Economic impact of AI

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Motivation

- Understanding the effects of AI on the economy (+ society)
  - Macro-level: wealth creation, global R&D strategies, technological effects...
  - Micro-level: increasing productivity, automation, effects on prices
  - Individual agents: entrepreneurship, demand, effects on salaries and employment

→ Climate change;

→ Fake news and democracy;

→ Global frauds and tax havens;

→ Wars; and China - US technological conflicts...

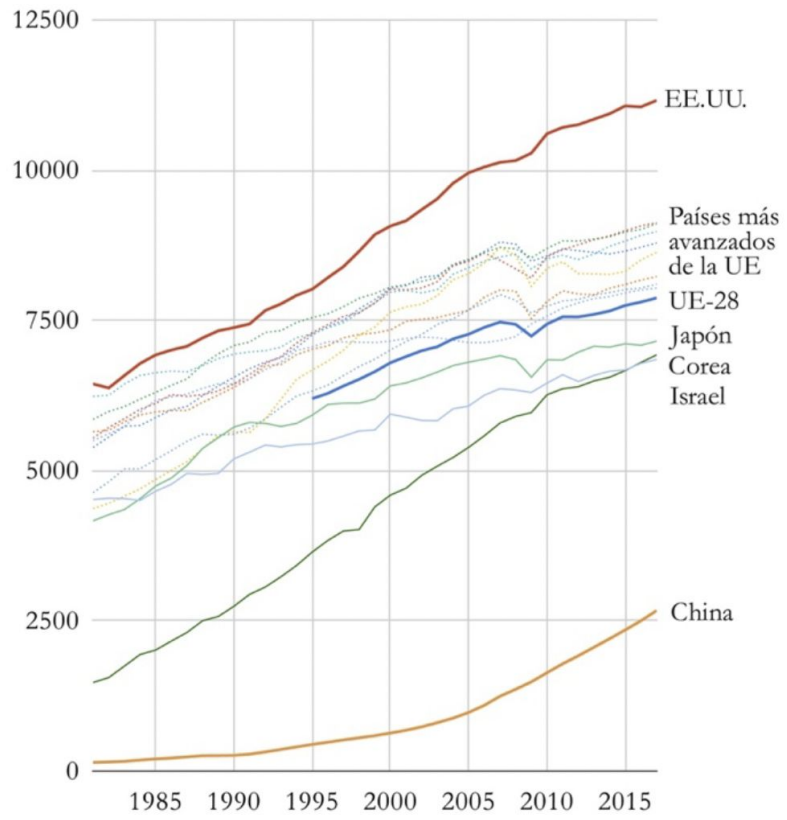
Understanding why

Robert M. Solow (1987): *'You can see the computer age everywhere but in the productivity statistics'.*

Robert M . Solow (1999): '*My beliefs are shifting on this subject; the story always was that it took a long time for people to use information technology and truly become more efficient. That story sounds a lot more convincing today than it did a year or two ago*'.

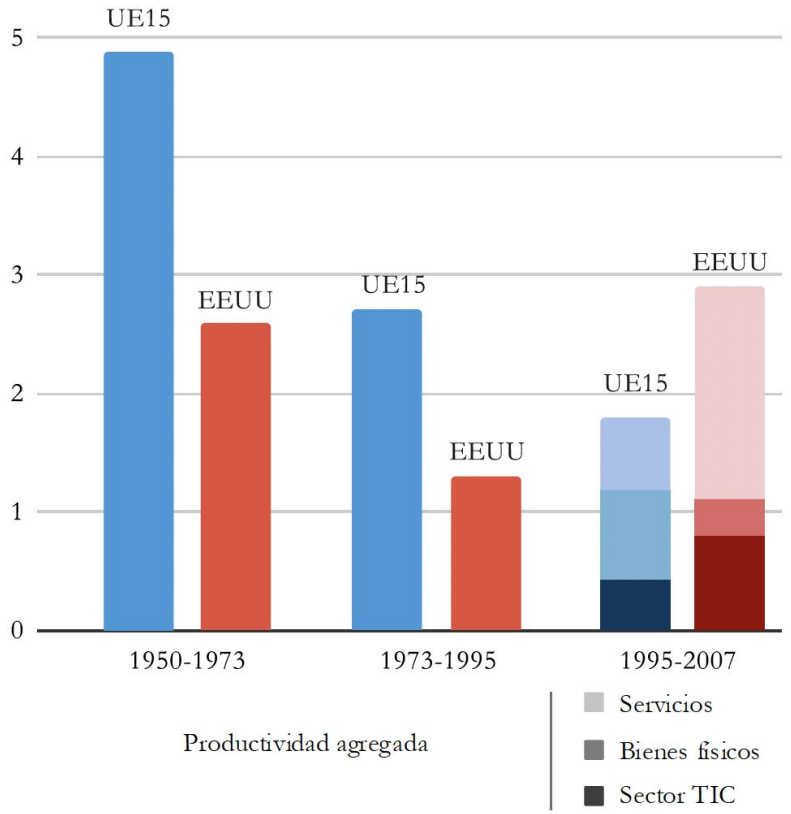
Understanding why

Productivity per employee



Source: Moreno Izquierdo and Pedreño Muñoz (2020)

Productivity per employee



Source: Moreno Izquierdo and Pedreño Muñoz (2020)

Making different questions

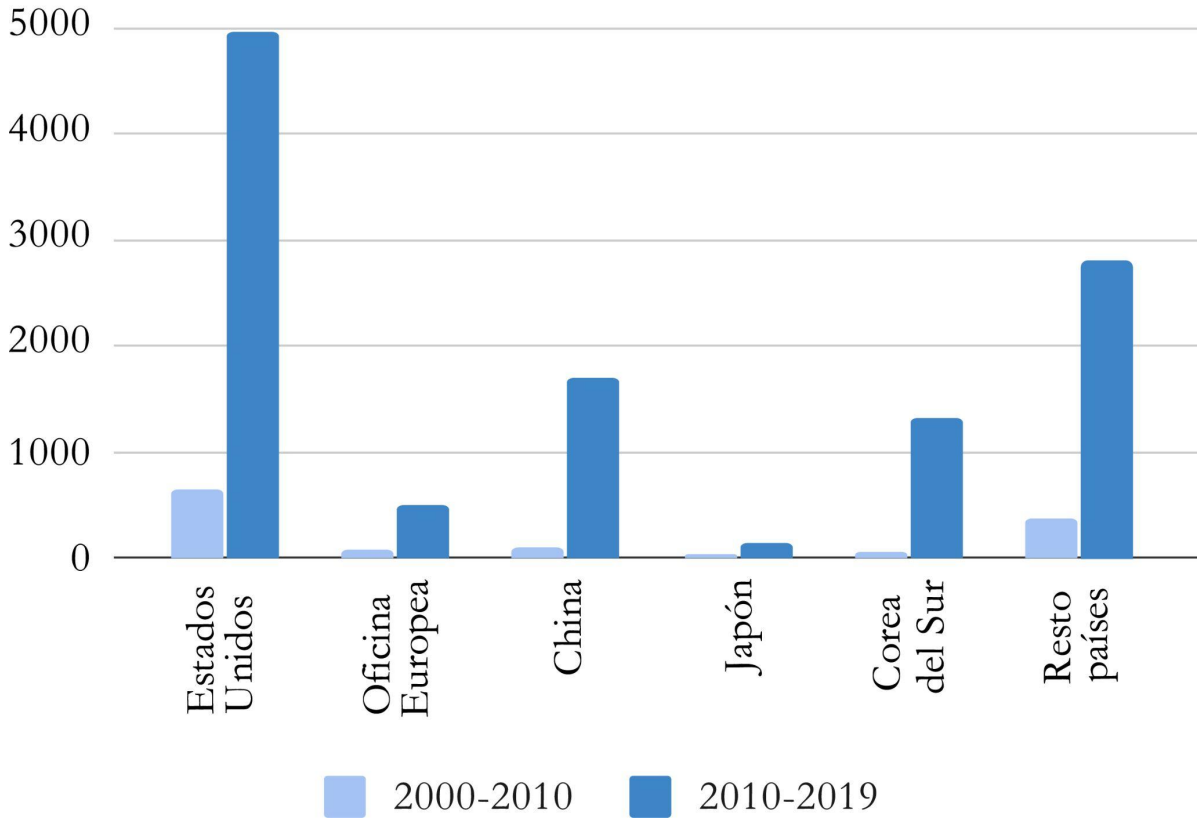
- **Is AI a disruptive technology?**
  - How different is it from the previous technologies?
  - Is AI causing a process of creative destruction?
- **How are the different sectors adapting to AI disruption?**
  - Are the sectors generating or adapting innovation?
  - How are technological companies interacting with the economic sectors?
- **How is the economic science integrating AI in its own evolution?**
  - Does AI implies new motivations for researchers?
  - Is there a methodological change in how economists study their science?

What we know...

- The economic History tells us that innovation is one of the engines of wealth and well-being.
- There is no discussion about that: AI will increase productivity (this is occurring right now) although the statistics may take some time to prove that.
- Therefore, we could estimate which sectors and countries will lead the economic development in the following decades.

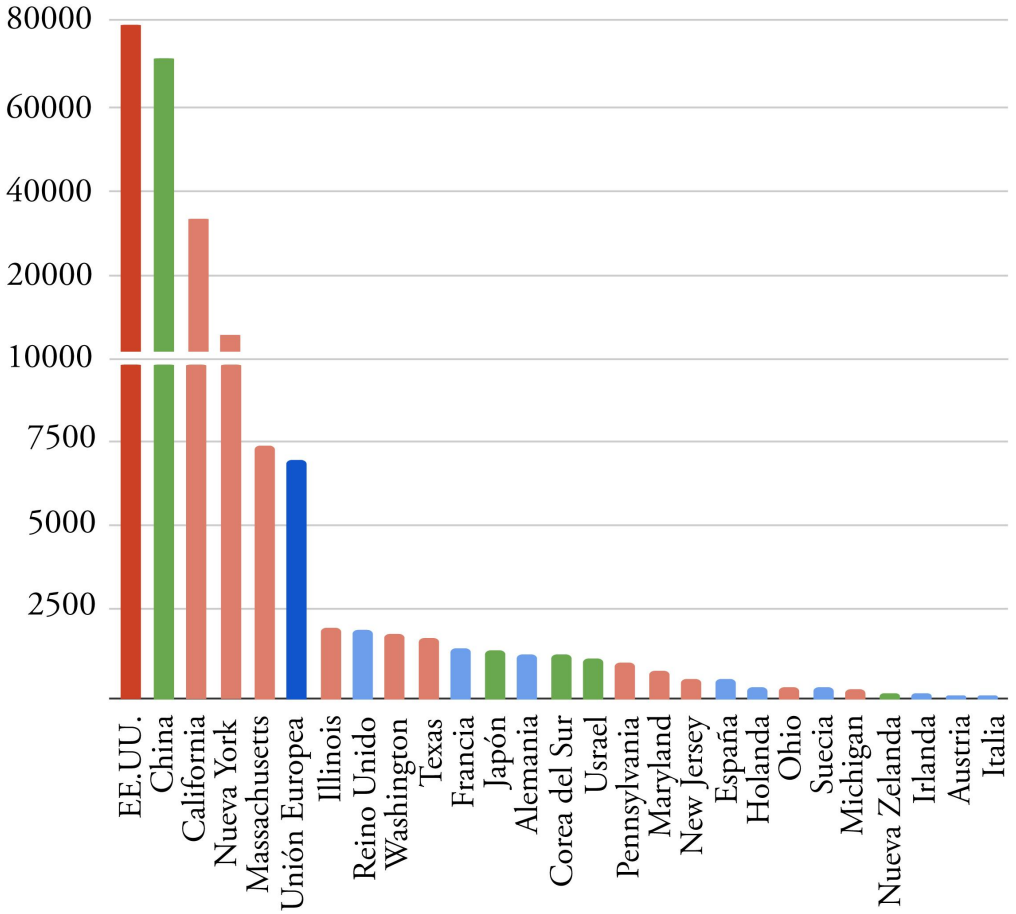
What we know... from a qualitative perspective

Registered AI patents



Source: Moreno Izquierdo and Pedreño Muñoz (2020)

Venture capital investment



Source: Moreno Izquierdo and Pedreño Muñoz (2020)

What we know... from a quantitative perspective

- By using the Borda Condorcet methodology we can establish the AI leadership studying different components such as:
  - Scientific publications on AI from 2015 to 2020 (% of total publications)
  - % of STEM graduates in tertiary education
  - % of top performers in Mathematics (levels 5 and 6)
  - % of AI companies with over $100 million in financing
  - IA patents from 2012 to 2021 per million inhabitants of urban population

$$\mathbf{BC} = \begin{pmatrix} B(1) & c_{12} & \dots & c_{1m} \\ c_{21} & B(2) & \dots & c_{2m} \\ \dots & \dots & \dots & \dots \\ c_{m1} & c_{m2} & \dots & B(m) \end{pmatrix}$$

$$c_{ij} = n_{ij} + \frac{e_{ij}}{2}$$

$$B(i) = \sum_{j \neq i} c_{ij}$$

What we know… from a quantitative perspective

Environment			Human capital			Social capital			TOTAL		
Denmark	0.2691	100	Estonia	0.160	100	UK	0.216	100	Germany	0.139	100
Sweden	0.2605	96.8	Portugal	0.149	93.2	France	0.129	59.8	UK	0.131	94.3
Germany	0.0875	32.5	Germany	0.146	91.4	Germany	0.104	47.9	Sweden	0.080	58.8
Netherl.	0.0784	29.1	Austria	0.132	82.7	Belgium	0.097	45.1	Netherl.	0.071	51.5
UK	0.0639	23.7	Greece	0.085	53.0	Ireland	0.079	36.5	Estonia	0.071	51.5
France	0.0630	23.4	UK	0.060	37.6	Netherl.	0.051	23.7	France	0.069	49.7
Estonia	0.0557	20.7	Finland	0.046	29.11	Austria	0.051	23.5	Belgium	0.063	45.9
Finland	0.0394	14.6	Netherl.	0.044	27.6	Italy	0.050	23.1	Finland	0.060	43.1
Belgium	0.0362	13.4	Ireland	0.038	23.8	Spain	0.045	21.1	Denmark	0.056	40.5
Spain	0.0229	8.51	Belgium	0.035	22.1	Finland	0.039	18.3	Austria	0.049	35.7
Ireland	0.0091	3.38	Italy	0.033	20.8	Greece	0.037	17.2	Greece	0.046	33.4
Greece	0.0058	2.16	Sweden	0.029	18.2	Sweden	0.036	16.7	Ireland	0.045	32.3
Portugal	0.0039	1.45	France	0.017	10.8	Denmark	0.026	12.1	Portugal	0.044	31.7
Austria	0.0034	1.26	Denmark	0.0117	7.29	Portugal	0.022	10.1	Spain	0.036	26.5

Source: Peretó Rovira, Moreno Izquierdo and Beviá (f.c.)

What we know... from a quantitative perspective

Environment			Human capital			Social capital			TOTAL		
Sweden	0.2043	100	China	0.423	100	USA	0.217	100	Singap.	0.158	100
Korea	0.1531	74.9	Singap.	0.295	69.8	Canada	0.151	69.6	Korea	0.147	92.8
Netherl.	0.0954	46.7	Korea	0.118	27.9	Singap.	0.142	65.5	China	0.114	71.9
UK	0.0948	46.4	Israel	0.046	10.9	China	0.137	63.2	Canada	0.080	50.9
Germany	0.0863	42.2	Germany	0.038	9.0	Korea	0.077	35.7	USA	0.077	48.8
USA	0.0666	32.6	Estonia	0.022	5.2	Japan	0.061	28.4	UK	0.062	39.4
France	0.0655	32.0	Canada	0.013	3.1	Australia	0.058	26.7	Germany	0.061	39.0
Singap.	0.0644	31.5	Japan	0.011	2.7	Israel	0.052	24.2	Estonia	0.046	29.6
Estonia	0.0600	29.3	UK	0.010	2.4	France	0.041	19.1	Sweden	0.046	29.5
Canada	0.0394	19.3	USA	0.006	1.4	UK	0.018	8.4	Netherl.	0.042	26.9
Australia	0.0280	13.7	Netherl.	0.005	1.3	Netherl.	0.016	7.7	France	0.042	26.6
China	0.0247	12.1	Sweden	0.003	0.9	Germany	0.013	6.2	Japan	0.041	26.1
Japan	0.0105	5.1	France	0.003	0.7	Sweden	0.007	3.3	Israel	0.041	26.1
Israel	0.0062	3.0	Australia	0.002	0.4	Estonia	0.002	1.2	Australia	0.035	22.4

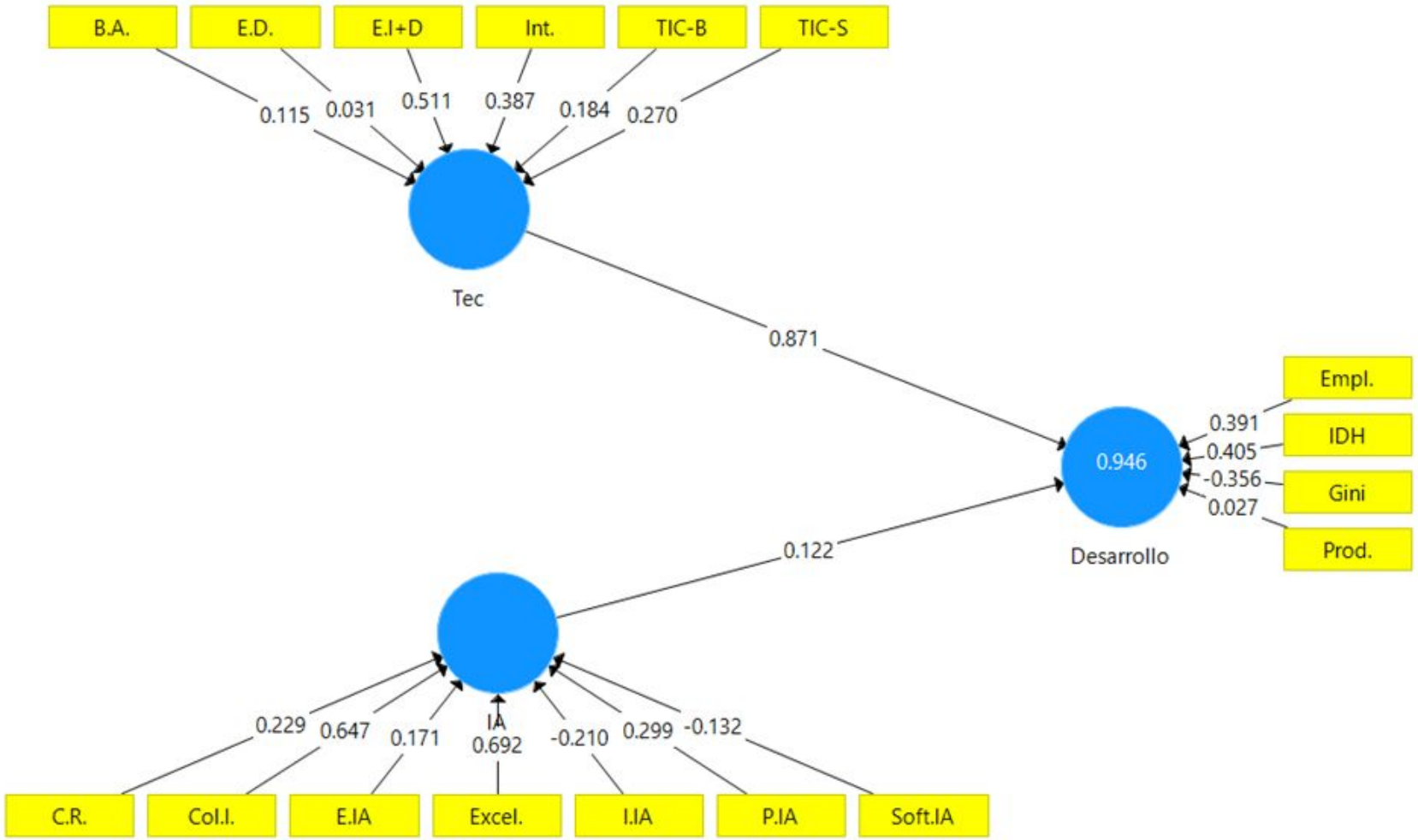
Source: Peretó Rovira, Moreno Izquierdo and Beviá (f.c.)

What we know… from a quantitative perspective

- By using PLS-SEM methodology we can understand how different technologies are impacting economic development.

$$PIB_t^h = PIB_t^{h,Tr} + PIB_t^{h,D} \begin{cases} PIB_t^{h,Tr} = f_t^{h,Tr}(FP_t^{h,Tr}, ASC_t^{h,Tr}, \delta^{Tr} A_t^{h,Tr}) \\ PIB_t^{h,D} = f_t^{h,D}(FP_t^{h,D}, ASC_t^{h,D}, \delta^{D} A_t^{h,D}) \end{cases}$$

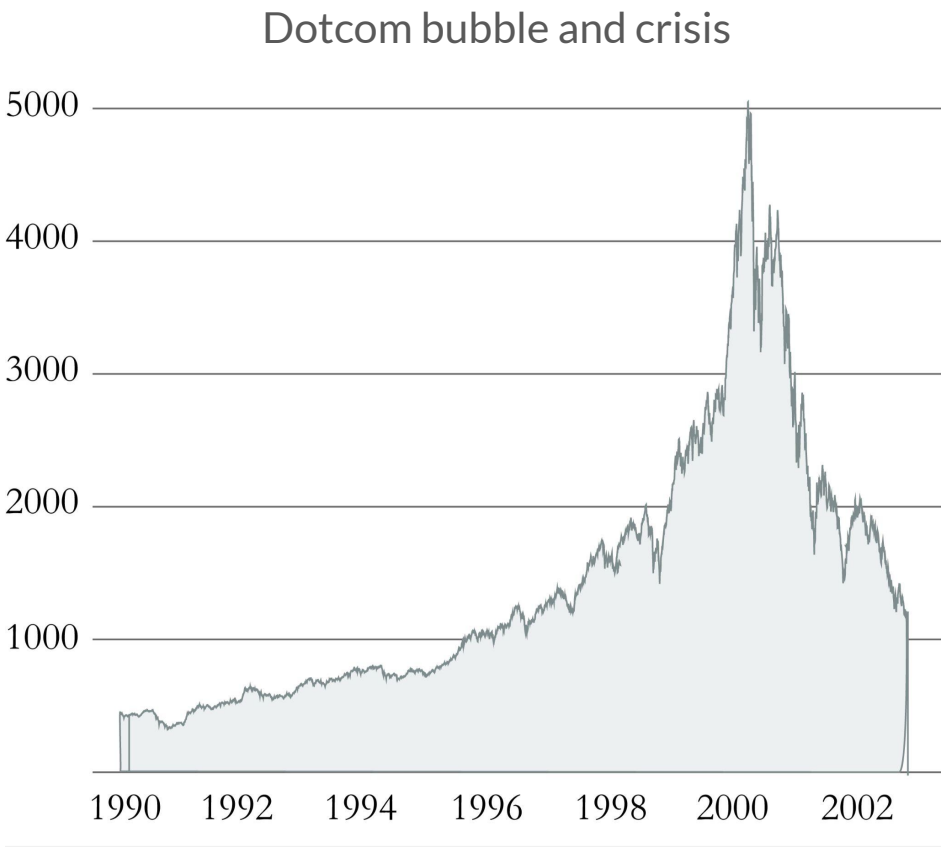
What we know... from a quantitative perspective



Source: Peretó Rovira and Moreno Izquierdo (f.c.)

What we don’t know…

- All the statistics, econometrics, and predictions indicate that AI will be an outstanding element in our lives…
- … but statistics have several problems:
  - The predictions are based on historical data.
  - The technology effects can be unpredictable.
  - Economic development experiences bubbles, crises, and cycles…



Source: Moreno Izquierdo and Pedreño Muñoz (2020)

What we don’t know…

- Theoretical models will help us to understand different scenarios for AI evolution and its effects on salaries, wellbeing, productivity, level of employment, ¡or even free time!

What we don't know...

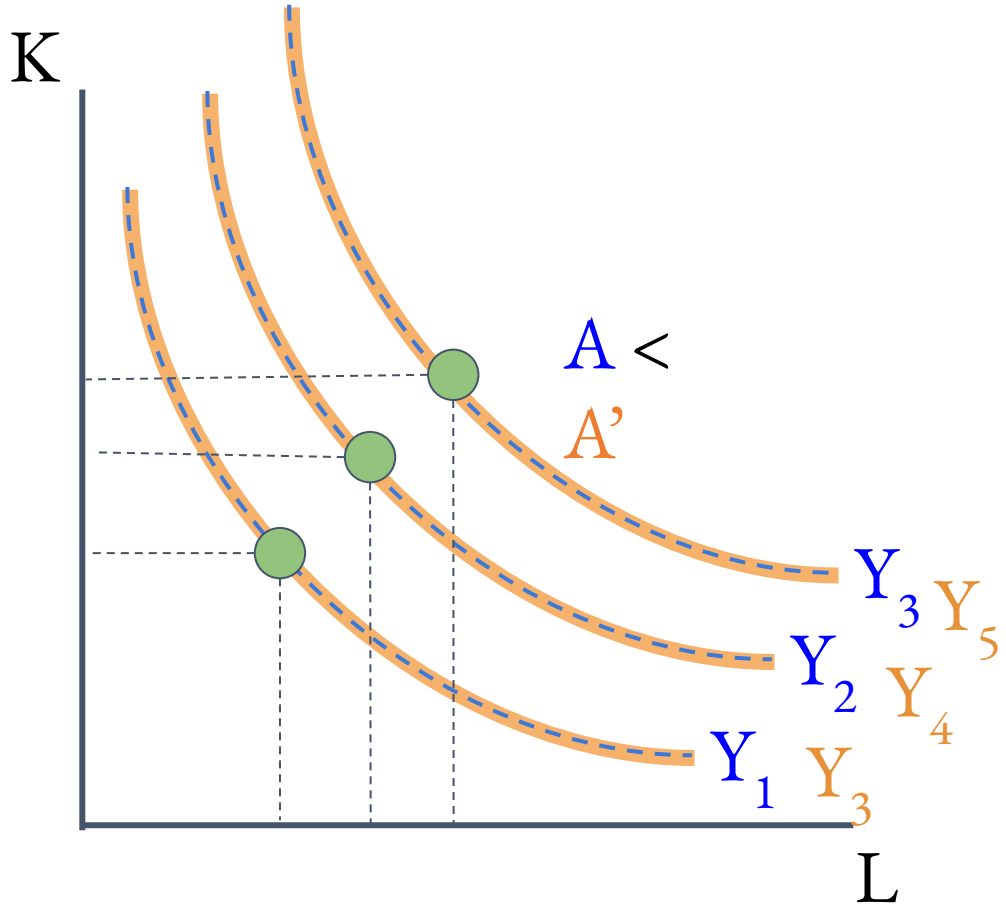
$$\min_{K,L} C = rK + wL$$

$$SMR_{Old} = w/r \; ; \; SMR_{New} = w^*/r^* \; ;$$

$$SMR_{Old} << RMS_{New}$$

$$u_C = -\alpha T + \beta C > u'_C = -\alpha T' + \beta C$$

where *T'* means a reduction of the number of hours worked per person because of a new technology (A'), increasing worker's utility (depending on the effect on salaries on consumption).



Source: Moreno Izquierdo and Garrido (f.c.)

Summarizing

- The economic impact of AI is not a novelty from a theoretical perspective:
  - There were previous *disruptive* technologies before AI
  - We are living in a digital age with a continuous increase in productivity
  - Every technology causes effects on other sectors, change social values, and creates new jobs.

Summarizing

- From the economic science we can only provide two kind of exercises:
  - Quantitative, measuring how AI is changing our lives
  - Theoretic, developing models to help us to predict different scenarios, in order to anticipate decisions.

- But for having a complete picture of the effects we will need to work hybridaly with other sciences, in order to implement in our models those aspects that escape from our science and can let us to define a better society for everyone.

Thank you!

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