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Innovation, Value Chains and Development

How Globalization Offers Opportunities for Catching-Up Based Growth



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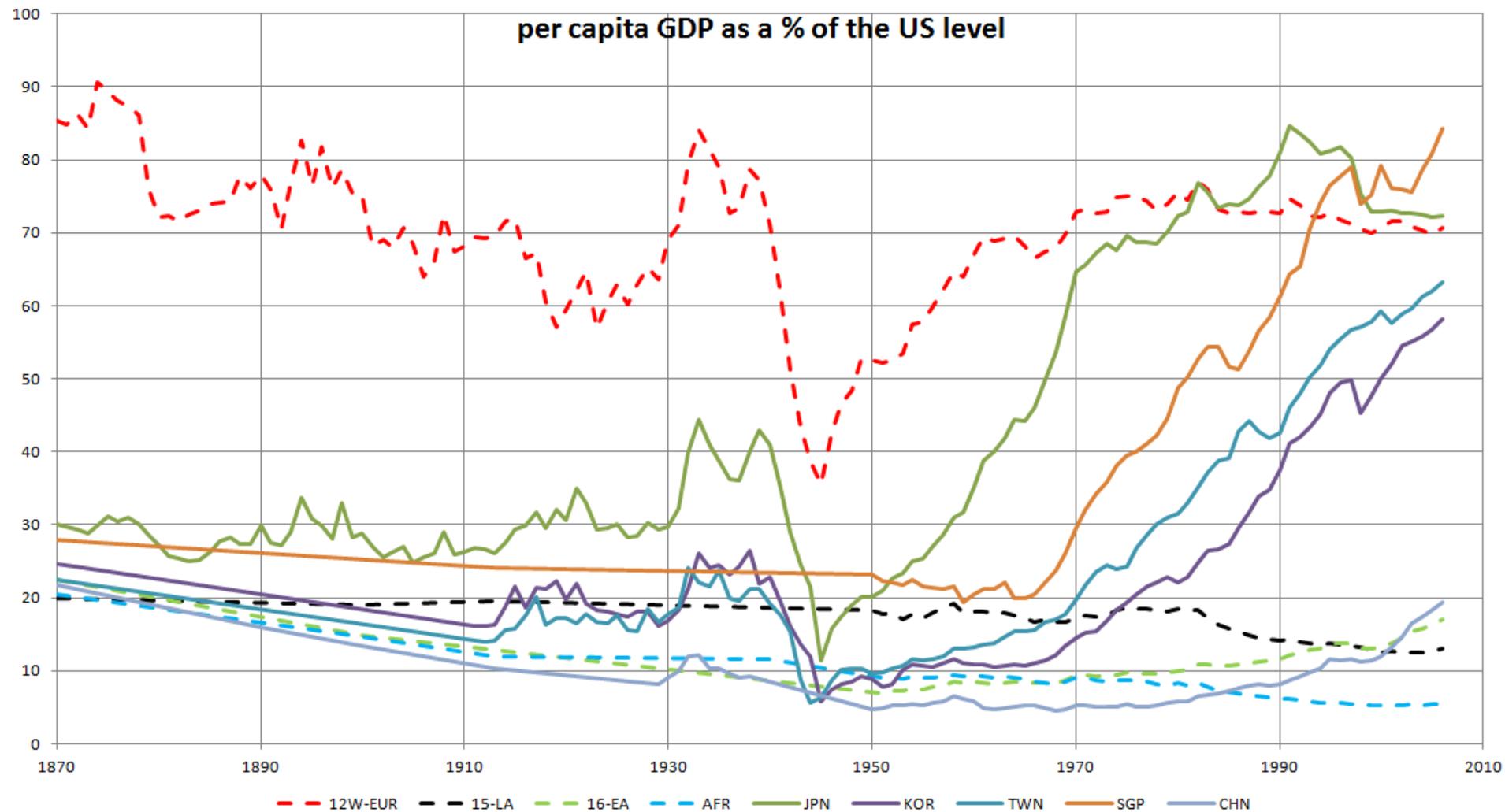


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Global Value Chains

- Global value chains are all the rage in business studies, international economics and with policymakers in international organizations such as the OECD, World Bank, etc.
- I am interested today in whether global value chains can help solve the fundamental problem of the global development gap
- Let's first look at two short examples of global value chains
 - The [iPhone5](#)
 - Cacao [farmers](#) in Africa
- Does the global production system offer similar opportunities to a Chinese factory worker and a small farmer in Côte d'Ivoire? What role can we see for innovation, and for Science, Technology & Innovation policy?

The global development gap (Maddison's data on living standards across the globe)

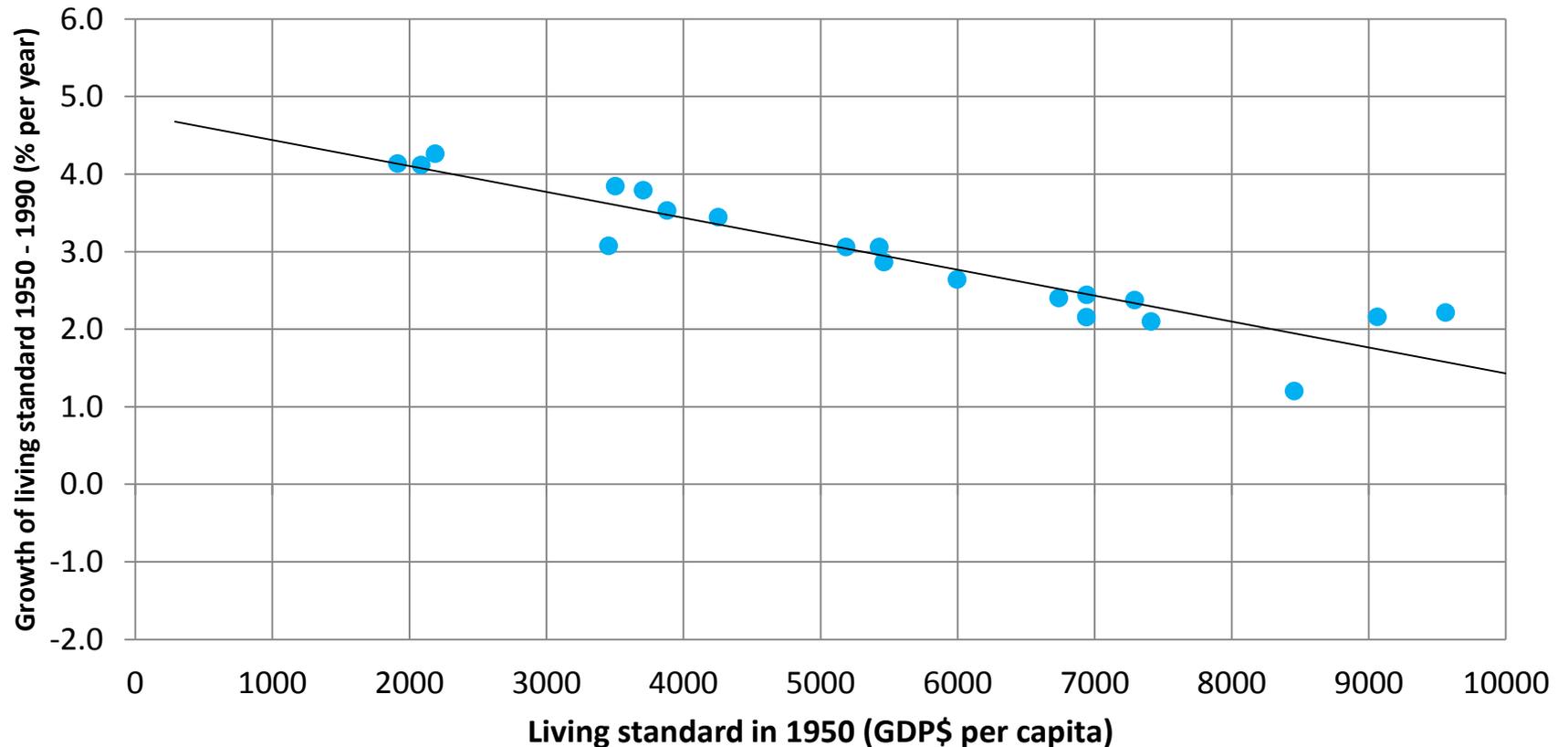


The Technology Gap Theory of global development

- Based on historical analysis (Gerschenkron, Abramovitz) and innovation economics (Fagerberg)
- Does the emergence of Global Value Chains (GVCs) change our theory, do they provide improved possibilities for *catching-up based growth*?
- Let's first explore the "old" theoretical framework, and the empirical evidence that was presented for it
- A starting point is the idea of *convergence* as a result of the diffusion of *technological knowledge* from rich to poor countries

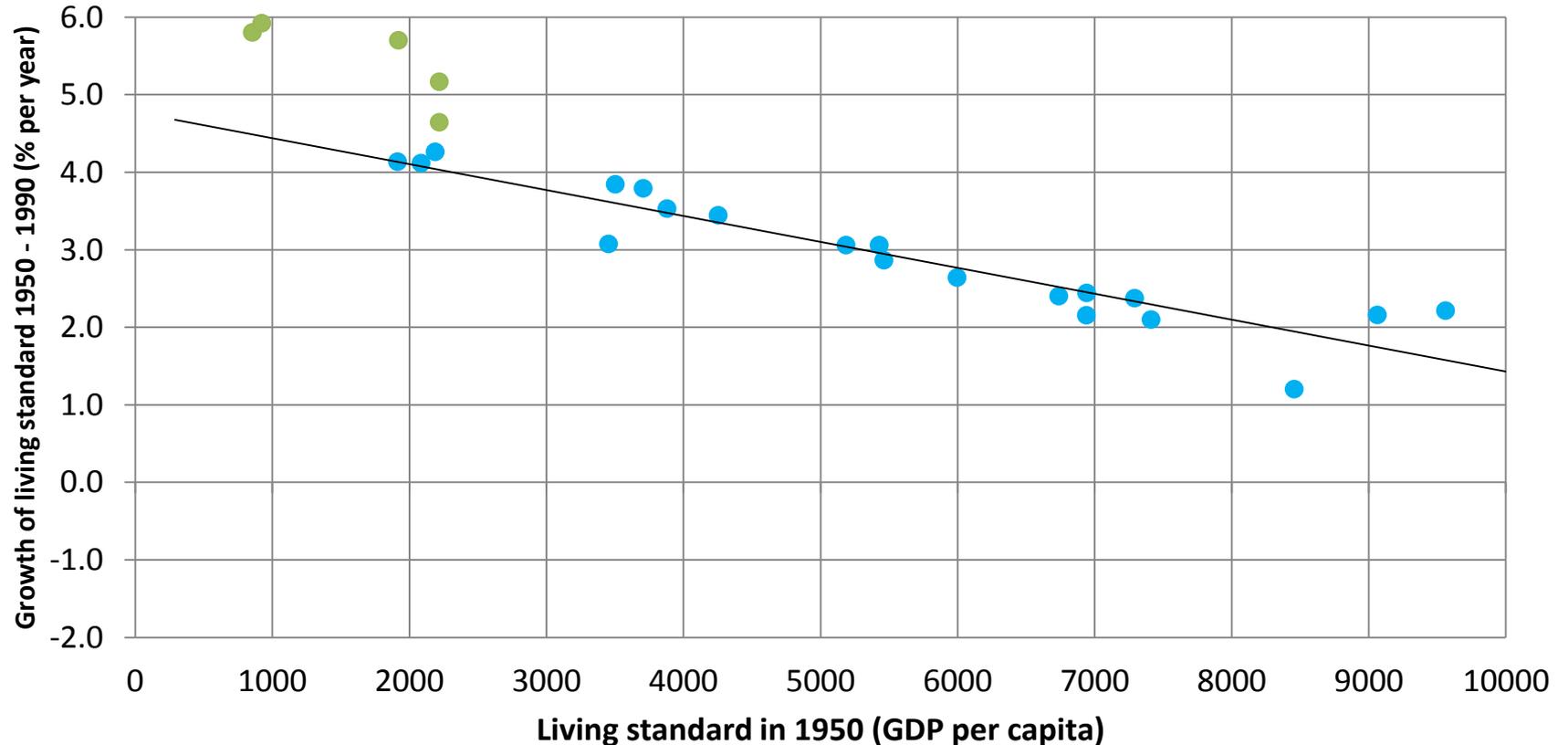
Convergence and divergence of living standards

(A graph that I presented in Oslo about 25 years ago, on my first-ever foreign study trip)



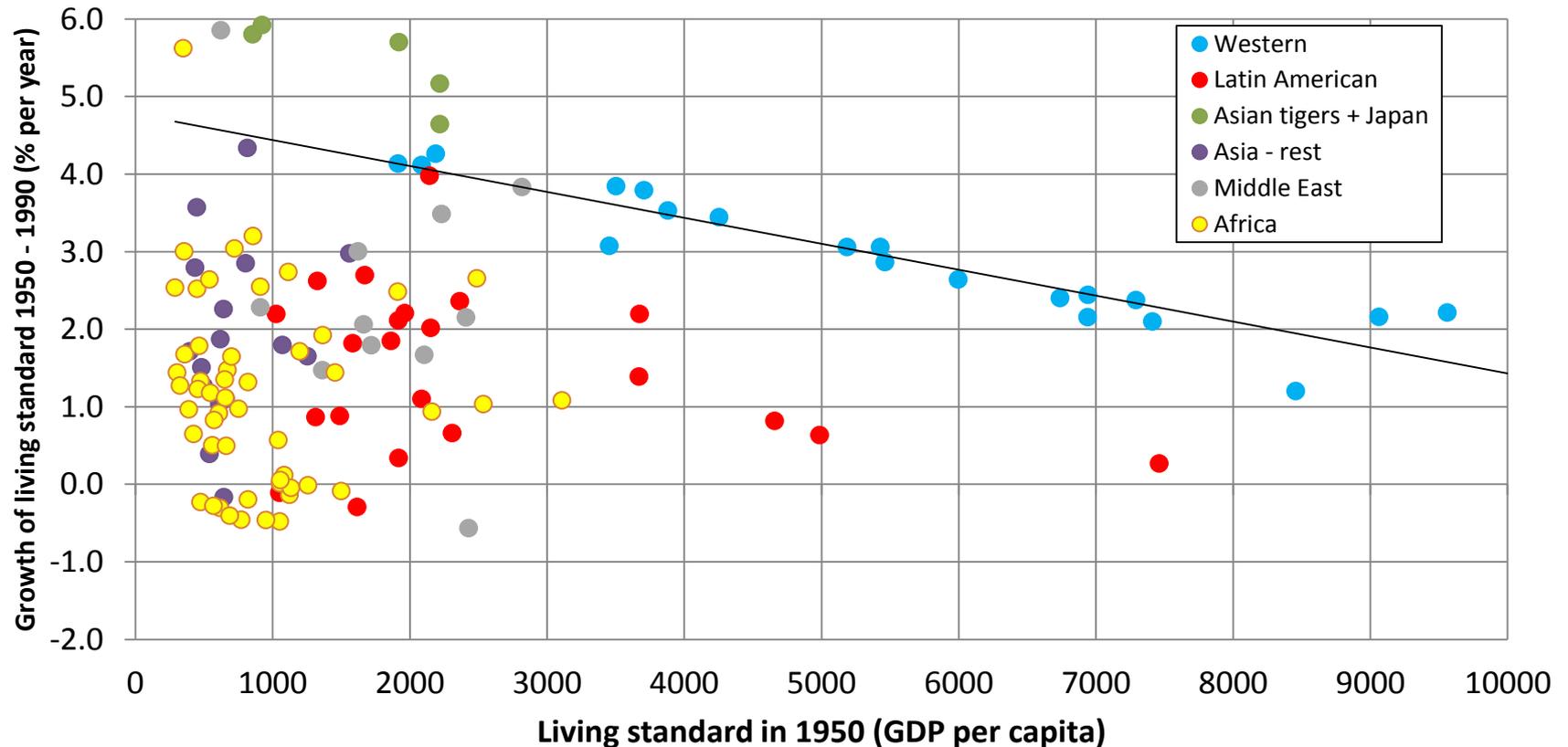
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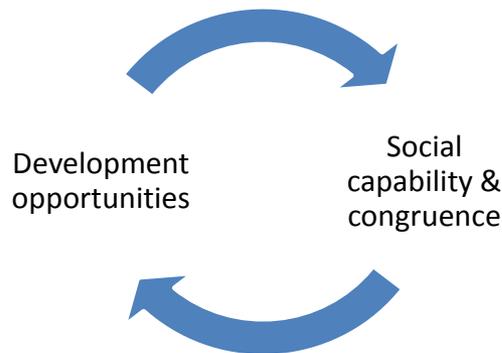


Innovation in the Technology Gap Theory

- There is only a gradual difference between developing new knowledge yourself, and acquiring & assimilating knowledge from abroad: “imitation” is also innovation
- The efficiency with which assimilating knowledge from abroad takes place depends on social capability and on technological congruence (Abramovitz)
 - Social capability captures broad institutions (politics), human capital (education), finance, infrastructure, etc.
 - Technological congruence is whether knowledge from abroad is relevant for the local production structure (microchips for an agricultural economy?)
- For the successful assimilation of foreign knowledge, social capability and technological congruence must be high

Development Traps and Innovation Gaps

- If social capability and technological congruence are initially low, it is very hard to grow by assimilating foreign knowledge
- Social capability will grow when development takes off
- Technological congruence will grow when the production system is modernized
- This mutual-reinforcing process can easily get stuck in a low development trap
- This is why so many countries are below the regression line for the developed world



How can countries break out of the trap?

- Countries can escape the trap by an active policy of learning, which enables them to follow an export-based path of industrialization and growth, but there are few successful examples of this (mainly, the Asian Tigers)
- Active industrial and innovation policy
- Export-oriented growth strategy (exporting to developed countries), combined with initial protection of domestic producers (trade barriers)
- Targeting of specific sectors and changing these targets along the way
- Gradual upgrading of firms' capabilities and increasing the complexity of goods produced and traded
- Modernization of society combined with economic development

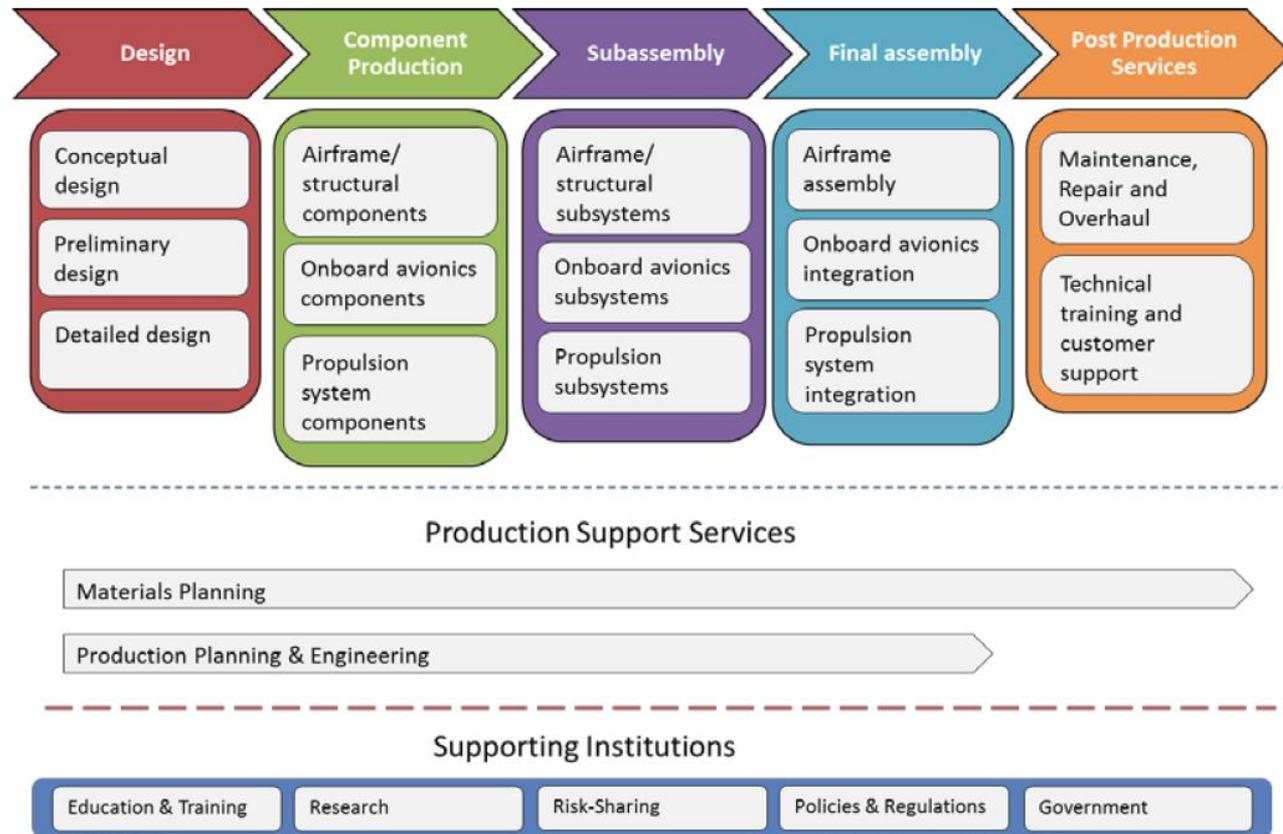
Why is it so difficult to break out of the trap?

- Learning is a collective, nation-wide process that requires coordination (the “developmental state” and “innovation systems”) and is inherently risky
 - There are also economic factors that may keep a country in the trap, e.g.,
 - Marxist historians (Wallerstein) stress a centre-periphery model in which the global economic centre applies political power to economically exploit the periphery
 - The Latin-American “structuralists” (recently Jorge Katz and J-A Ocampo) point to exchange rates and the balance-of-payments (Dutch disease) that keep the continent locked into resource-based specialization that provides few opportunities for learning
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- (*Chang’s Kicking Away the Ladder*)

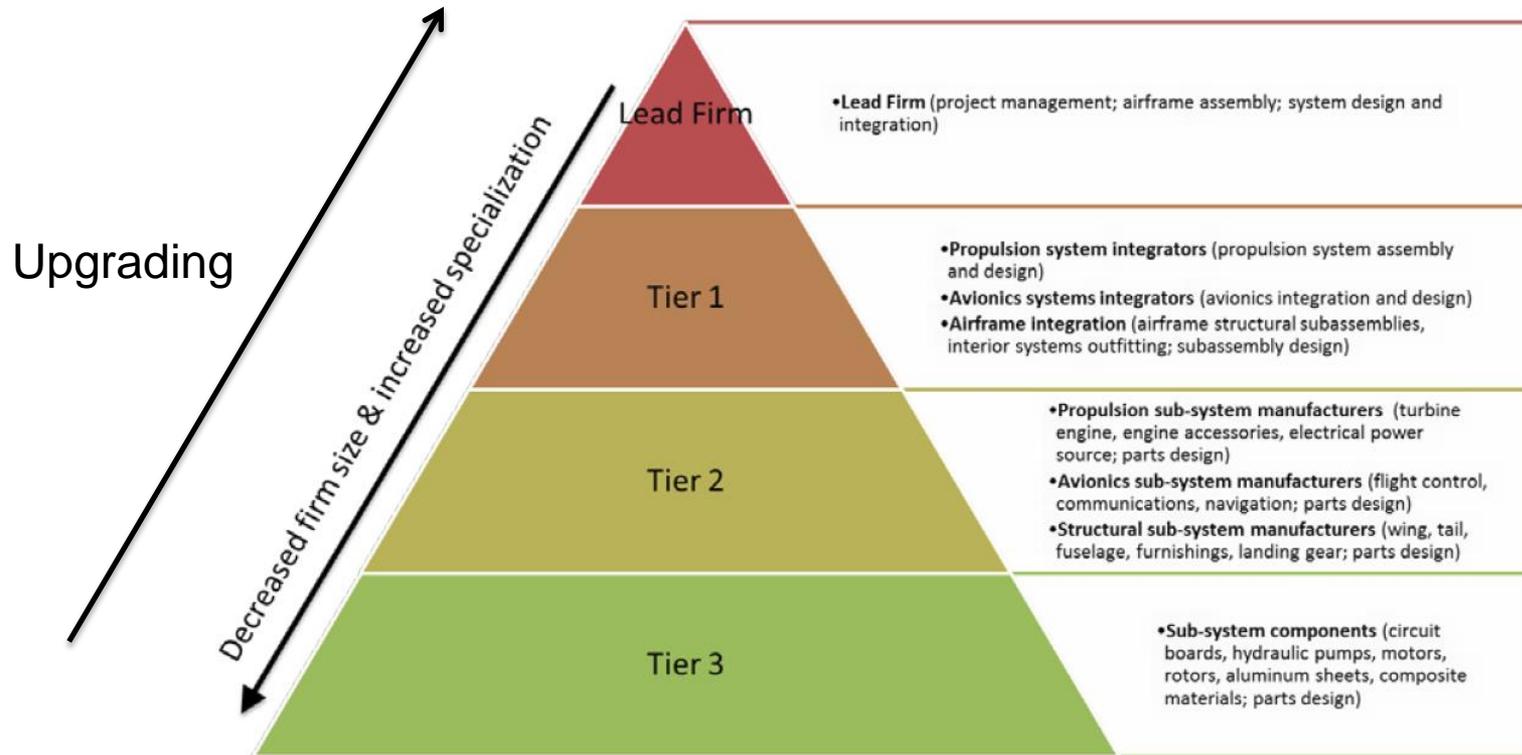
Back to Global Value Chains

- How do GVCs change the situation?
- Besides the “usual” argument about increased specialization leading to more efficient production:
- Easier to enter international trade: it is no longer necessary to master production of an entire (complex) product, the focus can be on a small part of the chain, and the firm will still be able to engage in international trade and enjoy the benefits of this
- Value chains are often organized by close, long-run relationships between the dominant firm and its suppliers, these relationships offer opportunities for learning and technology transfer
- Perhaps GVCs are an easy ticket out of the low development trap?

The perspective of Business Studies (Gereffi and collaborators) – Aerospace industry



The perspective of Business Studies (Gereffi and collaborators) – Aerospace industry



Sources: Niosi and Zhegu, 2005; Marques and Oliveira, 2006; Clearwater 2011; Kraemer-Mbula, 2008



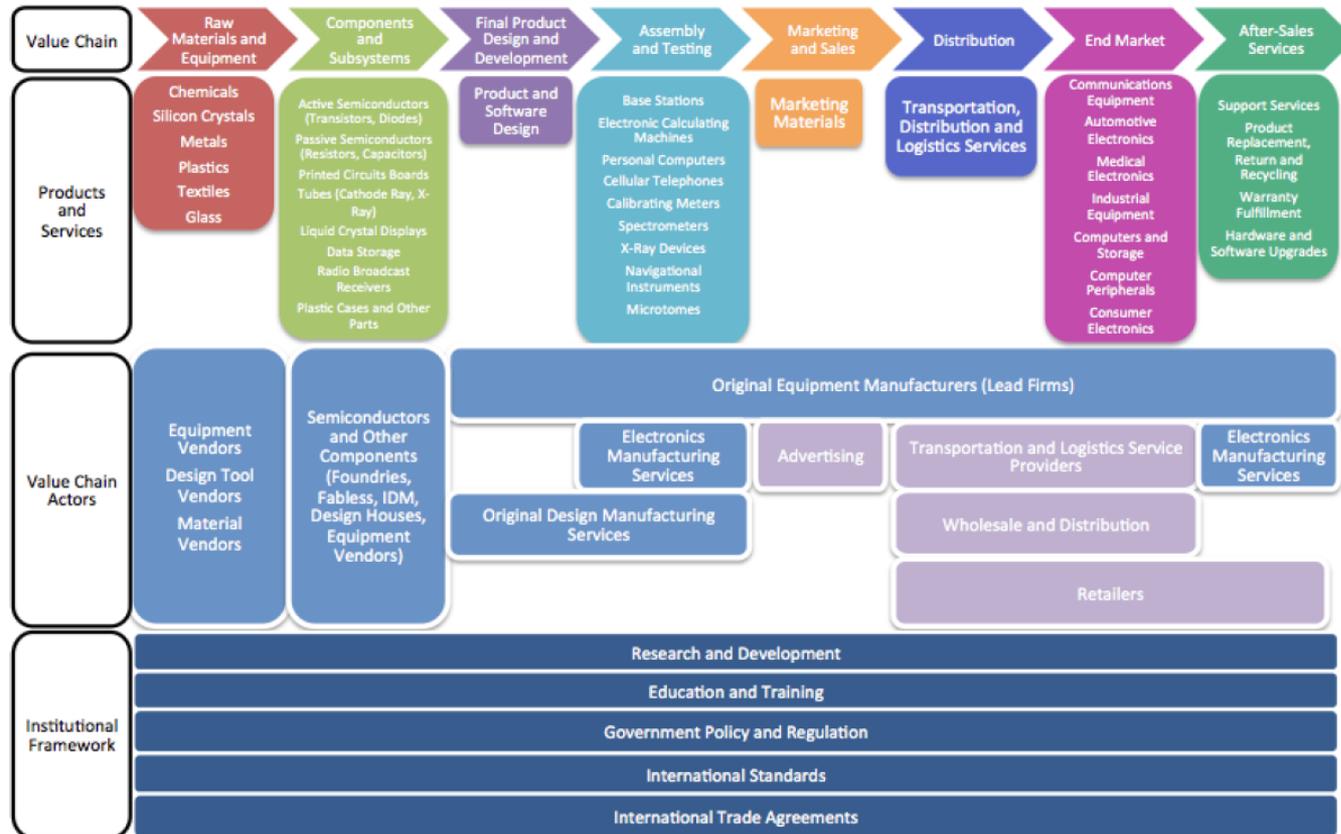
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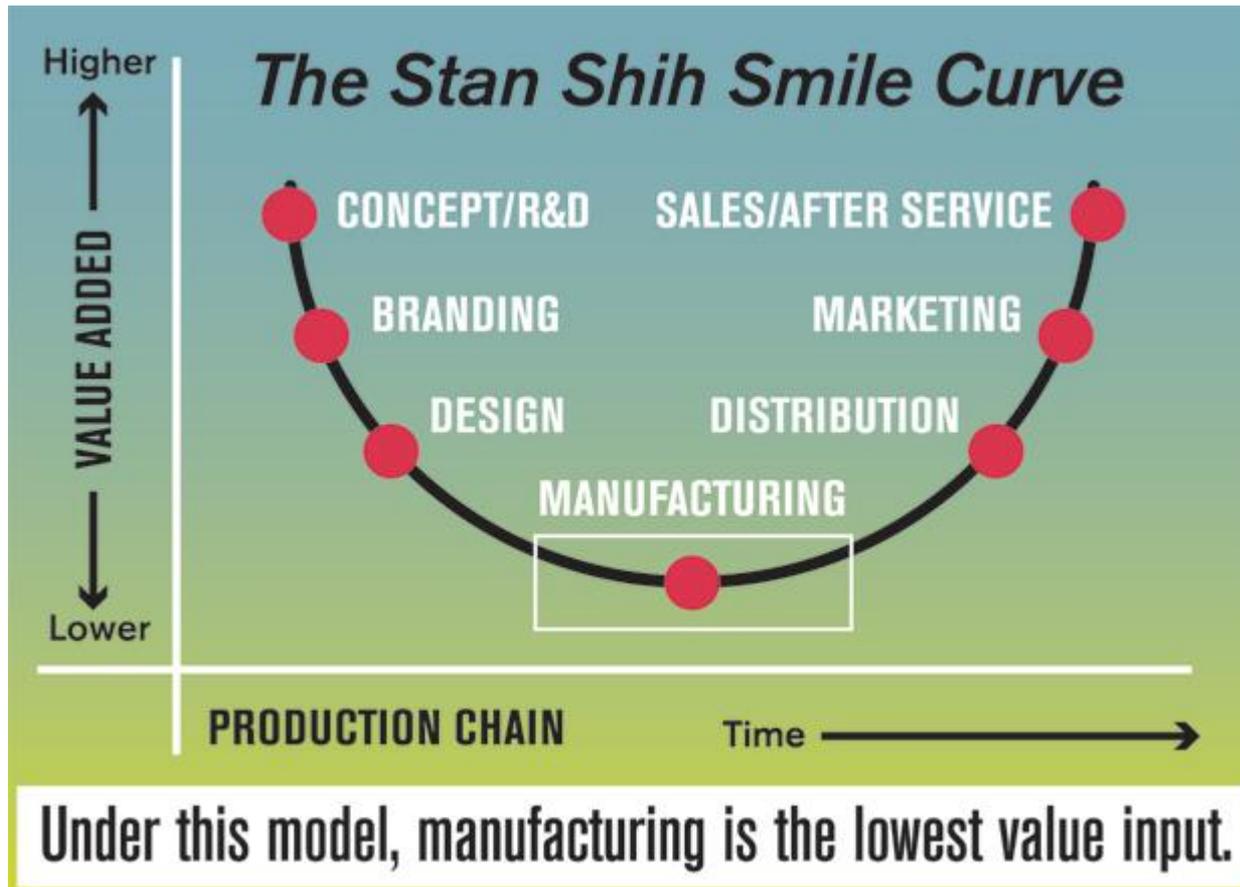


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The perspective of Business Studies (Gereffi and collaborators) – Electronics industry



Evidence on the distribution of value added along the value chain



Possible reasons why it may be hard to capture a large part of the value created in the entire chain

- The dominant firms (in developed countries) may only be interested in off-shoring low-value added content, and not be interested in sharing knowledge, because knowledge is high value added content (competing on wages is low value added content by definition)
- To participate in GVCs requires social capability (infrastructure, education, etc.): the low-development trap all over again
- Upgrading requires high-quality local innovation systems, which require active policy coordination and resources (Rabelotti, Pietrobelli)
- GVCs may only require a gradual modification of the Technology Gap theory: development traps could be as real as they were before the 1990s
- Let's explore the empirical evidence

The global macroeconomic view: Input-Output economics (Los & Timmer)

- The Input-Output table provides an accounting framework for goods and materials flows in the economy
- It ultimately calculates value added by subtracting intermediate inputs from gross outputs, and hence is the primary tool used by statistical agencies to calculate GDP
- For example, if the Chinese electronics industry sells an iPhone, the value added created by this transaction is the selling price (“gross output”) minus the costs of all components it had to buy from other sectors (roughly speaking, value added consists of labour costs and profits)
- We use the assumption that every unit of production (gross output) requires a fixed proportion of inputs of all kind (value added or intermediate/acquired)
- Using this assumption, we can calculate how final demand (consumption and investment goods) is “ultimately” produced using primary inputs from a range of sectors

Global Input-Output tables

- The input-output system is ideal to analyze value chains because it captures the indirect production links, but
- It has a different conception of value chains than the business literature that we briefly reviewed, because it captures a production chain, instead of the R&D – production – distribution cycle)
- We require global tables for global value chains
 - WIOD (Groningen, Los & Timmer)
 - EORA (Australia, Lenzen)
 - EORA is of rougher quality but has larger coverage (189 countries, 26 sectors), I use EORA to sketch the broad evolution of the global economy 1995 – 2011

The EORA – IO setup

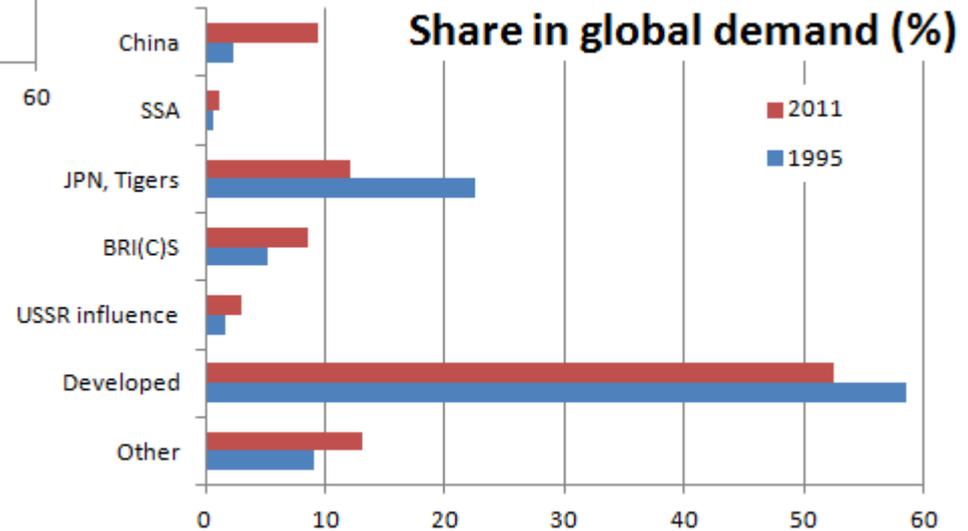
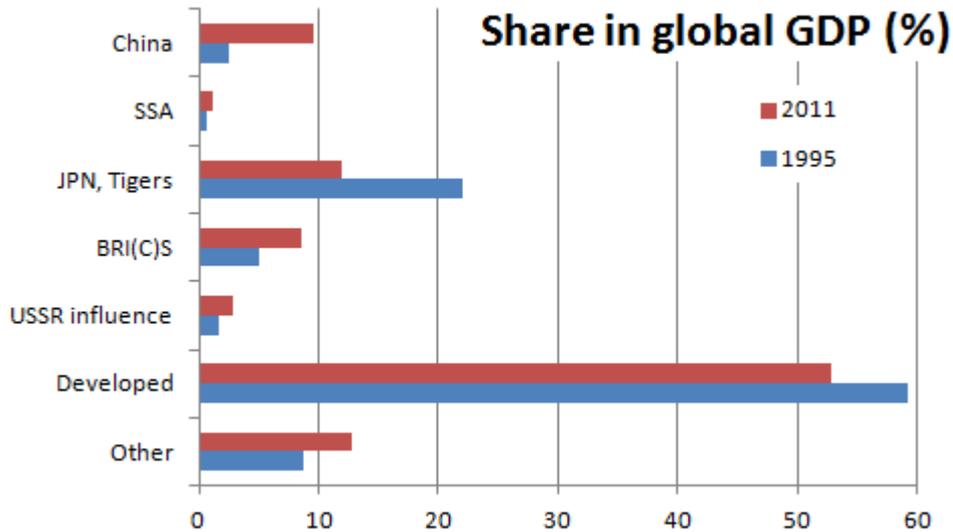
- I divide the world into 7 blocks: Developed – Dynamic Asia (Japan + Tigers) – former communist block in Europe – BRI(C)S (very large developing/emerging) – China (separate, because it is so exceptional) – Sub-Saharan African – other
- I merge the 26 sectors into 3 blocks: - resources (agriculture, mining, energy production) – manufacturing – other (services and the rest)
- This produces a 21x7 table that maps the macro aggregation of global value chains; the columns denote the global block where final demand is exercised, and the rows the sector where value added is produced

The global economy in 1995 (% of global GDP)

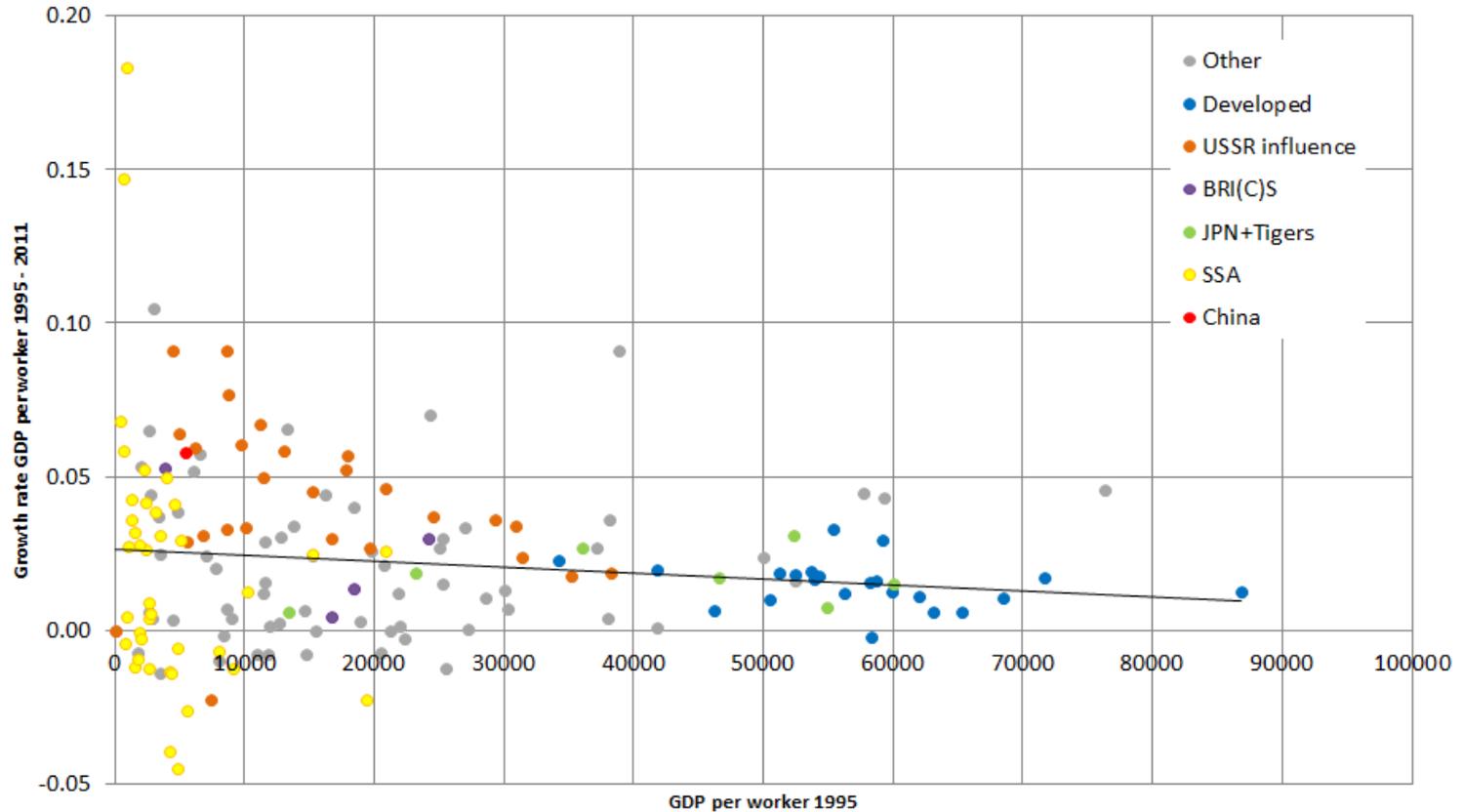
		Final demand exercised by:								
		Other	Developed	USSR influence	BRI(C)S	JPN, Tigers	SSA	China		
Other	RES	0.7	0.2	0.0	0.0	0.1	0.0	0.0	1.1	
Other	MAN	1.3	0.2	0.0	0.0	0.1	0.0	0.0	1.6	
Other	OTH	5.7	0.3	0.0	0.0	0.1	0.0	0.0	6.1	
Developed	RES	0.1	2.4	0.0	0.0	0.2	0.0	0.0	2.7	
Developed	MAN	0.4	8.9	0.1	0.2	0.6	0.0	0.1	10.4	
Developed	OTH	0.5	44.5	0.1	0.2	0.8	0.0	0.1	46.2	
USSR influence	RES	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.2	
USSR influence	MAN	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.4	
USSR influence	OTH	0.0	0.1	1.0	0.0	0.0	0.0	0.0	1.1	
BRI(C)S	RES	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.8	
BRI(C)S	MAN	0.0	0.1	0.0	0.8	0.0	0.0	0.0	1.0	
BRI(C)S	OTH	0.0	0.1	0.0	3.1	0.0	0.0	0.0	3.3	
JPN, Tigers	RES	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.1	
JPN, Tigers	MAN	0.1	0.6	0.0	0.0	3.9	0.0	0.1	4.8	
JPN, Tigers	OTH	0.1	0.6	0.0	0.0	15.3	0.0	0.1	16.2	
SSA	RES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	
SSA	MAN	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	
SSA	OTH	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.5	
China	RES	0.0	0.0	0.0	0.0	0.1	0.0	0.5	0.6	
China	MAN	0.0	0.1	0.0	0.0	0.1	0.0	0.6	0.9	
China	OTH	0.0	0.1	0.0	0.0	0.1	0.0	0.8	1.0	
		9.1	58.6	1.7	5.2	22.5	0.7	2.3		



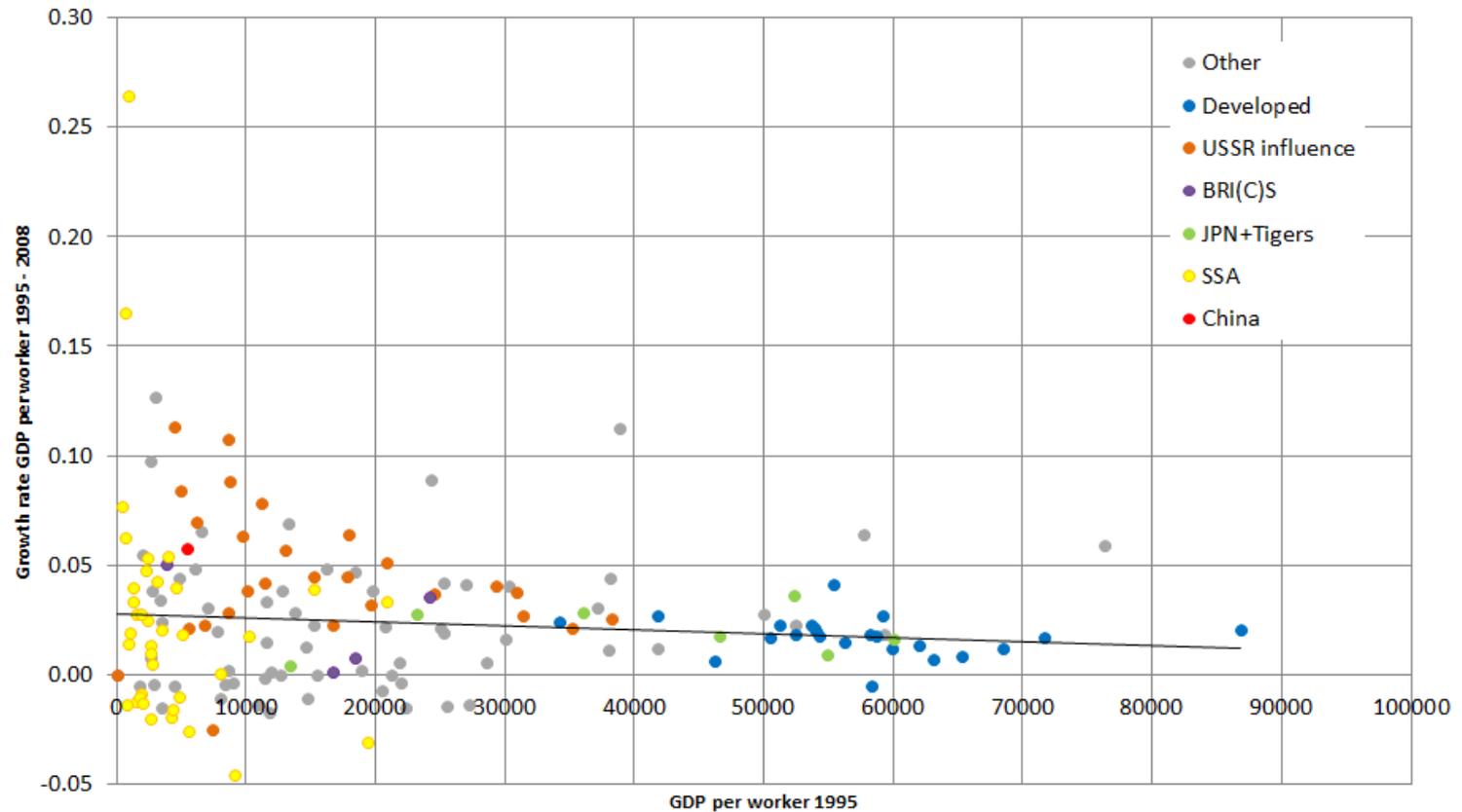
Global distribution with expanding GVCs 1995 – 2011



The convergence diagram again (1995 – 2011)

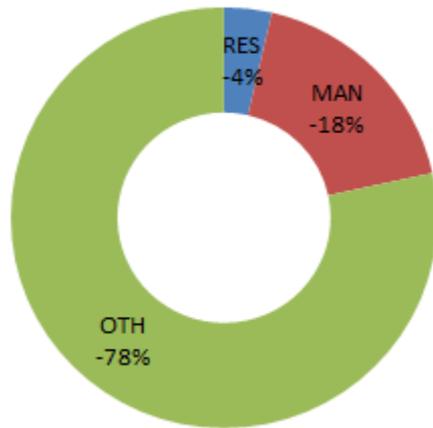


And it's not the crisis... (1995 – 2008)



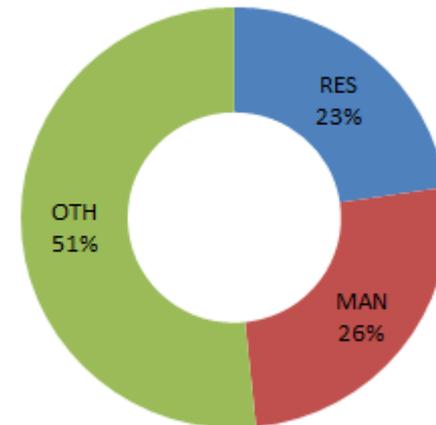
Changes in shares of global GDP 1995 - 2011

Within Developed



	Demand				
Developed	USSR influence	BRI(C)S	JPN, Tigers	SSA	China
	0.5	0.0	0.1	0.0	0.2
	-7.5	0.2			0.6
	0.1	0.8			0.0
	0.3	0.1			0.1
JPN, Tigers	0.1	-0.2	0.0		0.4
SSA	0.0	0.0	0.0		0.0
China	0.2	0.7	0.0		5.7

Within China



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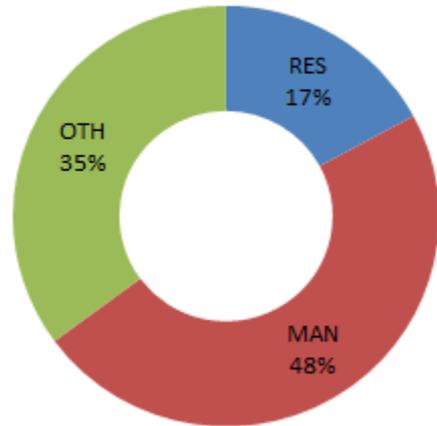
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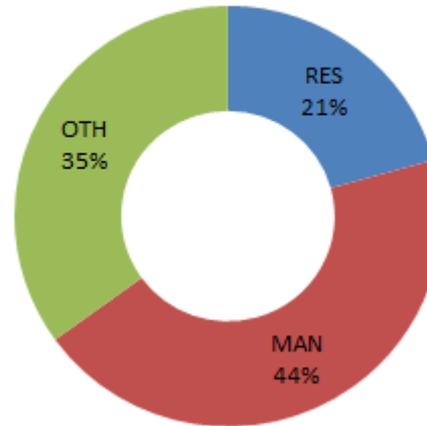
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Changes in shares of global GDP 1995 - 2011

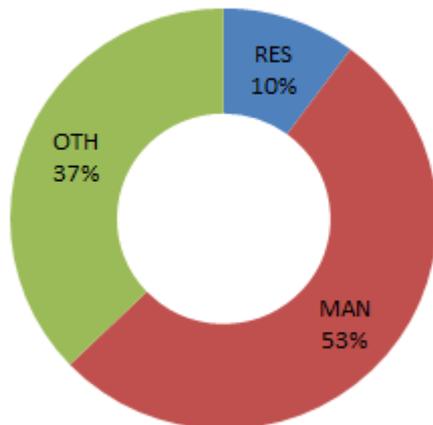
China --> Developed



China --> JPN+Tigers



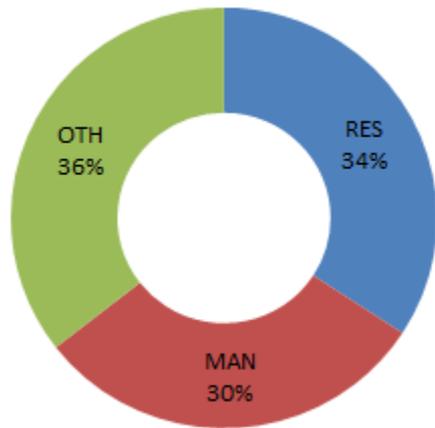
Developed --> China



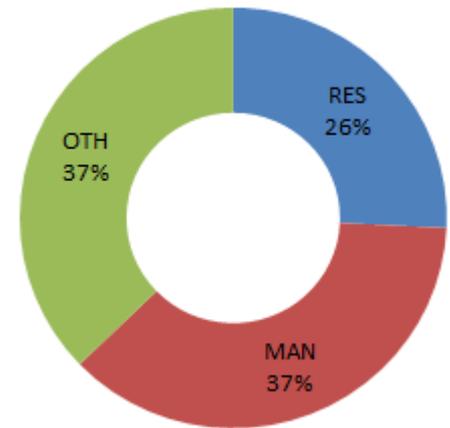
	Deve	JPN, Tigers	SSA	China
Deve				
JPN, Tigers	0.1		0.0	0.2
SSA	-0.4	0.0		0.6
China	0.0	0.0	0.0	0.0
	0.0	0.0	0.0	0.1
	-0.2	0.0	0.0	-10.5
	0.0	0.0	0.0	0.0
	0.7	0.0	0.1	0.4

Changes in shares of global GDP 1995 - 2011

Other --> Developed



BRI(C)S --> Developed



	Demand		
Developed	0.5	0.0	0.2
USSR influence	-7.5	0.2	0.2
BRI(C)S	0.1	0.8	0.2
	0.3	0.1	2.8

JPN, Tigers	0.1	-0.2	0.0	0.0	-10.5	0.0	0.4
SSA	0.0	0.0	0.0	0.0	0.0	0.4	0.0
China	0.2	0.7	0.0	0.1	0.4	0.0	5.7

A summary of global structural changes

- Developed world, including Japan + Asian Tigers shrinks relative to the rest of the world (less developed): the global income distribution is shifting
- Within major global groups, services and other sectors are responsible for the large shifts (this is mostly domestic)
- Between major global groups, manufacturing and resources are leading in terms of structural change

- Global value chains do seem to make an impact

What about Science, Technology & Innovation?

- Is the rise of the South also visible in terms of innovation systems? Do we see a rise of the South in STI indicators as well?
- I use Fagerberg's diagrams as a reference frame: GDP per workers vs. R&D intensity and patent intensity (patents over exports)
- Both R&D and patents are STI oriented and largely ignore other aspects of the innovation process, but R&D includes more elements of adaptation and "imitation"



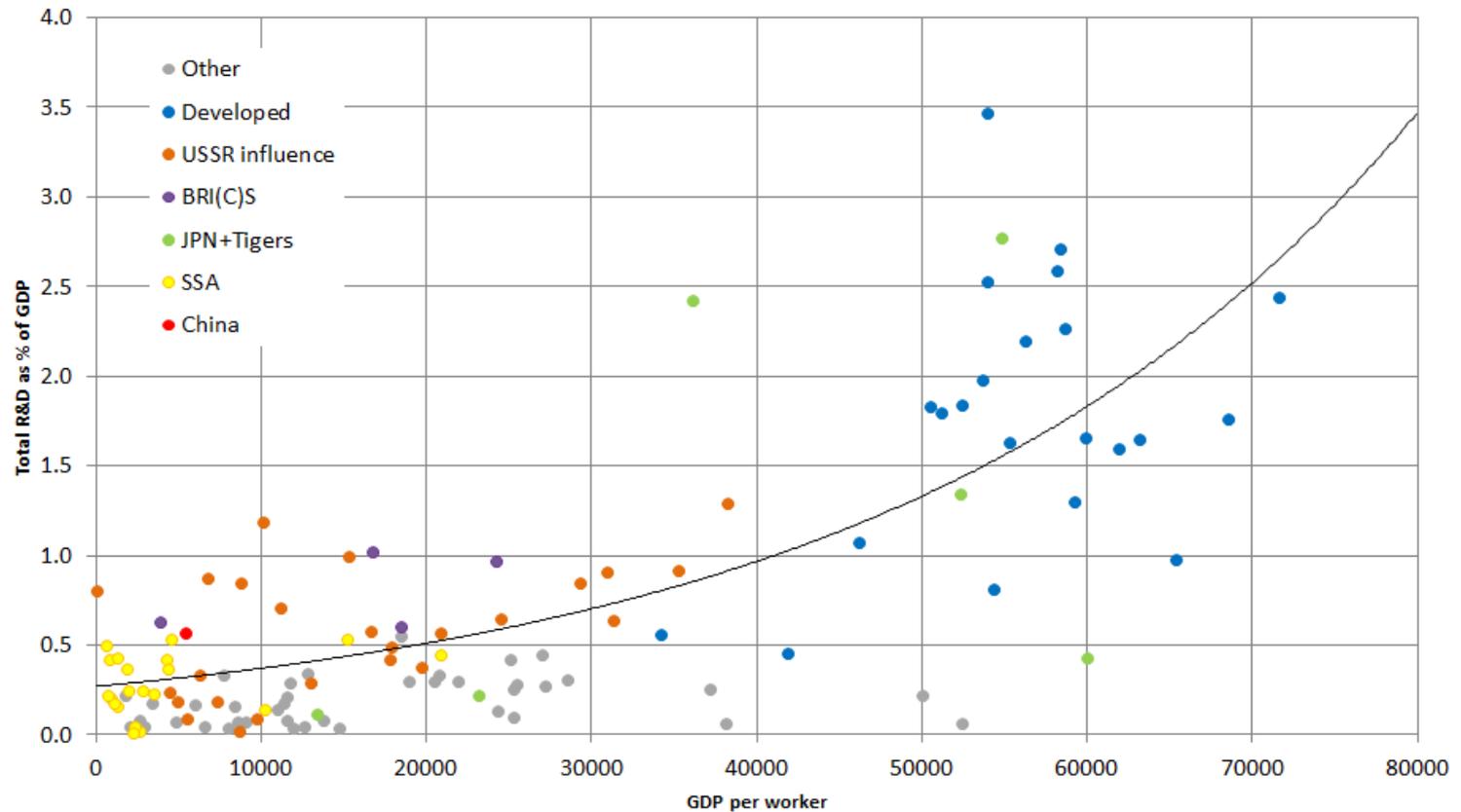
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R&D intensity vs GDP per worker, 1995



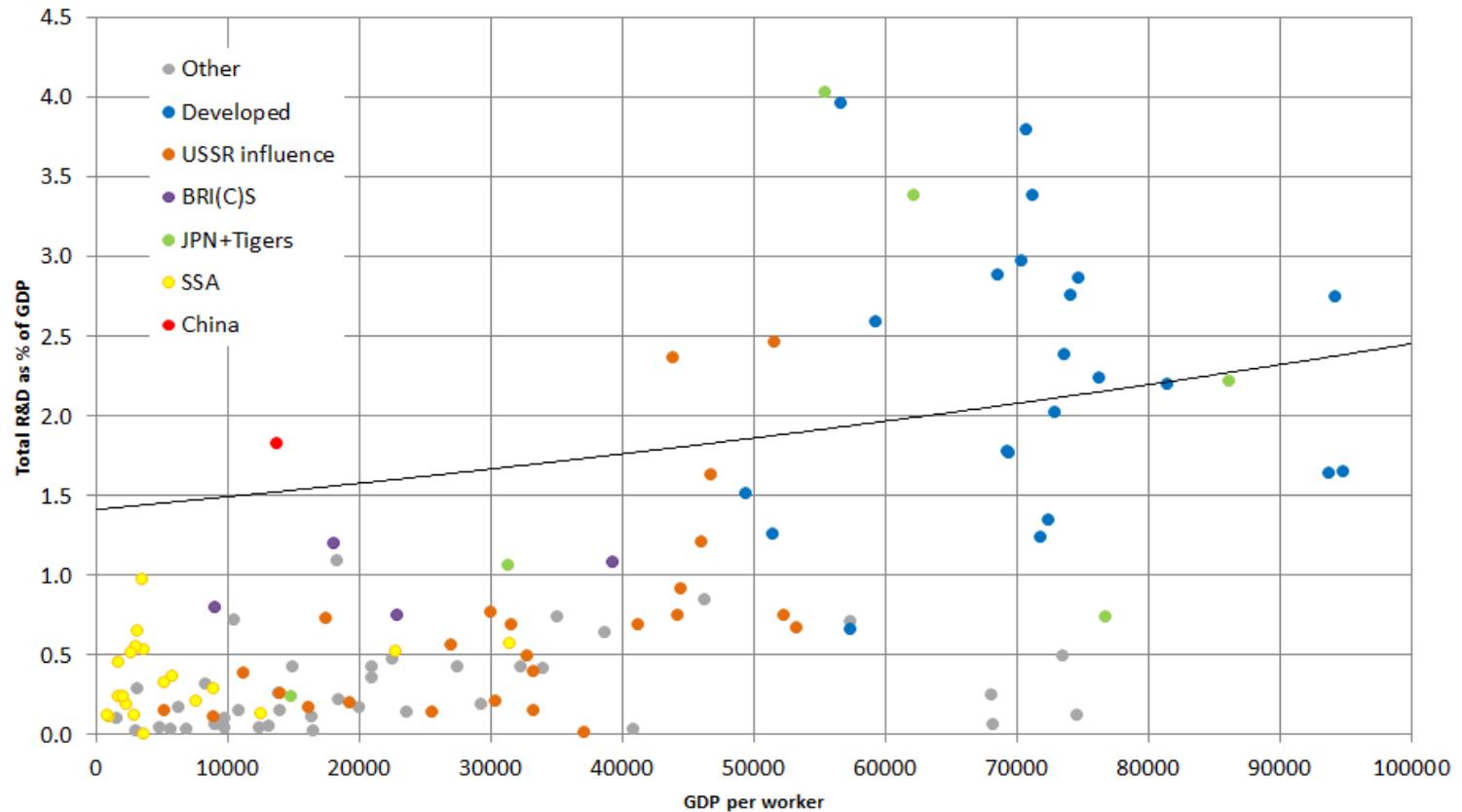
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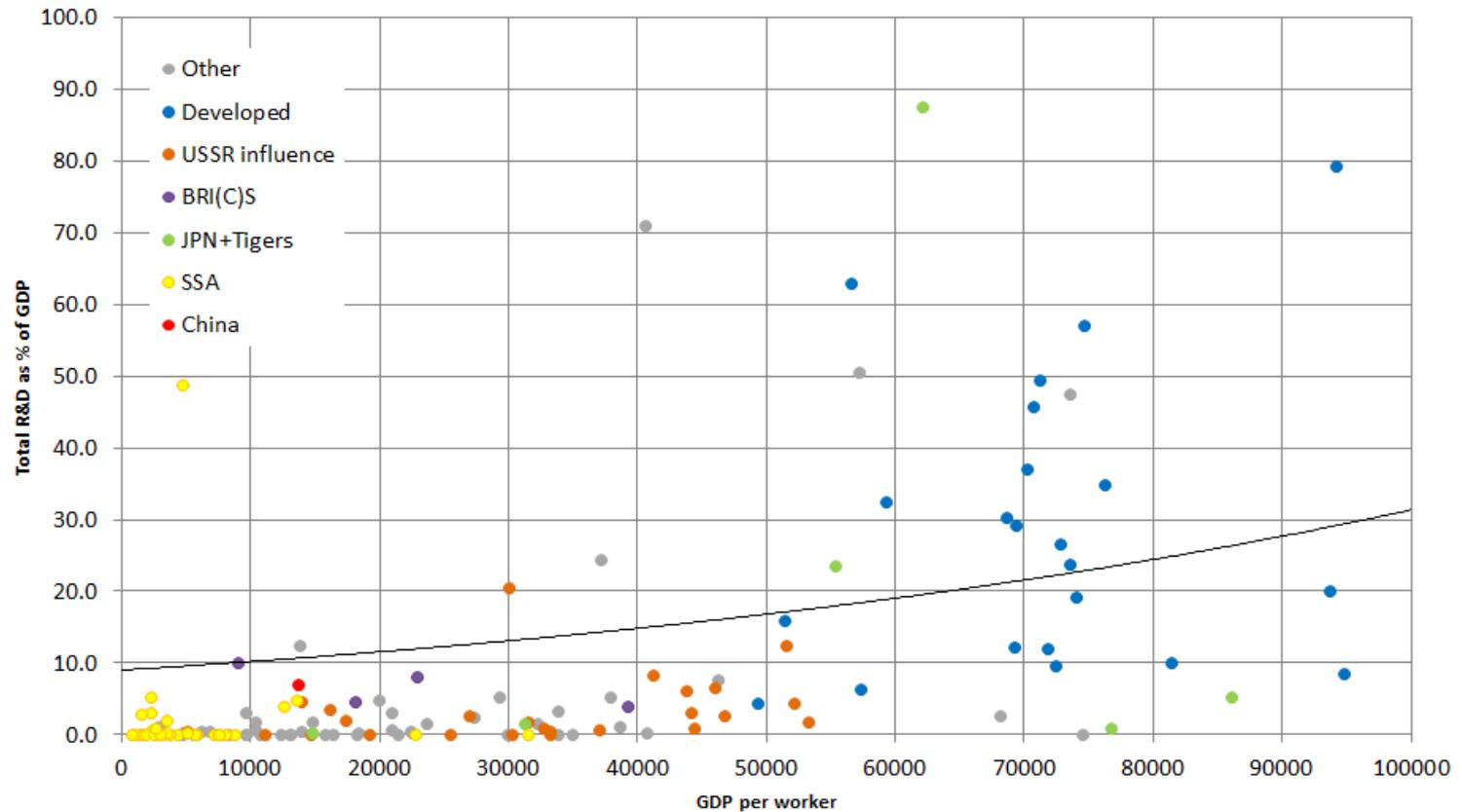


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R&D intensity vs GDP per worker, 2011



Patents per \$ export vs GDP per worker, 2011



Conclusions on innovation systems

- The dichotomy between North and South in terms of “hard” STI indicators is, if anything, becoming larger over the period 1995 – 2011
- But some countries in the global South are intensifying their efforts in STI
- This raises the question whether the global re-distribution of 1995 – 2011 is sustainable: the big push in terms of STI remains to be made in many countries that are lagging behind the frontier

An attempt at concluding

- Many global factors were at work during 1995 – 2011, the emergence of global value chains was one of them
- There is some cautious evidence that during this period, the global income distribution has shifted somewhat in favour of the developing world
- China is a major factor in this process, but there are also other countries that are catching up
- Manufacturing and resources remain the driving sectors of the international part of this catching-up process, but the services sector is a major factor behind domestically-sourced growth, also in developing countries
- The convergence process is generally not accompanied by a major shift in terms of STI efforts (this remains mostly a developed nations activity)
- We need to investigate the role of Science and Technology in developing nations' Innovation Systems (e.g., the project on African dependence that we are carrying out at UNU-MERIT)