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ROMA TRE UNIVERSITÀ DEGLI STUDI
RED Dipartimento di Economia

Industrial Policy, Quality and Institutions

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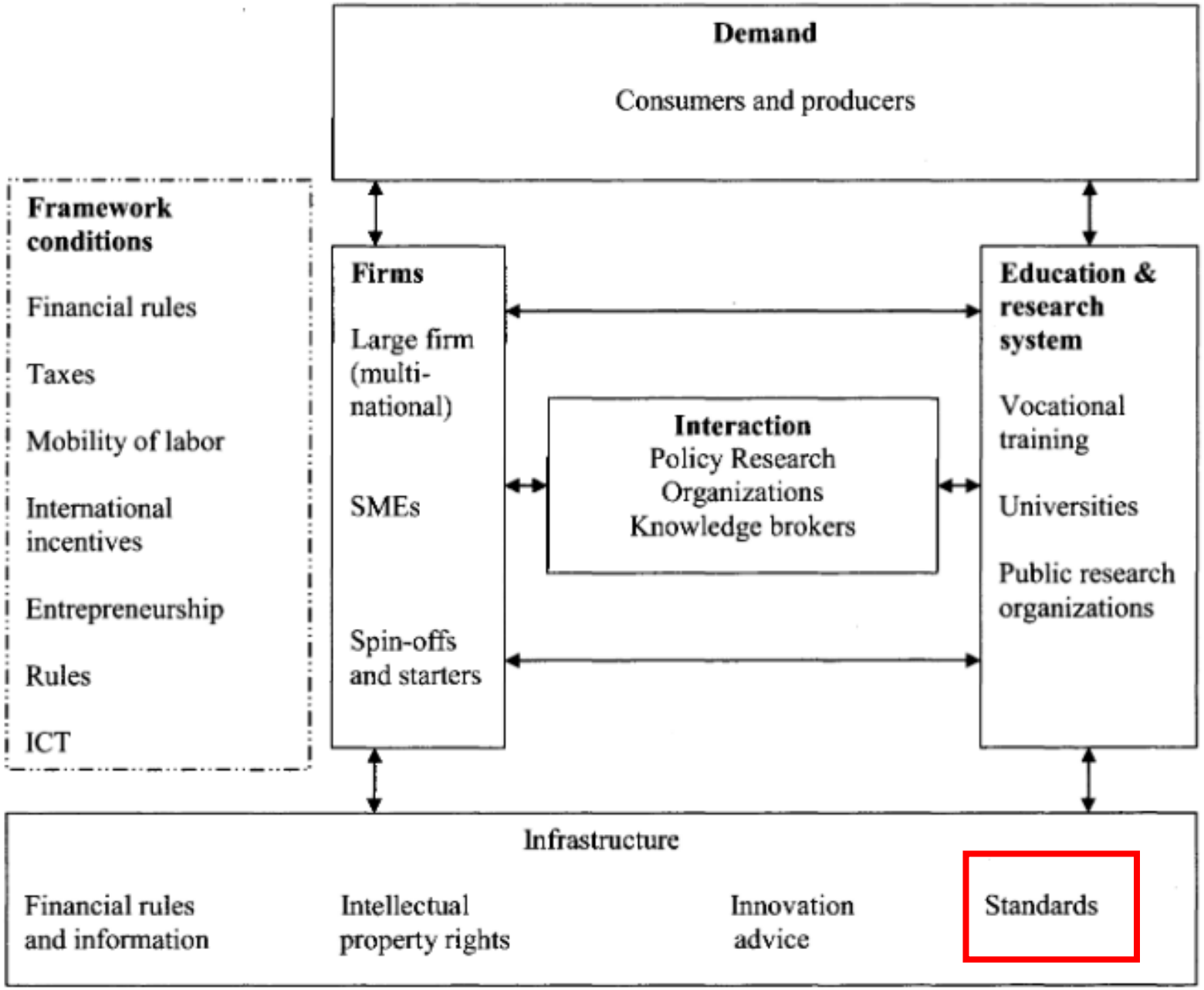
https://unu.edu/merit/event/phd-summer-school-economics-green-and-digital-transitions-innovation-strategies

Maastricht, 20 June 2025

QI in the NIS Model

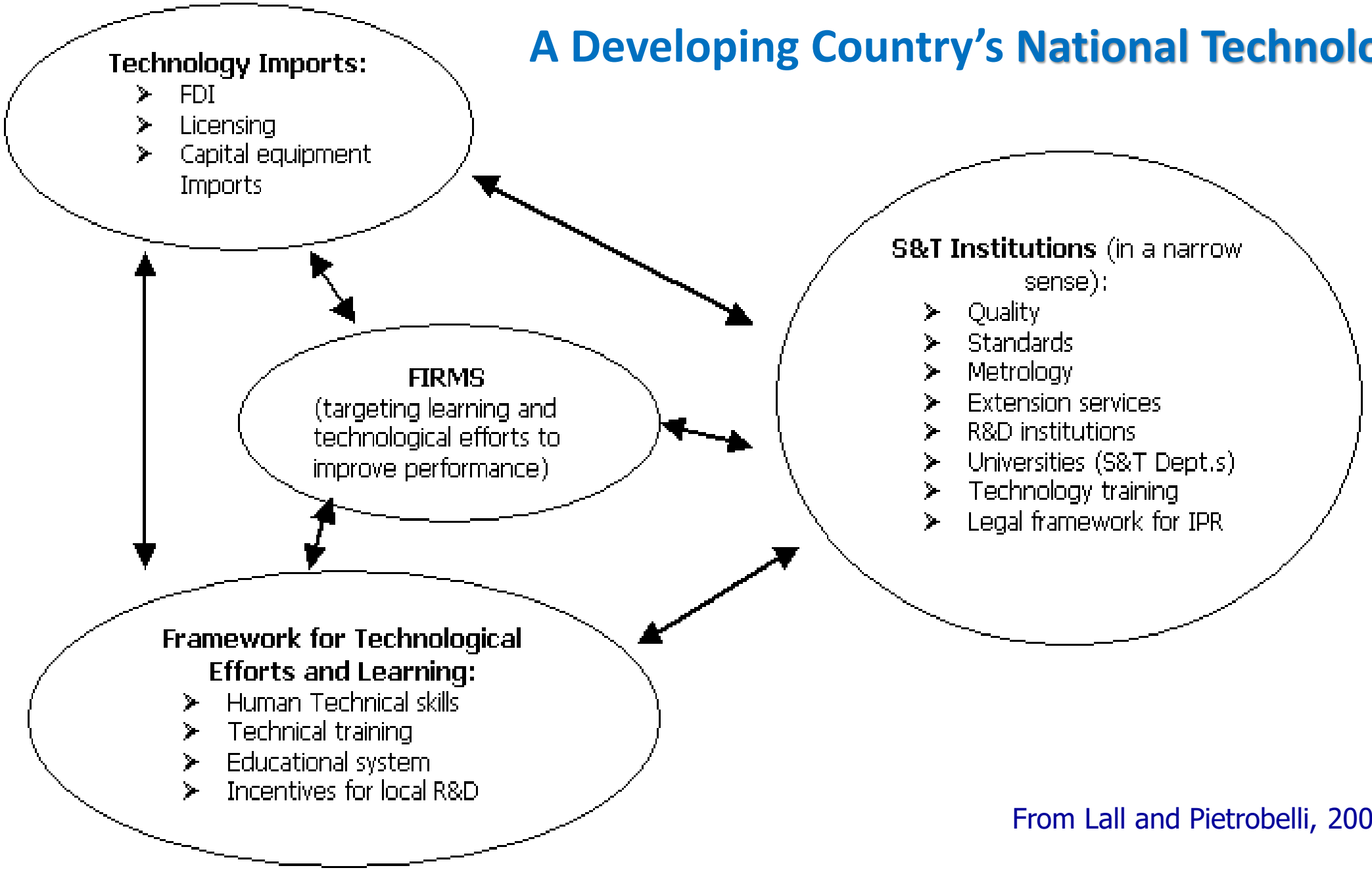
The Benchmark NIS Model



Source: Bremer et al. 2001.

https://www.tandfonline.com/doi/epdf/10.1080/00213624.2006.11506905?needAccess=true

A Developing Country's National Technology System



From Lall and Pietrobelli, 2005

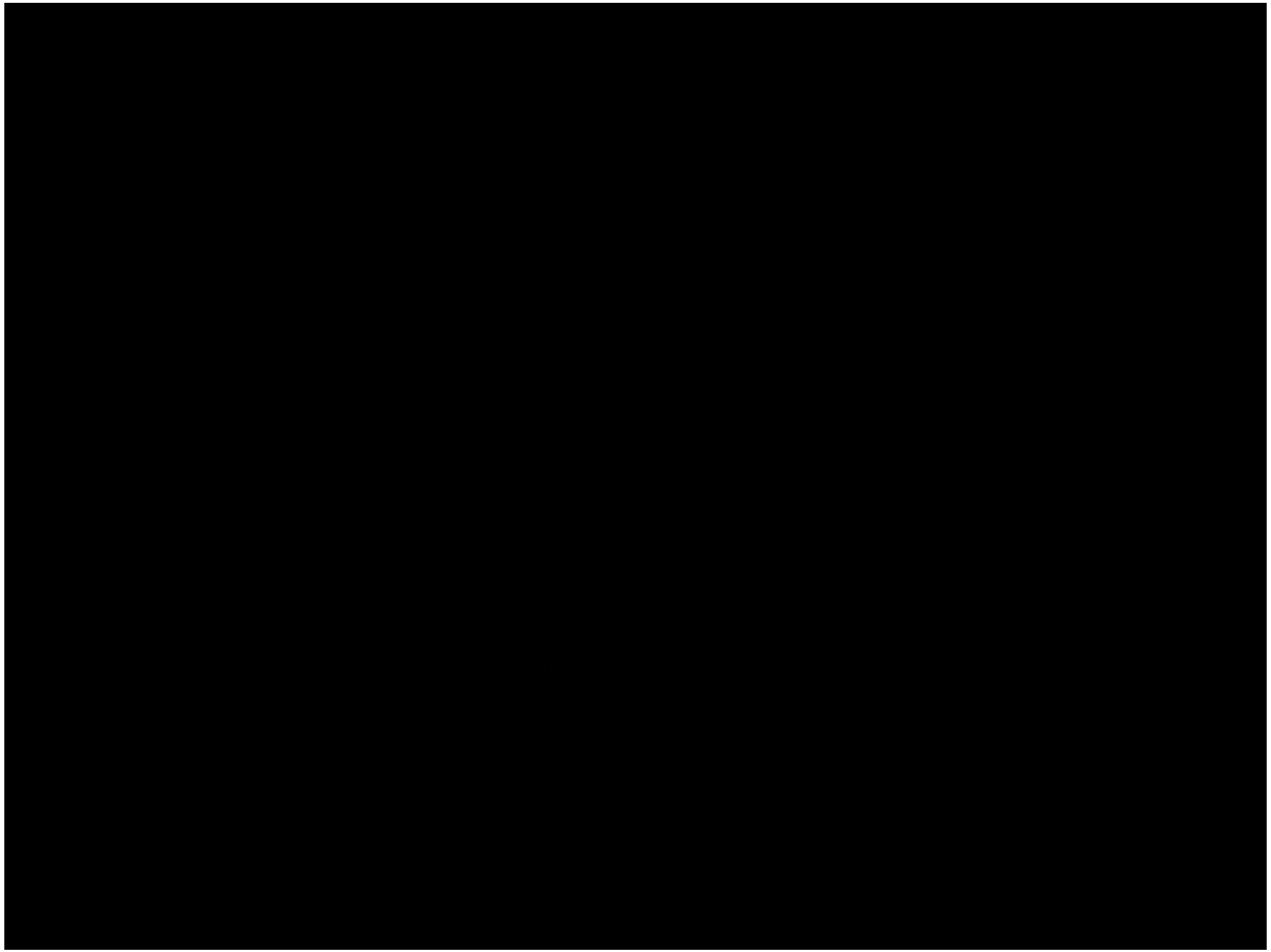
QI and innovation

Innovation (radical & incremental)

- matters for growth and development
- **firms** play a central role
- Occurs and is nurtured by a **«system»** and actors and linkages
- **QI is an essential component of the IS**
- **Varieties of IS and QI** across countries – not 1-best model -
- **Understanding IS and QI** – and adopting necessary policies – **requires measuring it**

QI provides standards, measurements, and certifications needed to support the development, diffusion, and acceptance of innovation

Need of standards, measurements, certifications has been rising



Why a Quality Infrastructure is needed

https://www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_q/q.3_internationale_zusammenarbeit/QI_in_fuenf_Minuten/englisch/02-UK-Why.mp4

Mechanisms to Link QI with firm (and SMEs) Learning
(Helping Link Demand and Supply)

- Baseline standards **force certification and testing**. This **triggers learning and innovation** – *not always the case if left to the market*
- QI can **help resolve collective action and coordination problems** – firms must share knowledge, and need resources for learning and capabilities transformation
- Testing and other MSTQ institutions become valuable **repositories of applied knowledge and problem solving**.
- Need to link MSTQ and testing with the training, extension, financing institutions (See Ferretti & Manson). This interaction also helps mutual capacity building of institutions too.
- **Governance** – the new learning communities of QI tap into public funds; but if left to themselves, then they become gatekeepers

Plan of today

1. **Introduction**
   - What is Quality Infrastructure (QI)?
   - The elements of QI – and their coherence
   - Why do we need QI?
2. Measurement of QI
   - Methods and indices
   - Percentile ranking
   - Sensitivity analysis
   - Regression.based weights
3. **Results**
4. **Research and Policy questions open**

What is Quality Infrastructure

Quality Infrastructure (QI)
The system comprising the organizations (public and private) together with the policies, relevant legal and regulatory framework, and practices needed to support and enhance the quality, safety and environmental soundness of goods, services and processes. [INET]

Required for the **effective operation of domestic markets** and to **enable access to foreign markets**.

A critical element in promoting and sustaining economic development, as well as environmental and social wellbeing.

It relies on

- metrology
- standardization
- accreditation
- conformity assessment
- market surveillance

In June 2017, definition was agreed by UNIDO, BIPM, IAF, IEC, ILAC, ISO, ITC, ITU, OIML, UNECE, WORLD BANK

Example on the relevance of QI: Canned fish

EXAMPLE: VALUE CHAIN IN PRODUCING CANNED FISH

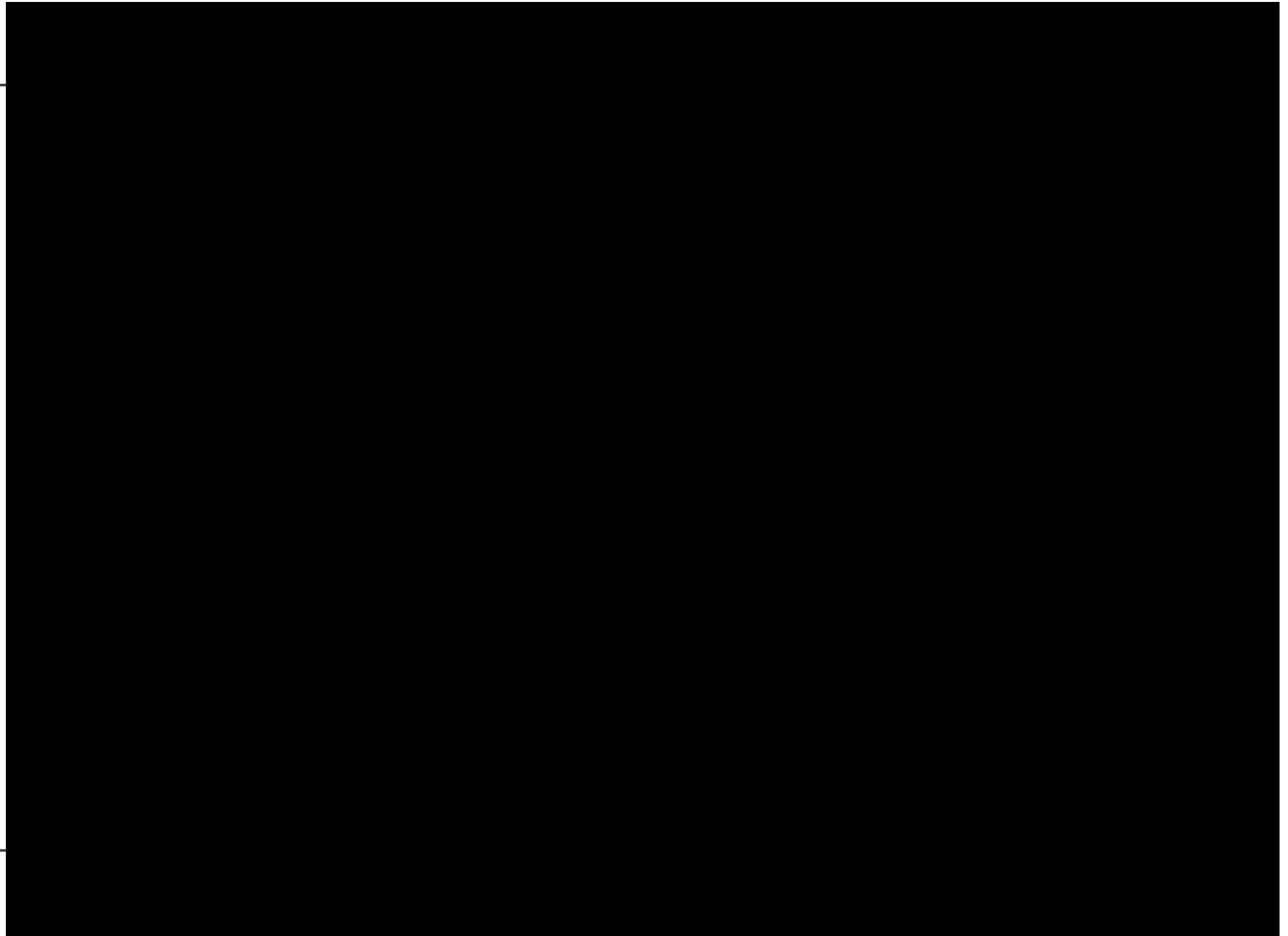
https://www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_q/q.3_internationale_zusammenarbeit/QI_in_fuenf_Minuten/englisch/06-UK-Canned-Fish.mp4

CONSUMERS' PERSPECTIVE: HOW CAN I BE SURE THAT THE FISH FROM THE SUPERMARKET IS REALLY GOOD, AND THAT THE DETAILS ABOUT QUALITY, QUANTITY, BEST-BEFORE DATE AND COUNTRY OF ORIGIN ARE ACCURATE?

PRODUCERS' PERSPECTIVE: HOW CAN I PLACE MY PRODUCTS ON THE WORLD MARKET?
HOW CAN I MAKE MY PROCESSES EFFICIENT?

POLITICIANS' PERSPECTIVE: HOW CAN I PROTECT CONSUMERS?
HOW DO I CREATE THE FRAMEWORK TO FACILITATE ECONOMIC DEVELOPMENT AND TRADE?

Example on the relevance of QI: Canned fish



Elements of Quality Infrastructure

1. Metrology
2. Standardization
3. Conformity assessment
4. Accreditation
5. Market surveillance

Metrology

- Metrology is the science of measurement and its application.
- Metrology has three subfields that all rely on the definition and realization of internationally agreed units of measurement:
  - Scientific metrology
  - Industrial metrology (calibration of instruments)
  - Legal metrology

Source: Harmes-Liedtke and Ramkissoon (2024)

Standardization

- A standard is a document, established by consensus and approved by a recognized body, that **sets out requirements, specifications, guidelines or characteristics** that aim to ensure that materials, products, processes and services are fit for their purpose
- They establish a **common language** defining safety and quality. They are prepared by experts representing all interested parties (i.e. industry, government, academia, consumers and NGOs).
- Application of a standard is always **voluntary**.
- **Public and private** standards.
- ISO, the IEC, and the ITU are the leading international standards developers.

Adapted from Harmes-Liedtke and Ramkissoon (2024)

Conformity Assessment

Conformity assessment (CA) comprises of testing, inspection and certification.

1. **Testing** is the assessment of an object's properties. It is a service delivered by private (public) laboratories to private (public) clients. Tests often based on the specifications included in standards.
2. **Inspection** is the examination of a product, process, service or installation, to determine conformity with specific or general requirements. It may involve testing or simply visual or other performance checks.
3. **Certification** is the confirmation of certain characteristics of a product, a service, a management system or a professional.

Certification is a service delivered by specialized companies which collaborate closely with testing laboratories. It may include the granting of the right to use a **mark of conformity**. It helps **foster trust** among stakeholders and the public.

Adapted from Harmes-Liedtke and Ramkissoon (2024) and Ramkissoon and Nisi (2024)

Accreditation

- **Accreditation** is the **confirmation of competency, independence, neutrality and overall preparedness** of testing laboratories, calibration laboratories, inspection bodies, certification bodies, proficiency testing providers, reference material producers, and verification and validation bodies for defined tasks of conformity assessment.
- Accreditation often according to specific **international** standards.
- Accreditation is voluntary, but often a pre-condition to operate in areas governed by legislation.

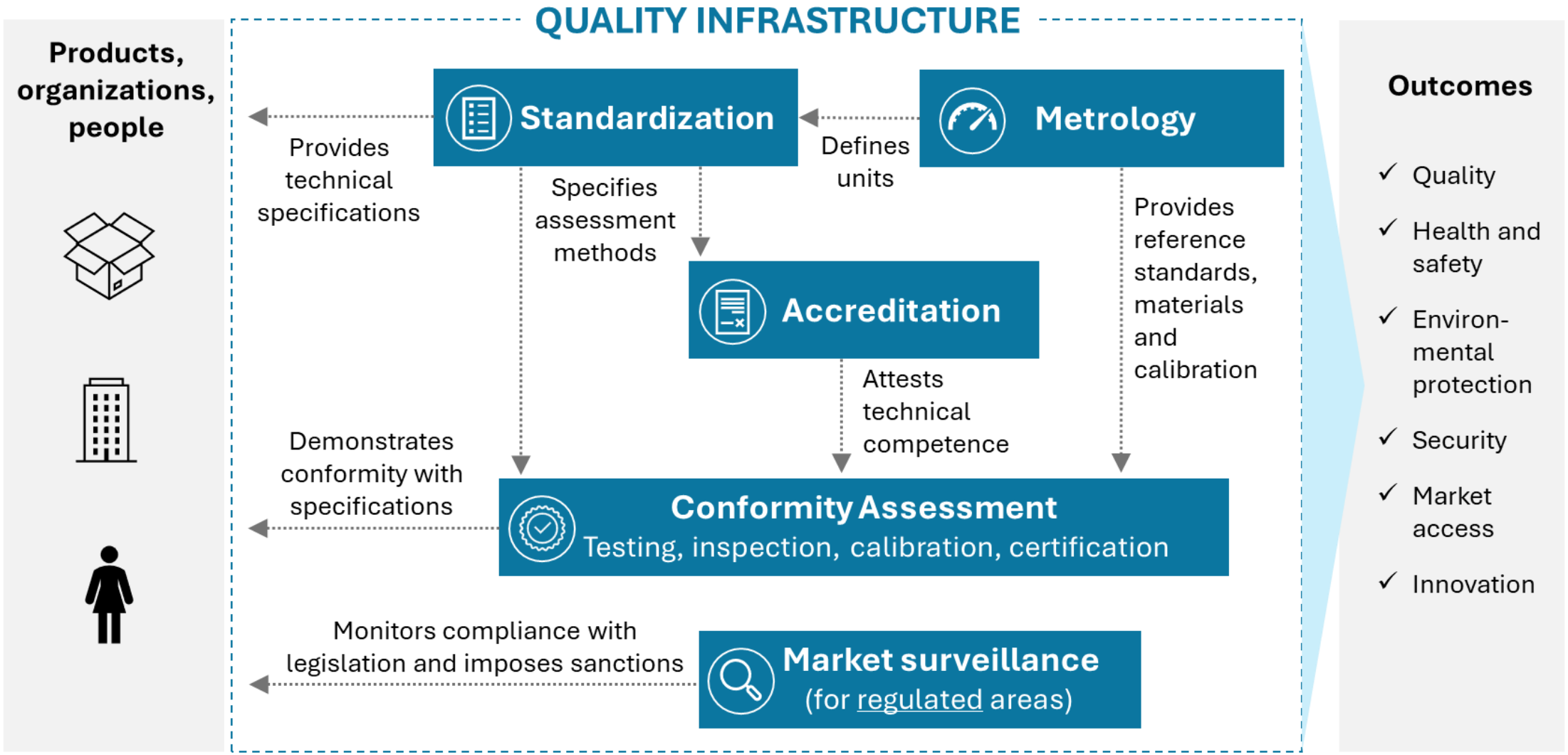
Adapted from Harmes-Liedtke and Ramkissoon (2024) and Ramkissoon and Nisi (2024)

Market surveillance

- **Market surveillance** concerns the monitoring of all products in the market and the enforcement of technical legislation for these products.
- Main aim is to protect consumers against unsafe products and unfair competition.
- Market surveillance is generally not considered to be one of the core QI disciplines. However, often indispensable for the overall functioning of modern QI

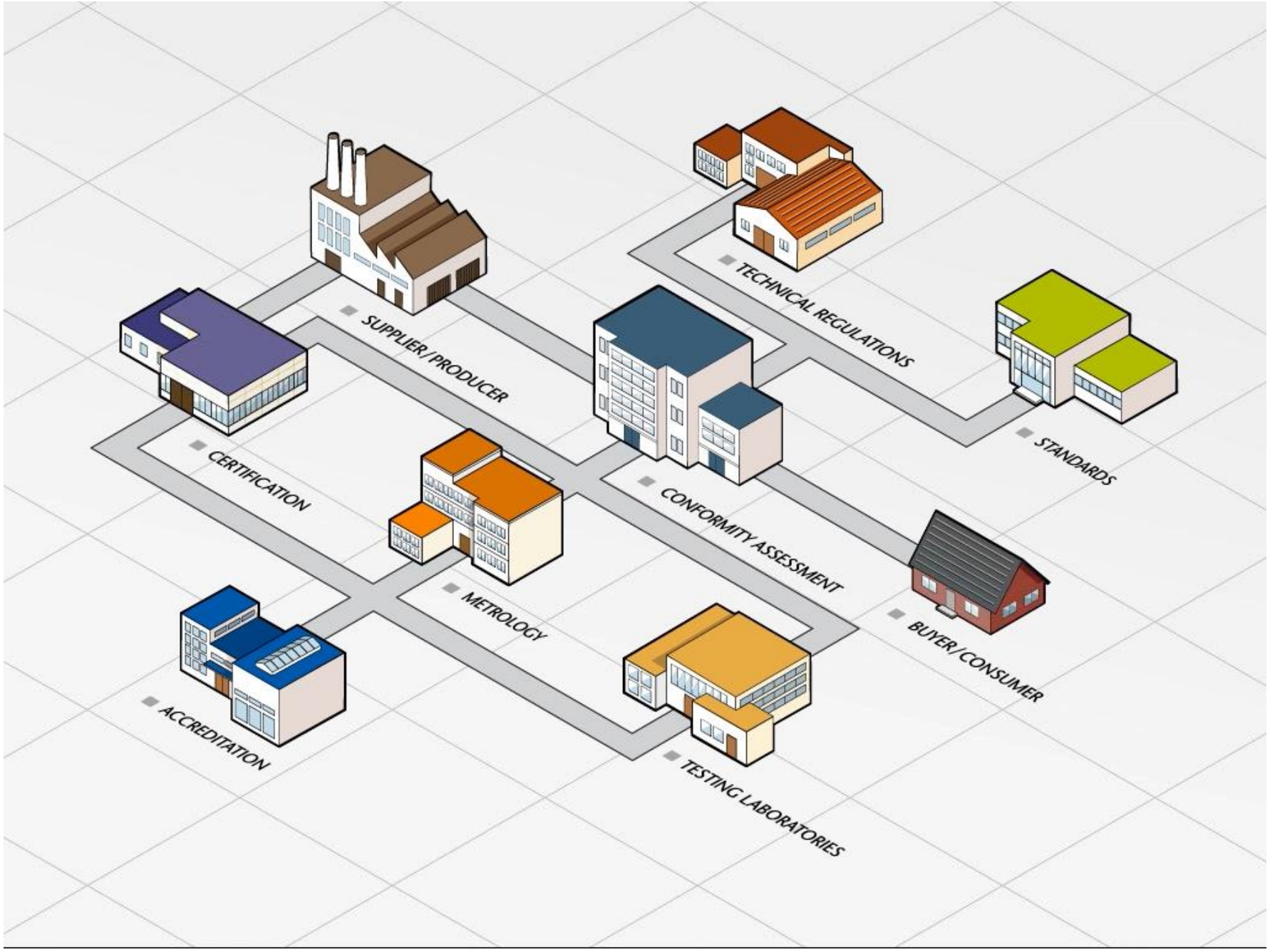
Adapted from Harmes-Liedtke and Ramkissoon (2024) and Ramkissoon and Nisi (2024)

Quality Infrastructure: A Coherent System of Checks and Balances



Source: World Development Report 2025; adapted from Guasch et al. 2007 and Kellermann 2019.

The 5 elements of QI



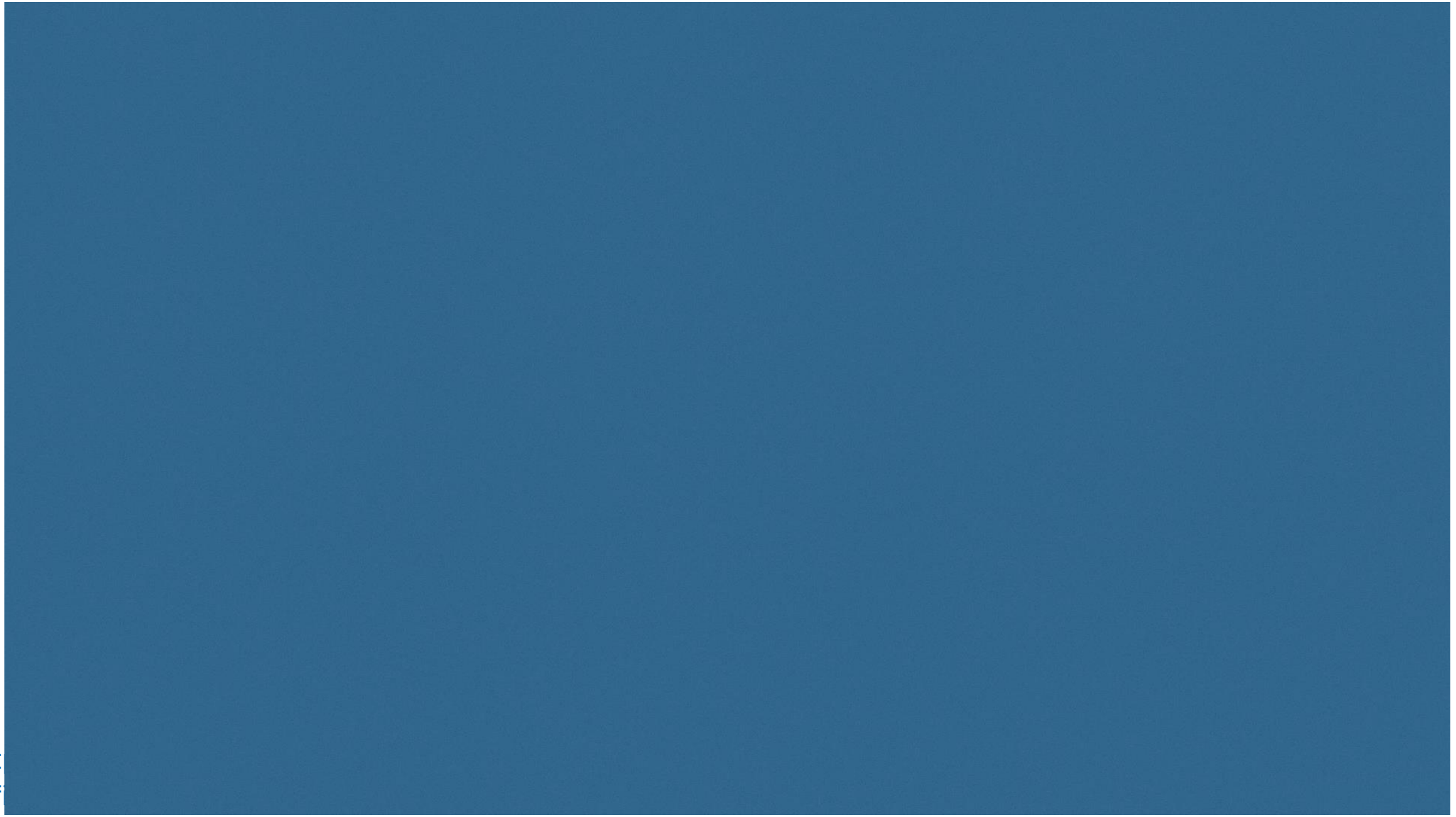
https://www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_q/q.3_internationale_zusammenarbeit/QI_in_fuenf_Minuten/englisch/03-UK-How.mp4

Digital Transformation, QI and Development

from PTB

https://www.ptb.de/cms/fileadmin/internet/fachabteilungen/abteilung_q/q.3_internationale_zusammenarbeit/filme/PTB_9.3_DigitalTransformation_QI_20210217.mp4

Digital Transformation, QI and Development *--- from PTB*



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Why measure QI development?

To understand the contribution of QI to economic development

To foster the identification of good practices and institutions

To provide a sound basis for cross-country comparisons

To facilitate monitoring and evaluation

To better understand the dynamic evolution of the system

To build credibility through international reliable comparisons

Adapted from Harmes-Liedtke and Ramkissoon (2024)

Evolution of QI measurement tools

2011-2019

The first study to measure the state of development of QI in different countries is conducted

2019 & 2021

The GQII is created becoming the first composite index on QI worldwide.

2022

UNIDO and INetQI launched the QI4SD Index to measure the overall state of development of a country's QI readiness to support the SDGs.

2023

A new edition of the GQII is published. Continued support of BMZ and PTB.

2024

Efforts to create a roadmap of collaboration to develop a single and integrated Index.

Global Quality Infrastructure Index (GQII)

Based on publicly available and official data from QI institutions (BIPM, ISO/IEC, IAF/ILAC, NABs, etc.)

The formula provides a ranking of the NQI worldwide

Elaborated by Mesopartner

Supported by BMZ, PTB and ONAC

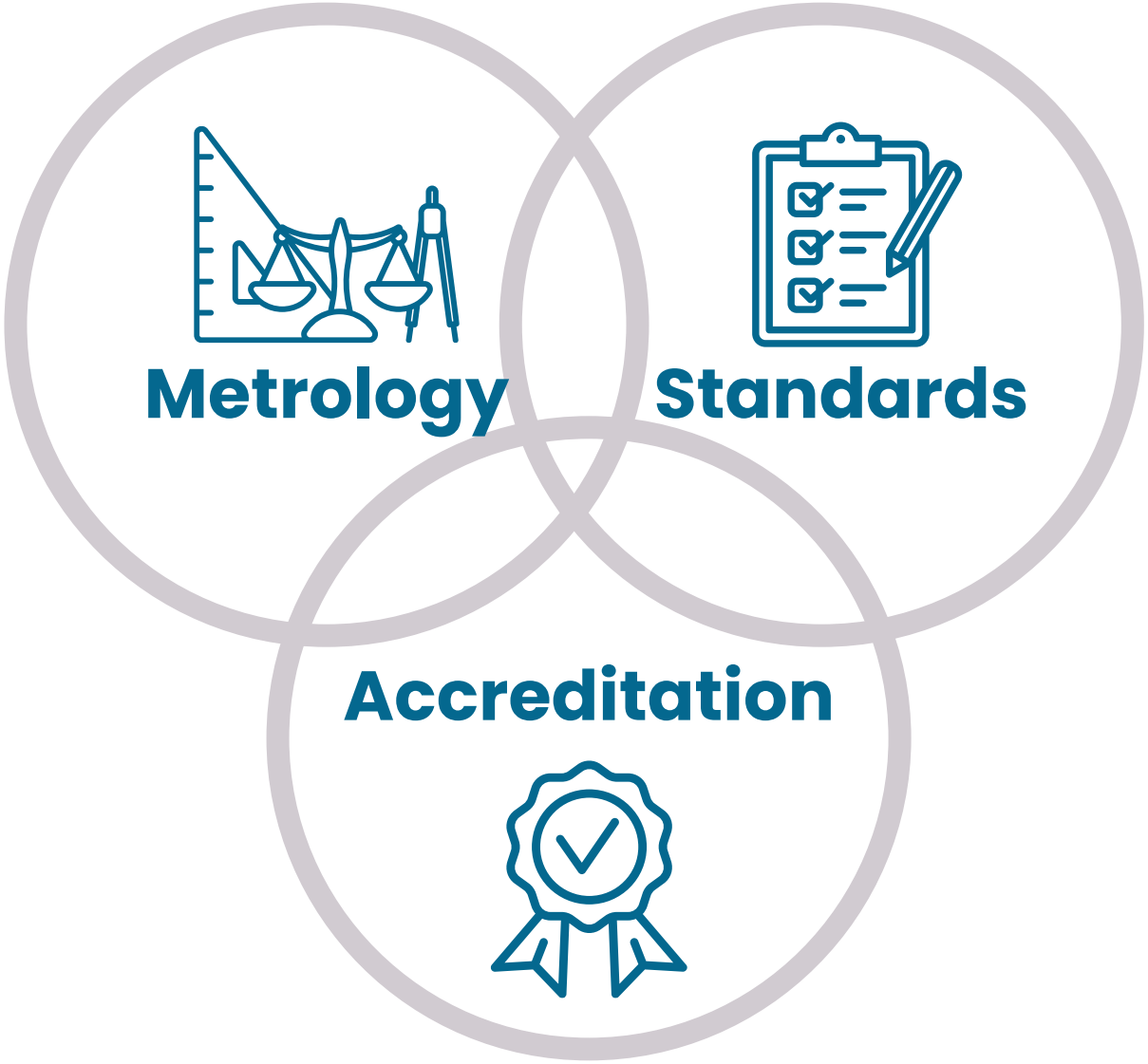
Index combines data from different QI components

QI experts and QI organizations validate the database

The index contains only QI data including cross-border and multi economy bodies unique information

The GQII
What does it measure?

GLOBAL QUALITY INFRASTRUCTURE INDEX



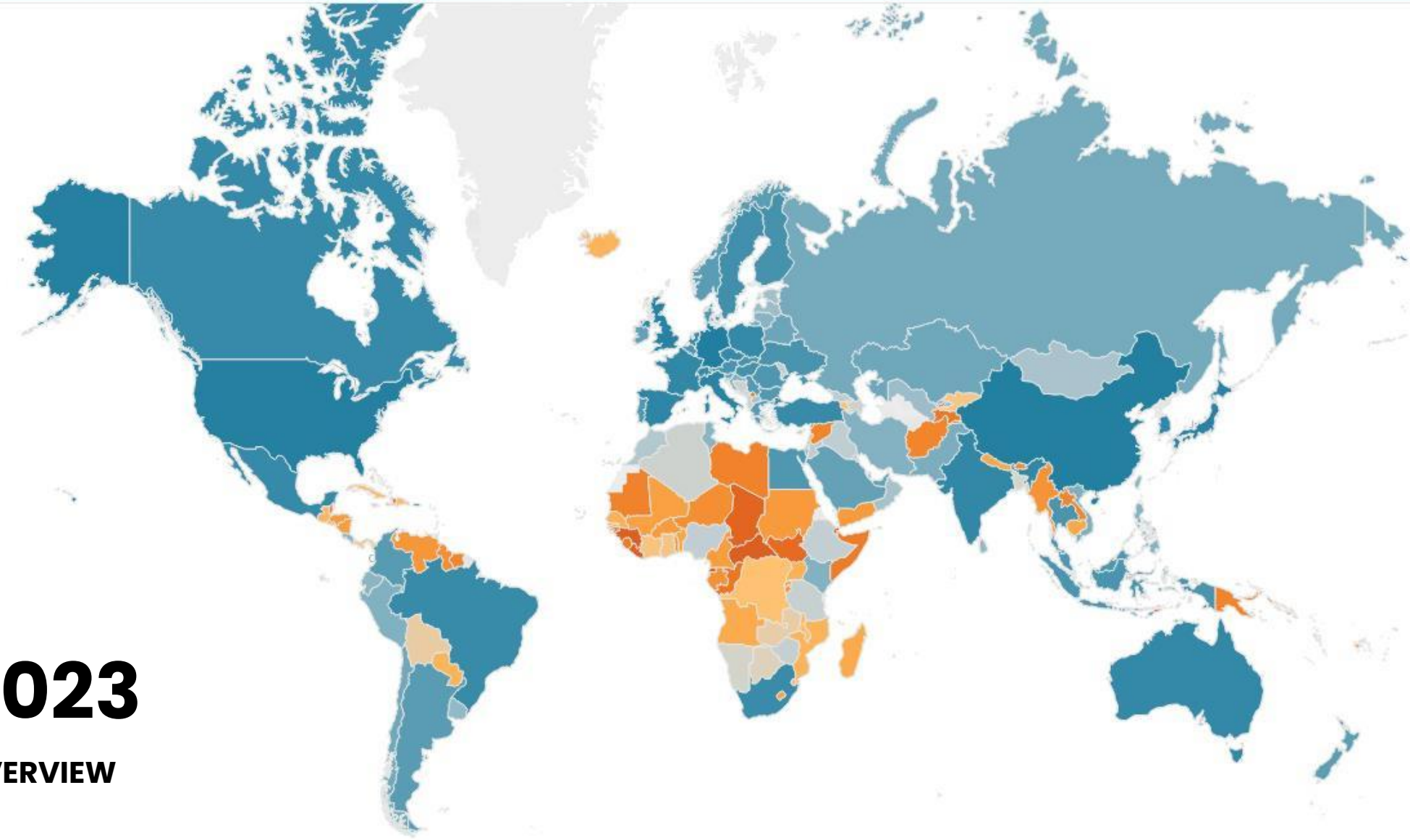
Indicators by component

METROLOGY	STANDARDS	ACCREDITATION
Metrology Membership (BIPM)	Standardization Bodies Membership	Accred. Membership
Calibration & Measurement Capabilities	IEC Technical Committees	Conformity Assessment Body (CAB) Coverage
CIPM Consultative Committees	ISO Technical Comm.s	CABs (ISO 17065)
Key & Supplementary Comparisons	ISO Survey (ISO certif.s issued	CABs (ISO 17021)
CABs (Calibrat. Labs)		CABs (Test.g Labs)

For example: Standardization data available on the websites of international standardization organizations

Data Category	ISO	IEC	ITU
Membership Data	✓	✓	✓
Data on Technical Committees (TCs) and Subcommittees (SCs)	✓	✓	✓
Number of published standards	✓	✓	✓
Net sales of standards (% of total revenue)	✓	✓	—
Royalties received from members selling IEC or ISO standards	✓	✓	—
Certification to standards	✓	✓	✗
Conformity Assessment Bodies	—	✓	✗

Quality Infrastructure World Overview: GQII 2023 over 185 economies



GQII 2023

GLOBAL QUALITY INFRASTRUCTURE INDEX

WORLD OVERVIEW

How is the GQII measured?

Unpacking the methodology

GQII = 1/3 Metrology + 1/3 Standards + 1/3 Accreditation

Metrology = 1/5 Met1 + 1/5 Met2 + … + 1/5 Met5

Standards = 1/4 Std1 + 1/4 Std2 + … + 1/4 Std4

Accreditation = 1/3 Acc1 + 1/3 Acc2 + 1/3(1/3 Acc3.1 + 1/3 Acc3.2 + 1/3 Acc3.3)

Met*n* is the percentile ranking of the metrology indicator *n*

Std*n* is the percentile ranking of the standards indicator *n*

Acc*n* is the percentile ranking of the accreditation indicator *n*

Global Ranking and Subrankings 2023

GQII 2023: Global Ranking and Subrankings by QI area (185 Economies)

Economy Name	Economy Code	GQII Rank 2023	Rank Metrology 2023	Rank Standardization 2023	Rank Accreditation 2023
Germany	DEU	1	2	2	2
China	CHN	2	3	1	6
United States	USA	3	1	7	1
United Kingdom	GBR	4	5	3	9
Japan	JPN	5	4	5	16
Italy	ITA	6	15	4	3
Spain	ESP	7	13	9	8
Korea, Republic of	KOR	8	6	6	36
France	FRA	9	7	26	11
India	IND	10	20	8	5
Australia	AUS	11	9	13	18
Poland	POL	12	18	16	7
Canada	CAN	13	8	23	17
Czech Republic	CZE	14	17	12	13
Mexico	MEX	15	11	40	4
Switzerland	CHE	16	14	11	22
Brazil	BRA	17	10	18	24
Türkiye	TUR	18	16	24	12
Netherlands	NLD	19	19	10	14
South Africa	ZAF	20	12	25	20
Sweden	SWE	21	21	15	29
Hungary	HUN	22	27	22	21
Finland	FIN	23	25	20	35
Slovak Republic	SVK	24	23	38	25
Austria	AUT	25	28	19	38

Issues with the Index

Percentiles vs values

GQII aggregates percentile rankings of metrology, standards, and accreditation, which are themselves made of percentile rankings of each component

This emphasizes **relative** positions but **may underestimate large differences** between countries in one or more indicators

Arbitrary weights

GQII gives equal weights to each component (metrology, standards and accreditation)

Rankings may be biased if some components matter more than others

Percentile rankings
Motivating example

Score	Percentile Ranking Methods		
	Method 1	Method 2	Method 3
65	20%	10%	0%
70	40%	30%	20%
75	60%	50%	40%
80	80%	70%	60%
80			
85	100%	90%	80%

Same dataset, different results

Duplicate values: When there are identical scores, the differences become even more pronounced - two students with the same score can end up in different percentiles.

Why does this happen?

Some methods consider the "exact position" of the value

Others look at how many values are "strictly lower" vs "lower or equal"

The handling of duplicate values varies between methods

Methodology

Approach	Description
GQII	Higher percentile = better performance. Only for countries with non-missing values
GQII'	Fixed denominator approach (all rankings on 212 countries)
Sensitivity analysis	Increase each component by 20%
Regression-based weights	Estimating the weights through regressions on economic indicators

Rankings comparison with GQII and GQII2

- Top countries remain unchanged
- Some countries change few positions
- Very few have extreme results

Highlighted countries with largest positive and negative differences

Country	GQII	GQII2	Country	GQII	GQII2	Country	GQII	GQII2	Country	GQII	GQII2
CHN	1	2	RUS	54	54	SYC	107	114	BLZ	160	162
DEU	2	1	TWN	55	71	PAN	108	109	GRD	161	165
USA	3	3	KEN	56	56	DOM	109	102	SOM	162	166
GBR	4	4	HRV	57	55	SWZ	110	125	LBY	163	144
ITA	5	6	LTU	58	57	MDG	111	120	GMB	164	168
JPN	6	5	ISR	59	59	CUB	112	115	SUR	165	169
ESP	7	7	TUN	60	58	AGO	113	122	PRI	166	151
IND	8	8	LKA	61	60	LSO	114	123	TJK	167	146
KOR	9	9	HKG	62	70	GTM	115	104	SMR	168	161
FRA	10	11	IRN	63	66	ISL	116	112	CUW	169	170
AUS	11	12	ECU	64	69	SEN	117	106	CPV	170	171
CZE	12	13	CRI	65	68	PRY	118	118	COG	170	171
POL	13	10	UZB	66	61	UGA	119	117	LIE	172	173
CHE	14	15	LUX	67	63	TTO	120	119	GUM	173	174
NLD	15	18	URY	68	72	SLV	121	121	NCL	174	175
BRA	16	16	LVA	69	62	BEN	122	124	MNP	175	177
TUR	17	17	QAT	70	64	LBN	123	110	REU	175	177
MEX	18	14	OMN	71	65	MLI	124	127	SSD	177	176
CAN	19	19	MNG	72	87	COM	125	134	TCA	178	179
ZAF	20	20	EST	73	67	YEM	125	134	VIR	178	179
SWE	21	21	JOR	74	76	NPL	127	111	ABW	178	179
HUN	22	22	CYP	75	74	PRK	128	126	BES	178	179
FIN	23	23	ETH	76	84	KHM	129	128	MTQ	178	179
AUT	24	25	GEO	77	73	BFA	130	129	SLB	178	179
IDN	25	24	KWT	78	83	NIC	131	130	WSM	178	179
ROU	26	31	MAR	79	75	RWA	132	137	MDV	178	179
THA	27	26	MDA	80	85	PSE	133	116	PYF	178	179
BEL	28	30	NGA	81	77	TGO	134	131	FSM	178	179
MYS	29	29	MUS	82	88	NER	135	133	SXM	178	179
SVK	30	27	MKD	83	86	LCA	136	138	CYM	178	179
DNK	31	34	TZA	84	93	BRB	137	139	GRL	190	191
UKR	32	28	ALB	85	80	HND	138	131	AND	191	167
SGP	33	32	ZWE	86	92	CMR	139	140	MCO	191	192
PRT	34	35	BHR	87	82	SDN	140	141	SNV	193	194
EGY	35	33	IRQ	88	78	FJI	141	142	SYR	194	193
SRB	36	36	NAM	89	95	GAB	142	145	KNA	195	195
BGR	37	37	DZA	90	81	VEN	143	157	HTI	196	196
GRC	38	38	BIH	91	79	BDI	144	148	VCT	197	197
COL	39	39	BWA	92	100	BHS	145	147	TCD	198	198
NOR	40	41	ZMB	93	101	XKX	146	143	ATG	199	199
ARG	41	40	KGZ	94	103	GUY	147	149	STP	200	200
IRL	42	43	AZE	95	99	MMR	148	150	VUT	201	201
NZL	43	42	COD	96	105	BTN	149	152	TLS	202	202
SAU	44	44	BGD	97	91	MAC	150	136	LBR	202	202
ARE	45	45	MWI	98	107	DMA	151	153	DJI	202	202
CHL	46	46	MNE	99	90	BRN	152	156	ERI	202	202
SVN	47	47	CIV	100	97	AFG	153	155	CAF	202	202
KAZ	48	49	GHA	101	96	MRT	154	158	GIN	202	202
BLR	49	48	BOL	102	94	GNB	155	154	GNQ	208	208
VNM	50	50	MLT	103	89	LAO	156	159	BMU	208	208
PAK	51	52	JAM	104	108	SLE	157	160	TON	208	208
PER	52	51	MOZ	105	113	TKM	158	164	MHL	208	208
PHL	53	53	ARM	106	98	PNG	159	163	GIB	208	208

Comparing different percentiles

Rankings are generally stable, but…

- High correlations between methods: Spearman's ρ: 0.97
- Average rank change: only 3.6 positions (maximum difference 24 positions)
- Top 5 countries remain consistent: China, Germany, USA, UK, Italy maintain leading positions
- **80-85% overlap in top 20 countries**

- Bottom performers also relatively stable
- **Middle-ranked countries more sensitive to methodology**
- Some countries show >10 position changes (Taiwan: 16-position; Andorra: 24-position difference; Syria: 24-position spread)

Sensitivity analysis – increase by 20% each GQII component: which indicator has the greatest influence on rankings

- No difference for metrology
- Slight changes for accreditation (Spearman 0.99) and standards (Spearman 0.95)
- Hypothesis of balanced development of 3 components

Rank	Country	ΔMET	ΔSTD	ΔACC	Max Difference	Best Component	Worst Component
1	SWZ	194	168	193	26	Standardization	Metrology
2	SYR	193	170	194	24	Standardization	Accreditation
3	MKD	82	89	80	9	Accreditation	Standardization
4	COM	126	129	121	8	Accreditation	Standardization
5	YEM	126	129	121	8	Accreditation	Standardization
6	ISR	59	55	62	7	Standardization	Accreditation
7	NGA	81	79	86	7	Standardization	Accreditation
8	ISL	116	110	117	7	Standardization	Accreditation
9	TWN	55	60	54	6	Accreditation	Standardization
10	IRN	64	62	68	6	Standardization	Accreditation
11	ALB	86	87	81	6	Accreditation	Standardization
12	IRQ	88	83	89	6	Standardization	Accreditation
13	UGA	120	118	124	6	Standardization	Accreditation
14	PRK	129	124	130	6	Standardization	Accreditation
15	XKX	147	149	143	6	Accreditation	Standardization
16	LVA	69	71	66	5	Accreditation	Standardization
17	PAN	105	106	110	5	Metrology	Accreditation
18	MOZ	106	107	102	5	Accreditation	Standardization
19	HRV	56	56	60	4	Metrology	Accreditation

Policy implications from sensitivity
Strategic guidance for QI development

For country policymakers

- **Focus on weakest QI component** rather than equal investment
- Use component analysis to identify priority areas
- Benchmark against similar development-level peers
- Support evidence-based QI investment strategies

For international organizations

- Consider **development-stage-adjusted weights**
- Develop **sector-specific QI indices**
- Address data quality and availability issues
- Target technical assistance to specific QI gaps

Regression-based weights *(reverse engineering)*

First we regress GDP on the three components

$$\text{Log}(GDP_i) = b_0 + b_1\, metrology_i + b_2\, standardization_i + b_3\, accreditation_i + e_i$$

and then we use the estimated coefficient to weigh the components

$$GQIIw = b_1\, metrology_i + b_2\, standardization_i + b_3\, accreditation_i$$

Regression-based weights

- Standardization counts more, followed by Accreditation and Metrology
- Top countries are **not** altered by weighting methods
- **Middle** and **bottom** countries can **either increase or decrease** their rankings

Normalised weights			
	Met	**Std**	**Acc**
GDP	0.107	0.681	0.212
Trade	0.460	0.370	0.170
Exports	0.280	0.598	0.122

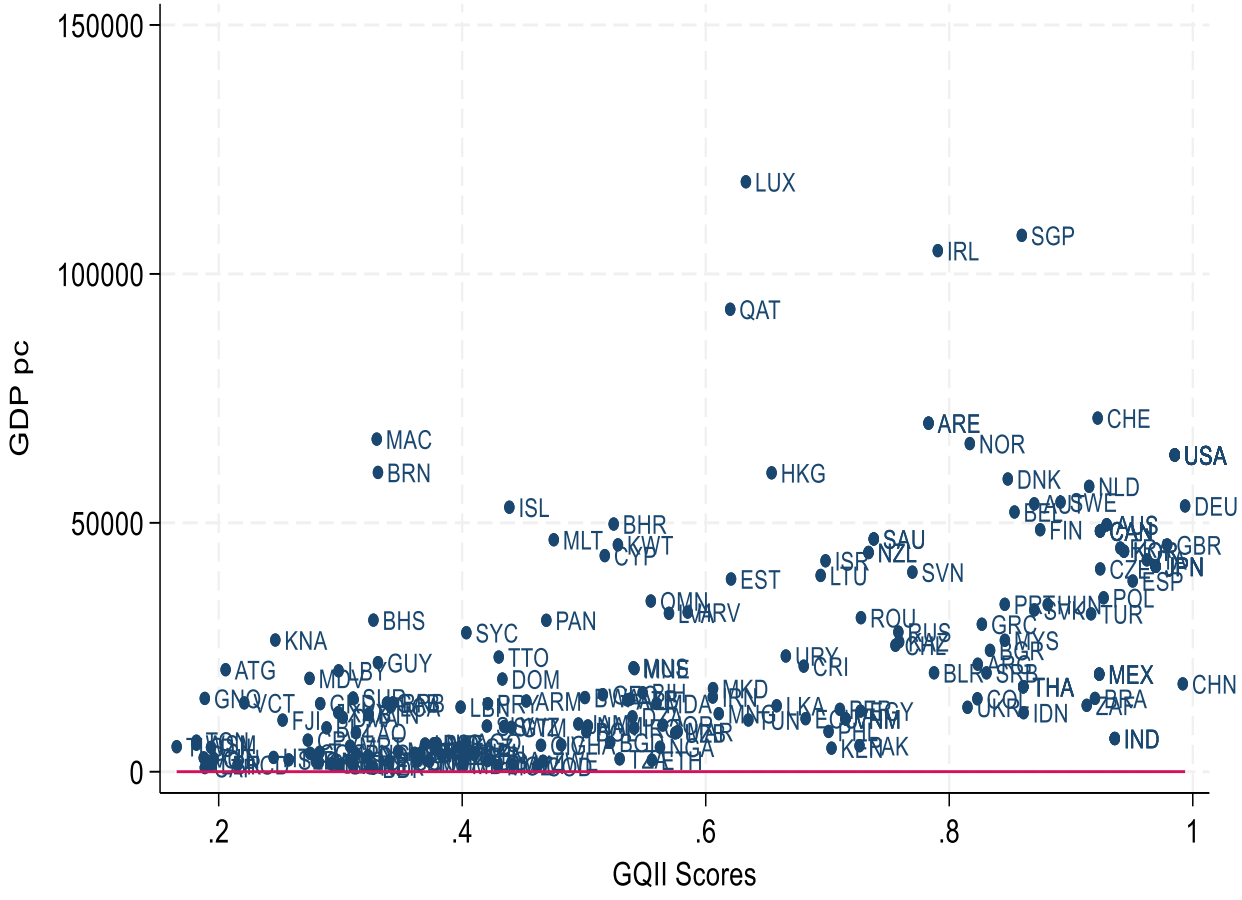
Country	GQII	GQIIw	Diff
SWZ	110	139	-29
TWN	55	81	-26
YEM	125	149.5	-24.5
COM	125	149.5	-24.5
VEN	143	167	-24
PRY	118	140	-22
XKX	146	165	-19
MKD	83	100	-17

Country	GQII	GQIIw	Diff
SYR	194	146	48
HTI	196	156	40
KNA	195	162	33
TCD	198	171	27
PRK	128	102	26
DZA	90	68	22
UGA	119	99	20
VCT	197	177	20

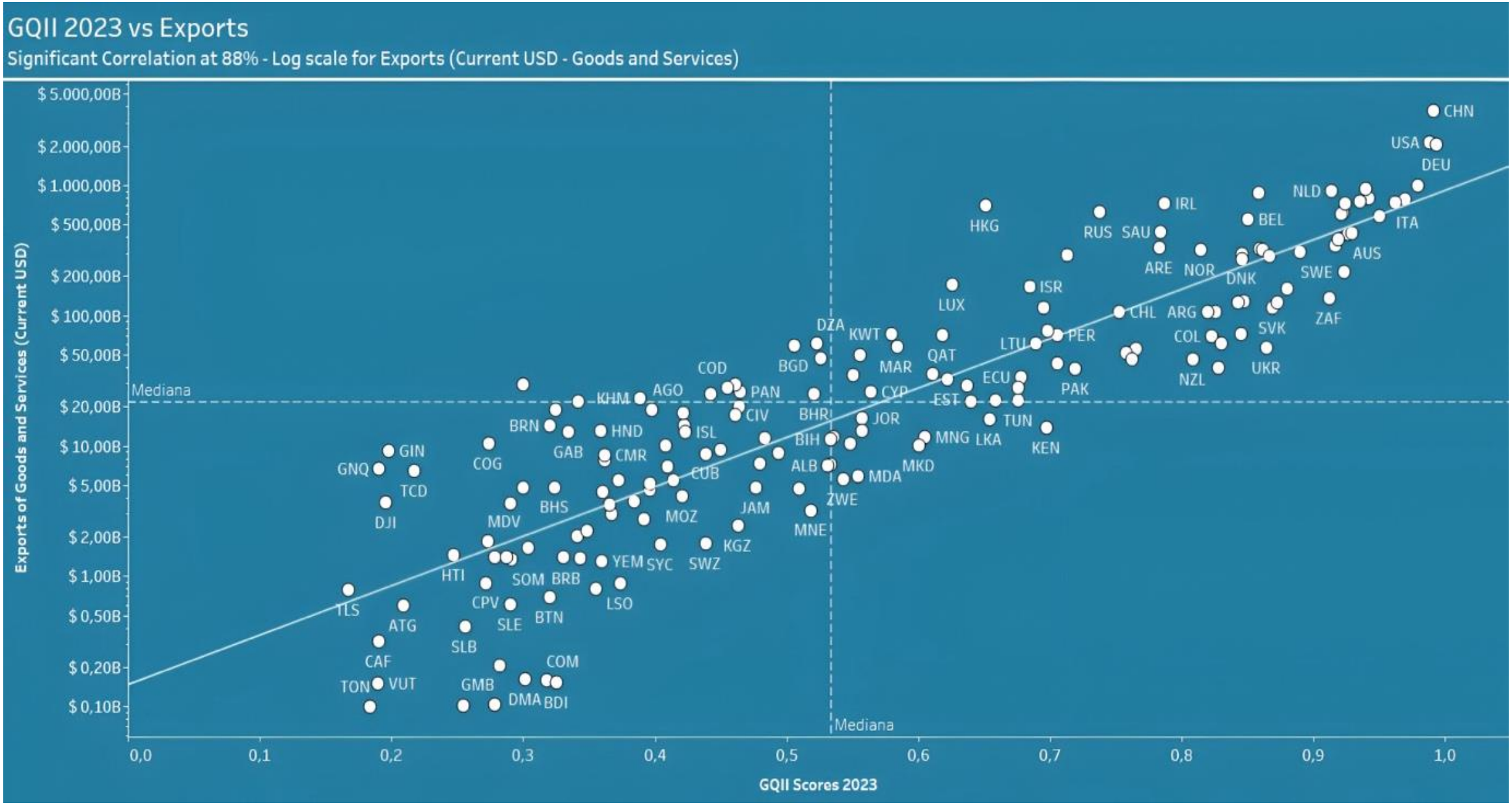
Results - summary

- Different approaches lead to similar conclusions
- **GQII reliable** – with some adjustments
- Top countries are robust to different methodologies
- Middle- and low-QI countries may perform differently depending on the approach
- The sensitivity analysis allows to explore strengths and weaknesses of each QI component (*balanced is better?*)
- Some outlier countries needed to be treated carefully
- **LIMITATIONS**: no consideration of population/economy scale; no dynamics; only supply-side of Qis (no demand/use of services)

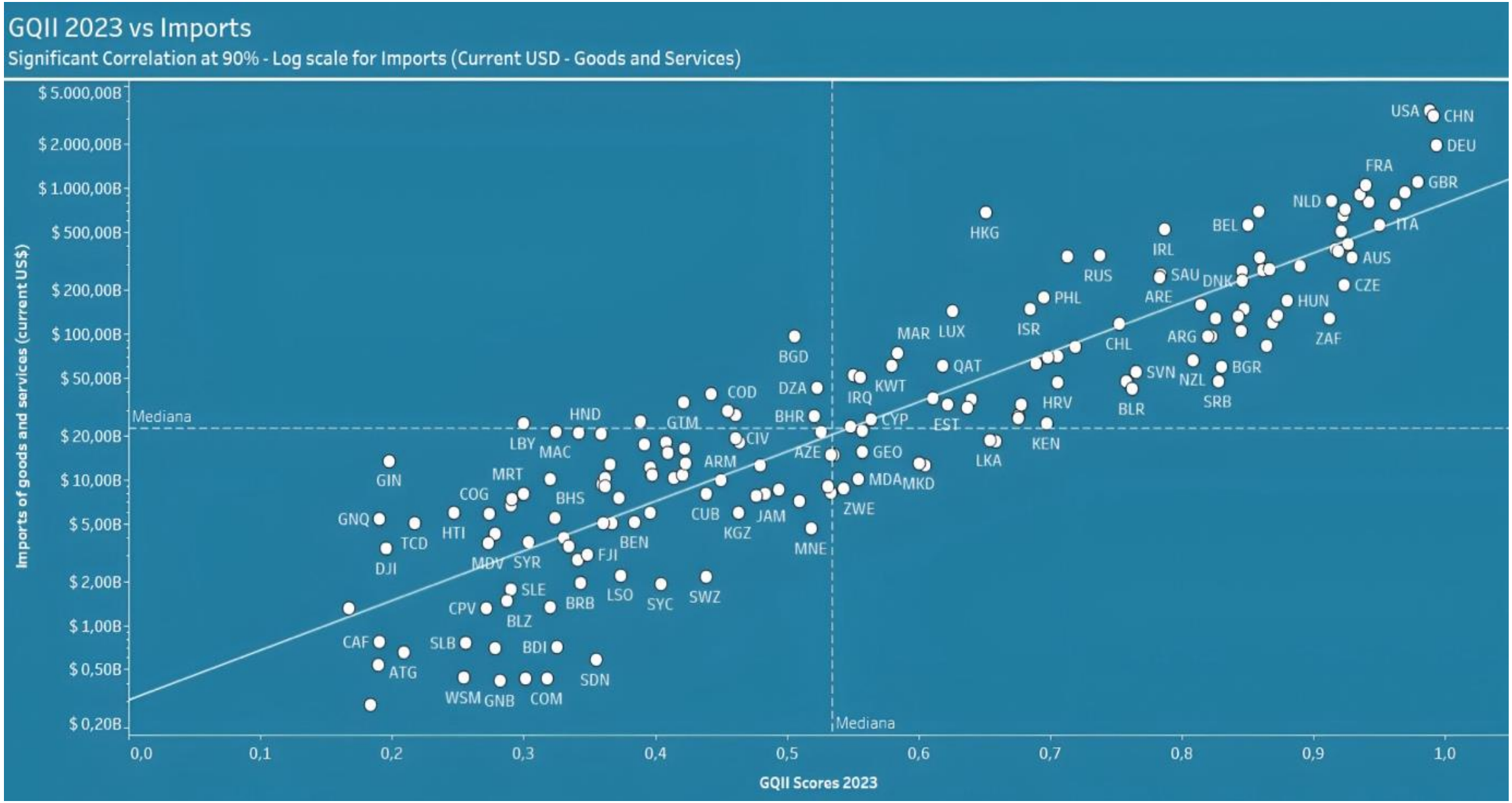
GQII and the economy



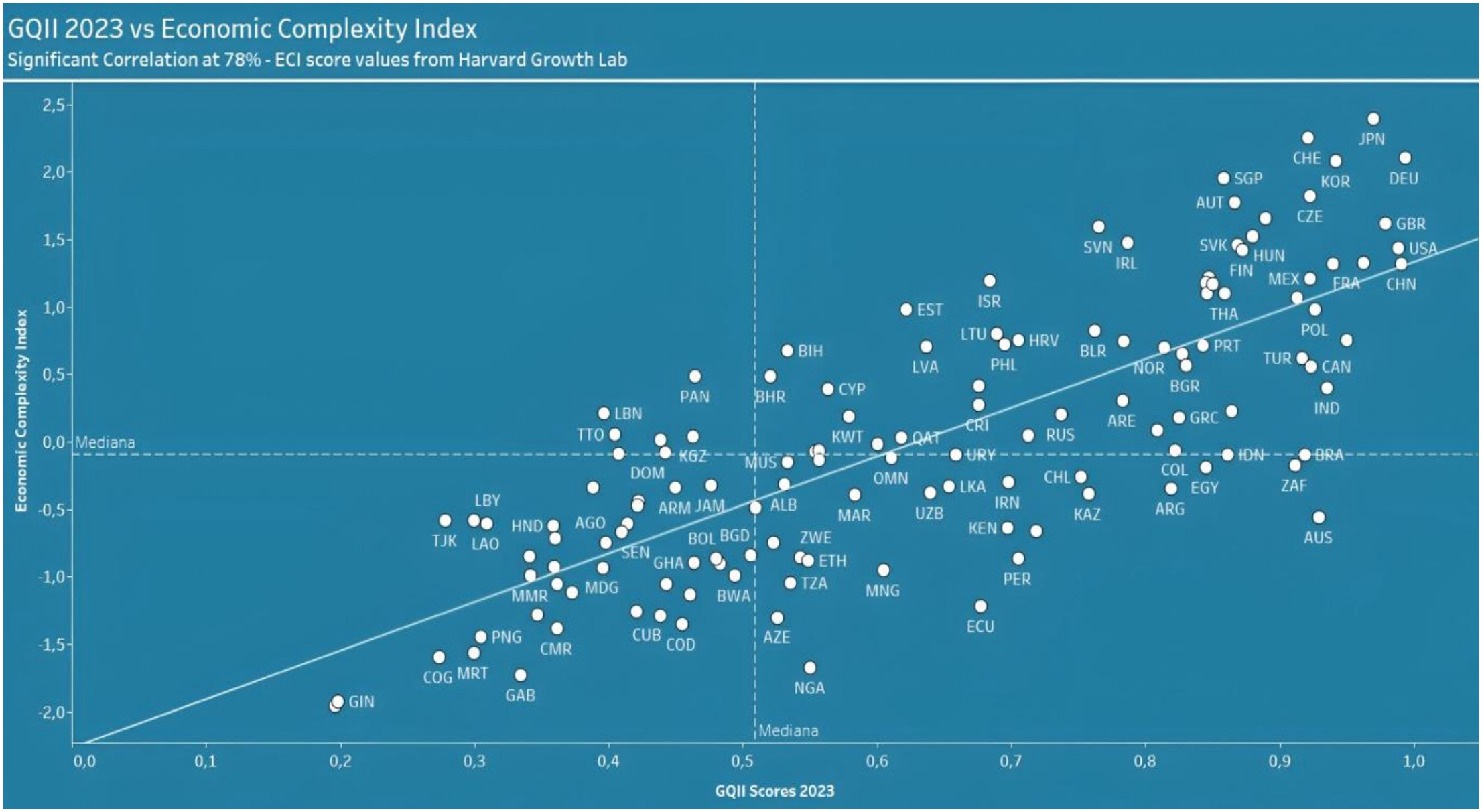
GQII and Exports



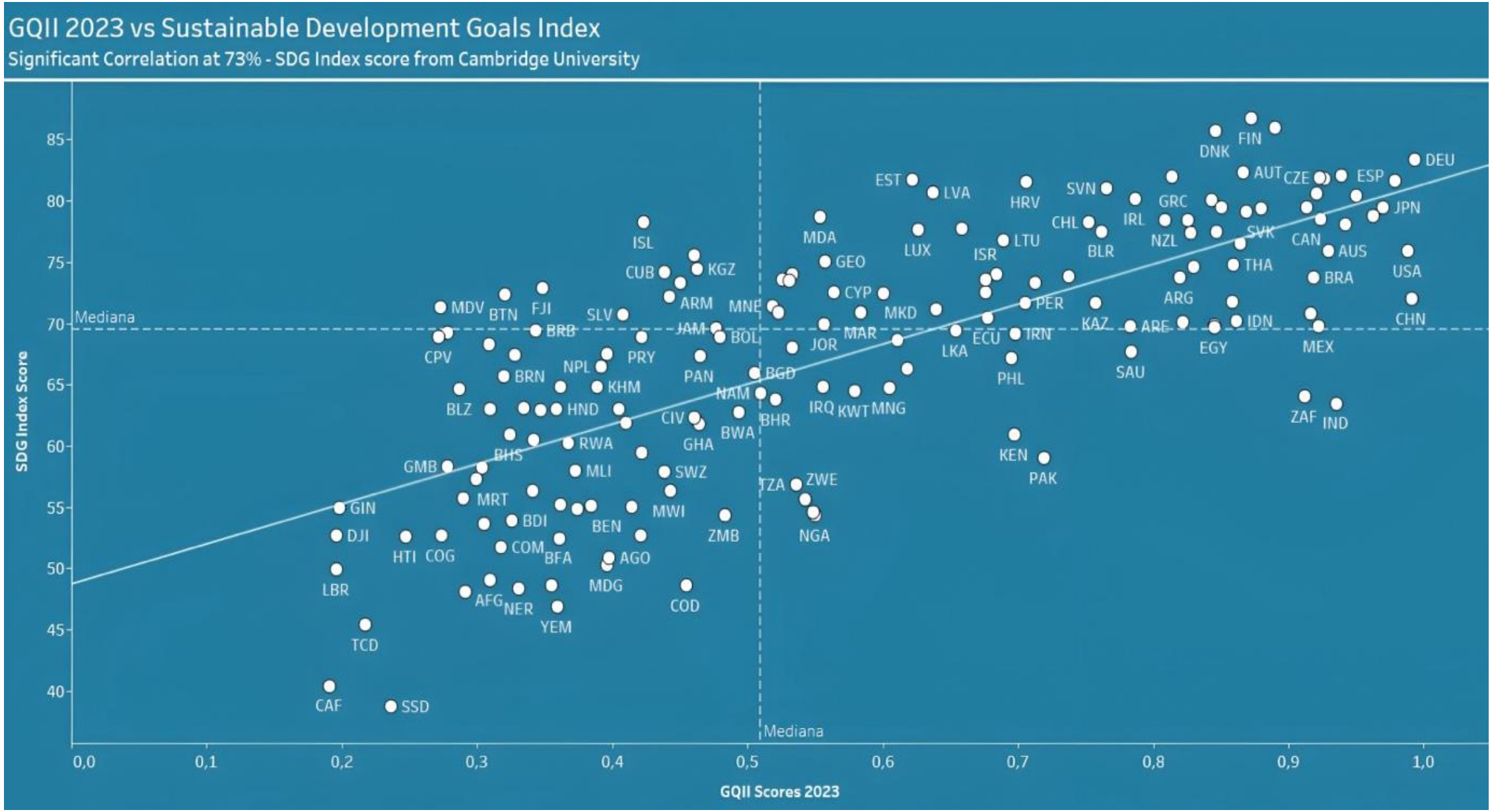
GQII and Imports



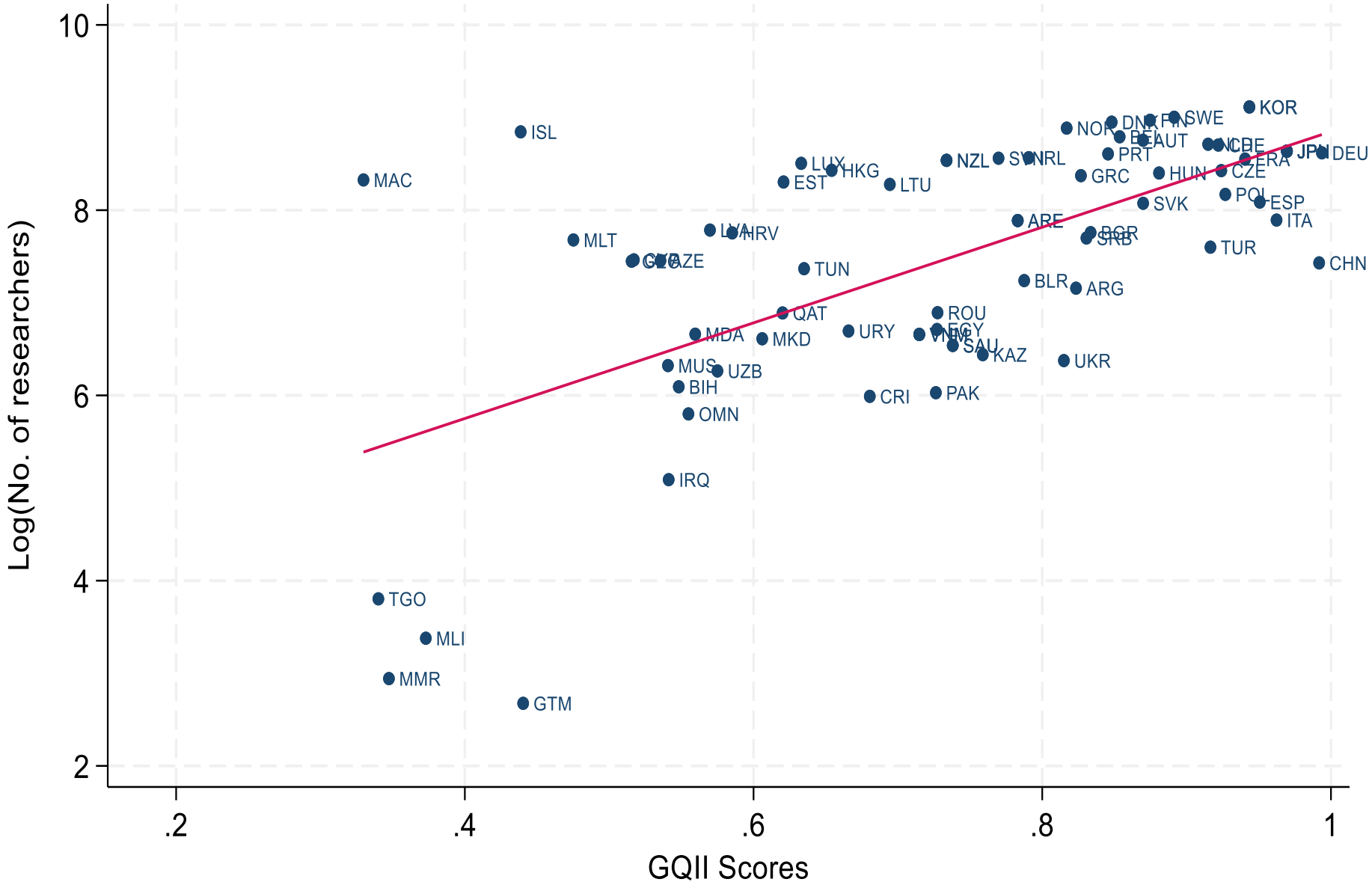
GQII and Economic Complexity



GQII and SDGs



GQII and innovation



Research Questions?
Policy Implications?
QI maturity models?

Maturity: The idea of gradual development, complexity, and optimization draws inspiration from natural processes *(WDR 2025)*

QI maturity levels

Mature QI
- Innovation-oriented QI with cutting-edge technology and services
- Fully competitive market for testing, certification, and inspection
- Globally integrated through ILAC, IAF, ISO, IEC, ITU, SIM, OIML

Advanced QI
- National institutions recognized internationally, with sectoral depth
- Growing private sector role in inspection, testing, and certification
- Standards and metrology systems aligned with international best practices

Basic QI
- Initial infrastructure for standards, metrology, and testing established
- Services mostly public sector–driven and focused on basic trade needs
- Relies on foreign accreditation and limited certification services

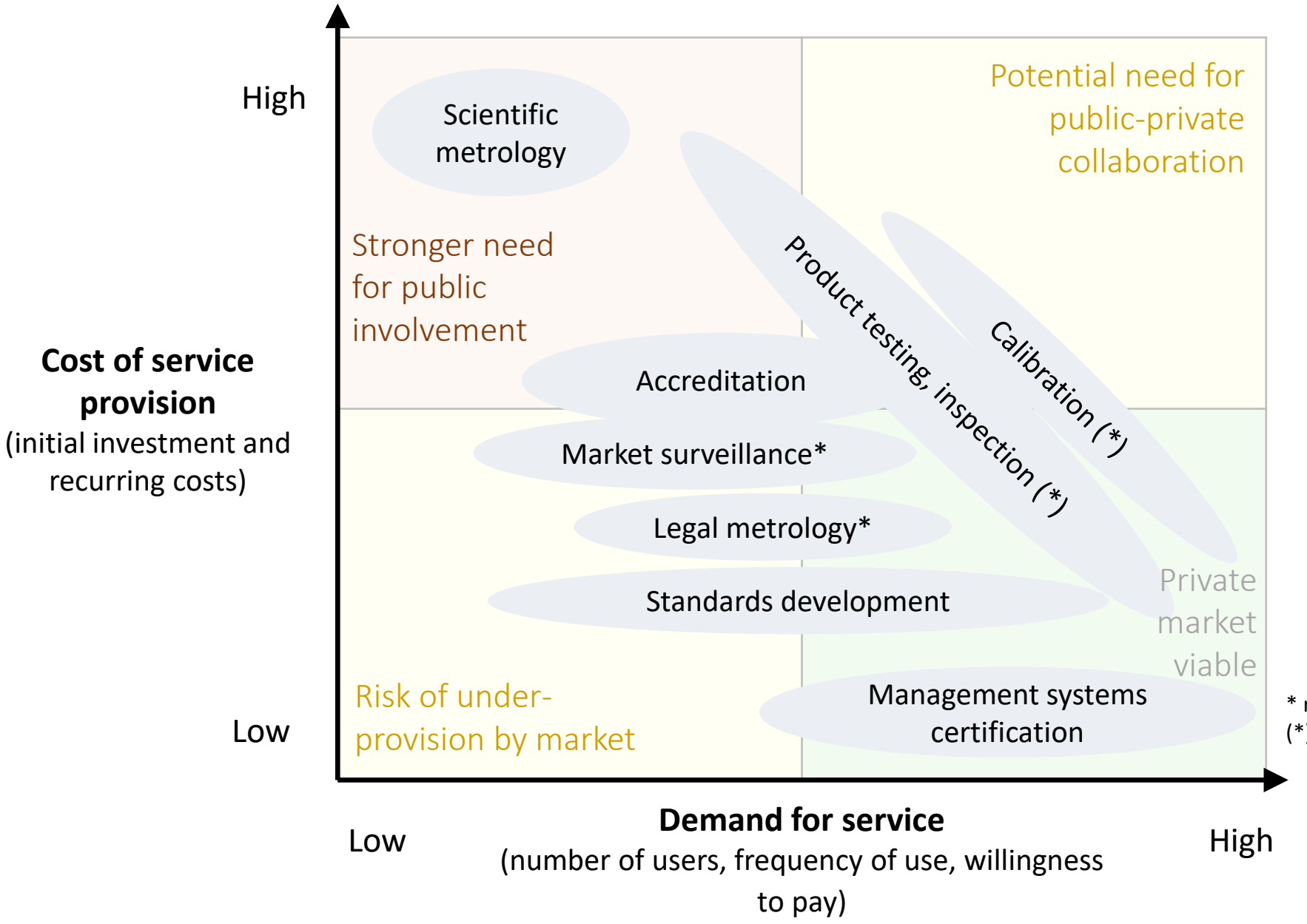
Rudimentary QI
- Minimal or no institutional QI framework in place
- Government functions as de facto standards/metrology body
- Limited or no testing, certification, or accreditation services

Typical QI demand and challenges along the development trajectory

Country features	• Primary industries • Informal firms	• Low-value added sectors	• Diversified economy • Higher economic complexity	• Innovation-based economies • Strong role in GVCs
Demand for QI	• Firms to meet export market regulations • Basic domestic regulation for safety and health (e.g., construction and food)	• Firms need quality upgrading for market access • Regulation expands to more sectors and goals (e.g., environment)	• Sophisticated demand from exporters and FDI-driven industries. • Quality-aware consumers • More advanced regulation (e.g., IT security, consumer protection)	• R&D heavy industries • Quality-oriented consumers • Wide range of regulated areas (e.g., sustainability, advanced consumer protection)
Typical QI challenges	• Lack of labs and low staff capacity • Domestic market too small for private QI providers • Firms do not adopt standards • Govt lacks enforcement capacity • Reliance on foreign QI	• Gaps in QI capacities • Low levels of international recognition • Strong presence of public sector in quality assurance • International participation	• Expansion of QI scopes • Public divestment from QI services • Effective coordination between public and private QI institutions • International participation	• Digitalization of QI • QI for services • Using QI for smart regulation • Leadership in international QI forums

Categorization of countries according to their QI level

Country	QI Level	Key Strengths
South Korea	**Mature**	High-tech industries, global leadership in metrology, standardization and accreditation; QI is deeply integrated into South Korea's industrial policy, innovation, and technology development. Early attempts to find the optimum systems of standardization and measurement in support of Korea's ambitious industrial goals.
Malaysia	Advanced	Malaysia has a well-structured QI system, with the Department of Standards Malaysia (DSM) overseeing standardization and accreditation, and the National Metrology Institute of Malaysia (NMIM) metrology.
Brazil	**Advanced**	Strong institutional QI framework with public INMETRO (metrology and accreditation) and private ABNT (standardization) leadership; QI is integral part of industrial policy; support of emergent and sustainability sectors.
Colombia	Advanced	Well-developed standardization (ICONTEC), metrology (INM), and accreditation (ONAC) system under the coordination of the Quality Council (SICAL).
Vietnam	**Advanced**	Vietnam's QI system continues to evolve, playing a crucial role in enhancing product quality, safety, and international trade competitiveness. Vietnam's QI system is led by the Ministry of Science and Technology (MOST), with STAMEQ overseeing standards, metrology, and conformity assessment. Key institutions include the Vietnam Metrology Institute (VMI) and the Bureau of Accreditation (BoA).
Kenya	Basic (progressing to Advanced)	Kenya Bureau of Standards (KEBS) and the Kenya Accreditation Service (KENAS) are established and recognized QI bodies. Leading role in East-African and Pan-African QI development and trade integration.
Ethiopia	**Basic**	Strong Government investments in Institute of Ethiopian Standards (IES), the Ethiopian Accreditation Service (EAS), and the Ethiopian Metrology Institute (EMI). QI services are still limited in scope, often depending on foreign laboratories and accreditation bodies.



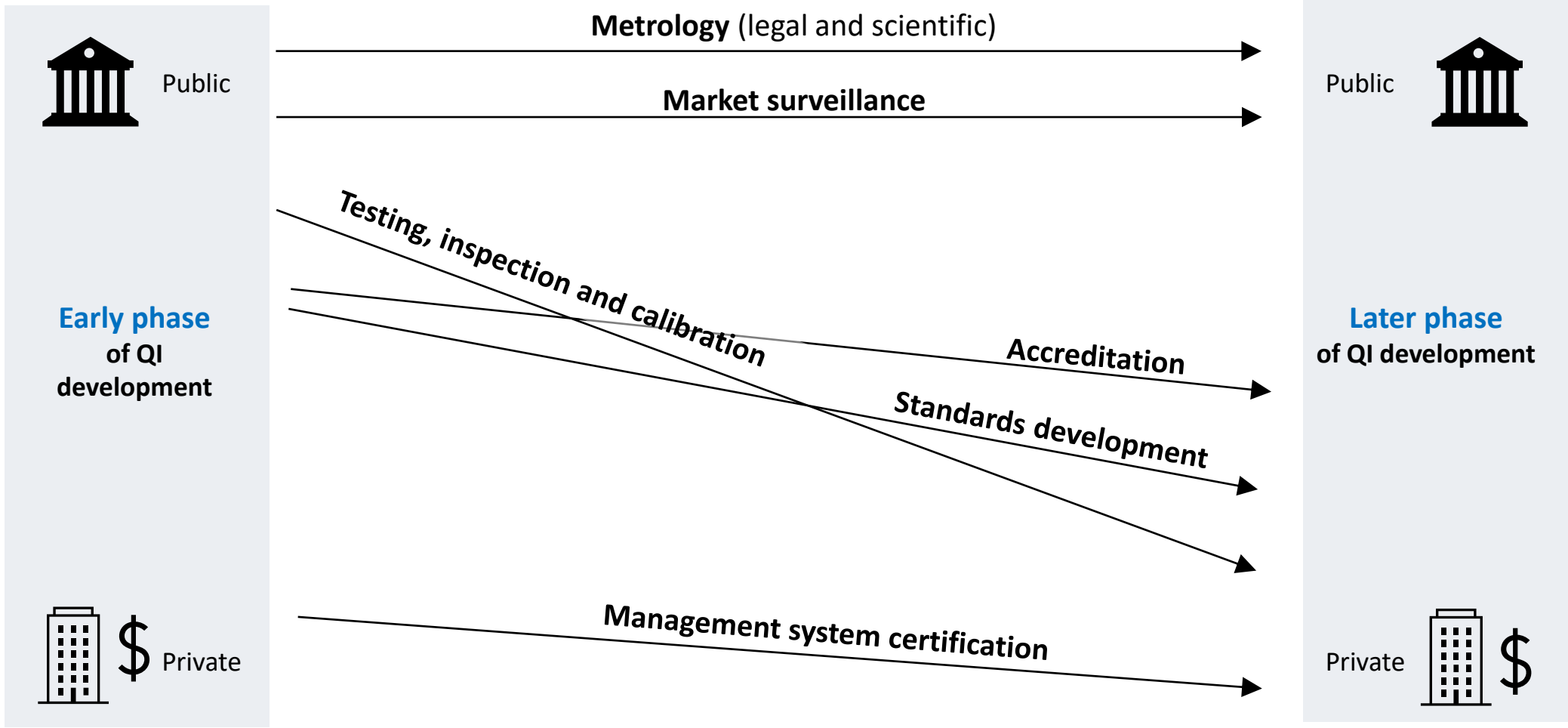
* regulated areas.
(*) sometimes regulated.

Policy-related Research Questions:

the room for policy space (WDR 2025)

Source: WDR25, adapted from Miesner 2009 and UNIDO 2007.

Public-private shifts of QI functions over development path (WDR 2025)



Source: WDR25.

Incorporating QI in innovation policies?

To foster innovation and ensure that new products and technologies meet safety, reliability, and performance standards, innovation policies must seamlessly integrate QI components:

- Integrate standardization in R&D activities and facilitate access to standardization resources
- Invest in metrology facilities to meet the needs of R&D activities, as well as the measurement needs of emerging technologies.
- Simplify and expedite the accreditation processes for CABS to support the rapid commercialization of innovative products and incentivise companies to use these services.
- Foster collaboration between stakeholders in innovation systems and QI institutions.
- Incorporate QI in STEM education.
- Link innovation funding to QI compliance.
- Participate in international QI efforts, e.g. working groups, consultative committees, etc.
- Align QI with sustainability goals to support sustainable and green innovations.
- Ensure QI services are accessible to stakeholders in innovation systems at all levels, e.g. MSMEs, startups, etc.

Take-aways

- We need to be able to measure
- Attempts are limited but improving
- GQII measures a new perspective on the economic system

Follow up

- What can GQII explain?
- Do trade partners (who you trade with) matter for GQII?
- Does the economic structure (share of manufacturing/agriculture/service) matter?
- What is the relationship with development?
- And with innovation?
- Ideal sequencing of QI building? Are all components equally necessary – scope for substitution? Different components in different development stages?

Questions and discussion

Thank you very much

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https://unu.edu/merit/unesco-chair

QI supports the development and diffusion of innovation

Standardization

- Facilitates the adoption and diffusion of innovations by providing benchmarks that ensure new products and technologies meet safety, interoperability, and performance criteria.
- Reduces uncertainty for consumers and businesses and promotes the widespread acceptance of new technologies.
- For example, the development of international standards for 5G technology has facilitated its global rollout, ensuring compatibility and performance across different markets.

Metrology

- Accurate measurements are essential for the development and quality assurance of new technologies.
- Underpins innovations by providing the necessary precision and consistency in measurements, which is crucial for R&D and manufacturing.
- For instance, the aerospace industry relies heavily on precise measurements and metrology to ensure safety and performance.

Accreditation and Conformity Assessment

- Validate that new products and services meet established standards and regulatory requirements.
- Builds consumer and investor confidence, which is essential for the commercialization of innovative products.
- For example, the certification of organic food products ensures that they meet specific environmental and health standards, supporting market acceptance and growth.