

# DIGITALIZACIÓN, GLOBALIZACIÓN Y TENDENCIAS DEMOGRÁFICAS

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Seminario “La Administración regional ante el reto de la digitalización”

26 de octubre de 2020

# INTRODUCCIÓN

- Naturaleza de los cambios tecnológicos
  - Nueva revolución tecnológica en un mundo global: Robótica, Inteligencia Artificial (IA), “Globótica”.
  - ¿Qué tienen de “nuevos” y por qué ahora?
- Globalización: Nuevos desarrollos (impulsados por los cambios tecnológicos)
  - Manufacturas sin empleos y servicios comercializables internacionalmente (*Jobless manufacturing and tradable services*)
  - La polarización del empleo y su concentración en “servicios protegidos” en los países avanzados
  - Capitalismo sin capital
- Cambios demográficos
  - La disminución (absoluta y relativa) de la población en edad de trabajar
  - Interacciones con cambios tecnológicos
- Comentarios finales
  - Consecuencias macroeconómicas
  - Implicaciones para las políticas públicas

# LOS CAMBIOS TECNOLÓGICOS DESDE UNA PERSPECTIVA ECONÓMICA

# TIPOS DE CAMBIOS TECNOLÓGICOS Y SUS EFECTOS

- Nuevas formas de producir que nos permiten obtener *más y/o nuevos* bienes y servicios con los mismos factores de producción (*Factor-augmenting technological progress*)
  - Innovaciones de **proceso** (producimos más con los mismos factores)
  - Innovaciones de **producto** (aparición de nuevos bienes y servicios con valor económico)
- Tienen tres efectos:
  - Aumentan la productividad (pero no de todos los puestos de trabajo por igual)
  - Desplazan trabajadores (pero tampoco a todos por igual)
  - Abren nuevas oportunidades de trabajo (normalmente con requerimientos de habilidades distintas a las de los puestos de trabajo que desplazan)
- La magnitud de estos efectos y cómo se transmiten al resto de la economía depende del cambio tecnológico en cuestión
  - Sesgo a favor de determinadas ocupaciones (“intelectuales” más que “manuales”)
  - Eliminación de trabajo rutinario (cualificado y no cualificado. Hacia la “polarización” del trabajo)
- Elemento clave: Relaciones de **complementariedad** entre factores de producción y los cambios tecnológicos

# IMPLICACIONES PARA EL TRABAJO Y EL EMPLEO

- Trabajo: factor de producción que combinado con otros factores (capital , input intermedios, etc.) genera bienes y servicios.
  - Tareas (ocupaciones): Las distintas formas en las que el trabajo entra en la “función de producción”
  - Habilidades (*skills*). Cualificaciones necesarias para llevar a cabo tareas laborales.
- Empleo: Forma contractual mediante la que el trabajo se aplica a la producción.
  - Empleo asalariado
  - Empleo autónomo (o independiente)
- Los cambios tecnológicos cambian la demanda de trabajo y su composición...
- y pueden también causar cambios en “las formas de empleo” (Uberization, Gig economy....)

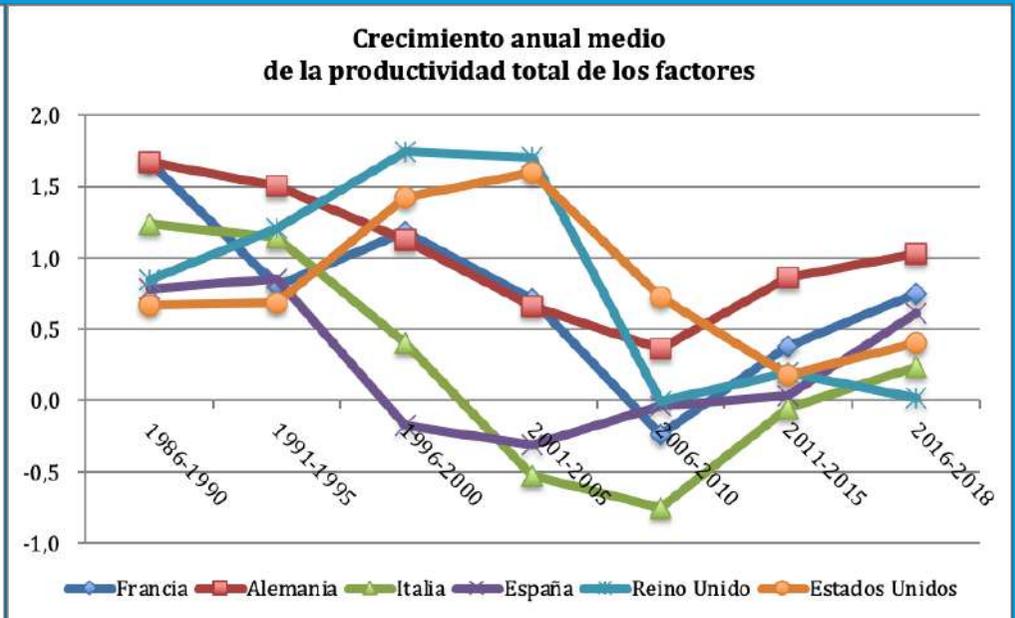
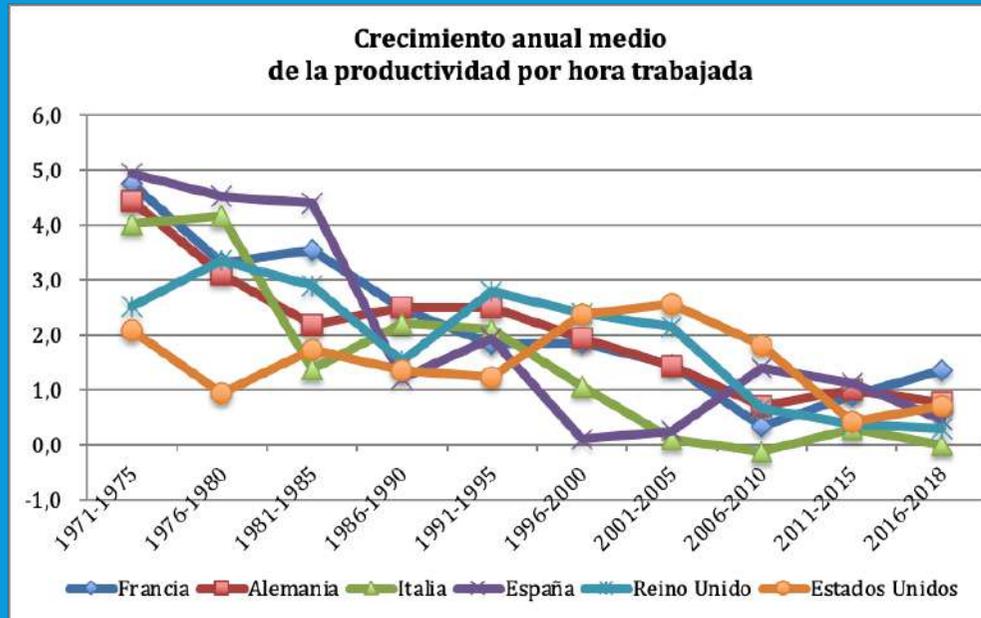
# LA ROBÓTICA Y LA INTELIGENCIA ARTIFICIAL: ¿ES ESTA VEZ DIFERENTE?

- Robótica e inteligencia artificial
  - ¿Algo más que "*Factor-augmenting technological progress*"?
  - Robots: Máquinas que son capaces de realizar tareas de producción de manera autónoma *sin intervención humana*
  - Inteligencia Artificial: Algoritmos que son capaces de "aprender" a realizar nuevas tareas *por sí mismos*, repitiendo o simulando la inteligencia humana
- Complementariedad con tecnologías de la información y de la comunicación ("digitalización")
  - (Casi) Todo es información.
  - Conversión de información en conocimiento por "fuerza bruta" (Big data, Machine Learning , Deep Learning)
- ¿Qué tareas de producción podrán llevar a cabo? (No olvidar que "un puesto de trabajo" suele requerir la realización de un conjunto de tareas, no una específica)
  - Paradoja de Polanyi: Sabemos hacer muchas más cosas de las que sabemos explicar cómo las hacemos
  - Paradoja de Moravec: Replicar pensamiento razonado requiere poca computación; replicar habilidades sensoriales y motoras (las de un niño de tres años, por ejemplo), requiere mucha más
  - Máquinas que sustituyen "cabezas", no "manos". Google: "*Humans work themselves out of jobs by teaching the machines how to act*"

# LOS CAMBIOS TECNOLÓGICOS Y LA INNOVACIÓN

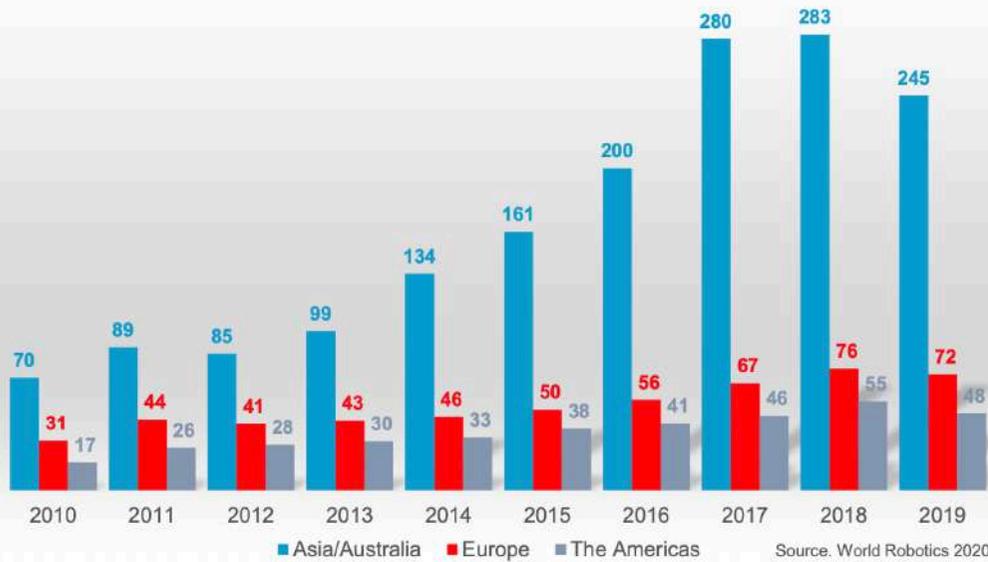
- ¿Qué nuevas tareas se desarrollarán por la I+D?
  - Relación de subsidiariedad entre innovación y automatización
  - La disminución de productividad en el sector de I+D: “New ideas are harder to get” (N. Bloom y J. van Reenen)
  - Innovación y demografía

# PRODUCTIVIDAD EN DESACELERACIÓN

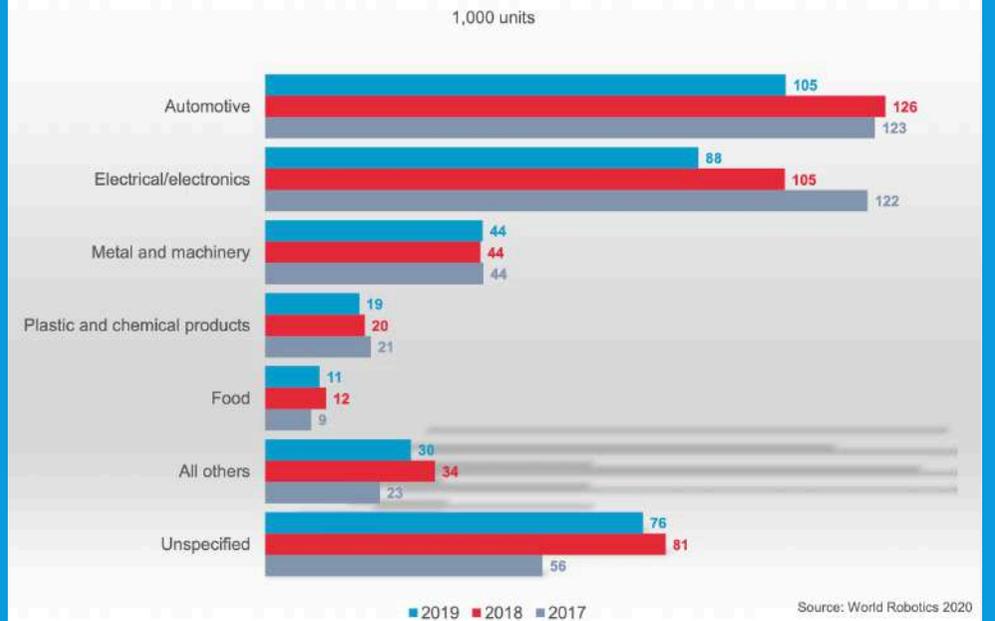


# ROBOTS EN EXPANSION (I)

Annual installations of industrial robots ('000 of units)



Annual installations of industrial robots by customer industry - World

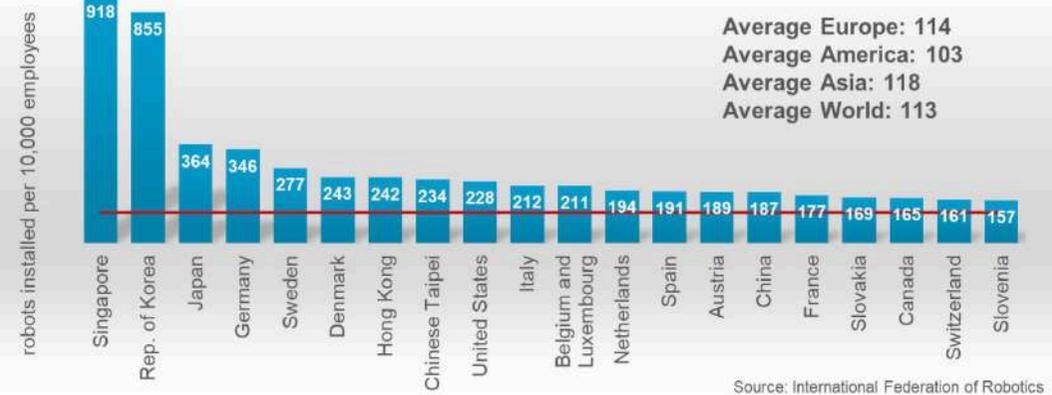


# ROBOTS EN EXPANSION (I)

Operational stock of industrial robots ('000 of units)

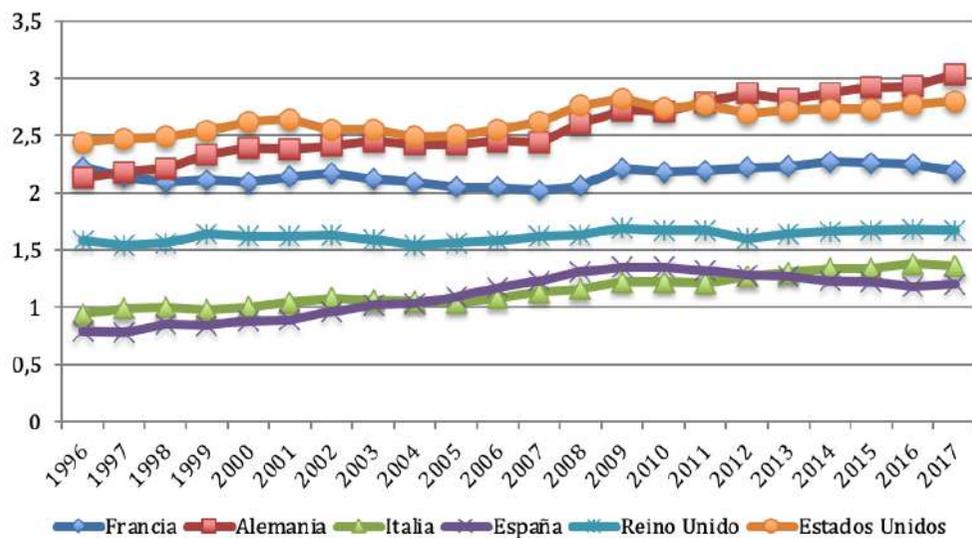


Robot density in the manufacturing industry 2019

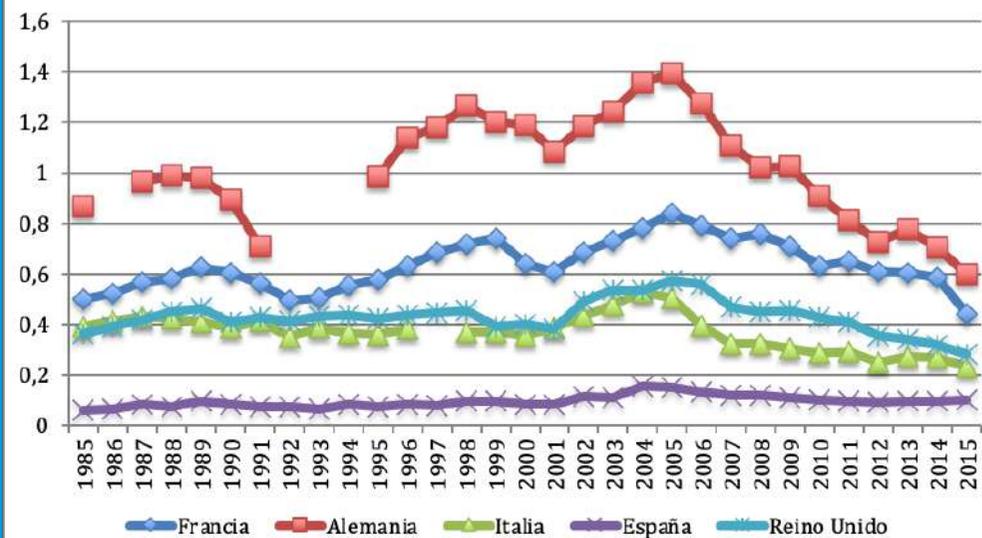


# INPUTS Y OUTPUTS DE LA I+D

### Gasto en I+D (% PIB)



### Patentes por empleado en actividades de I+D



# GLOBALIZACIÓN: NUEVAS CARACTERÍSTICAS

# LA NUEVA GLOBALIZACIÓN

- Manufacturas sin empleos (Robótica, Impresión 3D,...)
  - “Robofacturing”
  - Costes laborales disminuyendo, costes de transporte constantes.
- Servicios comercializables internacionalmente (Digitalización, inteligencia artificial,...)
  - Costes de transporte disminuyendo, costes laborales constantes (o crecientes)

# LAS GRANDES TRANSFORMACIONES (BALDWIN, FORSLID, 2019)

Table 1: The three grand economic transformations of modern times

Transformation	Employment shift	Technological breakthrough	Related automation starts	Related globalization starts
The Great Transformation (industrialization)	From farm to factory	Mechanical power (steam, etc.)	1720	1820
The Service Transformation (post-industrial society)	From factory to office	Computerization	1973	1990
The Globotics Transformation (sheltered service society)	From service jobs to sheltered service jobs	Machine learning	2016?	2016?

Note: the year 2016 was chosen since *Fortune* and *Forbes* magazines dubbed it the year of artificial intelligence (AI) (despite the phrase having been coined in the 1950s).

Source: authors' elaboration.

# LAS CAUSAS DE LA GLOBALIZACIÓN

- Los costes de transporte de productos
  - Concentración de actividad industrial en los países avanzados. Movimientos de bienes
- Los costes de transporte de las “ideas” (know-how)
  - Desplazamiento de actividad industrial a países en desarrollo. Movimiento de puestos de trabajo (“*offshoring*”)
- Los costes de la movilidad de los servicios del trabajo
  - Separación del “trabajador” de los “servicios del trabajo” (e.g., telepresencia/teletrabajo). Movimiento de trabajadores del sector servicios a países en desarrollo. “Telerobots” y “teledrones”. Tecnologías de presencia virtual y robots controlados a distancia.
  - Cambios tecnológicos y globalización tienen lugar al mismo tiempo.
  - Des-globalización (comercio de bienes), más probable post-Covid19.

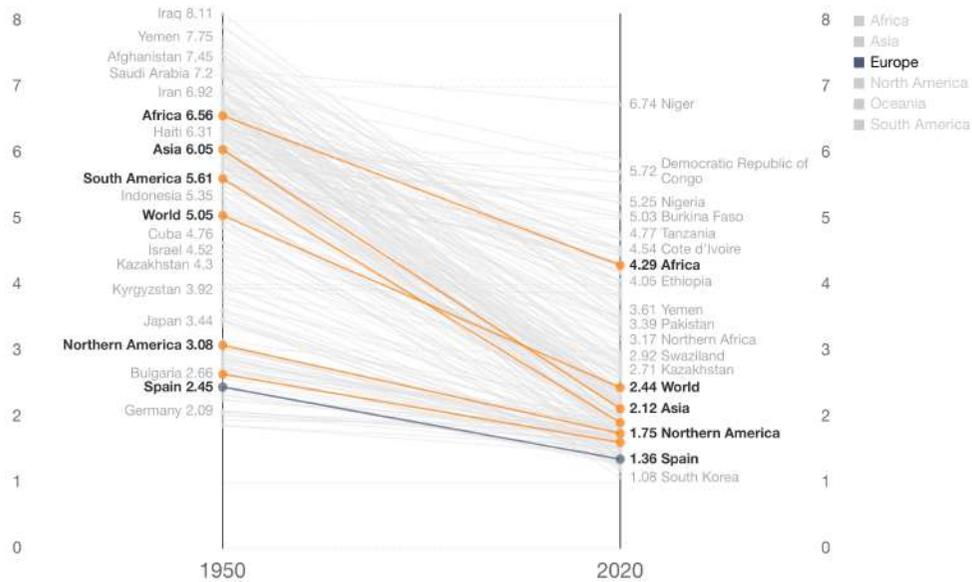
# CAMBIOS DEMOGRÁFICOS

# LOS DETERMINANTES DE LOS CAMBIOS DEMOGRÁFICOS

- Disminución continua, sostenida y global de la natalidad
- Aumento continuo, sostenido y global de la longevidad
- Aumento menor de la edad de jubilación

# NATALIDAD EN DESCENSO Y LONGEVIDAD EN ASCENSO

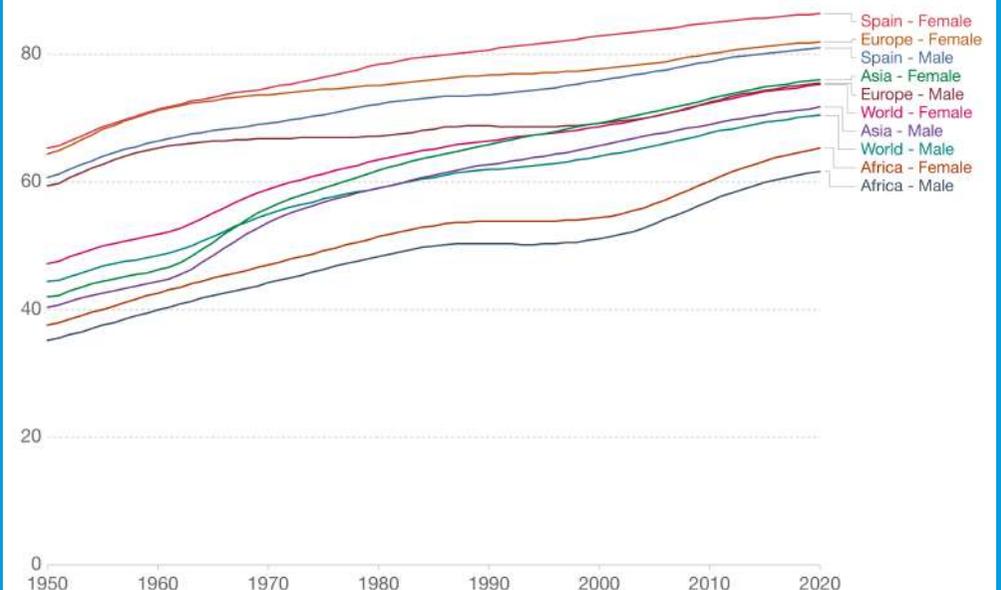
Children per woman, 1950 to 2020



Source: United Nations – Population Division (2019 Revision)

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Female and male life expectancy at birth



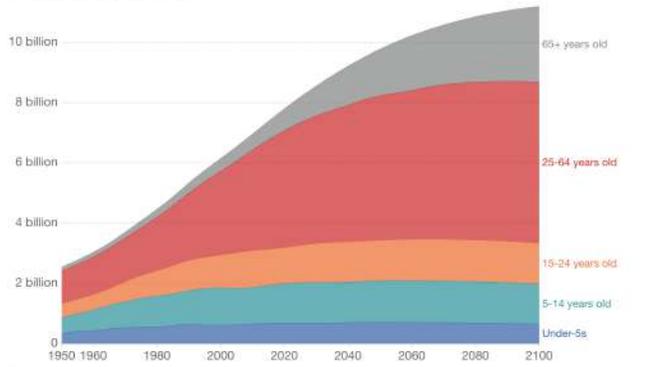
Source: United Nations – Population Division (2019 Revision)

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# POBLACIÓN POR GRUPOS DE EDAD

Population by broad age group projected to 2100, World, 1950 to 2100

Total population by broad age group, with historical estimates from 1950 to 2015 and projections to 2100 based on the UN's medium population scenario.

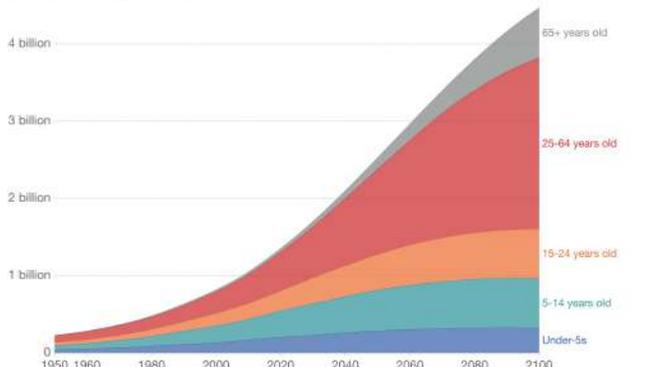


Source: UN World Population Prospects (2017)

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Population by broad age group projected to 2100, Africa, 1950 to 2100

Total population by broad age group, with historical estimates from 1950 to 2015 and projections to 2100 based on the UN's medium population scenario.

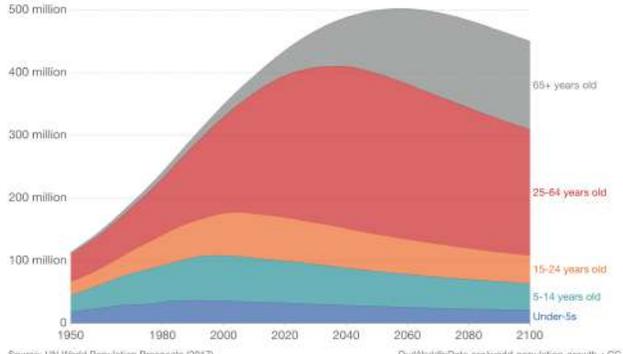


Source: UN World Population Prospects (2017)

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Population by broad age group projected to 2100, South America, 1950 to 2100

Total population by broad age group, with historical estimates from 1950 to 2015 and projections to 2100 based on the UN's medium population scenario.

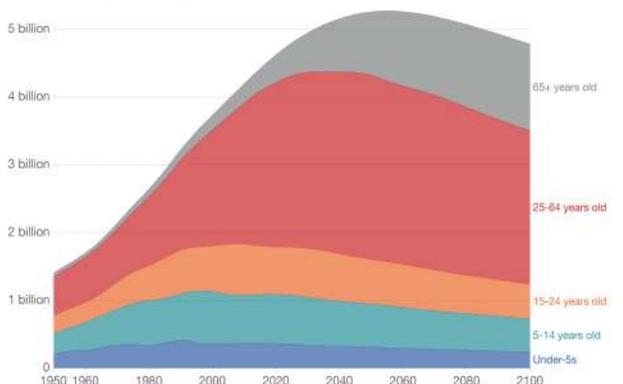


Source: UN World Population Prospects (2017)

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Population by broad age group projected to 2100, Asia, 1950 to 2100

Total population by broad age group, with historical estimates from 1950 to 2015 and projections to 2100 based on the UN's medium population scenario.

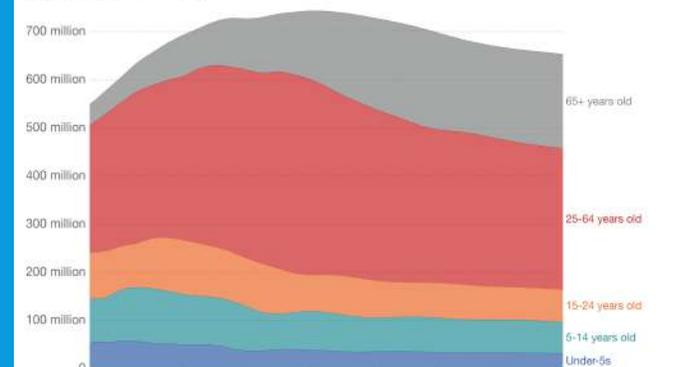


Source: UN World Population Prospects (2017)

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Population by broad age group projected to 2100, Europe, 1950 to 2100

Total population by broad age group, with historical estimates from 1950 to 2015 and projections to 2100 based on the UN's medium population scenario.

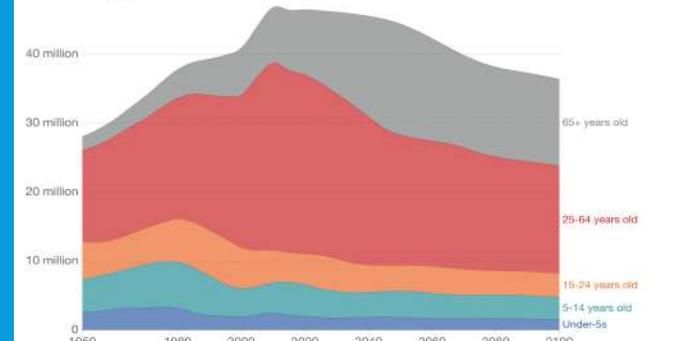


Source: UN World Population Prospects (2017)

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Population by broad age group projected to 2100, Spain, 1950 to 2100

Total population by broad age group, with historical estimates from 1950 to 2015 and projections to 2100 based on the UN's medium population scenario.



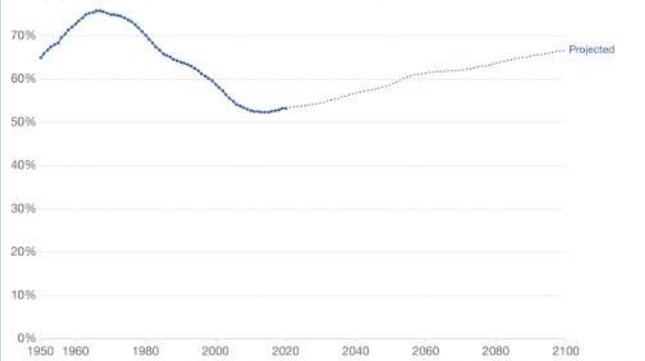
Source: UN World Population Prospects (2017)

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# TASAS DE DEPENDENCIA (POBLACIÓN MENOR DE 15 Y MAYOR DE 65 EN RELACIÓN CON POBLACIÓN 15-64)

## Age dependency ratio projected to 2100, World

The age dependency ratio is the sum of the young population (under age 15) and elderly population (age 65 and over) relative to the working-age population (ages 15 to 64). Data are shown as the number of dependents per 100 working-age population. Projections to 2100 are based on the UN's medium population scenario.

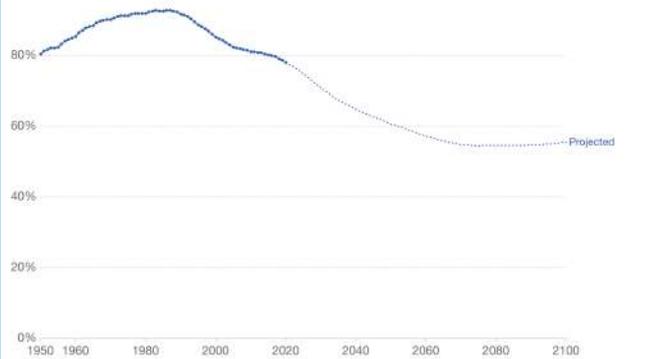


Source: United Nations - Population Division (2019 Revision)

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## Age dependency ratio projected to 2100, Africa

The age dependency ratio is the sum of the young population (under age 15) and elderly population (age 65 and over) relative to the working-age population (ages 15 to 64). Data are shown as the number of dependents per 100 working-age population. Projections to 2100 are based on the UN's medium population scenario.

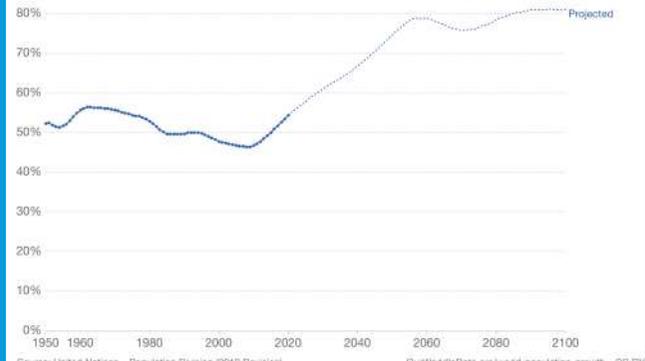


Source: United Nations - Population Division (2019 Revision)

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## Age dependency ratio projected to 2100, Europe

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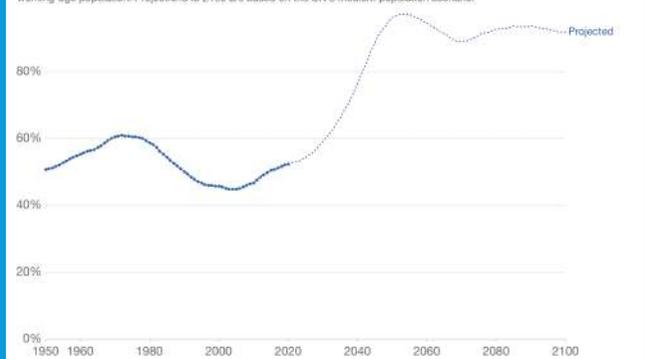


Source: United Nations - Population Division (2019 Revision)

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## Age dependency ratio projected to 2100, Spain

The age dependency ratio is the sum of the young population (under age 15) and elderly population (age 65 and over) relative to the working-age population (ages 15 to 64). Data are shown as the number of dependents per 100 working-age population. Projections to 2100 are based on the UN's medium population scenario.



Source: United Nations - Population Division (2019 Revision)

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# INTERACCIONES CON LOS CAMBIOS TECNOLÓGICOS

- Nueva era: Revolución Industrial 4.0 + Cambios demográficos profundos
  - *Baby boomers*, reducciones de la fertilidad y de la mortalidad → Menos trabajadores y más viejos
  - Menos trabajadores → Incentivos a la automatización
  - Trabajadores más viejos → Menos innovación y menos emprendimiento
- Dos restricciones importantes:
  - Inversión en innovación frente a inversión en automatización
  - Automatización como actividad subsidiaria de la innovación (no se puede automatizar las tareas que no se han inventado)

EVIDENCIA EMPÍRICA :  
¿CUÁNTO ESTÁ PASANDO YA?

# EVIDENCIA EMPÍRICA: POLARIZACIÓN

SERIEs (2018) 9:215–248  
https://doi.org/10.1007/s13209-018-0177-1



ORIGINAL ARTICLE

## Explaining job polarisation in Spain from a task perspective

Raquel Sebastian<sup>1</sup>

Received: 28 May 2017 / Accepted: 21 April 2018 / Published online: 10 May 2018  
© The Author(s) 2018

**Abstract** This paper presents new evidence on the evolution of job polarisation in Spain between 1994 and 2014. After showing the U-shaped relationship between employment share growth and job's percentile in the wage distribution, I use the task approach to investigate the main determinants behind job polarisation. Using the European Working Condition Survey I analyse in detail the task content of the jobs which display the most significant employment changes. I show that changes in employment shares are negatively related to the initial level of routine. I then explore the impact of computerisation on routine task inputs and I find that the routine measure is negatively related to computerisation. Finally, by using information on past jobs, I provide evidence on the displacement of middle-paid workers. Results suggest that they did not predominantly relocate their labour supply to bottom-paid occupations: while non-graduate middle workers move towards bottom occupations, graduate middle employees shift towards top occupations. This fact suggests that supply-side changes are important factors in explaining the expansion at the lower and upper tail of the employment distribution.

**Keywords** Job polarisation · Structural change · Routine employment · Occupational mobility

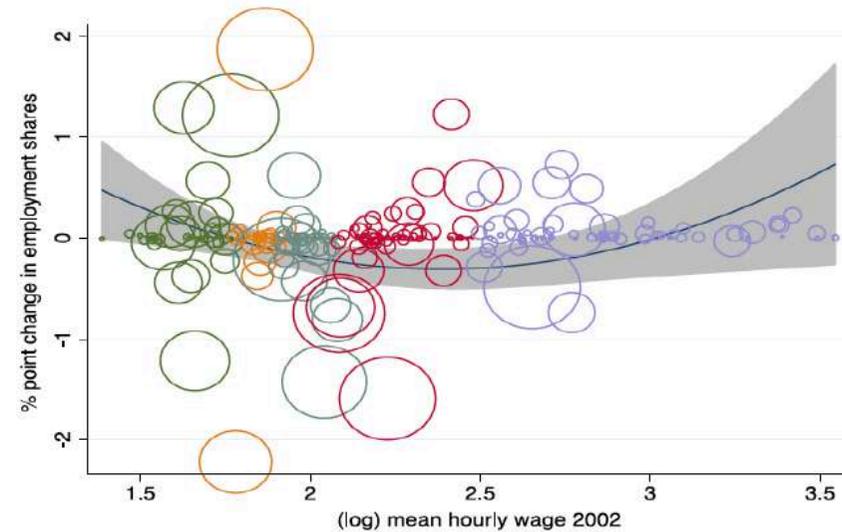
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SERIEs (2018) 9:215–248



**Fig. 1** Employment shares growth in Spain (1994–2014) by mean hourly wage. *Notes* scatter plot and quadratic prediction curve. The dimension of each circle corresponds to the number of observations within each ISCO-88 two-digit occupation and NACE.Rev.1 one-digit occupation in 1994; the grey area shows 95% confidence interval. Employment shares are measured in terms of workers. Colours represent the quintile of each job (green, first quintile; yellow, second quintile; grey, third quintile; red, fourth quintile; and violet, fifth quintile). *Sources*: author's analysis from the Spanish Labour Force Survey (1994, 2014), and the Structure of Earnings Survey (2002) (color figure online)

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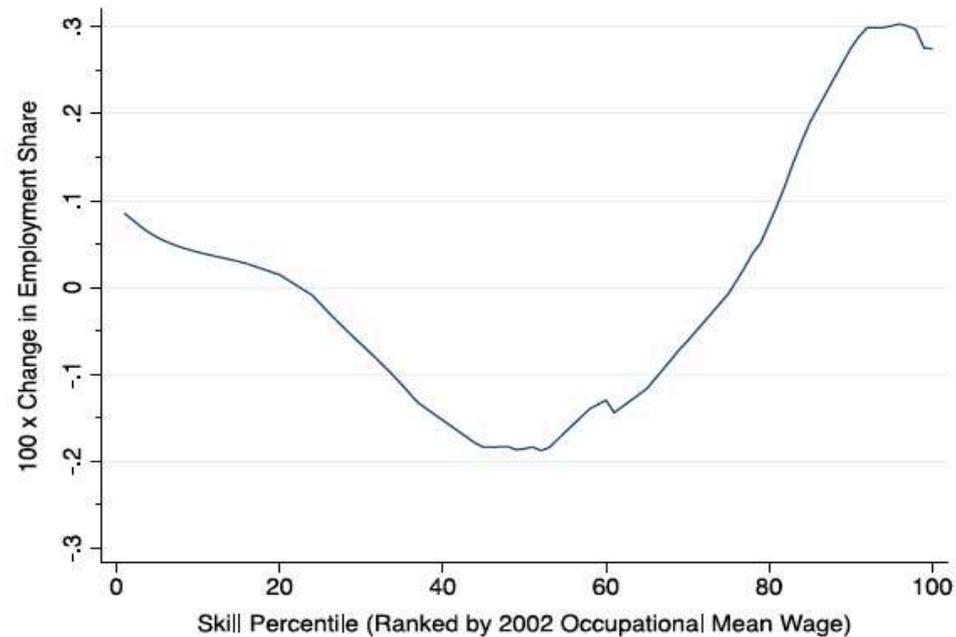
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**Fig. 2** Smoothed changes in Employment by wage percentile (1994, 2014). *Notes* the figure plots log changes in employment share by 2002 job skill percentile rank using a locally weighted smoothing regression (bandwidth 0.75 with 100 observations), where skill percentiles are measured as the employment-weighted percentile rank of a job's mean log wage in the 2002 ESS. *Sources*: author's analysis from the Spanish Labour Force Survey (1994, 2014), and the Structure of Earnings Survey (2002)

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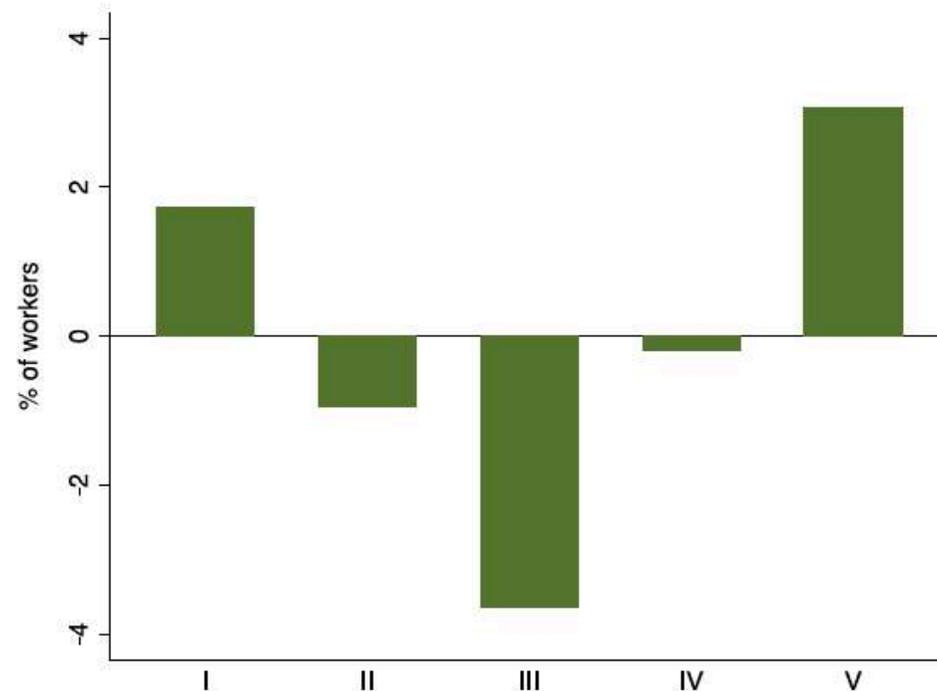
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**Fig. 3** Relative net employment change (1994, 2014) ranked by 2002 wage mean. *Notes* jobs wage quintiles are based on two-digit occupation and one-digit industry and on mean wages in 2002. It shows the relative net employment change quintiles (in percentage points). *Sources:* author's analysis from the Spanish Labour Force Survey (1994, 2014), Earnings Structure Survey (2002)

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Ocupaciones	% 1994	Cambio percentual 1994-2014	Salario medio	Abstracto	Rutinario	Manual
<b>1 Ejecutivos</b>	2.160	0.72	22.30	0.72	0.33	0.31
<b>2 Profesionales científicos e intelectuales</b>	12.32	1.80	15.23	0.76	0.36	0.30
<b>3 Técnico y profesional de nivel medio</b>	7.625	4.91	12.11	0.67	0.40	0.35
<b>4 Empleados de oficina</b>	12.1	-2.65	8.48	0.54	0.61	0.40
<b>8 Operadores de instalaciones y máquinas</b>	13.48	-2.77	7.82	0.48	0.71	0.64
<b>7 Oficiales, operarios y artesanos</b>	23.75	-3.96	7.33	0.60	0.70	0.62
<b>5 Trabajadores de los servicios personales y de protección</b>	15.68	1.80	6.39	0.53	0.52	0.59
<b>6 Agricultores y trabajadores agropecuarios y pesqueros</b>	0.10	-0.04	6.36	-	-	-
<b>9 Trabajadores no cualificados</b>	12.61	0.19	5.42	0.53	0.50	0.75

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**Abstract** This paper presents new evidence on the evolution of job polarisation in Spain between 1994 and 2014. After showing the U-shaped relationship between employment share growth and job's percentile in the wage distribution, I use the task approach to investigate the main determinants behind job polarisation. Using the European Working Condition Survey I analyse in detail the task content of the jobs which display the most significant employment changes. I show that changes in employment shares are negatively related to the initial level of routine. I then explore the impact of computerisation on routine task inputs and I find that the routine measure is negatively related to computerisation. Finally, by using information on past jobs, I provide evidence on the displacement of middle-paid workers. Results suggest that they did not predominantly relocate their labour supply to bottom-paid occupations: while non-graduate middle workers move towards bottom occupations, graduate middle employees shift towards top occupations. This fact suggests that supply-side changes are important factors in explaining the expansion at the lower and upper tail of the employment distribution.

**Keywords** Job polarisation · Structural change · Routine employment · Occupational mobility

**JEL Classification** J21 · J24 · R23 · R12

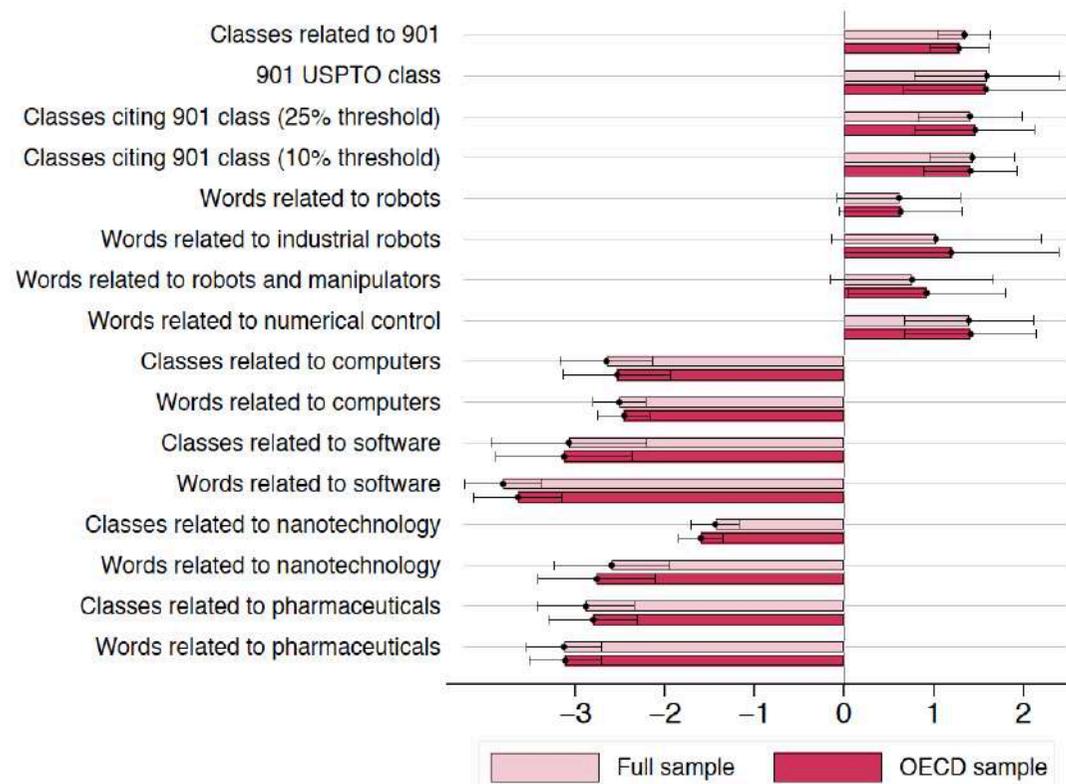
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B: Bajo  
 M: Medio  
 T: Alto

		B	M	T			B	M	T
<i>Trabajadores no graduados</i>									
		1997					2008		
1994	B	0.75	0.20	0.05	2005	B	0.80	0.12	0.08
	M	0.10	0.84	0.06		M	0.22	0.73	0.05
	T	0.10	0.10	0.80		T	0.12	0.15	0.83
		2000					2015		
1997	B	0.76	0.16	0.08	2012	B	0.81	0.15	0.04
	M	0.13	0.81	0.07		M	0.17	0.71	0.12
	T	0.10	0.12	0.82		T	0.13	0.15	0.82
<i>Trabajadores graduados</i>									
		1997					2008		
1994	B	0.73	0.20	0.07	2005	B	0.75	0.24	0.01
	M	0.06	0.87	0.07		M	0.04	0.79	0.17
	T	0.08	0.10	0.82		T	0.02	0.07	0.91
		2000					2015		
1997	B	0.75	0.21	0.04	2012	B	0.71	0.21	0.09
	M	0.08	0.83	0.09		M	0.04	0.81	0.15
	T	0.04	0.14	0.82		T	0.01	0.07	0.92

# EVOLUCIÓN DEL NÚMERO DE PATENTES POR CLASES



# COMENTARIOS FINALES

# CONSECUENCIAS MACROECONÓMICAS

- La resurrección del “estancamiento secular”
  - Desaparición del dividendo demográfico
  - Bajo crecimiento de la productividad (o elevado crecimiento de la productividad sin empleos)
  - Restricciones de la política fiscal y monetaria para reactivar/estabilizar la economía
  - Crisis Covid19
    - Aceleración de cambios tecnológicos (teletrabajo), disminución de servicios personales
    - Nuevas restricciones para políticas monetaria y fiscal

# IMPLICACIONES PARA LAS POLÍTICAS SOCIALES

- Menor peso del trabajo en la producción de bienes y servicios
  - Reconsideración del mix prestaciones contributivas/universales/asistenciales
  - Especialmente en el caso del sistema de pensiones
- ¿ Hacia un modelo de renta básica universal ?
  - Hoy por hoy, inasumible
- Nuevas políticas de empleo
  - La insuficiencia del Pilar Social Europeo
  - Cuentas individuales con transferencias directas a los trabajadores