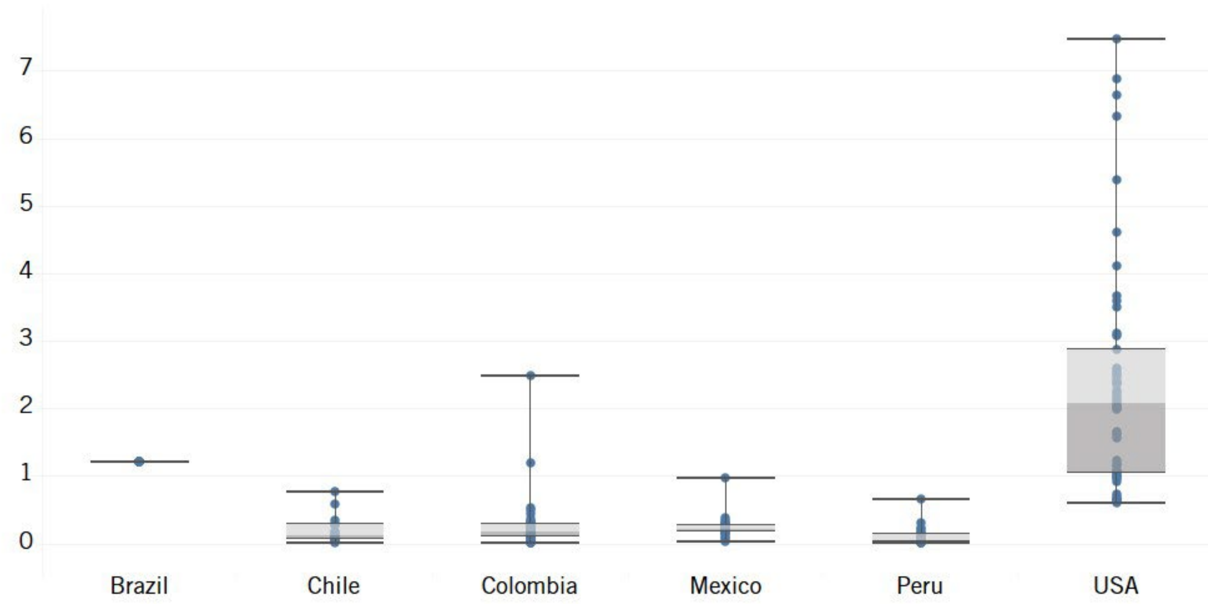
Figure 16: Performance map in broadband adoption indicator[36]



R&D Intensity

Why is this important? This indicator measures R&D expenditures in a region relative to its GDP considering R&D expenditures by all sectors: business, government, and higher education. R&D lies at the heart of innovation, as it represents the source of the new knowledge needed to discover, design, and implement innovative technologies and products. R&D results in slightly higher private returns and much larger social returns than other types of investment as new knowledge and technology spill over to the rest of an economy.[37]

Figure 17: R&D expenditures as a share of GDP, 2019 (%)[38]



The rankings: Peru's regions display varying levels of R&D intensity. Amazonas (0.7 percent) and Ayacucho (0.3 percent) lead in prioritizing research and innovation, while Tacna (0.01 percent), Huánuco (0.01 percent), and Apurímac (0.02 percent) have almost no R&D activity, suggesting potential areas for increased focus on research-driven growth.

Brazil displays noticeable variation in commitment to R&D across most of its regions. Rio de Janeiro (1.2 percent) and São Paulo (1.2 percent) lead the way, indicating potential in R&D.

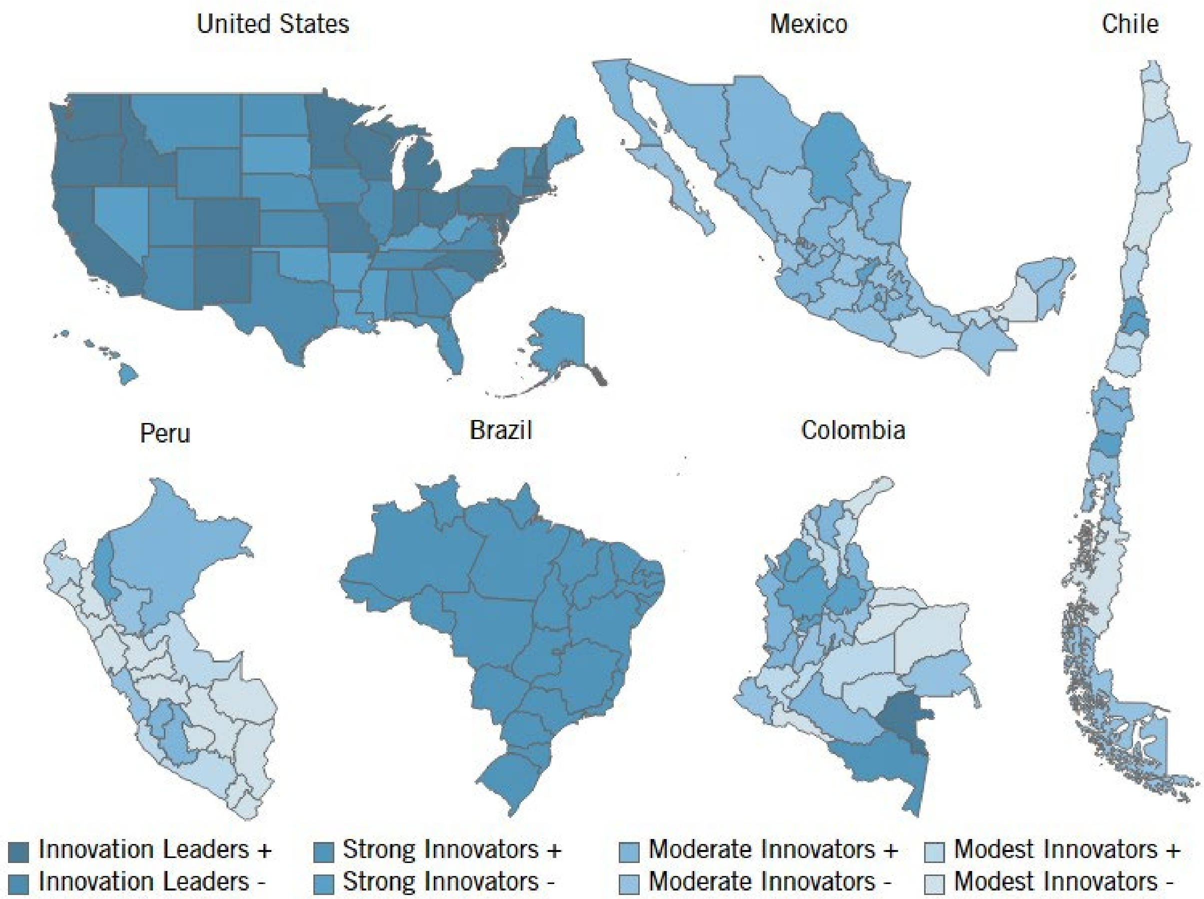
Mexico's regions demonstrate varying degrees of R&D intensity. Coahuila (1.0 percent) leads in research intensity, while regions like Oaxaca (0.1 percent) and Chiapas (0.1 percent) exhibit lower emphasis on research activities.

Chile's regions reflect a diverse approach to R&D. Los Ríos (0.8 percent) and Santiago (0.6 percent) lead in innovation efforts, while regions like Atacama (0.03 percent) and Aysen (0.01 percent) have room for improvement in boosting research activities.

Colombia varies in research and development across its regions. Vaupés (2.5 percent) leads in R&D intensity. By contrast, Putumayo (0.02 percent) and Vichada (0.01 percent) have almost no R&D activity.

The United States exhibits varied R&D intensity across its states. New Mexico (7.5 percent), Washington (6.9 percent), and Massachusetts (6.6 percent) lead in research emphasis, while states like Louisiana (0.6 percent) and Oklahoma (0.9 percent) have comparatively lower focus on research activities.

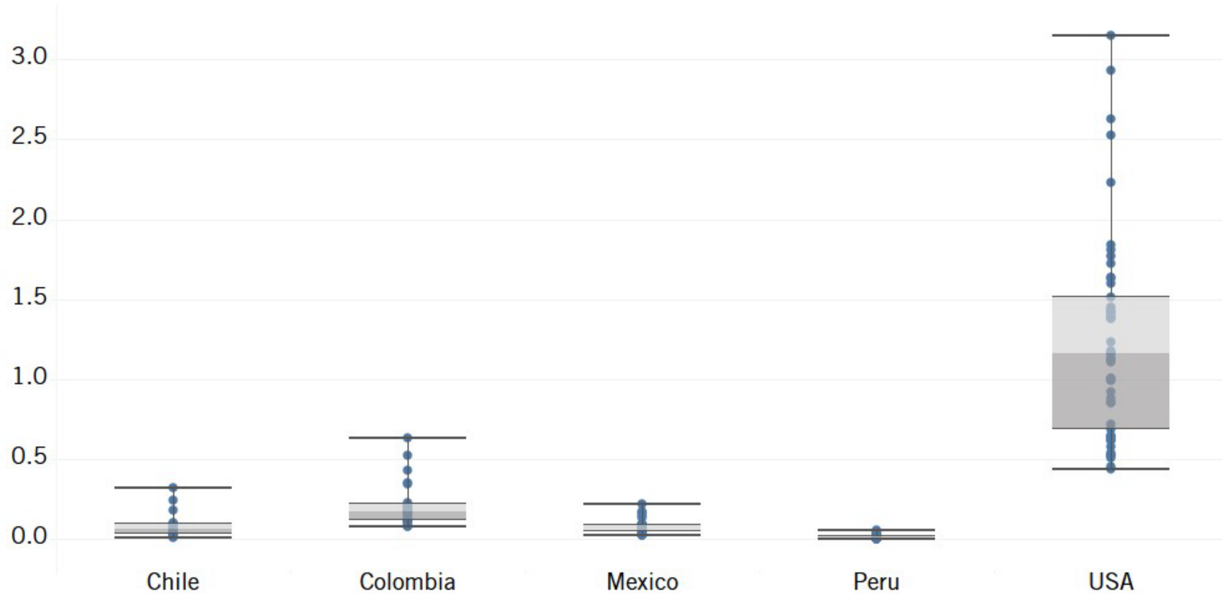
Figure 18: Performance map in R&D intensity indicator[39]



R&D Personnel

Why is this important? This indicator measures the number of R&D personnel as a share of all employees in each region. R&D personnel are indispensable to conducting R&D activities and turning investments into new productivity-enhancing knowledge and technologies.

Figure 19: R&D personnel as a share of total employees, 2017–2018 (%)[40]



The rankings: Peru's regions exhibit varying levels of R&D personnel. Ucayali (0.1 percent) leads in terms of human resources dedicated to R&D in Peru, while Lambayeque (0.002 percent), Cajamarca (0.001 percent), and Huánuco (0.001 percent) have lower levels, suggesting potential areas for increased investment in skilled researchers.

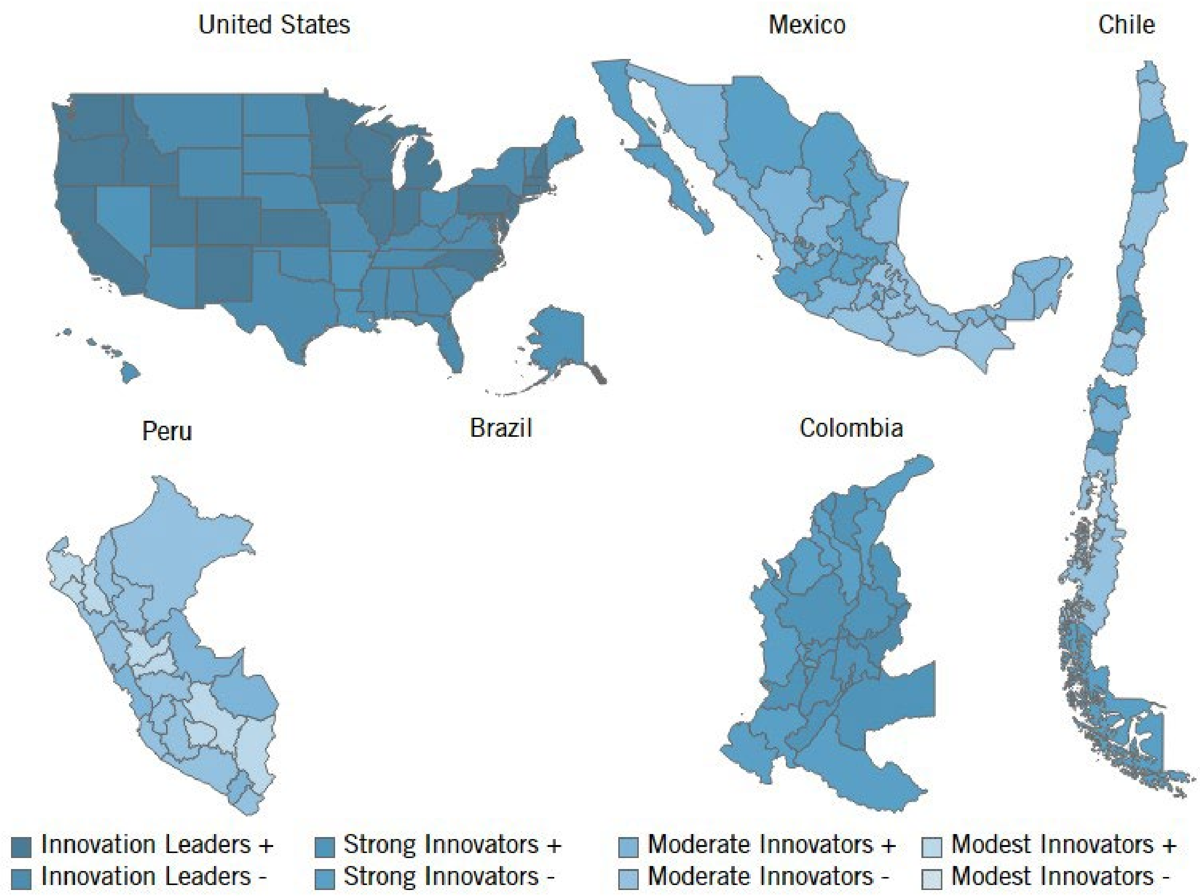
Mexico's regions display differing levels of R&D personnel. Nuevo León (0.2 percent) and Querétaro (0.2 percent) lead in allocating human resources to research, while regions like Chiapas (0.03 percent) and Oaxaca (0.02 percent) have comparatively fewer personnel dedicated to R&D.

Chile's regions showcase diverse approaches to R&D personnel. Santiago (0.3 percent) and Los Ríos (0.2 percent) stand out with comparatively greater human resources allocated to research, while regions like Atacama (0.02 percent) and Aysen (0.01 percent) trail.

Colombia's regions exhibit a commitment to research with substantial human resources allocated. Boyacá (0.6 percent) and Bogotá (0.5 percent) have the highest levels of R&D personnel, while Córdoba (0.1 percent) and Cauca (0.1 percent) have comparatively fewer R&D personnel.

The United States showcases varying levels of R&D personnel across its states. Washington (3.2 percent) and Massachusetts (2.6 percent) lead in human resources dedicated to research, while states like Alaska (0.4 percent), Arkansas (0.5 percent), and West Virginia (0.7 percent) have relatively fewer personnel engaged in R&D activities.

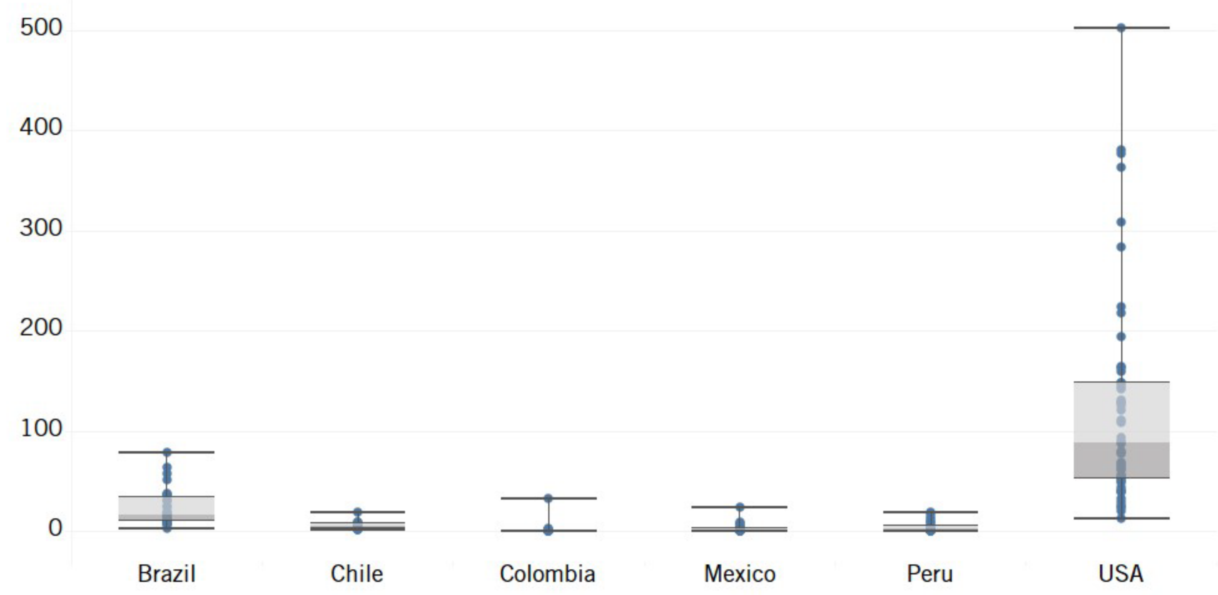
Figure 20: Performance map in R&D personnel indicator[41]



Patent Applications

Why is this important? This indicator measures international Patent Cooperation Treaty (PCT) patent applications filed by residents or entities within a region per one million residents. Patent output measures the "inventiveness" of a population. Patents also secure private returns on investment in R&D activities, which are necessary to incentivize these activities and their socially desirable spillover effects. By considering PCT patents, this indicator focuses on internationally filed patents to mitigate differences in patent qualifications between countries' patent offices.

Figure 21: PCT patent applications per million residents, 2015[42]



The rankings: Patent applications vary across Peru's regions, with Lima (18.1) and Arequipa (17.5) leading in terms of innovation activity, at least as expressed through patent filings. Cajamarca (0.6) and Piura (0.5) have very few applications, suggesting potential areas for increased focus on innovation.

Brazil's regions vary in terms of patent application intensity. Santa Catarina (78.9) and Rio Grande do Sul (64.0) are standout regions in terms of patent filings, showcasing comparatively strong efforts in intellectual property (IP) creation and technological advancement.

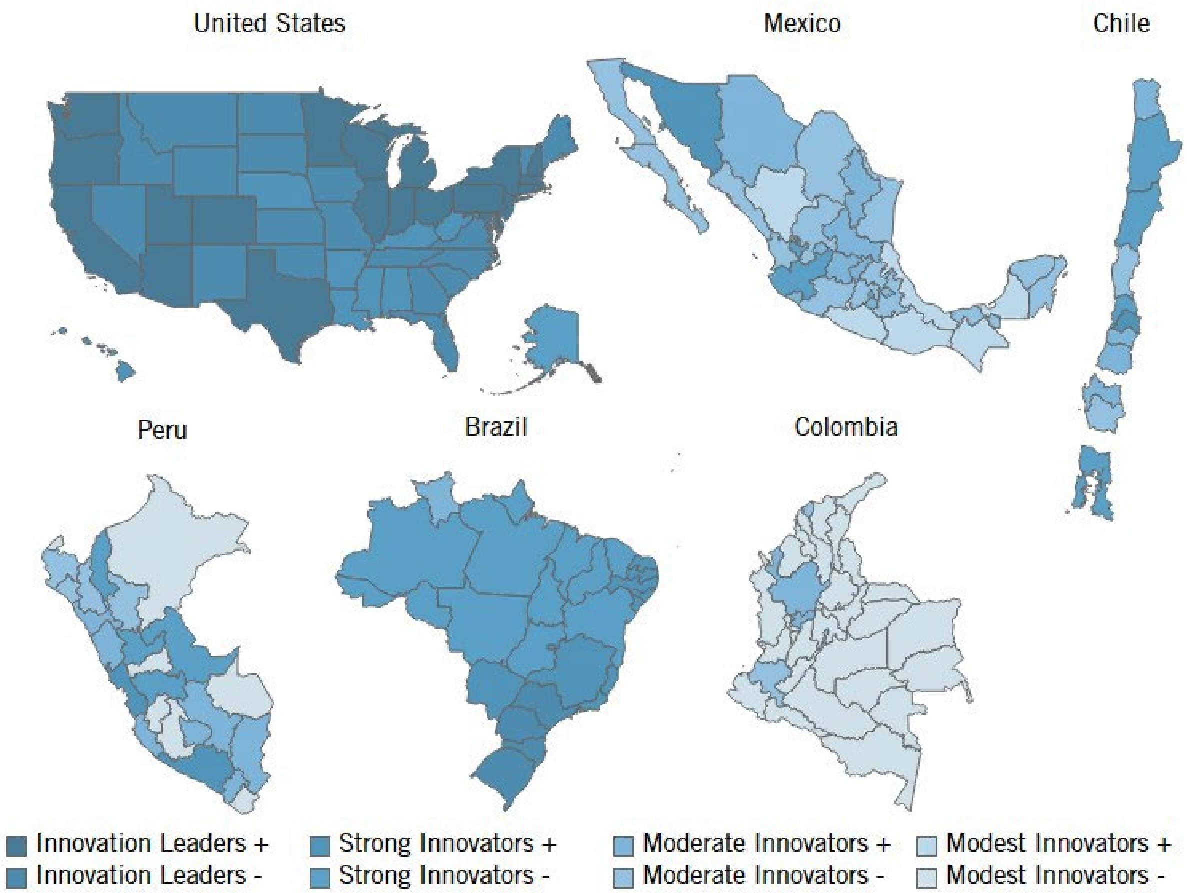
Mexico demonstrates varying levels of patenting activity across its regions. Sonora (23.9) leads in patent filings, while regions like Durango (0.3), Guerrero (0.1), and Chiapas (0.03) show room for potential improvement in innovation efforts.

Chile's regions exhibit diverse scores in patenting activity. Santiago (18.3) and Valparaíso (9.0) lead in patent applications, while Araucanía (1.0) and Coquimbo (1.1) show lower levels, suggesting opportunities for increased focus on IP creation.

Colombia displays significant variation in innovation across its regions. San Andrés y Providencia (32.6) leads in patent applications, while regions like Cauca (0.7) and Atlántico (0.4) evince very few patent applications.

The United States demonstrates varying levels of innovation across states. Massachusetts (502.4) and California (379.9) lead in patent applications, while states like Arkansas (32.4), Mississippi (20.0), and Alaska (12.2) have comparatively fewer patent filings, highlighting areas with potential for growth in IP creation.

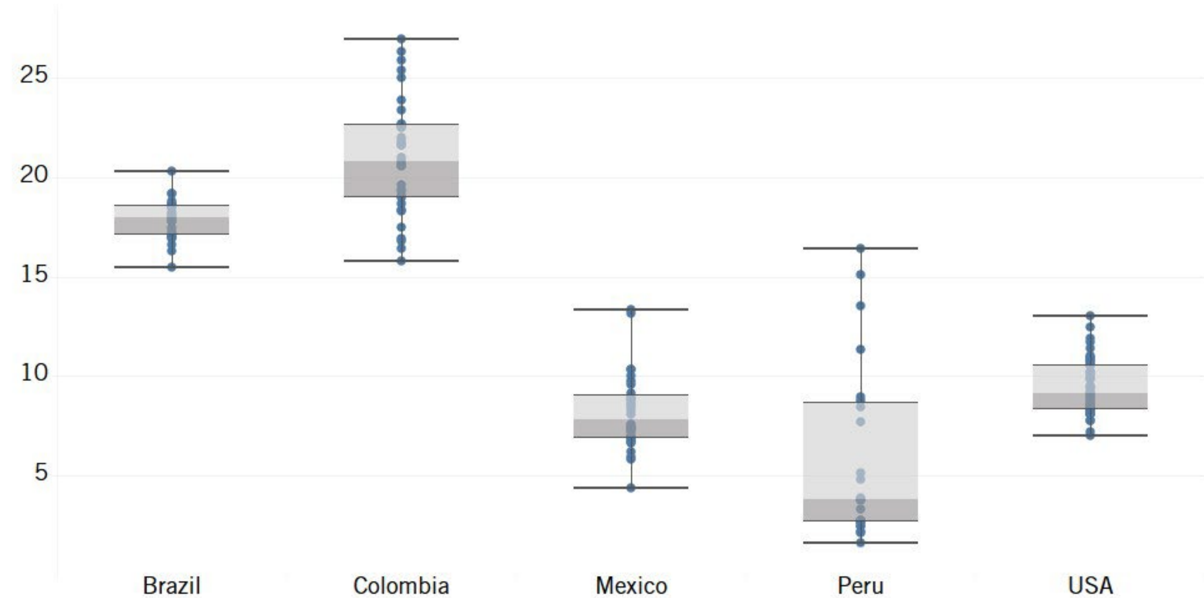
Figure 22: Performance map in patent applications indicator[43]



Business Creation

Why is this important? A thriving business ecosystem should experience a high volume of business start-ups. This indicator measures the share of a region's business enterprises that were established in the past year. The business creation indicator is limited in scope to new businesses, without capturing business turnover resulting from the market disruption and creative destruction that forces incumbents to innovate or leave the market. Thus, the full impact of business competition on innovation is not captured. Moreover, this metric does not differentiate between industries, so there is no differentiation between creation rates in advanced, innovative industries and those in less-advanced industries. Absent a better alternative at the cross-national regional level, this indicator reflects a region's overall economic resilience and regional competitiveness.

Figure 23: Economy-wide enterprise birth rate, 2016–2018 (%)[44]



The rankings: Business creation rates in Peru vary across regions, with Cusco (16.4 percent) and Huancavelica (15.1 percent) leading in fostering new businesses. Tumbes (1.6 percent) and Tacna (2.1 percent) show relatively lower rates, suggesting potential for increased entrepreneurial efforts.

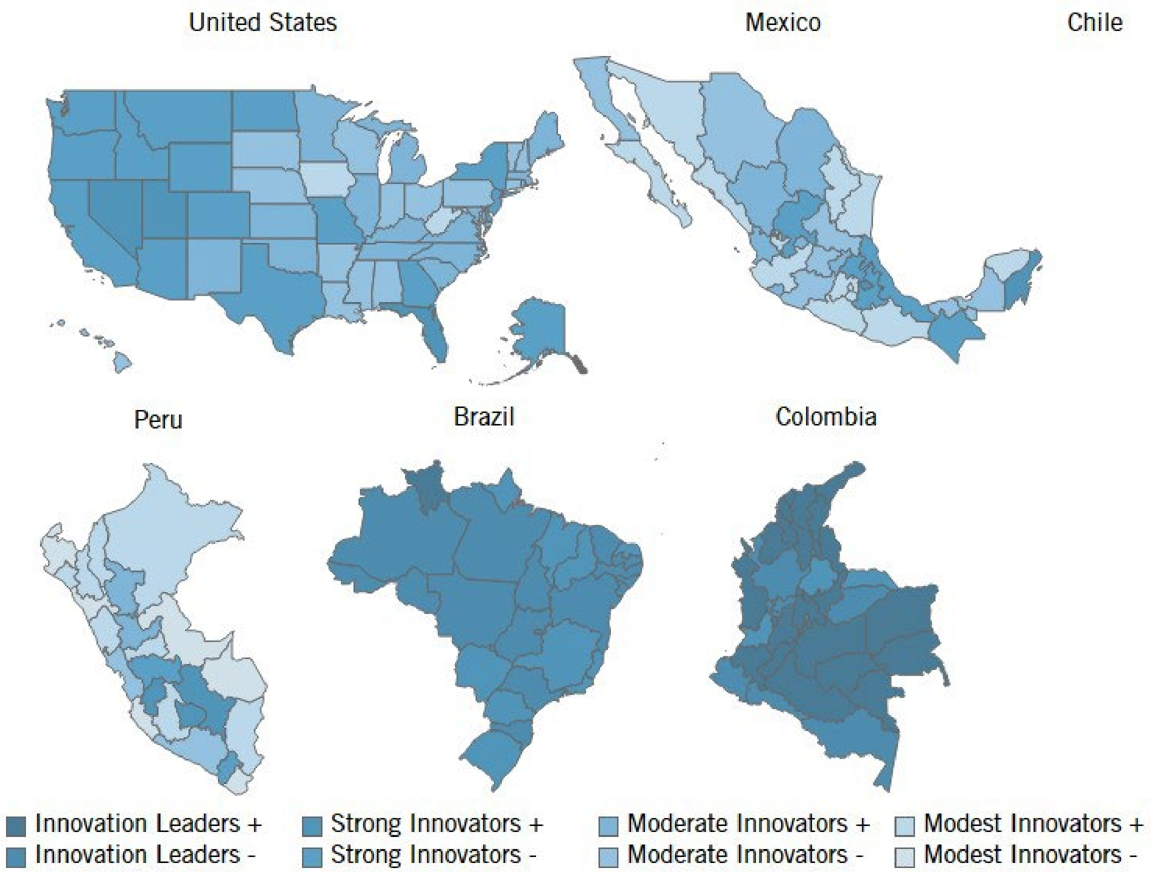
Brazil demonstrates a balanced entrepreneurial environment, with all regions having moderate business creation rates. Roraima (20.3 percent) and Amazonas (19.2 percent) have relatively higher rates, indicating favorable conditions for startups.

Mexico exhibits consistent entrepreneurial efforts across its regions. Quintana Roo (13.1 percent) and Tlaxcala (13.4 percent) stand out, showing a strong commitment to new business ventures.

Colombia's regions exhibit balanced entrepreneurial activities. Magdalena (26.3 percent) and Sucre (26.9 percent) lead, highlighting their vibrant startup ecosystems, while San Andrés y Providencia (16.8 percent), Santander (16.4 percent), and Bogotá (15.8 percent) show potential for further development.

The United States displays diverse entrepreneurial dynamics. Nevada (13.1 percent) and Florida (12.5 percent) lead in business creation, showcasing their entrepreneurial appeal, while Ohio (7.8 percent) and Iowa (7.2 percent) have comparatively lower rates, indicating scope for growth in their startup activity.

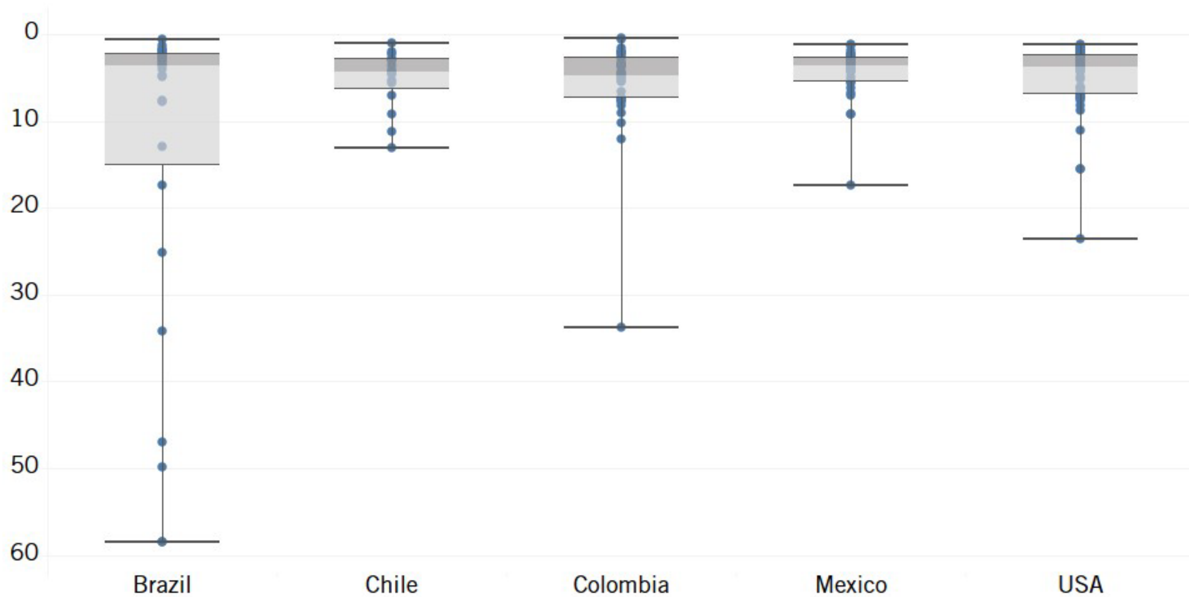
Figure 24: Performance map in business creation indicator[45]



Carbon Efficiency

Why is this important? As the world endeavors to combat climate change, decarbonization is of paramount importance. Regions' ability to innovate sustainably to achieve a reduction in and the efficient use of carbon and other greenhouse gases will determine their long-term competitiveness, as well as their national economic prosperity. This indicator measures carbon dioxide (CO_2) and other greenhouse gas efficiency per unit of output (as measured by PPP-adjusted GDP). It is noted that more-developed regions may have a slight advantage in this indicator due to their somewhat-more service-oriented economies. As policymakers look to improve efficiency and reduce overall emissions, they will take their lead from those regions that are devising new solutions and innovative technologies.

Figure 25: Metric tons of greenhouse gas (measured in CO2 equivalents) emitted per $10,000 of PPP-adjusted GDP, 2018[46]



The rankings: Brazil exhibits significant variation in carbon efficiency across its regions. Regions like Distrito Federal (0.5) and São Paulo (1.2) lead in carbon efficiency, displaying a national commitment to environmental responsibility. By contrast, regions like Acre (58.4) and Rondônia (58.5) exhibit a need for greater investment in reducing greenhouse gases.

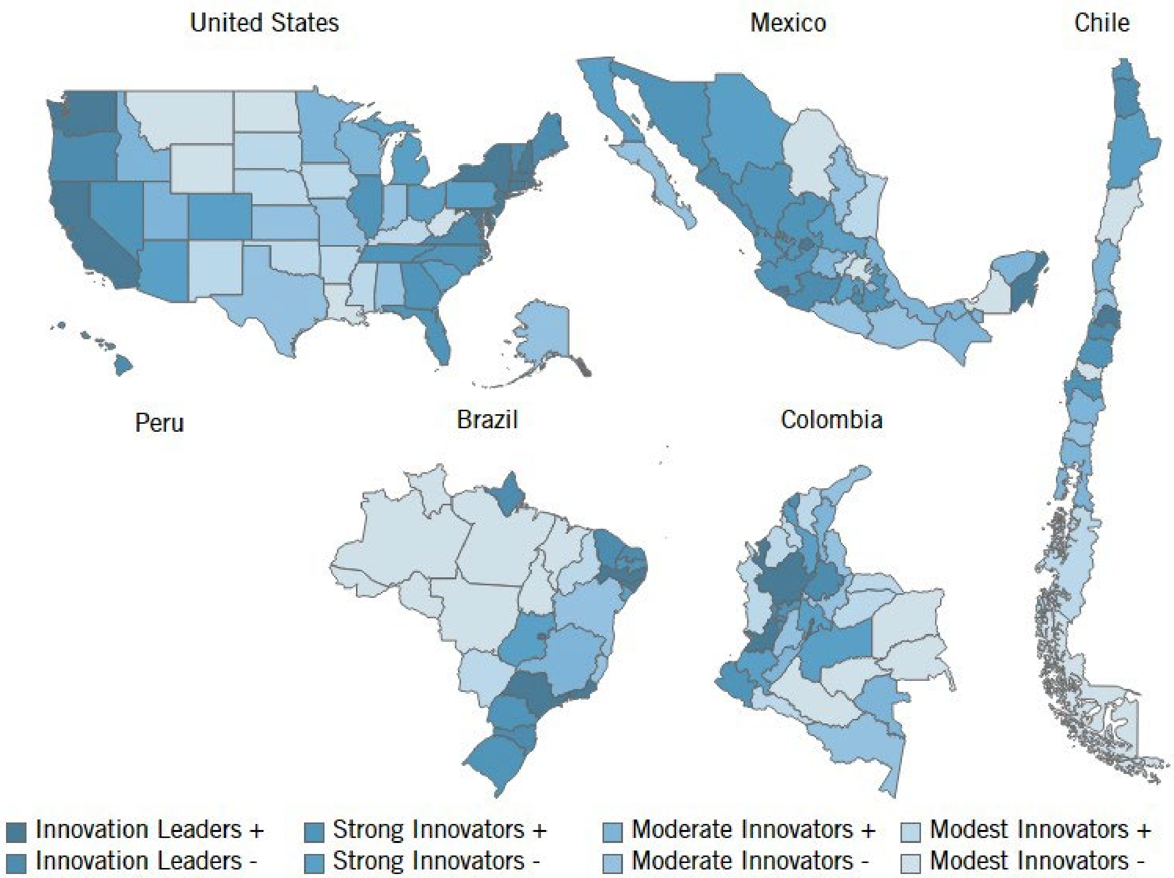
Mexico displays diverse carbon efficiency levels across its regions. Regions like Colima (1.1) and Aguascalientes (1.3) exhibit the lowest carbon footprints. By contrast, Coahuila (17.4), Hidalgo (9.2), and Campeche (9.1) have much higher levels of greenhouse gases.

Chile demonstrates a range of carbon efficiency levels. Regions like Santiago (0.9) and O'Higgins (2.0) display lower greenhouse gas emissions, while Atacama (13.1) and Ñuble (11.2) exhibit a much-greater carbon footprint.

Colombia showcases varying carbon efficiency across its regions. Regions like Bogotá (0.4) and San Andrés y Providencia (0.5) exhibit the lowest greenhouse gas emissions, while regions like Vichada (33.7) display a need for more investment in this regard.

The United States presents a diverse range of carbon efficiency levels across its states. While states like Massachusetts (1.2) and California (1.4) demonstrate strong carbon efficiency, states like Wyoming (23.5) and North Dakota (15.6) face more significant challenges in reducing their carbon footprint.

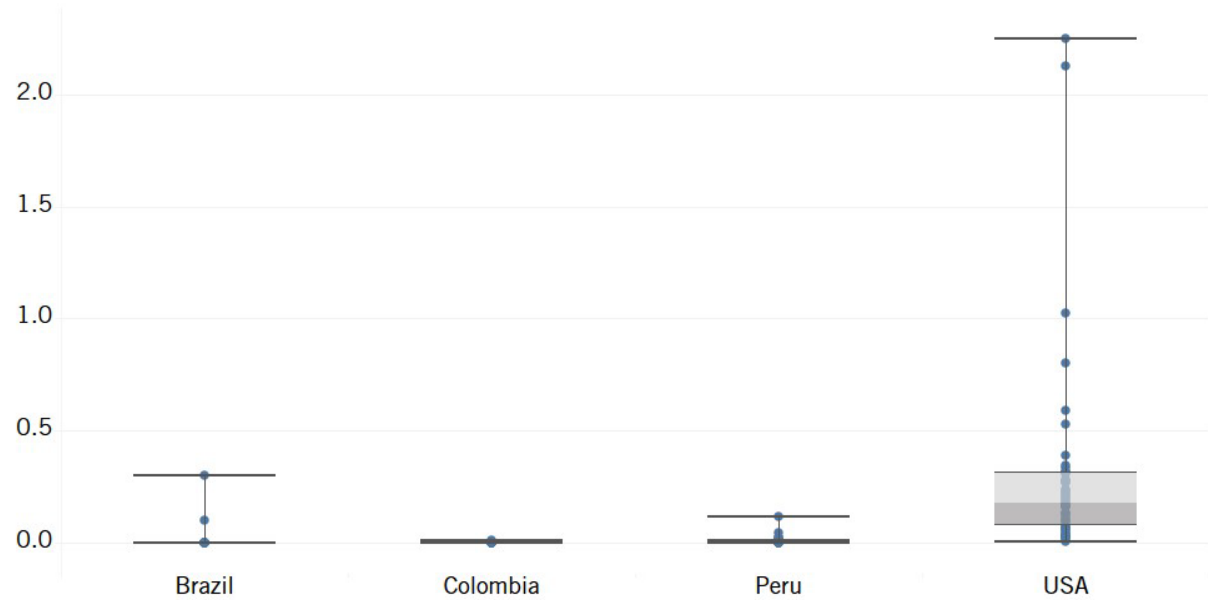
Figure 26: Performance map in carbon efficiency indicator[47]



Venture Capital

Why is this important? This indicator examines a region's total venture capital investment (measured as VC-receiving firms) relative to the size of its GDP. VC represents a form of business financing wherein investors provide funds to early-stage companies in exchange for equity in their firms. Given the considerable uncertainty regarding start-ups' success potential, VC investment assumes higher risks than other forms of investment. Accordingly, VC investment is often intended for companies with real or perceived high-growth potential, often associated with their innovative technology use or business model design. A region's receipt of VC investment reflects both the innovativeness of its start-up ecosystem as well as the commitment of its firms to lead in crucial technologies such as AI, biotechnology, clean energy, advanced manufacturing, and robotics. Due to the volatility of VC investment from year to year, this report considers regions' average scores between 2017 and 2019.

Figure 27: Venture capital investment received as a percentage of GDP, 2017–2019 (average) (%)[48]



The rankings: Peru's regions exhibit varying levels of venture capital attraction. Huancavelica (0.12 percent) leads the way in venture capital influx. Meanwhile, many regions like Apurímac (0.004 percent) and Loreto (0.003 percent) attract almost no venture capital at all.

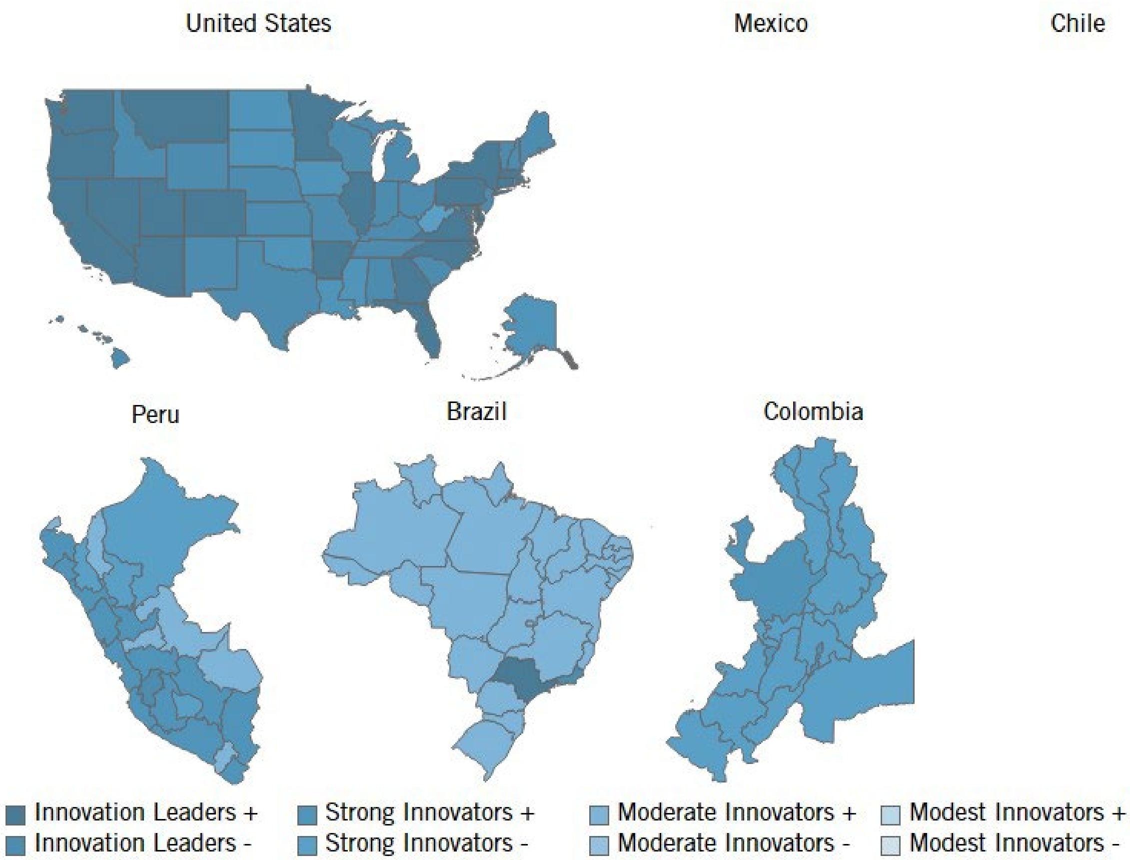
Brazil displays venture capital attraction in only a couple of areas. São Paulo (0.30 percent) and Rio de Janeiro (0.10 percent) lead the country, indicating robust entrepreneurial activities. However, most of the other regions show essentially no venture capital involvement.

Colombia demonstrates varying degrees of venture capital engagement across its regions. Bogotá (0.01 percent) leads the way for start-ups and innovative ventures, while regions like Cauca (0.0002 percent) and Magdalena (0.0003 percent) attract very little venture capital.

The United States showcases a robust venture capital landscape. States like Massachusetts (2.13 percent) and California (2.25 percent) lead the nation in attracting venture funding, reflecting their status as global tech and innovation hubs. Other regions like New York (1.03

percent), Utah (0.80 percent), and Texas (0.20 percent) also display substantial venture capital activities.

Figure 28: Performance map in venture capital indicator[49]



POLICY RECOMMENDATIONS

Brazil

Knowledge Economy

Analysis of the knowledge economy component brings to light troubling trends concerning Brazil's subpar indicators related to a highly educated population and its lackluster manufacturing labor productivity.

To effectively tackle these challenges and cultivate a heightened sense of competitiveness and innovation within the knowledge economy, it is imperative to adopt a focused and specific policy strategy. Addressing the shortcomings in highly educated population indicators and manufacturing labor productivity demands a comprehensive approach that underscores the importance of educational excellence, continuous lifelong learning, robust collaboration between industries and academia, all while embracing technological advancements. Additionally, promoting greater trade openness can invigorate industry competition, subsequently fostering remarkable strides in productivity gains.

Globalization

Brazil possesses the potential within its subnational regions to foster innovation, cultivate economic diversification, and bolster its global competitive standing. This transformation can give rise to a more harmoniously integrated and thriving business ecosystem at the subnational level, thereby making a substantial contribution to the country's growth trajectory and its resilience on the international stage.

Within this context, the globalization component of the analysis has shed light on substantial challenges, including the country's struggling indicators of high-tech exports and the uneven distribution of inward FDI across its states. Considering these obstacles, there arises a pressing need to adopt a strategic and focused policy approach that can galvanize Brazil's international competitiveness.

While Brazil has made notable strides in business creation, the metrics concerning broadband adoption, R&D intensity and personnel, patent applications, carbon efficiency, and venture capital indicate areas warranting attention.

This should entail a comprehensive strategy that includes the promotion of high-tech exports, the orchestration of targeted trade missions, bolstering the capabilities of high-tech industries through capacity-building initiatives, nurturing collaborative industry clusters and special economic zones, aligning and coordinating policies across various levels of governance, and establishing regional investment promotion agencies.

Innovation Capacity

The innovation capacity component underscores a diverse spectrum of challenges and opportunities among Brazilian states. While Brazil has made notable strides in business creation, the metrics concerning broadband adoption, R&D intensity and personnel, patent applications, carbon efficiency, and venture capital indicate areas warranting attention.

Brazil possesses the potential to bolster its subnational innovation capacity, cultivating an environment conducive to sustainable growth, technological progress, and inclusive development. To achieve this, a comprehensive approach encompassing improved infrastructure, heightened R&D investment, fortified IP protection legislation and IP culture, sustainable practices (particularly in the Amazon region, the mining sector, and the agribusiness sector), tailored support for start-ups beyond São Paulo and Rio de Janeiro, and amplified access to venture capital is all imperative. These strategic measures would undoubtedly fuel innovation and empower states across the nation to flourish amidst the swiftly evolving global landscape.

Chile

Knowledge Economy

Despite Chileans acceding to higher education as no previous generation had, there is still an important percentage of the labor force that does not have a bachelor's degree. On the other hand, the quality of school education is below the level of most Organization for Economic Cooperation and Development (OECD) members.[50] Both are reasons that explain the low labor productivity in Chile when compared with developed countries.[51]

To cope with these problems, the government should promote measures to improve the quality of education, especially in math; increase the percentage of formal workers by making the labor market more flexible—Chile has one of the highest costs for hiring and firing employees—and; in general, promote macro- and microeconomic conditions to elevate the labor productivity.

Regarding the attraction of talent from abroad, the percentage of immigrants with tertiary education is less than 3 percent. There exists tremendous room for improvement in advancing incentives to attract more skilled immigrants by targeting visas and simplifying the current process of receiving work authorizations. Moreover, the maximum of 15 percent of workers of a firm that can be foreigners is a restriction that should be removed.

Globalization

Chile has free trade agreements with most of the major economies in the world and recently joined the Comprehensive and Progressive Transpacific Partnership (CPTPP). However, its percentage of high-tech exports remains under 1 percent. In turn, exports of high-quality professional services have exhibited a significant increase in recent years and successive legal reforms have facilitated this development.

Chile has an open and transparent institutional framework to receive foreign investment and the government provides support to be able to manage the corresponding permits to materialize the investment.

The current administration has announced tax and permit management reforms to facilitate the entry of new foreign investment, which should be put in place as soon as possible.[52]

Innovation Capacity

Chile ranks higher than its peers in broadband adoption due to a competitive market of providers. The R&D activity in Chile is like in Peru, Colombia, and Mexico, and reflects the structure of the Chilean economy based on exploitation of natural resources.

The current government is trying to push more investment in R&D, but the incentives proposed are small and incoherent with other policies—such as the significant increase in tax collection that has been discussed recently. Chilean policymakers should consider working toward an easier tax scheme and reduction of firms' taxes to spur a rising interest in investing in VC.

The government has a program that seeks to increase advanced human capital for the development of science and technology in the country by financing postgraduate scholarships in Chile and abroad for graduates or professionals demonstrating academic excellence. Graduates are mainly incorporated into universities, and it is desirable that there is more hiring in private companies.

Ten years ago, a reform was implemented that created a digital platform to create a company in one day and at no cost. However, it is still necessary to reduce the bureaucracy in other kinds of authorizations that are necessary to run a business, such as those required by local governments.

On the other hand, the disparity in carbon efficiency among the regions reflects the main industries in each region and the availability of renewable sources of energy. Chile has a real chance to be an important player in the green hydrogen industry and remain an important producer of copper and lithium, which are key elements to the energy transition. However, there are bottlenecks in lithium production and the green hydrogen strategies that the government needs to solve soon to take advantage of its benefits.

Chile has free trade agreements with most of the major economies in the world and recently joined the Comprehensive and Progressive Transpacific Partnership (CPTPP).

VC investment has experienced remarkable growth in recent years. The VC funds, the number of deals, and success stories are increasing, and each year the VC ecosystem in Chile consolidates and expands. This has allowed the creation and development of great opportunities, recently highlighting several startups that are raising rounds at high valuations—including a couple of unicorns—reflecting an explosive and unprecedented growth for Chile.

It is very important to promote the participation of institutional investors in local private investment funds without the current restrictions. Chile should transition from the current intensive scheme of governmental contributions to a system where private investment is encouraged, but also allow private pension funds—among other institutional investors—to be released from regulatory restrictions and have the incentives to invest in VC.

Colombia

Knowledge Economy

Colombia faces low levels of access to tertiary education among its population. This issue is a direct consequence of the significant challenge of expanding the tertiary educational coverage in Colombia. Particularly, this has led to the concentration of the educated population in a few cities in Colombia. This can be seen in regions like Bogotá, Atlántico, Valle, and Antioquia. This challenge might be addressed through public policies aimed at allocating a larger budget for education in regions away from major cities. This will help generate a larger pool of professionals for the labor market.

Additionally, there is a need to enhance skills in STEM, bilingualism, and technology-focused education for the Fourth Industrial Revolution. On that note, it is crucial to update the curriculums at all levels of education in the country to guarantee that human capital has the skills required to promote innovative business, as well as the required capacities for the future labor market. Moreover, it must be central to the education policy of the country adopting municipal and departmental strategies to promote access to education.

Furthermore, promoting the acquisition of digital skills among the entire population is required to narrow the digital divide and enable universal access to information and communications technology (ICT) for all Colombians. This would allow for a more vibrant and dynamic digital ecosystem.

Finally, policies offering incentives for R&D are essential to retain and expand the number of individuals engaged in R&D in the country. Individuals involved in R&D must come not only from academia and government but also from private companies that contribute to the country's economic growth.

Globalization

Colombia is a major exporter of raw materials—which often lack added value—resulting in high-tech exports not being a prominent category in the economy. Policymakers should focus efforts on diversifying exports and incentivizing producers and exporters through favorable fiscal measures. On that note, it is key to strengthen legal certainty and harmonize legal frameworks related to the proper development of the country's business activities. This is especially true for tax laws, which are constantly undergoing changes that affect the competitiveness of the country. Additionally, when such modifications should occur, it is crucial to coordinate them with all the actors of the ecosystem to build trust and attract foreign investment and talent.

Technology exports are concentrated in some cities, which leads to very low levels of high-tech exports for the rest of the country. Therefore, it is crucial to undertake policies to provide less-developed regions of the country with more financing and strategies to promote the production of technology products and services. Also, it is important to strengthen the financing of tech startups to boost the entrepreneurship ecosystems in the country as well as to create frameworks that incentivize VC investments to contribute to the economy with foreign capital flows.

Innovation Capacity

Despite not having highly favorable productivity levels, Colombia has been making a positive leap in allocating resources for R&D, as evident from the indicators, showing consistent R&D intensity across all regions of the country, even in areas with greater educational, economic, and social disparities. Therefore, it should remain a priority for policymakers to incentivize innovation capacity.

Regarding Internet service penetration, there still are some regions that have very low penetration rates, and millions of people that are not yet connected. To tackle this, it is crucial to urge the government to continue promoting the proper development of connectivity through robust policies that facilitate effective spectrum allocation, efficient rolling out of telecom infrastructure, and optimal development of new technologies such as 5G.

Additionally, it is fundamental to enhance the ICT business environment and promote related research by encouraging research and adopting new, more efficient models and operations using ICT—such as AI, IoT, machine learning, and cloud, among others. This will lead to more-innovative industries providing competitive products and services across sectors.

Mexico

Knowledge Economy

Mexico's progress toward a knowledge-based economy can gain momentum through all-encompassing reforms centered on enhancing and cultivating skills. This can be achieved by adopting a triple helix approach that fosters collaboration among the public, private, and academic sectors. The education and labor regulatory frameworks and policies in Mexico, both at the federal and local levels, must transition toward a forward-looking perspective that anticipates the future skill demands for burgeoning markets heavily reliant on manufacturing, engineering, and technology.

To strengthen the Mexican education system, it's crucial to not only bolster STEM teaching methodologies across all educational levels but also to recognize the significance of nurturing both soft skills and technical prowess. This can be achieved through investments in teacher training, curriculum refinement, and the allocation of resources to facilitate hands-on learning opportunities. Moreover, forging symbiotic partnerships between universities and industry holds immense potential to cultivate practical learning environments that are finely attuned to the evolving demands of markets. A transformative approach involves embracing a dual education system that seamlessly melds classroom instruction with real-world work exposure, effectively bridging the gap between academic knowledge and the ever-evolving needs of the market. This holistic strategy not only equips students with technical acumen but also empowers them with vital soft skills, thereby propelling them toward fulfilling careers in a rapidly changing professional landscape. To achieve this, it is important to consider encouraging private sector involvement in education through incentives and formal partnerships.

In addition, Mexico needs to enhance its entrepreneurial ecosystem, which involves revitalizing public programs, primarily focusing on: 1) facilitating access to funding; 2) streamlining bureaucratic hurdles at federal, state, and municipal levels; and 3) enhancing taxation and compliance procedures, along with reinforcing frameworks for property rights enforcement and protection. Combining policies for improving conditions for startups and access to skilled talent will consolidate existing hubs and encourage risk-taking for the creation of new ones.

Furthermore, it is advisable to attract and retain skilled talent by implementing immigration policies that streamline the entry of international professionals and researchers.

Globalization

Mexico's globalization strategy should focus on strengthening regional collaborations and expanding its presence in international markets. Bolstering partnerships with neighboring countries and regional alliances, like the Pacific Alliance and the CTPP, will enhance trade and cooperation. Specifically, Mexico should not only strengthen regional collaborations and expand its international market presence but also strategically leverage its geographical proximity. To integrate nearshoring effectively into Mexico's development strategy, coordination among all levels of government is crucial. Subnational governments play a pivotal role in ensuring essential factors such as a skilled workforce, alignment with local social contexts, and the prevention and mitigation of supply chain and political risks.

Additionally, existing trade agreements, such as the U.S.-Mexico-Cananda Free Trade Agreement (USMCA) and the EU-Mexico Agreement, represent key platforms to increase exports, attract foreign investment, and promote technology transfer. Mexican policymakers must develop targeted policies to support Mexican startups in entering global markets, providing them with resources and guidance to navigate international expansion. Policymakers should also foster collaborations in key sectors such as manufacturing, automotive, electronics, aerospace, and renewable energy to tap into global value chains.

To position itself as a regional and global trade hub, Mexico must strategically strengthen and invest in logistics and infrastructure, while also enhancing the local rule of law. This will create an appealing environment for foreign investments and streamlined trade operations. This comprehensive strategy will enhance both subnational and national economic competitiveness, ultimately elevating Mexico's stature in the international trade arena.

Innovation Capacity

To amplify innovation capacity, Mexico should prioritize policies that incentivize research and development, foster the articulation of stakeholders, and cultivate a culture of innovation. Mexico must incorporate a gender and social inclusion cross-cutting approach in these efforts, ensuring that all individuals have equal opportunities to contribute and benefit from an innovation ecosystem.

Mexican policymakers should enhance both public and private investment in R&D by introducing compelling tax incentives, reactivating grants to support research, and funding avenues to support inventive ventures. Since the public institutional framework at the federal level has changed in terms of its scope and support for innovation, it is necessary to leverage and strengthen the existing mechanisms at the state level, as well as promote the engagement of these subnational stakeholders within the existing innovation ecosystem.

Mexican policymakers should enhance both public and private investment in R&D by introducing compelling tax incentives, reactivating grants to support research, and funding avenues to support inventive ventures.

Moreover, Mexican policymakers should bolster the safeguarding of intellectual property rights and data protection to not only protect inventions but also cultivate an environment that stimulates the commercialization of cutting-edge technologies for the development of Mexico's key economic sectors. Mexico must also establish decentralized dynamic innovation clusters and hubs—beyond Mexico City—that serve as vibrant convergence points for academia, research institutions, industry, and startups, nurturing a fertile ground for sharing knowledge and catalyzing cross-industry cooperation.

To bridge the academia-industry divide, Mexican policymakers should cultivate mechanisms that forge robust stakeholder engagement, nurturing collaborative projects and the seamless transfer of technology know-how. Simultaneously, policymakers should make strategic investments in digital infrastructure and initiate comprehensive digital literacy initiatives to ensure universal access to information and communication technologies. This proactive step opens the doors for broader participation, enabling diverse individuals to participate in the innovation ecosystem and contribute to Mexico's advancement.

Peru

Knowledge Economy

One of the main challenges that Peru faces in promoting an adequate innovation ecosystem is related to the still-inadequate levels of human capital in its labor force, which limits its performance in the dimension of the knowledge economy. The origins of these gaps can be traced from very high levels of anemia and malnutrition of the population under five years of age, and—during school years—to low educational performance in language and mathematics. Therefore, from a structural point of view, the first line of action to solve the gap is to promote effective policies for early childhood development and the improvement of educational quality in schools.[53] Likewise, it will be important to solve the problem of heterogeneity in the quality of technical and university education, especially to shorten the gaps between the capital and the provinces and public and private centers. In this way, beyond the quantity of PTS employment—where Peru is not doing badly in relative terms—it will be possible to strengthen the quality of PTS employment as well. For this, it is necessary to advance on several priority fronts, for example, promoting technical education in the last years of secondary school, strengthening the accreditation process of higher education institutions, institutionalizing solutions that contribute to the progressive closing of the gap between the training offer and labor demand, and promoting financing solutions (e.g., scholarships and/or educational loans).[54]

In this context, Peru has not yet been able to take advantage of the fact that, as part of the massive Venezuelan migration, a significant number of foreigners with high levels of qualification have arrived, which can be used to solve training gaps in specific sectors. However, for this to happen, it is a priority to adapt the institutional and legal framework to address migration, expand reception capacity—especially in areas with the highest concentration of migrant and refugee populations—with appropriate sectoral and cross-cutting policies. Peru also needs to mitigate risks and vulnerabilities that this process entails for the migrant and refugee populations, including the challenges of social and cultural integration, and challenges of gender discrimination. Peru also needs to build a social pact within Peru and with other countries for a more effective, social, and sustainable integration.[55] In addition, beyond the Venezuelan influence, initiatives designed to attract talent—foreign or repatriated—can begin to be put into practice, facilitating work permit procedures or special tax measures for non-residents within a framework of inter-institutional agreements that involve academia, the public, and the private sector.

One of the main challenges that Peru faces in promoting an adequate innovation ecosystem is related to the still-inadequate levels of human capital in its labor force, which limits its performance in the dimension of the knowledge economy.

Finally, another priority front pertains to the high level of informality in the country, which reflects productivity problems in the labor force and the competitiveness of firms. Beyond the extreme result of Moquegua, the levels of labor productivity specifically in the industrial sector are still low. All this limits the possibilities of investment both in worker training and investment in innovation and technology. For this reason, in addition to policies that reinforce the construction of human capital, it is important to promote a friendlier legal and institutional environment with the creation of formal jobs, to advance active labor policies that promote youth labor insertion and job training, and to attend to the still high productive heterogeneity by facilitating the adoption of technologies, especially in the medium- and small-enterprise (SME) segment.

Globalization

Over recent decades, Peru has been characterized by implementing trade opening policies and attracting foreign direct investment. However, to reinforce the globalization pillar, it is necessary to deepen these strategies so that they favor the productive diversification of the country and the expansion of high-value exports. In this sense, regarding the exportable supply, transversal policies become important: including:

- market opening, including compliance with international standards;
- sectoral policies, for example, public-private coordination spaces and promotion of strategic sectors with special labor and tax regimes; and
- specialized policies, to gain efficiencies in logistics services, administrative simplification, and digitization.[56]

Likewise, it is important to reinforce the role of the investment promotion agency to promote investment in areas of science, innovation, technology, and development; complemented with measures to improve the business environment in the country. The latter involves resuming the path of economic growth, but also through certain specific measures, such as institutionalizing regulatory quality and impact studies and solving critical bureaucratic barriers in R&D sectors.[57]

Innovation Capacity

One of the indicators where Peru shows adequate performance in relative terms is in the creation of companies. However, it is important to consider that due to the nature of the Peruvian labor market, many of these companies correspond to precarious or subsistence enterprises. For this reason, the results should not distract from the efforts that are still necessary to reinforce the competitiveness and productivity of the SME segment previously mentioned.

On the other hand, the performance in terms of R&D—including patent applications—is quite modest. This occurs due to existing distortions in the R&D ecosystem, where initiatives act in a disjointed manner, financing is insufficient, capacities are very limited, and there is a low participation of universities in the generation of new technologies for the productive sector. For this reason, it is necessary to advance in three priority axes. First, in the governance and institutional framework of the innovation system, avoiding the dispersion of initiatives based on an articulating approach between different actors and government levels. Second, increase the level of investment in R&D with a balanced participation of the various areas of knowledge in public financing. Third, promote the allocation of resources with an emphasis on strengthening science, technology, and innovation capacities.[58] One of the important reforms that are under debate in Peru is the creation of the Science and Technology Ministry to overcome the problems mentioned as well as the strengthening of the Productive, Innovation and Technological Transfer Centers—CITE, in Spanish.

The above initiatives should also be complemented by efforts at two levels. On the one hand, promoting digitization, and second, the adoption of more environmentally friendly technologies. In the first case, several initiatives stand out, such as, for example, promoting national and regional projects that allow the expansion of fiber optic networks, promoting greater adoption of 4G and 5G technologies, and reinforcing regulation, especially in what corresponds to the guarantee of reliable Internet connections. Strengthening monitoring and supervision procedures is crucial here to advance digitization of Peru's states as well as the adoption of a digital transformation policy at the national level.[59] In the second case, a priority aspect is to advance in the transformation of the country's energy matrix and accompany the technological changes driven by the private sector in critical sectors—agroindustry and mining.

United States

Knowledge Economy

To bolster the United States' innovation ecosystem and global competitiveness, a comprehensive policy approach is recommended. Firstly, the U.S. government must direct a substantial increase in funding for R&D toward universities, research institutions, and private sectors. Concurrently, a renewed emphasis on STEM education at all levels is imperative to cultivate a proficient and adaptable workforce. Introducing immersive technologies into classrooms has the potential to make the U.S. education system more effective, but before these technologies are deployed in schools, the federal government should increase R&D investments in key areas that need further research.[60] Additionally, the United States should streamline the immigration process for STEM professionals through the implementation of fast-track visas, green cards, and accessible pathways to permanent residency and citizenship. To ensure a resilient workforce, the United States must establish targeted programs for workforce training and reskilling, enabling professionals to stay relevant amidst technological advancements. For instance, the United States should establish a National Robotics Strategy Committee similar to Australia's, while revising education standards, preparing students for workplaces with robotics, and supporting workers affected by automation.[61] Simultaneously, investments in advanced manufacturing technologies, such as automation, robotics, and additive manufacturing, could not only enhance manufacturing productivity but also generate high-tech job opportunities. Finally, fostering global collaboration by partnering with international counterparts on research initiatives, knowledge exchange, and talent mobility would expand access to a diverse pool of expertise, propelling the nation's innovation capacity to new heights.

Globalization

The U.S. government should set a strategic policy framework focused on increasing high-tech exports and attracting FDI to elevate the United States' innovation competitiveness on the global stage. The United States must focus in particular on attracting greenfield as opposed to brownfield investment. The U.S. government should also implement targeted initiatives to promote the export of high-tech products and services, including streamlined export procedures, financial incentives, and trade missions that highlight the nation's technological prowess. Concurrently, the United States should adopt a proactive approach to attract FDI by offering attractive incentives, simplified regulatory processes, and enhanced investor protections. By fostering an environment conducive to high-tech exports and foreign investment, the United States can harness the power of international collaboration and propel its innovation ecosystem to unparalleled heights, solidifying its position as a global leader in cutting-edge technologies and industries. The federal government should avoid export policies that limit sales of U.S. high-tech products to civilian and commercial actors in China, as U.S. high-tech companies need access to large markets at scale and, moreover, every $1 a U.S. semiconductor firm (for example) earns in China is one that a Chinese competitor does not.[62]

Funding for initiatives advanced in the CHIPS and Science Act, such as the critically important regional innovation hubs program, should be fully advanced in Biden administration budget proposals and Congressional budgeting reality.

Innovation Capacity

The United States should implement several policies to bolster its innovation capacities. First, bolstering investment in education and research is imperative, involving increased funding for R&D across universities, research institutions, and private sectors. To catalyze innovation, the government should nurture a robust collaboration between academia and industry through partnerships, enabling seamless knowledge transfer and technology commercialization. The National Science Foundation's Technology, Innovation, and Partnerships (TIP) program should focus on 1) Artificial intelligence, machine learning, autonomy, and related advances; 2) High-performance computing, semiconductors, and advanced computer hardware and software; 3) Quantum information science and technology; 4) Robotics, automation, and advanced manufacturing; 5) Biotechnology, medical technology, genomics, and synthetic biology, and 6) advanced materials science.[63] The TIP should also focus on industry-relevant research with high technology readiness levels (TRLs) from the early stage because it avoids spillover of the value-added to other nations.[64]

The Biden administration should further build out the Manufacturing USA Network of Manufacturing Innovation Institutes and ensure that it achieves its promised goal of tripling funding for the Manufacturing Extension Partnership program. Funding for initiatives advanced in the CHIPS and Science Act, such as the regional innovation hubs program, should be fully advanced in Biden administration budget proposals and Congressional budgeting reality.

Moreover, supporting startups and entrepreneurship demands the creation of an enabling ecosystem, entailing grants, tax incentives, and access to venture capital, alongside the establishment of innovation hubs and accelerators. While some support for high-growth technology-intensive companies, such as the Small Business Innovation Research program is absolutely warranted, overall U.S. innovation policy should seek to be size neutral, in part because, to compete successfully in global markets in advanced-technology industries, size and scale matter.[65] Strategic infrastructure investment, encompassing modernization of transportation networks, energy grids, and digital connectivity, can attract and retain skilled talent and businesses. To incentivize innovation further, boosting R&D tax incentives and reinforcing intellectual property protection are crucial steps. By providing R&D grants, fostering public-private partnerships, streamlining regulations, and ensuring robust data privacy and security measures, the United States can create an environment conducive to innovation-driven economic growth. A first step in boosting R&D in the pharmaceutical industry is to reverse the Inflation Reduction Act's pharmaceutical pricing provisions that compel pharmaceutical companies to negotiate prices with the Department of Health and Human Services on the most popular Medicare Part D branded drugs.[66] The federal government must also step up its game in defense of a more-robust global IP regime to spur U.S. competitiveness, support American jobs, and advance innovation. To strengthen domestic policies, U.S. policymakers should adopt website-blocking legislation, improve public engagement and education about IP, and stop trying to weaken the Bayh-Dole Act by advocating for the use of march-in rights to control drug prices.[67]

CONCLUSION

As countries continue to move forward through the 21st century, they ought to adopt new policies aimed at improving their international competitiveness in the innovation economy. In the case of Latin American countries, these policies are crucial for advancing beyond middle-income status. Due to regional disparities within countries, national-level policymakers must consider targeted policies for local-specific challenges. This is especially the case regarding greenhouse gas emissions in Latin America. Countries should also develop their competitive capabilities in knowledge-based and technologically advanced industries via a variety of policies. These include but are not limited to, investment in STEM education, incentivizing R&D spending, ensuring a proper patent system, and attracting high-skilled foreign professionals and foreign investment. This report has highlighted 13 different indicators which together help to measure subnational competitiveness in the innovation economy. By analyzing this index, policymakers can gain suggestions on the specific policies they should pursue, with special attention to underdeveloped or lagging regions.

APPENDICES

Appendix A: Composite and Category Scores Methodology

For each indicator, regions' scores were converted to a standardized score, which was capped at ±3 to avoid an outlier performance on a single indicator from too heavily influencing the composite score. For composite and category scores, a weighted-average capped standardized score (WACSS) was calculated for each indicator, wherein the weights used are those listed in the table below (normalized such that an indicator's applied weight is equal to its listed weight divided by the sum of the listed weights—i.e., applied weights sum to one). For the composite score, this was calculated by including all indicator weights; for the category scores, this was done by including only the weights for the indicators that fall under that category. WACCS are rescaled to a 100-point scale via min-max normalization, in which the "maximum" parameter is the maximum WACCS plus one-quarter standard deviation of WACCS, and the "minimum" parameter is the minimum WACCS minus one-quarter standard deviation of WACCS.

Mathematically, the WACCS of region s is calculated as:

$$WACSS_s = \sum_i \omega_i CSS_{s,i}$$

wherein i denotes the indicator, $CSS_{s,i}$ denotes the capped standardized score for region s in indicator i, and ω_i is the applied weight of indicator i, defined as:

$$\omega_i = \frac{(listed\ weight)_i}{\sum_i (listed\ weight)_i}$$

such that $\sum_i \omega_i = 1$.

The scaled score for region/UT s is then calculated as:

$$Score_s = \frac{\left[WACSS_s - \left(min_{WACSS} - \frac{1}{4}\sigma_{WACSS}\right)\right]}{\left[\left(max_{WACSS} + \frac{1}{4}\sigma_{WACSS}\right) - \left(min_{WACSS} - \frac{1}{4}\sigma_{WACSS}\right)\right]} \cdot 100$$

Appendix B: Indicator Methodologies and Weights

Table A1: Indicator weights and descriptions

Indicator	Weight	Year	Description	Category
Broadband Adoption	0.50	2019	Share of households subscribing to broadband Internet	Innovation Capacity
Business Creation	0.50	2016–2018	Enterprise birth rate in share of employer enterprises	Innovation Capacity
Carbon Efficiency	0.50	2018	Metric tons of CO_2e emitted per $10,000 of PPP-adjusted GDP	Innovation Capacity
High-Tech Exports	0.75	2017	Exports in NACIS codes 333–335 (or equivalent) as a share of GDP	Globalization
Highly Educated Population	0.75	2019	Share of 25–64-year-old population with a bachelor's degree (or equivalent) or higher	Knowledge Economy
Inward FDI	0.75	2017–2019 (average)	FDI inflow as a share of GDP	Globalization
Manufacturing Labor Productivity	1.25	2019	PPP-adjusted GVA per worker in the manufacturing sector	Knowledge Economy
Patent Applications	1.25	2015	PCT patent applications per million residents	Innovation Capacity
Professional, Technical, and Scientific Employment	1.25	2019	Share of employees in professional, technical, and scientific activities sector	Knowledge Economy
R&D Intensity	1.50	2019	R&D expenditures as a share of GDP	Innovation Capacity
R&D Personnel	1.50	2017, 2018	R&D personnel as a share of total employees	Innovation Capacity
Skilled Immigration	0.50	2019	Share of population that is foreign born and has at least some tertiary education (ISEC 5–8)	Knowledge Economy
Venture Capital Received	1.00	2017–2019 (average)	Venture capital investments received as a share of GDP	Innovation Capacity

Appendix C: Estimation Methodologies

Estimating Unavailable Data

Subnational-level data was not available for all indicators and countries. To bridge this gap, we used available proxy indicators that are available on the subnational level, and we assumed that they correlate with the original indicator. For instance, if high-tech exports are only available on a national level but not on a subnational level, while all exports are available on a subnational level too, then it is possible to estimate the amount of subnational high-tech exports by using the distribution of all exports across regions. The national-level high-tech export data ensures that the estimated regional high-tech export measures are in line with the national performance. These estimations allow for capturing parts of the innovation competitiveness metrics of regions despite the unavailability of the exact original indicator.

Subnational data was not available for Mexico and Chile for the high-tech exports indicator and for Chile, Colombia, and Peru on the FDI indicator.

Innovation Categories

Regions were sorted into eight innovation competitiveness categories: modest innovator -, modest innovator +, moderate innovator -, moderate innovator +, strong innovator -, strong innovator +, innovation leader -, and innovation leader+ based on the regions' positions in the ranking. The number of regions in each category was selected to be 23 to place an equal number of regions in each category given that there are 182 regions in total. The minus sign in the name of the category indicates that its regions fall into a lower category than those regions that are in the respective category with a positive sign. As the colors of the charts indicate, the categories' ascending order is modest innovator, moderate innovator, strong innovator, and innovation leader, in line with the rankings in the European Innovation Scorecard.

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About GTIPA

The Global Trade and Innovation Policy Alliance (GTIPA) is a global network of independent think tanks that are ardent supporters of greater global trade liberalization and integration, deplore trade-distorting "innovation mercantilist" practices, but yet believe that governments can and should play important and proactive roles in spurring greater innovation and productivity in their enterprises and economies. Visit gtipa.org.

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