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Workshop on National and International Intellectual Property Practices and Policies: Assessing the Impact of Political, Economic and Technological Pressures

December 11, 2015

UNEDITED TRANSCRIPT

*This is a transcript of a proceeding of a Workshop on **National and International Intellectual Property Practices and Policies: Assessing the Impact of Political, Economic and Technological Pressures** prepared by the Federal News Service / ASC and is not an official report of the National Academies of Sciences, Engineering, and Medicine. Opinions, statements, and presentation materials included in the transcript are solely those of the individual participants at the workshop and are not necessarily endorsed or verified as accurate by the Academies.*

Planning Committee for Patent Reform in Brazil, Russia, India, China, and South Africa and the Impact on Intellectual Property Rights in the United States: A Workshop

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Workshop on National and International Intellectual Property Practices and Policies: Assessing the Impact of Political, Economic and Technological Pressures

AGENDA

December 11, 2015

The Lecture Room
National Academy of Sciences Building
2101 Constitution Avenue, NW Washington, DC

8:30 AM **Coffee and Breakfast Available**

8:45 AM **Welcome**
Alan Wolff, Co-chair, Innovation Policy Forum

8:50 AM **Introductory Remarks**
Richard Johnson, Chair of the Workshop Planning Committee

9:00 AM **Panel I: Trends in Emerging Markets, IP, and Technology**
Moderator: Richard Johnson, Global Helix LLC

Trends in Economic Growth, Exports, and Trade in Emerging Markets
Simon Johnson, MIT and Peterson Institute

Economic Growth and the Service Sector in Emerging Markets
Ejaz Ghani, World Bank

Technological Changes
Gary Marchant, Arizona State University

Free Trade Agreements
Thomas Bollyky, Council on Foreign Relations

9:45 AM **Break**

10:00 AM **Panel II: The Impact of Social and Political Trends on IP**
Moderator: E. William Colglazier, AAAS

New Climate Policies and Technology Transfer
Devinder Mahajan, Stony Brook University/Brookhaven National Laboratory

The New Politics of Pharmaceutical Patents in Developing Countries
Ken Shadlen, London School of Economics and Political Science

Open-Source Science, Big Data, and Collaborative Innovation
Katherine Strandburg, NYU School of Law

New Technologies, Fairness, and Cross Border Issues
Margo Bagley, University of Virginia School of Law

11:15 AM Q&A

11:30 AM **Panel III: Roundtable on Regional and Global Changes**
Moderator: Q. Todd Dickinson, Novak Druce Connolly Bove + Quigg, LLP
Panelists:

- *Peter Yu, Texas A&M University School of Law*
- *Nicholas Vonortas, George Washington University*
- *Aisha Salem, IP Attaché for the Middle East and North Africa, U.S. PTO*
- *Michael Lewis, IP Attaché for Mexico, Central America, and the Caribbean, U.S. PTO*
- *Don Townsend, IP Attaché for Russia and the Commonwealth of Independent States*

12:30 PM Q&A

12:45 PM **Working Lunch**

1:30 PM **Panel IV: Global Pressures and the Economics of Intellectual Property**
Moderator: William Bonvillian, MIT

The Significance of IP Chapters in Recent Regional Trade Agreements
Keith Maskus, University of Colorado

Emerging Models of Patent Ownership
Timothy Simcoe, Boston University

IPR and Global Technology Markets
Daniel Lederman, World Bank

2:30 PM Q&A

2:45 PM **Break**

3:00 PM **<u>Panel V: IP Institutions and Technological Change</u>**
Moderator: Brian Kahin, CCIA and University of Washington

Private and State Interests in High Tech IP
William Janeway, Warburg Pincus

The Role of Government Incentives and Subsidies
Nicholas Vonortas, George Washington University

Information Technology and Biotechnology Challenges to IP Frameworks
Arti Rai, Duke University School of Law/Duke Law Center for Innovation Policy

4:00 PM Q&A

4:15 PM **<u>Panel VI: Final Roundtable: What are the Implications for the U.S.?</u>**
Moderator: Richard Johnson
Panelists:

- *Walter Valdivia, Brookings Institution*
- *Alan Marco, U.S. PTO*
- *Rodney Ludema, U.S. State Department*

5:15 PM **Adjourn**

WOLFF: Good morning.

This workshop is being conducted under the auspices of the Innovation Policy Forum of the National Academies as a joint venture of the Board on Science, Technology and Economic Policy, the STEP Board, and the Committee on Science, Technology and Law.

I particularly want to thank our sponsors today from the private sector, IBM, the Director of National Intelligence, the U.S. Economic Development Administration of the Commerce Department and the Office of Naval Research for their very strong support. We welcome it and we need it.

Today's topic could not be more timely. If you look at this morning's Washington Post, the lead story is about intellectual property and international agreements. How often does that happen? Not very.

This story is about Congressional consideration of the Trans-Pacific Partnership, TPP. There are serious Congressional concerns about two IP issues, one of them related to pharmaceuticals, the other to tobacco —- issues that happen to involve the Majority Leader of the Senate and the Chairman of the Senate Finance Committee. These are not negligible individuals when it comes to trying to get a trade agreement through Congress.

As you may know, the trade ministers of twelve Pacific Rim countries came together in early November and concluded in an agreement. These countries represent 40 percent of global GDP, not an insignificant figure.

Six other countries are interested in joining. They are Korea, Indonesia, Thailand, Philippines, Colombia and Taiwan. And China has been following the negotiations closely, to evaluate whether it might come in at some point.

TPP may well form a foundation for the international rules that will govern most of world trade in the future, and will already cover a substantial part of world trade. For this to occur, Congress must approve TPP, and in turn, for that to happen, several issues need to be addressed by the Administration. What are the issues?

One of them is the period of data protection for biologics (pharmaceuticals derived from living organisms). In the United States, the period for data exclusivity is 12 years, in Europe, it's 10 plus one, in Japan and in Canada, it's eight years and in a number of other countries it is five.

And in several of the TPP parties, there is no period for data exclusivity.

After TPP is signed in February -- and implemented -- the period of data exclusivity is going to be a minimum of five years, which the administration argues might be eight, but that is a point that is in dispute.

The question presented is how to balance between what is needed to give an incentive for innovation versus the interest of generic producers in introducing biosimilars into the market. The trade-off is between innovation, without which new drugs would not be created in the first place, and making medicines more broadly available.

The United States' position is that 12 years of data exclusivity for test data is necessary; that this period strikes the correct balance. As the United States is the most innovative country in the world with respect to these drugs, that is where we believe the balance lies.

The U.S. negotiators did not convince many of the other participants to move one iota. So, it is now an issue with the Congress and it will not go away.

Another IP issue in TPP concerns tobacco. TPP contains a carve-out for tobacco control measures from investor-state dispute settlement. When an investor goes in, it is welcomed into a country and then something is taken from it, the question is does it get to have a right of arbitration? And in the case of tobacco, the answer is "no". Mitch McConnell and a number of senators from the Southeastern part of our country are deeply concerned about this denial of due process.

Separately, outside of TPP, for example in the U.S.-China bilateral investment treaty, there are also many IPR issues that are going to be addressed.

In short, this meeting could not be more timely. In each international negotiation, as well as in consideration of domestic law, there are questions of privacy, there are questions of health, there are questions of public safety that are intertwined, and as Brian Kahin mentioned to me this morning, they are all too often dealt with in silos.

What we are trying to achieve today with our distinguished panels -- of which there are many, so you have to stay focused -- is to break down those silos, and talk in one forum about the numerous policy issues that arise.

I will now turn to Richard Johnson who chairs the Planning Committee for this workshop to get us started on today's busy agenda. Each one of today's panels deserves a -- really an entire day of discussion.

I look forward to today's workshop giving us a overview of the important issues surrounding the forces that are shaping international IP practices; I am sure that it will.

Dr. Johnson, please proceed.

PANEL I

R. JOHNSON: Well, thank you, Alan.

Good morning. Welcome, everyone. Thank you for taking the time.

So, what the planning committee is really interested in doing is having two overarching goals addressed today. One is really to be thinking about how do we fully understand the full range and interplay of different technological, economic -- other trends that are occurring outside the United States in terms of how they're affecting both intellectual property internationally, but also domestically for us.

And so, how does this sort of factor recalibrate how we think about some of the U.S. national interests, about policy making and different components of it?

So, we've tried to come at this in -- in a number of different ways. We've -- as you see from the lineup, we have a terrific group of -- of experts to -- to address this.

So, the way we structured the workshop is into six modules. We're going to have an introductory sort of context setting, presentations now in terms of technology developments, economic developments, some of the new trade agreements that Alan was just mentioning.

The second panel that Bill Colglazier is going to chair is going to examine some of the impact of key social and political trends that are influencing intellectual property rights. Todd Dickinson's then going to chair the final morning round table discussion about regional and global challenges.

And -- and we're particularly pleased that this week, a number of the PTO IP attaches are joining the workshop. And so, we really want to draw on their expertise and the insights of what they're seeing at their different posts around the world to also help to inform our discussion.

We're going to have a very short lunch break. After lunch, Bill Bonvillian is going to chair a panel that's going to look at global pressures and how that is reshaping some of the economic and business models related to intellectual property.

Brian Kahin's going to take us through with his group some of the cutting edge, new developments, both in technology but also around IP institutions and evolving policies.

And then finally, we're going to have a wrap-up discussion at the end of the afternoon about what does this all mean for the United States and for how we have to be thinking about these interests, not only in terms of broader U.S. strategic national interests, but a range of other policy and diplomatic approaches and positions.

So, we have a lot of speakers. We want to keep everyone on time. We're not going to introduce people or bios. The bios are in your background, so it'll just be introductions of the individual speakers.

And then finally, before we get started and conserve our time, just in addition to thanking Alan, just wanted two particular groups of folks to thank besides our sponsors that Alan acknowledged.

And the first one is the rest of our Planning Committee – Bill Colglazier, Rochelle Dreyfuss, Brian Kahin and Keith Maskus. So, they have really been instrumental in pulling together how we approach these issues, the speakers and then the shaping of what I think is turning out to be a really interesting set of topics.

And then finally, obviously the -- the National Academy staff, without whom none of this would happen, and particularly Gail Cohen and Anne-Marie Mazza, who I hope can join us in the afternoon, as well as Gail staying throughout the day, of course.

So, let's get started immediately. And so, our first speaker is Simon Johnson, who most of you know from both the Peterson Institute and from MIT; and I'll turn it over to Simon.

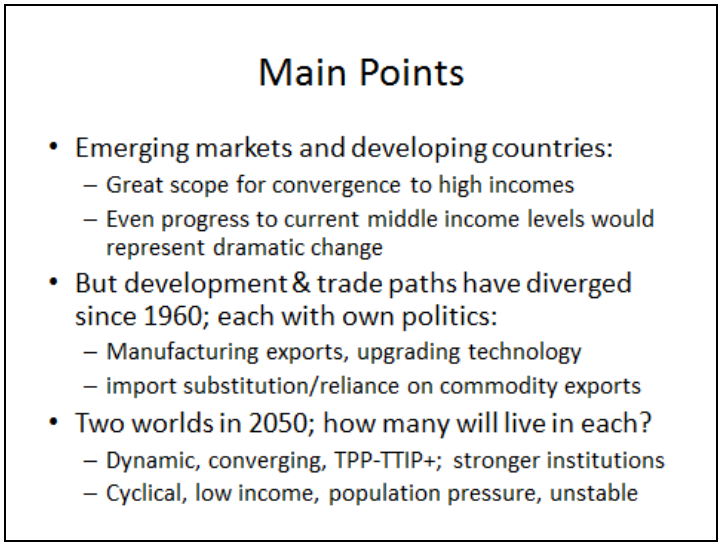
S. JOHNSON: OK. Thank you. Thank you very much, Richard.

So, I have 12 minutes to talk about the entire world of emerging markets in the context to try and convince you that we are in the middle of what I suggest we call the second great divergence, and if you don't -- it's going to be a long day in here, a lot of presentations.

At the end of the day, somebody might say to you, "What did Simon Johnson say?" As long as you say, "I don't know, but something diverged."

As long as you remember divergence, we've got a good start on something.

So, my three main points are that emerging markets and developing countries have at this moment still great potential for converging towards higher incomes and higher standards of living.



Presentation of Simon Johnson, 12/11/2015

And even if they make relatively modest progress towards what are considered standard income levels in middle-income countries, that would still be an amazing change over the next 30 or 40 years in many things, including how technology is developed and deployed around the world.

However, I think what we are seeing – and we should recognize a real divergence between two paths. This is not a recent divergence, but it's a divergence that continues and I think will be more evident over the next five years than it was over the last five years.

On one path, we have countries that have chosen to focus on manufacturing exports and countries that have upgraded their technology and moved towards wanting to develop their own intellectual property, issues Ambassador Wolff was absolutely right in flagging just now.

On the other hand, we have a set of countries that preferred what was in the past called import substitution. Now we may call it more reliance on commodity exports.

This path has had trouble delivering sustained increases or sustained convergence towards a higher income level. There is some drift upwards in income levels in most countries, but convergence we have not seen as much on that second path.

I think we're going to see two worlds in 2050. One will be dynamic, converging towards the U.S. – not by any means reach the U.S. It'll be about the Trans-Pacific Partnership plus the TTIP, the Transatlantic Trade and Investment Partnership, plus other similar plurilateral agreements may be expanding around TTP as the ambassador just said. And in these countries, we'll see stronger institutions, better rule of law, better protection for intellectual property, on some terms still to be determined.

The other set of countries will be cyclical. They'll go up, they'll go down; they'll be relatively low-income on average. There's going to be a lot of population pressure in those countries and those countries, I can assure you, are going to be unstable by every definition of the word.

The latest growth projections -- the IMF puts out these numbers consistently twice a year, so you can look at them. I think that the general story of world growth has been slow since the great financial crash and the recession of 2008, 2009. It's been slowing down even further since then.

Latest Growth Projections (IMF): Weak Global Growth, Slowing Down

	2016 (as projected in April)	2016 (as projected in Oct.)
World	3.8	3.6
United States	3.1	2.8
EU	1.6	1.6
Russia	-1.1	-0.6
China	6.3	**6.3**
India	7.5	7.5
Brazil	1.0	**-1.0**
Nigeria	5.0	4.3

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Brazil is a place where you can see this somewhat more dramatically. I also highlight the Chinese number because it's questionable, the sort of corner -- the cornerstone of this view is the world is slowing down in part because China's slowing down and in the IMF forecast, China is not slowing down. That just tells you something about the politics of forecasting.

Emerging markets are -- you know, irrespective of what you think about in the short-term picture, they are between 40 and 50 percent of today's GDP, depending on whether or not you like you to take a purchasing power parity approach or whether you want to use market exchange rates.

"Emerging Markets": 40-50 percent of World GDP

Composition of world GDP in 2014 (source: IMF's spring 2014 WEO)

	GDP in 2014		GDP in 2014	
	In current prices, using market exchange rates	As percent of world GDP	Using PPP weights, in IMF spring 2014 WEO	As percent of world GDP
	(Billions of dollars)		(Billions of dollars)	
World GDP	76,776.01		91,093.12	
Advanced economies	47,121.07	61.37	44,766.07	49.14
United States	17,528.38	22.83	17,528.38	19.24
European Union	18,451.08	24.03	16,773.34	**18.41**
euro area	13,416.04	17.47	11,668.66	12.81
Germany	3,875.76	5.05	3,338.02	3.66
Japan	5,020.91	6.54	4,968.13	5.45
Emerging market and developing	29,654.94	38.63	46,327.05	50.86
Emerging and developing Asia	14,481.80	18.86	24,420.66	26.81
China (before latest ICP release)	10,027.56	13.06	14,625.21	**16.06**
India	1,995.78	2.60	5,425.43	5.96
Sub-Saharan Africa	1,401.67	1.83	2,405.72	2.64
Middle East and North Africa	3,273.85	4.26	4,575.02	5.02
Latin America and Caribbean	5,697.30	7.42	7,819.47	8.58

PPP is Purchasing Power Parity – adjusting for price level differences

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If anything, actually, using the purchasing power parity approach, the Chinese contribution to world GDP is probably understated (13 – 16%). They don't want their number to appear too high. So, it's between 16 and 20 percent of world GDP if we were to calculate that correctly.

But there's no question that emerging markets are a force to be reckoned with as a market, as a source of innovation and politically.

Now, the point I would emphasize is the scope for further convergence in GDP per capita. We have pretty good numbers on relative GDP per capita going back to at least the beginning of the 1960s, which turns out to be a critical moment in the story that I'm telling. And the country that I would focus on perhaps as the most dramatic -- as representing a set of countries with the most dramatic success over this period is South Korea.

Considerable Scope for Further Convergence in GDP per capita

GDP per capita (index, with US=100)

	2011		1961	
	Based on PPPs	Based on exchange rates	Based on PPPs	Based on exchange rates
USA	100.0	100.0	100.0	100.0
Western Europe			52.8	39.1
Germany	82.3	89.1		
Italy	68.0	72.7		
Spain	64.6	63.3	18.4	11.5
Portugal	51.6	45.0	13.7	8.6
UK	70.5	78.8		
Russia	45.2	26.7	35.3	29.3
Japan	68.8	92.7	22.0	13.7
South Korea	**58.3**	45.0	**5.7**	3.8
Singapore	145.2	102.9	19.8	13.2
Malaysia	42.0	20.0	19.8	13.2
China	**20.2**	11.0	**6.0**	3.0
India	9.5	3.1	5.0	2.5
Brazil	29.4	25.9	13.4	9.6
Nigeria	6.3	3.1	4.8	3.0
Guinea-Bissau	2.7	1.3		
Africa			5.9	3.6

Source: World Bank for 2011, Rosenstein-Rodan for 1961; Russia in 1961 is USSR

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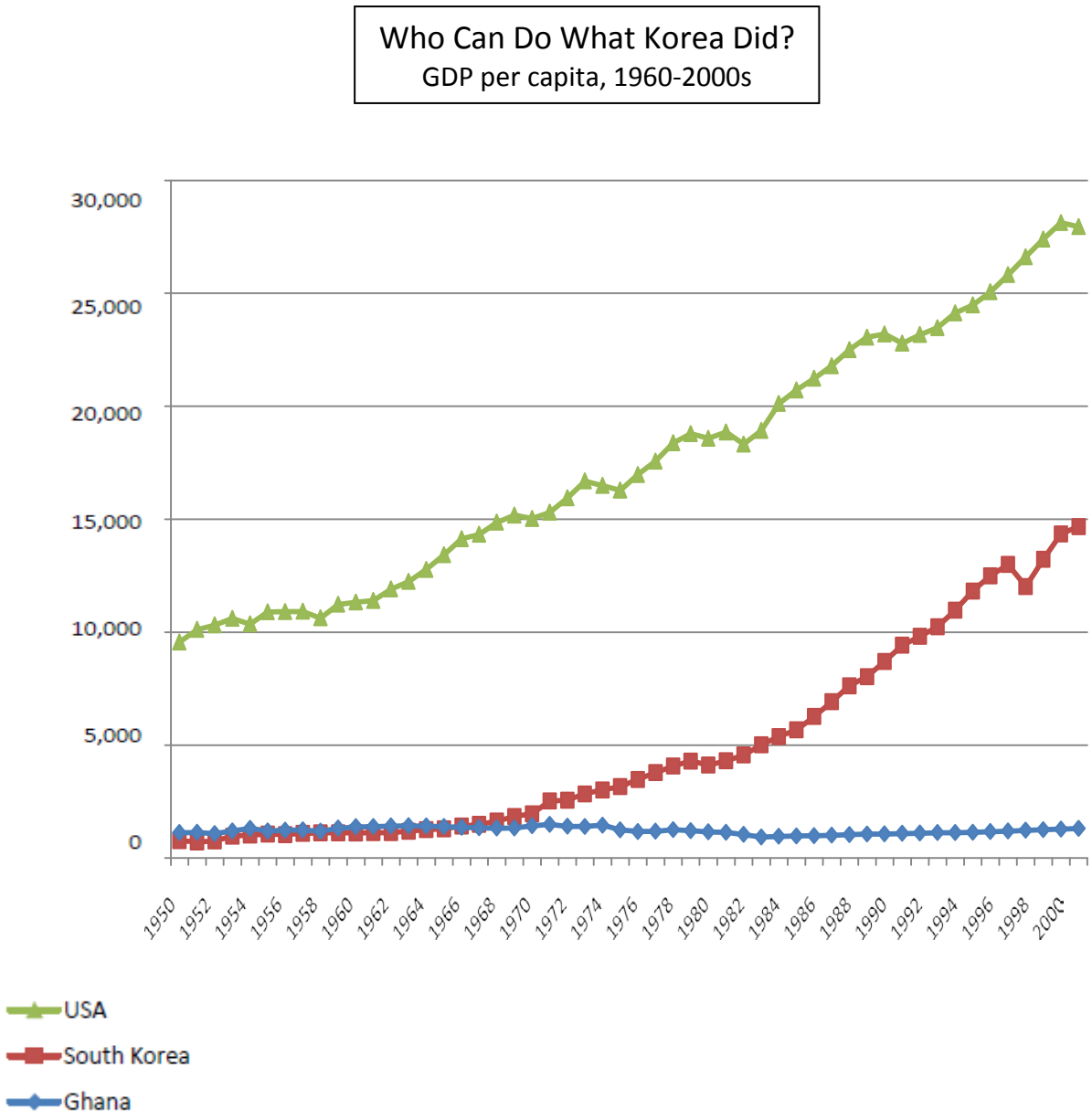
So, South Korea's GDP per capita relative to the United States -- there's an index where the U.S. is equal to a hundred — their GDP per capita was about four or six -- between four and six percent of the U.S. in 1961. It's now between 45 and 60 percent of the U.S.



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Now, that's an amazing transformation for a pretty decent sized country. Not a city, not a small region, but a country, and a country that started off without good conditions for economic development.

My wife's family is from Korea and I can tell you that all their personal histories, all their anecdotes confirm what you see in the data, which is in the 1950s, South Korea was poor, there was a serious disease burden; they received a lot of U.S. aid, it's true, but there was a massive amount of corruption; there was no dynamic, there was no growth, talented people wanted to leave. There was no thought of developing technology in South Korea; that would've been crazy.

Now South Korea is transformed and the question is who can today do what Korea did? And I'm sorry to pick on Ghana if there are any representatives of Ghana here. We could do this with many other countries.

Ghana is interesting because in the 1950s, there were experts who said Ghana had greater economic potential than South Korea did. Perhaps they were right about the potential. They were wrong about the outcome.

So, South Korea has reached at least around half the U.S. income per capita. There's a dynamic there, there are global companies, there's technology development. I believe South Korea will join the TPP and I believe that will be good for them and I believe that will be good for the United States.

So, who can do this? Who can start from a relatively weak place without what you would think of as being the preconditions and make something out of that? How do you do it?

Well, in part, it helps to have robust, growing global trade; there's no question about that. And this is a nice picture from the Wall Street Journal where they compared world trade to world GDP back to -- from 1950 when the ratio was about one up to today when the ratio is about four, and you can see there have been some stops and starts.

What Next for Global Trade?
TPP + TTIP + China (?)

Slide redacted; see Grep Ip's chart "The Long, Steep Path to Freer Trade" published in the Wall Street Journal, "Why Critics Are Misguided in TPP Misgivings," October 22, 2015, p. A2 (available online at http://topics.wsj.com/documents/print/WSJ_-A002-20151022.pdf)

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There was a lot of concern about whether trade was going to continue grow -- to grow in the 1980s, for example. Part of the dynamic that you see here is European Union development and integration; that's part of what we pick up in the trade data.

But there's also a big opening to trade across borders, across distances, across the Pacific Rim. And here is perhaps the money picture of my presentation, at least, which is exports as a share of world total – a nice graphic taken from the Economist -- taken from UNCTAD via the Economist – emerging East Asia, which is the Pacific Rim countries, including China, compared with Sub-Saharan Africa. And you can see that the emerging East Asia, at least the way we draw this graph, crosses Sub-Saharan Africa sometime in the mid-1970s.

The Second Great Divergence:
Development & Trade Paths, from 1960

Slide redacted, see The Economist's chart "Failure to launch" published on November 7, 2015 "Industrialisation in Africa: More a marathon than a sprint" (available online at http://www.economist.com/news/middle-east-and-africa/21677633-there-long-road-ahead-africa-emulate-east-asia-more-marathon)

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That dynamic dates from the early 1960s. It's about manufacturing exports and it's about the development of that strategy and the sustained nature of that strategy compared to what we've seen in Sub-Saharan Africa, with very few exceptions in Sub-Saharan Africa.

I just finished co-directing a large NBER project on what we called African successes. We have four volumes appearing next year from the University of Chicago Press and we were very generously supported by the Gates Foundation.

We looked for success and we documented and we found and we were very, very much accentuating positive stories from Africa. But we didn't find export dynamism, we didn't find manufacturing takeoff in anything like what we've seen in East Asia.

To further emphasize that point and also to pick up on something the ambassador said in opening, this is a graph the Economist adapted from a paper by Justin Lin, the former chief economist of the World Bank, where he looked at exports by sector for a few East Asian countries versus sub-Saharan African countries. I mean, there was some subjective criteria here, but I think the basic intuition is right.

Two Paths for Exports

Slide redacted, see The Economist's chart "A blessing and a curse" published on November 7, 2015 "Industrialisation in Africa: More a marathon than a sprint" (available online at http://www.economist.com/news/middle-east-and-africa/21677633-there-long-road-ahead-africa-emulate-east-asia-more-marathon)

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He looked at the composition of exports between commodities lightly processed, low-tech, medium-tech and high-tech. And he looked at some of the East Asian countries – Singapore, Taiwan, South Korea – and he looked at some African countries listed there.

And what he showed, and I think this is absolutely true, is that the African countries have stayed roughly where they were in terms of technology level – maybe a little bit higher for Nigeria over the past 30 years – whereas the East Asian countries have moved absolutely up some sort of technology ladder and their exports have become consistently more high-tech than they were 30 or 40 years ago.

This is a divergence. This is a sustained and substantial divergence.

Now, the big questions, I think, within this are the following. What happens to India? Will -- can India converge -- converge with whom?

Well, India, if you had a chance to glance at my earlier slide on where they are relative to U.S. GDP, hasn't moved much since the early 1960s. If India could get from where they are today to where China is today, about 20 percent of the U.S. income per capita level, that would be a big transformation.

What are the odds of that in India? Well, I think the odds are not as bad as commonly supposed.

The key question, of course, in all of these countries is, is there a pro-growth coalition? Do you have a set of business forces, social forces, political forces that want growth and that are willing to move aside the obstacles, regulatory hurdles and various kinds of problems -- acquiring land, the problems with transferring property and so on? It's a long list.

This is a nice picture that -- that again comes from UNCTAD via the Wall Street Journal, a set of pictures showing that if you pick your moment of liberalization of India as the early 1990s, you can actually argue that India is on a path that's relatively similar to what China has experienced since 1978.

Can India Converge –
At least With China?
Is there now a pro-growth coalition?

Slide redacted, see Raymond Zhong's chart "Closing the Gap" published in the Wall Street Journal, "India Looks to Chinese Economic Model," Monday, September 15, 2014, p. A2 (available online at http://online.wsj.com/public/resources/documents/print/WSJ_-A002-20140915.pdf)

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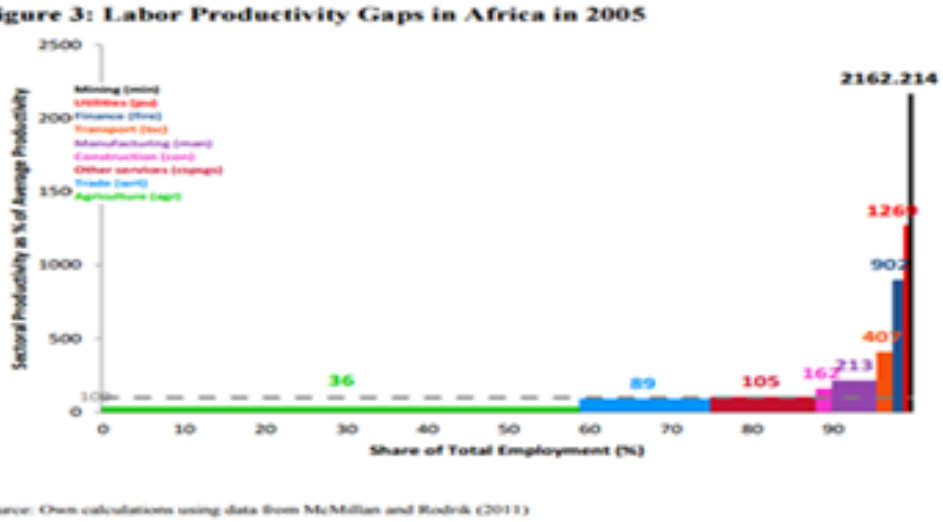
I wouldn't want to overdo that. I think the jury is still out on India, but this matters a lot in terms of the nature of the world we live in, certainly in terms of how many people live in the poorer parts of the world in 2050.

The big question for Africa I think is whether there's a technology change already being deployed that is changing Africa perhaps in a way that we haven't yet fully realized. And I think the one that would be the top of my list, top of most people's list is mobile phones.

Mobile phones and feature phones and now relatively cheap smartphones have been adopted in Africa much more than was initially anticipated. And there has been change in some parts of African society, again, much more than was anticipated. This is about the adoption of technology, not just hardware, but also software; M-Pesa, the money transfer system and the quasi banking system in Kenya would be, I think, the leading example of this.

Will Mobile Phones Change the Political Economy of Growth in Africa?



McMillan, M. and K. Harttgen, NBER Working Paper No. 2077, April 2014, Figure 3, available online at http://www.nber.org/papers/w20077.pdf. See also *The Economist*'s chart "Misallocated people" published on November 7, 2015 "Industrialisation in Africa: More a marathon than a sprint" (available online at http://www.economist.com/news/middle-east-and-africa/21677633-there-long-road-ahead-africa-emulate-east-asia-more-marathon)

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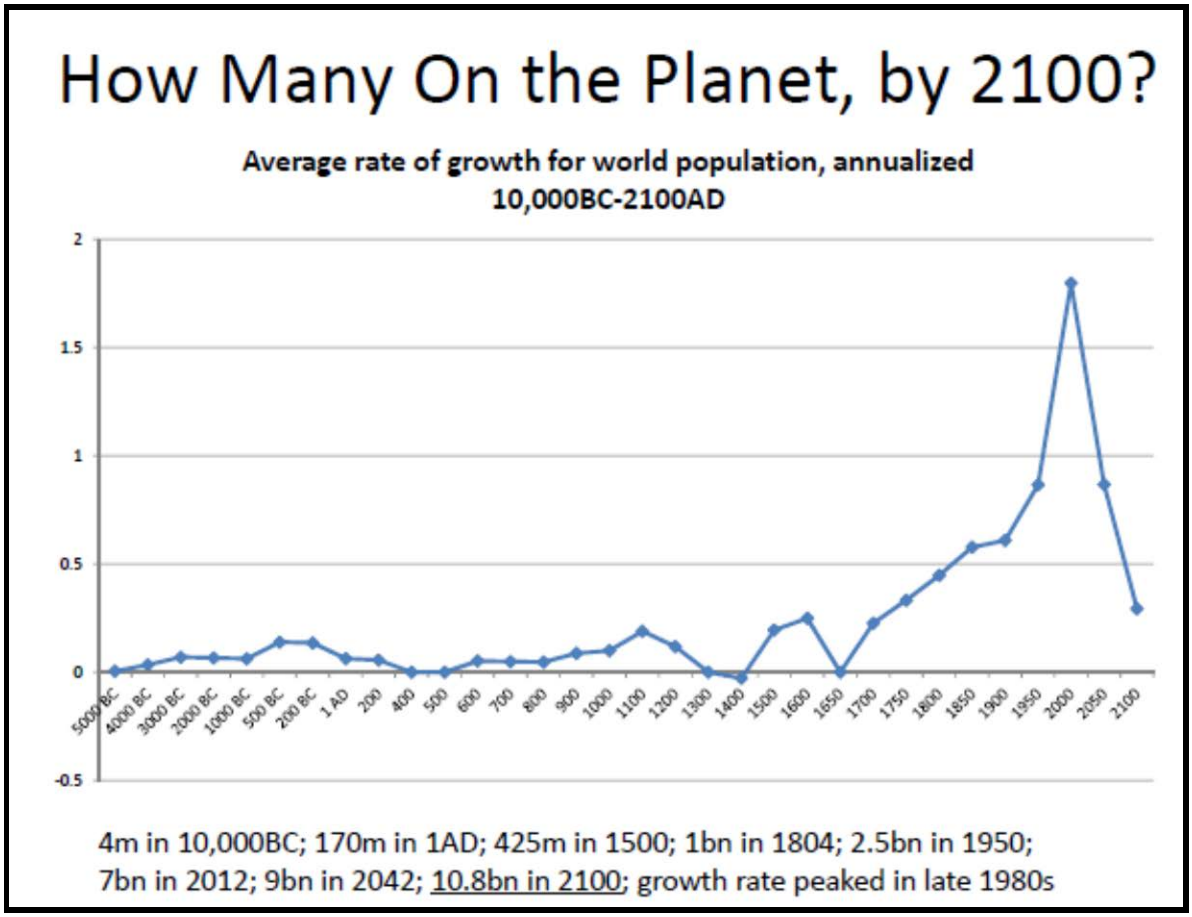
But it is a concern that even within Kenya, the amount of follow-on innovation on the M-Pesa system has been relatively limited, perhaps because the operator has a substantial monopoly at this point,

and also that the take-up of an M-Pesa type technology across other relatively poor countries has been much slower than it should've been, given the success that we see in Kenya.

So, these are questions, these are issues that hopefully we'll grapple with or you'll grapple with, we can all grapple with as we go forward. I don't yet see that transformation spreading higher productivity and -- and broader dynamism beyond telecommunications and beyond a relatively narrow set of services around telecommunications in Africa. I'll come back to that in a little bit more optimistic note in a minute.

You know, the big question of course is not just GDP and GDP per capita, it's population. We know that population growth around the world has slowed -- slowed since the 1980s. What we don't know is the rate at which fertility rates are going to come down in -- in today's relatively high fertility countries, which are, of course, almost entirely very poor countries.

Where is the population going to be in 2050? We know there's going to be about 1.2, 1.3 billion people in today's what we call developed countries, and we know there's going to be some accretion of the middle class in emerging markets, that's what will push that up to about 2 billion people living in and around relatively high income places. Although, of course, we can also talk about inequality in some of those places.



Presentation of Simon Johnson, 12/11/2015

A number of people living in less developed countries, living at income levels quite far from the U.S. GDP per capita, 10 percent, five percent of U.S. GDP per capita – that's going to be a big number. That's going to be at least seven billion, perhaps eight billion. The latest U.N. number suggested could be closer to nine billion people in poor places in 2050.

That's the optimistic scenario, I think, in terms of fertility decline, and we could talk about specific countries if you're interested.

Where Will They Live?

	Population, in billions			Share of total world population		
	2013	**2050**	**2100**	**2013**	**2050**	**2100**
World	7.162	9.550	10.853	100%	100%	100%
More developed countries	1.252	1.303	1.284	17%	14%	12%
Less developed countries	5.909	8.247	9.569	83%	86%	88%
Sub-Saharan Africa	0.901	2.074	3.816	13%	22%	35%
Nigeria	0.174	0.440	0.914	2%	5%	8%
Asia	4.299	5.164	4.712	60%	54%	43%
China	1.386	1.385	1.086	19%	15%	10%
Japan	0.127	0.108	0.084	2%	1%	1%
India	1.252	1.620	1.547	17%	17%	14%
Indonesia	0.250	0.321	0.315	3%	3%	3%
Pakistan	0.182	0.271	0.263	3%	3%	2%
Europe	0.742	0.709	0.639	10%	7%	6%
Russia	0.142	0.121	0.102	2%	1%	1%
UK	0.063	0.073	0.077	1%	1%	1%
Germany	0.083	0.073	0.057	1%	1%	1%
Latin America & Caribbean	0.617	0.782	0.736	9%	8%	7%
Brazil	0.200	0.231	0.195	3%	2%	2%
North America	0.355	0.446	0.513	5%	5%	5%
USA	0.320	0.401	0.462	4%	4%	4%
Oceania	0.038	0.057	0.070	1%	1%	1%

Source: UN; “more developed” means Europe, North America, Australia/New Zealand, and Japan

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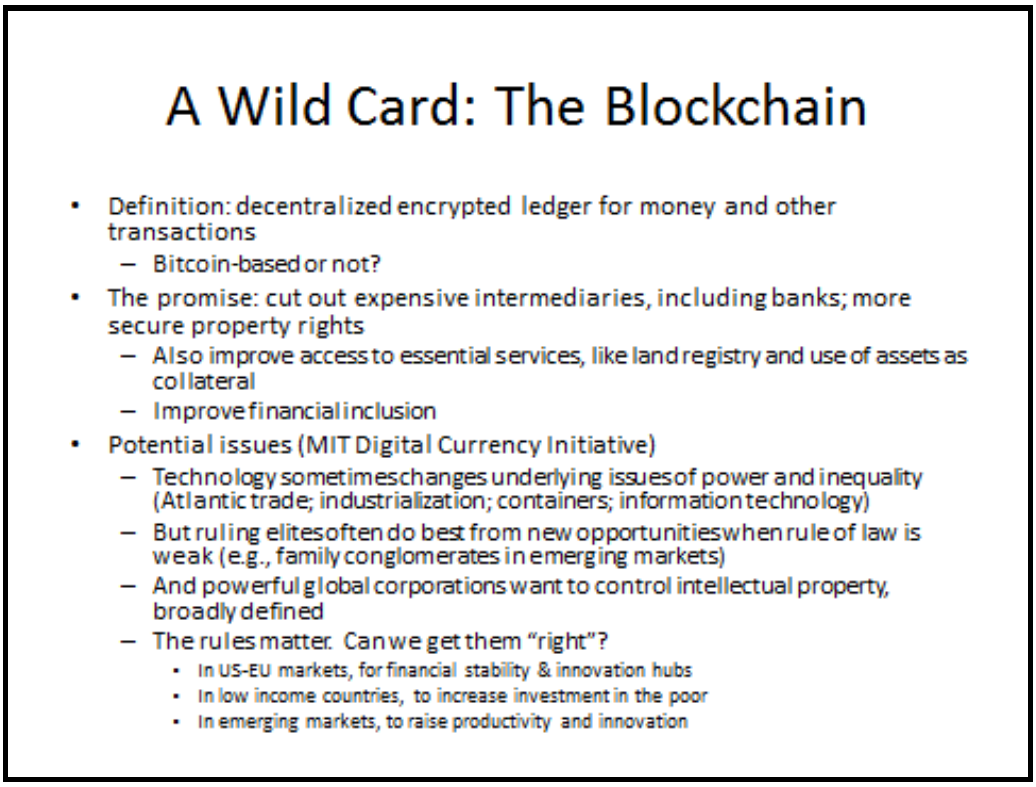
The last point, my last slide, is a wild card I'd like to throw into the mix for discussion today and going forward, which is, you know, is there another technology coming that will be transformative in terms

of the way opportunities are presented and the way that power is affected by industrial and service sector development?



Presentation of Simon Johnson, 12/11/2015

My contestant, just to put into the mix, is the blockchain, blockchain being the technology underlying bitcoin and other cryptocurrencies. It's some form of decentralized encrypted ledger for money and other asset transfers.

The promise here, of course, is that you can cut out expensive intermediaries and you don't have to rely as much on the banks, perhaps existing telephone companies, perhaps other intermediaries who are very positive, but who are unwilling to extend services to poor people, who are -- with their own view about how regulations should be run in financial markets and so on.

The problem, of course, is that technology -- I mean, I work at MIT and I need to be very careful -- technology rarely solves all our problems. It does change things, it does shift power one way or another. And we can think of big changes in economic history that have come from technology changes, including long distance trade across the oceans, industrialization, the development of containers and of course information technology more recently.

Very often, this technology gets taken up and held very tightly by people who are already powerful. And we don't know exactly what's going to happen with regard to blockchain, but perhaps because of its decentralized nature, we might be a little bit more optimistic.

There's also going to be a big fight about the intellectual property around the blockchain. Patents have already been filed; big players are lining up to contest this space. It's going to be a very hot topic within our emerging trade agreements and more broadly.

So, can we get the rules right? What will the rules be? Will these rules be conducive to financial stability and development of -- and continued development of -- strong innovation hubs in North America and the European Union and in Pacific Rim countries?

In low-income countries, do we get financial inclusion out of this? Do we allow the poor to use their property as collateral? Can they borrow against it in a way that's sustainable, in a way that works politically? That is a huge potential opportunity, but it's also a lot of risks there, as you know.

And in emerging markets in the set of countries that we're focused on today, does this kind of decentralized technology deployment raise productivity, improve access and ability to innovate and to develop new technologies?

Thank you very much.

(APPLAUSE)

R. JOHNSON: Thank you, Simon, for both provocative comments, staying to time and all of the other good things we can tell you about your presentation.

The -- our next speaker is Dr. Ejaz Ghani, who is lead economist from the World Bank who has looked at a range of -- a number of these different issues from different perspectives and recently has been looking extensively at some of the service sector issues in emerging markets as they may reshape some of the questions we're considering.

Dr. Ghani, thank you.

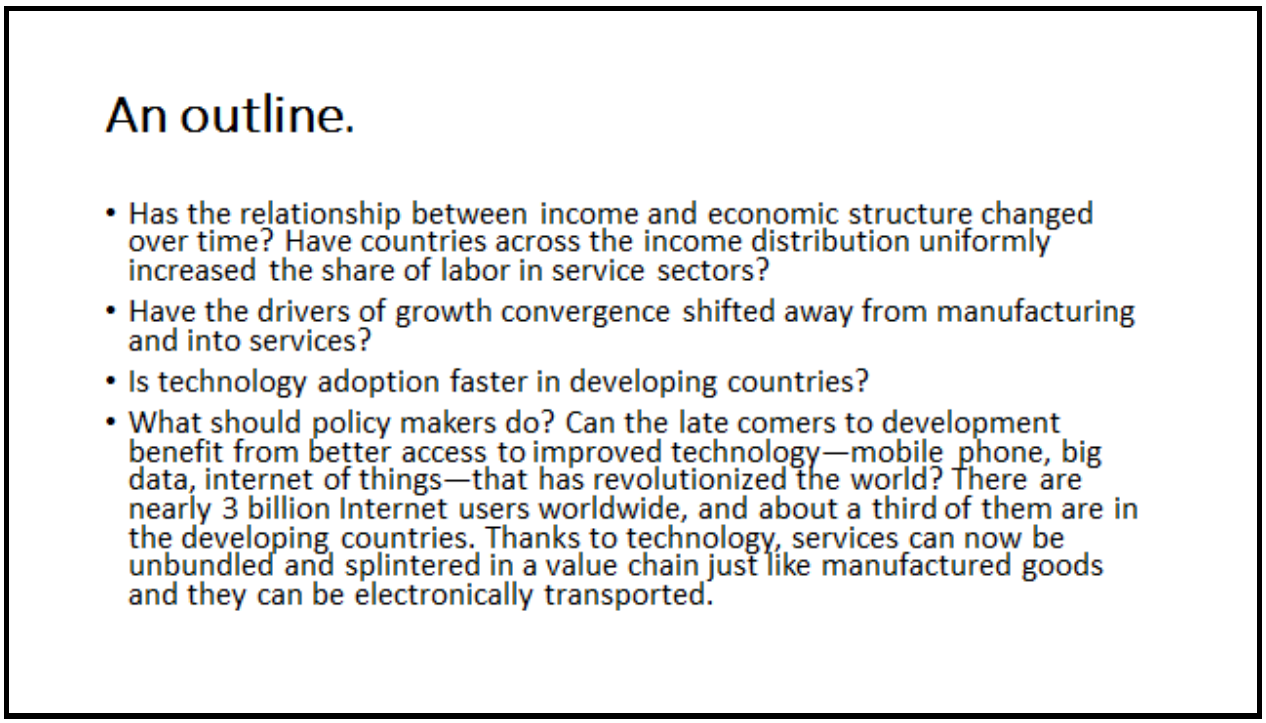
GHANI: Thank you very much, Richard.

I -- it's a great honor to visit National Academy of Sciences. And when I was asked to speak, I was actually thrilled and got a bit emotional because I thought, you know, technology reminded me of my high school days in India when I finished high school and my mother said, "Ejaz, now you must join a medical college."

I chose to do economics, and I was asking myself -- 20 years back in India, my parents were asking me to move to science and technology rather than a liberal arts. It's then that it signaled that there is something about technology that seems to be driving every mom and pop to encourage their children to move towards technology.

So, this is a difficult subject and it's -- it's even more difficult because what Simon has said is insightful, pathbreaking, but the evidence still seems to be mixed. And connecting the evidence to the global trends is, indeed, a difficult exercise.

So, here are a couple of questions that I want to ask, you know. Has the relationship between income and economic structure changed over time?



Presentation of Ejaz Ghani, 12/11/2015

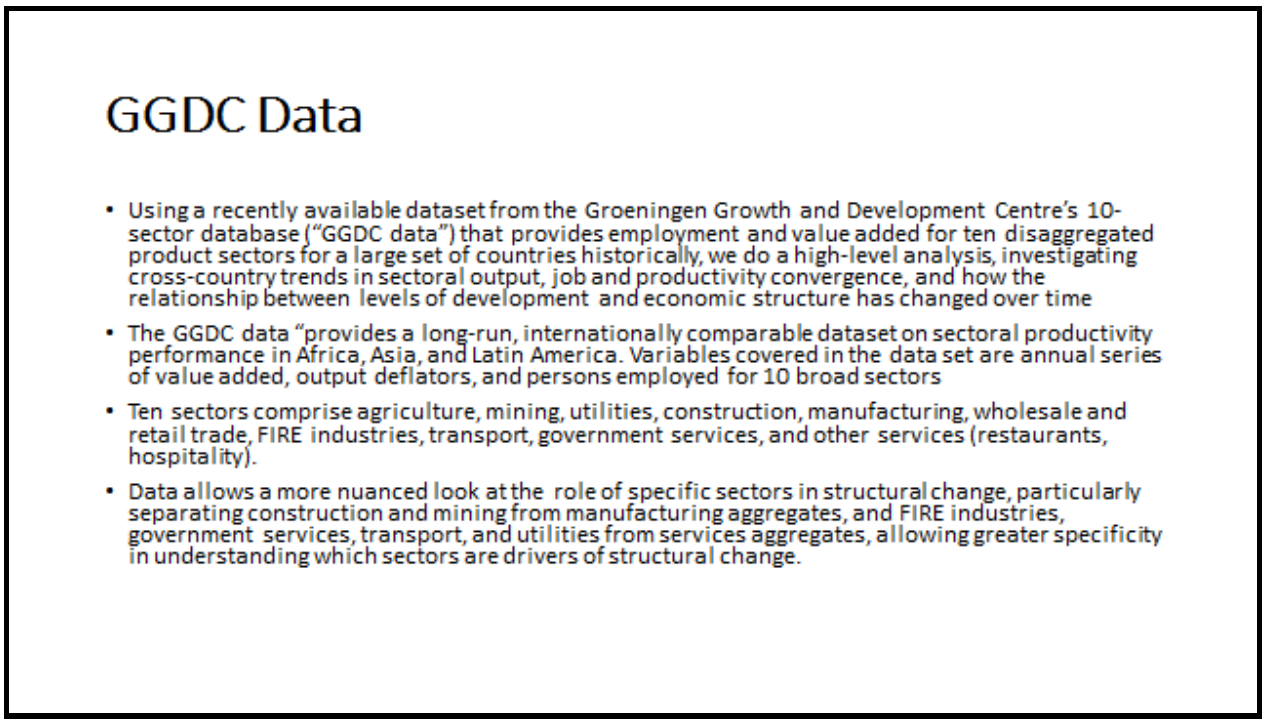
Where are the growth drivers? Is it in manufacturing services, agriculture, and how it connects to GDP growth, output growth, productivity growth, job growth? Which sectors are contributing more to growth, jobs and productivity, and which ones are shrinking?

Do we see that this relationship is changing across all countries, from Africa to U.S. – same change or we see different patterns of changes? In other words, have the drivers of growth shifted from manufacturing into services? And what role is technology playing in changing the drivers of growth? And what should policymakers do?

I don't think we'll be able to answer all of these questions, but that's the motivation to see whether there continues to be a growth divergence or actually we see signs of unconventional growth convergence but taking place through different channels. I think let's try and answer each one of them very quickly in the short timespan we have.

But in order to answer this question, we need a very detailed database because technology is not homogenous. It may -- its impact within manufacturing may differ across different activities in manufacturing. Within services, technology can play different role depending on which subcategory we are looking at.

So, what we need is a very detailed database and what we have done in this is to use the database from GGDC (Groningen Growth and Development Centre). But before that, let me just step back and discuss the evidence on growth -- Simon hinted that there is now growth divergence across countries.



Presentation of Ejaz Ghani, 12/11/2015

So, if we pick up a hundred countries and ask, are all of them converging towards a higher growth path or some are being left behind and others are moving ahead, there are two schools of thought on this.

The traditional school of thought has argued that manufacturing sector has played the role, with the help of technology, for poorer countries to grow faster than richer countries and catch up. That's the point that Simon was trying to make.

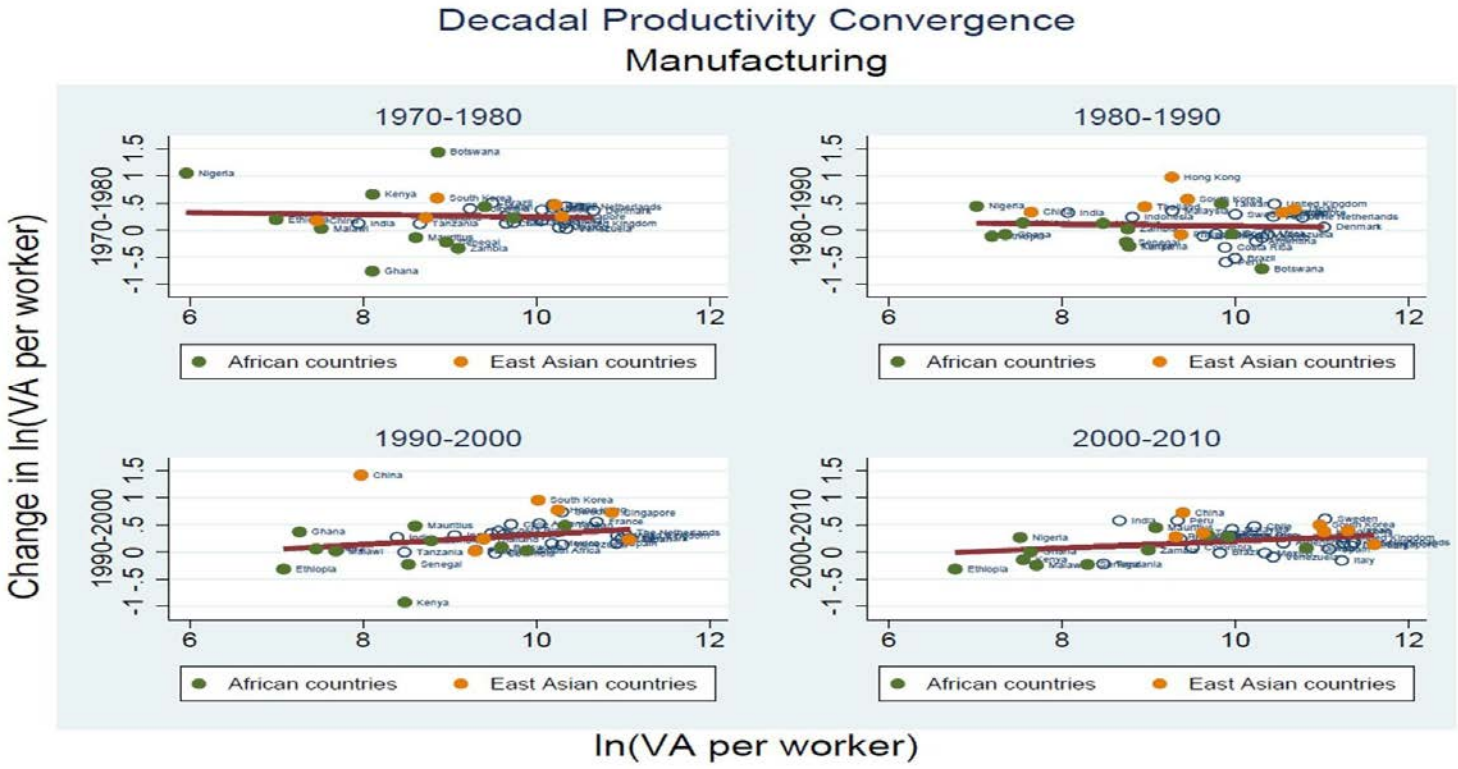
But increasingly, countries are facing premature deindustrialization. That's what Dani Rodrik has been saying that now the poorer countries are not converging anymore and that is a reason for concern. In other words, there is global growth divergence that has begun.

In contrast, we are going to argue that there is no evidence of global growth divergence yet. There was a big global financial crisis that happened and the evidence still shows that poorer countries grew faster than richer countries, despite the global financial crisis.

Yes, there is a premature deindustrialization that has set in and the manufacturing sector is not expanding anymore in the two poorest regions, South Asia and Africa. Yet, these two regions are growing faster than rich countries and we'll argue that there is evidence of global growth convergence that's happening.

And the data that we're going to use is from the GGDC database for foreign countries, which is extremely detailed, and it tracks what's been happening in different sectors, subsectors, how it connects with jobs, output productivity and various indicators.

So, what did we find? First thing, if you look at this, this is the decadal relationship between sectoral employment in the 1980s, '90s, 2000, 2010 for those 40 countries plotted against their per capita income -- level of income.



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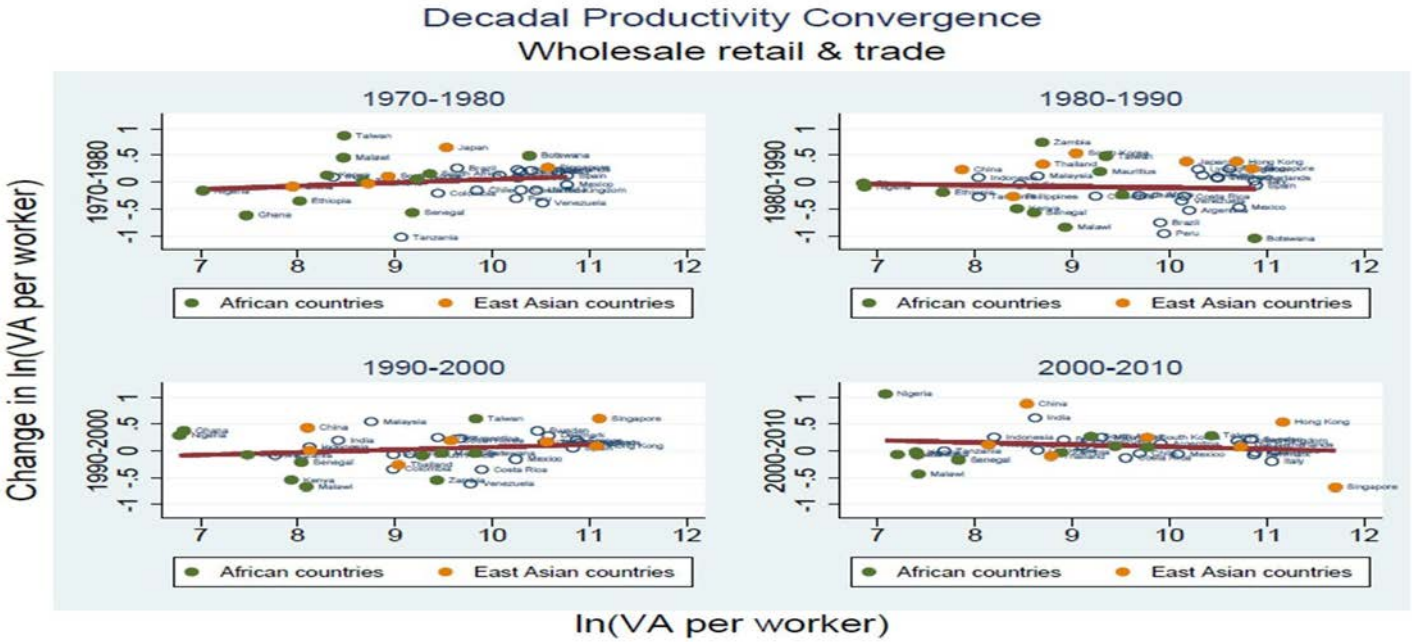
So you will notice how the curves have shifted over time. Earlier on, the manufacturing sector was growing faster in poorer countries, but over time, it has become flat; the curves have shifted and flattened out. The relationship between the economic structure and per capita income has shifted away from the role it was playing of growth convergence before.



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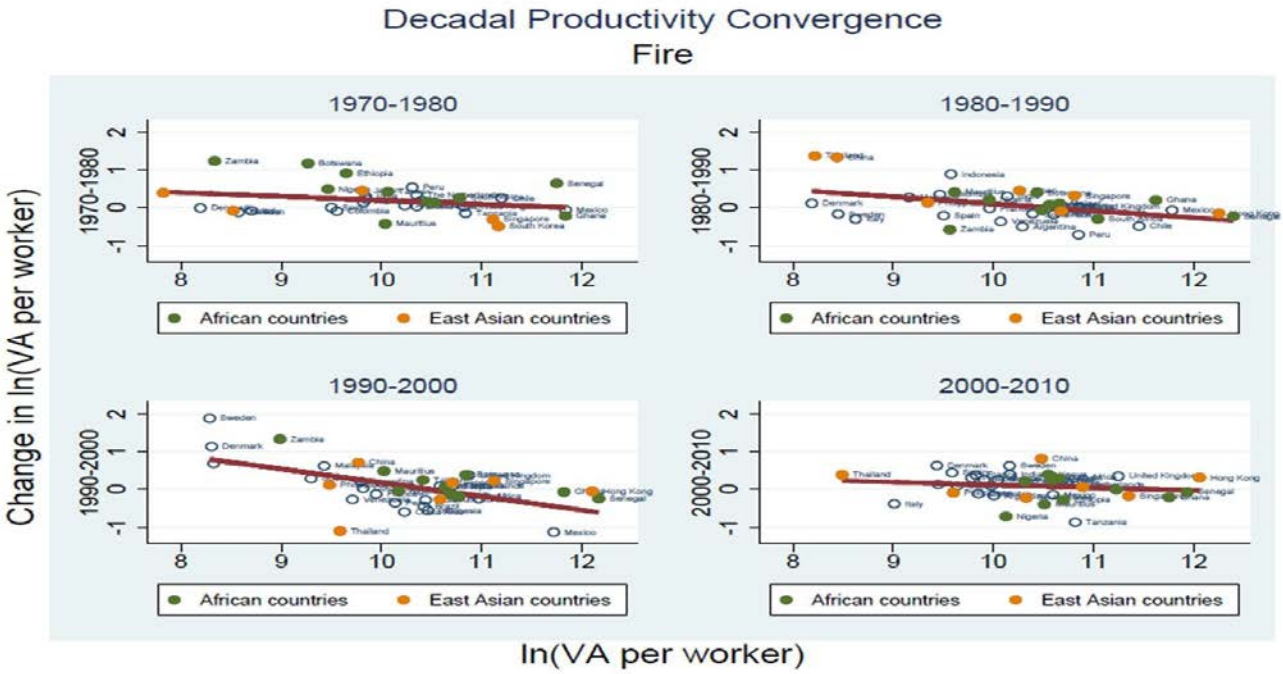
But if we now plot the same graphs for the services sector, services sector now seems to be performing the same role that manufacturing did earlier. The slopes have shifted, become steeper, meaning countries with lower per capita income are now employing many more workers in the services sector and growing. So these two plots kind of shows that growth convergence has continued, but that growth drivers have shifted from manufacturing into services.

This is much more detailed on how the growth convergence in manufacturing sector has weakened over time. It essentially shows that Dani Rodrik is right and Simon is also right that the relationship has flattened and manufacturing is playing less of an important role today than it played in previous years.

But we don't see this relationship weakening; if anything, it has trended in the services sector. It's a steep line and it shows that the countries with lower per capita income are making greater use of the services sector.

But not all services are the same. We see that modern services, which use more technology, seem to be growing much faster than traditional services. And modern services, you know, there can be a lot of debate on what these modern services are; it could be business, financial or any services which touches Internet or mobile phone and other things.



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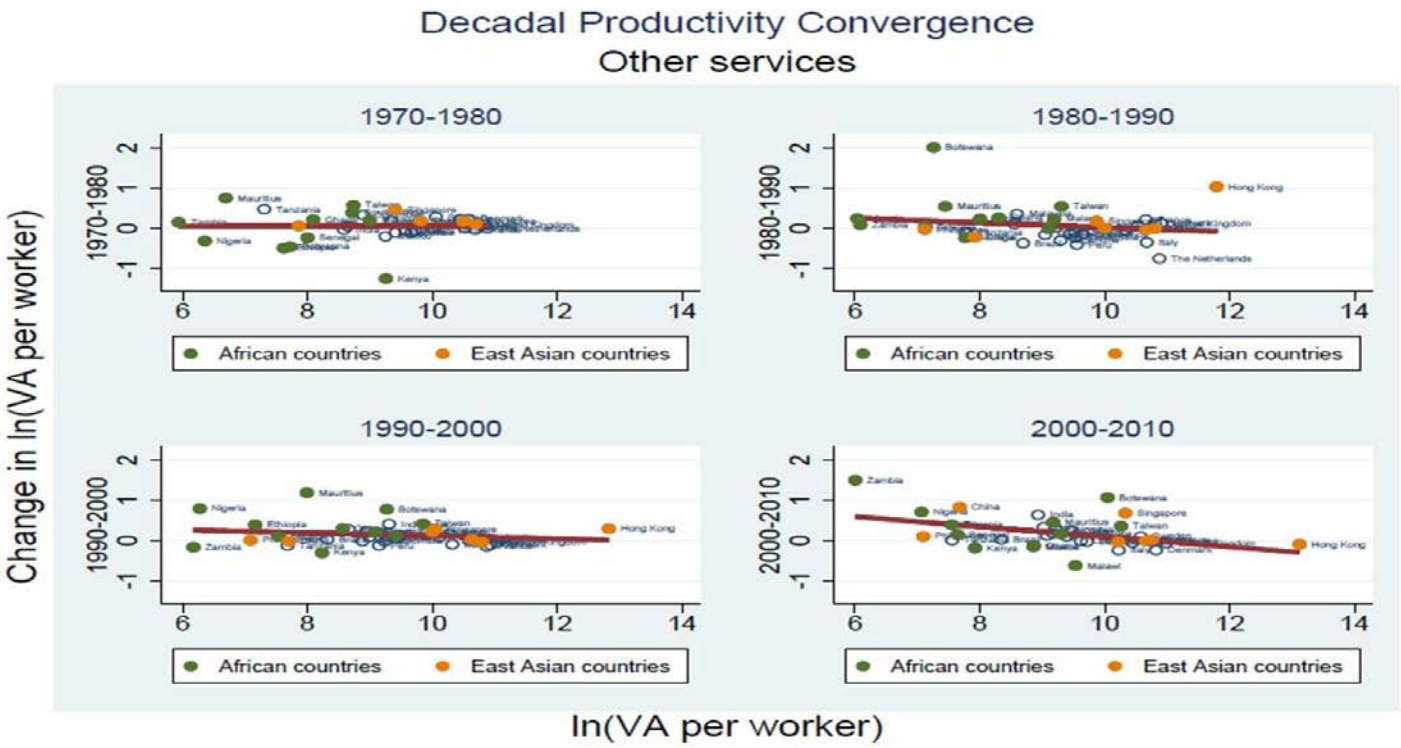
But we don't really have very detailed data to connect technology with economic activity, but we can use a couple of criteria. A very broad, traditional way is to separate services into modern and traditional services. And we're now seeing that the modern services are growing much faster and low-income countries are making greater use of that to grow faster.

Simon talked about mobile phone in Kenya, but there are other examples that come from India, China; name it and it is there, either through the Internet or mobile, that's actually connecting the world and enabling everyone to participate in the global economic activity. And those individuals in countries that are starting from a lower income base seem to be growing much faster.

We also see -- so, this is some more detail to show how hospitality, tourism and other -- many other services are growing and not just business and financial services that are growing fast. But this just -- when we examine agricultural sector, there is no evidence of growth convergence.



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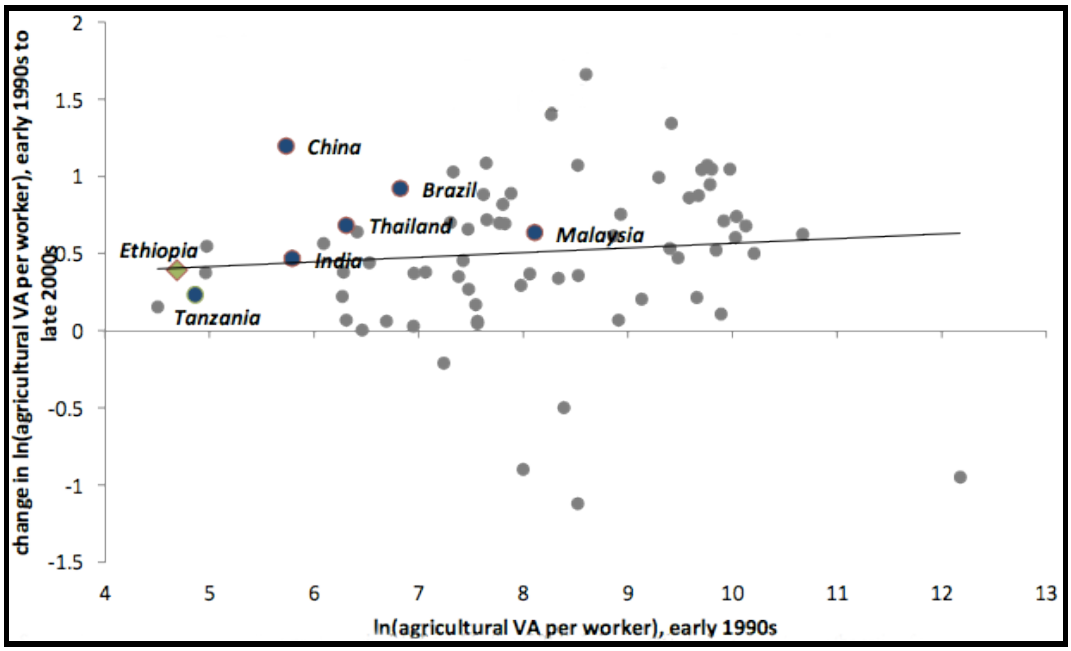
Now, this is sad news. And a large number of poor people actually work in the agricultural sector, and one would have expected technology to enable higher productivity growth in poorer countries in the agricultural sector. But we see no sign of growth convergence in the agricultural sector, which means that the poorer countries have simply not grown faster in the agricultural sector.



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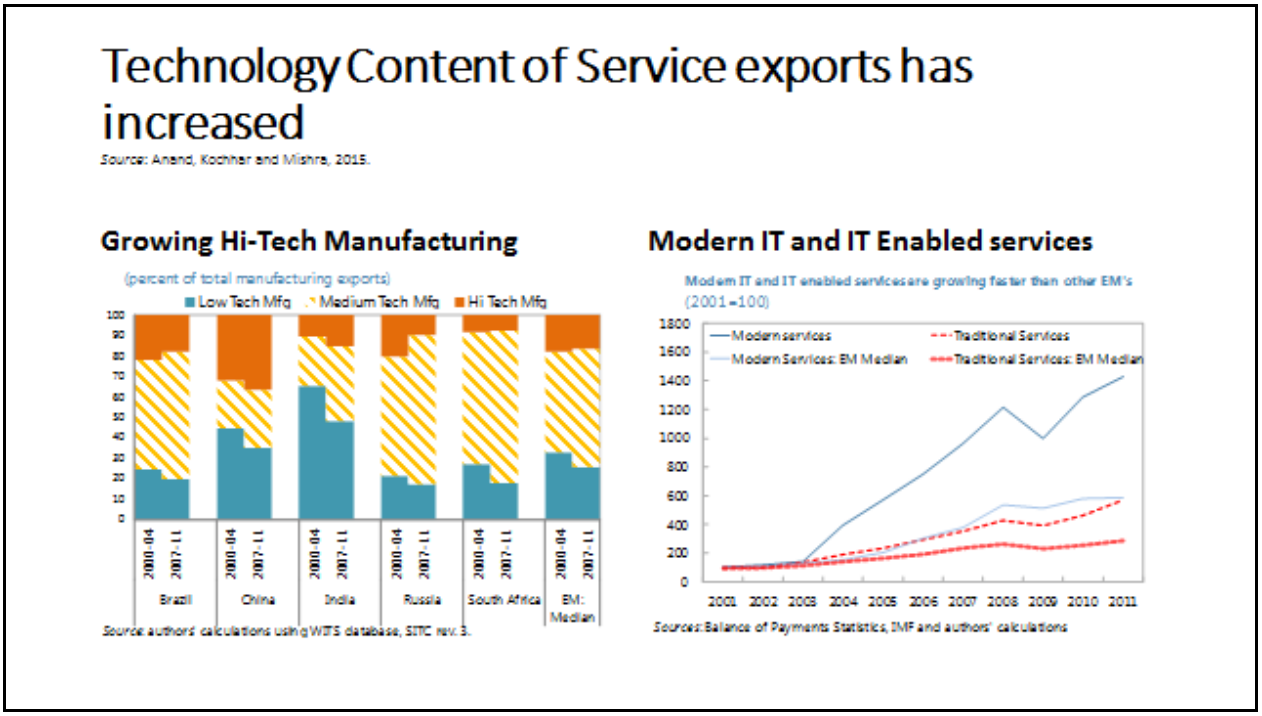
Now, let's -- Simon already talked about the role that trade has been playing, so I'm not going to focus so much on this. But evidence does show that the technology content of services has increased, both in the manufacturing sector, which is on the left-hand side -- this is from our colleagues in the IMF who put this together -- and as well as on the services sector, where we see on the right-hand side the modern IT and IT-enabled services growing faster.



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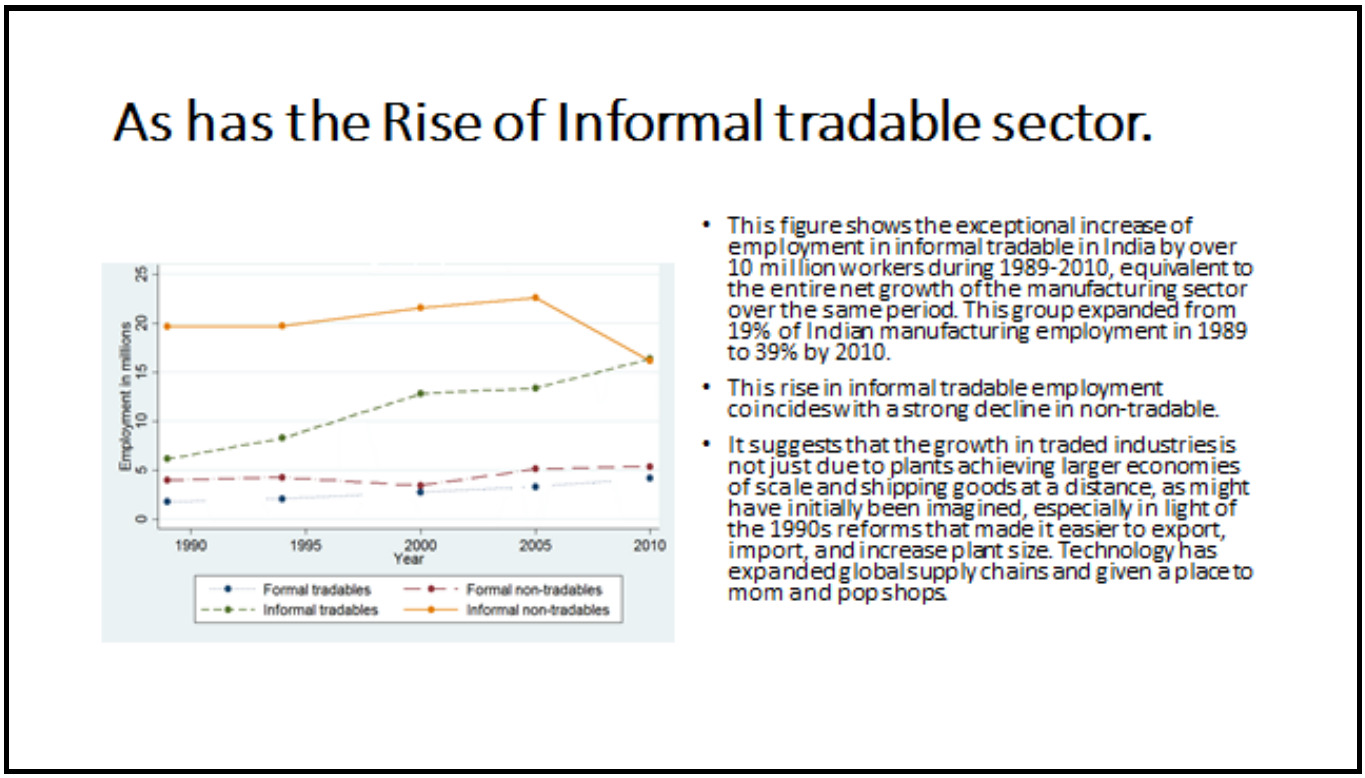
But this is well known to everybody that technology is enabling more sophisticated exports in manufacturing and services to be growing faster. But there's another thing which is not known to many people: Technology has also enabled mom and pop to connect to the global supply chains.

So, when we examined the enterprise data in 900 districts in India over the last two decades and started with the questions that the informal sector, which is an enterprise with less than 10 workers with electricity, less than 20 workers without electricity – they seem to employ 80 percent of the labor force in India and probably a majority of workers also in Africa. What happened to them?

We find that the informal sector has exploded in the tradable sector, but contracted in the non-tradable sector. Mom and pop shops through the global supply chains that's being enabled through Internet and technology are now connecting to the global supply chains.



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Large corporations are outsourcing small jobs for mom and pop to do and that's exploding. So I want to highlight that it's not just large corporations who are benefiting from technology, but even small mom and pop shops have exploded.

So where does this take us all in terms of policy? What do we conclude from this? I think, you know, as Simon said, that digital technology has exploded, be it in the Internet, mobile phone. It's everywhere in all sectors.

But we should also be mindful that almost 60 percent of the world is still offline. So in terms of public policy, technology still is restricted to 40 percent of the population; 60 percent of the world is still disconnected.

What can be done about that? The World Bank is doing a report, a WBR, on technology and public policy and that will come up with more details on what needs to be done.

Policy

- Digital technologies—the internet, mobile phones—have spread quickly. More households in developing countries own a mobile phone than have access to electricity or clean water, and nearly 70 percent of the bottom fifth of the population in developing countries own a mobile phone. Businesses, people, and governments are more connected than ever before.

- But nearly 60 percent of the world's people are still offline and can't participate in the digital economy in any meaningful way.

- World Bank WDR on Strengthening the digital revolution will provide a detailed narrative on public policy. Digital technologies have boosted growth, expanded opportunities, and improved service delivery. Yet their aggregate impact has fallen short and is unevenly distributed. For digital technologies to benefit everyone everywhere requires closing the remaining digital divide.

- In countries where the digital economy is still emerging, the priority is to facilitate connectivity and develop the foundation for effective competition regulation. Although 74 mostly middle- and high-income countries have unilaterally removed tariffs on ICT capital goods, computers and smartphones are still treated as luxury goods in some countries, where taxation adds almost half to the price of mobile handsets. Many countries treat their telecom firms as cash cows. Where firms may have limited knowledge about how the internet can improve their business, benchmarking exercises and information programs can be effective. And to allow more innovative companies to enter markets easily, countries need to improve firm registration and create greater market transparency to reduce price collusion, market sharing, and rigged public procurement. This can't be done overnight. It requires overcoming some of the most protracted development challenges: how to create an environment for firms to thrive, how to build effective education and training systems, and how to make service providers more responsive to citizens.

- Slow growth of Manufacturing is a concern for many observers.

- The vast informal sector in the world affects everything from poverty levels to the allocation of activity in the economy and beyond, so greater insights into its functioning are absolutely vital.

- Technology and in particular internet is in many respects global. Technology can be better managed with coordination across nations and serve as a powerful platform to facilitate global cooperation. Three priority areas are governing the internet, creating a global digital market, and providing global public goods— including those that promote poverty reduction and environmental sustainability.

- Finally, we need to learn more about how changes in technology impact and shape growth, jobs, and productivity.

Presentation of Ejaz Ghani, 12/11/2015

But there are a couple of things, three big messages that come out: One is technology needs more skill and more education. So, if countries don't have the skill and education, they're not going to catch up with technology.

The second big message is 60 percent of the people is not connected by technology; they still need to be connected. Huge investments needed, and that's a big policy agenda; hopefully many would address that.

The third one that's also emerging is we need a competitive market structure. Sometime, technology enables monopolistic behavior, which can restrict, we know, for a long time. So, we need to keep an eye on public policy to make sure that entry and exit barriers do not exist.

Is technology a national issue or a global issue? Increasingly, the evidence suggests that technology, be it mobile phone or Internet, is connecting the global world not just within the country but globally. So, a global lens to technology and its impact on growth would be a welcome addition.

Thank you very much.

(APPLAUSE)

R. JOHNSON: Thank you, Dr. Ghani.

So, we've had two introductory economic overviews from interesting perspectives.

So, Gary Marchant from Arizona State University is now going to switch the lens a little bit to technological changes that are occurring and sort of set the stage on that front for some of our later discussions.

Gary?

MARCHANT: Great, thank you. Good morning.

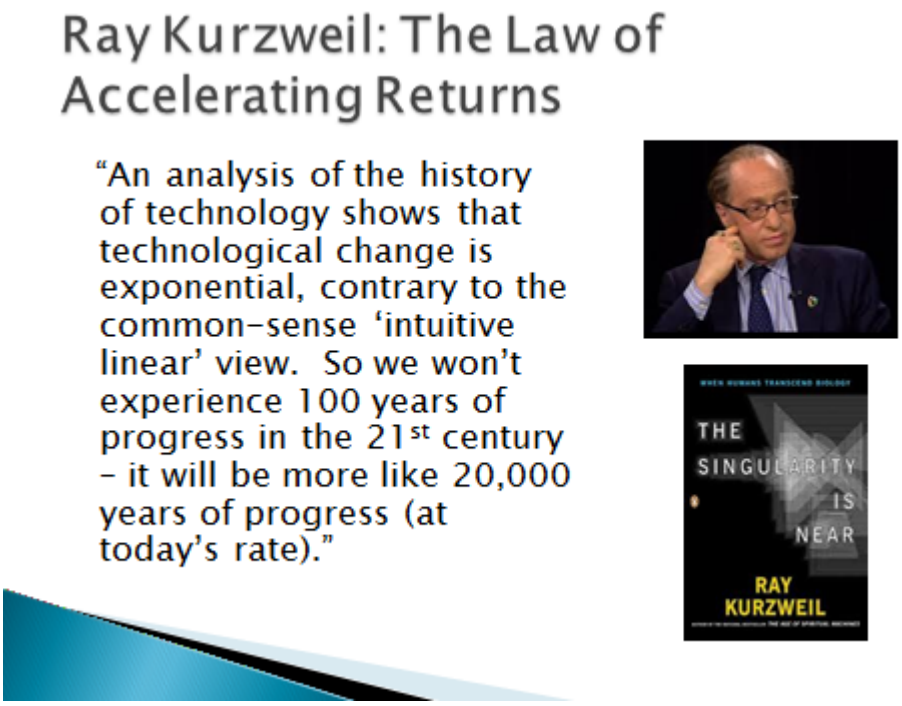
So, Simon -- sort of one word summary of his talk is divergence; mine is change. We're in this period of tremendous technological change.

Presentation of Gary Marchant, 12/11/2015

I love this quote from Chief Justice Roberts; he said, "Politicians, and judges, for that matter, should be wary the assumption that the future will be little more than an extension of things as they are," that we're in this period of not just major social and economic but also technology change.

We don't really notice it sometimes, but we wake up every day and think it's the same as it was yesterday and tomorrow will be the same. But in reality, we are in a period of change I think faster than any other time in human history, and that has all kinds of implications in looking at the type of issues you'll be looking at today.

You may have heard Ray Kurzweil's book, "The Singularity."



Presentation of Gary Marchant, 12/11/2015

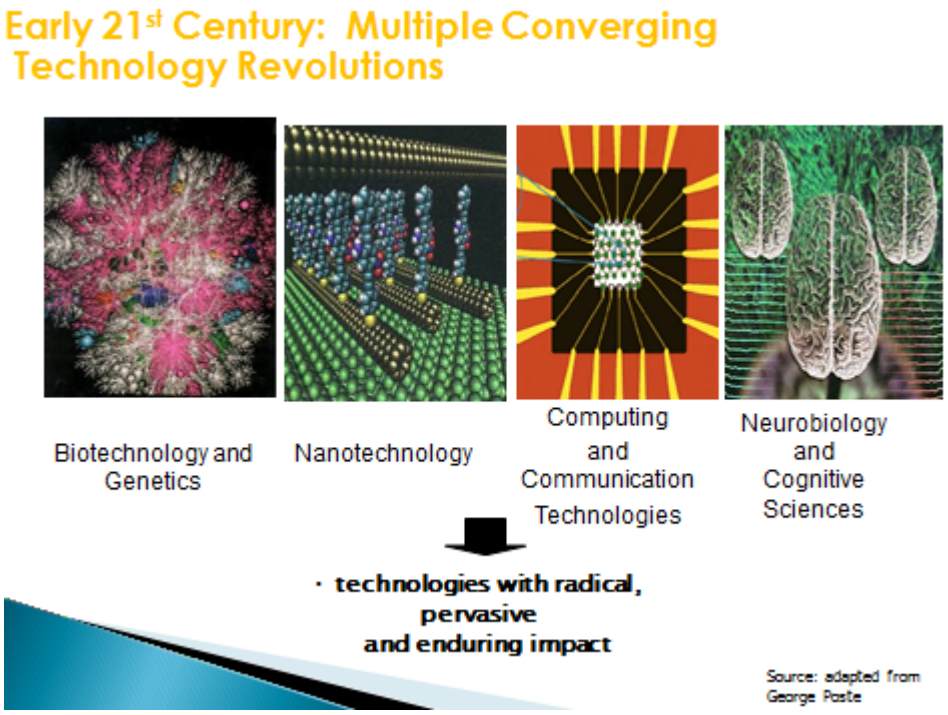
He sort of goes off the deep end on some of the singularity stuff, but it's fascinating just looking in the first half of the book how he documents how all these different technologies are on these exponential curves and how we're sort of hitting that elbow of that curve right around now and having this rapid change in one technology after another. He's, of course, the chief engineer at Google now where they're doing all kinds of funky stuff.

And you know, there's also the Gartner hype cycle -- talks about the hype going up really quickly, too, and then going down and then gradually going up. I love -- there was a quote once -- you know, we tend to overestimate the impacts of technologies in the short-term and underestimate them in the long-term. So, a lot of these sort of, you know, come with great gusto, sort of fizzle a little bit but then slowly have enormous implications.

But we are in this period of all these different technologies coming to the forefront now. If I compare it to the 20th century, if you look at the last century, I count sort of four fundamental transformative technologies: the car, the television, the computer and the airplane, all of which affected so many different parts of our lives, so many parts of our business and daily lives and so on and certainly the law, as well, many of which could never have been anticipated at the time those technologies came around.

But those were spread over 100 years and we had a lot of time to adapt to them, even though they were pretty revolutionary in a lot the ways they changed us.

Today, we have total streams of different technologies. This is a slide from my colleague George Poste who talks about sort of these four clusters in the biosciences, the nanosciences, the information communication technologies and the neurosciences, all coming forward full tilt, coming out of the laboratory into new combinations and new ways of converging and so on to create a whole set of different new technologies that are transforming us today.



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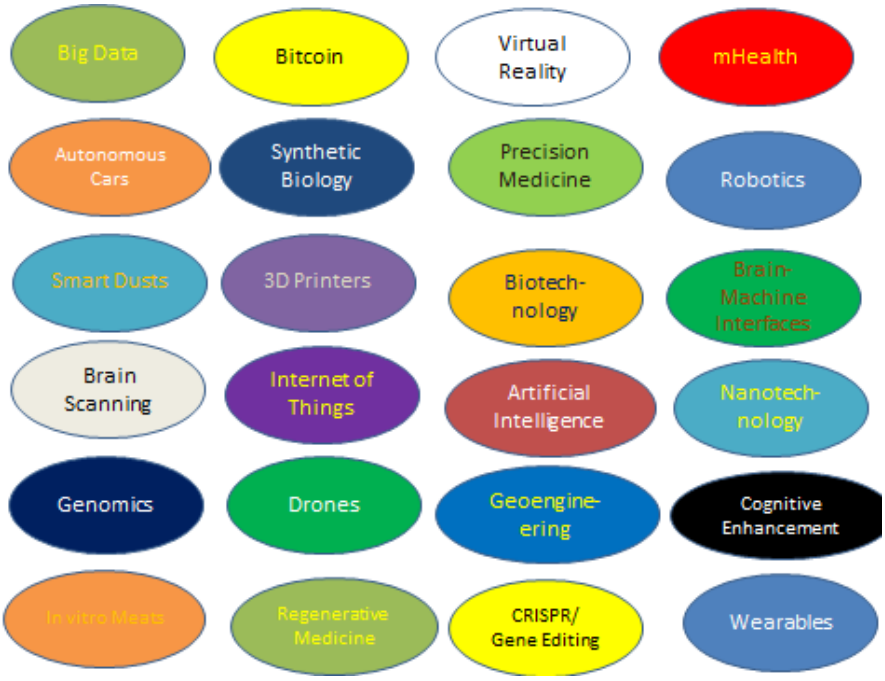
And just a list of some of those include big data, bitcoin and -- and the associated blockchain that goes with it, virtual reality, mobile health, autonomous cars, synthetic biology, precision medicine, robotics, smart dust, 3-D printers, biotechnology, brain-machine interfaces, brain scanning, Internet of Things, artificial intelligence, nanotechnology, genomics, drones, geoengineering, cognitive enhancement, in vitro meats, regenerative medicine, CRISPR gene editing, wearables.



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These are just some of these new technologies that most of them didn't exist, you know, a decade ago or even five years ago that are suddenly coming out into our -- our commerce today, are real companies and real products today. And all of them will have all kinds of transformative and radical implications for not only how we live our lives and how we do business but how we govern, including in the area of intellectual property.

Not only is there so many different technologies, but the pace at which they're moving forward is also greatly increased. So, if you look a century ago, when you look at these technologies like the telephone and the auto and the refrigerator and electricity, the time for half the population to adopt a new technology was measured in decades; sometimes 20, 30, 40, 50 years before half the population got a new technology.

And today, we're down to a year or less, you know, when a new tablet or a new smartphone comes out or whatever the newest gadget is. I mean, half the population has it within six months. And now, as we heard from the earlier talk, that's also true internationally; things like smartphones and things like this are spreading very quickly. So, we're -- we're getting more technologies with more profound impacts and coming a lot more quickly at us.

And so, these have a lot of implications and -- and issues for intellectual property. All of these technologies have intellectual property aspects of them. If we just pick a few of them, synthetic biology, basically fundamentally patenting sort of these fundamental technologies of life and where that goes from there has been very controversial.

If you look at precision medicine, diagnostic tests are the key underlaying of this technology. And there's all kinds of issues and problems about what should be the patentability of these, given that they're

sort of measuring natural relationships in our blood; and we had this case Mayo v. Prometheus here in the United States that really restricted that.

We just had the Federal Circuit a couple weeks ago, you know, in a split vote saying this could be raising a lot of issues and suggesting maybe -- some of the judges suggesting we need to revisit the law on this. So, it's very much up in the air how that's going to work out.

You look at 3-D printers, again, profound implications for intellectual property. People can just be printing things at their own house, whether they're Lego blocks or more sophisticated things like drugs and so on. That's going to have profound implications for our intellectual property system.

Biotechnology of living things; how do you patent things that are living? And what do you do about the subsequent generations? And so, we have issues with plants, and we had a Supreme Court case in the United States on this last year of does the first use doctrine apply to a living product.

We have all these modified animals now coming online. We have the genetically engineered salmon approved by the FDA here in the United States last week, this week, we had the first drug produced by genetically engineered chicken approved. We hear China's building all these cloned cow factories.

So, as we get these living organisms, what kind of unique issues do they create as more and more of our economy is going to move into this biosector?

And then we also have the issue of very highly regulated products like biotechnology drugs, but we don't have a generic system for biologics like we do for drugs. And as a lot of these G.M. crop patents are now expiring, we're getting all these new companies can come in place without these being patented. And how's that going to affect regulatory and particularly trade implications of these generic biotechs? It's, again, a profound issue suddenly thrust upon us.

Nanotech, another example of a technology raising all these unique issues of how do you and can you patent different sizes of the same molecule and the same material? And does that have different properties and when is it obvious and when is it not?

And again, coming so quickly that the PTO was sort of overwhelmed by this and had to create a whole new section just to deal with this to try to consolidate this because it was across so many different industries but we're getting inconsistent patent decisions as people were unaware and not familiar with this technology.

And then CRISPR gene editing, again, a brand new technology, but it's one that's changing so quickly. Who has the relevant patents and who doesn't? I mean, it seems like every week -- we had a big meeting here last week at the NAS on this. But there's already new versions of these, and the question is which are the ones that the patents apply to because the technology is changing so quickly.

So, we have all these different technologies raising all these issues in intellectual property, oversight regulation and trade. It's very difficult for the legal system to keep up with this fast-moving technology, sometimes called the pacing problem. How do you have law move as quick as these technologies do? And it's a -- I think -- a huge challenge.

And so, we have this unique context today that we're in this period of unprecedented rapid technology change that will rapidly and radically change our lives in many different ways, as well as our business and our law, and we're going to have all new kinds of industries and products and -- and legal issues come and go very quickly.

And you know, no one's ever been in this position before. We don't have a lot of precedent on how we handle this much change. How does the public deal with this much change? Do they get, you know, do they get restless and -- and worried or do they accept it? Do they give up? And then, you know, how does our legal system deal with it, how do our policymakers and so on?

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And so, it's going to have huge implications of how we educate our students to how we decide cases and how we write cases so they'll -- they'll apply to other technologies. How we practice in law, how we practice in science as these technologies we're relying on are changing so quickly. So, it has these profound implications.

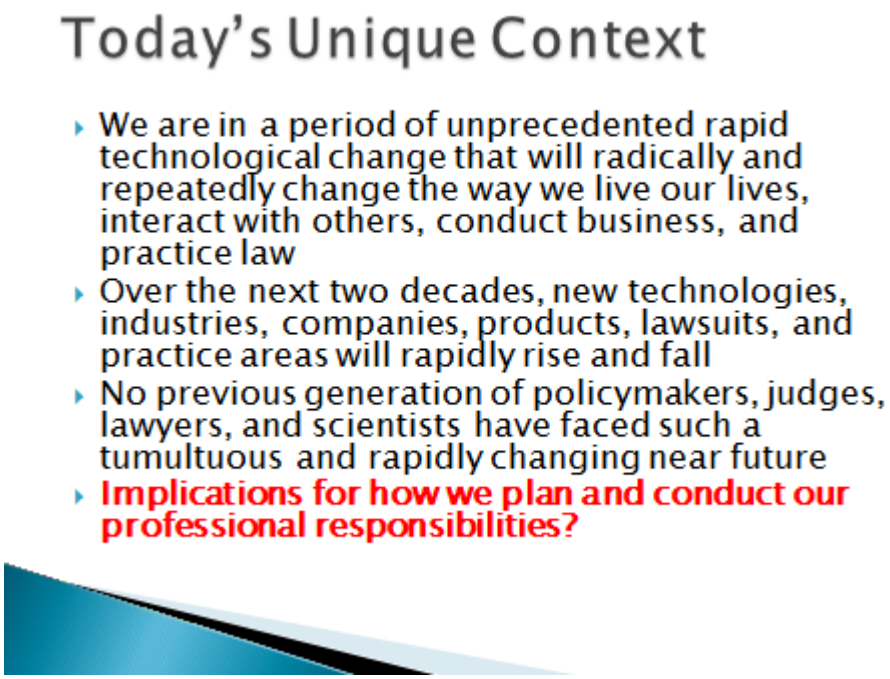
And particularly, in the area of intellectual property is what we're going to see is that a lot of these technologies are going to raise new issues, novel issues that maybe we haven't seen before. There's going to be a lot of the sort of foundational technologies that are going to be patented.

In the past, a lot of times the foundational technologies like Boyer and Cohen recombinant DNA technique of genetic engineering technology was patented, you know, 15 or 20 years before the real commercialization of the technology. And by the time the technology's coming to the marketplace, its foundational patents have expired.

Today, because the technologies move so quickly, we have the foundational patents right when it's being commercialized, creating potential things like patent thickets and other kinds of problems that we're seeing in a lot of technologies, frankly.

We have all these overlapping inventions and refinements like we're seeing with CRISPR right now and figuring out whose patent really controls, what's the technology that's going to become the standard, and so on.

The competency of patent offices to handle these new technologies is another challenge. They're built on an idea of static models of different technologies and areas, but technologies are changing so quickly with all this convergence and overlap, it's very difficult to keep up and be able to have the competency to make a sensible decision.



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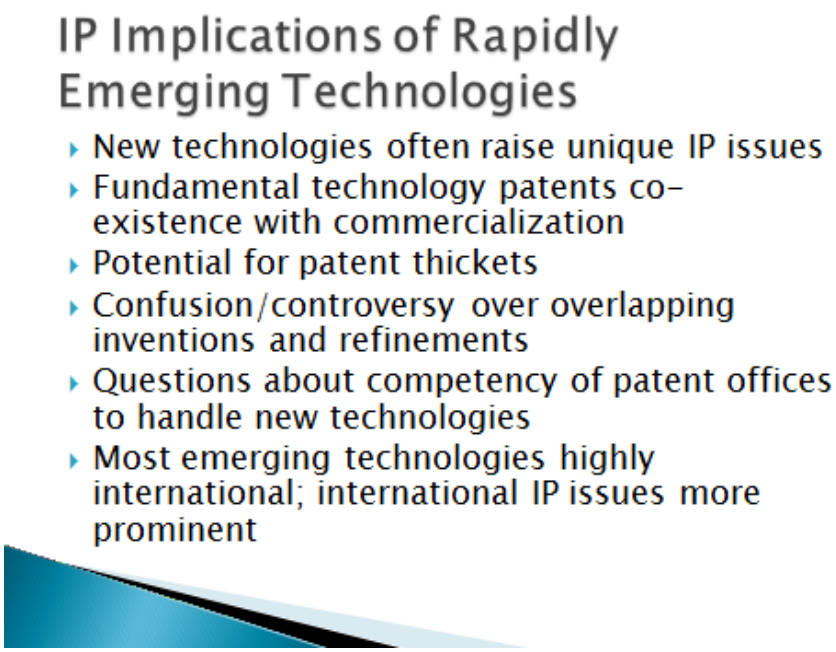
And then, you know, because these technologies are all new, it's not like the car industry or the computer industry that maybe the U.S. was just the natural leader in; every country is going to jump into this, every industrialized country. And we're going to have -- internationalization is going to be ever more important because of the way these technologies are moving, and that's obviously going to create a lot of issues that you'll be talking about today on international I.P.



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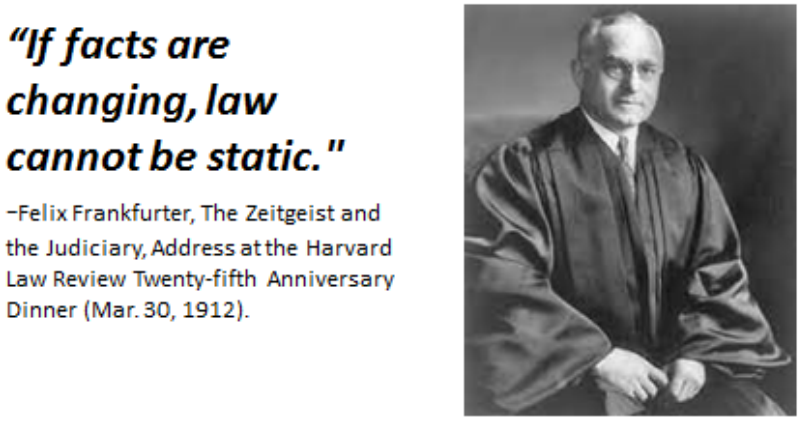
To just close with a quote I like, "if facts are changing, law cannot be static."



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We're in a period of this tremendous change and how do our legal and intellectual property systems keep up with that and adapt to it.

Thank you.

(APPLAUSE)

R. JOHNSON: Thank you, Gary.

I just might note, in chairing an OECD meeting last week on technology and innovation, my account was that there were 44 countries that indicated just the sets of issues that Gary was describing were central to sort of their strategic thinking about their our competitiveness and -- and innovation and -- and how it fits in in a national context.

Our last speaker in this session is Thomas Bollyky from the Council on Foreign Relations who has worked extensively on some of the free trade agreement issues related to IPR.

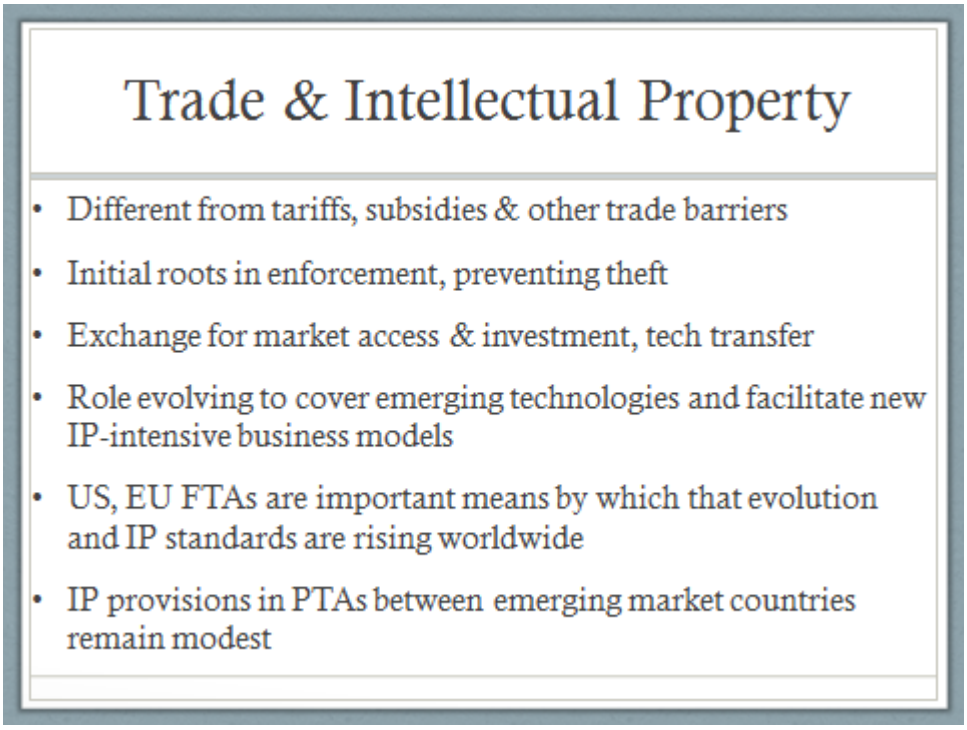
Tom?

BOLLYKY: Great, thanks a lot. It's a pleasure to be here. I am grateful for the opportunity.

I guess if we started our discussion on this panel with divergence and then moved to the potential of technological convergence. This talk is really the intellectual property architecture that helps decide these technology issues internationally and their future.

I'm going to give a bit of a general overview given that it's a mixed audience and I don't know how closely people follow the issues on the role of I.P. in free trade agreements. Then I'm going to talk a bit about the current treatment of intellectual property rights under free trade agreements and some of the likely trends for the future.

The first thing to acknowledge, which I think most everyone here in this audience will recognize, is that intellectual property is different from traditional barriers to trade. It's not like tariffs or subsidies or other trade barriers. There's no optimum level of intellectual property protection.



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There isn't an enormous amount of consensus that the increase of intellectual property protection is a good thing for all nations to do, or the fact that this increase should be similar in countries of different geography or different levels of economic development. Since there's no real consensus on these issues internationally, which of course has made the use of trade agreements to spread IP protections politically controversial.

The initial focus on intellectual property and trade discussions was really on enforcement or preventing theft. In the 1970s, IP was part of broader concerns of the U.S. and other developed countries being taken advantage in international trade. And this concern was reflected in the Trade Act of 1974.

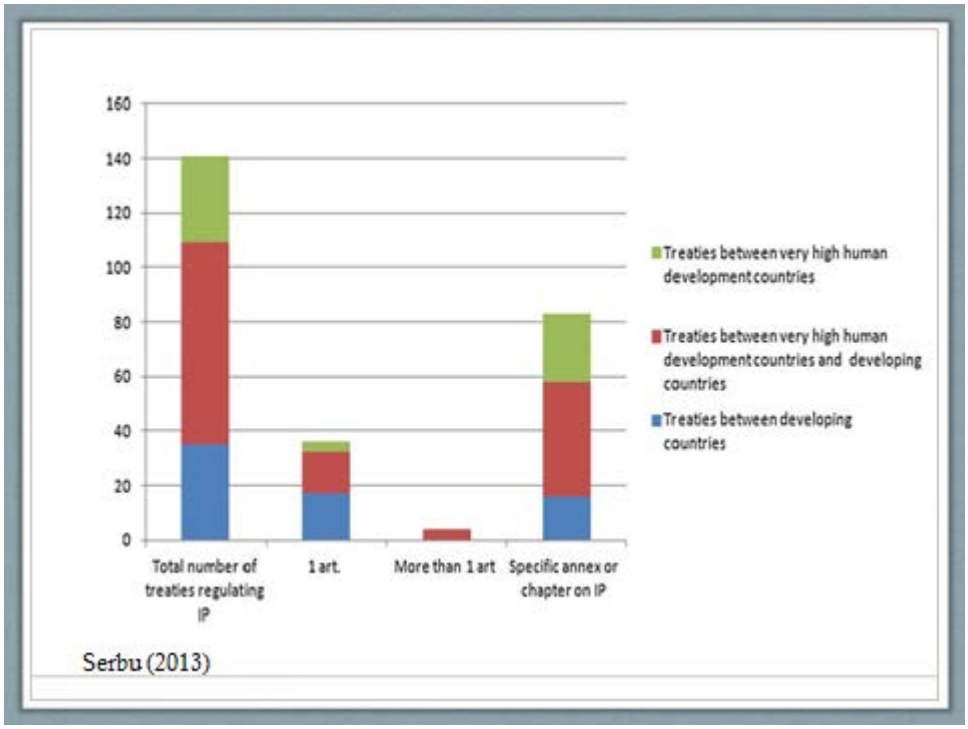
Intellectual property was inserted into the international trade agenda as part of the single undertaking in the World Trade Organization in 1995, with the Agreement on Trade-Related Aspects of Intellectual Property Rights. This agreement was included in exchange or perceived to be done in exchange for increased market access to agricultural and textiles for developing countries and as a way to increase investment and technology transfer to these countries.

Neither of those objectives really happened to the degree I think many people had hoped in the mid-1990s. Certainly, emerging markets have experienced increased investment. But there is not much evidence that the introduction of intellectual property systems has spurred that investment in poor nations.

The role of intellectual property provisions in free trade agreements has evolved since the WTO started and has started focusing more on facilitating architecture for emerging technologies and new I.P.-intensive business models. And to some degree, this approach looks more like traditional notions using these agreements to spur market access and facilitate trade.

The primary means by which this approach has been pursued is through U.S. and European free trade agreements. They are by far the most important means by which this evolution of intellectual property standards has been occurring worldwide. The intellectual property provisions in preferential trade agreements or free trade agreements between emerging market countries and other developing countries remains quite modest.

This is a series of figures from Xavier Seuba at the University of Strasbourg. He analyzed all the preferential trade agreements with intellectual property provisions. And what you'll see here is there's actually more activity than one might expect.



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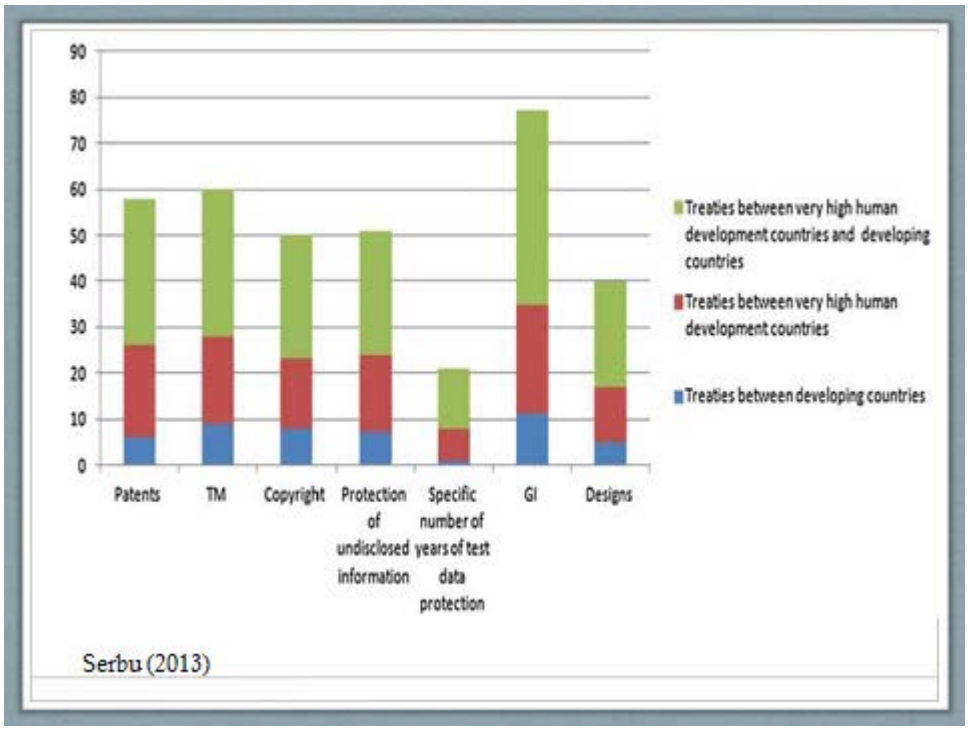
There are 141 preferential trade agreements with provisions on intellectual property. But what you can see here, the blue portion of this figure represents treaties between developing countries. Overwhelmingly the more substantive treaties are between developed countries or between a developed country and a developing country. Very few are between developing countries.

That's also not just a factor of number of provisions on IP; it's also in terms of the depth of those provisions. Again, the blue in this figure shows treaties between developing countries. This shows that the advancement beyond the minimum IP standards provided under the WTO TRIPS agreement is happening with preferential trade agreements between developed countries or between developed countries and less developed countries as opposed to developing countries driving this trend themselves.



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All right. So that's why it's worth focusing here on the U.S. and the European Union. So, what's the mandate on intellectual property for U.S. trade negotiators in these agreements?

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Well, that mandate has just been reaffirmed in the Trade Act of 2015, which passed recently with bipartisan support, not by much though. That Act replaces the 2002 version.

There are really two principal goals on IP in this piece of legislation. The first is that U.S. trade negotiators should ensure accelerated and full implementation of the TRIPS agreement, especially its terms on enforcement.

The second, and this is again getting at how I.P. is unusual in U.S. trade issues, requires U.S. negotiators for any agreement that includes provisions on intellectual property rights, to negotiate standards similar to those found in U.S. law. That is, of course, different from other areas of trade, where the legislation requires U.S. negotiators to simply pursue science-based, no more trade restrictive than necessary various standards.

So trade agreements are a means by which of negotiating provisions that are similar to U.S. law. There are also some secondary requirements in there about requiring U.S. trade agreements keep pace with technology changes, preventing theft and nondiscriminatory access.

The last trend that you will see in U.S. agreements is the expansion of provisions on fostering access to medicines or addressing other civil society concerns that have arisen with these trade agreements and their provisions on intellectual property.

Of course, free trade agreements are not the only tool in the toolbox for U.S. trade officials on intellectual property. The World Trade Organization, as I mentioned, has a TRIPS agreement. There is a council that is charged with implementing that agreement and that is an active forum for IP discussions. There's of course the possibility of WTO dispute settlement. Also, when countries accede to the WTO, it is a negotiated process and that affords opportunities to address IP concerns, as well.

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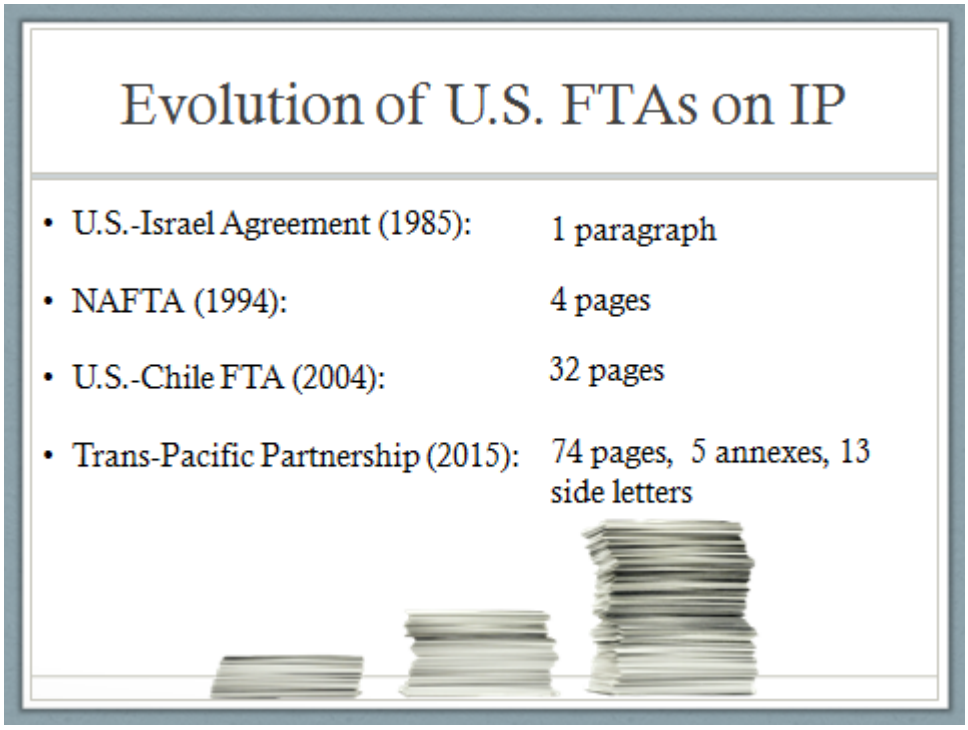
The 1974 Trade Act set up a process, called Special 301, that requires U.S. trade officials to identify annually countries that deny adequate and fair protection for intellectual property. That's another means of projecting out intellectual changes or monitoring changes in intellectual property system.

And, there is trade diplomacy. The U.S. has bilateral annual engagements with large emerging nations like China, like India, like Brazil. And these engagements are another means by which changes in intellectual property rights or improvement of their enforcement can occur.

There are U.S. trade preference programs with developing countries. There's a requirement in these programs that participating countries have adequate and effective I.P. That's another means by which the United States influences the intellectual property standards in other countries.

And then last and most importantly, there are U.S. free trade agreements. Why are they most important? Well, because the provisions on I.P. in these agreements must be given to other countries on a most favored nation and national treatment basis, meaning that these IP protections must be granted to other WTO member countries that aren't party to the U.S. trade agreement and they also must be granted to domestic entities. In this way, US trade agreements can ratchet up standards in other countries generally.

All right. So how have U.S. free trade agreements and their provisions on intellectual property rights changed over time? Well, when you go back to the first U.S. free trade agreement with Israel in 1985, 30 years ago, the provisions on I.P. were one paragraph long. They were largely a commitment to retain the bilateral and multilateral commitments these governments had already entered into.



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NAFTA, for all its controversy, has an I.P. chapter that's four pages long. That chapter largely anticipates the provisions of the TRIPS agreement.

10 years later when we get to the U.S.-Chile free trade agreement, its IP chapter is 32 pages long. The requirements that go beyond the TRIPS agreement in the U.S-Chile agreement are actually relatively modest, mostly around patents and data protection, the protection for undisclosed commercial confidential information, but the text is still 32 pages long.

So where are we with the Trans-Pacific Partnership, which was just completed? Well, its IP chapter is 74 pages long, with five annexes and 13 side letters.

And this gives you a sense of how these agreements have expanded on IP over time. This expansion has occurred both in terms of the scope of the protections offered, to some degree to follow on the technological changes that the other gentlemen from this panel have mentioned, but also to some degree to address some civil society concerns that have risen up with these trade agreements.

What is covered typically around intellectual property in U.S. free trade agreements? Well, they have general provisions about each side acceding to international agreements on intellectual property, providing more transparency on the process by which rights are granted and enforced.

There's coverage of trademarks and copyrights and patents and regulated products, protecting confidential information and trade secrets, which is a topic not really adequately addressed in the TRIPS agreement.

And there's also this trend in US agreements to try to include provisions that achieve a better balance between the competing interests on IP. This is particularly true in pharmaceutical issues where

there's concern that these treaties and the guarantees they provide limit access to affordable medicines. But it's also true on copyright where there has been a real split between Internet service providers and traditional content providers and how can you can use these agreement to accommodate those two business models.

I'm going to focus on the pharmaceutical provisions to give you a sense of what this looks like. This is a table that shows you the evolution of these agreements, starting back in Israel all the way to the Trans-Pacific Partnership.

The checks indicate where the agreement includes provisions. As you can see, as you move left to right, the short message is that the number of checks or pharmaceutical IP provisions have increased.

	Israel	NAFTA	Jordan	Chile	Singapore	CAFTA-DR	Australia	Morocco	Bahrain	Oman	Peru	Colombia	Panama	Republic of Korea	TPP
Date in Force:			*12/2001*	*1/2004*	*1/2004*	*9/2005-2009*	*1/2005*	*1/2006*	*1/2006*	*1/2009*	*4/2006 - 2009*	*5/2012*	*10/2012*	*3/2012*	*TBD*
Patent Term Extension			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Patents for New Uses			✓				✓	✓	✓	✓				✓	✓
Patent Linkage			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Protection			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Data Protection for New Uses				✓			✓	✓	✓	✓				✓	✓
Data Exclusivity for Biologics															✓
Count:	0/6	0/6	4/6	4/6	3/6	3/6	5/6	5/6	5/6	5/6	3/6	3/6	3/6	5/6	6/6

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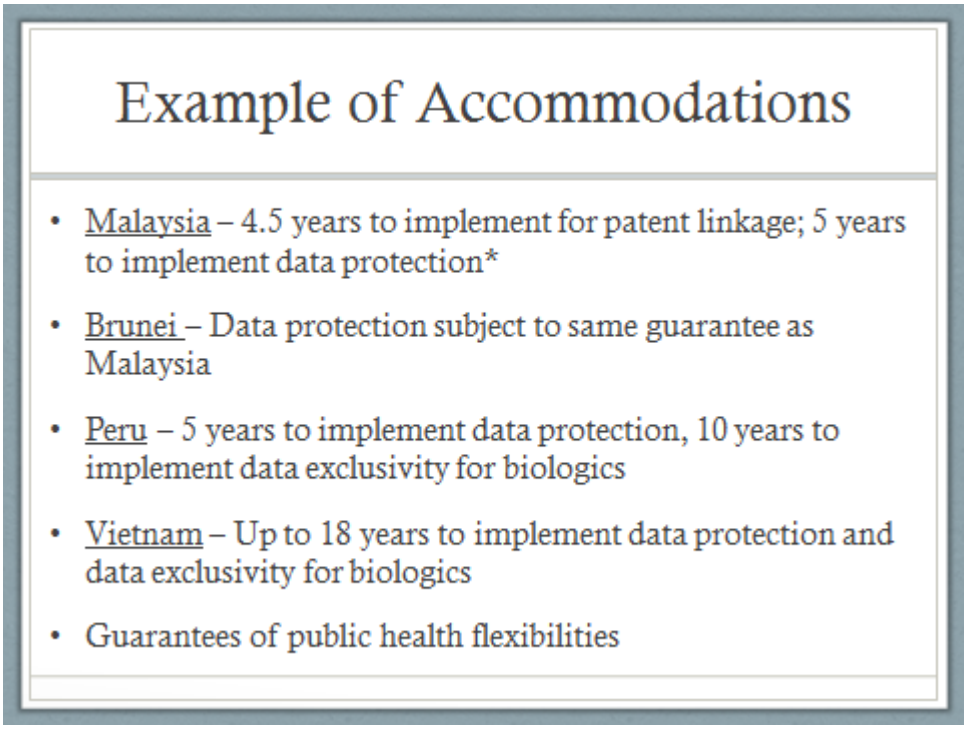
So the scope of the IP provisions have grown over time. They include patent term extensions, which provides the ability to extend your patent due to delays that occurred during the regulatory process. It includes provisions on the scope of patentability and the intersection between intellectual property system and the regulatory system. An example is patent linkage, which restricts the ability of regulators to grant approval for patent infringing drugs or vaccines.

Data protection on biologics, all the way down at the bottom of the table is, as Ambassador Wolff mentioned, a new topic addressed in US trade agreements. So, the pharmaceutical IP provisions expanded over time.

But it's not just that protection has expanded over time, there's also more extensive accommodations included in these agreements, which is part of why they're so complicated.

For the countries that are involved in the Trans-Pacific Partnership, the countries that are more developing have been given individualized accommodations for how long they will have to phase in the provisions. Some of these accommodations are really long.



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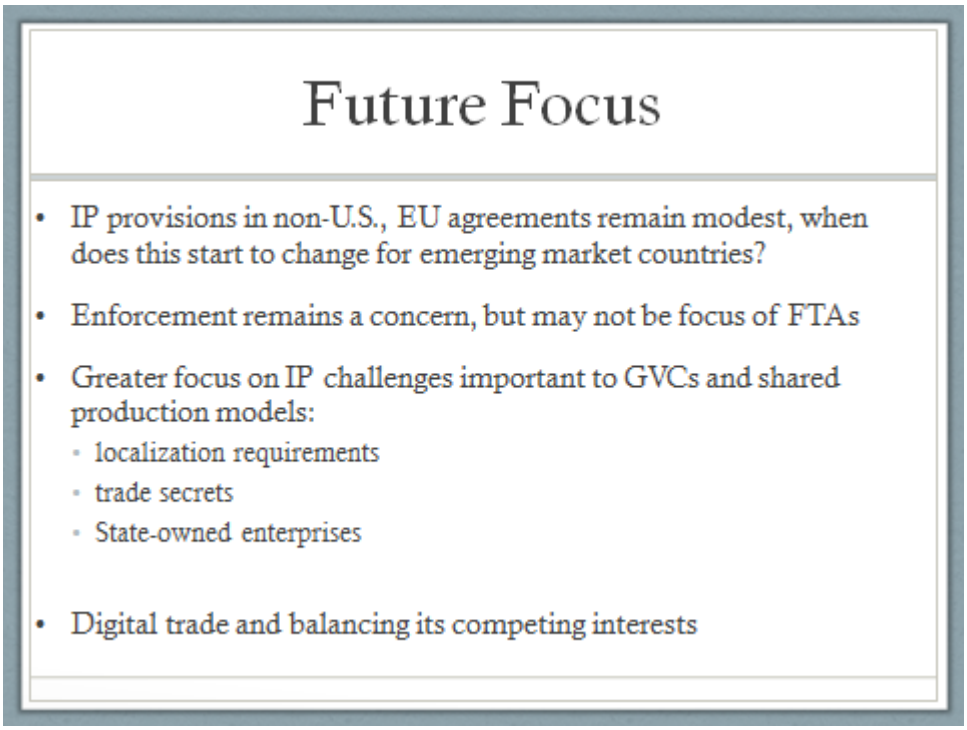
Vietnam receives a maximum of 18 years before they're required to implement the provisions in the TPP on data exclusivity on biologics. There are also provisions to which countries have taken reservations, effectively, about when they will give data protection that depend on when the product is launched in their market. So, lots of accommodations for how these -- these countries should be protected.

But it is ultimately going to be a uniform standard under the TPP, and in that sense, this agreement is meant to be compliant with that goal in the U.S. Trade Act of 2015 that these agreements should pursue IP provisions that look like the U.S. No matter how long it takes, eventually all the countries in here will have provisions that look like the U.S.

So, where are US trade agreements likely to go in the future? Well, a lot of emerging markets are starting to move up the innovation value chain. Some of that has been driven by intellectual property, but you're not seeing that translated into the free trade agreements negotiated by those countries.
Does that start to change? Do we see the regional trade agreements or bilateral trade agreements negotiated by emerging market countries that start to incorporate a competing vision of how the intellectual property system should work? Currently, it's really just largely absent from the agreements.

Enforcement remains a concern in terms of intellectual property, but it may not be the focus of future FTAs. Those of you that followed the negotiation of the Anti-Counterfeiting Trade Agreement recently, you may have recognized that there is some limits to how far that agenda can be pushed. That agreement was signed by over 20 countries, but only one country has ratified it, Japan, since it was concluded several years ago.

There is likely to be a greater focus on I.P. issues that start to address new technology issues, particularly in global value chains and shared production models, particularly the requirements that require localization of intellectual property.



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Localization requirements might require you to use local providers or offer subsidies that are only available if you use local technology, infrastructure, or standards. These requirements limit the ability for multinational actors, particularly from the U.S. and Europe, to occupy the same role in global value chains that they have now.

Trade secrets is going to be an increasing focus in trade agreements, as know-how also plays a significant role in these global value chains. Also expect to see more on the issue of state-owned enterprises and making sure that they are treated in the same way that commercial enterprises are treated in terms of restrictions on intellectual property and cyber-theft. Digital trade is likely to be a continuing focus, as well.

So, I will stop there with giving that broad overview and look forward to questions.

(APPLAUSE)

R. JOHNSON: Thank you, Tom, and appreciation to all of our speakers for both a quick whirlwind take of sort of setting the stage. We're going to try to drill down on some of these topics in the subsequent sessions.

Also, in the other sessions we've built in time for Q&A and for comments, so we hope you all will participate in -- in those discussions.

And again, my thanks to our speakers for setting the stage for I think what will be a lively discussion the rest of the day. Thanks.

PANEL II

COLGLAZIER: Great. Let me welcome you to our second panel. My name is Bill Colglazier. The first panel was great. I think you're going to find this session equally interesting and fascinating.

Let me just give you, briefly, my perspective. I sort of come from the science and technology side. Business is my background, but I spent many years in the Executive Office here at the Academies helping to oversee studies. But I spent, from 2011 to 2014, as the Science and Technology Adviser to the Secretary of State.

And in that job, I interacted with many countries -- between 50 and 70 about science and technology, countries at all level of development, from the poorest to the richest and everybody in between. And the striking thing was, every country that I interacted with -- with their government officials -- the first thing they wanted to talk about, and this is absolutely true of every single country, was the connection of science and technology to innovation and economic growth.

Every country is very much focused on that, as Simon Johnson's presentation -- his fine presentation this morning showed. Almost every country aspires to move to the model of upgrading their capabilities in science, technology and innovation, seeing that as a key to their future prosperity and competitiveness. And of course, the key issue is which ones are going to be successful and which ones are not.

Also, when I was at the State Department interacting with countries, they primarily want to talk about those sorts of issues. It actually was a great asset for U.S. diplomacy because most countries, even if their government doesn't like our government and vice versa, they still want to interact with our companies, with our universities, and engage in science, in technology, and still look, in many ways to the U.S. model, which actually is an asset for U.S. diplomacy trying to influence the behavior and investments and policies of other countries.

So what I'm particularly very much interested in is, essentially, the path of development in countries around the world, using science, technology and innovation -- what that creates in terms of possibilities, opportunities and challenges to the United States.

And then also, with science and technology moving so incredibly fast, which we heard from Gary Marchant this morning -- I think that's one of the reasons why countries are very much focused on these issues. And as you know, technological developments create opportunities and challenges and the objective is to maximize the opportunities, and you deal with challenges, and how all of this is affected by intellectual property rights, affecting technological development, affecting relations between countries, affecting the economic growth paths of countries I think is a fascinating and very important topic

So our four speakers today are experts on a number of issues. The first person, Devinder Mahajan is a good friend. He was a professor at University of New York at Stonybrook -- also at Brookhaven -- but he spent a year working in the State Department as a Jefferson Science Fellow.

But he comes from the science technology side. He has a large number of patents; he's interacted extensively on energy technologies around the world with China and Africa. When he was at the State Department, he also and still remains an adviser to the Economic Bureau in the State Department on IPR issues.

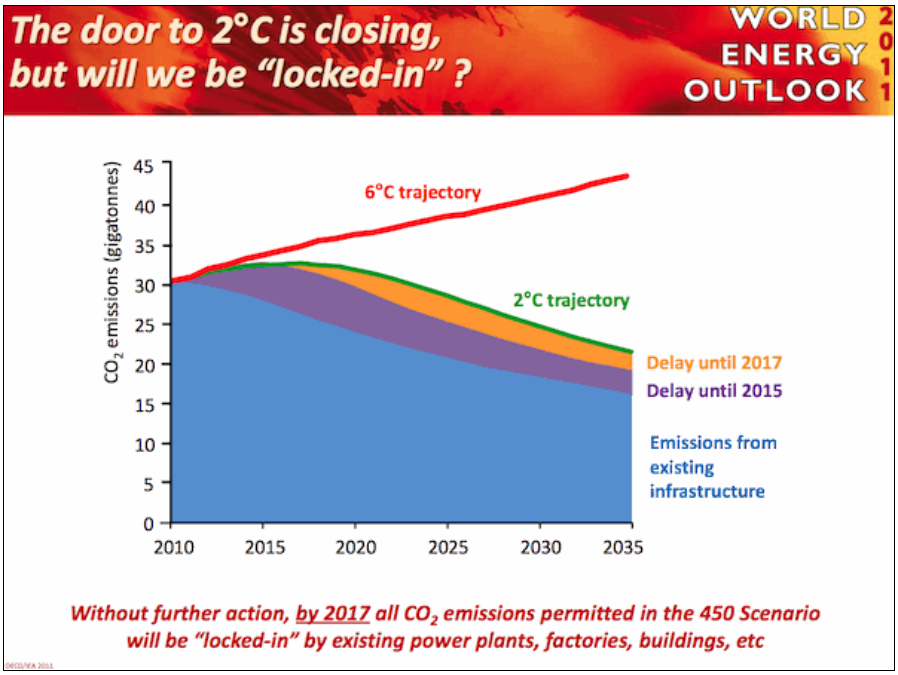
So I thought it would be interesting to hear from someone who is at the front line in terms of engaging with countries around the world on -- on IPR issues, but coming from the science and technology side.

So I'll turn it over to Devinder.

MAHAJAN: Thank you, Bill.

OK. So, it was a very fascinating first session this morning. So I am going to -- I just look at the make-up of this particular session and I see lawyers and economists. I'm the only technologist, so -- but, I get the lead, so -- so that's a good thing.

So I'm going to -- what I want to do is I'll give you a couple of minutes of what the drivers are for the technology and then go right into actually -- give you some examples of boots on the ground where, actually, I am in the front line, in the sense of into it with China -- we give the example also of Africa -- where we are very actively working some models.



Presentation of Devinder Mahajan, 12/11/2015

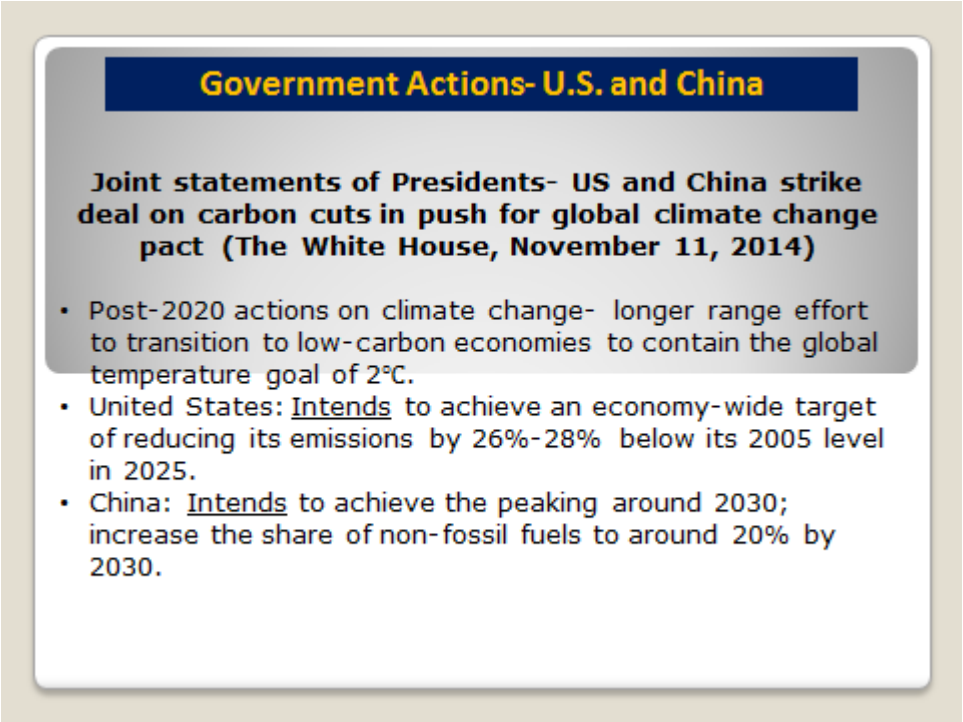
So what are the drivers? After several decades, the year I was at the State Department this report came out – the 2011 IEA World Energy Outlook projections on CO2 emissions. And essentially, you should look

at the graph. That line is actually six degrees Celsius, business as usual, and then you have of course, totally different scenario.

And the problem is, if you look at the -- some of the numbers, you will see -- so, right now we are 401 ppm CO2, and under that two degree scenario, we're looking at 450 ppm leveling. So, if that is the case, 80 percent of the emissions are locked in, and without further action, by 2017 100 percent will be locked in.

So, of course, whatever we do, we had to do something to -- going backwards. I mean, that's the only way it's going to work. So -- and also, this is just a summary from the 2011 IEA report, and Faith Birol, as the chief economist, this was his take.

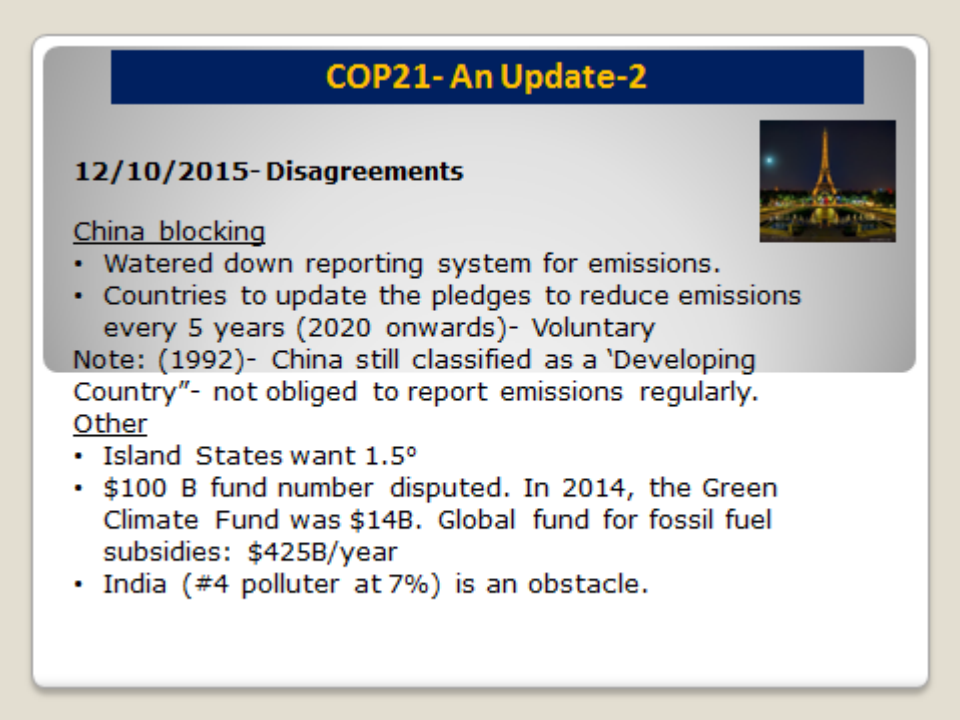
So, I'm going to actually go straight to last year's initiative from the White House after President Obama met with the Chinese President; this was the -- what came out of that was -- and in fact, this is what is going into the COP 21 -- that United States intends to reduce their emissions by up to 28 percent by 2025. China intends to achieve that figure at 2030. And -- but -- and they will do that by increasing its share of non-fossil fuel nonrenewables -- around 20 percent by 2030.



Presentation of Devinder Mahajan, 12/11/2015

Just to give you a quick update -- I mean where we were about two weeks ago -- into -- going into the COP21 in Paris and we are seeing that there were, obviously, pledges made before the day one. I happened to be in China so I had -- I had the privilege of listening to all the analysis of the Chinese President pledges -- everything that happened that day. But in any case, so Green Climate Fund U.S. pledges $3 billion new money; China, 3.1 billion, but that's going for the study for the least-developed countries seeking cooperation on climate change.

Also, they have pledged that by 2017 they're going to have a carbon emissions system in place. But if you look at the whole thing here, one of the things key is that they are counting on technology transfer -- and I want to come back to that in a minute. Technically -- capacity building and access to data.



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Now, these are words, but of course has a lot of implications what it means. This was as of six p.m. last night. I looked at it from what is coming out of the news and what we – this agreement essentially was -- this, again -- this not my words -- I just took it from the -- from the internet, and that is, China actually is resisting two things, and that is, they want to water down reporting CO2 emissions.

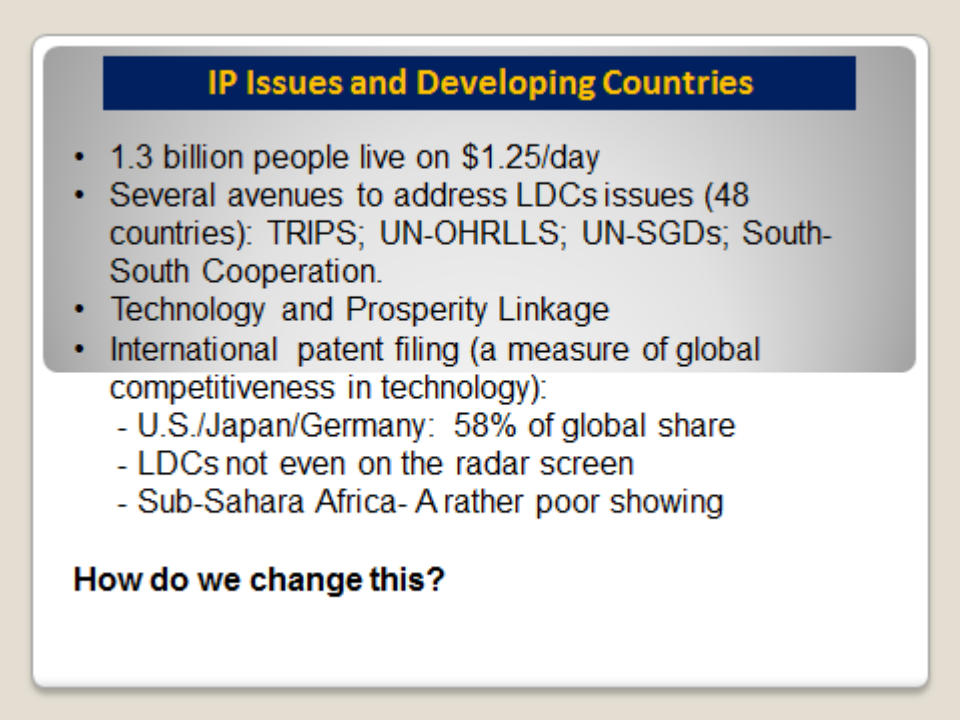
And you look at the law, China is classified as a developing country but also number two economy, and they are not obliged to report emissions regularly.

And also, the second point is that the countries to offer a pledge to reduce emissions every five years -- 2020 onwards -- and they are saying should we probably not -- that they have to. So -- I don't -- some of the other issues are also -- other states want 1.5 degrees, not two degrees Celsius. I have no idea how they're going to achieve that. Even two degrees are actually technologically could be an issue.

And also there are -- there are also -- there are other issues that -- global fossil fuels for subsidies -- for a year, but the Green Climate Fund is only about $14 billion in 2014 -- not a highly disputed number according to a lot of member states.

Anyway -- and the third thing they are putting in this category was in India, which is the number-four polluter at 7 percent is an obstacle. So, in any case, and also, I believe it's very possible that we may not have a -- an agreement by today or tomorrow. It could be going into the weekend.

Anyway, so there is our bit on the COP21, so let's go back now, looking at what I said before in the last slide.



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It's all coming down to technology, and those are the big issues. IP issues in developing countries is the real reason that there's a lot dispute. And so, you have 1.3 billion people living on $1.25 per day.

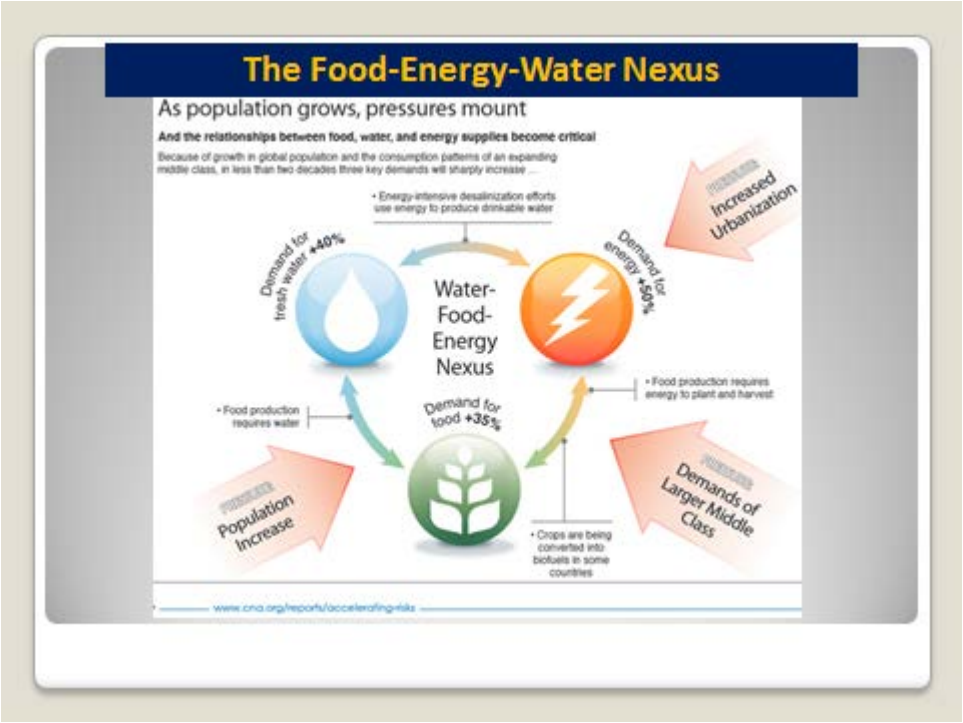
Several avenues has already been in place before going into COP21. You have TRIPS, which has already the last rules, the Least Developed Countries (LDCs), and also for compliance on IP issues. You have 48 countries classified as LDCs . You have TRIPS, where again are -- they have an eight year window until 2021 to comply. You have, also, the Office of the High Representative for the Least Developed Countries, Landlocked Countries and Small Island Developing States (OHRLLS) for the LDCs. Also, the Sustainable Development Goals (SDGs) -- they are all built into these for LDCs' cooperation.

So technology and prosperity, of course, has a linkage and you can look at it from the next bullet in the national patent filing -- imagine a global comparison in technology. U.S., Japan and Germany together account for about 58 percent global share in this -- in the patents. And of course, because that where they have -- the standard of living is much higher. And LDC is not even on the radar screen in this -- and then, also, give sub-Sahara Africa as a unit, another poor showing in this international patent filing.

So -- so, of course, coming up is “Yes, we will come out of COP21 with some resolutions again,” which are not going to be very different from what you see in TRIPS and -- how to help these LDC and other developing countries to go forward, but the problem is, how do we change this?

I was, about two weeks ago, three weeks ago, in Beijing, at a conference, a conference on food, energy, water and access. So, COP21 -- yes, it's a formality when it's coming out of that, but if you look at this, there are a lot of -- the people are realizing when you don't have -- in about 20 to 25 years you will have nine billion people. How are you going to -- how are you going to support nine billion people?

So these are some of the numbers -- if you look at this -- population increase to nine billion, urbanization, and demand for fresh water is going to go up by 40 percent. Look at some of the numbers – the demand for energy is expected to increase by 50 percent, and demand for food another 35 percent increase. I mean, those are, that's a tall order just in these three areas. How are you going to, how are we going to meet those?



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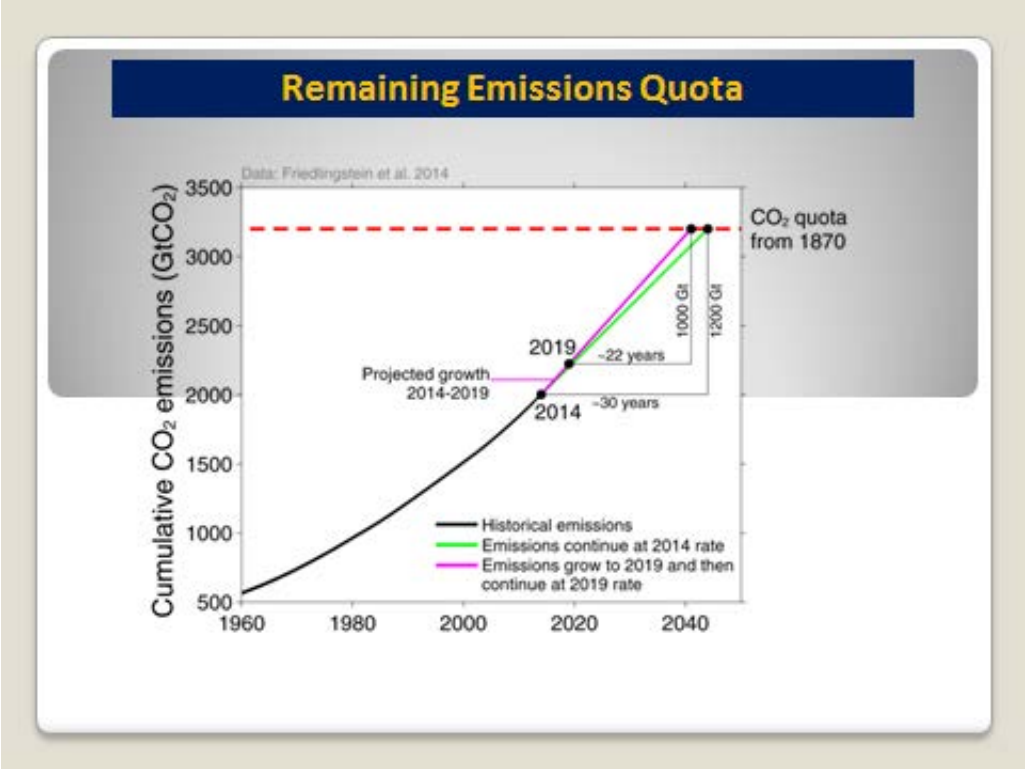
And technology has tried to limit this to two degrees Celsius; that's the issue because all these are energy intensive, so that means you have to find energy from somewhere to do this.

So, just to summarize what I just said is the Istanbul Plan of Action (IPoA), the 2011 agreement -- it's a bit very far -- specifically the technology bank that can be there for the LDCs to, to actually access. TRIPS has a very -- very intense provisions. UN has sustainable development goals – SDGs -- that are 2015. Same thing – sets out cooperation -- again -- there are a lot of entities going into COP21, but -- so coming out after COP21, I think there is a very generous share or care of the remaining CO2 quota that we have for LDCs.



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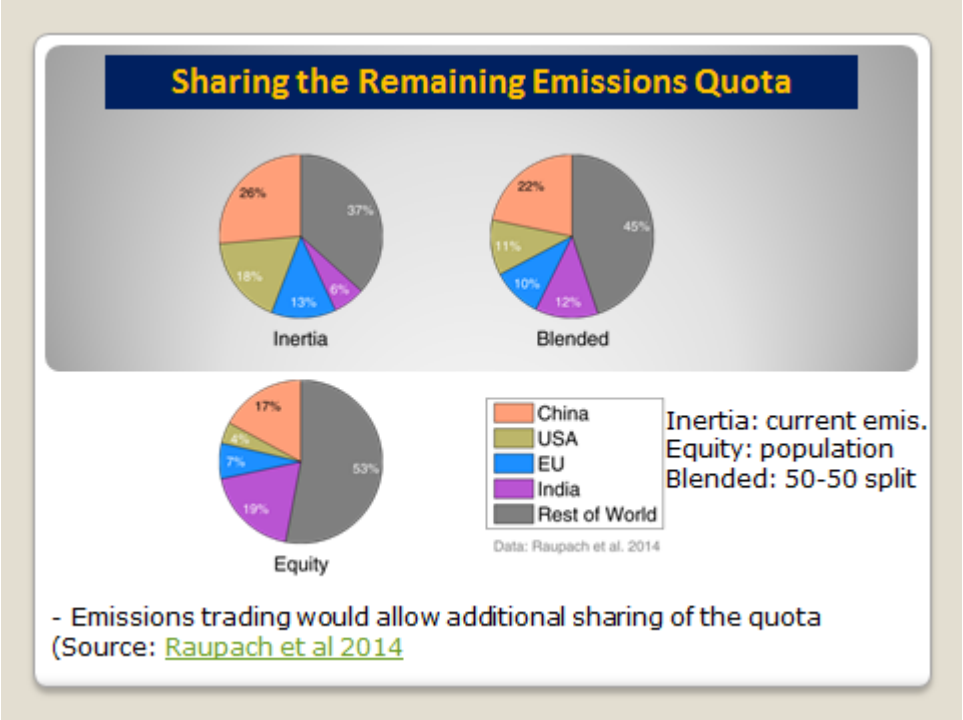
As I said, if you're going to meet that two degrees Celsius, you're going to have this -- we only have either 20 to 30 years depending upon how you count it. What is left? To me, that would be the 2 degrees Celsius -- the emissions.

And I think they are coming out pretty -- this is what the developing countries -- you look on the right -- which takes into account both the emission trading now, and also the equity -- the population. You take both of them on the right top -- blended model, actually -- it's fairly generous to both China and India compared to the U.S. and the E.U., which are the -- the top four polluters. So if you take this into account -- so they will do pretty well going forward in terms of how much you -- the developing countries -- or the LDC -- can produce.



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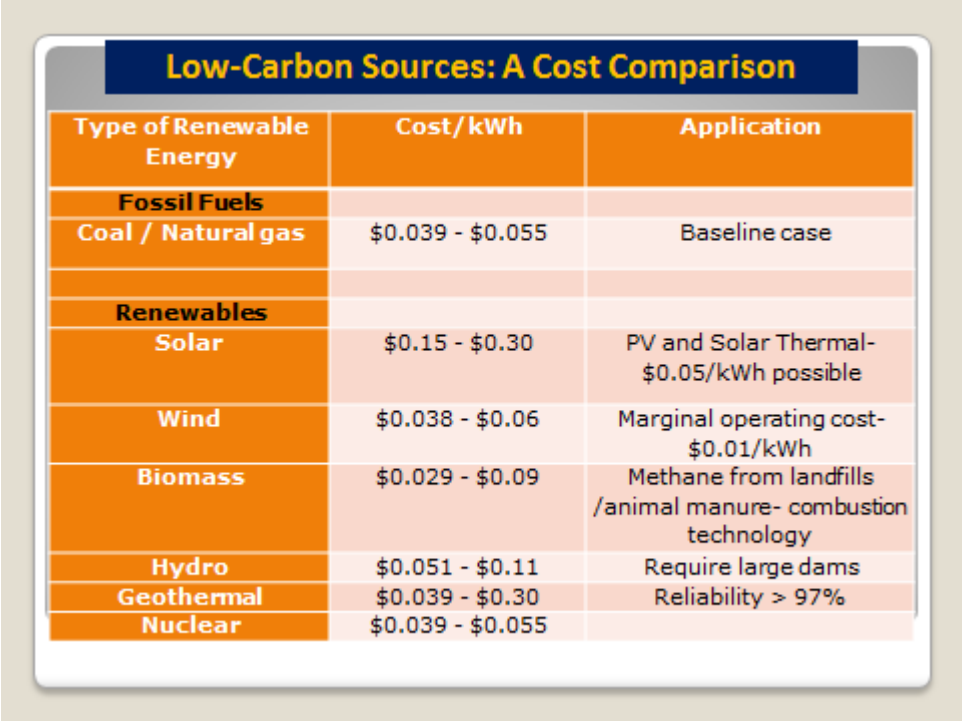
But the problem is -- that is fine. So here is a, let me throw this in at this point in technology. OK. So, to meet the two degrees Celsius, you had to start substituting renewables with fossil fuels. So as a baseline, I put in the coal/natural gas producing -- as an example -- 39 to 50 percent renewables -- solar, wind, biomass, hydro, nuclear -- all of them fairly good price range now -- they need small subsidies, maybe, but they are coming in terms of some of the other technology advances.



Type of Renewable Energy	Cost/kWh	Application
Fossil Fuels		
Coal / Natural gas	$0.039 - $0.055	Baseline case
Renewables		
Solar	$0.15 - $0.30	PV and Solar Thermal- $0.05/kWh possible
Wind	$0.038 - $0.06	Marginal operating cost- $0.01/kWh
Biomass	$0.029 - $0.09	Methane from landfills /animal manure- combustion technology
Hydro	$0.051 - $0.11	Require large dams
Geothermal	$0.039 - $0.30	Reliability > 97%
Nuclear	$0.039 - $0.055	

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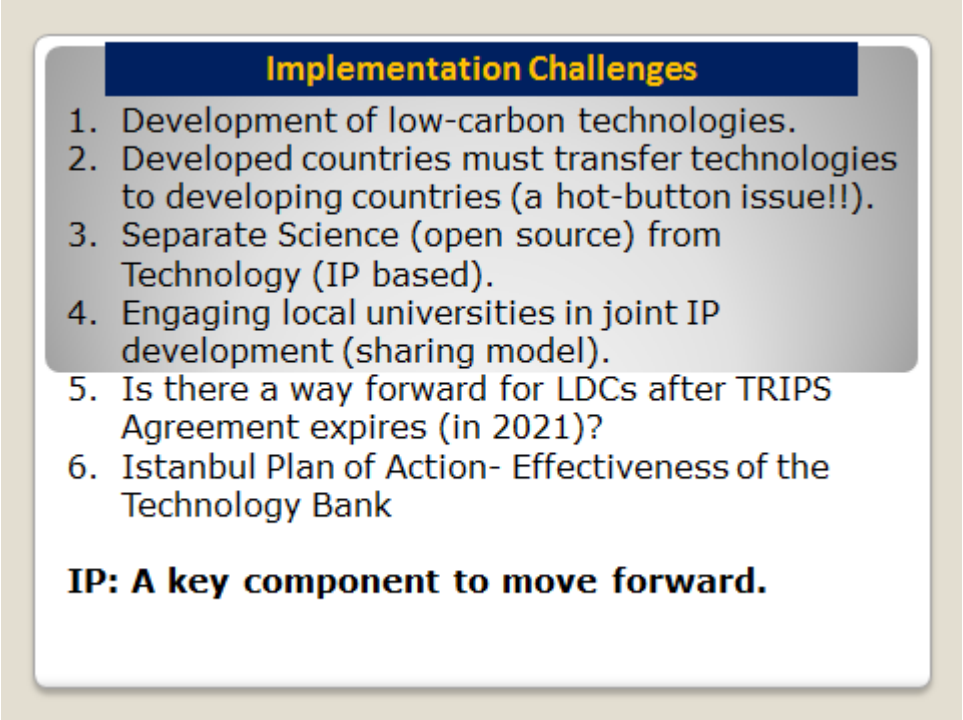
Solar is a good example how the -- how the solar panels -- the price has gone down over the last 15, 20 years and it's very competitive. But the problem is, these technologies, again, are -- are held mostly by the developed countries, and the question is how would -- how would it happen going forward that these are implemented? I mean, that is -- that's where the real challenge is.

So I have made a list of these implementation challenges if we are going to go forward and have some meaningful outcomes. So we should look at the development of low carbon technology – they are going to provide a base -- that's a very good base, I am actually part of that group that are developing these technologies, and I think it's very exciting to be in that -- in that particular space.



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Developing countries -- now this is a hot-button issue because from everything I have said so far, it is obvious that developed countries must transfer technology to developing countries. It's a hot-button issue because how do they get compensated is a problem.

Third thing, I just want to point you need to separate science from technology. My interaction so far internationally is that there is a confusion between science and technology. This is said in the same breath and I think they needs to be some more separated -- that science is an open source and technology is IP based. But since we say the same thing in one sentence, science and technology -- I think there's a lot of confusion internationally what it means.

Engaging local universities -- do you want IP development? I am going to talk a little bit about that in the few minutes I have left. And also, is there a way for in the TRIPS agreement -- so they have a -- all that is apparent in and the TRIPS 2013 agreement -- an eight-year extension for compliance. And there is a -- provision that it could be extended. You can't keep doing these extensions. That means we have to find somehow to include them so they actually do comply. It's the Istanbul Plan of Action – that affects the technology bank. So all these have an IP -- a key component to move forward.

I will give you, now, two examples of where I'm actually very, very personally involved in and that is China, where we have joint projects on fugitive gases containment, and East Africa where we are looking at the off-grid solutions -- to then make my point -- what I just said.

First one is, there's a -- there's a program under the Strategic and Economic Dialogue (S&ED) that happens between U.S. and China where there's eco-partnership. It's -- this is where both parties are coming together to actually define projects in energy and environment development. And we have just put out this -- this particular special volume -- that lists 18 active projects that are going right now. I have -- actually, outside I have put a few copies of this. It just came out and more than -- please help yourself to those.

And eco-partnership program actually is one of the bright spots with the U.S.-China relations right now, but that's on the technical side. I'm not going to go on the political side, but this particular program is very good in terms of the collaboration -- for example, the special volume of Eco-Partnership in which Brian Holuj (Eco-secretariat) and Wu Hongliang (NDRC, China) served as co-editors. He also contributed data.

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This is our part of the projects -- it's one of the 25 unless U.S.-China has another -- China has a big problem with emissions they produce just from landfills. And that produces about 14 percent of all methane emissions in China, and that integrative management can produce about 20 billion cubic meters of methane as a renewable. Remember, this is actually categorized as renewable methane, so that means it's part of renewables and it avoided 300 million metric tons of CO2.

So this project is looking at a future workshop, and then after that we have two technologies we're considering. One is on sulphur removal, which is very crucial, followed by a small company in California that we are working with who had developed a diesel substitute and it's very applicable to methane and CO2 which is a -- a good percentage comes out of the landfill -- 60/40 ratio, otherwise you cannot do anything about it. But, in this particular case, you can take both methane and CO2 and convert into a diesel substitute. So their technology is of interest to the Chinese and we are actually, at this point, looking -- there's a technology demonstration. So, anyway, this one -- one thing we are noticing since I got to China for -- again, going back to what I was saying -- science and technology. There is a confusion about what it means in terms of technology and licensing, and so forth. So there's a lot of discussions on the -- so, in terms of the challenges in this particular case, all I can tell you is there's a learning curve to ascertain what it means, even to the Chinese.

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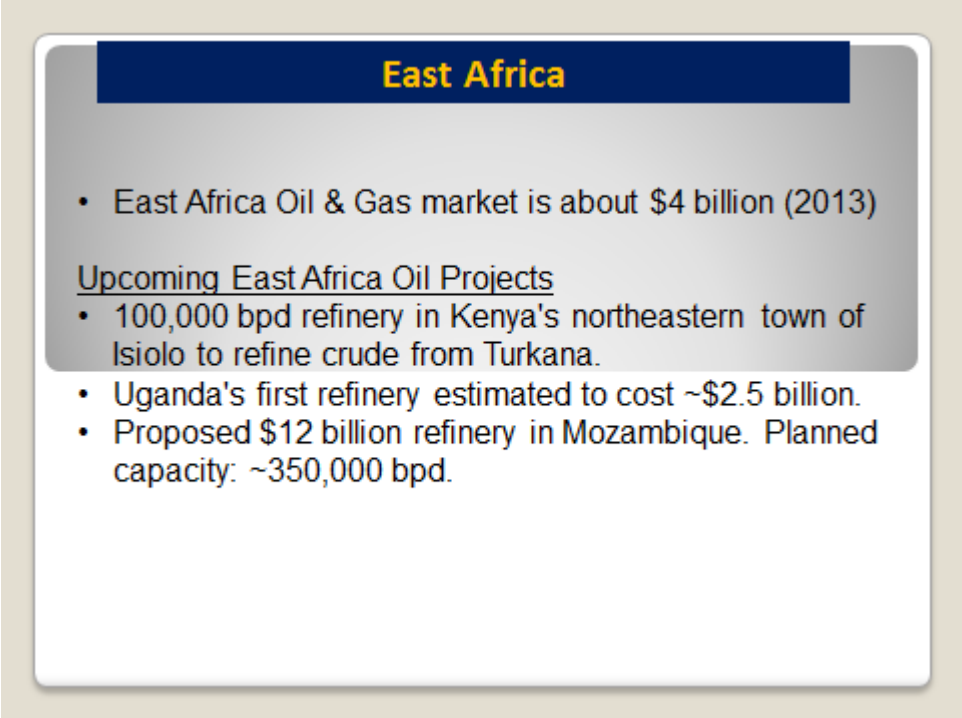
East Africa -- second example and then I'll be quick. Here, the problem is that they are finding oil and gas everywhere at this point, which is not good news from the perspective of trying to look at the climate change aspect. I mean, they are finding it, they are going to use, so what do we do about this?



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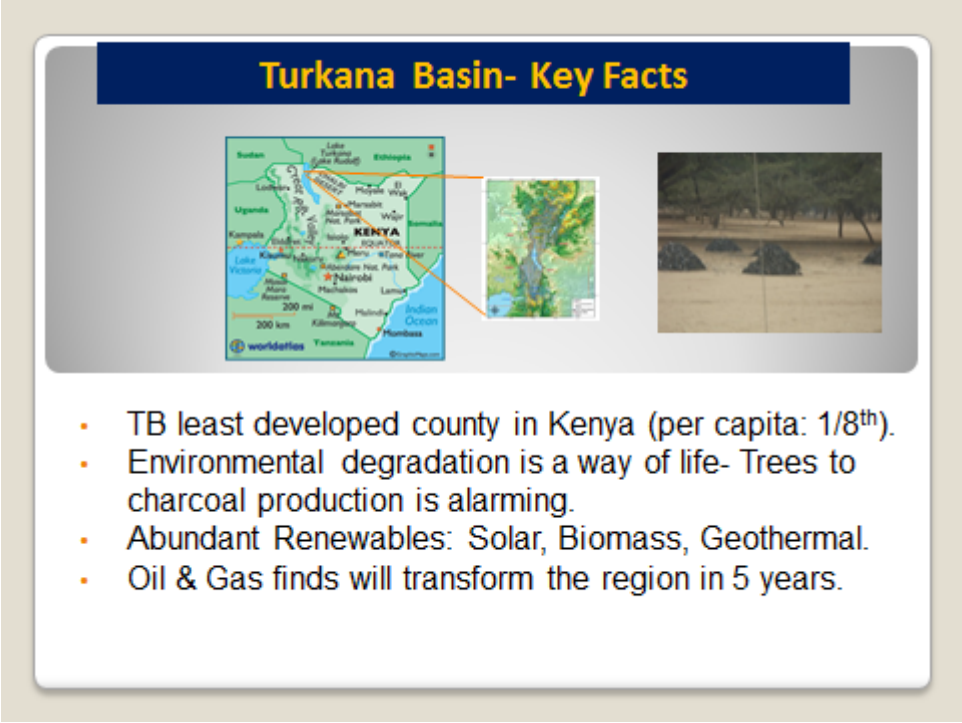
Turkana basin, which is part of northwest Kenya, this underdeveloped county represents actually in Kenya one-eighth of the per capita of even -- even within Kenya. They cut trees. They make charcoal and sell it to the refugee camps -- $2.50. There's a lot of abundant solar, bio, geothermal and that is where we are focusing on –– to stop environmental degradation.



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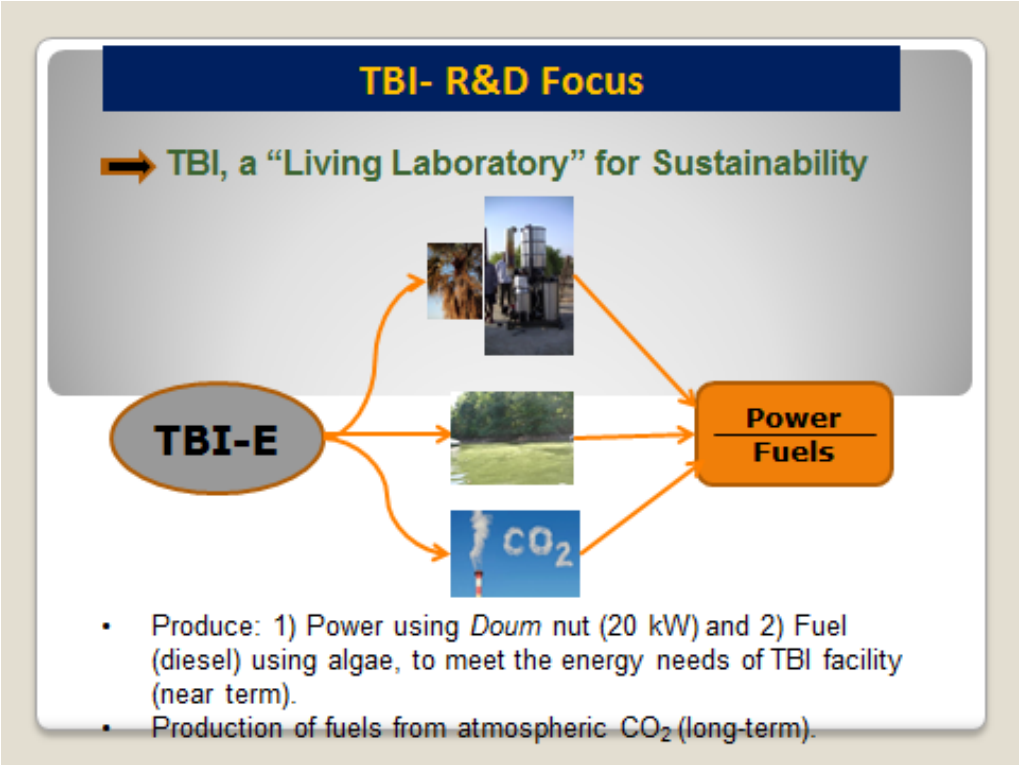
Richard Leakey -- he has, obviously, everybody knows who he is in terms of human evolution, he has the Turkana Basin Institute (TBI) where we're looking at energy -- living laboratory serving as a model for future upgrade -- there is nothing there, that means, both in terms of fuel and power you are to produce yourself -- figure out a way to do that.

And this is what we are doing there in terms of a small gasifier which is powered by a local waste of doum nuts to produce energy. And in the future, we're also looking at capturing CO2 from the air and trying to make power and fuels.



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So, what we are doing in terms of implementing TBI is that we are -- while we are developing these technologies, we are realizing that, again, going back to partnerships into IP that we have partnered with two local universities...

And, going forward, we are looking at bringing them in and making them our partners and anything that's developed, there will be joint IP.

So just to summarize in my final minute. So, essentially, going forward after COP21, you going to see a favorable share of the remaining part of emissions going to developing countries. That's not a problem, but where the problem is -- how do we handle going forward? And one is that educating international institutions on the IP issue is a crucial part.

I am with the State Department -- well, since 2012 with the IP office, we have developed a tool -- there's a PowerPoint that I use, actually, when I go to any type of these -- these institutions that actually

tells them what it means to take part into the revolution that's happened in the United States universities in the IP model.

I am a researcher, I also have patents and – and those are some of the licenses. And that is the royalties -- that is something to address that is appealing to them -- that you can do that, therefore, they need to protect it.

Clearly differentiate between science and technology -- I think that's going to be very important going forward, but there is a confusion that everything is free -- I mean once we have a partnership. How do you compensate for IP -- and one thing could be that, for the technology already in existence to license that, for example, when the World Bank and other institutions, they do a project financing -- maybe they should build in a small percentage of that to compensate to the developers for their technology that is already there.

Going forward, forge partnership, develop technology and get LDCs out of the cycle, so we don't have to come back and say "OK, you get another extension during TRIPS negotiations" in 2021. The Istanbul Plan of Action to establish a patent bank is a good idea, but I think the problem there is, there will be millions and millions of patents thrown in there. How are we going to sort these out? There's only about one percent that really can be commercialized. It's a big challenge when you have millions of patents, who is going to figure it out? Which patent should really be licensed or not?

So that's another challenge I think we are facing as we go forward and try to meet this. So I think that my time is up, so I'm going to finish here.

(APPLAUSE)

COLGLAZIER: Thank you, Devinder.

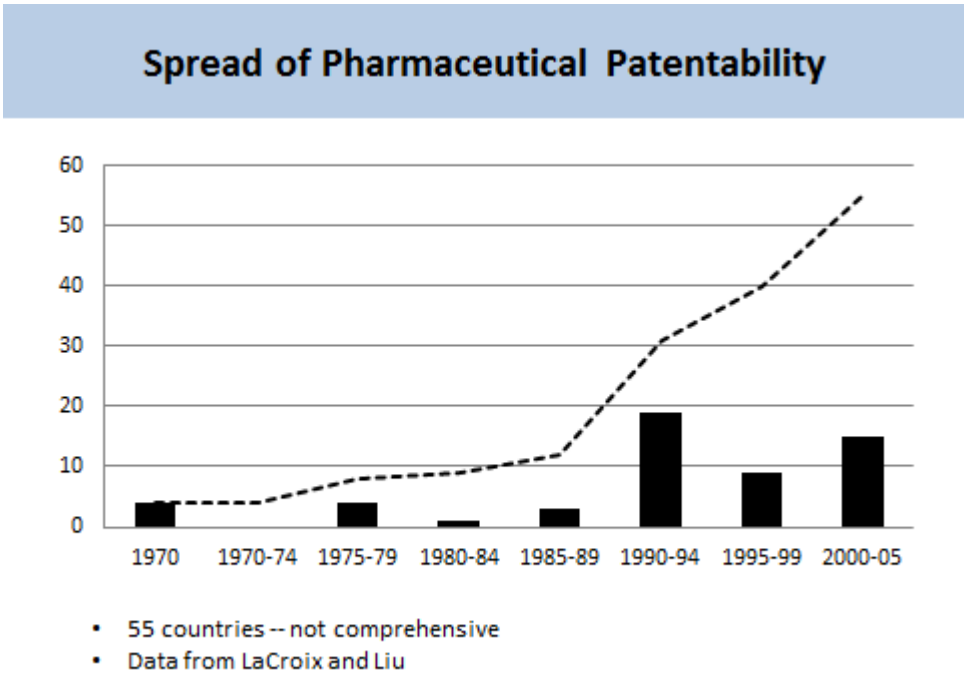
Next, we have Ken Shadlen. He's from the London School of Economics and Political Science, focused a lot on development issues, but in particular, on the pharma issues. We already heard a lot about pharma this morning. It's one of the key rapidly developing technologies and applications for both development, as well as future IPR regulations and law. So let me turn it over to Ken.

SHADLEN: Great. Thank you very much. Yes, we're back to drugs.

(LAUGHTER)

It's wonderful to be here. It's a real honor. It’s my first time at the NAS, and I'm thrilled to be here.

Let's start with a picture. This is plotting, in five-year periods, countries according to when they made pharmaceutical products patentable. So one of the things to remember, as overarching context for everything I’ll talk about, is that pharmaceutical patents are new.



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There are three things I want to draw your attention to here. What's going on the left side of this is basically countries in Western Europe -- the OECD countries -- allowing patents on pharmaceutical products that they didn't before.

The second thing that's going on here (though actually, which you don't see in the figure), is that in the 1970s many developing countries excluded pharmaceuticals from the realm of patentability, such that, by the time you get about halfway over into the early 1980s -- sort of when the negotiations for TRIPS start, at this brief moment we have a division in which pharmaceuticals can become patented in the North, but largely not in the South.

The third thing I just want to draw your attention to is that the action on the right side, which is developing countries making pharmaceutical products patentable -- not exclusively developing countries here, but mostly countries – this takes place not just after TRIPS, but during the whole context of the negotiations when the writing is on the wall that pharmaceuticals are going to become patentable.

Another thing, obviously, is that there are more than 55 countries in the world that allow patents on pharmaceuticals. This figure is based on data from two scholars that have published what they found. But the ones that are missing are over on the right side, as well. There aren't wealthy, developed countries that are missing from this, the missing countries are developing countries, and they all basically would be on the right side.

That was as long as I wanted to spend on this. This, what I'm calling universalization of pharmaceutical patentability, has inspired three waves of research.

Three Waves Research

1. The Globalization of IP
- How IP became "trade-related"
- Why pharmaceutical patenting became obligatory
- DV: IP obligations in international agreements

2. The Politics of Implementation
- How countries respond to international changes and obligations
- Variation in national patent systems
- DV: National policy choices

3. Effects of Policy Choices
- Not just what countries do, but what happens
- DV: outputs of policies/institutions

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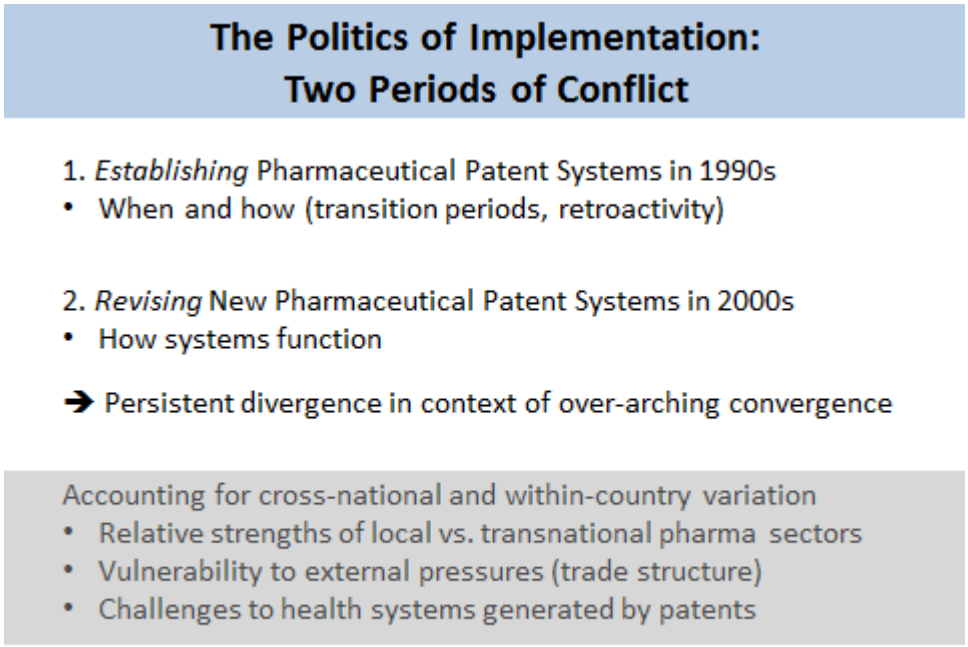
The first, and the one that's gotten the most amount attention from scholars, is the globalization of IP itself – this research examines, for example, how intellectual property became trade related, and why pharmaceutical patenting become obligatory rather than a question of national choice.
The outcome in these sorts of studies -- there's a lot of scholarship on this -- are the international intellectual property obligations in international agreements, such as, for example, the presentation that Tom, from the Council on Foreign Relations, gave this morning.

Another wave of research is about the politics of implementation, going beyond the international level and looking to see how countries respond to these new international changes and obligations. Here we're studying variation in national systems, so the outcome is not the rules in NAFTA or the rules in the WTO, for example, but what the rules are in a given country.

And then the third area of research, of course, regards the effects of policy choices. We want to know not just what countries do, but what happens as countries introduce pharmaceutical patents. Here the output that we're studying are not just countries' laws and the practices, but the outputs of these laws and practices on the ground.

My work is largely in the second and third areas, and that's what I'm going to spend a bit of time talking about today.

Starting with second point, implementation, I'm interested in -- how countries reacted to this new obligation to grant patents on pharmaceutical products. In my work, I focus on two different periods of conflict.



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One, roughly in the 1990s, when countries begin to do this new thing that they didn't do before, which is to establish a system to receive applications and grant pharmaceutical product patents. Here, the riveting questions that consumed all of the attention are nitty-gritty things like *when* and *how* are we going to do it. All these international agreements say we have to do it (introduce pharma patents), but there's a certain amount of leeway as to when we must do it, and how we're going to it (for example how we're going to treat applications and patents that were already in process in other countries).

I won't bore you with the technical details here, but these sorts of questions, the when and the how, were the sort of questions that consumed all of the attention in this first period.

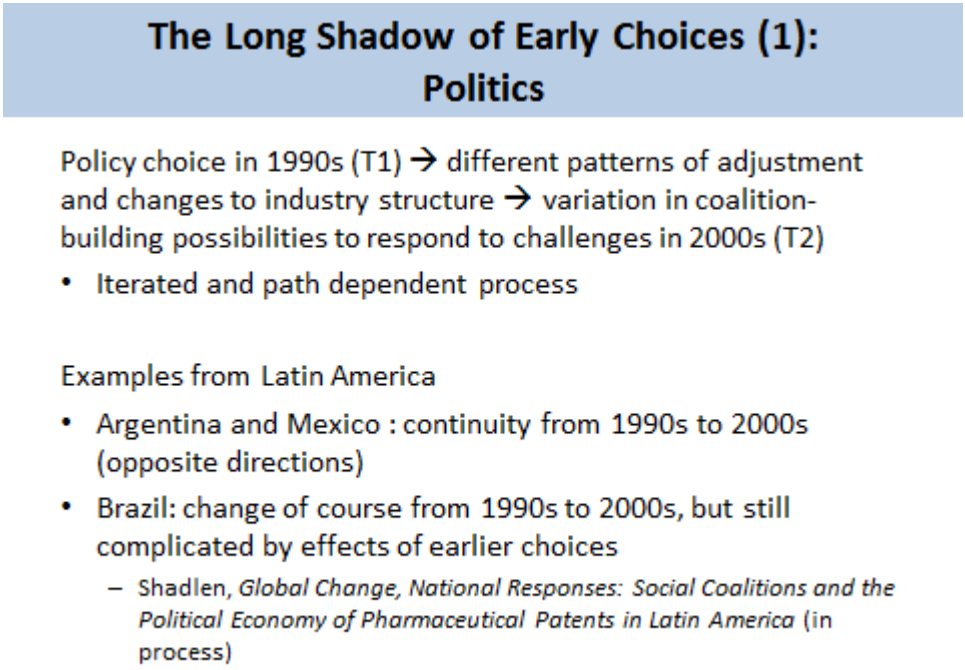
The second set of conflict, in the 2000s, is about revising these new systems. So, we've put these new systems in place, we made decisions about when and how we're going to introduce pharmaceutical product patents. Now, we've started to grant them, so the world has changed -- or it's starting to change -- and now we start caring about the kinds of things that actors care about here in the U.S., for example, which is how does the pharmaceutical patent system function?

One of the things that I've observed in my research on these two different periods of change (this is what I have here after the arrow), is that, yes, there's overarching convergence -- pharmaceutical patentability is now universal, or nearly universal – but there's still persistent divergence.

I'm not going to talk about the stuff that I shaded there in gray, because if I did, I'd be up here for a month, but I just want to flag that these are some of the factors that I focus on to explain cross-national and within-country variation.

I look at conflict between the local and trans-national pharmaceutical sectors, I look at how trade structure makes some countries more or less – sometimes in surprising ways -- vulnerable to external pressures, and I look at sort of how -- once you've adopted a pharma patent system, how doing so can generate shocks to health systems that might prompt ministries of health to try to revise things.

I want to draw your attention to some overarching points. I want to take a step back and talk about what I think of as the long shadow of early choices -- the reason why the decisions that were made in the early to mid-1990s still matter.



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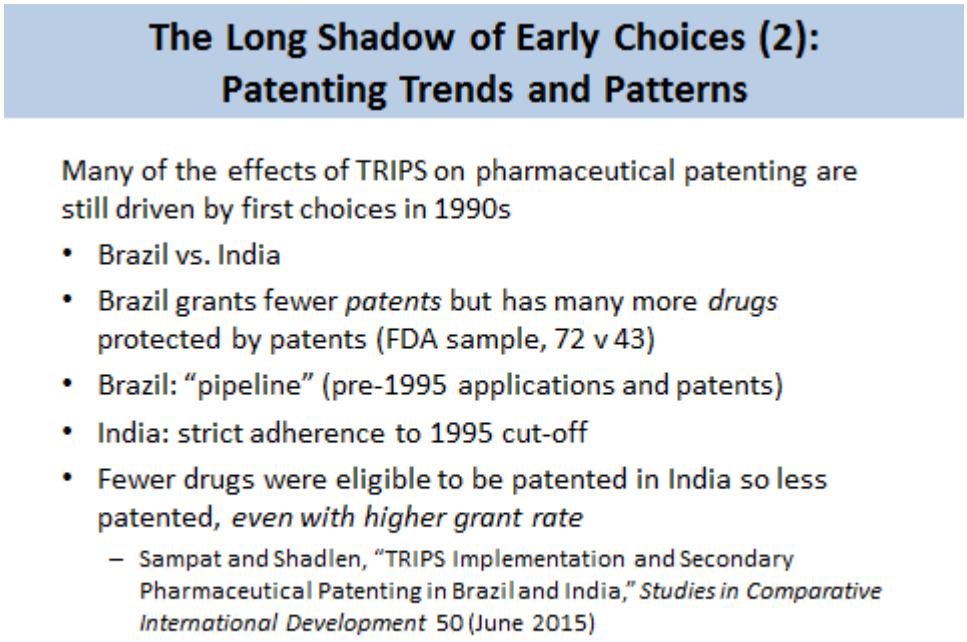
I put it up here very schematically. A country makes a policy choice at time one. This has effects. It affects industrial structure (pharmaceutical firms that used to be able to do one thing stopped being able to do it and now have to do other things), and it affects the state (new ministries are created, the budget is allocated to new ways). Things change, and these changes, then, set the boundaries for coalition-building possibilities in the second period, when governments want to respond to changes.

So I see the politics of implementation as an iterated process that takes place over time. I simplify it as two periods, but one could make it more complex. And it's a fairly path-dependent process. I'm using that term cautiously, in the sense that, basically, policies that are made at time T2 are made in the shadow of the policies made at time T1. We're not starting with a blank slate in the 2000s.

In a book that I've been working on for a while, I look at this in Latin America (the book is based on comparisons of Argentina, Brazil and Mexico). We have continuity, in opposite directions, in two of the countries, in which one country chose a set of policies in the early 1990s that included very early introduction of pharmaceutical patents with very strong levels of patent protection, and the result was

that, by 2000s when it came time to perhaps revise this system, the pathways were largely closed off and you get continuity of a very strong IP protection system in the pharma sector. That's Mexico. Argentina is in many ways the opposite, continuity too, but in the opposite direction.

Anytime anybody talks about processes having a path-dependent nature can be a bit worrisome, because it might imply more determined lock-in effects than is warranted. What if there's an election and a new government comes in and wants to change the policy? This happens all the time. Or, more simply, what if the health minister wakes up one morning and has new sets of data and evidence on his or her desk and wants to change policy? This happens too. Politicians often try to change directions, and Brazil is a case in my book in which I show the policy trying to chance directions greatly from 1990s to the 2000s. Without getting into the details here, the point is that even these efforts to change directions are constrained and complicated here – these efforts to change course are done in the shadow of the first sets of policy choices.



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A second point that I want to make within this context of the long shadow of early policy choices, and this is drawing on some additional work that I've been doing with my colleague, Bhaven Sampat, from Columbia University, is that many of the effects of TRIPS on pharmaceutical patenting are still driven by the first, earlier, set of choices. In a paper of ours that came out earlier in 2015, we looked at Brazil and India. We took all of the drugs that were approved by the U.S. FDA between 1996 and 2004 -- so a nine year period. We found all the US patents of those drugs that were listed in the Orange Book, and then we found the local applications in Brazil and India -- not patents, but local applications in those countries that were associated with the U.S. patents. Then we analyzed what happened to each of these applications in Brazil and India. We looked this at the patent level and at the drug level.

One of the things that we found is that Brazil grants many fewer patents than India. The grant rate in Brazil is much less than the grant rate in India, even on comparably similar sets of applications. But Brazil has many, many, many more drugs in this set protected by patents.

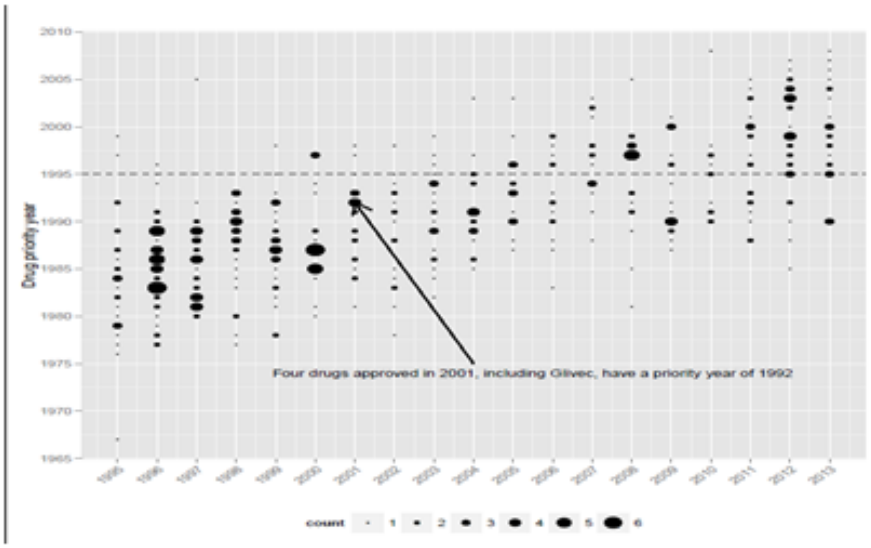
The reason why is that we're still living in the shadow of choices made in the 1990s, in which the Brazilians decided, when they started granting pharmaceutical patents in 1997, that they would also reach back and retroactively provide pharmaceutical patent protection to things that came earlier, at a time when patents were still not eligible in Brazil.

In contrast, India, as with some other countries, took a strict adherence to the 1995 cut off point that was in TRIPS. TRIPS in pharmaceuticals essentially says that countries can act as if the world started in January 1995, and so the Indians -- and not exclusively Indians -- sort of said "The world will start in 1995."

So even when India started granting pharmaceutical patents later, they would only consider applications that were filed at this cutoff point. The result is that fewer drugs were ever eligible to be patented in India, so less were patented. This is so even though, among applications that are eligible and examined, India actually has a much higher grant rate than Brazil.

Again, we observe differences in pharmaceutical patent systems and their effects. And – this is the key point here – these differences are not due to the day-to-day practices of what's going on in these two countries right now in 2015, or even ten years ago in 2005, but the decisions that were made, now 20 years ago, about when and how to implement pharmaceutical patents in the first place.

The Importance of 1995:
Priority Date of First Patent by Year of Drug Launch



Source: Sampat and Shadlen, "Drug Patenting in India: Looking Back and Looking Forward," *Nature Reviews: Drug Discovery* 14 (August 2015).

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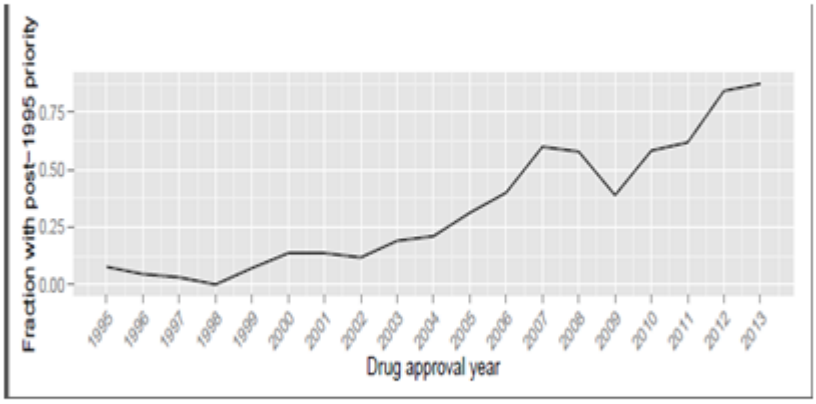
This chart basically tries to illustrate the importance of this 1995 cutoff date. What this chart shows is all drugs that were launched in the U.S. from '95 on. For each drug launched in the U.S., we identified the earliest patent (a drug's first, earliest patent is usually its strongest patent) and its application date. The size of the dots is just the number that are there in each combination of launch date and patent application year. What we see, of course, is that drugs that were launched a long time ago rely more on earlier patents -- not at all surprising. Drugs that are launched more recently, as we go to the right side, rely more on later patents -- not surprising either. What is surprising, and what I want to draw your attention to, is how much more action there is in the southwest than the northeast. Even going into the 2000s, most drugs that are being launched are still relying on earlier, pre-1995 patents.

One that we highlighted in the figure is Gleevec, which has gotten a ton of attention around the world. The earliest patent for Gleevec was pre-1995, so it never got granted in India. So there was all this hullabaloo about whether a later patent, a secondary patent, would get granted in India. It didn't, and that the firm (Novartis) got no patent protection in India, at all, for Gleevec. It so happens that in Brazil, Novartis didn't get that second patent either, but they didn't care because they got the first one – and that's because Brazil didn't have that strict adherence to the 1995.

The Transition Continues



Source: Sampat and Shadlen, "Drug Patenting in India: Looking Back and Looking Forward," *Nature Reviews: Drug Discovery* 14 (August 2015).

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This second figure basically tells the same story. This is the percentage of drugs launched in each year where the earliest patent is post-1995. What you can see from this is that as of halfway through the last decade, more than half the drugs that were launched in any given year, were still relying on older, pre-1995 patents. The first initial choices still mattered a lot.

This leads me to my final points. Pharmaceutical patenting is new, as I've explained. The effects of this new world of pharmaceutical patenting will depend, and continue to depend, on how countries go

about implementing this at the national level. These national-level implementation experiences, which can appear to be about boring details, are ultimately what matter.

Finally, we're now just entering a post-transition period. That is, we're just, finally, entering the period in which these 1995 cutoff dates become less relevant. Until this point, everything we've been studying and observing has occurred in this transition period, as we move from a world of no pharmaceutical patents in developing countries to a world of having them. In this transition period what countries decided about the 1995 cut-off date really mattered, as I have explained. Eventually, this shadow of the past will diminish in importance over time.

Thank you.

(APPLAUSE)

COLGLAZIER: Well, we've dealt with two big areas, energy and environmental technologies and the social and political trends, and then with pharmaceuticals for the same sort of thing.

And now we're at -- the third big area is sort of a big data/open source science and technology collaborative innovation and partnerships. And so Katherine Strandburg -- she's from the New York University School of Law -- has great experience in this area, so she'll open these issues to us.

STRANDBURG: Thank you. So thanks very much, again, to the organizers for inviting me here. In the short time that I have, I'm going to try to make two separate sets of points, or discuss two things which are related, but somewhat different.

So the first one is the implications for intellectual property of the user, open and collaborative innovation paradigms. And the overall point that I'm going to make is that there is tension between these innovation paradigms and the standard IP paradigm.

Just as an aside, responding to some of the things we heard about in the earlier panels, I'm not going to talk a whole lot about the international context or the developing versus developed country context specifically here. I'm going to be kind of big picture.

But I do want to make one point, which is that the policy choices we make about user, open and collaborative innovation may be very important for developing countries. We know, for example, from some studies, that user innovation is quite prevalent and important in developing countries. And we've seen that particularly in areas based on network technology, such as, for example, mobile phone and financial service innovation -- innovations related to small businesses, and so forth. These are areas where, in fact, there is a technology transfer from developing countries back to developed countries.

Returning to the tension between user, open and collaborative innovation and the standard IP paradigm, it is important to point out that these paradigms usually rely on either low or no formal IP. And this, in fact, challenges any assumptions that we might have that more IP protection is necessarily socially beneficial or even that beneficial to U.S. parochial interests.

The second thread of things I'm going to talk about in just a little bit -- and this is really going to be a high-level overview and questions, mostly -- about data driven innovation, sometimes also referred to as

big data. And I'm going to mention here a few questions about data-driven innovation and then a little bit about the concerns they raise about privacy and discriminatory impact.

OK, starting with the tension between user, open and collaborative innovation and the standard IP paradigm -– basically, IP has both costs and benefits, which I'm sure everyone here is well aware of. Benefits -- why do we have IP? We're going to motivate invention by deterring free riding, we want to motivate people to disclose their inventions rather than keep them secret, and we want to motivate people to disseminate their inventions so that others can use them though sales and licensing.

IP also has very well-known and accepted costs. So, higher prices and dead-weight economic losses. Downstream innovation is taxed, or sometimes precluded, or at least made exclusive by upstream IP. And then, probably a less recognized cost, but something I want to emphasize -- a lot of transaction costs associated with IP related to bargaining, licensing, defining, boundaries, notice, litigation and so forth.

But this standard benefit-cost discussion makes certain underlying assumptions, including these: First, that innovators need to be compensated for their investments in innovation monetarily through money that they get by sales;

Second, that innovators are entirely competitive. In other words, that any use by sharing with another -- with someone else in your field -- will be “free-riding”;

Third, that transaction costs associated with IP aren't so high as to outweigh the benefits;

Finally, for IP to function at all, you have to have market demand inducing the right innovations.

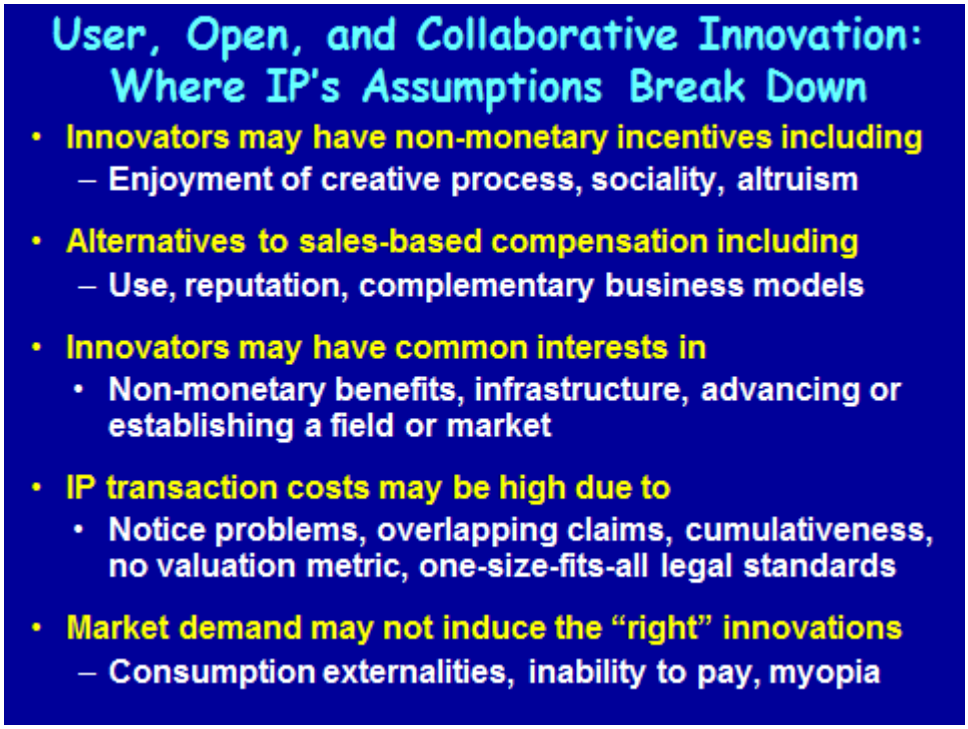
So one way to think about user, open and collaborative innovation paradigms is that they are things that we might like to have occur in places where IP's assumptions break down. So, for example, we now know that innovators can have non-monetary incentives which might include enjoyment of the creative process, sociality, altruism, and so forth. We also know that there are alternatives, sometimes, to sales-based compensation that include benefits of use, reputation, complementary business models and so on.

It's also the case that innovators in different fields are not always completely competitive. So they may have some common interests in some of the non-monetary benefits, but also maybe in producing infrastructure that's useful for a particular area of innovation or for establishing or advancing a new field or a new kind of market.

We also know that IP transaction costs sometimes may be high due to a variety of things, including notice problems, boundary definition problems, overlapping claims, cumulativeness of innovation, difficulties of valuation and so forth. And of course, we also know -- and we've already been talking about health and drug innovation -- we know that market demand is not going to always induce what we would socially prefer in terms of which innovations are made.

And that can happen because of consumption externalities, inability to pay, myopia, where we might talk about climate change -- myopia playing a big role there, and the like.

So I'm not going to go through this, but if anybody's interested, I just map out here some studied examples and how the IP assumptions break down in particular examples of open -- user open and collaborative innovation.



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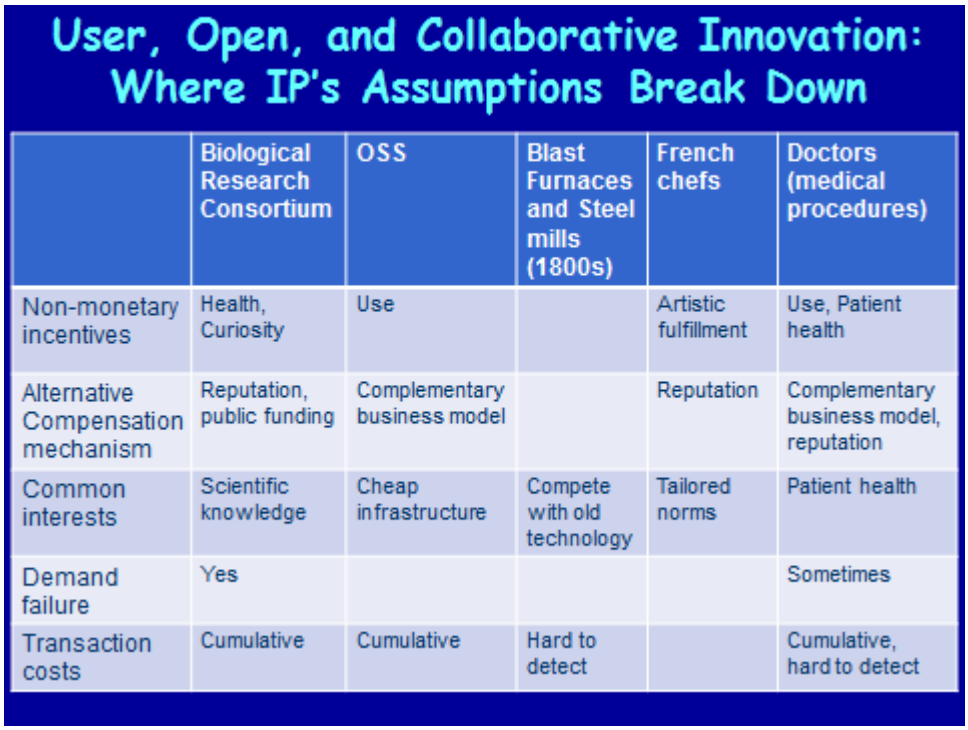

	Biological Research Consortium	OSS	Blast Furnaces and Steel mills (1800s)	French chefs	Doctors (medical procedures)
Non-monetary incentives	Health, Curiosity	Use		Artistic fulfillment	Use, Patient health
Alternative Compensation mechanism	Reputation, public funding	Complementary business model		Reputation	Complementary business model, reputation
Common interests	Scientific knowledge	Cheap infrastructure	Compete with old technology	Tailored norms	Patient health
Demand failure	Yes				Sometimes
Transaction costs	Cumulative	Cumulative	Hard to detect		Cumulative, hard to detect

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But I also want to point out that if we want to have open and collaborative innovation occur, it's not magic. It occurs when certain conditions are satisfied. Generally, you need governance for both setting norms and rules and enforcing them. You need rewards of some sort, even if not monetary and even if not through sales. Most often in these kinds of collaborations, those are reputational rewards -- or many times, anyway.

You need some rules about who -- who belongs to the group, who gets to share the data, the information, and whatever. And very often, you need some infrastructure to reduce the costs of collaborating and sharing. By infrastructure -- I mean this in a very broad sense -- things like databases, setting up meetings, bio-repositories, standards for compatibility, just establishing journals -- things like that.

So if we wanted to think about policy responses to these issues, we might consider that, at least in some kinds of areas, we might want to consider, and government already does this to some degree, subsidizing or perhaps mandating certain aspects of governance or provision of infrastructure for open and collaborative innovation in areas where we think this is the right way to go.

I also want to say that IP can destabilize open and collaborative innovation, which is an answer to people who say "Open collaboration, great. IP, great. Let's just have both. Let's everybody just be happy." I wish we could always say that, but I don't think we always can and that's because IP can undermine the stability of open and collaborative paradigms.

Insiders can use IP as a way to defect from the paradigm. Outsiders can free-ride on what's been made openly available by a community or group and then stake out IP claims.

I just want to point out as an aside here that this is an issue that is important in public-private partnerships between academia and commercial firms. IP can increase transaction costs for open and collaborative regimes, and IP doctrine -- and this actually gets back to the point that Devinder was making earlier about saying we need to distinguish between science and technology – can make those costs higher or lower.

I guess one way to summarize is to say that, from an institutional perspective, we need to distinguish between what's going to be done in an open and collaborative way and what's going to be done in a competitive and proprietary way. Well, IP doctrine helps to delineate this even if it's not the only thing that delineates this. What's pre-competitive and what's competitive? The things that aren't shared are necessarily pre-competitive.

The fact that IP doctrine helps determine which innovation will be done in an open and collaborative way also means that international differences in IP doctrine can complicate trying to have open and collaborative innovation regimes that span national boundaries. But it also means that converging to strong IP may not necessarily always be the way to go in harmonizing internationally because of this potential to undermine open and collaborative regimes where they are to be preferred.

So, possible policy responses to this -- and here I'm going to set aside the very big question of TRIPS compliance -- could be things like infringement, exemptions, fair use, research exemptions, and so forth, and patentable subject matter exclusions. One can see -- for better for worse, no matter what you think of it -- the Mayo v. Prometheus decision in the Supreme Court about diagnostics in this light. Another possibility or policy approach would be variation in how remedies are treated.

So that's the first topic. Second topic -- data driven innovation. And here, I just want to raise some concerns about the current euphoria -- or something like that -- about data driven innovation. This is not at all to say that data driven information isn't a great thing, but I think there tends to be some panacea or hype issue here.

There are a lot of questions that sometimes get forgotten or not discussed in a lot of the public debate about promoting data driven -- or big data innovation -- and I just want to raise some of them very quickly.

So, the first question is, "what data"? Is this data that you're going to use representative or is it biased? And in particular, do the biases, whatever biases are there, parallel problematic biases in society -- economic, racial, gender and so forth disparities? Is the data accurate?

Big doesn't mean accurate. Do we have the errors minimized and understood? Is it meaningful? Does the data that you can collect and that's available actually model the phenomenon of interest?

Now, these are, you know, boring old questions about data. But in the big data context, I think there's sometimes an idea -- a feeling that, well, if you just have enough data, it's going to compensate for these things. It can't.

Second question is “whose data is it”? Is the data proprietary or is it made available so that you can have scientific critique and validation? Do human data subjects -- and should they -- have any say in how the data is collected and/or used?

Next, what's the algorithm or methodology for analyzing the data, and is that algorithm open or is it proprietary? What kind of assumptions does the algorithm make? What are its limitations? What are the errors and tolerances in the outcomes?

And then, what are we trying to do with this data? What kind of innovation are we doing? So, one thing we might be trying to do is scientific understanding, we might be looking at large scale trends, but we also might be making decisions about individuals. We might be doing "prediction".

And as soon as we start to try to do prediction, we run into a lot of, again, sort of old problems -- correlation v. causation, whether or not we're going to end up with self-fulfilling prophecies and feedback issues in the actions we take based on the data, stereotyping and overgeneralization. Depending on how large the effects are we may need to worry about whether or not our predictions are ignoring the possibilities of rapid change and tipping points, as one of the earlier speakers discussed.

So, just bottom line here is that we often hear this “data is the new oil” trope. Well, yeah, maybe, but we need to watch out for smog, oil spills, climate change, and so forth. And in that light, I just wanted to mention that, at least when we're talking about data that pertains to individuals which, of course, is not all data and not all big data -- we need to worry about privacy and security questions.

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And here, again, we need to be thinking about who is going to have access to the data. So that might be concerns about hackers or malicious insiders, but we also might want to think about law enforcement access.

For example, there's a very recent issue at Carnegie Mellon with some research about Tor that some people may have heard about – it's important to remember that academic institutions can be subpoenaed. Is the data going to be anonymized? How effective is that anonymization? There are a lot of questions about anonymization algorithms.

How long is it going to sit around? Who's going to make decisions about what is done with it both initially but also, if it's retained, later. How are those decisions made? What are the governance mechanisms for data pools? Was consent required at the time of collection? Is consent meaningful if it is required?

How was the data obtained in the first place and are there regulations or ethical standards that we need to think about regarding means of obtaining data that might not be the same as the ethical standards that we have thought about in more standard types of small data research, both for researchers and for commercial actors?

And that's it. Thank you.

(APPLAUSE)

COLGLAZIER: Thank you. Our last speaker is Margo Bagley. She's from the University of Virginia School of Law. She's going to look at a number of issues, but including one I think is quite interesting in this

dialogue on fairness issues, and may talk a little bit in the area of genetic diversity and what countries own in terms of their intellectual property. So I'll turn it over to Margo.

BAGLEY: Thanks, Bill. And I'd like to thank the organizers for inviting me to participate in this really interesting and important discussion on fascinating issues.

So, due to time constraints, I'm actually going to limit my comments to just new technologies and fairness, with the new technology being synthetic biology, and fairness addressing issues that synthetic biology might be creating in relation to access and benefit sharing under the Nagoya Protocol.

So my work in this area really began with the 2013 Wilson Center Report that I was fortunate enough to co-author with Arti Rai where we were looking at potential impacts of the Nagoya Protocol for synthetic biology researchers.

Just this week, the Wilson Center released a new report that, unfortunately, Arti was not able to join me on, but in which I focused on digital DNA, the Nagoya Protocol, and looking further at the synthetic biology issues; in particular, with a potential new treaty that is being negotiated at WIPO -- the World Intellectual Property Organization.

So, for the next few minutes, I'd actually like to start in reverse and begin with the fairness concerns, and then move forward to the synthetic biology issues.

So a fair amount of the genetic resources that have been and are used in various types of research originated at one time or another in biodiversity-rich developing countries. This was a concern during colonization, but this concern took on an additional and different dimension after the United States Supreme Court decision in Diamond v. Chakrabarty in 1980 that basically opened the floodgates to biotech patenting.

The concern such patenting raised was given the name "bio-piracy" -- the patenting of plants, genes, and various other types of biological materials indigenous to a foreign country without compensating the keepers of those resources and the holders of knowledge -- traditional knowledge appropriated during ethnobiological research processes.

This bio-piracy term was in a sense a counter to the piracy rhetoric often used by developed countries in talking about software and other types of IP piracy rampant in many developing countries.

The Convention on Biological Diversity (CBD) was adopted, in part, as a response to this bio-piracy concern. The CBD has 196 parties, came into force in 1993, and has some important key principles.

One really important principle is that states have sovereign control over the biological resources within their borders. Now, states are to endeavor to create access to those resources, but the access should be with prior informed consent and on mutually agreed terms, and there should be a sharing, a fair and equitable sharing, of the benefits arising from the use of the genetic resources and associated traditional knowledge with the providing party.

So the CBD provided for access and benefit sharing, but didn't tell countries how to do it. And so, in the years following adoption of the CBD, we saw countries using widely differing legislative approaches to effectuate the goals of the CBD.

That ultimately led to the Nagoya Protocol, which was adopted by the parties to the CBD in 2010, came into force in October of 2014 after ratification by 50 parties to the agreement. The Nagoya Protocol creates a framework for prior informed consent and access and benefit sharing to hopefully provide greater legal certainty to both users and providers of genetic resources.

The Protocol has a number of important provisions. Among other things, it obligates parties to designate compliance checkpoints so that they can determine whether genetic resources that are being used within their borders have been accessed in accordance with the domestic legislation of the particular country from which the resources were obtained. It also requires a country to provide that genetic resources are accessed properly and to cooperate in cases where another country's genetic resource laws have been violated and the genetic resources are being used in this second country.

Interestingly enough, though, even with this framework and this goal of legal certainty, there is still considerable flexibility in what countries can still do in implementing Nagoya in their national laws. Nagoya basically provides floors, not ceilings -- no upper limits, really, on the kinds of protections or obligations that countries can impose.

Nevertheless, progress is being made. The Protocol's automated clearinghouse is up and running and countries are now notifying their laws and regulations and compliance checkpoints to this clearinghouse, and it is creating more transparency in the system.

Now, a logical Nagoya Protocol compliance checkpoint is an IP office -- a patent office, in particular, when someone is filing a patent application that involves use of a genetic resource. A country could require a application to disclose the origin of genetic resources used in creating that invention. And an agreement that's being worked on at WIPO in the Intergovernmental Committee on Intellectual Property, Genetic Resources, Traditional Knowledge, and Folklore (IGC) may help to facilitate Nagoya Protocol compliance through such a genetic resource disclosure of origin (DOO) requirement.

There are three draft texts that are being worked on in the IGC. The one that is important for our purposes today is the genetic resource text, which would have a mandatory disclosure of origin requirement for genetic resources in patent applications.

The IGC negotiations are somewhat contentious. They have been going on for around 15 years, though I must say that a lot of the controversy relates to the other two agreements relating to traditional knowledge and traditional cultural expressions, which actually would create new kinds of IP rights. That arguably is far more controversial than the genetic resource text -- in particular, since many countries already have been incorporating disclosure of origin requirements into their national laws in order to comply with the CBD, and now the Nagoya Protocol.

So why are biodiversity-rich developing countries pushing for a disclosure of origin requirement? A 2004 report by the Queen Mary Institute identified several reasons -- several concerns. Again, going back to this biopiracy notion and biotech patenting, the idea is that patent claims incorporate biological material. Biological diversity is believed to have tremendous economic potential. The patent system facilitates the misappropriation of free-riding -- or unfair use of these genetic resources without fair compensation to the developers, holders, and stewards of these resources.

Another concern is that modern IP law is very good at protecting certain kinds of knowledge and creativity, and not so good at protecting other kinds -- the kinds that might be more prevalent in developing countries, and that, as a consequences of the other reasons, there's an unfair distribution, not only of patent ownership, but an unequal sharing of the benefits obtained from uses of genetic resources that, as I mentioned, under the CBD, are the sovereign property of these countries.

So a genetic resource disclosure of origin requirement, such as is being considered at WIPO, could facilitate compliance with domestic genetic resource utilization laws under the Nagoya Protocol. It can serve as a transparency mechanism, providing information that can be used to identify violations of these laws.

And even the existence of a disclosure of origin requirement could encourage compliance with such laws by encouraging companies, researchers to, in the first instance, go ahead and obtain prior informed consent, agree to mutually agreed terms and set up benefit sharing arrangements. And the benefit sharing doesn't have to be monetary. The Nagoya Protocol provides a fairly long list of non-monetary benefits that can also be used.

Now these agreements that I am discussing are not directly related. The Nagoya Protocol is not an IP treaty – it is not administered by WIPO. But many WIPO members are party to the CBD and the Nagoya Protocol and will be implementing the Protocol. As I mentioned, a patent office is a logical checkpoint for Nagoya Protocol compliance. And there is also, as I mentioned, the provision in Nagoya for cross-border cooperation. We have already seen Denmark, for example, enact a law saying that genetic resources obtained in violation of other Nagoya members' laws cannot be used or commercialized in Denmark and providing for such violations.

Alright. So how does all of this relate to synthetic biology? Well, just to say a bit about what synthetic biology is, there is not a single definition, but we can think of it as the creation of standardized biological parts that can be assembled into more complex modules to perform particular functions -- hopefully improved or new functions.

There are different types of synthetic biology research going on -- vast amounts of it -- fundamental synthetic biology research, looking at designing principles for building systems, and translational synthetic biology -- redesigning sequences, redesigning organisms to achieve new functions.

Initial applications tend to be focused largely on replicating and modifying naturally occurring compounds and organisms, but the goals for synthetic biology are just -- there are no limits on what is considered possible.

An example of a revolutionary development is the creation of two new nucleotides, X and Y, to go along with the C, G, A, and T, which could lead to the creation of new proteins, new cures for various diseases. Something less revolutionary, but also important, is the report that researchers were able to coax yeast to produce a morphine precursor using genes from a variety of different species including poppies, a rodent, bacterium, et cetera.

So lots and lots of things are going on in synthetic biology research. While most of the synthetic biology research is centered in the United States, it is expanding. More and more researchers in other countries are getting involved. And while it is centered, often, in companies and universities, other researchers are also engaged in other types of facilities.

One of the interesting features of synthetic biology is its standardization and open-source nature. There are registries of standard biological parts that researchers can access and obtain parts and combine them to create new functionalities. But these registries are changing.

And while the registries currently contain physical DNA, more and more digital DNA is being included -- information about DNA sequences. These days there is often no need for the tangible material itself. This is in part a function of the reduction of the cost of DNA synthesis. There is software that allows you to design a new sequence which you can then send off to a foundry that will synthesize it and mail it to you.

That is all great for researchers, but that may be creating problems under the Nagoya Protocol -- or in relation to the access and benefit-sharing goals of the Nagoya Protocol, in particular, relating to Article 8. So this is one of the Nagoya Articles that was deemed a success because there was wide agreement that there should be simplified measures on access to genetic resources for non-commercial research purposes. Countries should make it easy for non-commercial researchers to access resources -- cut the red tape. And there are a number of non-commercial research endeavors that are generating vast amounts of DNA sequence information.

In many cases, this information is then being uploaded to publicly accessible databases, where it then can be taken and used in synthetic biology applications without any compensation to the original providers. And that has led to a new term being coined by some NGOs of “digital biopiracy” -- that you no longer need the physical removal of a material from a country, but you can have access to the digital information -- that's all that you need -- and it can be used in synthetic biology research without any ABS/PIC (Assess and Benefit Sharing, Prior Informed Consent) concerns.

Digital biopiracy or digital misappropriation is reminiscent of, and raises similar concerns to, what we have seen with illegal downloading of movies and music in violation of copyright laws, as well as the concerns regarding 3D printing. And these problems and concerns have a common source, which is digitization, which is making it easier and cheaper to copy and make use of the intangible property of others.

How these treaties are going to deal with this is not clear. The Nagoya Protocol really was designed largely to deal with tangible material. There was discussion of digital information, but nothing included in the treaty itself. But as I mentioned, there is quite a bit of flexibility for countries as they implement Nagoya to define its obligations however they wish.

For example, Brazil protects genetic heritage, which is broadly defined as *information* of genetic origin. That definition was in their provisional act to implement the CBD and it is also in Brazil’s updated 2015 Act.

There is a risk that, if countries are afraid that their genetic resources may be digitally misappropriated, they may limit access for non-commercial endeavors. That would not be a good thing for research or, most likely, for society at large. It was reported that in 2014, Indonesia was planning a moratorium on foreign biodiversity research because of these types of concerns.

It has been estimated that only 15 percent of plant species have been examined for biological activity, so we do not want countries to close their doors to this type of research. So finding a middle ground -- a way to have a win-win situation is going to be important.

So, to look at the intersection of fairness and synthetic biology, is there a disclosure of origin obligation with synthetic biology inventions, using DNA sequences, but not any tangible material? That is something we do not know yet, and which likely will vary by country, at least in the near term. This issue has not yet penetrated the IGC discussions at WIPO; and Nagoya is not explicit on it.

Thus, at this point, what we are likely to see is any provisions addressing this showing up in national laws, which tend to be more problematic for researchers if you're having to figure out what your obligations are in each different country. For this reason, it probably would be preferable to address this issue at the international level. There is also a role, perhaps, for public databases to play in requiring disclosure of source/origin, to the extent that countries do extend obligations to this type of digital information.

Bob Friedman at the J. Craig Venter Institute provided this language that they used with data from some of their sampling expeditions when uploading genetic information to publicly accessible databases. Basically, saying where the information came from, letting researchers know that if they want to use it, they should contact the CBD focal point and take it from there.

So to conclude, synthetic biology research may raise access and benefit sharing fairness concerns, especially for sequences in public databases. Countries that are implementing the Nagoya Protocol may impose its obligations on synthetic biology users through explicit provisions in their laws, in the way the laws are interpreted, and/or through access and benefit-sharing contract provisions. Also, identification of sequence origin in public databases could, ultimately, facilitate compliance with these disclosure of origin obligations as well.

Thank you.

(APPLAUSE)

COLGLAZIER: I'll look at Gail to see if she's going to allow us a minute for -- for questions. The -- I'm also going to let each of the speakers have one minute to make any comments they'd want, but I'll give them a question which they can either try to answer or ignore, so they can use the one minute however they -- they want.

With Devinder, I would be very interested to hear from your experience, actually, with the Chinese or in Kenya, since you indicated that in terms of we have these joint partnerships, they sort of feel like everything is free and open to them and trying to educate them on -- the intellectual property rights still have to be respected.

With -- with Ken, I'd be interested certainly in the area of pharmaceutical and drugs. The pressure that comes from civil society, from foundations and others that are trying to address the issues of, you know, health challenges in developing countries. What sort of pressure does that place, both on the pharma companies and on governments to make changes from the -- the paths they're on?

And for Katherine, with open source collaborations, there's been great interest in having grand challenges, open competitions to develop new innovations in areas which are actually very popular with young people, I found, in many developing countries, competing in these -- engineering students in others. I'd be interested in -- in Katherine's views -- she alluded a little bit to the -- the IP kind of issues and challenges that come from -- from open source, but you may want to say a few more words.

And lastly, with -- with Margo, since the U.S. is not a party to the Convention on Biological Diversity or the Nagoya Protocol, to what extent can the U.S. influence things? When I was in the State Department, we sent a very bright, young, terrific fellow, an expert on synthetic biology to go interact. I think that meeting -- that was in October of last year to -- to interact with the countries that are partners to the agreement, but have a very similar view as the United States in sort of having a coalition to see if they could influence the discussions, even though the U.S. was not a party.

So I'd be interested if she thinks that -- how the U.S. government has been involved in discussions of these issues, not being a party.

But again, as I said, you're free to answer any question you'd like to answer.

MAHAJAN: OK. So, as I mentioned, it's something that I'm doing with the Chinese. We have an eco-partnership project and right from the onset, we have implementation plan that you are required to submit to the Eco-Secretariat of the State Department, including the U.S. side, as well as NDRC China. But when you start actually doing the -- the projects going forward, it became very clear it was not enough.

Let -- let me also add that on the U.S. side, we do have patents that will be a force utilizing during this collaboration. So it became very clear that, going forward, although everything was written up, they just tried interacting, those lines started blurring where the previously held technology is also supposedly thrown in the same pot from their side so that we can move forward.

And I had to really sit down, very, very intense discussions explaining that what is being brought as an IP is a separate issue as we go forward when we are working together. That has to be under the U.S. patent laws. They have to be protected. So I think that discussion led to -- to a point where I offered to give a seminar on how do we protect or how do we share model from the university, which is federally-funded research.

However, any personal file – for example from Brookhaven -- so I actually then offered to give a seminar using that tool to the students at -- university. And this is a lecture and I -- after the lecture, they actually started appreciating that it is not a bad thing to start respecting the IP because there is some kind of confusion.

I mean, all though -- is a top notch school, it's very -- there's some issue that I -- I can't figure out what it is, but there's an issue that when you start working together, everything comes apart. I mean, that's -- that's what I'm trying to figure out, whether science and technology bundle together. I think that needs to be started from -- we need to do a better job in terms of defining the sciences, open source technologies, IP.

So I think that's the -- I am actively working right now with them. But to the lectures and everything else to clarify how we will work together going forward. Now, anything that will be developed jointly later is fine that we -- we do want to share. But previously held IP cannot be in the same pot.

COLGLAZIER: Thank you. Ken?

SHADLEN: Thanks. Yes, you're right. There's been an immense amount of civil society activism over these issues, both at the global level and within countries.

Very briefly, I think the role of activism at the national level can be overstated. That's a controversial claim, I know. It's tough to disentangle the cause and effects. Sometimes the government wants to move and that provides an opportunity for civil society to get more involved at the national level in terms of reforming the system. In my comparative research I find that it's coalitions between government and local industry that are more determinate of the changes observe. These coalitions, I find, are more important drivers than what local civil society groups are doing.

At the global level it's easier to make a case that civil society activism has been more determinate in changing things. The area where I think we'll see the most effects (this is a hypothesis, because we're not in this world yet), is that civil society activism has contributed to the establishment of what we call a norm a differential pricing for essential medicines. This will matter when[1] we arrive to the world of single, global suppliers for new drugs. We're not in that world yet, because, as I showed, many drugs have pre-95 dates and so there's a lot of Indian firms who are out there producing them. But, eventually, we're going to move to a world of single, global supplier for new drugs. What will happen?

I don't think that these drugs will be priced at exorbitantly high levels for governments and patients in the developing world, the way the anti-retrovirals were 15 years ago, before competition from Indian producers drove prices down. The reason for the difference in the future would be because of a norm having been established about differential pricing, a norm that wasn't there before. If that's correct, civil society activism has had a big part to play in establishing that norm.

STRANDBURG: OK. So just to -- very, very briefly in terms of -- back to the question about -- I think the question is essentially about price systems for, for providing innovation. And I don't have time to get into that because that's like a whole completely different paradigm and one that also has had a lot of interest recently.

So, I will, I will just mention that there is a fair amount of research that has been done and is being done about the effects of how you structure such a, such a prize competition? To what extent do you allow people to see other people's work? And -- and so forth. And if you're interested in that, prize competitions, I recommend the work of two people: Karim Lakhani at the Harvard Business School and -- and Michael Burstein at Cardozo Law School.

So, I'll just kind of refer you to them. I did want to make one comment on Margo's presentation because it occurred to me, that in fact, the issues that she is describing are exactly related to this question of, the line between an open, collaborative, pre-competitive innovation structure, like traditional knowledge, and a competitive one.

[1] Kapstein, Ethan B., and Joshua W. Busby. 2013. *AIDS Drugs For All: Social Movements and Market Transformations*. Cambridge University Press.

And, it's a story about the way that IP can disrupt these, these things. But one of the factors that comes into her story that I had not mentioned in my story and hadn't really thought about that much, and now I will, is that ordinarily we kind of assume that there will be this pre-compete and the competitive stuff, that the same players will be doing both, right?

When you don't have that, then you run into the fairness issues that Margo's talking about and actually, also the -- the fairness issues that come up a lot in the public-private partnership context.

BAGLEY: Thanks. So, regarding the question as to the U.S. not being a party to the CBD, nor a party to Nagoya, nevertheless, these treaties and the laws that are being implemented under these treaties very much affect U.S. researchers who are trying to obtain patents in other countries and who are obtaining genetic material from these countries.

More and more countries are enacting disclosure of origin requirements. In fact, China, the country that receives more patent applications than any other, has a disclosure of origin requirement. So, U.S. researchers trying to get patents in China already have to disclose the origin of their genetic resources and, and as I mentioned, more and more countries will be doing this as part of implementing the Nagoya Protocol.

So I think it would behoove the U.S. to take perhaps a different approach in the WIPO IGC negotiations. I have a particular perspective on this as I have been providing expert technical assistance to the government of Mozambique in these negotiations.

The United States is understandably concerned about a disclosure requirement creating burdens, unreasonable burdens, on patent applicants and creating legal uncertainty regarding patent rights; these are valid concerns. But it is possible to design and implement disclosure of origin requirements that are not unreasonable burdens and do not create unnecessary uncertainty.

And even in the U.S., we use the patent system to facilitate a variety of other policy objectives. For example, the Bayh-Dole Act allows universities to take title to inventions developed with federal funds. However, patent applications covering inventions arising from such funding must include disclosure of the funding source and the contract number, and the fact that the U.S. government has rights in the invention. It's a transparency mechanism.

Disclosure of origin is also a transparency mechanism and, as Paul Oldham and others have proposed, a reasonable genetic resource disclosure requirement could be modeled after the Bayh Dole Disclosure requirement. In addition, the disclosure requirement that the U.S. patent office was considering last year as part of its attributable ownership rules was also a transparency mechanism designed to effectuate other policy objectives. So, it is possible to require disclosure in a way that would work, and I think what might be more helpful to the U.S. is to recognize that disclosure of origin requirements globally probably are not going away.

What if we could actually put ceilings on some of the more onerous and problematic provisions that countries are implementing? So, for example, India's biodiversity law – you can violate it by filing a patent application anywhere in the world with genetic resources that you obtained from India without proper authorization. And you would be subject to criminal penalties, which seems pretty harsh.

Agreeing to a reasonable disclosure of origin requirement to perhaps negotiate regarding ameliorating significantly harsher provisions like that I think would be something that would be in the best interests of U.S. researchers and that the U.S. could definitely work towards.

COLGLAZIER: OK. Well, let's -- before we clap to thank the -- the very fascinating panel, I want to see if there are any further instructions from Gail. Are we going to have a break now or go right into the next panel? Go right to the next one.

OK, terrific. Thank you again.

(APPLAUSE)

PANEL III

DICKINSON: My name is Todd Dickinson and I want to also thank the National Academies for having me here today. I've been lucky enough to participate in a number of panels and moderate some study groups as part of the study group and I'm always pleased to be able to be back here again and help out.

I also had the good fortune, I think, to be first, the Deputy and then the Director of the United States Patent Trademark Office during the, I guess you could say the golden years of IP, the end of the last century. It seems a long time ago. By the way, people blame me sometimes for bad patents. I want to take a point of personal privilege; if you count up the years of expiration and the fact that only 25% of people pay their patents fee, less than 5% of patents that I signed are still in effect so don't blame me.

It was interesting to hear reflections too on particular treaties that have been around, and we're talking about the multinational look of IP because it was very much in vogue in the 90's. It's interesting to think back, again in maybe the golden age as well, we had some six multinational treaties concerning IP that were negotiated in the late 90's, mid to late 90's, starting with TRIPS to copyright treaties and patents treaty of sorts, trademark treaty, the Hague Agreement.

Today actually is the 16th anniversary of the day I was sitting in the Director General of the World IP Organization's office trying to persuade a transigent French delegate to give in on some minor point on the Artists and Authors' Rights Treaty; he never did. I probably should've been spending my time in Palm Beach County counting chads; that might've been a little more helpful but so much the better I'm pleased to be remembering that now.

I think it's reflective of what this panel is going to talk about because we've shifted in large part from sort of multinationalism in terms of IP. We tried, for example, several times now, to have a Substantive Patent Law Treaty and several things have stood in the way of that, WIPO agenda and just the framework of how to get it done. Can anybody here tell me the three major issues holding up Substantive Patent Law harmonization from de-harmonization?

No; grace period, secret prior art, and the definition of prior art; does that seem like it should hold up a treaty? Well, it is unfortunately and we have unfortunately not been able to move forward on International Substantive Harmonization.

Further in the back, somebody argued the opposite. So our goal today is to talk a little bit about what's happening, to use that phrase, "boots on the ground" in particular countries and particular regions where the IP system is working, or maybe not working but flourishing in many ways in Devinder's development despite the lack of multiculturalism or multinationalism.

So let me introduce all of the folks here on the panel first and we're going to have kind of free-flowing discussion. I'm going to ask you maybe each to give less than three, four, or five minutes to just hit on a few high points of either their country or their region and then we'll hopefully have a kind of conversation up here.

First, is Peter Yu. Peter is the Professor of Law and Co-Director at the Center of Law and IP at Texas A&M. He was born in Hong Kong and has a long experience and his education is in China so as you can imagine today up here he is going to be talking about China which is in many ways in this area the 800-pound gorilla in the room.

Next to him is Nicholas "Nick" Vonortas who is a Professor of Economics and International Affairs at the Elliott School here at GW and he holds the Saul Polo Excellence Chair, Innovation Policy in the state of Brazil. He's sort of our Brazilian representative today to talk about both in Brazil and that part of Latin America, South America and a number of issues.

Third is Aisha Salem. I wanted to mention something as well; one of the great developments in the U.S. Patent Administration globally has been the development of what's called the IP Attache Program. It's part of the State Department, as well as the other PTO employees I think still, technically.

When I was there, there was one person in Geneva who monitored both WIPO and WTO, now I think there's probably 10 or 15 around the world, Brazil and Russia, a couple in China, a couple in Geneva now, Southeast Asia, Latin America, Mexico and the Middle East and I'm probably leaving out a few. And to have these folks who are able to provide training, outreach, intelligence gatherings to a large degree, enforcement issues and enforcement information and information around tech transfer is I think a very, very valuable to both IP interests generally and the U.S.' interests as well.

So with that, Aisha Salem is the IP Attache for the Middle East and North Africa, which takes in an awful lot of territory Aisha, and she is based in Kuwait in the U.S. Embassy there in Kuwait. Prior to that she was a trademark examining attorney. Sometimes we overlook the importance of brands and brand management globally and brand enforcement particularly is consumer economies including China become more and more important. Protecting the brand in the consumer economy is extremely important so has experience with trademarks and she went to GW.

Next to her is Michael Lewis. Michael is the IP Attache for Mexico, Central America and the Caribbean, which again takes in a pretty broad territory as well. Michael has prior to that served over in IPEC in the White House, the IP Advisor for Intellectual Property Enforcement Coordinator, sorry the IPEC. We usually call it NIPRCC which was even worse but now it's called IPEC, and also served in several roles in the PTO including in his trademark office as well.

And last but not least, of course, Don Townsend. Don is the Attache for Russia and the CIS countries and he's dealt with a wide variety of issues. He has been a practicing patent attorney here in the United States and has a chemical engineering background.

So let me start off then with Peter. China as I said in many ways is kind of the elephant in the room. More applications are now filed in the Chinese patent office than any other office in the world. They've joined IP5 so they're one of the Big 5 offices in the world.

The number of patent applications filed by Chinese nationals has gone up 10-fold in the last five years, which is kind of astonishing. Enforcement which used to be, it still was a big issue, but enforcement more and more is becoming "regularized" I guess you might say; the courts and others have gotten in the game a little more importantly. They've even gone so far as a patent attorney, now I love this - they've subsidized the writing of patent applications for patent attorneys in China and they're giving subsidies, I understand, of reducing prison terms for prisoners who are inventing things that eventually become filed

patents so China is really an amazing place at the moment in IP. Peter, why don't you start off and tell us a little bit about what's going on from your point of view.

YU: Thank you, Todd. Basically, he gave me five minutes to talk about everything in China. So, what I'm going to do is to focus on three different sets of issues.

The first set of issues with which Todd started is that we need to change our discourse on intellectual property in China. In that discourse, we've always started with piracy, counterfeiting and enforcement issues. I think that has been going on since the mid-1990's and all the way up to about five years or so after China joined the WTO.

But now we increasingly see China actively participating in the IP system — for example, Todd already mentioned the patent applications. In 2008, China launched a National IP Strategy, and in 2010 it developed a National Patent Development Strategy. In terms of numbers, China is trying to get about two million patent applications every year. So, in five years it'll have about 10 million patent applications.

Now obviously, these applications include invention patents, utility model patents and design patents -- all three together -- but the numbers are just mind-boggling. In 2012, China already exceeded two million patent applications. So, if you look at the latest data from WIPO, Huawei Technologies and ZTE Corporation is number one and number three in the world in terms of PCT [Patent Cooperation Treaty] applications.

If you look at the numbers for trademark applications, China is number seven at the moment. Will the increasing numbers mean we'll have less piracy and counterfeiting? Not necessarily. I actually see that China will be developing in both directions at the same time. On the one hand, you'll have a lot of patent and trademark applications. On the other hand, you'll still have a lot of piracy and counterfeiting.

I don't think we've ever had any theory or scholarly literature talking about countries doing both at the same time. It is not just a transition issue, but it will go on for at least the next decade or so. So, I think that is something quite important.

DICKINSON: It's also interesting that, by the way, at the same time that the number of U.S. based applications, U.S. based national applications is falling in the U.S. office, the Chinese is going up.

YU: That's a very good point because people always criticize China for not having patent quality. But when you look at a lot of the patents filed by Chinese companies, these companies also file with the USPTO and the EPO. So, if you're saying there's no patent quality in China, how can you explain all those patents that Chinese companies got at the USPTO and the EPO?

The second set of issues concerns so-called hot button issues. There are three hot button issues that I think are particularly relevant to this crowd. The first one is indigenous innovation, and that is actually not the best English translation of China's innovation strategy. The first two Chinese words for that strategy is "zizhu" -- the first word means self, and the second means master. The whole idea is to make Chinese innovation independent; it doesn't have to be homegrown.

Let me give you an example. Lenovo bought the PC division of IBM, and that is considered part of independent innovation since it is now a Chinese company. Is it homegrown? Not necessarily. So, the relevant innovation can be found outside of the country. That's number one.

Number two is trade secrets. That is going to be a major issue at least on the U.S.-China agenda in the next few years. The issue will be about trade secret protection, but it will also cover undisclosed data with respect to clinical trials and biologics. I think, with the TPP going on, trade secrets will become an even bigger issue.

The challenge with respect to China is that, first, there's no international consensus, especially when you look at Article 39 of the TRIPS Agreement. So, China will probably drag its feet in pushing for stronger trade secret protection.

The other challenge, from what I've seen from officials on the ground, is that they recall China being pushed hard on copyright, trademark and patent protection, and now the U.S. is pushing them again on trade secrets. So, they feel they have been continuously pushed on issues that they always have to tackle. I can see some frustration on their part.

The last hot button issue which I think is important is the TPP, which has already been mentioned early on. What I find interesting is that we haven't spent time talking about the RCEP. When I mention the RCEP, people usually say "What?".

RCEP is the Regional Comprehensive Economic Partnership that is being negotiated by ASEAN and six other countries: China, Japan, South Korea, India, Australia and New Zealand. What is interesting about the RCEP is that seven RCEP parties are also negotiating the TPP. So, there is a significant overlap between the two. I think the TPP includes about 40% of the world's GDP, and then the RCEP includes about 50%. That will give you some figures for comparison.

The second thing, which is also quite important, is that Japan has already advanced an IP chapter for the RCEP with strong support from South Korea. So initially, people are wondering whether intellectual property will be on the RCEP. It now looks like it's very likely to be.

The last set of issues I want to end on comes from the first panel -- it is about divergence. I see three different directions of divergence, and I think they'll be quite important. The first type is national divergence. If you look at the very successful provinces filing patent applications, you've got about 140,000 patent applications just from the number one province. But if you look at some of the less successful provinces -- in the 19th, 20th, 21st, for example -- they have only about 5000 applications.

So, you can see a major divide in terms of both the stakeholders and patent developments within the country. I think that divide will become a major challenge within China, not just regarding intellectual property, but also as a major political issue — in terms of the fact that, if you're pushing for stronger IP developments on the coast and in the successful commercial areas, how will you explain that a lot of the losers will actually be in the inland areas or the West?

The second type is doctrinal divergence. Among the three main branches of IP, we can see a lot of developments in the trademark and patent systems. Trademark because of money — the system is about the growing middle class, and brands are getting more and more important. And patent because of the National IP Strategy.

The copyright system is always hindered by China's censorship policy and content regulations. So, when you look at the overall developments regarding intellectual property in China, you can see that the

patent and trademark systems have been developing very quickly, but the copyright system has been left behind. I think it is going to be quite challenging, especially with respect to both U.S. lobbying efforts and China's IP policies.

The last type is global divergence. We've already talked about the TPP and the RCEP, and we can see that discussions have been going on. One thing that I think is quite important for you to remember is that China has been actively negotiating a lot of free trade agreements. At the moment, China has not been actively pushing for IP chapters, but China already included a disclosure requirement in the Switzerland FTA as well as in FTAs with New Zealand, Peru and others. And many of these countries are members of the TPP. So, I'll stop here.

DICKINSON: Thank you. Nicholas, maybe give us three or four minutes on the situation in Brazil, traditionally not a very enthusiastic country as with regards to IP patents but one for which is becoming, as several speakers have said, more important.

VONORTAS: Thank you. Thanks to the organizers for inviting me here. I have a heavy foreign accent but it's not a Brazilian accent, it's a different accent. And so, I'm not from Brazil but I engage with Brazil heavily these days. As you might have heard, the Brazilian taxpayers have been very, very generous to set up a big shop at the University of Campinas which I head, and that shop is on innovation and technology policy.

So Brazil is one of those countries that is one of the BRICs, which is heavily interested in development. It's a diverse country. It has a very significantly large middle class, very well aware of international development, but it has also a lot of poor people. This is a very serious divide that the current administration has tried to address but it cannot be addressed in five or six years.

Now nobody in the audience, maybe somebody knows that Brazil was one of the first countries that ever embraced Intellectual Property. In 1804, the Portuguese colonial power, the kings if you remember, had been thrown out by Portugal by Napoleon and they moved to Brazil and they had the heavy interest and they were very much interested in developing the country because they thought that was going to be their residence from then on so they passed something that looked very close to what the legislation, the statutes of Great Britain at that time.

But interestingly enough, 150 years later, which makes it late in the second half of the 20th century, the country as Todd just said, had lost its enthusiasm for protecting Intellectual Property and the reason is very simple; for the economists it's very straight forward.

Actually, it would be surprising if the opposite was true. This one is very simple; in economics classes we say that when we deal with Intellectual Property there are two forces that are working against each other and one is the lack of efficiency and the other is dynamic efficiency.

So a lack of efficiency means this: if the world stops today, that is not tomorrow, then we have invented everything that had to be invented, we found it, it was here, and then the best for the economic system is for everybody to know everything; that is, no Intellectual Property protection -- zero. That's very clear in economics; it's high theory, nobody disputes this, it is absolutely true.

So if there is nothing to be invented in the future, Intellectual Property protection should be disbanded completely. The society will benefit if everybody knows everything that exists. However, there

is a lot to be invented in the future; and thus, if we open up the possibility of inventing in the future, then dynamic efficiency, that is coming up with a system that provides incentives to invent and that means temporary monopolies, is important.

So economists know very well that Intellectual Property actually is sort of the balance of these opposing forces; it's a balance. So where different countries fall in that balance very critically depends on their stage of development.

So if you are a poor developing country, clearly you will not choose dynamic efficiency, right, because you are not the one who is going to invent; you are interested in spreading whatever there is out there, whatever others have invented, spread it around everybody to understand, so you are on the side of the lack of efficiency. If you are a developed country, if you are the United States and you spent $450 billion every year on research, you are the other side.

So countries like the BRICs, I'm saying this because countries like the BRICs right now are in a major transition period. So they're moving from a stage where they were not interested in Intellectual Property because they were not hoping to invent much themselves; they were hoping to learn from others into a stage where they are interested in inventing.

In Brazil, the pharmaceutical industry, for example, is right now in the transition; they have already a very, very serious genetic pharmaceutical industry and they want to move into brands and they want to come up with actually medicines. That has changed very much the mentality and has changed very much the lobbying towards the government.

DICKINSON: One more minute.

VONORTAS: Yes. What's the government? Now what happened in Brazil and this happened more simply because currently the Brazilian legislation is fully standardized with international standards. It is a model of development aimed for substitution sometime in the 50's, 60's, 70's that was very similar to East Asia for part of it which is heavy protection of domestic industry but very different than the other half of in the sense that East Asia was pushing its companies to sell abroad, whereas the Brazilians were focusing on the domestic market; they thought they had picked already the domestic market and they thought they would do it there.

So what that has created is the problem of productivity, that as they open now to the rest of the world, is becoming a very limiting factor and Intellectual Property has helped them. Thus, they are trying to remedy this. Thank you.

DICKINSON: Thank you. Aisha, let me ask you about what's happening in the Middle East and North Africa, not an area we tend to traditionally think of as having a lot of IP but certainly an area of critical importance in the world today so what's happening there?

SALEM: Thank you, Todd. As you mentioned, the Middle East, with some exceptions, the main region is not a particularly innovative region where they're more of an importing society and, of course, there are exceptions to that, the pharmaceutical industry in Israel is obviously very active. There are a number of institutions in Saudi that are doing a lot of tech transfer types of things, but on the whole we don't have a lot of new stuff coming out of the region. So the majority of the work that my office does is in assisting U.S. companies is enforcement really.

So you mentioned the branding issue and a lot of the complaints my office gets from U.S. rights holders that all of the counterfeits are coming from China, transiting through Dubai and then throughout the rest of the region so we have a lot of engagement with Dubai customs and of course that raises some TRIPS concerns so that's where the international treaties come into play.

We do have FTA's in the region: Morocco, Jordan, Israel, Bahrain and Oman so a lot of the laws on the books are pretty good; it is the enforcement of that so that's a lot of the work that we do.

In terms of falling oil prices in the Gulf particularly, when that started happening about a year and a half ago, I was really excited, not really excited, but I thought that it was going to shift the governments into really focusing more on knowledge-based economies because there's a lot of talk about that throughout the region but there's not a lot of a practical push in that direction, again with some exceptions; the UAE is very forward thinking with that, Expo 20/20 is coming up so they're really pushing that and to build smart cities, that kind of thing.

But the initial reaction when oil prices fall traditionally in the past has been sort of a short term panic, a lot of keeping the money tight, keeping it close. But over the long term, it doesn't really have a huge impact on the economy as a whole.

So unfortunately, that shift to knowledge-based economies hasn't really started. So that's sort of the commodities issue coming down the pike.

One interesting thing; the KDIPA, the Kuwait Direct Investment Promotion Authority, is the first organization in the Gulf at least that is promoting international companies, foreign companies, to have 100% ownership.

So in the Gulf, there's a rule that you have to have a local partner and they usually have a fairly large stake in the profits that the company has, so KDIPA is changing that, and there's only a negative list of types of companies that can apply for one of these licenses and Huawei was one the first three to get one of those licenses. So it'll be interesting to see what comes out of that arrangement. So that's all I have initially for right now. So I'll pass it on to my colleague.

DICKINSON: Thank you. Michael, Mexico, Central America, Caribbean, great mandate there; Mexico, obviously one of our closest allies, part of NAFTA for a long time, in the TPP negotiations for good or bad, from their point of view. Why don't you tell us a little bit about Mexico and maybe highlight the TPP issue?

LEWIS: Absolutely. So when we talk about Mexico, we have to give context. Right now in terms of U.S. government, for policy reasons obviously China is one of the main focuses but Mexico is our third largest trading partner, over half a trillion dollars a year in trade, so it's interesting that Mexico doesn't get as much play in terms of our focus, but since I live there and that's all I do, to me it's an extremely interesting and vibrant kind of economy, especially with respect to Intellectual Property. It's also good to give a little bit of context. Currently, the Mexican government has been expending a lot of political capital on energy reform, education reform, as well as telecommunications reform.

So IP has not been on the front of the government's mind in that context; however, with the TPP negotiations, we have been able to push a sense of increased enforcement as well as Mexico doing a little

bit more to encourage an innovative economy and the like. But when you talk about some of the other broader issues in terms of enforcement, Mexico for the most part still struggles with coordination between different governmental agencies to properly enforce the rights of U.S. right holders.

A lot of my time is spent counseling small and medium-sized companies on the pitfalls of where they need to sort of sidestep landmines when it comes to Mexico. You have a judiciary that takes up to 10 to 14 years to process an IP case which especially for smaller companies that's just unacceptable and for them they can be held in limbo for a very long time in the courts. And I think a lot of Mexican companies that are engaging in questionable activity can use this to their advantage and delay enforcement for many of a number of years.

So while the focus in Mexico currently is on physical goods, physical piracy, we have been working on the sidelines of having to build the Mexican government's capacity to deal with online crimes as well. So I think Mexico recently created a digital IP crime unit which focuses specifically on digital crimes and we've worked with them and brought them to the U.S. to work the FBI as well as the Department of Homeland Security on building their particularly expertise in an area that they just have not worked in a lot.

In terms of TPP, I think for the most part, Mexico was a latecomer to the party and from my perspective, I think you always have to look at the lessons of NAFTA.

It took Mexico almost 18 years to implement data protection so when it comes to TPP, it's going to be challenging I think from the U.S. side and from other of the developed countries that are part of TPP in terms of how it's going to be implemented and is there going to be specific issues with language in implementing legislation that will be so broad as to water down the particular language in the TPP text and I think that's something that we certainly are going to be looking at moving forward and having discussions with our Mexican colleagues about best practices when it comes to implementation.

DICKINSON: Thank you very much. Last, Don, Russia is obviously an interesting country relative to IP because again it doesn't have a long tradition but it's really getting in the game these days. They just opened up a new court in Moscow, for example, and they're obviously a major global player so how do you see your mission there in Russia?

TOWNSEND: Yes, it's quite true that it doesn't have a very long tradition of Intellectual Property Rights, basically a little over 20 years in dramatic contrast to the rest of the BRICs. I mean the people in the whole former Soviet Union, and I covered all 11 countries of the former Soviet Union, they don't see any value in IP generally so it's a very tough sell in the part of the world.

Now saying that, they have instituted the new IP Court in Moscow and we've seen very good decisions come out of that court. So what are they good at in the former Soviet Union on IP? They're good at the Russian Patent Office; they will issue you a very good patent. The Moscow IP Court will give you a very fair decision generally. There is not as much indigenous innovation anymore.

Actually, Russia is a very inventive country; they have very good scientists; they have very good engineers, and historically during the Soviet time, they invented a lot of things but they didn't patent those things. They gave you a patent from the Soviet Patent Office which was of no use except to hang on your wall and they would give you like 100 rubles for patenting something and with those 100 rubles, you couldn't buy anything with because there was nothing in the store to buy it with.

Russia is a very interesting place from the IP standpoint. Now saying that, yes, you can enforce your patent, yes you can get a good patent and actually they're an international search authority for the Patent Cooperation Treaty (PCT). I used to file patents in the Rospatent (the Federal Service for Intellectual Property in Russia) or Russian Patent Office because we've got a fairly good product and it was for a very cheap price.

Now patents are one thing, there's not much activity in patents. Their laws are pretty good. The one issue that I deal with a lot is pharmaceutical patent infringement. The laws look good on paper. You get a good patent and then like in most of the countries of the former Soviet Union, most of those products are purchased through government tender.

Government will buy patent infringing goods, especially from a local generic and there's no patenting linkage. So it's a constant battle, not only in Russia, in all of the former Soviet Union, Central Asia, et cetera.

I can talk at length about pharmaceutical infringement but I only have five minutes so I will focus on the really problematic part of IP in my part of the world is trademark and especially copyright infringement; that has been a battle for many, many years; it's the haven, it's the base for pirate sites; it's the base for copyright infringement for all over the world, and historically in Russia and Ukraine.

The Russians instituted an anti-piracy law actually and they're one of the few countries that has permanent site blocking. They actually issued an injunction to permanently block several very famous pirate sites in Russian recently. That should happen within this month if they don't go into the appeal process. Trademark infringement is also a very big problem in our region and that is also very difficult to enforce against. I work with U.S. companies and my European colleagues fighting counterfeits.

Most of the counterfeits, as you would probably guess, are emanating from China through our customs union border in Kazakhstan and Kyrgyzstan flowing up and flowing over into the European Union. Ukraine is also a complete disaster with regards to IP enforcement. That's a constant battle for me; I spend a lot of time in Ukraine dealing with that. The problem with that is they've now signed the DCFTA with Europe; the Odessa Port which Chinese ships can pull directly into; we're very, very concerned about that particular issue.

So yes, as a whole, I think the BRICs are all in the same boat with IP enforcement. Russia and the former Soviet Union are a little different case. Laws are OK on the books; getting enforcement of them - very, very, very difficult.

DICKINSON: Great, thank you very much. Part of this is also intended to talk about regionalism. Most of what we talked about so far in the specific countries where you're individually based, almost all of the countries have a regional influence - China on Southeast Asia, Brazil on South America, Russia on the CIS countries, et cetera. You talked a little bit about how regionalism works on IP. Is there a leadership component to say the principal country in the area, or is there antagonism towards it, or what's the relationship like?

YU: So, let me start. I think the challenge for China is that it wants to keep the leadership within Asia, but it also fears that a lot of countries see a major threat coming from China. So, it is trying to balance the two positions, and it has been working closely with ASEAN.

On the one hand, it's pushing hard on those issues that China cares a lot about — usually not intellectual property. On the other hand, China is also developing so-called early harvest programs, so that Asian developing countries can get more benefits out of the FTAs, or other arrangements, before the more-developed parts of Asia can get the same treatment.

China has also been working closely with other Asian countries on patent examination — in terms of getting countries up to speed and promoting IP, but staying further away from enforcement, because of all the piracy and counterfeiting problems still within the country.

DICKINSON: Thank you. Anyone else?

VONORTAS: I think Latin America, there isn't much coordination. We heard in the presentation early on that showed that the two countries, Argentina and Chile, are going in very different directions so I haven't seen much. Everybody of course in Latin America of course understands that Brazil is the big economic gorilla but that gorilla has particular issues that the others don't; they have an Amazon and the Amazon is really a huge concern with the last presentation of Margo.

That treaty and how Brazil deals with that treaty is a major issue, but it has also a very large poor population there are concerns of what'll they do; their health system is going to break down if they accept to pay international prices in medicine. It's a very, very serious issue so big problem.

DICKINSON: I believe they've taken the first steps regionally towards developing a regional patent application and regional patent prosecution process, just the very first steps but it'll be a challenge to see if it takes that forward.

VONORTAS: May I say that for those of you who are interested in Brazil, the new Technology Attache at the Embassy here is an IP expert. He could not come here today because he has a personal problem, but he's great, he is young, he is very much into this and the country is changing its legislation right now; things are going through the Congress.

DICKINSON: Aisha, how about regionalism from your point of view?

SALEM: The one thing I will say is that the GCC, the Gulf Cooperation Council, the six member states, there is a GCC Patent Office that's separate from the Saudi Patent Office, it sits in Riyadh, so there's a whole separate team of patent examiners at the GCCPO. Enforcement is left up to individual member states but there is a centralized patent system that is good for all six countries.

So a lot of the advice I give for U.S. companies if they are coming into the region, some of the patent offices, individual member state patent offices, don't examine; they're just a holding office. So I highly recommend people filing for GCC patents. That's pretty much it.

DICKINSON: How about at a policy level, any policy differences there in the Middle East, or is it fairly consistent?

SALEM: It's fairly consistent. Again, enforcement is always a problem throughout the region.

When I talk about the region, Israel is sort of its own little island and certainly politically, none of the other countries in the region are going to look to Israel as something to emulate so that's just something separate. Jordan, though is sort of the gold standard in the region and our office does a lot to help facilitate Jordan being an Arab leader.

DICKINSON: Thank you. Michael?

LEWIS: So Mexico is certainly a leader in Central America. Mexico has programs and the Mexican Institute of Industrial Property has programs in place where they are actually the examining office for many of the Central American countries and you have to understand, and especially in Central America, the IP offices are extremely small; they might have two patent examiners on staff and they use contractors to examine so Mexico certainly fills a role because the Mexican IP office has a thousand people, so it's certainly much larger than any entity in Central America.

And you also see a lot of countries emulating policy-wise what Mexico is doing so we try as much as we can to work with Mexico and steer them on a positive track because we know that we could end up using those examples on a policy front to influence what's going on in Central America.

DICKINSON: And Don?

TOWNSEND: Well, my reason is quite unique because my regional all used to be one country and the Russians were definitely the leaders of that country and so the Russian Patent Office especially is much larger, more sophisticated, and better trained than any of the rest of the region.

DICKINSON: There's a Eurasian Patent Office, though too, right?

TOWNSEND: Yes, which is very -- most people don't even know about the Eurasian Patent and many rights holders come to me and ask me about it and one of the very interesting things is even when they file a Eurasian Patent which covers many of the countries in the Russia CIS Region, the local officials and the government, especially the Ministry of Health, don't even know about the existence of a Eurasian Patent and when we bring up the existence and try to argue that, hey this is a patented drug, you can't tender this out, they say well we don't know what this Eurasian Patent is, I've never seen one before.

So it's a very unusual situation. Generally, our rights holders tend to file that Eurasian Patent to cover the Central Asian countries and we have a very difficult time enforcing that, but yes, the Russians are the leaders and most of the countries emulate them except for two, Ukraine and Georgia; whatever they do, Ukraine and Georgians don't want to do for reasons that don't have anything to do with IP.

DICKINSON: Thank you all for committing to the time. We have time for questions today. We have a question over there. Do you want to give him the microphone or how do you want to work this? OK go to the microphones, introduce yourself and go ahead.

KAHIN: Brian Kahin with a question for Peter. I believe it's still the case that the amount of patent litigation in China is still about twice that of the U.S. and I'm wondering, what's your take on this? Is this some kind of legal calisthenics that is being promoted by the government and how does civil litigation compare with administrative processes that exist in China? That's sort of an unusual arrangement that may provide a cheaper alternative than civil litigation.

YU: That's a very good question. I have made statements about how China is now one of the most litigious countries in the world in the IP area. So, if you look at the number of patent, trademark and copyright cases, the numbers are very substantial. What is also quite interesting about patent litigation is that only about five percent or so -- now it's probably like 10 percent -- are actually from foreign patent-holders. So, these patent-holders are simply not using the judicial process.

I think this is troubling in the sense that, if you're complaining about how the process is not well developed, it is hard to be convincing if you're not using it? But at the same time, I can also see why foreign rights-holders do not want to litigate in China — because of the low damage awards and the limits on statutory or pre-established damages.

But going back to your question, I think part of the growing litigation is the result of the fact that you've got three different types of patents in China, which can cause complications when a utility model-holder sues a patent-holder. You also have a lot of Chinese companies going against each other. But it's unclear …

DICKINSON: Give us 30 seconds on what the difference would be.

YU: Yes.

DICKINSON: Between utility models and regular patents.

YU: So, for utility models, you do not need to go through substantive examination, and the protection is much more limited. Whereas for patents, you have the substantive examination process. What is also quite interesting is that China seems to be pushing for some type of examination at the moment even for utility models because they are concerned --

DICKINSON: Because three-quarters of patent applications are utility models --

YU: That's right.

DICKINSON: -- in China.

YU: That's right. And so --

DICKINSON: It's a permanent system -- for the folks in the room.

YU: If you're into the genesis of the utility model system, you can actually see why the Chinese want to offer this type of patent. I think that system was established because a lot of individuals and small companies will not be able to afford the patent prosecution process. So, China wants to set up a system that is more egalitarian. But at the same time, that system gets taken over a little bit, because some utility models and designs are closer to what we have as trade dress in the U.S. It's not really that close to patents.

And the other thing about counting numbers is that I'm unsure how they do it. When I talked to some experts in China with respect to how they count cases, they did not mention anything about patent, but with respect to copyright, they mentioned that if you got major litigation involving different ISPs [Internet service providers], they actually counted each ISP as a single case.

So, you end up having more cases than what you really have. I think, in 2010, Mark Cohen, another IP attaché from the PTO, counted about 25,000 copyright cases in China. But when you think about how the Chinese actually count the ISPs as different cases, the numbers may have actually been inflated a bit.

DICKINSON: Just a brief follow-up: There used to be a lot of concern for foreign entities about whether they were going to, basically, get a fair shake in the -- in the state courts there in China. The data seems to suggest, as I understand it now, that they are -- that there's not a home team bias in the court system at the moment, at least. Is that your experience?

YU: I think it depends on where you are doing your litigation. If you're doing it in the major cities, I don't think you've got the home base bias as much as in the past because a lot of the judges there are actually trained abroad. They have, for example, degrees in Europe or in the U.S. So, they are quite well-trained.

IP is very unique, because a lot of the cases actually go to younger judges, because a lot of senior judges are not well-equipped to handle the technicalities involved in IP cases. But once you go into the rural areas or outside the big cities, you can see that there's a lot of provincialism, local protectionism and corruption.

What's quite interesting is that China is now pushing for two different things, which are both quite important. One is about specialized IP courts, which have been developed in different areas. Does China need a specialized IP court for integrated circuits? I don't think so. But the country is now focusing on specialized IP courts.

The second thing, which is quite unique, is that China is now pushing for the so-called "three-in-one" -- basically administrative, judicial, and criminal enforcement all at the same time. The difficulty, though, is that the judges in the court system may not necessarily want to cooperate with prosecutors because they want a separate budget and different personnel. So, that is quite complicated.

One thing I forgot to mention when Todd asked me a question about regional developments. Keep in mind that China also has very close collaborations with both the Japanese Patent Office and the Korean Intellectual Property Office. In that discussion, the type of collaboration they do is actually very different from what China does with ASEAN.

DICKISON: All right. Another question?

Q: I wonder if you could talk about trade secrets in each of your regions. Are they important to U.S. and domestic firms? And, if they are, can you get the kind of enforcement you might like in case of theft?

LEWIS: I'll kick it off. In terms of Mexico, there are laws on the books for trade secrets; however, the burden of proof is extremely difficult. And we know that, you know, there are -- there are certainly a lot of issues that are going on in terms of employees leaving with proprietary information, but the cases just don't bear it out. I think last year there were zero in the courts. So these kind of cases are just not being litigated and, you know, companies are trying to figure out other ways in order to -- in order to keep the information from flowing from one to the next.

SALEM: Short answer is "no". I've heard of a couple of cases in Egypt in the ICT (Information and Communication Technologies) sector, and some in Saudi in the oil and gas sector, but no litigation. There's really -- the courts just aren't equipped to handle those kinds of cases.

VONORTAS: Brazil is exactly like Mexico. It's in the books, but I don't see a lot of action.

DICKINSON: It is criminalized, isn't it?

YU: Well, it depends on how you look at it. It's criminalized in the sense that trade secrets are protected by criminal law. One thing that's quite important to remember is that you have the anti-unfair competition law in China that covers trade secret protection. You also have protection for trade secrets in criminal law, employment law and contract law. The protections are fragmented.

There's the typical discussion about how China offers limited trade secret protection, but at the same time, when you look at the laws in bits and pieces, the protections are there. So, one of the major challenges for China at the moment is to revise its anti-unfair competition law.

The difficulty, though, is that this particular law has been drafted with the European or German unfair competition mindset. The drafters were not really looking at it from the trade secret perspective. So, a lot of the people who got involved in the revision process are basically experts on anti-monopoly law, as opposed to trade secret law. At the moment, one big debate within China is whether the country actually needs a separate trade secret law. That is somewhat different from the anti-unfair competition law, and the Chinese have been going back and forth.

The final thing I want to mention is that trade secret protection has been very difficult to improve in China for a number of reasons. Number one is that, what we are pushing for is actually not standard trade secret protection -- something we have in the Uniform Trade Secret Act, for example. What we are now pushing for is basically protection of undisclosed data from which we don't have any international consensus. That makes it very difficult.

Number two, as far as employment is involved, you always have major difficulties with respect to confidentiality within employment -- as well as with respect to employees in China, because the country started with a Socialist market economy. So, China wants to allow employees to move around, and a lot of companies used to be owned by the State.

Finally, the trade secret issue is difficult because it also has an intertwined relationship with the ongoing debates on hacking, industrial espionage and cybersecurity. I think that makes the discussion very difficult.

DICKINSON: And just to put it into a slight context -- I think many of you know, but maybe not all, that just this week that it was debated in the Senate and will, eventually, in the House, I believe -- a new trade secret act for the United States, which is basically the first time we've had a -- sort of a nationalized trade secret act. It seems to be going pretty smoothly so far, but in Congress we'll wait and see, right?

Q: The New Yorker -- the New Yorker recently had an article on nutmeg patent, and it also made reference to India's TKDL -- Traditional Knowledge Database Library. How do you see the IP issues in plant-based drugs playing out in the TPP, especially with countries which have very rich biodiversity?

YU: So, let me add something. I hesitate to respond because China is not a TPP country. Article 26 of the Chinese Patent Law includes a disclosure requirement, and a lot of the FTAs China has signed involve disclosure of genetic resources or traditional knowledge in patent applications. China is also a major backer of the proposed Article 29b, which requires disclosure at the international level. And I suspect if China has its way, it will probably lobby very hard for including the disclosure requirement within the RCEP.

At the moment, I think China is tentative because it doesn't want to push the IP issue on to the RCEP agenda. But if it's quite clear that there will be an IP chapter, I suspect the disclosure requirement will get in there. Also India has one of the most developed biodiversity law in the world. I think that's quite important. There is also the whole debate about Section 3(d) of the Indian Patent Act and how it will affect a lot of patent issues.

LEWIS: I just wanted to comment, actually, quickly on -- on the previous question, which is that there's a great paper by Prithwiraj (Raj) Choudhury at Harvard Business School on the effect that the -- writing down this traditional knowledge in this database had on the U.S. patent examination and European patent examination. And so I think that's an interesting interplay, right?

So you have this traditional knowledge -- if it's not written down and, in particular, translated in a way that can be accessed by examiners, then it won't be accessed by examiners and we might be patenting things that have significant prior art, say, thousands of years ago. And so Raj -- one of the things he showed in that paper is that there was a significant impact of writing that down, translating it, getting it in the hands of examiners, and influencing the prior art.

So it's an interesting interplay there. It's not directly responsive, but I wanted to mention it.

Q: This is also for Michael, but anybody can address it. Mexico is sort of -- research and development spending as a share of the economy, or science and technology's spending of the share of the economy is about the same now as it was 20 years ago. It's just flat. And it seems to me that, if you want buy-in, so that the country sees IP, not just as a matter of enforcement with people on the outside saying "Do more to enforce it, but also to see it as a project of their own so it's more integrated into their national economic development policy -- that there needs to be more spending.

And I'm just wondering if that's -- I realize that that's not your direct remit as your job, but is it something that, as an attache there, that anyone's working with them to try to increase it? It's even a law in Mexico that the government -- they're obligated to have it at one percent of GDP. It's been on the books since 2005, or something. I don't think they've ever come -- they're still at like .6 percent of GDP -- of -- yeah -- it's tiny.

LEWIS: Right. And I think the -- the big problem is that there's this, you know, top-down approach where the Secretary of Economy has, like, you know, 30 innovation offices throughout the country, but they do nothing. They actually shut down 20 of them last year because it was just a drag on -- you know, on the budget.

So, as an attache, we're always trying to develop the innovation economy of our region. And we have great examples. I mean, look at our Silicon Valley; look at all the other cities that are trying to incorporate these kinds of policies that will push forward innovation, patent filing, and the like.

The problem is, is that they don't -- they're not keen on following the organic examples. They think that from a government perspective, they can dictate the policy, and I think that's where the problem comes along.

Now, when you talk about budgets, you have to talk about reality. When we're talking about my part -- my part of the world, the murder rates are the highest in the world. So, a lot of the concern -- the political concern is about citizen safety, and not from health and safety of counterfeits, but health and safety from a criminal perspective. So you have to sort of understand that that is where a lot of the resources are going to, especially in my region.

VONORTAS: For a country like Brazil, which is very large, one should look inside to see the differences. So, in that particular country, there is one state -- the State of Sao Paolo -- that is very, very different from anything else. The State of Sao Paolo could sit in the middle of Europe and you would not tell the difference. It's fully -- basically fully developed, huge industry, a lot of high-tech -- all the high-tech industry of Brazil is already in that state. Very, very competitive financial sectors, and so forth.

That state -- the interests of that state and how they project them to Brasilia have been extremely influential on their intellectual property because, of course, Sao Paolo is very much interested in intellectual property. But if you take other -- other regions of the county -- Northeast, Northwest -- I mean, IP is not really their thing. What they do is tourism, and agriculture, and some very intensive kinds of agriculture, but not really what you would say for IP. So it is -- as we have in this country, huge difference between Massachusetts and -- I don't know what other states -- in the south --

(LAUGHTER)

VONORTAS: It's absolutely true. I mean -- yeah. It's very -- the same differences they have too, and there's a constant battle, right?

DICKINSON: Let me ask -- let me jump in just one second -- a more philosophical kind of question on patent -- on IP policy generally. Not only on the policy, but we're debating now some reforms -- litigation reforms in the U.S.

We've come through a period where we had the America Invents Act, which imposed a series of reforms. There's a lot of debate about whether we have too strong a system -- are we -- are we detecting too many things? The Supreme Court seems to, one after the other, find something not patent eligible. And part of that debate was, will other countries take that as a signal that we are weakening -- or we are being less aggressive about protecting our IP and, therefore, we should not necessarily follow your lead.

You can -- maybe this is to Peter. You can certainly get unanimity on Capitol Hill by saying "China, stop ripping us off on our IP", yet there's a sense that we're weakening in some cases, or at least right-sizing our own -- our own view of IP. Do – are any of the countries taking those signals in that way?

YU: I don’t think China is taking those signals at the moment, because when you look at both the National IP Strategy in 2008, as well as the new implementation plan in 2013, China still focuses heavily on metrics. So, China continues to push heavily on the number of patents.

One of the biggest challenges I see is that, down the road, I don't know how China is going to handle the patent troll issue. A few years ago, the Chinese administration -- at least high up in the administration --

looked at the issue and said, "This is not a problem at the moment, so we should keep on having the numbers -- keep on having a lot of patent applications."

But, increasingly, we see a lot of small Chinese companies trying to take advantage of the system, and the worst part in China is that the patent quality is not that consistent. You also have utility models trying to compete with invention patents.

So, if you think of the patent troll issue in terms of how you have a wide variety of patents, you'll also have a wide variety of players. That becomes highly complicated. But at the moment, I don't think the issue is a problem for China because the treatment of software patents is actually very similar to the EU -- judges are looking for technical effects. So, the recent cases don't affect China as much, but Chinese judges have been reading U.S. court cases very closely.

LEWIS: But, Todd, to your point, I think anything that happens, either in Congress, U.S. Courts -- folks in Mexico are always watching, and they're always either curious about where the U.S. is going, or they use it to their benefit. So I think that any whisper that comes out of Capitol Hill is being heard loudly, especially in my region.

DICKINSON: All right, thank you. And I think the -- the shorter answer to my question is one Peter touched on, that the current legislation -- it would, I think, fairly argued it was intended to deal with a fairly specific problem in the United States -- the so-called "patent troll" problem, which is directly related to our -- its own unique litigation system. That doesn't necessarily translate other places, and so other people should be giving it, necessarily, that much credence.

Yes?

Q: Yeah, I just wanted to know about the developing agenda in WIPO -- I'm curious what other countries are doing about that and are they doing any more with that -- that WIPO is asking developing countries like Brazil, I know --

LEWIS: I think our -- we have two attaches at WIPO; one working on WTO issues, and one working on world intellectual property organization issues. And usually what happens is, we coordinate with -- within our specific countries on the development agenda.

DICKINSON: A personal comment, both from my time at the office, but also, I was a representative to WIPO for several organizations, most recently the IPLA. I think the development agenda has been a huge challenge for WIPO, particularly for the current Director General because of the impact he's had on almost every facet of what the organization's trying to do.

And -- you know, either financially, or at the policy level, or whatever -- just -- I mentioned substantive harmonization. When we try to go back to WIPO to get that debate going again, the principle thing that was raised -- said we have to decide first is the development agenda, and how does my country -- or this -- someone else's country get a piece of the action, if you will, and the function of the overall U.N. goal of development agenda.

So, over -- how do you overlay the broad goal the U.N. it has for itself on an agency like WIPO is -- is -- I would submit, the single biggest challenge that they've got to deal with right at the moment.

One more? Okay, one more, quick question.

Q: Professor Stiglitz wrote a very strongly worded article in the New York Times in favor of the SCOTUS decision to reject gene patenting. His fundamental argument was that by -- that by monopolizing a lot of upstream -- that monopolization of a lot of upstream knowledge exacerbates inequality and also creates, you know, great impediments for access to medicines. In fact, he challenges the conventional notion of equilibrium between the short-term monopoly losses and longer term societal benefits.

So my question to you, Professor Vonortas, would be what would be your thoughts on that? And, secondly, this -- you know, this entire issue of monopolization of upstream knowledge and its impact on income inequality -- how to you see that playing out in TPP?

VONORTAS: Thank you for the question. It is not a Brazilian issue; this is a bigger question for -- but they are very, very much concerned, of course, because they have -- they have all this biodiversity business. My personal take -- this is an open debate -- I, personally, tend to align a little bit closer with Professor Stiglitz in that I see a lot of patents in that area being taken for things that we don't quite know what they are useful for, and that bothers me because the protection is just too broad.

I had a -- specifically, I had a dissertation written here for somebody who went back and looked at the situation of patents in hybrid corn -- the old story -- and how that -- that area has developed. And if you look at that dissertation, actually -- it's at the School of Public Policy -- if you look at that dissertation you will see that we have very serious issues in this country that we do not even know about.

How the incentives for government researchers are being created on the basis of intellectual property that is owned by large corporations that are not directly pressuring them -- they are not telling them no. But by just having certain patents, the incentives are very negative for further advancement of knowledge. So --

DICKINSON: It is a big issue. I think the -- if I could have a comment too. The -- Professor Stiglitz -- it was a good article. It was an important article. I think it tended to overlook a few factors in the -- in the set-up of -- of the premise about, particularly, gene-sequence patenting. First of all, he won the game there. The Supreme Court said that naturally occurring gene sequences are not patentable. I know the bio-scientists in the room wonder what that means, exactly, from a biology standpoint, but that's the state of the law at the moment.

I think that the other thing to remember is that patents have a term and that -- well, first of all, the Human Genome Project every night has put their data up on the internet, and so it became a priority immediately. And now we're 15 years in from that effort and so we're coming to the end of the day when the human genome itself -- we're talking about mutations or other pieces -- but the genome itself is almost all in the public domain, which I think is important to remember.

And thirdly, I think one key factor that got kind of left out in that debate was that, to the extent that that was funded research by the United States, under Bayh-Dole in particular, or just in general, there are -- the United States government had march-in rights. And for whatever reason, our good friends at the NIH, on the Muriad case, chose not to emphasize those march-in rights. I don't know why. You might want to ask Dr. Collins. But the -- the fact that the U.S. government research at least gives us an entree to that -- that data and that information, I think is an important thing to keep in mind, as well.

PANEL IV

BONVILLIAN: It's my privilege to introduce for a moment, because you have your bios in your materials, Panel IV, which will take us until 2:30 plus a little time for Q&A. It's on Global Pressures and the Economics of Intellectual Property. And we're going to hear from three highly respected commentators on different aspects of this story.

Keith Maskus, who is in the Department of Economics at University of Colorado, Boulder is a specialist in international trade analysis with an emphasis on empirical models of trade and FDI, the role of intellectual property rights and trade and in technology transfer in multinational trade policy.

And proceeding down to my left, to your right, Tim Simcoe at Boston University's Questrom School of Business where he teaches strategy and innovation. His research covers innovation, technology, intellectual property, corporate strategy with real expertise in areas of standards and standards development. And he has served as -- recently as a senior economist on the President's Council of Economic Advisers.

And then to Tim's left, Dan Lederman, who is with the World Bank. Dan became in 2013 the lead economist and deputy chief economist for Latin America and the Caribbean at the World Bank. He's both an economist and a political scientist and works on economic development, including financial crises, political economy of economic reforms, growth theory, innovation theory and particularly for our purposes, international trade and labor markets.

So, let's start with Keith, who is going to lead us through the significance of I.P. chapters in recent trade agreements and give us a perspective on those.

Keith, it's all yours.

MASKUS: Thank you, Bill. And I suppose I should also thank the organizers for the invitation, except that I am one of the organizers.

(LAUGHTER)

And we tried hard to find another economist to talk about these issues, and I can tell you that in the universe of international trade economists working on intellectual property, there's about a dozen of us and most of them were my graduate students, so...

(LAUGHTER)

Finding someone to do this turned out to be difficult. So here I am. I'm tired of listening to myself talk about this stuff, but I hope you don't mind too much.

Before I get to this, let me just say that saying something very specific about how important intellectual property chapters in regional trade agreements might be is quite difficult, for reasons I'll talk about. But what I'm going to do mostly is set up the issues and then take some lessons from other kinds of

studies to say something about what we might expect. So that's multiply conditional, but I hope you'll bear with me here.

The main points I want to make, first, as you all know, there's been very substantial and still ongoing globalization of IP regimes, primarily involving convergence of the emerging economies to developed economies.

There's lots of ways you can look at this. But the way I think about it is that when this process began essentially in 1995 with the implementation of TRIPS, there was a very strong divergence between the intellectual property regimes, especially in patents of the now middle-income emerging economies, some of them very rapidly growing economies.

And that's really where nearly all of the important action has been in terms of reforms of their intellectual property regimes. You see a lot of it as well in the poor countries, but that seems not to have had much impact.

One contributor to this trend is the proliferation of trade agreements with deeper attention to intellectual property issues. As I said, it's difficult to isolate the impacts of this component of trade agreements. It does deserve more study. And I'll mention this initial study that I'm working on now with a graduate student briefly.

Trade agreements, however, do have other features that emphasize the importance of IP, suggesting the likelihood of extensive amounts of what I call IP creation within RTAs. But in essence, the argument here is that you may not expect to see much in the data, the sort of record from looking at numbers, specifically from the fact that there are IP chapters that are stronger or weaker across trade agreements.

But the fact that these trade agreements have become larger and more comprehensive and cover more issues and more territory, as the TPP does, suggests that that would increase more within-region activity and intellectual property.

Main points

- There has been very substantial (and ongoing) globalization of IP regimes since 1990s, primarily involving convergence of emerging economies to developed economies.
- A contributor to this trend is the proliferation of RTAs with deep attention to IP issues.
- It is difficult to isolate the impacts of this component of RTAs, which deserves more study.
- But RTAs have other features that emphasize the importance of IP, suggesting the likelihood of extensive "IP creation" within RTAs.
- All of these statements are conditional: we don't see much evidence for IP-related trade or technological growth in poor countries.

Presentation of Keith Maskus, 12/11/2015

So all these statements, as I mentioned, are conditional. We don't see much evidence for these kinds of economic activities in poor countries, whether there are trade agreements involved or not.

Factors driving continuing IP globalization

- Familiar:
  - Rapid and diverse technological changes that challenge limits of existing IPR.
  - Dominance of IP-sensitive technologies and products in trade.
  - Rising upfront R&D investment costs and declining copying costs in key sectors.
  - Massive increases in cross-border trade and investment.
  - Concerns about technology losses in competitive emerging countries.
- And new:
  - Income-driven growth in product and technology varieties entering trade.
  - Proliferation of technical standards with IPR protection.
  - Growth and complexity of cross-border production and research networks.
  - Needs to organize research for and dissemination of public goods.
- Advocates see stronger IPR as a (partial) solution to all these issues.

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You're all familiar with the factors driving continuing IP globalization, so I won't say much about this. Here are some familiar issues.

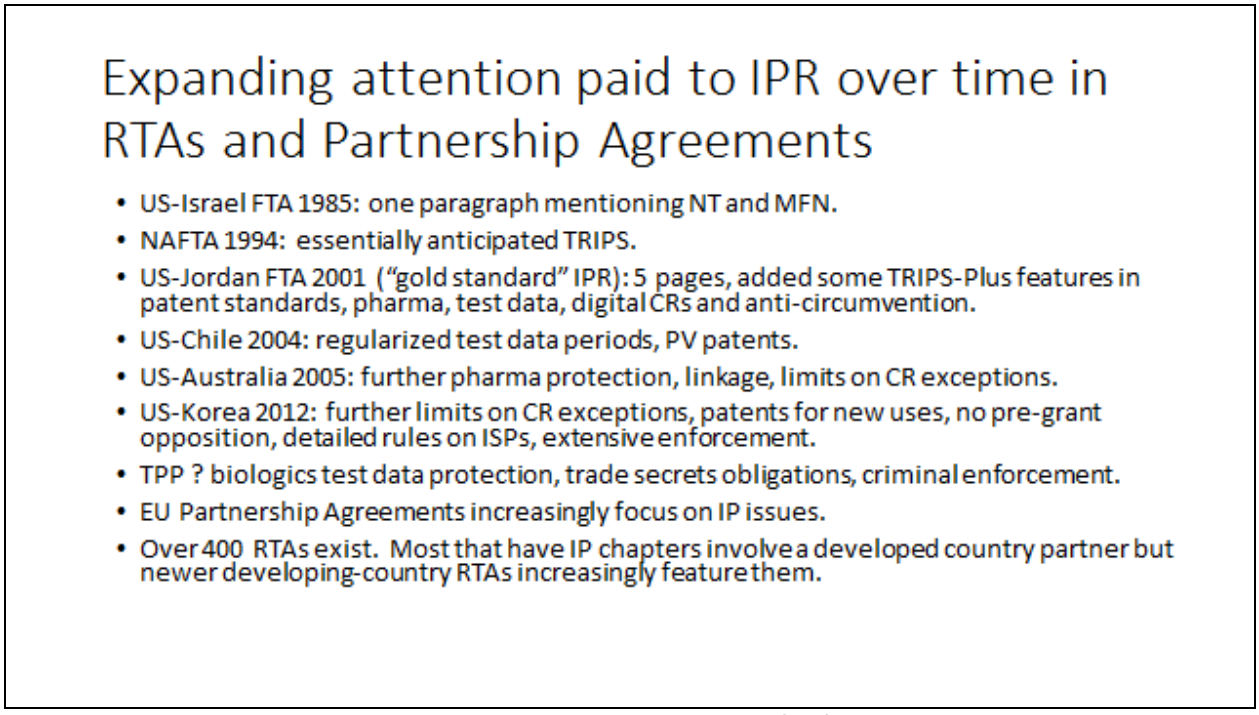
I actually think that much of the recent growth in interest in having IP written into trade agreements has to do with these newer issues, particularly issues of the proliferation of technical standards and their combination with intellectual property protection, and the growth and complexity of cross-border production and research networks.

One way to conceptualize TPP, just one way, is an attempt, ultimately, to try on the part of multinational corporations who have this strong interest, to try to regularize within a very large region their need to deal with things like rules of origin and different regulatory procedures and so on. And IP is -- it goes along with that context.

So, these are all interesting questions, with more or less written about them. IP advocates tend to see stronger intellectual property rights as a solution to all of these issues. I think that our evidence to date suggests that sometimes that's true, sometimes not. It depends on the issue you're talking about and the location you're talking about.

Earlier today, Tom Bollyky was talking about what's been going on with these trade agreements. I don't need to repeat that.

But just very briefly, in the last 20 years we've seen unprecedented increases in legislated and perceived protection of IP rights, mostly in the middle income economies, as I said. Several reasons for this, not only the TRIPS and so on, but also bilateral pressures, regional trade agreements, and very much emerging domestic interest in stronger protection for innovation in some countries.



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And you can see this in these trade agreements. This is just sort of the U.S. and European history here. But as Tom mentioned in the Israel agreement 1985, there was just one paragraph that said let's all just not discriminate. That's all it says.

NAFTA basically anticipated TRIPS. If you read the TRIPS agreement, it very much comes off the concepts in NAFTA.

The -- somebody mentioned earlier that the U.S.-Jordan Free Trade Agreement, often called the gold standard IP agreement, is only five pages long. And it added some TRIPS-plus features and standards and so on, but it's hardly what that TPP has in it.

Then in 2004, the Chilean agreement regularized some stuff on test data period -- test data protection and added patents for plant varieties.

Australia added further pharmaceutical protection, linkage to patents with generics, limits on copyright exceptions and so on.

The Korean agreement put even further limits on copyright exceptions, patents for new uses and so on.

So a lot -- this is just a loose description of what's going on in these – has been going on in these agreements. The point is that there's been just a sort of secular increase in the structure of protection over time.

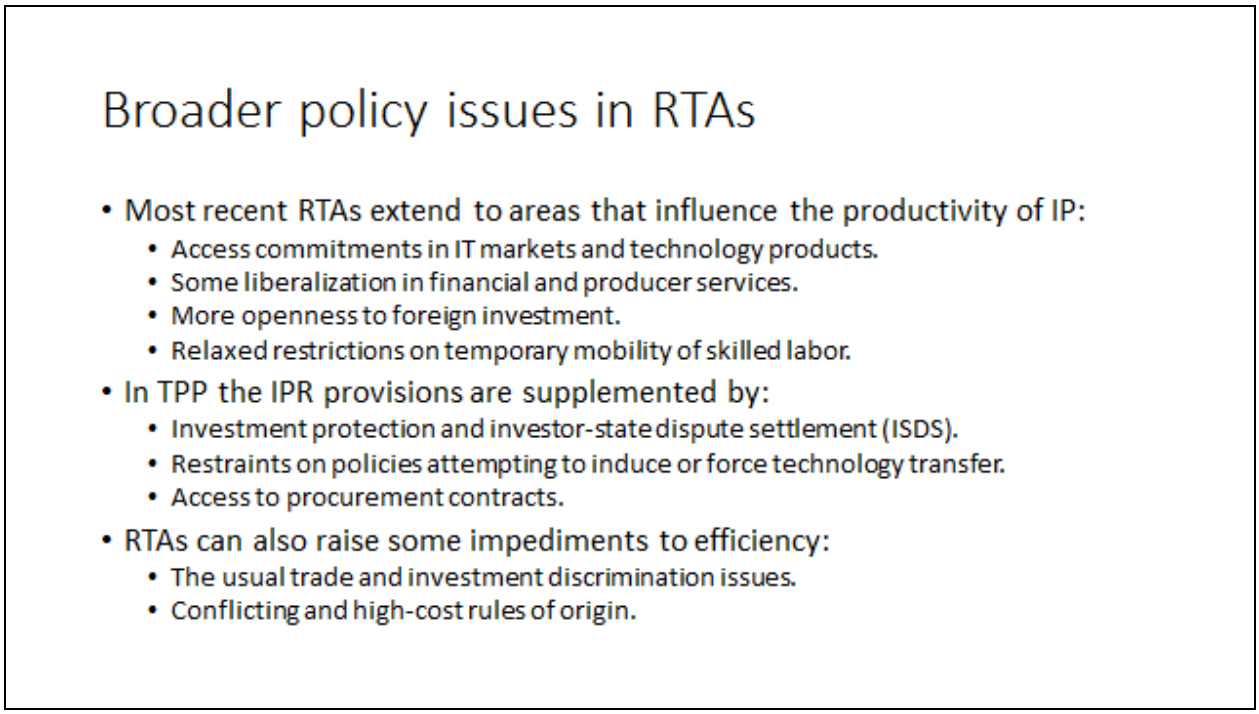
And with the TPP we get test data protection for biologics, additional trade secrets obligations, criminal enforcement of trade secrets and many other issues as well.

If you read the E.U. partnership agreements, they also have increasingly focused on IP issues. In fact, they're very much like the American agreements, with some interesting differences, mostly focusing on geographical indications and relatively more trade facilitation in those agreements than in American agreements. But on the IP stuff, it's not that different.

Right now over 400 RTAs exist that have been notified to the WTO. Most of these agreements that have IP chapters involve a developed country partner. As was mentioned earlier, most of the developing country agreements pay relatively little attention to IP

But some of the newer developing-country RTAs increasingly do feature them. And as Peter was talking about, as the RECEP (Regional Comprehensive Economic Partnership) extends itself in Asia, you'll probably see China agreeing to some changes there.

So, as I said, most recent trade agreements extend to areas that influence the productivity of intellectual property such as access commitments in IT markets and technology products, some liberalization in financial and producer services. I'll come back to that when I talk about some data here. More openness to foreign investment, relaxed restrictions, to some degree, on temporary mobility of skilled labor.



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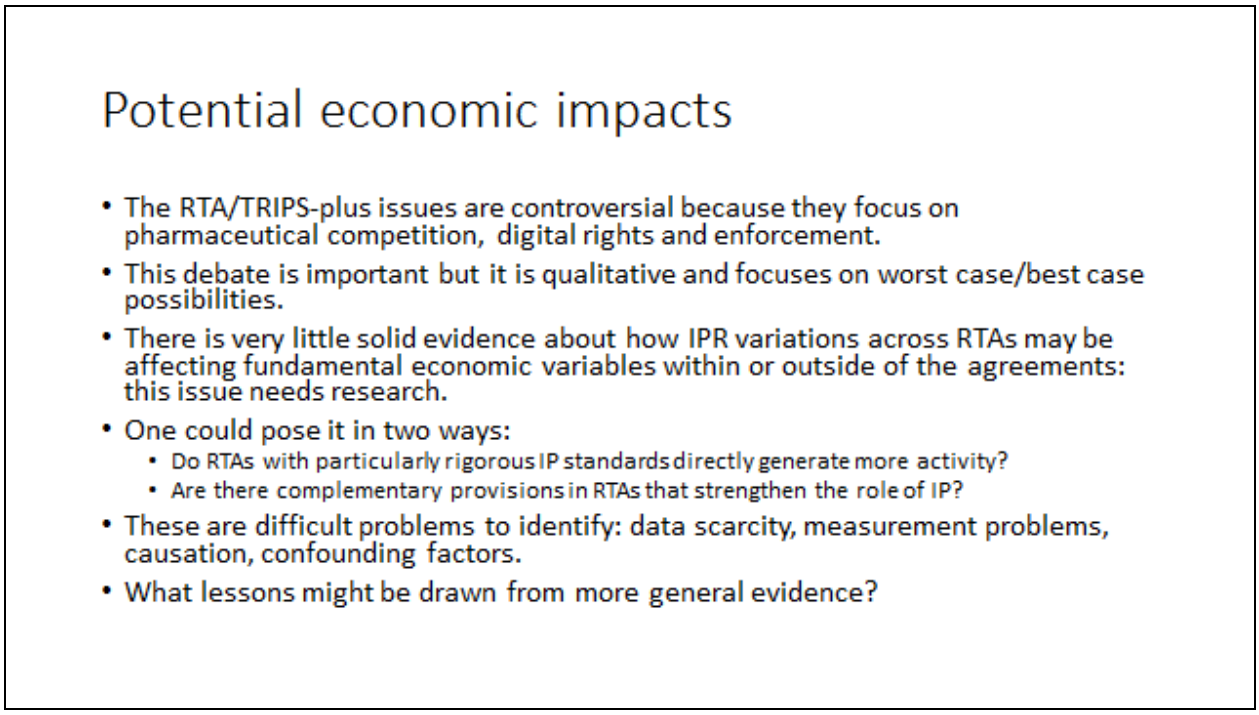
These are all strong contributors to technology transfer across borders and within regional trade agreements. So the fact that they actually put these kinds of provisions into these trade agreements generally you can be reasonably confident will have some complementary effect on the intellectual property arrangements in these agreements.

In TPP the IP provisions are supplemented as well by investment protection, investor state dispute settlement, restraints on policies attempting to reduce or force technology transfer, and access to procurement contracts. We could mention many others. So again, all of these are at least in principle or arguably, debatably some kind of complements to technology protection.

Of course, as we all know, trade agreements can also raise some impediments to efficiency. I'll be taking too long if I say much about this. But there are the usual kinds of discrimination issues and conflicting arrangements not just in rules of origin, but of course across the IP chapters as well.

Peru is an example. It has a trade agreement with the United States. It has a trade agreement with Europe. It's not clear, except to lawyers yet to be born I suspect, which of the agreements or which of the provisions on trademarks versus geographical indications will actually take precedence. When there is a conflict, it's probably going to be inevitable in those kinds of cross-cutting arrangements.

So, I spend my time thinking about the potential economic impacts of these kinds of institutional changes. As you all know, the provisions in trade agreements on pharmaceuticals, digital rights enforcement and some other areas are controversial, precisely because they focus on these kinds of quasi-public goods issues. But, this debate is extremely important and should be carried out as much as it can be.



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But to me as an economist, an international economist focusing on issues of trade and development and so on, the debate is qualitative, tends to focus on what can be the worst case-best case possibilities coming out of these things.

There's very little solid evidence available about how intellectual property variations across trade agreements may in fact be affecting fundamental economic variables within or outside of the agreements. And that's what I would argue really needs much research.

Now, you could try to pose that question in two conceptually related ways, kind of getting the direction of causation in both directions here. Do RTAs with particularly rigorous IP standards directly generate more economic activity, more innovation, more R&D? We don't have any studies of that yet, but it's an interesting question.

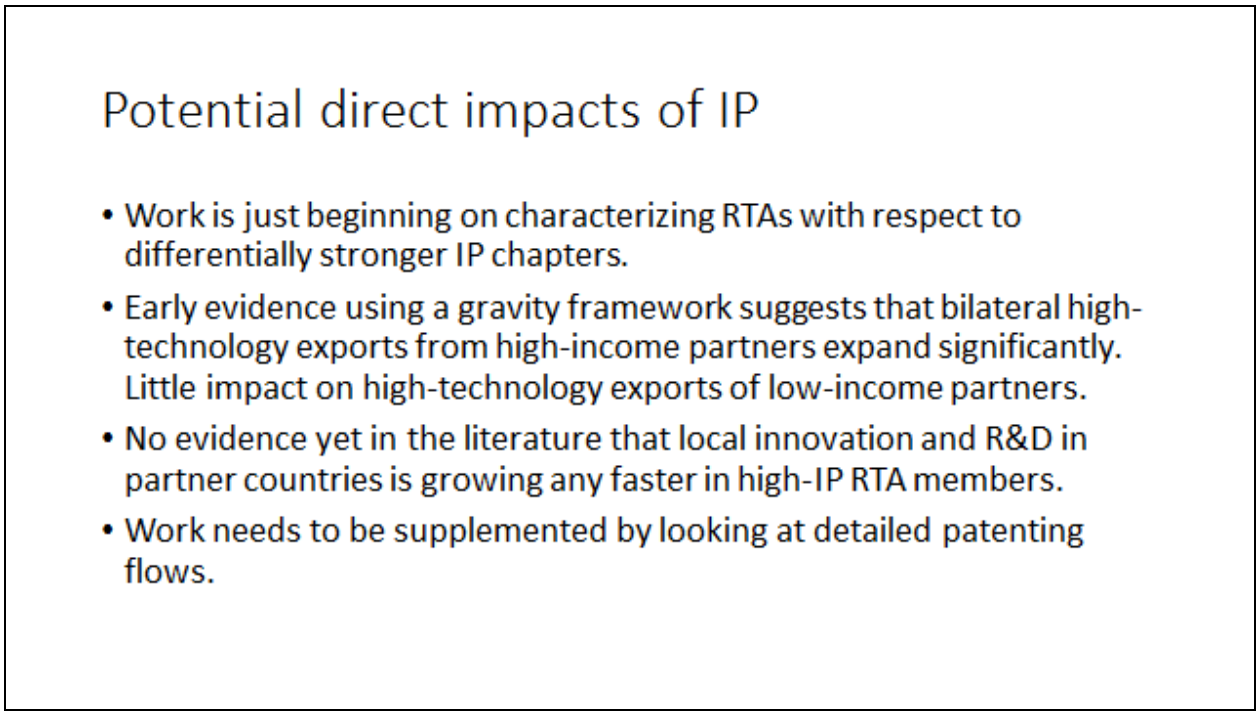
So how you would go about that, of course, is to try to qualify trade agreements by whether their IP chapters are in some sense particularly rigorous relative to what you'd expect from other kinds of trade agreements.

And I mentioned a project that I'm doing with a graduate student. We've gone through a lot of these trade agreements and done that characterization ourselves, along with the DESTA project you may know about in Switzerland.

Are there complementary provisions in RTAs that strengthen the role of IP? So this really turns the question around. What is it about RTAs that might make the role of IP better or worse in some sense?

So these are always difficult problems to identify because of the data scarcity, measurement problems and so on. I won't bore you with that. But we can ask what lessons can be drawn, perhaps, about what we might expect from the emergence of these very large, complicated trade agreements, the mega regionals and the more regional agreements that have strong IP protection in them.

Well, we can start with some potential direct impacts of IP I would say work is just beginning on characterizing these RTAs, as I mentioned. Some early evidence that we're getting using a gravity framework suggested bilateral high technology exports from high-income countries expands significantly.



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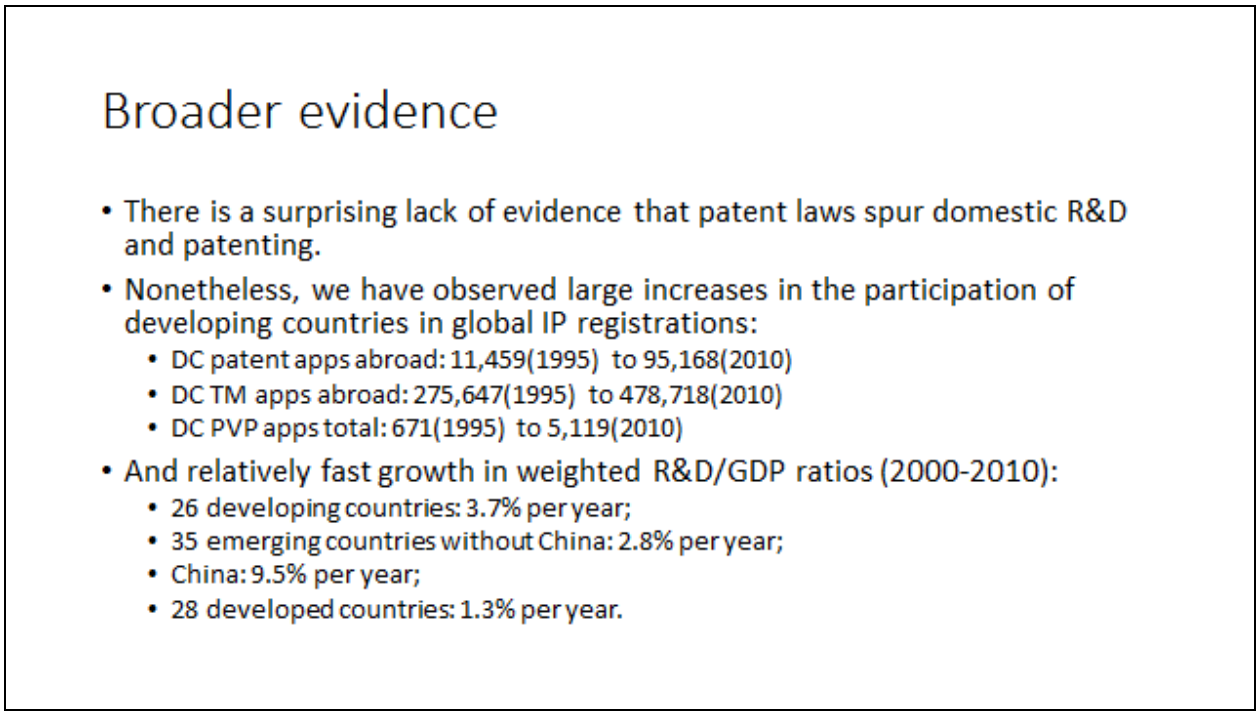
So to put that into some perspective, what that means is, looking at agreements with -- involving U.S. and Europe on one side and other partners on the other side, but involving some TRIPS-plus kinds of standards. That in those kinds of RTAs, trying to take account for as many other factors as possible, you do get more bilateral exports from the richer countries to the poorer countries in high-tech products. But there doesn't seem to be much impact in the other way, in the other direction.

Not much evidence yet in literature that local innovation and R&D in partner countries is growing any faster in IP RTA members versus non-IP RTA members. So in that context there may be some exceptions on an individual basis. But it's really hard to locate any suggestion like that in the data so far. We do need to supplement this work by looking at more detailed patenting flows.

Some broader evidence, turning this thing around a little because I only got a minute or so left, you probably are aware if you're in this area that there's a surprising lack of evidence that patent laws really do spur domestic R&D and patenting. To my way of thinking, if patent laws have a sort of positive impact on

economic activity, it's about protecting markets and pushing technology transfer and licensing and all of that, rather than the original invention.

That being said, we have observed large increases in the participation of developing countries over this period of time in global registration of IP There's some numbers for you.



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So, developing country patent applications abroad have gone up by almost a factor of nine and so on. So there certainly does appear to be some take up in this period of additional technology development or new product development.

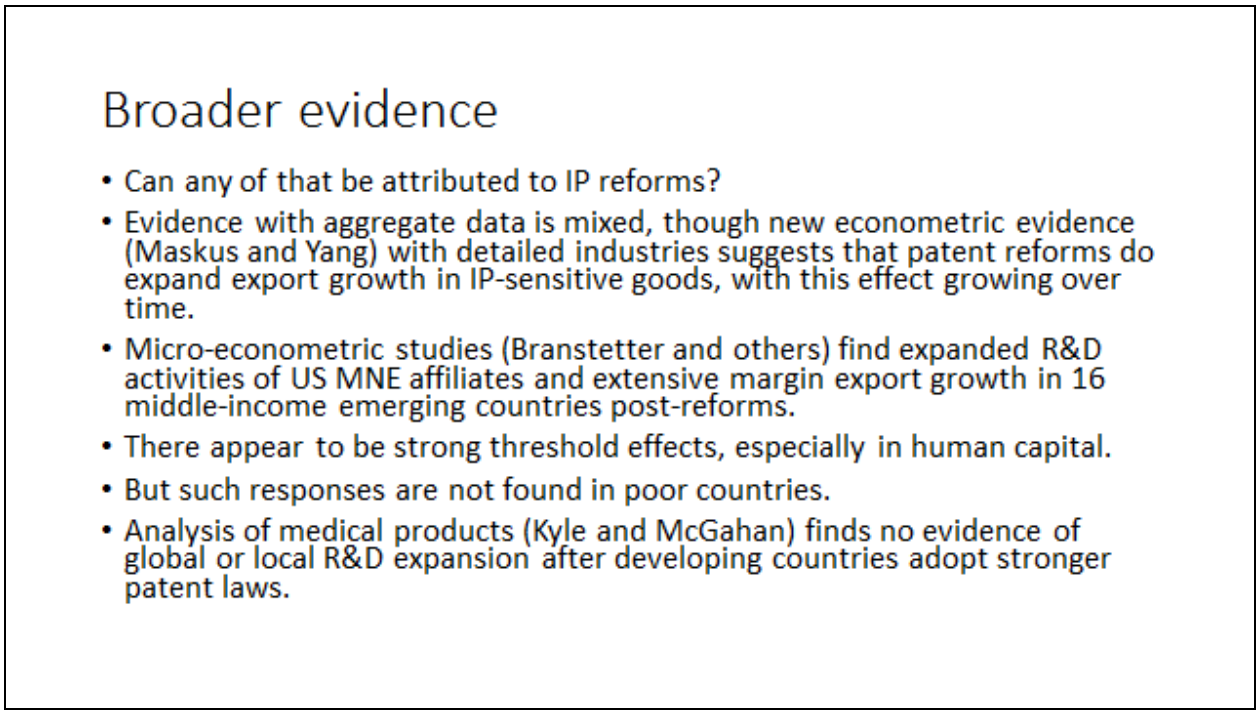
And we observe a relatively fast growth in weighted R&D over GDP ratios in the 2000s. So across 26 developing countries about 3.7 percent per year, those are the poor countries, and that's what I meant by developing countries, not the emerging economies in the prior bullet points, China, 9.5 percent, but all of that in comparison to the developed countries of 1.3 percent per year. So at least in that context you may be observing some convergence mostly in the emerging economies of course.

Can any of this be attributed to IP reforms with or without free trade agreements? Well, I'd say the evidence with aggregated data is mixed. But there is some new economic evidence, another project that I've got going with detailed industries, suggesting that patent reforms can expand export growth in I.P-sensitive goods, with this in fact growing over time.

So if you track through what's been happening in trade in IP-intensive, patent-intensive goods from 1995 to 2010, over that period of time you get a relatively larger expansion of exports in countries that have been reforming their patent laws by relatively more.

Microeconomic studies find that expanded R&D activities do exist in multinational affiliates, and that there's quite an extensive margin -- or a lot of extensive margin export growth in 16 middle income emerging economies. There do appear to be, though, strong threshold effects.

If you're going to get these kinds of stimulative impacts on technology exports and product development, it really only seems to be coming out of economies with a relatively strong base in human capital and some other characteristics that we can talk about. Geography matters, proximity matters, but there's really strong threshold effects, and for those reasons we don't find these responses yet in poor countries.



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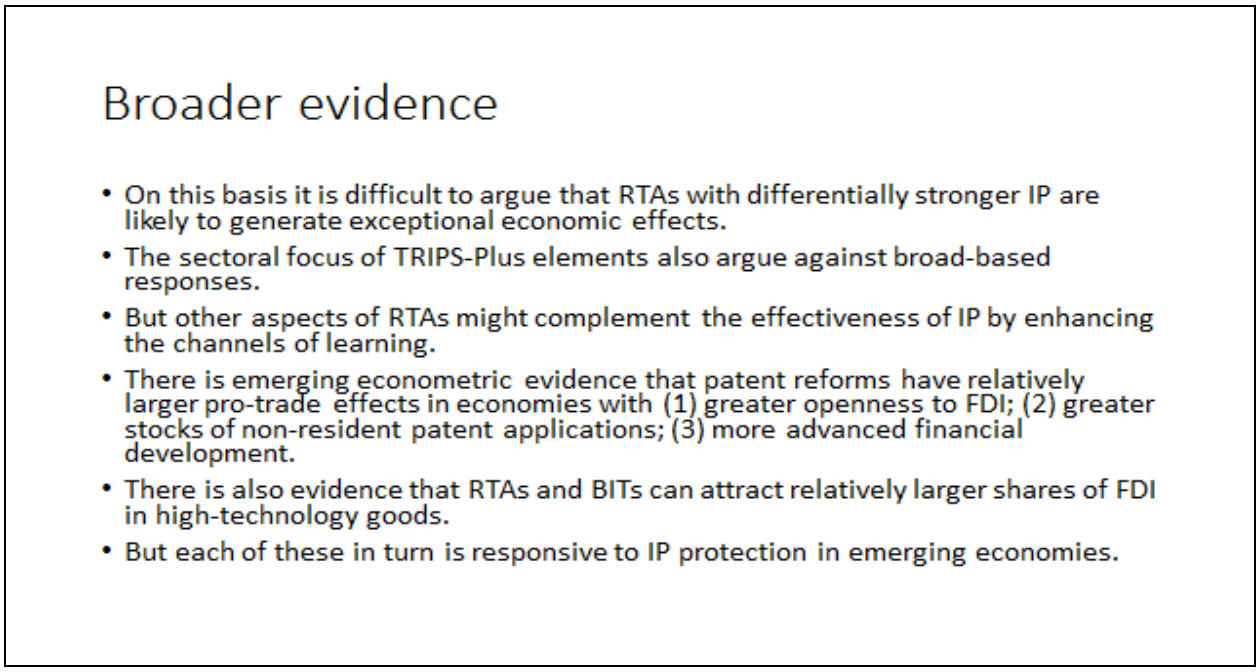
And you may know this paper by Margaret Kyle. There so far doesn't appear to be much evidence at all of an increase in global or local R&D expansion in medical products after developing countries adopt stronger patent laws.

Now, that data could be a little bit dated. But nevertheless, so far we haven't been able to find that. So, on all that basis, it's difficult I think now to argue that trade agreements with differentially stronger IP are likely to generate exceptional economic effects.

Now, don't misunderstand what I'm saying there. RTAs by themselves have very strong economic impacts.

But the argument here is having a somewhat stronger or relatively much stronger IP chapter, as far as the data suggests so far, you don't find much additional impact relative to just a standard RTA. That could very well be because of the sectoral focus of the TRIPS-plus elements focusing on pharmaceuticals and on digital products would suggest you're not likely to find broad based responses.



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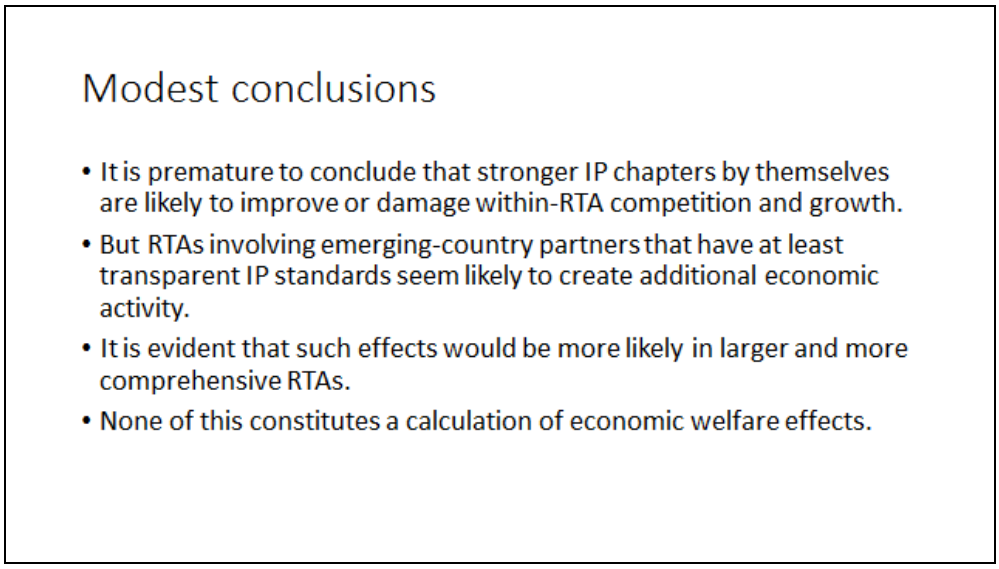
But there are, as I said, other aspects of trade agreements that might complement in the long run, the effectiveness of IP by enhancing the channels of learning. So, just to give you an example of what I mean here, there is emerging economic evidence that patent reforms have relatively larger pro trade effects in economies with greater openness to FDI, greater stocks of nonresident patent applications, and more advanced financial development.

There's really an interesting sort of complementarity between financial development and investment in R&D. And there's also evidence that trade agreements and bilateral investment treaties can attract relatively larger shares of FDI in high technology goods.

So, putting that all together, each of these things in turn is responsive to IP protection in emerging economies we find out from other kinds of studies.

So, some modest conclusions, my last slide here, and a little bit over time.



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It is premature, I think, to conclude that stronger IP chapters by themselves are likely to improve or cause damages within RTA competition and growth. We just don't know yet. But trade agreements involving emerging country partners that have at least transparent IP standards seem likely to create additional economic activity because the RTAs themselves do that, and there is this complementarity effect I was talking about.

It is evident that these effects are much more likely in larger, more comprehensive RTAs. So presumably the TPP, because it is comprehensive and covers a very large element of economic space, will have some, I think, positive impact on IP creation in the region.

But of course you should always keep in mind when you're hearing an economist, that none of this says anything about a calculation of economic welfare effects. This is about partial and general equilibrium and impacts on economic activity. I wouldn't take any of this and conclude from this that trade agreements are necessarily increasing economic welfare. It just depends on the situation.

So, thank you.

BONVILLIAN: Keith, thanks very much for letting this all out.

(APPLAUSE)

And we're going to turn to Tim Simcoe on emerging models of patent ownership.

SIMCOE: Hello. So, thank you to the organizers -- even Keith, I guess, who asked me to speak after him.

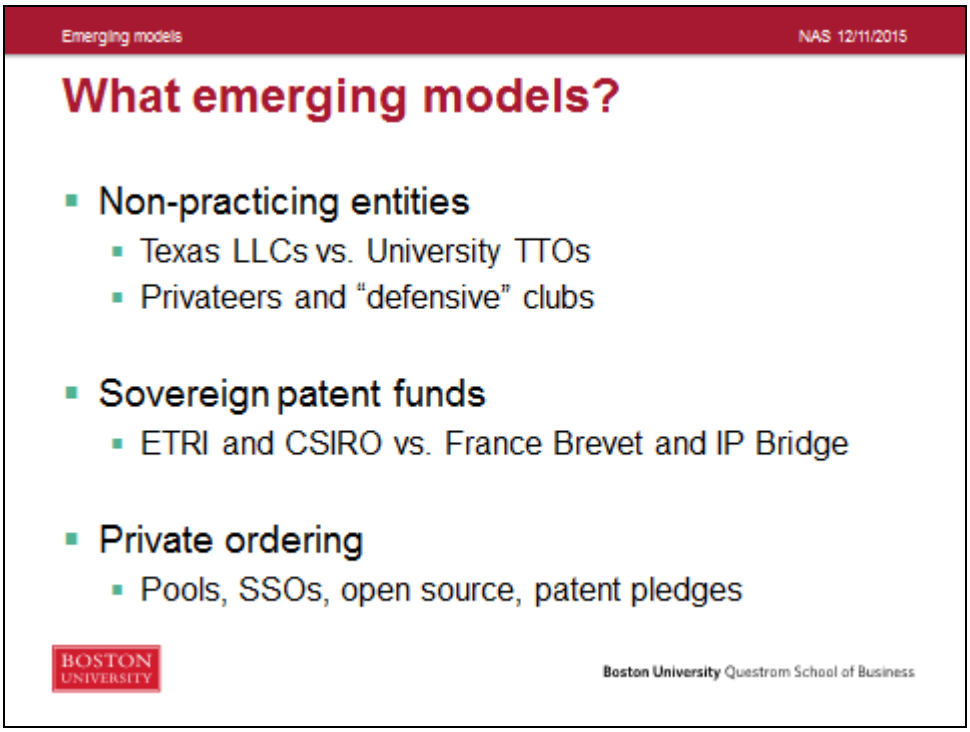
The reason I'm here, I think, is that Keith hit the end of that list of 12 graduate students who knows something about intellectual property and international trade, and began calling people who don't know that much about international trade.

(LAUGHTER)

So, I was asked to talk about emerging models of patent ownership. And let me say two things. This is patents and not intellectual properties. I'll talk mainly about patents and you know, sort of offering less data than I wish. The reasons are that, you know, sort of patents are kind of the lamppost that we're always looking under, and what people tend to talk about, and what I know most about. So I'll focus there.

Less data than I wish because it's often hard to get the data you would wish to have on how markets for intellectual property supported exchange of knowledge assets function. There is not a lot of price data out there, or quantities.

So with those caveats in mind, let's talk about emerging models. So what are emerging models? Let me try to break what I think people are considering emerging models up into three different groups.



Presentation of Timothy Simcoe, 12/11/2015

So the first group are organizations that don't necessarily practice a patent, often don't actually do R&D, but tend to purchase intellectual property rights and assert them. Non-practicing entities is one name, or patent assertion entities is another way people refer to them.

Let me try to make three observations about this group.

The first one, and I'm not the first to observe this, is that the lines between the "bad guys" and things that we're less -- we're more ambivalent about, are often very blurry here. I wouldn't be the first to

ask is my university tech office a troll? I don't know the answer to that, but it's something to keep in mind when thinking about these kinds of organizations.

The second observation is that this category isn't new. There have been folks who buy patents at various points in time domestically going, you know, a long ways back. And historians have written about this.

Probably some of the tactics are new, and, you know, sort of we saw some of the technologies are new, and some of the problems that come up when you're doing licensing of large bundles of technologies may be new.

Last observation about group number one is that at least anecdotally it seems to be mainly a U.S. phenomenon. You can go looking around and try to find debates about NPEs and PAEs and trolls in other countries. And you can find a few examples, but it seems to be a bigger deal here.

I don't think we know why. You might think it's something about the way the Patent Office functions and the types of patents they are giving out. You might think it's something about the way the courts work, and the plaintiff versus defendant system in the U.S., that we are biased relative to other countries. Maybe it's interactions between those two things. Maybe it's just the size of the U.S. market.

OK, second group. Second group are sort of something that I know less about because they're really new, but people are worked up about this. These are sort of -- I've heard them called sovereign patent funds. They're essentially groups that are also in the patent monetization business and they have a public-private dimension to them, right, so that there's some sort of public sector interest in the organization.

Two observations about these -- this group.

One -- the first observation is that, again, the lines are going to be blurry here. So ETRI (the Electronics and Telecommunications Research Institute) and CSIRO (Commonwealth Scientific and Industrial Research Organisation) you know are pretty long established cooperative R&D endeavors. ETRI is a telecoms research institute in Korea. CSIRO is the scientific research institute in Australia.

Both of them have patented things and asserted their patents and collected damages in, I believe in U.S. courts. They fit well in the sort of established ways of thinking about cooperative public-private R&D.

What has people talking are these new groups like France Brevets or IP Bridge, which are a French and Japanese, respectively sort of groups that seem to be less -- doing less R&D, and are also asserting patents. And I think the concern here is that this is part of some kind of protective industrial policy.

I guess my first response to that is that I would think those kinds of concerns might be legitimate. Though, it doesn't seem to me as important to sort of worry about these groups as to worry about direct application of countries' domestic IP and competition law in this space.

So then the third group of emerging models is this whole constellation of activity that I think we've seen mainly in high tech that I'll call private ordering. It includes things like patent pools and standards

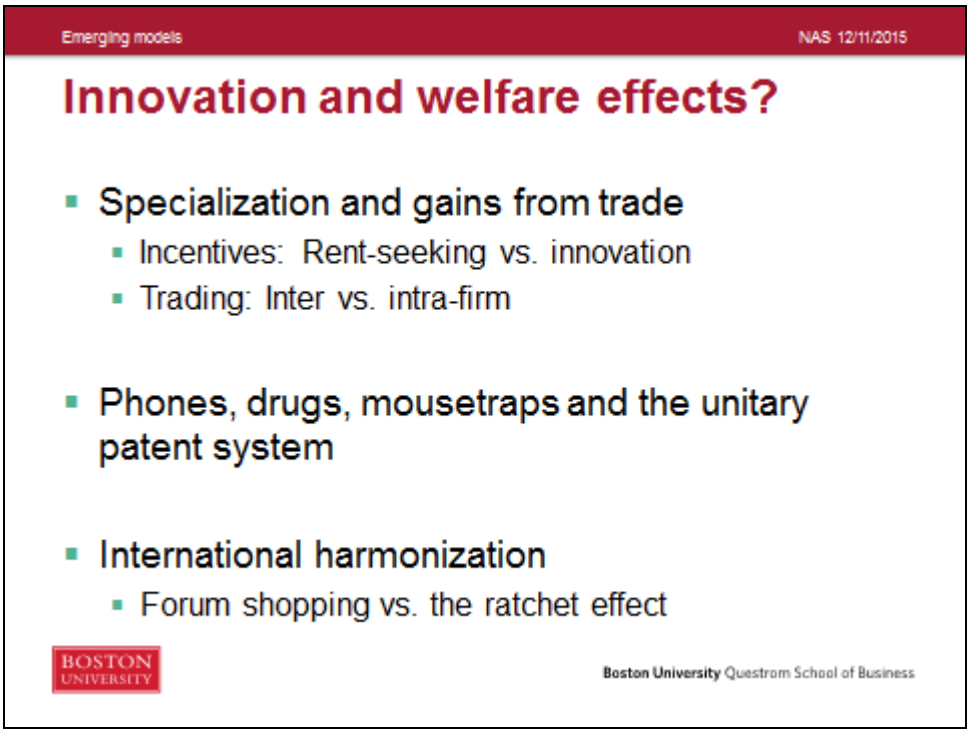
setting organizations and open source software communities and unilateral patent pledges that firms make.

This is all closely related to many things that Katherine Strandburg talked about earlier. These models are about sort of creating freedom to operate for companies, reducing transaction costs, prompting investments in platforms and complementary technologies. It's getting other people to build on my products, which may have IP associated with them.

And so that these kinds of private ordering, they mitigate problems that might otherwise emerge, particularly in complex product industries where there's lots of IPR around a given product. Those problems are things like holdup where someone invests in my platform and then I use my IP to sort of capture the value of their investments, or royalty stacking where the total amount of -- the royalty gets very large just because there are so many patents at the product level.

I think these institutions are useful and work and we should support them. We should also not presume that they work perfectly so that things like royalty stacking and holdup are just not a concern whatsoever.

So they asked me to talk about you know kind of what are the kind of innovation and welfare effects of all of these different emerging models. I guess the first thought I have on that is that -- you know I think this is echoing stuff that you just heard from Keith. We have evidence that there are benefits from the markets for ideas, and we shouldn't condemn vertical specialization.



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There are things that trade economists ought to be familiar with, ideas related to specialization and the gains from trade. So, when we wade into the kind of NPE/PAE debates, I think it's good to keep in mind theories of harm that focus on actions as opposed to actors.

At the same time, you have to say it's also really clear both theoretically and in practice that when you set up a system of government administered monopoly rights there's going to be a certain amount of rent seeking behavior, not entirely through socially productive innovation.

So, one example of that that I think maybe deserves more air time than it's gotten in the conversation about international trade is intra-firm trade and the tax implications. You look at the BEA data and you'll notice that a huge amount of the trade in IP amongst countries where we're talking about U.S. multinational enterprises is intra-firm. Some of it seems to be clearly motivated by tax as opposed to real economic considerations.

When start to get into those questions, I guess the difficult problem is another one that Keith alluded to, which is we don't know how much innovation the patent system actually produces, right? You know, the harder question empirically is the one about what do we get for granting the right in terms of incentives to innovate in the first place, as opposed to do we have better evidence on IP supporting exchange and vertical specialization and gains from trade.

And then people see the system through different lenses. Those of us, like myself, who work in kind of the complex products space will look at things like these private ordering solutions and say wait, I'm seeing companies expend a lot of effort making commitments not to assert their intellectual property. That feels like evidence that we might be able to get as much or more innovation with less patenting.

And then there are my colleagues who work in pharmaceutical and they worry that the rights may not be strong enough, given the big up-front costs and lack of product differentiation.

It's useful to keep in mind that everyone might be right. And that creates tension when you have a unitary system. Very large, practical difficulties when it comes to making or changing policies because it's tough to build coalitions of the phones, the drugs and the mousetraps people for change.

So then let's take that to the sort of international harmonization setting that Keith sort of offered you a more informed discussion of than I can give. I'll just make two observations about kind of harmonization, which seems to be a lot of what our, particularly our multilateral agreements that we're talking about now are going to bring.

My view personally is that we need to be very careful about pushing for international standards that comport with the letter of U.S. law, basically two reasons about that, one that we've hit on. It's there's lots of uncertainty about whether domestic policy is optimal.

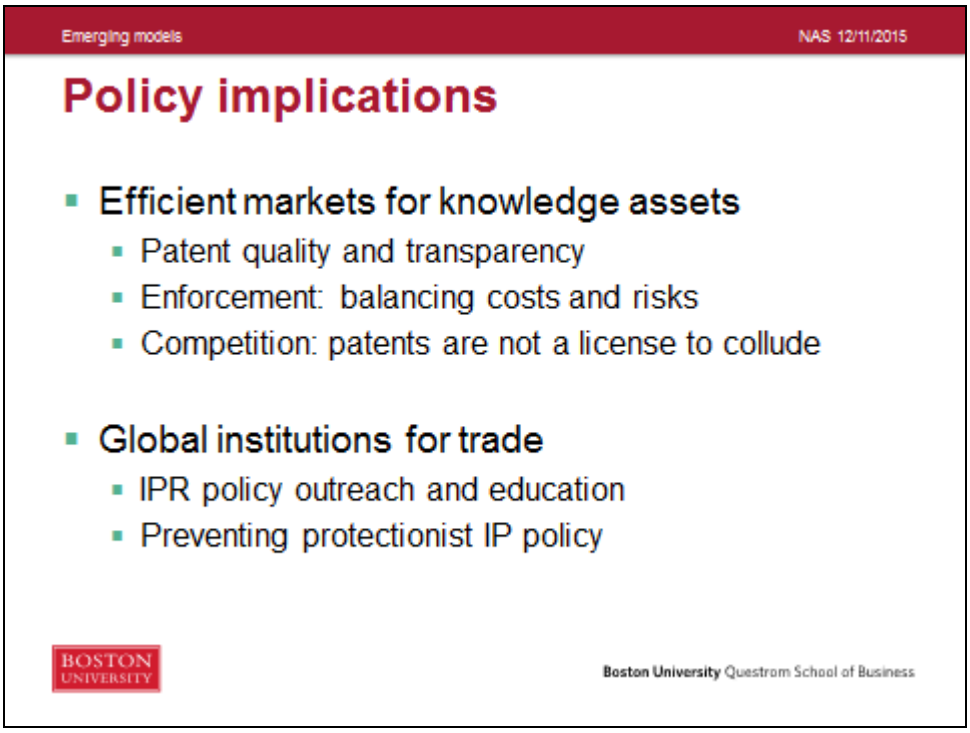
You can get a ratchet effect once we have all these international commitments in place it's hard to undo them. And we might want to undo some aspects of current U.S. policy. And there's option value in that flexibility that gets lost in the discussion about bringing everyone up to our standards.

Secondly, what do we want to impose on our trade partners? My sense is that these emerging models are very complicated and involve lots of tradeoffs that most of the time, at least we hope, our courts and regulatory and other agencies and institutions are able to deal with.

Our trade partners may sometimes lack the institutional capacity for that approach. And so rather than export all of the complexity at once, leaving them some flexibility may be wise from a global social welfare perspective.

OK. So I've tried to describe business model innovation taking place in markets for technology and to present a balanced view of the debates about how this affects innovation and welfare. What do I think are the implications for policy? Let me just offer a couple of remarks on that.

One, I think a useful thing for us to think about, both domestically and in the context of these free trade agreements, is policies for increasing transparency and reducing uncertainty in markets for transferring knowledge assets. This is very broadly construed.



Presentation of Timothy Simcoe, 12/11/2015

So by transparency I mean things both about say the certainty of patents' validity, for example, by improving the prosecution process. Or uncertainty about prices by standardizing within the judicial system ways we're going to approach damages, especially for multi-component, complicated products.

On the enforcement side, I think that many aspects of some of the proposals that are floating around here in Congress about litigation reform have sensible parts to them. I support many aspects of them, particularly around increased transparency of ownership of intellectual property rights and increased transparency in pleadings before courts.

And I also think that we need to be careful around injunctions and exclusion orders when you're dealing with very complicated multi-component products, right. So that changes the bargaining that

happens between a plaintiff and a defendant in a drastic way. And yet, we have some of our institutions for enforcement of intellectual property in the international realm that don't have flexibility to do damages outside of this kind of exclusion.

Lastly, I guess it's important to recognize the role of competition policy. If I put on my preacher hat, I would say patents are a right to exclude, not to collude and competition policy intersects with intellectual property policy in important ways -- this takes us back to the question of is the institutional capacity there within our trading partners to take a nuanced view of that, how those things interact with each other.

And then finally, I think sort of a more vanilla issue, something I hope we can all agree with, is that when we think about the emerging models for owning, commercializing, asserting intellectual property, the debate often gets pretty hot. I think it's important to recognize this issue (which came up in the last session) of how our trade partners view the conversations that's happening here, and what signals do they take away from it.

The right thing to do is to keep recognizing from where we sit the importance of education and outreach. So an example is (regardless of how you personally think about all the litigation that's been going on) a comparison between Apple and Samsung – it looks really different from Cupertino and Seoul.

So when we think that IP is being used as a cover for protectionist industrial policy outside the United States, step one is to explain how we're not doing that.

(LAUGHTER)

And step two is to rely on our international institutions and treaties to seek redress when it's warranted.

So those are my comments. I look forward to the Q&A.

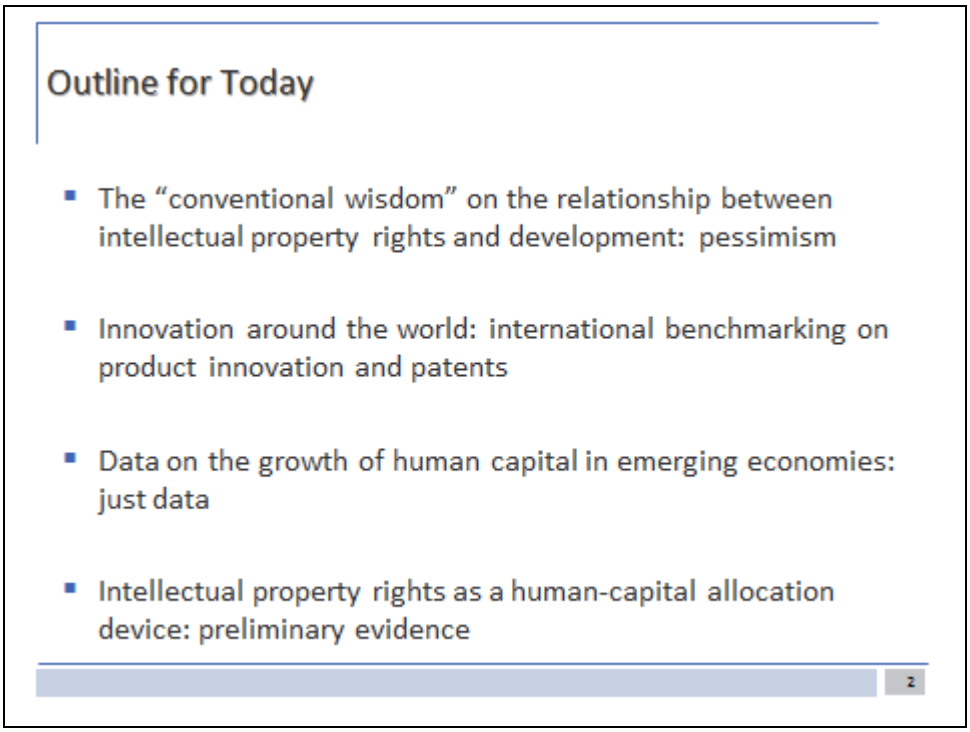
BONVILLIAN: Great. Thanks, Tim.

(APPLAUSE)

And then closing out our panel is Dan Lederman from the World Bank talking about intellectual property rights and global technology markets.

LEDERMAN: Good afternoon, everybody. My name is Dan Lederman, the deputy chief economist for Latin America and the Caribbean. And a lot of what I want to share with you today is going to have a Latin American tinge to it. But I think it's -- I sort of want to narrate to you guys today. I think it's of broader relevance around the developing world.

-- the title, a little bit relative to what's in the conference agenda. Just to highlight what I have in mind.



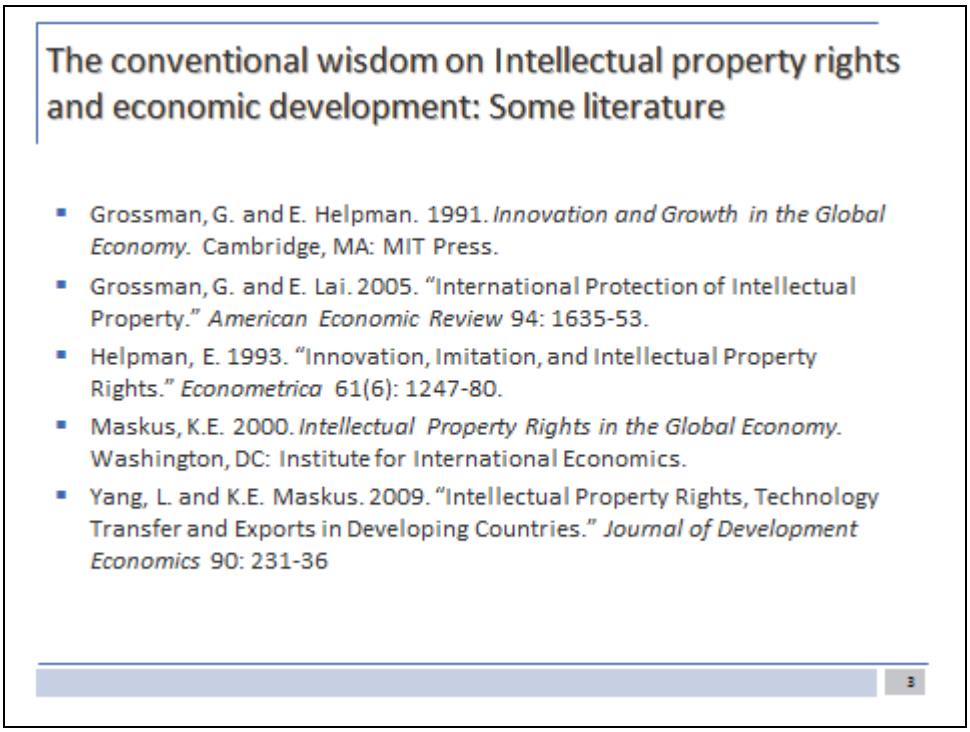
Presentation of Daniel Lederman, 12/11/2015

There's been a tremendous growth in the stock of human capital in the developing world, in emerging markets, middle-income countries, middle to high-income countries. And in my view this -- in our view, this changes a little bit what the role of intellectual property rights plays in economic development.

I think that part of the reason why there's notable and palpable, sometimes, resistance to IP chapter compared to trade agreements or otherwise is because the economics profession, which is very influential in development policy thinking, the conventional wisdom nowadays is one that's pessimistic about the potential development gains from strengthening intellectual property rights in socioeconomic context where the average level of education of the economically active population in people of more than 15 years of age, less than 64, more or less, that if they have five or six years of schooling on average, it is very unlikely that strengthening IPR is going to do anything favorable for that economy.

So I'll talk a little bit about that conventional wisdom and the logic of it. Then I'll talk a little about innovation around the world, doing some empirical international benchmarking on product innovation and patents. Then I'm going to give you some data on growth of human capital in emerging economies, and just going to be just data, though I'll need to explain a little bit.

Then I'm going to share with you some preliminary thoughts. By preliminary I mean tentative, meaning that I am not going to push it to say that I've uncovered sort of a causal effect of how the interaction between intellectual property rights and human capital or education, how it affects national investment in R&D, which is at the core of the narratives that are told by the conventional wisdom.



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So this slide, I just listed a few contributions to the literature. Keith has played an important role and intellectual role in pushing this literature forward. But I still feel that the conventional wisdom on intellectual property rights and economic development is pessimistic.

In my slides, I have the notes. For each one of these bullet points, I have sort of the punch line, single two sentences of my interpretation of what's the takeaway message from each one of these -- of each of these contributions to the literature. But let me take a couple minutes just to give you the intuition of how economists have been thinking about it.

So, economists think of -- economists are straight with each other, and specializing in a product mix that is consistent with a country's endowment characteristics. Usually innovation's modeled as a process through which human capital, highly educated individuals interact with investors or physical capital to create industries that are sort of "high tech." And there are some market failures in the process that for any given economy, the private investment in R&D would be suboptimal.

If you just view it as, from the point of view of say an economy such as the United States, because you can invest a lot of money in R&D, create a new product. And if people can reverse engineer that product, then you have paid all for the science for the knowledge of how to create for the idea, for the commercial idea. And then you'll have imitators that will chop away at your profits and you won't be able to recover some cost of investment.

So usually in the developed world, there's all sorts of public policy interventions, including the IPR regime, but including tax incentives or R&D subsidies that are -- take different forms, including defense expenditures. So there's a justification for this involvement.

But economies view this as a process that occurs mainly in countries that are well endowed in both human capital and money, in physical capital. And that creates a pattern of specialization production and international trade whereby the north or the rich countries would have a comparative advantage introducing these types of products that use a lot of R&D.

And the developing world in this type of stylized world would introduce products. In exchange, they would have to sell some other products in the world, but it's usually considered to be low tech, commodities and things like that.

I do not believe for a second that the oil industry or the mining industry's low tech. I mean, I think that that's just a figment of our imagination. But this is how the economists think about it.

And so any strengthening or attempt at "harmonizing" intellectual property rights between the rich north and the poorer south will lead to a worsening of what economists call in terms of trade because if you strengthen property protections, intellectual property protection in the south, then people who want to consume new pharmaceutical products or new machinery, they're going to have to pay not only the marginal cost of purchasing that drug or that machinery, but they're going to have to pay the rents that are embedded in patents.

So this would be reflected in the trade balance where all of a sudden, the price of the imports of the poor developing nations would worsen. This is the conclusion in most of the theories in Gene Grossman and Elhanan Helpman's book, in Gene's highly cited paper in the American Economic Review and Elhanan Helpman's Econometrica paper, very influential publications. This is essentially the bottom line.

Any attempt at harmonizing IPR institutions between rich countries and -- and poor countries will lead to a deterioration of the terms of trade that goes against the interest of the poor. And my feeling is that in spite of thoughtful research by Keith and his graduate students, this is the reigning conventional wisdom.

So, when you hear -- if you were to talk to Joe Stiglitz or even Paul Krugman, their kneejerk reaction as Nobel Prize winning economists who are not necessarily experts in this field, but are readers of these papers, they automatically tell you that they believe that TPP's a bad deal for Vietnam, Malaysia, Mexico, Peru and Chile because of the concern that they were -- are going to experience a worsening of the terms of trade by tightening intellectual property protection simultaneously with bringing up the standards of IPRs in the poor south to the standards of the north.

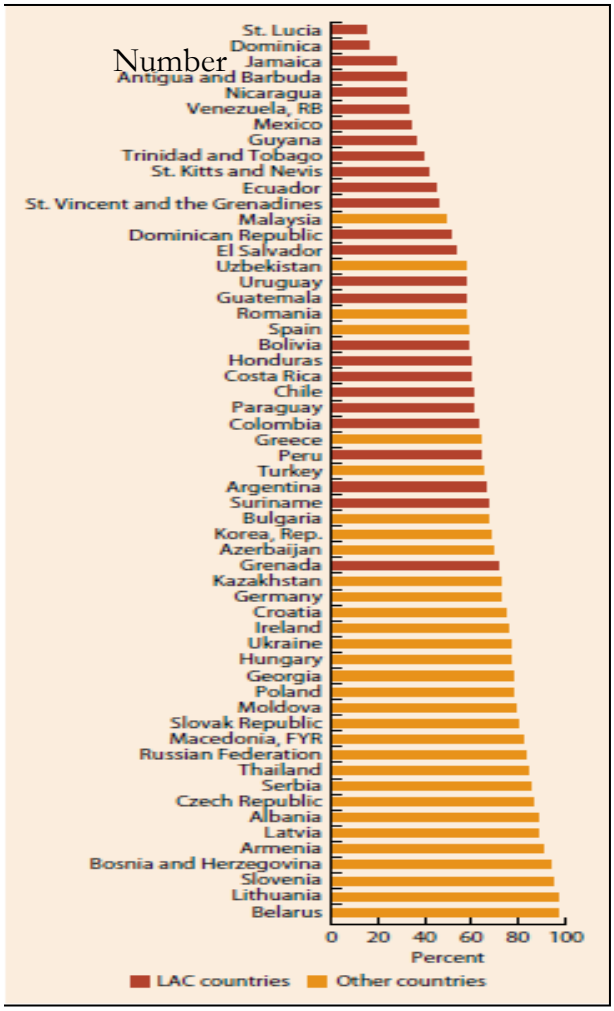
So that's sort of the mindset. I think it's important to keep in mind, and it's backed by a lot of very thoughtful academic, scientific work as far as economics can be scientific.

So it's not just a kneejerk reaction of special interest groups or a sense of economic imperially -- ideological to economic imperialism or anything like that. This is what graduate students in the top schools in the north are teaching.

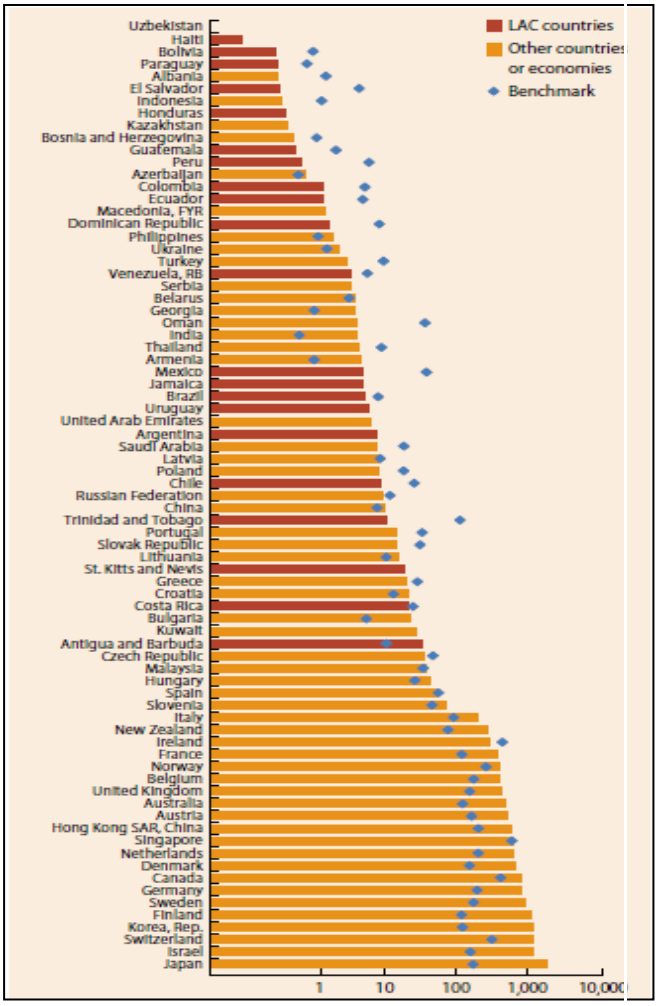
Now, let me show you some graphs and recent work that we've done. These graphs show the results from a series of enterprise surveys in the formal manufacturing industries in over 80 countries around the world. It's the World Bank's Enterprise Survey data.

Product Innovation and patent production around the World: International benchmarking

Percentage of firms introducing a new product



Number of patents per 1 million people



Source: World Bank, based on data from World Development Indicators, Seker 2013 and 2006 – 10 enterprise surveys, and USPTO 2012

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And here we plot the share of firms in that sample, formal manufacturing enterprises of at least 10 workers. These are big enterprises for developing country standards that report of having introduced new products. So this is sort of a product development proxy for innovation.

And the red bars are the Latin American and Caribbean countries. We've used this publication, which is called Latin American Entrepreneurs: Many Firms but Little Innovation, to make the point that Latin American and Caribbean firms, even the formal firms seem to underperform relative to other formal firms in other parts of the world.

So -- and then on the right, we've used the USPTO patent data. And the bars plot the number of patents per one million people as filed in the U.S. patent jurisdiction. And the little dots are what an economic model tells us would be the norm for the different countries depending on their level of development and exposure through exports to the U.S. market.

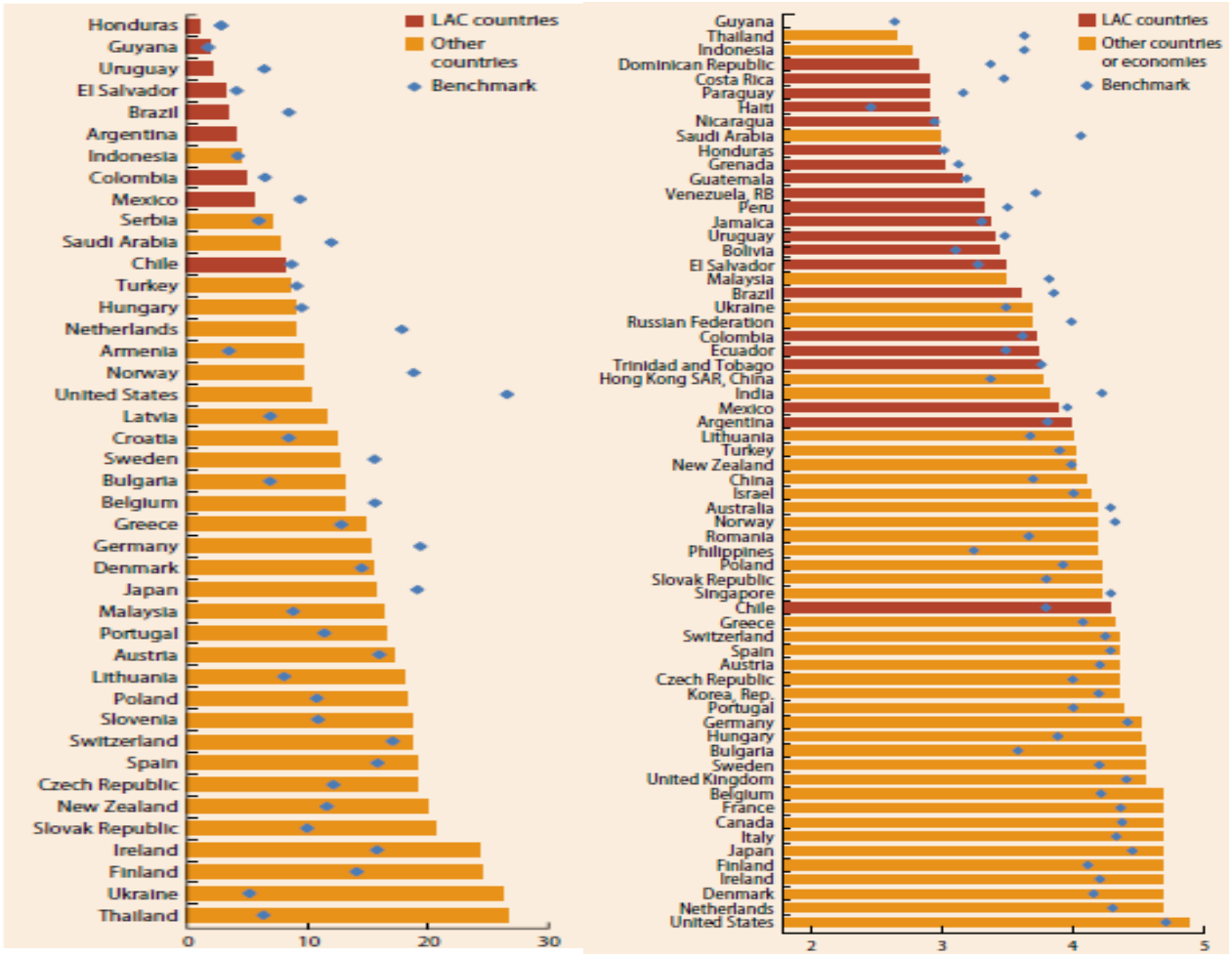
And you can see we're making some arguments here that a lot of Latin American countries, the dots are above the bar, which means that they have sort of a deficit. Given their level of development, the economic size, and importance of the U.S. market, they tend to underperform.

However, there's some countries such as Chile -- or very small countries that don't fit the pattern. But by and large, these tend to be richer countries and these tend to be poorer countries. And that's why you need to benchmark. But there's a lot of room there of innovation deficits in developing countries, even taking into account their economic characteristics.

Now, in terms of -- later on I'm going to show you -- I'm going to make an argument, empirical argument that there's an interaction between human capital and the institutions that protecting the intellectual property rights that yield effort in terms of R&D, which then presumably produces growth and patent as an intermediate outcome variable.

Product Innovation and patent production around the World: International benchmarking

Engineering Grads per thousand people, ages 15-24 Index of IPR, 2005



Source: World Bank, based on data from World Development Indicators, UNESCO 2013, and Park 2008

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And so we'll also be noticing that there -- I mean, in my country of Chile, for example, we produce lots of lawyers, lots of doctors in the best schools, which are public in Chile, the best schools there are. And we have sort of a dearth of engineers.

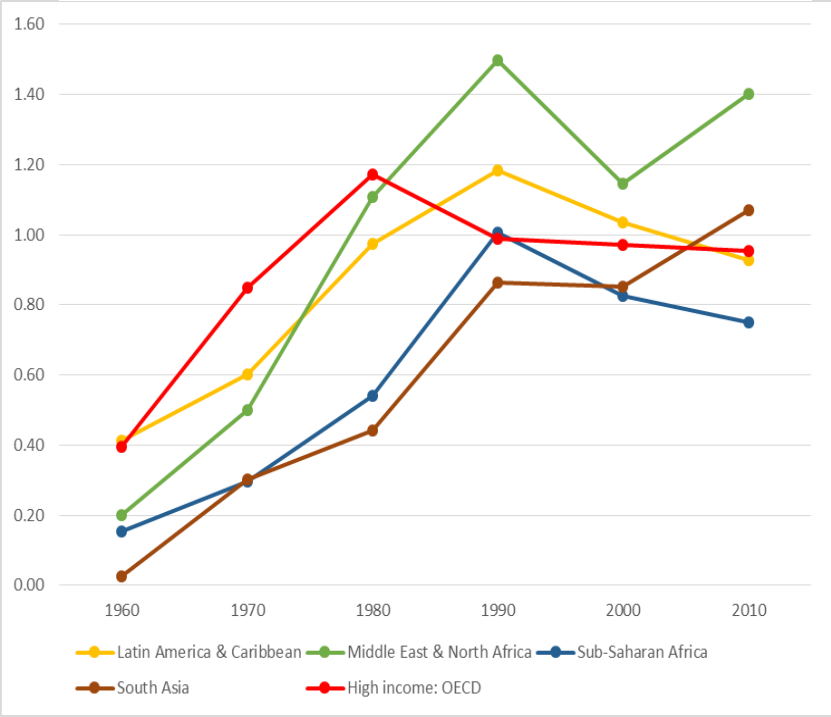
So later on, as I show you how the big push in education in the emerging market has progressed, that doesn't mean that we don't have sort of a quality issue with types of -- the type of education we're

providing our students. Though that itself, how many students choose to be scientists or engineers is itself, in my view, a result of the fact that maybe intellectual property protection is not sufficiently high.

So this is the data on the education push in developing countries.

Education push in the developing world: The rising years of schooling in emerging economies

10-year changes in average years of schooling



-Steady increases in average years of education across the developing world since the 1950s

-Regions such as Latin America & Caribbean & Middle East & North Africa have outpaced high-income OECD countries in improvements in educational attainment over the past 20 years

Source: Barro-Lee Educational Attainment Dataset

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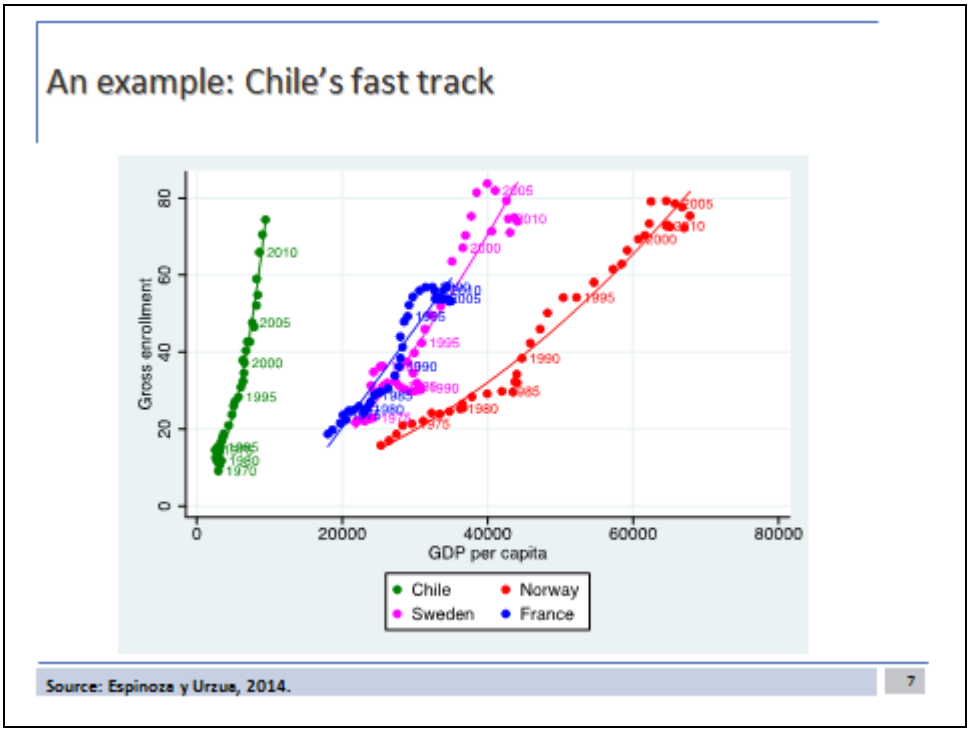
So here, I'm plotting 10-year changes in actually the -- in average years of schooling of each country. And what I'm plotting here is the median change. So the typical country belonging to the Latin American/Caribbean region to Middle East and North Africa, Sub-Saharan Africa, South Asia and East Asia, and the high-income countries of the OECD where the U.S. stands.

So from decade to decade, this is the change in the average years of schooling for the typical country in each category. As you can see that over time in the Middle East, in Latin America and in South Asia, the change in the average years of schooling between decades for the typical country -- so this hides the high performers -- are now expanding the average years of schooling of the typical developing country growing at a faster rate in the more recent years than the high-income countries.

And this sort of makes sense as you can only stay in school for so long, though I did my best to stay for more than I should perhaps. But there's been tremendous catch-up.

And this, by the way, the stock of human capital in economic parlance, meaning that to get this result of the -- of improvement in the averages of schooling in the working age population means that the effort in terms of expanding coverage of education at the primary level, secondary level and the university level has gone much faster. It will take a few more years to see the stocks rise.

So let me show you just an example of Chile's fast track.



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So here we're plotting GDP per capita in comparable currency units compared to Norway, France and Sweden, and then the gross enrollment rates. So this is the share of the population that is enrolled in school divided by the number of people who are of schooling age.

And it's called the gross enrollment rate because sometimes you have adults that have gone back to school. So you could presumably have more than 100 percent in gross enrollment rates in any given country.

Look at this slope. It's almost like a straight line up over time. So in the year 2000 Chile's gross enrollment rate was about 38 percent. By 2010 it had almost doubled. And by 2012, it's at 70 percent.

Like this is reaching levels of some of the most advanced natural resource rich economies in the world such as Norway and Sweden, and then we have France. In fact we're -- we've passed France in terms of enrollment rates.

And that's why in Chile -- in a country such as Chile the stock -- the average years of schooling of the labor force in the years ahead is going to look like the United States. And it's going to look like Germany. And it's going to look perhaps even better than France. It takes some time because these are the enrollment rates.

So this happened very quickly. And if you look at these lines, in the advanced countries they also had this historical progress in terms of coverage. But it occurred relative to the process of development much more slowly.

So Chile has expanded its coverage of education, producing more and more highly educated workers. But its level of average income per capita has not expanded at the same rate that we saw historically in the advanced economies.

And here I come to the extent of the evidence that in the developing world today, especially in the emerging markets of economies that have GDP per capita in dollar terms adjusted for price differences, close to $20,000 or higher per year.

The time might have come for developing country emerging policy market makers to reassess the conventional wisdom because it's -- Chile's not the same emerging developing country than it was 15 or 20 years ago. It's a much, much more highly educated yet not as rich as it should be yet.

But this means that there's an issue of where all of these university graduates, what are they going to -- what are they going to choose to do? There's only so many lawyers that we can pay. Though sometimes I feel that the IPR chapters of some of the credit agreements will help employ them as well.

IPRs as a human-capital allocation device: Some evidence on the Determinants of R&D.

	No FE	FE	RE	FE&TE	RE&TE
Average Years of Schooling (H)	-0.147	-0.143	-0.151	-0.195	-0.152
	[0.060]*	[0.144]	[0.039]**	[0.105]	[0.045]**
Intellectual Property Rights (IPR) Index	0.095	0.064	0.153	0.079	0.156
	[0.671]	[0.856]	[0.514]	[0.825]	[0.512]
Schooling Squared	-0.003	0.010	0.008	0.013	0.008
	[0.663]	[0.154]	[0.162]	[0.102]	[0.184]
IPR Squared	-0.111	-0.085	-0.101	-0.073	-0.090
	[0.056]*	[0.175]	[0.051]*	[0.258]	[0.088]*
Schooling*IPR	0.127	0.074	0.086	0.064	0.080
	[0.000]***	[0.020]**	[0.002]***	[0.053]*	[0.005]***

Specification Test	No FE	FE	RE	FE&TE	RE&TE
Linearity Test: P-Value	0.000	0.007	0.000	0.007	0.000
Separability Test: P-Value	0.000	0.261	0.016	0.315	0.014
FE=RE: P-Value		0.348		0.991	

-Interactions between human capital and IPRs determine global patterns of R&D activities
-Share of R&D in GDP is a non-linear function of IPRs and human capital
-The existence of strong IPRs provides incentives for the allocation of human capital into R&D

Source: Bravo-Ortega, C. and D. Lederman. 2010. "Intellectual Property Rights, Human Capital and the Incidence of R&D Expenditures." World Bank Policy Research Working Paper No. 5217, Washington, DC

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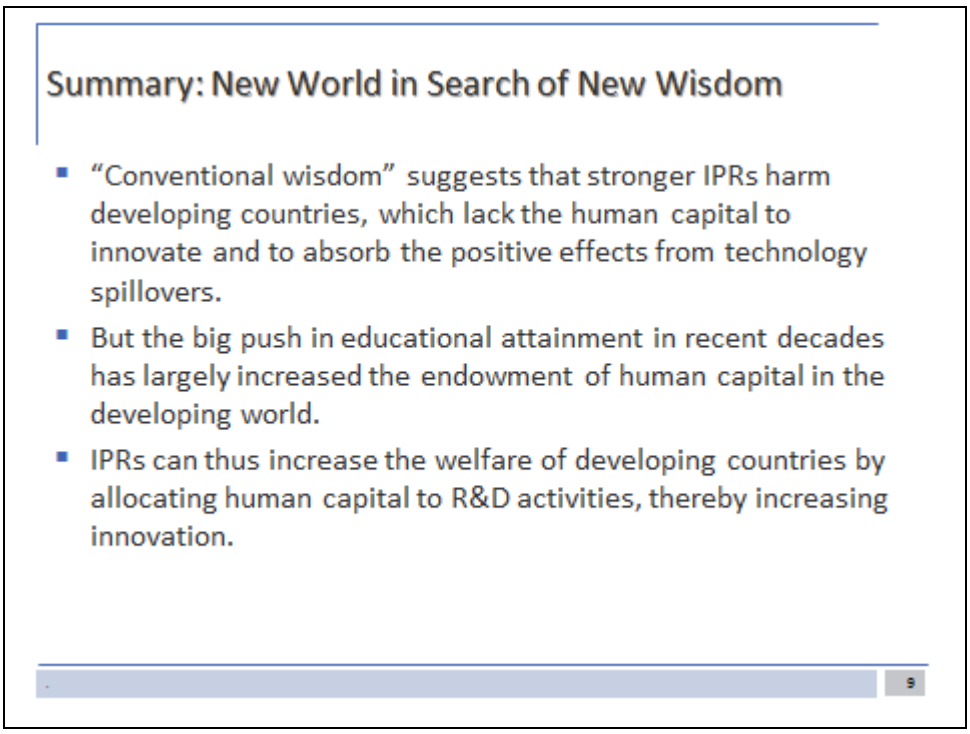
But the point here is that with different specifications of a model that's motivated by structural model, we get very strong interactions between the years of schooling of the labor force and level of protection of intellectual property rights. Here I'm using the Ginarte-Park Index that I can tell you more about.

But regardless of the specification, because these are different regression model results, roughly speaking what this is saying that increasing the -- say the coverage patent protection to all sectors will lead to a higher rate of return for each year's schooling of the population in terms of R&D efforts.

So the -- remember the conventional wisdom, which is that innovation is a result of human capital, mixing in with money, to create inventions. But then the state or the public sector protects in order to solve a market failure of some optimal private sector investment without the government intervention. And that this happens mostly in advanced countries that have both the money as well as the human capital.

My argument is that we're pretty much close to having many, many emerging markets having caught up in terms of the human capital accumulation. And we can begin to see or interpret intellectual property rights as a human capital labor allocation device where people just beginning to graduate as engineers or scientists or whatever it is, computer scientists from our top universities.

What are they going to do in the labor market? Are they going to go and try to be a manager of an enterprise? They're going to try to be lawyers, try to be doctors, try to be dentists? Or are they going to dedicate their lives to research.



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And that's what we were trying to get in. And when interpreting this empirical evidence is saying that the result that with the rising human capital in the developing world that IPRs will tend to play a more important role in terms of allocating this newly branded highly level human capital and entice our talent to dedicate their life to research and to the production of high technology, commercially valuable innovation processes.

So, we believe that the time is right for reassessment of the conventional wisdom. The big push in educational attainment in recent decades has largely increased our endowment in the developing world of human capital that could possibly be dedicated to R&D.

But because of lack of protections or incentives to go into the R&D sector, we still haven't experienced the big rise in R&D. And so IPRs could hopefully be seen as a device to nudge the brand new graduates from our top universities into a life of innovation.

Thank you very much.

(APPLAUSE)

Q: Thank you very much and congratulations to the panel, and I appreciated such a great conversation. I'm Patrick Kilbride from the U.S. Chamber of Commerce.

And you know, if you'll indulge a comment in response to some of the remarks, I think a couple of the speakers here and on previous panels have looked at trade agreements in force and the scope of the IPR chapters and concluded that countries over time have strengthened their I.P. systems through trade agreements.

And I would just gently challenge that assumption because I think as you look at the expanded chapters in some of these trade agreements, you've got more definition, more exceptions and limitations, but not really a lot in the way of stronger practical impacts on I.P. What I think is a much more important determinant to look at is the political commitment to intellectual property.

As an example, you point to U.S. trade agreements with Chile and Singapore. They're essentially the same chapters implemented at the same time. But Singapore has made a strong political commitment and investment in strengthening its I.P system where as Chile, if you forgive me for saying so, I think there's been a more resistance to strength in intellectual property.

And so I think you've seen a big difference over time in how those two countries have been able to attract investment from innovative industries which rose faster than the domestic environment for innovation. So I just wanted to suggest that maybe it would be a mistake to draw too many conclusions from the scope of the I.P. chapter in some of these agreements.

BONVILLIAN: Keith, do you want to respond to that?

MASKUS: Well, I'll tell you, I have a lot of sympathy for that because it's really quite challenging to read these things and say well that one's a three and this one's a two. In terms of the nature of the scope of those agreements and what they actually mean.

So you're right. You know a lot of people have written about Singapore as an economy that has attracted so much in the way of technology development and now is developing its own technology in important ways.

I think surely that's associated with some strong commitment to intellectual property, but also to their openness to having foreign direct investment come in, having educated workers come in. So there is lots to be said there.

I don't know if I would at this point be willing to make a strong claim about which way that causation really goes. But it's worthwhile, and I agree with you. It doesn't make a lot of sense to do something like count the number of paragraphs in these chapters and say that that's a definitive statement about whether there's an increase in these protection standards or not.

But having said that, I mean if you read them, the expectation about the scope of pharmaceutical protection is just secularly increasing these agreements. There's not much doubt about that.

BONVILLIAN: Question here?

Q: Hi. Stephen Ezell from the Information Technology and Innovation Foundation.

So, as I understand, the 2012 OECD report by Cavazos Cepeda, Lippoldt and Senft called Policy Complements to Strengthening IPR Rights in Developing Countries, it found that a 1 percent increase in patent rights as determined by the Park Index that there are statistically significant increases in levels of domestic R&D, inbound FDI, exports to developing countries and economic growth.

That seems to suggest to me that stronger IPR rights in developing countries, whether a reaction from trade agreements or just domestic policy, does in fact lead to better economic outcomes for those countries.

So is that really not the conventional wisdom any longer? Have we lost that sense? Or is there something wrong with this research from these OCDIs?

BONVILLIAN: Dan, I think that's all yours.

LEDERMAN: Yes.

Academics in the north are very picky with what they consider to be a credible identification strategy empirically to identify a causal effect. And I doubt it that Joe Stiglitz or Paul Krugman would look at the summations of Doug Lippoldt and his colleagues as having a causal effect.

My concern about that study is that the specification of the model, I mean just to use jargon, is not -- does not closely follow a theory. And so there's a lot of controls there. And it could be that in a global sample of countries there's an average effect of marginal improvement in the Ginarte-Park Index being associated with higher R&D effort. But that doesn't mean that every developing country would in the sample have that positive effect. OK?

And what we were trying to do in our 2010 paper is to show that statistically speaking you cannot separate the effect of IPR loss in policies on R&D from the level of human capital. And it sort of makes sense to me, given the whole trajectory of the literature itself, though I'm much more optimistic about the role of IPRs in the developing world than most economists.

I mean, I don't claim to be part of the mainstream in this particular issue. My argument is rather the developing world of today is very different than it was 15 years ago, and we need to update that. And maybe Doug's work with the OECD is a good study point for me, but it's not the way that the true academics would view it.

BONVILLIAN: Keith has thoughts on this as well.

Keith?

MASKUS: Well, since Dan raised the issue of conventional wisdom, let me try to put some perspective on that.

The way economists, especially economic theorists treat intellectual property is they develop a very complicated, generally global model of something. And then the IP system is represented by one

parameter and one equation, and if you change it that's supposed to give you a one unit directional impact on something.

And very few of those economists, none of them, including Stiglitz, and I've talked to him about this, ever actually read intellectual property laws or agreements. They don't know the difference between trademark and a copyright and a patent. To them it's just all -- you know, imitation cost goes up, innovation cost goes up, the effect of that is to reduce innovation, the global economy slows down.

Well, I at least, and I think Dan as well, have sort of – I am no Nobel Prize winner, never will be. But I've taken that view on very squarely myself by saying look, there are lots of things that intellectual property rights are supposed to accomplish.

And I think when you read what these laws are about and how they work and think more carefully about the incentive effects of what a patent regime does, you actually can make arguments that maybe that's the wrong parameter in your equation, that maybe what it does is reduce the cost of contracting and raising the certainty of investment. You get more technology transfer.

That's the kind of thing that I think is the more appropriate way to look at it. And if there's a conventional wisdom, the Nobel Prize winners are opposed, everybody else thinks it's probably true – but it all depends on circumstances and can be a good thing.

BONVILLIAN: How about a question for -- Rochelle, I want to recognize you also.

Q: Thank you.

So my question...

BONVILLIAN: Rochelle Dreyfuss, who has been a member of the planning committee and teaches at NYU's law school.

Q: So my question's to you, Daniel.

How do you segregate local effects? People are educated locally. They are trained locally. They work locally. Accordingly, local rules promoting access would be very helpful to them. Since producers' incentives are global, local rules that favor access over proprietary concerns would not significantly interfere with incentives for locals to innovate for world markets. You don't need intellectual product in Chile to create incentives to innovate. So, your point didn't quite make complete sense to me.

LEDERMAN: So, if I may rephrase, the argument is that there's no de facto global intellectual property regime and each market itself has its own regime, and so actually an innovator should not necessarily care that much if its own market is not protected because you can export.

Now, the issue with that is in the real world of development there is two things do matter. One is branding, that you see that a lot of our most highly educated scientists and engineers end up in the north because they can actually have a life doing research that might pay off. So we have a lot of -- we put a lot of public taxpayer money in educating.

We have very good universities around the developing world. And our star scientists go to MIT, get a PhD and they never come back. I wonder if the brain drain issue would be different if we had more incentives for commercial innovation in Chile.

Embedded in your argument there's also an issue that's also in the conventional wisdom in the academic literature, which has to do with market size. So if I'm in St. Lucia, it's never going to matter how strongly the intellectual property rights are in St. Lucia because the value of that patent for 10,000 consumers is very little.

You could argue that 18 million people in Chile, it doesn't matter that much. But then it begins to matter a little bit, right. Mexico, Malaysia, now we're talking about big markets. India, China, we're talking about big markets, right?

So I didn't talk a little bit -- I didn't talk about big markets. But I don't buy the implicit argument that it's -- that because of the IT revolution and the big freight boats around the world that distance doesn't matter. I can create something here and send it anywhere I want. I just don't think that that's the way that international commerce works.

Q: (OFF MIKE) – small economies who created a different kind of IP right knowing that they're small. So Canada has better research exemptions because the Canadian market is not as big as the U.S. market. So they're really selling to the U.S. anyway. So why not have a better environment to do research? You see the link?

BONVILLIAN: Yes. So I want to work in Tim's work on different models for patent ownership into this kind of broader conversation.

So who's got something for Tim? Right over there, Steve?

Q: Yes. Steve Merrill, Duke.

Given that the administration of intellectual property systems is not just a matter for generalist lawyers, but requires high level technical talent, that's especially true of patent systems. But with digitization it's true of copyright and trade secret as well.

Does anyone see any tradeoff of concern for developing countries in absorbing high level technical talent in I.P administrations versus say research or some other activity related to innovation? Does the World Bank? Or are the numbers so small?

I'm not suggesting that we should abandon pressures to upgrade the IP systems around the world, but maybe we should put more emphasis on regional arrangements than national ones.

BONVILLIAN: Tim, do you want to try and tackle that? I know it's right in the territory you were thinking about, but...

(LAUGHTER)

SIMCOE: I vehemently agree with the premise of the question. And it was implicit in the tail end of my remarks where I sort of talked about the importance of education and outreach.

Now it's -- I think Stephen is asking about do we have any good information about you know kind of how binding is the constraint with respect to human capital that might flow into the IP management system versus whatever other part of this developing economy. I'm not aware of it. And I'll punt it right back to my coconspirators.

BONVILLIAN: Keith?

MASKUS: I'm sure it's an issue. I don't know of anybody that studied it. Do you?

LEDERMAN: No. But I am doubtful that there -- that that's a big binding constraint, the lack of say experts in the management of the IP regime.

I mean, a country like Brazil has government size that's, in terms of expenditures, 45 percent of GDP. It's an economy of 160 million people. You find it hard to believe it produces hundreds of thousands of engineers per year. And lawyers you know I don't even count.

I just find it hard to believe that there be economies of scale issues of not having enough potential human capital, but could be trained to manage an IP system. We do pretty well in regulating banks, financial markets. And I just don't believe that it's a big problem.

BONVILLIAN: So, Keith's got a rejoinder too.

MASKUS: I could say one more thing briefly, just a practical observation from the days when I was traipsing around poor countries trying to understand how their systems worked or didn't work.

One of the big restraints on actually the registration and use of intellectual property in many poor countries was the patent attorney bar simply was very expensive and wasn't interested in increasing the business of patenting. And so I think if you actually transferred out institutions from that kind of control into engineering and sort of scientific control it might be better in some general equilibrium sense.

BONVILLIAN: We got one for Tim? I'll let you have the last one. Go ahead.

Q: So, I think it could go to Tim. So it's the flipside of Steve's question. And this is a problem for the U.S. as well.

Look, getting good human capital into our I.P examination system is a real challenge. And so how are -- and I don't imagine it's any better in developing countries to get really good human capital into the patent examination system. I know it's a huge problem for the U.S.

So you know, how do you imagine doing this?

LEDERMAN: So I just don't think it's an issue of raw numbers that we don't produce. I think it's an issue of training. And if we modernize the system it will be easier to attract the talent. But I just don't believe that it's an issue of not having enough quantity of people who could potentially be useful. I mean, you could also recruit internationally.

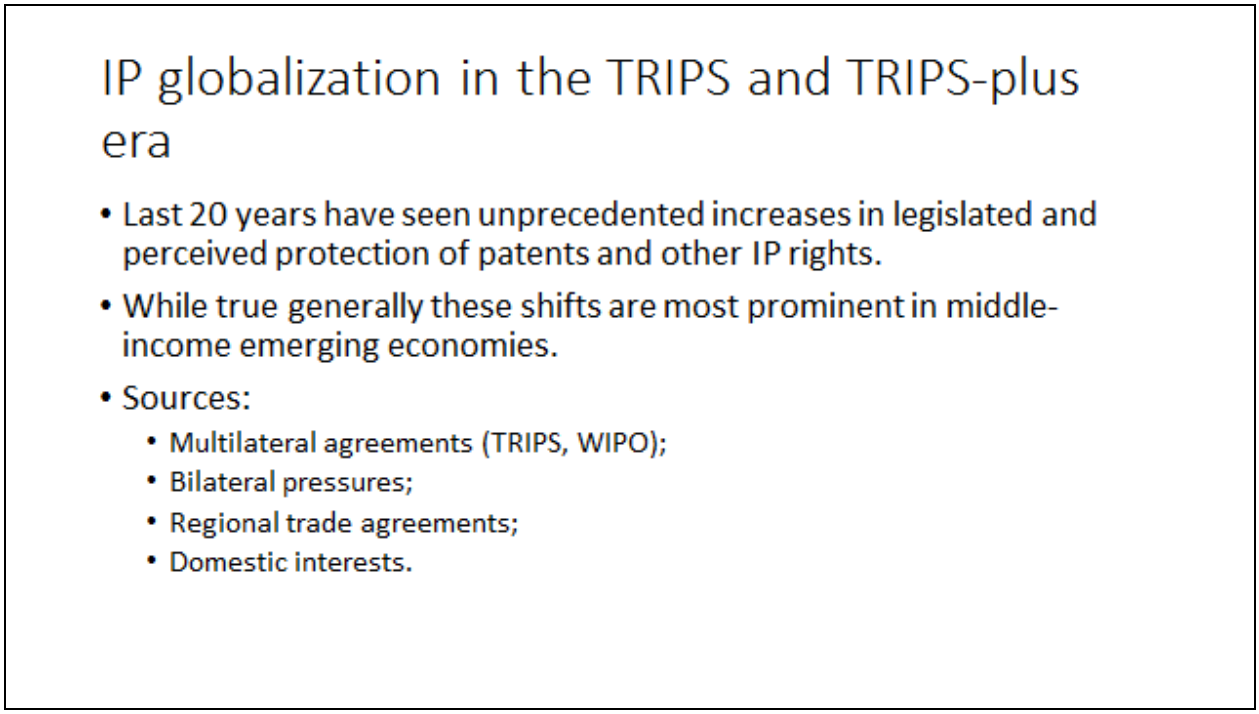
I mean I just don't think it's an issue of numbers. It might be an issue of incentives and loss and how much we pay our public servants to do that kind of work when you could just move to the United States and have that expertise and work in a technology company.

But so it's not an issue of numbers. It's an issue of incentives. It might be an issue of training and quality. But I just don't think it's an issue of not having enough people.

BONVILLIAN: Question over here.

Q: So, Tim, in your presentation you mentioned standard setting organizations and a number of other ways in which companies commit not to create risks for their potential customers or people who are going to build on their products. And that's especially important in complex product markets.

Keith had one bullet in his slide which intrigued me. And it was the increase in intellectual property rights embedded in international standards, if I understood what you were alluding to.



Presentation of Keith Maskus, 12/11/2015

And I'd be interested to hear you two talk about those things because it just strikes me that in terms of -- it's hard enough in a domestic context to make that work. How much harder is it in an international context?

SIMCOE: Well, it's very hard. Keith and I were coconspirators or coauthors of a report that there were some copies of out on the table there about standard setting and global intellectual property management. This is a very active area of law and economic research.

I think that the -- a big piece of the challenge is there's a large install base, if you want to think of it that way now, of patents that are out there that are subject to promises not to assert under terms that are unfair, are unreasonable or discriminatory, but the definitions of that are very vague. And there are some companies that make a lot of money licensing those patents, others who would like not to pay anything for them. And they – both of those sides -- square off.

There are efforts to promote clarity. I think it's been good we've been trying to push standard setting organizations, a form of these private ordering institutions to take more responsibility for articulating a clear commitment so as to avoid downstream fights over what these promises mean. International institutions could take on similar -- take on that task as well.

But you know, I also want to be clear about not saying that means we should have an ex post reinterpretation of install base relative to the nature of the commitments that's been made. Then we want to have more clarity around how promises to not assert or to license on particular kinds of terms so that others can build on my intellectual property or so that we create a commons that we can all collectively use -- how those are being interpreted and enforced.

BONVILLIAN: And Keith, add to that?

MASKUS: Tim's the expert here.

I will say that I don't think there's any capacity at the WTO to try to deal with this kind of question. So you're left almost ipso facto with agreements like the TPP, which appears -- you know the phrase FRAND appears there a time or two.

I don't really think that that's likely to generate a lot of harmonization at the judicial level across countries that even have such systems in place at this point. But it may set a benchmark for the poorer countries within TPP. And if it's extended to maybe make this thing a little more rational than it is now.

But sure, the global system is a real mess.

SIMCOE: You can link this back to Steve's question in some sense. The fights -- you know, OK we're going to go forward on the shop in litigation. Where are we going to do that? You know you want leverage in the negotiation that's going on behind the litigation.

So you're seeking injunctive relief in the United States, Germany and Japan, eventually China. So harmonization at that level you know is going to push the problem -- push toward a solution to a large extent.

How is this related to Steve's question about the capacity of national systems? I don't think it addresses issues around the examiner core, but on the enforcement end of the problem, the number of parties you have to get to agree on something gets smaller. You know it's still going to take a lot to get us to agree given sort of national vested interests.

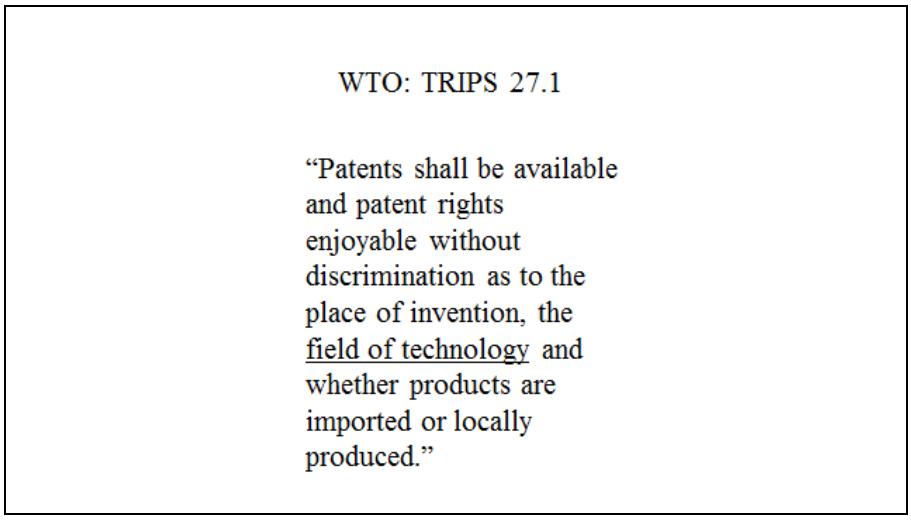
BONVILLIAN: OK. We're going to come back here in about 10 minutes at 3:00. But let's thank our terrific panel.

(APPLAUSE)

PANEL V

KAHIN: First let me say that we have decided to modify the format, and I'm going to excuse Bill ahead of time in case we run over, because he's got a train to catch. We're going this more of a round table in view of the hour and sort of staging -- setting the way for the final roundtable.

So I'm going to sort of frame the problem to begin with.

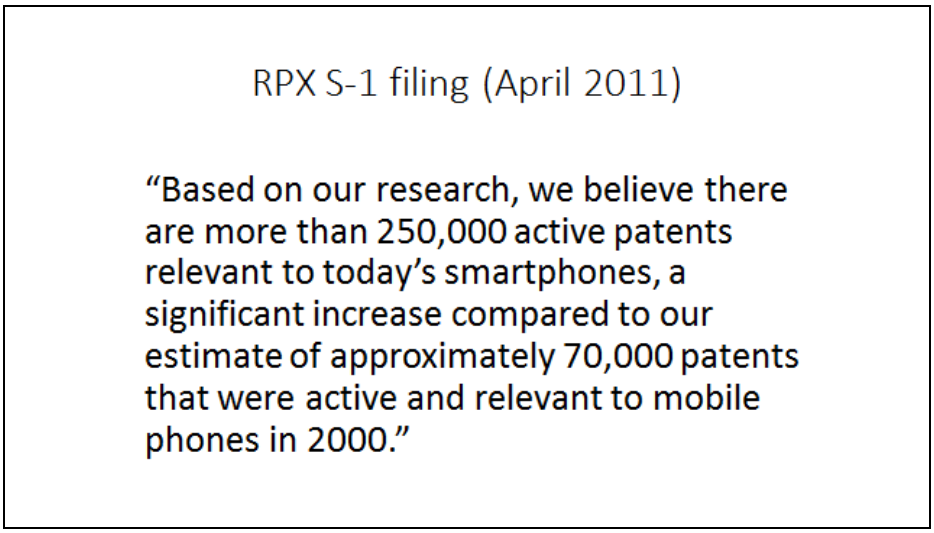


Presentation of Brian Kahin, 12/11/2015

You may be familiar with this quote from TRIPS Article 27.1 about all TRIPS really has to say about technology, and what I've always found interesting about this is that there's a principle of industrial policy sandwiched between two principles of trade policy.

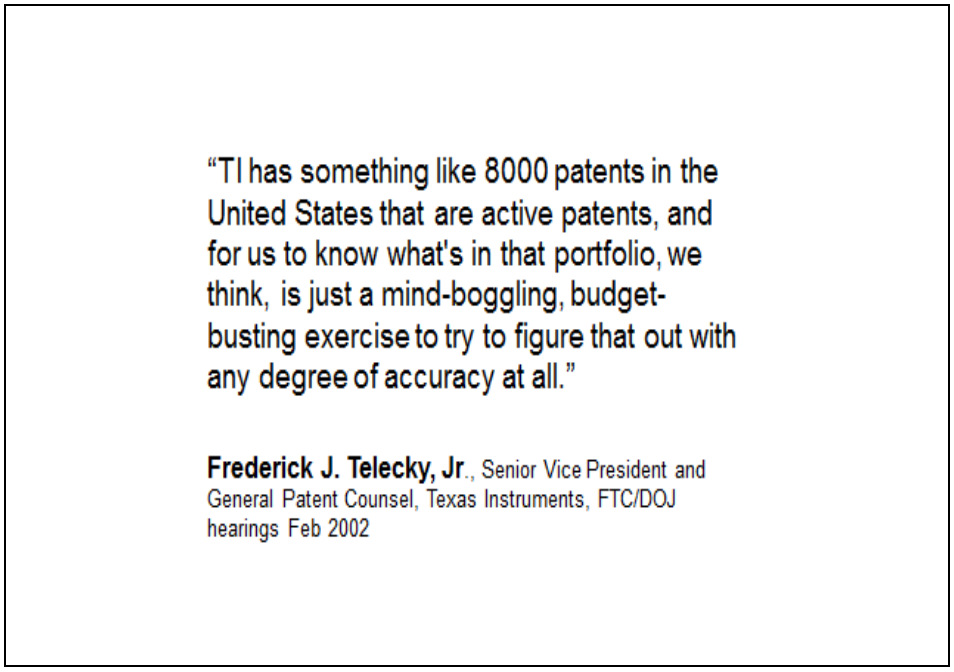
And Rochelle Dreyfuss has written about this very eloquently. You see the term "discrimination" here. She makes the point that discrimination is not differentiation, and she does this a lot more eloquently than the one decision that I'm aware of in this area, Canada - Pharmaceuticals, which says that a Hatch-Waxman-type regime that applies only to drugs is OK.

So this is the base line. TRIPS was, of course, done back in the early '90s, when we knew a lot less about the impact of the patent system on IT -- or the impact of IT on the patent system.



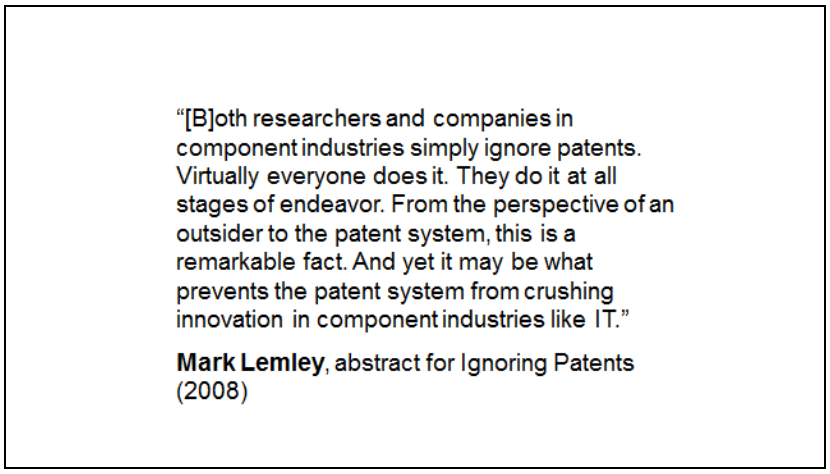
Presentation of Brian Kahin, 12/11/2015

RPX, the white hat aggregator, put this statement in its S-1 filing. The figure of 250,000 possible patents in a smartphone has been repeated by Google and many others.



Presentation of Brian Kahin, 12/11/2015

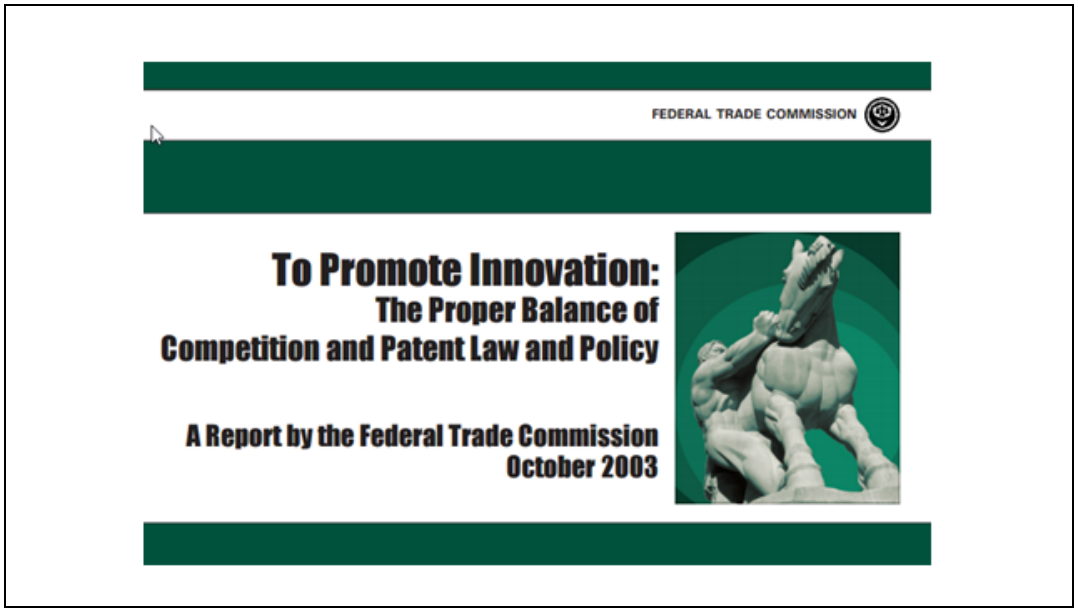
This is a famous quote from the FTC hearing by the senior vice president of Texas Instruments -- Frederick Telecky -- saying that they had so many patents they had no cost-effective way of making sense of them all. Mark Lemley, in an abstract for a paper called "Ignoring Patents", makes the point that there's so many patents that people in component industries, specifically IT, ignore them.



Presentation of Brian Kahin, 12/11/2015

Now, we are going to focus on the conventional distinction between IT at one end of the spectrum and pharmaceuticals at the other end of the spectrum. But a lot will repeat what Tim Simcoe talked about on the last panel, because a lot of what he talked about is peculiar to IT. A lot of those phenomena arise with IT.

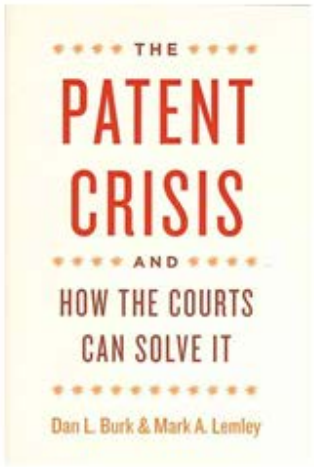
And there wasn't a lot of consciousness that this unitary patent system was in effect creating two very different models of practice. That is, there wasn't much realization of this until the FTC DOJ hearings in 2002 that resulted in this report.

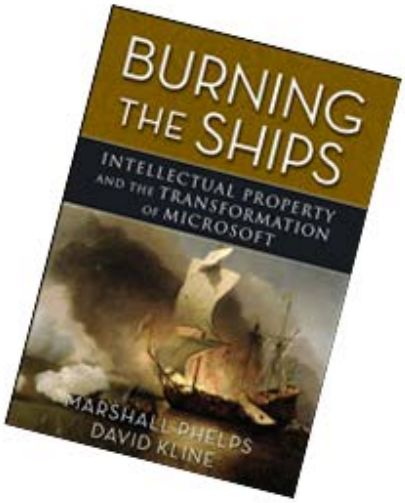


Presentation of Brian Kahin, 12/11/2015

And Chapter 3 of this report lays out in very graphic terms the differences in the way different industries see the patent system.

And that was followed by several books. One -- the first was "Patent Failure" by Jim Bessen and Mike Meurer, which did a rough cost-benefit analysis from industry perspectives, and found a vast difference between the chemical based industries, the molecule based industries at one end of the spectrum, and software and business methods on the other end of the spectrum.





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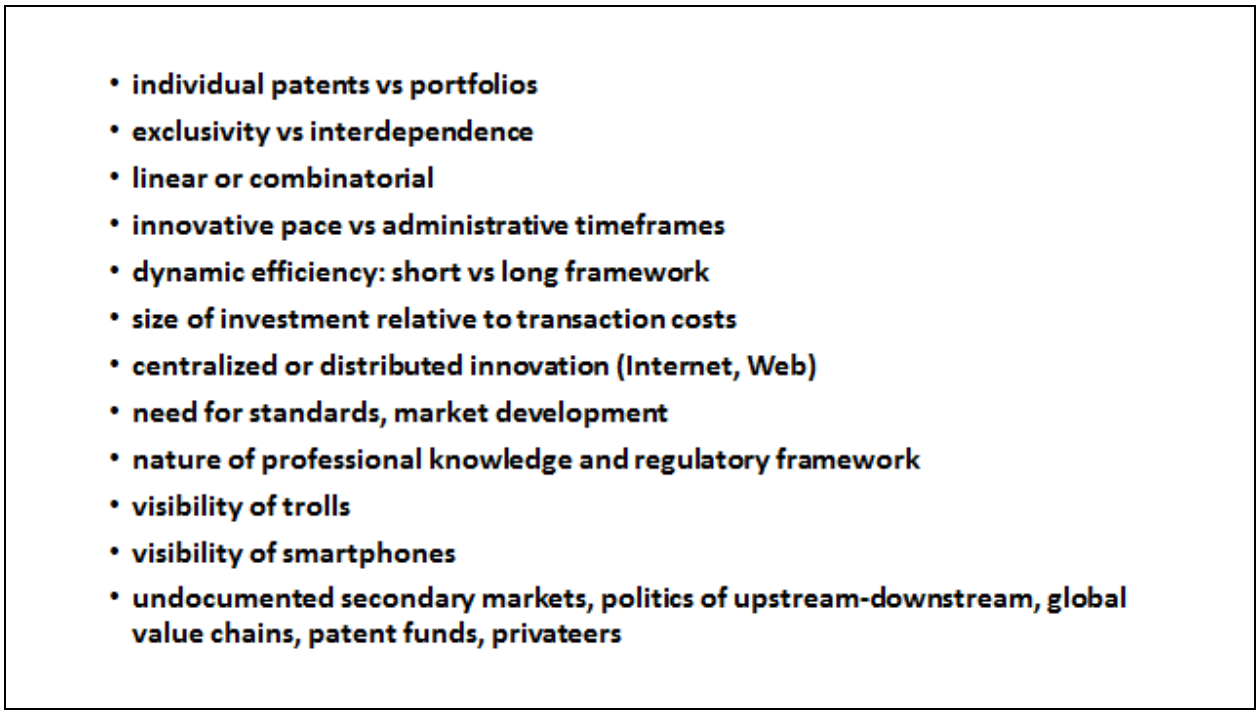
A book by Mark Lemley and Dan Burk came out the following year that focused very closely on the technology-specific problem, with a subtitle saying that the courts might be able to solve this. That was a big turn off for most readers, and the last I heard, the Federal Circuit has never cited this work.

(LAUGHTER)

And the final -- the final book is by Marshall Phelps, who basically engineered IBM's patent monetization program, and then Microsoft's, and wrote this apologia, if you will, that explained how the model had transitioned from exclusivity to interdependence and that Microsoft had to follow the new model.

So here's a laundry list of some of the challenges that information technology has posed.



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And we're dealing with patent portfolios instead of individual patents, so it just becomes more of a business issue and less of a purely legal issue. Exclusivity turns into interdependence, as I just mentioned re Marshall Phelps. Linear innovation is the old model. Combinatorial innovation is the IT model.

The pace of innovation in IT is much faster, and that can create problems within the time frames of the patent system – specifically, the 18 months to publication time frame and the period to grant, because the industry is moving so fast that that can be problematic.

Dynamic efficiency was mentioned earlier, but what is your framework for calculating dynamic efficiency? Is it short or long? Again, that goes back to the pace of innovation. Is innovation centralized or distributed? Well, we have two striking examples of distributed, transformative innovation in the Internet and Web, which basically exploded without any help from the patent system.

Need for standards -- Tim Simcoe mentioned this. This is particularly important in IT, partly for market development. Having a standardized framework builds confidence in the direction the technology is going and gives companies something to plan around.

The nature of professional knowledge and regulatory framework -- in pharmaceuticals, everybody knows what everybody else is doing. It's regulated by the FDA, whereas in software, there's voluminous independent innovation and nobody knows what anybody else is doing.

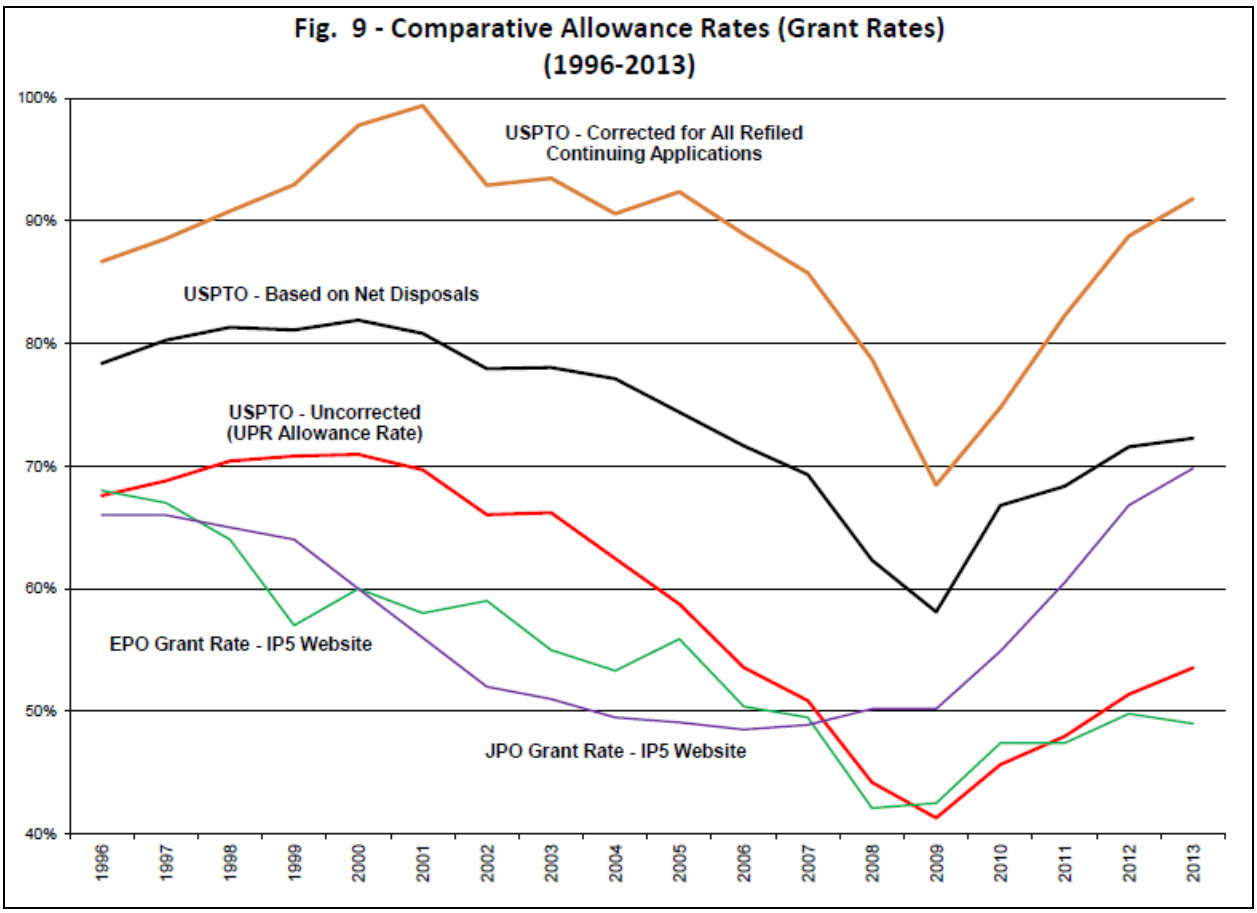
The visibility of trolls is a uniquely IT phenomenon, and it's derived from the fact that if you have automatic injunctive relief, as we had before the eBay decision, you can exert a tremendous amount of leverage against a company producing a product that accidentally infringes a single patent.

And the image of the troll has caught on and it's in the political process very graphically. The visibility of smartphones both as a personal device and then the smartphone wars, and again, as Tim commented, the smartphone wars look very different from Cupertino, compared to Seoul.

And finally, the explosion of undocumented secondary markets and the intermediaries that go with that. Politics, differentiation of upstream and downstream, particularly in the downstream direction, so that a lot of the pressure for reform is coming from distributors or retailers -- or ordinary users.

The emergence of global value chains is somewhat similar to that. The appearance of patent funds of various sorts, including the sovereign patent funds that Tim mentioned. Although sovereign investment patents can be used for -- actually for a variety of reasons, some of which do not necessarily involve IT.

So with that in mind -- the politics in mind at the end there, I also want to remind everybody that there's a political dimension to the patent system that is rarely acknowledged. And this -- this calculation -- this chart by Cotropia, Quillen, and Webster shows this remarkable shift between administrations for the effective allowance rate starting in 2009.



Presentation of Brian Kahin, 12/11/2015

So if I may I'm going to leave it there. This is a laundry list. I'm going to turn to Bill Janeway for his thoughts. We're going to try to keep this short and have a lot of interactive discussion.

JANEWAY: I'm talking about the relationship between private and state interests in high tech intellectual property. And so I want to begin by identifying two very different canonical stories in which state and private interests are aligned. And these relate to two very different regimes.

First, there are catch-up regimes, where the following nation is trying to catch up to the frontier and where the path forward for industrial development appears to be known or at least knowable.

And here of course, the beginning of wisdom is to recognize, as defined by, in my view, the most neglected great economist of the 19th century, Fredrich List, that economic development for followers begins with the appropriation of other people's intellectual properties.

List documented how England took the Italian silk weaving technology. And of course, right here in the U.S., we have the great story of Sam Slater memorizing both the layout and the individual machinery in Arkwright's textile mill, coming to the U.S. at a time when export of textile machinery from Britain was punishable by death or transportation.

And then funded by the non-slave owning branch of the Brown family in Providence, he founded the Slater mill in Pawtucket, Massachusetts, the first profitable textile mill in the United States, visible today as a national historic monumental to the theft of intellectual property.

(LAUGHTER)

Well, since then I'd also note that it was not until 1891 that the United States recognized foreign copyrights, as Charles Dickens wrote about elegantly and passionately when he visited the United States and was first greeted as a hero and then was practically tarred and feathered and driven back on the boat to go back to England in 1846.

Well, since then, we have the story of Japan, Korea and now China successfully following the leader. But there is an interesting evolution of this model documented succinctly by Danny Breznitz (from Georgia State to the University of Toronto) on how the decoupling of supply chains through IT creates more opportunities for followers to break through at particular stages of the industrial process or the industrial supply chain -- Israel in software development, Taiwan in semiconductor processing.

–So the first regime depends upon a state that tolerates, at least -- or even actively sponsors -- the appropriation of intellectual property and the private interests of those who get to exploit that intellectual property.

Second regime exists at the frontier. Well, here of course we're talking about how the patent regime can protect the inventor, create the opportunity for internalizing the lost externalities as theoretically defined by Ken Arrow more than 60 years ago.

And in fact, here I cite the work of Naomi Lamoreaux and the late Ken Sokoloff on the U.S. patent system and how the early radical development of a very open, low cost system, followed by expert validation of the quality of patents in the United States, led first to the U.S. catching up and passing Britain in per-capita patenting rates by roughly 1830.

And then it served to create a market in patents which resolved the coordination failure between the isolated individual inventor and the marketplace away from the towns, as the patent agents wandered the country on the new railroads and signed up inventors in return for part-ownership of the patents.

And that, it is argued, accelerated the U.S. catching up to the frontier and moving forward and beyond Britain by the late 19th century. Of course, by then, we already could observe that the implementation of patents in the second industrial revolution took so much capital that employers who had access to the capital would begin to require employees to assign the patents to the corporation.

And on the other hand we see the emergence of patent wars over the sewing machine patents, Bell's telephone patents, and how patents also could serve as hold-up mechanisms blocking innovation.

So those are the two canonical models where state policy and private interests are aligned. But there's a third model. It happens to be the one that's most important to my life as a venture capitalist in the software industry, particularly the enterprise software industry for 35 years.

The third regime was established by the Department of Defense, advancing the national interest by radically accelerating development of all the components of what we now think of as information technology, from silicon to software, enabled and motivated by DOD and the various arms of DOD well before DARPA was established to require an extremely open IT regime.

One aspect of policy was that patents generated by research funding had to be subject to fair, reasonable and non-discriminatory licensing. –Second, where critical components were being purchased, second sources had to actually be put into production and be ready to take over from the original innovator.

And this regime was actually complemented -- not by any deliberate action of policy -- by the activity of the anti-trust division of the U.S. Department of Justice with respect both to AT&T and IBM. In the first case, DOJ mandated that Bell Labs' inventions not directly applied to communications, again, had to be licensed fairly and non-discriminatorily.

And on the other hand, in the case of IBM, the threat of yet one more anti-trust suit led to IBM preemptively unbundling software from its proprietary hardware, thereby creating an independent software industry.

Now, –with respect to software, when I grew up in the industry in the '70s and '80s and right through to roughly 1990, it was taken for granted that software wasn't patentable.

And nobody cared, because competitive advantage, competitive success was a function of understanding customer requirements and aggressive marketing and sales. And again and again we have the experience of the best technology, the best implementation of a particular specification, being defeated in the marketplace by less good technology.

Two obvious examples are MS-DOS and the Oracle relational database system. It was sales and marketing prowess that made Microsoft and Oracle the dominant winners. But even in semiconductors: the x86 architecture was never patented. You could reverse engineer and design a chip that would execute the x86 instruction set, and people did.

Intel won through its amazing marketing ability -- it was iconically named "Operation Crush" -- which won Intel the IBM P.C. in 1981, and then its competitive advantage was reinforced, of course, by its patented process technology for manufacturing semiconductors.

Now, the patentability of software in roughly 1990, when it began to be both patented and people commercially had to take it as a given that it would be, coincided with an institutional transformation that had an enormous impact. And that was when the large IT incumbents -- specifically AT&T and IBM -- identified their patent estates as profit centers and began to inform the industries in which they played that they were owed money.

At the same time, patenting of software in the U.S. was extended to the absurd extremes of business process patents. And Jeff Bezos actually wound up apologizing for Amazon's one-click patent to Tim O'Reilly after Tim made a laughingstock of him across the industry.

But the contested nature of software patents continues. Of course, "software as such" is not patentable in Europe or the U.K. or India. It is in Japan and Korea and in the U.S. But the combination of the activities of the large patent stakeholders and the patent wars that emerged in the '90s, the extension of patenting into extreme limits, and more recently the rise of "patent trolls" has had a kind of dialectic effect, in my view.

I don't think anybody has attempted to do a genuine causality analysis, but anecdotally, I can assure you that the rise of open source software was a direct consequence of the perception that, first, value in IT had migrated from hardware to software and that, second, software innovation was going to be blocked by the patent regime. This produced the phenomenon of Linux and the Apache community, compounded by some very peculiar competitive issues. IBM funded Linux, for example, as a competitive thrust against Microsoft.

But the feedback has been to create what today is a return to an open IP environment for innovation in software and IT more generally. The combination of the open source tools that are freely available, plus the fact that you can now rent resources -- computing resources on an as-used basis -- means that the cost of launching a new software product, the cost of creating a disruptive software-enabled, internet-delivered, algorithmic business service like Uber, Airbnb as well as Facebook -- that cost has gone from order of magnitude $10 million or more to less than $100,000.

I was actually talking to an entrepreneur who's developing some new software for the financial services industry. I said, "Chris, how much is it going to cost you to get to where you actually have something you can launch and deliver to customers and it will work?" And he thought for a minute and he said, "you know, probably about $60,000 to $70,000. And by the way, my monthly bill to Amazon -- it's $0.37."

So in this environment, at the point at which innovation and IT is having its most radical and disruptive impact on the economy, patents have become irrelevant. Thank you.

(APPLAUSE)

KAHIN: It's not the Amazon website.

JANEWAY: Oh, no. It's Amazon Web Services.

KAHIN: Nick Vonortas.

VONORTAS: So I grew up in an era where intellectual property was -- was the heyday of intellectual property in our country and Yale, Dick Nelson and the others created their first industrial survey of -- for intellectual property.

And the results of that survey was that the actual patents were not the most important tools for innovation. There is, however, an industry or an industrial complex where patents have been traditionally important, and these are the chemicals, pharmaceuticals -- this part.

And there is still – although I doubt whether they're equally important as they used to be, intellectual property there. But it's still important. A working friction with that industry, however, and I think the discussion should go there today, is how they are going to enforce, or how they are trying to enforce the business model that they have in United States, which, from the point of view of other countries, is actually incredible. It's an industry pharmaceutical, it's an industry that's being -- on the front end with NIH here -- $30 billion every year.

And it is subsidized on the back end, because of course our systems cannot even negotiate within price. So there is no other country that can do this.

I was reading the other day that Norway has actually come up and said that its public health system is going to break if it accepts these conditions. It's Norway. Norway is a higher income country than the United States. They have higher income than us. Very rich country. Just imagine Brazil or Chile or the others.

So here is an industry for which the patent system has worked well. It has been disrupted more recently through biology and a different way of doing way of doing research, through that entry. But still they want to maintain the patent system.

So we go to the old question in my mind. If it looks like in the IT patents have become irrelevant, and the only reason companies take and -- for strategic reasons -- to create the word check, to threaten you, to hurt you, to whatever, which makes the -- actually developing countries very, very scared.

If, Brian, you put your last slide on there, if we -- and somebody from a developing country actually sees that slide and says “Oh my gosh, what is this?"

And then you have the non-practicing entities that was from -- the SPF, the patent pools -- they get very, very scared with all this.

So the old debate is whether we can have actually a patent system that is universal across all sectors or we should we differentiate. But then it's the problem of where's the line. What is the factor? Where do draw the line. So I think this should make some discussion.

Now, my final point I want to sort of reiterate something that I've said before. Countries, we have -- we see through history and I thank Bill for reminding of this because I don't think most people know the history of intellectual protection.

Countries change but they don't change accidentally. They don't change because we threaten them. They don't -- they see the reason for changing. And the reason for changing is when they develop and they start becoming more interested in protecting they think they can develop intellectual property now. Whereas before they couldn't.

Let me give you -- an example was Chile since we had heard about Chile from Daniel in the last panel. So last year I was part of an OECD group going to Chile to advise the government to look actually at the Chilean system and advise the government on whether this collaborative research centers that they have hook up all over the country which is aggressive in industries trying to sort of promote this. Whether they should have a couple ones in years that they have -- 10 years and you're out -- no matter if you're good or bad or whatever you are gone.

Or they should open it perhaps selectively to the better ones. In the process, we went around the country and we looked at some very interesting things that I was not aware countries like Chile do. Give you one example. Chile as you know has 70 percent of the global observation of outer space. With the global capability for telescopes. They are all in the north in the desert.

Now, the government has negotiated 10 percent of that land for the Chileans. It's too much for Chile and for time with this thing. So Chile now is thinking, both the private sector and government, of how to make money out of this. Out of -- so suddenly in that country there's very good ideas and they presented to us. Some very good ideas of how do you actually make a high tech industry out of servicing telescopes and -- and whether there is actually capability. Now there's a problem with intellectual property.

They have not certain that actually can do that. They are not certain that they can amass the intellectual property legally in order to service those telescopes. These are fears of developing countries. They think they are going to be shut out of the system, and it's very real in this case and I hope people like us we can help them. Thank you. That's all.

(LAUGHTER)

RAI: Well, that's a great intro. So I think this may help you a little bit. That said, it probably is a little bit different from the story that I think we've been hearing for much of the day.

I'm mostly a domestic IP person. I focus on the U.S. intellectual property system, and I think that it's probably in much more flux than people have focused on today as a consequence of a variety of both judicial -- and legislative changes.

Todd Dickinson alluded to some of this and I don't know if he is still here. But I will elaborate a little bit and then bring it within the framework of the technological change piece of this panel. It is the case that the biopharmaceutical industry has always been very enamored of patents.

That said, I'm not sure the current domestic law in the U.S. is as protective of them as some people may think. That's because a lot of what they're doing now looks like information technology.

So in the past -- and people have said this, and therefore I want to push back against it -- we used to think of biopharmaceutical companies as manufacturing stuff, while IT did information. But I'm not sure those boundaries are any longer clear, and in fact if you spend much time in biopharmaceutical

conferences these days, , all the talk is about so-called precision medicine. Precision medicine is just information -- correlations, essentially, between biomarkers and some sort of observable health condition.

So yes, there are still small-molecule drugs being manufactured. There are also still biologics being manufactured, and we can talk about the ways in which those particular products might be impacted by the changes in the domestic system.

But there's been, I think, a real sea change in terms of how the domestic changes have affected the informational components of the biopharmaceutical industry. Kathy Strandburg earlier mentioned the Prometheus case -- as many of you are probably aware, there's been a quartet of cases from the Supreme Court on what constitutes patent-eligible subject matter.

And I think it's fair to say that, for the information piece of the biopharmaceutical industry, they would tell you that patents in anything related to information and biopharmaceuticals are extremely suspect if not dead.

So ironically, what has happened, it seems to me, is that the Supreme Court has seen all of these problems in the information technology industry, and then soon thereafter saw a case from the biopharmaceutical industry also involving information and applied exactly the same mindset. The Court said, "OK, so this looks like another information patent, even though it comes from the medical arena, and we'll just apply the same test."

That test, as elucidated in the Mayo and Alice decisions, eliminates, I think, a fair number of software patents. But it also eliminates a fair number of biopharmaceutical patents that look more like information.

So I think that the technological boundary that has really collapsed quite a bit, and one irony of the biopharmaceutical industry wanting a very unitary system way back when in 1995 is that they're now suffering from that unitary system as a consequence of the Supreme Court decision.

So I see the issue, from at least a domestic standpoint, differently from how I've seen the issue framed by at least some of the speakers today.

Now some of you will immediately say, "Well, what about small-molecule drugs and biologics? Those are still protectable by patents." And yes, that is correct.

But even with these molecules there are lots of reasons to think that the patent system doesn't necessarily work optimally. That's in part why, once the biopharmaceutical industry got the opportunity to get data exclusivity in the biologics space, they pushed for 12 years. In fact, they pushed for more than that, but they only got 12 years in the U.S.

So, just to reiterate, there are lots of quirks in the system that make it difficult, at least in the U.S., to get the kind of patent protection biopharma wants, which is basically bulletproof patent protection.

So in the biopharmaceutical area, even outside of bioinformatics, but particularly in bioinformatics, the trend is going to be towards protection via data exclusivity and trade secrecy, as opposed to protection based exclusively on patents.

And certainly lots of areas of the biopharmaceutical industry are now just information -- I was going to show one slide of the first 3D-printed approved drug, but then I realized it could be so many different technologies within the biopharmaceutical industry.

I could have put in synthetic biology, I could have put in, really, anything that involves diagnostics, and therefore genomic medicine, precision medicine, all of that.

And so I do think that all technologies, as a consequence of this convergence into pure information, are being affected by the Supreme Court's "getting it", quote unquote, with respect to what's wrong with our patent system in information technology.

And going forward, I think it'll be very interesting to see how an emphasis, at least domestically, on trade secrecy and data exclusivity in the biopharmaceutical industry ends up translating in the international realm.

I suspect, no matter what, the biopharmaceutical industry is still going to push for more protection even on patents, because why not?

But I think what they really want is the data exclusivity and the trade secrecy. Hence, we see much more emphasis, not surprisingly, in trade agreements, on trade secrecy and data exclusivity.

So I will leave it at that. I think I've been a little bit provocative, which was intentional, and hope that I get some questions. Thanks.

KAHIN: Thank you, Arti. So let me begin, first of all let's get a reaction to -- I'm going to react specifically to –- (inaudible) --

JANEWAY: Brian, I think there's another factor here which relates to the Internet age, which relates to the fact that the IT infrastructure has matured to the point where Facebook can go to 2.2 billion users in a decade. And that is that the feedback from the economies of scale -- Amazon web services, Google-accumulated search data -- create environments in which the capital required and the risk associated to that capital to try to attack from the outside limits competition de facto.

Second, the nature of the world in which new stuff is developed so cheaply and is disseminated and consumed virtually friction free -- like Uber is or Facebook is -- means that the speed to reach dominant scale is extraordinarily rapid. And that in turn I think means that the classic model in IT of the venture-backed start-up, with or without patent protection, having the potential by way of an IPO of becoming a new, independent company no longer holds.

Actually, what venture guys are doing in the core technology is funding distributor research and development for big companies. And the goal is to do something distinctive enough that Microsoft, Amazon, Apple will compete to acquire you. This is clearly the case in anything to do with data science, with implementation of deep learning networks, for example. And that's a very different regime from what used to be the case. In part it reflects this orthogonal factor of the speed of scaling beyond critical mass to what the anti-trust people would call -- at least the prosecutors -- dominant market position that really changes the landscape in a very fundamental way.

VONORTAS: But Bill, is this dangerous?

JANEWAY: Well...

QUESTION: And how is this perceived internationally?

JANEWAY: Well, it certainly is perceived in Brussels, let us say, more aggressively than it has been perceived in Washington.

QUESTION: We're supposed to be focused on emerging economies.

JANEWAY: Well, and in emerging economies I can't say. Let me back up and make a distinction. I think this is a very important distinction that the guys in the Bay Area -- the disruptors -- have just been learning the hard way.

If you stay in the digital domain -- as Facebook does, for example -- where the service is distributed and consumed virtually, you are in one space. But when the disruptive service is delivered physically –- as are Uber and Airbnb -- while there still is no technical friction, there can be a hell of a lot of cultural and political and regulatory friction. And those frictions are geographically specific and highly heterogenuous.

And it's not just that Paris isn't San Francisco. Paris isn't Lyons as they're learning. Y Combinator is the premier incubator in the Valley. Y Combinator started hiring some people to advise their startups on how to think about local regulations that might affect their ability to scale the business.

Of course, the immediate response in the Bay Area is "this is all about monopolists protecting their rents."

But in fact, some of these regulations -- like the notion that, if you're renting out a room for money, you might be required to have a fire extinguisher –- are mere expressions of common sense that have evolved over 3,000 or 4,000 years of people renting out rooms for money.

So I think that's an aspect that can limit and make the locality of the delivery of the service, and the political economy of those localities, extremely important in the evolution of the digital economy.

KAHIN: Bob?

HUNT: I've been listening to Bill, enraptured...

(LAUGHTER)

... this is why, because if it's really the case that we've driven down -- and there's only parts of the economy where this is true, but it's big parts -- we've driven down the cost of R&D so much, and it's become so distributed. And you're actually talking about final markets -- service markets in which very often the consumer doesn't pay, right?

So we've now messed up national income accounting in a really bad way. Which -- we've figured out how to quality-adjust cars and computers, but we haven't really figured out how to quality-adjust how much better Uber is going to get or how much better Google is going to get.

And when you think about policy analysis for the innovation system or anything else, we don't now know how to measure the trajectory we are on for this very reason.

JANEWAY: I'll see you and raise you. We have no way of understanding how to measure productivity, where the measurement of productivity is actually critical to the definition to the understanding of monetary policy, of macroeconomic policy.

In Britain, they're going nuts because productivity has actually been declining during the slow recovery from the Great Recession. And all we know is what's going on is hitting both the numerator and the denominator of the productivity calculation, both output and the amount of work to produce that output, as we do things that other people used to get paid for that were counted in GDP but are no longer counted in GDP.

Frankly, I'm shopping, representing the Institute for New Economic Thinking, of which I'm a co-founder, for scholars who are interested in attempting to construct frameworks for evaluating productivity in this context.

In Britain, they're doing an overhaul -- they're doing a deep analysis of the national statistics, motivated in part by this. So it's beginning to happen; I think it's a huge issue.

VONORTAS: I have not heard of this at the OECD but why these discussions have not happened over there?

JANEWAY: Well, actually, I'm going to be there in February for Andy Wyckoff, and this is exactly what I propose to talk about. So I hope that OECD will pick up on this.

RAI: So, question, kind of following on. I'm very interested in regulatory barriers to entry as potential innovation incentives or innovation bars.

One of the arguments that's been made about IP is that it's a regulatory barrier to entry that's as accessible to small firms as it is to large firms, whereas other regulatory barriers to entry -- say, FDA approval, certainly, but maybe other regulatory barriers to entry are the sort that can only be surmounted by large firms.

And so is the fact that IP is being replaced by other regulatory barriers to entry creating a shift to requiring large-firm kind of organizational structures?

JANEWAY: When you think about the non-IP based new dominant players in disruptive Web services, the open question is, since it is so easy, so low cost, so many people trying to introduce a competitive offering, how secure are their franchises?

Second, since there are these different competitive conditions in different localities -- Uber is nowhere in China, and Uber in India is highly contested. So that -- how secure their apparent dominant market positions are, and the lack of friction that got them there, may also be their own worst enemy.

The fact is I use Uber, but the cost of my downloading the Lyft app is zero. If I decided that Uber let me down -- Uber is under very stringent competitive conditions. So I don't think we can know yet how secure these positions are. We do know -- it does appear that monopolies, whether or not they were

originally based on patents, like AT&T, that the life in the monopolist position does seem to be declining monotonically over the last 80 years, 60 years. So...

RAI: And we also know that the number of American – American small firms being started has gone down.

JANEWAY: It has, but remember, a lot of those were restaurants.

RAI: No, even high-tech.

JANEWAY: Oh, OK. Fair enough. Yes. Sorry.

RAI: This is, I feel like I want to expand the conversation beyond that to all sorts of regulatory scenarios.

JANEWAY: Yes, good point.

KAHIN: So Nathan, and then Rick -- do you want to?

JOHNSON: I have just...

NATHAN MUSICK: A question for Arti Rai: If I understand you correctly, you're arguing that recent modifications to the patent system as a result of recent Supreme Court rulings have not been limited to software products and business methods, but have had an impact as well on the life sciences. That development comes in addition to the Patent Trial and Appeal Board being petitioned to determine patentability across (to many) a surprisingly broad range of patentable subject matter – especially pharmaceuticals.

Is that correct? And if there's this broader effect – say, a spillover from IT to the life sciences – is that a good or a bad thing? Is it too early to tell? And what should we be thinking about when we consider the economic impact of those Supreme Court decisions?

RAI: Great question. I deliberately abstained from making a normative judgment, because I think it is a little bit too early to tell. That said, I think again in terms of the industrial organization question the modifications do create a challenge because FDA looks like it's going to regulate in a lot of those information heavy spaces in the life sciences. And the FDA's very concerned that free dissemination of health information is going to cause people to die essentially.

The FDA concern is not illegitimate. But the combination of a regulatory hurdle and a lack of IP could make large players extremely advantaged in that space relative to the small players. And that's a problem to the extent there's a reason to be concerned if small players can't enter a market.

KAHIN: Rick?

JOHNSON: Just a quick informational thing following on Bill's comment, wearing my chair of the OECD/BIAC technology and innovation committee -- three things. One is on productivity as actually being viewed as central. There is a ministerial this year that Chile has raised this as a central issue, and it will be in June. And there's the global science technology and economic ministers in the last two months have

basically said that this connection between productivity, I.P. rights and then knowledge base capital which Ken Jarboe and a number of the rest of us in the room have been involved with over a couple years has to be addressed as an urgent issue for the OECD.

So for their next three year work program, exactly the types of issues that Bill has mentioned are going to be front and center beginning with this ministerial that Chile will host and then a work program for the next couple years.

The last point being also –- and anybody in the room has great ideas please let me know because I want to be in touch with the right people – the statistical people have this conference, the blue sky conference, every few years about how national statistics should start to measure this better. And there is an urgent need and no real information to figure out how to get the numerator and denominator and anything else right.

JANEWAY: That's great. I just wanted to add one thing to what Arti said about how software moving over towards the life sciences. Mark Andreeson has this mantra that "software's eating the world" and that there is no industry which is not going to be infused with this dynamic and not going to be informed by the notion of algorithms, the cost of replication of which is zero.

And I just saw NBER paper number 21752 – the lead author is Lee Branstetter of Carnegie Mellon – called "Get With the Program: Software-Driven Innovation in Traditional Manufacturing." As GE is the pioneer where much of its heavy equipment business depends on predictive analytic software to improve the profitability of preemptive maintenance, it is becoming a software business.

So this is a very, very large scale, long-term phenomenon that -- and that's why the IT regime for software is going to become -- this already so systematically important.

KAHIN: Yes, sir?

PETERSON: Brad Peterson with Professor Chen, I was one of the two people in 2011 who gave a report to the STEP committee of National Academies on the report card for patent reform after The Academies' 2004 report which said one of the seven objectives should be unitary patent system. And as I hear the panelists now I gave Congress and the courts a A minus for unitary patent system strategies and certain organisms kind of set aside under the latent with that.

So it sounds like there's a shift in policy going on and is that reflective in kind of the other parts of the organizations – National Academies and STEP – that's going on that's saying we should maybe reconsider that position? And then as a thought-provoking one, rather than trying to segment different technologies knowing how difficult those lines really are, should we back up and think about segmenting our theories of IP protection?

And if you go to the German and China models, the utility model patents in some sense has a set only theory of recovery. Whereas the U.S. with its large reward system ends up having the troll problem perhaps because of the trespass theory of recovery instead of proof of theft like you would do in copyright infringements. And so just want your kind of thoughts and reactions to diverging not on segments but rather on the kind of size of the patent and what it's intended to do.

RAI: Sure. So it's a great question and one of the questions I have before we do anything further is I think we do need to look at the impact of cases like Alice and about what's about to and how they're going to flow through the system. I think that the impact certainly in the pure software space if can categorize that might be quite salutary.

So before we worry too much about doing more to combat the troll problem I think we should perhaps just look a little bit and wait. And there also -- and as discussion was suggesting earlier I think a lot is also -- there's a real peculiarities as you all know in the U.S. litigation system some of which are being addressed more broadly. So it's not just a patent specific problem.

As you also probably also well know there -- there have been lots of proposals along those lines, Keith, who have either petty patents or some sort of mens rea requirement not strict liability for patent infringement. I think those are all great things to keep on the table. I would like to see how Alice plays out before going further along those lines however.

And what I'm also doing and this will also be I think interesting to see how this plays out as well is how our administrative adjudication system that was set up in the AA plays out which is still TBD.

KAHIN: I've been told to let you know that the views of the panelists or workshop organizers do not reflect an official position of the National Academies.

(OFF MIKE)

RAI: Or even the speakers.

(LAUGHTER)

STRANDBURG: So I had two comments/questions, both of which relate to barriers to entry.

So, I've actually always had a question in my mind about whether there really is that big a difference between pharmaceutical innovation and, say, IT innovation or whether the difference is really mostly about regulatory barriers to entry. And it certainly seems like that question is becoming even more salient now, given changes in the types of innovation that are coming within the purview of FDA regulation. And that question leads to the question of whether patents are a good way to deal with regulatory barriers to entry.

And one reason that I think they might very well not be is that we already see all the problems we have with patents on software because of its cumulative nature, overlapping claims and so forth. The old story about small molecule drugs was that the patent covers the thing that actually is sold, and that means a nice correspondence between the regulated product and the patent. That's still the case for some regulated products, but probably not true anymore — to the extent it ever was for all innovation in the pharmaceutical area. So I guess I just wanted to raise -- sort of raise that point.

And then the other thing I wanted to say was I'm a little less sanguine about the frictionless nature of market entry in IT innovation because of possible barriers to entry. In a lot of situations the barrier to entry is not coming up with a good algorithm. The barrier to entry is that the incumbent -- Google for example -- has accumulated a huge amount of data and the data is a huge barrier to entry. So to the extent that that's what's going on, I don't think we can assume that entry is frictionless...

JANEWAY: I think that's an excellent point and I do agree with it. And the social media companies are all trying to emulate Google with more or less success. Twitter not with a lot of success right now.

But I do want to come back to the biotech versus IT innovation environment. I learned the hard way that there is a radical difference because when you're doing a startup you really have to think about the three different categories of risk -- obviously technology risk or, as an old partner of mine used to say, when you plug it in, will it light up?

Then the second risk is market risk. In IT, market risk often trumps technology risk. But in biotech if you actually have a target and a molecule and the molecule actually is safe and efficacious, you do not have any market risk.

And the demand curve is fully funded and effectively vertical, as Gilead has recently demonstrated with its Hepatitis C drug, whereas in IT historically we've had to explore the elasticity of demand, which can be a very expensive proposition whether it's for the consumer or the enterprise. And by the way, the fact that market risk is zero means that financing risk – the third category of risk for start-ups -- historically in biotech was much less than in IT. Because you have a phenomenon of -- that -- two different phenomenon.

RAI: You have so much technology risk.

JANEWAY: That's right. You do but as you...

(CROSSTALK)

RAI: As a technology risk, they might actually make it. Yeah...

(CROSSTALK)

JANEWAY: That's right. That's right. But the fact is that you have had these waves of IPOs -- in the last three years 75 percent of all U.S. venture-backed IPOs have been from biotech and almost none for IT, essentially none for IT with less than a billion dollar deal and at least $100 million of revenue. So IPOs for IT companies have basically disappeared. That creates a different dynamic in the venture world where you sell as early as possible in IT once you have some technical proof you have an opportunity to get cheap money from liquid investments.

RAI: That's fair. But it is -- it's actually biologic as opposed as small molecule -- yeah...

(CROSSTALK)

JANEWAY: OK.

RAI: Which is important for a variety of reason including the 12 years of exclusivity and...

JANEWAY: Well, and it's also the case that the -- the -- the speculators are betting that before they find out whether you actually pass the FDA big pharma will have to buy you one...

RAI: Right, right, right.

JANEWAY: Whereas their internal development productivity has become so poor.

QUESTION: But what is your product, right? So if your product is diagnostic that was derived from...

RAI: Right. Although now with the FDA not wanting to mess around with the diagnostic space now your technology...

(CROSSTALK)

QUESTION: (OFF MIKE)

RAI: Yeah. It's all about regulatory and I have become obsessed with regulatory as a topic so exactly your point.

SIMCOE: So these conversations often end up being about what we research which is two of the three things that I had on my plate was the drugs and the phones but we haven't talked about the better mousetrap, people.

And if we want to link this to the trade question maybe let's just stipulate that many of our trade partners will be more in the better mousetrap building than this -- Bill may disagree -- it's all going to be bids pretty soon.

But sort of does the -- do the – I haven't heard like really concrete proposed reforms but either the direction that things are headed or if we strike the balance and get the unitary system to work right as between drugs and phones, is it going to work all right for the mousetrap people in the view of these panelists?

KAHIN: I'm trying to identify...

(CROSSTALK)

SIMCOE: Industry. Like when we did patent reform conversations when I was first here we would hear from the manufacturing industry.

JANEWAY: Right. OK.

SIMCOE: Not super complex multi-component products but sort of complex products, OK? If you look at like Caterpillar would show up. OK? 3M would show up, OK? They're at the table. They don't fall into the buckets that we gravitate towards in this conversation because they're not a canonical of some -- they don't fit the model perfectly.

KAHIN: But you're thinking of them as big mousetrap?

There is -- well, better mousetrap in the sense that they make something you could put your hands on.

SIMCOE: Right.

KAHIN: And the patent covers kind of a feature improvement that you can point to.

VONORTAS: But Tim, the thing shows that the -- most of the value added of this products is services. And it is IT so you may sell a tractor but actually you sell services and IT to a large extent. So to the extent -- the spillovers from IT I think will affect them.

JANEWAY: I'd be interested if anybody knows as to what the IT regime is for the German mittelstand engineering companies, because those guys have been making mousetraps in some cases for 200 years and nine generations of families very profitably, despite very high-cost labor and with enormous competitive edge. To what extent are they dependent on patents, I have no idea.

KAHIN: They have utility models...

JANEWAY: Right. On...

VONORTAS: My impression is that they don't very much on there but it is more of a contractual -- they actually work with larger companies and that is...

KAHIN: OK. I think we're out of time. Thank you.

(APPLAUSE)

PANEL VI

JOHNSON: So in this panel, what we really want to do is bring it back to folks who have -- work for the U.S. government, and state policy -- take away and things that they've heard -- and sort of -- the key take aways since they occurred from -- what is the next step.

Walter Valdivia from Brookings Institution and the Center for Technology Innovation. Alan Marco is the Acting Chief Economist at the PTO. And Rod Ludema is the Chief Economist for the State Department and he is from Georgetown.

So actually, why don't we just start with Alan from the PTO perspective, but also it doesn't have to be limited to PTO, Alan, just some take aways.

MARCO: Thank you to the Academies for organizing this and to the other speakers, of course, for providing some really interesting insights.

I will just say, off the top, that I am presenting my own opinions and not official policy of the PTO. But, I will try to communicate my experience there in terms of what my own office is interested in, what we look at data-wise, and some current policy interests of the office.

Really it's a daunting task to summarize just a few take-aways from the day because all of the panel discussions could have gone on indefinitely. And, if we'd just been able to pull our chairs in a circle and keep going it could have made for a very interesting evening. Especially if the Academies were providing drinks.

(LAUGHTER)

A lot of topics were touched on today, so I want to mention something that Tim Simcoe alluded to earlier, that I think is an important theme. I also want to mention something I did not hear talked about a lot today, and interject that a bit into the conversation.

Number one, fundamentally, we—as economists and scientists--still don't know enough about how innovation happens and why and when. The “science of science,” if you will is really in its infancy.

So, it's interesting to be at a point where we're talking about harmonization and we're talking about agreements that may really crystallize our I.P. environment for years to come, when we don't really know enough about how innovation happens and how it depends on IP. And we don’t know how those incentives vary in different technologies, as was talked about in the last panel.

Without knowing that, it's difficult to think about how we would agree on optimality even domestically… which we clearly have not. So, we find ourselves saying "well, let's go ahead and agree on it internationally and then -- and then what"?

And then we're stuck. So, it's an important set of questions that have to be considered, and it’s interesting to think about where we really know we can agree, and where we know we still need to do a lot more research and ask a lot more questions.

One of the real thrusts in my office is understanding and getting better data on invention. One of our big investments is in what we call “inventor disambiguation:” knowing which John Smith is which John Smith, or which Jane Doe is which Jane Doe. If we can't distinguish one inventor from another, we're never going to really understand the invention process and the innovation process. So first and foremost, we need to know those things. And secondly, we need to know how much of those patented inventions rely and build on basic science investments.

We don't want to see patents as an end product themselves, right? Because they're not. We want to be thinking about them as intermediate steps in this longer process from basic science to applied science to invention to commercialization. And patents are certainly not the only things that are part of that process. We need to understand all that.

It's a little interesting to think about basic science, and about patent disclosure from a policy perspective. I forget who said this earlier in the day, but, look, U.S. policy is going to be from the perspective of the U.S., right? And, this is the same for all nations. When we go internationally and we say, "Hey other countries, you should adopt standards that are very similar to ours." Now what is each country really saying? We're saying we're responsible for protecting our own interests. So, we're saying, "You know what? If you adopt our standards… that would be really good for us." That’s what national interests are all about.

But the message that we're giving them is, "You know what? If you adopt our standards, it would be really good for you. But, by the way, our interests are really our own."

So, getting back to IP, think about what that means when part of the purpose and the patent system as a whole is to disclose new ideas to the general public. Disclosure is designed for the explicit sharing of knowledge, in order to stimulate more innovation. That’s the so-called “quid pro quo,” of the patent system. Disclosure is the “public good” part of the patent system. Should we be adopting policies that ensure that the knowledge disclosed in the patent remains within U.S. boundaries? Could we?

Really from a scientific perspective, that “public-good-ness” crosses borders. By its very nature, the knowledge from patent disclosures crosses borders.

It creates an interesting tension. And I'm just going to leave that one there, as something that policy makers need to consider in terms of international harmonization.

Secondly, something that wasn't really discussed very much today is the focus on IP assets. IP as an asset class.

With increased globalization, I think we increasingly need to think about IP as “assets.” Or, rather, I know that it is going to be increasingly discussed in finance circles, and policy-makers need to be prepared.

When I think about IP as an asset class, and when I hear increased discussion about it, it makes me a little bit worried that we're focusing on the wrong thing… that we're focusing on the intellectual property as an end in and of itself.

I was recently asked to visit a small developing country to talk to their I.P. office and their Ministry of Science and Technology about how to measure the contribution of I.P. to an economy. And I kept wondering whether there was a little bit of a mistranslation, because I kept hearing them say, “we want our economy to be an I.P. focused economy.” And, in talking to them, it really seemed that they were focused on I.P. valuation and building up IP assets. They seemed afraid to be left behind.

Because the industrialized world has these very valuable patents and they want valuable patents too. They were more focused on the I.P. as assets, rather than the purpose of the IP. As an aside, this is especially puzzling when you think about the off-shoring of IP.

Think about it. IPRs, Intellectual Property Rights, especially patents, are a right to exclude others from using them *within the country in which they were granted*. What does it mean to take that right and move it offshore? “We have a right to produce something in the U.S. and/or a right to exclude others from producing it in the U.S. But, we're going to move that right to another country for tax purposes.” I’m not sure I really comprehend that. But, from a policy perspective, we need to think about it.

What is perhaps more concerning is IP-backed securities: financial instruments based on IP assets. Or, even derivative securities: say, futures or options on IP-backed securities. What happens when we have complex securities--complex derivative securities--that are based on assets that, themselves, are difficult to value? I don't know. We'll have to ask 2008. I would not be surprised if the next financial bubble were to be in IP-backed securities.

Again, it's getting the focus on the wrong part of the equation. IP is really an intermediary step that’s about incentivizing innovation: the creation of new goods and services.

Understanding that link between intellectual property rights and the creation of new goods and services… understanding that critical link… is central to making good domestic policy, and central to effective harmonization.

I want to leave my remarks there, except maybe we'll have some time for some discussion. But I wanted to mention one thing in closing.

As far as harmonization, I think that there are few things that we can already agree upon that make for an effective global IP system.
Transparency is one of those things: transparency in ownership, transparency about patent scope, and data sharing between IP offices, for example. Those are the low hanging fruit. What transparency enables us to do is to focus our analysis and measure the effects of differences across offices.

It enables us to look at things like patent fees, and how the fees may differ from one jurisdiction to another. It enables us to study the differences across systems, even if the regulations themselves seem quite similar.

Just as one example, I’m told that the EPO compensates its examiners two points for rejections and one point for allowances, on the theory that rejections take more work. In the US, it's one point for an abandoned application and one point for an allowance, on the theory that we don’t want to bias the result. So, in the US it’s one for one and in the EPO it's two for one. Surprise, surprise, the U.S. has a higher allowance rate than the EPO.

Which one is optimal? Probably neither, but it gives us an opportunity to study the differences. Without some amount of harmonization across the data to make those kinds of comparisons and contrasts, we actually know very little about how these different systems work. Having some transparency and some ability to share data does enable us to start getting real answers to important questions.

JOHNSON: Well, thank you, Alan, those was really good. And also, I'm really glad you raised the issue of, sort of IP of assets. That was an issue that got us there, because I think not only the securitization in the financing instruments, but also just the state of assets thing and the role that plays in an increasing number of knowledge and networks and markets that have other implications back to the innovation as you mentioned that we don't understand what's really there.

So, our next speaker is Walter Valdivia. And Walter, what are your initial take aways?

VALDIVIA: I want to bring attention to some of the specific points. But let me start with a general one. Through the day, we have listened to very interesting presentations and discussions that are mostly from the economic angle.

And it's now about 115 years that economics exists as a discipline in itself. But before that it was political economy.

So I'd like to reintroduce in this conversation the political dimension in the economic analysis of trade and emerging technologies in emerging markets and the U.S.

So, one of the presentations – Tim Simcoe of Boston University warned us of the ratchet effect of harmonizing IP through trade agreements. That is a very important observation.

It crystallizes, as Alan Marco reminds us, patent law in the U.S. and creates more inflexibility for the law to be reformed. This is interesting because we would expect that a democracy reserves the ability to modify policy according to the public interest and changing conditions.

And I could use an example from a policy area in which I have done quite a bit of research, which is the Bayh-Dole Act. The introduction of the Bayh-Dole Act and its consequences is debated, but something that is not contested at all is that the act itself created its own lobby to protect it.

Whenever you modify the law, you create conditions for a political dynamic to perpetuate that reform.

If we pursue further harmonization internationally, we may create an environment in which we will be inflexible at home for the various reasons that include the political defense of a policy that has been replicated internationally; the defense of the status quo is more effective, even if the law's consequences have not been fully appraised.

I would like to bring to bear the political dimension on the discussion of the entire patent system and whether its protections should be uniform or segmented. And I think the remarks of Arti Rai really illuminated how industry responds not only to the policy environment strategically, but also responds to technological advancement.

Therefore, the benefits of patent law are uneven across industries. So what is interesting in this regard is that an industry that was not significant may emerge as a political actor for reform, which is what happened with Internet-based services industry.

In turn, another new industry, as it was biotech emerging in the '80's and '90's, became a significant lobby for defending particular formulations of patent law.

We seem to be in the midst of a debate as to whether patents are useful or not precisely because we have a uniform system. And the question of segmentation seems to be wise, except that it is very hard to do in the law.

The law should provide equal protection across sectors and agents. So considering the political element, it's very difficult to modify the law because segmentation is so controversial and so disputed.

And just a quick example, I will remind you that legislation introduced last year to curb patent-trolls was ultimately taken -- even though it had passed in the House -- it was taken out of committee in the Senate by the offices of the minority leader himself, who forced the hand of Senator Leahey to kill this bill.

So the difficulties of making reform in this highly polarized atmosphere should invite us to consider imaginative solutions that do not need legislation.

And if we see benefits of segmentation in the use of patents, if we wish to use patents not as a blunt instrument but as surgical tools, we should start looking into what kinds of organizations could implement that segmentation.

And going back to Bayh-Dole and universities, I would suggest that universities being not-for-profit organizations chartered with a public mission could be invited to manage their patents differentiating across segments to calibrate the uses of patents, particularly in those research areas of high public interest. By calibrating, I mean the use of licensing contracts to produce appropriate outcomes.

Maybe this is a modest proposal, but some of the university patents have very large consequences for the future of innovation. So you will have an effect that is more than proportional to the number of patents from universities.

Still, there could be low contestation areas of legislative reform -- by that I mean low political contestation such as introducing certain exceptions: for instance, formalizing exceptions from common law on experimental uses of patented inventions.

There's a landmark case that nearly eviscerated the experimental use exception. Congress could possibly assist research institutions, not-for-profit research allowing exemptions so that they are less exposed to infringement suits if they can prove they used patents for teaching or experimental purposes. And this kind of initiative could also be replicated across the trade partners of the U.S. which would, in turn, create further incentives for the integration of the global production of knowledge in scientific quarters.

I will stop there, and I wait for questions if any of these ideas merit further exploration.

JOHNSON: Thank you, Walter. Let me ask you, quickly, a one follow-up question right now. In light of what you're just saying about my goal and research schools, and experimental connection, how do you see the effects of international technological and geopolitical changes we've been discussing today on the vitality of the U.S. research enterprise overall?

I mean, I think some of us put our university hats on as we look at increasing amounts of university collaboration, both in an institutional but also the ongoing trends with P.I.s, et cetera, with co-creation.

We are beginning to see, at least I think some of us, some friction points of where the dis-junction of different intellectual property issues are then having some impact on international research collaboration.

I would just be interested in how you see that particular area.

VALDIVIA: A short answer for a very complex question is that when you extended the patent system onto the university in 1980, then you triggered a few different effects on the production of science and the organization of science.

And the National Academy actually has a report published in 2010 that considered the evidence up to that point and suggested that -- even though there is some anecdotal evidence of slowing down of basic research – suggested that there is no conclusive evidence of loss of research quality. All the threats to research collaboration and quality such as patent thickets or the anti-commons effect, while postulated and while considered had not, at that point, accumulated enough systematic evidence to claim they were observed.

But that is five years ago. Some of the studies have not been replicated to this day. However, some of the critics pointed out very strong reasons for why there is a loss of quality in science.

There are very important indicators of a detriment in the traditional communitarian ethos of science. There is effective proof that transfer of materials and sharing of data has become much more cumbersome, much more red-taped and much more costly across laboratories.

And so, my take in answering directly your question is that we could anticipate when we accumulate evidence, we will see a deterioration in the quality of collaboration and of science because of the use of patents -- further reason to think of patents as an instrument that should be used, differentiated in the sectors of the economy where they are useful.

JOHNSON: And Rod. What is your initial take away from some of these points? And not limited to how State views these issues, but how they, as a good-standing economist on an international scale? How do you view this?

LUDEMA: All right. Thank you. Well, Alan said that he was speaking on his own behalf, and not on behalf of his agency. I didn't know that that was an option.

(LAUGHTER)

I would have prepared a different speech, but...

(LAUGHTER)

MARCO: I didn't ask.

LUDEMA: No. In any case -- so I guess what I wanted to do is focus my comments mainly on the connection between what we're all talking about here with respect to intellectual property and U.S. trade agreements. TTP in particular, and U.S. foreign policy, more generally.

In my current job, I get to do a fair amount of traveling and talking to -- talking to finance ministers, and foreign ministers, trade ministers.

And the world over, there seems to be a consensus that the future of -- picture economy depends upon technology.

Every government wants to promote the use, the development, and so on of technology. For different reasons, in many cases. In the case of most big developed economies and some large developing economies like China, the motivation is mainly looking ahead at where their economy's going to go, and being very afraid.

What you see in most economies is slowing labor force growth rates, aging populations, and declining growth in labor productivity.

It's not very easy to do anything about the demographic shifts. But to avoid long-term stagnation in governments that are unable to respond to the challenges ahead, because they're so focused on taking care of the older populations. There's got to be something that improves the prospects for the economy.

And everybody pins their hopes on increasing labor productivity, and they see that, they see technology as being the key to that -- to that happening.

For some of the smaller, younger, developing countries that don't face what the media calls this ticking time bomb, in the near future, it's more about trying to participate in what they see as an economy. A world economy that's moving farther and farther away from where they currently are.

For everybody wants to jump onto the technology train. So, that's the first point. Where I think that you get some differences of opinion is over this -- is -- and this is where I think it relates to the protection of intellectual property -- is that it's the difference between those who perceive themselves as being innovators or likely to be innovators versus the rest.

And what I -- so there's been a fair amount of discussion here this afternoon about, you know, developing countries and how they feel that if they were to protect intellectual property, they would somehow be left behind.

They wouldn't be able to -- they wouldn't be able to innovate and instead there would basically be a shift in the terms of trade that is against them.

Actually, when you talk to, at least, smart governments, they don't see it that way. They recognize that the effects of intellectual property is a necessary condition for them to participate in the -- in the global economy.

Even if they are not the ones responsible for the innovation. If they want to participate in global value chains, they have to protect intellectual property because global value chains are very flexible and they will bypass countries that don't collect and protect intellectual property.

If they want to have medicines introduced in their countries, they're going to have to protect pharmaceutical patents, because otherwise threats, you know, pharmaceutical industry companies are not going to introduce products in these economies.

And so, this is a point that I've sort of been on a -- kind of on a bandwagon about. That it's really important to understand -- to think of, from the protection of intellectual property not as a zero-sum game.

That countries can benefit not actually from innovation per se, but also from the adoption of technology from the infusion of technology. And that intellectual property reform in developing countries themselves can facilitate the latter.

And that's actually where the big productivity gains here are going to come from. Now specifically on the issue of TPP, the important thing to understand about TPP is that TPP is not an IP agreement.

It is a trade agreement that has a -- has an IP chapter in it. But it's important to understand and put that in perspective. That as a trade agreement that is designed to promote market access in goods and services and we want that to extend to goods and services that happen to be IP intensive.

The reason we want to extend the agreements to these goods because those are the goods in which the U.S. has a comparative advantage. We export a ton of IP intensive goods and services.

We are the world leader in the export of services, and we have a big trade surplus in service. So just like in any trade agreement, what we're going to do is we're going to push for the things that we -- for greater mobilization in the things that we export. And in exchange, we're going to have to give up market access in the areas in which we import. That's how the trade agreements work.

But it's also important to understand that, you know, when we talk about the intellectual property components of something like TPP, the countries that were participating, it's not like we're putting a gun -- gun to their heads and saying, "look, you have to -- you have to accept U.S. law when it comes to -- comes to IP."

Most countries are very willing to improve their intellectual property protection. And they've held out basically to do it in the context of a trade agreement, so that they can get things in exchange.

Moreover, we see lots of countries in TPP that are going to be doing most of the improving of their intellectual property, we've seen from Vietnam, Malaysia, a few other countries.

They're doing this in conjunction with a whole slew of reforms that are designed to increase the productivity of their economies.

So it's important, I think, to put IP in perspective -- that it's just one component in a relatively small component of agreements which is designed to promote trade and, in particular, to promote trade in these areas where the U.S. has a comparative advantage.

The reason we're doing it is because -- this is the final point I want to make – is that, you know, TPP, TTIP, which is the next agreement that we're going to sign, and the plurilateral agreements that we're also negotiating in the WTO on information technology, on environmental goods, on services, the BIT that we're negotiating, a bilateral investment treaty that we're negotiating with China currently -- all of these things are in response to a broken multilateral trading system. The WTO doesn't work. The WTO doesn't work, because we can't get the BRICs -- primarily because we can't get the BRICs to go along with expanding market access and the types goods and service in which the U.S. has a comparative advantage.

And so this is -- and you have to understand TPP. That's it's not a -- it's a means to an end. It's a strategic agreement that is designed, not only to benefit the U.S. economy in the near-term, but also to put pressure on other countries, so as to get better and better agreements to a multilateral level.

Now, I've incidentally given you my last point, and I just want to make. We'll go back to TPP because there's actually some important components in TPP that are very important for innovation, but which don't have anything to do with -- or they don't directly have any to do with the IP chapter.

The one I think that we're most excited about at the State Department is the chapter on e-commerce, which guarantees the free flow of data across borders, prevents the data localization, and prevents the trade barriers being put on digital goods.

I think that looking forward, and a number of people this afternoon have alluded to it, where technology is really going, it's all going digital.

And so putting, right, these types of these elements in TPP is really what makes it a 21st century agreement. So that's where I'll stop.

JOHNSON: OK. Thanks, Rod. And I want to open it up for questions and comments in a second. Let me follow up on your interesting points about both on the global value chains and the technology chains.

And in particular, in light of the TPP and the other agreements, I mean, if I look out there, I see, over the next 10 years, a reorganization in many of those value chains enabled by technology, not only in Internet or Internet of Things, but biologically, et cetera.

I mean, well, you can see it in an advanced level in terms of, say, with Germany with the Industry 4.0 Program, which is basically a new type of fiber physical system of integrating, you know, manufacturing internet of things, automation of data, new ways; us in the U.S. with advanced manufacturing, biological, by data-driven innovation.

The OECD has a new mandate among many of its countries around next production evolution. Koreans, as their creative economy is working also with the small advanced emerging economies on a systems innovation platform.

So my question is: do you think that the provisions and types of things that we're seeing in the current agreements are going to be adequate as the global value chains reorganize? And how you after-value in those chains with over the next 10 years?

Hard thing to look into the crystal ball about, but I'd be interested in your thoughts about it.

LUDEMA: Are they going to be adequate? I would say probably not. I think it's a start that we're seeing here in TPP. I think it's a start of a pretty good agreement, TPP, but you know, particularly on this -- on the free-flow of the digital e-commerce – free-flow data.

There are a whole bunch of other things. Components of the TPP that are designed to facilitate -- to facilitate, you know, global value chains. Intellectual property chapter is one of them.

Rules of origin is another important component. I think that, you know, you'll see components of the agreement throughout that are specifically designed to promote global value chains, as well as to promote access to global value chains for the relatively small and medium-sized businesses that, you know, heretofore have largely been -- have largely been shut out, where, when we think that there's a lot of potential for growth.

So I mean, there's a ton of provisions that are -- that are there. I wouldn't say it's a seamless approach. I think that the -- you know, the other rules of origin, for example, are still a bit complicated and hard to figure out.

And that has got to be streamlined. I think that even on some of the provisions that we have in TPP, it's not clear that we're going to get those same provisions at the multilateral level, which I think would be really beneficial for promoting global value chains rather than just the specific regional value chains, which is what the TPP directed us.

So I would say it's a -- it's a -- it's a great first step. And I would say the most admissive that anybody has attempted to make thus far.

And so, I guess I would – I'm a sort of glass half full guy.

JOHNSON: Let me invite questions, comments. We also particularly would welcome comments as well as questions to any of the panelists about things that you've heard things, things that we think -- things that you think we really should be focusing more on.

Or -- gaps, what haven't we talked about today that we really have missed in sort of this quick whirlwind overview of some of these trends. So questions, comments? Go ahead -- go ahead, Ken.

QUESTION: Ken Jarboe, now with the National Academy of Engineering. In my previous life, I did a lot of thinking about tangible assets as assets.

And I go back to the story that somebody had on an earlier panel, where they said they'd went to a small country, who wanted important assets.

Well, they wanted IP, not because of innovation but they wanted IP because they were value, quote-unquote, "valuable," and therefore, they would get return. Supposedly tax revenue, et cetera, et cetera, et cetera.

That comes with having the income from the IP. And I want to go back to Alan's point, when you said you're seeing securitization of IP now, and worried about that as a bubble.

For me, who spent a lot of time thinking about intangible assets, I'm both pleased and frightened by that statement. The pleased part obviously is because it means people are paying attention now and they're thinking about these things -- of assets.

The frightened part is they could really screw it up and screw it up badly. So could you say a little bit more about that? And to get to your point, Michael, what's missing? Let me just reinforce that part of it.

Because we all know that patents have the right to exclude. But we also know that the right to exclude brings with it the right to include. And that's where the monetization comes from.

It's not from the patent per say, it's from the contract to license that patent -- to the patch to that patent -- so it's already in many ways a derivative.

So could you say a little bit more about what you're seeing and why you're worried about it?

MARCO: Well, I'd agree with you that I see it -- I'm a little ambivalent, I would say. Right, I'm worried -- I'm worried about the enthusiasm with which part of the market is sort of looking at these securities.

But also I do think it points to some really good things about the marketplace. One is that it does show there's an ability for IP to be used in ways that weren't possible before. And anytime that you enable that, then you increase the value of those rights.

For example, we see an increase over the last couple of decades in the use of IP to secure debt financing. These “security agreements” are especially common with trademarks, actually--more so than patents. Now, the data we're looking at is voluntarily reported, so we don't know exactly how much we're missing. But I think that in the case of trademarks, it is a real trend. The increase in security agreements makes it by far the most common type of assignment recorded at the PTO.

As opposed to the sale of a trademark or one involved in a merger and acquisition or a name change or anything else. But securitization is the number one category of assignment at PTO. It’s incredible growth over the last 20 years.

What this is showing is that now the owner of IP has more options on what to do with those assets. Before, if they wanted to monetize their IP, they were either going to produce, license it, or sell it. Those were their options. Now, they can more easily put it up as collateral and get some debt financing. I don't think that would be happening unless the marketplace understood trademark valuation and patent valuation better than it used to. So I think that's a positive sign about the valuation that's out there and about the way that folks understand these types of assets.

That said, like anything else we still have uncertainty. If you think about real estate transactions, we have far more information about those transactions than we ever do about intangible asset transactions. They're recorded, we know who own them, and we can get insurance on them and so forth. We really understood a lot about these real property. And yet there's a real problem in valuing mortgage-backed securities, all the more so with IP-backed securities.

I have hope that we have more information and the valuation metrics are becoming better understood. At the same time, the uncertainty can still lead to a bubble or the other kinds of bad outcomes that we might expect. So, I'll leave it there.

JOHNSON: And before having Brian speak, Alan, do you have any orders of magnitude of the numbers we're talking about? There was a five in the IT markets were now dealing with in terms of intermediary, you know, just pure tradable assets, securitization.

MARCO: In dollars? I really don't. I do know, again, what we've seen even in patents--aside from the defaults assignment from the inventor to the employer—security agreements are among the most frequent type of transaction. But as far as dollars go, unfortunately we don't have any good data on that.

JOHNSON: Brian?

KAHIN: Well, I think I'm going to continue on along this line of inquiry, because it's something I've been thinking about a lot. You know, it's kind of ironic that the patent system is supposed to promote disclosure information, and we have so damn little information about how it works in practice.

And I think this is, you know, going back to a comment, "this is a scary thing," for other countries. They don't know what's going on with the secondary patent markets, particularly in the U.S.

And what we're told by practitioners is these markets are mostly driven by evidence of use. You know, this is not technology transfers as normally thought of.

That is, knowing that somebody inadvertently or not, is infringing a patent and trying to exploit that. So, how do we get at this problem, and we improve the statistics collection, because it's terrible.

And my view is this is one reason why governments get involved in sovereign patent funds or state investment in patents directly, including through intellectual ventures.

Several public universities are invested in intellectual venture, because that's the only way they can find out about the market, by participating in it.

MARCO: Yeah. If you own it, then at least you know who owns it, right? Interesting point. I do think that there are certain areas of transparency that would be relatively low hanging fruit.

And ownership is, I think, one of them. There are other areas where it's still going to be always more difficult with intangible property than in physical property. I mean, simple valuation is always going to be more difficult with intangibles. But from the standpoint of ownership, I think from a public policy standpoint, there's no reason why we shouldn't know who owns the asset.

Now, I will say that there could be reasons why you may want a lag in reporting. If you have large incumbent firms you want to lower the barriers to entry. You might want a period of 12 months or

something before a new entrant has to report. But at some point you want that reporting to happen and you want to know that you can trust what's on the book.

I think that's the low hanging fruit. As far as other areas of transparency, I think the 18 month publication is one where, honestly, because of international agreements, we're locked into that. So, we're not going to see anything before 18 months. And whether we should or not, that's just going to be the way it is and there's no way to change that. But on the ownership side, it seems to me that it's the low-hanging fruit.

QUESTION: Hi, Tom Noel with ODNI. So several times today, the connection and the distinction between science and technology has been made. And Bayh-Dole Act has been mentioned.

The Bayh-Dole Act has created some problems for the government, because sometimes the government does invest in science for the purpose of developing a capability, and eventually trying to get a technology. But then the government doesn't actually own the IP through the research that it funds.

It's also -- there are some problems related to that with inter-access between the academy and the commercial sector. For many universities, especially the top research universities in the U.S. have created technology transfer offices that can be generously described as aggressive.

And we, you know, in my role I have talked to a lot of private companies that do not engage universities in research, because the universities will not agree to any circumstance -- arrangement in which the company would actually own the IP from the research that it funds.

We have a big problem in this country with the transfer of technology, kind of, you know, the transfer from science to technology moving from the laboratory to a product.

Now, my question is, what does this situation look like in foreign countries? And if they have regulatory frameworks that better allows the transition from laboratory to product, what kind of real advantage would that give them over the United States?

VALDIVIA: I'll take that one. I agree with many of the premises of your question. But I would like to clarify one important point, which is for about 40 years, innovation studies have made an effort to discredit the Linear Model of Innovation, in which we imagine ideas moving down a conveyor belt of increasing application into the market.

Innovation happens only rarely this way. But most innovation is generated by a circuitous system of interactions between the actors of innovation, in which there are many feedback loops.

And sometimes technology pulls in the science to emerge. And I make this clarification because the Bayh-Dole Model is designed with the Linear Model of Innovation in mind.

That was the understanding then and we would imagine that after 35 years, policymakers do not use the linear innovation model anymore.

But proponents of Bayh-Dole keep using this idea that the university is a center of insular research where the ideas emerge from thin air and need to be somehow made appropriable, and what's best to do that than the patent system? The reality is that innovation doesn't happen that way.

So the challenge that you pose is to ask, what is a better way to promote tech transfer and how could other countries benefit from the U.S. experience?

I would answer that first we must realize that universities provide a vast array of services including knowledge production and innovation, and only a few of those services benefit from patenting. If you will, patenting is one lane in an eight-lane highway.

Recognizing the university has many channels to contribute to society, it is sometimes perplexing that we focus so much on the importance of patents; the university system as a system has very little -- should have very little interest in defending stronger patent protection.

Patents and patent protection will have their own protectors and their own political interests. It's vexing that universities would advocate for that one channel, and not take the larger perspective that their contributions are vast. And I can name a few: the training of the labor force and calibrating the training of the labor force to the future demands of industry.

Also, a huge amount of knowledge transfer into the economy involves faculty consulting, and perhaps the most important lane, the HOV lane, is the dissemination of new knowledge in the public domain - which has traditionally been a very important source of contributions of universities to the economy.

And when we take this perspective or we correct our misconceptions of tech transfer from universities to industry in the U.S., perhaps we should be more humble in understanding that other countries will have their own configurations, with several lanes themselves, and that pushing for more -- or stronger patent protection is perhaps inserting ourselves in the evolution of their innovation system and the way their universities contribute to their economy.

Patents have a place. I'm not dismissing patents. But they are not the silver bullet of tech transfer or innovation.

JOHNSON: And I just want to mention quickly. I have looked at this a fair amount in the last couple of years, and I think what you're also seeing is that you had a trend for a number of years where people are trying to copy Bayh-Dole and thought that was the magic recipe, and it didn't work for their country.

And now you're seeing a lot of different leapfrog strategies, the sort of new types of models, but it's too early to say whether they're going to work.

And obviously they're not stand alone. They're also in corporate factors in those countries where it's still not OK to fail. It's really hard to go lab-to-market in those countries where you don't have a soft infrastructure.

Where you get that, you know, outstanding thing comes up – at --institution or at MIT, any of the top U.S. universities where you have networks and people who can help in different ways to facilitate.

You know, that's what -- that -- a lot of parts of the recipe are missing in some of these other new models. But more importantly, I think the short answer is, there are a lot of new models out there to look

at that we better be paying attention to, A, to see what's going on and B, saying, those are some good ideas that we can adapt for our own purposes...

Go ahead.

QUESTION: No. I think this follows perfectly. This is – from the ITC. Another thing we heard about was the rising importance of trade secrets as patents become more uncertain.

And I wonder if you can comment on the ramifications of that for innovation? Is it possible that because of that lamp post problem that someone mentioned, we've been overemphasizing the importance of patents to innovation?

And are there some benefits to moving away from it towards a sort of theft-based intellectual property system rather than a trespass-based one?

MARCO: I'll try to address part of that. So, it's difficult to contemplate what the trend has been when the trade secret component of that is so unknown.

I don't know that I would say that patents have become more uncertain, because I'm a little more sanguine about that. I actually think that, in a lot of ways, the new patent licenses are becoming more clear rather than less clear--certainly in more mature technologies.

However, in terms of thinking about how firms use patents, I mean, it's clear that it's been constantly studied because they're in the light. However, I think that that's really pulled us away from some other things that are also in the light. Which is, if we're really seeing innovation the best way to measure that is in the final goods and services that are provided. We should see higher quality goods at lower prices. And those should change more quickly with more innovation. I think that more research can be done on that.

Now, the last thing, and I'll mention the incredible difficulty in measuring it, is what's the value of IP to the economy? The fact that I can, in my hand look up on the internet what a certain acronym means--I typed it in and now I know it. What value is that to me? That I can know that in two minutes instead of going to my dictionary, later tonight and finding that out. Can that be quantified?

Those things are really still difficult to measure. But nonetheless, if the innovation is due to trade secrets or it's IP driven, no matter what it is, it should show up in higher quality goods and services at lower prices. And hopefully available to a broader group.

To the extent then that we can go identify that, and go back and tie it to patents, tie it to something else, then the remainder would have to be all the other stuff including trade secrets. So it's a little bit like the Solow residual in economics.

JOHNSON: Anyone have a final question or comment? Arti, did I see you wanting to make an intervention?

RAI: No, I was going to intervene on the specifics -- is there a bubble and how would we know that we are in trouble?

(LAUGHTER)

JOHNSON: Here's the mic.

RAI: On that question of the data you're setting, Alan, which says that trademarks are being securitized. Might you have a selection bias, or not a selection bias, or a problem because patent assignments are really under-reported?

MARCO: Yeah. Absolutely. That's why I trust the trademark data a little bit more than the patent data, because there are more institutional reasons why they would want to be more forthcoming with that information.

RAI: Right.

MARCO: In some cases I absolutely think it's under-reported. You can still see the trend though. We can't tell whether it's more or less under-reported than other types of transactions, that's the main thing.

RAI: But even in patents given, you know, even given the under-reported you see...

MARCO: Oh, absolutely. It's increasing. We also know, anecdotally from firms that are in the business of writing insurance. And this is where we have some financial innovation going on, where they will offer an insurance contract to the lender to say, "We know you don't know how to value this stuff. We'll take salvage value. Here's how much we'll give you."

It removes all uncertainty from the part of the lender, and there's a specialized group of intermediaries that take on the risk. Which, I think, is a useful innovation… unless 2008, you know.

RAI: Yes, exactly.

YU: So my question's for Alan. So the former director of the ITP parliament of Hong Kong has been pushing for IP trading. And so, in the U.S., before the crash – is doing that.

So given the bubble, I'm wondering what's your take on all this effort to push for IP trading as part of a national strategy?

MARCO: So, I would -- I just want to be clear. I wouldn't say that we're necessarily in a bubble. I would say that I predict that the next big bubble will be in I.P.

But you know, that could be 20 years from now. I think that it's about getting better data. I really think that this issue of transparency is at the core of being able to facilitate any sort of trades.

Whether it's wholesale trading on the actual patent rights or trademarks to being able to buy and trade license rights, which is a much more complex kind of thing. We have to get the first things first. To get that first stage efficient in any way, we need better information.

I do think that, in talking about Bayh-Dole and government interest in patents, I think that this is also low hanging fruit. There are laws on the books that require this information to be told to the PTO. When there is a government interest in a patent, we are supposed to be told when it's traded.

By whom? I don't know how explicit it is. But we could start to enforce patents with a government interest first, and build a framework that's in place before we start folding in private transactions.

We should have better information on patents in which there's a government interest. I think that's something that's clear and obvious, and I think that that's where we start.

And until we can get that market efficient and even know when it's right, we can talk about the after markets, but I think we have to start there.

JOHNSON: OK. That's appropriate. The last one goes to Steve.

QUESTION: Very quickly. The more often you say, low-hanging fruit and first things first, the more I think it's incumbent on you to explain why it's so difficult to get ownership data?

MARCO: Well, I'll give the very short answer: politics. It's not a technological reason. It's primarily politics. Secondarily, I think that the USPTO has not invested in creating systems to reduce the costs of compliance for the industry to provide that information.

If we provided writable API's, where owners could easily feed data directly into our systems, it would lower the compliance cost. We haven't done our job, investing to reduce the compliance costs. Since we haven't reduced the compliance cost, there's always going to be a segment of the economy and a segment of the users, that object to providing more information.

And honestly, it's difficult for us to ask more than the bare minimum in order to grant a patent, because our statute says "a patent shall issue unless…" and Arti probably can answer this question better than I can. The basic thing is that there is a list of things you need to show to get a patent. And if you can show that, why do you have to tell me exactly what you're going to do after the patent is granted?

JOHNSON: Well, thank you all. A couple of rounds of thanks first to our panel here.

(APPLAUSE)

And I'd like to thank again our sponsors, because I think there's really timely and appreciate their support: ODNI, IBM, the Economic Development Administration, and the Office of Naval Research.

Obviously, the organizing committee put together a great set of speakers, so for Brian and Rochelle, and Keith and Bill Colglazier, we want to thank you for your participation.

We hope this is not actually the end of this discussion. And Gail is over there, you all know Gail, and so for ideas about what we should do with this, beyond -- obviously, this is very valuable to have a one-day workshop like this.

I think many of us in the room and I, even just in small, blind conversations in the course of the day, were thinking we need to find some focal points to be able to take this forward because it really is the important set of issues and subsets of issues.

So again, than you very much for your attendance, and have a great weekend. Thank you.

(APPLAUSE)