Do Regional Free Trade Deals Spell Opportunity or Challenge for Growth? – Role of Technology Transfer

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January 17th, 2022

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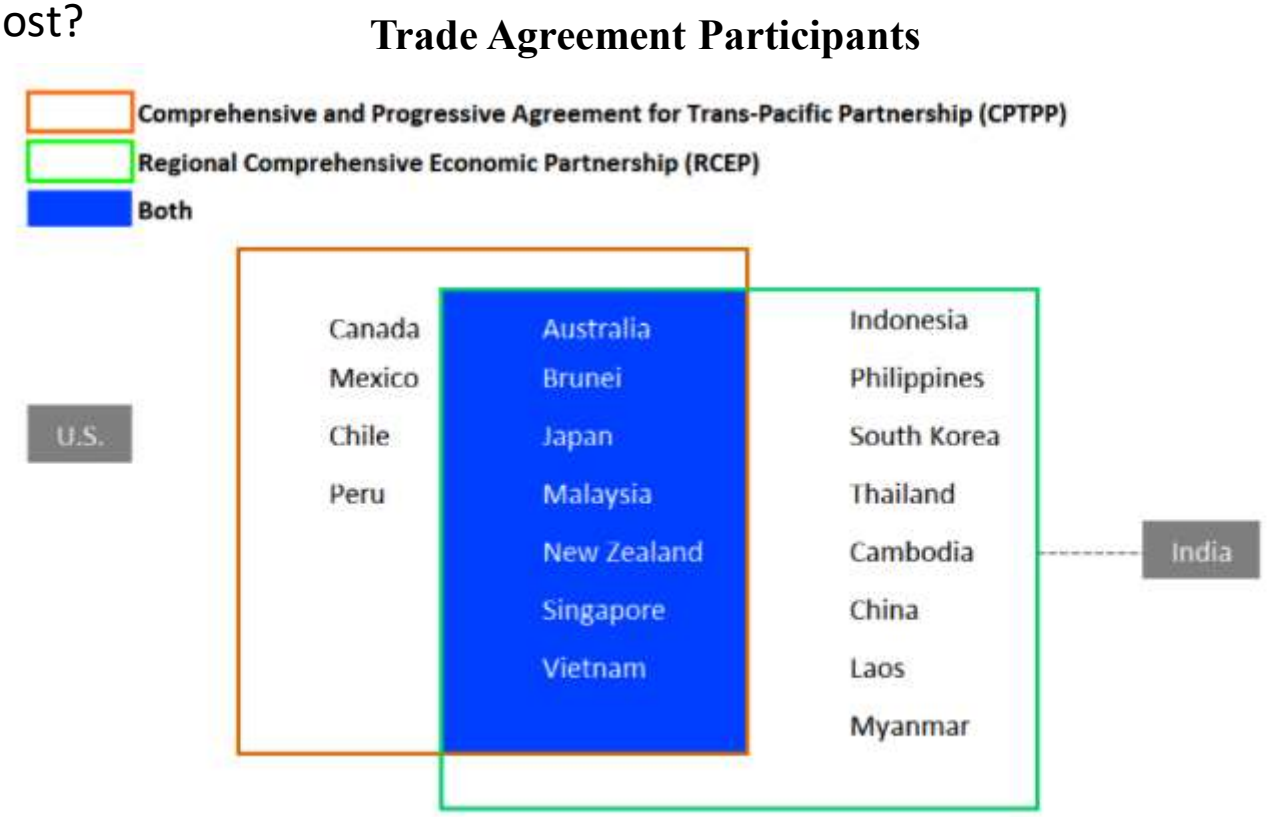
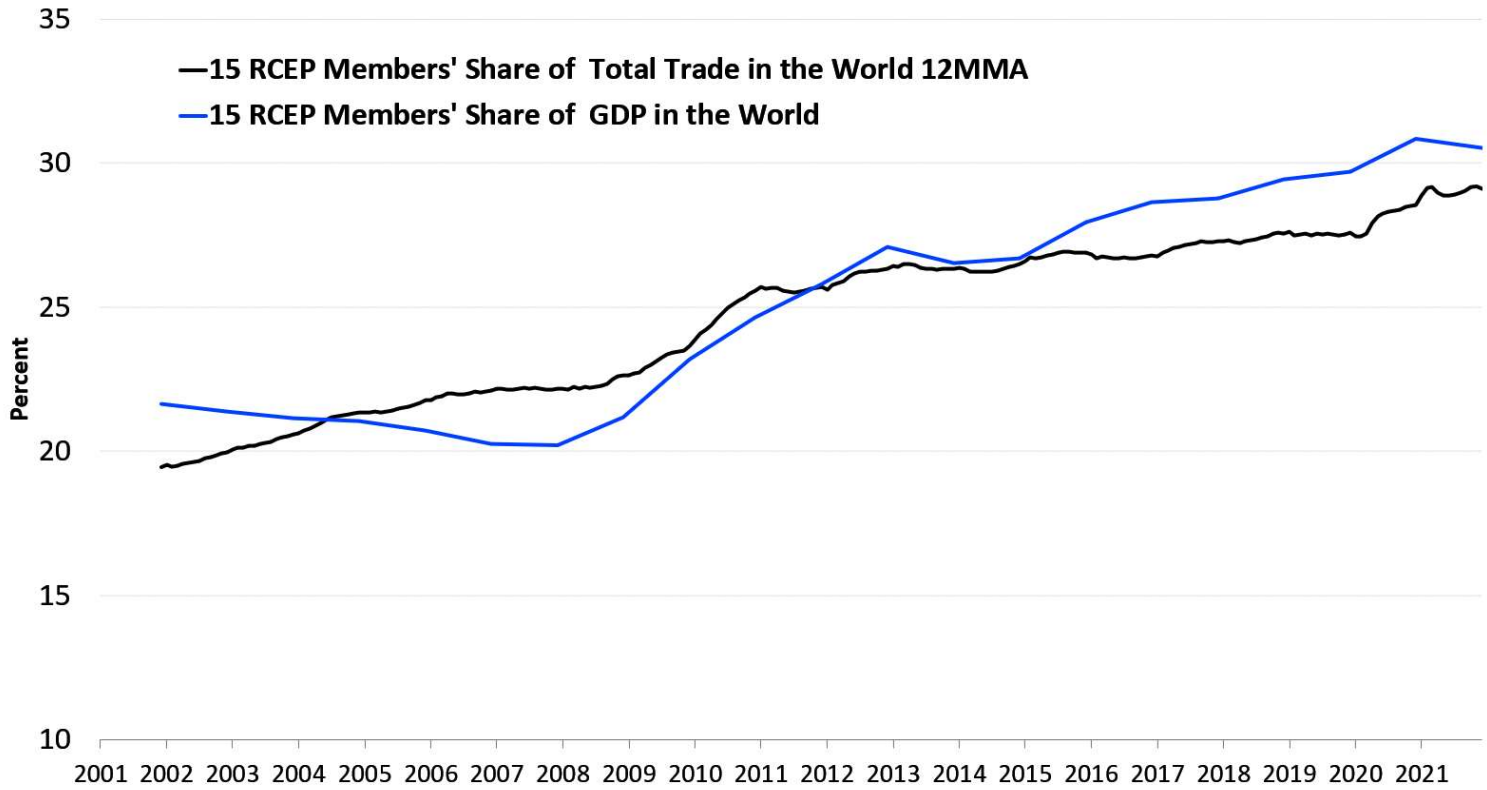
MOTIVATION AND QUESTIONS

- Two mega regional free trade deals in Asia and Pacific recently launched (RCEP in Jan. 2022 and CPTPP in Dec. 2018) and could expand further
  - Who will benefits most?
  - And How much?



BIGGER OPPORTUNITY FOR RCEP

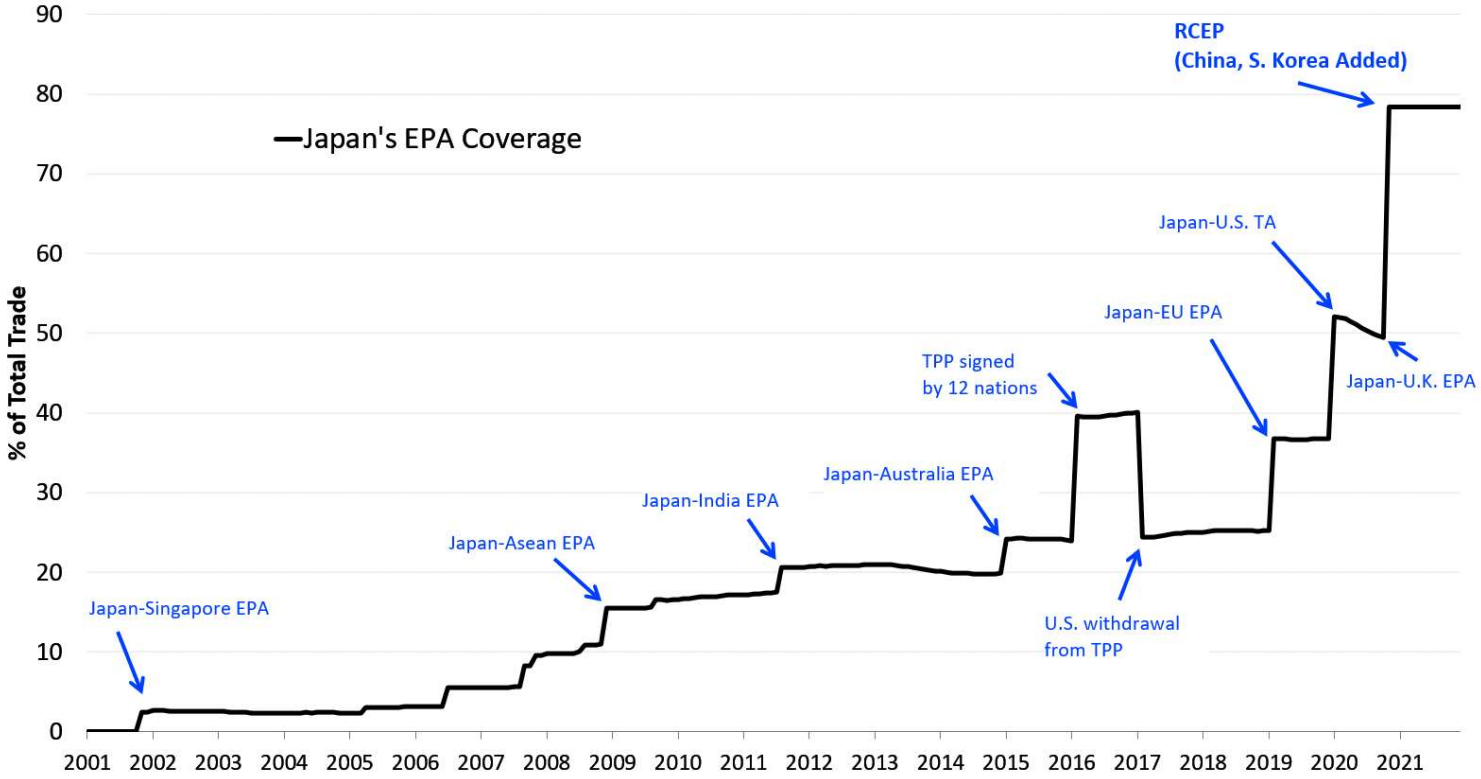
Global share of total trade and GDP in RCEP members



Source: IMF, Bloomberg Economics

JAPAN'S LONG AMBITION TO EXPAND FTA AREAS

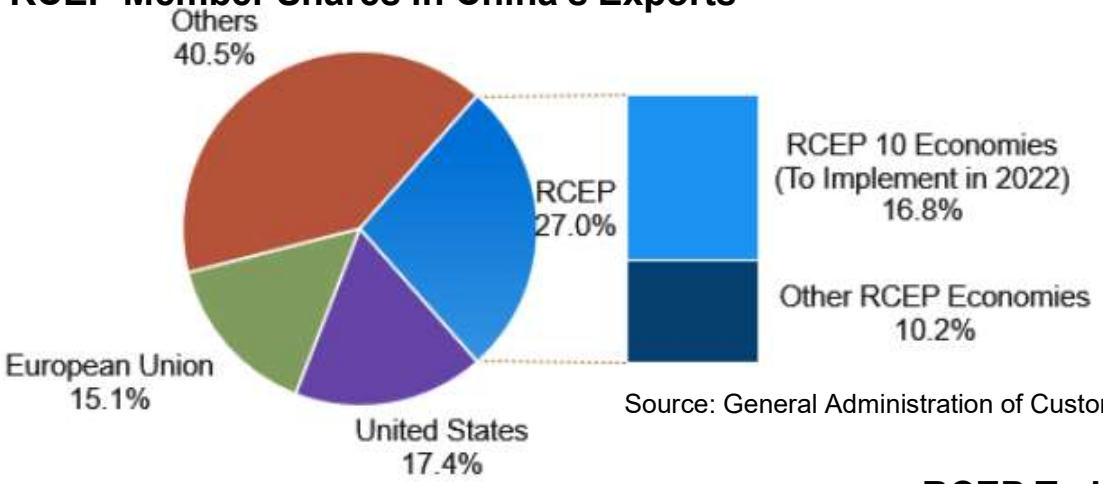
- **Japan's Free Trade Agreement coverage increased rapidly for two decades**
- **RCEP is probably a final piece but U.S. participation in CPTPP**



Source: Ministry of Finance, Bloomberg Economics

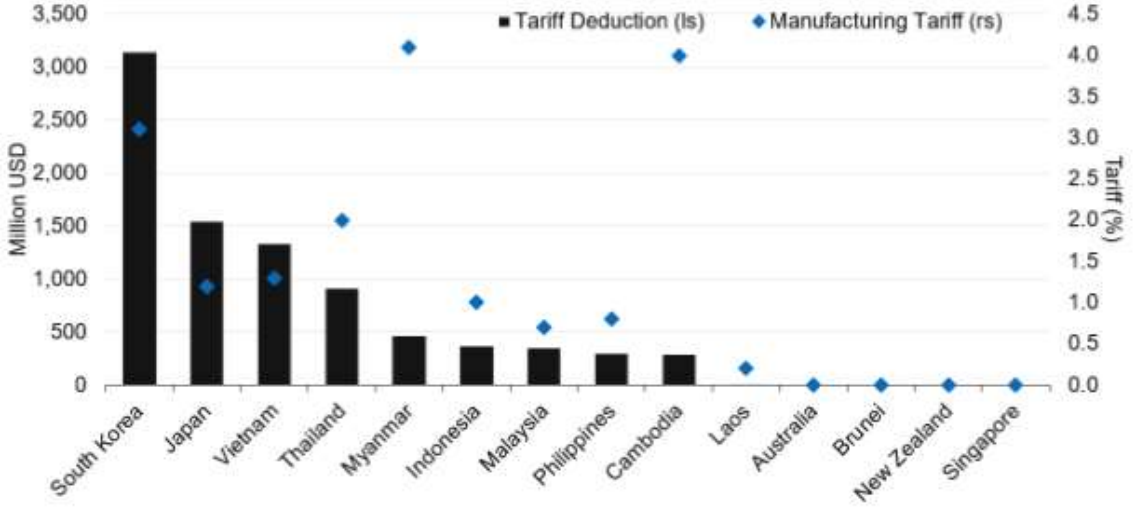
CHINA ALSO BENEFITS FROM RCEP

RCEP Member Shares in China's Exports



Source: General Administration of Customs, Bloomberg Economics

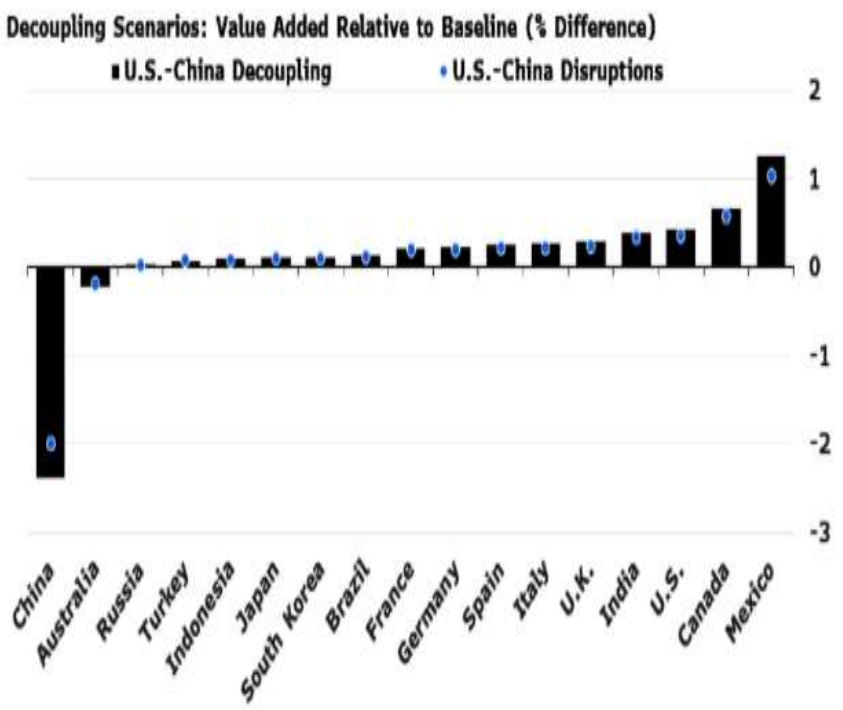
RCEP Tariffs, China's Expected Tariff Deductions

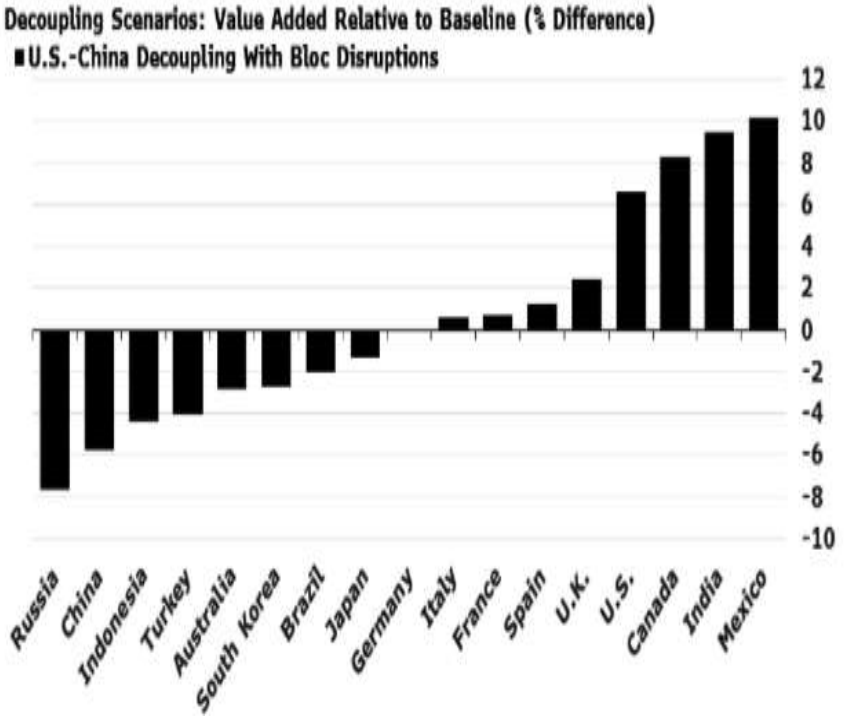


Source: United Nations Conference on Trade and Development, Bloomberg Economics

U.S.-CHINA TRADE WAR AND NEW TRADE BLOC

New Cold War May Cost China 6% of GDP, Lift U.S.



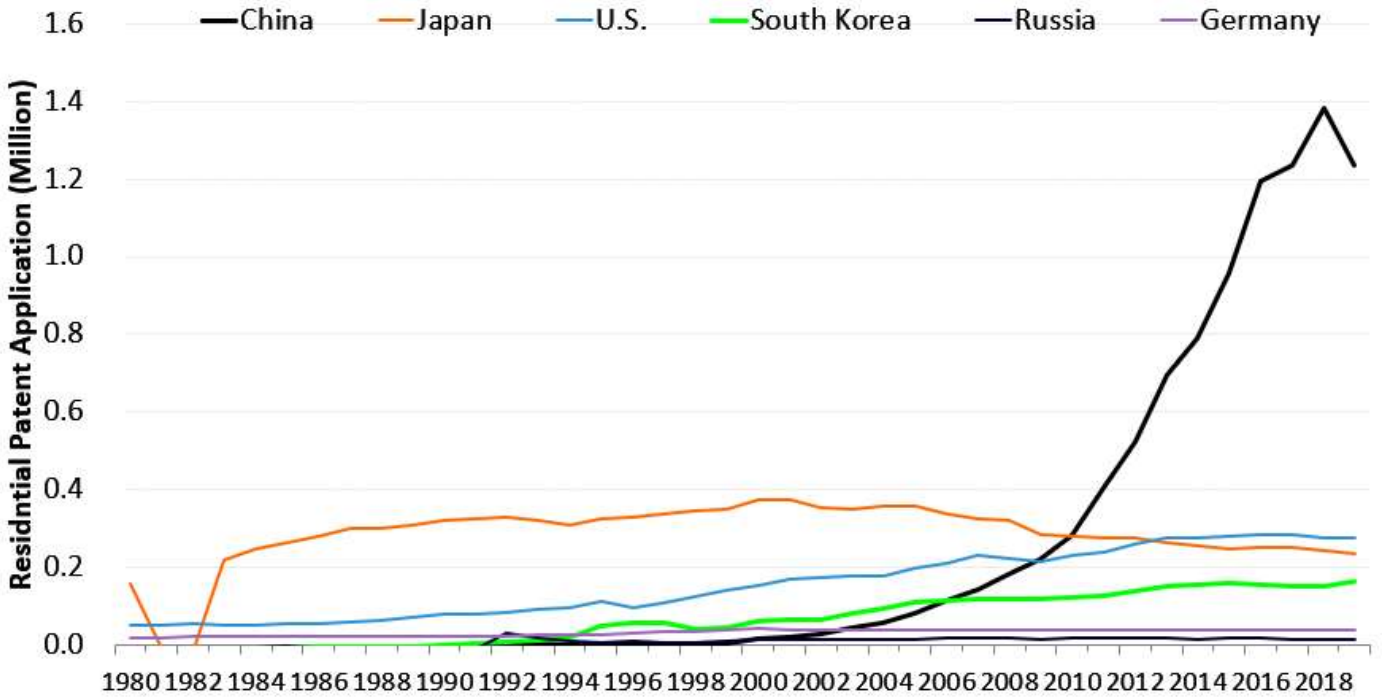


Source: van Roye, Cousin and Orlik (2021), Bloomberg Economics

MOTIVATION AND QUESTIONS

- Economic Security versus Benefits from High Tech Trade
  - How quickly China is catching up technologies ?

China's Domestic patent application Jumped



PATENT SHOWS STRENGTH IN TECHNOLOGY

The U.S. Is Strong in Share of Biopharmacy, Medical Device Technology Patents

Source: Bloomberg Economics, World Intellectual Property Organization, Japan Ministry of Economy, Trade and Industry

QUESTIONS

1. Do Mega Free Trade Deals and U.S.-China decoupling spell opportunity or challenge for growth?
2. How much do technology transfer boost potential growth (total factor productivity) via international trade and domestic patent accumulation?

LITERATURE REVIEW

Coe and Helpman (1995), Madsen (2007)

– The Link between long-term spillover of imports of technology and total factor productivity (TFP)

Petri and Plummer (2020), Park, Petri, and Plummer (2021)

– The CGE model analysis of RCEP, TPP, U.S.-China trade conflicts on trade and income growth

Masujima (2021)

– Scenario analysis of RCEP, TPP

CONTRIBUTION OF THIS PAPER

- Confirmed the C&H hypothesis that foreign knowledge influences growth through the channel of trade in both advanced and developing countries
- Added quality adjustment to domestic knowledge accumulation
- Showed that the influence on TFP of imports of knowledge is not driven by an independent positive effect of trade openness on TFP

  → Removing non-tariff barriers could increase value of openness

- Showed elasticities for both domestic and foreign knowledge are close to the elasticities achieved in the literature using R&D data

→ Patent data with time-variant quality adjustment could substitute to R&D expenditure

THE KEY FINDINGS

- **The biggest swing factor is the U.S. decision on CPTPP**
- Formation of RCEP has significant benefits for the participants, but CPTPP expansion has a greater impact on technology transfers due its lower barriers to goods and services trade and cross-border investment flows.
- In the best-case scenario -- RCEP succeeds and the U.S. joins CPTPP -- the U.S. and China both benefit from a 0.3 percentage-point bump to productivity growth relative to the baseline view. With more still to gain from technology transfer, Vietnam benefits even more, with productivity up 0.6 ppt.

Scenario	Baseline	2		3		4	
	RCEP Succeeds; U.S. not in CPTPP	RCEP Fails; U.S. not in CPTPP		RCEP Fails; U.S. joins in CPTPP		RCEP Succeeds; U.S. joins CPTPP	
	GDP in 2030 (Tri $)	Deviation (%)	Change in TFP (ppt)	Deviation (%)	Change in TFP (ppt)	Deviation (%)	Change in TFP (ppt)
China	24.6	-0.5	-0.1	-0.5	-0.1	1.4	0.3
U.S.	25.0	0.2	0.0	0.7	0.1	0.9	0.3
Japan	5.1	-1.3	-0.2	0.7	0.1	2.1	0.2
Korea	2.1	-1.4	-0.1	-1.4	-0.1	0.0	0.0
Vietnam	0.5	-1.4	-0.1	6.0	0.5	6.4	0.6

DATA

DATA

- Sample period: annual data from 1995 until 2019
- Patent Stock Index constructed from Patent Applications Residents (World Intellectual Property Organization)
- High tech trade share made from bilateral trade data by Products – HS92 6-digit (BACI)
- Nominal GDP (USD), Employment, Population (IMF)
- 38 countries (Adv 12, Asia EM 11, ME/Africa 7, Latin AM 6, East EU 2)
  - U.S., Germany, France, Italy, Spain, Sweden, Norway, Japan, U.K., Canada, S. Korea, Australia, New Zealand, Singapore, China, India, Brazil, Russia, Poland, Indonesia, South Africa, Mexico, Chile, Argentina, Colombia, Peru, Thailand, Philippines, Malaysia, Vietnam, Turkey, Saudi Arabia, Egypt, Ghana, Nigeria, Kenia, Pakistan, Bangladesh

MODEL

THE MODEL

Knowledge Spillovers on TFP

stock of domestic patents

stock of technology imports

$$\ln TFP_{it} = \alpha_0 + \alpha^{d} \ln S^{d}_{it} + \alpha^{f} m^{x} \ln S^{f}_{it} + CD + e_{it}$$

Total Factor Productivity

propensity to imports (proxy of trade openness)

country fixed effect dummies

Flow of the propensity to imports

Total Imports

$$m^{x-F}_{it} = \frac{M_{it}}{Y^{n}_{it}}$$

Nominal GDP

Test both variables --flow and stock

Flow of the propensity to high tech imports

High Tech Imports

$$S^{fL-F}_{it} = \sum_{j=1}^{38} \frac{M^{\lambda}_{ijt}}{Y^{n}_{ijt}} S^{d}_{jt} \qquad i \neq j$$

Nominal GDP

Stock of the propensity to imports

$$m^{x-S}_{it} = \frac{M^{S}_{it}}{Y^{S}_{it}} = \frac{M_{it} + (1-\delta) M^{S}_{i,t-1}}{Y^{n}_{it} + (1-\delta) Y^{n,S}_{i,t-1}} = \frac{M_{it} + 0.95 M^{S}_{i,t-1}}{Y^{n}_{it} + 0.95 Y^{n,S}_{i,t-1}}$$

5% depreciation rate

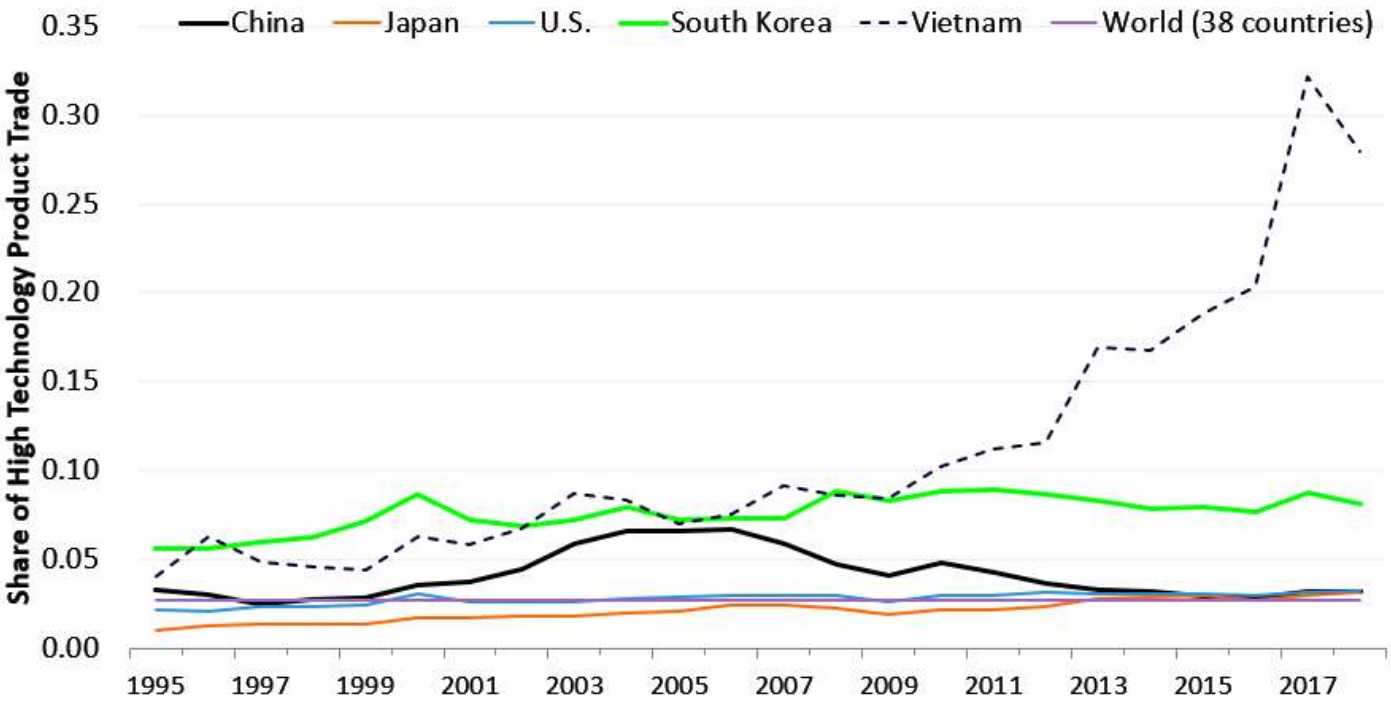
Stock of the propensity to high tech imports

$$S^{fL-S}_{it} = \sum_{j=1}^{38} \left[\frac{M^{\lambda}_{ijt} + 0.95 M^{\lambda S}_{i,t-1}}{Y^{n}_{ijt} + 0.95 Y^{n,S}_{i,t-1}} \right] S^{d}_{jt} \qquad i \neq j$$

KEY INDEXES

HIGH TECHNOLOGY TRADE

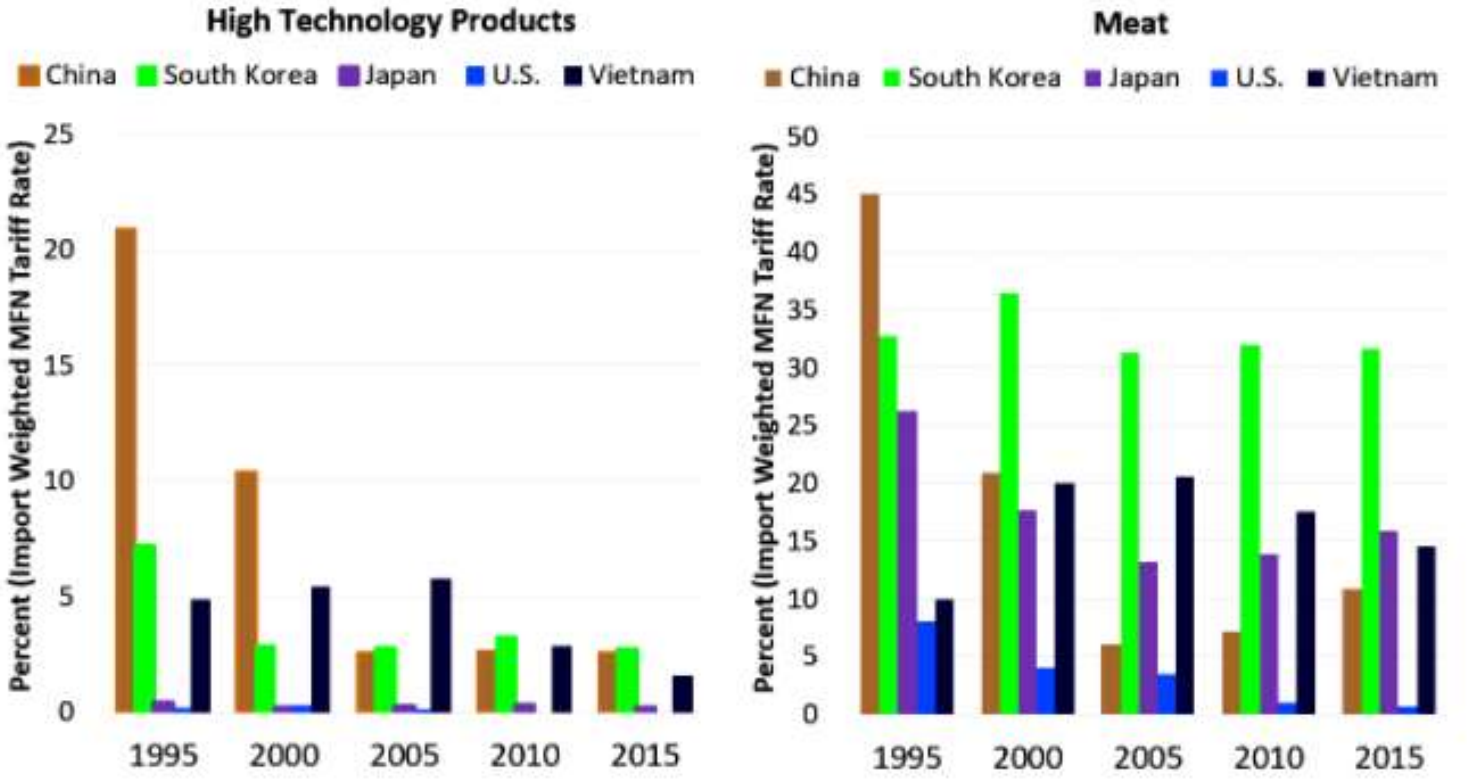
Share of High Technology Products to Total Trade



- Using BACI annual trade data from 1995 until 2019 – HS92 6 digits
- Create bilateral high technology product flow, by using the definition of the World Bank (SITC Rev.3)
- The average HT product share of 38 countries is about 0.04 (High Tech Product Trade/ Total trade)

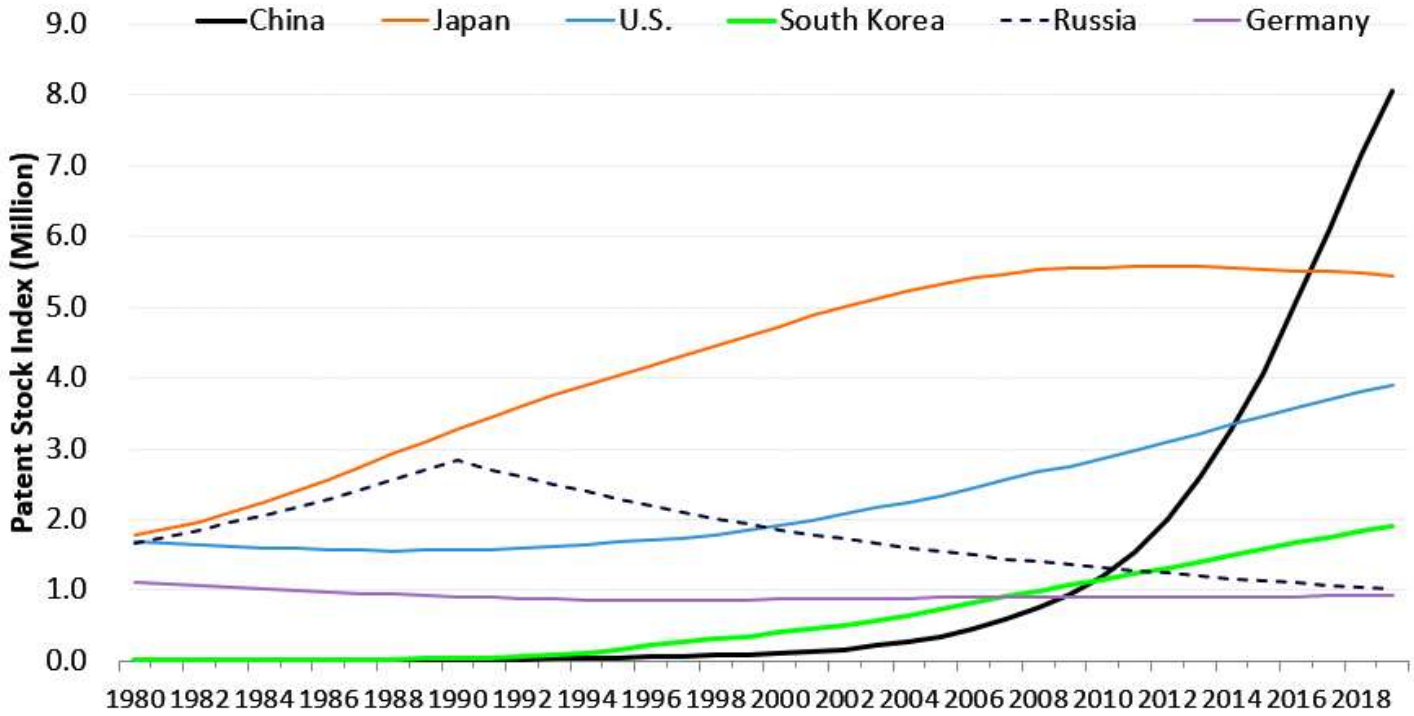
ASIAN COUNTRIES STILL HAVE TARIFFS AND NON-TARIFF BARRIERS – HIGHER BENEFIT FROM FTA

Tariff Rates by Products



Source: Computed by Kazunobu Hayakawa (IDE-JETRO) using the WITS

PATENT STOCK INDEX
– QUALITY ADJ. NEEDED



- New patent applications are added to knowledge stocks every year, with 5% depreciation of existing stocks and a patent quality adjustment for developing countries.
- The domestic stock of knowledge is measured using domestic patent application data back to 1870, following C&H the perpetual inventory method
- Patents applied for are probably better measures of the innovative activity than patents granted for international comparisons because the granting frequency varies substantially across countries.

PROPENSITY TO INNOVATE INDEX – 4 SECTIONS

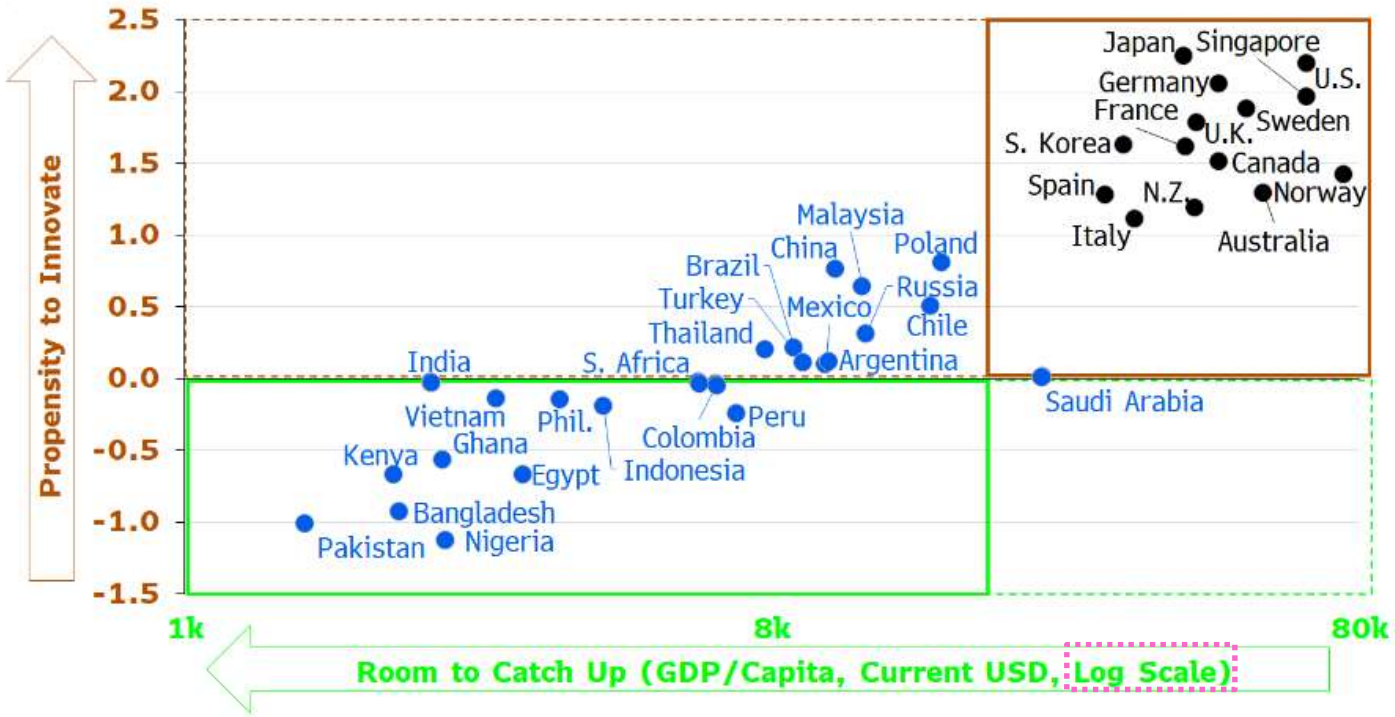
These scores are used for quality adjustment for patents

	Institutions	IT Deepening	Economy	Human Capital
1 Japan	1.63	1.76	2.51	2.62
2 U.S.	1.43	2.28	1.89	2.73
3 Germany	1.56	1.77	2.14	2.32
4 Switzerland	1.90	2.32	2.33	1.00
5 Singapore	1.45	2.48	1.98	1.53
6 Taiwan	1.35	2.93	2.07	1.03
7 Sweden	1.79	2.13	1.93	1.27
8 Denmark	1.78	2.77	1.44	1.09
9 Netherlands	1.79	2.27	1.50	1.44
10 U.K.	1.35	1.17	1.99	2.24
11 Finland	1.90	1.74	1.71	1.16
12 South Korea	1.09	1.53	1.95	1.61
13 France	1.40	1.25	1.65	1.82
14 Canada	1.68	1.10	1.28	1.67
15 Belgium	1.25	1.37	1.74	1.22
16 Norway	1.84	1.54	1.07	0.93
17 Hong Kong	1.27	1.15	1.51	1.35
18 Austria	1.42	1.32	1.74	0.76
19 Australia	1.58	1.07	0.74	1.49
20 Spain	1.07	1.04	1.43	1.31
21 Ireland	1.45	1.35	1.30	0.75
22 New Zealand	1.64	1.12	0.80	0.95
23 Czech Rep.	1.00	1.17	1.37	0.94
24 Israel	1.02	1.16	1.08	1.05
25 Iceland	1.45	1.51	0.47	0.82
26 Italy	0.59	0.56	1.58	1.48
27 Estonia	1.24	1.64	0.55	0.65
28 Slovenia	1.19	1.20	1.01	0.55
29 Portugal	1.28	0.70	1.00	0.76
30 Poland	0.72	0.75	0.73	0.86
31 Lithuania	1.11	0.92	0.26	0.60
32 China	-0.37	0.24	0.90	2.11
33 Hungary	0.41	0.90	0.64	0.63
34 Latvia	1.06	0.68	0.09	0.62
35 Malaysia	0.62	0.62	0.80	0.39
36 Malta	1.02	0.41	0.23	0.70
37 Slovakia	0.80	0.66	0.60	0.27
38 Cyprus	1.04	0.29	0.51	0.51
39 Chile	1.11	0.04	0.20	0.56
40 UAE	0.43	0.45	0.44	0.49
41 Croatia	0.58	0.45	0.35	0.39
42 Greece	0.53	0.33	0.31	0.58
43 Bulgaria	0.37	0.51	0.19	0.53
44 Russia	-0.64	0.40	-0.02	1.44
45 Serbia	0.07	0.31	0.22	0.47
46 Uruguay	0.82	0.10	-0.23	0.34
47 Brazil	-0.23	0.10	0.40	0.54
48 Thailand	-0.18	0.19	0.85	-0.11
49 Romania	0.02	0.35	0.38	-0.02
50 Costa Rica	0.60	-0.14	-0.05	0.18
51 Montenegro	0.04	-0.16	0.65	0.00
52 Argentina	0.26	-0.03	-0.28	0.50
53 Turkey	-0.44	0.05	0.31	0.48
54 Mexico	-0.17	-0.23	0.40	0.35
55 Mauritius	0.94	-0.28	-0.16	-0.15
56 Qatar	-0.06	-0.03	-0.12	0.42
57 Panama	0.21	-0.33	0.48	-0.29
58 Saudi Arabia	-0.53	0.20	0.14	0.22
59 Georgia	0.38	-0.22	-0.13	-0.03
60 Bahrain	-0.58	0.01	-0.05	0.52
61 India	0.26	-0.42	0.19	-0.13
62 South Africa	0.41	-0.03	0.17	-0.65
63 Colombia	-0.07	-0.32	0.03	0.21
64 Ukraine	-0.37	-0.13	-0.15	0.50
65 Albania	0.09	0.02	-0.33	0.00
66 Oman	-0.42	-0.14	-0.06	0.32
67 Kuwait	-0.46	-0.08	-0.14	0.24
68 Kazakhstan	-0.54	-0.07	-0.39	0.52
69 Trin. & Tob.	0.34	-0.16	-0.61	-0.06
70 Vietnam	-0.60	-0.19	0.27	-0.01
71 Philippines	-0.06	-0.35	0.15	-0.30
72 Jamaica	0.52	-0.40	-0.33	-0.44
73 Jordan	-0.30	-0.40	-0.11	0.13
74 Indonesia	0.06	-0.45	-0.13	-0.22
75 Peru	-0.12	-0.43	-0.49	0.09
76 Tunisia	-0.04	-0.29	-0.36	-0.43
77 Namibia	0.22	-0.55	-0.05	-0.82
78 Armenia	-0.19	-0.30	-0.51	-0.20
79 Mongolia	0.05	-0.54	-0.94	0.21
80 Dom. Rep.	-0.29	-0.16	-0.48	-0.30
81 Bosnia-Herz.	-0.64	-0.31	-0.10	-0.22
82 Ecuador	-0.21	-0.32	-0.78	0.03
83 Lebanon	-0.77	-0.51	-0.03	-0.08
84 Moldova	-0.43	-0.10	-0.56	-0.40
85 Botswana	0.32	-0.63	-0.59	-0.68
86 Azerbaijan	-0.80	-0.27	-0.59	-0.10
87 El Salvador	-0.34	-0.70	-0.37	-0.37
88 Paraguay	-0.41	-0.43	-0.64	-0.39
89 Morocco	-0.54	-0.37	-0.61	-0.54
90 Sri Lanka	-0.31	-0.49	-0.61	-0.69
91 Kyrgyz Rep.	-0.81	-0.56	-0.36	-0.43
92 Ghana	0.04	-0.55	-0.88	-0.76
93 Egypt	-1.02	-0.54	-0.29	-0.70
94 Kenya	-0.54	-0.69	-0.63	-0.68
95 Guatemala	-0.69	-0.65	-0.73	-0.71
96 Honduras	-0.74	-0.91	-0.53	-0.61
97 Algeria	-0.75	-0.63	-1.20	-0.26
98 Cambodia	-0.96	-0.74	-0.23	-0.94
99 Senegal	-0.14	-0.74	-0.90	-1.09
100 Nicaragua	-1.05	-0.83	-0.64	-0.40
101 Gabon	-1.17	-0.55	-1.04	-0.26
102 Benin	-0.43	-1.06	-0.90	-0.88
103 Zambia	-0.58	-1.01	-0.78	-1.03
104 Rwanda	-0.41	-0.74	-0.54	-1.72
105 Cote D'Ivoire	-0.62	-0.84	-0.80	-1.17
106 Nepal	-0.81	-0.79	-0.95	-0.98
107 Bangladesh	-0.91	-0.85	-0.95	-0.82
108 Mozambique	-0.92	-1.08	-0.24	-1.32
109 R. Congo	-1.51	-1.18	-0.24	-0.73
110 Lao P.D.R.	-1.17	-1.11	-0.49	-0.90
111 Pakistan	-0.84	-1.01	-0.84	-1.15
112 Tanzania	-0.91	-0.97	-0.72	-1.25
113 Malawi	-0.60	-1.18	-0.75	-1.36
114 Myanmar	-1.27	-0.90	-0.98	-0.89
115 Uganda	-0.87	-0.90	-0.82	-1.46
116 Cameroon	-1.22	-0.99	-1.08	-0.80
117 Madagascar	-0.93	-0.83	-1.05	-1.35
118 Tajikistan	-1.56	-0.95	-0.97	-0.72
119 Burkina Faso	-0.57	-0.97	-1.28	-1.45
120 Nigeria	-1.01	-0.84	-1.31	-1.12
121 Zimbabwe	-1.38	-0.80	-1.19	-0.95
122 Mauritania	-0.96	-1.24	-1.07	-1.30
123 Ethiopia	-1.00	-1.19	-0.92	-1.49
124 Mali	-1.07	-1.15	-0.97	-1.60
125 Haiti	-1.79	-1.16	-1.25	-0.65
126 Papua NG	-0.57	-1.24	-1.49	-1.56
127 Guinea	-1.06	-1.32	-1.35	-1.29
128 Angola	-1.23	-1.11	-1.74	-0.99
129 Iraq	-1.44	-0.74	-2.05	-0.94
130 DR Congo	-1.78	-1.22	-1.13	-1.15
131 Niger	-0.81	-1.57	-1.22	-1.98
132 Sudan	-1.91	-1.12	-1.32	-1.33
133 Afghanistan	-1.60	-1.24	-1.60	-1.36
134 Yemen	-2.38	-1.21	-1.39	-1.37
135 Chad	-1.78	-1.53	-1.79	-1.88

Underlying indicators, weights and sources are shown below.

- Institutions: Government Effectiveness Index (2x weight, World Bank), Freedom in the World score (1x, Freedom House).
- IT Deepening: broadband internet speeds (2x, Cable), secure servers per million population (2x, World Bank and Netcraft), internet usage per capita (1x, International Telecommunication Union), E-Government Development Index (2x, United Nations), R&D spending to GDP (2x, World Bank).
- Business climate: export complexity (2x, Observatory of Economic Complexity), Logistics Performance Index (1x, World Bank), Financial Development Index (1x, International Monetary Fund), inward foreign direct investment to GDP(1x, emerging economies only, World Bank).
- Human Capital: learning-adjusted years of schooling (2x, World Bank), total scientific journal contributions (2x, SCImago), urbanization relative to total population (1x, United Nations).

PROPENSITY TO INNOVATE INDEX

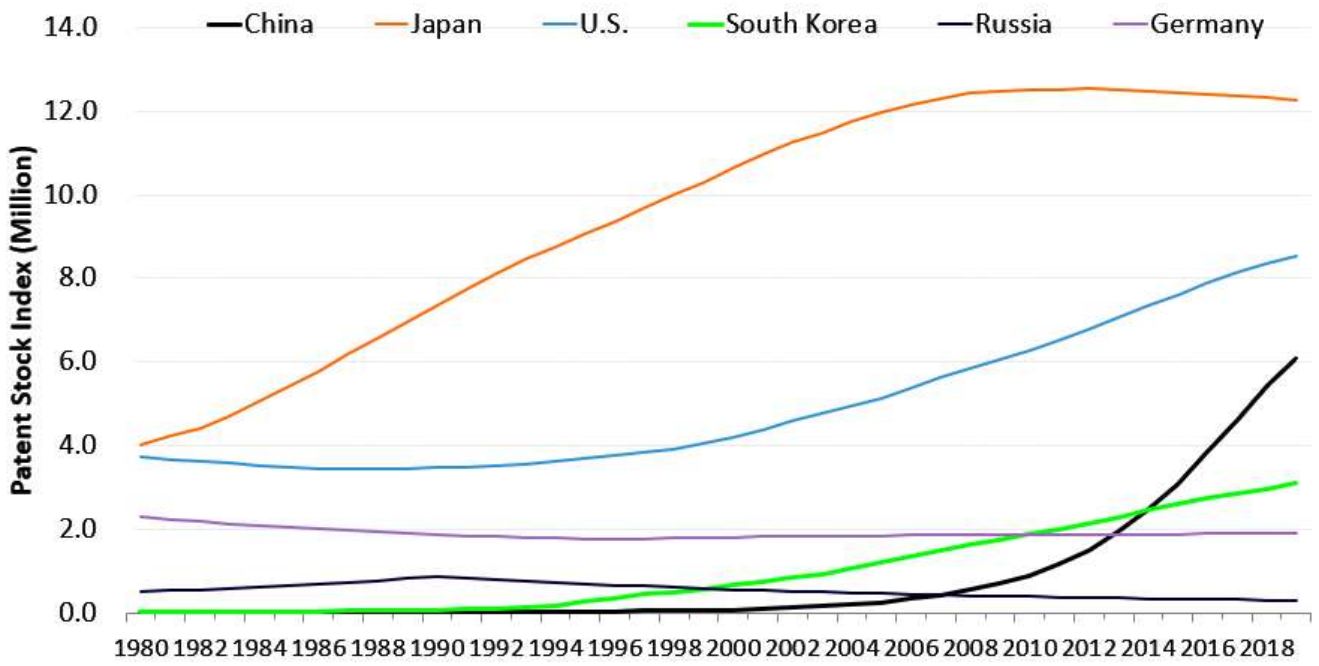


Methodology

- To construct the scorecard, we standardized available data for 135 countries relative to the average for each indicator to arrive at Z-score. Values more than three standard deviations from the mean were truncated to a score of 3 or -3.
- Each pillar reflects a weighted average of its components. The overall ranking is a simple average of the scores across the four categories. At each stage, we standardized the scores again to maintain a mean of zero and a standard deviation of 1.

MODIFIED PATENT STOCK INDEX

Daily Activity Index and CNY



- Modified patent stock index = the original patent stock index data * propensity to innovate index
- There is a log-linear relationship between Propensity to Innovate Index and GDP per capita. Based on this relationship, time-variant quality adjusted patent stock indexes were estimated.

EMPIRICAL RESULTS

TECHNOLOGY SPILLOVER ESTIMATION (DOLS)
(TIME-VARIANT QUALITY ADJUSTED PATENT INDEX)

stock of domestic patents

stock of technology imports

$$\ln \mathrm{TFP}_{it} = \alpha_0 + \alpha^{\mathrm{d}} \ln S^{\mathrm{d}}_{it} + \alpha^{\mathrm{f}} m^{\mathrm{x}} \ln S^{\mathrm{f}}_{it} + \mathrm{CD} + e_{it}$$

Total Factor Productivity

propensity to imports (proxy of trade openness)

country fixed effect dummies

Row	Foreign knowledge measure	Depreciation rate (δ)	Import interaction term, if any (m^{x})	Foreign knowledge coefficient (α^{f})	Domestic knowledge coefficient (α^{d})	Cointegration test statistic (VR_P)
1	$S^{fL\text{-}S}$ (L&P, stock of import ratio)	5	None (m^{x}=1)	0.35 (4.43)	0.08 (7.36)	-3.4 (0)
2	$S^{fL\text{-}F}$ (L&P, flow of import ratio)	5	None (m^{x}=1)	0.46 (2.56)	0.06 (1.72)	0.8 (0.55)
3	$S^{fL\text{-}S}$ (L&P, stock of import ratio)	5	$m^{x\text{-}S}$	0.2 (0.21)	0.43 (1.09)	2.3 (0.87)
4	$S^{fL\text{-}S}$ (L&P, stock of import ratio)	5	$m^{x\text{-}F}$	0.08 (0.14)	0.46 (1.23)	2.5 (0.95)
5	$S^{fP\text{-}S}$ ($S^{fL\text{-}S}$ normalized by pop)	5	None (m^{x}=1)	0.78 (6.54)	0.12 (3.24)	-1.8 (0.01)
6	$S^{fL\text{-}S}$ (L&P, stock of import ratio)	20	None (m^{x}=1)	0.44 (5.39)	0.07 (2.28)	-4.8 (0.05)
7	$S^{fP\text{-}S}$ ($S^{fL\text{-}S}$ normalized by pop)	20	None (m^{x}=1)	0.55 (7.82)	0.09 (1.98)	-4.6 (0.03)

High Tech Imports

Nominal GDP

Note. The numbers in parentheses are absolute t-statistics except in the last column where the numbers in parentheses are p-values. Constant terms and fixed-effect dummies are included in the estimates but not shown. Two-period lags and leads and concurrent values of the explanatory variables in first-differences are included as additional regressors in the estimates. The t-statistics are corrected for autocorrelation following Stock andWatson (1993). VR_p is Westerlund's (2005) variance ratio test for cointegration and is distributed as $N(0,1)$ under the null hypothesis of no cointegration. δ is the rate of depreciation as a percentage for the stock of knowledge and the stock of import ratios. Domestic stock of knowledge is normalised by population in the estimates in rows 5 and 7. Column m^{x} indicates whether the log of the stock of foreign knowledge is multiplied by the propensity to import. L&P = the index advised by Lichtenberg and van Potterie (see Eq. (2)). $m^{x\text{-}S}$ is the 'stock' of the import propensity and $m^{x,\text{-}F}$ is the 'flow' of the import propensity.

$$S^{fL-F}_{it} = \sum_{j=1}^{38} \frac{M^{\lambda}_{ijt}}{Y^{n}_{ijt}} S^{d}_{jt} \qquad i \neq j$$

Flow of the propensity to high tech imports

$$S^{fL-S}_{it} = \sum_{j=1}^{38} \left[\frac{M^{\lambda}_{ijt} + 0.95 M^{\lambda S}_{i,t-1}}{Y^{n}_{ijt} + 0.95 Y^{n,S}_{i,t-1}} \right] S^{d}_{jt} \qquad i \neq j$$

Stock of the propensity to high tech imports

IMPACTS OF ASIA-PACIFIC TRADE AGREEMENTS: FOUR SCENARIOS

FTAs increases volume of trade more than GDP(GNI), increasing trade openness, high-tech trade

stock of domestic patents

stock of technology imports

$$\ln TFP_{it} = \alpha_0 + \alpha^{d} \ln S^{d}_{it} + \alpha^{f} m^{x} \ln S^{f}_{it} + CD + e_{it}$$

Total Factor Productivity

propensity to imports (proxy of trade openness)

country fixed effect dummies

Scenario	Baseline	2		3		4	
	RCEP Succeeds; U.S. not in CPTPP	RCEP Fails; U.S. not in CPTPP		RCEP Fails; U.S. joins in CPTPP		RCEP Succeeds; U.S. joins CPTPP	
	GDP in 2030 (Tri $)	Deviation (%)	Change in TFP (ppt)	Deviation (%)	Change in TFP (ppt)	Deviation (%)	Change in TFP (ppt)
China	24.6	-0.5	-0.1	-0.5	-0.1	1.4	0.3
U.S.	25.0	0.2	0.0	0.7	0.1	0.9	0.3
Japan	5.1	-1.3	-0.2	0.7	0.1	2.1	0.2
Korea	2.1	-1.4	-0.1	-1.4	-0.1	0.0	0.0
Vietnam	0.5	-1.4	-0.1	6.0	0.5	6.4	0.6

Bloomberg

Data for impact estimation -- Petri and Plummer (2020), Potential GDP Forecast in Bloomberg

POLICY IMPLICATION

1. Enhancing high-technology trade contributes to boosting total factor productivity
2. A continuing effort to expand the FTA coverage, particularly to include the U.S. is beneficial for the global economy
3. Economic security is important, but quantitative assessment of cost-benefits analysis in FTAs and EPAs is also imperative to make a policy decision

DISCLAIMER